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International Decade of Soils 2015-2024

FROM THE PRESIDENT'S DESK

Govt. should more thrust on Watershed Development

Currently, rainfed agriculture accounts for more than 50 per cent of the net sown area, and about 60 per cent of India's farmer population. Rainfed agriculture is crucial to the country's economy and food security. Presently, it accounts for around 40 per cent of the total food grain production, (85, 83, 70 and 65 per cent of nutri-cereals, pulses, oilseeds and cotton, respectively); supports two-thirds of livestock and 40 per cent of the human population. Further, the livelihood of 80 per cent of small and marginal farmers is impacted. Crop diversity in rainfed regions is well recognized as almost 34 major crops grown annually compared to 4 to 5 major ones in irrigated areas. Rainfed farmers follow a diverse portfolio of economic activities including horticulture, agroforestry, spices, medicinal & aromatic plants, fishery, livestock and beekeeping etc. Rainfed regions have higher potential of productivity enhancement compared to that of irrigated areas, more vulnerable to climate change and also the poverty & nutrition deficiency is predominant in rainfed eco-system. Above facts justifies that the focal point of the government vision of doubling the farmers' income; bringing greater resilience to climatic challenges; and ensuring food & nutritional security should be rainfed areas.

Even though rainfed agriculture contributes around 60 per cent of the value of agriculture GDP of India, there exists a serious policy bias, when it comes to public funding/support to rainfed farming and farmers. According to the estimates of the Centre for Budget and Governance Accountability (CBGA), during the period 1997-98 to 2011-12, rainfed agriculture received merely 1 per cent of the total expenditure on agricultural subsidies of about Rs. 11.5 lakh crore. The rainfed agriculture has been given inadequate importance in terms of investment and sustainable programme design where as the productivity almost one third to that of irrigated areas and farm income is about Rs. 2400/family in rainfed areas which is about Rs. 13000/family in irrigated areas.

Watershed Development is the ideal catalyst for poverty alleviation, improved livelihoods and conserving land, water, & other natural resources for holistic eco-

system development, for rainfed regions. The concept of watershed development has existed for millennia. The Atharva Veda text from 800 BC contains what may well be the first written reference to watershed management. Atharva Veda verse 19, 2.1 states that: "one should take proper managerial action to use and conserve water from mountains, wells, rivers and also rainwater for use in drinking, agriculture, industries".

In this context, National Rainfed Area Authority (NRAA) has drafted 'New Generation Watershed Development Guidelines' for the watershed development component of PMKSY. The restructured guidelines effect transformative approach to land and water management based on the principles of economy, equity and ecology. It provides greater focus on ecological sustainability and rely more on bio-economy and integrated livelihood development. This revised "Guidelines for New Generation Watershed Development Projects (WDC-PMKSY 2.0)" clearly metamorphoses the current over-emphasized engineering-centric soil & water conservation treatment approach to agronomic and biological treatments. Further, on assuming the critical importance of Springsheds in Himalayan regions, attention is drawn for revival of dried springs through comprehensive set of landscape-based treatment on hydrologic principles.

There is need for a mission mode comprehensive development approach for rainfed areas by government in terms of investments and polices. Further, both central and state governments need to pool their resources and strategies on a priority basis for rainfed ecosystem, which has been deprived of its dues for a long period. Given competing demands on all resources including financial resources, developmental planning by prioritization of the districts in co-opting the weaker ones into developmental ambit is need of the hour. Building & managing a centralised data base vis-a-vis the basket of indicators for vulnerability assessment and evaluation is necessary. Hence a more focused and holistic rainfed areas development with watershed development as the prime tool, will affirm the Hon'ble Prime Minister's call for saving every drop of water and aid to nation's commitment towards doubling the farmers' income.

Dr. Suraj Bhan
President SCSI

Diagnosis of Nutrient Deficiencies Through Artificial Intelligence

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In the era of modernization and the developing world, technologies play a vital role in almost all sectors. Human survival greatly depends on Agriculture but we are still using the traditional methods in the agricultural practices. Plants require essential nutrients for normal functioning and growth. Nutrient is a vital factor that strongly determines the growth rate, productivity and fertilization. Deficiencies in any essential nutrient significantly affect and cause a severe loss in agriculture. Identifying nutrient deficiency in crops is still difficult for farmers. We are still using ancient methods to identify nutrient deficiency in crops which consume more time, labour and cost.

