



ICAR-IISS Newsletter



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Editors

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SARDAR PATEL OUTSTANDING ICAR INSTITUTION AWARD

ICAR-Indian Institute of Soil Science, Bhopal, Madhya Pradesh has been bestowed Sardar Patel Outstanding ICAR Institution Award-2018 for Small Institute category.

ICAR - Indian Institute of Soil Science, Bhopal, the only institute exclusively focused on soil science has conducted frontier research on basic and strategic aspects in various types of soils for last 30 years. The institute has achieved landmark success in improving soil health management and achieving balanced crop nutrition through integrated soil management technologies and soil test crop response based nutrient recommendations that have enhanced productivity significantly while conserving soil and nutrient resources and improving nutrient and water use efficiency.



The institute has continuously expanded the horizons of its activity to meet the emerging challenges of soil science research and raised the standards to global level which is reflected in terms of significant international publication, recognition and citations. The institute continues to focus on new endeavors through basic and strategic research in emerging areas to maintain a leadership role in the field of soil science. Recently the institute has developed a mini lab named 'Mridaparikshak' for soil health assessment which can measure fifteen soil parameters and is proving very instrumental in fulfilling the task of providing soil health card to each farmer of the country. Improving soil quality, input use efficiency, carbon sequestration, GIS based fertility mapping, conservation agriculture, organic farming, microbial diversity and biofertilizers, soil genomics, bio-fortification, waste management, climate change mitigation strategies, nano fertilizers etc. are some of the major research accomplishments of the institute.

ICAR-Indian Institute of Soil Science, Bhopal (An ISO 9001:2015 Certified Institute)

From the Director's Desk

Conserving Soil for the Good of Posterity



Soil is a finite natural resource and is the key to achieve a food secure, climate resilient and zero-hunger future. It takes about 500-1000 years to produce an inch of soil. To raise awareness on the precious resource, World Soil Day (WSD) is celebrated as an International event, on 5th December every year. For the first time, WSD was celebrated in 2013 and in a span of only six years, it has risen from a less known event to a widely celebrated occurrence across several global networks in the world. Since then, WSD is celebrated every year with a different theme to highlight different aspects needing immediate attention of stakeholders and policymakers. In this endeavour, role of the 68th UN General Assembly declaring 2015 as the International Year of Soils was also praiseworthy. World soil day 2019 '*stop soil erosion, save our future*' was celebrated in 100 countries across the world including our country.

Soil erosion and land degradation are the major challenges to global food security. As per the statistics of FAO, 33% of the Earth's soils are already degraded. Soil erosion is a natural process, but, the anthropogenic interventions and unsustainable land management practices lead to accelerated erosion by up to 1000 times. As soil is the growing medium for 95% of the food we eat, hence, managing soil resources is central to address the global challenges of food insecurity, climate change mitigation and adaptation and depleting natural resources. World population is set to increase to about 9 billion by 2050 and the consequent surge in the food demand is likely to put heavy burden on the production systems and on soil and natural resources.

Soil degradation has assumed serious proportion in our country, and as per the estimates about 104 Mha of arable land faces one or other form of soil degradation, out of which 73 Mha suffers from water erosion and 12 Mha from wind erosion. The different processes of soil erosion result an estimated 5.3 billion tonnes of soil loss and 8 million tonnes of nutrient loss every year in our country. As per the latest study by the Indian Institute of Soil Science, 28% of Indian soils are deficient in sulphur, 36% zinc and 23% in boron, which need immediate attention for balanced application of fertilizers. This year, the Indian Institute of Soil Science, Bhopal organized one-week long Soil Health Awareness program starting from 1st December. A massive campaign for preserving "SOIL – Our Mother Earth", was organized on World Soil Day, 5th December. A March – Past was organized from the Institute campus to the city of Bhopal.

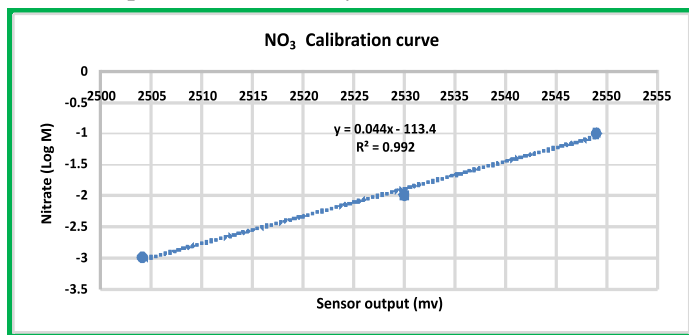
Soil erosion mitigation through Sustainable Soil Management (SSM) and adoption of Best Management Practices (BMPs) is critical for protecting soil health while ensuring food security and production sustainability. In this direction, the Institute is working on developing a host array of technologies and recommendations employing residue and resource management principles in form of conservation agriculture, soil test based fertilizer recommendations, integrated nutrient management packages including biofertilizers to suit crops and cropping systems and nano based fertilizer materials to enhance nutrient and resource use efficiency.

Monitoring soil health and developing nutrient management strategies in changing climate through application of artificial intelligence and digital technologies is another prime area of current research. Considering the importance of soil nutrition to plant, animal and human health, the Institute has developed geo-referenced soil nutrient database and fertility maps for major and micro nutrients in various states of our country and is working in the direction of realizing goals of 'One Health' concept. The 'One Health' model that is gaining importance recognizes human health to be intricately connected to health of animals and the environment including soil.


(Ashok K. Patra)
Director

Automated soil nutrient sensing system

This project was planned to automate the whole process of soil testing starting from sample collection to analysis. The auto soil sampler fixed with tractor has been made in collaboration with ICAR-CIAE. This can automatically collect the soil samples through tractor thus reducing the time for soil sample collection. For developing methodology of quick analysis, the soil samples from Vertisols, Bhopal and Inceptisols, Chandigarh were collected and analysed for fertility parameters using standard laboratory procedures and ion selective field effect transistors (ISFET). The good calibration curves for the estimation of nitrate, phosphate and potassium ions have been successfully prepared (Fig. showing calibration for nitrate). The use of ISFET is expected to simplify and hasten the process of soil analysis.



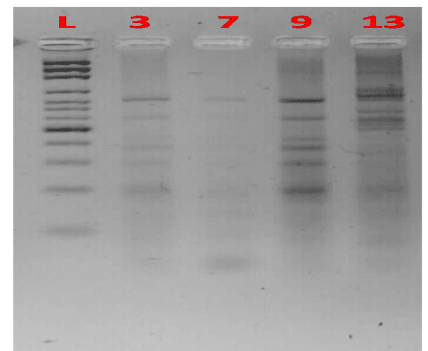
Nitrate calibration curve drawn through ion selective field effect transistors (ISFET)

Imbalanced use of chemical fertilizers has a more pronounced effect on water quality than on soil quality

In intensive agriculture areas, effect of high quantity of fertilizer use on soil and water quality has raised concern at both scientific and policy levels. A study thus was taken up collecting geo-referenced soil and water samples from Udham Singh Nagar district of Uttarakhand. Consumption of chemical fertilizers in this district was 545 kg per hectare with rice-wheat and sugarcane-wheat as the major cropping systems. The content of SOC in the 0-15 cm soil depth was in the medium range in 44% of samples. However, 79% samples were low in available N content ($<250 \text{ kg ha}^{-1}$). On the other hand, all the samples were high in available P content ($>25 \text{ kg ha}^{-1}$). About 60% samples were deficient in available S content. The activity of soil enzymes was satisfactory, with about 69% samples showed dehydrogenase activity in the range of 100-200 $\mu\text{g TPF}/24 \text{ hr}$. The $\text{NO}_3\text{-N}$ content in the water samples varied from 5 to 25 mg L^{-1} with about 66% water samples containing more than the permissible limit of 10 mg L^{-1} . Results indicate water quality is more affected than soil quality parameters due to high fertilization in the studied district.

