Proceedings of IRC Meeting

(16-17 and 20 & 22 December, 2021

3-4 August and 12 August, 2022)

ICAR-Indian Institute of Soil Science

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

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INTRODUCTORY REMARKS OF THE CHAIRMAN, IRC

The IRC meeting was held during 16-17 & 20, 22 December 2021 and 3-4 August and 12 August 2022 in hybrid mode (offline/online) in the Conference Hall of the institute. The member Secretary IRC welcomed the Chairman and other members of IRC and briefed about the purpose and agenda of the meeting. I/c PME Cell presented an account of the ongoing and new projects in the institute and the modalities for presentation. The Director and Chairman of the IRC welcomed all the members of IRC and took this opportunity to congratulate the award winning scientists for their recognitions and honors. He emphasized that all scientists must submit quality research proposals for external funding as well as institute in house funding. He has informed all concerned to highlight the new findings/salient achievements in the presentations and discuss in an interactive mode. The following ongoing and new projects were presented.

Proceedings IRC meeting (pre RPP1, RPP1, RPP-II) held during 16-18 and 20, 22 December 2021 and 3-5 August and 12 August, 2022

Date: 16-18 and 20, 22 December 2021 and 3-5 August and 12 August 2022 (11:00 AM to 6:00 PM) at Conference Hall/Zoom

Institute in-house and external funded projects (RPP-II)
Programme- I Soil Health and Input use efficiency

a) Institute in-house projects

Sl. No.	Title of Project	PI and Co-PI	Division/ Unit	Period		RPP Status	Remarks
1.	Long-term evaluation of integrated plant nutrient supply modules for sustainable productivity in Vertisol	B. P. Meena A. K. Biswas, A. B. Singh, R. S. Chaudhary, R.H. Wanjari	SC&F	Recon-structed April 2012	Long term		• Project to be continued • Change in cropping pattern w.r.t. replacing chickpea with wheat may be made in consultation with project team. • Year wise change in Carbon fractions/stock to be analysed • New scientists Dr. Khushboo Rani and Dr. Hiranmoy Das to be included in discussion with project team
2.	Evaluation of glauconite as source of potassium for crops	A.O. Shirale, Gurav Priya Pandurang, Sanjay Srivastava, B.P. Meena, A.K. Biswas	SC&F	Nov, 2017	Nov 2020		• Project extended up to Dec 2021 • Technology to be brought out with complete recommendations and information on companies who can take up this technology. • New offshoot project to be made
3.	Enhancing the productivity of major crops through improving the natural resource base of tribal inhabited areas of central India	Shinogi K.C., Sanjay Srivastava, B.P. Meena, N.K. Sinha, K. Bharati, Gurav Priya Pandurang, A.K. Tripathi, Hiranmoy Das, R.L. Raut (KVK, Balaghat), Rameshwar Ahirwar (KVK, Balaghat), Aparna Jaiswal (COA, Balaghat)	SC&F	Jan 2018	Dec 2022		• Project to be continued • Quantify the impact of the technologies for last four years • Maps (GIS) to be depicted • Dr. Abhijit Sarkar to be included
4.	Mineralogy of Vertisols in relation K availability in central and western India	Gurav Priya Pandurang, A.O. Shirale, B.P. Meena, B.L. Lakaria, Sanjay Srivastava, P.	SC&F	June 2018	Dec 2023	RPP-II to be submitted	• Project to be continued • Co-PI (Dr. S. Sandeep, Deptt. of Soil Science, KSCSTE, KFRI, Thrissur, Kerala)

		Chandran (ICAR-NBSS&LUP, Nagpur)					to be included • Discussion with ICAR-NBSS&LUP, Nagpur to be done
5.	Micronutrients distribution in major soil orders of India as influenced by soil properties and land use pattern	S.K. Behera, A.K. Shukla, N.K. Sinha, J.K. Thakur, K. Kartikeyan (ICAR-NBSS&LUP, Nagpur)	MSPE	2019	2023	RPP-II 2020-21 to be submitted	• Not presented in December 2021 • RPP-II to be presented • Project to be continued
6.	Enhancement of Soil Health and Livelihood of Tribals in Central India	RH Wanjari, R Elanchezhian, Prabhat Tripathi, RK Singh, KC Shinogi, MV Coumar, J Somasundaram, AO Shirale, Asit Mandal, Hiranmoy Das, AB Singh, Asha Sahu, SK Behera, AK Vishwakarma, M Mohanty, Seema Bhardwaj, Madhumonti Saha, Sanjay Srivastava, K. Bharati, Priya Gurav, BP Meena, AK Tripathi, Abhijit Sarkar, NK Sinha, JK Thakur, I/c KVK Barwani (MP), I/c KVK Rajnandgaon (Chhattisgarh), I/c KVK Betul (MP)	LTFE	April 2018	March 2022	RPP-II 2018-19 to be submitted	• Project extended up to March 2026 in principle subject to approval of EFC • Dr P. Tripathi has requested for replacing him as PI of Rajnandgaon, for which Dr M.V. Coumar has agreed and recommended • Dr. Narayan Lal to be included in place of Dr. Vasudev Meena • Additional tribal area/farmers to be covered • Impact on livelihood to be looked into
7.	Assessment of nutrient (N & P) use efficiency in wheat genotypes for improved crop productivity	R. Elanchezhian, A.O. Shirale, B.P. Meena, Alka Rani, Sanjay Srivastava, Ajay, S. Ramana, A.K. Biswas, MV Coumar, Renu Pandey (ICAR-IARI, New Delhi)	SC&F	October 2019	Sept 2023	RPP-II to be submitted	• Project to be continued • Biochemist (Dr. A.B. Singh) to be included
8.	Development of agri-horticultural system for central India under Vertisols, its impact on soil health and improvement in productivity and quality of fruits	Narayan Lal, Brij Lal Lakaria, AK Vishwakarma, Asha Sahu, Hiranmoy Das, AK Biswas, Pradip Dey, AB Singh	SC&F	July 2020	June 2024	RPP-I & RPP-II 2020-21 to be submitted	• Project to be continued • Crop regulation with urea dosage to be standardized • Organic residue to be used • C-sequestration part to be studied
9.	Studying of climate change impact on nitrogen	NK Lenka, Sangeeta	SC&F	Oct 2020	Dec 2024	Pre-	• Approved

	dynamics and water use in two contrasting cropping system of Central India	Lenka, Pramod Jha, JK Thakur, BP Meena				IRC/IRC/RPP-I to be presented	• Maize-wheat system to be included
10.	Enhancing livelihood security of subsistence farming community through improvement in soil health crop productivity and capacity building in Bhopal district of Madhya Pradesh	BL Lakaria, Ajay, AK Vishwakarma, Jitendra Kumar, Dolamani Amat and all scientists of all divisions	SC&F	April 2020	March 2022	RPP-II to be presented	• Project to be continued

b) Externally Funded Projects

11	All India Network Programme on Organic Farming funded by ICAR-IISFR, Modipuram	A. B. Singh, B.P. Meena, Brij Lal Lakaria, J.K. Thakur	Soil Biology	July 2004	March 2022		• Dr. R. Elanchezhian, Mr. Abinash Das and Dr. N.K. Sinha to be included for Natural/Organic Farming activities • Project extended up to March 2026 subject to EFC approval
12	Ensuring food security, sustainability and soil health through resource conservation based farmer FIRST approach in central India funded by ICAR-New Delhi	A.K. Patra (Project leader), A.K. Vishwakarma (PI), R.K. Singh, A.B. Singh, B.L. Lakaria, R.H. Wanjari, K. Bharati, Asha Sahu, Shinogi K.C., A.O. Shirale, Hiranmoy Das, Narayan Lal	SC&F	March 2016	March 2018	Report 2020-21 to be submitted	• Project extended up to March 2022 subject to EFC approval • Success stories/Report on doubling farmer's income (70 Nos.) to be submitted through PME Cell
13	Development of an automated soil nutrient sensing system funded by NASF	Sanjay Srivastava, A.O. Shirale, P.S. Tiwari (ICAR-CIAE, Bhopal), Vijay Kumar (ICAR-CIAE, Bhopal), Ramesh Kumar Sahani (ICAR-CIAE, Bhopal), Baban Kumar (CSIR-CSIO, Chandigarh), Neelam (CSIR-CSIO, Chandigarh)	SC&F	9 May 2017	8 Dec 2020	Report 2020-21 to be submitted	• Research paper to be prepared and submitted • Project completion report to be submitted
14	Assessing the impact of imbalanced use of chemical fertilizer on soil health using a soil function based quantitative approach funded by DST, New Delhi	N.K. Lenka, B.P. Meena, Sangeeta Lenka, A.O. Shirale, R.H. Wanjari	SC&F	May 2018	April 2021		RPP-III to be presented

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

a) Institute Projects

15	Assessing greenhouse gas emission and soil carbon storage with reversal in tillage practice	Sangeeta Lenka, N. K. Lenka, S. Bhattacharjya	ESS	June 2016	May 2020	RPP-III to be submitted	• RPP-III to be presented • Project concluded • Bulleting to be published
16	Climate change impact on water productivity of major crops in central India	N.K. Sinha, M. Mohanty, J. Somasundaram, Pramod Jha, Alka Rani, Seema Bhardwaj, Hiranmoy Das, K.M. Hati, R.S. Chaudhary	Soil Physics	2019	2023	RPP-I & RPP-II 2019-20, 2020-21 to be submitted	• Project to be continued • Prediction for RCP 8.5 data may be checked
17	Impacts of conservation agriculture on runoff and soil loss under different cropping system in Vertisols	Prabhat Tripathi, R.K. Singh, R.S. Chaudhary, Seema Bhardwaj, J. Somasundaram, M. Mohanty, K.M. Hati	Soil Physics	2019	2024	RPP-I & RPP-II 2019-20, 2020-21 to be submitted	• Project to be continued • Mr. Rahul Mishra to be included
18	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	Jitendra Kumar, NK Sinha, M Mohanty, J. Somasundaram, Alka Rani, KM Hati, RS Chaudhary	Soil Physics	July 2020	June 2024	RPP-II 2020-21 to be submitted	• Project to be continued • Data to be verified
	(b) Soil moisture estimation through remote sensing for agriculture drought monitoring and early warning	Alka Rani, NK Sinha, M Mohanty, Jitendra Kumar, Seema Bhardwaj, RS Chaudhary, KM Hati, RK Singh	Soil Physics	July 2020	June 2024	RPP-II 2020-21 to be submitted	• Dr. N.K. Sinha presented on behalf of PI. • Project to be continued
	(c) Evaluation of deficit irrigation levels and phosphorus nutrition levels for optimizing water productivity rooting behaviour and yield of wheat in semiarid climate of central India	Seema Bhardwaj, Alka Rani, Jitendra Kumar, Prabhat Tripathi, J Somasundaram, RS Chaudhary, M Mohanty	Soil Physics	July 2020	June 2024	RPP-I & RPP-II 2020-21 to be submitted	• Not presented in December 2021 • PI informed that project was not started • IRC recommends to drop this project

b) Externally Funded Projects

19	Assessment of important soil properties of India using mid-infrared spectroscopy funded by ICARAF, Nairobi	K.M. Hati, M. Mohanty, Pramod Jha, R.S. Chaudhary, N.K. Sinha, J.K. Thakur, M.V. Coumar, Pradip Dey, Dhiraj Kumar, A.K. Patra, Javed Rizvi	Soil Physics	May 2015	June 2020	RPP-II 2015-16, RPP-II 2016-17, RPP-II 2017-18, RPP-II 2018-19, RPP-II 2019-20,	• Project extended up to June 2026 • Title revised as "Assessment of important soil properties of India using infrared spectroscopy"

