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Food and Agriculture Organization of the United Nations

# Global Soil Partnership Plenary Assembly

GLOBAL SOIL PARTNERSHIP

| **Sixth session** |
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| **Rome, 11-13 June 2018** |
| **Progress under the GSP Pillars including the development/execution of implementation plans: for information and decision (GSPPA:VI/2018/3)** |


**Executive Summary**

- The five "Pillars of Action" underlie the technical work of the GSP, which is carried out at both the global and the regional levels (via Regional Soil Partnerships). Based on "Plans of Action" for each Pillar, specific activities, products, governance dimensions and needs for funding and capacity development were more concretely addressed through so-called implementations plans. Until now, such plans have been formulated, building on inclusive and participatory processes, and subsequently endorsed for Pillars 2, 4 and 5, in accordance with the agreed GSP guidelines.
- At the current Plenary Assembly, the Implementation Plans for Pillars 1 and 3 are presented to complete this important conceptual and practical work. Based on earlier discussions, actions under these two Pillars are mainly relevant to the regional (and of course national) level. Therefore, the Regional Soil Partnerships, as well as individual GSP partners, are particularly challenged to engage in their full realization. Of highest priority is the implementation of the Voluntary Guidelines for Sustainable Soil Management.
- Three important technical networks were established to support the execution of activities under Pillars 1, 4 and 5: the International Network of Black Soils (INBS), the International Network of Soil Information Institutions (INSII) and the Global Soil Laboratory Network (GLOSOLAN) with its regional chapters RESOLANS.
- Thanks to the active commitment of partners, a significant number of activities are currently being implemented along the five pillars, some at a more advanced stage than others. However, the goal remains for the GSP to ensure the full execution of the five global implementation plans. Financial resources are very much needed for that purpose, including

the secondment of technical experts to the Secretariat

- The first product of GLOSIS (Global Soil Information System) is the Global Soil Organic Carbon Map (GSOCMap). It has allowed to demonstrate that a GSP country-driven mechanism has worked well, and that the process of scientific supervision by the ITPS and operational implementation by INSII members successfully operates. This first experience should be rapidly scaled up to fully establish GLOSIS. However, there are still a number of critical challenges regarding Pillar 4 and GLOSIS which need to be addressed by GSP partners.
- The GLOSOLAN, and associated SEALNET and LATSOLAN, have also demonstrated their utility in improving the quality of laboratory analyses and generating technical exchanges between countries.
- Heeding the request from COAG to strengthen work on food safety through fertilizers and pesticides, an International Code of Conduct for the Use and Management of Fertilizers was developed (text in Annex I).

**Suggested action by the GSP Plenary Assembly**

The Plenary Assembly may wish to:

- acknowledge the extensive work done so far in developing global and regional implementation plans, as well as executing many underlying concrete actions. It may urge all partners to delegate their national experts and institutions into the respective working groups of the Pillars, and to allocate resources for travel and implementation, particularly as regards INSII and GLOSIS (Pillars 4 and 5), GLOSOLAN (Pillar 5), INBS (Pillar 1), as well as working groups under the Regional Soil Partnerships;
- request the GSP Secretariat to continue coordinating the overall implementation under all Pillars, and to ensure effective coordination among the Regional Soil Partnerships;
- Note with appreciation, the development of the Pillars 1 and 3 GIPs and request the Secretariat to move into the execution phase, together with all interested partners;
- invite members (who have not yet done so) to join the International Network of Black Soils (INBS) and play an active role in the global assessment of black soils;
- stress adherence to the GSP Data Policy when sharing data under GLOSIS;
- discuss and agree solutions to various challenges and issues in the further development of GLOSIS, together with ways to strengthen supportive mechanisms (INSII, Pillar 4 working group and the GSP Secretariat);
- welcome the efforts made by the ITPS, the GSP Secretariat and all GSP members in the preparation of the Global Soil Organic Carbon Map (GSOCMap), and ask all partners to further engage with version 2 and other related updates;
- invite members to join in the work of GLOSOLAN, including SELANET and LATSOLAN;
- endorse the planning document for proficiency tests under GLOSOLAN and the concept note for the best practice manual on soil laboratory analysis; also financially support the execution of proficiency tests by GSP partner institutions;
- endorse the Code of Conduct for the Use and Management of Fertilizers and submit it for consideration by the 26$^{th}$ session of COAG.

## 3.1 Pillar 1: Presentation of the implementation plan

1. The Global Implementation Plan for Pillar 1 was endorsed by the Pillar 1 Working Group (composed of representatives from the nine RSPs and one member of the ITPS) in April 2018 and subsequently approved by the ITPS during its 8th session (30 April to 4 May 2018).
2. The GIP (**reproduced in document GSPPA: VI/2018/3 Add.1**) with prime focus on sustainable soil management practices, includes activities and actions over a five-year period (2018-2022) to respond to the five recommendations highlighted in the Pillar 1 Plan of Action. Four major activities provide for global coordination and facilitation of regional and national work, as detailed in seven regional implementation plans. The GIP also takes account of requests from the GSP Plenary Assembly.
3. The GIP seeks to enhance sustainable soil management (SSM) by identifying appropriate SSM practices and systems for all land uses and working with land managers to put them in place at appropriate scales. Relevant data and information from these SSM practices will be included in the Global Soil Information System (GLOSIS), including critical characteristics such as: land use, pedoclimatic zone, and prevalent soil threats. Due attention is given to developing comprehensive SSM project proposals which would address aspects such as: the potential barriers to SSM adoption and how these would be overcome; the formulation of relevant policies and how they can be supported; capacity building prior to, and during project implementation; and monitoring of SSM management impacts on soil functions and ecosystem services.
4. The GIP for Pillar 1 is expected to undergo revision as needed, depending on effective progress, assessment of results, and reflection of lessons learnt.