Carbon dioxide enrichment influences soil carbon mineralization and microbial activity

Results from a field experiment under elevated CO_2 and/or elevated temperature conditions in Open Top Field Chambers (OTC) indicated mineralizable carbon content is significantly affected under elevated CO_2 and/or temperature



Fingerprint generated after restriction digestion of DNA with Taq1

respiration as measured by alkali trap method was observed in these treatments as compared to ambient. The signature lipid profile from the Phospholipid Fatty Acid analysis (PLFA) of soil samples indicated a significant increase in fungi-bacteria ratio, significant reduction in ratio of Gram ve^+/ve^- bacteria and ratio of saturated to unsaturated fatty acid content under elevated CO_2 and/or temperature. The amplified ribosomal DNA restriction analysis (ARDRA) of prokaryotic 16s rDNA using Taq1 restriction enzyme indicated shift in the microbial composition under elevated CO_2 and/or temperature treatments. The gel fingerprint indicated a narrowing down of microbial diversity under the climate change conditions.

Carbon dioxide elevation enhances uptake of micronutrients in soybean

The field study using Open Top Field Chambers with two CO_2 levels and four N levels indicated elevation in CO_2 did not significantly alter the concentration of Zn, Cu, Fe and Mn in seed and straw of soybean. However, a significant increase in Cu concentration was observed in straw. In terms of uptake, CO_2 elevation showed significant increase in uptake of micronutrients in both seed and straw. Uptake of Zn, Cu, Fe and Mn increased by 39, 34, 59 and 47%, respectively in seed and by 30, 65, 32 and 29% in straw. Total uptake (seed and straw) of Cu and Fe increased by 48% each, whereas, uptake of Zn increased by 37% and Mn by 40% under elevated CO_2 .

Evaluation of Integrated Plant Nutrient Supply Modules in a Vertisol

Results from a long-term experiment involving 12 integrated nutrient management (INM) combinations of fertilizers (NPK), farmyard manure (FYM), poultry manure (PM), urban compost (UC), maize residue (MR), glyricidia loppings (GL) and soil test crop response

(STCR) based fertilizer dose revealed that crop yield was sustained over the years with INM practices. STCR based 75% NPK of STCR along with FYM at 5 t ha⁻¹ recorded higher maize yield as compared to general recommended dose (GRD) and 100% NPK alone over years. The response to urban compost (UC) and STCR based NPK was nearly equal and their application along with 75% NPK of STCR along with FYM based fertilizer. Crop yields under sole application of organic sources of nutrients were significantly lower as compared to integration of organic and inorganic fertilizers.

Evaluation of glauconite as source of potassium for crops

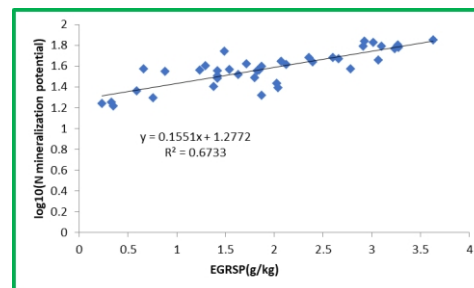
An evaluation study taking glauconite as an indigenous source of K was conducted in a pot experiment with maize (*kharij*) and wheat (*rabi*) crops in two different soil types, viz. black soil (Vertisol, Wanirambhapur soil series) and red soil (Alfisol, Vijayapura soil series). Results indicate sole application of glauconite as source of K was not effective. However, application of calcined glauconite [Glauconite and calcium chloride (CaCl₂ 2H₂O) in 1:1 ratio heated at 900 °C for 60 min] and acidulated calcined glauconite application alone or in combination with FYM showed higher growth of maize. Application of glauconite and FYM was also found effective in enhancing growth of maize.

ICAR-IISS participated in the Proficiency Testing Program of Food and Agriculture Organization (FAO)

The Proficiency Testing (PT) program was launched in 2018 by FAO under the framework of pillar 5 of Global Soil Partnership (GSP). The PT program identifies any systemic error in a laboratory and seeks to correct that error. It also seeks to ensure uniformity in the analytical methods among the laboratories so that the results emanating from different laboratories can be interpreted uniformly. In the year 2018, India participated in the PT for the parameters soil pH, Organic C, Available P (Olsen and Bray 1) and Exchangeable K. The results obtained in the year 2019 for all the five parameters were within +/- 2 Z score, showing a satisfactory laboratory performance.

Easily extractable glomalin related soil protein: A good predictor of nitrogen supplying capacity of soil

Glomalin-related soil protein (GRSP) is a glycoprotein produced by the hyphae of arbuscular mycorrhizal fungi (AMF). Net N mineralization during 35 d incubation was significantly and positively correlated with the easily extractable GRSP (EEGRSP) concentration ($R^2=0.67$, $P=0.001$). Hence, the pool of proteins extracted by this method can be viewed broadly as an indicator of soil available N supply that reflects the primary pool of organically bound N in soil and, thus, as a potentially



Relation between EEGRSP and N mineralization potential

available organic N in soil. Furthermore, it could be concluded that EEGRSP may potentially be used as an index of N availability in soil.

Mid-Infrared Spectroscopy for Rapid Estimation of Properties of Inceptisols

Attempts were made to develop mid infrared spectroscopy based chemometric models for simultaneous and rapid assessment of important properties of Inceptisols. About 450 geo-referenced soil samples collected from the arable lands of upper and middle Indo-Gangetic plains of Haryana, UP and Bihar were used for development of MIR spectral library for Inceptisols. Validation of the model with independent dataset showed that the predictability as expressed through coefficient of determination (R^2) and root mean square error (RMSE) varied markedly among the different soil properties. The SOC and pH of the soils could be predicted with a reasonable accuracy ($R^2 > 0.8$) using the validated models. However, prediction was poor for the extractable nutrient concentrations namely, available P and K. Relative contribution of different spectral bands towards prediction of pH and SOC content of the soils were also identified.

Soil aggregation as influenced by different tillage and cropping system after 9 crop cycles

Tillage showed significant effect on soil aggregation after 9 crop cycles. But cropping system effect on mean weight diameter (MWD) was not significant. The surface layer (0-5cm) recorded higher MWD as compared to subsurface layer (5-15 cm) and it decreased with depth. The mean MWD of surface layer for conventional tillage (CT) and no-tillage (NT) was 1.60 mm and 1.80 mm, respectively. The interaction effect of tillage x cropping system x depth was not significant. Results indicated that conservation agriculture management practices had a positive effect on soil aggregation and aggregate stability.

Temporal variation in soil moisture content under different tillage system

Soil moisture observation up to the depth of 70 cm was recorded using the frequency domain reflectometry (FDR) during the wheat crop in maize-wheat cropping system after the 8th year of the cropping cycle. The results showed that soil moisture content was continuously higher in NT

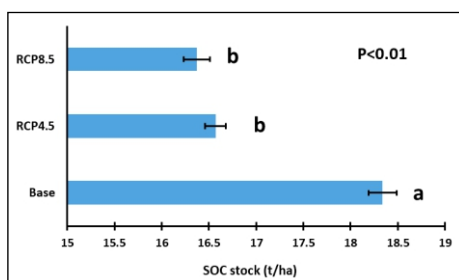
compared to the CT. Total differences in water content for the cropping period was $184 \text{ m}^3 \text{ ha}^{-1}$. Higher moisture content in NT may be attributed to the higher soil organic carbon (14% higher SOC in NT) compared to CT.

Aggregate associated carbon under different tillage and cropping systems

Effect of different tillage and cropping system on aggregate associated carbon (C) at different soil depths were evaluated. The study indicated that the aggregate-associated C content increased with aggregate size and was in the following order : large macro-aggregate (LM) > small macro-aggregate (SM) > silt+clay (S+C) > micro-aggregate (M). Overall, LM had the highest aggregate C, whereas, small macro-aggregate and micro-aggregate were at par. Tillage practices and cropping systems had significant effect on large macro-aggregate associated-C. Similarly, tillage had a significant effect on small macro-aggregate. In contrast, cropping system had a significant effect on micro-aggregate C and silt+clay aggregate C. The interaction of cropping system \times depth was significant for LM-C but did not show significant effect on the other aggregate classes. There was more LM aggregate C for NT (0.93%), and CT (0.83) at 0-5 cm depth and aggregate C decreased with lower depth *i.e.* 5-15 cm and 15-30 cm. Similar trend was observed in SM aggregate C, M aggregate C and S+C aggregate C.

