

**INSII-II/16/Report**



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



**GLOBAL SOIL  
PARTNERSHIP**

# **Report of the second workshop of the International Network of Soil Information Institutions (INSII)**

**Rome, Italy, 24-25 November 2016**

**INSII-II/16/Report**

**REPORT OF THE SECOND WORKSHOP OF THE INTERNATIONAL  
NETWORK OF SOIL INFORMATION INSTITUTIONS (INSII)**

**Rome, Italy, 24-25 November, 2016**

**FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS  
Rome, 2016**

The designations employed and the presentation of material in this publication do not imply the expression of any opinion whatsoever on the part of the Food and Agriculture Organization of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

## Contents

<b>List of Acronyms</b> .....	1
<b>1. Opening of the workshop and tour de table</b> .....	2
<b>2. Introduction to the workshop and progress report</b> .....	2
<b>3. Pillar 4 Implementation Plan (P4IP) and current soil information developments</b> .....	2
<b>4. Election of the INSII Chair</b> .....	3
<b>5. Formalization of INSII (Arrangement)</b> .....	3
<b>6. GSP Data Policy (for sharing soil data)</b> .....	4
<b>7. Call for the Global Soils Spatial Data Infrastructure Centre (GSSDIC)</b> .....	4
<b>8. The Global Soil Information System (GSIS) and SoilSTAT</b> .....	5
<b>9. Stakeholders and synergies of the Global Soil Information System (GLOSIS)</b> .....	6
<b>10. The global soil organic carbon map (GSOC)</b> .....	6
Report by the ITPS SOC working group.....	6
Global Soil Organic Carbon Map .....	7
Capacity development and the cookbook .....	8
Roadmap .....	8
Discussion.....	9
Feedback from INSII institutions.....	9
<b>11. Way Forward</b> .....	12
<b>Annex I: Report of the technical workshop on the Global Soil Organic Carbon Map (GSOC), 23 November 2016</b> .....	13
<b>Annex II: List of participants</b> .....	15

## List of Acronyms

CBD	United Nations Convention on Biological Diversity
FAO	Food and Agriculture Organization of the United Nations
GEOSS	Global Earth Observation System of Systems
GODAN	Global Open Data for Agriculture and Nutrition
GSIS	Global Soil Information System
GSOC	Global Soil Organic Carbon
GSOC17	Global Symposium on Soil Organic Carbon, Rome, 21-23 March 2017
GSP	Global Soil Partnership
GSSDIC	Global Soil Spatial Data Information Centre
HWSDv2	Harmonized World Soil Database version 2
INSII	International Network of Soil Information Institutions
IPCC	Intergovernmental Panel on Climate Change
ISO	International Organization for Standardization
ITPS	Intergovernmental Technical Panel on Soils
MoU	Memorandum of Understanding
OGC	Open Geospatial Consortium
P4	Pillar 4
P4IP	Pillar 4 implementation plan
P4WG	Pillar 4 Working Group
P5	Pillar 5
PA	Plenary Assembly
SDF	Spatial Data Facility
SDGs	Sustainable Development Goals
SDF	Soil Data Facility [ <i>replaces GSSDIC</i> ]
SDI	Spatial Data Infrastructure
SOC	Soil organic carbon
SOM	Soil organic matter
SPI	Science-Policy Interface of UNCCD
UNCCD	United Nations Convention to Combat Desertification
UNFCCC	United Nations Framework Convention on Climate Change
WMO	World Meteorological Organization
WSD	World Soil Day

## 1. Opening of the workshop and tour de table

The second workshop of the International Network of Soil Information Institutions (INSII) was held at the Food and Agriculture Organization of the United Nations (FAO) Headquarters, Rome, Italy, on 24-25 November, 2016.

Mr. Olcay Unver, Deputy Director of the FAO Land and Water Division, opened the meeting and welcomed the participants. He highlighted the importance of INSII for developing the Global Soil Information System (GSIS), reiterating FAO's commitment to the Global Soil Partnership (GSP) and emphasizing the task to develop a Global Soil Organic Carbon (GSOC) map to be released by 5 December 2017.

Mr. Luca Montanarella (Chair of GSP's Intergovernmental Technical Panel on Soils - ITPS) was invited to chair the meeting. He accepted this role, and introduced the agenda for acceptance or additions. Upon request by Mr. Bas Kempen (International Soil Reference and Information Centre - ISRIC, Netherlands), more time was allocated to discuss the data policy and the call for the Global Soil Spatial Data Information Centre (GSSDIC).

## 2. Introduction to the workshop and progress report

Mr. Ronald Vargas, GSP Secretary, described the momentum soil has gained in the global agenda (soil and climate change; Sustainable Development Goals), by recalling the main achievements/events to be celebrated on the occasion of World Soil Day (WSD) 2016:

- The endorsement of the Voluntary Guidelines for Sustainable Soil Management by the FAO Council on 5 December 2016, Rome;
- The book launch – 'Soils and Pulses, symbiosis for life' – in New York and Rome;
- The award of the first Glinka World Soil Prize.