### 3.1.1 Report of the survey on the implementation of the revised World Soil Charter

The revision of the World Soil Charter (WSC), a policy instrument adopted by the FAO Conference as far back as November 1981, was carried out under the aegis of the GSP and the ITPS. Updating the vision and guiding principles in the Charter was indeed necessary in a fast evolving world, especially with respect to new issues that emerged or were exacerbated during the last decades, like soil pollution and its consequences for the environment, climate change adaptation and mitigation, and urban sprawl impacts on soil availability and functions. The reformulation process involved extensive consultations and culminated in the unanimous endorsement of the revised World Soil Charter by the FAO Conference at its 39th session in June 2015 (coinciding with the International Year of Soils).

In order to assess how the different stakeholders used the revised charter and its principles and guidelines, an online survey was designed by the GSP Secretariat with the support of the ITPS, and was launched in March 2018. On 22 April 2018, the survey was closed, with 87 complete responses submitted. Inputs were mainly provided by Asian countries (46%), followed by Europe (19%), South America (12%), Africa (10%), Central America and the Caribbean (5%), the Near East and North Africa (6%) and North America (2%). No inputs were received from Eurasia and the Pacific regions.

Respondents to the survey were mainly partners to the GSP (63%), followed by GSP national focal points (31%) and others (6%). While 36% advised to be familiar with the original World Soil Charter, familiarity with the revised Charter stood at 52%. Participants in the survey, were asked to identify themselves in terms of the main stakeholder groups highlighted in the Charter (governments – 67%, academia and science community – 23%, individual and private sector – 7%, and international organizations – 4%) and to provide information on the status of implementation of activities for their group in respective countries.

Representatives from the private sector were from Africa, Asia and Europe. Overall, activities for this stakeholder group were mainly under implementation (50%), 25% had been implemented and no action was YET taken for the remaining 25% of the activities.

Representatives from professional groups and the science community were from Asia, Central America and the Caribbean, Europe, North America and South America. Many activities for this stakeholder groups were reported as implemented (63%). Respondents also reported that 32% of the activities were under implementation and that no action was taken to implement the remaining 5% of the activities.

Representatives from governments were from Africa, Asia, Central America and the Caribbean, Europe, the Near East and North Africa, and South America. Again, many activities for this stakeholder group were under implementation (68%). Respondents also reported that 17% of activities were implemented and that no action was taken to implement the remaining 15% of activities.

Representatives from international organizations were from Africa, Asia and South America. While a large share of activities were under implementation (89%), respondents also reported that the remaining 11% of the activities were implemented.

The survey was particularly useful in highlighting the major barriers to the implementation of the principles in the revised WSC, i.e.: unavailability of funds, the lack of awareness of the Charter, the absence of, or inadequate policies on soil protection, and the absence of monitoring systems (e.g. on the use of subsidies for soil protection, on soil status, etc.). Emphasis was put on the fact that the benefits of sustainable soil management are not visible in the short term, and that there are serious weaknesses in the extension services at the national/local level. Other barriers less prominently identified were: the unreadiness of those managing soil resources to change their practices, some mistrust in scientific findings from the academia, policy decisions and public sector tools, and the perception that these policies are not workable/implementable at the field level. Some accent was also made on the priority given by land users to economic benefits, at the possible expense of the application of sustainable soil management practices.

Respondents were also asked for suggestions on how to promote, disseminate and implement the revised WSC at the national/local level. The main ones are:

- Investment in awareness raising activities (e.g. roadshows, media campaigns, promotional events, official celebrations like the World Soil Day, stakeholder consultations, etc.) to put the topic of soil health preservation in the top priority list of national governments and land users. In this regard, the suggestion to link the revised WSC to research/development programmes was also made;
- Improve communication with key development agents (cooperatives, agricultural credit banks, technical assistance agencies, etc.);
- The organization of high-level inception meetings, and the involvement of the government in large scale sustainable soil management projects. Additionally, the revised WSC and similar policy documents on soils should be presented to the head of State and relevant Ministers through preferential communication channels;
- The establishment (by national governments) of rewarding/sanction systems on the implementation of sustainable soil management;
- Provide policy makers and land users with analytical tools to implement the principles in the revised WSC (e.g. decision analysis and support tools, and better information for targeting interventions);

- Establish demonstration sites and provide practical examples on how to implement the principles in the revised WSC;
- Enquiries on community needs in relation to soils to enlighten policy makers (including making use of national wide complaints to trigger action);
- Establish a study on the economic benefits of sustainable soil management;
- Rectify UN declarations as regards soils, like the Paris agreement;
- Presenting the revised WSC to interdisciplinary meetings (food production, climate change, energy);
- Set targets and standards linked to the implementation of principles in the revised WSC;
- Improve communication with donors in order to increase the mobilization of financial resources at the national, regional and global levels.

Ultimately, issues or aspects related to soils that were deemed to be omitted in the revised WSC were identified, such as:

- Actions to manage and restore salt-affected soils, which are covering a large surface area globally;
- Highlighting the role of soils and soil organic carbon in climate change adaptation and mitigation, in this regard, the importance of managing peatlands was noted);
- Actions for managing anthropogenic soils;
- Stressing the issues of urban expansion, mining, land use change policies and land tax systems;
- Including educational institutions as a separate main stakeholder group;
- Being more specific on how to monitor the implementation of activities in the revised WSC and eventually propose deadlines for their implementation;
- Linking more clearly the principles in the revised WSC to the Sustainable Development Goals and major social challenges.