						2020-21 to be submitted	
20	CRP-Conservation Agriculture Development, refinement and validation of conservation agriculture in Vertisols of central India and quantifying impact of CA practices on soil and environment	LCPC: Dr. A.K. Biswas and Dy LCPC: Dr. R.S. Chaudhary K M Hati (PPI), J Somasundaram, A.K. Vishwakarma, R.K. Singh, Pramod Jha	SC&F & Soil Physics	April 2015	March 2022	Report for 2015-16; 2016-17, 2017-18, 2018-19, 2019-20, 2020-21 to be submitted	• Project to be extended up to March 2026. • Subject to approval of EFC 2021-2026
	(a) Demonstration of best-bet conservation agriculture practices on farmers' fields in Vertisols of Central India	A.K. Vishwakarma, R.H. Wanjari, Shinogi KC and A.K. Tripathi	SC&F	April 2015	March 2022	Report for 2015-16; 2016-17, 2017-18, 2018-19, 2019-20, 2020-21 to be submitted	• Project to be extended up to March 2026 • Interaction effect may be studied
	(b) Fine-tuning of conservation agriculture practices for Vertisols of Central India	J. Somasundaram, S. Ramana, B.P. Meena and A.O. Shirale	Soil Physics	April 2015	March 2022	Report for 2015-16; 2016-17, 2017-18, 2018-19, 2019-20, 2020-21 to be submitted	• Not presented in December 2021 • Project to be continued
	(c) Development of water and nutrient management practices in conservation agriculture for Vertisols of Central India	R.K. Singh, Sanjay Srivastava, N.K. Sinha and Priya Gurav Pandurang	Soil Physics	April 2015	March 2022	Report for 2015-16; 2016-17, 2017-18, 2018-19, 2019-20, 2020-21 to be submitted	Project to be extended up to March 2026
	(d) Impact of conservation agricultural practices on soil health, carbon sequestration and greenhouse gas emission in different production systems	Pramod Jha, B.L. Lakaria, M. Mohanty, J.K. Thakur, K. Bharati	SC&F	April 2015	March 2022		Project to be extended up to March 2026
21	Cropping systems and soil management effects on soil organic carbon sequestration and greenhouse gas emission in Vertisols of central India under change climate scenarios funded by NICRA II-Phase	M. Mohanty, Pramod Jha, Sangeeta Lenka, J. Somasundaram, N.K. Sinha, A.K. Vishwakarma, R.S. Chaudhary and	Soil Physics	February 2017	March 2021	Project report 2018-19 and 2019-20, 2020-21, RPP-III to be submitted	• Not presented in December 2021 • RPP-III to be presented • Not presented, to be presented in next time

		Muneshwar Singh, Seema Bhardwaj					
22	Hyper-spectral remote sensing approaches to evaluate soil quality and crop productivity of central India (under DST sponsored Network Project on Hyper-spectral Big Data Analytics)	M. Mohanty, N.K. Sinha, K.M. Hati, R.K. Singh, Pradip Dey, R.S. Chaudhary, A.K. Patra, Bharat Bhaskar Gaikwad	Soil Physics	April 2016	March 2019	Completion report submitted RPP-III	• Not presented in December 2021 • RPP-III to be presented • Not presented, to be presented in next time
23	Strategies for enhancing yield of soybean (Glycine Max L) and pigeonpea (Cajanus cajan, L) in India using climate variability information and crop growth simulation models in collaboration with ICAR-IISR, Indore funded by IITM	M. Mohanty, B.S. Bhatia, N.K. Sinha, Prabhat Tripathi, R.S. Chaudhary, Seema Bhardwaj, A.K. Patra	Soil Physics	July 2018	June 2021	Report 2018-19 and 2019-20, 2020-21 to be submitted Extension letter to be submitted to PME Cell	• PI informed that project extended without financial implication up to March 2022
24	Sustainable adaptive water management resilient to variable climates in Madhya Pradesh funded by ICARDA	M. Mohanty, N.K. Sinha, A.K. Patra	Soil Physics	April 2018	March 2021	Report 2018-19 and 2019-20, 2020-21 to be submitted	• Project extended up to March 2022
25	Vulnerability and impact assessment of climate change on soil and crop production in Madhya Pradesh funding Agency: UNDP-GEF-MoEFCC	Sangeeta Lenka, N. K. Lenka, M. Mohanty, R. H. Wanjari, A. K. Patra	ESS	Dec 2017	Dec 2021	Report 2017-18, 2018-19, 2019-20, 2020-21, RPP-III to be submitted	• Not presented in December 2021 • RPP-III to be presented • Project concluded • Bulleting to be prepared
26	Assessing the potential impact of climate smart technologies on soil health and nutrient accounting in selected vulnerable districts of MP funded by EPCO, Bhopal	Sangeeta Lenka, N.K. Lenka, MV Coumar, M. Mohanty, J.K. Saha, A.K. Patra, Dolamani Amat	ESS	August 2018	July 2021		• Project extended up to July 2022 • Soil quality maps to be prepared • Dr. Dinesh Kumar Yadav to be included
27	Assessing the potential impact of climate change and management on soil carbon and nitrogen storage in selected ecosystems of India funded by NASF	Sangeeta Lenka, N.K. Lenka, Asit Mandal, Biswapati Mandal (BCKV, West Bengal)	ESS	August 2018	July 2021		• Project extended up to 31 July 2022 • Dr. Kaushik Batabayal in place of Dr. Biswapati Mandal (BCKV, West Bengal) after retirement from Jan 2020

Programme III – Soil Microbial Diversity and Biotechnology

a) Institute Projects/ Inter-institute collaborative project

28	Effects of long term use of fertilizer and manure on soil functional diversity and nutrient supplying capacity under different soils and cropping systems (Inter-institute collaborative project with ICAR-IISR, Indore	Sudeshna Bhattacharjya, Asha Sahu, M.C. Manna, Muneshwar Singh, R.H. Wanjari, M.P. Sharma (ICAR-IISR, Indore),	Soil Biology	April 2016	March 2021	RPP-III to be submitted	• Not presented in December 2021 • RPP-III to be presented • Project concluded • Data to be checked on MBK

		A.K. Patra					
29	Characterization and prospects of soil biota for enhancing nutrient use efficiency						
	(a) Deciphering thermophiles from hot springs of Central India for rapid decomposition of crop residues	Asha Sahu, Sudeshna Bhattacharjya, Dolamani Amat, Nisha Sahu, K Bharati, Anita Tilwari	Soil Biology	July 2020	June 2024		• Project to be continued • Evaluate potential isolates with normal existing bacteria
	(b) Exploring endophytic microbial diversity of selected major field crops of India for nutrient supplementation and biocontrol	J.K. Thakur, Asit Mandal, Dolamani Amat, MC Manna	Soil Biology	July 2020	June 2024		• Project to be continued • Dr. A.B. Singh included in place of Dr. M.C. Manna • Consortia to be evaluated without urea

b) Externally Funded Projects

30	Enhancing decomposition rate and quality of bio-waste through microbial consortia for improving soil health funded by NASF	M.C. Manna, Asha Sahu, S. Bhattacharjya, A.B. Singh, A.K. Tripathi, J.K. Thakur, Dolamani Amat, Asit Mandal	Soil Biology	June 2018	March 2021	RPP-III to presented	PI changed from 24 September 2020 as Dr. A.B. Singh due to deputation transfer of Dr. M.C. Manna
31	Eco-genomics of soil microbes involved in global climate mitigation and nitrogen use efficiency in rice-wheat agroecosystem of central India under elevated CO_2 and temperature" funded by DST	S.R. Mohanty, K Bharati, S Gangil (ICAR-CIAE, Bhopal), A.K. Vishwakarma	SBB	September 2018	April 2021	Report 2018-19 and 2019-20, 2020-21 to be submitted	Project extended up to March 2022
32	Evaluation of Soybean-rhizobia interaction under elevated CO_2 and temperature to develop climate ready microbial inoculants for central India funded by AMAAS	S.R. Mohanty, Asit Mandal, K Bharati	SBB	April 2017	March 2020	Report 2017-18, 2018-19, 2019-20, 2020-21 to be submitted	• Project extended up to March 2026 • Consortia to be tested under field conditions.
33	Exploring soil microbial community and mechanism in soil carbon sequestration under long term land uses in semi-arid sub-humid Central India funded by SERB, DST, New Delhi	Sudeshana Bhattacharjya	Soil Biology	10 August 2017	9 August 2020	RPP-III to be submitted	• Not presented in December 2021 • RPP-III to be presented • Project concluded
34	Methanogenic bio-electrode driven conversion of CO_2 to CH_4 to enhance methanogenesis and mitigation of greenhouse gas from agro-waste based bioenergy systems" funded by DST-JSPS programme	S.R. Mohanty, K. Bharati, A.K. Patra, Seiya Tsujimura, Masanori Kaneko (University of Tsukuba, Japan)	SBB	March 2020	Jan 2022	Report 2020-21 to be submitted	Project to be continued

Programme IV: Soil Pollution, Remediation and Environmental Security
a) Institute Project:

35	Assessment of acid mine drainage affected areas in Madhya Pradesh	Madhumonti Saha, Ajay, Abhijit Sarkar (I/c PI), J.K. Saha, Hiranmoy Das	ESS	Sept 2019	Aug 2022	RPP-II 2019-20, 2020-21 to be submitted	• Project to be continued • Total carbon to be analyzed • Management for acidity to be done /recommended.
36	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	Nisha Sahu, Madhumonti Saha, JK Saha, NK Sinha, H Biswas (ICAR-NBSSLUP), Mrunalini Kancheti (ICAR-IIPR, Kanpur)	ESS	July 2020	June 2024	RPP-I & RPP-II 2020-21 to be submitted	• Project to be continued • As Mrs. Madhumonti Saha is on study leave, Mr. Rahul Mishra to be included.
	(b) Municipal solid waste compost quality assessment for sustainable crop production and environmental protection	MV Coumar, Tapan Adhikari, Abhijit Sarkar, Nisha Sahu, J. K. Saha, Hiranmoy Das, Ajay	ESS	July 2020	June 2024	RPP-I & RPP-II 2020-21 to be submitted	• Project to be continued • Dr. Dinesh Kumar Yadav (IISS) and Dr Sunil Kumar Meena (CPCB, Bhopal) to be added and letter to be sent to CPCB, Bhopal

b) Externally funded projects

37	Reclamation and rehabilitation of coper mining affected land in Malanjkhand area of Madhya Pradesh (Hindustan Copper Limited)	Ajay, Tapan Adhikari, Asit Mandal, J.K. Saha	ESS	April 2016	March 2019	Report for 2018-19, RPP-III to be submitted	• Not presented in December 2021 • RPP-III to be presented • Project concluded • Success story to be prepared (in two months)
38	Management of Municipal Solid Waste (MSW) contaminated landfill area of Bhanpur, Bhopal funded by BMC, Bhopal	Ajay, Tapan Adhiakari, K. Bharati, Asit Mandal, J.K. Saha	ESS	Nov. 2016	Oct. 2019	Report for 2016-17, 2017-18, 2018-19, RPP-III to be submitted	• Not presented in December 2021 • RPP-III to be presented • Project concluded
39	Reclamation and management of Municipal Solid Waste contaminated dumping area of Bhanpur, Bhopal funded by MPCST, Bhopal	Ajay, Tapan Adhikari, K. Bharati, Asit Mandal	ESS	Feb 2019	Jan 2021	Report 2019-20, 2020-2, RPP-III to be submitted	• Not presented in December 2021 • RPP-III to be presented • Project concluded
40	Exploring endophytic fungi for the phytoremediation of heavy metal contaminated soils funded by DST	Asit Mandal	Soil Biology	Sept 2018	Sept 2021	Report 2018-19 and 2019-20, 2020-21 to be submitted	• Project extended up to March 2022