Simulation of soil organic carbon (SOC) stock under different climate change scenarios in maize-wheat cropping system of central India

To quantify the effect of climate change on SOC stock in Central India, a well-calibrated and validated APSIM crop growth model was used at ten locations under the base (1980-2010), RCP 4.5 and RCP 8.5 scenarios for mid-century (2050) time slice. The APSIM model also considered the change in CO_2 for different scenarios. Results showed significant changes in SOC stock in RCP 4.5 and RCP 8.5 compared to the base SOC stock. However, no significant effect was observed in RCP 8.5 in comparison to RCP 4.5. The value of SOC stock for base, RCP 4.5 and RCP 8.5 were 18.34, 16.57 and 16.38 t/ha, respectively.



SOC stock (0-30 cm, t/ha) under different climatic scenarios for mid-century time slice

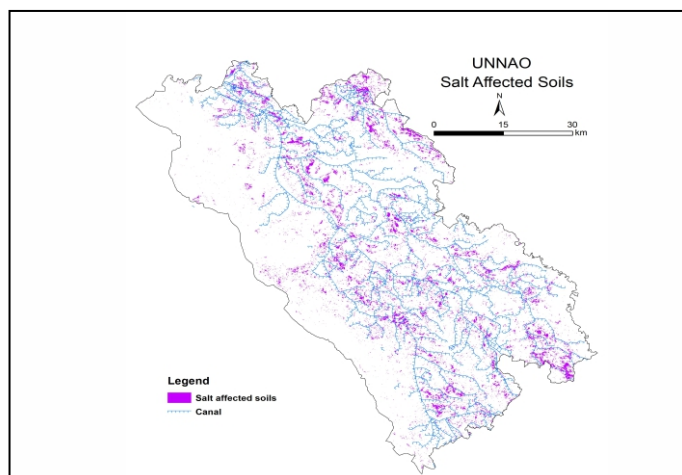
Correlation analysis of plant phosphorus content (%) with visible and near infrared spectra

An attempt was made to quantify the plant P content

through visible and near-infrared plant spectra. The preliminary analysis showed that correlations between plant P and diversely transformed spectra greatly improved as compared to unprocessed reflectance. The first derivative of absorbance would be most effective for the development of a regression model for estimating plant P content.

Identification of salt-affected soils using remote sensing

An attempt was made to identify salt-affected soils in Unnao district of Uttar Pradesh using satellite remote sensing. A machine learning technique *i.e.* random forest, was applied on individual bands of the Landsat 8 images and various salinity indices were computed using these bands, Digital Elevation Model data, ground water depth data, nearness to canal, and MODIS NDVI 16 days composite data to identify salt affected soils. For training and testing of random forest model, 1680 sample points were taken out of which 600 samples belonged to salt-affected soils and remaining points represented other features. 70% data was used for training and 30% data for testing the random forest model. The trained model was then used for the identification of salt-affected soils in the district. The results were validated with field observations and with high resolution Google Earth data. It was found that the random forest model was able to identify the moderate and severe saline-sodic soils in Unnao district with acceptable level of accuracy. The spatial distribution of salt-affected soils also depicted an association with nearness to canal.

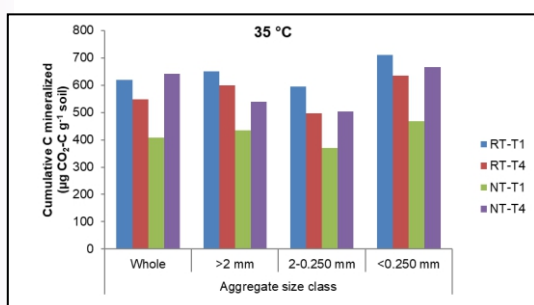


Map of saline-sodic soils of Unnao district as identified by satellite remote sensing using random forest technique

Soil organic carbon mineralization in aggregate fractions under different tillage and nutrient management as influenced by temperature

A laboratory incubation study was undertaken to study the effect of temperature on SOC mineralization in aggregate size fractions under different tillage and nutrient management from an eight year old long-term experiment

in soybean-wheat system of Vertisol. The cumulative mineralizable C from aggregate fraction was higher by 30% in RT than NT with greatest differences in the microaggregate size classes (<0.250 mm) across all temperatures in NPK treatment. However, there was no difference in cumulative mineralizable C between NT and RT in NPK + FYM treatment at 35 and 45°C. The cumulative SOC mineralization increased significantly with increase in incubation temperature. The Q₁₀ values of soil C mineralization were significantly affected by the main effects of land management, aggregate size class and their interactive effect. The Q₁₀ values of soil C mineralization were greater for the low temperature range, 25-35°C, than the high temperature range, 35-45°C. In RT treatment Q₁₀ was lower than NT treatments and application of FYM increased the Q₁₀ of soil C mineralization in both RT and NT.



Carbon mineralization pattern under different aggregate size

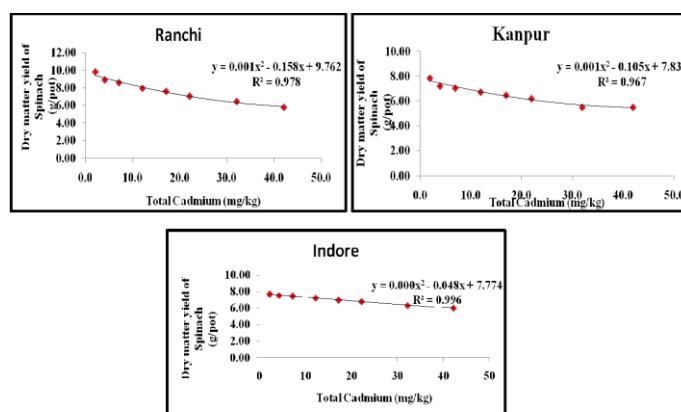
Influence of long-term soil management on soil organic carbon (SOC) storage in soybean based cropping systems of Central India

Effect of long-term soil management on the change in SOC storage and related soil properties in soybean based cropping systems under different agro-climatic regions (ACRs) was studied from three long term trials at three locations. Soil carbon sequestration was significantly higher in Bhopal and Jabalpur receiving higher rainfall than Indore in the surface soil layer (0-15 cm). Soybean-wheat cropping system sequestered more SOC than soybean-fallow cropping system. Integrated use of nutrients (100% NPK+ FYM) increased SOC storage and enzyme activities than sole NPK fertilization at all sites. Reduced tillage together with 30% residue retention and application of 100% NPK + FYM @ 6 t/ha had the highest SOC sequestration (0.37 Mg/ha/yr) at Bhopal. Across site, the SOC sequestration ranged from 0.009 Mg/ha/yr (Conventional tillage, Indore) to 0.374 Mg/ha/yr (reduced tillage + integrated use of nutrients, Bhopal).

Ageing effect of spiked cadmium on bioavailability and phytotoxicity in spinach

Pot culture experiments were conducted to derive phytotoxicity limits of cadmium for major soil orders (Alfisol, Vertisol and Inceptisol) of India. Cadmium was spiked with graded levels ranging from 0 to 40 mg/kg soil

(0, 2, 5, 10, 15, 20, 30, 40 mg/kg soil) in the three soils during April 2016. The bioavailable Cd content and toxicity over a period of time (3 years) remained almost similar in case of Alfisol, whereas the plant phytotoxicity and bioavailability reduced significantly in Vertisol at the end of third year as compared to 1st year of spiking. In Alluvial soil, there was a slight decrease in bioavailable Cd content and phytotoxicity. The data on phytotoxicity limits showed that the average percent reduction in dry biomass of spinach leaf at the highest level of Cd contamination (40 mg/kg) over control was 43.67, 39.19 and 26.31% in Alfisol, Inceptisol and Vertisol, respectively. Even after the three consecutive spinach growth the phytotoxicity limit of Cd for spinach biomass was higher in alluvial soil as compared to black soil.