A comprehensive report on the results of the online survey will be prepared and issued by the GSP Secretariat.

### 3.1.2 Report on the implementation of the Voluntary Guidelines for Sustainable Soil Management

5. The VGSSM were endorsed by the 155th session of the FAO Council in December 2016 and their implementation at all levels will take a central place under Pillar 1. The VGSSM focus mostly on the provision of ecosystem services and elaborate on the principles outlined in the revised World Soil Charter, taking into account the evidence provided in the Status of the World's Soil Resources report. Attention was given to disseminating the VGSSM (that were issued in the UN languages) in as wide a manner as possible. A global dialogue is to be organized to discuss with stakeholders (mainly countries) how they could be implemented at the national level, and resources are being identified to support this dialogue. Meanwhile, attention is given to advocating implementation at national level. Concrete examples like Costa Rica and Italy could serve as an example for scaling up.
6. Together with the ITPS, the Secretariat identified the need for developing a protocol to assess if a given soil management practice is in line with the definition of sustainable soil management as given by the ITPS in 2015. It is intended to be used in the assessment and documentation of SSM practices. The aim is to have examples of good SSM practices that will be then disseminated together with the VGSSM. This protocol is available in document **GSPPA: VI/2018/3 Add.3**.

7. Furthermore, in cooperation with the FAO partnerships division, a due diligence tool is under preparation to advocate for the implementation of the VGSSM by the development banks.

#### 3.1.2.1 Preparation of a Code of Conduct for the Use and Management of fertilizers

The Committee on Agriculture (COAG), at its 25th session (26-30 September 2016): "*recommended that FAO intensify its food safety work and technical support to smallholders at local level concerning the safe use of fertilizers and pesticides*".

The Status of the World's Soil Resources (SWSR) highlights the fact that '*humanity is close to the global limits for total fixation of nitrogen (N) and regional limits for phosphorus (P) use*'. In addition, the SWSR identifies contamination through agricultural inputs such as fertilizers as a major threat to soils. This issue, as well as that of nutrient imbalances, is given due emphasis in the Voluntary Guidelines for Sustainable Soil Management (VGSSM), an instrument which is moving into full implementation, as highlighted above. It is also important to note that during the preparation and endorsement of the VGSSM, some countries requested the inclusion of tolerance levels of heavy metals in fertilizers and also some regulatory aspects of their use. The Secretariat explained that these details will be incorporated into the technical manuals which is an important step in the process.

The ITPS has been taking other bold actions to implement the VGSSM, including the organization of Global Symposiums on 'Soil Organic Carbon' in 2017 and 'Soil Pollution' in 2018, as well as the issuance of technical manuals for the different sections of the VGSSM.

Therefore, the ITPS and the GSP Secretariat, together with AGP and CBL Divisions in FAO, considered that there was a need for a proactive role in implementing the VGSSM chapter on nutrient imbalance, thereby also addressing the COAG request in relation to food safety. This has led to the initiative of developing a Code of Conduct for the Use and Management of Fertilizers (CoCoFe) without any further delay.

During its 7th working session in 2017, the ITPS agreed on a process to develop this Code of Conduct. An online consultation was opened to the public (from December 21, 2017 to 11 February, 2018) to acquire feedback on contents and objectives of the Code from a broad range of stakeholders. A drafting group (composed of ITPS members and the Secretariat) used this feedback to produce a zero-draft of the CoCoFe with guidance from the ITPS as well as from various experts within FAO. During its 8th working session (30th April – 4th May 2018), the ITPS reviewed and endorsed a "zero draft CoCoFe". The zero-draft was reviewed by an open-ended working group (OEWG) of experts in fertilizer management and related policy formulation during a meeting held on 7-9 May 2018. The OEWG was constituted of 27 members selected by member countries to represent all the regions, as well as 13 representatives from the fertilizer industry, academia, the research community and civil society. The OEWG reviewed and finalized the draft Code of Conduct, which is herewith submitted to the 6th Plenary Session of the PA for endorsement. If endorsed, the draft will be submitted to the Committee on Agriculture (COAG) for review and possible endorsement in September 2018.

The CoCoFe supports both Pillars 1 and 2 by promoting the sustainable use of fertilizers to avoid any negative impacts on soils, and by encouraging the cooperation of different stakeholders, governments, industry and civil society in doing so. The draft endorsed by the 8th working session of the ITPS and then reviewed and finalized by the Open-Ended Working Group can be found in **Annex 1**.

### 3.1.3 Establishment of the International Network of Black Soils

8. The International Network of Black Soils (INBS) was launched on 21 March 2017 during the Global Symposium on Soil Organic Carbon (GSOC17), held at FAO headquarters, as a platform for countries endowed with black soils to discuss common technical issues related to the

conservation and sustainable management of these soils. The first meeting of this network will take place on 10-12 September 2018 in Harbin, China, as part of the International Symposium on Black Soils. Meanwhile, there is an interactive exchange within this network to agree on a definition of black soils and the preparation of a work plan that will include a Global Assessment of Black Soils.