A plant's sufficiency range is the range of nutrient amount necessary to meet the plant's nutritional needs and maximize
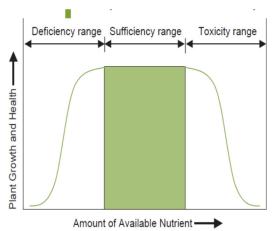

Figure 1: Relationship between plant growth and health and amount of nutrient available

growth. Nutrient levels outside of a plant's sufficiency range cause overall crop growth and health to decline due to either deficiency or toxicity.

Importance of nutrient deficiency detection

The detection of nutrient deficiencies refers to the task of recognizing nutrient limitations of crops, such as nitrogen (N), phosphorous (P) and potassium (K) deficiency. Reliable diagnosis of the nutritional status of crops is an essential part of farm management. Both excess and deficiency of nutrients can cause severe damage and yield loss. If identified wrongly, product yield, money and time will tend to lose. Hence, accurate determination of the nutritional status not only prevents yield losses but also waste of financial resources is avoided and environmental impacts are reduced.

In general, nutrient deficiencies are identified through agricultural laboratories and experienced people (farmers and researchers). The predictions on nutrient deficiencies manually may go wrong due to several factors. The nutrient deficiency in crops can appear in their leaves, stem, flowers, fruits, etc. These nutrients are divided into micronutrients and macronutrients. The deficiency in these nutrients causes many disorders in the crops. This will ultimately affect the yield rate. Generally, the nutrient deficiencies are identified in the leaves of the crop plants by the symptoms such as yellowing of leaves, reduction in leaf size, distorted edges, necrosis, etc. The farmer or the researcher needs to uproot the entire plant and test the defected plant in the corresponding laboratory to identify the appropriate nutrient deficiencies.

Artificial Intelligence

One of the most recent tools for nutrient deficiency detection is by using artificial intelligence technologies. Spectral sensing has become a versatile tool for evaluating nutrient status and determining fertilizer demand. The term "Artificial Intelligence" was coined by American scientist John McCarthy in 1956. Artificial intelligence (AI) is branch of computer science by which intelligent machines are created which can behave like a human, think like humans, and able to make decisions on their own.

According to John McCarthy, "Every aspect of learning or any other feature of intelligence can in principle be so precisely described that a machine can be made to simulate it. The present write-up is an attempt to find how to make machines use language, form abstractions and concepts, solve kinds of problems reserved for humans and improve themselves".

Branches of artificial intelligence

Artificial intelligence refers to the simulation of human intelligence in machines that are programmed to think like humans and mimic their actions. The term may also be applied to any machine that exhibits traits associated with a human mind such as learning and problem solving. Artificial intelligence makes it possible for machines to learn from experience, adjust to new inputs and perform human like tasks. These tasks rely heavily on deep learning algorithms. Using these technologies, computers can be trained to accomplish scientific tasks by processing large amounts of data and recognizing patterns in the data. Artificial intelligence is a broad branch of computer science which mainly can be divided into two branches: symbolic learning and machine learning. Symbolic learning consists of sub-branches like robotics and computer vision and machine learning consists of sub-branch deep learning which can be further divided into artificial neural network (ANN), convolutional neural network (CNN) and recurrent neural network (RNN)
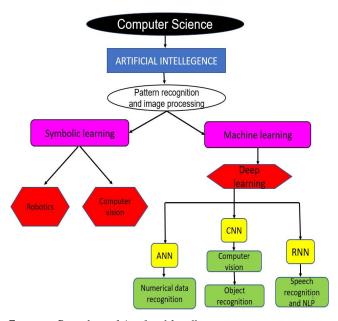

Figure 2: Branches of Artificial Intelligence

which mainly performs the work of numerical data recognition, object recognition and speech recognition and natural language processing respectively.

Drone technology

A drone is a device fitted with sensors, camera and GPS to collect information of the crop. Drones are of great importance as they can aid farmers to deal with their everyday tasks in a more advanced way. It is allowed to fly over the field and detect and track the object of interest by associating a univocal ID to each crop. Pictures of every single crop are taken. The sensors are connected to the transmitter which transmits the information to the receiver i.e., computer. These data are then used to train the deep learning model and later, this model can detect the crops that it has never seen before and generate the image map.

Figure 3: Drone

Computer vision technology

Computer vision is a field of artificial intelligence that trains computers to interpret and understand the visual world i.e., the computer sees the image from camera and deep learning model. As soon as the computer sees the image, it analyses the image and matches with its stored data. With the development of computer and technology progress, computer vision provides a new solution for the research of healthy plant growth.

