Proceedings of IRC Meeting

(18-20, and 26th July, 2013)

भाकृअनुप
ICAR

Indian Institute of Soil Science

Nabibagh, Berasia Road

Bhopal – 462 038 (M. P.)

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Personal Secretary

INTRODUCTORY REMARKS OF THE CHAIRMAN, IRC

The 2nd Institute Research Council (IRC) meeting for the financial year 2012-13 started on 18th July, 2013 and the Member-Secretary (IRC), Dr. A. K. Biswas welcomed the participants and detailed the agenda items of the IRC. He further stressed on the importance of linking the RPP/HYPM/AAR with RFD/Performance Indicators/ASRB proforma/assessment parameters. Dr. A. Subba Rao, Director IISS and Chairman of IRC in his introductory remark informed the house about HOD's meeting with Director General. He stressed to maintain a database of projects as we are ought to be accountable for the public investment in research. He further added that NRM institutes have to a research programme that is able to attract investments/budget from ICAR. He mentioned that IISS has to work as per Vision-2050. He also mentioned about the call for a new perspective in research with efficient/inefficient cultivars with respect to nutrient use efficiency, need for the development of GAP/BMPs, and soil health assessment and monitoring in some bench mark sites in production systems across agroecological region. Thus, use efficiency research has to be given a new meaning. Thereafter all the projects under the following research themes were presented in detail by the respective PIs as follows

RESEARCH PROGRAMMES

Programme I	:	**Soil Health and Input Use Efficiency**
Programme II	:	**Conservation Agriculture and Carbon Sequestration vis-à-vis Climate Change**
Programme III	:	**Soil Microbial Diversity and Genomics**
Programme IV	:	**Soil Pollution, Remediation and Environnemental Security**

STATUS OF PROGRAMME WISE ONGOING PROJECTS

Approved on-going projects

Programme I: Soil Health and Input Use Efficiency

A) Institute Project

Sl. No.	Title of the project	Leader and Associates	Unit/ Division	Start	Completion	Remarks
1.	Long-term Evaluation of Integrated Plant Nutrient Supply Modules for sustainable productivity in Vertisol.	Muneshwar Singh A. K. Biswas A. B. Singh R. S. Chaudhary B. P. Meena	LTFE	April 2002	Long term	Progress is satisfactory and project to be continued
2.	Study on nanoporous zeolites for soil and crop management.	K. Ramesh I. Rashmi	Soil Chemistry and Fertility	March 2010	February 2014	Progress is satisfactory and project to be continued.
	Comment: With the help of NBSS&LUP characterize all natural zeolites included and conclude in the stipulated time frame. **(Action: Dr. K. Ramesh)**					
3.	Efficacy of soil sampling strategies for describing spatial variability of soil attributes.	Neenu S Sanjay Srivastava Hironmoy Das	Soil Chemistry and Fertility	August 2010	July 2013	**Project concluded.**
	Comment: Summarize the work to arrive at soil sampling strategy for precision agriculture. Boron estimation may be checked as per procedure outlined by Dr. J.K. Saha (**Action: Dr. Neenu S**)					
4.	Studies on soil resilience in relation to soil organic matter in selected soils.	N. K. Lenka, Sangeeta Lenka Brij Lal Lakaria Asit Mandal	Soil Chemistry and Fertility	July 2010	July 2015	Progress is satisfactory and project to be continued.
	Comment: Pot culture study may be conducted to ascertain the effect on crop productivity. **(Action Dr. N.K. Lenka)**					

5.	Changing climatic factors' influence on the nutrient acquisition, utilization and recovery by soybean and wheat/gram germplasm lines/ genotypes on black soils of central India.	Neenu S. K. Ramesh S. Ramana J. Somasundaram I. Rashmi	Soil Chemistry and Fertility	June 2010	June 2013	**Project is concluded**
	Comment: Come out with final report with plant parameters that were affected by variable weather. **(Action Dr. Neenu. S.)**					
6.	Biofortification of grain sorghum and finger millet varieties with zinc through agronomic measures.	Ajay A.K.Shukla J.K.Saha,	ESS	July 2010	July 2013	**Project is concluded**
	Comment: Data be discussed with project associates and HOD (ESS) before making final presentation. **(Action Dr. Ajay)**					
7.	Development of phosphorus saturation indices for selected Indian soils.	I. Rashmi Neenu S	Soil Chemistry and Fertility	April 2011	April 2014	Project to be continued
8.	Biochar on soil properties and crop performance	Brij Lal Lakaria Pramod Jha A.K. Biswas K.M. Hati J. K. Thakur Vassanda Coumar A. K. Dubey (CIAE) S. Gangil (CIAE)	Soil Chemistry and Fertility	January, 2012	January 2017	Progress is satisfactory and project to be continued.
9.	Detection of water and nitrogen stress and prediction of yield of soybean and maize using hyper-spectral reflectance and vegetation indices.	K. M. Hati R. K. Singh	Soil Physics	June 2009	June 2013	**Project is concluded**
10.	Participatory assessment of qualitative parameters for categorizing different degrees of soil quality to enhance the soil health and	R. S. Chaudhary J. Somasundaram, Santosh R.	Soil Physics	March 2010	August 2013	**Project is concluded**

	productivity.	Mohanty A. B. Singh				
11.	Impact of crop covers on soil and nutrient losses through runoff in Vertisol.	R. K.Singh, J. Somasundaram I. Rashmi	Soil Physics	June 2010	May 2014	Progress is satisfactory and project to be continued.
12.	Characterizing rooting behaviours, soil water patterns and nutrient uptake of soybean – chickpea under different tillage and water regimes in Vertisols.	N. K. Sinha M. Mohanty Ritesh Saha I. Rashmi	Soil Physics	June 2011	December 2014	Progress is satisfactory and project to be continued.
13.	Soil Resilience and its Indicators under Some Major Soil Orders of India.	Ritesh Saha K.M. Hati Pramod Jha M. Mohanty R.S. Chaudhary	Soil Physics	March 2011	February, 2014	Progress is satisfactory and project to be continued.
14.	Integrated assessment of some IISS Technology in enhancing Agro-Ecosystems productivity and livelihood sustainability	Shinogi K.C. Sanjay Srivastava A.B. Singh D.L.N. Rao Radha T.K B.P. Meena N.K. Sinha Hiranmoy Das	ITMU Unit	Jan 2013	Jan 2016	Progress is satisfactory and project to be continued.
15.	Nano particle delivery and internalization in plant systems for improving nutrient use efficiency	R. Elanchezian A.K. Biswas Tapan Adhikari K. Ramesh, S. Kundu A.K. Shukla A. Subba Rao	Soil Chemistry and Fertility	July, 2013	July 2016	Progress is satisfactory and project to be continued.
16.	Soil quality assessment for enhancing crop productivity in some tribal districts of Madhya Pradesh	Rajendiran S. M. L. Dotaniya M. Vassanda Coumar	ESS	July 2011	June 2015	Progress is satisfactory and project to be continued.

		N. K. Sinha Sanjay Srivastava A. K. Tripathi S. Kundu				

Externally Funded Projects

17.	Understanding the mechanism of variation in status of a few nutrietionally important micronutrients in some important food crops and the mechanism of micronutrient enrichment in plant parts (NAIP project)	A.K. Shukla Muneshwar Singh Tapan Adhikari	MSN	Feb. 2009	March 2014	Progress is satisfactory and project to be continued.
18.	Nano-technology for Enhanced Utilization of Native-Phosphosrus by Plants and Higher Moisture Retention in Arid Soils (NAIP Project)	Tapan Adhikari A. K. Biswas S. Kundu	ESS	July 2008	March 2014	Progress is satisfactory and project to be continued.
	Comment: Packaging of nano particles as a fertilizer product is to be the most important part of the project. **(Action: Dr. Tapan Adhikari)**					
19.	GPS and GIS based model soil fertility maps for selected districts for precise fertilizer recommendations to the farmers of India.	A. Subba Rao Pradip Dey (ExecutivePI) A. K. Shukla Muneshwar Singh Sanjay Srivastava R. H. Wanjari Hiranmoy Das	STCR	June 2009	Continue	Progress is satisfactory and project to be continued in view of further possibilities of financial sanction from DAC.
	Comment: Critical limits of micronutrients are an important point of contention and hence, needs re-validation, on state/regional basis. **(Action: Dr. Pradip Day and Dr. A.K. Shukla)**					
20.	Network Project on Organic Farming	A. B. Singh K. Ramesh Brij Lal Lakaria S. Ramana J.K. Thakur	Soil Biology	July 2004	March 2014	Progress is satisfactory and project to be continued.