### 3.2 Pillar 2: Execution of the implementation plan

9. The Pillar 2 GIP provides the road map over five years (2017-2021) to achieve sustainable soil management by focusing on six interlinked components: investment, policy, education, extension, societal awareness, and technical and scientific cooperation. Ultimately, the Pillar 2 GIP is to contribute to success under all the other GSP Pillars, because it aims to involve stakeholders in promoting, investing in, and practicing sustainable soil management.
10. Concerning **investments**, the GSP Secretariat is working on building partnerships with investment funds and establishing safeguard standards, primarily via the new Healthy Soils Multipartner Platform (cf. Item 5);
11. As regards the **policy** facet, the impact of policy documents produced within the Global Soil Partnership is constantly monitored. In this regard, the results of an online survey to assess activities by GSP partners in support of the principles of the revised World Soil Charter (developed and launched in March 2018) have been extensively addressed above.
12. Under **education** and **awareness raising**, materials were produced especially on the key topics of soil organic carbon and soil pollution. Material was also produced in relation to the implementation of the outcomes of the Global Symposium on Soil Organic Carbon and to the theme of the World Soil Day 2017, *Caring for the planet starts from the ground.*
13. In order to promote **technical and scientific cooperation**, the Secretariat organized and/or co-organized regional and international meetings, such as the annual meetings of the Regional Soil Partnerships, the Global Symposium on Soil Pollution and the International Symposium on Soil Health and Sustainable Development. Additionally, work is under way to establish EduSOILS, a GSP educational platform to operate in 2019, depending on resources availability.
14. Under **extension**, prime emphasis is placed on the Soil Doctors Global Programme, which will be implemented in selected "volunteer" countries in Africa and South America by the end of 2018. Interested countries will be provided with an implementation manual, guidelines for soil analysis and other ad-hoc educational materials. Countries implementing the programme in 2018 will serve as case studies to refine its objectives and promote its implementation in other countries and regions.

### 3.3 Pillar 3: Presentation of the implementation plan

15. The Global Implementation Plan for Pillar 3 (**reproduced in document GSPPA: VI/2018/3 Add.2**) was endorsed in April 2018 by the Pillar 3 Working Group (composed of representatives from the nine RSPs, one member of the ITPS, as well as representatives from the following institutions: International Union of Soil Sciences, BonaRes[1]) and subsequently approved by the ITPS during its 8th session on 30th April 4th May 2018.
16. The plan was developed to identify concrete research and development (R&D) activities and actions over five years (2018-2022), to implement the four recommendations made in the Pillar 3 Plan of Action. Five activities were included to provide for global coordination and facilitation of regional and national research activities, as detailed in seven regional implementation plans.

[1] BMBF funding initiative "Soil as a sustainable resource for the bioeconomy - BonaRes", Germany

17. The implementation plan aims to facilitate wide and easy access to soil R&D information through a global internet platform as a knowledge hub for different users. Information will include: involved research partners, facilities, programmes, identified research gaps and various additional fields. It will seek to capitalize on existing R&D initiatives at the regional level, as well as identify research priorities at global, regional and national levels. Ultimately, the identified gaps would be filled through inter- and transdisciplinary research facilitated through regional platforms.
18. The GIP for Pillar 3 is considered a living document and is expected to undergo revision as needed, especially considering the dynamic nature of research work.

## 3.4 Pillar 4: Execution of the implementation plan

19. The basis for action under Pillar 4 is the Global Implementation Plan (Pillar 4 GIP), supplemented by Regional Implementation Plans. Some progress may be reported on establishing different elements of the Global Soil Information System (GLOSIS). However, there is an evident need to mobilize financial resources in order to move on to the full establishment of GLOSIS.
20. The process of developing and sharing harmonized transboundary soil information through GLOSIS is also directly supported by Pillar 5. Both Pillars complement each other, and rely on activities of the International Network of Soil Information Institutions (INSII).

### 3.4.1 Establishment of the Global Soil Information System (GLOSIS) and report by INSII Chair

#### a) Report by the INSII Chair

21. The INSII chair was elected during the 5th GSP Plenary Assembly. He has started operating, chairing the 3rd INSII workshop, as well as two video conferences with the Pillar 4 working group. In addition, he is a member of the Pillar 5 WG. Effective results will depend on a fully representative INSII network and increased budgeting of resources by partners for Pillar 4 activities. A full report from the INSII chair is provided in **Annex 2,** also drawing attention to critical issues and challenges.

#### b) Arrangement to establish (GLOSIS), including the International Network of Soil Information Institutions

22. The core objective of the Pillar 4 GIP (and supported by Pillar 5 GIP) is the development of the Global Soil Information System (GLOSIS). The main implementing actors are the members of the International Network of Soil Information Institutions (INSII). The formal basis for these institutions to operate as a recognized and officially mandated network is the 'Arrangement for the establishment of GLOSIS', as endorsed during the 5th GSP Plenary Assembly in 2017.

#### c) International Network of Soil Information Institutions (INSII)

23. The Third Workshop of INSII was held at FAO Headquarters on 31 Oct - 1 Nov 2017. The workshop agreed on priority activities for 2018 and this effectively forms the annual work plan for the Pillar 4 Working Group. The Pillar 4 Working Group has met three times since the 5th GSP Plenary Assembly.

#### d) GSP Soil Data Facility (SDF)

24. ISRIC World Soil Data, supported by the Dutch government, was nominated and selected to become the GSP SDF during the 5th Plenary Assembly. The GSP SDF is member of the Pillar 4 and Pillar 5 working groups and the INSII network. Officers of the GSP SDF have developed components of the required soil data infrastructure and they are conducting various harmonization activities (see Pillar 5). The SDF has contributed to the Global Soil Organic Carbon Map through capacity development and by supporting the preparation of the technical instructions manual (the "cookbook").

**e) GSP Data Policy**

25. The GSP Data Policy has been in place since the 5th Plenary Assembly of 2017. It reaffirms national data rights and protects all data products developed and shared via GLOSIS.