He then provided background about INSII, referring to the first meeting held in December 2015. He stressed the complementary role between Pillar 4 (P4) and Pillar 5 (P5), referring to indicator selection and data harmonization. He explained that, after the presentation of the Pillar 4 Implementation Plan (P4IP) to the 4<sup>th</sup> GSP Plenary Assembly (PA) in May 2016, the implementation phase has begun, with the GSOC map as priority to respond to the request by the United Convention to Combat Desertification in support to the SDGs indicators. He informed that the recent FAO's Committee on Agriculture endorsed the establishment of the Global Soil information System and the development of the Global Soil Organic Carbon Map; this decision will be finally endorsed (as part of the 4<sup>th</sup> GSP Plenary Assembly Report) by the 155<sup>th</sup> session of the FAO Council. An upcoming key milestone for GSP and ITPS action is the Global Symposium on Soil Organic Carbon (GSOC17), to be held at FAO headquarters on 21-23 March 2017, jointly organized with the Intergovernmental Panel on Climate Change (IPCC), the United Nations Convention to Combat Desertification (UNCCD) and its Science-Policy Interface (SPI), and the World Meteorological Organization (WMO).

## 3. Pillar 4 Implementation Plan (P4IP) and current soil information developments

Mr. Rainer Baritz (GSP Secretariat, on behalf of the Pillar 4 Working Group - P4WG) presented the progress made in Pillars 4 and 5 since the first INSII workshop, referring to regional as well as global level aspects<sup>1</sup>. As underlined in the P4 Implementation Plan, INSII members would produce national data and products following agreed specifications (upon drafts developed by the P4WG; the GSOC map is a first example). Besides the GSOC map, implementation

---

<sup>1</sup> Most regional partnerships have already developed implementation plans that cover all five Pillars in one plan. The global-level Pillar 5 Implementation Plan is currently under development; some work items to be included in the global implementation plan, especially at regional level, are already being implemented.

activities for P4 during 2016 have focussed on developing a draft GSP data policy and the call for GSSDIC. In addition, an approach was prepared to formalize the INSII network (via a so-called “Arrangement”). A Code of Ethics, as suggested in the P4 Plan of Action, became integrated into the draft GSP data policy. All documents were prepared by the GSP Secretariat together with the P4WG.

According to the P4IP, several other tasks were foreseen for the P4WG in 2016: (a) developing a P4 brochure for resource partners; (b) finalizing a concept note for soil monitoring; (c) drafting Tier 2 soil profile data base specifications; (d) achieving progress with the updating of the Harmonized World Soil Database version 2 (HWSDv2). These tasks are delayed because preference has been given to the GSOC map. However, some progress has been made regarding SoilSTAT (see Section 8).

In 2017, according to the P4IP, the P4WG shall develop a capacity development programme, and draft specifications for the global polygon coverage and fine resolution grid.

To ensure that INSII works efficiently and remains well-supported by its member institutions, it was recommended that each INSII member may establish close linkages to its national spatial data infrastructure and develop synergies with other national institutions working on soil information.

During the 4<sup>th</sup> PA, the GSP Secretariat informed about potential cooperation with GODAN. Based on this, a GODAN working group on soil data was recently established, and GSP members are welcome to join.

During the subsequent discussion, concerns were raised regarding a possible lack of efficiency of the P4WG. More commitment by the members would help to improve effectiveness of the group. However, the crucial importance of the P4WG was recognized. In order to address the issue, the following suggestions were made:

- Having a P4WG chair is seen as a major requirement and priority. The chair should not come from the GSSDIC in order to avoid conflict of interest;
- It was suggested that members of the P4WG commit to a regular monthly meeting.

#### 4. Election of the INSII Chair

Before the election, the roles of the INSII chair were clarified, and the need to coordinate the P4WG and GSSDIC and to moderate the annual INSII meeting, was highlighted.

Mr. Luca Montanarella kindly agreed to chair the INSII meeting until the election of an official INSII chair. Nominations from the floor were called and Mr. Bas Kempen informed about the candidature of ISRIC’s Director Mr. Rick van den Bosch. The offer was greatly appreciated, however, participants expressed their concern particularly considering that ISRIC had expressed its interest to respond to the call for the GSSDIC. Following some debate on potential conflict of interest and especially on the crucial role of the chair, participants preferred that a separate call be issued which would reach out to all GSP members and focal points. Until a chair is found through such a call, Mr. Luca Montanarella agreed to be the acting INSII chair. The GSP Secretariat was then asked to prepare such a call in collaboration with P4WG, and to share it with all INSII members prior to its publishing. The INSII chair would be designated during the 5<sup>th</sup> PA on 20-22 June 2017.

#### 5. Formalization of INSII (Arrangement)

Taking note of the request by some members to formalize INSII, the Secretariat presented the procedure to formally address this request. A draft ‘Arrangement’ was prepared for its submission to the upcoming 5<sup>th</sup> GSP Plenary Assembly

in 2017. It would specify the role of INSII members in the establishment of the Global Soil Information System (GLOSIS), which was already endorsed by FAO Council.

INSII members asked the GSP Secretariat to share the draft Arrangement together with the meeting report.

## 6. GSP Data Policy (for sharing soil data)

Mr. Rainer Baritz, on behalf of the GSP Secretariat and the P4WG, introduced the draft GSP Data policy to facilitate data sharing within the GLOSIS. This draft policy was jointly developed by the Secretariat and the P4IP, and it is based on the following principles:

- It supports the so-called distributed system (shared web data services);
- It pursues the full and open exchange of primary and derived data respecting the frame conditions expressed by the data owner and provider (through metadata and licences). **The relevant national data policies and legislation with regard to intellectual property rights (IPR) are fully respected and always overrule the generic draft GSP Data Policy;**
- It involves a Code of Conduct, which replaces the initially envisaged Code of Ethics;

It was again emphasized that the fundamental principle behind the GSP Data Policy is **data exchange through web services**. In the draft GSP Data Policy, this is referred to as the primary data flow. However, if needed, a centralized data flow is also possible, which would probably require additional bilateral agreements. An important element related to the primary data flow is that national soil data infrastructures need to be developed (discovery and download services, data extracts from local data bases transformed to web services).