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

A. Institute Projects

21	Soil carbon saturation and stabilization in some soils in India.	Pramod Jha, Brij Lal Lakaria Ritesh Saha S.R. Mohanty A.K. Biswas Muneshwar Singh	Soil Chemistry and Fertility	March 2010	February 2014	Progress is satisfactory and project to be continued.
22	Evaluating conservation tillage on various sequences/rotations for stabilizing crops productivity under erratic climatic conditions in black soils of Central India	J. Somasundaram R. S. Chaudhary Neenu S Ajay	Soil Physics	March 2010	June 2016	Progress is satisfactory and project to be continued.
23.	Assessing impacts of climate change on different cropping systems in Central India and evaluating adaptation studies through crop simulation models	M. Mohanty K.M. Hati N.K. Sinha Sangeeta Lenka Pramod Jha Neenu S. R. S. Choudhary R. Elanchezian A. Subba Rao	Soil Physics	June 2011	May 2016	Progress is satisfactory and project to be continued.
24..	Tillage and manure interactive effects on soil aggregate dynamics, soil organic carbon accumulation and by pass flow in vertisols	Sangeeta Lenka M. C. Manna Brij Lal Lakaria R. K. Singh R. C. Singh (CIAE)	Soil Physics	June 2008	June 2014	Progress is satisfactory and project to be continued.
	Comment: Green House gas emission data acquisition need to be checked and standardized. **(Action: Dr. Sangeeta Lenka)**					

B. Externally Funded Projects

25	Evaluating Conservation Agriculture for Stabilizing Crop Productivity and Carbon Sequestration by Resilient Cropping Systems/Sequences under aberrant Climatic Conditions in Black Soils of Central India.	J. Somasundaram R. S. Chaudhary M. Vassanda Coumar K. M. Hati A. Subba Rao Pramod Jha K. Ramesh, Ajay	Soil Physics	August 2011	March 2014	Progress is satisfactory and project to be continued.
26.	Quantifying Green house gases (GHGs) emissions in soybean-wheat system of M.P. (MPCOST)	Sangeeta Lenka N.K. Lenka S. Kundu A. Subba Rao	Soil Physics	June 2011	June 2014	Progress is satisfactory and project to be continued.
	Comment: Calculations on gaseous emission need to be checked; **(Action: Dr. Sangeeta Lenka)**					

Programme III – Soil Microbial Diversity and Biotechnology

A. Institute Projects

27.	Structural and functional diversity of microbes in soil and rhizosphere	Santosh R. Mohanty M.C. Manna Muneshwar Singh	Soil Biology	January 2010	January 2014	Progress is satisfactory and project to be continued
	Comment: There is a need for check/ascertain archaeal population. **(Action: Dr. Santosh R. Mohanty)**					
28..	Consequences of transgenic cotton on soil microbial diversity	Asit Mandal J.K. Thakur Asha Sahu M.C. Manna	Soil Biology	March 2011	February 2014	Progress is satisfactory and project to be continued
	Comment: More focus is needed on metagenomics and if possible, effect of toxins on PGPR to be assessed. **(Action: Dr. Asit Mandal)**					

29.	Actinomycetes diversity in Daccan plateau, hot, arid region and semi arid eco-sub-region (AER 3 and 6) and evaluation of their PGPR activity.	Radha T.K. D.L.N. Rao	Network Coordinate (BF)	August 2010	August 2013	Progress is satisfactory and project to be continued
	Comment: Six-months extension is granted to repeat some experiments (up to April, 2014) **(Action: Dr. Radha T. K)**					
30.	Developing technique for acceleration of decomposition process using thermophilic organisms	Asha Sahu U. B. Singh (NBAIM) J.K. Thakur V. K Bhargav (CIAE) H.L. Kushwaha (CIAE) Asit Mandal, M.C. Manna A. Subba Rao	Soil Biology	September 2011	August 2014	Progress is satisfactory and project to be continued
	Comment: Absolute data may be presented along with the relative data set and percent values. **(Action: Dr. Asha Sahu)**					
31.	Chemical and Microbiological Evaluation of Biodynamic and Organic Preparations.	J. K. Thakur, Asha Sahu, Asit Mandal A. B. Singh.	Soil Biology	June 2011	June 2013	Progress is satisfactory and project to be continued
	Comment : Data presented is to be refined with respect to root/shoot and total biomass and yield. **(Action: Dr. J.K. Thakur)**					
32.	Greenhouse gas (GHG) emission from composting systems and characterization of GHG regulating microbes	K. Bharati, J.K. Saha, S.R. Mohanty Shinogi K C	Soil Biology	June 2012	June 2016	Progress is satisfactory and project to be continued
	Comment: Gas flux to be measured in well-defined compost pit or stock. **(Action: Dr. K. Bharati)**					

B. Externally Funded Projects

33.	Metagenomic characterization and spatio-temporal changes in the prevalence of microbes involved in nutrient cycling in the rhizoplane of bioenergy crops (DST)	Santhosh R. Mohanty Asit Mandal K. Bharati	Soil Biology	November 2011	November 2014	Progress is satisfactory and project to be continued
	Comment: Equipment procured, Now project work needs acceleration to meet the target, as it is externally funded project **(Action: Dr. Santosh R. Mohanty)**					
34.	Novel bio-filtration method using selected mesophilic fungi for removal of heavy metals from municipal solid waste in Madhya Pradesh (MPCOST).	M.C. Manna Asit Mandal Asha Sahu J. K. Thakur S. Ramana A. Subba Rao	Soil Biology	July 2012	July 2014	Progress is satisfactory and project to be continued

Programme IV: Soil Pollution, Remediation and Environnemental Security

A. Institute Project

35.	Phyto-extraction of Cr by some floriculture plants.	S. Ramana A.K. Biswas Ajay	Soil Biology	June 2009	December 2013	Progress is satisfactory and project to be continued.
36.	Non point sources of phosphorus loading to upper lake, Bhopal.	M. Vassanda Coumar M. L. Dotaniya Vasudev Meena J. Somasundaram J.K. Saha	ESS	April 2011	March 2014	Progress is satisfactory and project to be continued.
37.	Interaction among tannery effluents constituents on heavy metals uptake by spinach.	M. L. Dotaniya J. K. Saha Rajendiran S M. Vassanda Coumar S. Kundu	ESS	January 2012	December 2016	Progress is satisfactory and project to be continued.
	Comment: Need focused presentation and good slide-making with clear cut legends and units. **(Action: Dr. M. L. Dotaniya)**					

B. Externally Funded Projects

Nil

Contractual Projects

S. No.	Title	Sponsorer	PI & Co-PI	Division/Unit	Period		Remarks
38	Evaluation of plant nutrition product (NP - 1) for nutrient use efficiency in cereal crops	Nagarjuna Fertilizers and Chemicals Pvt. Ltd., Hyderabad	R. Elanchezhian A.K. Biswas K Ramesh, N.K. Lenka, A. Subba Rao	Soil Chemistry and Fertility	December 2012	December 2013	Project is satisfactory and project to be continued
39.	Effect of urea pestlile productivity and nutrient use efficiency in some soils of India	Sandvik India Pvt. Ltd.	Pramod Jha B.L. Lakaria A.K. Biswas Pradip Day A. Subba Rao B. Kumar-Ranchi S.R. Singh – Barrackpur	Soil Chemistry and Fertility	December 2012	December 2013	Project is satisfactory and project to be continued
40	Investigations on the safe use of sludge in agriculture land generated from effluent from plant of a soft drink.	Coca Cola India Pvt Ltd, Gurgaon	J.K. Saha A. Subba Rao S. Kundu Vassanda Coumar	ESS	July 2012	June 2014	Project is satisfactory and project to be continued
41.	Testing a new slow release 14-7-14 NPK fertilizer for its efficiency under field conditions	PRII, Gurgaon	Dr. Sanjay Srivastava K. Ramesh P. Dey A.K. Biswas A. Subba Rao	Soil Chemistry and Fertility	July 2013	June 2014	Project to be continued

New Projects Presented

Institute Projects

42.	Evaluating rockphosphate for their suitability for direct application	Sanjay Srivastava K. Ramesh A.K. Tripathi I. Rashmi P Dey	Soil Chemistry and Fertility	October 2013	September 2016	Approved in Programme –I
43..	Evaluation of modified urea materials and agronomic interventions for enhancing nitrogen use efficiency and sustaining crop productivity	B.P. Meena K. Ramesh Neenu, S. R. Elanchezhian	Soil Chemistry and Fertility	October 2013	September 2017	Approved in Programme – I
44.	Impact of Long Term Use of Sewage Water Irrigation on Soil and Crop Quality in Bhopal region of Madhya Pradesh	Vasudev Meena M. L. Dotaniya Vassanda Coumar Rajendiran S Asha Sahu S. Kundu	ESS	August 2013	July 2016	Approved in Programme - IV

Project Concluded (Nos.)