### 3.4.2 Workplan 2018/2019

26. A concept note for SoilSTAT (as new element of FAOSTATS family) is in preparation by the GSP Secretariat.
27. Activities of the Pillar 4 WG focus on the development of the spatial data infrastructure, including effective task sharing between the GSP Secretariat and the SDF. The following activities are currently underway:
    - Drafting of a promotional brochure for current and potential resource partners;
    - Developing technical specifications for Tier 1 and Tier 2 soil profile databases;
    - Clarifying whether an updated version of the Harmonised World Soil Database is needed;
    - Updating the technical specifications for the fine resolution grids in collaboration with the Working Group on GlobalSoilMap of the International Union of Soil Sciences (IUSS);
    - Supporting Version 2 of the GSOCmap;
    - Preparing guidelines for National Soil information Systems.
28. The regional Pillar 4 (and Pillar 5) working groups have to be made fully operational so that regional (thus global) implementation can progress. As a minimum, these regional working groups are composed of the pertinent INSII members.
29. The 4th INSII meeting will be held at FAO Headquarters on 23-25 Oct 2018.

### 3.4.3 Global Soil Organic Carbon Map (GSOCMap)

30. The preparation of the Global Soil Organic Carbon map (GSOCMap) was mandated by the 4th GSP Plenary Assembly to the ITPS and GSP Secretariat. This request was endorsed by the 25th session of the Committee on Agriculture (COAG) held on 26-30 September 2016 (document here) and the 155th FAO Council held on 5-9 December (document here). Initially, the preparation of this map came as a request from the SPI-UNCCD as a contribution to the SDG process, particularly for monitoring of the SDG indicator 15.3.1. This initiative gained further traction during the Global Symposium on Soil Organic Carbon (GSOC17). It was emphasized that the GSOCmap should form the reference layer for future updating and trend analysis.
31. The issuance of the GSOCmap was conceived as a first data product of GLOSIS. Therefore, the preparation process followed the distributed system approach in which member countries produce their own soil organic carbon map according to guidelines/technical specifications. Additionally, a cookbook as a technical instructions manual was developed.
32. During the GSOCmap development, many countries expressed their need for capacity development/training on the use of digital soil mapping tools. The GSP Secretariat, assited by donor funding, has organized many training sessions in all regional soil partnerships, and in other cases, at the national level (cf. Table).

| | |
|---|---|
| NENA | 10-14 Oct 2016, Rabat, Morocco |
| Asia | 24-29 April 2017 Bangkok, Thailand |
| Africa | 3-7 July 2017 Nairobi, Kenya |
| Central America and the Caribbean | 26-30 June 2017 Aguas Calientes, Mexico |
| Eurasia | 24-29 July 2017 Tashkent, Uzbekistan |

| | |
|---|---|
| 17 countries from 6 regional soil partnerships | 6-23 June 2017, Wageningen, The Netherlands |

Other previous training sessions on digital soil mapping were conducted in Cali, Colombia (2012), Rio de Janeiro, Brazil (2012 and 2013), Accra, Ghana (2015), Amman, Jordan (2015), Almaty, Kazakhstan (2016).

33. 75 countries (68% of world area) have contributed to the GSOCmap by 5 December 2017 (World Soil Day). In total, more than 1 million soil profiles/sampling locations were used by the countries. In order to avoid gaps, the GSP Secretariat has prepared national GSOCmaps based on publicly available soil data.
34. The GSOCmap was reviewed by the ITPS during its 7th working session (23-27 October 2017) which was organized jointly with the 3rd INSII workshop. The map was endorsed by ITPS as a product to be continuously updated. The current version of GSOCmap is 1.2.0, and will be periodically updated with new contributions from countries. The GSOCMap was successfully launched during World Soil Day on 5 December 2017. The technical report describing the development of GSOCmap, and the 2nd eddition of the Soil Organic Carbon Mapping Cookbook were released in April 2018. The list of countries which contributed with their national maps to the GSOCmap version 1.2.0 were:

| | |
|---|---|
| National SOC maps | Argentina, Armenia, Austria, Australia, Azerbaijan, Belgium, Bolivia, Brazil, Bhutan, Canada, Chile, Colombia, Costa Rica, Cuba, Germany, Denmark, Ecuador, Ethiopia, Finland, France, Ghana, Hungary, Indonesia, Iraq, Italy, Jordan, Japan, Kazakhstan, Kenya, Lebanon, Lesotho, Luxembourg, Morocco, Moldova, Mexico, Mongolia, Mozambique, Malawi, Nigeria, Nicaragua, Netherlands, Nepal, New Zealand, Panama, Peru, Philippines, Paraguay, Russian Federation, Sudan, Senegal, El Salvador, Slovakia, Slovenia, Sri Lanka, Sweden, Swaziland, Tanzania, Thailand, Trinidad & Tobago, Turkey, Ukraine, Uruguay, United Kingdom of Great Britain and Northern Ireland, United States of America, Uzbekistan, Venezuela, Vietnam |
| SOC maps in cooperation with the GSP Secretariat | Dominican Republic, India, Laos, Myanmar, Somalia, South Africa, Switzerland, Syria, Iran, Bosnia Herzegovina, Cambodia |
| New SOC maps for the GSOCMap update | Madagascar, Cameroon, Rwanda, Afghanistan, Iran, Cambodia, Bosnia Herzegovina, China |

35. Considering the successful experience with the preparation of the GSOCmap, the Secretariat will pursue improvements by bringing new countries producing their national SOC maps. At the same time, clear need for producing a SOC sequestration potential and Global Soil Organic Monitoring System should be addressed.

## 3.5 Pillar 5: Execution of the implementation plan

### 3.5.1 Implementation plan and governance

**a) Implementation Plan**

36. The Pillar 5 Implementation Plan (P5 GIP) has been endorsed during the 5th Plenary Assembly 2017. Pillar 5 actions are closely linked to Pillar 4, INSII and GLOSIS. They also involve activities of the global and regional soil laboratory networks (GLOSOLAN, RESOLAN).