Effect of Cadmium levels on dry matter yield of spinach leaf (average of 3 season crop cycle)

Impact of industrial effluent water on water quality and crop growth

On the bank of Chambal river near Nagda in Madhya Pradesh industries such as M/s Grasim Industries Ltd., M/s Lensx India Pvt Ltd, M/s Arkema Catalyst India Ltd, Aromi Chemicals, M/s Goyal Gases Pvt Ltd etc are located. The effluent water from these industries and municipal domestic sewage water are mixed with river water. The farmers of surrounding area utilize this river water for irrigation, due to shortage of surface or groundwater. EC and pH of the river water of downstream area were 6.982 dS/m and 7.62, respectively, whereas in upstream area of Chambal river, EC and pH values were 0.45 dS/m and 7.10, respectively. Also, the color of the Chambal river water at downstream area is red. As farmers of downstream area used this contaminated river water to irrigate the field, it badly affected the crop (wheat and chick pea) growth and soil health.

Phytoremediation of acid mine drainage (AMD) affected areas in Malanjkhand copper mining area

Malanjkhand copper site is a base metal mine which contains copper, iron, mang-anese along with fluoride and some toxic elements like arsenic, lead, and cadmium in the parent rock. The mine water samples were collected from

various drainage/seepage locations in and around the project site. The Cu concentration in mine water was < 45 mg/L in majority of samples, whereas, Fe concentration varied between 0.08 and 5.55 mg/L and Mn concentration was 0.81–3.60 mg/L. The pH range of mine water was 3.1 and 6.5. *Typha angustifolia* (Typhaceae) plant was used to decontaminate the AMD affected area inside the mine premises.



Effect of long-term use of FYM and inorganic fertilizer on soil microbial community and potential nitrification

Phospho Lipid Fatty Acid (PLFA) content showed distinct variation among nutrient management treatments in alluvial soils from Barrackpore. Total microbial biomass and eukaryote biomass determined by PLFA analysis were highest in 100% NPK+FYM treatment in 100% NPK+FYM showed the lower ratio of Predator/Prey, Cyclo/Monounsaturated precursor and higher ratio of G+ve/G-ve bacteria. Lowest ratio of Cyclo/Monounsaturated precursor in 100% NPK+FYM indicated lower stress on soil microbial community. On the contrary, significantly higher ratio of Cyclo/Monounsaturated precursor in control, 100% N, 100% NP indicated higher stress on soil microbial community. Likewise, ratio of G+ve/G-ve bacteria also increased from imbalanced to balanced fertilizer application and highest was noticed in integrated nutrient management. It reflected the dominance of oligotrophs as compared to copiotrophs under manure treated INM.

A significant heterotrophic nitrification activity (HNA) was observed. While, autotrophic nitrification activity (ANA) contributed 55-80% of total NA in different treatments, HNA contributed 19.6–49.6% of total NA. The INM treatment (100% NPK+FYM) had significantly higher NA as compared to other treatments.

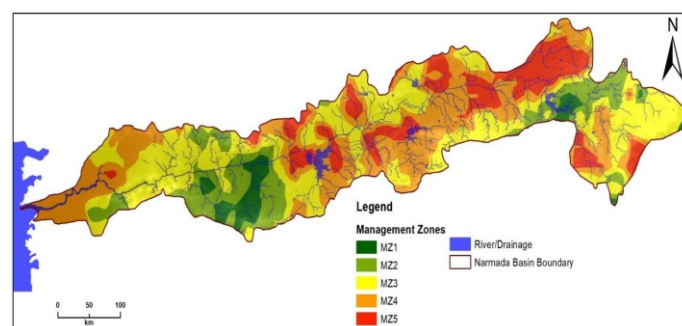
Critical carbon content in soil for sustainable soil productivity

To work out critical carbon content in soil, data on changes in soil carbon and crop productivity was analyzed from 45-years old long-term fertilizer experiments (LTFE). Results revealed that the critical carbon content differs from soil to soil. In alluvial (Inceptisols), critical C content was found to be 0.30% to sustain the soil productivity whereas in Vertisols, it was around 0.75%. Higher value of critical C in Vertisols could be due to higher clay content, which protects C participating in the process of mineralization/nutrient transformation. Results further indicated that critical carbon content in respective soil can be maintained on

balanced application of nutrients and incorporation of organic matter. The LTFE data showed application of 5t FYM/ha along with NPK is sufficient enough to maintain critical carbon in soil.

Delineation of soil management zones for ameliorating sulphur and micronutrients deficiencies in Narmada river basin

A total of 5984 geo-referenced top layer (0-15 cm) soil samples were collected from Narmada river basin (NRB) of India, and analysed for basic soil parameters and contents of phyto-available sulphur and phyto-available micronutrients. The soils had acidic to alkaline pH, non-saline EC values and wide SOC range. Geostatistical analysis resulted in semi-variograms with exponential model for different soil parameters. About 41.2, 78.6, 10.1, 2.70, and 32.6% area of NRB exhibited deficiency (including acute deficient, deficient and latent deficient areas) in phyto-available S, Zn, Fe, Mn, and B, respectively. The principal component analysis and fuzzy c-means clustering produced five MZs with different mean values of soil parameters and S and micronutrient deficient areas.

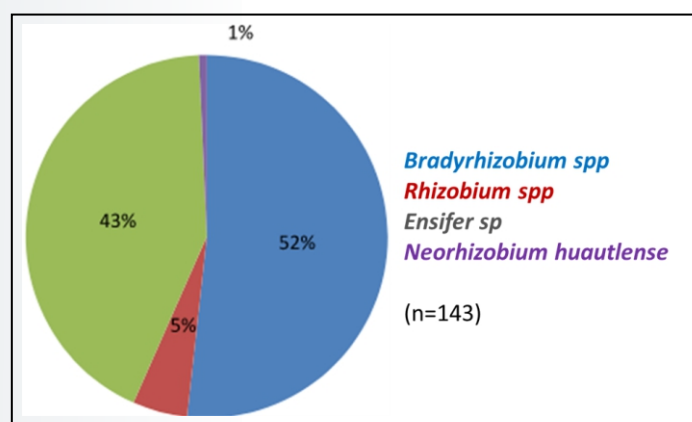


Sulphur and micronutrient management zones of Narmada river basin of India

Diversity and plant growth promoting activities of Pigeon pea rhizobia in Inceptisols of Indo-Gangetic Plains

The assessment study showed the population of rhizobia was very low in areas of Punjab and western Uttar Pradesh (0 to 113 cells/ g soil) and was optimal in Eastern UP (40 to 2820 cells/ g soil). Sequencing of 16s rRNA gene clearly brought out the fact that pigeon pea is a promiscuous crop and gets nodulated by both fast and slow growing rhizobia. Among the isolates, 57 belonged to genus *Bradyrhizobium*, 58 to *Ensifer*, 12 to *Rhizobium* and 1 to *Neorhizobium*. There were six species of *Bradyrhizobium* (*B. yuanmingense*; *B. neotropicale*; *B. subterraneum*; *B. valentinum*; *B. kavagense*; *B. paxllaeri*); eight species of *Ensifer* (*E. sesbaniae*; *E. terrangae*; *E. mexicanus*; *E. shofinae*; *E. alkalisoli*; *E. americanus*; *E. kostiensis*; *E. adhaerens*); seven species of *Rhizobium* (*R. aegypticum*; *R. viscosum*; *R. miluonense*; *R. alvei*; *R. radiobacter*; *R. pusense*; *R. nepotum*) and 1 species of *Neorhizobium* (*N. huautlense*). The metagenome analysis of nodules indicated

presence of endophytes besides rhizobia which included both bacteria and fungi. Inoculation experiments led to the identification of 32 efficient strains that could improve the nodulation and growth parameters by more than 50%. Five pigeon pea cultivars were tested with 16 efficient strains of rhizobia to identify optimum combinations. ICPL 332 and Asha performed well with all strains. Among the strains, NBAIM 12 was found better followed by NBAIM 3. NBAIM 1, 5, 10, 12, 14 and 16 were found to be efficient in improving the nodulation and growth parameters of all the three cultivars.



