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International Decade of Soils 2015-2024

Healthy soil for a healthy life

वार्षिक प्रतिवेदन
Annual Report
2024





ICAR-Indian Institute of Soil Science

Nabibagh, Berasia Road, Bhopal – 462 038 (M.P.)

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भाकृअनुप- भारतीय मृदा विज्ञान संस्थान

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Sardar Patel Outstanding ICAR Institution
King Bhumibol World Soil Day Awardee

वार्षिक प्रतिवेदन

ANNUAL REPORT

2024

हर कदम, हर डगर
किसानों का हमसफर
भारतीय कृषि अनुसंधान परिषद
Agrisearch with a human touch

भाकृअनुप–भारतीय मृदा विज्ञान संस्थान

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Preface



Soils host an array of life, from microbes to macro-fauna, which plays a critical role in soil health and function. They are a vast network of interconnected ecosystems where biotic and abiotic components interact in complex ways that are yet to be understood fully. Despite advancements in soil research, key aspects of soil systems beneath our feet, still remain a mystery, with limitations in analytical tools and theoretical frameworks. Though soils provide life support, produce food, and recycle nutrients, yet their true capabilities and complexities are not fully appreciated. Hence, understanding soils is not just a scientific curiosity but a practical necessity for ensuring sustainable agriculture, managing resources, and addressing global challenges like climate change. Globally, the shrinking agricultural land resources coupled with soil degradation poses a greater risk to food production system, which adversely affects crop yields and leads to malnourishment. The soil scientists and others working in allied specializations have a greater sense of responsibility towards thorough research on the sustainable management of soil resources. It is recognized that the sustainable management of soil health is indispensable for augmenting agricultural productivity. This demands regular assessment of our soil resources and providing appropriate technological interventions for enhancing soil health and crop productivity. Besides, the institute has the mandate to create awareness among farmer and other stakeholders on the roles and functions of soil for the sustenance of humanity through national / international collaborations/campaigns.

ICAR-Indian Institute of Soil Science (ICAR-IISS), Bhopal is engaged in research and developmental activities with mandate "to provide scientific basis for enhancing and sustaining productivity of soil resource with minimal environmental degradation". The institute has developed many potential and feasible technologies with laboratory cum field-level validation for the improvement of soil health to address the emerging issues and challenges. This annual report vividly illustrates the multi-scale approaches and work done in the area of soil health and input use efficiency, conservation agriculture and carbon sequestration, soil microbial diversity and genomics, soil pollution, remediation and environmental security. The report also describes the work done on farmers' participatory research and demonstration of the technologies at farmers' fields as well as across the length and breadth of the country through various AICRPs, AINP, CRP centres of the institute and SCSP and TSP programs.

During the period under report, some new technologies and methodologies were developed and further refined by the institute, viz. STCR Based IPNS-Technology for Maize-wheat Cropping System in Central India, nutrient use efficient genotypes of wheat grown on Vertisols, CA practices for soybean-wheat cropping systems, Web enabled MIR spectroscopy analysis system for predicting soil properties digital nutrient mapping through web enabled PFSR system etc.

I take this opportunity to express my sincere appreciation to all the In-charge Project Coordinators and Head of the Divisions for compiling the information at AICRP/Divisional level. I also extend my gratitude to all the scientists and staff members of the institute for their painstaking efforts in carrying out the research and other developmental activities of the institute.

I place on record, my sincere appreciation to Drs R Elanchezhian, NK Sinha, Asha Sahu, BP Meena, Abhijit Sarkar, Immanuel CH and Aditi Agrawal for their dedicated efforts in compiling and editing the report. The service rendered by Mr Sanjay Kumar Kori and Mr Sanjay Kumar Parihar in collecting information and typesetting the manuscript is appreciated.

I acknowledge, with gratefulness and respect, Hon'ble Dr. Himanshu Pathak, Secretary, DARE and Director General, ICAR for his consistent guidance, inspiration and encouragement as well as providing necessary financial support for the overall growth and development of the institute. I am highly thankful to Dr. S.K. Chaudhari, Former Deputy Director General (NRM), Dr. A. K. Nayak, Deputy Director General (NRM) and Dr. A. Velmurugan, Assistant Director General (S&WM) for their consistence guidance, active involvement and constructive suggestions in carrying out various research and development activities for the overall progress of the institute.

Monoranjan Mohanty

Bhopal
July 2025

(Monoranjan Mohanty)
Director

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कार्यकारी सारांश

विषयवस्तु–I: मृदा स्वास्थ्य एवं पोषक तत्व उपयोग दक्षता

- वर्टिसोल की पोषक तत्वों की कमी वाली स्थितियों में गेहूँ के 24 जीनोटाइप की ग्रोथ और शारीरिक प्रतिक्रियाओं का मूल्यांकन किया गया। कुछ जीनोटाइप HI 8737, HI 1563, HI 1605, HI 1531, HI 8498, और नर्मदा 14 ने >4 t/ha से ज़्यादा अनाज की पैदावार दिखाई, और सुझाए गए नाइट्रोजन और कम नाइट्रोजन डोज वाली स्थितियों में इस्तेमाल किए गए नाइट्रोजन के लिए क्रमशः 30 प्रतिशत और 50 प्रतिशत एग्रोनॉमिक इस्तेमाल की क्षमता दिखाई।
- LTFEs के तहत मुख्य फसलों में लंबे समय तक फर्टिलाइजर और खाद के इस्तेमाल से यह साफ पता चला कि न्यूट्रिएंट्स के असंतुलित इस्तेमाल की वजह से सस्टेनेबल यील्ड इंडेक्स (SYI) और सॉइल क्वालिटी इंडेक्स (SQI) में गिरावट आई और यह 100 प्रतिशत NPK+FYM(INM) के इस्तेमाल के साथ सबसे ज़्यादा पाया गया। 150% NPK ने वर्टिसोल्स में 100 प्रतिशत NPK+FYM के बराबर वैल्यू भी दी। बैलेंस्ड और INM (100 प्रतिशत NPK+FYM) फसल की पैदावार और मिट्टी की क्वालिटी के मामले में सस्टेनेबल पाए गए।
- रबी 2023–24 के दौरान ICAR-IISS में एक प्रयोग में, अलग–अलग पोषक तत्वों की मात्रा में 24 गेहूँ के जीनोटाइप की शारीरिक और पोषक तत्वों के इस्तेमाल की क्षमता वाली विशेषताओं का मूल्यांकन किया गया। कई जीनोटाइप, खासकर HI 1605, HI 1531, HI 8498, और DBW 88 ने कम नाइट्रोजन की स्थिति में भी ज़्यादा नाइट्रोजन उपयोग दक्षता (>50 kg अनाज/kg N) और लगातार अनाज की पैदावार (>4 t/h) दिखाई।
- रॉथC मॉडल को मध्य प्रदेश के वर्टिसोल में लंबे समय तक मिट्टी के कार्बन डायनामिक्स को सिम्युलेट करने के लिए CA डेटा पर CRP का उपयोग करके सफलतापूर्वक पैरामीटराइज और वैलिडेट किया गया। मॉडल के आउ. टपुट से पता चला कि बिना जुताई की स्थिति में अवशेषों को बनाए रखने से मिट्टी में कार्बन स्टोरेज बढ़ा, और मॉडल का प्रदर्शन संतोषजनक रहा (RMSE = 0.80)।
- अलग–अलग अवशेषों को बनाए रखने के स्तरों के तहत मिट्टी में पोटेशियम की मात्रा–तीव्रता के अध्ययनों से पता चला कि CR90 प्लॉट में सबसे अधिक घुलनशील K और गतिविधि अनुपात था और पारंपरिक जुताई में सबसे कम था। सभी उपचारों में मध्यम K–आपूर्ति क्षमता दिखाई दी, जिसमें CR90 ने K की उपलब्धता में सुधार किया और CT ने खराब K स्थिति की ओर गिरावट दिखाई।
- 2024 के दौरान एक फील्ड एक्सपेरिमेंट में मक्का–गेहूँ सिस्टम में 12 IPNS मॉड्यूल का मूल्यांकन किया गया ताकि प्रोडक्टिविटी और मिट्टी की सेहत के लिए सबसे अच्छी पोषक तत्व प्रबंधन रणनीति की पहचान की जा सके। इंटीग्रेटेड न्यूट्रिएंट मैनेजमेंट, खासकर STCR–आधारित 75% NPK + FYM या वर्मीकम्पोस्ट, ने GRD और सिर्फ केमिकल फर्टिलाइजेशन की तुलना में वटि. र्सोल में फसल की पैदावार, SOC स्टॉक और कार्बन सीक्वेस्ट्रेशन को काफी बढ़ाया।
- फलियों पर आधारित कृषि–बागवानी प्रणालियों, खासकर चना–सोयाबीन सीक्वेंस ने आम, अमरूद, नींबू और आंवला के बागों में मिट्टी की सेहत, पोषक तत्वों की उपलब्धता और फलों की गुणवत्ता को बढ़ाया। इनमें से, आंवला में सबसे ज़्यादा कार्बन जमाव और पत्तियां गिरीं, जबकि अमरूद ने पत्तियों के कचरे के जरिए सबसे ज़्यादा पोषक तत्व लौटाए।
- पत्तागोभी पर एक फील्ड एक्सपेरिमेंट में तीन सिंचाई लेवल (100%, 80%, और 60% पानी की जरूरत) को तीन मल्च टाइपकृकाले प्लास्टिक, सिल्वर और धान के पुआल के साथ मिलाकर टेस्ट किया गया। शुरुआती नतीजों से पता चला कि 80% सिंचाई के साथ धान के पुआल की मल्च ने मिट्टी की नमी में सुधार किया और कंट्रोल की तुलना में 15–20% ज़्यादा उत्पादन दिया।
- वर्टिसोल मिट्टी पर एक स्टडी में सोयाबीन–गेहूँ और मक्का–चना सिस्टम के तहत रनऑफ और मिट्टी के नुकसान पर कंजर्वेशन एग्रीकल्चर के असर का आकलन किया गया। अवशेषों को बनाए रखने वाली कंजर्वेशन जुताई (खासकर NT & 60% CR) ने पारंपरिक जुताई की तुलना में मिट्टी, कार्बन और नाइट्रोजन के नुकसान को काफी कम किया, जिसमें मक्का–चना में सोयाबीन–गेहूँ की तुलना में कुल मिलाकर ज़्यादा कटाव देखा गया।
- MEGH डिवाइस, जो एक Arduino–बेस्ड सिस्टम है, को स्पेक्ट्रोस्कोपिक सेंसिंग का इस्तेमाल करके रियल–

टाइम, बिना नुकसान पहुंचाए मिट्टी की नमी का अनुमान लगाने के लिए डेवलप किया गया था। यह ऑप्टिकल रिस्पॉन्स, तापमान और नमी को मापता है, और बड़े डेटा एनालिसिस और सटीक खेती के लिए फैसले लेने में मदद के लिए डेटा को क्लाउड प्लेटफॉर्म पर भेजता है।

- मिट्टी में पानी की स्थिति की बिना संपर्क के निगरानी के लिए $CoCl_2$–इन्फ्यूज्ड सेलुलोज मेम्ब्रेन का इस्तेमाल करके एक कलरिमेट्रिक मिट्टी नमी सेंसर डेवलप किया गया था। मेम्ब्रेन का नमी पर निर्भर कलर रिस्पॉन्स, जिसे MEGH प्रोटोटाइप के जरिए मापा गया, ने मिट्टी की नमी के साथ एक मजबूत संबंध दिखाया, जो अलग–अलग तरह की मिट्टी में रियल–टाइम सिंचाई मैनेजमेंट के लिए एक कम लागत वाला, स्केलेबल तरीका दिखाता है।
- ICAR–IISS भोपाल में एक मल्टी–सीजन फील्ड ट्रायल में बायोडिग्रेडेबल और सिंथेटिक पॉली–मल्च के डिग्रेडेशन का आकलन किया गया। बायोडिग्रेडेबल मल्च में हर सीजन में लगातार 40% वजन कम हुआ, जो सिंथेटिक मल्च के मुकाबले लगभग दोगुना था, और बहुत कम अवशेष बचे, जिससे टिकाऊ और प्लास्टिक–मुक्त कृषि तरीकों के लिए इसकी क्षमता सामने आती है।
- मिट्टी में माइक्रोप्लास्टिक के एटमॉस्फेरिक डिपोजिशन का आकलन करने के लिए ICAR–IISS, भोपाल में एक स्टैंडर्ड रेन गेज (नोवा लिंक्स, USA) का इस्तेमाल करके एक मॉनिटरिंग सेटअप स्थापित किया गया। सितंबर 2024 से हर दो हफ्ते में इकट्ठा किए गए बारिश के पानी और मिट्टी के नमूनों का माइक्रोप्लास्टिक के आकार, आकृति और मात्रा के साथ–साथ मिट्टी के मुख्य भौतिक–रासायनिक मापदंडों के लिए विश्लेषण किया जा रहा है।
- अलग–अलग पोषक तत्व प्रबंधन तरीकों की लंबे समय तक चलने वाली स्थिरता का आकलन करने के लिए सस्टेनेबल यील्ड इंडेक्स (SYI) का इस्तेमाल किया गया। अलग–अलग जगहों के नतीजों से पता चला कि संतुलित उर्वरक और INM (100% NPK + FYM/GM) से सबसे ज्यादा SYI मान मिले, जो बेहतर मिट्टी की गुणवत्ता और उपज में स्थिरता को दिखाते हैं। अकोला में, ज्वार और गेहूँ के लिए 100% NPK + FYM और 150% NPK ने सबसे ज्यादा SYI दर्ज किया, जबकि जबलपुर में, वर्टिसोल मिट्टी में सोयाबीन और गेहूँ के लिए 100% NPK + FYM ने अधिकतम SYI दिया। इसके विपरीत, असंतुलित पोषक तत्वों के इस्तेमाल (कंट्रोल, 100: N, 100% NP, 50% NPK) के परिणामस्वरूप SYI मान काफी कम रहे।
- हरियाणा की खेती वाली मिट्टी पर एक स्पेशियो –टेम्पोरल स्टडी (2016–2023) से पता चला कि EC, उपलब्ध S, Zn, Fe, और Mn में काफी कमी आई है, जो समय के साथ पोषक तत्वों की कमी को दिखाता है। जगह के हिसाब से बांटने के पैटर्न में बदलाव से पोषक तत्वों की कमी वाले इलाकों का बढ़ना पता चला, जिससे मिट्टी की उपजाऊ क्षमता पर लगातार नजर रखने और टिकाऊ फसल उत्पादन के लिए इलाके के हिसाब से सटीक पोषक तत्व मैनेजमेंट की स्ट्रेटेजी अपनाने की जरूरत पर जोर दिया गया।
- पूरे उत्तर–पूर्वी भारत में बड़े पैमाने पर मिट्टी के सर्वे (17,471 सैंपल) में S, B, Zn, Mn, Fe, Cu, SOC, pH, और EC की जगह के बदलाव के आधार पर Ng मिट्टी न्यूट्रिएंट मैनेजमेंट जोन (M) को दिखाने के लिए PCA और फजी क्लस्टरिंग का इस्तेमाल किया गया। स्टडी में मुख्य न्यूट्रिएंट की कमी (S, B, Zn) की पहचान की गई और इस इलाके में मिट्टी की फर्टिलिटी सुधारने और फसल की प्रोडक्टिविटी बनाए रखने के लिए M–बेस्ड सटीक न्यूट्रिएंट मैनेजमेंट की उपयोगिता दिखाई गई।
- उत्तर–पश्चिम भारत के तराई इलाके में छह साल की फील्ड स्टडी में चावल–गेहूँ सिस्टम पर बोरॉन फर्टिलाइजेशन के असर का मूल्यांकन किया गया। हर दूसरे साल 1.5kg B ha^{-1} इस्तेमाल करने से सिस्टम चावल के बराबर पैदावार 6-7% बढ़ी, सबसे ज्यादा SYI हासिल हुआ, और सुरक्षित इकोलॉजिकल लिमिट बनी रही, जिससे यह पता चला कि मध्यम, समय–समय पर B सप्लीमेंटेशन RWCS में प्रोडक्टिविटी और सस्टेनेबिलिटी को बेहतर बनाता है।
- डायरेक्ट सीडेड एरोबिक राइस (DSR) पर एक पॉट स्टडी में पाया गया कि 1.0% $FeSO_4 7H_2O$ के साथ सीड प्राइमिंग से अनाज की पैदावार कंट्रोल के मुकाबले 12.7% बढ़ी और ग्रोथ और क्लोरोफिल कंटेंट में सुधार हुआ। जबकि Fe-EDTA (0.5% Fe) ने अनाज में Fe कंसंट्रेशन बढ़ाया, ज्यादा डोज से पैदावार कम हुई। इस तरह, DSR में पैदावार और Fe कंटेंट बढ़ाने के लिए $FeSO_4 \cdot 7H_2O$ (1.0% Fe) सबसे असरदार साबित हुआ।
- केरल के कुट्टनाड और कोले इलाकों की एसिड सल्फेट मिट्टी का हेवी मेटल्स के लिए एनालिसिस किया गया, जिसमें Cr > Ni > Co >Pb> Cd का ऑर्डर दिखा। एवरेज Ni (292 ppm) Cr (861 ppm) और Co (74 ppm) लेवल FAO/WHO, यूरोपियन और इंडियन स्टैंडर्ड से ज्यादा थे, जबकि Cd और Pb आम तौर पर कम थे लेकिन कभी–कभी सेफ लिमिट से ऊपर थे, जो लोकल कंटैमिनेशन रिस्क दिखाता है।
- फ्रंटलाइन डेमोंस्ट्रेशन से पता चला कि डिंडोरी, मध्य प्रदेश में किसानों के तरीकों की तुलना में 5 kg Zn ha^{-1} डालने से चावल की पैदावार 7-6–15-5% (औसत

9.1%) बढ़ गई। इसी तरह, हिसार, हरियाणा में फील्ड ट्रायल से पता चला कि सल्फर डालने से सरसों और चने की पैदावार में काफी सुधार हुआ, जिप्सम के जरिए 40 kg S ha^{-1} (सरसों) और 20 kg S ha^{-1} (चना) पर सबसे अच्छा और सस्ता असर हुआ।

- AICRP-STCR के तहत, मुख्य फसलों के लिए फर्टिलाइजर प्रिस्क्रिप्शन इक्वेशन बनाए गए ताकि न्यूट्रिएंट की जरूरतों (N, P_2O_5, K_2O) को मिट्टी के टेस्ट वैल्यू और टारगेट पैदावार से जोड़ा जा सके, जि. ससे केमिकल और IPNS मोड के तहत सटीक, साइट–स्पेसिफिक न्यूट्रिएंट मैनेजमेंट मुमकिन हो सके। एक लंबे समय तक चलने वाली वर्टिसोल स्टडी से पता चला कि ऑर्गेनिक खादों के साथ खाद मिलाने से पैदावार में स्थिरता, सस्टेनेबिलिटी और K की उपलब्धता में सुध ाार हुआ, हालांकि नेगेटिव K बैलेंस ने लंबे समय तक उपजाऊपन के लिए और K इनपुट की जरूरत बताई।

विषयवस्तु–II: संरक्षण कृषि, कार्बन पृथक्करण और जलवायु परिवर्तन

- वर्टिसोल मिट्टी पर किए गए संरक्षण कृषि प्रयोगों से पता चला कि ड्रिप और स्प्रिंकलर प्रणालियों से गेहूँ की उपज 51–53 क्विंटल प्रति हेक्टेयर बनी रही, जबकि जल उपयोग दक्षता बाढ़ सिंचाई के तहत 15.0 किलोग्राम प्रति हेक्टेयर प्रति मिमी से बढ़कर स्प्रिंकलर प्रणाली से 18.2 और ड्रिप प्रणाली से 22.9 हो गई। ड्रिप प्रणाली में 35–40% और स्प्रिंकलर प्रणाली में 17–20% पानी की बचत हुई।
- गेहूँ और सोयाबीन में, विभिन्न जुताई या पोषक तत्व व्यवस्थाओं के बावजूद उपज में कोई महत्वपूर्ण कमी नहीं देखी गई, जो उर्वरक उपयोग में 25% तक की कमी (100% से 75% आरडीएफ या एसटीसी आर/एलसीसी–आधारित प्रबंधन तक) और कम या बिना जुताई को व्यापक रूप से अपनाने की संभावना को दर्शाती है। इससे उपसतह प्रतिरोध में थोड़ी वृद्धि के बावजूद सतह के पास की मिट्टी की नमी में भी वृद्धि हुई।
- मक्का–चना और सोयाबीन–गेहूँ प्रणालियों में पूरक अवशेष–पोषक तत्व परीक्षणों से पता चला कि जब अवशेषों की मात्रा 0 से बढ़ाकर 60–90% की गई, तो उपज में लगातार सुधार हुआ। 90% अवशेषों पर मक्का की उपज 5.40 से बढ़कर 6.69 टन प्रति हेक्टेयर हो गई और चने की उपज लगभग 1.5 टन प्रति हेक्टेयर से बढ़कर 2.2 टन प्रति हेक्टेयर से अधिक हो गई, जबकि सोयाबीन और गेहूँ की उपज भी उच्च अवशेष स्तरों पर चरम पर पहुंच गई।
- दीर्घकालीन संरक्षण जुताई अध्ययनों से पता चला कि पारंपरिक जुताई में सतही प्रवेश प्रतिरोध अधिक होता है, जबकि बिना जुताई में उपसतही परतों में प्रारंभिक सघनता (कम्पैक्शन) और कम जल प्रवेश दर पाई गई, जो निरंतर नो–टिल प्रणाली में समय–समय पर निगरानी और गहरी ढीलापन की आवश्यकता को दर्शाता है।
- वेब–सक्षम मिड–इन्फ्रारेड स्पेक्ट्रोस्कोपी विश्लेषण प्रणाली के विकास और उपयोग के माध्यम से डिजिटल और स्पेक्ट्रोस्कोपिक उपकरणों को उन्नत किया गया। प्रमुख मृदा गुणों के लिए मॉडल कैलिब्रेशन में उच्च सटीकता प्राप्त हुई, जिसमें क्ले और pH के लिए R^2 मान 0.97 तक और वैलिडेशन R^2 लगभग 0.85–0.87 रहा, साथ ही कई गुणों के लिए RPD मान 2 से अधिक रहा, जो टेक्सचर, pH,SOC, कुल कार्बन और जलधारण क्षमता के नियमित उपयोग के लिए विश्वसनीयता दर्शाता है। विनिमेय पोटाश (K) और कुल सूक्ष्म पोषक तत्व (Cu, Mn, Zn) की भविष्यवाणी मध्यम विश्वसनीयता के साथ की गई।
- मध्य प्रदेश और हरियाणा के लिए विकसित वेब – आधारित PFRS प्लेटफॉर्म के माध्यम से सटीक उर्वरक सिफारिशों के समर्थन हेतु डिजिटल पोषक तत्व मानचित्रण पर कार्य किया गया।
- ओपन–टॉप चेंबर और तापमान वृद्धि अध्ययनों से पता चला कि केवल तापमान वृद्धि (3°C) से उपलब्ध N, P और K क्रमशः लगभग 141, 23.8 और 399 किग्रा/हेक्टेयर तक बढ़ गए, जो नियंत्रण की तुलना में अधिक खनिजीकरण को दर्शाता है, जबकि बढ़े हुए CO_2 और ताप वृद्धि के संयुक्त प्रभाव अधिक जटिल पाए गए। बढ़े हुए CO_2 (600 ppm) और +2 C ताप वृद्धि के तहत फ्रैक्शनेशन में वार्मिंग के तहत Olsen-P में लगभग 30: वृद्धि और बढ़े CO_2 के तहत हल्की कमी देखी गई, जबकि कुल P लगभग 1.05–1.08 टन/हेक्टेयर रहा और Ca-P प्रमुख रूप (55–60 प्रतिशत) में रहा, जो कुल भंडार परिवर्तन की बजाय पौधों के लिए उपलब्ध और सक्रिय पूलों में बदलाव को दर्शाता है।
- पूर्वी भारत के लिए APSIM–ORYZA सिमुलेशन से संकेत मिला कि मध्यम ताप वृद्धि और बढ़े CO_2 (2040 के दशक) के तहत धान उत्पादन प्रारंभ में बढ़ सकता है, लेकिन उच्च उत्सर्जन परिस्थितियों में 2080 के दशक तक घट सकता है। हालांकि अधिक पौध घनत्व, रोपाई समय में समायोजन और नाइट्रोजन की मात्रा बढ़ाने जैसे अनुकूलन उपाय संभावित उत्पादन हानि को आंशिक रूप से कम कर सकते हैं।

- SSP 1–2.6, 2–4.5, 3–6.0 और 4–8.5 परिदृश्यों के तहत RothC सिमुलेशन से पता चला कि 2100 तक SOC लगभग 20.7 से घटकर 16.6–17.9 टन/हेक्टेयर तक आ सकता है, जिसमें औसत वार्षिक हानि लगभग 0.027 से 0.041 टन/हेक्टेयर रही, जो भविष्य की जलवायु परिस्थितियों में मृदा कार्बन संरक्षण हेतु फसल अवशेष संरक्षण, कम जुताई, जैविक इनपुट और कृषि वानिकी की आवश्यकता को दर्शाता है।
- वर्टिसोल मृदाओं के लिए SWAP मॉडल कैलिब्रेशन से पता चला कि बिना जुताई प्रणाली ने जल धारण क्षमता लगभग 10% तक बढ़ाई और ऊपरी 10 सेमी में सतह तापमान लगभग 8.5% तक कम किया। SMAP L4 मृदा नमी डेटा को 9 किमी से 1 किमी तक डाउनस्केल करने के लिए विभिन्न मशीन लर्निंग विधियों का उपयोग किया गया, जिसमें स्थानीय आंकड़ों से सीमित मेल मिला, जो स्थानीय स्तर पर नमी अनुमान के लिए मोटे सैटेलाइट डेटा की सीमाओं को दर्शाता है।
- मुरैना और श्योपुर जिलों में बीहड़ प्रबंधन पर परामर्श कार्य के माध्यम से परिदृश्य स्तर पर भूमि पुनर्स्थापन योजना का अध्ययन किया गया, जिसमें बहुत कम SOC (1 < 0.5%) कम N और P, तथा गली निर्माण के संरचनात्मक कारणों का दस्तावेजीकरण किया गया। साथ ही एकीकृत भूमि उपचार, फसल प्रणाली परिवर्तन और चराई प्रबंधन को सर्वोत्तम बीहड़ प्रबंधन योजना के रूप में प्रस्तावित किया गया।

विषयवस्तु – III : सूक्ष्मजीवी विविधता और जैव प्रौद्योगिकी

- मिट्टी में बैक्टीरिया की डाइवर्सिटी (16S rRNA V3–V4 एम्प्लिकॉन सीक्वेंसिंग) ऑर्गेनिक खेती में सबसे ज्यादा थी (शैनन इंडेक्स 5.06), उसके बाद नेचुरल खेती (5.02) और कंट्रोल (4.72) का नंबर था। सभी ट्रीटमेंट में प्रोटियोबैक्टीरिया हावी थे, जिसमें गैमाप्रोटियोबैक्टीरिया सबसे ज्यादा थे, जबकि अल्फा – और बीटाप्रोटियो बैक्टीरिया नेचुरल खेती में ज्यादा पाए गए।
- ऑर्गेनिक खेती में सबसे ज्यादा टोटल ग्लोमालिन रिलेटेड सॉइल प्रोटीन (TGRSP) (617.1 $\mu g\ g^{-1}$) पाया गया, इसके बाद नेचुरल फार्मिंग (585.6) और ICM (573.8) का नंबर आया। TGRSP माइक्रोएग्रीगेट्स (53–250 μm) में सबसे ज्यादा पाया गया, जो ग्लोमालिन रिटेंशन के जरिए बेहतर SOC स्टेबिलिटी दिखाता है।
- नेक्स्ट–जेनरेशन सीक्वेंसिंग से पता चला कि डीकंपोजर ट्रीटमेंट ने मिट्टी के माइक्रोबियल समुदाय में काफी बदलाव किया, जिससे मुख्य ग्रुप्स की विविधता और संख्या बढ़ी। एक्टिनोबैक्टीरिया (बेहतर डीकंपोजिशन), क्लो. रोफ्लेक्सी (कार्बन टर्नओवर), एसिडोबैक्टीरिया (पोषक तत्व साइक्लिंग), और जेमैटिमोनैडोटा (फॉस्फोरस साइक्लिंग) में उल्लेखनीय वृद्धि देखी गई, जो बेहतर मिट्टी के स्वास्थ्य और पौधों की वृद्धि में सहायक है।
- टमाटर के पौधे पर ह्यूमिक एसिड (HA)@ 0.1% + 0% RDF (T4) के फोलियर एप्लीकेशन वाली पॉट स्टडी ने सबसे अच्छा प्रदर्शन किया, जिससे कंट्रोल की तुलना में पौधे की ऊंचाई और फल लगने में 10% की बढ़ोतरी हुई। ये नतीजे शुरुआती हैं और फील्ड एक्सपेरिमेंट से इनकी पुष्टि की जानी बाकी है।
- PSB और SSB एप्लीकेशन पर एक फील्ड स्टडी से पता चला कि 75% RDF + PSB 4 (T3) से धान की सबसे ज्यादा पैदावार हुई, जो अकेले 75% RDF की तुलना में 25% ज्यादा थी।
- अरहर से मिले 48 राइजोबिया आइसोलेट्स में से, छह स्ट्रेन (चार धीरे बढ़ने वाले और दो तेजी से बढ़ने वाले) ने बेहतर PGP गुण दिखाए, जिनकी पहचान ब्रैडीराइजोबियम, राइजोबियम और साइनोराइजोबियम के रूप में की गई। BRP20 (धीरे बढ़ने वाला) और BRP8 (तेजी से बढ़ने वाला) के मिले–जुले इस्तेमाल को अरहर और दूसरी फलियों की पैदावार को बेहतर बनाने के लिए संभावित बायोइनोक्यूलेंट के तौर पर सुझाया गया है।
- AINP on SBB सेंटर, TNAU में एक लंबे समय तक चले फर्टिलाइजर एक्सपेरिमेंट में सभी ट्रीटमेंट में एक जैसी माइक्रोबियल डाइवर्सिटी (30–33 फाइला) दिखी, लेकिन न्यूट्रिएंट मैनेजमेंट ने कम्युनिटी कंपोजिशन और रिलेटिव एबंडेंस को काफी बदल दिया, जो मिट्टी के माइक्रोबायोम को आकार देने में इसकी भूमिका को दिखाता है।

विषयवस्तु– IV: मृदा प्रदूषण, पुनःस्थापन और पर्यावरण सुरक्षा

- स्टीम–एक्टिवेटेड बायोचार और अल्कली–ट्रीटेड फ्लाई ऐश ने दूषित मिट्टी में उगाए गए गेहूँ में Pb और Cd के अवशोषण को काफी कम कर दिया। Pb को कम करने में बायोचार ज्यादा प्रभावी था, जबकि फ्लाई ऐश ने Cd को कम करने में बेहतर नतीजे दिखाए। इन उपायों से

प्रदूषित कंट्रोल की तुलना में पौधों की ग्रोथ भी बेहतर हुई, जो भारी धातु से दूषित खेती की मिट्टी को ठीक करने में उनकी क्षमता को दिखाता है।

- म्युनिसिपल स्लज से बॉल मिलिंग का इस्तेमाल करके नैनोबॉयोचार बनाया गया। हालांकि ज़्यादातर कण 300–400 nm के बीच थे, लेकिन उनमें बेहतर सतह क्षेत्र और रिएक्टिविटी दिखी। यह नैनोमटेरियल मिट्टी की सफाई और पोषक तत्वों की डिलीवरी के लिए फायदेमंद है, क्योंकि इसकी बेहतर फिजिकल प्रॉपर्टीज को डायनामिक लाइट स्कैटरिंग एनालिसिस से वेरिफाई किया गया है।
- कानपुर के जाजमऊ क्षेत्र में मिट्टी में भारी धातुओं का अनुमान लगाने के लिए VNIR स्पेक्ट्रोस्कोपी का उपयोग करके PLSR और ANN मॉडल का इस्तेमाल किया गया। PLSR ने क्रोमियम और कैडमियम का प्रभावी ढंग से अनुमान लगाया, जबकि ANN ने लेड और आयरन को बेहतर ढंग से मॉडल किया। ये उपकरण स्पेक्ट्रल और मशीन लर्निंग तकनीकों का उपयोग करके दूषित मिट्टी के लिए तेज, लागत प्रभावी मूल्यांकन प्रदान करते हैं।
- MEGH डिवाइस मिट्टी की नमी का बिना किसी नुकसान के अनुमान लगाने के लिए स्पेक्ट्रोस्कोपिक एनालिसिस और ANN इंटीग्रेशन का इस्तेमाल करता है। यह RGB सेंसर के जरिए रिलेटिव ह्यूमिडिटी को मापता है और सिंचाई के फैसलों के लिए रियल–टाइम डेटा अपलोड करता है। यह सिस्टम मिट्टी में पानी की स्थिति की कम लागत वाली, क्लाउड से जुड़ी, ऑटोमेटेड मॉनिटरिंग करके सटीक खेती को सपोर्ट करता है।
- एक $CoCl_2$–युक्त सेलूलोज मेम्ब्रेन सेंसर आस–पास की रिलेटिव ह्यूमिडिटी के आधार पर मिट्टी की नमी को दिखाता है। MEGH प्रोटोटाइप के साथ इस्तेमाल करने पर, यह अलग–अलग तरह की मिट्टी में नमी के साथ अच्छी तरह से मेल खाता है। यह सिस्टम सिंचाई मैनेजमेंट के लिए पानी की उपलब्धता की निगरानी करने का एक स्केलेबल, बिना संपर्क वाला और किफायती तरीका देता है।
- फील्ड परीक्षणों से पता चला कि सिंथेटिक मल्च की तुलना में बायोडिग्रेडेबल मल्च चार फसल मौसमों में तेजी से (40%) खराब हो गया। इसने मिट्टी में प्लास्टिक के अवशेषों के जमाव को कम किया, जो टिकाऊ खेती के लिए इसकी उपयुक्तता को दर्शाता है। खरीफ में बायोडिग्रेडेशन रबी की तुलना में तेजी से हुआ, जिससे मौसम पर निर्भर मल्च के प्रदर्शन की पुष्टि हुई।
- ICAR-IISS में वायुमंडलीय माइक्रोप्लास्टिक जमाव की निगरानी के लिए एक रेन गेज सिस्टम का इस्तेमाल किया गया। बारिश के पानी और मिट्टी के नमूनों का 15–दिनों के अंतराल पर विश्लेषण किया गया, जिसमें माइक्रोप्लास्टिक की मात्रा, आकार और पर्यावरणीय चर का आकलन किया गया। यह अध्ययन मिट्टी में हवा में मौजूद माइक्रोप्लास्टिक के प्रवाह को समझने और इसे कम करने की रणनीतियों की आवश्यकता का समर्थन करता है।
- भोपाल, इंदौर और सीहोर के STP से लिए गए म्युनि. सिपल स्लज के नमूनों में pH, EC, नमी, पोषक तत्वों और भारी धातुओं में भिन्नता पाई गई। अपशिष्ट जल स्रोतों और उपचार दक्षता से प्रभावित, निष्कर्ष सुरक्षित पुनरू उपयोग या निपटान के लिए साइट–विशिष्ट निग. रानी और स्लज प्रबंधन की आवश्यकता पर जोर देते हैं।
- अलग–अलग गेहूँ के अवशेष और पोषक तत्वों के इनपुट के तहत GHG उत्सर्जन का आकलन मिट्टी के प्रकारों के आधार पर किया गया। इनसेप्टिसोल में कम N_2O और CH_4 प्रवाह देखा गया, जबकि एल्फिसोल में सबसे ज़्यादा कार्बन मिनरलाइजेशन और GWP था। मिट्टी के प्रकारों के हिसाब से बनाए गए अवशेष–पोषक तत्वों के सही कॉम्बिनेशन से उत्पादकता बनाए रखते हुए उत्सर्जन को कम किया जा सकता है।
- पाइपर प्लॉट एनालिसिस से पता चला कि मॉनसून के बाद Ca/Mg-Cl टाइप की हाइड्रोकेमिस्ट्री थी, जो खेती और सीवेज से होने वाले प्रदूषण का संकेत देती है। मौसमी बदलावों में Mg^{+2} और Cl^{-1} की प्रधानता बढ़ी हुई दिखी। फेसेस की पहचान करने से प्रदूषण के स्रोतों को समझने और भोजताल वेटलैंड में पानी की गुणवत्ता की रक्षा के लिए उपाय तैयार करने में मदद मिलती है।

Executive Summary

Theme - I: Soil Health and Nutrient Use Efficiency

- Twenty four genotypes of wheat were evaluated for growth and physiological responses under nutrient deficient conditions of vertisols. Few genotypes HI 8737, HI 1563, HI 1605, HI 1531, HI 8498, and Narmada 14 exhibited higher grain yield >4 t/ha with 30% and 50% Agronomic use efficiency for applied N under recommended N and low N dose conditions, respectively.
- The long-term application of fertilizers and manures in major crops under LTFEs clearly demonstrated that the sustainable yield index (SYI) and soil quality index (SQI) declined due to imbalance nutrient application and found to be maximum with application of 100% NPK+FYM (INM). The 150% NPK also gave at par values with 100% NPK+FYM in Vertisols. The balanced and INM (100% NPK+FYM) found to be sustainable in terms of crop yield and soil quality.
- An experiment at ICAR-IISS during rabi 2023–24 evaluated 24 wheat genotypes for physiological and nutrient use efficiency traits under varying nutrient gradients. Several genotypes, notably HI 1605, HI 1531, HI 8498, and DBW 88, demonstrated high nitrogen use efficiency (>50 kg grain/kg N) and sustained grain yields (>4 t/ha) even under low nitrogen conditions.
- The RothC model was successfully parameterized and validated using CRP on CA data to simulate long-term soil carbon dynamics in Vertisols of Madhya Pradesh. Model outputs indicated that increasing residue retention under no-till conditions enhanced soil carbon storage, with satisfactory model performance (RMSE = 0.80).
- Soil potassium quantity–intensity studies under varying residue retention levels revealed the highest labile K and activity ratio in CR90 plots and the lowest in conventional tillage. All treatments exhibited medium K-supplying capacity, with CR90 improving K availability and CT showing a decline toward poor K status.
- A field experiment during 2024 evaluated 12 IPNS modules in a maize–wheat system to identify the best nutrient management strategy for productivity and soil health. Integrated nutrient management, particularly STCR-based 75% NPK + FYM or vermicompost, significantly enhanced crop yield, SOC stocks, and carbon sequestration in Vertisols compared to GRD and sole chemical fertilization.
- Legume-based agri-horticultural systems, particularly chickpea–soybean sequences, enhanced soil health, nutrient availability, and fruit quality across mango, guava, lime, and aonla orchards. Among them, aonla showed the highest carbon buildup and leaf fall, while guava contributed the greatest nutrient return through leaf litter.
- A field experiment on cabbage evaluated three irrigation levels (100%, 80%, and 60% of water requirement) combined with three mulch types—black plastic, silver, and paddy straw. Preliminary results indicated that paddy straw mulch with 80% irrigation improved soil moisture and yielded 15–20% higher production compared to the control.
- A study on Vertisols assessed the impact of conservation agriculture on runoff and soil loss under soybean–wheat and maize–chickpea systems. Conservation tillage with residue retention (particularly NT-60% CR) substantially reduced soil, carbon, and nitrogen losses compared to conventional tillage, with maize–chickpea showing higher overall erosion than soybean–wheat.
- The MEGH device, an Arduino-based system, was developed for real-time, non-invasive soil moisture estimation using spectroscopic sensing. It measures optical responses, temperature, and humidity, transmitting data to a cloud platform for big-data analysis and precision agricultural decision support.
- A colorimetric soil moisture sensor using $CoCl_2$-infused cellulose membranes was developed for non-contact monitoring of soil water status. The membrane's humidity-dependent colour response, quantified via the MEGH prototype, showed a strong correlation with soil moisture, demonstrating a low-cost, scalable approach for real-time irrigation management across diverse soil types.
- A multi-season field trial at ICAR-IISS, Bhopal,

assessed the degradation of biodegradable and synthetic poly-mulches. Biodegradable mulch consistently exhibited ~40% weight loss per season nearly double that of synthetic mulches while leaving minimal residue, highlighting its potential for sustainable and plastic-free agricultural practices.

- A monitoring setup using a Standard Rain Gauge (Nova LYNX, USA) was established at ICAR-IISS, Bhopal, to assess atmospheric deposition of microplastics in soil. Rainwater and soil samples collected biweekly since September 2024 are being analyzed for microplastic size, shape, and abundance, alongside key soil physicochemical parameters.
- The Sustainable Yield Index (SYI) was used to assess the long-term sustainability of various nutrient management practices. Results across locations showed that balanced fertilization and INM (100% NPK + FYM/GM) achieved the highest SYI values, indicating improved soil quality and yield stability. At Akola, 100% NPK + FYM and 150% NPK recorded the highest SYI for sorghum and wheat, while at Jabalpur, 100% NPK + FYM gave maximum SYI for soybean and wheat in Vertisols. In contrast, imbalanced nutrient applications (Control, 100% N, 100% NP, 50% NPK) resulted in markedly lower SYI values.
- A spatio-temporal study (2016–2023) on cultivated soils of Haryana revealed significant declines in EC, available S, Zn, Fe, and Mn, indicating nutrient depletion over time. Shifts in spatial distribution patterns highlighted an expansion of nutrient-deficient zones, emphasizing the need for continuous soil fertility monitoring and adoption of area-specific precision nutrient management strategies for sustainable crop production.
- A large-scale soil survey (17,471 samples) across northeastern India used PCA and fuzzy clustering to delineate six soil nutrient management zones (MZs) based on spatial variability of S, B, Zn, Mn, Fe, Cu, SOC, pH, and EC. The study identified key nutrient deficiencies (S, B, Zn) and demonstrated the utility of MZ-based precision nutrient management for improving soil fertility and sustaining crop productivity in the region.
- A six-year field study in the Tarai region of North-West India evaluated boron fertilization effects on the rice–wheat system. Alternate-year application of 1.5 kg B ha^{-1} enhanced system rice equivalent yield by 6.7%, achieved the highest SYI, and maintained safe ecological limits, demonstrating that moderate, periodic B supplementation optimizes productivity and sustainability in the RWCS.
- A pot study on direct seeded aerobic rice (DSR) found that seed priming with 1.0% $FeSO_4 \cdot 7H_2O$ increased grain yield by 12.7% over control and improved growth and chlorophyll content. While Fe-EDTA (0.5% Fe) enhanced grain Fe concentration, higher doses reduced yield. Thus, $FeSO_4 \cdot 7H_2O$ (1.0% Fe) proved most effective for boosting yield and Fe content in DSR.
- Acid sulphate soils from Kerala's Kuttanad and Kole regions were analyzed for heavy metals, showing the order Cr > Ni > Co > Pb > Cd. Average Ni (292 ppm), Cr (861 ppm), and Co (74 ppm) levels exceeded FAO/WHO, European, and Indian standards, while Cd and Pb were generally lower but occasionally above safe limits, indicating localized contamination risk.
- Frontline demonstrations showed that applying 5 kg Zn ha^{-1} increased rice yield by 7.6–15.5% (mean 9.1%) over farmers' practices in Dindori, Madhya Pradesh. Similarly, field trials in Hisar, Haryana revealed that sulphur application significantly improved mustard and chickpea yields, with optimal and economical responses at 40 kg S ha^{-1} (mustard) and 20 kg S ha^{-1} (chickpea) through gypsum.
- Under AICRP-STCR, fertilizer prescription equations were developed for major crops to link nutrient needs (N, P_2O_5, K_2O) with soil test values and target yields, enabling precise, site-specific nutrient management under chemical and IPNS modes. A long-term Vertisol study showed that integrating fertilizers with organics improved yield stability, sustainability, and K availability, though a negative K balance indicated the need for additional K inputs for long-term fertility.

Theme II: Conservation Agriculture, Carbon Sequestration and Climate Change

- Conservation agriculture experiments on Vertisols demonstrated that drip and sprinkler systems-

maintained wheat yields of 51–53 q ha^{-1} while increasing water use efficiency from 15.0 kg ha^{-1} mm^{-1} under flood irrigation to 18.2 with sprinkler and 22.9 with drip, saving 35–40% water in drip and 17–20% in sprinkler systems.

