

**SEALNET-II/18/Report**



**Food and Agriculture  
Organization of the  
United Nations**



# **Report of the Second meeting of the South-East Asia Laboratory Network (SEALNET)**

Bhopal, India, 19-23 November 2018

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LABORATORY NETWORK (SEALNET)**

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FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

Rome, 2018

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## Introduction

The second meeting of the Regional Soil Laboratory Network for Asia, the so called South-East Asia Laboratory Network (SEALNET), was organized in Bhopal, India on 19-23 November 2018. The meeting was co-organized by the Global Soil Partnership (GSP) and the Indian Council of Agricultural Research, Indian Institute of Soil Science (ICAR-IISS), and it was attended by 36 participants from 17 countries. The full list of participants in the meeting is available in Annex I.

The meeting aimed to (1) review the work performed by national reference laboratories in SEALNET since the launch of the network, (2) endorse the SOPs developed in 2018 as well as the guidelines for implementing and maintaining good laboratory practices and quality management in soil laboratories, and (3) agree on the work plan for the year 2019.

The meeting lasted five full days (see the agenda in Annex II) and consisted of presentations to introduce topics for discussion including internal quality control, ring test results evaluation and interpretation, standard operating procedures review and endorsement, and the position of SEALNET in GLOSOLAN. Ultimately, the work plan of SEALNET for the year 2019 was defined. To note that the first day of the meeting was dedicated to the Indian National Network; the government soil health card scheme, infrastructure and achievements was presented as well as soil parameters, analysis protocols, interpretation, and fertilizer recommendations. Ultimately, Indian experts presented on soil and plant potassium management, and infrared spectroscopy and its potential for estimating soil properties. The minutes of the Indian National Network session were prepared by ICAR-IISS and are available in Annex III.

## Internal quality control

Each lab manager was asked to report on the use of an *internal quality control system*, a set of rules to detect analytical errors within a lab, which can influence the precision and accuracy of a measurement. Special attention was posed to the presence of written rules, the frequency of the assessment (how often do you use your internal quality control system?), the characteristics of the material used for quality control, and the soil parameters assessed using the control material. The frequency by which the control material is analyzed itself was inquired.

Additional information were collected on the use of databases and quality charts for reporting control material results, and the way specific statistical limits for the acceptance or rejection of the results were determine. In case the quality control procedure indicates a failure (results out of the statistical limits), the procedure used by the responding laboratory to address this issue was explained. To conclude, the qualification of the lab staff to run the internal quality control was enquired. Questions ranged from the presence or absence of a quality control officer to its qualification: did he/she receive any special training on internal quality control? If yes, which one? Are these trainings provided on a regular basis (frequency and duration)?

Country profiles on internal quality control are summarized in Annex IV.

## Ring test

### Evaluation of the ring test results 2018

During the first SEALNET meeting in November 2017, it was decided to launch a regional ring test among National Reference Laboratories. Thus, the Land Development Department of Thailand provided a set of

14 bags containing approximately 30 g of soil each to 16 participating countries. Due to the impossibility to ship soil samples to China, this country was excluded from the ring test. Samples were prepared with the financial support of IRD France and shipped by the Global Soil Partnership, FAO. Ultimately, samples were analyzed for those same parameters SEALNET committed to develop regionally harmonized Standard Operational Procedures (SOPs): pH (in soil water ratio 1:2.5), organic carbon (OC) (Walkley and Black), available phosphorus (Olsen method) and exchangeable potassium (Ammonium Acetate method)

Each laboratory submitted its ring test results to the GSP Secretariat, who anonymized them before sharing them with Mr. Christian Hartmann (IRD France) and Ms. Nopmanee Suvannang (GLOSOLAN Chair) for analysis. In this regard, ring test data were treated according to the GSP Soil Data policy and were not made public. The statistical evaluation consisted of calculating the *z score* for each parameter, soil sample and laboratory, and in making a comparison between the consensus values and the variability in SEALNET. Information on the soil samples used and the homogeneity test are in the ring test evaluation report.

The participation of countries in the ring test is summarized in Table 1.

<b>Soil parameter discussed during the 1<sup>st</sup> SEALNET meeting</b>	<b>No. of labs that agreed to join the regional ring test</b>	<b>No. of labs that submitted the ring test results</b>
pH water 1:2.5	18	16
Organic carbon (W&B)	18	16
Carbon (combustion)	No commitment during the meeting	
Exchangeable K (NH <sub>4</sub> OAc pH 7.0)	18	16
Available P (OLSEN)	18	16
Available P (BRAY I)	No commitment during the meeting	
Available P (BRAY II)	No commitment during the meeting	

*Table 1. Countries' participation in the ring test. General remarks: (i) no samples could be delivered to China due to import regulations and (ii) Mongolia did not send the results*

Overall, most of the laboratories submitted precise and overall comparable results. Because outliers were largely distant from the consensus value, errors in the measurement were considered easy to identify and solve. A large variability of the data results was observed for organic carbon and exchangeable potassium. While the variability in the measurement for the soil organic carbon content could be related to the method used for the analysis and a misunderstanding between “organic carbon” and “organic matter”, the causes of the variability in the measurement for exchangeable potassium should be investigated.

### Ring test 2019

Countries agreed to run another ring test on pH water, organic carbon (OC), available phosphorus and exchangeable potassium in 2019. However, in 2019, the ring test will be executed putting into practice the SOPs developed by SEALNET for these soil parameters. Countries that could prepare the reference material for the second SEALNET ring test are:

- Thailand and China after confirming their internal possibility to provide samples;

- Mongolia, a training on how to collect the soil and prepare the samples is needed;
- the Philippines that committed to prepare the samples for the ring test in 2020.

A decision on the provider of the reference samples for the ring test in 2019 will be made after hearing back from Thailand and China.