The draft GSP data policy was shared with INSII participants and some members expressed their conformity with it while other provided comments and suggestions for consideration. At the end, members suggested that the draft should be distributed again and time is given for final comments. A new version will be developed together with the P4WG and will be submitted to the upcoming 5<sup>th</sup> GSP Plenary Assembly.

## 7. Call for the Global Soils Spatial Data Infrastructure Centre (GSSDIC)

During the 1<sup>st</sup> INSII meeting in 2015, the terms of reference for the GSSDIC were developed (based on the terms of reference provided by the P4IP). As per this plan, the main function of the GSSDIC is to provide technical support for building the GLOSIS. Following acceptance of the P4IP during the 4<sup>th</sup> PA 2016, the GSP Secretariat (including FAO's legal office) prepared a draft open call for the GSSDIC together with the P4WG. This draft version was shared with INSII participants shortly before the meeting.

During the meeting, the draft call was discussed. The debate mainly focused on aspects related to the roles of GSSDIC, P4WG and GSP Secretariat in managing the GLOSIS. Referring back to the debate during the 1<sup>st</sup> INSII meeting, the GSP Secretariat explained the multilateral, intergovernmental dimension of FAO in which GSP operates. The following topics were discussed:

- GSSDIC name: the current name is difficult to use and it was suggested instead the Global Soil Partnership Soil Data Facility (SDF). The operation of the SDF will be based on own funding.

It was commented that this could exclude institutions otherwise interested to apply. The GSP Secretariat explained that in-kind resources or additional national support would be an important criterion for selecting the SDF, since all GSP activities depend on extra-budgetary resources.

- It was suggested to reformulate or delete a footnote in the call which informs about FAO and the SDI for SoilSTAT.  
The activity of FAO engaging with SoilSTAT and the corresponding SDI is stated in the P4IP. Additional information about the multilateral GSP mechanism, the role of FAO and the GSP Secretariat, and the nature of FAOSTAT, was provided by the GSP Secretariat.
- Clarification was requested about the possibility to form a SDF-consortium consisting of several INSII members.  
The formulation, which already indirectly allowed for several institutions to form the SDF, shall be stated more clearly.
- The relation between the Pillar 4 working group (P4WG) and the future SDF should be clarified.  
It was suggested to add new roles for the P4WG inside the call.
- Several participants stated that the SDF cannot chair INSII and the P4WG, because of the potential conflict of interest, and that this should be clearly stated in the call.

A small review team was created (led by Mr. Neil McKenzie, CSIRO, Australia) to capture suggested changes in the GSSDIC call to be presented on the 25<sup>th</sup> November.

The modified version was presented by the team and the various suggestions were discussed. At the end, the GSP Secretariat explained that this new version has to be reviewed again by the FAO Legal office in order to ensure its legal and institutional compliance. After this review, the GSP Secretariat would share it with INSII members and P4WG for final review before officially launching the call in mid-January 2017. The deadline for applications shall be extended to 31 March 2017.

## 8. The Global Soil Information System (GSIS) and SoilSTAT

Mr. Rainer Baritz (GSP Secretariat) presented the components of GLOSIS and FAO's support towards establishing SoilSTAT and its associated spatial data infrastructure. He highlighted the importance of sharing data across borders, and presented the SoilSTAT concept as a platform for exchanging information about soil indicators. The selection of indicators is a Pillar 5 task (another example demonstrating the close relationship between Pillars 4 and 5). The draft concept for SoilSTAT will be discussed with the P4WG.

Several questions concerned the role and position of FAO in this process. The Secretariat then referred to the P4IP, which suggests that a detailed concept note for SoilSTAT, embedded in the FAOSTATs family, would be developed by FAO.

Mr. Baritz also presented aspects of Pillar 5 relevant to GLOSIS. An agreed global soil information model is needed in order to produce web services with interoperable soil data. For that, the GSP Secretariat follows up the current Open Geospatial Consortium (OGC) and International Organization for Standardization (ISO) processes.

The process of sharing soil data through open web services is also supported by the GODAN<sup>2</sup> network. Cooperation with GODAN was presented to the 4<sup>th</sup> PA which supported the initiative. During the 4<sup>th</sup> PA, it was agreed that GSP

---

<sup>2</sup> GODAN is a public-private network, initially founded with governmental support from USA, UK and Kenya; FAO as a member; GODAN is also supported by UN ECOSOC. During its summit in New York, September 2016, a soil data working group has been founded with the objective to broaden the community of stakeholders for shared soil data, to help solving the challenge to develop a soil information modelling standard, and to mobilize resources for building national soil informatics capacity and

as a single entity could not become a GODAN member, but individual GSP members, especially INSII institutions, directly or through their governments, could do so based on own interest and decision.

Mr. Baritz also informed about the revision of ISO 25177 Soil quality – Field soil description, which is currently in its final stage of review. Upon request by the GSP Secretariat, INSII members would receive the opportunity to review the current draft of this document. The documentation will be shared by the GSP Secretariat soon after this INSII meeting, allowing for review until the end of February 2017. It has to be noted that the draft revised standard builds on the Guideline for Soil Description (FAO 2006). It is suggested in the Pillar 5 Plan of Action that the FAO guidelines need to be revised. However, the current revision of ISO 25177 will be based on the unchanged initial version of FAO (2006).

## 9. Stakeholders and synergies of the Global Soil Information System (GLOSIS)

Based on his relevant experience with the Globalsoilmap.net initiative, Mr. Neil McKenzie presented the lessons learnt from this initiative, and provided recommendations for the full implementation of GLOSIS. Global soil information plays an increasingly important role in the agendas of many initiatives and programmes, such as UN conventions, the SDGs and many national activities.