Machine learning based nutrient deficiency detection in crops

The machine learning usage has grown in recent years to meet the growing demand for fast and accurate methods in monitoring nutrient status. The extracted features from the image are compared with the trained and already available dataset and identified whether it is a healthy or nutrient deficient plant.

Support vector machine algorithm

It is a machine learning algorithm which classifies the images as a point in space and the coordinates of the point are called features. It is a classifier which classifies the raw data into separate classes through feature extraction by generating a hyperplane.

Remote sensing and GIS technology

Remote sensing is the basis of precision agri-horticulture, which aims to use more efficiently the inputs, optimize yield, and minimize environmental impact. The satellite data are collected and subjected to processing techniques which then go for k-means clustering and segmentation into different classes. Then correlation with the laboratory results of the soil samples was studied and the highest correlation will give the signature bandwidth. Based on that signature band, similar types of soils can be studied further on different locations thereby reducing the laborious chemical soil analysis in the laboratory.

Limitations

In many cases farmers and researchers do not have enough knowledge about the machine learning techniques they are applying. As a result, the experiment is not always appropriate, causing many proposed methods to be suboptimal. To avoid this kind of error, someone with experience in machine learning should always be involved in the experiments.

Conclusion

Artificial intelligence is useful in early prediction of nutrient deficiencies. Visual alterations in the plant's colour and morphology can be detected using the appropriate technology. Classification problem can be suitably tackled, as long as the experiments have been adequately designed and the data available is representative enough. But, building a dataset for model calibration and training of all possible classes of symptom is a tedious task, especially in the case of crop nutrient disorders. Overall the artificial intelligence is the game changing tool for the modern agriculture.

SCSI HQ Celebrated "World Soil Day"

World Soil Day is celebrated every year on 5 December with the aim to give importance of healthy soil and to advocate for the sustainable management of soil resources.

"The International Union of Soil Sciences (IUSS), in 2002, adopted a resolution proposing that 5 December be marked as World Soil Day to celebrate the importance of soil as a critical component of the natural system and as a vital contributor to human well-being. The date of 5 December was chosen because it corresponds with the official birthday of the late H.M. King Bhumibol Adulyadej, King of Thailand, who was one of the main proponents of this initiative".

The Food and Agriculture Organization of the UN (FAO) Conference held in June 2013, unanimously endorsed World Soil Day. The 68th UN General Assembly held in December 2013 declared 5 December as the World Soil Day. This year, the UN decided the theme of world soil day is "Soils: Where food begins" which aims to raise awareness of the importance of maintaining healthy ecosystems and human well-being by addressing the growing challenges in soil management, increasing soil awareness and encouraging societies to improve soil health.

Soil nutrient loss is a major soil degradation process threatening nutrition and is recognized as being among the most important problems at a global level for food security and sustainability all around the globe. Keeping the importance of the world soil day, the Soil Conservation Society of India (SCSI) and International Soil Conservation Organization (ISCO) celebrated word soil day on 5th December 2022 under the able guidance of Dr. Suraj Bhan, President, Soil Conservation Society of India (SCSI) & President, International Soil Conservation Organization (ISCO) by organising a panel discussion followed by a tree plantation at NASC Complex at Soil Conservation Society of India, National Societies Block G-4/A, National Agricultural Science Centre Complex, Dev Prakash Shastri Marg, Pusa, New Delhi–110 012.

The session was chaired by the Senior Vice President, Soil Conservation Society of India. Dr. T.B.S. Rajput. Dr. Rajput welcomed the members present and described the importance of the world soil day. He has also mentioned the importance of soil along with other natural resources for nutritional security.

Er. Bisweswar Rath, Technical Expert (WM) National Rainfed Area Authority (NRAA), New Delhi talked about the need and importance of soil conservation in the present-day scenario.

Dr. Mukesh Kumar, Treasurer, SCSI described the importance of soil health particularly for agricultural and nutritional security. Two scientists from Indian Agricultural Research Institute (IARI), New Delhi, Dr. R.N. Garg (SCSI Member), Sh. O.P. Choudhary, Councillor, SCSI and all staff of SCSI participated in the panel discussion. After discussion, all the members have planted a tree in the park, National Agricultural Science Centre (NASC) Complex, Pusa Campus, New Delhi.

The programme was ended with the vote of thanks.