## Interpretation of data results

In order to open the path for SEALNET (and GLOSOLAN) to work on the interpretation of lab data results, each laboratory was asked to provide information on their rating scale for pH in water, organic carbon (OC), available phosphorus and exchangeable potassium. Laboratories will send these information to the GSP Secretariat at their earlier convenience.

## Standard Operating Procedures (SOPs)

The Standard Operating Procedures (SOPs) for pH in water, organic carbon (OC), available phosphorus and exchangeable potassium, as developed by the SEALNET working group, were revised and endorsed by the participants in the meeting. However, a final review of the SOPs will be done before their publishing. The GSP Secretariat will ensure that the SOPs are English proof read before publishing. The SEALNET SOPs for pH in water, organic carbon (OC), available phosphorus and exchangeable potassium are available on the SEALNET webpage.

Ultimately, SEALNET made a proposal for the regional SOPs to develop in 2019 but agreed to wait for GLOSOLAN to decide how to harmonize regional activities at the global level.

If left to decide alone, in 2019, SEALNET will work on the development of the SOPs for Cation Exchange Capacity (CEC), Electrical Conductivity (EC), available phosphorous using the Bray I and Bray II methods, and the soil moisture content. Leading authors for the writing of these SOPs will be:

- Ms. Su Su Win for the Cation Exchange Capacity (CEC)
- Ms. Gina Nilo for the Electrical Conductivity (EC)
- Ms. Gina Nilo for available phosphorous using the Bray I and Bray II methods
- Mr. Jamyang for the soil moisture content

Acknowledging the importance of harmonizing basic soil parameters at first, SEALNET decided that the following should be kept into consideration when prioritizing the SOPs to develop: the results of the First GLOSOLAN survey, international pressing needs (e.g. maps development), and GSP Pillars 4 and 5 needs (e.g. soil classification and the establishment of the Global Soil Information System -GLOSIS). After 2019, SEALNET committed to follow the GLOSOLAN work plan and advised to work on the SOPs for soil micro- and macronutrients, biology, texture and others.

In conclusion, SEALNET suggested Pillar 4 and other working groups in Pillar 5 to work on the harmonization of the sampling method and the soil sample preparation, which are critical to the lab analysis.

## SEALNET position in GLOSOLAN

In order to support Ms. Gina Nilo in representing SEALNET at the 2nd GLOSOLAN meeting (28-30 November 2018, FAO HQ), the position of SEALNET in GLOSOLAN was enquired.

- Opinion of SEALNET on the **objectives of GLOSOLAN**:

GLOSOLAN should aim to (1) strengthen the performance of laboratories towards the development of standards, (2) harmonize soil analyses in order to make soil information across laboratories, countries and regions comparable and interpretable, and (3) provide a certification for technical competencies and laboratory's analysis.

The **overarching goal of GLOSOLAN** is that of improving the quality of soil laboratory data in order to support decision making at the field level to eradicate hunger (link to food security and nutrition) and to ensure environmental quality. This would create a concrete connection between GLOSOLAN and the other GSP Pillars. As an **outcome**, already degraded land and land threaten by soil degradation processes (e.g. salinity, contamination, acidification, erosion, fertility decline, etc.) or climate change (link to soil organic carbon sequestration and release) can be monitored and assessed for specific soil parameters using harmonized methods.

- Opinion of SEALNET on the **expected impacts of GLOSOLAN:**

GLOSOLAN will (i) support decision making either in the field or at the policy level, (ii) assist reporting on the SDG and other international commitments, (iii) contribute to international standard formulation, (iv) contribute and support the establishment of the Global Soil Information System (GLOSIS), (v) contribute to the development of indicators, and (vi) develop harmonized methods for the assessment and monitoring of degraded lands and/or affected by climate change.

- Opinion of SEALNET on the **indicators for the assessment of GLOSOLAN performance/success:**

- Number of labs joining GLOSOLAN
- Number of countries joining GLOSOLAN
- Number of SOPs produced
- Number of labs participating in the ring test
- Number of labs providing reference material
- Number of labs that get accredited/certified/pass the ring test
- Number of labs implementing good laboratory practices
- Number of national soil laboratory networks established
- Number of training programmes conducted at the national and international level and number of staff capacitated
- Number of labs' facilities and equipment upgraded/enhanced to assess agreed basic soil parameters within GLOSOLAN

- Opinion of SEALNET on the development of **Standard Operating Procedures (SOPs)**, including the potential contribution of the **International Standard Organization (ISO)** to GLOSOLAN:

It was the opinion of SEALNET that the prioritization of the SOPs to develop should be made keeping into consideration:

- Basic soil parameters should be harmonized at first;
- the results of the First GLOSOLAN survey;

- international pressing needs (e.g. maps development); and
- GSP Pillars 4 and 5 needs (e.g. soil classification and the establishment of the Global Soil Information System -GLOSIS).

In this context, SEALNET advised GLOSOLAN to make its decisions using a holistic approach that takes all these criteria for selection into consideration.

SEALNET left to GLOSOLAN the decision on how SOPs developed by different regions should be harmonized at the global level, and advised GLOSOLAN to make a decision on a potential collaboration with ISO keeping into consideration the issues of accreditation and certification of GLOSOLAN laboratories. In this regard, if GLOSOLAN will not collaborate with ISO, then GLOSOLAN should consider providing its own certification or develop its own accreditation system.

Ultimately, SEALNET advised GLOSOLAN to develop a format for SOP reporting and publishing.

- Opinion of SEALNET on the harmonizing **new technologies like spectroscopy** (MIR and NIR):

SEALNET left to GLOSOLAN the decision on how to work with new technologies keeping into consideration that these are mostly used in China for research purposes only and that MIR or NIR is under calibration in India, Myanmar, Thailand and the Philippines.