He highlighted potential challenges when engaging through voluntary actions: clarity, transparency and inclusive decision-making processes are important to take into account. He stressed the impact of good information standards, such as the guideline for SOC mapping, in order to obtain the best quality possible. He then presented the Australian approach to SOC mapping (using the specifications for soil property mapping developed by GlobalSoilMap), its importance for national-level actions, and at the same time, reaching compatibility with similar maps developed by other countries. He suggested that INSII meetings should become the most wanted meetings to be attended by soil information producers. To reach that aim, attention should be paid to governance, inclusiveness and clarity regarding the roles of every component of the system.

## 10. The global soil organic carbon map (GSOC)

Report by the ITPS SOC working group

Mr. Miguel Taboada (Chair of the ITPS SOC Working Group) introduced the ITPS work on Global Management of Soil Organic Matter (SOM). The working group currently evaluates the impact of different initiatives, practices, and actions related to SOM. This activity, which will be presented as a report, has the aim to collect and share information which helps to improve soil functions, soil fertility, structural stability and the water household in (agro-)ecosystems. He also reiterated the interaction between ITPS and other international scientific advisory bodies, such as UNCCD's Science-Policy Interface (SPI), regarding soil organic carbon (SOC) in the context of the SDGs. He further mentioned the Global Symposium on Soil Organic Carbon (GSOC17), jointly organised by FAO/GSP/ITPS, the Intergovernmental Panel on Climate Change (IPCC), SPI and the World Meteorological Organization (WMO), to be held on 21-23 March 2017 at FAO headquarters in Rome.

The working group sent a template to the GSP focal points, requesting information about SOM management. However, only 23 countries have supplied feedback to date.

---

infrastructures. Participation in the Soil Data Working Group is open to any interested institution. [www.godan.info/working-groups/soil-data](http://www.godan.info/working-groups/soil-data).

Mr. Victor Castillo (UNCCD, Germany) shared additional information about a new IPCC Special Report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems. He emphasized the importance of new information about the size of the terrestrial SOC pool.

### Global Soil Organic Carbon Map

Ms. Liesl Wiese from the GSP Secretariat introduced the global SOC mapping activity. GSP/ITPS was requested by the UNCCD secretariat to develop a global soil organic carbon (GSOC) stock map by the end of 2017. The proposal was presented during the 4<sup>th</sup> PA, which endorsed the ITPS work plan, including the development of the GSOC map. The GSOC map will be compiled from national SOC maps, developed using a specific guideline. A draft of this guideline was shared with the INSII members before this workshop.

A combination of reliable national SOC estimates across the globe would provide a new baseline about the size and spatial distribution of currently existing terrestrial SOC pool. The guideline contains specifications which are intended to ensure that national maps are comparable. During this session, the mapping specifications and the detailed methodologies were discussed, and examples of national SOC maps presented.

The main features of the guidelines are presented below:

- (1) The general approach is 'country driven', meaning that the global map will be compiled from national maps, all developed independently, but following specifications as proposed in the guideline.
- (2) It is important to note that the SOC mapping will be conducted before the GSP Pillar 4 spatial data infrastructure becomes fully established, meaning that a centralized approach will be used: the national SOC layers will be collected by the GSP Secretariat and merged towards a global product. Ideally, as with the planned version 0 and version 1 soil grids under Pillar 4, data will be exchanged via web services.
- (3) The definition of SOC and the equations to calculate SOC stocks are identical to the UNFCCC/IPCC greenhouse gas (GHG) inventory definitions and methods (0–30 cm depth; a subdivision of the depth classes is possible). The resolution of the SOC grid is 1x1 km. SOC in the organic layer of the forest floor shall be added to the 0–30 cm layer.
- (4) The national SOC grids should be generated using existing soil profile data and soil polygon maps. If possible, the grids shall be produced using digital soil mapping, and the uncertainties assessed.

Depending on available funding, the GSP secretariat reaffirmed that it will continue its efforts to support digital soil mapping through capacity development activities. INSII members were also requested to closely cooperate within the regional soil partnerships.

The guideline for SOC mapping contains all relevant definitions, formulas and approaches. This specification will be supplemented by a cookbook which will present detailed processes and descriptions.

Ms. Wiese listed four possible scenarios for the national SOC map development:

- a) *Best case scenario*: countries already have national SOC maps which comply with the guidelines;
- b) National SOC maps are available, but do not conform to the global specifications; some adjustments/re-calculations of the data base are necessary.
- c) National SOC maps do not exist; data may be partially unavailable and/or scattered in different institutions; in this situation, the basic data need to be compiled, and the maps produced. Most likely this would also require support to build capacities.

- d) *Worst case scenario*: countries have SOC data, but do not have the capacity to develop SOC maps. The raw point data (georeferenced, digitized soil profile data including soil organic carbon values) need to be compiled, and may be shared with the GSP Secretariat which would then assist such countries by coordinating partner support.

### Capacity development and the cookbook

Mr. Federico Olmedo from INTA, Argentina, presented a soil carbon mapping case study based on multiple regression analysis. He provided insight into the technical steps necessary for SOC mapping, starting from the preparation of the soil profile data set and the calculation of SOC stocks.

The GSOC mapping cookbook will provide detailed data preparation operations and descriptions of SOC mapping procedures/methodologies using conventional upscaling and digital soil mapping. For example, this would include solutions for calculating the 0-30 cm SOC pool, the development of covariates and uncertainty assessments. An e-learning tool is under development to support the use of the cookbook. The process of data sharing will be coordinated by the GSP Secretariat and the GSP data policy will ensure that the national terms and conditions for data sharing are fully respected. Data can be shared using common GIS formats; metadata should be compiled in an Excel file for which a template will be provided.