The celebration programme of World Soil Day 2022 at Society Office was organised by Dr. Mukesh Kumar, Treasurer, SCSI.
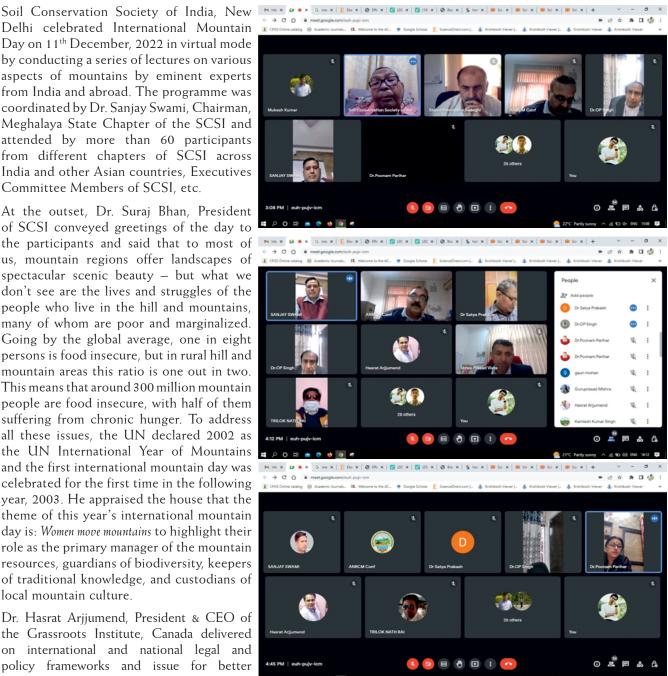
SCSI HQ Celebrated "International Mountain Day"

Soil Conservation Society of India, New Delhi celebrated International Mountain Day on 11th December, 2022 in virtual mode by conducting a series of lectures on various aspects of mountains by eminent experts from India and abroad. The programme was coordinated by Dr. Sanjay Swami, Chairman, Meghalaya State Chapter of the SCSI and attended by more than 60 participants from different chapters of SCSI across India and other Asian countries, Executives Committee Members of SCSI, etc.

At the outset, Dr. Suraj Bhan, President of SCSI conveyed greetings of the day to the participants and said that to most of us, mountain regions offer landscapes of spectacular scenic beauty – but what we don't see are the lives and struggles of the people who live in the hill and mountains, many of whom are poor and marginalized. Going by the global average, one in eight persons is food insecure, but in rural hill and mountain areas this ratio is one out in two. This means that around 300 million mountain people are food insecure, with half of them suffering from chronic hunger. To address all these issues, the UN declared 2002 as the UN International Year of Mountains and the first international mountain day was celebrated for the first time in the following year, 2003. He appraised the house that the theme of this year's international mountain day is: *Women move mountains* to highlight their role as the primary manager of the mountain resources, guardians of biodiversity, keepers of traditional knowledge, and custodians of local mountain culture.

Dr. Hasrat Arjjumend, President & CEO of the Grassroots Institute, Canada delivered on international and national legal and policy frameworks and issue for better

developments of the mountain regions, whereas Dr. Sanjay Arora, Principal Scientist, ICAR-CSSRI, Regional Centre, Lucknow spoke comprehensively on various soil and water conservation technologies suitable for foothills to increase crop production. Thereafter, Dr. Poonam Parihar, Associate Professor, SKUAST-Jammu highlighted the women's contribution in sustaining the hill ecosystem. She emphasized that indigenous women have a special relationship to natural resources. Their cultures and practices promote a balanced, respectful use and preservation of mountain resources so that future generations can meet their needs. However, they are unable to exercise their full potential in natural resource and environmental management due to discrimination, given their lack of training, status, land and property rights and capital. There is an urgent need to address all these issues.

Dr. O.P. Singh from Mizoram dwelled upon various general challenges and opportunities in mountain agriculture across the globe, while Dr. S.P. Vista, Senior Scientist, Nepal Agricultural Research Council, Kathmandu highlighted on managing agricultural sustainability in high hill of Hindu Kush Himalayas through latest soil and water conservation technologies like snow harvesting and utilization. In the last lectures, Dr. Devendra Kumar, Scientist D & Head, NERC, GBP NIHE, Itanagar delivered an expert lecture on assessing the lichen diversity in relation to changing climate in Indian Himalayas.