- Opinion of SEALNET on how GLOSOLAN should work on **harmonization**:

SEALNET remitted to GLOSOLAN the decision on how to work on harmonization.

- Opinion of SEALNET on the writing of the **Best Practice Manual**:

In order to avoid replications, SEALNET agreed to put on hold the writing of the *Guidelines for implementing and maintaining good laboratory practices and quality management in soil laboratories* so for GLOSOLAN to consider the possibility to integrate it in its *Best Practice Manual*.

- Opinion of SEALNET on the execution of **ring tests** in GLOSOLAN, including the potential contribution of **WEPAL** to GLOSOLAN:

Building on the results of the first SEALNET ring test, it is the opinion of SEALNET that Asian laboratories have the capability to organize and run their own regional ring tests. In this regard, they agreed to involve WEPAL in SEALNET and GLOSOLAN as a reference samples provider only.

## Venue and time of the next meeting

A decision was made to organize the Third SEALNET meeting in Manila, Philippines at the end of October/beginning of November 2019. The final date of the meeting will be confirmed in the first quarter of 2019 by Ms. Gina Nilo and the GSP Secretariat. A note was made of the importance of organizing the meeting some weeks before the 3th GLOSOLAN meeting.

## Other

Dr. Liping Yang and Dr. Wang Hong from CAAS, China, expressed their interest in joining the SEALNET working group.

## Annex I. List of participants

### Opening:

Dr. Ashok Patra, Director ICAR-IISS

Mr. Tomio Shichiri, FAO Representative for India

Mr. Jamyang, SEALNET Chair, Soil & Plant Analytical Laboratory (SPAL), NSSC, Department of Agriculture, MoAF, Kingdom of Bhutan

Ms. Lucrezia Caon, GSP Secretariat, FAO HQ

Dr. S.K. Chaudhari, Assistant Director General, Natural Resource Management, Indian Council of Agricultural Research, New Delhi

Dr. Sanjay Srivastava, Principal Scientist, Division of Soil Chem. & Fertil., ICAR-IISS

### Technical moderators:

Ms. Nopmanee Suvannang, GLOSOLAN Chair

Dr. Christian Hartmann, IRD, France

### Official participants

Dr. Begom Samia Sultana, Central Laboratory, Soil Resource Development Institute, Bangladesh

Dr. Jamyang, Soil and Plant analytical Laboratory, Bhutan

Mr. Sun Sarak, National Agriculture Laboratory, Cambodia

Dr. Liping Yang, CAAS, China

Dr. Wang Hong, CAAS, China

Dr. Ashok Kumar Patra, ICAR-Indian Institute of Soil Science, Bhopal, India

Ms. Lenita Herawati, Laboratory Manager, Indonesian Soil Research Institute, Indonesia

Dr. Linca Anggria, Technical Manager, Indonesian Soil Research Institute, Indonesia

Dr. Yasuhito Shirato, NARO, Japan

Dr. Yuji Maejima, NARO, Japan

Mr. Xaysatith Souliyavongsa, Soil Analysis Unit, Agriculture Land Use Planning Centre, LAO PDR

Mr. Muhammad Izzat Bin Ilmin, Analytical Service Section, Soil Management and Conservation Division, Malaysia

Ms. Bazarradnaa Enkhtuya, Soil, agro-chemistry laboratory, Mongolia

Ms. Su Su Win, Soil and plant analysis laboratory, Myanmar

Dr. Janardan Khadka, Soil Management Directorate, Nepal

Dr. Gina P. Nilo, Bureau of Soils And Water Management Laboratory Services Division, Philippines

Mr. Bergil G. Bernaldo, Bureau of Soils And Water Management Laboratory Services Division, Philippines

Dr. N. R. N. Silva, Horticultural Research and Development Centre, Departementof Agriculture  
Gannoruwa, Peradeniya, Sri Lanka

Ms. Chanida Charanworapan, Land Development Departement, Thailand

Mr. Do Duy Phai, Soils and Fertilizers Research Institute, Vietnam

#### Local participants

A. K. Vishwakarma, ICAR-IISS

Monoranjan Mohanty, ICAR-IISS

Asit Mandal, ICAR-IISS

Hiranmoy Das, ICAR-IISS

Sanjay Srivastava, ICAR-IISS

A. K. Biswas, ICAR-IISS

J. Somasundaram, ICAR-IISS

Pramod Jha, ICAR-IISS

Vassanda Coumar, ICAR-IISS

Shinogi K. C., ICAR-IISS

Priya Gurav, ICAR-IISS

R. Elanchezhian, ICAR-IISS

K. M. Hati, ICAR-IISS

## Annex II: Agenda

Monday, 19 November 2018	
9.30 – 10:00	<b>Registration</b>
10:00 – 11:00	<p><b>Item 1. Opening</b></p> <p>Dr. Ashok K. Patra, Director of ICAR-IISS on behalf of the organizing committee</p> <p>Mr. Tomio Shichiri, FAO representative in India</p> <p>Mr. Jamyang, SEALNET Chair, Soil &amp; Plant Analytical Laboratory (SPAL), NSSC, Department of Agriculture, MoAF, Kingdom of Bhutan</p> <p>Ms. Lucrezia Caon, GSP Secretariat, FAO HQ</p> <p>Dr. S. K. Chaudhari, Assistant Director General, Natural Resource Management, Indian Council of Agricultural Research</p> <p>Dr. Sanjay Srivastava, Principal Scientist, Division of Soil Chem. &amp; Fertil., ICAR-IISS</p>
11:00 – 11:10	<b>Group picture</b>
11:10 - 11:40	<b>Tea/Coffee break</b>
11:40 - 12:10	<p><b>Item 2. Endorsement of the agenda and review of the work performed since the first SEALNET meeting</b></p> <p>Ms. Lucrezia Caon, FAO</p>
<b>Session 1: Indian National Network</b>	
12:10 – 13:00	<p><b>Item 3. Indian Government Soil Health Card Sceme: Protocols for sampling and analysis; interpretation of results and farmers' field level impact</b></p> <p><b>Chairman:</b> Dr. S. K Chaudhari, ICAR, New Delhi</p> <p><b>Rapporteur:</b> Dr. A. K. Biswas, ICAR-IISS, Bhopal and Dr. R. S. Chaudhary, ICAR-IISS, Bhopal</p> <p>Government soil health card scheme, Dr. S. K. Chaudhari, ADG (SW&amp;M), NRM, ICAR, New Delhi, India</p>