Sl. No.	Programme No.	Sl. No. in IRC Proceedings	Title of Project	PI and Co-PI	Division/Unit	Period	
1	I	3.	Efficacy of soil sampling strategies for describing spatial variability of soil attributes.	Neenu S Sanjay Srivastava Hironmoy Das	Soil Chemistry and Fertility	August 2010	July 2013
2		5.	Changing climatic factors' influence on the nutrient acquisition, utilization and recovery by soybean and wheat/gram germplasm lines/ genotypes on black soils of central India.	Neenu S. K. Ramesh S. Ramana J. Somasundaram I. Rashmi	Soil Chemistry and Fertility	June 2010	June 2013
3		6	Biofortification of grain sorghum and finger millet varieties with zinc through agronomic measures.	Ajay A.K.Shukla J.K.Saha,	ESS	July 2010	July 2013
4		9.	Detection of water and nitrogen stress and prediction of yield of soybean and maize using hyper-spectral reflectance and vegetation indices.	K. M. Hati R. K. Singh	Soil Physics	June 2009	June 2013
5		10.	Participatory assessment of qualitative parameters for categorizing different degrees of soil quality to enhance the soil health and productivity.	R. S. Chaudhary J. Somasundaram, Santosh R. Mohanty A. B. Singh	Soil Physics	March 2010	August 2013

Concluding Remarks of the Chairman

In the concluding remarks the chairman of IRC and Director of the Institute Dr. A. Subba Rao mentioned that all the completed projects have to give concrete results in a form so that it can be evaluated properly and categorization is possible as new knowledge, new methods, new technologies, new packages of practices etc. All scientists of the institute must put their efforts together to come out with tangible output from NRM institute like ours. New issues like nano technology, precision agriculture, genomics should also be considered and it is also important to frame new research works different from other institutes with respect to nutrient use efficiency and soil health. He also pointed out the issues like the clarity in the real picture of total soil health a scenario of the country. Further, studies on rhizosphere conditions, up scaling of Bio- and phytoremediation technologies, and conservation agriculture need our attention. We need to calculate tangible/intangible benefits or carbon credits as well as simulation for sequestration under different management practices. The question that deserves immense importance at present is whether our soil management systems are aggrading or degrading soil. The chairman concluded the session with a call to synthesize information from all divisions and come out with good management practices.

In addition to above, following important points were also made during presentation of individual projects:

- All the scientists involved in soil resilience aspects should frame a new project to get in depth and detailed information on soil resilience.
- All green house gas emission projects are needed to have standardized procedures for measurement of greenhouse gas emission and calculations. PIs of these projects should come out with the protocol for measurement and calculation.

Division wise/Co-coordinating Unit wise Number of Projects

Sl. No.	AICRP/ Division	Sl. No. of Project	Total
1.	AICRP on LTFE	1	1
2.	AICRP on STCR	19	1
3.	AICRP on MSN	17	1
4.	AINP on Biofertilizers	29	1
5.	Soil Chemistry and Fertility	2, 4, 7, 8,15,21	6
6.	Soil Physics	11, 12,13,22, 23, 24, 25, 26	8
7.	Soil Biology	20, 27,28,30, 31,32, 33, 35	9
8.	Environnemental Soil Science	15,16,18,36, 37	5
9.	ITMU	14	1

Division-wise no. of Externally Funded Projects

Sl. No.	Centre/Co-coordinating Unit	Sl. No. of Project	Total
1.	AICRP LTFE	-	-
2.	AICRP STCR	19	1
3.	AICRP MSN	17	1
4.	AINP BF	-	-
5.	Soil Chemistry and Fertility	-	-
6.	Soil Physics	25, 26	2
7.	Soil Biology	20, 33, 34	3
8.	Environmental Soil Science	18	1
9.	ITMU	-	-

Division-wise no. of Contractual Projects

Sl. No.	Division/Co-coordinating Unit	Sl. No.	Total
1	AICRP LTFE	-	-
2	AICRP STCR	-	-
3	AICRP MSN	-	-
4	AINP BF	-	-
5	Soil Chemistry and Fertility	38, 39, 41	3
6	Soil Physics	-	-
7	Soil Biology	-	-
8	Environmental Soil Science	40	1
9	ITMU	-	-

New Projects Approved in IRC Meeting of July, 2013

Sl. No.	Division/Co-coordinating Unit	Sl. No.	Total
1	AICRP LTFE	-	-
2	AICRP STCR	-	-
3	AICRP MSN	-	-
4	AINP BF	-	-
5	Soil Chemistry and Fertility	42, 43	2
6	Soil Physics	-	-
7	Soil Biology	-	-
8	Environmental Soil Science	44	1
9	ITMU	-	-

PROJECT (SERIAL NUMBERS) WITH INDIVIDUAL SCIENTIST

S. No.	Name of Scientist	Designation	Sl. Of projects	
			PI	Co-PI
1	**Dr. A. Subba Rao**	**Director**	19	15,23,25, 26, 30, 34
AICRP on LTFE				
1	Dr. Muneshwar Singh*	Project Co-coordinator	1	17, 19, 21, 27
2	Dr. R.H.Wanjari	Senior Scientist	-	19
AICRP on STCR				
1	Dr. Pradip Dey*	Project Co-ordinator	19	-
2	Dr. Abhishek Rathore**	Scientist (SS)	-	-
3	Dr. Hiranmoy Das	Scientist	-	14, 19
AICRP on MSN				
1	Dr. A.K. Shukla	Project Co-ordinator	17	15, 19
AINP on BF				
1	Dr. D.L.N. Rao	Project Co-ordinator	-	14, 29
2	Ms.T.K. Radha	Scientist	29	14
Soil Chemistry and Fertility				
1	Dr. A.K.Biswas*	Head of Division & Pr. Scientist	-	1, 8, 15, 18, 21, 35
2	Dr. Sanjay Srivastava	Principal Scientist	42	14, 16, 19
3	Dr. Brij Lal Lakaria	Principal Scientist	8	4, 20, 21, 24
4	Dr. R. Elanchezian	Principal Scientist	15	23
5	Dr. N.K. Lenka	Senior Scientist	4	26
6	Dr. K.Ramesh	Senior Scientist	2	15, 20, 25
7	Dr. Pramod Jha	Senior Scientist	21	8, 13, 23, 25
8	Ms. I.Rashmi	Scientist	7	2, 11, 12
9	Ms. Neenu S	Scientist	-	7, 22, 23
10	Dr. J.S.V. Tenshia**	Scientist	-	-
11	Dr. B.P. Meena	Scientist	43	1, 14

Soil Physics Division				
1	Dr. R.S. Chaudhary	Head of Division and Prin. Scientist	-	1, 13, 22, 23, 25
2	Dr. Kuntal M. Hati	Principal Scientist	-	8, 13, 23, 25
3	Dr. R.K.Singh	Scientist Senior Scale	11	9, 24
4	Dr. Ritesh Saha	Senior Scientist	13	12, 21
5	Dr. J. Somasundaram	Senior Scientist	25, 22	10, 11, 36
6	Sh. M.Mohanty	Scientist	23	12, 13
7	Dr.(Mrs.) Sangeeta Lenka	Scientist	24, 26	4, 23
8	Dr. N.K. Sinha	Scientist	12	14, 16, 23
Soil Biology				
1	Dr. M.C. Manna	Head of Division and Prin. Scientist	34	24, 27, 28
2	Dr. A.K. Tripathi	Principal Scientist	-	16
3	Dr. A.B. Singh	Principal Scientist	20	1, 10, 14, 31
4	Dr. S. Ramana	Principal Scientist	35	20, 34
5	Dr. S.R.Mohanty	Senior Scientist	33, 27	10, 21, 32
6	Dr. Kollah Bharti	Senior Scientist	32	20, 33
7	Dr. Asit Mandal	Scientist	28	4, 30, 31, 33, 34
8	Dr. Asha Sahu	Scientist	30	28, 31, 34
9	Dr. Jyoti Kumar Thakur	Scientist	31	8, 20, 28, 30, 34
Environmental Soil Science				
1	Dr. S. Kundu	Head of Division and Prin. Scientist	-	15, 16, 18, 26, 37
2	Dr. Ajay	Principal Scientist	-	22, 25, 35
3	Dr. J.K. Saha	Principal Scientist	-	32, 36, 37
4	Dr. Tapan Adhikari	Principal Scientist	18	15, 17
5	Dr. Vasanda Coumar	Scientist	36	8, 16, 25, 37
6	Dr. M.L. Dotaniya	Scientist	37	16, 36
7	Dr. S. Rajendiran	Scientist	16	37
8	Mr. Vasudev Meena	Scientist	44	36
Institute Technology management Unit (ITMU)				
1.	Dr. Shinogi K C	Scientist	14	32

Scientists from other Institutes				
1	Dr. R.C. Singh	Principal Scientist, CIAE, Bhopal	-	24
2	Dr. A.K. Dubey	Principal Scientist, CIAE, Bhopal	-	8
3	Dr. S. Gangil	Principal Scientist, CIAE, Bhopal	-	8
4	Dr. Vinod Bhargav	Senior Scientist, CIAE, Bhopal	-	30
5	H.L. Kushwaha (CIAE)	Senior Scientist, CIAE, Bhopal	-	30
6	Udai B. Singh	Mau	-	30

* Operational/Executive PI, ** On deputation/Leave.