**b) Composition of Pillar 5 Working Group - update**

37. The Pillar 5 WG has benefitted from additional members: chair INSII and Pillar 4 WG (Neil McKenzie), Chair GLOSOLAN (Nopmanee Suvannang), new member for the South American Regional Partnership (Jefe Leao Ribeiro), a temporary member for the Pacific Region (Peter Wilson), the International Union of Soil Science (IUSS) (John Galbraith), and the GSP Soil Data Facility (Rik van den Bosch). Due to organizational changes in the Technical Committee 190 (Soil Quality) of the International Standardization Organization (ISO), a new member for the Pillar 5 WG still needs to be nominated. The representative of the ITPS, Bhanooduth Lalljee, will also represent the African RSP.

### 3.5.2 Workplan 2018/2019

**a) Tender Global Soil Information Model (P5 GIP section 4.1)**

38. A concept note for a subcontract to finalise the global interoperability conceptual model has been developed by the Pillar 5 WG. This foresees the review of existing activities, products and experiences regarding the exchange of digital soil data via web services. The task will be examining the usefulness of ISO 28258, to detect remaining challenges and to suggest and implement a solution. Having an agreed upon soil information model is key for building GLOSIS. Once in place, INSII members will be engaged in national testings. It is a fundamental requirement that any standard recommended by Pillar 5 is compatible with national models already in place (including INSPIRE for Europe). The subcontracting will be implemented by the GSP Secretariat using funding from the Healthy Soil Facility.

**b) Sub-Group on Soil Indicators**

39. A working group to elaborate these indicators will be established involving the key networks and experts.
40. A new policy will be developed by GLOSOLAN, ensuring proper rights for analytical data developed during ring tests.

### 3.5.3 Report on the Global Soil Laboratory Network (GLOSOLAN) and RESOLAN

41. The Global Soil Laboratory Network (GLOSOLAN) was launched (http://www.fao.org/3/BU271/bu271.PDF) in November 2017 with the purpose of tackling the harmonization of methods, measurements, and indicators for the sustainable management and protection of the soil resources. GLOSOLAN would serve to: (1) make soil information across laboratories, countries, and regions comparable and interpretable, (2) build a set of agreed upon harmonization principles, (3) improve quality assurance and control (QA/QC) of soil analyses, and (4) promote information and experience exchange to develop capacities wherever needed.

42. The election of the GLOSOLAN Chair and the establishment of the GLOSOLAN Working Group took place during the kick-off meeting of the network. During the same meeting, the roadmap for GLOSOLAN was defined for the year 2018.

43. A call for laboratories to register in the network was made and 99 laboratories from all over the world joined GLOSOLAN. As per the GLOSOLAN roadmap, the first questionnaire was finalized by the GLOSOLAN working group and launched in the form of an online survey. The survey closed on 30 March 2018 and 110 responses were received. Results from the survey will be presented in a report.

44. A protocol for the execution of the first GLOSOLAN ring test was prepared with the support of WEPAL as well as a concept note for a best practice manual. Both these documents were revised and approved by the GLOSOLAN working group. A concept note for the best practice manual could be found in **document GSPPA: VI/2018/3 Add.4**.

45. The Regional Soil Laboratory Networks (RESOLAN) for Asia (SEALNET) and for Latin America (LATSOLAN) were launched in November 2017 and March 2018, respectively. During these kick-off meetings, the Chair, co-Chair and members of the working groups for these RESOLANs were identified and regional work plans were developed. The launch of RESOLANs for other regions is undergoing, starting from one for both Europe and Eurasia, the Chairs of which agreed to work as a combined region.

46. Under SEALNET (http://www.fao.org/3/I9063EN/i9063en.pdf ), 17 of the 18 countries in the network participated in the kick-off meeting. Countries agreed to write four Standard Operational Procedures (SOPs) for pH in water, organic carbon, exchangeable potassium and available phosphorus, as well as “Guidelines for implementing and maintaining good laboratory practices and quality management in soil laboratories”. SOPs will be developed looking at those already in use in SEALNET’s member laboratories so as to make their implementation easier. Laboratories in SEALNET also agreed to perform an internal quality control and a ring test for external quality control. In this regard, standard soil samples were prepared by the Land Development Department of Thailand and shipped with the support of the FAO Thailand office.

47. Under LATSOLAN, twenty countries participated in the kick-off meeting of the network and agreed on working together on the harmonization of their soil laboratory procedures. In this regard, soil samples for a regional ring test were distributed to participants during the kick-off meeting. Ultimately, countries agreed to produce a regional “*Manual on harmonized soil laboratory analysis*” by the end of 2018.

# Annex 1:

# International Code of Conduct for the Use and Management of Fertilizers

First draft initially prepared by the Intergovernmental Technical Panel on Soils (ITPS) and then reviewed and finalized by the Open-Ended Working Group (OEWG)

Fertilizers are important and widely used inputs in modern agriculture contributing to global food security, farmer livelihoods and essential human nutrition. However, they may have negative impacts on the environment, human health and animal health if not used responsibly. As agrochemicals, fertilizers are subject to various legislation and regulations relating to production, trade, distribution, marketing, safety and use that can vary between countries or regions. Responsible use and management of fertilizers at the farm level requires careful consideration of many parameters including the crop to be grown, the soil type and condition, previous agronomic activities, water application, weather, access to fertilizers and farm economics. In addition, the use of fertilizers must be considered at the landscape and global levels due to potential nutrient losses to the environment and the negative effects of such losses.