41	Use of fly ash in agriculture for sustainable crop protection and environmental protection funded by NTPC, Noida	J.K. Saha, M.V. Coumar, Abhijit Sarkar, A.K. Patra, Tapan Adhikari, Ajay, K.M. Hati, A.K. Vishwakarma, Sangeeta Lenka, Asit Mandal, Madhumonti Saha, S Ramana, Hiranmoy Das	ESS	April 2021	July 2031	Report 2020-21 to be submitted	• Mr. Rahul Mishra in place of Dr. Vasudev Meena and Dr. Nisha Sahu in place of Dr. S. Ramana to be included • Data on sand/silt/clay & N may be checked

Contractual Projects

42	Impact of viscose staple fibre industry treated effluent on soil health and crop production surroundings Nagda, M.P funded by M/s Grasim Industries Limited, Nagda, Ujjain, M.P.	Tapan Adhikari, J.K. Saha, M.V. Coumar, R.H. Wanjari, N.K. Sinha, A.K. Patra	ESS	Nov 2017	Oct 2020	Report 2017-18, 2018-19 and 2019-20, 2020-21 and RPP-III to be submitted	• Not presented in December 2021 • RPP-III to be presented • Not presented, to be presented in next time
43	Evaluation of effect of Zeba fertilizer product on nitrate-N leaching funded by M/s UPL Limited, UPL House, 610Bl2, Bandra Village, Off Western Express Highway, Bandra-East, Mumbai- 400 051	A.K. Biswas, R. Elanchezhian, N.K. Lenka, A.O. Shirale, A.K. Patra	SC&F	Dec 2018	June 2020	Report for 2019-20 and RPP-III to be submitted	• Not presented in December 2021 • RPP-III to be presented • Project concluded

New Externally funded Projects (RPP-1)

S. No.	Project Title	PI/Co-PI	Division/ Unit	Start	End	
44.	Evaluating the impact of Geoxol.com on soil health and crop productivity funded by M/s Privi Life Science, Mumbai (Contractual project)	J Somasundaram, NK Sinha, M Mohanty, RS Chaudhary, KM Hati, AO Shirale, AK Patra	Soil Physics	Oct 2020	Dec 2022	• RPP-I and RPP-II to be presented • Project to be continued
45.	Microbial based agricultural waste management using vermicomposting funded by Swachchta Action Plan, ICAR, New Delhi	AK Patra (Project leader), AK Vishwakarma (PI), JK Thakur, AB Singh, BL Lakaria, BP Meena, RS Chaudhary, Asha Sahu, Asit Mandal	SC&F	Oct 2020	March 2023	RPP-I presented and approved
46.	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	Tapan Adhikari, C. D. Singh, Samir Kumar Pal, S N Bose	ESS	June 2021	May 2024	• RPP-I to be presented • Presented, project to be continued • Moisture availability may be created for effective cmpanies
47.	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	Pramod Jha, R Elanchezhian, BL Lakaria, B.P. Meena, Pradip Dey, AK Biswas	SC&F	1 July 2021	June 2023	RPP-I presented and approved
48.	Sustainable biochar production agroforestry systems and its application: A climate resilient soil management approach funded by ICRAF	BL Lakaria, Pramod Jha, AK Biswas, AK Vishwakarma, BP Meena, M Vassanda Coumar, Jitendra Kumar, Abinash Das, AK Patra, Javed Rizvi, SK Dhyani, Aqeel Hasan Rizvi, Archna Singh, Jamal Pervez Noor	S&CF	1 July 2021	31 March 2023	RPP-I presented and approved
49.	Investigation of potentials of soil as a sink for nitrous oxide and strategies for mitigation nitrous oxide emission funded by DST SERB –POWER Fellowship	Sangeeta Lenka	ESS	April 2021	March 2024	RPP-I presented and approved
50.	Modelling soil carbon storage and dynamics in different agro-ecosystems of India under the changing climate scenarios funded by NICRA	M. Mohanty, N.K. Sinha, Pramod Jha, Dhiraj Kumar, R.H. Wanjari, Prabhat Tripathi, AK Patra	Soil Physics	April 2021	March 2026	• RPP-I to be presented • Project to be continued • Dr J Somasundaram to be added after Dr P Jha
51.	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	M. Mohanty, N.K. Sinha, J. Somasundaram, Pramod Jha, K. Bharati, Jitendra Kumar, Sangeeta Lenka, J.K. Thakur, Abinash Das, KM Hati, RS Chaudhary, AK Patra	Soil Physics	April 2021	March 2026	• RPP-I to be presented • Dr J Somasundaram after Dr NK Sinha • Dr Dhiraj Kumar to be added

52.	ICAR Network Program on Precision Agriculture	NK Sinha, J Somasundaram, M. Mohanty, Pradip Dey, Jitendra Kumar, Dhiraj Kumar, Alka Rani, KM Hati, RS Chaudhary, AK Patra	Soil Physics	August 2021	July 2026	• RPP-I to be presented • Rs. 197.00 lakhs • Project to be continued • Dr J Somasundaram to be next Co-PI • Mr Rahul Mishra to be added
53.	Do agricultural micro plastics undermine food security and sustainable development in less economically developed countries?	AK Patra, Tapan Adhikari, JK Thakur, Asit Mandal	ESS	Jan 2022	Jun 2025	• RPP-I to be presented • PI on tour- Not presented
54.	Evaluating the effect of Bio.soilz on soil nutrient availability and microbial activity under maize-wheat cropping system in vertisols of Central India funded by M/s Blu Soils Agro Pvt. Ltd, Patna (Contractual project)	Asit Mandal, JK Thakur, AB Singh, R Elanchezhian, AK Patra	Soil Biology	30 Nov 2021	May 2023	RPP-I presented and Approved
55.	UAV based soil moisture measurement and dissemination-IoT based approach for soil moisture monitoring and dissemination (Collaborative project with IIT Delhi)	NK Sinha, AK Vishwakarma, J Somasundaram, KM Hati, M Mohanty, Jitendra Kumar Alka Rani, S Sen (IIT Delhi)	Soil Physics	April 2020	March 2021	Project to be deleted and dropped due to funding issues

New institute projects (RPP1)

S. No.	Project Title	PI/Co-PI	Division/Unit	Start	End	
56.	Impact of Water and nitrogen management strategies on soil quality /soil health under conservation agriculture in Vertisols	J. Somasundaram	Soil Physics			• Pre-IRC to be presented • RPP-I to be presented
57.	Impact of long term conservation agriculture practices on soil phosphorus and potassium dynamics and soil quality under diverse agro-ecological zones	Khushboo Rani, Priya Gurav, Pramod Jha, AK Vishwakarma, S Srivastava, AK Biswas	SC&F	2022	2026	• Pre-IRC to be presented • RPP-I to be presented and RPP-I to be submitted with treatments (including S dynamics)
58.	Effect of long term nutrient management on various fractions and forms of soil organic carbon and nitrogen, carbon stabilization and biological activity in dominant cropping systems	Dhiraj Kumar, RH Wanjari, M Mohanty, J Somasundaram, Pramod Jha, R Mishra, IC Haokip	LTFE			• Pre-IRC to be presented • RPP-I to be presented and RPP-I to be submitted with revised treatments
59.	Quantification of heavy metal concentration in contaminated soils, sludge and compost using pXRF and ICP-OES"	Mr Rahul Mishra, NK Sinha, KM Hati, MV Coumar, M Mohanty, A Sarkar, Dhiraj Kumar, DK Yadav, RS Chaudhary, JK Thakur	ESS			• Pre-IRC to be presented • RPP-I to be presented and title of project to be revised and RPP-I to be submitted

60.	Effect of in-situ decomposition of crop residue mediated by lignocellulolytic microbes on soil health under rice-wheat cropping system"	Dolamani Amat	Soil Biology			• Pre-IRC to be presented • Project to be revised and presented by Dr JK Thakur • Mr Abinash Das to be continue
61.	Soil quality and yield sustainability assessment of targeted yield fertilizer prescription based long-term integrated nutrient management in major soil orders of India	Immanueal C Haokip, Pradip Dey, NK Lenka, H Das, Dhiraj Kumar, MH Devi,	STCR			• Pre-IRC to be presented • RPP-I presented and RPP-I to be submitted

Contractual projects (RPP1)

S. No.	Project Title	PI/Co-PI	Division/Unit	Start	End	
62.	On-farm evaluation of ECOWELL ORGAIIIC PRODUCTS under soybean-wheat cropping system	Asha Sahu, Sudeshna Bhattacharjya, Dolamani Amat, K Bharati, AB Singh, AK Patra	Soil Biology	1 April 2022	31 May 2023	• Pre-IRC to be presented • RPP-I presented and RPP-I and II to be submitted

Remarks by I/c PME Cell

1. Quality of publications in scopus/web of science journal is required to enhance the research performance matrix.
2. Other project information/training details may be shared with PME Cell within stipulated time for easy process and record maintenance.
3. New project for external finding may be submitted by scientists 7/15 days advance before the deadline date/closing date for easy process and approval of competent authority.
4. MoU needs to be done before actual project initiation with private university/organization/institute and consent of both the parties is required to avoid IPR complications & smooth run of project activities.
5. RPP-III presentation will be carried out on separate date.
6. For plagiarism check, authenticated software/DKMA may be consulted.
7. All PIs/CCPIs may submit all the RPPs (RPP-I, II, III etc.) of the relevant projects on time.

Concluding remarks by Chairman, IRC

1. Chairman congratulated all awardees and PIs of externally funded projects.
2. Bulletin to be submitted with RPP-III.
3. All research communications/ Full papers to be submitted to PME Cell for approval of CA and maintenance of record.
4. All award/project to be forwarded through PME Cell and will be excluded from institute publications if it is not forwarded through PME Cell.
5. Infrastructure facility to be shared among Division/Units
6. Permission to attend seminar/symposium/training/webinar to be routed through PME Cell.
7. Young scientists meeting to be conducted
8. All scientists may cooperate with all other staff of institute to smooth run the institutional R&D activities.

Division wise/Co-coordinating Unit-wise Number of Projects

Sl. No.	AICRP/ Division	Sl. No. of Project	Total
1.	AICRP on LTFE	6,58,	2
2.	AICRP on STCR	61	1
3.	AICRP on MSPE	5	1
4.	AINP on SBB	34	1
5.	Soil Chemistry and Fertility	1,2,3,4,7,8,9,10,12,13,14,20,20a, 20d,43,45,47,48,57,	19
6.	Soil Physics	16,17,18a,18b,18c,19,20,20b,20c,21,22, 23,24,44,50,51,52,55,56,	19
7.	Soil Biology	11,28,29a,29b,30,31,32,33,40,54,60,62	12
8.	Environmental Soil Science	15,25,26,27,35,36a,36b,37,38,39, 41,42,46,49,53,59	16

Division-wise no. of Externally Funded Projects

Sl. No.	Centre/Co-coordinating Unit	Sl. No. of Project	Total
1.	AICRP LTFE	58	1
2.	AICRP STCR	61	1
3.	AICRP MSPE	-	-
4.	AINP SBB	31,32,34,	3
5.	Soil Chemistry and Fertility	12,13,14,20,20a,43,45,47,48,57,	10
6.	Soil Physics	19,20,20b,20c,20d,21,22,23, 44,50,51,52,55,56,	14
7.	Soil Biology	11,30,33,40,54,60,62	7
8.	Environmental Soil Science	24,26,27,37,38,39,41,42, 46,49,53,59,	12

New Projects Approved

Sl. No.	Division/Co-coordinating Unit	Sl. No.	Total
1	AICRP LTFE	58	1
2	AICRP STCR	61	1
3	AICRP MSPE	-	-
4	AINP SBB	-	-
5	Soil Chemistry and Fertility	45,47,48,57,	4
6	Soil Physics	44,50,51,52,56,	5
7	Soil Biology	60,62	2
8	Environmental Soil Science	46,49,53,59,	4