### Roadmap

Activity	Description and due date
Guidelines for GSOC mapping (GSP Secretariat and P4WG)	<ul style="list-style-type: none"> <li>– The current version 1, as attached to this report, includes comments shared during the INSII meeting; this version is open for comments until 8<sup>th</sup> January 2017.</li> <li>– Final Version to be published and distributed by 31<sup>st</sup> January 2017.</li> <li>– Summary of specifications provided as overview by GSP Secretariat: January 2017 (including a website)</li> </ul>
Cookbook (INSII members and invited experts)	– The book is envisaged to be completed by February 2017, so that it could be used in training sessions and by INSII members
Country extracts of the global (empty) 1 km grid (30 arcseconds)	– To raster shall be provided to all member countries by February 2017.
Capacity development	– The Secretariat will organize regional and national on-the-job training sessions for SOC mapping through the Regional Soil Partnerships, so that those countries who expressed their needs on training will be addressed. January-May 2017
Development of national SOC maps (INSII members)	<ul style="list-style-type: none"> <li>– Dec 2016/Jan 2017: preparation of national work plans to develop SOC maps. INSII members to share and discuss work plans with national GSP focal points, and then inform the GSP Secretariat.</li> <li>– Dec 2016 - Aug 2017: preparation of national SOC maps; production of metadata and data sharing</li> </ul>
Status quo of national contributions (INSII members)	<ul style="list-style-type: none"> <li>– INSII members are invited to participate in the Global Symposium on Soil Organic Carbon, FAO headquarter, Rome, 21-23 March 2017</li> <li>– Selected countries may present case studies on SOC mapping</li> </ul>
Map collection (GSP Secretariat, supported by SDF)	– Aug 2017
Modification/adjustment of national SOC maps where necessary	– Sep – Nov 2017
Final GSOC map	– 5 Dec 2017 (World Soil Day)

Each INSII member should reflect on the mapping guideline provided. It is very important that INSII members develop work plans in order to communicate with their respective national GSP focal points, and with the GSP Secretariat, in order to allow for the planning of capacity development measures.

Regarding the jointly organised GSOC17 (see above), the purpose is to showcase national examples of SOC stock maps and the status of national actions to date, as a means to discuss the way forward in terms of global representation and applications of this new SOC data base.

### Discussion

Ms. Marion Bardy (INRA, France) raised several important questions regarding:

(1) The possibility to deliver a partially complete product by March 2017: according to the GSP Secretariat, this is possible.

(2) How to bridge the gap between countries' "best and worst case scenario"? Who would be in charge for the compilation and the (regular?) updating of the final product? Both questions will be discussed by the P4WG.

(3) The ownership of the SOC outputs: The GSP Data Policy refers.

Mr. Neil McKenzie proposed the selection of a Scientific Panel to oversee the scientific quality of the GSOC map. The GSP Secretariat responded that this was the role of the ITPS working group on SOM and the P4WG, but shared the view that important experts in SOC mapping may not be adequately involved.

In the further discussions, it was stressed that the SOC grid may be considered to be a first product fitting the requirements for the Pillar 4 Version 0 grids. In addition, it needs to be ensured that permafrost soils are fully represented in the GSOC map.

Mr. Carlos Omar Cruz Gaistardo (Red Nacional de Laboratorios para el Análisis, Uso, Conservación y Manejo del Suelo, Mexico) and other participants were concerned about the fact that many countries were not represented at the present meeting. The GSP Secretariat was strongly encouraged to attract and support participation of all GSP partners.

### Feedback from INSII institutions

Participants briefly presented the status of work and commitment to the national SOC mapping activity. The majority of institutions attested that data and maps have been prepared to begin data processing; others have data but do not yet conform to the specifications required in the guidelines. Some institutions indicated that limited SOC data was available in-country, or that existing data may not be georeferenced.

Several participants (CSIRO, Australia; Agriculture and Agri-Food, Canada; Council for Research in Agriculture, CREA, Italy; ISRIC, Netherlands) declared to provide training and support to less technologically advanced countries. Few persons stated their countries unable to provide data and asked for technical advice.

Specific feedback from INSII members was given as follows:

## Asia and the Pacific

**Mr. Toshiaki Ohkhura (NARO-NIAES, Japan):** Japan has already developed soil carbon maps, and will achieve a layer following the GSOC specifications as soon as possible.

**Mr. Rodelio Carating (Bureau of Soil and Water Management, Philippines):** The Philippines intend to follow the Australian example, because the approach can also be used to map soil fertility. As part of the Asian Soil Partnership, they would like to play an active role in the region and support their neighbours.

**Mr. Liu Feng (Institute for Soil Science, China):** Expects to successfully implement the task, but still needs time to organise the work.

**Mr. Lee Changhoon (National Institute of Agricultural Sciences, RDA, Republic of Korea):** They have already developed soil analytical maps, but the existing data base needs to be improved for SOC mapping.

**Mr. Tien Minh Tran (Soils and Fertilizers Research Institute, Vietnam):** A national SOC map for the topsoil has already been developed in 2014. In order to apply digital soil mapping and to improve the map statistically, capacity building is needed.

**Mr. Suresh Kumar Chaudhari (Indian Council of Agricultural Research, India):** A good network exists among relevant soil institutions in India. A national dataset has recently been improved, and needs to be adapted following the SOC guideline.