	<p>Soil health card infrastructure and achievements in the state of Madhya Pradesh, India, Dr. M L Meena/Mr. B M Sahare, Director of Agriculture, Government of madhya Pradesh, India</p> <p>Soil parameters, analysis protocols, interpretation, and fertilizer recommendations, Drs. Sanjay Srivastava and Pradip Dey, ICAR-IISS, Bhopal, India</p>
13:00 – 14:00	<b>Lunch break</b>
14:00 – 15:30	<p><b>Item 3. Indian Government Soil Health Card Sceme: Protocols for sampling and analysis; interpretation of results and farmers' field level impact [continuation]</b></p> <p>Potassium in soil and plant: analytical and management issues: T Satyanarayana, PhD Director, South Asia Program, International Plant Nutrition Institute (IPNI)</p> <p>Infrared Spectroscopy and its potential for estimation of soil properties: Dr. K M Hati, Principal Scientist, ICAR-IISS, Bhopal, India</p> <p>Experience sharing: Discussion and reflection by foreign delegates on convergence and divergence on soil testing procedures</p>
15:30 – 16.00	<b>Tea/Coffee break</b>
15:00 - 17:00	<p><b>Item 3. Indian Government Soil Health Card Sceme: Protocols for sampling and analysis; interpretation of results and farmers' field level impact [continuation]</b></p> <p>Demonstration/discussion:</p> <ul style="list-style-type: none"> <li>• Mini lab</li> <li>• MIR/NIR</li> <li>• Soil test kit</li> </ul>
<b>Tuesday, 20 November 2018</b>	
<b>Session 2: National profiles</b>	
<b>Moderator: Lucrezia Caon, FAO</b>	
9:00 – 10:30	<p><b>Item 4. Countries' presentation on internal quality control (10 minutes per country)</b></p> <p><b>Ms. Begom Samia Sultana</b>, Central Laboratory, Soil Resource Development Institute, Bangladesh</p> <p><b>Mr. Jamyang</b>, Soil Plant Analytical Laboratory, Bhutan</p> <p><b>Mr. Sun Sarak</b>, National Agriculture Laboratory, Cambodia</p>

	<p><b>Ms. Liping Yang and Mr. Wang Hong</b> China National Center for Quality Supervision and Test of Chemical Fertilizers(Beijing)</p> <p><b>Mr. Ashok Kumar Patra</b>, ICAR – Indian Institute of Soil Science, India</p> <p><b>Ms. Lenita Herawaty and Ms. Linca Anggria</b>, Laboratorium Pengujian, Balittanah, Soil Test Laboratory, Indonesian Soil Research Institute, Indonesia</p> <p><b>Mr. Yasuhito Shirato</b>, National Agriculture and Food Research Organization, Japan and <b>Mr. Yuji Maejima</b>, Institute for Agro-Environmental Sciences, NARO (NIAES)</p> <p><b>Mr. Xaysatith Souliyavongsa</b>, Soil Analysis Unit, Department of Agricultural Land Management, Lao DPR</p> <p><b>Mr Muhammad Izzat Bin Ilmin</b>, Lab Division, Department of Agriculture, Malaysia</p>
10:30 - 11:00	<b>Coffee break</b>
11:00 - 13:00	<p><b>Item 4. Countries' presentation on internal quality control (10 minutes per country) continuation</b></p> <p><b>Ms. Bazarradnaa Enkhtuya</b>, Soil, agro-chemistry laboratory of Institute of Plant and Agricultural Sciences, Mongolia</p> <p><b>Ms. Su Su Win</b>, Soil and Plant Analysis Laboratory, Department of Agricultural Research, Myanmar</p> <p><b>Mr. Janardan Khadka</b>, Soil Management Directorate, Nepal</p> <p><b>Ms. Gina P. Nilo</b>, Bureau of Soils and Water Management Laboratory Services Division, Philippines</p> <p><b>Ms. N. R. N. Silva</b>, Horticultural Research and Development Centre, Sri Lanka</p> <p><b>Ms. Chanida Charanworapan</b>, Office of Science for Land Development, Land Development Department, Thailand</p> <p><b>Mr. Phai Đổ Duy</b>, Central Analytical Laboratory - Soils and Fertilizers Research Institute, Vietnam</p>
13:00 – 14:00	<b>Lunch</b>
<b>Session 3: Ring test analysis</b>	
14:00 – 16:00	<b>Item 5. Evaluation of the ring test results</b>