Project (serial numbers) with individual scientist

S. No.	Name of Scientist	Designation	Sl. of projects		
			PI	Co-PI	
1	Dr. A.K. Patra	Director	12,45,53,	19,22,23,24,25,26,28,34,41, 42,43,44,48,50,51,52,54,62	21
AICRP on LTFE					
1	Dr. Muneshwar Singh	Ex-Project Co-coordinator (Retired on 31/08/2020)	-	21,28	2
2	Dr. R. H. Wanjari	Pr. Scientist	6	1,12,14,20a,25,28,42,50	9
3	Dr. Dhiraj Kumar	Scientist	58	19,50,52,	4
AICRP on STCR					
1	Dr. Pradip Dey	I/c Project Co-ordinator	-	8,19,22,47,52	5
2	Dr. Hiranmoy Das	Scientist	-	3,6,8,12,16,35,36b,41,	8
AICRP on MSPE					
1	Dr. A.K. Shukla	I/c Project Co-ordinator	-	5	1
2	Dr. S.K. Behera	Pr. Scientist	5	6	2
AINP on BF					
1	Dr. S.R. Mohanty	I/c Project Co-ordinator	31,32,34	-	3
Soil Chemistry and Fertility					
1	Dr. A. K. Biswas	I/c HoD (Soil Chemistry & Fertility)	43	1,2,7,8,20,47,48	8
2	Dr. Sanjay Srivastava	Pr. Scientist	13	2,3,4,6,7,20c	7
3	Dr. Brij Lal Lakaria	Pr. Scientist	48	4,8,10,11,20d,45,47	8
4	Dr. R. Elanchezhian	Pr. Scientist	7	6,43,47,54	5
5	Dr. N.K. Lenka	Pr. Scientist	9,14	15,25,26,27,43	7
6	Dr. A.K. Vishwakarma	Pr. Scientist	20a	6,8,10,12,20,21,31,41,45,48 ,55	12
7	Dr. Pramod Jha	Pr. Scientist	20d,47,	9,16,19,20,21,48,50,51	10
8	Dr. B.P. Meena	Sr. Scientist	1	2,3,4,6,7,9,11,14,20b,45,47, 48	13
9	Dr. Shinogi K.C.	Sr. Scientist	3	6,12,20(a),	4
10	Dr. A.O. Shirale	Scientist	2	4,6,7,12,13,14,20(b),43,44,	10
11	Dr. Gurav Priya Pandurang	Scientist	4	2,3,6,20(c),	5
12	Dr. Narayan Lal	Scientist	8	12	2
13	Dr. Khushboo Rani	Scientist	57		1
Soil Physics					
1	Dr. R.S. Chaudhary	I/c HoD (Soil Physics)	-	16,17,18(a,b,c),19,20,21,22, 23,44,45,51,52	12
2	Dr. K.M. Hati	Pr. Scientist	19	16,17,18(a,b),20,22,41,44, 51,52,55,	11
3	Dr. R.K. Singh	Pr. Scientist	-	6,12,17,18(b),20, 20(c),22	7
4	Dr. J. Somasundaram	Pr. Scientist	44	6,16,17,18(a,c),20,20(c),21, 51,52,55,	11
5	Dr. Prabhat Tripathi	Pr. Scientist	17	6,18(c),23,50,	5
6	Dr. M. Mohanty	Pr. Scientist	21,22,23 ,24,50, 51	6,16,17,18(a,b,c),19,20,25, 26,52,55,58,59,	20
7	Dr. N.K. Sinha	Scientist	16,52,55	3,5,6,18(a,b,c),20(c),21,22, 23,24,36(a),42,44,50,51,59	20

8	Mrs. Seema Bhardwaj	Scientist	18c	6,16,17,18(b),21,23,	7
9	Dr. Jitendra Kumar	Scientist	18a	10, 18(b), 18c,48,51,52,55	8
10	Miss Alka Rani	Scientist	18(b)	7,16, 18a, 18c,52,55	7
Soil Biology					
1	Dr. M.C. Manna	Ex-HoD (Soil Biology)	30	28,29b,	3
2	Dr. A.B. Singh	HoD (Soil Biology)	11	1,6,8,12,30,45,54,62	9
3	Dr. A.K. Tripathi	Pr. Scientist		3,6,20b,30	4
4	Dr. S.R. Mohanty	Pr. Scientist	31,32,34	44	4
5	Dr. K. Bharati	Pr. Scientist	-	3,6,12,20d,29a,31,32,34,38, 39,51,62	12
6	Dr. Asit Mandal	Sr. Scientist	40,54	6,27,29b,30,32,37,38,39,41, 45,53,	13
7	Dr. Asha Sahu	Scientist	29a	6,8,12,28,30,45,62	8
8	Dr. J.K. Thakur	Scientist	29b	5,6,9,11,19,20d,30,45,51,53 ,54,59	13
9	Dr. Sudeshna Bhattacharjya	Scientist	33	15,28,29a,30,62	6
10	Dr. Dolamani Amat	Scientist	60	10,2629a,b,30,62	7
11	Mr. Abinash Das	Scientist	-	48,51	2
Environmental Soil Science					
1	Dr. J.K. Saha	I/c HoD (Environmental Soil Science)	41	26,35,36a,b, 37,38,42	8
2	Dr. Ajay	Pr. Scientist		36b	1
3	Dr. Tapan Adhikari	Pr. Scientist	42,46	36b,37,39,41,53	7
4	Dr. S. Ramana	Ex-Pr. Scientist	-	7,20b,41	3
5	Dr. M. V. Coumar	Sr. Scientist	36b	6,7,19,26,41,42,48,59	9
6	Dr. Sangeeta Lenka	Sr. Scientist	15,25,26 ,27,49	9,14,21,41,51	10
7	Dr. Vasudev Meena	Ex-Scientist (Relived on 23.01.2021)	-	-	0
8	Dr. Abhijit Sarkar	Scientist	-	6,35,36b,41,59	5
9	Miss. Madhumonti Saha	Scientist	35	6,36a,41	4
10	Dr. Nisha Sahu	Scientist	36a	29a,36b	3
11	Dr. Dinesh Kumar Yadav	Scientist	-	59	1
12	Mr. Rahul Mishra	Scientist	59	58	2
Scientists from other Institutes					
1.	Mr. R.L. Raut	KVK, Balaghat		3	1
2.	Mr. Rameshwar Ahirwar	KVK, Balaghat		3	1
3.	Miss Aparna Jaiswal	COA, Balaghat		3	1
4.	Dr. P. Chandran	ICAR-NBSS&LUP, Nagpur		4	1
5.	Dr. K. Kartikeyan	ICAR-NBSS&LUP, Nagpur		5	1
6.	I/c KVK Barwani (MP), I/c KVK Rajnandgaon (Chhattisgarh), I/c KVK Betul (MP)	I/c KVK Barwani (MP), I/c KVK Rajnandgaon (Chhattisgarh), I/c KVK Betul (MP)		6	1
7.	Dr. Renu Pandey	ICAR-IARI, New Delhi		7	1
8.	Dr. P.S. Tiwari	ICAR-CIAE, Bhopal		13	1
9.	Mr. Vijay Kumar	ICAR-CIAE, Bhopal		13	1
10.	Mr. Ramesh Kumar Sahani	ICAR-CIAE, Bhopal		13	1
11.	Mr. Baban Kumar	CSIR-CSIO, Chandigarh		13	1
12.	Miss Neelam	CSIR-CSIO, Chandigarh		13	1
13.	Mr. Javed Rizvi	Director, South Asia Program, World		19,48	2

		Agroforestry Center (ICRAF), New Delhi-India			
14.	Dr. Bharat Bhaskar Gaikwad	ICAR-NIASM, Baramati		22	1
15.	Dr. B.S. Bhatia,	Ex-Director, ICAR-IISR, Indore		23	1
16.	Dr. Biswapati Mandal	BCKV, West Bengal		26	1
17.	Dr. M.P. Sharma	ICAR-IISR, Indore		28	1
18.	Dr. Anita Tilwari	MPCST, Bhopal		29a	1
19.	Dr. S Gangil	ICAR-CIAE, Bhopal		31	1
20.	Drs. Seiya Tsujimura, Masanori Kaneko	University of Tsukuba, Japan		34	1
21.	Dr. H Biswas	ICAR-NBSSLUP		36a	1
22.	Dr. Mrunalini Kancheti	ICAR-IIPR, Kanpur		36a	1
23.	Dr. S Gangil	ICAR-CIAE, Bhopal		31	1
24.	Dr. C. D. Singh,	ICAR-CIAE, Bhopal		46	1
25.	Dr. Samir Kumar Pal	S N Bose National Centre for Basic Sciences, Kolkata		46	1

LIST OF PARTICIPANTS

S. No.	Name of Scientist	Designation
1.	Dr. A. K. Patra	Director & Chairman, IRC
2.	Dr. R.S. Chaudhary	I/c HoD (Soil Physics) & Member Secretary IRC
3.	Dr. R. Elanchezhian	Principal Scientist & I/c PME Cell
4.	Dr. A.K. Shukla	Project Co-ordinator, MSPE
5.	Dr. Pradip Dey	Project Co-ordinator, STCR
6.	Dr. A.K. Biswas	I/c HoD (Soil Chemistry & Fertility)
7.	Dr. J.K. Saha	I/c HoD (Environmental Soil Science)
8.	Dr. A.B. Singh	I/c HoD (Soil Biology)
9.	Dr. Ajay	Principal Scientist
10.	Dr. A.K. Tripathi	Principal Scientist
11.	Dr. Sanjay Srivastava	Principal Scientist
12.	Dr. Brij Lal Lakaria	Principal Scientist
13.	Dr. Kuntal M. Hati	Principal Scientist
14.	Dr. Prabhat Tripathi	Principal Scientist
15.	Dr. NK Lenka	Principal Scientist
16.	Dr. R.K. Singh	Principal Scientist
17.	Dr. R.H. Wanjari	Principal Scientist
18.	Dr. A.K. Vishwakarma	Principal Scientist
19.	Dr. J. Somasundaram	Principal Scientist
20.	Dr. S.R. Mohanty	Principal Scientist
21.	Dr. Pramod Jha	Principal Scientist
22.	Dr. K. Bharati	Principal Scientist
23.	Dr. M. Mohanty	Principal Scientist
24.	Dr. SK Behera	Principal Scientist
25.	Dr. Sangeeta Lenka	Senior Scientist
26.	Dr. M.V. Coumar	Senior Scientist
27.	Dr. Asit Mandal	Senior Scientist
28.	Dr. Hiranmoy Das	Scientist
29.	Dr. N.K. Sinha	Scientist
30.	Dr. Asha Sahu	Scientist
31.	Dr. JK Thakur	Scientist
32.	Dr. Shinogi K C	Scientist
33.	Dr. Bharat Prakash Meena	Scientist
34.	Dr. AO Shirale	Scientist
35.	Dr. Gurav Priya Pandurang	Scientist
36.	Dr. Dolamani Amat	Scientist
37.	Dr. Abhijit Sarkar	Scientist
38.	Dr. Narayan Lal	Scientist
39.	Dr. Nisha Sahu	Scientist
40.	Dr. Jitendra Kumar	Scientist
41.	Dr. Immanuel Chongboi Haokip	Scientist
42.	Dr M. Homeshwari Devi	Scientist
43.	Dr Dhiraj Kumar	Scientist
44.	Dr. Dinesh Kumar Yadav	Scientist
45.	Dr. Khushboo Rani	Scientist
46.	Mr. Abinash Das	Scientist
47.	Mr. Rahul Mishra	Scientist

Research Achievements (2021)