Diversity of pigeon pea rhizobia in Inceptisols of Indo Gangetic plains

Role of *Burkholderia* on rhizobia-soybean interaction

A *Burkholderia* sp isolated from Vertisol having high P solubilization potential was assessed for its role in soybean-rhizobia interaction. Field experiment was undertaken with following treatments: Control (None), T1- *Burkholderia* sp and T2-*Burkholderia*+*Rhizobia* sp. Sequence of 16S rRNA gene of this bacteria has been submitted to GenBank, assigned with Accession No. MN174806. Seeds were inoculated with strains or consortia and sown during *kharif* 2019. Root nodules and plant biomass were estimated after 30 days of sowing. Values of crop parameters followed the trend of T2>T1>control. *Burkholderia* sp stimulated nodulation and biomass of soybean. Based on the above findings, it is presumed that *Burkholderia* sp may exhibit plant growth promoting activities through secretion of certain biomolecules.

Microbial Inoculation Improves Carbon Sequestration and Soil Health

The role of microbes in maintaining soil health is well known, however their role in sequestering carbon and formation of soil organic matter (SOM) is poorly understood. The formation of melanin and other precursor molecules in the formation of organic matter by bacteria-*Microbacterium testaceum*, *Arthrobacter* sp., *Streptomyces* spp. *Lysinibacillus* sp. and *Bacillus subtilis* was studied *in vitro* in culture media. Spectrophotometric measurements

showed that melanin production was highest in total consortium of all cultures and in *Arthrobacter* spp. An increase in aromaticity reflected in a decrease of A365/A550 and A465/A665 ratios; the lowest was observed in *Arthrobacter* sp., AR7, *Arthrobacter* mixture AR3+AR7 and total consortium.

The role of these bacteria *in vivo* in soil microcosms for formation of SOM and improvement of soil health attributes was studied in incubation experiments over 270 days. The microbial consortium of *Arthrobacter*+*Streptomyces*+*Bacillus* inoculation increased C mineralization in plant residue (wheat straw + legume residue) amended soils by 14.3% over uninoculated soils (at 120 DOI), extracellular protein content by 35% (180 DOI); and showed 0.05% higher organic C and 0.003% higher labile C (absolute values) along with 13.3% higher soil dehydrogenase activity (270 DOI). The improvement of soil organic matter content and soil biological properties in the inoculated soils was consistent over the entire study period of nine months. The microbial consortium of *Arthrobacter*+*Streptomyces*+*Bacillus* performed well in farmers' field trials for two years in Village Parwaliya and Raslakhedi, Bhopal with yield increases in chickpea, wheat, soybean and maize ranging from 3.3, 9.2, 23.3 and 30.5% respectively. The farmers own perception of an increase of ~3-4 quintals/acre in wheat and ~8 quintals/acre in maize based on their visual observations that match well with the measured increases and are indicative of the confidence gained by farmers on the benefits of using inoculants. It is concluded that bio-inoculants use should be widely promoted not only for the well-known benefits of reducing fertilizer nutrient usage but also to build up soil organic matter and soil health.

Programmes Held

Release of Logo of ICAR-Indian Institute of Soil Science, Bhopal

Dr. K. Alagusundaram, DDG (Agri. Engineering & NRM) visited ICAR-Indian Institute of Soil Science, Bhopal on 20 July 2019 and released the logo of the Institute. Different components of the logo were explained to audience. He also congratulated all the staff of institute for the receipt of Sardar Patel Outstanding ICAR Institution Award – 2018. During the visit, he reviewed the cadre strength of institute. He encouraged the scientists to work for developing "On the go soil health analysis and fertilizer applicator". He lauded the efforts of scientists in getting more number of externally funded projects with quality publications. He motivated all the young scientists to concentrate more on innovative research work. He also urged the employees to do service to nation and go along with the system for a better output. He visited the laboratories and field facilities of the institute and reviewed the different project activities. He also interacted with progressive farmers and Deputy Director (Agriculture), Bhopal.



Research Advisory Committee (RAC)

The RAC meeting of the Institute was held during 3-4 December, 2019 under the chairmanship of Dr. N. N. Goswami, eminent Soil Scientist and Ex-Vice Chancellor, CSAUAT, Kanpur. Other members participated in the meeting were Dr. D.K. Das, former Head, IARI, New Delhi; Prof. H.K. Senapati, former Dean, OUAT, Bhubaneswar; Dr. J.C. Tarafdar, former Principal Scientist, ICAR-CAZRI, Jodhpur; Dr. A.K. Patra, Director, IISS; Sh. Thakur Bhupendra Singh, Progressive Farmer; Sh. Om Prakash Yadav, Progressive Farmer and Dr. A.K. Biswas, Head, Division of SCF as Member Secretary. At the outset, Dr. A.K. Patra, Director, IISS welcomed the honourable members of the RAC and presented the brief achievements of the Institute. The Member Secretary presented the ATR. Presentations were held by the Head of the Divisions and Project Coordinators before the RAC.



Soil Health Awareness Week

The Institute celebrated 'Soil health awareness week' in the premises of the Institute, and also in nearby schools and villages. The Institute organized a one-week long 'Soil Health Awareness' program including 'Agriculture Education Day' and 'World Soil Day' during 1-7 December 2019.

Agricultural Education Day

The Institute organized the soil health awareness program for about 100 school children of Sardar Patel Govt School, Bhopal. The scientists briefed about importance of soil health and its management and made the students aware about 'Agricultural Education Day'. A quiz competition on the theme 'Soil health and Agriculture Education Day' and a 'Scientist-student-interaction' was also conducted.

An exposure visit-cum-expert session on 'Soil health for sustaining soil productivity' was organized for B. Sc. students of The Bhopal School of Social Sciences (BSSS), Bhopal at ICAR-IISS on 2nd December 2019. A field visit to vermicomposting pit as well as organic farming field demonstrations was arranged. Dr Ashok K Patra, Director, ICAR-IISS, Bhopal elaborated on several issues.



Field demonstration under Organic Farming

World Soil Day

A massive campaign for preserving “SOIL-Our Mother Earth”, was organized on the occasion of World Soil Day on 5th December, 2019. The scientists and staff members outfitted in the T Shirts bearing a slogan 'Stop Soil Erosion, Save our Future' proclaimed by Food and Agriculture Organization (FAO). A march-past was organized in the city of Bhopal to create awareness amongst the citizens on the importance of soil for the survival of the plants, animals and human beings.



March-Past on the 'World Soil Day' (5th December 2019)

On the same day, a farmer-scientist interaction meet was organised at village Parwalia Sadak (Dist Bhopal, M.P.). Prof. N. N. Goswami (Ex-Vice Chancellor, CSAUAT, Kanpur) graced the function along with Prof. D.K. Das (New Delhi), Prof. H.K. Senapati (Bhubaneswar), Dr. J.C. Tarafdar (Jodhpur). Prof. N.N. Goswami emphasized the role of soil for the survival of the mankind and requested to start up a national movement for awareness amongst villagers to protect a precious natural resource (i.e. soil) for the future generation. Soil health cards were distributed to the farmers. During the events, scientists, officials, students and about 300 farmers from nearby villages participated. Dr. Ashok K. Patra, Director of the Institute welcomed all experts and participants and called upon wholehearted action for the cause of conserving soil and water for the prosperity of the nation.



World Soil Day celebrated at Parwalia Sadak (5th December 2019)

Training and Interaction meet

A training program on soil health management under SCSP at ICAR-IISS was organized on 6th December, 2019. Training was imparted to about 50 SC farmers from different villages. Dr. Ashok K. Patra, Director, ICAR-IISS Bhopal emphasized on the balance nutrient management for improvement of soil health to enhance soil productivity. On this occasion, field visits to the field experiments and composting unit at IISS, Bhopal were also organized for the farmers.