	Mr. Christian Hartmann, IRD, and Ms. Nopmanee Suvannang, LDD
16:00 - 16:30	<b>Coffee break</b>
16:30 – 17:30	<b>Item 6. Interpretation of data results</b>  Moderator: Mr. Christian Hartmann, IRD, and Ms. Nopmanee Suvannang, LDD
<b>Wednesday, 21 November 2018</b>	
<b>Session 4: Standardization and harmonization</b> Moderator: Ms. Lucrezia Caon, FAO, and Ms. Nopmanee Suvannang, LDD	
9:00 – 11:00	<b>Item 7. Standard Operating Procedures (SOPs)</b>  - Review and endorsement of the SOPs for pH, OC, available phosphorous, exchangeable potassium and CEC  Mr. Ashok Patra Ms. Gina P. Nilo Ms. Su Su Win  Moderator: Ms. Lucrezia Caon, FAO, and Ms. Nopmanee Suvannang, LDD
11:00 - 11:30	<b>Coffee break</b>
11:30 – 13:00	<b>Item 8. Standard Operating Procedures (SOPs) (continuation)</b>
13:00 – 14:00	<b>Lunch</b>
14:00 – 16:00	<b>Item 9. Standard Operating Procedures (SOPs) (continuation)</b>
16:00 – 16:30	<b>Coffee break</b>
16:30 – 17:30	<b>Item 10. Decision on the SOPs to develop in 2018-2019</b>  Mr. Christian Hartmann, IRD, and Ms. Nopmanee Suvannang, LDD
<b>Thursday, 22 November 2018</b>	
<b>FIELD TRIP</b>	

<b>Evening: Cultural Programme</b>	
Friday, 23 November 2018	
<b>Session 4 Standardization and harmonization (continued)</b>	
<b>Moderator: Lucrezia Caon, FAO</b>	
9:00 – 11:00	<p><b>Item 11. Guidelines for implementing and maintaining good laboratory practices and quality management in soil laboratories</b></p> <ul style="list-style-type: none"> <li>- Review and endorsement of the document</li> </ul> <p>Mr. Christian Hartmann, IRD</p>
11:00 – 11:30	<b>Coffee break</b>
11:30 – 13:00	<p><b>Item 12. Global Soil Laboratory Network (GLOSOLAN)</b></p> <p><b>Moderator:</b> Ms. Nopmanee Suvannang, GLOSOLAN Chairperson, and Ms. Lucrezia Caon, FAO</p>
13:00 – 14:00	<b>Lunch</b>
14:00 – 15:00	<p><b>Item 13. Conclusions and way forward</b></p> <ul style="list-style-type: none"> <li>- Review of the SEALNET roadmap in 2018-2019 (planning, timing and roles)</li> <li>- Topics to bring to the attention of GLOSOLAN</li> </ul> <p><b>Moderator:</b> Lucrezia Caon, FAO</p>
15:00 – 15:30	<b>Item 14. Time and venue of the next meeting</b>

## Annex III: minutes on the Indian National Network by ICAR-IISS

The session started under the chairmanship of Dr. S. K Chaudhary ADG (ISWN) ICAR. The first presentation was made by the chairman himself on “Soil Health Card Scheme of Govt. of India- Procedure for sampling and analysis”. He apprised of the major issues which India is facing in soil health management which are similar to South East Asea in general. They comprise of soil erosion, soil and nutrient loss, soil erosion, soil salinity and soil acidity. This is resulting in crop loss of 13.4 mt by water erosion, 5.66 mt by soil salinity, 11.18 mt by soil alkalinity and 6.85 mt by wind erosion. Other issues included low SOC (< 0.5 %) , multi nutrient deficiency, low nutrient use efficiency, decline in fertilizer response ratio, imbalanced fertilizer use and crop residue burning. Other major concerns enumerated by Dr. Chaudhary were, monitoring of land degradation, improving physical, chemical and biological soil health, SOC sequestration to reduce carbon footprint, increasing NUE and fertilizer response ratio and to decrease the contamination.

He narrated the challenges in soil health monitoring on account of inadequate soil testing laboratories (1268 static+ 368 mobile) with limited analytical capacity and quality control. He also mentioned the strengths and research initiatives of ICAR, which is having the second largest research network in the world with 4 NRM Institutes (IISS, NBSS & LUP, CSSRI & IISWC) 4 AICRPs, 2 Network projects and 1 CRP on CA. Among policy initiatives, Dr. Chaudhary enumerated initiatives like coating urea with neem oil, integrated watershed management program, national mission on sustainable agriculture and Soil Health Card Scheme. He opined that the areas that needs to be addressed involve; new tools and techniques in soil sampling; conservation agriculture and soil water conservation; liquid fertilizer application by drip irrigation and the use of organics.

During the question - answer session, the SEALNET chair, Mr. Jamyang queried as to what are the causes of inland salinity, weather fertilizer or geology, to which Dr. Chaudhary replied that in central and southern parts of the country the parent materials like basalts and feldspars contribute to the salinity of inland soils. Whereas in Indo Gangatic plains, the alluvial soil from Himalayas brings the salts with runoff water. To the question of Gina P Nilo as to why is coating of urea done by neem oil, Dr. Chaudhary replied that it is practised to reduce N losses and to divert the use of urea from alternative purposes. Mrs. Su Su Win expressed her concern of the neem oil application as lethal agent for soil microbes to which the speaker replied that neem oil coating is in very small quantity and thus may not be harmful to the soil microbes

Second lecture on delivered by “Soil health card infrastructure and achievement in the state of Madhya Pradesh, India” by Mr B.M. Sahare, DA, Govt. of Madhya Pradesh. The speaker apprised the house of distribution of farm holdings in MP (India) whose largest part are the small and marginal farm holdings. The soil health card scheme in MP started in 2015-16 with the objective of issuing SHCs to all farmers; to develop, promote soil test recommendation based fertilizer management in all the districts; to strengthen the STLs to build up the capacity with the target of revisiting each SHC every 2 years. He narrated that soil sampling is grid based with 2.5 ha grid in irrigated areas and 10 ha grid in rainfed areas involving a cost of Rs 300/ SHC. He also explained some strategies of soil analysis, in two shifts of 7hrs–7hrs, temporary hiring of the technical staff and use of minilabs. He also explained total number of sample analysed every year, variety development in MP, NPK ratio management, 5 times Krishi Karman Award to MP and largest pulse production in MP.