Programme- I Soil Health and Input use efficiency

c) Institute in-house projects

Sl. No.	Title of Project	PI and Co-PI	Achievements (in bullet form not more than 100 words)
1.	Long-term evaluation of integrated plant nutrient supply modules for sustainable productivity in Vertisol	B. P. Meena A. K. Biswas, A. B. Singh, R. S. Chaudhary, R.H. Wanjari	• Balanced use of nutrients through STCR based fertilizers (75% NPK) with organic manures (25%) sustained the maize yield over the years. • Adoption of FYM @ 25 t $ha^{-1}$was significantly increased the available soil N, P and K concentration as compared to rest of treatments. • INM practices increased the SOC contents, different carbon fractions (*C*frac I, *C*frac II, *C*frac III, and *C*frac IV) and their stocks with application of higher amount of FYM (25t ha^{-1}) followed by 75% NPK based on STCR along with 5 t ha^{-1} FYM as compared to GRD and 100% NPK based on STCR. • Therefore, it can be inferred that adoption of STCR based INM modules is the best technology to improve organic carbon stock in Vertisols of Central India.
2.	Evaluation of glauconite as source of potassium for crops	A.O. Shirale, Gurav Priya Pandurang, Sanjay Srivastava, B.P. Meena, A.K. Biswas	The pot experiments were conducted with maize-wheat as test crops the results of the experiment • The response of the crops to the application of glauconite was more pronounced in Alfisol than Vertisol • The biomass yield of maize and wheat was significantly higher under the treatment of calcined glauconite along with FYM treatment in Alfisol followed by MOP • The application of acidulated calcined glauconite along with FYM; acidulated glauconite along with FYM and glauconite along with FYM also effective in improving biomass yield of maize and wheat • The highest uptake of K was found under the treatment of MOP followed calcined glauconite along with FYM and acidulated calcined glauconite along with FYM in both the soils. • Application of glauconite alone or in combination with FYM showed higher K residual soil fertility • Therefore, it can be inferred that use of glauconite/calcined glauconite/acidulated glauconite along with FYM is the best technique for utilization agriculture
3.	Enhancing the productivity of major crops through improving the natural resource base of tribal inhabited areas of central India	Shinogi K.C., Sanjay Srivastava, B.P. Meena, N.K. Sinha, K. Bharati, Gurav Priya Pandurang, A.K. Tripathi, Hiranmoy Das, R.L. Raut (KVK, Balaghat), Rameshwar Ahirwar (KVK, Balaghat), Aparna Jaiswal (COA, Balaghat)	• Soil samples collected from eighty locations of twenty two tribal farmlands and analyzed for physical and chemical properties. Soils identified as rich in organic carbon with moderate availability of nitrogen, phosphorus, potassium, zinc, iron, manganese and copper but, deficient in sulphur and boron. • Soil Health Cards were prepared based on the soil test results with nutrient recommendation for their organic-by default rice-fallow systems and distributed to the farmers. • Water samples collected from 19 water resources of the three villages for analyzing the chemical and biological aspects and thus to assess the quality of water resources in the agro-ecosystem.
4.	Mineralogy of Vertisols in relation K availability in central and western India	Gurav Priya Pandurang, A.O. Shirale, B.P. Meena, B.L. Lakaria, Sanjay	• The highest water soluble K, Exchangeable K, non-exchangeable K and Total K content was found in the soils of Sarole series followed by Nabibagh and Jalwara series, of Madhya Pradesh and Rajasthan respectively.

		Srivastava, P. Chandran (ICAR-NBSS&LUP, Nagpur)	• The soils of Junagad, Gujarat are low in all fractions of potassium content. • In all the soil series it is observed that the pristine soils contain high amount of K in all fractions analyzed by using different methods.
5.	Micronutrients distribution in major soil orders of India as influenced by soil properties and land use pattern	S.K. Behera, A.K. Shukla, N.K. Sinha, J.K. Thakur, K. Kartikeyan (ICAR-NBSS&LUP, Nagpur)	• During the period under report, different fractions of Zn, Cu, Fe and Mn, physical and biological properties in profile soil samples of Vertisols under different land uses were estimated. • Atotal of 288 profile soil samples of Aridisols, Entisols, Inceptisols and Mollisolsat 6 different depths (0-10, 10-20, 20-40, 40-60, 60-80, 80-100 cm depths) from grazing land, forest land, agriculture land and horticulture land uses were collected. • The collected soil samples have been processed and the analysis of different partameters have been intitated.
6.	Enhancement of Soil Health and Livelihood of Tribals in Central India	RH Wanjari, R Elanchezhian, Prabhat Tripathi, RK Singh, KC Shinogi, MV Coumar, Vasudev Meena, J Somasundaram, AO Shirale, Asit Mandal, Hiranmoy Das, AB Singh, Asha Sahu, SK Behera, AK Vishwakarma, M Mohanty, Seema Bhardwaj, Madhumonti Saha, Sanjay Srivastava, K. Bharati, Priya Gurav, BP Meena, AK Tripathi, Abhijit Sarkar, NK Sinha, JK Thakur, I/c KVK Barwani (MP), I/c KVK Rajnandgaon (Chhattisgarh), I/c KVK Betul (MP)	• Adoption of high yielding varieties (HYVs) and balanced fertilizer use in major crops has improved the crop productivity in tribal areas. • ITKs (Indigenous technical knowledge) indicated that the majority of tribals are using the traditional ways of using organic manures, less doses of fertilizers, traditional cultivation practices such as insect pest and disease control etc. • Awareness about soil health and related issues through capacity building programmes like Training, Workshop, Kisan Sangoshthi organized for tribal farmers. • Distribution of agricultural inputs found to be effective to enhance livelihood of tribals.
7.	Assessment of nutrient (N & P) use efficiency in wheat genotypes for improved crop productivity	R. Elanchezhian, A.O. Shirale, B.P. Meena, Alka Rani, Sanjay Srivastava, Ajay, S. Ramana, A.K. Biswas, MV Coumar, Renu Pandey (ICAR-IARI, New Delhi)	• A field experiment was carried out to assess genotypic variation in Nitrogen and Phosphorus uptake and their efficiency in wheat in the vertisols of Central India in the rabi season (2020-2021) at research farm of ICAR-Indian institute of soil science Bhopal (India). The experiment was carried out to screen 120 genotypes of wheat with four levels of nutrients (0%NPK, 100%NPK, 50%N+100%PK and 100%NK+50%P) for nutrient use efficiency. Agro-morphological, physiological and yield parameters including nutrient uptake, apparent nutrient recovery, agronomic and physiological efficiencies were assessed. The selected genotypes exhibited varying degree of response w.r.to leaf area, plant biomass, yield, chlorophyll content, nitrate reductase enzyme activity, photosynthetic rate and nutrient use efficiencies. At 100%NPK, the highest grain yield (5580.88 kg ha-1) was obtained in var. HI8713. The variety HI1544 exhibited the high nitrogen concentration in grain and straw. The var. HI8713 also exhibited highest amount of total N uptake 97.89kg/ha and the var. HI8663 variety exhibited highest agronomic use efficiency for nitrogen and apparent nitrogen recovery. Among the varieties the highest amount of physiological use efficiency was reported in NARMADA14 (60.45%). Among the varieties the highest amount of P uptake was reported in HI8713 variety (10.93 kg/ha) and highest amount of agronomic use efficiency for phosphorus and phosphorus recovery was reported in reduced phosphorus dose

			treatment.
8.	Development of agri-horticultural system for central India under Vertisols, its impact on soil health and improvement in productivity and quality of fruits	Narayan Lal, Brij Lal Lakaria, AK Vishwakarma, AshaSahu, Hiranmoy Das, AK Biswas, Pradip Dey, AB Singh	• Guava and lime are severely pruned to remove unwanted branches which resulted in scaffold branches lead to good fruiting. • Guava was severely infested with bark eating caterpillar which has been totally controlled. • Light pruning in mango resulted in good flowering and fruiting in the last year (2020-21) • Gram and wheat have been grown as intercrops in the available between rows of fruit crops to get additional income from the same piece of land. • Age basis application of Paclobutrazol in soil near rootzone of mango resulted in good flowering during 2021-22 in alternate bearing cultivars.
9.	Studying of climate change impact on nitrogen dynamics and water use in two contrasting cropping system of Central India	NK Lenka, Sangeeta Lenka, Pramod Jha, JK Thakur, BP Meena	• New project
10.	Enhancing livelihood security of subsistence farming community through improvement in soil health crop productivity and capacity building in Bhopal district of Madhya Pradesh	BL Lakaria, Ajay, AK Vishwakarma, Jitendra Kumar, Dolamani Amat and all scientists of all divisions	• In SCSP project, four village clusters have been identified covering 16 villages. Agricultural inputs have been arranged and distributed to the families of scheduled caste community. Under the capital head, provision of audiovisual aids for providing training to the SC farmers were procured and installed. Demonstration of institute technologies is being carried out in about 1.5 acre land with each farmer. About 75 demonstrations have been conducted on rabi crops involving balanced fertilizer application, integrated nutrient management and farmer practice. There is positive response of the institute technologies at the farmers field. Different necessary inputs for agriculture were procured from the SCSP sub-plan budget. All necessary inputs such as seed (wheat, soybean, gram, maize) & fertilizer (Urea, 12:32:16); vermibeds, agricultural implements (axes, scateures, shovels etc), horticulture seedlings and audiovisual aids etc were procured for SCSP families in the adopted villages. A sum total of Rs. 37.29 lakhs has been utilized under this plan.

c) Externally Funded Projects

11	All India Network Programme on Organic Farming funded by ICAR-IISFR, Modipuram	A. B. Singh, B.P. Meena, Brij Lal Lakaria, J.K. Thakur	Field experiments were conducted under AI NPOF project during 2020-21 at ICAR-Indian Institute of Soil Science, Bhopal. The salient achievements are given below: • In kharif season, the highest soybean yield was recorded in 100 % organic treatment followed by 50 % organic + 50 % inorganic treatment, which were significantly higher than 100% inorganic treatment. Among the cropping systems, soybean-wheat system recorded highest seed yield of soybean followed by soybean-linseed, soybean- mustard and soybean-chickpea cropping systems. • In rabi season, the seed yield of wheat, mustard, chickpea and linseed were found to be significantly different under different nutrient management systems. The highest seed yield of wheat, mustard, chickpea and linseed were recorded with 100% organic treatment practices as compared to 100% inorganic and state recommendation. In general, integrated nutrient management was better than inorganic management systems. • The mean SOC was recorded higher in 100% organic management (1.02%) followed by 50 % organic + Natural Farming (0.95%) and lowest was found in state recommendations. Among the copping systems soybean-wheat recorded higher SOC followed by soybean-mustard, soybean-chickpea and soybean-linseed. The increase in soil organic carbon may be due to the addition of more carbon source through manures. • Highest soil available NPK was found in 100% organic treatment as compared to other treatments. • Soil enzyme activity in terms of fluoresceindiacetate (FDA), dehydrogenase, alkaline phosphatase and β