On 7th December 2019, training-cum-farmer-scientist interaction meet was organized at Khamkheda village (Dist Bhopal). About 100 farmers from Khamkheda as well as nearby villages participated in this training cum interactive meet with a focus on soil health. On this occasion, soil health cards were distributed to the farmers. Experts

elaborated parameters mentioned on soil health cards including critical ranges and suggested the nutrient application strategies. The remedial measures were suggested based on the symptoms of plant samples brought in by the farmer.

Swachhta Hi Sewa (SHS) Pakhwada (11 September to 1 October, 2019)

Under Swachh Bharat Mission, Swachhta Hi Sewa (SHS) Pakhwada was celebrated during 11 September to 1 October, 2019. Different activities under Swachh Bharat Mission (SBM) and 150th Birth anniversary of Mahatma Gandhi Ji were taken up at ICAR- Indian Institute of Soil Science, Bhopal. The following activities viz., awareness of single use plastics (SUP) in the Institute, display of banner for celebration of 150th birth anniversary of Mahatma Gandhi Ji, Essay Competition on contribution of Mahatma Gandhi in agriculture and rural upliftment, Quiz Competition on Life of Mahatma Gandhi, Disposal of single use plastics from labs, offices and institute premises were conducted at different dates.



Swachhta Pakhwada (16-31 December, 2019)

The Swachhta Pakhwada at ICAR-IISS was celebrated with great enthusiasm. During this period, both on-campus and off-campus cleanliness activities were performed involving ICAR Scientist /Staff/ Students/ Farmers/ common citizens. On the first day, all the staff were administered Swachhta Pledge. Further, twelve teams each comprising of 6-7 members were formed and they were allocated responsibilities as per suggested activities to clean institute premises along with adjoining areas, create awareness, to take up sanitation drives in the villages adopted under the Mera Gaon Mera Gaurav programme, Swachhta drive at tourist places and celebration of Kisan Diwas.



Independence Day Celebration

Independence Day was celebrated with lots of fervor and joy in the Institute on 15th August. Dr. Muneshwar Singh, I/c Director hoisted the flag and addressed the gathering on this occasion. Many sports and cultural activities were also organized.



Vigilance Awareness Week

The ICAR-Indian Institute of Soil Science, Bhopal celebrated the Vigilance Awareness Week from October 28 to Nov 2, 2019, with the theme 'Integrity - A Way of Life' as per direction of Central Vigilance Commission. Dr. Ashok K Patra, Director of the Institute administered the pledge on 28 November at 11.00 AM among the employees of the Institute. During the week-long celebration various activities such as debate, quiz, essay writing competitions were organized. The staff of the institute participated actively in the week long programmes. Various posters, banners etc. were also displayed to sensitize the people about vigilance, corruption, honesty etc. A guest lecture was organized on 29 Nov in CIAE auditorium, wherein Shri S. K. Sinha, Ex-Under Secretary (Vigilance) spoke about importance of vigilance in Govt. departments and integrity among officials. On the concluding day, Shri Ashutosh Kumar, Dy. Superintendent of Police (CBI), Bhopal was invited as the Chief guest.

Awards/Honours/Recognitions

- Dr. Ashok K. Patra, as President delivered the presidential address at the 84th Annual Convention of the Indian Society of Soil Science held at BHU, Varanasi during 15-18 November, 2019



- Dr. Pradip Dey was elected as Vice-President of the Indian Society of Soil Science for the biennium 2020-21.

- Dr. Sanjay Srivastava was elected as Vice-Chairman of South East Asia Laboratory Network (SEALNET) of FAO during 3rd SEALNET meeting held in Manila, Philippines in September, 2019.
- Dr. Ashok K. Patra was selected as a member of ITPS, FAO, Rome.



- Dr. R.S. Chaudhary was elected as councillor of the Indian Society of Soil Science for the biennium 2020-21.
- Dr. N.K. Lenka was elected as treasurer of Bhopal Chapter of the National Academy of Agricultural Sciences.
- Dr. Sanjay Srivastava invited to act as adviser to assist the Chairman of Rajasthan Public Service Commission in recruitment process during July 1-3, 2019.
- Dr Sanjay Srivastava acted as examiner for the evaluation of Ph. D. thesis of Tamil Nadu Agricultural University, Coimbatore.
- Dr. Monoranjan Mohanty received 'Twelfth International Congress Commemoration award-2019' in 84th Annual Convention of Indian Society of Soil Science held at BHU, Varanasi (U.P.) during 15-18 November 2019.
- Dr. N.K. Lenka and Dr. Sangeeta Lenka received Dr. J.S.P. Yadav Memorial Award for excellence in Soil Science-2019 at the 84th Annual Convention of the Indian Society of Soil Science at Varanasi during 15-18 November 2019.



- Dr. R.S. Chaudhary chaired a technical session on “Soil Physics and Soil Education and Public Awareness” on November 16, 2019 during 84th Annual Convention of the Indian Society of Soil Science at BHU, Varanasi (U.P.).
- ICAR-IISS, Bhopal participated in Central Zone Sports Meet, 2019 at ICAR-NBSS & LUP, Nagpur and won a Gold medal in Chess and a Silver medal in Carrom.
- Dr. J. Somasundaram conferred 'The Scientist Award – 2019 for Commendable contribution to Soil Science' by Dr. B. Vasantharaj David Foundation on 17th November 2019 at Chennai, Tamil Nadu.



- Dr. J. Somasundaram was selected as associate editor for the journal 'Frontier in Sustainable Food Systems'.
- Mrs. Seema Bhardwaj selected for the “Young Scientist Award-2019” in the 10th International Conference on Agriculture, Horticulture and Food Sciences on 21-22 December 2019 at New Delhi, India by the Society of Tropical Agriculture.
- Dr. Brij Lal Lakaria acted as an Expert for interview board of Rajasthan Public Service Commission for the selection of Assistant Agriculture Officers during 08-10 July, 2019
- Dr. Sangeeta Lenka, Dr. Asit Mandal, Dr. Asha Sahu and Dr. Sudeshna Bhattacharjya acted as Rapporteurs in one day workshop of NAAS on "Improving Soybean yield in Central India- Potential Strategies" on 1 October, 2019.
- Dr. N.K. Lenka was the organizing secretary of the Workshop on 'Improving Soybean Yield in Central India' organized by NAAS-Bhopal Chapter at the Indian Institute of Soil Science, Bhopal on 1 October, 2019.
- Dr. Ashok K. Patra delivered Dr. M.V. Rao Memorial lecture at ICAR-IARI, Regional Station, Indore on 3 October, 2019.
- Dr. Asit Mandal selected as editorial board member of the “Journal of Environmental Biology” (Consulting Editor).
- Best Poster award was received by Dr. Sangeeta Lenka, Dr. N.K. Lenka, Dr. Asit Mandal, Dr. Vasudev Meena, Dr. Muneshwar Singh, Dr. Bharat Singh, Ms. Priyanka Jadon, Dr. Swarnima Shrivastva, Dr. J.K. Saha, and Dr. A.K. Patra at the 84th Annual Convention of the Indian Society of Soil Science at Varanasi from 15-18 November 2019.
- Dr. Sangeeta Lenka participated as an invited panelist in the workshop on “Carbon Management in Soils through Resource Conservation Technologies: Issues and Strategies” on 2 November, 2019 at BCKV, Mohanpur, West Bengal.
- Dr. K.M. Hati acted as an external expert for M.Sc. (Ag.) Viva-Voce examination at Banaras Hindu University, Varanasi

- Dr. Pramod Jha acted as external expert for Ph.D. Viva-Voce examination at IGKV, Raipur
- Dr. Pradip Dey was member of NICRA Zonal Committee
- Dr. Pradip Dey acted as expert for assessment of ARS scientist at ICAR-IISR, Lucknow

Distinguished Visitors

- Dr Javed Rizvi, Regional Director, International Centre for Research in Agroforestry (ICRAF), New Delhi; Dr. S.K. Dhyani, Former Director, ICAR-CAFRI, Jhansi and Senior Agroforestry Specialist, South Asia Regional Centre, ICRAF, New Delhi, Dr. Sunil Londhe, Soil Health and Geo-informatics Scientist, South Asia Regional Centre, ICRAF, New Delhi and Dr. R.N. Sahoo, ICAR-IARI, New Delhi visited ICAR-IISS on 17 December, 2019.
- Dr. K. Alagusundaram, DDG (Agri. Engineering & NRM) visited ICAR-IISS, Bhopal on 20 July 2019 and 2 November, 2019.