On the query of Gina P Nilo as to what are basis of the soil sampling, speaker replied that the grids are the basis and principle remains the same. On another question by Gina P Nilo and Began Sultana regarding the

increase/difference in number of samples every year, Mr. Sahare replied that this due to factors like variation in infrastructure, annual targets and the objective of issuing SHC to each farmer. Since the number of famers are variable in each grid, hence the increase/difference in number of samples every year.

The third presentation was made on “Soil parameters, analysis protocols, interpretation, and fertilizer recommendations”, by Dr. Sanjay Srivastava, ICAR-IISS, Bhopal. The speaker explained that India uses standard protocols for analysis of nutrients following the procedures used in USDA labs. He informed the house of the mini soil lab generation at IISS- Bhopal. It was started with 5-12 soil parameters and special characteristics like gypsum requirement. Fertilizer recommendations are made for N P K S & Zn because some soil don't need all parameters. Recommendations are based on GRDs obtained from agronomic trials and varied based on, rating of soil test, critical limit based application and target yield concept. Towards this a mini lab was developed by IISS Bhopal and the speaker explained the procedure of operating this mini lab and making nutrient recommendations based upon soil and the crop. He explained the effect of high temperature (> 25 OC) which may affect the extraction of micro nutrients like Zn, Fe, Mn and Cu and explained the need to harmonise the methodology of their extraction. He also explained the effect of other factors on the results such as effect of duration of retention of extractants, accuracy vs. sensitivity and the pH which needs to be harmonised.

During the question hours, Mr. Jam Yang asked that when would you use lime and when gypsum as both are need based, to which speaker replied that pH gives the indication whether we needs gypsum/ lime. At low pH soil need lime and at high pH gypsum is required. To the another question of Mr. JamYang that if OC is <0.25 than on water basis we rate it very low? Speaker replied that so far there are no scientific basis and still the agronomic trials needs to be done. To the query of Janardhan Khadka that the gypsum application at > 8.5 pH is needed in high quantity and whether it is economically viable or not. The speaker replied that under such situation when gypsum requirement is 10 t/ ha we apply 2.5t/ ha. In India if gypsum was not subsidised it would not have been economical, but in India it is subsidise by the Govt. Mr. Janardhan Khadka expressed his concern of having harmonised rating chart for soil carbon for different ecological zones towards better comparison of data across the nations.

Fourth speaker Dr. T Satyanarayana, Director IPNI, made presentation on “Potassium in soil and plant: analytical and management issues”. He expressed the need for harmonisation of soil test method for determination of plant available K and the interpretation with respect to clay minerals and K fertilizer response. He opined that illite and smectite differ in exchangeability of inter layer cations; that extraction from illite may be lower than smectite but not nil; that the amount of available K depends upon nature of crop and further upon variety; that low K contents may or may not correlate with lower yields and thus we may have to consider plant factors, soil factors and utilization capacity of the species. The speaker emphasized the need to revise the critical limits of K in soils based on dominant mineral presence.

During the question hours Mrs. Nopamane, Gina P Nilo and Mr. Jam Yang questioned the method of Neutral Normal Ammonium Acetate and to rely on other matrix too, since they said that even after applying K fertilizer in smectite dominant areas there is no correlation with yield. It was suggested to include a micro biologist in K dynamics studies.

The last presentation of the session was on “Infrared spectroscopy and its potential for estimation of soil properties”, by Dr. K.M Hati, ICAR-IISS Bhopal. The speaker narrated the importance of NIR & MIR based soil analysis techniques in economising the time, energy money and other resources in addition to its high resolution capacity and frequent revisit of sampling sites. Using the correlation coefficients between soil

spectra and soil properties it has become possible to draw information on soil pH, OC, available NPK and few other soil parameters. The speaker explained in detail, the models developed and validated with good correlation for SOC, pH and CEC. The models still needs to achieve accuracy for available N P & K. Dr. Hati explained in detail the procedure of generating soil spectra, correlating with the wet chemistry results and generating and validating the models by processing the data with statistical and other mathematical tools.

The session ended with vote of thanks by the chairman.

## Annex IV: Internal quality control

Country	Internal quality control system available	If yes...		Characteristics of the reference material					
		Written rules	Frequency of use	Natural soils?	Synthetic material?	Chemicals?	Material prepared by yourself	Prepared out of the laboratory	Bought as certified reference material
Bangladesh	Yes	Yes	Every working day	Yes	No	Yes	Yes	No	Yes in case of chemicals
Bhutan	Yes	Yes	On regular basis	Yes	No	No	Yes	No	No
Cambodia	Yes	Yes	Control chart	No	No	Yes	Yes	No	Yes
China	Yes	Yes	Every analytical batch (10 samples)	Yes	No	No	Yes	No	No
India	Yes, check samples (known value)	N/A	Always for research, every batch	Yes	Yes/No	Yes (standard curve)	N/A	N/A	N/A
Indonesia	Yes	Yes, in work instructions	Every batch	Yes	No	No	Yes	No	No
Japan	Yes (in case of pH, T-C, Ex-K)	No	Every time in the experiment	Yes	No	No	Yes (T-C)	No	Yes (pH, Ex-K)
Laos	Yes	Yes	Every batch	Yes	No	Yes (buffer/standard solution)	Yes (H&K soil)	Yes (ASPAC, WEPAL)	Yes (buffer/standard solution)