- Across wheat and soybean, no significant yield reductions were observed among different tillage or nutrient regimes, indicating potential for a 25% reduction in fertilizer use (from 100% to 75% RDF or STCR/LCC-based management) and broader adoption of reduced or no-tillage, which also enhanced near-surface soil moisture despite slightly increased subsurface resistance.
- Complementary residue–nutrient trials in maize–chickpea and soybean–wheat systems showed consistent yield improvements when residue retention increased from 0 to 60–90%. Maize grain yield increased from 5.40 to 6.69 t ha^{-1} and chickpea yield from about 1.5 to over 2.2 t ha^{-1} at 90% residue, while soybean and wheat yield also peaked at high residue levels.
- Long-term conservation tillage studies reveal that surface penetration resistance is higher under conventional tillage, whereas subsurface layers in no-tillage exhibit initial compaction and lower infiltration rates, highlighting the need for periodic monitoring and possible deep loosening under continuous no-till.
- Digital and spectroscopic tools were enhanced through the development and deployment of the web-enabled Mid-Infrared Spectroscopy Analysis System. Model calibration for key soil properties demonstrated high accuracy, with calibration R^2 up to 0.97 for clay and pH, and validation R^2 around 0.85–0.87, along with RPD values above 2 for several properties, indicating reliable routine use for texture, pH, SOC, total C, and water retention. Exchangeable K and total micronutrients (Cu, Mn, Zn) were predicted with moderate reliability.
- Work on digital nutrient mapping carried out to support precision fertilizer recommendations through the web-based PFRS platform, developed for Madhya Pradesh and Haryana.
- Open-top chamber and temperature elevation studies showed that elevated temperature alone (+3 °C) increased available N, P, and K to approximately 141, 23.8, and 399 kg ha^{-1}, respectively, relative to the control, indicating enhanced mineralization, whereas combined elevated CO_2 and warming produced more complex responses. P fractionation under elevated CO_2 (~600 ppm) and +2 °C warming showed about 30% increases in Olsen-P under warming and a marginal decline under elevated CO_2, with total P remaining around 1.05–1.08 t ha^{-1} and Ca-P dominating (55–60%), highlighting shifts in plant-available and labile pools rather than total stock change.
- APSIM–ORYZA simulations for eastern India indicated that rice yields may initially increase under moderate warming with elevated CO_2 (2040s) but decline towards the 2080s under high-emission pathways, while adaptive measures such as higher plant density, adjusted transplanting windows, and increased N application can partially offset projected yield losses.
- RothC simulations under SSP1–2.6, 2–4.5, 3–6.0, and 4–8.5 scenarios showed SOC declining from approximately 20.7 to 16.6–17.9 t ha^{-1} by 2100, with mean annual losses ranging from approximately 0.027 to 0.041 t ha^{-1}, reinforcing the need for residue retention, reduced tillage, organic inputs, and agroforestry to conserve soil carbon under future climates.
- The SWAP model calibration for Vertisols showed that no-tillage improved water retention by approximately 10% and reduced surface temperature by approximately 8.5% in the top 10 cm. Downscaling of SMAP L4 soil moisture from 9 to 1 km using multiple machine learning methods produced modest agreement with in situ data indicating the current limitations of coarse satellite products for local-scale moisture estimation.
- A landscape-level restoration planning was studied through a consultancy on ravine management in Morena and Sheopur districts, documenting very low SOC (<0.5%), low N and P, and structural causes of gully formation, and proposing integrated land treatment, cropping system change, and grazing management as part of an optimal ravine management plan.

Theme III: Microbial Diversity and Biotechnology

- The Soil bacterial diversity (16S rRNA V3–V4 amplicon sequencing) was highest under organic farming (Shannon index 5.06), followed by natural farming (5.02) and control (4.72). Proteobacteria dominated across treatments, with Gammaproteobacteria most abundant, while Alpha- and Betaproteobacteria were enriched under natural farming.
- Organic farming recorded the highest total glomalin related soil protein (TGRSP) (617.1 $\mu g\ g^{-1}$), followed by natural farming (585.6) and ICM (573.8). The TGRSP was most enriched in microaggregates (53–250 μm), indicating better SOC stability through glomalin retention.
- Next-Generation Sequencingrevealed that decomposer treatments significantly shifted the soil microbial community, enhancing diversity and abundance of key groups. Notable increases were observed in Actinobacteria (improved decomposition), Chloroflexi (carbon turnover), Acidobacteria (nutrient cycling), and Gemmatimonadota (phosphorus cycling), supporting better soil health and plant growth.
- The pot study with foliar application of humic acid (HA) @ 0.1% + 50% RDF (T4) on tomato plant performed best, showing a 10% increase in plant height and fruiting over control. Results are preliminary and require validation through field experiments.
- A field study on PSB and SSB applications showed that 75% RDF + PSB 4 (T3) gave the highest rice yield, with a 25% increase over 75% RDF alone.
- Among 48 rhizobia isolates from pigeonpea, six strains (four slow and two fast growers) showed superior PGP traits, identified as Bradyrhizobium, Rhizobium, and Sinorhizobium. Combined use of BRP20 (slow) and BRP8 (fast) is suggested as potential bioinoculants to improve pigeonpea and other legume productivity.
- A long-term fertilizer experiment at AINP-SBB centre, TNAU showed similar microbial diversity across treatments (30–33 phyla), but nutrient management significantly altered community composition and relative abundance, highlighting its role in shaping soil microbiomes.

Theme-IV: Soil Pollution, Remediation and Environmental Security

- Steam-activated biochar and alkali-treated fly ash significantly reduced Pb and Cd uptake in wheat grown in contaminated soils. Biochar was more effective for Pb reduction, while fly ash showed higher Cd mitigation. These amendments also improved plant growth metrics compared to polluted controls, indicating their potential in remediating heavy metal-contaminated agricultural soils.
- Nanobiochar was produced from municipal sludge using ball milling. Although most particles ranged between 300–400 nm, they exhibited enhanced surface area and reactivity. This nanomaterial is promising for soil remediation and nutrient delivery, owing to its improved physical properties validated through dynamic light scattering analysis.
- PLSR and ANN models were used to predict soil heavy metals in Kanpur's Jajmau region using VNIR spectroscopy. PLSR effectively predicted chromium and cadmium, while ANN better modeled lead and iron. These tools provide rapid, cost-effective assessment for contaminated soils using spectral and machine learning techniques.
- The MEGH device uses spectroscopic analysis and ANN integration to non-invasively estimate soil moisture. It measures relative humidity via RGB sensors and uploads real-time data for irrigation decisions. The system supports precision agriculture by offering low-cost, cloud-connected, automated monitoring of soil water status.
- A $CoCl_2$-infused cellulose membrane sensor visually indicates soil moisture based on ambient relative humidity. Used with the MEGH prototype, it correlates well with soil moisture across different soils. The system offers a scalable, non-contact, and economical method for monitoring water availability for irrigation management.
- Field trials revealed that biodegradable mulch degraded faster (~40%) across four cropping seasons compared to synthetic mulches. It reduced plastic residue accumulation in soils, highlighting its suitability for sustainable farming.

Biodegradation was quicker in kharif than rabi, confirming season-dependent mulch performance.

- A rain gauge system was used to monitor atmospheric microplastic deposition at ICAR-IISS. Rainwater and soil samples were analyzed at 15-day intervals, assessing microplastic content, morphology, and environmental variables. This study supports understanding airborne microplastic influx into soils and the need for mitigation strategies.
- Municipal sludge samples from STPs in Bhopal, Indore, and Sehore showed variability in pH, EC, moisture, nutrients, and heavy metals. Influenced by wastewater sources and treatment efficiency, findings underscore the necessity for site-specific monitoring and sludge management for safe reuse or disposal.
- GHG emissions under varying wheat residue and nutrient inputs were assessed across soil types. Inceptisol showed low N_2O and CH_4 flux, while Alfisol had the highest carbon mineralization and GWP. Optimized residue-nutrient combinations tailored to soil types can minimize emissions while maintaining productivity.
- Piper plot analysis revealed Ca/Mg-Cl type hydrochemistry during post-monsoon, indicating contamination from agriculture and sewage. Seasonal shifts showed increased Mg^{2+} and Cl^{-} dominance. Identifying facies aids in understanding pollution sources and designing interventions to protect water quality in Bhojtal wetland.

1. Introduction

Soil science research, by addressing the physical, chemical, and biological properties of soil, plays a vital role in maintaining soil health, sustaining crop productivity and ensuring food and nutritional security, with effective soil management serving as a key driver of agricultural production and a critical pathway to achieving the Sustainable Development Goals of United Nations: End Poverty (SDG 1), Zero Hunger (SDG 2), Good Health and Wellbeing (SDG 3), Sustainable Cities and Communities (SDG 11), Responsible Consumption and Production (SDG 12), Climate Action (13) and Life on Land (15). Recent developments in soil science research focuses on climate-resilient soil management, precision nutrient management and advanced nutrient-use efficiency, circular economy in recycling technologies, digital soil mapping, and genomics and soil microbiome-based interventions for sustainable agriculture. Emerging tools such as remote sensing, artificial intelligence, and precision farming are transforming soil monitoring and decision-making. To feed the ever growing population from shrinking cropped lands, there is an urgent need for sustainable intensification of cropping systems through integrated soil-water-nutrient management, policy-driven soil conservation strategies, and location-specific technologies, carbon sequestration for climate change mitigation, restoring degraded soils, and harnessing beneficial microbes for improved nutrient cycling. Collectively, these efforts will not only safeguard the soil but also ensure a resilient food system, environmental sustainability, and direct contributions toward achieving the Sustainable Development Goals.

ICAR-IISS was established on 16 April, 1988 with the mission of "Providing scientific basis for enhancing and sustaining productivity of soil resources with minimal environmental degradation". Since its inception, the institute has made rigorous efforts to attain its mission and received national and international recognitions. Presently, the institute activity has been strengthened further by the scientific and managerial activities of three All India Coordinated Research Projects, one All India Network Project and one Consortia Research Platform project. These five institute-based projects act as a part of the "Network-Support Programmes" of the Institute with their centers located in various State Agricultural Universities and ICAR institutes, thereby providing access to the diverse soils, agro-ecosystems across the agro-ecological zones of the country for effective implementation of the various programs of the Institute at national level. During the year under report the institute has made significant scientific contributions in the frontier areas of soil science such as soil health &input use efficiency, carbon sequestration and climate change, organic matter recycling and management, soil biodiversity and genomics, environmental impact on agricultural production, utilization of solid wastes and bio and phyto-remediation, etc. The salient research findings, infrastructural development, technology transfer, human resource development, awards and recognitions and linkages and collaborations etc. are briefly highlighted in this annual report.

1.1 Mission and Mandate

The Institute has the mission of "Providing scientific basis for enhancing and sustaining productivity of soil resources with minimal environmental degradation" with following mandates:

- Basic and strategic research on physical, chemical and biological processes in soils related to management of nutrients, water and energy
- Advanced technologies for sustainable soil health and quality
- Coordinate the network research with State Agricultural Universities, National, International and other Research Organizations

1.2 Priorities and Thrust Areas

The priorities of the institute are to broaden the soil science research by encouraging multidisciplinary research for efficient utilization of already created infrastructure and, therefore, carry out research work rigorously in the following critical areas:

Programme 1: Soil Health and Input Use Efficiency

- Integrated nutrient management: Indigenous mineral and by-product sources
- Nano-technology
- Precision agriculture
- Fertilizer fortification

- Resilience of degraded soils
- Developing a workable index of soil quality
- Organic farming and produce quality

Programme 2 : Conservation Agriculture and Carbon Sequestration vis-à-vis Climate Change

- Conservation agriculture and carbon sequestration sustainable management of land and soil resources
- Tillage and nutrient interactions
- Crop simulation modeling and adaption to climate change
- Remote sensing and GIS

Programme 3: Microbial Diversity and Genomics

- Characterization and prospecting of soil bio-diversity
- Testing of mixed bio-fertilizer formulations
- Quality compost production and quality standards
- Exploring microbial diversity for improvement of contaminated soil and water
- Exploring C-sequestration potential mediated microbes under different agro-eco-systems

Programme 4: Soil Pollution, Remediation and Environmental Security

- Soil pollution impact assessment and toxicity amelioration
- Phytoremediation and bioremediation of contaminated soils
- Developing technology for efficient reuse/disposal of city and industrial waste
- Developing soil management practices for minimizing emission of greenhouse gases
- Environmental impact risk assessment of nanoparticles on soil health and plant nutrition

1.3 Organization Set-Up

Divisions

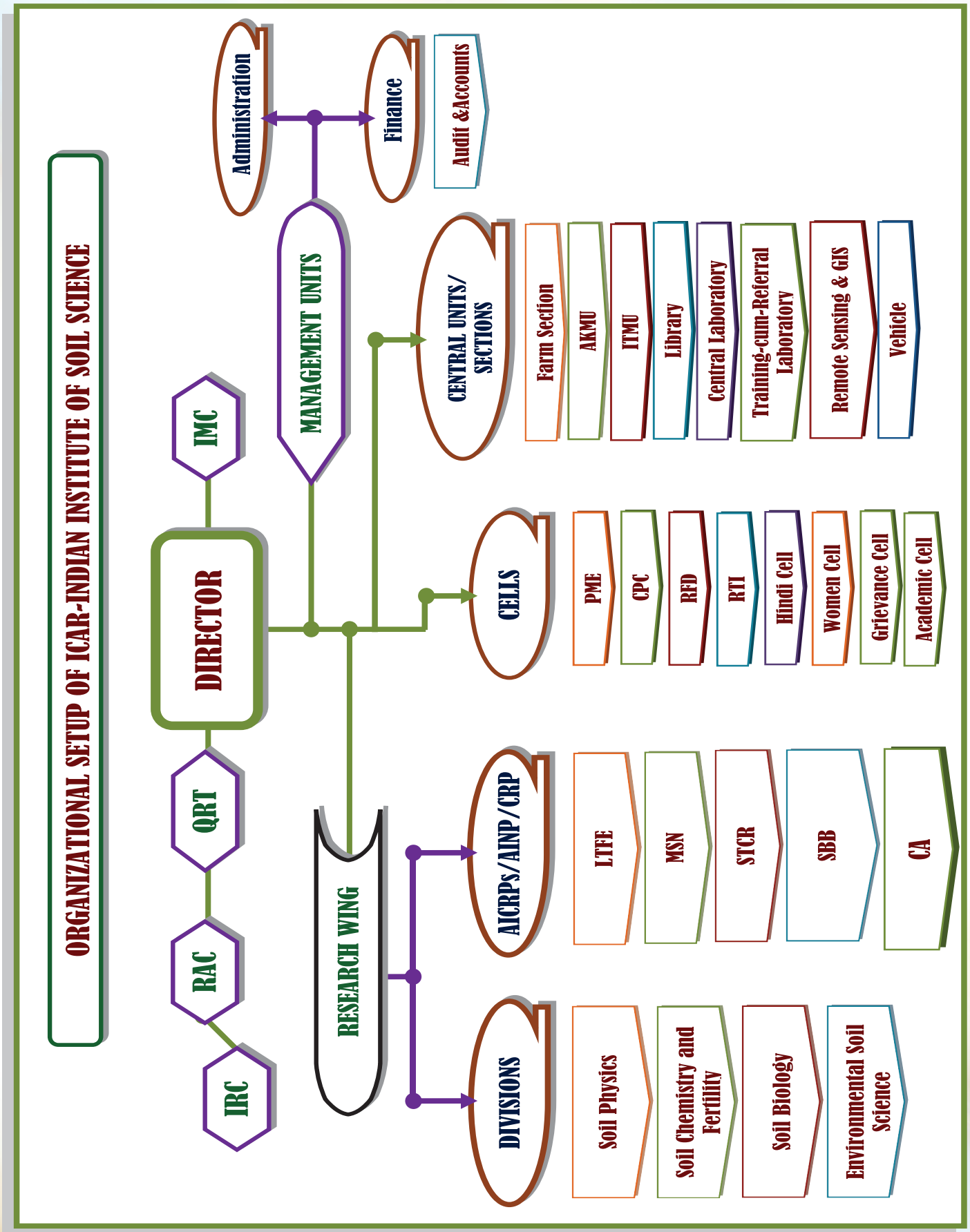
- Soil Physics
- Soil Chemistry & Fertility
- Soil Biology
- Environmental Soil Science

Sections/Central Units/Technical Units/Cells

- Farm
- Administration
- Remote Sensing & GIS
- Prioritization, Monitoring and Evaluation Cell (PME)
- Agriculture Knowledge Management Unit (AKMU)
- Institute Technology Management Unit (ITMU)
- Library, Information and Documentation Unit
- Right to Information (RTI) Cell
- Consultancy Processing Cell (CPC)
- Official Language Cell (Hindi Cell)
- Vehicle
- Training Hostel
- Referral Lab
- Women Cell

All India Co-ordinated Research Projects (AICRPs/ AINP/ CRP)

- AICRP on Long -Term Fertilizer Experimentsto Study Changes in Soil Quality, Crop Productivity and Sustainability (LTFE)
- AICRP on Soil Test and Crop Response (STCR)
- AICRP on Micro and Secondary Nutrients and Pollutant Elements in Soils and Plants (MSPE)
- AINP on Soil Biodiversity and Biofertilizers (SBB)
- CRP on Conservation Agriculture (CRP-CA)


ORGANIZATIONAL SETUP OF ICAR-INDIAN INSTITUTE OF SOIL SCIENCE
IRC
RAC
QRT
IMC
DIRECTOR
RESEARCH WING
MANAGEMENT UNITS
Administration
Finance
Audit &Accounts
CENTRAL UNITS/ SECTIONS
Farm Section
AKMU
ITMU
Library
Central Laboratory
Training-cum-Referral Laboratory
Remote Sensing & GIS
Vehicle
CELLS
PME
CPC
RFD
RTI
Hindi Cell
Women Cell
Grievance Cell
Academic Cell
AICRPs/AINP/CRP
LTFE
MSN
STCR
SBB
CA
DIVISIONS
Soil Physics
Soil Chemistry and Fertility
Soil Biology
Environmental Soil Science

Manpower

(a) Scientific

S. No.	Discipline	Sanctioned				In Position			
		PS	SS	S	Total	PS	SS	S	Total
1	Agricultural Chemicals	0	0	1	1	0	0	1	1
2	Agricultural Economics	0	0	2	2	0	0	1	0
3	Agricultural Extension	0	0	1	1	0	0	1	1
4	Agricultural Microbiology	0	1	2	3	0	1	1	2
5	Agricultural Physics	0	1	0	1	0	0	0	0
6	Agricultural Statistics	0	0	1	1	0	0	0	0
7	Agronomy	0	1	4	5	0	0	3	3
8	Electronics & Instrumentation	0	1	0	1	0	0	0	0
9	Fruit Science	0	0	1	1	0	0	1	1
10	Plant Biochemistry	0	1	0	1	0	0	0	0
11	Plant Physiology	1	1	1	3	1	1	0	2
12	Soil Science	0	4	27	31	1	4	21	26
	Total	1	10	40	51	2	06	29	37
13	HoDs	4	0	0	4	4	0	0	4
14	Project Coordinators	0	0	0	0	0	0	0	0
15	RMP	1	0	0	1	1	0	0	1
	Grand Total	6	10	40	56	7	06	29	42

(b) Technical

S. No.	Posts	Sanctioned	In Position
1	T-1	11	9
2	T-2	-	-
3	T-3	7	4
4	T-4	-	-
5	T-5	-	-
6	T-6	1	0
7	T-7-8	-	-
8	T-9	-	-
	Total	19	13

(c) Administrative

S. No.	Designation	Sanctioned	In Position
1	Assistant Director (OL)	1	0
1	Sr. Administrative Officer	1	0
2	Sr. Finance & Accounts Officer	1	1
3	Administrative Officer	1	1

5	Assistant Administrative Officer	2	2
6	Private Secretary	3	3
7	Assistant	8	4
8	Personal Assistant	4	2
11	Upper Division Clerk	3	2
12	Lower Division Clerk	4	4
	Total	28	19

d) Supporting Staff

1	Skilled Supporting Staff	17	8
	Total	17	8

Finance: Budget statement (In lakhs) 2024-25 is as follows

Institute/AICRPs	Budget	Expenditure
Main ICAR-IISS Institute	2553.05	2552.62
AICRP on MSN	990.46	990.46
AICRP on STCR	1282.03	1281.94
AICRP on LTFE	783.49	783.47
AINP on SBB	218.88	218.80
CRP on CA	373.19	373.13
Total	6201.10	6200.42

Resource Generation

S.No	Head of Account	Rs.
1	Sale of Farm Produce	10,94,285.00
2	Income from royalty, sale of publication and advertisement	30,927.00
3	License Fee	9,97,186.00
4	Interest earned on loans and Advance	9,85,078.00
5	Analytical and Testing Fees	1,22,529.00
6	Interest earned on short Term Deposits	87,65,454.00
7	Recoveries of Loans & Advances	19,78,820.00
8	Miscellaneous Receipts	30,98,329.00
9	Unspent balance of grants of previous year	2,81,26,456.00
10	Receipt from schemes	4,48,937.00
	Total	4,56,48,001.00

2. Research Achievements

Theme - I: Soil Health and Nutrient Use Efficiency

2.1 Improving Input Use Efficiency

2.1.1 Assessment of wheat genotypes for physiological efficiency during nutrient stress

An experiment was conducted during the rabi season of 2023-2024 at ICAR-IISS research farm and 24 selected varieties of wheat were evaluated for crop physiological and nutrient use efficiency attributes. These genotypes were evaluated under plots of nutrient gradient with low nitrogen (50% N), low phosphorus (50%P) and general recommended dose (100%NPK) of fertilizer nutrient (120-60-40 kg ha^{-1} owf NPK) under field conditions. Among the physiological traits, the Electron Transfer Rate (ETR) during light reaction of photosynthesis ranged from 150 to 300 μM electron m^{-2} s^{-1} and photosystem II yield ranged from 0.68 to 0.76. Under low nitrogen conditions (50%N), genotypes HI 8737, HI 1563, HI 1605, HI 1531, HI 8498, and Narmada 14 exhibited grain yield >4 t ha^{-1}. Ten genotypes showed more than 30% and 50% agronomic use efficiency for applied N under recommended N and low N dose conditions, respectively. The genotypes HI 1605, HI 1531, HI 8498 and DBW 88 exhibited more than 50 kg^{-1} of applied N. Besides, the remaining 96 wheat genotypes were maintained separately for germplasm conservation (Fig. 2.1.1).

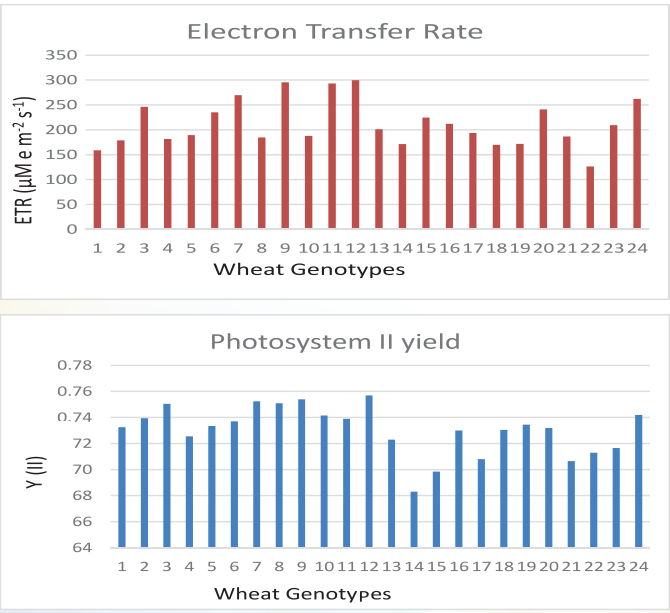


Fig. 2.1.1 Electron transfer rate and PS II yield of wheat genotypes

2.1.2 Modelling the soil organic carbon dynamics under no till system with different levels of residue retention using Rothamsted carbon model

An attempt was made to parameterize and validate the global carbon model-RothC using the data of CRP on CA and further simulate the long-term impact of retention of different levels of residues on soil carbon dynamics in high clayey soils of Madhya Pradesh. The experiment was having four different levels of residues (0, 30, 60, and 90%) under no tillage system along with a treatment of conventional agriculture. The site was established on a Vertisol under sub-humid, dryland conditions. Using long-term climate, soil, and residue management inputs, the Rothamsted Carbon (RothC) model was applied to assess the current and future SOC stocks in the Vertisols. The carbon input varies from 2.02, 2.54, 3.08, 3.970 and 5.1 mg ha^{-1} yr^{-1} under the treatments of conventional agriculture (CA), NT (0%), NT (30%), NT (60%) and NT (90%), respectively. Retention of 0, 30 and 60% of residue of previous crops accumulated 28.35, 29.24, and 29.75 Mg ha^{-1} of carbon storage, respectively. The RMSE of model output is 0.80. In this case, the RMSE represents a relatively small average deviation between the observed and predicted values, suggesting reasonable model performance. The RothC model can be parameterized to predict soil carbon storage under the practice of no till system with different levels of residue retention (Fig.2.1.2). The changes in soil carbon pools under different levels of residue retention is depicted in table 2.1.2.

Table 2.1.2 Changes in soil carbon pools with residue retention in soybean-wheat cropping system

Carbon pools	NT-90%	NT-60%	NT-30%	NT-00%	CT-00
DPM	0.7	0.54	0.42	0.35	0.27
RPM	7.41	5.76	4.53	3.78	3.05
BIO	1.12	0.89	0.71	0.6	0.5
HUM	22.76	21.24	20.35	19.8	19.27
IOM	1.91	191	191	1.91	1.91
Total	33.92	30.35	27.94	26.46	25.03

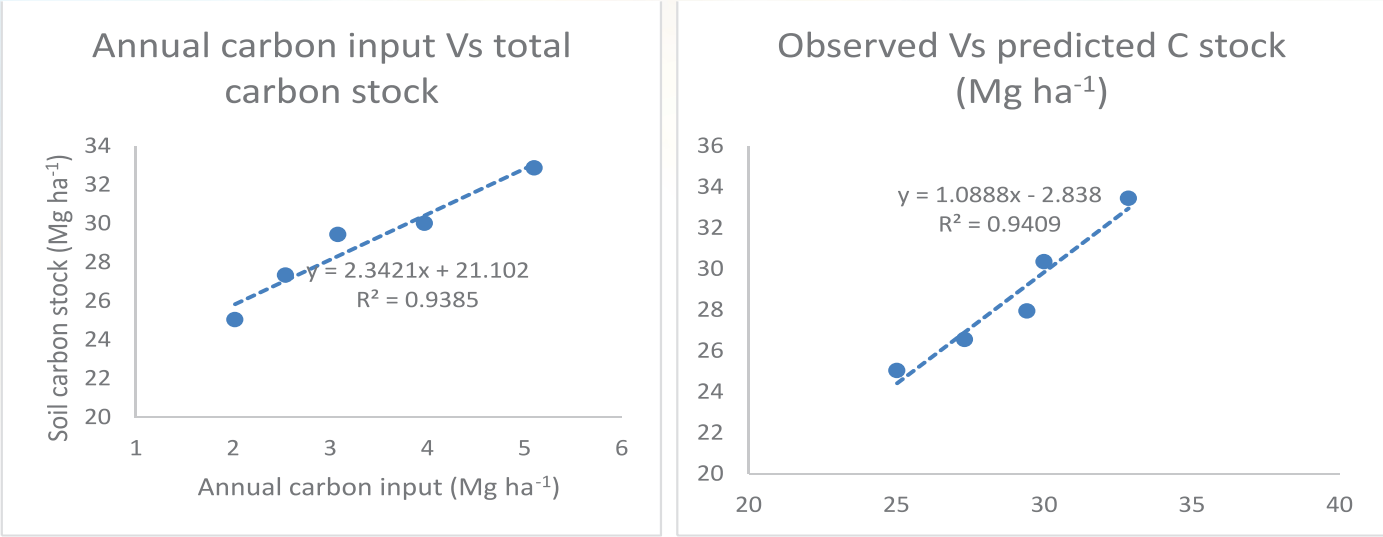


Fig. 2.1.2 Relationship between annual carbon input and soil carbon stock (a) and observed and predicted carbon stocks using RothC model (b)

2.1.3 Relationship between Conservation tillage and K supplying capacity

Soils with conservation tillage and continuous addition of crop residues (CR90) shows improvement in K supplying capacity on the basis of Q-I relationship study and Gibb's free energy concept. Soil samples were collected from an ongoing field experiment under CRP on CA. The experiment consisted of four levels of crop residue retention, CR0 (without residue), CR30 (30% residue), CR60 (60% residue), and CR90 (90% residue) and one conventionally tilled plot (CT). The samples were subjected to Quantity-Intensity studies for potassium. Results revealed highest labile K (quantity factor) and equilibrium activity ratio (intensity factor) in the CR90% plots and the least in CT plots. Potential buffering capacity under all the treatments were at par. Highly negative values of Gibbs free energy (ΔG°) associated with low equilibrium activity ratio values indicate very strong bond between solid phase and K in solution. All the treatments were grouped under medium K supplying capacity based on ΔG° concept (Woodruff, 1955). However, the highest negative value in case of CT signifies its tendency to move towards poor K availability whereas, CR90 shows improvement towards high K availability (Table 2.1.3).

Table 2.1.3 Quantity -intensity relationship as affected by levels of residue retention under CA

Treatments	Planar K (K_0) (cmol kg^{-1})	Specifically held K (K_X) (cmol kg^{-1})	Labile K (K_L) (cmol kg^{-1})	$CRe^{0K}*10^{-3}$ [(mol $L^{-1})^{1/2}$	PBC^K [cmol kg^{-1} (mol $L^{-1})^{-1/2}$]	ΔG^o (cal mol-1)
CR0%	0.832	0.526	1.358	3.36	248	-3361
CR30%	0.854	0.782	1.636	4.4	194	-3202
CR60%	0.921	0.867	1.788	3.85	239	-3280
CR90%	1.123	0.794	1.917	5.22	214	-3101
CT	0.797	0.308	1.105	3.25	245	-3380

2.1.4 Integrated plant nutrient supply modules for sustainable maize-wheat system productivity

During 2024, a field study was conducted to find out the best-suited nutrient management modules for improving crop productivity and soil health. Hence, 12 integrated plant nutrient supply (IPNS) modules, namely GRD, STCR-based NPK, integration of organic and inorganic, purely organic, and integration of different organic sources of nutrients, were investigated in

the maize-wheat system. Results indicated that crop yield of maize and wheat was significantly influenced by the application of different nutrient management strategies, and higher grain yield of maize and wheat was recorded with INM modules, i.e., STCR-based 75% NPK + FYM @ 5 h ha^{-1}, followed by STCR-based 75%NPK + vermicompost (VC) as compared to GRD (Fig. 2.1.4).

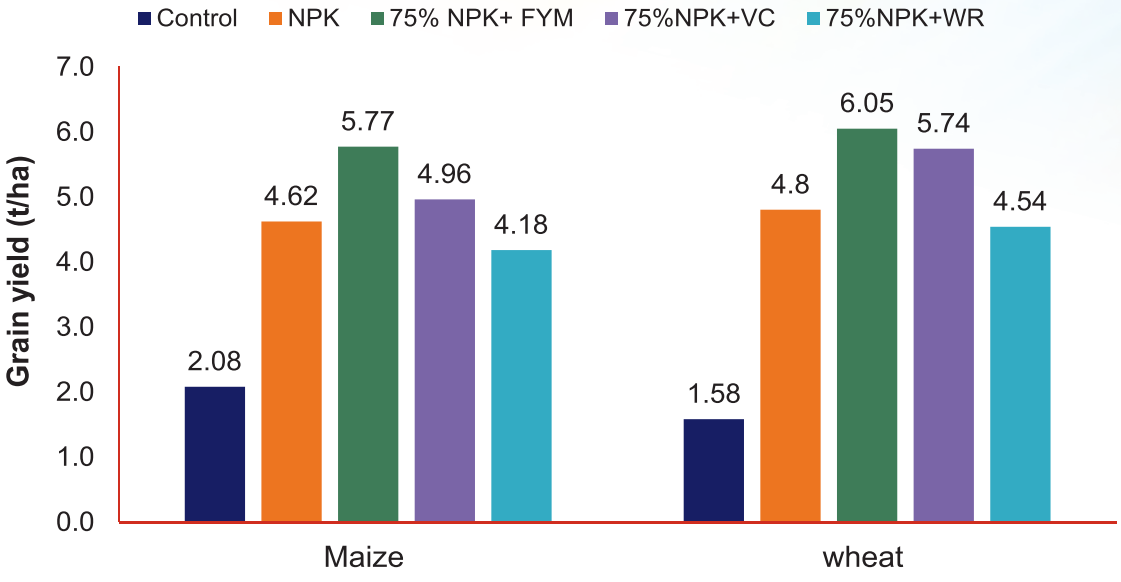


Fig. 2.1.4 Effect of IPNS modules on maize and wheat productivity



Plate 2.1.4 Effect of IPNS modules on maize and wheat productivity

2.1.5 Soil organic carbon (SOC) and carbon sequestration influenced by IPNS modules

Soil organic carbon and carbon sequestration rate significantly influenced with adoption IPNS modules. Adoption of higher amount of FYM (25t ha^{-1}) increased the SOC contents, SOC stocks and carbon sequestration rate followed by 75% NPK based on STCR along with 5 t ha^{-1} FYM as compared to GRD and 100% NPK based on STCR. Integration of different organic sources of nutrients also improved the carbon sequestration rate as compared control and chemical fertilization (GRD, STCR 100%). Although application of GRD and STCR based fertilization also improved the carbon sequestration over no fertilization. Therefore, it can be inferred that adoption of IPNS modules is the best technology to improve SOC stocks and carbon sequestration rate in Vertisols (Fig. 2.1.5).

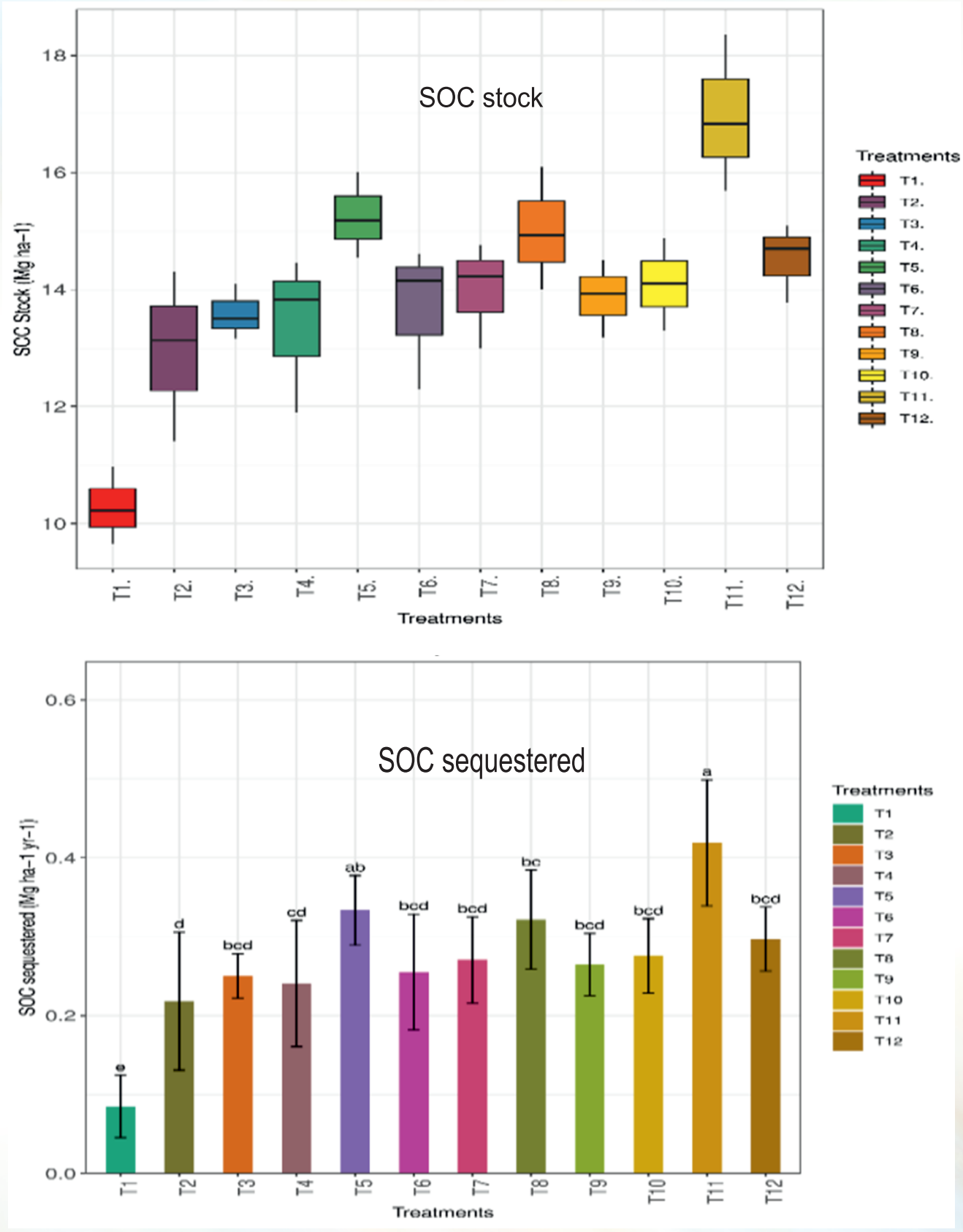


Fig. 2.1.5 Effect of treatments on SOC stock and sequestration in a Vertisol

2.1.6 Effect of agri-horticultural system on soil health and produce quality

Agri-horticultural systems have been developed in four orchards namely; mango + wheat - cow pea, mango + chick pea – soybean and mango + mustard – cow pea and similar combinations were developed in guava, lime and aonla orchard. Legume based agri-horti systems (chick pea – soybean) resulted in good soil health for sustainable crop production. Chick pea and soybean intercropping improved nutrient content in soil of all orchards (mango, guava, lime and aonla). This system also improved nutrient content in leaf and fruit of mango, guava, lime and aonla, and improved produce quality. Among the four orchards, guava orchard increased nutrient content in intercrops viz., wheat, chick pea, mustard, soybean and cow pea. Carbon build up rate was highest in aonla followed by guava orchard. Leaf fall was highest in aonla orchard (818.33 kg/ha/year) followed by guava (787.79 kg/ha/year) but guava leaf fall contributed more nutrient (N-13.86, P-1.42 and K-10.16 kg/ha/year) in the orchard (Fig. 2.1.6).

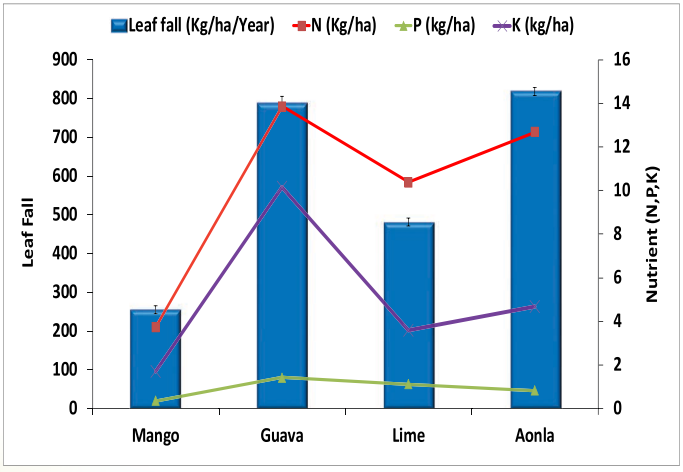


Fig. 2.1.6 Leaf fall in various fruit crops and its nutritional contribution in soil

2.1.7 Enhancing nutrient and water productivity through mulching and micro irrigation methods

A field experiment of cabbage plants has been established comprising three irrigation treatments of 100, 80, and 60% of water requirements as a main plot in subplot three different types of mulch. Black plastic mulch, silver mulch, and paddy straw mulch have been used. An initial soil sample has been collected before the experiment. Data showed that paddy straw mulch with 80% of water application had shown good performance 15-20% more yield compare to control (Plate 2.1.7).



Plate 2.1.7 Effect of mulching and micro-irrigation method on nutrient and water productivity in cabbage

2.1.8 Impact of conservation agriculture on Runoff and soil loss in Vertisols under different cropping system

Two cropping systems namely soybean-wheat and maize-chickpea were evaluated for runoff, soil loss impact on nutrient loss under various conservation tillage treatments. Total five treatments (i) Conventional tillage -CT (ii)Reduced tillage + 30 % residue RT-30% CR (iii) Reduced tillage + 60 % residue RT-60%CR (iv) No- tillage + 30 % residue NT-30% CR (v) No- tillage + 60 % residue NT-60% CR were imposed. In the soybean-wheat cropping system, soil loss varied between 4.96 and 2.93 t/ha, with the highest loss occurring under conventional tillage, followed by reduced and no-tillage treatments. Similarly, in the maize-chickpea system, conventional tillage caused greater soil loss, ranging from 5.99 to 3.42 t ha^{-1}, compared to the reduced and no-tillage methods. The decrease in soil loss under conservation tillage is largely due to crop residue retention on the soil surface, which acts as a protective barrier against erosion. It is also noteworthy that soil loss was generally higher in the maize-chickpea system than in the soybean-wheat system. The soil organic carbon loss ranged from 21.24 to 32.31 kg ha^{-1} in soybean-wheat cropping system and 24.57 to 40.73 kg ha^{-1} in maize-chickpea cropping system. The total nitrogen loss ranged from 2.73 to 6.93 kg ha^{-1} in soybean-wheat

cropping system and 3.07 to 7.18 kg ha^{-1} in maize-chickpea cropping system (Fig. 2.1.8).

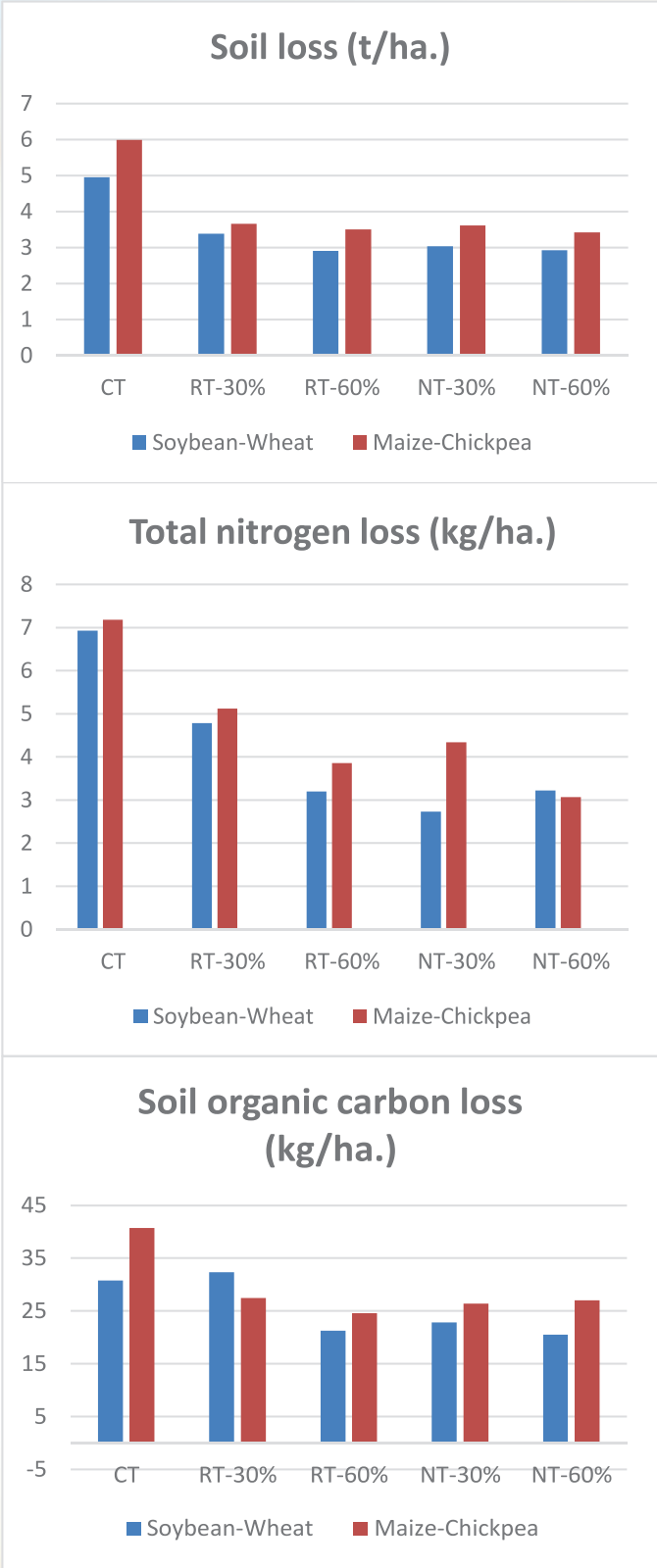


Fig. 2.1.8 Soil, nitrogen and SOC loss under different treatments

2.1.9 MEGH device development and spectroscopic soil moisture estimation

The MEGH device integrates an Arduino-based interface for soil moisture estimation using spectroscopic methods. It captures optical parameters from a sensor-strip placed 20 cm above soil, calculating RH in equilibrium with soil moisture. The device also records air temperature, ambient humidity, and uploads the data to a cloud server for big-data analysis. This system enables real-time, non-invasive soil moisture monitoring and decision support in agriculture (Fig. 2.1.9a, b and c).