			Glucosidase were found highest in 100% organic treated plots. • Performance of different varieties of groundnut (kharif) and mustard (rabi), were evaluated for their yield response to screen out promising varieties fororganic farming practices in central India. Among the groundnut varieties,GPBD-5 (1983 kg/ha) out performed in terms of yield followed by GJG-17 (1887 kg/ha) and DH-245(1773 kg/ha). Among the mustard varieties, Aravali (1988 kg/ha) out performed in yield followed by CS-52 (1970kg/ha). • In Natural farming experiment, the highest yield of soybean and wheat were recorded in integrated crop management with pesticide (ICMP) treatment, which was at par with integrated crop management with natural farming (ICMNF) and AI NPOF package treatment as compared to other treatments. Among the natural farming treatments, highest yield was recorded in complete natural farming treatment as compared to other natural farming treatments.
12	Ensuring food security, sustainability and soil health through resource conservation based farmer FIRST approach in central India funded by ICAR-New Delhi	A.K. Patra (Project leader), A.K. Vishwakarma (PI), R.K. Singh, A.B. Singh, B.L. Lakaria, R.H. Wanjari, K. Bharati, Asha Sahu, Shinogi K.C., A.O. Shirale, Hiranmoy Das, Narayan Lal	• Total area of the cluster is about 1000 ha. Four villages, namely Kham Kheda, Bherupur, Kanchbavli and Kalyanpur includes 628 household are located in two panchayats viz. Kham Kheda and Golkhedi respectively in the Huzur tehsil of Phanda block in Bhopal district between the Geographic coordinates of Latitude 23°22'16.15"N to 23°23'02.16"N and Longitude 77°24'42.01"E to 77°25'34.04"E and an Altitude of 478-485m, it has an average annual rainfall of 1070 mm. The project envisages an overall development of the people of the cluster in a participatory mode. The major problems of the agriculture, preferences of the people of the cluster, their capability and willingness have been considered while preparing this proposal. The major emphasis has been given to holistic development with a focus on resource conservation and soil health development.
13	Development of an automated soil nutrient sensing system funded by NASF	Sanjay Srivastava, A.O. Shirale, P.S. Tiwari (ICAR-CIAE, Bhopal), Vijay Kumar (ICAR-CIAE, Bhopal), Ramesh Kumar Sahani (ICAR-CIAE, Bhopal), Baban Kumar (CSIR-CSIO, Chandigarh), Neelam (CSIR-CSIO, Chandigarh)	The prototype of automated soil sampler has been developed and evaluated under field conditions. • Protocols for the estimation of soil pH, Nitrate-nitrogen (NO_3^-), Phosphate-phosphorus ($H_2PO_4^{--}$) and potassium (K^+) were developed using Ion Selective Field Effect Transistors. Models/functions for the estimation of the referred parameters were developed and validated for important soils of India. The models were validated against the standard lab methods. We found that the parameters such as soil pH, nitrate and potassium could be successfully estimated by using 0.1 M copper sulphate ($CuSO_4$) through ISFET. We also tested the estimation of soil nitrate and potassium directly in the soil suspension and found that soil: copper sulphate suspension (0.1 M) (5 g soil+ 15 ml copper sulphate) (1:3) could be used for the estimation of nitrate and potassium by directly dipping the ISFET in the suspension. • DGPS interfacing integrated with soil sampler has been completed and field-tested at ICAR-Central Institute of Agricultural Engineering (CIAE), Bhopal. The interfacing of the spectrophotometer with the communication module was done. Spectral data along with the intensity waveform are obtained via the communication protocol established. Eventually, the integrated system was designed after the prediction results via the ISE/ISFET technology received from the IISS. The system can be incorporated with the automated sampler designed by the ICAR-CIAE, Bhopal to give the final deliverable of the project.

14	Assessing the impact of imbalanced use of chemical fertilizer on soil health using a soil function based quantitative approach funded by DST, New Delhi	N.K. Lenka, B.P. Meena, Sangeeta Lenka, A.O. Shirale, R.H. Wanjari	• Normalization of data, minimum dataset formation and principal component analysis of soil quality parameters collected from US Nagar, West Godavari and Davengere districts. • Computation of Soil Quality Index using minimum dataset and linear scoring method • Laboratory analysis of soil and water samples for soil and water quality parameters of Hoshangabad district in Madhya Pradesh.

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

a) Institute Projects

15	Assessing greenhouse gas emission and soil carbon storage with reversal in tillage practice	Sangeeta Lenka, N. K. Lenka, S. Bhattacharjya	Project completed
16	Climate change impact on water productivity of major crops in central India	N.K. Sinha, M. Mohanty, J. Somasundaram, Pramod Jha, Alka Rani, Seema Bhardwaj, Hiranmoy Das, K.M. Hati, R.S. Chaudhary	•
17	Impacts of conservation agriculture on runoff and soil loss under different cropping system in Vertisols	Prabhat Tripathi, R.K. Singh, R.S. Chaudhary, Seema Bhardwaj, J. Somasundaram, M. Mohanty, K.M. Hati	• This project was initiated with two objectives i.e. To determine the run off and soil loss under different tillage and cropping systems and To study the effect of runoff and soil loss on soil properties and crop productivity. During the report year soil loss varied 2.57 to 6.27 t/ha in soybean-wheat cropping system however it was 2.90 to 6.77 t/ha in maize-chickpea cropping system. In the same manner percent run off varied 21.42 to 29.96 in soybean-wheat system and 21.70 to 34.59 in maize- chickpea cropping system. Phosphorus losses were maximum with conventional tillage in maize-chickpea system. The treatments containing residues were observed with lower losses of P and K. Same trend was observed in case of organic carbon loss. Most of the micronutrient losses were associated with soil loss however runoff water loss was observed without any significant contents of micro nutrients. The variation in bulk density under both the cropping system was found non significant.
18	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	Jitendra Kumar, NK Sinha, M Mohanty, J. Somasundaram, Alka Rani, KM Hati, RS Chaudhary	A. Impact of tillage on Soil temperature • The effect of tillage and N management was studied and found that the effect of tillage was significant on the soil temperature. • Zero tillage has shown a moderating effect when temperature was rising during the March and April in both the soil layer (0-5 and 5-10cm). B. Impact of tillage on Soil Hydraulic conductivity • The effect of tillage up to 20 cm depth shown significant effect while below this depth was having no significant. • In general, the saturated hydraulic conductivity in the No-till was higher than the conventional tillage system. • In both the Conventional tillage and no-till system having higher N application resulted into higher HC compare to the less N application plot. • It was also recorded that with an increase in the depth of the soil the hydraulic conductivity was

			reduced in both no tillage and conventional tillage system.
	(b) Soil moisture estimation through remote sensing for agriculture drought monitoring and early warning	Alka Rani, NK Sinha, M Mohanty, Jitendra Kumar, Seema Bhardwaj, RS Chaudhary, KM Hati, RK Singh	• As per ESA CCI near-surface soil moisture data for the past 40 years, the volumetric soil moisture content during Kharif season ranged from 0.25 to 0.34 m^3/m^3 whereas for Rabi season, it ranged from 0.15 to 0.24 m^3/m^3. • The pattern of variation in soil moisture matches well with the seasonal pattern of water availability i.e. more soil moisture during monsoon and less soil moisture during summer. • The years having less soil moisture i.e. 1992, 2000, 2002, 2009, 2014 and 2015, are the years which coincide with the presence of drought in Madhya Pradesh as declared by the state government. • The highest and lowest soil moisture was found in Chhattisgarh plains and Bundelkhand zone, respectively during both Kharif and Rabi cropping seasons. • The Bundelkhand and Gird agro-climatic zones, having lower soil moisture as compared to other zones, are more vulnerable towards drought. • Kharif season shows positive and Rabi season shows negative trend in soil moisture content. • The positive trend in soil moisture content was found during the months of April, May, June, July, September, October, November, December, while negative trend during January, February, March and August. • The soil moisture data from AMSR2 C band (6.9 GHz) and AMSR2 X band is of poor quality while the data from ESA CCI, SMAP L3, SMAP L4 and AMSR2 C band (7.3 GHz) appears to be fine.
	(c) Evaluation of deficit irrigation levels and phosphorus nutrition levels for optimizing water productivity rooting behaviour and yield of wheat in semiarid climate of central India	Seema Bhardwaj, Alka Rani, Jitendra Kumar, Prabhat Tripathi, J Somasundaram, RS Chaudhary, M Mohanty	• Study leave w.e.f. 26/02/2021

d) Externally Funded Projects

19	Assessment of important soil properties of India using mid-infrared spectroscopy funded by ICRAF, Nairobi	K.M. Hati, M. Mohanty, Pramod Jha, R.S. Chaudhary, N.K. Sinha, J.K. Thakur, M.V. Coumar, Pradip Dey, Dhiraj Kumar, A.K. Patra, Javed Rizvi	• Evaluated the protocol for recording of spectra using the newly acquired Neospectra NIR based spectral scanner instrument, which provides best suited soil spectra for model development. • Developed and validated chemometric prediction models for the NIR region and compared those models with the MIR prediction models. • MIR Based prediction models for soil physical and chemical properties of Vertisols and Alfisols were developed using partial least square and different machine learning tools.
20	CRP-Conservation Agriculture Development, refinement and validation of conservation agriculture in Vertisols of central India and quantifying impact of CA practices on soil and environment	LCPC: Dr. A.K. Biswas and Dy LCPC: Dr. R.S. Chaudhary K M Hati (PPI), J Somasundaram, A.K. Vishwakarma, R.K. Singh, Pramod Jha	•
	(a) Demonstration of best-bet conservation	A.K. Vishwakarma, R.H.	•

	agriculture practices on farmers' fields in Vertisols of Central India	Wanjari, Shinogi KC, A.K. Tripathi	
	(b) Fine-tuning of conservation agriculture practices for Vertisols of Central India	J. Somasundaram, S. Ramana, B.P. Meena, A.O. Shirale	•
	(c) Development of water and nutrient management practices in conservation agriculture for Vertisols of Central India	R.K. Singh, Sanjay Srivastava, N.K. Sinha, Priya Gurav Pandurang	• The experiment on soybean and wheat were conducted with different tillage system and different nutrient doses in soybean. Grain yield and biomass of soybean were not found significant difference among the tillage and different nutrients doses. All the treatments were significantly at par. In wheat crop, the different tillage systems and different nutrient doses under different irrigation methods were tested during 2020-2021. The grain yield and straw biomass were not found significant differences among the different irrigation methods but water use efficiency was significantly higher under drip and sprinkler irrigation over flood irrigation. The tillage systems and nutrient doses were also not found significant differences. Based on data of soybean and wheat crops, it can be concluded that the conservation tillage system can save energy in respect of fuel charge and about 25 % fertilizer can be saved. The irrigation water can also be saved upto 20-40 % of flood irrigation.
	(d) Impact of conservation agricultural practices on soil health, carbon sequestration and greenhouse gas emission in different production systems	Pramod Jha, B.L. Lakaria, M. Mohanty, J.K. Thakur, K. Bharati	• The impact of CA on soil properties is confined to 0-10 cm of soil depth. • Residue retention to the extent of 30% is not sufficient to make significant change in soil properties • Maintenance of 60 and 90% of residue retention significantly improved soil carbon and nitrogen stock, POM-C and POM-N concentration and N mineralization in soil. • Retention of residue contributed carbon mainly to very labile pool of soil organic matter • *In situ* residue decomposition study clearly depicts that mass loss and carbon mineralization is much faster in case of incorporated residue in comparison to surface retained. • Surface retention of residues (wheat and maize) encourage N immobilization, for soybean it occurs only for first 4 months of retention
21	Cropping systems and soil management effects on soil organic carbon sequestration and greenhouse gas emission in Vertisols of central India under change climate scenarios funded by NICRA II-Phase	M. Mohanty, Pramod Jha, Sangeeta Lenka, J. Somasundaram, N.K. Sinha, A.K. Vishwakarma, R.S. Chaudhary and Muneshwar Singh, Seema Bhardwaj	•
22	Hyper-spectral remote sensing approaches to evaluate soil quality and crop productivity of central India (under DST sponsored Network Project on Hyper-spectral Big Data Analytics)	M. Mohanty, N.K. Sinha, K.M. Hati, R.K. Singh, Pradip Dey, R.S. Chaudhary, A.K. Patra, Bharat Bhaskar Gaikwad	•