International Co-operation

- ICAR-IISS participated and recognized with a certificate in the Proficiency Testing Program of Food and Agriculture Organization (FAO)



ICAR-IISS, Bhopal participated in third SEALNET meeting of FAO

Dr. Sanjay Srivastava, Pr. Scientist, participated in the Third meeting of the South East Asia Laboratory Network (SEALNET) of FAO at Bureau of Soil and Water Management (BSWM), Quezon city, Philippines during

23-27 September, 2019. Sixteen South-East Asian countries viz., Bangladesh, Bhutan, Cambodia, China, India, Indonesia, Japan, Laos, Malaysia, Mongolia, Myanmar, Nepal, Philippines, Sri Lanka, Thailand, Vietnam participated. Besides, there was representation from France and Australia as resource persons. During the meeting, Dr Srivastava presented the Proficiency Testing Plan of India, and participated in the development of Standard Operating Procedures (SOP) for the estimation of soil parameters. Dr. S. Srivastava was also elected as Vice-Chairman, SEALNET.



- Dr. S.R. Mohanty visited Lawrence Berkeley National Laboratory, California, USA during 1 October-30 November, 2019 under Fulbright-Nehru Academic and Professional Excellence (FNAPE) fellowship.
- Dr. M. Vassanda Coumar attended 14-days training programme on 'Environmental Management' at Galilee International Management Institute, Nahalal, Israel during 10-23 September, 2019.

Staff News

Joining

- Dr. Nisha Sahu, Scientist, joined at ICAR-IISS on 30 November, 2019 on transfer from ICAR-NBSS & LUP, Nagpur.
- Dr. Narayan Lal, Scientist, joined at ICAR-IISS on 24 December, 2019 on transfer from ICAR-NRC Litchi, Muzaffarpur.



Obituary

The Institute condoles the untimely demise of Sh. Vinod Babu Pal, ACTO

Extension Activities

Demonstration of Mridaparikshak mini-lab during UNEP innovation summit

Dr. Sanjay Srivastava demonstrated the Mridaparikshak mini-lab in United Nations Environment Programme (UNEP) Innovation Summit at Dr. Ambedkar International Centre, New Delhi on Sept 10 and 11, 2019. The

Mridaparikshak mini-lab was listed as prominent technology in their compendium



Enhancing the productivity of major crops through improving the natural resource base of tribal inhabited areas of Madhya Pradesh

Soil samples were collected from 40 locations of the three selected villages (Kaweli, Kulpa and Sarra) of Balaghat district. Soil health cards were prepared based on the analysis of soil samples in terms of organic inputs like farmyard manure, azolla, green leaves like gliricidia, compost and steamed bone meal as the farming system is an organic-by-default one. Along with the soil health card a leaflet explaining how to use the organic nutrient inputs recommended in the Soil Health Card was also prepared as a supplementary material and distributed to farmers.

Farmers' Training and seminar on Soil Health Management

Three days' training program on "Soil Health Management" was organized for the tribal framers of Betul district of Madhya Pradesh at Krishi Vigyan Kendra, Betul during 26-28 November, 2019. About 57 tribal farmers from six villages participated in the three days program. Scientists from ICAR-IISS, Bhopal made the participant farmers aware about the importance of managing the physical, chemical and biological aspects of soil health for sustainable crop growth.

On 29 November, 2019 a Farmers' Seminar (Kisan Sangoshthi) on Soil Health Card for the tribal farmers of Betul district was jointly organized by ICAR- Indian Institute of Soil Science, Bhopal and Krishi Vigyan Kendra, Betul at to sensitize tribal farmers about soil health card and soil test based fertilizer use in their farmlands. More than 200 tribal farmers attended the programme. Scientists from both ICAR-IISS, Bhopal and KVK, Betul interacted with farmers.



Training for SC farmers under SCSP program

Three farmers' training programs were organized by the Institute under SCSP program. Total 150 SC Farmers benefitted during the training programme held at Khamkheda, Karond Khurd, Kanera, Bhaironpura, Parawalia Sadak, Mungaliahat villages in Bhopal district on 6 November, 6 December and 18 December 2019, respectively. Farm implements such as Cono-weeder, manual peg type Dry land weeder and Maize sheller were distributed to the SC farmers.



Mera Gaon Mera Gaurav (MGMG)

Under the MGMG program, scientists of the Institute organized various activities such as trainings, demonstrations, interface meetings or gosthis with farmers in the adopted villages. Apart from these, mobile based advisories and literature support on various aspect were provided. Farm inputs like certified seeds, fertilizers, insecticides, weedicides *etc.* were distributed to the beneficiaries. At farmer's field, demonstrations were conducted on soybean, rice and wheat crop. Some improved practices like integrated nutrient management, rapo-composting, vermicomposting and organic farming practices were advocated to the farmers. A massive campaign for preserving "SOIL - Our Mother Earth", was organized on the occasion of World Soil Day on 5 December, 2019. A farmer-scientist interaction meet was organized at village Parawalia Sadak, Dist.- Bhopal.

Field Visit

The entrepreneurs of 'Diploma in Agriculture Extension and Services for Input Dealers' facilitated by Directorate of Extension, Indore (M.P.) sponsored by Ministry of Agriculture & Farmers Welfare, Govt. of India visited the ICAR-IISS Research Farm on 14 October 2019.

Exposure Visit

Drs. Sangeeta Lenka, Jyoti K. Thakur and Asit Mandal coordinated and organized one day exposure visit to the Institute on 16 November, 2019 for 150 students



and their escort teachers from Navodaya Vidyalaya Samiti selected for Regional Science Congress.

ICAR-IISS Participated in Exhibition on 'Science Fiesta 2019'

The ICAR-IISS participated in the exhibition on 'Science Fiesta 2019 at Regional Science Centre, Bhopal during 13-14 November, 2019. The Institute's technologies including 'Mridaparikshak' were displayed in the exhibition. The students and teachers from different schools actively participated and interacted in this exhibition.



Training Program/Workshop Organized

- One-day workshop on "ICAR-IISS in the service of farmers" was organized on July 22, 2019. During the event, Dr. S.K. Chaudhari, ADG (SWM), ICAR, New Delhi, Dr. M. Din, Director, ICAR-CIAE, Bhopal, Dr. A.K. Patra, Director, ICAR-IISS, Bhopal, Dr. Rajesh Sharma, DG, MPCOST, Bhopal graced the occasion.



- Review Meeting of the ICAR-IISS & ICRAF Collaborative Project on "Assessment of important soil properties of India using Mid-Infrared Spectroscopy" was organized at ICAR-IISS, Bhopal on 17 December, 2019.
- Dr. M. Mohanty organized one-day workshop on simulation modelling approaches in natural resource management under ICAR-ICARDA project on 23 September, 2019.
- Dr. B.L. Lakaria, Dr. Pramod Jha and Dr. A.K. Biswas organized a brainstorming session on "Bio-char: Potential availability, use-fulness and limitations in context of Indian Agriculture" on November 27, 2019.



- Dr. Pramod Jha, Dr. Brij Lal Lakaria and Dr. N.K. Lenka organized a short course on “Recent advances in Soil carbon sequestration and stabilization for soil health improvement and climate change mitigation” from 10-19 December, 2019 at ICAR-IISS, Bhopal sponsored by ICAR.