This document is an International Code of Conduct for the Use and Management of Fertilizers. It has been prepared to support and implement the Voluntary Guidelines on Sustainable Soil Management and to assist countries to address the multiple and complex issues related to the responsible use and management of fertilizers in agriculture, from that at the farm level to the national level, while keeping in mind a global perspective.

**Preamble and Introduction**

Fertilizers make a significant contribution toward sustaining the population of the world by providing food security, enhancing farmer livelihood, providing essential human nutrition, and minimizing the conversion of land from native ecosystems to agricultural production. Fertilizers can dramatically increase the availability of nutrients to crops, thus improving soil ecosystem services that contribute, directly and indirectly, to 95% of global food production. However, impacts of fertilizer use can include contribution to global climate change and degradation of soil and water resources and air quality, particularly when not properly utilized. Overall, the intent of this document is to maximize the benefits from utilizing fertilizers while minimizing any negative impacts.

The UN Agencies and their Member Countries are working towards achieving the Sustainable Development Goals (SDGs) by responding with various actions and recommendations in relation to sustainable soil and nutrient management.

The Committee on Agriculture (COAG), during its 25th session held 26-30 September 2016, recommended that FAO intensify its food safety work and technical support to smallholders at the local level concerning the safe use of fertilizers and pesticides (FAO, 2016).

The recent Status of the World's Soil Resources (SWSR) report published by FAO and the Intergovernmental Technical Panel on Soils (ITPS) identified ten major threats to soils that need to be addressed if the SDGs are to be achieved (FAO and ITPS, 2015). The Global Soil Partnership (GSP) and FAO subsequently produced the Voluntary Guidelines for Sustainable Soil Management (VGSSM) as a first step to addressing these threats, two of which are 'nutrient imbalances' and 'soil pollution' and involve fertilizer applications that can be excessive, insufficient or polluting, none of which are sustainable (FAO, 2017). The relevant chapters in the VGSSM; 3.3 - Foster nutrient balances and cycles, and 3.5 - Prevent and minimize soil contamination, provide initial guidance on promoting sustainable nutrient use in relation to soils, agriculture and the environment, however further support is required to implement these recommendations.

In addition, a declaration on managing soil pollution to achieve sustainable development was adopted in the recent third UN Environment Assembly (UNEA 3) held in Nairobi in December 2017 (UN Environment, 2017).

During the seventh Intergovernmental Technical Panel on Soils (ITPS) working session, 30 October - 3 November 2017, ITPS agreed with the support of the Secretariat to develop an International Code of Conduct for the Use and Management of Fertilizers, hereafter referred to as the 'Fertilizer Code', or 'Code':

(i) in response to COAG's request to increase food safety and safe use of fertilizers;
(ii) to facilitate the implementation of the VGSSM to address nutrient imbalance and soil pollution; and
(iii) to respond to the UNEA3 declaration on soil pollution.

Inputs to, and feedback on the contents and objectives of the Fertilizer Code, was obtained from a broad range of stakeholders during an online consultation that was open to the public from 21 December 2017 to 11 February 2018. The feedback generated in the forum was used to produce a zero-draft Fertilizer Code with the support and guidance of the ITPS, as well as from various experts within FAO. The zero-draft was reviewed by an open-ended working group (OEWG) of experts in the field of fertilizer management and policy, 7-9 May 2018. The OEWG constituted persons selected by member countries to represent the regions, as well as representatives from the fertilizer industry, academia, the research community and civil society.

The Fertilizer Code is to be presented to the 6th GSP Plenary Assembly, 11-13 June 2018, requesting endorsement, and subsequent presentation by the GSP to the Committee on Agriculture (COAG) in September 2018 and FAO Council in December.

GOAL

The goal of the International Code of Conduct for the Use and Management of Fertilizers is to contribute to sustainable agriculture and food security from a nutrient management perspective. It will provide a framework under which governments, the fertilizer industry, agricultural extension and advisory services, supporting academic and research institutions, actors in the nutrient recycling

industry, civil society and end-users can contribute to this goal by following or adhering to the guidelines and recommendations provided.

WHAT IS A FERTILIZER?

When using the term ‘fertilizer’ we refer to a chemical or natural substance or material that is used to provide nutrients to plants, usually via application to the soil, but also to foliage or through water in rice systems, fertigation or hydroponics or aquaculture operations. Thus, multiple nutrient types and sources are considered within this Fertilizer Code including: chemical and mineral fertilizers; organic fertilizers such as livestock manures and composts; and sources of recycled nutrients such as wastewater, sewage sludge and digestates.

## 1. Scope, Goals, and Objectives

1.1. The International Code of Conduct for the Use and Management of Fertilizers is a set of agreed-upon expectations for behavior by various stakeholders for the use and management of plant nutrients.

1.2. This Fertilizer Code is addressed to governments, policy makers, the fertilizer industry, academia, research, agricultural and analytical service laboratories, agricultural extension and advisory services, civil society and users of fertilizers, including farmers.

1.3. The intent of the Fertilizer Code is to assist countries in the establishment of systems for monitoring the production, trade, distribution, quality, management and use of fertilizers to achieve sustainable agriculture and the Sustainable Development Goals (SDGs) by promoting integrated, efficient and effective use of quality fertilizers with the following outcomes:

1.3.1. Ensure global food production and food security while maintaining soil fertility, ecosystems services and protecting the environment;

1.3.2. Maximize the effective and efficient use of fertilizers to meet agricultural demands and minimize nutrient losses to the environment, thus enhance sustainable agriculture;

1.3.3. Preserve ecosystem services and minimize environmental impacts from the use of fertilizers including soil and water pollution, ammonia volatilization, greenhouse gas emissions and other nutrient loss mechanisms;

1.3.4. Maximize the potential economic and environmental benefits accrued from using fertilizers, including reducing the need for additional land to be brought into production, increased carbon storage in soils, and improvements in soil health;

1.3.5. Minimize the negative impacts of excess nutrients in ground and surface waters on human and animal health;

1.3.6. Minimize the negative effects and potential toxicity of contaminants in fertilizers on soil, soil biodiversity as well as animal and human health;

1.3.7. Maintain and improve food safety, diets, nutritional quality and human health.

1.4. The objectives of the Fertilizer Code are to:

1.4.1. Provide a set of voluntary standards of practice for all stakeholders involved in the use and management of fertilizers, including governments, the fertilizer industry, agricultural extension and advisory services, the private sector, academia and research, end users and other public entities.