There was an interaction session after completion of lectures wherein many participants raised their queries and concerns on different issues which were responded by the concerned experts. The programme ended with the vote of thanks proposed by Dr. Sanjay Swami, Coordinator of the event.

"World Soil Day" Celebrated by Meghalaya State Chapter

Meghalaya Chapter of the Soil Conservation Society of India celebrated World Soil Day on 5th December, 2022 with the farmer friends at Umkali village of Nongpoh in Ri-Bhoi district of Meghalaya. More than 100 farmers participated in this mega event.

Dr. Sanjay Swami, Professor (Soil Science) and Chairman of the SCSI-Meghalaya Chapter while welcoming the farmers said that about 95% of the food is directly or indirectly produced on our soils, which have a natural capacity to support plants by providing them with nutrients through the soil solution. Healthy soils are crucial to our basic survival as well as our planet's sustainable future. On World Soil Day 2022 under the theme "Soils, Where Food Begins", the United Nations not only reminds us to raise awareness of the importance of healthy soils, but also to engage

citizens around the world to stand up for soils. Farmers can be agents of change if they adopt good practices. However, they cannot be charged with this task alone, as there should be provision of incentives and an enabling environment for this to happen. We need to support farmers to adopt sustainable soil management practices that are adapted to the

country and are the result of a combination of scientific and local knowledge. This will restore the balance and harmony of our soils.

Dr. N.J. Singh, Assistant Professor (Soil Science) and Secretary of the SCSI-Meghalaya Chapter addressed the gathering emphasizing on acidic soils and their management. He highlighted that our soils are in danger, mostly because of human activities. One third of global soils are already degraded, and the trend is rising because of 10 threats: soil erosion by wind, water and tillage, loss of soil organic carbon, nutrient mismanagement, salinization and sodification, soil pollution, compaction, acidification, loss of soil biodiversity, and soil sealing and water logging. The severity of the threats differs across regions.

Dr. A K Singh, Assistant Professor (Agronomy) correlated the healthy soil with crop production and informed the farmers about the importance of doing production based on crop calendar and soil health card. He further added that investing in healthy soils brings many benefits, including these climate-related ones. It will increase productivity, healthier food production, water storage and biodiversity conservation, making agri-food systems more sustainable and resilient.

Ms. Ventina Yumnum and Mr. Shubham Singh, members of the SCSI Meghalaya Chapter demonstrated the scientific method of collecting representative soil sample on farmer's field so that farmers can collect right soil sample and get tested from the soil testing laboratories. On this occasion, vermicompost packets were also distributed to nearly 100 farmers. The village headman appreciated the SCSI team for such a wonderful event and requested to distribute soil health cards to the farmers for better soil fertility management. The vote of thanks was proposed by Dr. N.J. Singh, Secretary of the SCSI-Meghalaya Chapter.

World Soil Day
5th December 2022
One Day Seminar on Soils, Where Food Begins

SCSI, Jammu Chapter associated with the Division of Soil Science and Agricultural Chemistry, SKUAST Jammu to celebrate the World Soil Day, 2022 December 5th 2022. A one day Seminar on Soils, Where Food Begins was held at SKUAST Jammu. The event was sponsored by the Jammu and Kashmir Science, Technology and Innovation Council and ANRCM. The event consisted of four sessions. Prof J. P. Sharma, ViZZce Chancellor, SKUAST-J was the Chief Guest during the function. He emphasized to protect the soils from further deterioration and to make all efforts for their preservation and good health. Prof. Sharma while deliberating on the theme stressed upon the scientists and students to raise awareness about the importance of the soil among the common masses. Prof. Sharma while quoting from ancient Indian literature said that soil is considered as living entity in our tradition. He stressed upon the scientist to develop climate smart modules which can enhance fertilizer and water use efficiency. Prof. Sharma was of the opinion that farmers' should be made aware about the interpretation of the soil health cards so that they can get maximum out of this scheme. The formal welcome address and 'about the programme' was presented by Prof. Vikas Sharma, HOD Soil Science and Convener of the Programme, who highlighted the importance of the soils and the works and projects being carried out by Soils' division. Other guests included Dr. Pradeep Wali, Director Research; Dr. S.K. Gupta, Registrar; Dr. B C Sharma, Dean FoA & Coordinator IDP; Dr. Sushil Sharma, Dean FoAE; & other senior faculty members apart from a large number of students and faculty from divisions involved in management of natural resources. JKSTIC was represented

by Ms. Sunita Razdan, Joint Director (JKSTIC) and Mr. Sanjay Kharoo, Joint Director (JKSTIC).