- A training on "Soil Testing and Nutritional Recommendation for Kharif and Rabi Crops" sponsored by SIAET, Bhopal (Madhya Pradesh) organized at ICAR-Indian Institute of Soil Science, Bhopal during 2-6 July, 2019. The training was conducted by Dr. R.H. Wanjari as Training Coordinator & Dr. A.B. Singh and Dr. A.K. Vishwakarma as Training Co-Coordinators.



- A Model Training Course (MTC) on "Balanced Nutrient Management for Sustainable Crop Production and Soil Health" was organised by Dr RH Wanjari (Course Director), Dr Muneshwar Singh and Dr Pramod Jha (Course Co-Directors) at ICAR-IISS, Bhopal during 23-30 September, 2019. This was sponsored by Directorate of Extension, Ministry of Agriculture and Farmers Welfare, Govt. of India, New Delhi.



- Dr. A.B. Singh delivered training on “Organic Farming and Composting techniques” to the farmers from Dausa, Rajasthan on 13 December, 2019. Fifty farmers participated in the training.
- Dr. Vasudev Meena organized one day training on skill development programme for 50 farmers from Mugalia haat and Pura Chindwara village under SCSP on 18 December, 2019 on the day of “Kisan Diwas”.
- Dr. Vasudev Meena coordinated and organized one day exposure visit for M.P. state agriculture department officials visited from “State Institute Agriculture & Extension Training, Bhopal on 26 July, 2019.

Scientists' Participation in Training/Seminar/Workshop

| Name | Program attended/participated | Venue | Date in the year 2019 |
|---------------------------------------|---|-------------------------------|-----------------------|
| Ms. Alka Rani | Professional Attachment Training | ICAR-NBSS&LUP, Nagpur | May 24 – August 24 |
| Dr. Ashok K. Patra and Dr. Pradip Dey | FAI Round table discussion on “Potassium in balanced fertilization-Emerging Issues” which was organized by the Fertilizer Association of India (FAI) in collaboration with the International Potash Institute (IPI) | FAI House, New Delhi | July 10 |
| Dr. Ashok K. Patra | Award Ceremony of ICAR | New Delhi | July 16 |
| All Scientists of the Institute | Workshop on "ICAR-IISS in the service of farmers" and celebration of "Sardar Patel Outstanding ICAR Institution Award" | ICAR-IISS, Bhopal | July 22 |
| Dr. J. Somasundaram | Research Collaboration Meeting between ICAR & IIT-Delhi | NASC Complex, Pusa, New Delhi | July 31 |
| Dr. Pradip Dey | Meeting of ICAR- Regional Committee No. VII | NBSSLUP, Nagpur | August 8-11 |
| Dr. Ashok K. Patra | Meeting of ICAR- Regional Committee No. VII | NBSSLUP, Nagpur | August 9-10 |
| Dr. K.M. Hati | Workshop on “Conservation Agriculture” organized by the Centre of Advanced Agricultural Science and Technology (CAAST) on Conservation Agriculture | BCKV, Mohanpur, W.B. | August 13-14 |
| Dr. Pradip Dey | Workshop on Joint Working of ICAR & MSME to promote and develop Agro and Rural Enterprises' | New Delhi | August 21 |
| Dr. S. Srivastava | Presentation on soil testing laboratories by Acharya Balachandra before Hon'ble Minister of Agriculture, Gol | Krishi Bhavan, New Delhi | August 21 |
| Dr. A. B. Singh | Workshop on Kharif crops | Gulab Garden, Bhopal | August 22 |
| Dr. Ashok K. Patra | Brainstorming session on “Technological Innovations and Strategies for Farmers' Prosperity in Madhya Pradesh & Chattisgarh” | NASC complex, New Delhi | August 26-27 |
| Dr. K.M. Hati | Science Seminar on “Soil health assessment through MIR” organized by South Asia Regional Centre, ICRAF, New Delhi | NASC Complex, Pusa, New Delhi | August 27 |

| Name | Program attended/participated | Venue | Date in the year 2019 |
|---|--|--|-----------------------|
| Dr. Ashok K. Patra | Annual Review Workshop of the Network Project on AMAAS | New Delhi | August 29 |
| Dr. J. Somasundaram | One day Review Workshop on GHG emissions studies & future | ICAR-NRRI, Cuttack | August 29 |
| Dr. Pradip Dey | Global Micronutrient Summit 2019 | New Delhi | September 5-6 |
| Dr. S. Srivastava | Meeting called by Farmers Association of India on the issues of bifurcation of ICAR | NASC, New Delhi | September 11 |
| Drs. A. B. Singh, Asha Sahu and R. H. Wanjari | Global Organic Convention-2019 on 'Natural Resource Management for Sustainable Agriculture, Soil Health and Quality food' | Hotel Le Meridian, Nagpur | September 15-17 |
| Dr. Pradip Dey | CIMMYT meeting on Fertilizer recommendations | New Delhi | September 18 |
| All Scientists of the Institute | Workshop on "Improving Soybean yield in central India- Potential Strategies" | NAAS-Bhopal chapter at ICAR-IISS, Bhopal | October 1 |
| Dr. Pradip Dey | International Workshop on "Legal Governance for Sustainable Soil Management to achieve Land Degradation Neutrality" jointly organized by UBA JNU & GIZ | JNU, New Delhi | October 15-16 |
| Dr. Ashok K. Patra | FAI Advisory Committee on Agricultural Sciences | FAI, New Delhi | October 16 |
| Dr. Ashok K. Patra | Brainstorming Session on "Advanced Microbial Bioproduction and Consortia" | TERI, New Delhi | October 17 |
| Dr. Sangeeta Lenka | Workshop on "Carbon Management in Soils through Resource Conservation Technologies: Issues and Strategies" | BCKV, Mohanpur, West Bengal | November 2 |
| Dr. A. B. Singh | Workshop on Rabi crops | ICAR-CIAE | November 7 |
| Dr. Pradip Dey | International Conference on "Soil and Water Resource Management for Climate –Smart Agriculture, Global Food and Livelihood Security" | New Delhi | November 7 |
| Dr. A. B. Singh | 14th Annual Group Meeting of AI-NPOF | ICAR-Central Island Agricultural Research Institute, Port Blair | November 12-14 |
| Drs. R.H. Wanjari and A.L. Kamble | Exhibition on 'Science Fiesta 2019' | Regional Science Centre, Bhopal | November 13-14 |
| Drs. M C Manna, A.B. Singh, Asha Sahu, N.K. Lenka, R.S. Chaudhary, Sudeshna Bhattacharjya | 84 th Annual Convention of Indian Society of Soil Science | Banaras Hindu University, Varanasi | November 15-18 |
| Dr. J. Somasundaram | National seminar on "Trends in Higher Education, Taxonomy, Agriculture, Biotechnology and Toxicology" | Vijaya Park, Chennai, Tamil Nadu | November 17 |
| Dr. Ashok K. Patra | 11th Session of Inter-Governmental Panel on soils (ITPS) | FAO, Rome, Italy | November 20-22 |
| Dr. Pradip Dey | Workshop on "Impact Assessment of ICAR Technologies" | ICAR-National Institute of Agricultural Economics and Policy Research, New Delhi | November 28 |
| Drs. A. B. Singh, Hiranmoy Das | "Kisaan Sangosthi" on "Soil Health Card" under the institute STC/TSP project | KVK, Betul (M.P.) | November 28-29 |
| Dr. Pradip Dey | Panelist of World Soil Day organized by GIZ | New Delhi | December 2 |
| Dr. Ashok K. Patra | Meeting of Experts to develop guidelines for testing and demonstration of nano fertilizers | | December 9 |
| Mrs. Seema Bhardwaj | Short course on "Recent Advances in solar energy utilization for agro-produce processing and production system" | ICAR-CIAE, Bhopal | December 10-19 |
| Mrs. Seema Bhardwaj | One day workshop on "Energy conservation 2019" organized by green energy club, SoEEM, BEE-GOI, MPUVN-Govt of M.P. | RGPV, Bhopal | December 17 |
| Dr. Ashok K. Patra | National Conference on "Climate change and agriculture : Impacts, resilience & Adaptations for sustainable food security" | New Delhi | December 20-21 |

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