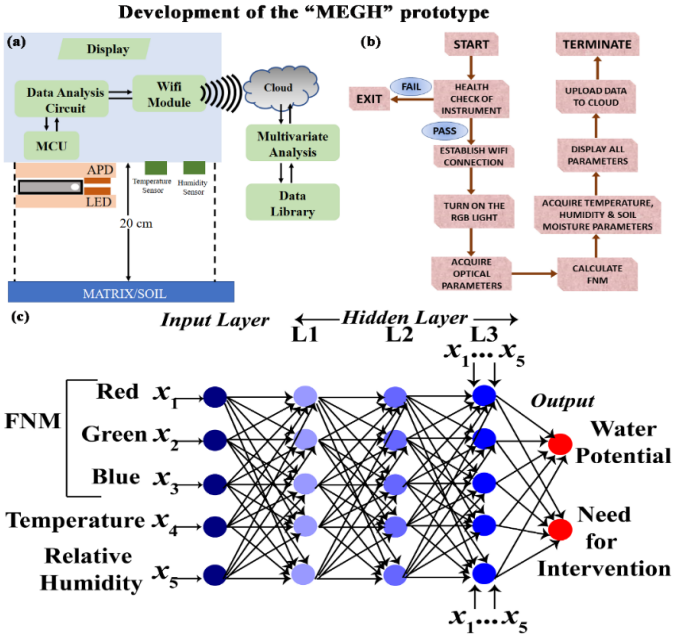


Fig. 2.1.9 (a) MEGH device along with its components; (b) workflow chart for the operation of the device; (c) ANN incorporated into device for determination of water potential

2.1.10 Colorimetric sensor for soil moisture monitoring using $CoCl_2$-infused membranes

A non-contact soil moisture sensor was developed using functionalized fibrous cellulose membranes with cobalt chloride ($CoCl_2$), which responds to relative humidity changes. The $CoCl_2$ concentration did not affect the membrane's morphology, allowing consistent response characteristics. Color changes in the membrane, dependent on humidity, were quantified using the MEGH prototype placed 20 cm above the soil surface. A strong correlation was observed between RH values and soil moisture content. Tests across

different soil types revealed that hydrophobic soils retained more plant-available water than hydrophilic ones, as confirmed through simulation studies. The device thus effectively estimated soil water availability by monitoring ambient RH in equilibrium with the soil matrix. This innovative sensor and device combination can be applied in the agricultural sector to assess water stress across various soil types, offering a low-cost and scalable method for real-time irrigation scheduling and moisture-based crop management (Fig. 2.1.10).



Fig. 2.1.10 (a) development of non-contact nano sensor prototype; (b) irrigation system layout and experimental plot at ICAR-IISS, Bhopal Farm with non-contact nano sensor

2.1.11 Poly-mulch degradation in agronomic trials across growing seasons

An agronomic field trial was conducted at ICAR-IISS, Bhopal, to evaluate the degradation of biodegradable, UK synthetic, and India synthetic poly mulches. During Growing Season-I (maize, June-October 2022), biodegradable mulch showed 39.4% weight reduction, UK synthetic 23%, and India synthetic 21.4%. In Growing Season-II (okra, November 2022-May 2023), reductions were 37.7%, 21.7%, and 19.5%, respectively. For Growing Season-III (sweet corn, June–October 2023), the biodegradable mulch lost 40% weight, UK synthetic 22.2%, and India synthetic 21%. In Season IV (broad bean, November 2023-March 2024), respective reductions were 40.6%, 23%, and 21%. Biodegradable mulch began degrading one month after sowing in kharif and 60 days post-sowing in rabi (Fig. 2.1.11). Visual inspection post-harvest showed fewer macroplastic residues under biodegradable mulch compared to synthetic variants. These results underscore the potential of biodegradable mulch for sustainable agriculture while reducing microplastic accumulation in soil compared to synthetic options (Plate 2.1.11).

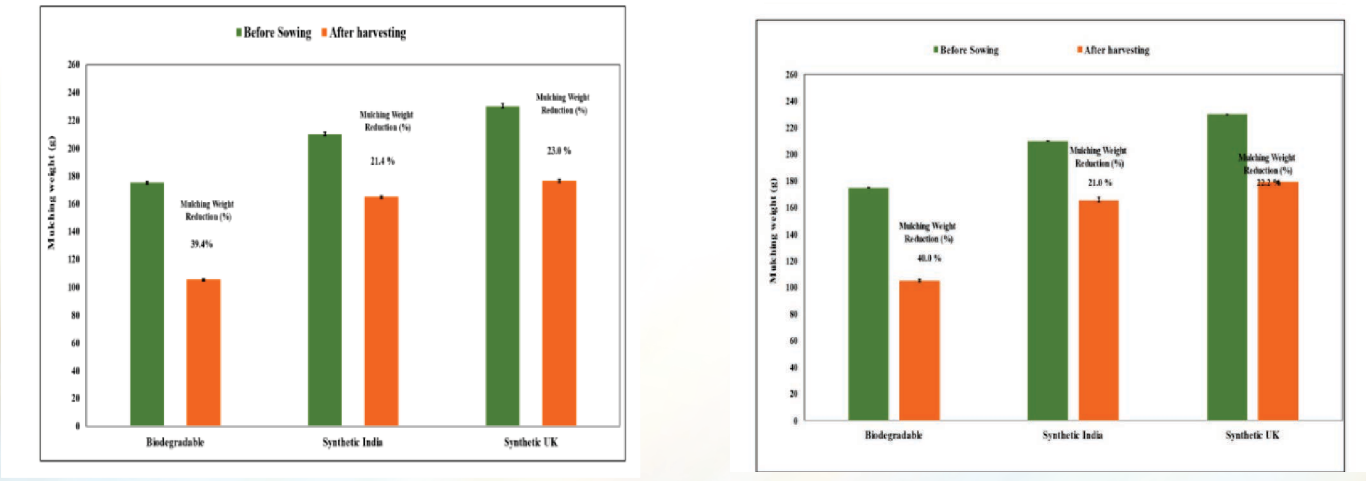


Fig. 2.1.11 Changes in weight of different mulches before and after harvesting

2.1.12 Atmospheric deposition of microplastic in soil

Standard Rain Gauge (Nova LYNX, USA) was installed at ICAR-IISS, Bhopal farm on 02/09/2024 to determine theatmospheric deposition of microplastic in soil. Samples (Soil, Rainwater) were collected on 15 days interval from 16/09/2024 onwards. Soil parameters including pH, EC, Organic matter content, Soil moisture, Bulk Density were estimated. Microplastics from rainwater were extracted by following standard protocol and size, shape, numbers are being estimated through image (Plate 2.1.12).



Plate 2.1.12 Field experimental set up for the atmospheric microplastic deposition

2.2 AICRP on Long-Term Fertilizer Experiments to Study Changes in Soil Quality, Crop Productivity and Sustainability

Impact on Sustainability

(a) Sustainable yield index (SYI)

The sustainable yield index (SYI) is one of the ways to evaluate sustainability of nutrient management options. More SYI value implies better soil quality. Sustainable Yield Index (SYI) was computed for crop by using following equation. i.e. SYI = $(\hat{y}-\sigma)/ Ymax$(where, $\hat{y}$= Average yield of the treatment; σ = Treatment standard deviation; Ymax= Maximum yield in the experiment over the year. Thus, from SYI data it is concluded that balanced application of nutrient resulted in higher SYI irrespective of crop and soil type which means management of nutrients appropriately is responsible for sustainability and soil quality as well. The SYI indicated that the imbalance nutrient application (Control, 100% N, 100% NP, 50% NPK) resulted in lower values compared to balance and INM (100% NPK+FYM/GM) (Table 2.2).

Akola: The SYI for sorghum and wheat at Akola ranged between -0.004 to 0.65. The higher SYI was recorded in 100% NPK + FYM and 150% NPK. It has been prominently reflected on the crop growth and yield performance of sorghum (Plate 2.2a). The application of 100% NPK along with S and Zn also recorded higher SYI as compared to balanced fertilization.

Jabalpur: The maximum SYI was recorded with 100% NPK+FYM in both of soybean and wheat in Vertisols of Jabalpur. This may be attributed to the additional benefit of FYM for improvement in crop growth and productivity over 100% NPK. While, lower SYI was observed in 100% N alone and control. It has been prominently reflected on the crop growth and yield performance of soybean (Plate 2.2b).



Control



100% NPK



100% NPK+FYM



Control 100% NPK 100% NPK+FYM

Plate 2.2a Impact of nutrient management in sorghum at Akola and soybean at Jabalpur in Vertisols under LTFEs

Raipur: The sustainable yield index of rice and wheat in Vertisols of Raipur as influenced by long term continuous manuring and fertilization indicates that 150% NPK recorded higher SYI for rice and wheat which is almost similar to 100% NPK + FYM. It indicates that balanced fertilizer application either alone or with organic (FYM) can sustain yield of rice-wheat system in long-run. The SYI registered higher values when other organic sources of nutrients (Green Manuring and Blue Green Algae) are included in fertilizer schedule as compared to 50% NPK which was indicated by higher SYI of 50% NPK+ GM compared to 50% NPK. The SYI has almost similar values for rice and wheat under application of recommended dose of fertilizer (100% NPK and 100% NPK+Zn). Imbalanced (100% N alone) application recorded lowest SYI by rice and wheat thereby cannot sustain rice and wheat productivity in long run.

Parbhani: The highest SYI in soybean-safflower system (Vertisols of Parbhani) was observed with the application of 100% NPK + FYM. However, the SYI values were low under absolute control treatment. Thus, treatment 100% NPK + FYM has highest SYI compared to all the other treatments.

Table 2.2 Long term effect of various treatments on sustainable yield index (SYI) of different crops in LTFEs in India

Centre	Crop	Control	100% N	100% NP	50% NPK	100% NPK	100% NPK+Zn	150% NPK	50% NPK+ GM	100% NPK+ FYM
Akola	Sorghum	-0.004	0.22	0.35	0.28	0.47	0.52	0.62	-	0.65
	Wheat	0.44	0.59	0.62	0.43	0.53	0.52	0.61	-	0.58
Jabalpur	Soybean	0.12	0.14	0.24	0.21	0.30	0.28	0.32	-	0.34
	Wheat	0.14	0.15	0.49	0.35	0.56	0.58	0.59	-	0.61
Raipur	Rice	0.28	0.44	0.63	0.51	0.64	0.63	0.71	0.58	0.70
	Wheat	0.20	0.31	0.49	0.35	0.51	0.35	0.60	0.40	0.58
Parbhani	Soybean	0.18	0.22	0.70	0.69	0.75	0.75	0.78	-	0.80
	Safflower	0.33	0.38	0.66	0.51	0.73	0.76	0.85	-	0.87

b) Soil Quality

Soil quality in one of the key issues as influenced by continuous fertilizer use. In order to estimate soil quality index (SQI), a total 25-30 soil attributes (chemical, physical and biological) were taken into account depending upon soil type at different centres. These attributes were subjected to principal component analysis (PCA) to find out soil indicators and soil quality index using the expression $SQI = \sum_{i=1} W_i S_i$ (where, S is the score for the subscripted variable and W_i weighted factor derived from PCA. Higher is the score better is the soil quality. More the SQI value better will be the soil quality. Soil indicators are not constant or fixed, varies with soil type. The SQI was estimated through PCA for some of LTFEs and data indicated that the values were poor with imbalance nutrient application (Control, 100% N, 100% NP, 50% NPK) compared to balance (100% NPK) as well as application of 100% NPK+FYM (Fig. 2.2).

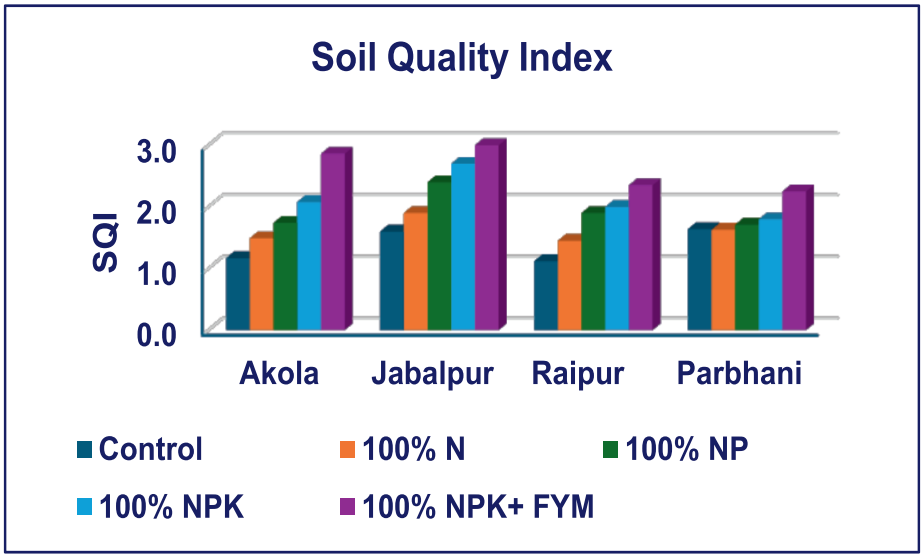
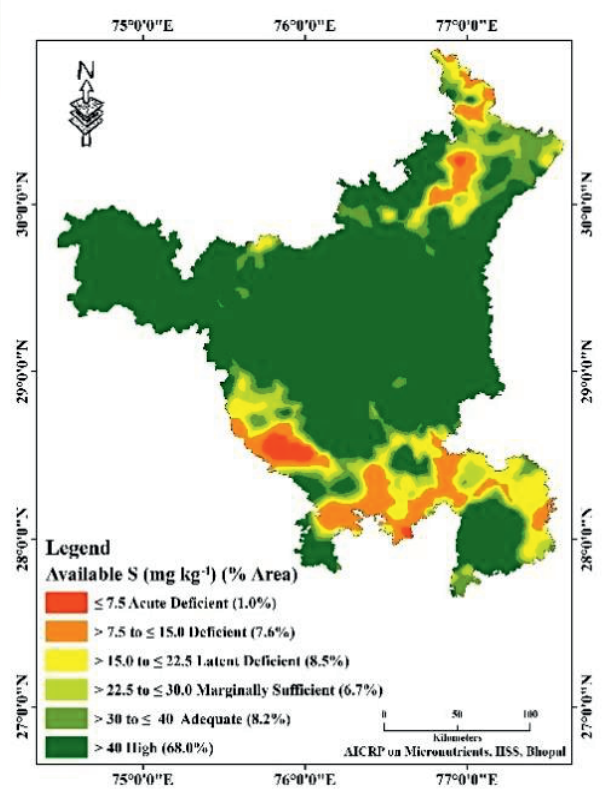


Fig. 2.2 Long term effect of various treatments on Soil Quality Index (SQI)

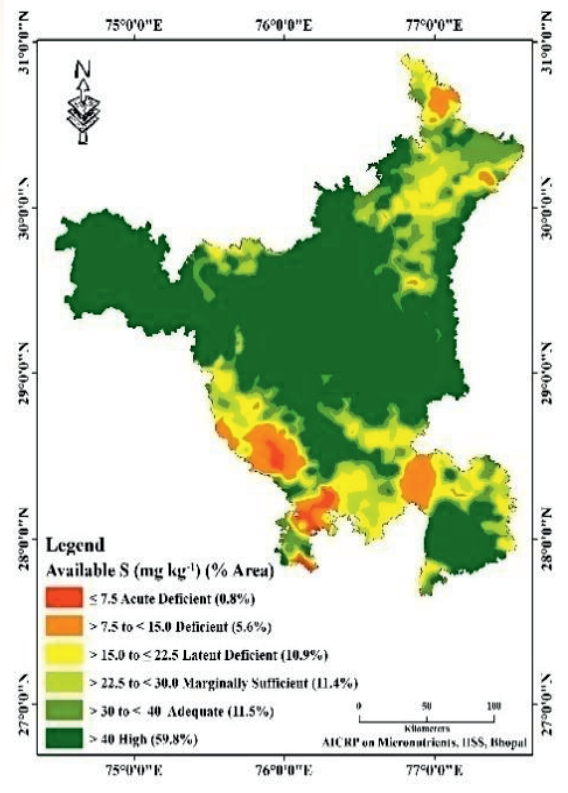
2.3 AICRP on Micro and Secondary Nutrients and Pollutant Elements in Soils and Plants (MSPE)

2.3.1 Spatio-temporal distribution patterns of soil fertility parameters of Haryana, India

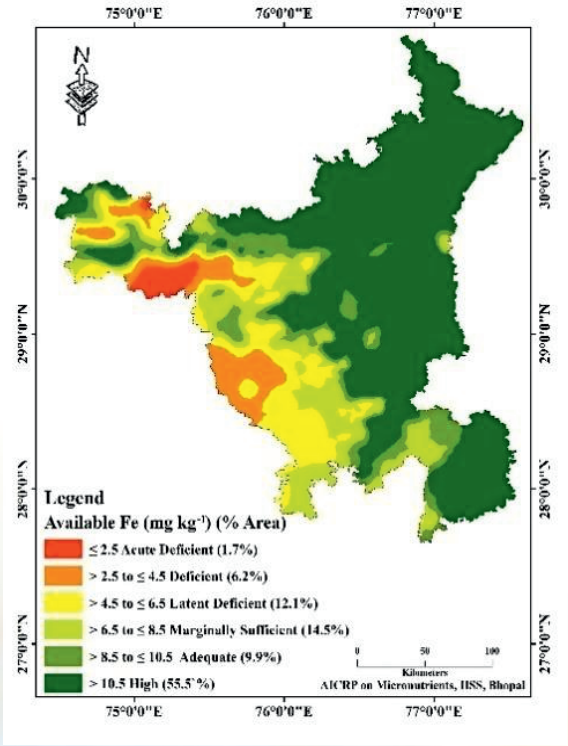
Soil properties and soil-crop management practices influence temporal changes in spatial distribution (SD) of soil fertility parameters (SFP). Proper understanding of temporal changes in SD of SFP is crucial for adoption of modified and informed area specific precision nutrient management strategies (ASPNMS), in order to achieve sustainable crop production. We carried out the present study to assess temporal changes (during 2016 to 2023) in values in SD of soil pH, electrical conductivity (EC), soil organic carbon (SOC), plant available sulphur (S) (AS), zinc (AZn), manganese (AMn), iron (AFe), copper (ACu), and boron (AB) in cultivated soils of Haryana state, India. The values of evaluated SFP varied widely with coefficient of variation of 6.22% (soil pH) to 127% (EC). There was significant reduction in mean value of EC (0.39dS m^{-1}), AS (65.9 mg kg^{-1}), AZn (1.56 mg kg^{-1}), AFe (11.0 mg kg^{-1}), and AMn (9.14 mg kg^{-1}) in 2023 compared to mean value of EC (0.50 dS m^{-1}), AS (83.4 mg kg^{-1}), AZn (1.99 mg kg^{-1}), AFe (12.6 mg kg^{-1}), and AMn (11.6 mg kg^{-1}) in 2016. SFP had weak to strong spatial dependence; exponential, Gaussian and stable best-fitted (with lower mean square error value) models; and different distribution patterns. There were changes in SD patterns of SFP during the study period. The areas with lower concentration of AS, AZn, AFe, and AMn increased during 7 years period. This research elucidates occurrence of temporal changes in mean values and SD patterns of SFP in the study area highlighting the importance of monitoring the changes in SFP in cultivated areas for applying ASPNMS (Fig. 2.3.1).



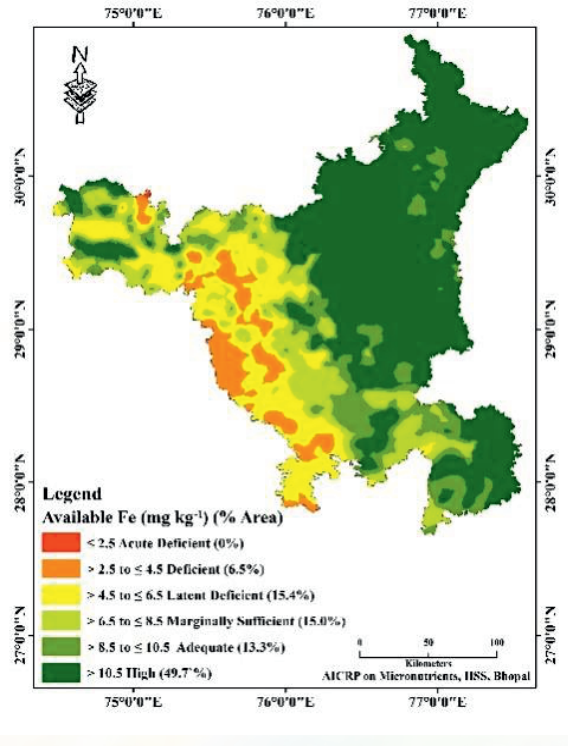
AS 2016



AS 2023



AFe 2016



AFe 2023

Fig. 2.3.1 Spatial distribution maps of AS and AFe in 2016 and 2023

2.3.2 PCA and fuzzy clustering-based delineation of soil nutrient (S, B, Zn, Mn, Fe, and Cu) management zones of sub-tropical northeastern India for precision nutrient management

Understanding the spatial distribution of plant available soil nutrients and influencing soil properties and delineation soil nutrient management zones (MZs) are important for implementing precision nutrient management options (PNMO) in an area to achieve maintainable crop production. We assessed spatial distribution pattern of plant available sulfur (S) (PAS), boron (B) (PAB), zinc (PAZn), manganese (PAMn), iron (PAFe), and copper (PACu), and soil organic carbon (SOC), pH, and electrical conductivity (EC) to delineate soil nutrients MZs in northeastern region of India. A total of 17471 representative surface (0-15 cm depth) soil samples were collected from the region, processed, and analyzed for above-mentioned soil parameters. The values of PAS (0.22 to 99.2 mg kg^{-1}), PAB (0.01 to 6.45 mg kg^{-1}), PAZn (0.05 to 13.9 mg kg^{-1}), PAMn (0.08 to 158 mg kg^{-1}), PAFe (0.50 to 472 mg kg^{-1}), PACu (0.01 to 19.2 mg kg^{-1}), SOC (0.01 to 5.80%), pH (3.19 to 7.56) and EC (0.01 to 1.66 dS m^{-1}) varied widely with coefficient of variation of 15.5 to 108%. The semivariogram analysis highlighted exponential, Gaussian and stable best fitted models for soil parameters with weak (PACu), moderate (PAB, PAZn, PAFe, SOC, pH, and EC) and strong (PAS, and PAMn) spatial dependence. The ordinary kriging interpolation revealed different distribution patterns of soil parameters. About 14.8, 27.5, and 3.40% area of the region had PAS of ≤15.0 mg kg^{-1}, PAB of ≤0.50 mg kg^{-1}, and PAZn of ≤0.90 mg kg^{-1}, respectively. About 67.5, and 32.5% area had SOC content >1.00 and <1.00%, respectively. Soil pH was ≤5.50, and >5.50 to ≤6.50 in 41.7 and 40.3% area of the region, respectively. The techniques of principal component analysis and fuzzy c-mean algorithm clustering produced 6 MZs of the region with different areas and values of soil parameters. The MZs had different levels of deficiency pertaining to PAS, PAB, and PAZn. The produced MZ maps could be used for managing PAS, PAB, PAZn, SOC and soil pH in order to implement PNMO. The study highlighted the usefulness of MZ delineation technique for implementation of PNMO in different cultivated areas for sustainable crop production (Fig. 2.3.2).

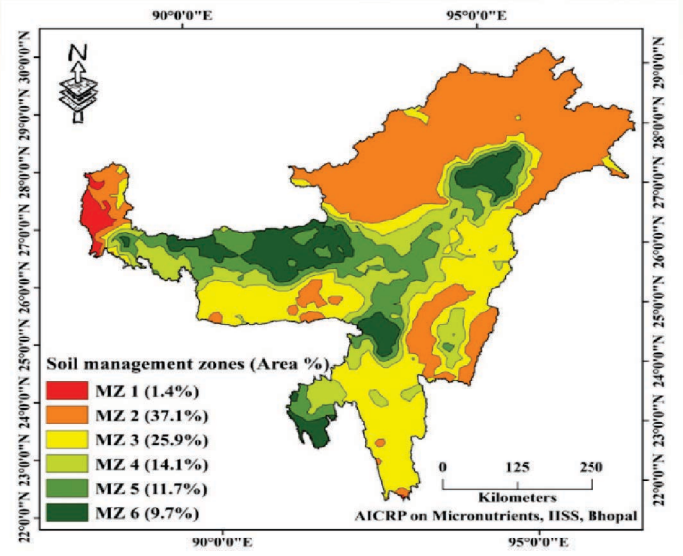


Fig. 2.3.2 Soil nutrient management zones of northeastern India

2.3.3 Effect of boron fertilization on productivity and sustainability of rice-wheat cropping system in Tarai region, North-West India

Extensive global dependency on rice and wheat crops has necessitated the adoption of intensive cultivation practices, thereby compelling to closely monitor the potential yield-limiting factors, among which, boron (B) deficiency stands out to be a prime concern. The present study explores the effects of B fertilization strategies within the Rice-Wheat Cropping System (RWCS) in the Tarai region of North-West India. A comprehensive six-year field experiment was conducted at G.B. Pant University of Agriculture and Technology, Uttarakhand, India. The experiment tested graded B doses (0.5, 1.0, 1.5, and 2.0 kg ha^{-1}) at varied frequencies (single, alternate, and annual) in a factorial design. The study revealed significant impacts of alternate B application at 1.5 kg ha^{-1} on crop yields and the Sustainable Yield Index (SYI). The System Rice Equivalent Yield (SREY) exhibited an increase of 6.7% with B supplementation over B-deprived plots, highlighting the pivotal role of B fertilizer in enhancing productivity within the RWCS. The economic optimum B dose was found to be 1.422 kg ha^{-1} using a linear plus plateau model, resulting in a calculated annual SREY of 9.73 t ha^{-1} when applied alternately to the cropping system. Continuous application and higher B rates demonstrated substantial increases in various B fractions, while the mobility factor remained within

10%, depicting safe ecological limits. The distribution of fractions in B-treated plots on average followed the order: residual B > organically-bound B > oxide bound B > specifically adsorbed B > readily soluble B. Similarities in the distribution patterns of B fractions between B-treated plots and the control indicated potential influence of biotic or abiotic processes on B fraction dynamics, even in the absence of external B application. To sum up, B application in alternate years at 1.5 kg ha^{-1} was most sustainable in enhancing the SREY, SYI, available soil B, and B fractions and lowering the environmental hazards.

2.3.4 Comparative potential of different Fe sources for seed priming to enhance yield and iron content in direct seeded aerobic rice

Direct seeded aerobic rice (DSR) is an emerging production system in Asia due to declining water availability and labour scarcity. Iron (Fe) deficiency is a severe problem in DSR as Fe^{2+} oxidized to Fe^{3+} and become unavailable to plants. Seed treatment is one of the emerging approaches to deal with Fe deficiency and content in rice crop to compensate this issue. Hence, pot experiment was planned in randomized block design to study the effect of Fe seed priming through different sources, i.e., iron sulfate ($FeSO_4.7H_2O$), Chelated iron (Fe-EDTA) and nano iron (FeONPs) and their levels on yield and Fe content in direct seeded aerobic rice (variety PR 126) under sandy loam and silt loam soils with three replications. On an average, seed priming with $FeSO_4.7H_2O$ solution (1.0% Fe) showed the highest increase in grain yield (12.7%) over the control. On the other hand, increasing dose of Fe from 0.5 to 1.0% through Fe-EDTA showed adverse effects on rice yield due to higher residual effects. The plant height and chlorophyll content in rice plants varied from 26.1 to 42.2 cm and from 30.9 to 35.1 as SPAD value with maximum content in treatment having $FeSO_4.7H_2O$ (0.5%Fe) in both the soils. The total and ferrous Fe content in rice plants ranged from 42.7 to 62.2 mg kg^{-1} and from 35.8 to 41.0 in harvested grains with the highest content in treatment having Fe-EDTA (0.5%Fe) followed by treatment $FeSO_4.7H_2O$ (1.0%Fe) and treatment Fe-EDTA (0.25%Fe), respectively. Thus, seed priming of rice with 1.0%Fe solution using $FeSO_4.7H_2O$ can be used for further studies to reduce Fe malnutrition in global population.

2.3.5 Establishing optimal nutrient level of magnesium and boron in black pepper for optimization of productivity in Western Ghats of Kerala

Critical nutrient level of magnesium and boron in soil and plant biomass of black pepper (*Piper nigrum*) have been estimated in Western Ghats of Kerala by conducting field experiments in three seasons by magnesium (Mg) and boron (B) fertilization. Nutrient management in black pepper plantations wins important value due to its wider use as spice all over the world. As black pepper plants are easily prone to Mg and B deficiency, its response to Mg in the form of magnesium sulphate and B as borax was evaluated in terms of yield, plant nutrient content and nutrient status in soil. Effect of Mg as well as B application on the other available nutrients and leaf nutrient content were also determined in the study. Response curves were fitted by plotting relative yield of black pepper with Mg and B in soil and index leaf. The graphical method of Cate and Nelson was used to derive the optimal concentrations of nutrients. The critical levels of magnesium in soil and black pepper leaves were established as 140 mg kg^{-1} and 0.44 % respectively. Optimum dose of magnesium sulphate for getting highest yield of black pepper was found as 120 kg ha^{-1} followed by $MgSO_4$ @ 80 kg ha^{-1}. Similarly critical limit of B in the soil and index leaf of black pepper were 0.58 and 21 mg kg^{-1} respectively. The maximum potential yield was obtained by applying boron as borax at 0.2% via foliar application and at a higher dosage of 2 kg ha^{-1} through soil application.

2.3.6 Characterization of acid sulphate soils of Kerala with respect to heavy metals

Representative samples from acid sulphate soils of Kerala viz. i) Kuttanad (Inceptisols) ii) Kole land (Entisols & Inceptisols) were collected and analyzed for different heavy metals. Heavy metal distribution pattern was as follows: Cr > Ni > Co >Pb> Cd. The results were compared with the standards of FAO/ WHO, European Commission and Indian Standard. The average concentration of Ni (292 ppm), Cr (861 ppm) and Co (74 ppm) was higher than the standards. In the present study, the Ni concentration varied from 111 to 809 ppm. The Co concentration of study area recorded up to 184 ppm. The average concentrations of Cd and Pb were lower than the standard values.

However, the Cd concentrations in some locations were higher than the FAO/WHO, European, and Indian standards. Pb concentrations in some were higher than FAO/WHO standards and lower than European and Indian standards.

2.4 AICRP on Soil Test and Crop Response Correlation (STCR)

2.4.1 Development of prescription equation based on soil test crop response correlation

Crop (Variety)	
Jute (JRO M1)	FN =4.89 T –0.52 SN –0.34 OP FP_2O_5 = 1.60 T –1.06 SP –0.18 OK FK_2O = 3.00 T –0.55 SK –0.07 OK
Garlic (Local)	FN =5.62 T –0.52 SN –0.42 ON FP_2O_5 = 2.11 T –1.92 SP –0.30 OP FK_2O= 3.36 T –0.55 SK –0.19 OK
Onion (N-2-4-1)	FN=0.83T – 0.65 SN FP_2O_5= 0.41T– 3.21SP FK_2O= 0.45 T– 0.18 SK
Wheat (UP 2855)	FN= 3.30 T-0.43 SN FP_2O_5=2.68 T-2.25 SP FK_2O=1.66 T- 0.21 SK
Brinjal (Hisar Shyamal)	FN = 0.78 T – 0.32 SN - 0.16 ON FP_2O_5 = 0.28 T – 1.33 SP – 0.11 OP FK_2O = 0.28 T - 0.17 SK - 0.08 OK
Fababeans (Vikrant HFB-1)	FN = 1.62 T – 0.13 SN FP_2O_5 = 2.07 T – 0.79 SP FK_2O = 1.92 T – 0.20 SK
Garlic (Local)	FN= 4.72 T – 0.70 SN – 0.25 ON FP_2O_5 = 1.22 T – 2.72 SP – 0.20 OP FK_2O = 1.37 T – 0.09 SK – 0.06 OK
Wheat (var. Kanishka)	FN = 7.18 T – 0.39 SN – 0.27 ON FP_2O_5 = 2.29 T – 2.40 SP – 0.12 OP FK_2O= 2.42 T – 0.07 SK – 0.10 OK
Capsicum (Sweet pepper)	For chemical mode FN = 1.12 T - 0.42 SN FP_2O_5 = 0.64 T - 3.97 SP FK_2O = 0.57 T – 0.14 SK For IPNS mode FN = 1.00 T – 0.38 SN – 1.81 ON FP_2O_5 = 0.59 T – 3.68 SP – 0.66 OP FK_2O = 0.55 T – 0.13 SK – 0.64 OK
Wheat (UP 2855)	FN = 3.30 T-0.43 SN FP_2O_5 =2.68 T-2.25 SP FK_2O = 1.66 T- 0.21 SK

* Where, FN, FP_2O_5 and FK_2O are the fertilizer doses (N, P_2O_5 & K_2O) in kg ha^{-1}, T is target yield (q ha^{-1}), SN, SP and SK are soil available N, P & K in kg ha^{-1} and ON, OP & OK indicates the doses of N, P and K applied through FYM in kg ha^{-1}.

2.4.2 Soil test-based nutrient management improve crop yield, sustainability and available K in a Vertisol

The effects of soil test based application of chemical fertilizers with organics on crop yield, sustainability and potassium balance was studied under a long term experiment with six treatments: control, recommended dose of fertilizer (RDF), soil test-based NPK for target yield of 5 t ha^{-1} for rice and 4.5 t ha^{-1} for wheat (NPK5/4.5), soil test-based NPK for target yield of 6 t ha^{-1} for rice and 6 t ha^{-1} for wheat (NPK6/6), and co-application of chemical fertilizers with organics based on soil test for a target yield of 5 t ha^{-1} for rice and 4.5 t ha^{-1} for wheat (NPKO5/4.5), and chemical fertilizers with organics based on soil test for target yield of 6 t ha^{-1} for rice and 6 t ha^{-1} for wheat (NPKO6/6), in randomized block design replicated thrice was selected. Results showed that crop yield is more stable and sustainable in soil test-based application of nutrients. The K balance was negative in all fertilization regimes. Though soil test-based combined application of chemical fertilizers and organics improve long-term crop yield and K supplying capacity, it is insufficient to achieve positive K balance (Fig. 2.4.2).

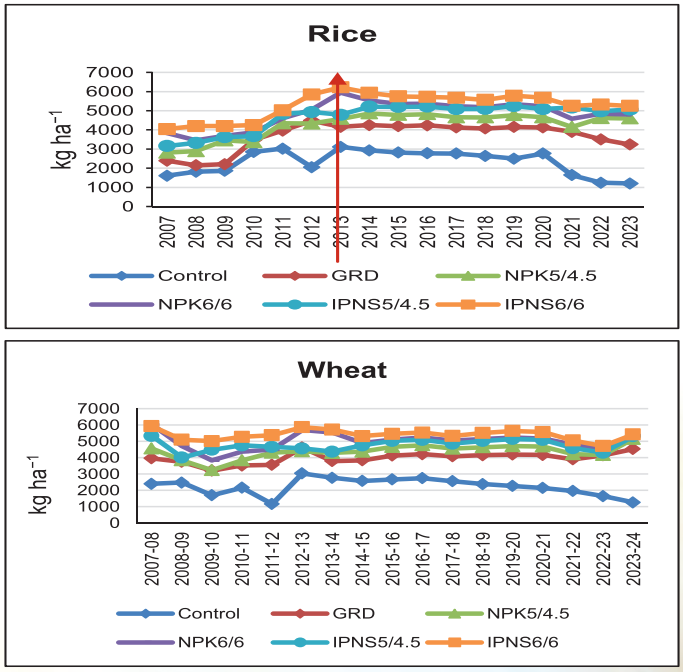


Fig. 2.4.2 Rice and wheat grain yield (kg ha^{-1}) and trends in different fertilization treatments over 17-year period from 2007 to 2024. Arrow indicates change of target yield of rice.

Theme II. Conservation Agriculture, Carbon Sequestration and Climate Change

2.5.1 Development of Water and Nutrient Management Practices for Vertisols of Central India under Conservation Agriculture

This study assessed water and nutrient management strategies for conservation agriculture on Vertisols in central India, focusing on wheat in Rabi 2023–24 and soybean in Kharif 2024. Wheat (cv. HI 1544) received flood, sprinkler, or drip irrigation with seasonal applications of 345, 285, and 224 mm, respectively, combined with three tillage systems (conventional, reduced, no-till) and four nutrient regimes (100% RDF, 75% RDF, STCR, and LCC). Seasonal rainfall during wheat growth was 61 mm. Growth attributes of wheat, including plant height, dry matter, roots, and tiller number, showed no significant differences across irrigation methods, tillage systems, or nutrient doses. Canopy vigor measured by NDVI was higher under drip and sprinkler than flood at 60 and 90 DAS, and slightly higher under CT and RT compared to NT; 100% RDF, STCR, and LCC outperformed 75% RDF in NDVI at both times. SPAD values did not vary with irrigation or tillage but were higher under STCR and LCC than under 100% and 75% RDF. Soil penetration resistance at 0–30 cm was lowest under drip and highest under sprinkler at 60 DAS, with minor differences persisting at 90 DAS; across tillage systems, subsurface resistance was generally lowest under CT and higher under RT. Profile soil moisture averaged 20.85% under drip, 19.87% under flood, and 18.16% under sprinkler; no-till plots retained slightly more moisture than CT and RT.

Wheat grain yield, straw yield, and harvest index near 0.46 were statistically similar across all irrigation, tillage, and nutrient treatments, averaging about 51–53 q ha^{-1} for grain. Despite similar yields, water use efficiency increased with more precise irrigation, from 15.0 kg ha^{-1} mm^{-1} under flood to 18.2 kg ha^{-1} mm^{-1} under sprinkler and 22.9 kg ha^{-1} mm^{-1} under drip. These improvements reflect reduced evaporation and percolation, along with better temporal distribution through smaller, frequent applications. Compared to flood irrigation, water savings were approximately 120 mm under drip and 60 mm under sprinkler, equating to about 35–40% and 17–20% savings, respectively, without yield loss. Since there was no yield difference among nutrient regimes, a 25% fertilizer reduction is possible, and reduced or no-till practices can decrease fuel and labor costs while maintaining yield, although with slightly higher subsurface resistance in NT.

In soybean, CT, RT, and NT were combined with 100% RDF, 75% RDF, and STCR during June to October 2024. Plant height, branch number, nodulation traits, LAI, and yields did not differ significantly among treatments. Grain yields ranged from 6.1 to 6.5 q ha^{-1}, straw yields from 18 to 21 q ha^{-1}, and the harvest index was around 0.31; RT showed a small, non-significant advantage in both grain and straw. Overall, the results suggest that on Vertisols, conservation-oriented irrigation methods such as drip or sprinkler can save water and increase water productivity while maintaining wheat yields comparable to flood irrigation. Nutrient optimization using STCR or LCC allows at least a 25% reduction in fertilizer without sacrificing yield in both crops. Operational efficiencies from RT or NT further enhance input use and labor efficiency, with NT offering better near-surface moisture retention but slightly higher subsurface resistance. The overall approach promotes stable productivity, better resource efficiency, and aligns with conservation agriculture goals for Vertisols (Table 2.5.1a and b).





Plate 2.5.1a Field view of development of Water and Nutrient Management Practices (2023-2024)

Table 2.5.1a Effect of tillage systems and different nutrients doses under different irrigation systems on grain yield of wheat crop year 2023-2024.

	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Harvest Index (%)	WUE (kg ha^{-1} mm^{-1})
Irrigation Methods				
FI	52.3	59.6	0.46	15.0
SI	51.6	59.2	0.46	18.2
DI	51.3	58.5	0.46	22.9
LSD (0.05)	NS	NS	NS	2.92
Tillage systems				
CT	52.1	59.8	0.46	19.0
RT	52.2	59.3	0.46	18.5
NT	51.9	58.2	0.46	18.7
LSD (0.05)	NS	NS	NS	NS
Nutrient doses				
F1	51.6	59.6	0.46	18.7
F2	49.9	58.1	0.44	17.9
F3	53.0	59.2	0.47	19.4
F4	52.5	59.3	0.46	18.8
LSD (0.05)	NS	NS	NS	NS

Table 2.5.1b Effect of tillage systems and fertilizer doses on grain and straw yield of soybean in 2024

Treatments	Grain yield (q ha^{-1})				Straw yield (q ha^{-1})				Harvest index			
	F1	F2	F3	Mean	F1	F2	F3	Mean	F1	F2	F3	Mean
CT	6.18	6.02	6.15	6.12	19.5	18.4	18.1	18.7	0.29	0.30	0.32	0.30
RT	6.04	6.33	6.98	6.45	20.2	20.6	23.3	21.4	0.29	0.30	0.31	0.30
NT	6.46	6.06	6.03	6.18	18.8	17.9	18.3	18.4	0.33	0.34	0.31	0.32
Mean	6.23	6.14	6.39		19.5	19.0	19.9		0.31	0.31	0.31	
	Tillage (T): NS, Dose (D): NS T X D: NS				Tillage (T): NS, Dose (D): NS T X D: NS				Tillage (T): NS, Dose (D): NS T X D: NS			

2.5.2 Development of Web-Enabled Mid-Infrared Spectroscopy Analysis System (MIDAS) for Indian Agroecosystem

Soil analysis plays a vital role in promoting sustainable agriculture, environmental monitoring, and effective natural resource management. Conventional laboratory-based methods, though reliable, are often labour-intensive, costly, and require technical expertise. To address these limitations, ICAR-IISS, Bhopal, has developed the **Mid-Infrared Spectroscopy Analysis System (MIDAS)**-a web-based platform designed to provide rapid, accurate, and cost-effective soil property analysis using Mid-Infrared Spectroscopy (MIRS). The MIRS offers high analytical precision with minimal sample preparation, making it a promising tool for large-scale soil health monitoring. However, its broader application has been constrained by the complexity of spectral data interpretation. The MIDAS platform overcomes this challenge by incorporating machine learning algorithms that streamline spectral data processing and enhance prediction accuracy for key soil parameters. This user-friendly system enables efficient analysis of individual soil spectra and

supports nationwide and global initiatives in precision agriculture and soil resource assessment. The MIDAS application is freely accessible at https://midas-system.streamlit.app/, offering valuable support for stakeholders involved in soil health management and sustainable land use planning.

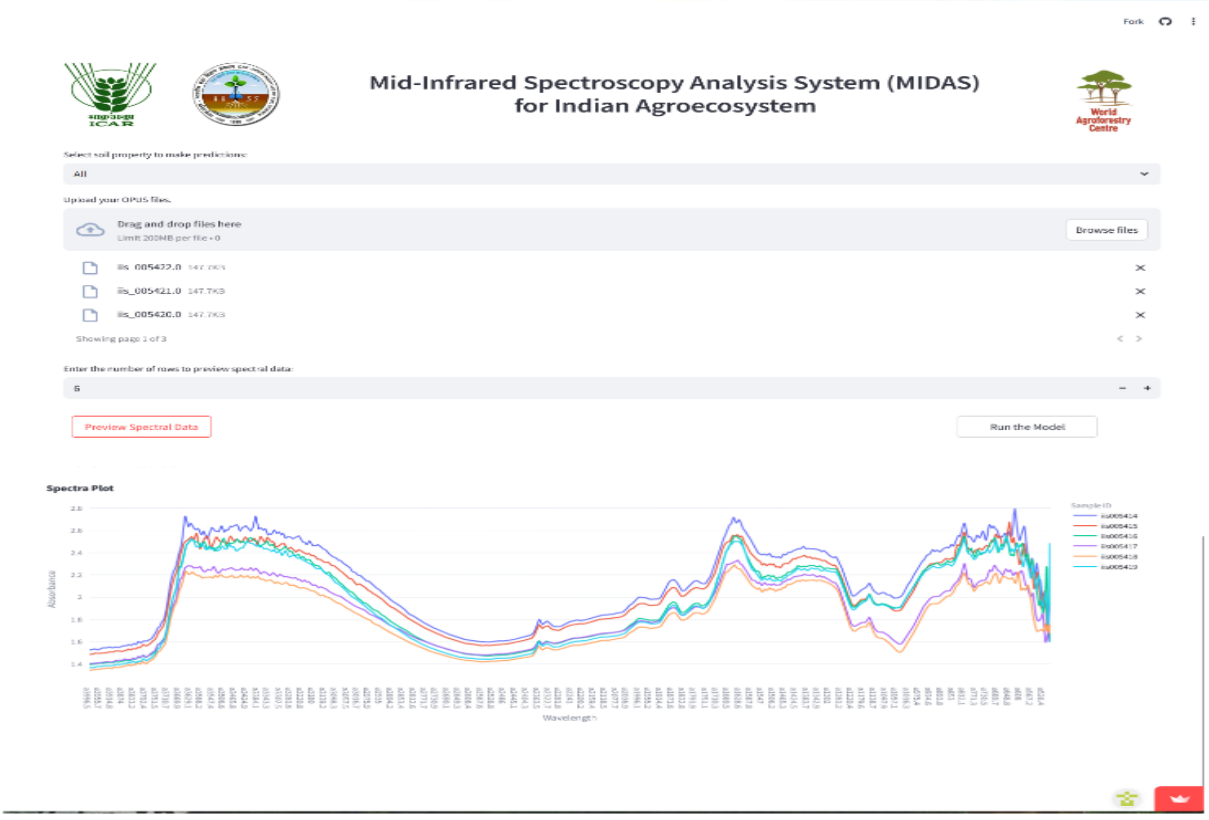


Fig. 2.5.2 Screenshot depicting the functionality of the MIR Spectroscopy Analysis System (MIDAS)

2.5.3 Advancing Soil Property Prediction through MIR-Based Machine Learning Models

ICAR-IISS, Bhopal, has made significant progress in utilizing Mid-Infrared (MIR) spectroscopy for rapid and cost-effective soil analysis. The workflow includes soil sampling, grinding, reference chemical analysis, and spectral data acquisition. Advanced preprocessing techniques—such as Standard Normal Variate (SNV), Multiplicative Scatter Correction (MSC), and Savitzky-Golay (SG) filtering—were applied to improve spectral quality. Predictive models were developed using machine learning algorithms including PLSR, Random Forest, SVM-Cubist, and memory based learning. Model performance was evaluated using R^2, RMSE, and RPD metrics. For soil texture components, specifically clay, silt, and sand, as well as soil pH, the models demonstrated strong calibration, with R^2 values of 0.97 for Clay and 0.97 for pH. They also showed good validation accuracy, with R^2 values of 0.87 for Clay and 0.6 for soil pH, and RPD values exceeding 2.0, indicating reliable predictions. The models also performed well for soil oxidizable organic carbon (SOC) and total carbon (TC), achieving calibration R^2 values of 0.96 and 0.93 for SOC and TC, respectively. However, validation RPD for SOC and TC was reported at 1.84 and 2.12, respectively. The models exhibited moderate performance for water retention properties, such as permanent wilting point (PWP) at 15.0 bars and field capacity (FC) at 0.33 bars, with validation R^2 values around 0.77 for PWP and RPD values near 2.0, suggesting moderate predictive power. For exchangeable potassium (K) and total micronutrients (Cu, Mn, Zn), the models showed acceptable calibration and validation accuracy, exemplified by an R^2 of 0.83 for Cu. However, the validation RPD was below 2.5, indicating that these predictions have moderate reliability (Table 2.5.3).