* Position as on September, 2013

NUMBER OF PROJECTS WITH INDIVIDUAL SCIENTIST

S. No.	Name of Scientist	Designation	No. of projects		Total
			PI	Co-PI	
1	**Dr. A. Subba Rao**	**Director**	1	6	7
AICRP on LTFE					
1	Dr. Muneshwar Singh*	Project Co-coordinator	1	4	5
2	Dr. R.H.Wanjari	Senior Scientist	-	1	1
AICRP on STCR					
1	Dr. Pradip Dey*	Project Co-ordinator	1	-	1
2	Dr. Abhishek Rathore**	Scientist (SS)	-	-	-
3	Dr. Hiranmoy Das	Scientist	-	2	2
AICRP on MSN					
1	Dr. A.K. Shukla	Project Co-ordinator	1	2	3
AINP on BF					
1	Dr. D.L.N. Rao	Project Co-ordinator	-	2	2
2	Ms.T.K. Radha	Scientist	1	1	2
Soil Chemistry and Fertility					
1	Dr. A.K.Biswas*	Head of Division & Prin. Scientist	-	6	6
2	Dr. Sanjay Srivastava	Principal Scientist	1	3	4
3	Dr. Brij Lal Lakaria	Principal Scientist	1	4	5
4	Dr. R. Elanchezian	Principal Scientist	1	1	2
5	Dr. N.K. Lenka	Senior Scientist	1	1	2
6	Dr. K.Ramesh	Senior Scientist	1	3	4
7	Dr. Pramod Jha	Senior Scientist	1	4	5
8	Ms. I.Rashmi	Scientist	1	3	4
9	Ms. Neenu S	Scientist	-	3	3
10	Dr. J.S.V. Tenshia**	Scientist	-	-	-
11	Dr. B.P. Meena	Scientist	1	2	3

Soil Physics					
1	Dr. R.S. Chaudhary	Head of Division and Prin. Scientist	-	5	5
2	Dr. Kuntal M. Hati	Principal Scientist	-	4	4
3	Dr. R.K.Singh	Scientist Senior Scale	1	2	3
4	Dr. Ritesh Saha	Senior Scientist	1	2	3
5	Dr. J. Somasundaram	Senior Scientist	2	3	5
6	Sh. M.Mohanty	Scientist	1	2	3
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5	Dr. Vasanda Coumar	Scientist	1	4	5
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1	Dr. Abhisek Rathore*	Scientist	On deputation (ICRISAT)
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Annexure – I

Progress of Approved on-going projects:

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.

In the intervening period effect of different INM modules vis-à-vis control and recommended NPK on performance of Chickpea in terms of yield parameters was evaluated. The highest seed yield of chickpea of 19.5q/ha was obtained in plots receiving fresh application of either chemical or organic form of nutrients. Treatments receiving organic sources of nutrients in the preceding season had superiority over other modules. There has been a clear cut build-up of N, P, k in soil in the treatment receiving 25t FYM/ha annually since the beginning of the experiment. Plant analysis is in progress.

2 Study on nanoporous zeolites for soil and crop management.

Pore volume distribution patterns of zeolite samples have been deduced and the results are presented. A comparison of water extraction of available nitrogen from zeolite-manure mixture with 1M KCl extraction has been made. Zeolite – organic manure interactions have shown the ammonium trapping by the zeolites. Nitrogen release dynamics from soil-urea-zeolite mixture has been completed. NBSS&LUP have agreed for the identification of various compounds in the zeolite samples and as a partner of the project.

3 Efficacy of soil sampling strategies for describing spatial variability of soil attributes.

Sampling of the rabi crop (wheat) was carried out in the farmer's field (Dhamarrah) by taking 36 random points within the field. The crop was air dried and yield of the grain was taken. The field was then divided into 5 zones based on yield map and 5 samples were collected from each of the zones. Grid based soil sample collection was performed for both the fields. For this purpose, soil samples were collected based on ½ acre, 1 acre, 2 acre and 5 acre grids. Collected samples were air dried and grinded and were analyzed for pH, EC, organic carbon, Available N, P, K, B and Zn.

4 Studies on soil resilience in relation to soil organic matter in selected soils.

The pot experiment was continued with wheat as the test crop in rabi season, grown under three soil carbon levels and four management practices in the Alfisol and Inceptisol. From the 2012 rabi season, vertisols of Bhopal region was included with the same management treatments, but with four native C levels. The plant related observations such as plant height and leaf area at peak growth stage and above ground plant biomass, grain yield at harvest were recorded. Soil samples from each treatment were analysed for the particulate organic matter (POM) fraction carbon and C content in silt + clay fraction. The effect of native soil C level on C mineralization pattern was studied with a 12 day incubation study for the vertisols.

5 Changing climatic factors' influence on the nutrient acquisition, utilization and recovery by soybean and wheat/gram germplasm lines/ genotypes on black soils of central India.

Analysis of soil and plant samples from third year experiment with soybean was done. The third year rabi season experiment using chickpea varieties and 4 fertilizer management practices was successfully carried out. Field observations were taken. It was found that the treatment INM (50:50) recorded the highest yield in all varieties except one (JG 16). This indicated that the best nutrient management practice for JG 11, JG 315 and JG 218 could be INM (50:50) for high yield target. The variety JG 16 recorded the highest yield for organic farming treatment for high yield target and other best management practices for this variety recorded comparatively low yields than organic treatments. Under late sowing conditions organic farming treatment for high yield target recorded higher yield in all varieties than other treatments. The soil and plant samples were collected for analysis. Soil analysis is almost completed. Plant analysis is going on.

6 Biofortification of grain sorghum and finger millet varieties with zinc through agronomic measures

Continuing on the last IRC (25th Mar, 2013), there is a compilation of characteristics of three zinc varieties – Low, Medium and High varieties.The parameters selected are biometric, yield, enzymes, vigor, photosynthesis (respiration), and Zinc content. However, to avoid the water logging, the experiment is again under progress at new location.

7 Development of phosphorus saturation indices for selected Indian soils.

The incubated soils with different levels of P were used for incubation studies and column experiment. The incubated soils were extracted with different extractants namely Olsen, Bray, ABDTPA, Mehlich3 P, Ammonium oxalate. In olsen extracted P inceptisols extracted higher amount of P as compared to vertisols, followed by alfisol and ultisols. In case of Bray extractant which is mostly used for acidic soils, ultisol recorded highest P extraction followed by alfisols, inceptisol and vertisol. Mehlich 3 was able to extract high P from acidic soils of alfisol and ultisol soil order as compared to vertisol and inceptisol. DPS indices were calculated in Delhi, Jabalpur, Bangalore and Trivandrum soils using the incubated soils with different extractants. The incubated soils were used for column experiment to study P leaching and distribution in soil layers and breakthrough curves were also prepared for batch wise leaching events.

8 Biochar on soil properties and crop performance

Pot studies were conducted to assess the effect of various treatments involving biochar on crop performance. Wheat and spinach were used as test crops. Spinach yield improved with biochar application alone however its application along with 100% NPK resulted in best performance. FYM application alone behaved similar to biochar application, however, its application along with NPK could not produce fresh leaf yield similar to 100% NPK + biochar. Application of both biochar and FYM did not result in additive result and the increase in yield was not proportional. Similar behavior of the treatments was observed was observed in case of wheatcrop. Carbon mineralization behavior of biochar was also studied.

9 Detection of water and nitrogen stress and prediction of yield of soybean and maize using hyper-spectral reflectance and vegetation indices.

To study the effect of water and nitrogen stress on wheat crop growth, leaf nitrogen changes and corresponding spectral reflectance characteristics a field experiment was conducted during the winter season of 2012-13. Wheat (cv. WH-147) was grown with four nitrogen and two irrigation levels on a split plot design. During the cropping season leaf area, biomass, leaf nitrogen content and spectral reflectance from crop as well as from the bare soil was recorded at important crop growth stages and yield and yield parameters were recorded at crop physiological maturity. The LAI, biomass values showed significant variations between the nitrogen levels and irrigation regimes. Both the LAI and biomass were higher at higher nitrogen doses. From the spectral reflectance data vegetation indices like NDVI, green-NDVI, normalized difference red index (NDRE), modified spectral ratio (MSR) were calculated and they showed good correlation with the LAI and biomass during the vegetation stage of crop growth. The nitrogen content of the wheat leaf collected during the maximum vegetative stage was estimated and it was correlated with the spectral reflectance recorded during that period. Like maize, two new vegetative indices double-peak canopy nitrogen index (DCNI) and combined index (CI) were also tested for estimation of nitrogen stress in wheat. Both the vegetative indices showed significant correlation with the nitrogen content of wheat leaf, however DCNI was found to be better predictor (65%) for wheat leaf nitrogen content. Highest grain yield of wheat (4268 kg/ha) was recorded in $N_{150\%}$ nitrogen with four irrigation treatment. Wheat yield increased with increasing irrigation and nitrogen level. Irrigation X nitrogen interaction effect was significant on wheat grain and biomass yield.