Malaysia	Yes	Yes	Every batch	Yes	No	Yes	Yes, standard solution	Yes, PT samples	No, still in future planning
Mongolia	Yes	Yes, there is a lab manual but it is an old one	Every new analytical batch	Yes	No	No	Yes (internal control)	Yes (external control)	No
Myanmar	Yes	Yes	Every 20 samples	Yes	No	No	Yes (internal check)	Yes (external check)	No but it is planned to use them
Nepal	Yes	Yes	Once a year	Yes	No	No	Yes	No	No
Philippines	Yes	yes	every batch	Yes (check samples or IRM, quality control material and certified reference material)	No	Yes (NSIT standards, buffers and reagents)	Yes (working standards from NIST standards + check samples or IRM)	No	Yes (quality control material and certified reference material)
Sri Lanka	Yes	Yes	Every batch (3 reference material are used)	Yes	No	No	Yes	No	No
Thailand	Yes	Yes	Every batch (2 reference material are used)	Yes	No	Yes	Yes	No	Yes
Vietnam	Yes	Yes	N/A	Yes	No	Yes	Yes	No	No

Country	Control material used for the analysis of all analytical parameters?	If no, for the analysis of which soil parameters is the control material used?				Frequency of analysis of the control material				
		pH	EC	Carbon	Other (specify)	In every analytical batch	Every hours	Once a day	Once a week	Once a month
Bangladesh	Yes					Yes				
Bhutan	Yes					Yes				
Cambodia	Yes					Yes				
China	Yes					Yes				
India	Yes					Yes				
Indonesia	Yes					Yes				
Japan	No	Yes	No	Yes	T-C, T-N, Ex.-Ca, Mg, K, Na	Yes				
Laos	Yes					Yes				
Malaysia	No	Yes	Yes	Yes	Nitrogen, available phosphorus, CEC, exchangeable K, Na, Mg and Ca, Sulphur NO for Fe and Al	Yes				
Mongolia	No	Yes		Yes	P2O5, K2O, NO3, Ca/Mg	Yes				Yes
Myanmar	Yes					Yes				
Nepal	Yes					No	No	No	No	No
Philippines	Yes					Yes				
Sri Lanka	Yes					Yes				

Thailand	No	Yes	Yes	Yes	available phosphorus, CEC, exchangeable K, Na, Mg and Ca,	Yes				
Vietnam	No	Yes	Yes	Yes	Total N, total P, Total K, available P, available K	Yes				

Country	Comparison of control material results to specific statistical limits			Actions in case of failure of the quality control procedure	Is there a quality control officer?	If yes...	
	Database for reporting control material results available	Quality charts to plot results are used	How are statistic limits for the acceptance/rejection of the results determined?			Did they receive special trainings on quality control? If yes, which ones?	Are they trained on a regular basis? If yes, how often?
Bangladesh	Yes	Yes	Statistical software is used to analyze the data. ANOVA and univariate analysis are performed. Means are separated by SLD at 5% level of significance	Results observed out of the statistical limit are discarded and the concerned laboratories are instructed to re-check their standard solutions, weighing balance and the quality of distilled or deionized water used for analysis	Yes	No, only some of them receive a 6 months training on Advanced Laboratory Technique at the Denmark Royal Veterinary and Agricultural University	No, new officers get trained by old ones
Bhutan	Yes	Yes	The statistical limits are determined by using $\text{mean} \pm 2\text{SD}$ for Warning Limits and $\text{mean} \pm 3\text{SD}$ for action limits or upper or lower control limits	<ol style="list-style-type: none"> <li>1. First check if the set of standards and drifts are okay for calibration</li> <li>2. Check the analytical system – instrument failure. If it is ok then...</li> <li>3. Same batch re-analysed. If the problem persist then the reagent is suspected</li> <li>4. Re-digest or re-extract the batch. If</li> </ol>	No		

				the problem persists... 5. Check with the processing staff or the equipment operator			
Cambodia	Yes	Yes	Example provided in the presentation	We need to redo and check the procedure or chemical reagent	Yes	Yes, experience acquired during their studies	No
China	Yes	Yes		Analytical results for the internal reference were plotted on a quality control chart to monitor the performance of the analysis over time. Corrective action could be taken if a single value exceeds the $\pm 3$ standard deviation limits or if two successive values exceed the $\pm 2$ standard deviations. If data exceed control limits (3S) rather than warning limits (2S), check the measurement process and further tests conducted.	Yes	Yes. Laboratory internal auditor training certificate by China National Accreditation Service for Conformity Assessment (CNAL)	No
India	Done individually	N/A	N/A	- Repeat the measurement	Ensured at scientist level	Yes	Yes

	by each scientist			<ul style="list-style-type: none"> <li>- Replicated samples</li> <li>- If variation &gt;5-7%</li> </ul>			
Indonesia	Yes	Yes	<p>To guarantee quality testing in the form of graphics to monitor the stability of the process:</p> <ol style="list-style-type: none"> <li>1. Collect and record data according to test parameters</li> <li>2. Calculate each test parameter data and create a tabulation table to simplify the calculation of average (x) and standard deviation (SD)</li> <li>3. Identify the right scale and match then enter into the statistical data</li> <li>4. Calculate the upper line for the upper control limit, lower within limit for the lowest control limit and</li> </ol>	<ol style="list-style-type: none"> <li>1. Check the expiration date of reagent</li> <li>2. Retest the control. If the new value is within acceptable limits, record both values and proceed with sample testing</li> <li>3. If the new control value is out of control, troubleshoot the instrument (check sampling, reagent delivery, mixing, lamp integrity, and reaction temperature). Recalibrate the method, especially if two or more controls have shifted</li> <li>4. If controls shift after a new reagent lot number has been introduced, rerun</li> </ol>	Yes (supervisor)	No	No

			<p>the central line for average according to the formula of each control chart</p> <p>5. Enter the upper and lower limit data in the chart</p> <p>6. Conduct investigations and corrective actions if necessary</p>	<p>samples and standard</p> <p>5. If they are poor, the reagent probably is not good</p>			
Japan	No	No	In the case of carbon content, if the measured value of the standard sample is within 3SD of the average value, it is acceptable. But if it is out of range, measure again.	Check the error ( $\pm 3\sigma$ ), and carry out re-experiment	No		
Laos	Yes	Yes	See presentation	<ol style="list-style-type: none"> <li>1. Analysis procedure will be asked by lab manager</li> <li>2. Check the note book (soil weight, tritiation, blank, calibration, etc.)</li> <li>3. Check entering data, calculation</li> <li>4. Check the date of chemical preparation</li> </ol>	Yes (lab manager, boss)	Yes (SEALNET)	No