Table 2.5.3 Statistical Evaluation of Predictive Models for Soil Properties Using MIR Spectroscopy

	Clay (%)		Silt (%)		Sand (%)		pH	
Statistics	Cal	Val	Cal	Val	Cal	Val	Cal	Val
R^2	0.972	0.871	0.985	0.832	0.981	0.870	0.973	0.856
RMSE	1.674	3.79	1.502	4.308	2.143	5.708	0.221	0.538
RPD	5.185	2.499	7.529	2.331	6.553	2.411	5.461	2.474
	SOC (%)		PWP-15 bar		FC-0.33 bar		Total Carbon (%)	
Statistics	Cal	Val	Cal	Val	Cal	Val	Cal	Val
R^2	0.961	0.846	0.969	0.769	0.975	0.805	0.934	0.864
RMSE	0.083	0.173	1.002	2.718	1.371	3.569	0.113	0.25
RPD	3.638	1.835	4.951	1.885	5.654	2.041	2.843	2.12
	Exc. K (log[cmolc kg^{-1}])		Total Cu (ppm)		Total Mn (ppm)		Total Zn (ppm)	
Statistics	Cal	Val	Cal	Val	Cal	Val	Cal	Val
R^2	0.871	0.792	0.91	0.83	0.82	0.75	0.85	0.71
RMSE	0.243	0.463	0.28	0.48	0.33	0.63	10.51	15.3
RPD	2.02	1.942	2.85	2.42	2.01	1.83	2.10	1.76

2.5.4 Development of precision Soil fertilizer recommendation system for Madhya Pradesh and Haryana State

The Precision Soil Fertilizer Recommendation system (PSFR) is a data-driven technology designed to deliver precise fertilizer recommendations by leveraging digital soil maps and a target yield approach, emphasizing maintaining and improving soil health. By integrating real-time soil data with yield targets, PFSR optimizes fertilizer application to ensure that crops receive exactly what they need, preventing overuse and minimizing nutrient runoff. This targeted approach not only maximizes crop productivity but also nurtures long-term soil vitality, enhancing nutrient cycling, preserving soil structure, and maintaining organic matter levels. The PSFR empowers farmers to make informed decisions that boost profitability while promoting sustainable farming practices and protecting soil health for future generations. Farmers, extension workers, and agricultural consultants can easily access the PSFR from the user-friendly online platform at http://65.0.105.229:8080/pfrs/. This accessibility supports informed decision-making, higher crop yields, and improved profitability, all while fostering sustainable farming practices.

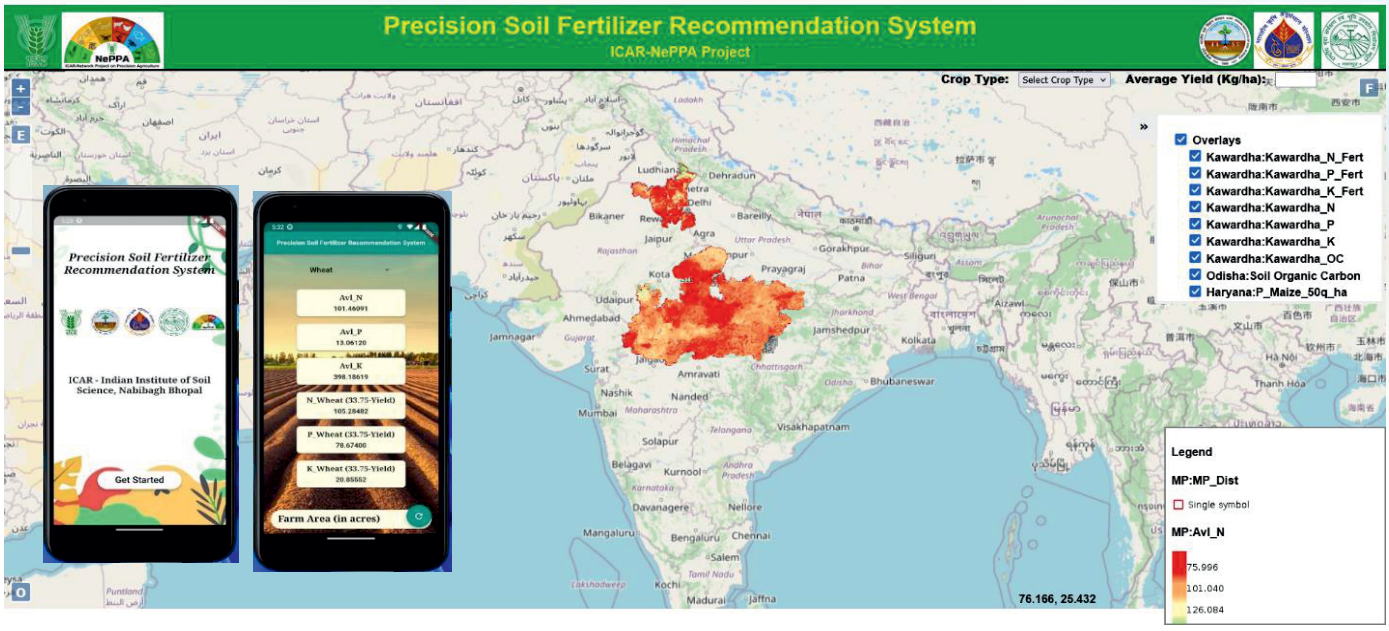


Fig. 2.5.4 Web-based Precision Soil Fertilizer Recommendation system developed by ICAR-IISS, Bhopal

2.5.5 Effect of Elevated CO_2 and Temperature on Available Soil Nutrients

To understand the impact of climate change variables on soil health, a study was conducted to evaluate the combined and individual effects of elevated atmospheric carbon dioxide (CO_2 at 600 ppm) and increased temperature (+2 °C and +2 °C) on key soil parameters. The results revealed that soil pH remained relatively stable across treatments, with a slight reduction observed under elevated temperature alone (T2). Electrical conductivity (EC) showed minimal variation, with the highest value recorded in the control treatment. Available nitrogen (N), phosphorus (P), and potassium (K) levels were significantly influenced by the treatments. The treatment with elevated temperature (+30C) alone (T4) resulted in the highest nutrient availability—141 kg ha^{-1} for N, 23.8 kg ha^{-1} for P and 399 kg ha^{-1} for K—indicating that warming may accelerate nutrient mineralization or alter soil nutrient dynamics. These findings highlight the differential responses of soil properties to elevated CO_2 and warming, with temperature playing a more prominent role in influencing soil nutrient availability. The study underscores the need for continued research to understand the long-term implications of climate change on soil health and to inform the development of adaptive nutrient management strategies (Table 2.5.5).

Table 2.5.5 Soil nutrient dynamics under elevated temperature and carbon dioxide.

Treatments		pH	EC (dS/m)	Available N(kg/ha)	Available P (kg/ha)	Available K (kg/ha)	Available S (kg/ha)
Control	T1	8.16ab	0.23a	135ab	14.9b	361b	9.1b
Elevated CO_2 (600 ppm) + Ambient temp.	T2	8.01b	0.17ab	128b	19.5ab	364b	10.0b
Ambient CO_2 + Elevated temp. (+2 ^{0}C)	T3	8.23ab	0.15ab	134ab	20.5ab	391ab	14.6a
Ambient CO_2 + Elevated temp. (+3 ^{0}C)	T4	8.33a	0.14b	141a	23.8a	399a	15.2a

Elevated CO_2 (600 ppm) + Elevated temp. (+2 ^{0}C)	T5	8.26ab	0.18ab	131ab	18.5ab	390ab	13.4ab
Elevated CO_2 (600 ppm) + Elevated temp. (+3 ^{0}C)	T6	8.20ab	0.20ab	133ab	17.8ab	380ab	15.3a

2.5.6 Phosphorous dynamics under elevated climatic conditions

An experiment was conducted to quantify the impact of two key climate drivers—elevated atmospheric CO_2 (approximately 600 ppm) and a 2°C temperature rise—on soil phosphorus (P). Warming alone enhanced Olsen-P by roughly 30% (median ≈ 52 kg ha^{-1}) relative to the ambient control (≈ 40 kg ha^{-1}), reflecting accelerated mineralization. In contrast, elevated CO_2 reduced Olsen-P to ≈ 36 kg ha^{-1} (≈ –10 %). Fractionation of inorganic P (soluble-P, Al-P, Fe-P, reductant-P and Ca-P) revealed a clear redistribution rather than a change in total P stocks (≈ 1.05–1.08 t ha^{-1}). Calcium-bound P remained dominant (55–60 % of total P) across all treatments, characteristic of the soil's calcareous nature. The labile pools, Al-P and Fe-P, increased by 8% and 6%, respectively, under warming, following the rise in Olsen-P. Elevated CO_2, however, marginally depleted these fractions, reinforcing the decline observed in plant-available P. These results indicate that projected warming may temporarily boost plant-available P through enhanced mineralization, whereas rising CO_2 could restrict P cycling. The contrasting responses underscore the need for adaptive P-management strategies to maintain crop P nutrition while minimizing environmental losses under future climate conditions (Fig. 2.5.6).

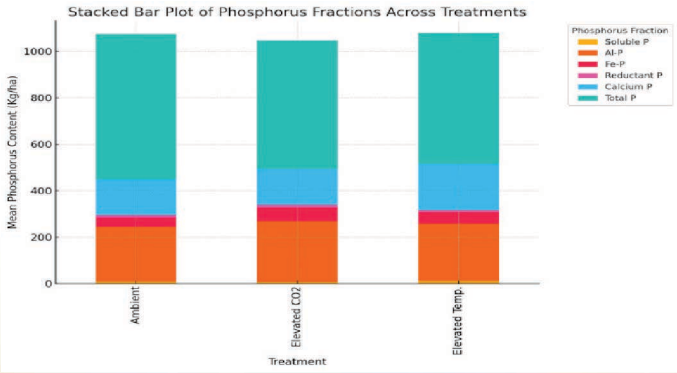


Fig.2.5.6 Phosphorus Dynamics under elevated CO_2 and temperature Scenarios

2.5.7 Impacts of Elevated Temperature and CO_2 on Rice Productivity under Future Climate Scenarios and Adaptation Strategies

Climate change-marked by rising temperatures, elevated CO_2 levels and variable rainfall—poses a growing risk to food security. Eastern India, a major rice-producing region, is especially vulnerable to these changes. To assess future impacts, the APSIM-ORYZA 2000 model was used to simulate rice yields from the 2020s to the 2080s under RCP 4.5 and RCP 8.5 scenarios, both with and without elevated CO_2. The simulations revealed significant increases in temperature and rainfall across decades, with grain yields peaking around the 2040s before declining under all scenarios. Straw yield followed a similar trend, except under elevated CO_2 conditions, where it continued to rise through the 2080s. Moderate warming and CO_2 enrichment (RCP 4.5+CO_2) enhanced both grain and straw yield, while higher temperature scenarios (RCP 8.5) led to yield declines. Adaptive agronomic practices, such as increased plant density, delayed transplanting, and higher nitrogen rates, helped offset yield losses, highlighting their importance in climate-resilient rice production (Fig. 2.5.7).

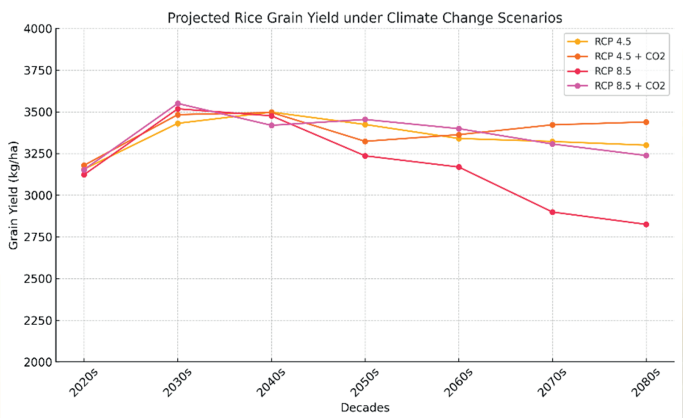


Fig. 2.5.7 Projected Rice Grain Yield under Climate Change Scenarios

2.5.8 Long-Term Changes in Soil Carbon Stocks under Future Climate Scenarios

This study assessed the long-term changes in SOC over time under four different climate scenarios, represented by the Shared Socioeconomic Pathways (SSPs): SSP1–2.6, SSP2–4.5, SSP3–6.0, and SSP4–8.5.The Roth C simulation results show a clear and continuous decline in soil carbon stocks from 2030 onwards across all scenarios. Although all scenarios begin with a similar SOC level of approximately 20.7 t/ha, the rate of decline varies depending on the severity of the climate pathway. Under SSP1–2.6, which represents a low-emission, sustainable development scenario, the decline is most gradual, with SOC levels projected to reach around 17.9 t ha^{-1} by 2100. This scenario reflects effective climate mitigation and sustainable land use practices that help slow down carbon losses from the soil. In contrast, SSP2–4.5 and SSP3–6.0, which reflect intermediate and high-medium emission pathways, respectively, show moderate declines, with SOC reducing to approximately 17.1 to 17.3 t ha^{-1} by the end of the century. These scenarios indicate the consequences of less ambitious mitigation efforts and more conventional development trajectories. The most drastic decline is observed under SSP4–8.5, a high-emission scenario characterized by continued fossil fuel dependence and limited climate policies. Under this pathway, SOC is projected to drop to around 16.6 t ha^{-1} by 2100, reflecting the compounded effects of higher temperatures, increased decomposition rates, and reduced organic matter inputs to the soil. Overall, the results highlight that climate change has a profound impact on soil carbon dynamics. Without adequate mitigation measures, rising temperatures and altered precipitation patterns are likely to accelerate the loss of soil carbon, thereby undermining soil health, productivity, and its capacity to sequester carbon. These findings emphasize the urgent need to adopt climate-resilient and carbon-conserving land management strategies-such as reduced tillage, residue retention, organic amendments, and agroforestry-to maintain soil carbon stocks under future climate conditions (Fig. 2.5.8).

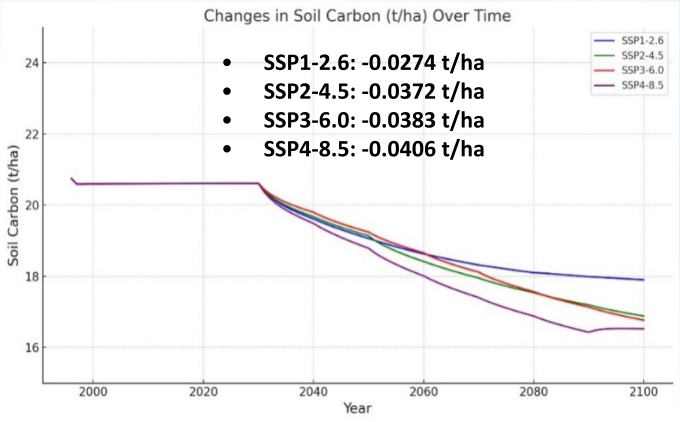


Fig. 2.5.8 Changes in soil carbon (t/ha) over time under different climatic scenarios

2.5.9 Predictive mapping of soil macronutrients (N, P, K) in Central India using SCORPAN-Driven Environmental Covariates and Machine Learning

Accurate spatial prediction of macronutrients such as available Nitrogen (N), Phosphorus (P), and Potassium (K) is critical for site-specific nutrient management in India's agricultural systems. This study employs digital soil mapping (DSM) techniques to model and map N, P, and K concentrations across Madhya Pradesh using 163,428 geo-referenced soil samples from the Soil Health Card (SHC) scheme and a suite of 30 SCORPAN-based environmental covariates processed via Google Earth Engine. Three machine learning algorithms—Classification and Regression Trees (CART), Random Forest (RF), and Gradient Tree Boosting (GTB)-were evaluated using spatial cross-validation to assess their prediction accuracy and uncertainty. Among the models, RF outperformed others for P and K with R^2 values of 0.53 and 0.54 respectively, while N prediction remained weak ($R^2 = 0.46$), indicating high spatial variability and limited covariate explanatory power. RF and GTB achieved satisfactory reliability for P and K predictions (RPD > 1.73), while N predictions were less dependable. Covariate importance analysis revealed that climatic and topographic variables such as precipitation seasonality, elevation, and slope played major roles in nutrient prediction. This work underscores the utility of large-scale ML-driven DSM frameworks for generating high-resolution (100 m) nutrient maps to support precision fertilizer application and improved soil health management (Fig. 2.5.9).

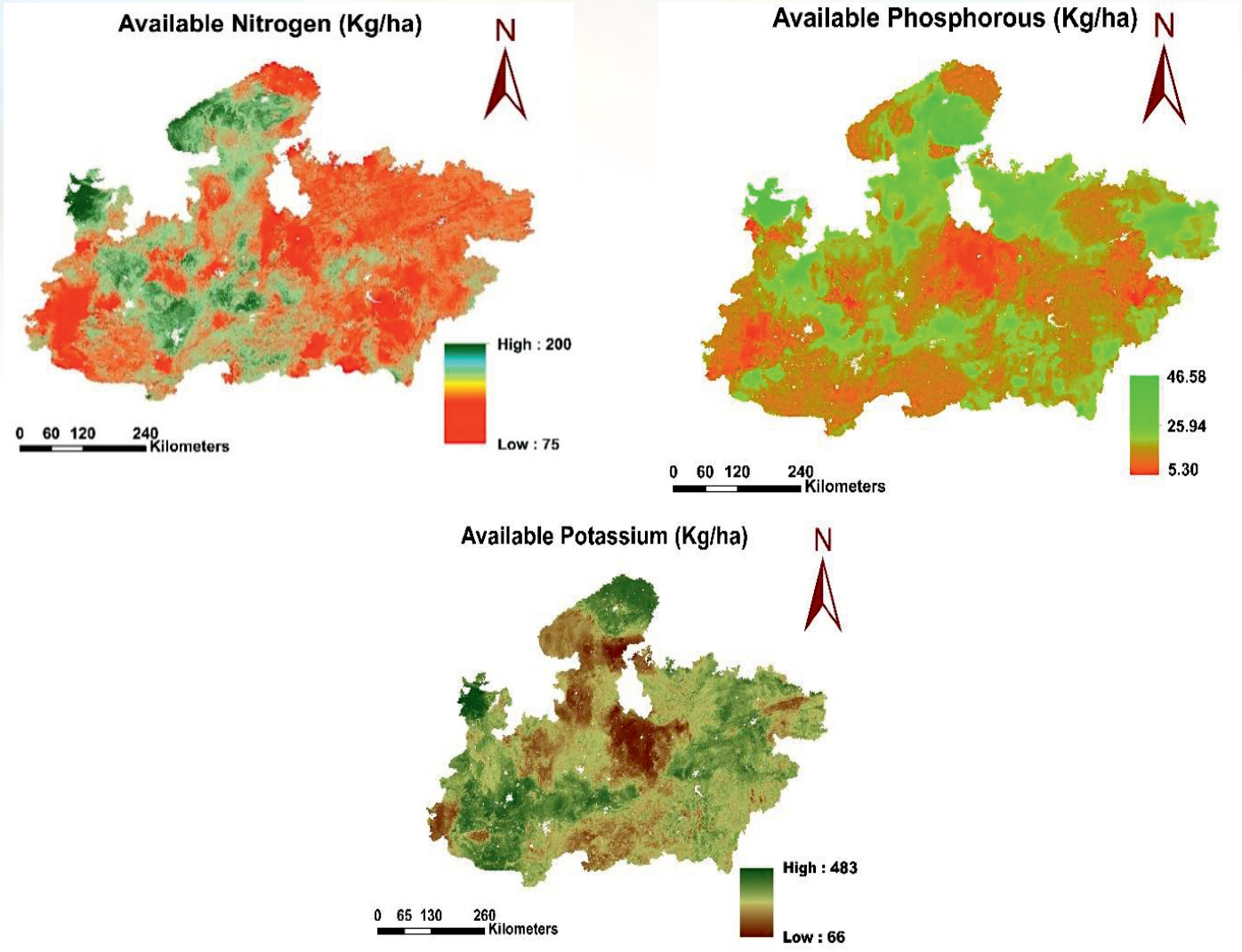


Fig. 2.5.9 Spatial distribution of soil macronutrients in Madhya Pradesh state

2.5.10 Sensitivity evaluation of SWAP model in Vertisol under various tillage practices and Nitrogen application

Field experiments of two growing year examined four nitrogen application rates (0, 50, 100, and 150 kg N ha^{-1}) across conventional tillage (CT) and no-tillage (NT) treatments. The SWAP model, incorporating Richards' equation for soil water transport, was calibrated and validated against measured soil water content and temperature data from 0-60 cm depth. Model performance varied substantially between tillage systems. Conventional tillage yielded superior simulation accuracy, with Root Mean Square Error (RMSE) values of 2.3% for soil water content in the surface layer (0-10 cm) and 11% in the subsurface layer (10-20 cm) under no-tillage conditions. Mean relative error ranged from 8% for soil temperature to 10% for grain yield predictions. No-tillage management demonstrated distinct soil modifications compared to conventional practices: 10.1% greater water retention and 8.5% lower temperatures in the upper 10 cm soil layer. These findings indicate tillage-induced changes in soil physical properties significantly influence water and heat transfer processes. The SWAP model demonstrates robust potential for simulating coupled water-temperature dynamics under variable tillage regimes, providing a valuable decision-support tool for optimizing soil and water management in semi-arid cropping systems. The validated model framework enables scenario-based assessment of tillage impacts on soil hydrothermal behavior, supporting evidence-based agricultural management strategies (Fig. 2.5.10).

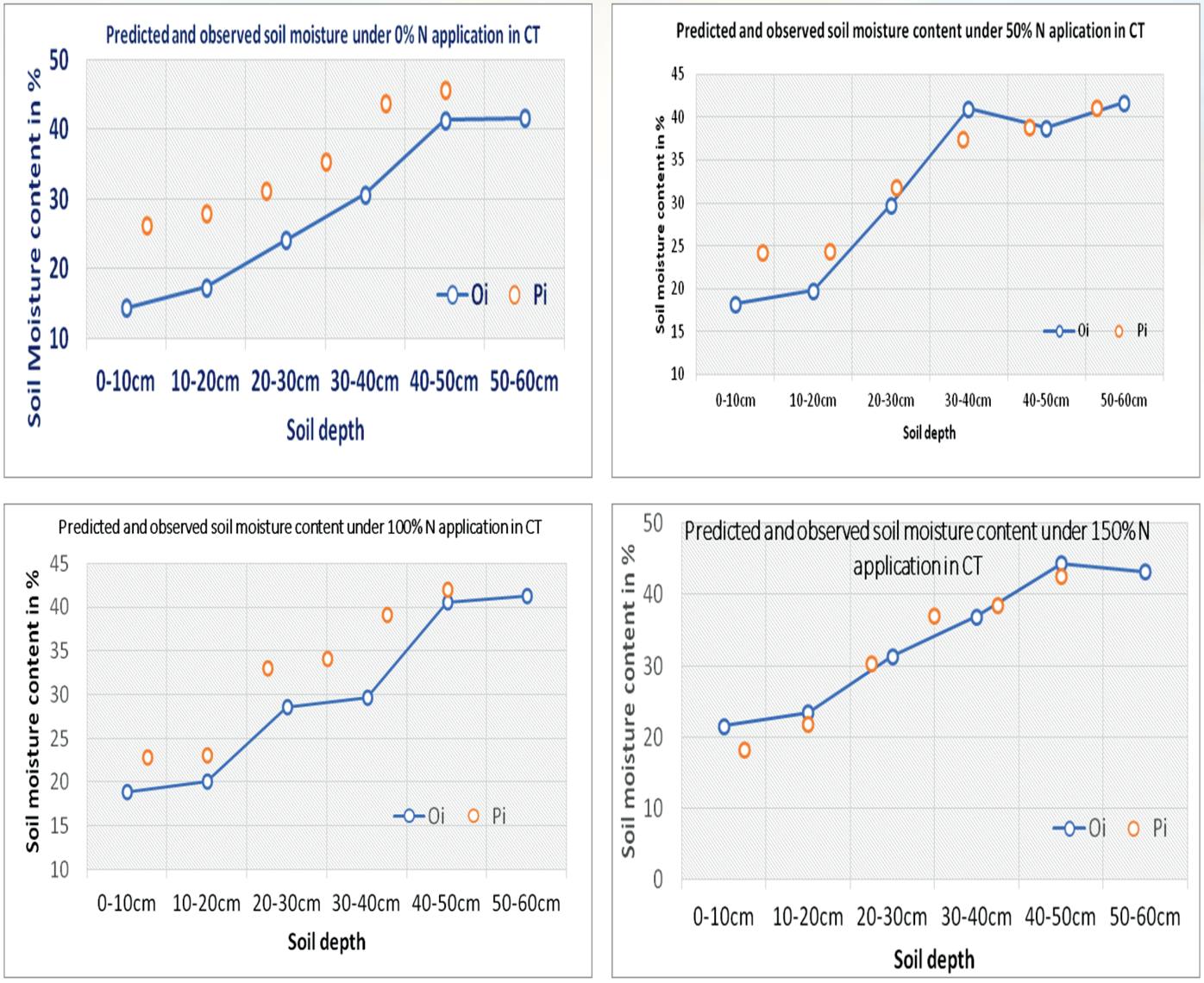
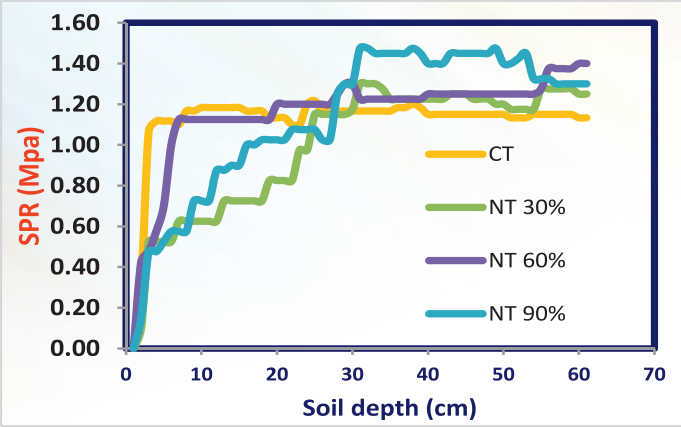


Fig. 2.5.10 Soil moisture under varied N application rate with soil depth

2.5.11 Effect of eight years of conservation tillage on soil compaction and infiltration

In an on-going eight years' old study on conservation tillage in the Vertisols at the research farm of the ICAR-IISS, the compaction behavior down the soil profile up to 60 cm soil depth was assessed during wheat crop of 2023 crop season. The penetration resistance was measured at 60-70% Field Capacity moisture range in four treatments with replicates at 90 days after sowing using a digital cone penetrometer. The treatments consisted of conventional tillage (CT) and No-tillage with 30, 60 and 90% residue retention. The resistance values varied from 0.48 to 1.13 MPa in the surface and from 0.83 to 1.48 MPa in the sub-surface layers. The results indicated higher penetration resistance under CT as compared to NT treatments in the surface layer (in the 20 cm soil depth). However, after 25 cm soil depth, the trend was clearly opposite, with NT treatments at any residue level showing higher resistance as compared to CT. The results indicate possibility of sub-surface compaction under No-tillage. The data on infiltration rate showed basic infiltration rate to be higher under CT than the CA practices. No significant differences were observed between NT and RT and also the residue levels under these two tillage treatments. However, the basic infiltration rate was almost half under the CA treatments than the CT treatment.



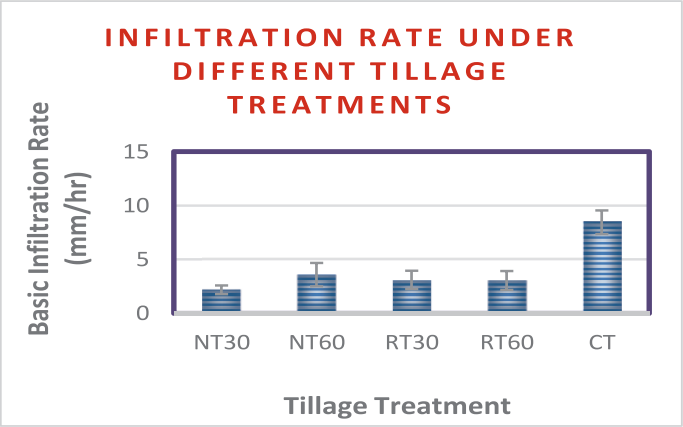


Fig. 2.5.11 Soil compaction and infiltration rate with different tillage management

2.5.12 Consultancy Project on "Optimal Ravine Management in the Chambal Landscape – Madhya Pradesh" under the GreenAg project of FAO

The study used the soil and land use maps prepared by ISRO from the satellite data of IRS LISS IV, Sentinel 2 and Landsat, questionnaire survey, field visit and soil sample analysis, for development of a detailed plan for ravine management in the critical ravine affected areas. From the data, it was observed that in Morena district, 20 villages and in Sheopur district, 27 villages are acutely affected by ravines. Soils of the two districts are alkaline with pH more than 8.0, low fertility with low soil organic carbon (almost all samples with less than 0.5% SOC), low available nitrogen and low available phosphorus content. Plant available potassium mostly in the medium to high range. Micronutrients deficiency was not observed. The major reasons for soil erosion in form of formation of gullies in arable lands, are faulty "parbandi" system (draining excess water from one field to the other), lack of intercrops with good surface cover in the rainy season crop of pearl millet, absence of bunding, along the slope cultivation, absence of land levelling, cut and carry system of fodder collection during rainy season, absence of major gully control measures in the upper reaches leading to excessive runoff and consequent erosion, overstocking and low carrying capacity of grazing lands.



Plate 2.5.12 Bare soils in ravines very prone to erosion

2.5.13 Downscaling of satellite-derived surface soil moisture through machine learning

Using machine learning techniques, the SMAP L4 surface soil moisture product was downscaled from 9 km to 1 km spatial resolution for Berasia tehsil, Bhopal. Ancillary dynamic data, including Normalized Difference Vegetation Index (NDVI), Enhanced Vegetation Index (EVI), surface reflectance in red and near-infrared (NIR) bands, and actual evapotranspiration, were sourced from MODIS at 1 km resolution from 2016 to 2023. Static data, such as soil texture, field capacity, permanent wilting point, and soil saturation limit, were obtained from ISRIC-SoilGrids having 1 km spatial resolution. These dynamic and static ancillary data were upscaled to 9 km for model training. Four machine learning models—Multiple Linear Regression (MLR), Artificial Neural Network (ANN), Support Vector Machine (SVM), and Random Forest (RF)—were developed using data from 2016 to 2023. The models were trained with ancillary data as predictors and SMAP L4 soil moisture as the target variable. The downscaled data

was validated using in-situ soil moisture observations from 50 sampling sites within the study area. Results showed that the in-situ surface soil moisture ranged from 0.12 to 0.24 m^3/m^3, while downscaled values ranged from 0.12 to 0.17 m^3/m^3, closely following the SMAP L4 data. Validation metrics revealed RMSE values from 0.09 (RF) to 0.13 (MLR) and R^2 values from 0.08 (MLR) to 0.25 (RF). The findings suggest that the downscaling models could not accurately replicate the observed in-situ soil moisture variability, highlighting the limitations of using coarse-resolution satellite products for downscaling (Fig. 2.5.13).

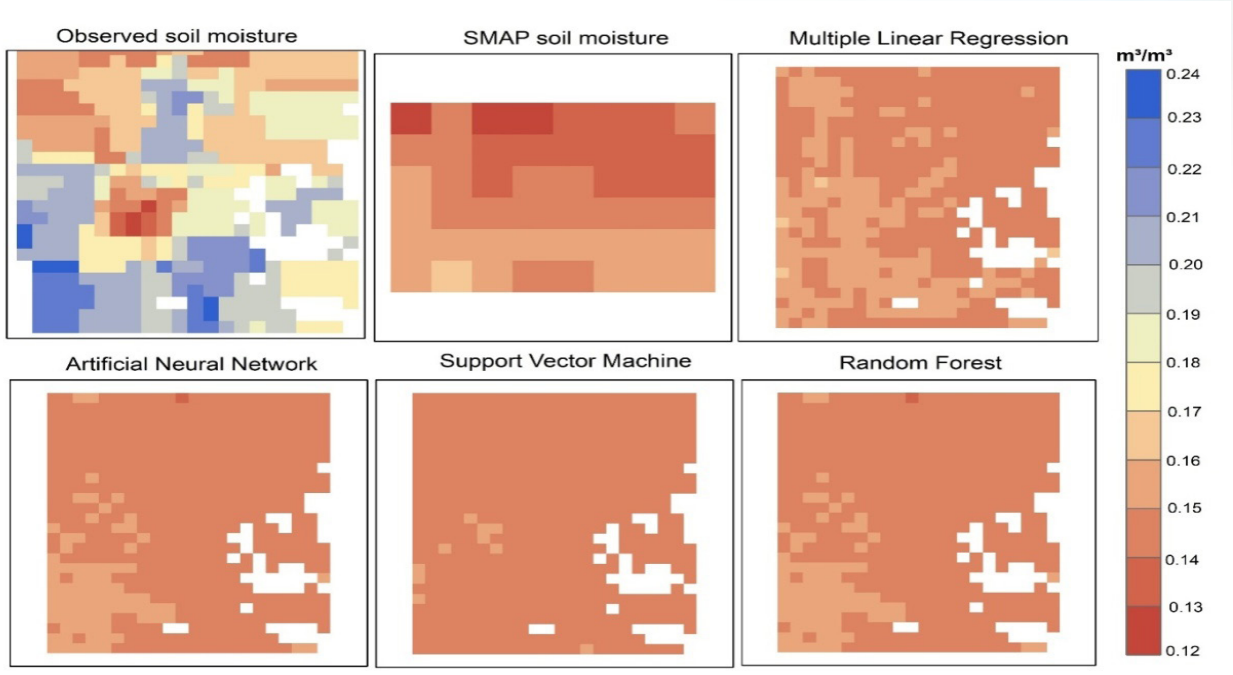


Fig. 2.5.13 Validation of different machine learning models for downscaling surface soil moisture with the observed data

2.5.14 Impact of crop residue and nutrient levels on crop productivity and soil health in maize-chickpea cropping system under conservation agriculture.

The experiment examined conservation agriculture practices in a maize-chickpea rotation using a factorial randomized design with four residue retention levels (0%, 30%, 60%, and 90%) and reduced nutrient doses compared to full application. For maize, residue retention significantly impacted productivity. Mean grain yields increased from 5.40 t ha^{-1} at 0% residue to 6.69 t/ha at 90% residue, with the best treatment being 90% residue combined with full nutrient application (R90+N1). The lowest yield occurred when no residues were present and nitrogen was reduced to 75% (R0+N2), at 3.67 t ha^{-1}. While the interaction between residue and nutrients was mostly non-significant, R90+N1 outperformed others, indicating potential for nutrient economization once residue levels are at or above 60%. Chickpea yields also peaked at 90% residue with full nutrients, ranging from 2.25 to 2.53 t/ha, and dropped to 1.521 t/ha at 0% residue with reduced nitrogen. The consistent positive effects of residue highlight its importance, while the main effects of nutrients showed no significant results, suggesting that moderate nutrient reduction can be viable with high residue levels.

Findings from the soybean-wheat residue trial support the observed trends. Soybean grain yield increased from 0.655 t ha^1 under conventional tillage and 0.826 t ha^{-1} with 0% residue to a range of 0.910–0.938 t ha^{-1} at 30–60% residue, peaking at 1.050 t ha^{-1} with 90% residue. Similarly, wheat grain yield rose from 4.421 t ha^{-1} under conventional tillage and 4.48 t ha^{-1} with 0% residue to between 4.713 and 4.85 t ha^{-1} at 30–60% residue, reaching a peak of 4.92 t ha^{-1} with 90% residue. Across both crop rotations, higher residue retention consistently improved yields, with the most significant gains observed when transitioning from residue removal to 60% or more retention. Overall, the results indicate that maintaining at least

60% residue and aiming for 90% where possible stabilizes and increases crop productivity. Full recommended dose of fertilizers (RDF) should be applied when residue is limited; however, with 60% or more residue, strategic reductions in fertilizer can be considered without compromising yields, particularly for maize. Combining residue retention with careful nutrient management provides a practical approach to conserving inputs and enhancing overall system performance within conservation agriculture. While quantitative soil-health indicators were intended for this study, they are not included here. Based on the yield responses, it is likely that there are positive effects on soil health, warranting further reporting (Fig. 2.5.14a and b).

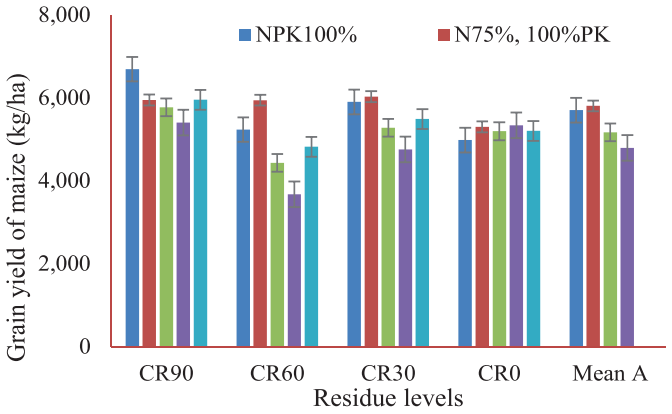


Fig. 2.5.14a Effect of different levels of crop residue and nutrient doses on grain yield of maize

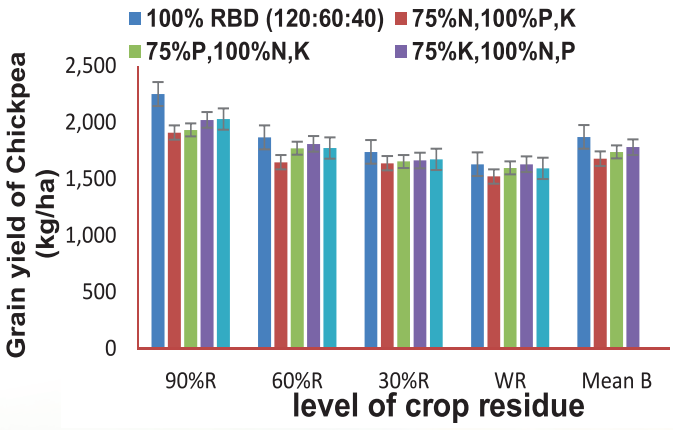


Fig. 2.5.14b Effect of different levels of crop residue and nutrient doses on grain yield kg ha^{-1} on chickpea crop.

Theme -III : Microbial Diversity and Genomics

2.6 Soil microbial diversity influenced by organic and natural farming practice

Structural diversity of soil bacterial was studied by amplicon sequencing of V3-V4 region of 16S rRNA from soil metagenome. Based on the abundance operational taxonomic unit (OUT), Shannon diversity index was found highest for organic farming (5.06) followed by natural farming (5.02) and least in control (4.72). Among bacterial phyla, Proteobacteria, Firmicutes, Actinobacteria, Chloroflexi and Bacteriodetes were the dominant phyla across the treatment. Proteobacteria was dominant phyla of bacteria with highest proportion under organic farming. Comparing the bacterial classes within proteobacteria, Gammaproteobacteria was major class. Proportion of alpha and beta proteobacteria was found to be higher under natural farming treatment compared to other treatments. Alpha proteobacteria includes many agriculturally important organisms such as Rhizobium, Bradyrhizoboum, Beijerinckia, Gluconobacter, Nitrobacter, Rhoodopseudomonas etc whereas betaproteobacteria includes Aquaspirillum, Gallionella, Nitrosomonas, Thiobacillus etc. (Fig. 2.6a and b).

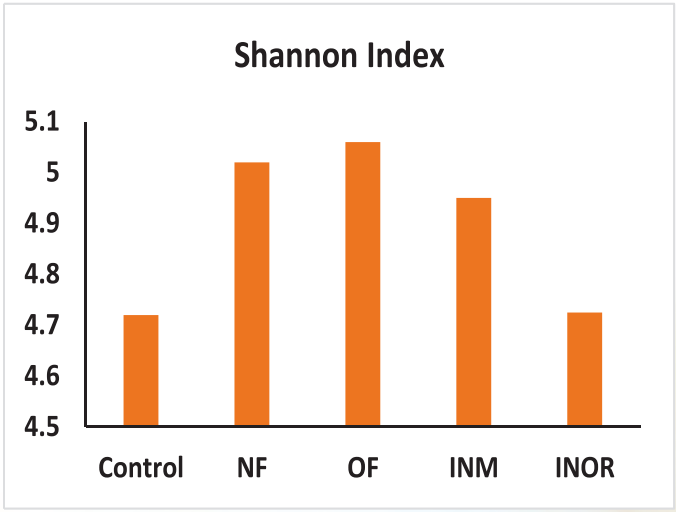


Fig. 2.6a Diversity index under different nutrient management practices

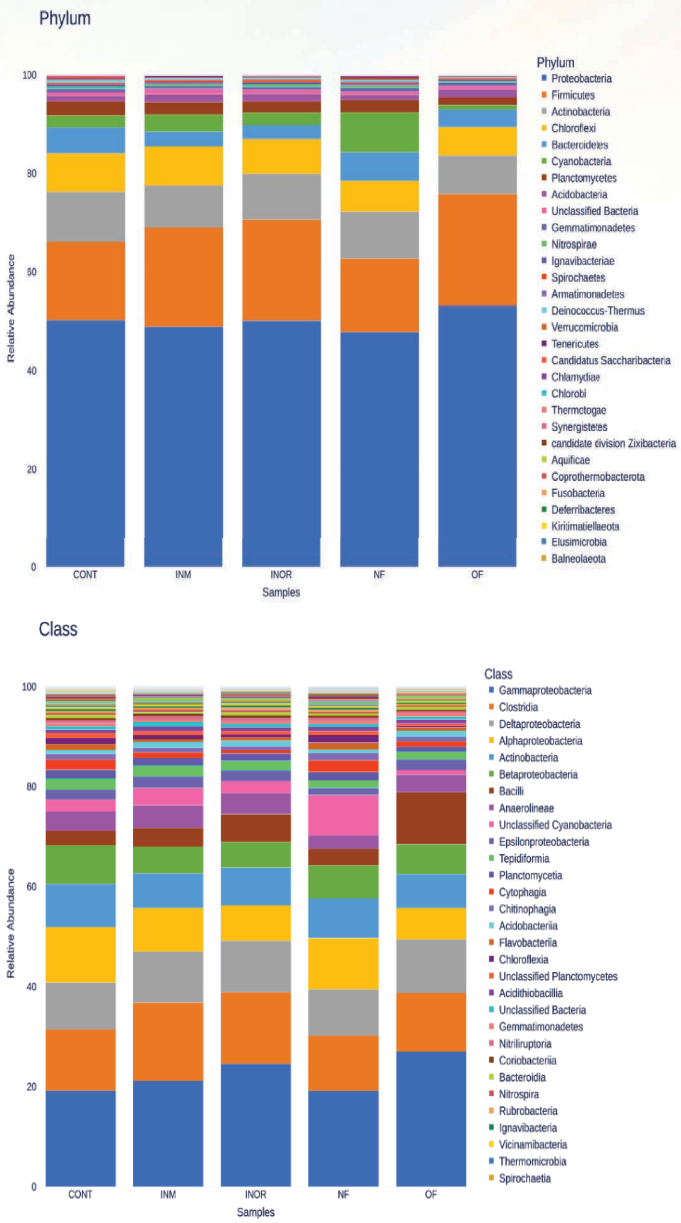


Fig. 2.6b Abundance of bacteria under various nutrient management system

(Control: no fertilizer or manure; INM: Integrated Nutrient Management practice; INOR: Chemical fertilizer application NF: Natural Farming; OF: organic farming)

2.7 Evaluation of different decomposers for rapid crop residue management

The experiment was laid out with 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). It was concluded after Next-Generation Sequencing (NGS) that the decomposer treatment caused significant shift in the microbial community structure, increasing the diversity and abundance of certain bacterial groups Fig. 2.7. The significant rise Actinobacteria (Thermoleophilia- Gaiellales) from 90 (T1) to 626 (T3) counts suggests enhanced decomposition of organic matter, leading to improved nutrient availability. The rise in Chloroflexi counts indicates enhanced carbon turnover and potential remediation of organic pollutants. The higher abundance of Acidobacteria contributes to nutrient cycling and creates a more favorable environment for plant growth. A higher count of Gemmatimonadota bacteria suggests improved phosphorus cycling, enhancing plant nutrient uptake.