23	Strategies for enhancing yield of soybean (Glycine Max L) and pigeonpea (Cajanus cajan, L) in India using climate variability information and crop growth simulation models in collaboration with ICAR-IISR, Indore funded by IITM	M. Mohanty, B.S. Bhatia, N.K. Sinha, Prabhat Tripathi, R.S. Chaudhary, Seema Bhardwaj, A.K. Patra	•
24	Sustainable adaptive water management resilient to variable climates in Madhya Pradesh funded by ICARDA	M. Mohanty, N.K. Sinha, A.K. Patra	•
25	Vulnerability and impact assessment of climate change on soil and crop production in Madhya Pradesh funding Agency: UNDP-GEF-MoEFCC	Sangeeta Lenka, N. K. Lenka, M. Mohanty, R. H. Wanjari, A. K. Patra	• The overall climate vulnerability of the Madhya Pradesh districts is projected to increase towards mid- and end-century as compared to the current conditions for both emission scenarios of RCP 4.5 and RCP 8.5. • Districts vulnerability under RCP8.5 scenario is projected to be higher as compared to RCP4.5 scenario. The projected increase in vulnerability towards end-century is higher than that of mid-century for RCP8.5 scenario while the projected increase in vulnerability towards end-century is relatively lower than that of mid-century for RCP4.5 scenario. • Factors contributing to projected increase in climate vulnerability of districts include projected increase in rainfall variability and higher sensitivity to heat stress.
26	Assessing the potential impact of climate smart technologies on soil health and nutrient accounting in selected vulnerable districts of MP funded by EPCO, Bhopal	Sangeeta Lenka, N.K. Lenka, MV Coumar, M. Mohanty, J.K. Saha, A.K. Patra, Dolamani Amat	• Developed baseline georeferenced soil fertility maps for twenty climate smart villages of Rajgarh Sehore and Satna districts. • The maps have been communicated to the funding agency for due communication to the concerned farmers of the two districts. • Soil health card along with site specific recommendations prepared in hindi and distributed to famers of the twenty climate smart villages of the three districts. • Climate smart soil and agricultural intervention carried out in farmer's field for the three districts.
27	Assessing the potential impact of climate change and management on soil carbon and nitrogen storage in selected ecosystems of India funded by NASF	Sangeeta Lenka, N.K. Lenka, Vasudev Meena, Asit Mandal, Biswapati Mandal (BCKV, West Bengal)	• The natural abundance of 13C stable isotope estimation proved that INM significantly improved the proportion new carbon at all depths compared with only inorganic and control treatments. • Approximately 18 to 40% of total soil organic carbon is new carbon under INM and 100% NPK. • In Alfisol nutrient management can influence SOC pool even till 45-60 cm soil depth. However, in Vertisol nutrient management can influence SOC pool only till 15-30 cm soil depth. • Therefore soil type and climate are the driving factors regulating the responses of SOC pool to different nutrient management. • Litter decomposition study demonstrated that residue quality other than C:N ratio would drive the magnitude and direction of residue decomposition and nutrient release.Nutrient and tillage management influence the nutrient release kinetics from litter.

Programme III – Soil Microbial Diversity and Biotechnology

a) Institute Projects/ Inter-institute collaborative project

28	Effects of long term use of fertilizer and manure on soil functional diversity and nutrient supplying capacity under different soils and cropping systems (Inter-institute collaborative project with ICAR-IISR, Indore	Sudeshna Bhattacharjya, Asha Sahu, M.C. Manna, Muneshwar Singh, R.H. Wanjari, M.P. Sharma (ICAR-IISR, Indore), A.K. Patra	• Not presented
29	Characterization and prospects of soil biota for enhancing nutrient use efficiency		
	(a) Deciphering thermophiles from hot springs of Central India for rapid decomposition of crop residues	Asha Sahu, Sudeshna Bhattacharjya, Dolamani Amat, Nisha Sahu, K Bharati, Anita Tilwari	• Isolated 101 thermophilic bacteria from 3 hotsprings (ChotiAnhoni, Badi Anhoni and Tatapani) of Central India. • Most of the bacterial isolates showed thermozymes production potential. • Pot experiments were conducted with six potential isolates, it was concluded that the consortia of isolates showed better crop growth than control. • It was also observed that consortium culture treatment recorded significant enhancement in the root and shoot growth as well as ARA activity in comparison with control. • The study has demonstrated that the bacterial isolates possessing heat tolerance coupled with PGP properties. Thus, it could serve as efficient biofertilizer candidates for improving plant growth under stress conditions.
	(b) Exploring endophytic microbial diversity of selected major field crops of India for nutrient supplementation and biocontrol	J.K. Thakur, Asit Mandal, Dolamani Amat, MC Manna	• From wheat grown in three different soil viz. Vertisols, Inceptisols and Alfisols, 27 bacteria were isolated form root tissues and rhizoplane of which, six could grow on nitrogen free medium, fifteen isolate solubilized P from tricalcium phosphate, nine isolate solubilized potassium from glauconite and five had zinc solubilizing ability. • The diversity of the microbes was studied using Amplified Ribosomal DNA Restriction Analysis (ARDRA) fingerprinting technique using HaeIII restriction endonuclease and aldo using BOX PCR.Similarity in the isolates on rhizoplane and endophytes was observed which indicate that the isolates strongly colonizing on the rhizoplane could establish as endophyte. • Difference occurred in the endophytic flora of same host grown in different soil types with few of the common organisms found in host of all the soil types as revealed by ARDRA. • Many of the isolates from different soil types clustered together indicating plant genotype driven recruitment of the isolate for endophytic colonization.

c) Externally Funded Projects

30	Enhancing decomposition rate and quality of bio-waste through microbial consortia for improving soil health funded by NASF	M.C. Manna, Asha Sahu, S. Bhattacharjya, A.B. Singh, A.K. Tripathi, J.K. Thakur, Dolamani Amat, Asit Mandal	• Project completed and report submitted
31	Eco-genomics of soil microbes involved in global climate mitigation and nitrogen use efficiency in rice-wheat agroecosystem of central India under elevated CO_2 and temperature" funded by DST	S.R. Mohanty, K Bharati, S Gangil (ICAR-CIAE, Bhopal), A.K. Vishwakarma	•

32	Evaluation of Soybean-rhizobia interaction under elevated CO_2 and temperature to develop climate ready microbial inoculants for central India funded by AMAAS	S.R. Mohanty, Asit Mandal, K Bharati	•
33	Exploring soil microbial community and mechanism in soil carbon sequestration under long term land uses in semi-arid sub-humid Central India funded by SERB, DST, New Delhi	Sudeshna Bhattacharjya	•
34	Methanogenic bio-electrode driven conversion of CO_2 to CH_4 to enhance methanogenesis and mitigation of greenhouse gas from agro-waste based bioenergy systems" funded by DST-JSPS programme	S.R. Mohanty, K. Bharati, A.K. Patra, Seiya Tsujimura, Masanori Kaneko (University of Tsukuba, Japan)	•

Programme IV: Soil Pollution, Remediation and Environmental Security
a) Institute Project:

35	Assessment of acid mine drainage affected areas in Madhya Pradesh	Madhumonti Saha, Ajay, Abhijit Sarkar (I/c PI), J.K. Saha, Hiranmoy Das	• In Singrauli coal mine area two coal mine area e.g., Jhingurdaand Jayant coal mine area were selected based the production and ease of sampling. Soil and water samples were collected georeferenced points. Laboratory analysis indicated that the Jhingurda coal mine area water has Cu, Ni and Fe within safe limit; Cd, Co, Cr, Pb and Zn in BDL; Mn > 0.2 mg/ L; whereas, Jayant coal mine area water has Co, Cu, Ni, Fe, Pb and Zn within safe limit; Cd and Cr in BDL; Mn > 0.2 mg/ L. Nearby village area water also gave Cu and Fe within safe limit; Co, Ni, Cd, Cr, Pb and Zn in BDL; Mn > 0.2 mg/ L. Overall, Jhingurda coal mine area soil high in organic carbon, low to medium in available P and medium in available K; whereas, Jayant coal mine area soil high in organic carbon, low to medium in available P and high in available K. Nearby village area soil high in organic carbon, low in available P and medium to high in available K. • Coal, soil and water samples were collected from Amlai, Sharda coal mine area (SECL, Amlai) to assess the quality of soils and water in coal mine areas and surrounding villages. Sharda coal mine area water has Co, Cr, Cu, Fe, Mn, Ni, Pb and Zn within safe limit; Cd in BDL. Nearby village area water has Co, Cr, Cu, Fe (except Kelauhri and Bargaon village hand pump), Mn (except Kelauhri village hand pump), Ni, Pb and Zn within safe limit; Cd in BDL. Sharda coal mine area soil high in organic carbon, low to medium in available P and medium in available K. Nearby village area soil high in organic carbon, low in available P and medium to high in available K. • Malanjkhand copper mine water samples recorded Cd, Fe, Ni, Pb and Zn within safe limit; Mn > 0.2 mg/ L, Co > 0.05 mg/ L and Cu >>0.2 mg/ L (3 – 70 mg/ L). Nearby village area water Cd, Fe, Ni, Pb and Zn within safe limit; Mn > 0.2 mg/ L, Co > 0.05 mg/ L (except Banzar river) and Cu >>0.2 mg/ L (22 – 64 mg/ L). Malanjkhand copper mine area soil high in organic carbon, low in available P and low to medium in available K. Nearby village area soil low to medium in organic carbon, low to medium in available P and medium to high in available K.
36	Heavy metal and its remediation for sustainable crop production and environmental protection		
	(a) Assessment/quantification of soil heavy	Nisha Sahu,	• Surveyed Jajmau industrial area, Kanpur and collected surface soil samples gridwise at interval of 250

	metals using spectroscopy and multi spectral remote data from industrial areas of Kanpur	Madhumonti Saha, JK Saha, NK Sinha, H Biswas (ICAR-NBSSLUP), Mrunalini Kancheti (ICAR-IIPR, Kanpur)	m for conventional and spectral analysis. • Prepared Land Use/Land Cover map using Satellite imagery Sentinal-2A data of 10 m resolution. • Mr. Rahul Mishra to be included in place of Mrs. Madhumonti Saha as she is in study leave.
	(b) Municipal solid waste compost quality assessment for sustainable crop production and environmental protection	MV Coumar, Tapan Adhikari, Abhijit Sarkar, Nisha Sahu, J. K. Saha, Hiranmoy Das, Ajay	• Pot culture experiment was conducted to evaluate the effect of relatively uncontaminated municipal solid waste compost (MSWC), contaminated municipal solid waste compost and co-composted product of MSW with biochar, zeolite and lime application on heavy metal dynamics in soil and its transfer to spinach crop. In the present study, the use of soft wood (pigeon pea) biochar as an additive during the process of co-composting with MSW improved the quality of the co-composted product, MSWBC. Application of MSWBC-10% PPB in soil significantly reduced the DTPA-extractable heavy metal content by 14.7% (Ni) to 62.5% (Cd) and reduced heavy metal mobility (transfer coefficient values) from the soil to the plant system. Application of municipal solid waste biochar compost (MSWBC) significantly ($P < 0.05$) reduced the heavy metal content in spinach leaves and roots compared to MSW amended soil. The percent decrease in spinach leaf following the application of MSWBC-10% PPB compared to MSW was 20.62, 28.95, 36.02, 41.88, 41.50, and 41.23% for Cu, Cd, Pb, Cr, Ni, and Zn, respectively.