				5. Re-analysis if all above points were done correctly			
Malaysia	Yes, under development	Yes	QC is accepted when it falls within warning upper or lower limit. Warning limit are determined by 2 x RSD for QC mean (collected every 30 batch analysis). If QC exceeds the warning limit, analysis will be repeated. If the repeated analysis shows that QC falls back into acceptable limits, the analysis results will be accepted. If QC exceed the control limit, new samples will be tested. If the problem still occur, analysis will be stopped and further investigation will commence. QC control limit is determined by 3xRSD for QC mean.	<ol style="list-style-type: none"> <li>1. Repeat the analysis and confirm the error</li> <li>2. Inform the technical manager</li> <li>3. The TM shall withhold testing or issue of test report</li> <li>4. Initiate the investigation on procedures, equipment and test material/samples</li> <li>5. Retest may be requested by TM</li> <li>6. The causes of anomaly shall be conveyed t the staff concerned for remedial actions</li> <li>7. TM shall call for resumption of work thereafter</li> <li>8. If investigation indicates that the non conforming work would recur, the corrective action procedures</li> </ol>	Yes	Yes, analytical and statistical trainings: <ul style="list-style-type: none"> <li>- Measurement uncertainty</li> <li>- Internal audit for MS ISO/IEC 17025</li> <li>- Basic statistic</li> <li>- Method validation and verification</li> </ul>	Yes, Malaysian government policy require the public service officers to undergo 7 days mandatory training annually

				shall be promptly adhered			
Mongolia	No but data are reported in a lab journal	Yes	N/A	Repeat the analysis	Officially no but this role is taken by the lab manager	No	Yes, training organized 4 times per year
Myanmar	Yes	No	The standard should not vary from the mean value by more than 3-5%. Before accepting the results for the unknowns, the values for the blanks and standards should be confirmed.	In case of failure, extensive investigation to determine likely causes of error should be undertaken. If no cause is found, the batch should be repeated.	Yes (lab in charge)	Yes, one month lab training in UNE Soil Lab (Human Resource Development Program for Quality Assurance of Laboratory Analysis under ACIAR Project)	No but she regularly practice in the lab and trains others.
Nepal	No	No	N/A	Comparative chart has been prepared, discussions are initiated and suggestions are made	No		
Philippines	No (compiled in specific logbooks and folders)	Yes	<ol style="list-style-type: none"> <li>1. Use of a control chart</li> <li>2. Precision test: relative standard deviation</li> <li>3. Accuracy test: recovery test</li> <li>4. Accuracy test: use of certified reference material</li> </ol>	<ol style="list-style-type: none"> <li>1. Identification and analysis of the root cause for the failure in quality controls.</li> <li>2. The Quality Control Officer/Supervisor will ask the analyst to perform a repeat analysis for one sample or the</li> </ol>	Yes	Yes: - Measurement Uncertainty - Quality Assurance/Control - Method Validation	Yes, annual training as per training plan

			<p>5. Accuracy test: participation in proficiency testing programs</p> <p><math> z  \leq 2</math>: satisfactory</p> <p><math>2 &lt;  z  &lt; 3</math>: questionable</p> <p><math> z  \geq 3</math>: unsatisfactory</p>	<p>whole batch depending on what kind of quality control failed.</p> <p>3. All quality controls for the repeat analysis will be checked if it passes all the statistical limits (e.g. RSD, control chart, etc.)</p> <p>4. If the repeated results passes the quality controls, the Supervisor will capture the repeated results and will be cleared for release.</p>			
Sri Lanka	Yes	Yes	<p>Acceptable range: <math>&lt;2SD</math> and <math>&gt; -2SD</math></p> <p>Questionable range: <math>(2SD - 3SD)</math> and <math>(-2SD - 3SD)</math></p> <p>Rejection range: <math>&gt;3SD</math> and <math>&lt; -3SD</math></p>	<p>Pool the data and draw QC chart using pool data. If it is outside the acceptance limits, referene material and samples will be reanalyzed. If the results still fall in rejection limit, new reference material will be prepared.</p>	Yes	<p>Yes, training on quality control of test methods by Subdra Jayasinghe, FAO consultant on laboratory accreditation</p>	No
Thailand	Yes	Yes	<p>Lines drawn on a control chart to provide graphic</p>	<p>- checking of results</p> <p>calculation of transcription errors</p>	Yes	Yes	<p>- quality control training</p>

			<p>criteria for assessing whether a measurement procedure is in control or out of control. To monitor the combination of systematic and random effects. System is in control when:</p> <ul style="list-style-type: none"> <li>- warning line: 19/20 of random measurement fall within <math>\pm 2SD</math> or 95.5% of the time</li> <li>- control line: all random measurements fall within <math>\pm 3SD</math> or 99.7% of the time</li> </ul>	<ul style="list-style-type: none"> <li>- preparation of new standards</li> <li>- recalibration of instrument</li> <li>- reanalysis of all samples with new reagents</li> <li>- use of alternate system</li> <li>- repeating analysis</li> <li>- use of new analyst</li> </ul>			<p>(online course twice per year)</p> <ul style="list-style-type: none"> <li>- quality process analyst on the job training, calibration and test equipment training course (every other year)</li> </ul>
Vietnam	N/A	N/A	N/A	<p>Check analysis equipment, chemical reagent, standard solution, etc., environmental condition (temperature, contamination, etc.), balance, recording, SOPs</p>	No		