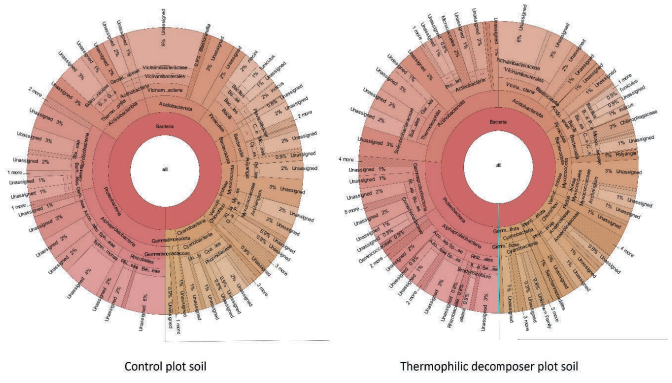


Fig. 2.7 Microbial diversity under different decomposers application for rapid crop residue management

2.8 Evaluation of Humic Acid (HA) from vermicompost as biostimulantson vegetable crops

The experiment was planned with 9 treatments: Control (T0), 50%RDF (T1), HA @ 0.1% (T2), HA @ 0.2% (T3), HA @ 0.1%+ RDF 50% (T4), HA @ 0.2%+ RDF 50% (T5), vermicompost @ 5 t ha^{-1} (T6), vermicompost @ 5 t ha^{-1} + RDF (50%) (T7), RDF (100%) (T8). The study confirmed that the foliar application of HA @ 0.1%+ RDF 50% (T4) performed better and showed 10% increase in plant height and fruiting than control. This is preliminary study and further confirmation of the treatments will be evaluated by field experiments (Plate 2.8a and b).



Plate 2.8a Steps of preparing humic acid solution for foliar application over the plant.



Plate 2.8b Physiological view of tomato crop under different treatments

2.9 Impact of silicon solubilizing bacteria (SSB) on rice productivity in Vertisols of Central India

A field experiment was carried out to assess the effectiveness of PSB (P) and SSB (Si) on the growth and yield of rice-wheat cropping system in Vertisols of Central India. The experiments included seven treatments: T0- control; T1-75% RDF; T2- 100 % RDF; T3- 75% RDF + PSB 4; T4- 75%RDF +PSB 5; T5- 75% RDF + SSB 3 and T6- 75% RDF + SSB 4 with three replications. In rice crop, the treatment 75% RDF + PSB 4 (T3) yielded highest, while the control had the lowest yield. The yield increased over the 75 % RDF (T1) was observed as follows:T3, 75%RDF + PSB 4 (25%) > T6, 75% RDF + SSB 4 (23%) > T4, 75%RDF +PSB 5 (13%)> T5, 75% RDF + SSB 3 (9.6%)> T2, 100 % RDF (8.8%). This study suggests that the application of Si and P as SSB and PSB significantly benefits the rice growth and productivity in Central India's Vertisol (Plate 2.9).





Plate 2.9 Treatment wise comparison of rice growth (PB 1) at vegetative and harvest stage

2.10 Cross nodulation ability of slow and fast growing pigeonpea rhizobia across intra and inter species leguminous crops

The study evaluated 48 rhizobia isolates (27 slow and 21 fast-growing) from pigeonpea to compare their plant growth-promoting (PGP) traits. Significant variation was observed, with four slow growers (BRP5, BRP9, BRP20, BRP24) and two fast growers (BRP8, BRP14) showing superior PGP potential. Phylogenetic analysis identified them as Bradyrhizobium, Rhizobium, and Sinorhizobium. Nodulation was cultivar-specific, with slow growers favoring pigeonpea cultivars Asha and MKK ICPH 2740, while fast growers preferred ICPL 332 WR and ICPL 14003. Cross-inoculation showed all six strains could nodulate multiple legumes *Vigna radiata* > *Cajanus cajan* > *Vigna mungo* > *Sesbania cannabina* > *Glycine max*, but not species like fenugreek, clover, groundnut, lentil, or pea. The findings suggest that combined use of BRP20 (slow grower) and BRP8 (fast grower) as bioinoculants may enhance pigeonpea and other legume productivity.

Slow and fast growing pigeonpea rhizobia : PGP activities and nodulation across intra and inter species of legumes

PGP activities	▪All pigeonpea rhizobia produced IAA. Fast growers produced higher IAA than slow growers ▪Fast growers : Nitrate reduction > siderophore production >phosphate solubilization > ACC deaminase > HCN production ▪Slow growers : Nitrate reduction > siderophore production = phosphate solubilization > HCN production > ACC deaminase
Nodulation across cultivars	▪Fast growers : Nodulated ICPL 332 WR > ICPL 14003 >Asha (ICPL 87119)> MKK ICPH 2740 > IPCL 85063 > IPCL 88039 > IPCL 84031 > ICPL 87 ▪Slow growers Nodulated Asha (ICPL 87119)> MKK ICPH 2740 > ICPL 332 WR> ICPL 14003 > IPCL 85063 > IPCL 88039 > ICPL 87 > IPCL 84031
Nodulation across Legumes	▪No nodulation - *Trigonella foenum-graecum,Trifolium alexandrium, Arachis hypogaea, Lens culanaris, and Pisum* ▪Nodulation - *Cajanua cajan*, *Glycine max, Sesbania bispinosa, Vigna radiata and Vigna mungo*

2.11 Effect of organic farming, natural farming and integrated crop management on total glomalin related soil protein and its distribution in soil aggregates.

In a comparative evaluation of organic farming (OF), natural farming (NF) and integrated crop management (ICM), it has been found that OF had highest total glomalin related soil protein (TGRSP) content of 617.1 $\mu g\ g^{-1}$ soil followed by NF having TGRSP content of 585.6 $\mu g\ g^{-1}$ and ICM with TGRSP content of 573.8 $\mu g\ g^{-1}$. In case of distribution of TGRSP in different soil aggregate fractions, it has been noticed that 2000 μm fraction had the lowest content of TGRSP of 485.3 whereas 53-250 μm fraction had the highest amount of TGRSP enrichment. This finding reflects the protection and preservation of TGRSP within microaggregates fraction (53-250 μm), which have been reported to

promote the accumulation of resistant carbon fractions and augmenting the stability of SOC especially due to retention of glomalin (Fig. 2.11).

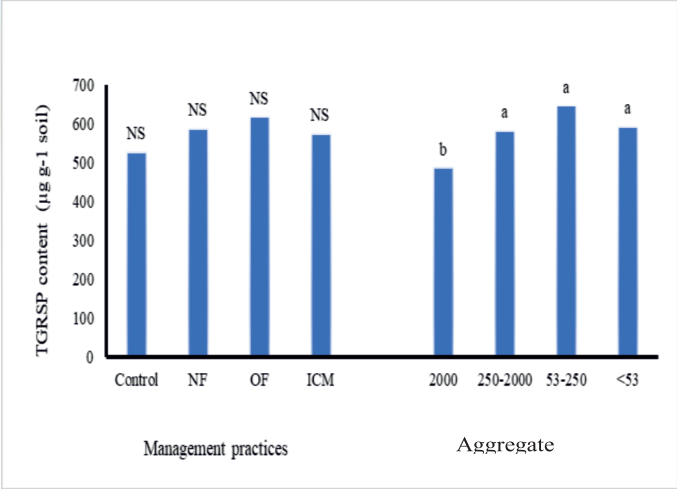


Fig. 2.11 TGRSP content under different management practices and aggregate fraction

2.12 Effect of in-situ decomposition of crop residue mediated by lignocellulolytic microbes on crop yield under rice-wheat cropping system

The experiment was planned with six experiments: residue incorporation (T1), microbial consortia application on residue incorporation (T2), microbial consortia application on residue+spray and incorporation (T3), residue removal (T4), residue burning (T5), residue retention (T6). After one year of crop cycle, there was no significant effect of residue management treatments (microbial consortia application) on rice yield but application of microbial consortia with/without urea application exhibited its effect on wheat yield.

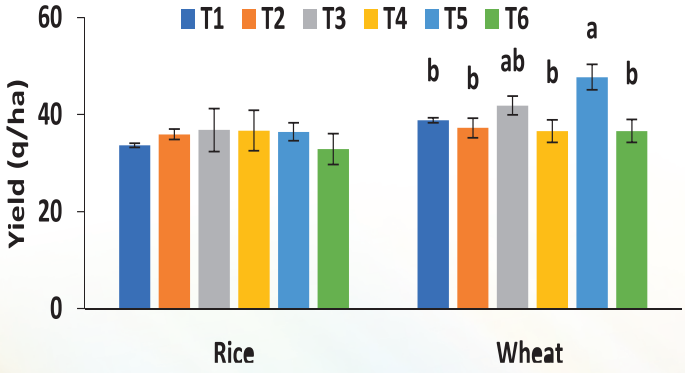


Fig. 2.12 Crop yield under rice-wheat cropping system

The soil samples of surface (0-15 cm) layer were analyzed for soil properties after one year crop cycle. The results obtained were as following.The residue management treatments had significant effect on the following selected soil properties and no significant difference was observed in other properties.

Table 2.12 Effect of residue management treatments on soil K status, FDA and phosphatase activity

	Available K (kg ha^{-1})	FDA (μg Flourg^{-1} hr^{-1})	Phosphatase (μ PNPg soil^{-1}hr^{-1})
T1	660 b	22.4 abc	259 a
T2	709 a	26.8 a	261 a
T3	710 a	24.6 ab	266 a
T4	636 b	18.6 c	228 b
T5	680 ab	19.7 bc	245 ab
T6	677 ab	21.8 abc	266 a

2.13 Evaluating the effect of Bio.Soilz application on the vegetable crops

A pot culture study was conducted only with the application of bio.soilz with increasing doses of bio. soilz (unfertilized control and 0, 1x, 2x doses of bio. soilz) application on the growth and productivity of orka and cowpea vegetables. It has observed that the with the enhancement of bio.soilz application there is enhancement of growth biomass of okra and cowpea.



Plate 2.13 Effect of Bio.Soilz application on the vegetable crops

2.14 All India Network Project (AINP) on Soil Biodiversity and Biofertilizer

2.14.1 The microbial diversity study in the century-old long term fertilizer experiment

Experiment conducted at the long term fertilizer experimental site at TNAU, Coimbatore under AINP on Soil Biodiversity Biofertilizers. Study revealed nuanced impacts of nutrient management on soil microbial communities. Analysis using 16S rRNA gene sequencing identified similar overall bacterial and archaeal diversity across treatments, with approximately 33 phyla in Organic Amendment (OM) soils, 31 in Integrated Nutrient Management (INM) soils, and 30 in both Inorganic Fertilizer (IC) and Control soils. Overall, while long-term nutrient management did not significantly change phylum-level diversity, it markedly influenced the composition and relative abundance of microbial communities.

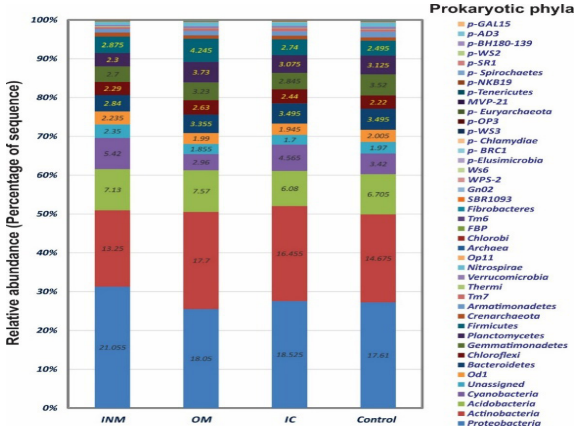


Fig. 2.14.1 Effect of long-term fertilizer experiment on microbial diversity

2.15.2 Microbiome of Chickpea

The bacterial communities associated with bulk soil, rhizosphere soil, root, nodule and shoot tissues of chickpea was carried out using 16S amplicon sequencing. The species richness in terms of CHAO1 was higher in soil samples (13.96-14.91) compared to chickpea tissues (2.41-8.57). Plant samples showed distinct bacterial members in comparison to soil samples. The bacterial diversity was 13% higher in rhizosphere soil in comparison to bulk soil. Rhizosphere soil samples harboured 356 known genera while 286 genera were observed in bulk soil. Among the various plant tissues, roots were colonized with higher bacterial diversity, and supported the colonization of 192 genera, whereas nodules were colonized by 105 genera. Poor bacterial diversity was observed in chickpea shoots, with colonisation of only 4 different genera. Canonical correlation analysis (CCA) analysis showed that Firmicutes is the dominant phylum in which genus Bacillus and Paenibacillus are predominantly present in the soil, followed by Bacteroidetes. However, Mesorhizobium (αProteobacteria) and Cellvibrio (γProteobacteria) were the most abundant colonisers in the root and nodule tissues with Mesorhizobium being the abundant in nodule samples and Cellvibriopredominant in root tissues. The results clearly suggest dynamic changes in terms of bacterial acquisition in spatial compartments of chickpea plants (Fig. 2.15).

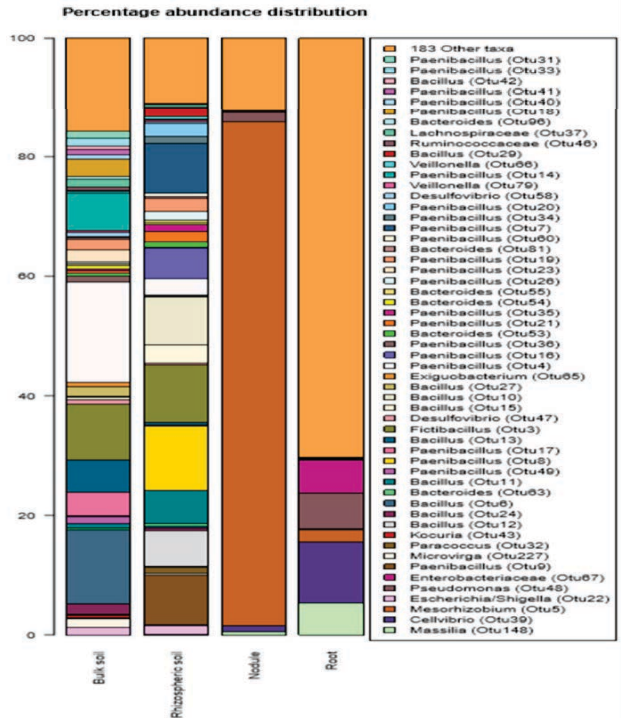


Fig. 2.15.2 Changes of microbiome in chickpea

Theme IV: Soil Pollution, Remediation and Environmental Security.

2.16 Effect of biochar and fly ash amendments on Pb and Cd uptake in wheat

Two amendments-steam-activated wheat straw biochar (WB) and microwave-assisted alkali-infused fly ash (MF) were evaluated for their effects on Pb and Cd uptake by wheat (*Triticum aestivum L.*) in contaminated soils (Plate 2.16.1). A pot experiment with seven treatments (T1 to T7) was conducted in triplicate. T2 (polluted soil) showed a reduction in fresh shoot, dry shoot, fresh root, dry root weight, and leaf area by ~18.5, 21.0, 18.9, 31.4, and 37.3%, respectively, compared to the control (T1). T5 (fresh soil +

wastewater) recorded respective reductions of ~9.7, 8.2, 15.2, 27.5, and 34.8%. Maximum Pb reduction in shoot (65.2%) and root (54%) occurred in T3 (polluted soil + WB). For T6 (fresh soil + wastewater + WB), Pb was reduced in shoot (54.5%) and root (50%). Maximum Cd reduction in T4 (polluted soil + MF) was 58% (shoot) and 53.8% (root). T7 (fresh soil + wastewater + MF) reduced Cd by 70% (shoot) and 61.5% (root) (Fig. 2.1.1).



Plate 2.16.1 Wheat plant images after 25 days after sowing

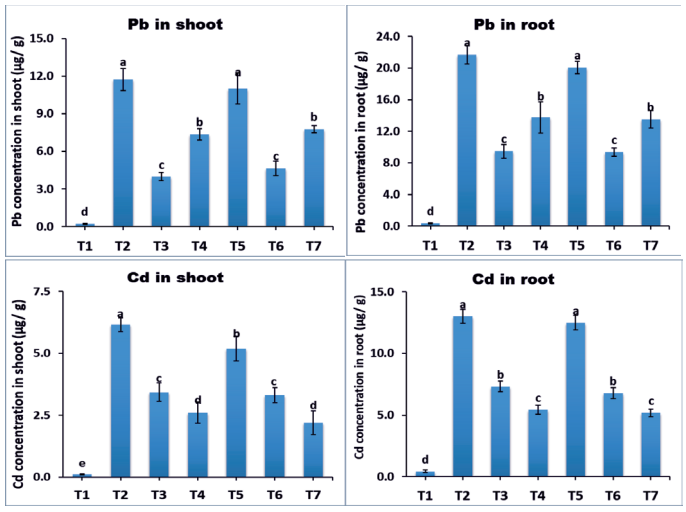


Fig. 2.16.1 Pb and Cd concentration in above and below ground biomass in wheat

2.16.2 Preparation and characterization of nanobiochar from municipal sludge biochar

Nanobiochar was synthesized using municipal sludge biochar (MSB) via ball milling at ICAR-IARI, New Delhi. The process employed a Retsch PM 400 planetary ball mill using 10 mm stainless-steel balls. A sample-to-ball weight ratio of 1:2.5 was maintained, ensuring efficient contact for particle size reduction. The milling process operated at 300 rpm for 32 hours. Post-milling, the reduced-size biochar was collected for analysis. Particle size distribution was measured using the Brookhaven Instruments NanoBrook Omni Model at IPFT, Gurgaon. Dynamic Light Scattering (DLS) analysis showed that although a small fraction of particles measured below 100 nm, most particles exhibited diameters between 300 and 400 nm (Fig. 2.16.2). This approach enabled production of uniform and smaller-sized biochar particles, with enhanced surface area and potentially higher reactivity, suitable for agricultural and environmental applications. The characterization confirmed suitability for further use in soil remediation and nutrient delivery systems.

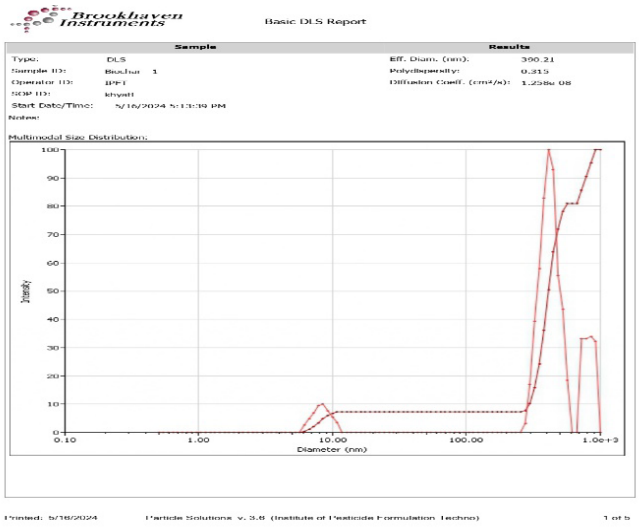


Fig. 2.16.2 Basic DLS report of size reduced biochar

2.16.3 Assessment of soil heavy metals of Jajmau industrial area, Kanpur using machine learning algorithms

The Partial Least Square Regression (PLSR) and Artificial Neural Network (ANN) model was developed to rapidly assess the Chromium, cadmium, lead and iron content (ppm) in contaminated soil of Jajmau, Kanpur. The model was evaluated with the independent dataset using statistical criteria such as the ratio of performance of deviation (RPD), coefficient of determination (R2) and root mean square error (RMSE). The R2 (0.73 and 0.44) and RMSE (300.24 and 2.37) values for validation in PLSR model indicates that chromium and cadmium could be predicted with reasonable accuracy whereas for lead and iron ANN model was found best fit with R2 (0.46 and 0.13) and RMSE (9.26 and 2331.71) values for validation using Visble Near Infrared (VNIR) Spectroscopy (Fig. 2.16.3).

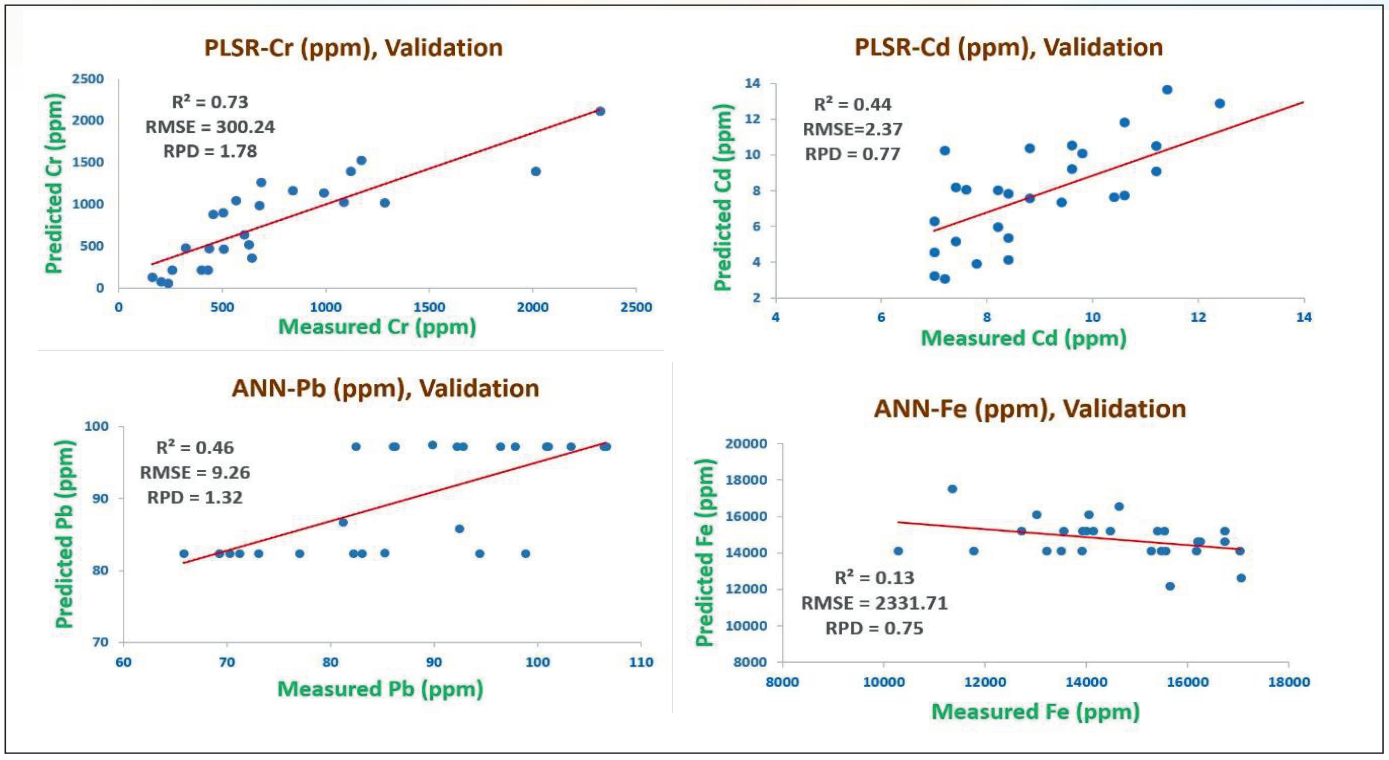


Fig. 2.16.3 Validation of Cr, Cd, Pb and Fe with machine learning algorithms

2.16.4 Characterization of municipal sludge from sewage treatment plants (STPs) across Madhya Pradesh

Municipal sludge generated from sewage treatment plants (STPs) is a complex by-product that varies in physicochemical composition depending on treatment technology, urban infrastructure, and influent characteristics. This study aims to characterize the municipal sludge from selected STPs across different cities of Madhya Pradesh, including Bhopal, Indore, and Sehore (Plate 2.16.4). Representative sludge samples were analyzed for key parameters such as pH (6.30 – 7.30), electrical conductivity (EC) (1.76 – 3.76 dS/m), moisture (8.70 – 16.8%), total organic carbon (TOC) (17.2 – 23.1%), total nitrogen (TN) (2.21 – 2.37%), total phosphorus (TP) (0.12 – 0.28%), and heavy metals (Cd, Pb, Zn, Cr, Cu). The results revealed substantial variability in sludge quality among the STPs, primarily influenced by source wastewater composition and operational efficiency of the plants. The study highlights the need for regular monitoring and site-specific management strategies to ensure safe disposal or beneficial reuse of municipal sludge.

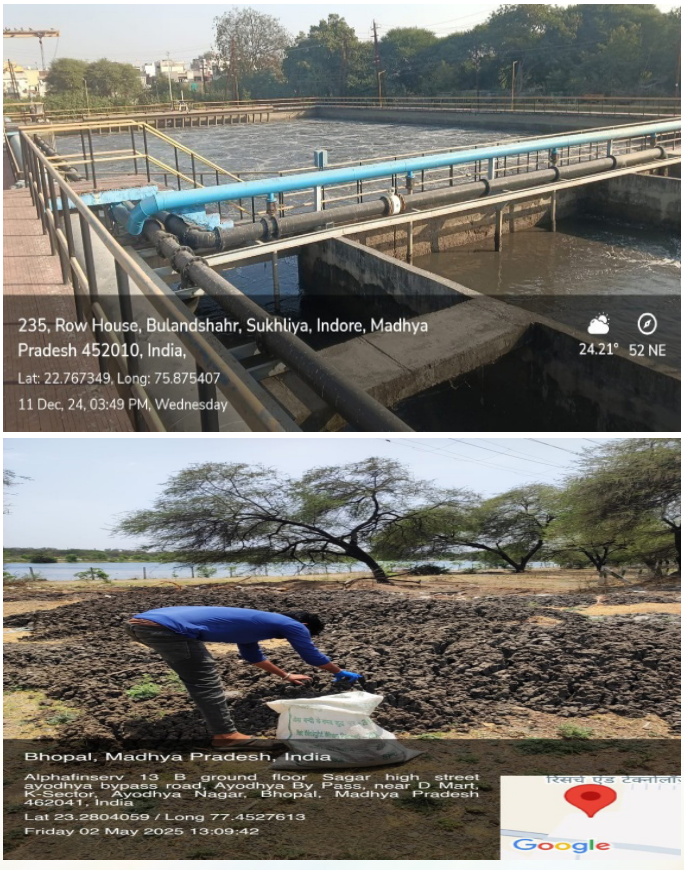
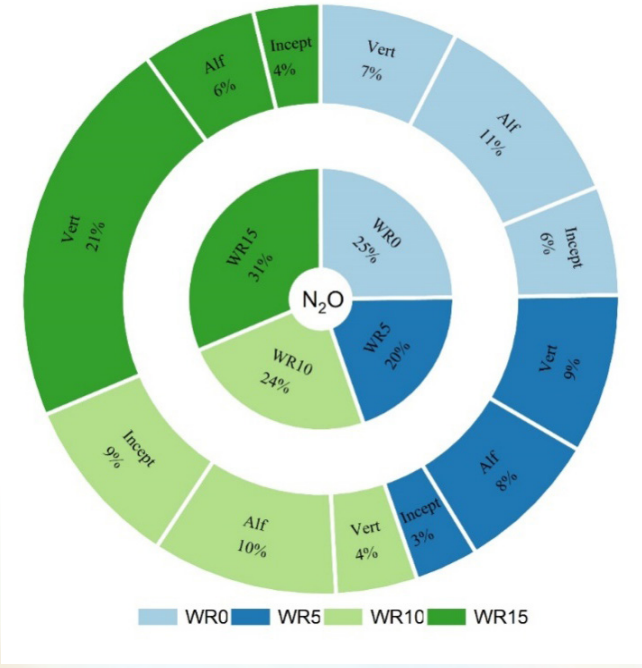


Plate 2.16.4 Collection of municipal sludge of sewage treatment plant

2.16.5 GHG emissions under wheat residue and nutrient management in different soils

This study assessed greenhouse gas (GHG) emissions under varying wheat residue (WR) levels (0, 5, 10, 15 Mg ha^{-1}) and nutrient inputs (NP0: no nutrient, NP1: balanced N and P for WR5, NP2: 3×NP1) across Alfisol, Vertisol, and Inceptisol soils. Inceptisol showed negative N_2O flux, attributed to high legacy P (19.7 mg kg^{-1}), high pH (8.49), and low clay content (13%), which limited microbial activity. CH_4 emissions were notably reduced under high residue inputs in Vertisol and Inceptisol. N_2O emissions increased in Vertisol under WR15 and high nutrient levels. Alfisol demonstrated the highest total carbon mineralization and global warming potential (GWP), with cumulative GWP 1.2× and 1.4× higher than Vertisol and Inceptisol, respectively (Fig. 2.16.5). These findings suggest that soil type, residue input, and nutrient management collectively influence GHG dynamics. Optimizing residue and nutrient strategies according to soil properties could mitigate emissions while maintaining soil health and crop productivity. Alfisol exhibited the highest total carbon mineralization and GWP, with cumulative GWP being 1.2 times higher than Vertisol and 1.4 times higher than Inceptisol across residue and nutrient input.



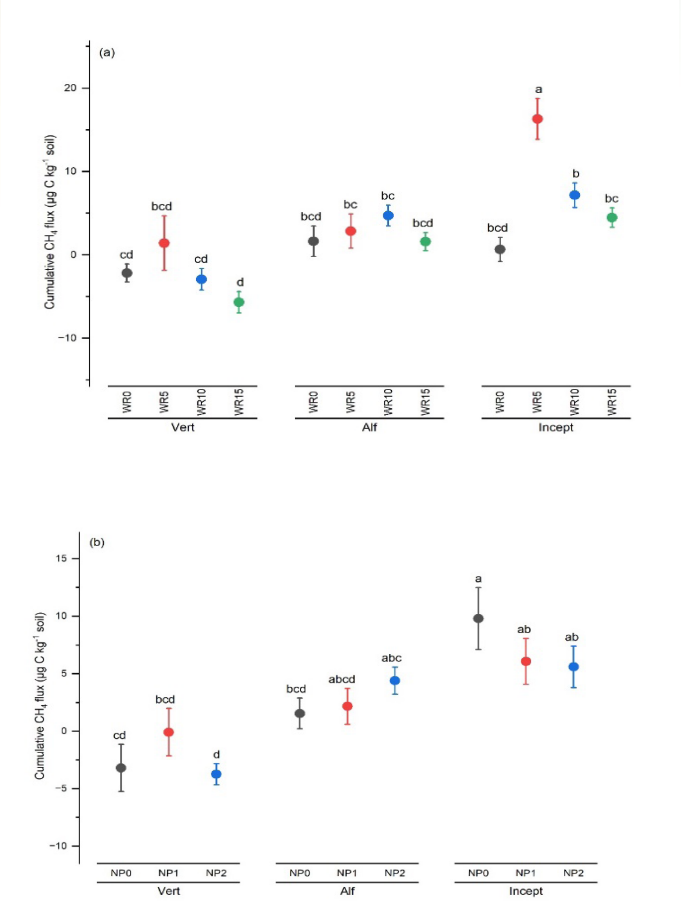


Fig. 2.16.5 Response of predominant soil types of India to different levels of residue retention on greenhouse gas emissions

2.16.6 Hydrogeochemical Facies Analysis of Bhojtal Wetland Using Piper Plot

A Piper tri-linear plot was used to study hydrogeochemical facies in Bhojtal wetland. Cations (Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}) and anions (HCO_3^-, SO_4^{-2}, Cl^-) were dominant. In the monsoon, water chemistry was mostly Ca^{2+}/Mg^{2+} and Cl^- type. About 22% of samples (from KH and KB) fell under Class II (Ca/Mg-HCO_3^-), indicating freshwater recharge and geological influence. Around 67% showed Mg^{2+}-Cl^- dominance, reflecting agricultural runoff and sewage input post-monsoon. Post-monsoon water quality showed Mg^{2+} and Cl^- dominance across all samples, categorized as Class IV (Cl^--Ca^{2-}/Mg^{2+}). The Lakhapur site exhibited mixed hydrochemistry. Identifying hydrogeochemical facies revealed sources of contamination Cl^- from domestic/industrial wastewater and HCO_3^- from lesser-impacted zones. These insights help track seasonal and

spatial pollution trends in the wetland, highlighting the role of anthropogenic activities. Monitoring facies types supports the development of strategies for water quality protection and restoration in ecologically sensitive areas like Bhojtal wetland (Fig. 2.16.6).

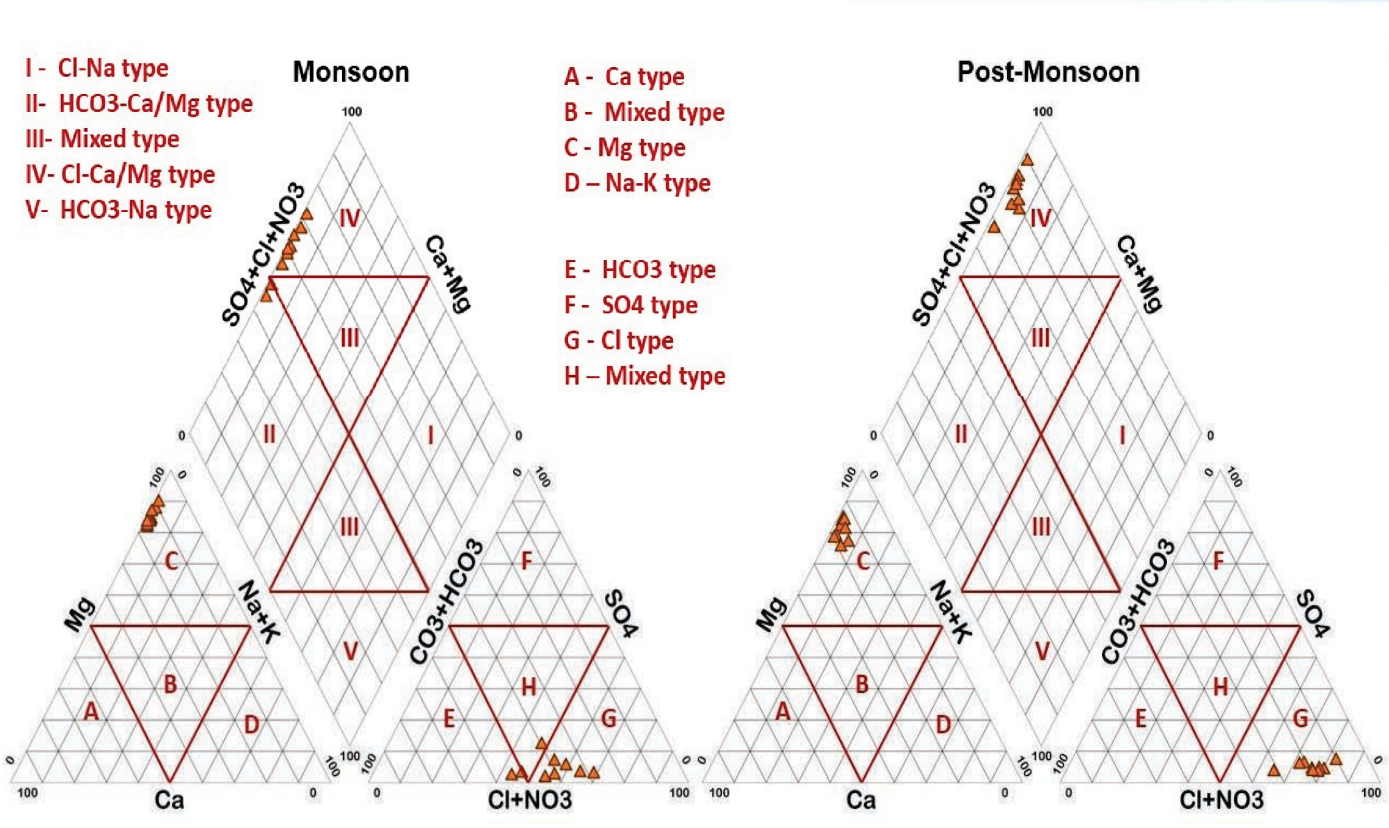


Fig. 2.16.6 Chemometric assessment and hydrogeochemical classification of anthropogenically impacted ancient artificial wetland, Bhojtal, India

3. Transfer of Technology

3.1 Frontline Demonstrations

3.1.1 Participatory Demonstrations on Diversified Farm Income under the Farmer FIRST Project

During the 2024 crop season, project activities were carried out in six villages Kham Kheda, Kalyanpura, Kanchbavli, Bherupura, Khajuri, and Barkhedi Hajjam of Bhopal district, Madhya Pradesh. The major interventions included field demonstrations of crop management technologies and capacity-building programs for farmers. Under the "Crop" and "Natural Resource Management (NRM)" modules, field demonstrations of high-yielding varieties and resource-conserving technologies such as reduced tillage and residue recycling through *in-situ* composting were conducted in 30 farm fields following soybean-wheat, soybean-chickpea, rice-wheat, and rice-chickpea cropping systems. To promote soil test-based fertilizer application, soil samples were collected from the same 30 farm fields after the cropping season and Soil Health Cards with field-specific nutrient recommendations were distributed. Additionally, method demonstrations on residue management using microbial-based decomposer capsules were conducted in the villages. An impact analysis conducted after seven years of project implementation revealed that interventions under the Crop and NRM modules led to yield increases of 5.26% in soybean, 11.64% in wheat, and 11.75% in chickpea, along with a significant reduction in cultivation costs across all crops. Furthermore, the success story of an agripreneur from Kalyanpura village covered under the enterprise module was documented and published as both a short video and a popular article.



Soil Health Card distribution



In-situ decomposition demonstration in farmers' field





Demonstration at farmers field of Ekcel microbial decomposer under wheat-rice cropping system on May 8, 2024 at 4 farmers field of Bhagvan Singh Meena (Beenapur), Pehlad Malviya (Khajuri), Santosh Rajput (Khajuri), Ramesh Rajput (Khajuri).

3.1.2 Microbial - based agricultural waste management using vermi - composting

Mass worm mother culture multiplication was done at worm mother culture unit, ICAR-IISS Bhopal. About 110 kg worm mother culture was multiplied during the period of April 2024 to March 2025 for distribution to

the beneficiary farmers under the SAP project in the adopted villages. Vermi beds were distributed to the farmers for vermincomposting towards safe disposal of farm waste, thus promoting Swachhta in the village and creating wealth out of waste. Various training program were organized under the Swachhta Campaign in different villages in which 692 farmers participated. Kisan Diwas was organized on the occasion of National Farmers Day at ICAR- IISS, Bhopal on December 23, 2024. In this program, farmers from Rasuliya Pathar, Tarasewaniya, Ratibad, Ratanpur and Kalakedi participated. Besides, various activities were organized for rapid recycling of farm wastes through vermicomposting in which 1360 farmers, students and women farmers participated.

Mass multiplication of Earthworm Mother Culture

Mass worm mother culture multiplication was done at worm mother culture unit, ICAR-IISS Bhopal. About 110 kg worm mother culture was multiplied during the period of April 2024 to March 2025 for distribution to the beneficiary farmers under the SAP project in the adopted villages.



Mass worm mother culture multiplication

Distribution of vermi beds and worm mother culture

Vermibeds were distributed to the farmers for establishment of vermicomposting units for safe disposal of farm waste, thus promoting Swachhata in the village and creating wealth out of waste. Worm mother culture was also provided to the farmers for establishment of vermicomposting units.

S.No	Name of Village	No. of Vermibed	Worm Mother Culture (Kg)	Date
1	Ratibad, Bhopal	4	8	14.05.2024
2	Ratibad, Kalakhedi, Bhopal	7	14	20.06.2024
3	Rasuliya Pathar, Ratibad,Kalakhedi,Bhopal	4	8	25.07.2024
4	Kalakhedi, Ratanpur, Bhopal	6	12	28.08.2024
5	Ratanpur, Bhopal	3	6	20.09.2024
6	Ratibad, Bhopal	2	4	20.12.2024





Distribution of Vermibeds

Multiplication of microbial cultures for *in-situ* crop residue management

The microbial cultures were multiplied on large scale in laboratory, for preparation of capsules. These capsules will be distributed among the farmers and also to set up demonstration of *in-situ* decomposition of wheat residue in selected villages. The farmers visiting the institute were elaborated about use of decomposer

capsules for composting in field and pit.

Preparation of microbial culture capsule for accelerating composting process

After demonstration of indoor composting using microbial culture in adopted villages, the culture formulated in the form of capsules by the Soil Biology Division under SAP, was prepared in more numbers to distribute among the farmers. The microbes in capsules can be easily activated by the farmers in Sugar-Bran solution to use in compost pit. The capsules were used for *in-situ* decomposition of wheat residue in field.



Capsules for farm waste and crop residue decomposition



Multiplication of decomposer cultures

Follow up programme

Regular follow-up programs were organized at beneficiary farmer's field. In which programme farmers were instructed to maintain their bags, watering on time and also informed to use their prepared vermicompost to their field. The farmers were also made aware about the ways for recycling of crop residues without burning.



Follow up of vermicomposting technology

3.1.3 Effect of Zn application on rice yield

Ten front line demonstrations were conducted at Shivari village of Bajag block in Dindori district of Madhya Pradesh to show the effect of zinc application on productivity of rice. The farmer fields had available Zn of 0.29 to 0.87 mg kg^{-1} with mean value of 0.58 mg kg^{-1}. Grain yield of rice under farmer's practice (FP) without Zn application ranged from 2.81 to 3.16 t ha^{-1} with average yield of 2.64 t ha^{-1}, while grain yield was enhanced to the extent of 7.61 to 15.46 % with mean value of 9.11% over farmer's practices with application of 5.0 kg Zn ha^{-1}. Soil Health cards for the respective fields were prepared and provided to all selected farmers.



Plate 3.1.3a Frontline demonstrations

Response of mustard and chickpea to S application

Field experiments were conducted during rabi season to study response of mustard and chickpea to S application at farmers' field in Hisar district of Haryana. The physicochemical properties of experimental field sown with mustard were pH 8.5, EC 0.26 dS m^{-1}, OC 0.52%, $CaCl_2$ extractable S was 7.5 mg kg^{-1} and loamy sand in texture. In chickpea field experiment, the pH of soils was 8.6, EC 0.13 dS m^{-1}, OC 0.22%, $CaCl_2$ extractable S was 7.5 mg kg^{-1} and sand in texture. Sulphur was applied @ 0, 20, 40 and 60 kg ha^{-1} through gypsum as basal application. Mustard (var. RH 30) and chickpea (var. HC-7) were used as test crops and allowed to grow up to maturity. Result indicated that the seed yield of mustard and chickpea increased consistently with each level of S application. However, as per BC ratio, basal application gypsum @ 40 kg ha^{-1} in mustard and 20 kg ha^{-1} in chickpea crop was found to be more economical and optimum doses.



Plate 3.1.3b Frontline demonstrations

3.1.4 Promotion of Conservation Agriculture Machinery for Major Crops in Vertisols

Conservation agriculture machines like slit- till-drill (T1), mulcher -cum-seeder (T2), residue cleaner-cum-seeder/conservation seeder (T3) were tested for direct sowing of maize (Variety NathSamrat- 1144), wheat

(HI-1544) and moong (Varity PDM- 139) at research farm of ICAR-CIAE, Bhopal and compared with commercially available happy seeder as control (C) in full residue condition during 2024.The assessment is based on the crop yield, cost of operation and energy expenditure. The maize yield (NathSamrat- 1144) was 4.13 (T1), 4.12 (T2), 4.10 (T3) and 3.70 (C), tonne/ha. Wheat yield (HD CSW- 18) was 4.18 (T1), 3.85 (T2), 3.66 (3), 3.80 (C), tonne ha^{-1} and green gram yield (PDM-139, Samrat) was 0.54 (T1), 0.56 (T2), 0.41 (3), 0.52. (C), tonne ha^{-1}. The tractor-drawn CA machinery for slit-till drill, mulcher-cum seeder, residue cleaner-cum-seeder, and happy seeder required 45, 55, 45, and 60 hp, respectively. The field capacity was 0.62, 0.61, 0.65, and 0.76 ha^{-1} for their respective treatments. The cost of operation was 717.16, 899.43, 690.5, and 988.0Rs/ha; and energy expenditure was 23438.84, 23475.06, 23415.07, and 23529.37 MJ ha^{-1}, for their respective treatments. To popularize the suitable CA machinery among the stakeholders through various skill development programs and to build the confidence of farmers for adoption of machinery, the institute developed technology (Slit till drill) was demonstrated in various villages (08 farmer's field) for sowing of wheat in irrigated field after harvesting of paddy crop. The crop germinated was satisfactory and farmers were happy with saving in operational cost.



Slit-till drill | Mulcher-cum-seeder | Conservation seeder | Turbo happy seeder

Field experiment with four machine

Demonstration of Best-Bet Conservation Agriculture Practices on Farmers' Fields in Vertisols of Central India

Farmers field experiments were conducted in a participatory mode in adopted villages *viz.*, Khamkheda, Raslakhedi, Raipur and Karodkhurd using soybean (JS 2029), wheat (HI 1544) and chickpea (RVG 202) as test crops to evaluate the different crop establishment techniques such as zero tillage (ZT), reduced tillage (RT) and conventional tillage (CT) at 40 farmers field during kharif and rabi season of 2024-25. The standard agronomic protocols were followed to raise the crops at farmers' fields at different villages. Besides, the recommended herbicides were adopted under different treatments to check the growth of weeds.