b) Externally funded projects

37	Reclamation and rehabilitation of coper mining affected land in Malanjkhand area of Madhya Pradesh (Hindustan Copper Limited)	Ajay, Tapan Adhikari, Asit Mandal, J.K. Saha	• Anthropogenic activities such as mining is consider as one of the major component to alter ecosystems habitat at unprecedented rates and leading to accelerated loss of biodiversity and serious environmental pollution. The Tailing Dam is formed in the adjacent area of mining industry is a storage of tailings or waste material generated from the ore concentration plant. The sand is pilled along the periphery of the reservoir. The sandy bed and the water storage areas are devoid of any vegetation except with some scattered bushes and gives an appearance of a desert. Overall, this copper mining plant created major problems of Solid waste left (mainly unused rocks) after ore–processing for metal extraction dumped on the forest land. This debris is the major source of heavy metal pollution from mining activity and contaminated a vast land of forest. More than 90% of ore is rejected as tailings after metal in mineral processing plants and are stored in tailing impoundments. These tailings often contain substantial quantities of other metals (other than target metal) and the percentage of these metals well below the cut off grade. Tailings are composed of mostly silt or sand sized particles, lack of nutrients (N, P, K) and contain no organic matter. Bio-toxicity in mine tailings are driven primarily by low pH and high metal content. As a result, most tailings disposal sites are devoid of vegetation and have a stressed heterotrophic microbial community. In the present study, Vetiver (Chrysopogon zizanioides) planted at Tailing Dam Embankment to see the effect of established plants on rhizopshereic microorganisms and microbial activity. The rhizosphereic study was conducted to estimate the population of Fungi, bacteria and actinomycetes which are known to colonize diverse habitats and substrates and they are known to play substantial role in plant health and productivity besides producing diseases. Overall, higher population of bacteria, fungi and actinomycetes was observed in the rhizospheres soils of Vetivar than the tailing sand. The soil enzymatic activities such as dehydrogenase activity and fluorescein di-acetate activity was found higher in case of rizhospheres of vetivar vegetation as compared to tailing sand.
38	Management of Municipal Solid Waste (MSW)	Ajay, Tapan Adhiakari,	• Project completed

	contaminated landfill area of Bhanpur, Bhopal funded by BMC, Bhopal	K. Bharati, Asit Mandal, J.K. Saha	
39	Reclamation and management of Municipal Solid Waste contaminated dumping area of Bhanpur, Bhopal funded by MPCST, Bhopal	Ajay, Tapan Adhikari, K. Bharati, Asit Mandal	Bhanpur dumping waste sites are comprises of all the wastes arising from human and animal activities that are normally termed as municipal solid waste. Solid waste consists of heterogeneous mixture of undesirable mass or materials coming from the industrial, agricultural, institutional and domestic and animal waste. By means of land filling with this municipal solid waste poses several problems, such as rising land filled management and increasing risk that substances leaching from landfills may contaminate groundwater and surface water as well soil contamination of nearby areas. The toxic components of the waste such as heavy metals, organic pollutants caused further cause degradation of soil health, ground water quality, affects plant growth, livestock and human health if they enter the food chain or drinking water supply. There is an urgent need to identify economically viable technique to minimize of the toxicity from various kinds of pollutants and protect the soil health by the transformation of toxic compounds/heavy metals to a harmless state. The present project initiated to the aims to management and standardization of protocol to develop greenery in the municipal solid waste dumping area at Bhanpur. Development of best package of practices for growing of plants in the contaminated sites and phyto-remediation of heavy metal contaminated sites of MSW dumping areas with plants like Vetivar (Chrysopogon zizanioides), and other suitable plants have great effect on soil microbiological properties by developing the green cover. This study it was observed that, the rhizosphere of the established plants have positive influence on the improvement in microbiological activities. The microbial populations such as total heterotrophs, fungi and actinomycetes population was found more in the rhizosphere of vetivar plants as compared to control or unpolluted soil. The microbial activities in terms of soil respiration and soil enzyme activities such as soil dehydrogenase activities, fluorescein di-acetate hydrolysis was also found higher in the rhizosphere soil of the contaminated waste site as compared to control. The microbiological activities enhance the decomposition of MSW.
40	Exploring endophytic fungi for the phytoremediation of heavy metal contaminated soils funded by DST	Asit Mandal	• 12 morphologically different endophytic fungi were isolated out of 14 fungal isolates were identified and obtained NCBI accession number. • The fungal isolates belong to genera of *Fusarium* and Curvularia sp. show wide range of HM tolerance • Most of the fungal isolates show tolerance to current studied HMs and Tolerance index (TI) were more than 50 %. • *Aspergillus, Fusarium* and *Alternaria* sp has great potential for phosphorus solubilization and IAA production whereas the Curvularia, Fusarium and *Paecilomyces has great potential for siderophore production.* • Endophytes inoculation with the seeds of wheat and maize improved plant growth promotion.
41	Use of fly ash in agriculture for sustainable crop protection and environmental protection funded by NTPC, Noida	J.K. Saha, M.V. Coumar, Vasudev Meena, Abhijit Sarkar, A.K. Patra, Tapan Adhikari, Ajay, K.M. Hati, A.K. Vishwakarma, Sangeeta Lenka, Asit Mandal, Madhumonti Saha, S Ramana, Hiranmoy Das	• Fly ash from 5 different thermal power plants had higher radioactivity from radionuclides 238U, 226Rd and 232Th and lower radioactivity from 40K compared to soil. However, their values in both ashes and soils from different locations were within safe limits. • In all the 5 centers, field experiments were initiated with kharif season crops (Soybean in IISS Bhopal, Rice in OUAT Bhubaneswar and BCKV Mohanpur, Maize in IARI New Delhi and annual & perennial fodder crops in IGFRI Jhansi). • In Bhopal, fly ash at higher rate of application had positive influence on plant height, leaf area, seed and straw biomass of soybean. • Fly ash application had significant influence on soil physical properties, viz., BD, Infiltration capacity and penetration resistance after 1st crop of soybean in Vertisol of Bhopal.

Contractual Projects

42	Impact of viscose staple fibre industry treated effluent on soil health and crop production surroundings Nagda, M.P funded by M/s Grasim Industries Limited, Nagda, Ujjain, M.P.	Tapan Adhikari, J.K. Saha, M.V. Coumar, R.H. Wanjari, N.K. Sinha, A.K. Patra	Nagda town in Ujjain district of M.P. is housing a large number of important industries. The effluent water from those industries and municipal domestic sewage water are also mixed with Chambal river water. The present study was conducted by ICAR-Indian Institute of Soil Science, Bhopal, in collaboration with GRASIM Company, Nagda, to explore the possibility of utilization of Chambal river water with maximum profitability in agriculture while ensuring minimal degradation of soil quality. Judicious use of fertilizers and precise irrigation practices play pivotal roles for the management of agricultural soil salinity and sustaining crop productivity in regions coming under secondary salinization. Field experiments were conducted to investigate the effect of contaminated Chambal river water on wheat (Triticum aestivum L.) crop production and its management through plastic mulch drip irrigation and organic manure application. Eight treatments were performed where two sources of irrigation water like bore well water and river water as well as four levels of farm yard manure (FYM) viz.0, 5, 10, 20 t/ha were applied. Treatment 20 t FYM/ha favored the increment of organic carbon and moisture content in soil and lower salt content in root zone. Under the same treatment, the yield of wheat crop was enhanced 2% in comparison to control. The combination of plastic mulch drip irrigation and organic manure application with the introduction of salt tolerant wheat variety (KRL 210) would be an effective strategy for maintaining crop productivity and improve soil health for this contaminated area. This study provides valuable information of the water quality status suitable for irrigation purpose, soil health condition, enhance quality of crop produce and yield. It also contributes to the future developments of modern irrigation technology, use of salt tolerant varieties and as well as providing guidelines for safe use of contaminated Chambal river water in agricultural practice.
43	Evaluation of effect of Zeba fertilizer product on nitrate-N leaching funded by M/s UPL Limited, UPL House, 610Bl2, Bandra Village, Off Western Express Highway, Bandra-East, Mumbai- 400 051	A.K. Biswas, R. Elanchezhian, N.K. Lenka, A.O. Shirale, A.K. Patra	• Project completed and report submitted.

New Externally funded Projects (RPP-1)

S. No.	Project Title	PI/Co-PI	
44.	Evaluating the impact of Geoxol.com on soil health and crop productivity funded by M/s Privi Life Science, Mumbai (Contractual project)	J Somasundaram, NK Sinha, M Mohanty, RS Chaudhary, KM Hati, AO Shirale, AK Patra	•
45.	Microbial based agricultural waste management using vermicomposting funded by Swachchta Action Plan, ICAR, New Delhi	AK Patra (Project leader), AK Vishwakarma (PI), JK Thakur, AB Singh, BL Lakaria, BP Meena, RS Chaudhary, Asha Sahu, Asit Mandal	
46.	Development of Nano Sensor and its application	Tapan Adhikari, C. D.	•

	through cloud based network for real time irrigation to soil and plant funded by NASF, ICAR, New Delhi	Singh, Samir Kumar Pal, S N Bose	
47.	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	Pramod Jha, R Elanchezhian, BL Lakaria, B.P. Meena, Pradip Dey, AK Biswas	
48.	Sustainable biochar production agroforestry systems and its application: A climate resilient soil management approach funded by ICRAF	BL Lakaria, Pramod Jha, AK Biswas, AK Vishwakarma, BP Meena, M Vassanda Coumar, Jitendra Kumar, Abinash Das, AK Patra, Javed Rizvi, SK Dhyani, Aqeel Hasan Rizvi, Archna Singh, Jamal Pervez Noor	
49.	Investigation of potentials of soil as a sink for nitrous oxide and strategies for mitigation nitrous oxide emission funded by DST SERB – POWER Fellowship	Sangeeta Lenka	
50.	Modelling soil carbon storage and dynamics in different agro-ecosystems of India under the changing climate scenarios funded by NICRA	M. Mohanty, N.K. Sinha, Pramod Jha, Dhiraj Kumar, R.H. Wanjari, Prabhat Tripathi, AK Patra	•
51.	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	M. Mohanty, N.K. Sinha, J. Somasundaram, Pramod Jha, K. Bharati, Jitendra Kumar, Sangeetal Lenka, J.K. Thakur, Abinash Das, KM Hati, RS Chaudhary, AK Patra	•
52.	ICAR Network Program on Precision Agriculture	NK Sinha, J Somasundaram, M. Mohanty, Pradip Dey, Jitendra Kumar, Dhiraj Kumar, Alka Rani, KM Hati, RS Chaudhary, AK Patra	•
53.	Do agricultural micro plastics undermine food security and sustainable development in less	AK Patra, Tapan Adhikari, JK Thakur,	•

	economically developed countries?	Asit Mandal	
54.	Evaluating the effect of Bio.soilz on soil nutrient availability and microbial activity under maize-wheat cropping system in vertisols of Central India funded by M/s Blu Soils Agro Pvt. Ltd, Patna (Contractual project)	Asit Mandal, JK Thakur, AB Singh, R Elanchezhian, AK Patra	
55.	UAV based soil moisture measurement and dissemination-IoT based approach for soil moisture monitoring and dissemination (Collaborative project with IIT Delhi)	NK Sinha, AK Vishwakarma, J Somasundaram, KM Hati, M Mohanty, Jitendra Kumar Alka Rani, S Sen (IIT Delhi)	

New institute projects (RPP1)

S. No.	Project Title	PI/Co-PI	
56.	Impact of Water and nitrogen management strategies on soil quality /soil health under conservation agriculture in Vertisols	J. Somasundaram	•
57.	Impact of long term conservation agriculture practices on soil phosphorus and potassium dynamics and soil quality under diverse agro-ecological zones	Khushboo Rani	•
58.	Effect of long term nutrient management on various fractions and forms of soil organic carbon and nitrogen, carbon stabilization and biological activity in dominant cropping systems	Dhiraj Kumar	•
59.	Quantification of heavy metal concentration in contaminated soils, sludge and compost using pXRF and ICP-OES"	Mr Rahul Mishra	•
60.	Effect of in-situ decomposition of crop residue mediated by lignocellulolytic microbes on soil health under rice-wheat cropping system"	Dolamani Amat	•
61.	Soil quality and yield sustainability assessment of targeted yield fertilizer prescription based long-term integrated nutrient management in major soil orders of India	Immanueal C Haokip	•

Contractual projects (RPP1)

S. No.	Project Title	PI/Co-PI	
62.	On-farm evaluation of ECOWELL ORGAIIIC PRODUCTS under soybean-wheat cropping system	Asha Sahu, Sudeshna Bhattacharjya, Dolamani Amat, K Bharati, AB Singh, AK Patra	•

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