10. Participatory assessment of qualitative parameters for categorizing different degrees of soil quality to enhance the soil health and productivity.

11. Impact of crop covers on soil and nutrient losses through runoff in Vertisol.

The experiment is being conducted to assess the impact of crop covers on soil and nutrient losses through run off in vertisol at IISS Research Farm, Bhopal. The seven treatments were consisted with three sole (soybean, maize and pigeon pea) and three intercrops viz, soybean + maize (1:1), soybean + pigeon pea (2:1) and maize + pigeon pea (1:1) with cultivated fallow as a control. The maximum losses of SOC, nitrogen, phosphorus and potassium nutrients were recorded under cultivated fallow plot than sole as well as intercrop due to higher runoff and soil loss. Among the crops covers, the losses of SOC, nitrogen, phosphorus and potassium were higher in sole crops namely pigeon pea and maize and lowest was in soybean and intercrops. The per cent reductions of SOC, nitrogen, phosphorus and potassium were higher in sole soybean and intercrops as compared to maize and pigeon pea followed by maize. The intercrops in combination of maize + pigeon pea (1:1) recorded highest soybean equivalent yield (SEY) followed by maize, soybean + maize (2:1), soybean + pigeon pea (2:1) and lowest in sole soybean. It is indicated that pigeonpea crop in combination recorded higher soybean equivalent yield. The soil organic carbon content (SOC), available P, available, K and infiltration rate was lower in cultivated fallow as compared to sole as well intercrops. Among the crop treatment, the intercrop recorded higher SOC, available P, available K and infiltration rate as compared to sole crops.

12 Characterizing rooting behaviours, soil water patterns and nutrient uptake of soybean – chickpea under different tillage and water regimes in Vertisols.

As per schedule activity, two cultivars of chickpea viz JG130 and JG 11 were grown as Rabi crop under different tillage and water regimes. Plant root and shoot samples were taken at different vegetative and reproductive stages to study dynamics root length density, root mass density, root diameter and root surface area under different tillage and moisture regimes. In all the treatments, maximum root length density was observed at flowering stage of crop. Various statistical model was tested and evaluated to explain distribution of root mass with depth. Further, soil moisture was periodically (once in a week) recorded upto 90 cm depth throughout the crop period to study temporal variation in moisture around rhizosphere.

13 Soil Resilience and its Indicators under Some Major Soil Orders of India.

During the period under report, laboratory study carried out to analyse the index properties like plasticity, maximum dry density, and optimum moisture content of black soil treated with various soil amendments. Study showed that the plasticity parameters such as liquid limit, plastic limit and shrinkage limit exhibit favorable changes in the values i.e. the liquid and plastic limits decrease (23-37%) while the shrinkage limit increases (19-28%) with the addition of fly ash. The compaction characteristics like the maximum dry density increases with the corresponding decrease in optimum moisture content. The addition of fly ash results in increased flocculation due to increased availability of free lime content of fly ash. This increases the repulsive forces of soil particles, thereby increasing the resistance to compactive effort and hence the density of mix starts decreasing. Incubation study conducted with Inceptisol for biological resilience during this period. Cu stress is given for reducing the short-term decomposition and to find the recovery rate under various FYM management practices. It was found that Cu stress significantly reduced the soil microbial biomass C (SMBC) as compared to untreated soils (without Cu stress). In general, SMBC showed its recovery after 4 weeks of incubation period under Cu stressed condition. However, it showed recovery after 2 weeks only in case of higher doses of FYM application. Among the various treatments, soil without FYM showed the lower resistance hence higher reduction in SMBC followed by other FYM treated soils at the end of 2-4 weeks after incubation.

14 Integrated assessment of some IISS Technologies in Enhancing Agro-Ecosystems productivity and livelihood sustainability

Adoption of the technologies, developed by the institute over the past twenty five years, by the farming community, has to be the key activity to enhance and sustain the agro-ecosystem health in future. For this it is important to identify and quantify the socio-economic situations of the farming community wherein the particular technology can be disseminated, and also interlinks between the technology adoption and its impact on their livelihood. Hence the project has been conceived with the following treatments T_1: IPNS (50% recommended rate of NPKS + 5t FYM/ha + Rhizobium to soybean), T_2: IPNS with Enriched Compost, T_3: STCR Recommendation, T_4: BBF with Reduced Tillage. Bio-fertilizers. The site/location of work would be Megra Kalan village situated in Berasia district. The village represents farmers with a range of economic and social strata as well as has sufficiently large site variability in soil and other natural resources. The team of Project Scientists has conducted visits to the selected village for an inventory to the available resources of the village and selection of farmers for the project implementation. Fifteen farmers were selected from different parts of the village and conducted Participatory Diagnosis for Constraints and Opportunities to get the first hand information about their existing farming condition. Further, soil samples were collected from each field and analyzed for available nutrient content. The sowing of Kharif soybean in thirteen farmers' fields has been done.

15. Nano particle delivery and internalization in plant systems for improving nutrient use efficiency

The project activities will be initiated in the ensuing kharif season. Literature has been collected on the aspect of nanoparticle delivery and internalization with respect to nutrient use efficiency. The purchase of nanoparticles for the project has been has been under process and the treatments will be imposed after procurement of nanoparticles.

B. Externally Funded Projects

16 Understanding the mechanism of variation in status of a few nutritionally important micronutrients in some important food crops and the mechanism of micronutrient enrichment in plant parts (NAIP project)

during last year to identify the effect of Zn fertilization strategies on Zn enrichment in edible plant parts. Three efficient cultivars of wheat (GW 322, JW 3211, HI 8627) and pigeon pea (ICPL 87119, T 15-15, Virsa Arhar 1) and three inefficient cultivars of each wheat (HW 2004, JW 17, C 306) and pigeon pea (Hisar H02-60, Hisar Paras, Hisar Manak) were tested for various Zn management strategies. The following inferences were drawn: Zn application has significant effect on grain yield of inefficient cultivars of both wheat and pigeon pea; however, a little response was registered with efficient cultivars. Among the methods, soil + foliar application was the best to enhance both yield and concentration together but residual Zn plus foliar feeding of Zn had similar results, indicating higher rate of basal dressing of Zn in wheat had significant residual effect in second year, both in terms of grain yield & Zn concentration, if combined with the foliar spray. Protein content in wheat was related with Zn concentration in grain, however, in pigeon pea this relation could not hold good. As compared to SOD activity in wheat the activity of carbonic anhydrase was much influenced by change in Zn concentration. Maximum accumulation of Zn was recorded in leaves, however remobilization of the Zn varied with cultivars. In efficient wheat cultivars the remobilization rate was more from pseudostem but in inefficient it was more from leaves. Application of K along with Zn combined had synergistic effect on grain yield and Zn concentration in pigeon pea. Biochemical parameters like Carbonic Anhydrase, Methionine were improved with combined application of K & Zn. Although both Zn and phytate content increased with best Zn management option but Phytate: Zn ratio decreased because of increase in Zn concentration was much higher pace than that of Phytate.

17 Nano-technology for Enhanced Utilization of Native-Phosphosrus by Plants and Higher Moisture Retention in Arid Soils (NAIP Project)

Under the project as per approved programme schedule, all the activities like effect of nano particles on nutrient use efficiency, plant metabolism and enzyme exudation, characterization of synthetic and biologically developed nano particles, synthesis of nano- rock phosphate particles, assessing potential of nano-granules P and application and their doses in different experiments were completed. During this extended period a bulk amount of rock phosphate has been synthesized through high energy ball mill. Besides field trial at IISS, Bhopal to evaluate the effect of different doses of nano rock phosphate on the growth, yield and phosphorus uptake by the maize, a multi location trial is being conducted at Bhubaneswar (Orissa), Anand (Gujarat), Akola (Maharasthra) and Hyderabad (AP) to evaluate the effect of nano rock phosphate on different cropping system in comparison to conventional P fertilizer.

18 GPS and GIS based model soil fertility maps for selected districts for precise fertilizer recommendations to the farmers of India.