**Mr. Neil McKenzie (CSIRO, Australia):** Australia has already generated a national SOC map; the data base is regularly updated. CSIRO expects to support Fiji with a version 0 grid, but the delivery will be 2019–2020.

## Eurasia

**Mr. Giorgi Ghambashidze (Soil Fertility Research Service, Georgia):** Soil data are still mostly analogue and require digitization. Soil profile data from 20% of the territory are not accessible to the government. Georgia needs to build technical expertise in order to develop reliable soil data.

**Mr. Oleg Golozubov (M.V. Lomonosov Moscow State University, Russia):** It is a great challenge to involve all relevant data holding institutions in Russia, while there is a strong history of attention to soil carbon. The 1<sup>st</sup> SOC map was published 20 years ago, and was later digitized. This map was based on expert knowledge of forest soils using soil profile data. The GSOC map is an opportunity to test and demonstrate how regional data centres can cooperate to develop maps online in real time. Russia is committed to developing a national SOC map, but cannot promise to collect all the data by August 2017.

**Ms. Gulchekhira Khasankhanova (Design and Research Institute, UZGIP, Uzbekistan):** Uzbekistan is confronted with various challenges: lack of analytical data and lack of capacity for digital soil mapping.

**Mr. Arkadiy Levin, Mr. Konstantyn Viatkin (National Scientific Center Institute for Soil Science and Agro-Chemistry Research, Ukraine):** Ukraine has more than 2,000 profiles and 250 parameters of soil data. However, more than half of the source information dates back 1957-61 and is scattered among different ministries. The Center requires urgent technical and financial support, and additional training is needed as well.

**Mr. Aliaksandr Chervan (Institute for Soil Science and Agrochemistry National Academy of Sciences of Belarus, Belarus):** A land information system for Belarus exists; its further development and use for SOC mapping may require some additional support from the GSP Secretariat.

**Mr. Hukmatullo Ahmadov (Soil Science Institute, Tajikistan):** Tajikistan has soil carbon information, but this information is held by different organizations and it is not easy to arrange collaboration between them.

## North America

**Mr. Scott Smith, Mr. David Lee (Agriculture and Agri-Food, Canada):** Canada supports the development of the GSOC map and has a digital soil mapping working group in place which coordinates various universities and state partners.

## Western Europe

**Ms. Siri Svendgaard-Stokke (Norwegian Institute of Bioeconomy Research, Norway):** Norway does not have a SOC map, but work is under progress. However it will be a demanding task to develop a national SOC map covering all land uses.

**Ms. Katrien Oorts (Flemish Government, Belgium):** Regional governments in Belgium are responsible for data collection and reporting activities. They have several resolutions of maps for soil carbon concentration, although the source data are quite old. Scientific details about SOC stocks in Belgium shall be developed soon.

**Ms. Marion Bardy (GIS Soil INRA, France):** A national SOC map was produced in 2015. Data are owned by the regional departments. INRA intends to modify this map following GSP specifications.

**Mr. Bas Kempen (ISRIC, Netherlands):** A sufficient SOC data base is available for The Netherlands to produce a national SOC map.

**Ms. Svetla Rousseva (Institute of Soil Science Agrotechnology and Plant Protection "N. Poushkarov", Bulgaria):** Bulgaria faces the challenge that recently digitized legacy data are not available to the Institute. A solution is being sought.

**Mr. Rastislav Skalsky (National Agricultural and Food Centre, Slovakia):** A national SOC map can be delivered in time. Most of the agricultural soil data available were generated in the 1970s; ongoing monitoring will update these data, but it will most likely not be available in time for the GSOC mapping activity.

**Mr. Johan Stendhal (Swedish University of Agricultural Sciences, Sweden):** Soil information is collected by universities; coverage of existing local point observations is sufficient to produce a national SOC map. Sweden looks to the European Soil Partnership for regional coordination.

**Ms. Anna Benedetti, Mr. Eduardo Costantini (CREA, Italy):** Assessing SOC levels for Italian soils has been an important task for many years. However, there are differences between the Italian soil data and those required by the SOC guideline. Nevertheless, Italy will deliver a national SOC map following the GSP roadmap.

**Mr. Josef Kozak, (Agricultural University of Prague, Czech Republic):**

The Czech soil information system, as hosted by the Agricultural University, is currently being updated. It is possible for the Czech Republic to produce a national SOC map.

## South America

**Mr. Guillermo Federico Olmedo, Mr. Miguel Taboada (INTA, Argentina):** Despite Argentina's heterogeneous territory, a data base of representative soil profiles exists. INTA is currently discussing the SOC mapping campaign with the government. Agreement about the methodology and involved institutions is expected soon.

**Mr. Carlos Omar Cruz Gaistardo (Red Nacional de Laboratorios para el Análisis, Uso, Conservación y Manejo del Suelo, Mexico):** Mexico has a national SOC map, and conforming it to the GSOC specifications is being investigated.

**Ms. Beata Eموke Madari, Ms. Roberta Lima (EMBRAPA, Brazil):** Brazil has expertise and the most important data available to develop a national SOC map; a web-based national soil system is in place. If sufficient time is allowed to focus on this activity, Brazil may be able to contribute to the GSOC map by December 2017. EMBRAPA's engagement relies a lot on the data policy and Brazil considers the data policy sufficient for this purpose.

**Mr. Napoleon Ordonez (Geographic Institute Agustin Codazzi, Colombia):** There is limited availability of SOC data in Colombia and the country needs a proper methodology to develop the national SOC map.

**Mr. Luis Beltran Rivero (Istituto de Suelos, Cuba):** There is only one soil institute in Cuba, and it welcomes the SOC mapping project. Currently, the guideline is being studied and a suitable method needs to be found.