General view of farmers' field during sowing operation

Crop – Soybean

Farmers field experiments were conducted in a participatory mode in adopted villages *viz*., Khamkheda, Raslakhedi, Raipur and Karodkhurd using soybean (JS 2029) as test crop to evaluate the different crop establishment techniques such as zero tillage (ZT), reduced tillage (RT) and conventional tillage (CT) at 40 farmers field during kharif season of 2024. All the recommended agronomic practices were followed as per technical details. Average data revealed that zero tillage recorded higher grain and biological yield of soybean at most of farmers' fields as compared to reduced and conventional tillage. However, reduced and conventional tillage also improved the grain and biological yield of soybean at some farmer's field as compared to zero till farming.





Crop-Wheat

Wheat crop was raised in participatory mode under CRP on CA at different farmers' fields (24 demonstrations) in adopted villages. Growth and yield parameters were recorded in wheat crop in different farmer's field under different tillage practices.





Grain yield of wheat was recorded under different tillage practices at participatory and results revealed that the higher grain yield was observed under zero tillage at most of the farmer's field. However, some farmers recorded higher yield under reduced and conventional tillage as compared to zero tillage. Furthermore, the mean data of wheat revealed that zero tillage recorded higher grain yield (4850 kg ha^{-1}) of wheat as compared to reduce tillage and conventional tillage. The higher harvest index was recorded under reduced tillage (47.1) at most of farmer's field as compared to zero tillage (44.32) and conventional tillage (44.51).

Crop – Chickpea

Under chickpea, fourteen (14) field demonstrations were conducted during rabi season at different farmers' fields in adopted villages *viz*., Khamkheda, Raslakhedi, Raipur and Karodkhurd using RVG 202 variety of chickpea under conservation agriculture in participatory mode. The chickpea yield was also recorded at different field experiments in participatory mode under CRP on CA. The higher grain yield of chickpea was recorded under reduced tillage which is more or less similar to zero tillage, however, lower grain yield of chickpea was noticed under conventional tillage practices at farmers' fields.





3.2 Capacity building programs

Various activities were organized under the Swachhta Action Plan (SAP) project in different villages by involving farming community, members of the civil society and dignitaries. Farmers were made aware to eliminate open defecation and efficient crop residue management without burning. Various events organized at;

S. No	Name of Village/ Event	No. of participants	Date
1	ICAR-IISS Bhopal	60	05.06.2024
2	Ratanpur, Bhopal	65	28.08.2024
3	ICAR-IISS Bhopal	50	17.09.2024
4	ICAR-IISS Bhopal	70	18.09.2024
5	ICAR-IISS Bhopal	60	19.09.2024
6	ICAR-IISS Bhopal	50	20.09.2024
7	ICAR-IISS Bhopal	15	22.09.2024
8	ICAR-IISS Bhopal	15	23.09.2024
9	ICAR-IISS Bhopal	25	24.09.2024
10	Deshna Public school, Karond, Bhopal	30	26.09.2024
11	ICAR-IISS Bhopal	10	27.09.2024
12	Barkhedi Hajjam, Bhopal	20	29.09.2024
13	Chopra Kala, Bhopal	10	30.09.2024
14	ICAR-IISS Bhopal	20	01.10.2024
15	Kalakhedi, Bhopal	60	02.10.2024
16	ICAR-IISS Bhopal	60	16.12.2024
17	ICAR-IISS Bhopal	25	17.12.2024
18	ICAR-IISS, Bhopal	30	18.12.2024
19	ICAR-IISS, Bhopal	25	19.12.2024
20	ICAR-IISS, Bhopal	20	20.12.2024
21	Khajuri, Bhopal	15	21.12.2024
22	ICAR-IISS, Bhopal	60	22.12.2024
23	Khajuri, Bhopal	100	23.12.2024
24	ICAR-IISS, Bhopal	65	24.12.2024

25	ICAR-IISS Bhopal	10	25.12.2024
26	ICAR-IISS, Bhopal	30	26.12.2024
27	ICAR-IISS Bhopal	20	27.12.2024
28	ICAR-IISS Bhopal	15	28.12.2024
29	ICAR-IISS Bhopal	10	29.12.2024
30	Raipur, Bhopal	25	30.12.2024
31	ICAR-IISS, Bhopal	20	31.12.2024

Drone demonstration A field-day demonstration of pesticide application through drones was demonstrated on August 16, 2024 amongst the farmers of Momanpur. Demonstrated the drone technology to the SIAET trainee (State department extension officials) on September 18, 2024.



The institute organized a five days training program on "Climate Resilient Agriculture through Regenerative Farming Practices" under NICRA Project from February 27 to March 2, 2024.

Input distribution Under Farmer FIRST project

Kadaknath chicks were distributed to farmers of Berkhedi Hajjam on January 31, 2024 and the Farmer FIRST team organized PRA at Khajuri Village under FFP on March 18, 2024.



3.3. Tribal Sub-Plan/Scheduled Tribe Component

3.3.1 Enhancement of Soil Health and Livelihood of Tribals in Central India:

Enhancement of Soil Health and Livelihood of Tribals of Barwani District in Madhya Pradesh

Under project of Enhancement of Soil Health and Livelihood of Tribals of Barwani District in Madhya Pradesh, the agricultural inputs like seeds (soybean, wheat and chickpea) and planting material (drumsticks) and vermicompost packets were distributed to the tribal farmers in different blocks of Barwani district under STC project during 2024. The field demonstration trials were conducted in different at tribal farmer's field to see the effect of improved practices over farmers' practices. Under improved Practice, Improved variety and balanced recommended dose of fertilizers were used and for Farmers' practices, the local variety and imbalance nutrient dose of fertilizer were used. The crop yield of wheat, chickpea and soybean increased 18.4 to 41.0 %. higher under improved practices over farmer's practice.

Table 1 Frontline demonstrations in year 2024 under TSP project in Barwani District of Madhya Pradesh

Name of crops	No of Field Trials	Improved Practices(IP) Average crop yield	Farmers Practices (FP)Average crop yield under	Change in yield (%) over FP
Wheat	25	4960 kg ha^{-1}	3990 kg ha^{-1}	24.4%
Chickpea	24	1640kg ha^{-1}	1380 kg ha^{-1}	18.4%
Soybean	50	1716kg ha^{-1}	1312 kg ha^{-1}	41.0%

Training and Capacity Building

Training on soil health management and agricultural input distribution programme organized by Indian Institute of Soil Science, Bhopal at KVK Barwani on

February 7-8, 2024 under TSP project (Dr. R.K. Singh, Dr Jitendra Kumar, Asit Mandal, Dr Dhiraj Kumar and Dr S.K. Badodiya, Inchrge, KVK, Barwani).About 45 tribal farmers were participated in one day training programme from different villages of Barwani district. At the end of programme, the vermicompost packets and drumsticks planting material were distributed to the tribal farmers.





Training on soil health management and agricultural input distribution programme organized by Indian Institute of Soil Science, Bhopal at KVK Barwani on June 25, 2024 under TSP project (Dr Jitendra Kumar, Dr Abhinash Das, Dr Khushaboo Rani and Dr S.K. Badodiya, Inchrge, KVK, Barwani). About 50 tribal farmers were participated in one day training programme from different villages of Barwani district. At end the programme, the vermicompost packets and drumsticks planting material were distributed to the tribal farmers.





Training on soil health management and agricultural input distribution programme organized by Indian Institute of Soil Science, Bhopal at KVK Barwani on November 10, 2024 under TSP project (Dr Jitendra Kumar, Dr Dhiraj Kumar, Dr Rahul Mishra and Dr S.K. Badodiya, Incharge, KVK, Barwani). About 60 tribal farmers were participated in one day training programme from different villages of Barwani district. At the end of programme, the wheat and gram seeds were distributed to the tribal farmers.

Soil fertility status of different blocks of Barwani district

The soil samples from 0-15 cm soil depth were collected from different blocks of barwani dictrict under TSP project. The soil fertility status of different blocks are given below:

Table 2 - Soil fertility status of different blocks of Barwani district

	Soil pH	Soil EC (dS/m)	SOC (%)	Available N (kg ha^{-1})	AvailableP (kg ha^{-1})	Available K (kg ha^{-1})
Block: Barwani (No of samples - 40)						
Min.	6.74	0.078	0.31	50.2	2.20	130
Max.	8.35	1.440	1.95	326.1	160.0	1342
Mean	--	0.280	0.86	157.1	36.2	544
Block: Rajpur ((No of samples - 24)						
Min.	6.84	0.087	0.23	50.0	1.10	65
Max.	8.22	0.460	1.86	238.2	92.0	975
Mean	--	0.220	0.68	159.4	30.9	317
Block: Sendhwa (Nos of samples- 18)						
Min.	6.32	0.081	0.15	112.9	8.27	71
Max.	8.10	0.324	1.29	225.8	161.57	375
Mean	--	0.224	0.83	155.4	39.24	163
Block: Verla (No of samples-15)						
Min.	6.68	0.170	0.63	138.0	12.7	68
Max.	7.97	0.864	1.31	188.2	183.5	535
Mean	--	0.317	0.98	162.4	38.0	204

3.3.2 Enhancement of Soil Health and Livelihood of Tribals in Central India (Chhattisgarh)

Workshop cum training on Soil Health and Plant Nutrient Managementat Rajnandgaon district of Chhattisgarh

ICAR- Indian Institute of Soil Science, Bhopal (M.P.) organized workshop cum training and Input distribution during 11-12 November 2024 at KVK Surgi, Rajnandgaon district, Chhattisgarh. Shri Sanjay Agarwal, District Collector Rajnandgaon graced the occasion as Chief Guest and interacted with the farmers on various aspects of livelihood improvement. Ms Suruchi Singh, Chief Executive Officer, Rajnandgaon district presided over the occasion and encouraged the farmers to avail the government schemes. Dr. Pratibha Katiyar, Professor, IGKV, Raipur, Dr. S. K. Singh, IFFCO, Raipur, Dr. Gunjan Jha, Senior Scientist & Head, KVK, Dr. Vinamarta Jain, Professors, College of Agriculture, Rajnandgaon and Dr. Nageswar Pandey, Deputy Director Agriculture participated in the program. During this occasion, 12.6 quintal chickpea and 70 kg cowpea seeds were distributed to tribal farmers. The workshop cum training on Soil Health and Plant Nutrient Management was addressed by the team of ICAR-IISS, Bhopal comprising Dr. R. Elanchezhian, Dr. M. Vassanda Coumar, Dr. Nisha Sahu, Dr Narayan Lal and Dr Dinesh Kumar Yadav. On 12 November 2024, an On-Farm training was conducted at Malpuri village, Rajnandgaon district, where tribal farmers participated. The scientific team of IISS Bhopal visited the on farm-demonstrations and emphasized the importance of soil health and modern techniques in crop production for enhancing farm income and livelihood. The events were given a wide coverage in the local press and media.





Krishi Mela cum Workshop on Natural Farming at KVK Surgi, Rajnandgaon district, Chhattisgarh

Inputs supplied:

Seed packets of 12.6 quintal of chickpea and 70 kg of cowpea were distributed to tribal farmers of Rajnandgaon district, Chhattisgarh to improve the seed replacement ratio with high yielding chickpea and cow pea varieties and balanced nutrient management for maintaining soil health.





3.4 Enhancing Livelihood Security of Subsistence Farming Community through Improvement in Soil Health, Crop Productivity and Capacity Building in Madhya Pradesh under SCSP

A study was conducted under SCSP sub plan to enhance the livelihood security of subsistence farming community. Sixteen villages were selected under four clusters. During year 2024, the following agricultural inputs like seeds, fertilizer and other implements were distributed to the scheduled caste (SC) category in different villages of Bhopal district.

A. Distribution of agri-inputs to the farmers under the SCSP Project

Various inputs have been provided to farmers of the community for easing out their agricultural expenses as per direction from government. A brief detail is given in the Table 1.

Table 3 - Details of Agricultural inputs under SCSP project

Items	Quantity	Amount spent (Rs.)	No. of Beneficiaries
Soybean	10 Quintals	89000	33
Maize	3 Quintals	67500	15
Wheat	30 Quintals	115500	75
Gram	19.8 Quintals	154440	66
Urea	200 bags	53300	200
NPK mixture (12:32:16)	200 bags	294000	200
Garden rake	524 Nos.	211696	524
Single wheel cycle hoe	180 Nos.	463500	180
Back carrying power sprayer	44 Nos.	109252	44

B. Training organized under SCSP

Various trainings have been conducted to farmers of the community for creating awareness about management of soil health, preparation of vermicompost and crop residue management. A brief detail is given in the Table 2.

Table 4 - Details of organized training under SCSP project

S. No.	Topic	No. of Participants	Date
1	Soil Health Management and Vermicompost Preparation	83	21.02.2024
2	Soil Health Management and Vermicompost Preparation	56	22.02.2024
3	Soil health and Women Empowerment	27	07.03.2024
4	Soil Health Management and Crop Residue Management	33	15.03.2024
5	Soil Health Management and Vermicompost Preparation	27	18.07.2024
6	Soil Health Management and Vermicompost Preparation	28	05.08.2024

Demonstration at farmer's field

The field demonstration trials were conducted under SCSP sub plan at adopted farmers' fields. Under field demonstration trials, the three interventions like integrated nutrient management, recommended dose of fertilizer (RDF) and farmers practices (FP) were tested. Maize and soybean were grown in kharif season. Grain yield of soybean and maize was higher under integrated nutrient management (INM) and Recommended dose of fertilizer (RDF) over Farmers practices (FP). The grain yield of soybean and maize is given in Table 3.

Table 5 - Effect of INM, RDF and FP interventions on grain yield of soybean and maize crop

S. No.	Name of farmers	Name of Village	Soybean grain yield (q/ha)			Maize grain yield (q/ha)		
			INM	RDF	FP	INM	RDF	FP
1	Shri Narayan Singh	Nipaniya Sukha	16.5	15.0	13.5	48.2	42.9	41.7
2	Shri Laxmi Bai	Nipaniya Sukha	18.0	16.5	14.0	46.7	47.7	43.6
3	Shri Ramesh	Ratatal	18.5	15.0	13.0	49.8	46.8	43.9
4	Shri Charan Singh	Ratatal	20.0	17.0	16.5	48.5	46.2	43.4
5	Shri Phul Singh	Chanderi	19.5	16.0	14.5	48.2	45.8	43.1
6	Shri Durga Prasad / Uka Prasad	Agariya	21.1	20.2	20.5	52.2	49.4	43.5
7	Shri Gopal /Prem Narayan	Agariya	20.4	19.8	18.5	55.0	51.2	46.0
8	Shri Kailash/Uka Prasad	Agariya	20.8	20.6	19.4	57.5	50.6	37.5
9	Shri Narvada Prasad/ Shayam Lal	Agariya	21.1	20.5	20.4	58.5	54.0	48.9
10	Shri Shriram/Rammu Lal	Agariya	20.2	20.0	19.8	55.0	52.8	49.7
11	Shri Nirbhay Singh	Prathvipura	19.0	16.5	14.8	56.0	50.0	46.0
12	Shri Phul Singh Ahirwar	Prathvipura	16.2	15.2	15.2	58.5	55.0	52.0
13	Shri Kamalesh	Guradiya	18.5	16.2	18.0	53.0	48.5	46.0
14	Shri Bhero Singh	Guradiya	14.5	13.5	13.2	55.0	52.0	49.0
15	Shri Hirdesh Ahirwar	Gunga	17.0	15.5	15.0	57.0	54.5	50.0
16	Shri Babalu	Barkhedihajjam	19.0	16.5	16.5	63.0	42.0	41.7
17	Shri Karan Singh	Hinotiyajagir	16.0	15.1	13.0	52.1	41.0	40.1
18	Shri Prem Narayan	Hinotiyajagir	18.0	16.0	11.0	54.0	52.0	44.0
19	Shri Jaiky Silavat	Rassuliapathar	14.3	13.5	13.2	62.0	58.0	48.0
20	Shri Jagannath	Berkhadi	17.0	15.0	16.0	56.6	54.0	44.2
		Min. Yield	14.3	13.5	11.0	46.7	41.0	37.5
		Max. Yield	21.1	20.6	20.5	63.0	58.0	52.0
		Average yield	18.1	16.5	15.6	54.0	49.3	44.8






Distribution of agri-inputs to the farmers under SCSP project

Fertilizers and seeds of Soybean and Maize in June were distributed to the farmers of different village of Bhopal district under SCSP project. In November distributed Wheat and Chick Pea seed. Besides, under SCSP activity successfully distributed vermicompost to 25 SCSP farmers of four villages (Ratatal, NipaniyaSukha, Kardai, Chanderi) during July 9-15, 2024.

Under SCSP activity successfully distributed IISS vermicompost to 26 SCSP farmers of four villages (Jagdishpur, Mugaliyakot, Chhapar, Agariya) on July 18, 2024. Also, Drs Dhiraj Kumar, Rahul Mishra and Abinash Das organized training cum agricultural inputs distribution programme at KVK Barwani (M.P.) during November 9-10, 2024 for 55 tribal farmers of Barwani district of Madhya Pradesh.






Demonstration of Nutrient management technology in the farmer's field.

A total of 17 demonstrations on balanced use of fertilizers and integrated nutrient management were taken during the rabi season from October 2024 to March 2025 demonstrations on wheat and chickpea under SCSP at farmers fields in Agaria, Chapar, Magalia kot and Jagdishpur villages.





Farmers training program at Gunga village under SCSP project

Drs. Ajay, Abhijit Sarkar and Dinesh Kumar Yadav have organized a farmers training program under SCSP Program on February 22, 2024 at Gunga village of Bhopal district. In this program, farmers were urged to keep village open defection free, maintain the village clean, adoption of conservation agriculture to avoid burning the crop residue for environmental safety and soil health, convert farm waste to vermicompost and compost. Also, Drs. Ajay, AK Tripathi, Abinash Das and MH Devi organized awareness program on March 18, 2024 at Nipaniya Sukha village, Bhopal under SCSP project.





Training on "Use of vermicompost for soil health management" was conducted on July 18, 2024, under the SCSP program, in which a total 30 farmers participated. In this program, vermicompost and spray pumps were also distributed to the farmers. A Kisan Sangosthi and input distribution program was organized at ICAR- IISS, Bhopal on March 6, March 7, May 30 and May 31, 2024 for SC farmers (SCSP) under CRP on CA.

Input Distribution under CA

Input distribution program was organized under Demonstration of Best-Bet Conservation Agriculture Practices on Farmers' Fields in Vertisols of Central India (CRP on CA). Urea (30 bags), DAP (30 bags) and soybean, wheat and chickpea seeds were also distributed among the adopted villages to demonstrate the CA practices in participatory mode. Also,Vermibed were distributed at adopted villages under SAP project.





Distributed of Vermicompost (4.0 tonne), plant seedlings of mango (150), Guava (150) and Lemon (110) and farm implements like two wheel hoe (15) among SC farmers under CRP on CA.

Kisan sangosthi and input distribution programm was organised at ICAR- IISS, Bhopal on March 6, March 7, May 30 and May 31, 2024 for SC farmers (SCSP) under CRP on CA.

Input distribution was done (wheat seed- 480 kg, chickpea seed 240 kg, fertilizers NPK (12:32:16) 20 bags and herbicides- glyphosate (10 liter), paraquat (10 liter under) at adopted villages under demonstration of Best-Bet Conservation Agriculture Practices on Farmers' Fields in Vertisols of Central India project under CRP on CA.









Radio Talk/TV Programme

Dr. Asha Sahu gave talk on "मिट्टी परीक्षण की सही विधि एवं उसका महत्व" to Prasaar Bharti Akashvani, Bhopal on May 2, 2024.



Mera Gaon Mera Gaurav (MGMG) Activities

Under MGMG, various team members visited adopted villages periodically, interacted with the farmers and discussed about their agricultural activities and related problems.

Adopted Villages under MGMG by the Institute

Group	Members	Name of five villages adopted by Group Leader
1.	Dr. S.P. Datta Dr. Sudeshna Bhattacharjya Dr. NishaSahu, Dr. Narayan Lal,	Dobra, Khejra, Perwalia Sadak, Badarkha Sadak, Mubarakpur
2.	Dr. R. Elanchezhian, Dr. P. Tripathi Dr. N.K. Sinha Dr. Abinash Das	Acharpura, Parewakheda, Arwali, Hazampura and ParewaliaSahani
3.	Dr. S.R. Mohanty Dr. R.H. Wanjari, Dr. R.K. Singh, Dr. K. Bharati, Dr. Seema Bhardwaj	Choupdakala, Ghatkheri, SayyaidSemara, Emaliya Chopra and Amoni
4.	Dr. J.K. Saha Dr. Sanjay Srivastava Dr. Madhumounti Saha Dr. Dinesh Kumar Yadav Dr. Alka Rani	Islam Nagar, Dewalkhedi, Bharonpura, Kalyanpura, Puraman Bhavan
5.	Dr. S.K. Behera Dr. Dhiraj Kumar Dr. K.C. Shinogi	Bankhedi, Baroda, Sojna, Amaravadi and Kuravadi
6.	Dr. Pramod Jha Dr. J.K. Thakur	Sagoni, Munirgarh, Gudawal, Chhattarpura, Chiklodkhurd
7.	Dr. A. K. Biswas Dr. Bharat P. Meena Dr. Khushboo Rani	Golkhedi, Binapur, Kanchbavli, Khamkheda and Raslakhedi
8.	Dr. R.S. Choudhary Dr. Abhijit Sarkar Dr. Jitendra Kumar Dr. Asha Sahu	Raipur, Kanera, Momanpur, Kadhaiya and Karodkhurd
9.	Dr. N.K. Lenka, Dr. M. Vassanda Coumar Dr. Immanuel Chongboi Haokip	Ratibad, RasuliyaPathar, Mugaliahat, RatanpurSadak, Chandukhedi
10.	Dr. A.K. Tripathi Dr. Rahul Mishra Dr. Mayanglambom Homeshwari Devi	Dobra Jagir, KoluaKhurd, Sagoni Kalan, ChorSagoni, AdampurChhawni
11.	Dr. Ajay Dr. Tapan Adhikari Dr. Sangeeta Lenka Dr. Asit Mandal	Shahpur, Devpur, KasiBarkeda, Sagoni, and BarkediHajam

4. Training and Capacity Building

4.1. Training Attended by Staffs

A. Participation in Training (Category-wise)

S. No.	Category	No. of employees undergone training during 2024
1	Scientist	21
2	Technical	1
3	Administrative & Finance	0
4	Skilled Supporting Staff	0
Total		**22**

B. HRD fund allocation and utilization (Rs. in Lakhs April 2024 to March 2025)

S.No.	RE for HRD	Actual Expenditure for HRD
1.	3.63425	3.63425

C. Training attended during January to December 2024
C1 Category: Scientific staff

S. No.	Name of employee	Title	Organizer/Venue	Duration
1.	Dr Sanjay Srivastava, Dr R Elanchezhian, Dr Pramod Jha, Dr M Vassanda Coumar, Dr Asha Sahu, Sudeshana Bhattacharjya, Dr M Homeshwari Devi and Dr Narayan Lal	AgrIP 2024 short course on Patents	Online, IP&TM Unit, ICAR, New Delhi and Zonal Technological management-Agribusiness Incubation centre, ICAR-CIFT, Kochi	January 15 - February 15, 2024
2.	Dr Abinash Das	Advanced Forecasting Techniques in Agriculture Science Research	ICAR-IASRI, New Delhi	January 24, 2024 to February 13, 2024
3.	Dr. Immanuel C. Haokip,	Development of Al based Android Application in Agriculture	ICAR-IASRI, New Delhi	March 5-25, 2024
4.	Drs Tapan Adhikari, NK Lenka, SR Mohanty SK Behera	Management Development Program (MDP)	ICAR-NAARM, Hyderabad	June 3-14, 2024
5.	Dr Nisha Sahu	Building Climate Resilient Agricultural Systems through community-based approaches	ICAR-IISS & MANAGE	June 10-14, 2024

6.	Drs RH Wanjari, Asit Mandal, Asha Sahu, Nisha Sahu, Dhiraj Kumar, Narayan Lal, Abhijit Sarkar, DK Yadav, Khushboo Rani, Abinash Das	IP Awareness Week	IP& TM Unit, ICAR, New Delhi & ICAR-IISWC, Dehradun	June 12-19, 2024
7.	Drs K Bharati, MadhumontiSaha	Mission LiFE – Life Style for Environment"	IIFM, Bhopal	July 8 – 11, 2024
8.	Drs Asit Mandal, JK Thakur	Microbial community analysis using metabarcoding techniques and plastic analysis	Bangor University, UK	July 22-26, 2024
9.	Drs.Abinash Das, Khushboo Rani	Multivariate Data Analysis using R	Online, ICAR-NAARM, Hyderabad	July 22-26, 2024
10.	Dr. Seema Bhardwaj	Online training programme under National Intellectual property Awareness Mission	Intellectual property office, India	August 9, 2024
11.	Dr JK Thakur	Sustainable and Green Finance	IIFM, Bhopal	September 2-4, 2024
12.	Dr Narayan Lal	IP Awareness/ Training program under National intellectual property awareness mission	Intellectual Property Office, India	October 18, 2024
13.	Dr Pramod Jha	Pay fixation, E-waste disposal and leave rules	Institute of Secretariat Training and Management	December 19, 2024
14.	Dr Pramod Jha	APAR	Institute of Secretariat Training and Management	December 20, 2024
15.	Dr Pramod Jha	Yoga Break at workplace	Morarji Desai National Institute of Yoga	December 20, 2024
16.	Dr Pramod Jha	Prevention of sexual harassment of women at workplace, Decision making and Introduction to E office-BSNL	Institute of Secretariat Training and Management	December 31, 2024

C2 Category: Technical staff				
S.No.	**Name of employee**	**Title**		
1	Shri SK Parihar	IP Awareness Week	IP&/TM Unit, ICAR, New Delhi & ICAR-IISWC, Dehradun	June 12-19, 2024
C3 Category: Administrative & Finance				
S.No.	**Name of employee**	**Title**		
1	-	-		

4.2. Professional Attachment Training organized for Scientist Probationers: Nil

4.3. Research Guidance for Degree Students

S. No.	Name of the Student	Name of the College/Institute/ University	Degree	Name of the Guide/Co-Guide
1	Miss Komal Agrawal	RVSKVV, Gwalior (MP)	Ph.D	Dr Kollah Bharati
2	Mr Rakesh	RVSKVV, Gwalior (MP)	Ph.D	Dr Santosh R Mohanty
3	Mr Shubham Singh	RVSKVV, Gwalior (MP)	Ph.D.	Dr Asit Mandal
4	Miss Soniya Sisodiya	R.A.K College of Agriculture Sehore, RVSKVV, Gwalior (MP)	M.Sc.(Ag.) SSAC	Dr Sudeshna Bhattacharjya
5	Mr Girraj Dhakad	RVSKVV, Gwalior (MP)	M.Sc.	Dr Khushboo Rani

4.4 Training imparted to the farmers/Extensions officers/Students/Visits

Name of the Scientist	Event	Date	Venue	Beneficiary
Dr. Asha Sahu	Trainee visit	January 8, 2024	ICAR-IISS, Bhopal	25 trainees of "Agri-Clinic & Agri-Business Centre Scheme from Indo-European Chamber of Commerce and Industry nominated by MANAGE, Hyderabad
Dr. Asha Sahu	Educational tour	January 9, 2024	ICAR-IISS, Bhopal	70 B.Sc. (Ag.) students of Shri Vaishnav Institute of Agriculture, Indore
Dr. Asha Sahu	Training on Economic Empowerment of Small and Marginal Farmers through Backyard Poultry Farming	January 19,2024	ICAR-IISS, Bhopal	40 farmers from Khajuri and Barkhedi village under Farmer FIRST project
Dr. Khushboo Rani	Student visit	January 30, 2024	ICAR-IISS, Bhopal	Students (15) of Saheed Bhagat Singh Government Degree college, Asta, Sehore, M.P.

Dr. Asit Mandal	Training cum input distribution and field day	February 7-8, 2024	Barwani district, M.P.	100 tribal farmers under TSP
Dr. Asha Sahu	Training on Vermicomposting: Efficient way to enhance soil health	February 9, 2024	ICAR-IISS, Bhopal	50 girls students of Gitanjali Girls College
Dr. Khushboo Rani	Awareness programme on sustainable agricultural practices and available institute technologies	February 22, 2024	ICAR-IISS, Bhopal	Farmers of Gunga Village of Bhopal under SCSP & MGMG village
Dr Khushboo Rani	Training cum exposure visit of women farmers on "Recycling of Agri-waste"	March 7, 2024	ICAR-IISS	Women farmers
Dr Khushboo Rani	Visit of Agri Input Distributors	March 12, 2024	ICAR-IISS	Agri Input Distributors under KVK, Atma (Raisen), M.P.
Dr. Abinash Das	Awareness programme on sustainable agricultural practices and available institute technologies	March 18, 2024	ICAR-IISS, Bhopal	Farmers of Nipaniya Sukha village of Bhopal Dist. under SCSP &MGMG village
Dr BP Meena	Training & Exposure visit	April10, 2024	ICAR- IISS, Bhopal	Representatives of FPOs
Dr. JK Thakur	Training on Organic farming and Composting demonstration	May 21, 2024	IISS, Bhopal	25 trainees from Narmada samagra NGO, Narmadapuram
Drs Asha Sahu, Khushboo Rani Abinash Das, Nisha Sahu	Student visit	June 4, 2024	ICAR-IISS, Bhopal	80 UG Agri students of Sam Global University, School of Agricultural Sciences, Raisen and Plant Research, Development and Training centre, Bhopal
Drs. Khushboo Rani, Abinash Das	Training cum agricultural inputs distribution	June 25, 2024	ICAR-IISS, Bhopal	Tribal Farmers at KVK Barwani (MP)
Drs. SR Mohanty, Asit Mandal, J K Thakur, Asha Sahu, S Bhattacharjya, K Bharati, Abinash Das and M Homeshwari Devi	Training on Soil Nutrient and Biological Health Management for Millets Production	June 26-30, 2024	ICAR-IISS, Bhopal	38 farmers from ATMA Kaimur, Bihar
Dr. Asha Sahu	Visit of Input Dealers	July 12, 2024	ICAR-IISS, Bhopal	25 Agricultural Input Dealers under DAESI Diploma sponsored by ATMA, Raisen
Dr. Asha Sahu	Training on Soil health and Vermicomposting	July 15, 2024	ICAR-IISS, Bhopal	25 SCSP farmers

Drs. Khushboo Rani, Abinash Das	Visit of students	July 25, 2024	ICAR-IISS, Bhopal	Trainees of Sagar Institute of Research, Technology & Science - Pharmacy, Bhopal
Dr. Asha Sahu, Dr. Sudeshna Bhattacharjya, and Dr. Abinash Das	Visit	July 29 - August 1, 2024	ICAR-IISS, Bhopal	50 Farmers and officers from ATMA Shivpuri
Dr Khushboo Rani	Visit for Sagar B Pharma student	September 10, 2024	ICAR-IISS	Students
Dr. J K Thakur	Training cum visit at IISS	September 13, 2024	IISS Bhopal (Organized by SIAET)	25 trainee cum visit RAEO on Organic farming, composting and soil health
Dr. Asha Sahu, Dr. Sudeshna Bhattacharjya, Dr. Nisha Sahu, Dr. Madhumonti Saha	Student visit in Soil Biology Division	September 20, 2024	ICAR-IISS, Bhopal	80 students of class X from Sagar Public School, Gandhi Nagar, Bhopal and 20 students of MSB Educational Institute, Bhopal
Dr Sudeshna Bhattacharjya, Dr Mayanglambam Homeshwari Devi, Khushboo Rani and Dr Abinash Das	Student visit in Soil Biology Division	October 8, 2024	ICAR-IISS, Bhopal	60 students of B.Sc. (Hons) Agriculture of RKDF University, Bhopal
Drs Dhiraj Kumar, Rahul Mishra and Abinash Das	Training cum agricultural inputs distribution programme	November 9-10, 2024	ICAR-IISS, Bhopal	Tribal Farmers of Barwani District
Drs KC Shinogi, Immanuel C Haokip	Farmers Scientist Interaction meeting	December 3, 2024	ICAR-IISS, Bhopal	Farmersunder FARMERS FIRST project
Dr BP Meena	Farmers- Scientists Interface Meeting	December 4, 2024	ICAR-IISS, Bhopal	Farmers- Scientists Interfaceat Ratibad, Bhopal, under SAP project
Dr Khushboo Rani	Sudent visit	December 9, 2024	ICAR-IISS	Students (15) of JNCT Professional University, Bhopal
Miss Aditi Agrawal	Technology and field demonstration	December 12, 2024	ICAR-IISS, Bhopal	40 farmers from Sohagpur and Pipariya organized by ATMA
Dr Khushboo Rani	Sudent visit	December 13, 2024	ICAR-IISS	Students (40) of Sagar Public School, Bhopal

Dr Asit Mandal, Madhumonti Saha, Alka Rani and Mr Prashant Gour	Essay competition for SwachhataPakhwada on the theme "Cleanliness of nature, cleanliness of culture	December 23-31, 2024	ICAR-IISS, Bhopal	Among the school students of St. George. Sr. Sec. Co-Ed School and Red Rose Co-Ed School of Bhopal
Dr. Asha Sahu, Dr. Sudeshna Bhattacharjya, Dr. Khushboo Rani, Dr. Madhumonti Saha, Dr DK Yadav	Visit and tour of ICAR-IISS, Bhopal	December 18, 2024	ICAR-IISS, Bhopal	60 Students from Rajkiya Madhyamik Vidyalayas, Lalitpur, Uttar Pradesh
Dr. J.K. Thakur	Composting demonstration and organic-natural farming field visit	December 20, 2024	ICAR-IISS, Bhopal	60 farmers and input dealers from Hoshangabad (Pipariya) and Rajgarh
Dr. Aditi Agrawal	Conducted technology and field demonstration at ICAR-IISS, Bhopal	December 22, 2024	ICAR-IISS, Bhopal	30 farmers from SeoniMalwa and Narmadapuram under Rajya ke andar krishak bhraman organized by ATMA
Drs. Asha Sahu, Khushboo Rani	Training programme on 'Crop Diversification and Soil Health Management	December 23-27, 2024	ICAR-IISS, Bhopal	27 Progressive farmers sponsored by Office of the Chief District Agriculture fficer (DEBADATTA CLUB), Bargarh, Govt. of Odisha
Drs. Sudeshna Bhattacharjya, Khushboo Rani	Visit	December 23, 2024	ICAR-IISS, Bhopal	25 students of B.Sc. (Biochemistry) from Motilal Vigyan Mahavidyalaya' Bhopal
Dr BP Meena	Kisan Diwas (Farmer's field Day) on the occasion of National Farmers Day at Rasuliya Pathar, Bhopal	December 23, 2024	ICAR- IISS Bhopal	60 farmers
Drs. Asit Mandal, Madhumonti Saha and Alka Rani	Writing for the students of St. George School and Red Rose Co-Ed School under Swachhta Pakhwada activity	December 23, 2024	ICAR- IISS Bhopal	Students

Dr Khushboo Rani	Visit of ICAR-IISS, Bhopal	December 30, 2024	ICAR-IISS	15 students (B. Tech) of Aanand Agricultural University
Dr BP Meena	Swachhta Pakhwada	December 16-31, 2024	ICAR-IISS, Bhopal	For farmers


















Agri-Clinics and Agri-Business Centres (AC&ABC) Scheme
Indo-European Chamber of Commerce and Industry






भा.कृ.अनु.प. -भारतीय मृदा विज्ञान संस्थान
ICAR-INDIAN INSTITUTE OF SOIL SCIENCE









Drs. K. Bharati, Asha Sahu, K.C. Shinogi visited Farmer training Centre, Vidisha and sensitized the DAESI students regarding advanced crop residue management techniques on December 13, 2024.





On December 17, 2024, Dr. Asha Sahu, Dr. Sudeshna Bhattacharjya and Dr. K. Bharati, led a Swachhta Awareness Day at ICAR-IISS, Bhopal. The event featured a one-day training program on "Converting Waste to Wealth" and "Safe disposal of all kinds of waste". Total 25 beneficiaries (20 men; 5 women) participated in the training program.





5. AWARDS, HONOURS AND RECOGNITIONS

Awards

- Drs. Nishant K Sinha, Monoranjan Mohanty, Pramod Jha, Dhiraj Kumar, Jitendra Kumar, Rahul Mishra, R.H. Wanjari, Prabhat Tripathi, Narendra Lenka and RS Chaudhary received Best Poster Presentation Award for the paper entitled "Modelling dynamics of soil organic carbon in response to climate change in different agro-ecosystems of India". Global Soils Conference (GSC) at the 88th Annual Convention of the Society at NASC Complex, New Delhi on 21st November 2024.
- Drs Tapan Adhikari and Sanjib Kumar Behera received the Fellowship of Indian Society of Soil Science during the Global Conference on Soil (November 19-22, 2024) organized ISSS, New Delhi on November 19, 2024.





- Dr. Nisha Sahu received Distinguished Women Scientist Award 2023-24 by SAATD, Uttarakand.
- Dr. Nisha Sahu received Global Young Scientist Award-2024 by Agricultural Technology Development Society (ATDS), Uttar Pradesh.
- Dr Dhiraj Kumar received "Eminent Scientist Award" in International Conference Cum Expo (NAHEP) 2024 organized by Commerce and Industry Development Foundation, Eco Fast Agri Solution and Bharti Media and Events Pvt. Ltd held at ICAR-CIAE, Bhopal during December 20-22, 2024.
- Drs Dhiraj Kumar, RH Wanjari, NK Sinha and Anil Nagwanshi received 1st Best Oral Presentation Award for the paper entitled "Long term effect of fertilizer and manure on soil quality and yield sustainability of maize-wheat cropping system in Inceptisols and Alfisols'. International Conference-cum-Expo (NAHEP), 2024 held at CIAE-Bhopal from December 20-22, 2024.
- Dr. Sanjib Kumar Behera received Fellowship of National Academy of Agricultural Sciences (NAAS), New Delhi



- Dr. Narayan Lal Honoured with Young Horticulturist Scientist Award by Society for Horticultural Research and Development, Ghaziabad, UP during 3rd Indian Horticulture Summit-Cum-International Conferences-2024 on Technological Intervention for Boosting Horticultural Production during February 1-3, 2024 at RARI, Durgapura, Jaipur, Rajasthan.
- Dr. Narayan Lal received Best oral presentation on Agri-horti systems for soil health Management during6th International Conference in Hybrid Mode on Innovative and Current Advances in Agriculture & Allied Sciences (ICAAAS-2024) July 15-20, 2024 at Hanoi, Vietnam.

- Dr. Narayan Lal received best oral presentation award on Allelopathic effect of fruit crops in agri-horti systems under vertisolsduring International conference on current Innovation and technological advances in agriculture and allied science during August 29-30, 2024 jointly organized BY Guru Kashi University & Talwandi Sabo and Just Agriculture Education Group & ISASTR, Noida.
- Dr. Narayan Lal received invited as External Expert for Conducting Viva-Voce test of students of M.Sc. Veg. Science/Fruit Science by Dr. B.R. Ambedkar University of Social Sciences, Indore, State University, Government of MP on September 23, 2024.
- Drs. Rangare NR, Lal N, Bisen S, Aarwe R, Bisen D, Kumar M, Fatehpuria PK, Bhhooriya MS and Kuldeep DK.2024. Patent Design on AI Based Robot for Fruit & Vegetable Sorting. Design Number: 418306-001. Dated: 29/05/2024.
- Drs. Rangare SB, Bahadur V, Maske G, Chandel SKS, Lal N, Yadav B, Tiwari S, Mishra A, Rangare NR. 2024. Patent Design on Multi-function Vegetable Cutting Machine. Design Number: 422089-001. Dated: 03/07/2024.
- Dr. B.P. Meena awarded IASWC Young Scientist Award by Indian Association of Soil and Water Conservationists (IASWC), Dehradun, Uttarakhand 248195 during National Conference on Living with Nature: Soil, Water & Society in Ecosystem Conservation (LNSWSEC-2024) during June 20-22, 2024.
- Drs. Shirale AO, Bharat Prakash Meena, Gurav Priya Pandurang, Sanjay Shrivastava, A. K. Biswas, R.K. Naitam, K. Karthikeyan, P.C. Moharana, M.S. Raghuwanshi, H. Biswas and A.K. Patra received Best Poster Presentation Award-2024 entitled "Characterization and Valorization of Indian Glauconitic shale as Slow-Release K Fertilizer" in the National Seminar on "Soil Ecosystem Services for Sustainable Agriculture (SESSA) at ICAR-NBSS & LUP Campus, Nagpur.



- Dr. K.C. Shinogi awarded Best Paper Award for the paper "Indigenous agriculture knowledge of tribal farmers in Madhya Pradesh for land resource management and sustainable food system" at the National Conference on Next Generation Agriculture-Organic and Natural Farming Pathways: Extension Strategies & Approaches, organized by International Society of Extension Education at ICAR-ATARI Jabalpur, Madhya Pradesh held during 28-30 January 2024.
- Dr.KC. Shinogi awarded Best Paper Award for the paper "Eco-friendly nutrient management interventions for improved yield and income from the tribal farmlands of Madhya Pradesh" at the National Seminar on Transformative agriculture and sustainable development: Rethinking agriculture for a changing world, organized by the Society for Community Mobilization for Sustainable Development (MOBILIZATION) New Delhi at Maharana Pratap University of Agriculture and Technology (MPUAT) Udaipur held during 05-07 March 2024.
- Shri Hem Raj Yadav received IARI Innovative Farmers Award -2024 at IARI, New Delhi on June 6, 2024 (under CRP on CA)



- Dr. RS Chaudhary was mentor to Swachhta Sarthi Fellows, in the office of Principal Scientific Advisor to PMO, GoI, New Delhi.
- Dr. Nishant K. Sinha was awarded the Eminent Scientist Award -2023 from the Society for the Science of Climate Change and Sustainable Environment on 24 August 2024, afternoon at ICAR-Central Agroforestry Research Institute, Jhansi.

Honours and Recognitions

- Dr R Elanchezhian acted as Invited Speaker at the National Conference of Plant Physiology organized by ISPP New Delhi and ICAR-CPCRI Kasaragod during 17-19 December 2024.
- Dr R Elanchezhian acted as Editor of Plant Physiology Reports of Indian Society for Plant Physiology
- Dr R Elanchezhian acted as Reviewer / Referee for the journal FCR, JPN, BMC journals, and Plant Physiology Reports (Springer Nature)
- Dr. B.P. Meena acted as External Examiner to set the question paper for B.Sc. Agriculture (1st Sem) Fundamental Agriculture at Sarojini Naidu Govt. Girls P.G. Autonomous College, Shivaji Nagar, Bhopal 462016 (Madhya Pradesh).
- Dr Abinash Das selected as Councilor (Central Zone) for The Clay Minerals Society of India (CMSI) during the executive Council meeting of the Clay Minerals Society of India (CMSI), New Delhi held online on May 12, 2024.
- Dr. Nisha Sahu recognized as Member, Editorial Board, Agriculture Letters.
- Dr. Nisha Sahu recognized as Editorial Board Member of American Journal of Environmental Science and Engineering (AJESE) from September 9, 2022 to September 9, 2024.
- Dr. Jitendra Kumar presented a research paper on Simulating the impact of contrasting tillage practices on soil physical processes and wheat yield using the SWAP model in Global Soils Conference 2024 during 19-22 November at NAAS Complex New Delhi
- Dr. Jitendra Kumar participated in the Advanced International Course on Conservation and Regenerative Agriculture' in India from December 3 to 23, 2024. Course is jointly hosted by ICAR, CIMMYT and BISA.
- Dr. Nishant K. Sinha has been nominated as an associate editor in the editorial board of Annals of Plant and Soil Research, G.K.V. Society, Agra. Dr. Narendra Kumar Lenka was the Invited Speaker to deliver lecture on "Role of Soil in Climate Change Mitigation" at the Centre for Science and Environment (CSE) Climate week – Agriculture Discussion held at AAETI, Nimli, Rajasthan during 15-16 October 2024
- Dr. Narendra Kumar Lenka was an external member for career assessment of scientist at ICAR-IARI, New Delhi during 17-18 December 2024
- Dr. Narendra Kumar Lenka is Co-Chief Editor of the Indian Journal of Soil Conservation
- Drs. NK Lenka, P. Tripathi and N. Lal received and completed a consultancy assignment on Optimal Ravine Management in the Chambal Landscape of MP, under the FAO sponsored GreenAg Project
- Jitendra Kumar awarded the certificate of recognition for review of the manuscript entitled "Performance Evaluation of Different Soil Infiltration Models under Long Term Conservation Agricultural Practices" by journal of Environmental Biology
- Dr. RS Chaudhary is continuing as the Editor of the Journal of Agricultural Physics, published by Indian Society of Agro Physics, Indian Agricultural Research Institute, Pusa, New Delhi.
- Dr. RS Chaudhary is continuing as the Editor of the Indian Journal of Soil Conservation, published by Indian Association of Soil and Water Conservationists, Kaulagarh Road, Dehradun, Uttarakhand.
- Dr. RS Chaudhary elected as Vice President (Central Zone) of Indian Association of Soil and Water Conservationists, Kaulagarh Road, Dehradun, Uttarakhand
- Dr. RS Chaudhary was external member for career advancement committee at ICAR-IISWC,

Dehradun on December 6, 2024.