Soil scientists from reputed institutes were invited to present their work and share their experiences with students and faculty members during this session. The expert lectures were given by Dr. Narender Kumar Sankhyan, Head of the Department, Soil Science, CSK Himachal Pradesh Krishi Vishavvidyalaya, Palampur, HP; Dr. Pardeep Kumar, Principal Scientist Incharge of All India Coordinated Research Project on Micronutrients, Department of Soil Science, CSK Himachal Pradesh Krishi Vishavvidyalaya, Palampur, HP and Dr. Sanjay Arora, Principal Scientist, ICAR-CSSRI (Indian Council of Agricultural Research – Central Soil Salinity Research Institute), Lucknow, UP. Dr. Sankhyan spoke about balanced plant nutrition through balanced fertilization maintaining both soil and plant quality. He stressed

Experts speaking on the occasion of world soil Day 2022

biological properties in drylands of India, Ms Sugandha Khajuria discussed impact of the rice based high intensity cropping systems on soil carbon and quality, Mr Altaf advocated the usage of mulching on productivity of nectarine (*Prunus persica L Batsch var nucipersica*) cv Snow Queen, Ms Tamanna Sharma presented the effect of high intensity cropping on soil nitrogen pools. Besides these presentations were also made on soil characterization and soil erosion, advancement in soil technology, effect of integrated nutrient management on soil properties and Spatial Variability of Heavy Metal Concentration in soils. The presentations were adjudged first, second and third based on the evaluation by Chairpersons.

that this approach is essential for sustained agriculture production. The importance of micronutrients was highlighted by Dr. Pardeep Kumar. A healthy soil should have optimal amount of micronutrients. Soil degradation is a cause for concern. Microbes can play an important role in improving soil health. Dr. Sanjay Arora spoke in length about the usage of microbes in improving soil health and efficient cycling of nutrients.

There were eleven oral presentations made in the technical session II covering different aspects of soil health management and remediation by the students. Before the oral presentations by students, a lead expert lecture was delivered by Dr. Vivak M. Arya, Associate Professor, Soil Science at SKUAST Jammu on the soil health and its management in Jammu and Kashmir. Dr. Arya deliberated at length on the remediations for improving soil health in the region. Ms Shruti Kumari suggested to use Nanocomposites for the remediation of arsenic contamination soils, Ms Divya Chadha discussed the remediation of salt affected soils through microbial formulations, Ms Tanjot presented the influence of tillage practices in mustard based cropping system on soil

The third technical session dealt with scientific poster presentations mainly by the students on various aspects of soils and their management. The presentations covered topics like effect of foliar application of Nano urea on growth and productivity of fine rice; soil microbiota: The key player for conservation of soil health under changing climate; Organic Farming- The gateway to Sustainable Agriculture; Soil erosion - Effects and control measures; Land Degradation and Soil Erosion Control; Rejuvenation of Village Ponds; Biochar – Climate Change Solution; Refinement of Soil Quality Index in Rainfed Orchards; Effect of climate change on soils; Impact of Organic Matter on Soil Permittivity; salt affected soils and reclamation of sodic soil with polyhalite. Students presented their works during this session and interacted with faculty and other students on their topics. Overall 12 posters was presented in this session. Their posters were also evaluated by judges for their merit and quality of work.

Successful work completion of MEL&D project of IWMP Assam by Soil Conservation society of India (SCSI), New Delhi

The Soil Conservation society of India (SCSI) was awarded the project on Monitoring, Evaluation, Learning and Documentation (MEL&D) of Integrated Watershed Management Programme (IWMP) 1st Batch (2009-10), 2nd Batch (2010-11), 3rd Batch (2011-12) and 4th Batch (2012-13) of the state of Assam for its two administrative divisions, namely Cachar (3 Districts) and Haflong & Maibang (1 District) comprising the districts of Cachar, Karimganj, Hailakandi & Dima Hasao by State Level Nodal

Agency (SLNA, WDC-PMKSY), Department of Soil Conservation, Govt. of Assam on 06th January 2015.

With the cooperation and help of all the members of the society and Executive Council members of SCSI especially Secretary General and joint Secretary of SCSI along with all the staff of the Soil Conservation Society of India, the tasks of the study were carried out professionally and completed successfully. The SLNA, Assam issued an appreciation letter to the SCSI for their entire satisfaction.