**Mr. Jesús Viloria (Universidad Central de Venezuela, Venezuela):** Technical capacity is lacking to develop the SOC map, so Venezuela is looking for support by a well-experienced partner.

### **Africa and Near East**

**Mr. Michael Shapiro (Ministry of Agriculture and Rural Development, Israel):** Anthropomorphic influence has affected the land condition, including soils, in Israel. Israel has reliable data on agricultural soils and soils covered by forestry.

**Ms. Olufunmilayo Titilayo Ande (Institute of Agricultural Research and Training, Nigeria):** Soil investigations in Nigeria have been conducted since 1991. A SOC map for Nigeria was recently developed, but it is not yet known whether this map conforms with the guideline specifications.

**Nthatuoa Kuleile (Ministry of Forestry, Range and Soil Conservation, Lesotho):** Lesotho is currently supported by FAO through a technical cooperation project enabling the creation of a soil information system. Some necessary parameters for GSOC are still missing, but it is expected that the project will allow the development of a national SOC map.

**Mr. Zacharie Segda (Bureau National des Sols, Burkina Faso):** National soil information is still being developed. At this point it is not quite sure how the challenge to develop the GSOC map, can be met.

**Ms. Noronirina Yolande Rakotomanana (Ministry of Environment Ecology and Forest, Madagascar):** There is great interest to develop a national SOC map, although it is not clear yet how this can be achieved provided the lack of a soil information system and funding in Madagascar.

**Mr. Elmobarak Abdelmagid Ali (Land and Water Research Centre, ARC, Sudan):** Cooperation with FAO started in the 1960s and 1970s. Soil information is still in paper format, and the level of detail is variable. Sudan expects that the support by FAO will continue so that a national SOC map can be produced.

**Mr. James L. Banda (Land resources conservation department, Malawi):** Malawi was recently supported by FAO to build a national soil information system. A voluntary presentation is attached to the presentations of the SOC workshop. Experience with SOC mapping exists in two districts. Further capacity is needed to engage in SOC mapping for the whole country.

**Mr. Stalin Sichinga (Zambia Agriculture Research Institute, Zambia):** The Agriculture Research Institute has a soil survey programme which has generated much data. An integrated land use assessment was done by FAO and includes soil carbon data, but assistance is needed to compile data to produce a national SOC map.

## **11. Way Forward**

It was agreed that the Secretariat will distribute the following documents for consideration of INSII members and focal points: Call for the GSSDIC/SDF, GSP Data Policy, Guidelines for SOC Mapping, 2<sup>nd</sup> INSII meeting draft report, and Arrangement for GLOSIS and SoilSTAT. Feedback on the documents will be expected according to the Roadmap, by early January 2017, so that final versions will be prepared for submission to the 5<sup>th</sup> GSP Plenary Assembly (20-22 June 2017).

## Annex I: Report of the technical workshop on the Global Soil Organic Carbon Map (GSOC), 23 November 2016

Upon various requests, the GSP Secretariat organized a special workshop on soil organic carbon mapping. This workshop was aimed at introducing the GSOC mapping guideline, and to provide technical background.

Mr. Rainer Baritz (GSP Secretariat) opened the meeting, highlighting the importance of global soil organic carbon data, as well as the need to develop national capacities in digital soil mapping. Before entering the discussion of details about the guideline, he informed about the general scope of Pillar 4: the national SOC maps and the underlying soil profile data bases are part of the pillar 4 implementation process. The first step would be the development of national soil information (systems), followed by the selection of data sets to be shared according to the Pillar 4 implementation plan (P4IP).

The introduction was followed by the presentation of three different national SOC mapping activities, representing three different methodologies: Australia, Mexico, and Tanzania.

The Australian national SOC map, presented by Neil McKenzie (CSIRO), follows the GlobalSoilMap specifications and was developed within the framework of the Soil and Landscape Grid of Australia (SLGA). The national SOC map was developed as the official soil map in Australia's National Carbon Accounting System. The map is based on ca. 5,500 sampling sites which were regionalized based on a decision tree approach with stepwise regression and geostatistical modelling of residuals. This approach not only allows for easy reproduction, but also for uncertainty assessment.

The next example was provided by Carlos Cruz Gaistardo (INEGI, Mexico). The Mexican SOC map is based on 62,000 sites that were regionalized using a national soil polygon map in combination with land use and climate maps (geomatching). The objective of the map was to determine the regional SOC concentrations and stocks, and to quantify the role of soils for the national greenhouse gas inventory, SOC dynamics and uncertainties. Mexico has great interest to use this data base for the development of soil grids based on digital soil mapping.

The Tanzania example was presented by Bas Kempen (ISRIC). The map was developed using regression kriging of 3,215 observations to develop a raster map with 250m spatial resolution. R script was used to develop the map which makes the process transparent and reproducible. Map validation was conducted using 10-fold cross-validation.

During the discussion of the three presentations, participants developed clarity of the kind of product to be developed under the GSOC campaign. Asked about the procedure of how the global map will be compiled, Mr. Baritz explained that copies of the national digital SOC grids will be collected and then merged. This is however not the procedure envisaged by Pillar 4, where priority is given to the exchange of data through web services. Since most countries do not have such an infrastructure in place yet, conventional data collection will be conducted during 2017. In the further implementation of Pillar 4, GSOC mapping may eventually become a shared system based on individual national web coverage services.

The discussion was followed by a technical presentation by Federico Olmedo (INTA, Argentina). He introduced the pre-processing of soil profile datasets (derivation of SOC stocks for 0-30 cm from genetic soil horizons, and upscaling using regression kriging). This presentation gave a first insight what INSII members could expect from the cookbook on SOC mapping. Mr. Olmedo also mentioned the production of an e-learning tool to support the GSOC mapping activity.