GPS and GIS based soil fertility maps of 152 districts of India showed that almost all soils of different districts of North, South, East and West zones are deficient in available N. In North Zone, majority of the soils are medium to high in available P and available K status. Only few soils (1-4%) in 2-3 districts are low in P and K. In West Zone, majority of the soils are low to medium in available P except Gujarat. About 92-100% area in Gujarat is medium to high in available P. Altogether only 1-3% area in west zone is low in available K. Most of the soils in Gujarat and Maharashtra are high and Rajasthan are in medium in available K. In East Zone, most of the area in Orissa (73-97%) is low in available P. Majority of the soils of Assam and West Bengal are medium to high in available P status of soils. Majority of the soils in East Zone are medium in available K except Kurda district in Orissa where 58% of the area is low in available K. In South Zone, majority of the soils in Andhra Pradesh, Tamil Nadu and Kerala are high in available P. In Karnataka, most of the soils are medium in available P. Available K content of majority soils of Tamil Nadu, Karnataka, Kerala are medium, and majority of the soils of Andhra Pradesh are high in available K. Micronutrient fertility maps showed that almost all soils of Punjab, Haryana, and Himachal Pradesh in North Zone are high in available Zn whereas majority of Uttar Pradesh soils are medium in available Zn. Majority of soils of this zone are high in available Fe, Cu and Mn with minor exceptions. Manganese deficiency is wide spread in 4 districts of Punjab (15-56%). Fe deficiency was observed over an area of 25-61% in Fatehabad and Hisar districts. In West Zone, Zn and Fe deficiency is wide spread in Maharashtra. Other-wise, majority of soils are sufficient in available Zn, Fe, Cu and Mn. In East Zone, majority of soils are high in available micro nutrients. Zn deficiency was observed only in West Bengal. In South Zone, Majority of soils of Andhra Pradesh, Karnataka, and Kerala are sufficient in available micro nutrients. In Tamil Nadu, about 50-60% of the area is low in available Zn and 20-30% deficient in Cu. All soils of Wayanad district in Kerala are deficient in Mn.

19. Network Project on Organic Farming

In ninth year of field experiment Rabi (2012-2013), 100% organic manure treatment recorded higher yield of wheat, mustard and linseed in soybean-wheat, soybean-mustard and soybean-linseed cropping systems as compared to 100 % inorganic. Among the cropping systems, soybean-wheat/gram performed better than soybean-mustard/linseed cropping systems. In chickpea crop, integrated nutrient management showed higher yield as compared to organic and inorganic management. In mustard crop, integrated nutrient management and organic management were statistically similar. In the second experiment, application of BD, panchgavya along with the organic manures recorded the higher grain yield of wheat as compared to other management methods. Analysis of soil chemical, biological parameters as well as nutritional quality parameters of the crop is in progress. The experiment –II have been concluded and new experiment is being started on “Response of different varieties of major crops for organic farming” with the following objective, to evaluate the response of different varieties with varying duration of major crops (Soybean and Maize, Wheat and Gram) to organic production system and to identify the suitable varieties of crops for organic management practices. The experiment was taken up as per recommendations of Annual Group Meeting of NPOF 26-27 April, 2013 held at Sikkim. Experiment-I, will be continued with slight modification. Sowing of kharif crops (soybean and maize) for the year 2013-14 have been taken up in the experiment.

20 Soil quality assessment for enhancing crop productivity in some tribal districts of Madhya Pradesh

The geo-referenced surface (0-15 cm) soil samples were collected from 540 farmers' field of the Jhabua district. The collected soils were analyzed for their physico-chemical properties. Most of the soils in this region were sandy loam in texture with bulk density of 1.3- 1.6 Mg m^{-3} and low available moisture content of 7-12%. The pH of the soils was in the range between 5.5 and 8, and 61%, 32% and 7% of the soil samples were low, medium and high in soil organic carbon status, respectively. The percentage of soil sample low and medium in mineralizable-N was 84% and 16%. In case of available P, 49% of the soil samples were low, 42% were in medium and 9% were in high category. The 67%, 28% and 5% of soil samples were high, medium and low in available K. Available S status is low in 78% of soil samples. Among DTPA extractable micronutrients, soils were mostly deficient in Zn and sufficient in respect with Fe, Mn and Cu.

Programme II: Conservation Agriculture and Carbon sequestration vis-à-vis climate change

A. Institute Project

21 Soil carbon saturation and stabilization in some soils in India.

Potentially organic C mineralization (PMC) indicates the total metabolic activity of heterotrophic microbes releasing labile organic carbon as CO_2.The investigation was carried out using the samples collected from different land use systems (agriculture, fallow and forest) from three different agro-ecological regions of the country (Palampur, Jabalpur, and Ranchi). All together 14 soil samples having different soil and climatic conditions are used for determining potential carbon mineralization by conducting long-term incubation studies (247 days). The amount of C evolved in the form of C-CO_2 during different time intervals of incubation study was used for computation of PCM in soil. The cumulative C-CO_2 evolved during different time intervals were fitted with non-linear regression (least square) using statistical software. PCM and decay constant was determined for different soil types. It was ranged from 61.9-146.1 mg C-CO_2 evolved $100g^{-1}$ soil whereas decay constant of PMC ranged from 0.013 -0.041 day^{-1}. Subsequently 12 variables including soil and climatic conditions were subjected to Principal Component Analysis technique for determining the factors responsible for PMC in soil. Finally it was observed that silt, clay and C:N ratio is the factors which are affecting potential carbon mineralization in Indian soil. Subsequently, simple process based model for computation of PCM in soil has been developed.

22 Evaluating conservation tillage on various sequences/rotations for stabilizing crops productivity under erratic climatic conditions in black soils of Central India

The study was laid out in a split – plot design with two tillage treatments namely conventional tillage (CT) and reduced tillage (RT) along with six cropping systems i) Soybean- Fallow, ii) Maize- Gram, iii) Soybean- Fallow, iv) Soybean + Pigeon pea (2:1), v) Soybean+ Cotton (2:1) and vi) Soybean– Wheat.During the reported period, third year experimental crops were taken. Kharif and rabi crops were harvested and yield parameters were recorded. Maize-gram cropping system recorded the highest soybean grain equivalent yield (SGEY) followed by soybean-wheat and soybean + pigeon pea (2:1). From the soil analysis data, it was inferred that both tillage and cropping systems did not have any significant effect on soil pH and EC. Physical properties like soil moisture, soil temperature, penetration resistance and bulk density have been favourably influenced by tillage and cropping systems. Infiltration rate and mean weight diameter (MWD) is higher in RT compared to CT. Soil organic carbon (SOC) was also higher in RT compared to

CT after third crop-cycle.

23	**Assessing impacts of climate change on different cropping systems in Central India and evaluating adaptation studies through crop simulation models**
	Under this project, soybean cultivars, JS 335, JS 9560, JS 9305 and Maize cultivars K 101, K 103, chickpea cultivars JG 11 and JG 130, wheat cultivars WH 147, GW 22, Sujata were taken for calibrating the crop modules of APSIM, DSSAT and CropSyst models. Calibration of most of the cultivars for APSIM model is completed and some for DSSAT and CropSyst. The field experimentation for validation of maize is under progress and the small experiments for second year experimentation on soybean cv JS 9560 and JS 9305 is under progress. However, calibration of the APSIM, DSSAT and CropSyst models for the crop cultivars of chickpea and wheat of the year 2012-13 will be completed after obtaining the whole year weather data (2013) only. The APSIM model was used to do series of simulations on water and N management in wheat under different climate change strategies. Thus, it revealed the various adaptation strategies for the crop to reduce the impact of climate change for central Indian conditions.
24	**Tillage and manure interactive effects on soil aggregate dynamics soil organic carbon accumulation and by pass flow in vesrtisols**
	Effect of tillage and manure on wheat productivity and nutrient uptake was studied. The experiment was taken in a split plot design for soybean-wheat cropping seasons since 2008, with two tillage treatments, no tillage (NT) and reduced tillage (RT) in the main plot, and seven manure treatments in the sub plots. The seven manure treatments included application of FYM at the rate of 0, 0.5, 1.0 and 2.0 Mg C ha^{-1}, applied every year and 2.5, 5.0 and 10.0 Mg C ha^{-1}, applied at initiation of experiment. In general, relatively higher wheat grain and biomass yield were measured in NT compared to RT treatments. The ANOVA test indicated that tillage methods and the interaction effect had no significant effect on wheat yield (grain and biomass). However, manure rate and frequency had significant effect ($p<0.05$) on grain and biomass yield. Grain yield (Mg/ha) increased from 4.94 to 5.88 and 4.55 to 5.73 under NT and RT, respectively, with increase in FYM rate from 0 to 6 Mg ha^{-1}. NT with application of manure recorded significantly higher total (grain + straw) uptake of N, P, K over inorganic fertilizer plus reduced tillage. The SOC concentration was dependent on tillage operation and manure application, and followed the trend of higher SOC for NT followed by RT at 0-5 cm soil depth. However the SOC storage for the entire soil profile (0-30 cm) was not significantly different between RT and NT.