- Dr. RS Chaudhary was external member for career advancement committee at ICAR-NBSS&LUP, Nagpur for 6 scientists on April 22, 2024.
- Dr. RS Chaudhary was invited speaker at National Agriculture Education and Research Managers' Conclave organized by Bhartiya Agro-Economic Centre at NASC New Delhi on September 25, 2024.
- Dr. RS Chaudhary was invited panelist in the International Conference on "Rainfed Agriculture: Building Pathways to Resilient and Sustainable Livelihood", organized by CRIDA, Hyderabad from January 29-31, 2025.
- Dr. Asit Mandal acted as External examiner held on January 15, 2024 for the evaluation of Ph.D Student Ganpat Lauhar (online).
- Dr Asit Mandal as member of External Advisory Board at the SYMBIOREM consortium meeting held online February 15, 2024 and October 2, 2024.
- Dr Asit Mandal as Academic Editor, PLOS one and International Journal of Plant and Soil Science (2024). Associate Editor for Frontiers in Soil Science (2024) and Indian Journal of soil conservation (2024)
- Dr Asha Sahu received Best Oral presentation award for paper entitled "Harnessing the Plant Growth Potential of Thermophilic Bacteria Isolated from Hot Springs of Central India" during International Conference on "Current Innovations and Technological Advances in Agriculture and Allied Sciences" (CITAAS-2024) during August 29-31, 2024 at GKU, Talwandi Sabo.
- Dr Asha Sahu invited as keynote speaker by SAGE University during Summer School 2024 on Innovative Technologies in Agriculture during August 5- 16, 2024.
- Dr Asha Sahu invited as an expert for a workshop on "Waste to Wealth" theme under Swachhta hi Sewa Programme, on September 25, 2024 organized by ICAR-Central Institute for Arid Horticulture, Rajasthan.
- Dr. B.P. Meena appointed as Expert Member of Board of Study (Agriculture) at Sarojini Naidu Govt. Girls P.G. Autonomous College, Shivaji Nagar, Bhopal 462016 (Madhya Pradesh).
- Dr. B.P. Meena appointed as Expert Member for Selection Committee Meeting for Appointment to the Posts of Assistant Professor (Agronomy) at RVSKVV, Gwalior, on 21 October, 2024.
- Dr. B.P. Meena acted as External Examiner to set the question paper for B.Sc. (Hons.) Agro-meteorology and climate change (HNM-312) 2nd Sem-2024 at Banda University of Agriculture & Technology, Banda-210001 (U.P.), India.
- Dr. B.P. Meena acted as External Examiner to set the question paper for B.Sc. (Hons.) course title and code Fundamental of Agronomy 1st Sem-2025 at Banda University of Agriculture & Technology, Banda-210001 (U.P.), India.
- Dr Asha Sahu nominated as Chairperson of the selection committee for engagement of Young Professional-II scheduled on January 30, 2024.
- Dr. Asha Sahu invited as Keynote Speaker at the 3rd World Conference on Recycling and Waste Management on topic "Enhancing Soil Health through Improved Quality of Bio-Waste and Accelerated Decomposition using Microbial Consortia" held during April 22, 2024, Berlin, Germany (online).
- Dr Asha Sahu invited as an External Examiner for conducting the M.Sc. Microbiology 2nd Semester Viva-voce Examination on May 31, 2024 at Department of Microbiology, Barkatullah University, Bhopal.



- Dr Asha Sahu invited as Distinguished Speaker at "6th Edition of the Advanced Chemistry World Congress" held at London, UK during March 27-28, 2025.
- Dr JK Thakur as external member for assessment of IARI Student (Ms. Sonam M., Ph.D. student) for upgradation from JRF to SRF held on January 4, 2024 (online)
- Drs A Mandal and J. K. Thakur as Invited expert in Strategy workshop on "microplastics pollution: strategies for remediation in sustainable environmental management, organized by NAAS, New Delhi on December 3, 2024.
- Dr M Homeshwari Devi certified as Excellence in reviewing Asian Journal of Agricultural and Horticultural Research. March14, 2024.
- Dr M Homeshwari Devi certified as Excellence in reviewing Asian Journal of Agricultural and Horticultural Research. April 9, 2024.
- Dr M Homeshwari Devi certified as Excellence in reviewing Asian Journal of Research in Crop Science. May 24, 2024.
- Dr Khushboo Rani acted as reviewer for an article in Frontiers in Sustainable Food Systems, and Indian Journal of Soil Conservation.
- Dr Sudeshna Bhattacharjya was invited as key speaker by Sri Sri University in the webinar on "Diverse microbiome-A future of soil restoration and soil health" on February 29, 2024.
- Dr. B.P. Meena recognized as Editor in the Indian Society of Agronomy, New Delhi and as Associate Editor of the Indian Journal of Soil Conservation, Dehradun.
- Dr. Pramod Jha invited as External Expert of Assessment Committee for Upgradation Students of Division of Soil Science & Agricultural Chemistry, IARI, New Delhi from JRF to SRF.
- Dr. Pramod Jha invited as Member of the technical Committee to support in methodological, standards, guidelines, clarifications and other methodological matters to facilitate the development of emission reduction and removal activities in the agricultural sector under chairmanship of Additional Secretary (NRM), DA&FW, Government of India.
- Dr. Pramod Jha invited as Member of the technical Committee for implementation of Voluntary Carbon Market in Fisheries Sector, Ministry of Fishries, Animal Husbandary & Dairying< Government of India (12 August, 2024)
- Dr. Pramod Jha performed the duty of panelist under the theme Water Stewardship in Regenerative Agriculture during stakeholders Consultation meet on 8th July 2024 at Jehan-Numa Palace, Bhopal
- Dr. Pramod Jha invited for delivering panel discussion on Quantifying the C-a simplified Indian method for MRV under the Chairmanship of Dr H Pathak, Secretary (DARE) & DG ICAR, organized by NAAS on May 4, 2024 at NASC Complex, New Delhi
- Dr. Pramod Jha acted as Section Editor Indian Journal of Agricultural Sciences, New Delhi, Journal of the Indian Society of Soil Science, New Delhi, Pantnagar Journal of Research, Pantnagar and as Reviewer for Agricultural Research

6. Linkages and Collaboration

The Institute has linkages with several ICAR institutes and SAUs located throughout the country. The three AICRPs (LTFE, MSPE & STCR), one AINP on SBB and one CRP on CA stationed at ICAR-IISS Bhopal have 94 cooperating centers spread across the country. The Institute is undertaking external funded projects (ICRAF, CEFIPRA, UKRI, NASF, DST, DBT, NICRA, MPCOST, EPCO) involving linkage with several ICAR Institutes.Besides, several private firms, viz., M/sBlu Soils Agro Pvt. Ltd, Patna is collaborating with the Institute on various R&D activities. The institute is running academic activities for PG programs under the ICAR Global University at Bhopal hub. Also, efforts have been made to strengthen research collaborative activities with SAUs through guidance of PG students by the Institute scientists.

List of Co-operating Centres under AICRPs/AINP

AICRPs/AINP	No. of Cooperating Centres		
	ICAR	SAUs/SGUs	Total
AICRP on LTFE : UAS GKVK, Bangalore; OUAT, Bhubaneswar; TNAU, Coimbatore; PJTSAU, Hyderabad; JNKVV, Jabalpur; PAU, Ludhiana; CSKHPKV, Palampur; BAU, Ranchi; GBPUAT, Pantnagar; KAU, Pattambi; JAU, Junagarh; MPUAT, Udaipur; VNMAU, Parbhani; Dr PDKV, Akola; IGKVV, Raipur; ICAR-IARI, New Delhi; ICAR-CRIJAF, Barrackpore; ICAR-IASRI, New Delhi	3	15	18
AICRP on MSPE : PJTSAU, Hyderabad; RAU, Pusa; AAU, Anand;HAU, Hisar; JNKVV, Jabalpur; Dr PDKV, Akola; OUAT, Bhubaneshwar;PAU, Ludhiana;TNAU, Coimbatore;GBPUAT, Pantnagar;AAU, Jorhat; BCKV, Kalyani; RAU, Ranchi;CSKHPKV, Palampur; CSAUAT, Kanpur; KAU Kerala; UAS Bengaluru; CAU, Manipur; NIANP Bengaluru;ICAR-IARI, New Delhi; RLBCAU, Jhansi	2	19	21
AICRP on STCR : PJTSAU, Hyderabad; RAU, Pusa; IGKV, Raipur; ICAR-IARI, New Delhi; HAU, Hisar; HPKV, Palampur, GKVK, Bengaluru; KAU, Vellanikara; JNKVV, Jabalpur; MPKV, Rahuri; OUAT, Bhubaneswar; PAU, Ludhiana; SKRAU, Bikaner; TNAU, Coimbatore; GPUAT, Pantnagar; BCKVV, Kalyani; ICAR-CRIJAF, Barrackpore; PAJANCOA, Puduchery; BHU, Varanasi; AAU, Jorhat; JAU, Gujarat; SKUAT, Srinagar; BAU, Ranchi; ICAR-IISR, Lucknow; ICAR-Complex, Manipur	4	21	25
AINP on Soil Biodiversity-Biofertilizers : AAU, Jorhat; ANGRAU, Amaravathi; BAU, Ranchi; HAU, Hisar; JNKVV, Jabalpur; KAU, Thrissur; MAU, Parbhani; MPUAT, Udaipur; OUAT, Bhubaneswar; RAU, Pusa; TNAU, Coimbatore; YSPUHF, Solan; CRRI, Hazaribagh; ICAR-IARI, New Delhi; DGR, Junagarh; GBPUAT, Pantnagar; UAS, Dharwad	3	14	17
CRP on CA : PIC New Delhi, PIU Bhopal, ICAR-IISS Bhopal, ICAR-CRIDA Hyderabad, ICAR-IARI Delhi, ICAR-DWR Jabalpur, ICAR-RCER Patna, ICAR-CSSRI Karnal, ICAR-NIASM Baramati, ICAR-IIWBR Karnal, ICAR-NRRI Cuttack, ICAR-IIFSR Modipuram, ICAR-CIAE Bhopal	13	0	13

International linkage:

Dr S R Mohanty received international grant funded by DST India and Mission Innovation (MI) USA to collaborate with SanDiego State University, CA, USA under the call Carbon Capture Utilization and Storage (CCUS).

Drs SR Mohanty and K Bharati visited University of Strasbourg, France under Indo-France CEFIPRA project during September 15-26, 2024.

7. Ongoing Research Projects

7.1 Programme I: Soil Health and Input Use Efficiency

(A) Institute Project

1. Long-term evaluation of integrated plant nutrient supply modules for sustainable productivity in Vertisol

   Investigators: BP Meena, AK Biswas, RS Chaudhary, RH Wanjari, Khushboo Rani

2. Enhancement of Soil Health and Livelihood of Tribals in Central India

   Investigators: RK Singh, RH Wanjari, R Elanchezhian, Prabhat Tripathi, KC Shinogi, MV Coumar,Narayan Lal, Asit Mandal, Asha Sahu, SK Behera, Seema Bhardwaj, Madhumonti Saha, Sanjay Srivastava, K Bharati, Priya Gurav, BP Meena, AK Tripathi, Abhijit Sarkar, NK Sinha, JK Thakur, Khushboo Rani, DK Yadav, Immanuel C Haokip, Dhiraj Kumar, Rahul Mishra, M Homeshwari Devi, I/c KVK Barwani (MP), I/c KVK Rajnandgaon (Chhattisgarh) and I/c KVK Betul (MP)

3. Assessment of nutrient (N & P) use efficiency in wheat genotypes for improved crop productivity

   Investigators: R Elanchezhian, BP Meena, Alka Rani, Sanjay Srivastava, Ajay, AK Biswas, MV Coumar, and Renu Pandey (ICAR-IARI, New Delhi).

4. Soil health assessment and input use efficiency

   Development of agri-horticultural system for central India under Vertisols, its impact on soil health and improvement in productivity and quality of fruits

   Investigators: Narayan Lal, BL Lakaria, Asha Sahu,AK Biswas

5. Studying of climate change impact on nitrogen dynamics and water use in two contrasting cropping system of Central India

   Investigators : NK Lenka, Sangeeta Lenka, Pramod Jha, JK Thakur, BP Meena

6. Enhancing livelihood security of subsistence farming community through improvement in soil health crop productivity and capacity building in Bhopal district of Madhya Pradesh

   Investigators: Ajay, AK Vishwakarma, Jitendra Kumar, DolamaniAmat and all scientists

7. Assessing soil quality and yield sustainability under long term soil test crop response correlation (STCR) based nutrient in major soil orders of India

   Investigators: Immanuel C Haokip, NK Lenka, Dhiraj Kumar, M Homeshwari Devi, Khushboo Rani, RH Wanjari, AK Tripathi

8. Enhancing nutrient use efficiency, and managing soil health for sustainable crop production and improved produce quality

   Investigators: SK Behera, AK Biswas, Sanjay Srivastava, Pramod Jha, R Elanchezhian, Shinogi KC, BP Meena, Narayan Lal, Seema Bhardwaj, Khushboo Rani, Dhiraj Kumar, Immanuel Chongboi Haokip, Rahul Mishra, Sudeshna Bhattacharjya, RH Wanjari, JK Thakur, NK Sinha, Jitendra Kumar, Abinash Das, SR Mohanty, MK Tripathi, M Homeshwari Devi, Nisha Sahu, Prabhat Tripathi, Ajay, R.S. Chaudhary

(B) Externally Funded Projects

9. All India Network Programme on Organic Farming (ICAR, New Delhi)

   Investigators: JK Thakur, BP Meena, BL Lakaria, RElanchezhian, NK Sinha, Abinash Das

10 Ensuring food security, sustainability and soil health through resource conservation-based farmer FIRST approach in central India, (ICAR New Delhi)

   Investigators: Shinogi KC, RK Singh, BL Lakaria, RH Wanjari, K Bharati, Asha Sahu, Narayan Lal

11. Studies on N-(n-butyl) Thiophosphoric Triamide (NBPT) as a Urease Inhibitor for Improving Nitrogen Use Efficiency in major cropping

systems in India funded by ICAR- CIMMYT collaboration

Investigators: Pramod Jha, R Elanchezhian, BP Meena, AK Biswas

12. Development of Nano Sensor and its application through cloud-based network for real time irrigation to soil and plant funded by NASF, ICAR, New Delhi

Investigators: Tapan Adhikari, CD Singh, Samir Kumar Pal, SN Bose

13. Hyperspectral reflectance and multi-nutrient extrant based assessment of soil properties for sustainable soil health in India funded by NASF

Investigators: MV Coumar, Immanuel C.H.

14. Assessment of Traditional Knowledge System of Tribal Farmers for Managing Land Resources funded by DST, MoSC, New Delhi

Investigators:Shinogi KC, Sanjay Srivastava, Sudesna Bhattacharjya, Dinesh Kumar Yadav

7.2 Programme II: Conservation Agriculture and Carbon Sequestration vis-à-vis Climate Change

A. Institute Projects

15. Impact of climate change on soil processes

a. Impact of climate change on soil physical process in maize based cropping systems in vertisols of central India

Investigators:Jitendra Kumar, NK Sinha, Alka Rani, RS Chaudhary

b. Downscaling of satellite-derived soil moisture product and its application for agricultural drought monitoring and outlook

Investigators:Alka Rani, NK Sinha, Jitendra Kumar, Seema Bhardwaj, RS Chaudhary, RK Singh

16. Improving soil physical environment through resource conservation and precision management tools for climate resilient agriculture

Investigators: N.K. Lenka, Prabhat Tripathi, R.K. Singh, N.K. Sinha, Jitendra Kumar, Alka Rani, R.S. Chaudhary, R. Elanchezhian, SangeetaLenka, PramodJha, Immanuel Haokip Chongboi, Rahul Mishra, Dhiraj Kumar, Abhijit Sarkar, Madhumonti Saha, Dinesh Kumar Yadav, Narayan Lal

B. External funded projects

17. Assessment of important soil properties of India using mid-infrared spectroscopy (ICAR-ICRAF, Nairobi)

Investigators: NK Sinha, Pramod Jha, RS Chaudhary, JK Thakur, MV Coumar, Dhiraj Kumar, Javed Rizvi

18. Development, refinement and validation of conservation agriculture in Vertisols of central India and quantifying impact of CA practices on soil and environment

CRP-Conservation Agriculture (LCPC: Dr AK Biswas and DLCPC: Dr RS Chaudhary) (ICAR)

a. Demonstration of best-bet conservation agriculture practices on farmers' fields in Vertisols of central India

Investigators: BP Meena, RH Wanjari, KC Shinogi, AK Tripathi

b. Fine-tuning of conservation agricultural practices for Vertisols of central India

Investigators: Prabhat Tripathi, Sangeeta Lenka, Alka Rani, DK Yadav

c. Development of water and nutrient management practices in conservation agriculture for Vertisols of central India

Investigators: RK Singh, Sanjay Srivastava, NK Sinha, Jitendra Kumar, Immanuel C Haokip

d. Impact of conservation agricultural practices on soil health, carbon sequestration and greenhouse gas emissions in different production systems

Investigators: Pramod Jha, JK Thakur, K Bharati, Khushboo Rani

19. Modelling soil carbon storage and dynamics in different agro-ecosystems of India under the changing climate scenarios funded by NICRA

Investigators: NK Sinha, Pramod Jha, Dhiraj Kumar, RH Wanjari, Prabhat Tripathi, J Kumar

and R Mishra

20. Integrated assessment of soils and crops under varying climate conditions to improve nutrient dynamics and efficiencies, carbon sequestration and greenhouse gas mitigation funded by NICRA

Investigators:NK Sinha, Pramod Jha, K Bharati, Jitendra Kumar, Sangeeta Lenka, JK Thakur, Abinash Das, RS Chaudhary, Dhiraj Kumar, T Adhikari and R Mishra.

21. ICAR Network Program on Precision Agriculture

Investigators: NK Sinha, S Srivastava, Jitendra Kumar, Dhiraj Kumar, Alka Rani, CH Immanuel, RS Chaudhary, N Sahu and Rahul Mishra

7.3 Programme III – Soil Microbial Diversity and Biotechnology

22. Structure and function of biomes in agro-ecosystems for prospecting biological resources to improve soil health, crop response, green house gas mitigation and ecosystem services

Investigators: S.R. Mohanty, A.K. Tripathi, K. Bharati, Asit Mandal, J.K. Thakur, Asha Sahu, Sudeshna Bhattacharjya, M.Homeshwari Devi, Abinash Das, BP Meena, R Elanchezhian, Khushoo Rani, Pramod Jhan, NK Sinha, IC Haokip, N Sahu.

A. Inter-Institute Project

23. Characterization and prospecting of soil biota for enhancing nutrient use efficiency

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

Investigators: Asha Sahu, Sudeshna Bhattacharjya, Nisha Sahu, K Bharati and Anita Tilwari

b. Exploring endophytic microbial diversity of selected major field crops of India for nutrient supplementation and biocontrol

Investigators:JK Thakur, Asit Mandal

24. Effect of in-situ decomposition of crop residue mediated by lignocellulolytic microbes on soil health under rice-wheat cropping system

Investigators: Abinash Das

25. Silicon solubilizing bacteria for enhancing nutrient use efficiency of Rice-wheat cropping system in Vertisol of central India

Investigators: M. Homeshwari Devi

B. Externally Funded Projects

26. Microbial based agricultural waste management using vermicomposting funded by Swachchta Action Plan, ICAR, New Delhi

Investigators: SP Datta (Project leader), BP Meena (PI), JK Thakur, RS Chaudhary, Asha Sahu, Asit Mandal, DK Yadav & Abhijit Sarkar

27. Phyllospheremethylotroph driven bioconversion of atmospheric greenhouse gas and volatiles to plant metabolites leveraging primary productivity in major crops and mitigation of climate change funded by Indo-France

Investigators: SP Datta, SR Mohanty, K Bharati, M. Homeshwari Devi

7.4 Programme IV: Soil Pollution, Remediation and Environmental Security

A. Institute Project

28. Heavy metal and its remediation for sustainable crop production and environmental protection

a. Assessment/quantification of soil heavy metals using spectroscopy and multi spectral remote data from industrial areas of Kanpur

Investigators: Nisha Sahu, JK Saha, NK Sinha, H Biswas (ICAR-NBSS&LUP Nagpur), Mrunalini Kancheti (ICAR-IIPR, Kanpur), Rahul Mishra

b. Municipal solid waste compost quality assessment for sustainable crop production and environmental protection

Investigators: M Vassanda Coumar, Tapan Adhikari, Abhijit Sarkar, Nisha Sahu, JK Saha, Ajay, DK Yadav and SK Meena (CPCB)

c. Risk minimization and economic exploration of municipal sludge

Investigators: Abhijit Sarkar

29. Assessment and Management of Pollution in Soil-Water-Air-Plant Continuum (SWAPC) for Sustainable Crop Production and Environmental Protection.

Investigators: Tapan Adhikari, Ajay, J.K. Saha, Sangeeta Lenka, M.V. Coumar, Nisha Sahu, Abhijit Sarkar, Madhumonti Saha, Dinesh Kumar Yadav, N.K. Lenka, Pramod Jha, Asit Mandal, N.K. Sinha, B.P. Meena, Abinash Das

B. Externally Funded Projects

30 Use of fly ash in agriculture for sustainable crop protection and environmental protection fundedby NTPC, Noida

Investigators: J.K. Saha, M. V. Coumar, Abhijit Sarkar, Tapan Adhikari, Ajay, Madhumonti Saha, Sangeeta Lenka, Asit Mandal, Rahul Mishra, Nisha Sahu, RS Chaudhary, Dinesh Kumar Yadav, BP Meena

31 Investigation of potentials of soil as a sink for nitrous oxide and strategies for mitigation nitrous oxide emission funded by DST SERB –POWER Fellowship

Investigators: SangeetaLenka

32 Do agricultural micro plastics undermine food security and sustainable development in less economically developed countries?

Investigators: Tapan Adhikari, JK Thakur, Asit Mandal

33. Valorization of sewage sludge: Waste to wealth using nanotechnology for circular economy funded by MPCST

Investigators: Dinesh Kumar Yadav, Sangeeta Lenka, Abhijit Sarkar, MV Coumar, JK Saha

Collaborative projects in other institutes where ICAR-IISS scientists are associated

- Development and promotion of CA machinery (ICAR-IISS, Bhopal and ICAR-CIAE, Bhopal)

  Investigators: Dushyant Singh, NS Chandel, AK Vishwakarma, BP Meena

- Enhancing input use efficiency and productivity of pulses production system in central India (ICAR-IISS, Bhopal and ICAR-IIPR, Kanpur)

  Investigators:Sandeep Kumar, Narendra Kumar, Pramod Jha, R Elanchezhian

- Monitoring, mapping and development of agricultural farms using GIS at ICAR-CIAE

  Investigators: Shashi Rawat, K Singh, HS Pandey and Khushboo Rani

8. Consultancies, Contractual Services, Patents and Technology Commercialization

Consultancies /Contractual Services

S. No.	Title	Sponsorer	Project team
1	Evaluating the effect of Bio Soilz on soil nutrient availability and microbial activity under maize-wheat cropping system in Vertisols of Central India	M/s Blu Soils Agro Pvt. Ltd, Patna	Asit Mandal, JK Thakur, AB Singh, R Elanchezhian, AK Patra

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S. No.	Copyright (Technology) details	Copyright	Authors/ Developers
1.	Web-based precision soil fertilizer Recommendation system (WEB-PFRS)	SW-18892/2024, dated 03/06/2024	Nishant K Sinha, Monoranjan Mohanty, Rabi Narayan Sahoo, Pradip Dey, Nirmal Kumar
2.	Mobile app for precision soil fertilizer Recommendation system (MOBILE-BASED PFRS)	SW-19621/2024, dated 6/11/2024	Nishant K Sinha, Monoranjan Mohanty, Rabi Narayan Sahoo, Pradip Dey, Nirmal Kumar, Somasundaram Jayaraman
3.	Methodology for Regional Scale Soil Health Assessment	L-144760/2024, dated 13/03/2024	NK Lenka, AK Biswas, Sangeeta Lenka, Ashok K Patra
4.	Spatial soil fertility map of Rajnandgaon Chhattisgarh an aspirational tribal district	L-154703/2024, dated 01/10/2024	R Elanchezhian, MV Coumar, Nisha Sahu, DK Yadav, Eklavya Thakur, Prabhat Tripathi, Narayan Lal, RK Singh, RH Wanjari

Patents and Technology Commercialization

Patent Filed:

R. Ghosh, N. Bhattacharyya, S. Singh, Tapan Adhikari, S. K. Pal, Ajay Kumar, N. K. Sinha, A. K. Patra. Non contact sensing of water potential in a matrix (Application Number: 202311021215. Date March 25, 2024).

9. Publications

9.1 Papers in Research journal

9.1.1. International/ National (NAAS rating more than 6)

1. Anantha KC, Penjarla R, Challa VR, Bairi R, Kurella CS, Gokenapally S, Wanjari RH (2024). Phosphorus transformation and balancing under a long-term rice-rice cropping system in an Inceptisol of India. Journal of Plant Nutrition, 47(18): 3035–3050. (NAAS Rating: 8.10)

2. Bangre Jyoti, Sinha NK, Mohanty M, Jayaraman Somasundaram, Sahoo Rabi Narayan, Dwivedi Anil Kumar, Wanjari RH, Jha Pramod, Kumar Dhiraj, Kumar Jitendra, Mandloi Subash, Chaudhary RS, Reddy KS, Prabhakar M, Patra AK, Singh VK, Rao Ch Srinivasa (2024). Long-term Impact of inorganic fertilizers and farmyard manure on soil quality and productivity in subtropical Vertisols under a soybean-wheat cropping system. Land Degradation & and Development, 35(14): 4257-4270. https://doi.org/10.1002/ldr.5220. (NAAS Rating : 10.70)

3. Beena VI, Geetha P, Prabha Susan Philip, Sureshkumar P, Anusree T, Amrutha SA, Amrutha K K, Nihala Jabin PP, Reji AM, Sruthi K, Behera SK (2024). Establishing optimal nutrient level of magnesium and boron in black pepper for optimization of productivity in Western Ghats of Kerala. Plant Science Today, 11(sp3), 18-24. https:// doi.org/10.14719/pst.4852. (NAAS Rating: 6.90)

4. Bhattacharjya Sudeshna, Ghosh A, Sahu Asha, Agnihotri R, Pal N, Sharma P, Manna MC, Sharma MP, Singh AB (2024). Utilizing soil metabolomics to investigate the untapped metabolic potential of soil microbial communities and their role in driving soil ecosystem processes: a review. Applied Soil Ecology, 195, 105238. (NAAS: 10.80)

5. Das A, Purakayastha TJ, Ahmed N, Bhaduri D, Das R, Biswas S (2024). Imprint of clay mineralogy, sesquioxides, and crop residue addition for evaluation of soil organic carbon stability and associated microbial activity in dominant soil orders of Indian subcontinent. Environmental Geochemistry and Health, 46(3), 73. (NAAS Rating : 10.20)

6. Dhaliwal SS, Shukla AK, Behera SK, Dubey SK, Mandal A, Randhawa MK, Brar SK, Kaur G, Toor AS, Walia SS, Khambalkar PA (2024). Fertilization and soil ploughing practices under changing physical environment lead to soil organic carbon dynamics under conservation agriculture in rice-wheat cropping system: A scoping review. Agricultural Sciences, 15, 82-113. https://doi.org/10.4236/as.2024.151006. (NAAS Rating: 6.40)

7. Dhaliwal SS, Shukla AK, Behera SK, Dubey SK, Sharma S, Randhawa MK, Kaur G, Walia SS, Toor AS (2024). Impact of fertilization and tillage practices on transformations of carbon, essential plant nutrients and microbial biota composition in soils - A review. Technology in Agronomy, 4, e003. https://doi.org/10.48130/tia-0023-0020. (NAAS Rating/ IF 0.6)

8. Garnaik Saheed, Samant PK, Mandal Mitali, Patra RK, Wanjari RH, Mohanty Tushar R, Dwivedi SK, Parihar CM, Nayak HS (2024). Diverse nutrient management strategies for achievinga sustainable energy, food, environment nexus in rice-rice production systems. Environment, Development and Sustainability Online, (https:// doi.org/10.1007/s10668-024-04737-9). (NAAS Rating: 10.90)

9. Ghosh A, Ahmad S, Singh AK, Jha P, Kumar Yadav R, Jiménez Ballesta R, Bhatt SS, Biradar, N, Hamid Mir N (2024). Soil Carbon Storage, Enzymatic Stoichiometry and Ecosystem Functions in Indian Himalayan Legume Diversified Pastures. Land, 13(4), 452. https://doi.org/10.3390/land13040452. (NAAS Rating: 6.00)

10. Gowthamchand NJ, Dhaliwal SS, Sharma V, Shukla AK, Behera SK, Kaur M (2024). Variation of trace metal minerals among different soil orders under different land use systems falling in Malwa region of Punjab in north-western India. Journal of Trace Elements and Minerals, 9,100162. https://doi.org/10.1016/j.jtemin.2024.100162. (NAAS Rating: 9.50)

11. Gurav PP, Kollah B, Shirale AO, Yadav DK, Mohanty SR, Babu S, Yadav D, Yeasin MD,

Meena BP, Shinogi KC, Das R (2024). Phosphorus solubilizing microorganisms: a technique for enhancing phosphorus use efficiency. Journal of Plant Nutrition, 47(20):3906-20 (Corresponding author). (NAAS Rating: 8.10)

12. Gurav PP, Kollah B, Shirale AO, Yadav DK, Mohanty SR, Babu S, Yadav D, Yeasin MD, Meena BP, Shinogi KC, Das R (2024). Phosphorus solubilizing microorganisms: a technique for enhancing phosphorus use efficiency. Journal of Plant Nutrition, pp.1-15. (NAAS Rating: 8.10)

13. Lal N, Kumar A (2024). Panicle and fruit characteristics influenced by plant age in litchi cv. Rose scented. Bangladesh Journal of Botany, 53(2): 279-285. DOI: https://doi.org/10.3329/bjb.v53i2.74047. (NAAS Rating: 6.30)

14. Lal N, Kumar A, Marboh ES, Gupta AK, Pandey SD, Nath V (2024). Effect of temperature and duration of storage on seed germination in litchi (Litchi chinensis Sonn.). National Academy of Science Letters, https://doi.org/10.1007/s40009-024-01468-3. (NAAS Rating/IF 1.1)

15. Lal N, Kumar A, Pandey SD (2024). Assessing the genetic diversity and character association of yield components in litchi (Litchi chinensis Sonn.). Bangladesh Journal of Botany, 53(3): 465-473. (NAAS Rating: 6.30)

16. Lal N, Kumar A, Pandey SD, Sahu N (2024). Impact of climatic variability on litchi yields in the Tarai region of India. Applied Fruit Science, https://doi.org/10.1007/s10341-024-01195-5. (IF: 0.857).

17. Lal N, Pandey SK, Nath V (2024). Effect of weather on panicle development, flower morphogenesis and fruit set in litchi cv. Shahi. Plant Physiology Reports, https://doi.org/10.1007/s40502-024-00816-1. (NAAS Rating: 7.70)

18. Lal N, Pandey SK, Nath V (2024). Fruit drop in litchi influenced by various factors at different stages under Eastern India. Plant Physiology Reports, https://doi.org/10.1007/s40502-024-00817-0. (NAAS Rating: 7.70)

19. Manorama K, Reddy GPO, Suresh K, Ray SS, Behera SK, Kumar N, Mathur RK (2024). Characterization and mapping of the potential area of oil palm using multi-criteria decision analysis in a geographic information systems environment. Agriculture, 14, 986. https://doi.org/10.3390/agriculture14070986. (NAAS Rating/ IF 3.6)

20. Mishra R, Datta SP, Golui D, Meena MC, Raza MD, Rahman MM, Chaudhary M, Behera SK, Chaudhary A, Upadhyay DP, Shukla AK (2024). Mapping arsenic contamination and health risk assessment of arsenic in agricultural soils of eastern India. Water, Air and Soil Pollution, 235, 559. https://doi.org/10.1007/s11270-024-07359-z. (NAAS Rating: 8.90)

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9.2 Technical/Popular articles

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9.3 Technical Bulletins

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Books, Reports, Souvenir and Manuals

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New Delhi, India. ISBN: 978-81-19915-06-4 Pp: 1-165.

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Edited Book

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9.	Mrs. Babita Tiwari, AAO	Coordinator
Monitoring/Utilization of Plant/Machinery/Equipments/Instruments		
1.	Dr. Ajay, Pr. Scientist	In charge
2.	Dr. Kollah Bharati, Pr. Scientist	Member
3.	Dr. Immanuel Chongboi Haokip, Scientist	Member
Remote Sensing, GIS and AI Laboratory		
1.	Dr. N.K. Sinha, Sr. Scientist	Chairman

2.	Dr. Nisha Sahu, Sr. Scientist	Member
3.	Dr. Jitendra Kumar, Sr. Scientist	Member
4.	Dr. Alka Rani	Member
5.	Dr. Rahul Mishra, Scientist	Member
Training Hostel Co-ordination Committee		
1.	Dr. Rahul Mishra, Scientist	Chairman
2.	Dr. Dinesh Kumar Yadav, Scientist	Member
3.	Shri. M.K. Mulani, SFAO	In-charge
4.	Shri. P.K. Chauhan, T-5	Member
5.	Shri. Sunny Kumar, PA	Member
6.	Shri. Sanjay Narayan Gharde	Member
7.	Shri. Jagannath Gour, SSS	Care Taker
Swachh Bharat Mission		
1.	Dr. B. P. Meena, Sr. Scientist	Nodal Officer
2.	Dr. Asit Mandal, Sr. Scientist	Member
3.	Dr. J.K. Thakur, Sr. Scientist	Member
4.	Dr. Asha Sahu, Sr. Scientist	Member
5.	Dr. Jitendra Kumar, Sr. Scientist	Member
6.	Dr. Abinash Das, Scientist	Member
7.	Shri. Kalicharan, SSS	Member
8.	Shri. Janak Singh, SSS	Member
Agricultural Knowledge Management Unit (AKMU)		
1.	Dr. N.K. Sinha, Sr. Scientist	In-charge
2.	Dr. Rahul Mishra, Scientist	Member
3.	Dr. Dhiraj Kumar, Scientist	Member
Vehicle Operation Advisory Committee		
1.	Dr. Asit Mandal, Sr. Scientist	Chairman
2.	Dr. Jitendra Kumar, Sr. Scientist	Member
3.	Dr. Dinesh Kumar Yadav, Scientist	Member
4.	Shri. M.K. Mulani, SFAO	In-charge
5.	Shri. Deepak Kaul, CTO	Member
6.	Shri. Pramod K.Chauhan, TO	Member
7.	Shri. Hira Lal Gupta, Assistant	Member
8.	Shri. Sanjay Kumar Parihar, TA	Member
Right To Information (RTI Cell)		
1.	Dr. R. Elanchezhian, Pr. Scientist & I/c PME	Nodal officer & CPIO (Scientific)
2.	Dr. J.K. Thakur, Sr. Scientist	Member
3.	Dr. Immanuel Chongboi Haokip, Scientist	Member
4.	S.A.O	CPIO (Admin. Matters)
5.	Shri Sanjay Kumar Kori, PA	Office Staff
6.	ShriSanjay Kumar Parihar, TA	Office Staff

Screen House		
1.	Dr. M.Vassanda Coumar, Sr. Scientist	Incharge
2.	Dr. Immanuel Chongboi Haokip, Scientist	Member
3.	Dr. M. Homeshwari Devi, Scientist	Member
4.	Dr. Khushboo Rani, Scientist	Member
5.	Dr. Abinash Das, Scientist	Member
HRD (Training)		
1.	Dr. J.K. Saha, Pr. Scientist	Nodal Officer
2.	Dr. R.K. Singh, Pr. Scientist	Member
3.	Dr. Kollah Bharati, Pr. Scientist	Member
4.	Dr. Immanuel Chongboi Haokip, Scientist	Member
5.	Dr. M. Homeshwari Devi, Scientist	Member
6.	Dr. Dinesh Kumar Yadav, Scientist	Member
Mera Gaon Mera Gaurav		
1.	Dr. Prabhat Tripathi, Pr. Scientist	Nodal Officer
2.	Dr. Sangeeta Lenka, Pr. Scientist	Member
3.	Dr. Jitendra Kumar, Sr. Scientist	Member
4.	Dr. Sudeshna Bhattacharjya, Scientist	Member
5.	Dr. Dhiraj Kumar, Scientist	Member
TSP/STC Programme Implementation Committee		
1.	Dr. R.K. Singh, Pr. Scientist	Chairman
2.	Dr. R.H. Wanjari, Pr. Scientist	Member
3.	Dr. Asit Mandal, Sr. Scientist	Member
4.	Dr. K.C. Shinogi, Sr. Scientist	Member
5.	Dr. B.P. Meena, Sr. Scientist	Member
6.	Dr. Jitendra Kumar, Sr. Scientist	Member
7.	Dr. Dhiraj Kumar, Scientist	Member
8.	Dr. Dinesh Kumar Yadav, Scientist	Member
9.	Shri M.K.Mulani, S.F.A.O	Member
10.	S.A.O	Member
11.	Shri Sanjay Katinga, UDC	Member
Schedule Castes Sub Plan (SCSP)		
1.	Dr. Ajay, Pr. Scientist	Chairman
2.	Dr. Jitendra Kumar, Sr. Scientist	Member
3.	Dr. Narayan Lal, Sr. Scientist	Member
4.	Dr. Dhiraj Kumar, Scientist	Member
5.	Dr. Immanuel Chongboi Haokip, Scientist	Member
6.	Dr. M. Homeshwari Devi, Scientist	Member
7.	Dr. Abinash Das, Scientist	Member
8.	Shri M.K. Mulani, S.F.A.O	Member
9.	S.A.O	Member
10.	Dr. B.P. Meena, Sr. Scientist	Member Secretary

Campus Development and Facility Committee		
1.	Dr. Sanjay Srivastava, Pr. Scientist &I/c PC STCR	Chairman
2.	Dr. Dhiraj Kumar, Scientist	Member
3.	Dr. Sudeshna Bhattacharjya, Scientist	Member
4.	Dr. Dinesh Kumar Yadav, Scientist	Member
5.	Dr. Khushboo Rani, Scientist	Member
6.	Dr. Abinash Das, Scientist	Member
7.	Shri M.K. Mulani, S.F.A.O	Member
8.	S.A.O	Member
9.	Shri Venny Joy, Private Secretary	Member
10.	Shri Hukum Singh TO	Member
11.	Shri Sukram Sen, TO	Member
12.	Shri Sunny Kumar, PA	Member
13.	Shri Kalicharan, SSS	Member
Punctuality Committee/Biometric Monitoring Committee		
1.	Dr. S.K. Behera, HOD (SC&F)	Chairman
2.	Dr. Tapan Adhikari, HOD (ESS)	Member
3.	Dr. N.K. Lenka, HOD (SPD)	Member
4.	Dr. S.R. Mohanty, HOD (SBD)	Member
5.	Dr. Pramod Jha, Pr.Scientist	Member
6.	Shri M.K.Mulani, SFAO	Member
7.	S.A.O	Member
8.	Shri Hira Lal Gupta, Assistant, IJSC Member	Member
Externally Funded Project Evaluation Committee		
1.	Director	Chairman
2.	All Heads	Member
3.	All I/c PCs/NC/LCPC	Member
4.	SAO	Member
5.	Shri M.K. Mulani, SFAO	Member
6.	PI of Project	Member
7.	I/c PME Cell	Member Secretary
Proprietary Committee		
1.	Dr. Pramod Jha, Pr. Scientist	Chairman
2.	Dr. S.K. Behera, Pr. Scientist&HOD (SC&F)	Member
3.	Dr. Sangeeta Lenka, Pr. Scientist	Member
4.	Dr. J.K. Thakur, Sr. Scienstist	Member
5.	AAO (P&S)	Member

11. IMPORTANT MEETINGS/ACTIVITIES

Institute Management Committee Meeting

Institute Management Committee (IMC) meeting was conducted on January 19, 2024 under the chairmanship of Dr SP Datta, Director, ICAR-IISS, Bhopal to discuss the administration and management of the institute and ensure its smooth functioning. The meeting was also attended by members nominated from ICAR, New Delhi: Dr DR Biswas, Principal Scientist, Division of Soil Science & Agricultural Chemistry, ICAR-IARI, New Delhi; Dr G Ravindra Chary, Principal Scientist (Agronomy) & I/c PC AICRP-DA, CRIDA, Hyderabad; Dr Pratap Bhattacharya, Head (Soil Science), Crop Production Division, NRRI, Cuttack; Dr RS Yadav, Principal Scientist & Head, ICAR-IISWC, Regional Centre, Datia.



Republic Day

The 75th Republic Day was celebrated on January 26, 2024 in the Institute premises with great gaiety and fervor. Dr. S.P. Datta, Director, addressed the gathering and requested all the staff and their family members to work with sincerity for the welfare of the nation.





International Women's Day

The Women Cell of the institute organized one day workshop for female farmers on Reuse of Agricultural Waste on March 7, 2024. Mrs Padmapriya Balakrishnan, Director Van Vihar, Bhopal graced the occasion as Chief Guest.





37th Foundation Day

The Institute celebrated its 37th Foundation Day on April 16, 2024. Dr SK Chaudhari, DDG (NRM), ICAR, New Delhi graced the occasion (online) as the Chief Guest. Dr A Velmurugan, ADG (SWM) NRM, ICAR, New Delhi (online) and Dr PK Sharma,

Former Vice Chancellor, SKUAST, Jammu acted as the Guest of Honour. Dr SP Datta, Director, ICAR-IISS highlighted the Institute's achievements and future thrust areas. The institute felicitated the progressive farmers namely Smt. Tara Bai Meena, Shri Manohar Patidar, Shri Hemraj Yadav, Shri Arjun Singh and Shri Anil Ahirwar for their innovativeness and adoption of modern agricultural practices. Dr SP Datta was also felicitated for completion of twenty-nine years of dedicated service in ICAR. The Best Worker Award was given to Shri Deepak Kaul, and Shri Sanjay Parihar (Technical), Shri Venny Joy, Shri Sanjay Gharde (Administration) and Shri Rakesh Sen (Supporting). The dignitaries also released the several publications for the benefit of farmers. The celebration was attended by more than 200 people and the function ended with formal vote of thanks by Dr R Elanchezhian, Organizing Secretary.





National Campaign on Soil Health Management and Composting

ICAR Indian Institute of Soil Science (IISS), Bhopal organized a National Campaign on Soil Health Management and Composting under mission LiFE (Lifestyle for Environment), Govt of India on April 23, 2024. In this campaign, scientists and staffs from different ICAR institutes, state agricultural universities, KVKs and representatives from state governments, farmers and school students participated in with great enthusiasm and fervor. Dr SK Chaudhari, Deputy Director General (NRM), ICAR, New Delhi graced the occasion as Chief Guest. The campaign involved about 25 organizations (institute/KVKs/SAUs/NGOs/ Farmers) and 1000 participants (200 in physical & 800 online).





International Yoga Day

The ICAR-IISS, Bhopal celebrated the 10th International Yoga Day on June 21, 2024 with a demonstration cum awareness lecture on yoga. Dr SP Datta, Director, ICAR- IISS, Bhopal inaugurated the program and briefed about the importance of yoga in modern life. He further highlighted the significance of yoga and emphasized its relevance in today's lifestyle, stressing the need of healthy body for a healthy mind. In this program, various exercises, yoga asanas, pranayama, etc. were demonstrated and conducted by Yoga expert Shri GP Patel. He explained the benefits

of regular practice of these asanas and pranayama for relieving several health issues such as diabetes, heart and lung diseases. Scientists, technical and administrative officers of the institute participated in the program.





Institute Research Council (IRC) Meeting

Field IRC was held on January 13, 2024 and IRC meeting was held on October 25, 2024 to review the progress of the projects and research activities of the scientists. Dr SP Datta, Director chaired the session and four ongoing in-house projects were presented and reviewed.



Field IRC

78th Independence Day

The 78th Independence Day was celebrated on August 15, 2024 in the Institute with great gaiety and fervor. Dr SP Datta, Director, addressed the gathering and requested all the staff and their family members to work for the welfare of the nation.





हिन्दी पखवाड़ा

दिनांक 14 से 30 सितंबर 2024 तक संस्थान में हिन्दी पखवाड़ा मनाया गया। जिसमें वाद–विवाद, हिन्दी ट्रांसलेशन, क्विज, नोटिंग, ड्राफ्टिंग, हिन्दी टाइपिंग आदि प्रतियोगिताएँ आयोजित की गई।





संस्थान की हिंदी समिति द्वारा दिनांक अक्टूबर 16, 2024 को हिंदी कार्यशाला और पुरस्कार वितरण समारोह आयोजित किया गया जिस में मुख्य अतिथि डॉ. खेम सिंह डेहरिया, कुलगुरू, अटल विहारी वाजपेयी हिंदी विश्वविद्यालय, भोपाल थे।



Swachhta Pakhwada

As part of Swachhta Hi Seva campaign, the institute organized the mega cleanliness drives at the institute from September 15 to October 2, 2024. As such, there is no black spot for cleanliness inside the campus premises; the agricultural waste and crop residue generated from the experimental research farm of the Institute is recycled through various composting techniques such as microbial-mediated composting and vermicomposting techniques under the Swachhata Action Plan (SAP). All the staff of the farm and civil and electrical sections of the institute actively participated in the cleanliness drive.