At the end of the day a roadmap was proposed (see above report of the INSII meeting 24-25 Nov, section 10). The Global Soil Organic Carbon (GSOC) map represents a country-driven, bottom-up mapping approach and was perceived as a great challenge and opportunity. Capacity development towards version 0 and version 1 soil grids has primary attention.

## Annex II: List of participants

Surname	Name	Country	Institution	SOC Work-shop	INSII Workshop	
				23 <sup>rd</sup> Nov	24 <sup>th</sup> Nov	25 <sup>th</sup> Nov
Abdelmagid Ali	Elmobarak	SUDAN	Land and Water Research Centre, ARC	X	X	X
Ahmadov	Hukmatullo	TAJIKISTAN	Soil Science Institute		X	X
Ande	Olufunmilayo Titilayo	NIGERIA	Institute of Agricultural Research and Training	X	X	X
Banda	James L.	MALAWI	Land Resources Conservation Department	X	X	X
Bardy	Marion	FRANCE	INRA, Infosol		X	X
Benedetti	Anna	ITALY	CREA-RPS			X
Carating	Rodelio	PHILIPPINES	Bureau of Soils and Water Management	X	X	X
Castillo	Victor	GERMANY	UNCCD Secretariat	X	X	X
Chaudhari	Suresh Kumar	INDIA	Indian Council of Agricultural Research			X
Chervan	Aliaksandr	BELARUS	Institute for Soil Science and Agrochemistry, National Academy of Sciences of Belarus	X	X	X
Costantini	Eduardo	ITALY	CREA	X	X	X
Cruz Gaistardo	Carlos Omar	MEXICO	Red Nacional de Laboratorios para el Análisis, Uso, Conservación y Manejo del Suelo	X	X	X
Ghambashidze	Giorgi	GEORGIA	Soil Fertility Research Service	X	X	X
Golozubov	Oleg	RUSSIA	M.V.Lomonosov Moscow State University	X	X	X
Kempen	Bas	NETHERLANDS	ISRIC	X	X	X
Khasankhanova	Gulchekhra	UZBEKISTAN	Design and Research Institute UZGIP	X	X	X
Kozak	Joseph	CZECH REPUBLIC	Czech University of Life Sciences		X	
Kuleile	Nthatua	LESOTHO	Ministry of Forestry, Range and Soil Conservation	X	X	X
Lee	Changhoon	REP. OF KOREA	National Institute of Agricultural Sciences, RDA		X	X
Lee	David	CANADA	Agriculture and Agri-Food Canada		X	X
Levin	Arkadiy	UKRAINE	National Scientific Center Institute for Soil Science and Agrochemistry Research		X	X
Lima	Roberta	BRAZIL	Permanent Representation of Brazil to FAO	X		X
Liu	Feng	CHINA	Institute of soil science	X	X	X

L' Abate	Giovanni	ITALY	Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria (CREA)	X		
Madari	Beata Eموke	BRAZIL	Embrapa	X	X	X
McKenzie	Neil	AUSTRALIA	CSIRO Australia	X	X	X
Montanarella	Luca	Montanarelle	European Commission		X	X
Ohkhura	Toshiaki	JAPAN	NARO-NIAES	X	X	X
Olmedo	Guillermo Federico	ARGENTINA	INTA	X	X	
Oorts	Katrien	BELGIUM	Flemish Government	X	X	X
Ordonez	Napoleon	COLOMBIA	GEOGRAPHIC INSTITUTE AGUSTIN CODAZZI	X	X	X
Rakotomanana	Noronirina Yolande	MADAGASCAR	Ministry of Environment Ecology and Forest		X (1/2 day)	X
Rivero	Luis Beltran	CUBA	Istituto de Suelos		X	
Rousseva	Svetla	BULGARIA	Institute of Soil Science, Agrotechnology and Plant Protection "N. Poushkarov"		X	X
Segda	Zacharie	BURKINA FASO	Bureau National des Sols	X	X	X
Shapiro	Michael	ISRAEL	Ministry of Agriculture and Rural Development		X	X
Skalsky	Rastislav	SLOVAKIA	National Agricultural and Food Centre		X	X
Sichinga	Stalin	ZAMBIA	Zambia Agriculture Research Institute	X	X	X
Smith	Scott	CANADA	Agriculture and Agri-Food Canada	X	X	X
Stendhal	Johan	SWEDEN	Swedish University of Agricultural Sciences		X	
Sung	Jwakyung	REP. OF KOREA	National Institute of Agricultural Sciences, RDA		X	X
Svendgaard-Stokke	Siri	NORWAY	Norwegian Institute of Bioeconomy Research	X	X	X
Taboada	Miguel	ARGENTINA	INTA	X		X
Tran	Minh Tien	VIETNAM	Soils and Fertilizers Research Institute	X	X	X
Viatkin	Kostiantyn	UKRAINE	Institute for Soil Science and Agrochemistry Research	X	X	X
Viloria	Jesús	VENEZUELA	Universidad Central de Venezuela	X	X	X
Vargas	Ronald	ITALY	FAO/GSP Secretariat	X	X	X
Baritz	Rainer	ITALY	FAO/GSP Secretariat	X	X	X
Wiese	Liesl	ITALY	FAO/GSP Secretariat	X	X	X
Stanco	Giulia	ITALY	FAO/GSP Secretariat	X	X	X
Lefevre	Clara	ITALY	FAO/GSP Secretariat	X	X	