B. Externally Funded Projects

25.	**Evaluating Conservation Agriculture for Stabilizing Crop Productivity and Carbon Sequestration by Resilient Cropping Systems/Sequences under aberrant Climatic Conditions in Black Soils of Central India.**
	Experimental crops were taken up. Kharif and rabi crops were harvested and yield parameters were recorded. After kharif crop harvest, soil samples were collected and analyzed for soil organic carbon; the following trend were observed (0-5 cm) NT: OC varied from 0.52 to 0.75%; CT: 0.50 to 0.77% ; RT: 0.56 to 0.68% and similar trend were observed for 5-15cm depth across the cropping systems. Soil temperature (0-5cm) recorded during (wheat) residue burning; about 15°C was increased due to burning of residues. Soil samples collected for analysis after completion of crop-cycle. Carbon pools data indicated that increase in labile and less labile carbon pools were observed after 1st crop cycle. However, very labile carbon pools were decreased after 1st crop cycle over the initial value. SOC stocks data indicated that there was no change in SOC among the tillage systems. Yield data indicated that tillage systems did not have significant effect on crop yields. Among the cropping system studied under CA, maize based cropping system recorded higher yield in terms soybean equivalent yield (SEY) compared to soybean based cropping system. Other analysis like soil aggregate size disribution, carbon in different size fractions are in progress.

26 Quantifying Green house gases (GHGs) emissions in soybean-wheat systems of M.P. (MPCOST)

Greenhouse gas emissions were recorded in two long-term experiments on soybean-wheat during wheat growing season. The significant outputs are across tillage application of organic manure significantly increased emissions of carbon dioxide compared to inorganic fertilization. Emission of carbondioxide and nitrous oxide was relatively higher in reduced tillage compared to no tillage at almost all sampling dates except for few. In long term experiment of organic farming, emission of CO_2 was found to be higher in totally organic treatment followed by integrated and inorganic treatment. In contrary, the emission of nitrous oxide was higher in inorganic treatment compared to integrated and organic treatments. Successful and encouraging results of conservation tillage along with manure application compared to conventional tillage from long-term experiments on tillage and manure at Indian Institute of Soil Science were translated to farmers (2 nos.) field at village Bagroda Dist. Bhopal. The promising results of reduced tillage with manure application in soybean and no tillage in wheat crop in farmer's field have prompted other farmers to take up conservation tillage practice over conventional tillage with residue burning.

Programme III : Soil Microbial Diversity and Biotechnology

A. Institute Projects

27. Structural and functional diversity of microbes in soil and rhizosphere

Unlike bacteria, archaea communities have only recently been discovered as ubiquitous soil residents. However, their diversity and function in the complex soil environment is still not fully understood. Experiment carried out to explore the structure and function of bacteria and nitrifying crenarchaeota, their interaction in the development of biogeochemical cycles in relation to the plant growth and ecosystem function. Nitrification process in the vertisol was measured in soybean under different crop growth stages and fertilizer treatments. Nitrification rate was high in the vegetative period and followed the trend of inorganic > integrated > organic > control. Nitrifying bacteria and archaea diversity estimated by terminal restriction fragment length polymorphism (TRFLP). Genomic DNA was extracted and PCR amplification carried out using defined primers using standard protocol. Relative fluorescence of nitrifying bacteria remained high while archaea did not vary significantly in contrast to their initial abundance. To test the role of archaea in soil, nitrification process was explored under sequential reduction electron acceptors or terminal electron accepting process (TEAPs). Nitrification rate increased at NO_3^{1-} and Fe^{3+} reduction while decreased under SO_4^{2-} and CO_2 reduction (methanogenesis). Relative fluorescence of nitrifiers TRFs remained unchanged during sequential reduction. However relative fluorescence of archaea (crenarcheota clade 1.1a, and crenarcheota clade 1.1b) increased with soil reduction. Results highlighted significance of archaea diversity and their interaction with bacteria in different soil biogeochemical process that are relevant to the plant nutrient transformation.

28. Consequences of transgenic cotton on soil microbial diversity

The impact of transgenic (Bt) cotton on soil beneficial microorganisms such as soil heterotrophs, nitrogen fixers, P solubilizers, cellulose decomposers, and biological properties were assessed. Under Bt-cotton system soil microbial biomass carbon (212-275 mg kg^{-1}) and soil respiration (139-178 mg kg^{-1}10 d^{-1}) were higher compared to non Bt cotton system where they were ranged from 136 to 248 mg kg^{-1} and 114 to 152 mg kg^{-1} 10 d^{-1} respectively. Soil enzymes such as dehydrogenase, fluorescin di-acetate and alkaline phosphatase activities were found 15%, 23% and 6% respectively higher in Bt rhizosphere soil as compared to non Bt. The glomalin protein content was also found higher (39-110 mg kg^{-1}) in Bt-cotton based cropping systems compared to non-Bt (38-57 mg kg^{-1}). Further, soil biological activities were significantly correlated with soil active pools of carbon (water soluble carbon, carbohydrates and microbial biomass carbon). Soil microbial counts such as total heterotrophs, aerobic nitrogen fixers, P solubilizers and cellulose decomposers were found higher in Bt rhizosphere soil than non Bt. Soil DNA isolation and purification was done using metagenomic kits. The metagenomics study for assessing structural diversity is in progress.

29. Actinomycetes diversity in Daccan plateau, hot, arid region and semi arid eco-sub-region (AER 3 and 6) and evaluation of their PGPR activity.

Seventeen isolates of actinomycetes were field tested on Chick pea; among all the isolates tested, germination was found to be better with B10 isolate. Shoot length was significant with B4 and B10 while root length was significant with B2, B4, B7, B9, B10 and B17. Number of nodules/plant was statistically better with B2, B3, B4, B5 and B10 isolates but only one isolate i.e. B10 could significantly yielded oven dried nodular mass over FUI. Nodule nitrogen content was significantly superior with B2, B3, B5, B6, B7, B10, B11, B12, B16 and B17 isolates over FUI .Among all the isolates tested B6 and B10 gave good yield response.

30. Developing technique for acceleration of decomposition process using thermophilic organisms

Lab-scale study of decomposition of various collected agrowaste was done by inoculating the screened organisms. Different physico-chemical parameters like C:N ratio, Lignin, Cellulose, Water Soluble Carbon, Water Soluble Carbohydrate, CEC were also tested at equal intervals. Bacterial DNA extraction and purification was done from National Bureau of Agriculturally Important Microorganisms (NBAIM), Mau. CAD model of the bioreactor was designed by Central Institute of Agricultural Engineering (CIAE) and standardization of the model is under process. The project work is in progress.

31. Chemical and Microbiological Evaluation of Biodynamic and Organic Preparations.

Pot culture study was conducted with wheat as test crop and different organic and biodynamic preparation as nutrient source. Initial soil chemical and microbiological parameters for the soil used in pot culture experiment were estimated. Plant parameters like plant height, plant biomass and yield with different treatment were recorded. Chemical analysis of plant and soil for N, P, K and micronutrients (Cu, Mn, Zn and Fe) was done. Microbial enumeration for soil receiving different nutrient sources were done by viable cell count of total heterotrophic bacteria, fungi, actinomycetes, aerobic N fixers and P solubilizers using dilution plating technique. Soil dehydrogenase, FDA and soil respiration of pot soil was also determined to see the effect of treatment on soil microbial activity. There were no significant difference between the treatment in terms of available N, P, Zn and Fe content of soil. Though, plant height was found to be less in T5 (biodynamic preparations as nutrient source) and T6 (Panchagavya as nutrient source), root/shoot length ratio was highest in T5 followed by T6. No difference in grain yield/10g biomass was recorded with different treatment except control which showed least grain wt. per unit plant biomass. Similarly there was no significant difference in dehydrogenase and FDA activity of soil between integrated, organic, biodynamic and panchagavya treatment. Reduction in viable count of heterotrophic bacteria in soil was observed when chemical fertilizers were used as nutrient source.