Cleanliness drive under Swachhta Hi Seva



Tree plantation under Swachhta Hi Seva



Swachchta awareness program

Quinquennial Review Team Meeting

A Quinquennial Review Team (QRT) reviewed the work done by the ICAR-IISS, Bhopal and different centres of AICRPs on Long Term Fertilizer Experiments, Micro and Secondary Nutrients and Pollutant Elements in Soil and Plants, Soil Test Crop Response; AINP on Soil Biodiversity-Biofertilizers and CRP on Conservation Agriculture for the period 2018-2023. The team was led under the chairmanship of Dr PK Sharma, Former VC, SKUAST, Jammu. The team had its meeting with the Director, PCs, HODs and all the scientists of the Institute on May 20-21, 2024 at ICAR-IISS, Bhopal to review the research work of different divisions and project coordinating units. The review meeting with different AICRPs, AINP, CRP centres were held during June 2024 to August 2024 at SKUAST, Srinagar (North zone; 27-

29 June), ICAR CRIJAF Barrackpore (East zone; 11-13 July), PJTSAU, Hyderabad (South zone; 30 Jul-1 Aug) and MPUAT, Udaipur (West zone; 20-22 Aug) where scientists of respective zones participated. The team interacted with Vice Chancellors, Directors of institute, Directors of Research of SAUs, staffs of the projects, progressive farmers and other stakeholders to ascertain their view. The meeting concluded on September 12-13, 2024 at ICAR-IISS, Bhopal with preparation of the report and recommendations. All the events at ICAR-IISS Bhopal and respective zones were coordinated by Dr R Elanchezhian, Member Secretary QRT.









Vigilance Awareness Week

A vigilance awareness campaign 2024 was carried out at ICAR- IISS, Bhopal during August 16- November 15, 2024 and number of activities were organized. The vigilance awareness week was observed from October 28 to November 3, 2024 with theme "सत्यनिष्ठा की संस्कृति से राष्ट्र की समृद्धि" (Culture of Integrity for Nation's Prosperity). Quiz, debate and essay competitions were organized on above theme. A Gram Sabha awareness programme was also organized at Momanpur village by ICAR- IISS, Bhopal.



Pledge taken by staff



Gram Sabha awareness Programme

Research Advisory Committee Meeting

Research Advisory Committee (RAC) meeting was organized during November 13-14, 2024 under the chairmanship of Dr VS Tomar, Ex EV, JNKVV, Jabalpur to evaluate the significant achievements presented by HODs and AICRP In-Charges. The meeting was also attended by external experts Dr DK Sharma, Ex Director, ICAR-CSSRI, Karnal; Dr AK Saxena, Ex Director, ICAR-NBAIM, Mau; Dr Dinesh Mohan, Professor, School of Environment Science, JNU, Delhi; Dr SK Pattanayak, Ex Head, Division of Soil Science, CoA, OUAT, Bhubaneshwar, Dr M Suresh Kumar, Chief Scientist, Environmental Impact and Sustainability Division, CSIR-NEERI; Dr RN Sahu, Principal Scientist, Division of Agricultural Physics, IARI, New Delhi and Dr A Velmurugan, ADG (S&WM), ICAR, New Delhi.




World Soil Day 2024

The ICAR- Indian Institute of Soil Science celebrated World Soil Day on December 5, 2024 with the theme "Caring the Soils: Measure, Monitor and Manage". On this occasion, a march-past was organized from the Institute to the nearby premises to create awareness among the common people. The formal session was graced by Padam Shri Awardee and World Food Prize Winner, Dr. Rattan Lal, Distinguished Professor, The Ohio State University, Columbus, USA as the Chief Guest. Dr Rattan Lal emphasized on making a healthy soil, atmosphere and earth planet. He reiterated the basic things and indicated his concerns on the issues such as (i) Burgeoning population, (ii) Per capita land area, (iii) Extent of soil and land degradation, (iv) Per capita availability of water and soil is the largest reservoir of green water, (v) Climate change, (vi) Energy level, (vii) Per capita grain consumption, (viii) Nutritional quality rather than food production to prevent malnutrition, (ix) Per capita carbon dioxide (CO2) production to be decreased, and (x) World peace is more of scientific issue rather than political one.






World Soil Day celebration with farmers at Ratibad Village, Bhopal

International Conference on Regenerative Agriculture

An International Conference on "Regenerative Agriculture for Improving Soil Health, Enhancing Carbon Sequestration and Building Climate Resilience" was jointly organized by ICAR-Indian Institute of Soil Science, Bhopal; M/s Solidaridad and M/s Nico Roozen at Silver Jubilee Hall of ICAR-CIAE, Bhopal on December 6, 2024. Dr SK Chaudhari, DDG (NRM), ICAR, New Delhi graced the occasion as the Chief Guest and urged a collective effort for a healthy planet earth for future. On this occasion, Padam Shri and World Food Prize Winner Professor Dr. Rattan Lal, Distinguished Professor, The Ohio State University, Columbus, Ohio, USA, stated the significance and scope of 'Regenerative Agriculture' and enumerated the challenges for 21st Century before the country and emphasized sustainable management of natural resources such as soil, water and environment. Dr SP Datta, Director, ICAR-IISS, Bhopal presented the role of the Institute towards promotion of regenerative agriculture and soil health management practices. Dr Shatadru Chattopadhayay, Managing Director, Solidaridad Asia spoke on "Carbon, Climate & Community: Solidaridad's global approach towards promoting Regenerative Agriculture for Balanced Ecosystem & Building Sustainable Supply Chains". About 300 delegates including farmers, students and scientists from different organizations participated in the conference. The event was coordinated by conveners Dr R Elanchezhain, Dr S Lenka and Organizing Secretaries, Dr P Jha.









Agriculture Education Day

Agriculture Education Day was observed during 'Soil Health Awareness Programme', during December 3-6, 2024 by ICAR-IISS, Bhopal. About 50 students from PM Shri Higher Secondary School, Parwalia Sadak; PM Shri Jawahar Navoday School, Ratibad; CM Rise Sardar Patel School, Karond, and St. George School, Karond participated in the event.



Kisan Diwas (Farmer's Day) and Swachhta Awareness Program





12. PARTICIPATION OF SCIENTISTS IN CONFERENCES/ SYMPOSIA/ SEMINARS/ WORKSHOPS/ MEETING

Name of the Scientist	Programme Attended	Venue/Organizer	Period
All Scientists	Interaction Meeting of Hon'ble DG, ICAR with Scientists of ICAR	Online	January 5, 2024
Drs Pramod Jha, Vassanda Coumar, Jitendra Kumar, Sudeshna Bhattacharjya, Khusboo Rani and Abinash Das	Science Fiesta	Regional Science Center, Bhopal	January 11-13, 2024
Drs RH Wanjari and Dhiraj Kumar	Relevance of Ideology of Swami Vivekanand and Sri Ram Krishna Paramhansa in man making and Nation Building' by Dr PS Brahmanand, PD, WTC	ICAR-IARI, New Delhi	January 12, 2024
Drs RH Wanjari and Dhiraj Kumar	Meeting of AICRP LTFE w.r.t. QRT 2012-17 ATR	Online	January 16, 2024
Dr Shinogi KC	National Conference on Next Generation Agriculture-Organic and Natural Farming Pathways: Extension Strategies & Approaches	JNKVV, Jabalpur, MP	January 28-30, 2024
Dr Narayan Lal	3rd Indian Horticulture Summit-Cum-International Conferences-2024 on Technological Intervention for Boosting Horticultural Production	RARI, Durgapura, Jaipur, Rajasthan	February 1-3, 2024
Dr Sanjay Srivastava	Surveyed soils of tribal farmers in Balaghat, Madhya Pradesh and Farmers' field schools	Balaghat, Madhya Pradesh	February 3-7, 2024
Dr Sanjay Srivastava	Refresher course of technical assessors	NABL, New Delhi	February 9, 2024
Drs JK Thakur, Asit Mandal, Nisha Sahu, Immanuel C Haokip	National Webinar and 11th Annual convention of Society for Fertilizers and Environment	Online, Society for Fertilizers and Environment, Kolkata	February 23-24, 2024
Dr Nisha Sahu	International Conference on Environment and Earth Sciences (ICEES-2024)	VDGOOD Professional Association, India	February 24, 2024
Dr Pramod Jha	Orientation Workshop on Mission Karamyogi organized by DARE/ICAR	NASC, New Delhi	February 27, 2025
Drs Nisha Sahu, Immanuel C Haokip,	National Conference on Novel Strategies for Mitigating Biotic and Abiotic Stresses for Agricultural and Environmental sustainability	ICAR-NIBSM, Raipur, CG	February 28-29, 2024
Dr Dhiraj Kumar	Pedagogical Development Programme on Enhancing Pedagogical Competencies for Agricultural Education	NAAS, New Delhi	March 4-8, 2024

Dr Shinogi KC	National Seminar on Transformative agriculture and sustainable development: Rethinking agriculture for a changing world,	MPUA&T, Udaipur, Rajasthan	March 5-7, 2024
All Scientists	National Workshop cum Mid- term Review Meeting NTPC funded project Use of fly ash for sustainable crop production and environmental protection	ICAR-IISS, Bhopal	March 12-13, 2024
Dr Asha Sahu	6th Edition of the Advanced Chemistry World Congress	Online, London, UK	March 27-28, 2025
All Scientists	Review Meeting of SMDs (Extension, Horticulture and Animal Science Divisions) Chaired by DG ICAR	Online	April 5, 2024
Drs RH Wanjari and Dhiraj Kumar	Eco-regional programme of ICAR	Online	April 12, 2024
Dr Asha Sahu	3rd World Conference on Recycling and Waste Management	Online, Berlin, Germany	April 22, 2024
Dr M Homeshwari Devi, Immanuel Chongboi Haokip	International Conference on "Recent Advances in Agriculture for Aatmanirbhar Bharat (RAAAB-2024)	Agri Meet Foundation, UP	April 19-21, 2024
Dr M Homeshwari Devi	International Conference on Collaborative excellence in Multidisciplinary research	Manipur International University	April 22-24, 2024
Dr Seema Bhardwaj	Workshop on Promotion and Dissemination of Climate Resilient Millet Technology	ICAR-VPKAS, Almora	April 26, 2024
Dr Madhumonti Saha	Pedagogical Development Programme (7th Batch)	NAAS complex, New Delhi	April 29 - May 3, 2024
All Scientists	Lecture on Power of Intellectual Property Rights on World Intellectual Property Day 2024	Online	April 30, 2024
All Scientists	Viksit Bharat Meeting (Horticulture Crops) of ICAR in various commodities like Rice, Wheat, Maize, Oilseed, Pulses, Meat, Fruit Crops, Vegetable Crops, Mushroom, Potato & Tuber Crops, Flowers/Orchids and Medicinal Crops, Spices etc	Online	May 1-2, 2024
Drs JK Thakur, Asit Mandal, Asha Sahu	Round Tables on Advancing Waste Management Practices in India	Swachh Bharat Mission – Urban, New Delhi (Online)	May 10, 2024
Dr Asit Mandal	Advancing waste management practices in India (Round Table Discussion)	Ministry of Housing and Urban Affairs	May 13, 2024
Dr Asit Mandal	Regional Consultation on Science of Natural farming	Department of Agriculture, Govt. of Maharashtra	May 16, 2024
Dr Nisha Sahu	7th International Conference on Global Approaches in Agricultural, Biological, Environment and Life Sciences for Sustainable Future (GABELS- 2024)	Online	June 8-10, 2024

All Scientists	Commodity presentation meeting of Animal Science Division of ICAR	Online	June 10, 2024
Dr BP Meena	Regional consultation on Science of Natural Farming	MANAGE, Hyderabad	June 14, 2024
All Scientists	ICAR- AUs Interaction meeting	Online	June 15, 2024
Dr. Asit Mandal	National Symposium and IARI Alumni meet	Online, ICAR-IARI, New Delhi	June 22, 2024
Dr Pramod Jha	Panellist in Water Stewardship in Regenerative Agriculture during stakeholders Consultation meet	Jehan-Numa Palace, Bhopal	July 8, 2024
Dr Shinogi KC	Group Monitoring Workshop for Scheduled Caste Sub Plan (SCSP) and Tribal Sub Plan (TSP) projects funded by DST	GITAM University, Visakhapatnam, Andhra Pradesh	July 10, 2024
Dr DK Yadav	Crop Protection Solutions: Group MRL and Minor Uses of Pesticides	NAAS, New Delhi	July 12, 2024
Dr Narayan Lal	Agri-horti systems for soil health Management during 6th International Conference in Hybrid Mode on Innovative and Current Advances in Agriculture & Allied Sciences (ICAAAS-2024)	Online Hanoi, Vietnam	July 15-20, 2024
All Scientists	96th Foundation Day of ICAR	Online	July 16, 2024
Drs RH Wanjari, Dhiraj Kumar	Information System on Long Term Fertilizer Experiments (ISLTFE)	Online	July 18, 2024
Drs RH Wanjari, Dhiraj Kumar, Sanjay Srivastava, Immanuel C Haokip	Consultative Meeting on Reutilization of the Accumulated Phosphorus in Soil under Chairmanship of DDG (NRM), ICAR, New Delhi	Online	July 26, 2024
Drs Asit Mandal, JK Thakur	World Bank Round Table meeting on Air Quality Meeting across Indo-Gangetic plains	World Bank New Delhi office (Online)	August 1, 2024
Dr Nisha Sahu	Online meeting on CSR 1 Registration details	Shri Nitin Khera, Head, Finance Division, Third Planet Foundation	August 2, 2024
Dr DK Yadav	Fifth CSR webinar	CSIR – Institute of Microbial Technology (IMTECH), Chandigarh	August 12, 2024
Dr Nisha Sahu	Fifth Knowledge Series Webinar on A Decade of Strategic CSR	Online	August 12, 2024
Dr SR Mohanty	Review meeting of Foreign Aided Projects (FAP)	CRIDA Hyderabad	August 13 -14, 2024

Dr Asit Mandal	Microplastics Removal from Environmental Matrices: Current Scenario, Challenges, & Future Perspectives	ICMR-NIREH, Bhopal	August 22-23, 2024
Dr Asha Sahu	International Conference on Current Innovations and Technological Advances in Agriculture and Allied Sciences (CITAAS-2024)	Guru Kashi University, Talwandi Sabo (ICAR accredited) and Just Agriculture Education Group and ISASTR, Noida	August 29-31, 2024
Dr DK Yadav	Annual Review Meeting of the MPCoST project	Nehru Nagar, Bhopal	August 31, 2024
Dr Seema Bhardwaj	Workshop on geospatial application for plantation crop organized by CPCRI &RRSC South, NRSC, ISRO, Bengaluru	Online, ICAR-CPCRI, Kasargod	September 5, 2024
Dr M Homeshwari Devi	7th International conference on "Advances in agriculture technology and Allied sciences (ICAATAS 2024)	Society of Agriculture Research and Social Development, New Delhi	September 15-16, 2024
All Staff	Swachhata Pledge administered by Hon'ble Secretary (DARE) & DG (ICAR)	Online	September 17, 2024
Drs Asha Sahu, Narayan Lal	Webinar (online) on Carbon Credits in Agriculture: Unravelling the Enigma	UAS, Bengaluru	September 19, 2024
Dr RS Chaudhary	National Agriculture Education and Research Managers' Conclave organized by Bhartiya Agro-Economic Centre	NASC New Delhi	September 25, 2024
Drs Asha Sahu, Immanuel C Haokip	The Global Symposium on Soil Information & Data (GSID24)	FAO& Chinese Academy of Sciences, Nanjing, China (Online)	September 25-28, 2024
Dr Abinash Das	Fourth Edition of International Conference Plant Security and Food Safety: Microbiology, Soil Science, Food Quality and Agricultural Genetics	Toruń, Poland (Online)	September 26-27, 2024
Dr Nisha Sahu	Leadership Development Programme for Scientists	ASCI, Bella Vista, Hyderabad	October 14-18, 2024
Dr Abinash Das	9th International Symposium of Interactions of Soil Minerals with Organic Components and Microorganisms (ISMOM)	Ibaraki, Tsukuba, Japan	October 15-18, 2024
Dr Pramod Jha	Workshop on Long term low emission development Strategy for Madhya Pradesh	EPCO, Bhopal	October 18, 2024
Dr Immanuel C Haokip	Training on National Intellectual Property Awareness Mission	Intellectual Property Office, India (Online)	October 18, 2024

13. WORKSHOPS, SEMINARS AND TRAININGS ORGANIZED

Workshop/Webinar/Conference/Meeting/Day/Mela/Pakhwada/Week/Campaign/Symposium

Title	Course Directors/ Coordinators	Duration	Sponsored by
Kisan Mela/Workshop cum Training at KVK, Surgi Rajnandgaon, Chhattisgarh	Drs Prabhat Tripathi, R. Elanchezhian, MV Coumar, Nisha Sahu, Narayan Lal and DK Yadav	February 26-29, 2024	ICAR-IISS, Bhopal
High-end workshop or Karyashala on State-of-the-art instrumentation for appraising soil biogeochemical processes and microbial diversity with respect to soil-climate feedback response	Drs Sudeshna Bhattacharjya, K Bharati, Asha Sahu, Asit Mandal, J K Thakur, M Homeshwari Devi, Khushboo Rani, Abinash Das	March 4-13, 2024	SERB, New Delhi
National campaign on Soil Health Management and Composting organized under LiFE	Drs SP Datta, Dr SR Mohanty, JK Thakur, Asha Sahu, BP Meena	April 24, 2024	ICAR- IISS, Bhopal
Training cum agricultural inputs distribution programme at KVK Barwani (M.P.) was held on for 50 tribal farmers of Barwani district of Madhya Pradesh	Drs Jitendra Kumar, Khushboo Rani and Dr Abinash Das	June 25, 2024	KVK, Barwani & ICAR-IISS, Bhopal
19th Parthenium Awareness Week	Drs AK Tripathi, Prabhat Tripathi, BP Meena	August 16-22, 2024	ICAR- IISS, Bhopal
Swachhta Hi Sewa Campaign	Dr BP Meena	September 15 - October 2, 2024	ICAR-IISS, Bhopal
Special Campaign 4.0 for institutionalizing Swachhata and minimizing pendency in Government offices	Dr BP Meena	October 2-31, 2024	ICAR-IISS, Bhopal
Workshop cum training for tribal farmers at KVK, Rajnandgaon, Chhattisgarh	Drs. R. Elanchezhian, M. V. Coumar, Nisha Sahu, Narayan Lal and D.K. Yadav	November 10-12, 2024	ICAR-IISS, Bhopal
Kisan Diwas (Farmer's field Day) on the occasion of National Farmers Day at Rasuliya Pathar, Bhopal	Dr BP Meena	December 23, 2024	ICAR- IISS Bhopal

Training

Title	Course Directors/Coordinators	Duration	Sponsored by
Economic Empowerment of Small and Marginal Farmers through Backyard Poultry Farming under the livestock module of the Farmer FIRST	Drs KC Shinogi, Sanjay Srivastava, K Bharti, Asha Sahu, Narayan Lal, RH Wanjari, RK Singh, Immanuel C Haokip, Dinesh K Yadav	January 19, 2024	ICAR-IISS, Bhopal
Training & Exposure visit of farmer's producer's organizations representatives	Dr BP Meena	April 10, 2024	ICAR- IISS, Bhopal
Soil Health Management for Sustainable Agriculture for farmers and officials of ATMA	Drs Pramod Jha, B.P. Meena, Khushboo Rani, SK Behera	May 30- June 3, 2024	ATMA, Begusarai, Bihar
Soils of India for Fruit Production	Drs. Narayan Lal, Nisha Sahu, Khushboo Rani, Seema Bhardwaj	June 5-7, 2024	VNR, Nursery, Raipur, Chhattisgarh
Building Climate Resilient Agricultural Systems through Community Based Approaches	Drs. Shinogi KC, Sanjay Srivastava, Immanuel Chongboi Haokip, Balasubramani N and Sreelakshmi C (MANAGE)	June 10-14, 2024	ICAR- IISS, Bhopal & MANAGE, Hyderabad,
Crop Diversification and Soil Health Management	Drs AK Tripathi, BP Meena, Narayan Lal	September 30-October 3, 2024	Chief District Agriculture Officer Bargarh District, Govt. of Odisha
Poly mulch in crop cultivation: pros and cons	Drs. Tapan Adhikari, Asit Mandal, Jyoti Thakur and SP Datta	November 27-28, 2024	ICAR-IISS, Bhopal
Crop Diversification and Soil Health Management for Progressive Farmers	Drs AK Trapathi, BP Meena	December 23-27, 2024	Chief District Agriculture Officer, Bargarh, Govt. of Odisha

Glimpses of Events Organized by the Institute





Workshop on poly mulch in crop cultivation: pros and cons





Essay writing competition at St. George School and Red Rose Co-Ed School



Kisan Mela/Workshop cum Training at KVK, Surgi Rajnandgaon, Chhattisgarh



Workshop cum training at KVK, Rajnandgaon, Chhattisgarh



Training on crop diversification and soil health management



Training on crop diversification and soil health management



Training cum- workshop at Rajnandgaon, Chhattisgarh



Farmer-scientist interaction on soil health management



Farmers field day at Ratanpur village, Bhopal



Training on Backyard Poultry Farming under Farmer FIRST



Training on soils of India for fruit production

Workshop cum training on Soil Health and Plant Nutrient Management at Rajnandgaon district of Chhattisgarh

ICAR- Indian Institute of Soil Science, Bhopal (M.P.) organized workshop cum training and Input distribution during November 11-12, 2024 at KVK Surgi, Rajnandgaon district, Chhattisgarh. Shri Sanjay Agarwal, District Collector, Rajnandgaon graced the occasion as Chief Guest and interacted with the farmers on various aspects of livelihood improvement. Ms Suruchi Singh, Chief Executive Officer, Rajnandgaon district presided over the occasion and encouraged the farmers to avail the government schemes. Dr. Pratibha Katiyar, Professor, IGKV, Raipur, Dr. S. K. Singh, IFFCO, Raipur; Dr. Gunjan Jha, Senior Scientist & Head, KVK; Dr. Vinamrata Jain, Professors, College of Agriculture, Rajnandgaon and Dr. Nageswar Pandey, Deputy Director Agriculture participated in the program. During this occasion, 12.6 quintal chickpea and 70 kg cowpea seeds were distributed to tribal farmers. The workshop cum training on Soil Health and Plant Nutrient Management was addressed by the team of ICAR-IISS, Bhopal comprising Dr. R. Elanchezhian, Dr. M. Vassanda Coumar, Dr. Nisha Sahu, Dr Narayan Lal and Dr Dinesh Kumar Yadav. On 12 November 2024, an On-Farm training was conducted at Malpuri village, Rajnandgaon district, where tribal farmers participated. The scientific team of IISS Bhopal visited the on farm-demonstrations and emphasized the importance of soil health and modern techniques in crop production for enhancing farm income and livelihood. The events were given a wide coverage in the local press and media.





Krishi Mela cum Workshop on Natural Farming at KVK Surgi, Rajnandgaon district, Chhattisgarh

Media Coverage of Various Activities

पत्रिका

बसें भी बड़वानी से धार की ओर लगाने से बचे।

किसानों को दिया कृषि आदान वितरण और मृदा स्वास्थ्य प्रबंधन का प्रशिक्षण

पत्रिका न्यूज नेटवर्क
patrika.com



बड़वानी. किसानों को प्रशिक्षण देते कृषि वैज्ञानिक।

बड़वानी. भारतीय मृदा विज्ञान संस्थान भोपाल और स्थानीय कृषि विज्ञान केंद्र के तत्वावधान में कृषि आदान वितरण और कृषक प्रशिक्षण कार्यक्रम का आयोजन केवीके में किया गया। इस दौरान प्रधान वैज्ञानिक डॉ. एसके बड़ोदिया सहित भारतीय मृदा विज्ञान संस्थान भोपाल के प्रधान वैज्ञानिक डॉ. आरके सिंह, वरिष्ठ वैज्ञानिक डॉ. जितेन्द्र कुमार, डॉ. आसित मंडल, डॉ. धीरज कुमार ने किसानों को कृषि आदान वितरण और मृदा स्वास्थ्य प्रबंधन पर आवश्यक जानकारियां दी।

डॉ. जितेंद्र कुमार ने कृषकों से प्राकृतिक खेती के महत्व की जानकारी देकर आने वाले समय के लिए उपयोगी बताया। डॉ. आरके सिंह ने मृदा स्वास्थ्य प्रबंधन के विषय में जानकारी दी। साथ ही वर्तमान समय में मृदा परीक्षण की आवश्यकता पर जोर दिया और फसल चक्र अपनाकर संरक्षित खेती अपनाने का आह्वान किया। वहीं डॉ. बड़ोदिया ने आदिवासी उप योजनांतर्गत केंद्र द्वारा किए जा रहे कार्यों की जानकारी दी। प्रशिक्षण में किसानों को वीडियो फिल्म के माध्यम से चना फसल में बीजोपचार व वैज्ञानिकों द्वारा रबी की प्रमुख फसलों की उन्नत उत्पादन तकनीकी की जानकारी दी। इस मौके पर वैज्ञानिकों ने किसानों के प्रक्षेत्र का भ्रमण कर मृदा नमूने एकत्रित किए।

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किसानों को दी प्राकृतिक खेती की जानकारी

बड़वानी | भारतीय मृदा विज्ञान संस्थान भोपाल व कृषि विज्ञान केंद्र बड़वानी के सहयोग से बुधवार को एक दिनी कृषि आदान वितरण व कृषक प्रशिक्षण आयोजन कृषि विज्ञान केंद्र में किया गया। प्रधान वैज्ञानिक डॉ. एसके बड़ोदिया ने प्रशिक्षण में विशिष्ट अतिथि के रूप में भोपाल के वरिष्ठ वैज्ञानिक डॉ. जितेंद्र कुमार, डॉ. खुशबू रानी व डॉ. अभिनाश दास शामिल हुए। उन्होंने कहा- मृदा परीक्षण कराया जाना अत्यंत आवश्यक है। खरीफ फसलों में बीजोपचार के महत्व की जानकारी दी। वैज्ञानिकों ने किसानों को प्राकृतिक खेती के महत्व की जानकारी देकर आने वाले समय के लिए उपयोगी बताया। मृदा में समन्वित पोषक तत्व प्रबंधन करने की बात कही। इस दौरान बड़ी संख्या में किसान मौजूद थे।

सिटी एक्टिविटी

मृदा स्वास्थ्य प्रबंधन पर क्विज प्रतियोगिता



भोपाल। आईसीएआर-भारतीय मृदा विज्ञान संस्थान ने 'मृदा स्वास्थ्य प्रबंधन और कंपोस्टिंग' पर राष्ट्रीय अभियान चलाया। डॉ. एसके चौधरी, उप-महानिदेशक (प्राकृतिक संसाधन प्रबंधन) ने मानव जीवन को बचाने के लिए मृदा स्वास्थ्य के महत्व पर प्रकाश डाला। उन्होंने कहा कि मिट्टी पौधे, मनुष्य और जानवरों का पोषण करती है। मिट्टी को बचाना और संरक्षित करना प्रमुख जिम्मेदारी है। स्कूली छात्रों ने मिट्टी बचाओ, पृथ्वी बचाओ थीम पर स्लोगन, और ड्राइंग प्रतियोगिता में भाग लिया। विजेताओं को समारोह के मुख्य अतिथि द्वारा पुरस्कृत किया गया। आयोजक सचिव डॉ. एसआर मोहंती द्वारा कार्यक्रम का संचालन किया गया।

दैनिक भास्कर खरगोन 27-06-2024

किसानों को दी प्राकृतिक खेती की जानकारी

14. DISTINGUISHED VISITORS



Dr. Patricio Grassini, Sunkist Distinguished Professor and Dr. Walter Carciochi, Assistant Professor, Department of Agronomy and Horticulture, University of Nebraska-Lincoln, USA visited ICAR-IISS, Bhopal on February 08, 2024



Dr NK Tyagi, Former Member, ASRB visited institute on February 23, 2024



Dr. Francoise Bringel, Director CNRS Research, University of Strasbourg, France visited the Institute during March 3-10, 2024



Dr A Velmurugan, ADG (S&WM) visited institute on September 19, 2024



Dr. Rattan Lal, Distinguished Professor, The Ohio State University, Columbus, USA and Dr SK Chaudhari, DDG (NRM), ICAR visited the institute on December 5-6, 2024



Dr Sushma Singh, Member, Governing Body of ICAR visited the institute on September 26, 2024



Dr Rameshwar S Kanwar, Charles F Curtiss Distinguished Professor of Soil and Water Resource Engineering, Iowa State University, Ames, Iowa visited the institute from March 12-16, 2024

15. INFRASTRUCTURE DEVELOPMENT

Instrument/Equipment Purchased

During the year 2024, Refrigerators, Deep Freezer, Revolving Chairs, Electrophoresis System, Monitor for BET Instrument, Smart Television, Integrated Sheet Fed Scanner, UPSs, Portable Projector, Stainless Steel Vacuum Pump, Laptop, Irrigation Monitoring System, Refrigerated Centrifuge, CPVC Ball Valve 1/2 inch, Water Bath, Multifunction Printer/Machince, Scanner, Nanodrop Spectrophotometer, Computer Table, Almirah Steel, Non-Revolving Chair, Analytical Balance, Environmental Shaker Incubator, Nitrogen Digestion cum Distillation Unit, Seed Drill 11 Tines, Single Beds, pH Meter, Laboratory Hot Air Oven, Laboratory Rotary Shaker, Soil Moisture Sensor, Visible Spectrophotometer, Brush Cutter, Chain Saw, Lawn Mower, Power Tiller, Submersible Pump, Webcam (USB PTZ Camera with Speaker Phone & Optical Zoom & Remote), Rotary Shaker, Mild Steel Single Wheel Hoe, UTM Firewall-NGFW (Sophos), LED Screen (People Link Display Interactive Panel), Spare"Starter Relay of auto cut off control" for Double Distillation Unitwere purchased.

Inaugurated Furnished Institute Main Gate and Selfie Point on April 23, 2024.





Inauguration of furnished institute main gate and selfie point by Hon'ble Dr. S.K. Chaudhary, DDG (NRM)

Library

The library section maintained books, journals, bulletins and annual report and providedlending, referencing and reprographic services etc. The library exchanged publications of the institute with other ICAR institutes and SAUs. During the period under report, the library has acquired the documents as mentioned below:

Documents	Addition during 2024	Total
Books	66	2721
Bound Journals	Nil	3180
Annual Reports	25	2772
Foreign and Indian Journals	Nil	Nil

Farm Activities

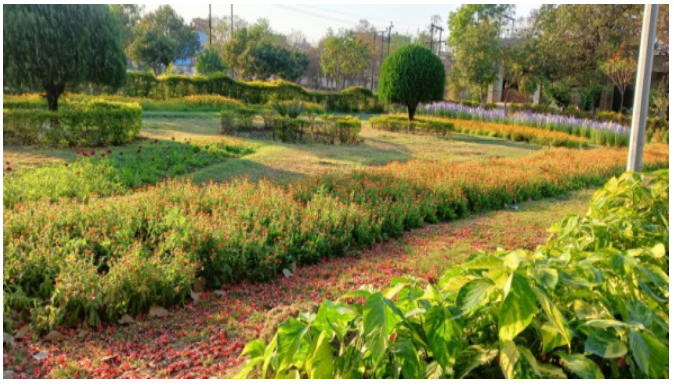
During the year 2024 all farm inputs such as seeds, manure &fertilizers and irrigations water etc. required for various research experiments and general area in kharif, rabi & summer season were arranged by the farm section A scientific plan was made and executed in general farm cropping for rabi season. Farm section updated cleanliness of entire farm; efficient management and utilization of water and

other farm resources in experiments and general farm; shaping of farm ponds and its embankments, made them tractorable for easy mowing of grasses/ other maintenances; cleaning of haphazardly heaped stone slabs behind the main building and placing them systematically on the boarders for making lawn there; installed drip irrigation system in guava, lemon and amla orchards worth Rs 5.80 lakhs; cleaned and applied manure and fertilizers in the fruit orchards; procured latest equipments for horticulture and farm like hedger, brush cutters, lawn mower, chain saw worth Rs 2 lakhs; and seed drills, tine cultivator, water tanker worth Rs 4.00 lakhs; repaired the farm implements and tractors; Orders placed at ICAR-CIAE for more equipments worth Rs 3.35 lakhs. At the same time lawn and gardens were maintained in a very efficient manner.

The total revenue generated during the year 2024-25 was Rs.10, 94,285/- in addition to the fruit sale. To address, water scarcity, drilling of a new bore well has been initiated.



A view of horticulture crops



A panoromic view of front garden

16. SCIENTIFIC, TECHNICAL, ADMINISTRATIVE, SUPPORTING PERSONNEL

Details of manpower

Name	Designation	Discipline/ category	Date of Joining ICAR	Date of Joining IISS
DIRECTOR'S CELL				
Dr Siba Prasad Datta	Director	Soil Chemistry/Fertility/ Microbiology	25.07.1994	13.02.2023
Mr Venny Joy	Private Secretary	Office Staff	14.02.1991	23.03.1998
Mr Sunny Kumar	Personal Assistant	Office Staff	21.12.2011	21.12.2011
Mr Sukhram Sen	Senior Technical Assistant	Staff Car Driver	25.01.1991	25.01.1991
Mr Darashram	Skilled Supporting Staff	Lab Attendant	15.03.1990	15.03.1990
DIVISION OF SOIL PHYSICS				
Dr Narendra Kumar Lenka	Pr. Scientist & Head	Soil Physics/Soil & Water Conservation	30.11.2000	09.10.2009
Dr Ranjeet Singh Chaudhary	Pr. Scientist	Soil Physics/Soil & Water Conservation	10.11.1993	09.12.1999
Dr Rakesh Kumar Singh	Pr. Scientist	Soil Physics/Soil & Water Conservation	25.01.1993	16.10.2002
Dr Prabhat Tripathi	Pr. Scientist	Agronomy	19.09.1998	28.06.2017
Dr Nishant Kumar Sinha	Sr. Scientist	Agricultural Physics	20.04.2010	27.08.2010
Dr Jitendra Kumar	Sr. Scientist	Soil Science/Soil Physics	15.09.2011	02.01.2020
Dr Alka Rani	Scientist	Soil Science	04.01.2019	12.04.2019
Mr Jai Singh	Asst. Chief Technical Officer	T-7-8	22.05.1990	22.05.1990
Mr Janak Singh Mehra	Skilled Supporting Staff	Khalasi	08.09.1997	08.09.1997
DIVISION OF SOIL CHEMISTRY AND FERTILITY				
Dr Sanjib Kumar Behera	Pr. Scientist& Head	Soil Science & Agricultural Chemistry	08.01.2007	27.06.2017
Dr Ashis Kumar Biswas	Pr. Scientist & I/c Head	Soil Chemistry/Fertility/ Microbiology	21.01.1992	11.01.1993
Dr Sanjay Srivastava	Pr. Scientist	Soil Chemistry/Fertility/ Microbiology	22.03.1996	02.09.1996
Dr R Elanchezhian	Pr. Scientist	Plant Physiology	09.11.1998	17.2.2012
Dr Pramod Jha	Pr. Scientist	Soil Chemistry/Fertility/ Microbiology	16.04.2003	17.07.2009
Dr Shinogi KC	Senior Scientist	Agricultural Extension	27.04.2011	05.09.2011
Dr Bharat Prakash Meena	Senior Scientist	Agronomy	15.09.2011	22.12.2011
Dr Seema Bhardwaj	Scientist	Soil Science (Pedology)	07.01.2008	07.07.2018
Dr Narayan Lal	Scientist	Fruit Science	01.01.2013	24.12.2019
Dr Khushboo Rani	Scientist	Soil Science	05.10.2020	13.01.2021
Ms Aditi Agrawal	Scientist	Agricultural Economics	25.10.2024	05.12.2024
Mr Deepak Kaul	Chief Technical Officer	T-9	29.12.1988	29.12.1988
Mr Prahlad Rajak	Technician	T-1	26.04.2024	26.04.2024
Mr Harish Kumar Barmaiya	Technician	T-1	14.03.1990	14.03.1990
DIVISION OF SOIL BIOLOGY				
Dr Santosh Ranjan Mohanty	Pr. Scientist& Head	Soil Chemistry/Fertility/ Microbiology	18.06.2009	18.06.2009

Dr Awadesh Kumar Tripathi	Pr. Scientist	Soil Chemistry/Fertility/ Microbiology	05.08.1991	25.07.1992
Dr Kollah Bharati	Pr. Scientist	Microbiology – Plant Science	29.10.2009	05.04.2011
Dr Asit Mandal	Sr. Scientist	Soil Chemistry/Fertility	23.06.2009	30.10.2009
Dr Jyoti Kumar Thakur	Sr. Scientist	Agricultural Microbiology	20.04.2010	27.08.2010
Dr Asha Sahu	Sr. Scientist	Soil Chemistry/Fertility/ Microbiology	03.05.2010	03.05.2010
Dr Sudeshna Bhattacharjya	Scientist	Soil Science	01.01.2015	10.04.2015
Dr Abinash Das	Scientist	Soil Science	05.10.2020	13.01.2021
Mr Sant Kumar Rai	Sr. Technical Asstt (T-4)	(T-4)	15.06.1989	15.06.1989
Mr Kalicharan	Skilled Supporting Staff	Lab attendant	10.06.1999	10.06.1999
DIVISION OF ENVIRONMENTAL SOIL SCIENCE				
Dr Tapan Adhikari	Pr. Scientist & Head	Soil Chemistry/Fertility/ Microbiology	22.03.1996	07.11.1996
Dr Jayant Kumar Saha	Pr. Scientist	Soil Chemistry/Fertility/ Microbiology	21.01.1992	02.01.1993
Dr Ajay	Pr. Scientist	Plant Physiology	12.04.1993	31.08.1999
Dr Sangeeta Lenka	Pr. Scientist	Soil Physics/Soil & Water Conservation	08.01.2007	18.05.2007
Dr M Vassanda Coumar	Sr. Scientist	Soil Chemistry/Fertility	04.11.2009	15.03.2010
Dr Nisha Sahu	Sr .Scientist	Soil Science: Soil Chemistry	23.01.2012	30.11.2019
Dr Abhijit Sarkar	Scientist	Soil Science	05.07.2016	29.06.2018
Mrs Madhumonti Saha	Scientist	Soil Science	05.07.2017	29.06.2018
Dr Dinesh Kumar Yadav	Scientist	Agricultural Chemicals	05.10.2020	12.01.2021
Mr Shahab Siddiqui	Chief Technical Officer	T-9	05.10.1992	05.10.1992
Mr SundramLodhi	Technician	T-1	26.04.2024	26.04.2024
Mr Ram Bharose	Skilled Supporting Staff	Lab attendant	20.03.1990	20.03.1990
AICRP-LONG TERM FERTILIZER EXPERIMENT				
Dr Ravi Harishchandra Wanjari	Pr. Scientist	Agronomy	07.01.1999	07.01.1999
Dr Dhiraj Kumar	Scientist	Soil Science & Agricultural Chemistry	01.01.2015	13.08.2020
Mr Jagannath Gour	Skilled Supporting Staff	Lab attendant	20.07.1992	20.07.1992
AICRP-MICRO- AND SECONDARY NUTRIENTS AND POLLUTANT ELEMENTS IN SOILS AND PLANTS				
Dr Sanjib Kumar Behera	Pr. Scientist & I/c PC, MSPE	Soil Science & Agricultural Chemistry	08.01.2007	27.06.2017
Dr Rahul Mishra	Scientist	Soil Science	05.10.2020	11.01.2021
Mrs Geeta Yadav	Private Secretary	Office Staff	26.12.1995	26.12.1995
Mr Pramod Kumar Chouhan	Technical Officer	T-5	15.02.1993	15.02.1993
AICRP-SOIL TEST AND CROP RESPONSE				
Dr Sanjay Srivastava	Pr. Scientist & I/c PC (STCR)	Soil Chemistry/Fertility/ Microbiology	22.03.1996	02.09.1996
Dr Immanuel Chongboi Haokip	Scientist	Soil Science	07.01.2020	04.04.2020
Mrs Yojana Meshram	Private Secretary	Office Staff	12.05.1997	12.05.1997

Mrs Kavita Bai	Skilled Supporting Staff	Safaiwala	20.12.1988	20.12.1988
AINP- SOIL BIODIVERSITY & BIOFERTILIZERS				
Dr Santosh Ranjan Mohanty	Pr. Scientist, Head & I/C Network Coordinator	Soil Chemistry/Fertility/ Microbiology	18.06.2009	18.06.2009
Dr M.Homeshwari Devi	Scientist	Soil Science	07.01.2020	04.04.2020
PRIORITY SETTING, MONITORING, AND EVALUATION CELL				
Dr R Elanchezhian	Pr. Scientist	I/c PME Cell	09.11.1998	17.02.2012
Mr Sanjay Kumar Kori	Personal Assistant	Office Staff	03.01.2012	03.01.2012
Mr Sanjay Kumar Parihar	Technical Assistant	T-3	29.06.2019	29.06.2019
INSTITUTE TECHNOLOGY MANAGEMENT UNIT (ITMU)				
Dr Sanjay Srivastava	Pr. Scientist	Officer In-Charge	22.03.1996	02.09.1996
Mr Sanjay Kumar Parihar	Technical Assistant	T-3	29.06.2019	29.06.2019
AGRICULTURAL KNOWLEDGE MANAGEMENT UNIT (AKMU)				
Dr Nishant Kumar Sinha	Sr. Scientist	Agricultural Physics	20.04.2010	27.08.2010
REMOTE SENSING & GIS LABORATORY				
Dr Nishant Kumar Sinha	Sr. Scientist	Agricultural Physics	20.04.2010	27.08.2010
LIBRARY SECTION				
Mrs Nirmala Mahajan	Chief Technical Officer	T-9	15.03.1993	15.03.1993
CENTRAL LAB				
Dr Santosh Ranjan Mohanty	Pr. Scientist & Head	Officer In-Charge	18.06.2009	18.06.2009
FARM SECTION				
Dr R S Chaudhary	Pr. Scientist	Soil Physics/Soil & Water Conservation	10.11.1993	09.12.1999
Mr Dashrat Rao Darwai	Sr. Technical Officer	T-6 (Field Assistant)	23.01.1993	23.01.1993
Mr Hukum Singh	Technical Officer	T-5	30.12.1988	30.12.1988
Mr Bhagwat Prasad	Technician	T-1	24.01.1992	24.01.1992
Mr Lalaram Sahu	Skilled Supporting Staff	Beldar	24.07.1992	24.07.1992
Mr Rakesh Kumar Sen	Skilled Supporting Staff	Beldar	08.09.1997	08.09.1997
VEHICLE SECTION				
Smt Babita Tiwari	Assistant Administrative Officer	Purchase & Store	30.05.1996	30.05.1996
REPAIR AND MAINTENANCE SECTION				
Smt Babita Tiwari	Assistant Administrative Officer	Purchase & Store	30.05.1996	30.05.1996
Mr Chandrabhan Tulsiram Wankhede	Technical Officer	T-5 (Electrician)	03.08.1992	03.08.1992
ADMINISTRATION SECTION				
Shri Mahesh Kumar Mulani	Senior Finance & Accounts Officer	Audit and Account	04.12.1987	13.10.2021
Shri Ganesh Kumar Meena	Administrative Officer	Administration	20.03.2024	22.04.2024
MrAnupam Sahasi Rajput	AAO	Establishment-Recruitment, Bill & DDO	14.03.1990	14.03.1990
Mrs Babita Tiwari	AAO	Purchase & Store	30.05.1996	30.05.1996
Mr Bansilal Sarsodia	Assistant	Purchase section	10.09.1997	10.09.1997
Mr Hira Lal Gupta	Assistant	Bill section	23.12.1988	23.12.1988
Mr Deepak	Assistant	Bill Section	01.11.2024	01.11.2024

Mr Om Prakash Yadav	Assistant	Audit & Account	19.12.1988	19.12.1988
Mr Sanjay Katinga	UDC	Cash Section	20.06.1989	20.06.1989
Mrs Raksha Dixit	UDC	Establishment Section	24.05.2013	24.05.2013
Mr Prashant Gour	LDC	Bill Section	15.01.2021	15.01.2021
Mr Bhoi Lal Uikey	LDC	Diary & Dispatch Section	13.11.1995	13.11.1995
Mr Arun Kumar Mishra	LDC	Purchase & Store Section	01.09.1993	10.06.1999
Mr Sanjay Narayan Gharde	LDC	Audit & Accounts Section	15.06.1999	15.06.1999
Mr Pramod Kumar Raut	Skilled Supporting Staff	Beldar	21.07.1992	21.07.1992
Mr Dharam Raj Singh	Skilled Supporting Staff	Messenger	10.09.1993	14.06.1999

Joining

- Shri Ganesh Kumar Meena, Administrative Officer joined on March 20, 2024.
- Shri Sundaram Lodhi, Technicial and Shri Prahlad Rajak, Technician joined on April 26, 2024.
- Shri Deepak, Assistant joined on November 1, 2024.
- Ms Aditi Agrawal, Scientist joined on December 5, 2024.

Promotion

- Shri Darash Ram Manjhi, Skilled Supporting Staff promoted to the post of Technician on October 4, 2024.

Transfer

- Shri Mahesh Kumar Mulani, Senior Finance & Accounts Officer transferred to ICAR-Central Institute of Agricultural Engineering, Bhopal on December 3, 2024.

Retirement

- Shri Jai Singh, Assistant Chief Technical Officer and Smt Kavita Bai, Skilled Supporting Staff superannuated on February 29, 2024.
- Shri Deepak Kaul, Chief Technical Officer and Shri Sant Kumar Rai, Senior Technical Assistant superannuated on November 30, 2024.