32. Greenhouse gas (GHG) emission from composting systems and characterization of GHG regulating micropes

Study was carried out to investigate the impact of several parameters on CH_4 oxidation of the farm yard manure (FYM). CH_4 oxidation was studied with different moisture regimes (30-80%) and temperatures (30-65^{0}C). Compost moisture at 50-60% stimulated CH_4 consumption than at 30% and 80% MHC. Similarly incubation experiment with different temperature revealed that FYM exhibited maximum CH_4 oxidation at 35C. To develop an environmental friendly microbial technology to reduce CH_4 emission from compost, methane oxidizing bacteria (methanotrophs) from FYM were isolated and enriched under laboratory condition. These isolated cultures were tested for their efficiency in enhancing CH_4 oxidation potential of the composts. Methanotrophic bacterial population was added in the range of 10^7-10^{10} cells (CFU) per gram of compost (FYM). Methanotrophs bacteria applied at 10^8 cells showed maximum oxidation (22 ug g^{-1} d^{-1}) while with higher bacterial population did not show any significant increase in CH_4 oxidation rate. A laboratory experiment carried out to underpin the complex interaction of biochar, composts and soil microbial process involved in GHG production and consumption. Soil was amended with composts and biochar at 80Kg N ha^{-1} and 10 % w/w respectively. Three types of composts including vermicompost (VC), poutry manure (PM), and farm yard manure (FYM) and two sizes of biochar (<0.25 mm, and 0.25-2.00 mm) were applied as single or in combination to soil. CO_2 production, CH_4 production, N_2O production and CH_4 oxidation was measured. Production of GHG followed the trend of CO_2>CH_4>N_2O. N_2O production from soil was in the range of 30 µg g^{-1} soil while interestingly BC amendment reduced N_2O production over control. Apparent rate constant of CH_4 oxidation k (µg CH_4 consumed g-1 soil d^{-1}) varied from 0.051 to 0.242. Amendment of biochar enhanced k value in all treatments but their response was maximum in small size (<0.25 mm) fraction than large size (0.25 – 2.00 mm). One way ANOVA and correlation analysis revealed that CH_4 consumption significantly correlated with methanotrophic microbial population ($p<0.0001$) indicating the significant role of biochar in mitigating GHG emission from compost.

B. Externally Funded Projects

33 Metagenomic characterization and spatio-temporal changes in the prevalence of microbes involved in nutrient cycling in the rhizoplane of bioenergy crops (DST)

The relationship between soil / rhizospheric microbial community involved in nutrient cycling / transformation in rhizosphere of Biodiesel crop Jatropha curcas are relatively poorly understood. To address the variability in the abundance of different functional microbial groups involved in nutrient transformation in the rhizosphere were quantified using quantitative real time PCR. Rhizospheric soil samples from different yield varieties were also characterized in order to define the plant microbial interaction that regulates plant attributes. Genomic DNA was extracted from soil samples using extraction buffer (SDS, CTAB based) and phenol:$CHCl_3$ separation protocol. Before real time PCR amplification products were tested in 1% agarose gel. Real time PCR carried out using SYBR green targeting functional gene specific primer sets. Eubacteria (16S rRNA), ammonium oxidizers (amoA), nitrogen fixers (nifH), P solubilizers, and denitrifiers (nirK). Preliminary results revealed that Alp gene (P solubilizer) varied from $5.8*10^4$ – $8.1*10^6$ genes g^{-1} soil, and amoA $1.5*10^6$-$5.5*10^8$ genes g^{-1} soil. Data revealed differential abundance of functional genes indicating significance of microbial interaction in the rhizosphere of bioenergy crop J curcas.

34. Novel bio-filtration method using selected mesophilic fungi for removal of heavy metals from municipal solid waste in Madhya Pradesh (MPCOST).

A survey of dumping site of Bhopal city was done and samples were collected (Plate 1). To study the metal tolerance, six fungi have been identified from untreated domestic sewage sludge of Bhopal city. The mesophilic fungi were Trichoderma viride; Aspergillus heteromorphus; Rhizomucor pusillus; Aspergillus flavus; Aspergillus terrus and Aspergillus awamori. The weight of the mycelial mat was recorded highest in the flask with no heavy melats content. The mature growth T. viride was visible up to 100 ppm of Cd, Cu and Pb and 150 ppm of Cr. and Ni and 400ppm of Zn. It was observed that Pb and Zn is less affected on biomass of this fungi compared to Cd,Cu, Zn, and Cr. The growth performance of mesophilic fungi Aspergillus heteromorphus was affected greater than T. Viridi and visible upto 5 ppm of Cd, 25 ppm of Cr and Cu, 75 ppm of Ni, 100 ppm Zn and 400 ppm of Pb. The work is in progress

Programme IV: Soil Pollution, Remidiationa nd Environmenal Security

A Institute Project

35. Phyto-extraction of Cr by some floriculture plants.

An experiment was undertaken to evaluate the physiological responses of Gladiolus to Cr, its effect on growth, phytotoxicity, uptake and transport for remediation of soil contaminated with Cr. The soil for the experiment was collected from 0-15 cm depth from the nearby agricultural field, dried under shade, ground and passed through two mm sieve and was then transferred to 5 kg plastic pots. The soil contamination was performed by adding a specific amount of stock solution of potassium dichromate. A stock solution of 1000 ppm Cr (VI) solution was prepared by dissolving 2.83 g $K_2Cr_2O_7$ in 1000 ml distilled water. The soil in the pot was then treated with aqueous solution of $K_2Cr_2O_7$ so as get the desired level of contamination. Overall, the experiment consisted of 5 treatments including soil without chromium i.e., control(Cr_0); 12.5 mg Cr Kg^{-1} soil, 25 mg Cr Kg^{-1} soil and 50 mg Cr Kg^{-1} soil. The results revealed that the applied Cr significantly decreased the total dry weight of the plant right from the lowest level (Cr 12.5 mg kg^{-1} soil). Beyond 12.5 mg kg^{-1} soil, toxic symptoms were observed. There was a delay in the emergence of the seedling beyond 25 mg kg^{-1} soil. But unfortunately, no flowering was observed even in the control plants. Therefore, the experiment was discarded and being repeated this year. The samples of rhizosphere collected from Euphorbia were analysed for organic acid(malic, oxalo acidic, citric acid etc.)content. Only malic acid was found in the rhizosphere samples. The secretion of malic was higher at higher levels of Cr stress.Further, the samples of Cotton were analysed for Cr content. The results revealed that, the roots accumulated the highest content of Cr and they were followed shoots and fibre. The experiment is going to be concluded in December, 2013. During this period, Asit Mandal, S. Ramana, T. J. Purakayastha, Debarati Bhaduri, M. C. Manna and A. Subba Rao a review on "Status of phyto-remediation of heavy metals in India was also communicated to Current Science"

36. Non point sources of phosphorus loading to upper lake, Bhopal.

Sediment and water sample collection from different streams of catchment area of Upper Lake, Bhopal is in progress. So far geo-referenced samples from 30 locations were collected and analysis for different P fractions is in progress.

37. Interaction among tannery effluents constituents on heavy metals uptake by spinach.

Treatment combinations were made on the basis of collected soil and effluent samples from the tannery industrial area of Kanpur. Spinach was grown as a test crop with one fifth dose of the treatment. After the spinach crop, we analyzed the pot soil for available Cr concentration and soil salinity. Application of Cr as a salt enhanced the salinity in pot experiment. Chromium reduction also measured and it was reduced upto 40-50% from Cr (VI) to Cr (III). Again we have grown the spinach crop to confirm the previous spinach crop results, it's due to Cr VI or other factors.

B. Externally Funded Projects

Nil

Contractual Projects

38 Evaluation of plant nutrition product (NP-1) for nutrient use efficiency in cereal crops

Malwa Shakti was undertaken to study the effect of plant nutrition product (NP1) on the nutrient use efficiency of crop. The morphological and physio-biochemical parameters of the wheat plant (Tritium durum) at different growth stages was observed. The effect of various combinations of NP1 and conventional recommended dose of fertilizers were studied with respect to morpho-physiological parameters like growth and yield attributing traits in the wheat variety Malwa Shakti. Soil physio-chemical characters like pH, EC, OC, TOC available N, Phosphorus and

Potassium were recorded initially. The NPK status of the plants was also studied in the above mentioned various treatments for analyzing the use efficiency.

39. Effect of urea pestle productivity and nutrient use efficiency in some soils of India

A contractual project on effect of Urea Pastilles on crop productivity and N use efficiency in some soils of India has been initiated at Bhopal and Ranchi centres. All together 10 treatment combinations were tested in randomized block design with 3 replications. In Bhopal, the experiment was conducted at Farmer's field in Islamnagar whereas in Ranchi it was conducted at Ranchi Agricultural College, B.A.U. Ranchi. In both the sites, application of N significantly enhanced the yield and N content in grain and straw in comparison to unfertilized control. Application of N through urea pastilles @ 120 kg/ha was found to be the best in both the sites. However, application of urea through pastilles @90 kg/ha was found at par with application rate of 120 kg/ha. Although urea pastilles found to be superior in comparison to prilled urea however, statistically the difference was insignificant.

40. Investigations on the safe use of sludge in agriculture land generated from effluent from plant of a soft drink.

41 Testing a new slow release 14-7-14 NPK fertilizer for its efficiency under field conditions