1.4.2. Encourage cooperation and collaboration between all stakeholders involved in the fertilizer value chain for the responsible and sustainable development, production, use and management of fertilizers and reused and recycled nutrients.

1.4.3. Promote collaboration, partnership and information exchange among the fertilizer industry in the access to and use of fertilizers consistent with legal competition obligations.

1.4.4. Promote recycling of nutrients for agricultural and other land uses to reduce the environmental impacts of excess nutrients in the biosphere.

1.4.5. Inspire governments and the private sector to promote and fund innovation in sustainable agricultural nutrient technologies and management.

1.4.6. Assist countries and regions to control and enforce fertilizer quality through appropriate regulatory mechanisms and reducing economic losses to end users.

1.4.7. Improve fertilizer safety and reduce the risks to human and animal health.

1.4.8. Encourage the promotion and dissemination of knowledge, including comparable statistics, on all matters related to fertilizer use and management through appropriate mechanisms, institutions and outreach programmes.

1.4.9. Encourage Integrated Soil Fertility Management (ISFM) using nutrients from a range of sources.

1.5. This Code is a living document and should be reviewed and updated by FAO every five to ten years, or, when and where deemed appropriate by Member Countries and through the appropriate FAO governing bodies.

## 2. Terms and Definitions

**Agricultural extension and advisory services (AEAS):** refers to any organization in the public or private sectors (NGOs, farmer organizations, private firms, etc.) that facilitates farmers' and other rural actors' access to knowledge, information and technologies, and their interactions with other actors; and assists them to develop their own technical, organizational and management skills and practices, so as to improve their livelihoods and well-being. (Christoplos, 2010)

**Advertising**: the promotion of the fair sale and wise use of fertilizers by printed and electronic media, social media, signs, displays, gifts, demonstration or word of mouth.

**Animal manure:** materials from livestock production operations used for fertilization purposes, including manure, urine, straw and other bedding materials.

**Application rate**: the quantity of fertilizer applied per unit area. May include an element of time, for example per growing season or year.

**Biodiversity:** the diversity among living organisms, which is essential to ecosystems function and services delivery (FAO, 2018a)

**Biofertiizer:** a substance containing live microorganism which, when used for plant production, increase the supply or availability of primary nutrients to plants through nitrogen fixation, phosphorus solubilization and the stimulation of plant growth through the synthesis of growth-promoting substances.

**Biosolids:** organic solids from wastewater that have been treated so that they can be used as a soil conditioner to provide plant nutrients, carbon, and other beneficial substances. See sewage sludge.

**Biostimulant:** product that stimulates plant nutrition processes independently of nutrient content, with the aim of improving one or more of: the plants' nutrient use efficiency or uptake; tolerance to abiotic stress; or, crop quality traits.

**Contaminant:** substance contained within fertilizers that are not plant nutrients. May include, but is not limited to, heavy metals, pathogens and fillers.

**Digestate:** solid material remaining after various digestion processes have been used on waste products such as livestock manures.

**Disposal:** any operation to dispose, recycle, neutralize, or isolate fertilizers and fertilizer waste, containers and contaminated materials.

**Distribution:** the process by which fertilizers are supplied and transported through trade channels to local, national or international markets and lands.

**Ecosystem services:** the multitude of benefits that nature provides to society. (FAO, 2018a)

**Fertigation:** the application of a plant nutrient, soil amendment, or reclaimed water from food processing and wastewater treatment facilities with irrigation water.

**Fertilizer:** a substance that is used to provide nutrients to plants, usually via application to the soil, but also to foliage or through water in rice systems, fertigation, hydroponics or aquaculture operations.

**Fertilizer additives**: substances added to or modifications of fertilizers, or products added to the soil, designed to increase fertilizer use efficiency through a variety of actions including, but not limited to, reductions in solubility, coatings of fertilizer granules, inhibition of nitrification or urea hydrolysis, or stimulation of soil microorganisms.

**Fertilizer application:** unless specified otherwise, 'application of fertilizer(s)' or 'fertilizer application' refers to the application of nutrients for the benefit of plant growth in general, and not to any specific type of fertilizer. It includes applications for agricultural and other purposes, including recreational and sporting facilities, public and private gardens and lawns.

**Fertilizer grade or plant available nutrient content**: the total amount of a plant nutrient in a fertilizer that is considered available for plant uptake.

**Fertilizer industry:** the entire value-chain involved in producing fertilizers, including basic production or mining, processing into final products, transportation, storage, and ultimate delivery to the fertilizer user.

**Fertilizer management:** the regulation and technical control of all aspects of fertilizers, including production (manufacture and formulation), authorization, import, export, labeling, distribution, sale, supply, transport, storage, handling, application and disposal of fertilizers to ensure safety, quality and use efficacy and to minimize adverse health and environmental effects and human and animal exposure.

**Fertilizer misuse**: can involve, but is not limited to, the application of one or more plant nutrients to the soil, foliage or water that would not reasonably be expected to produce a positive response on crop growth and development, fertilizer spills, or the application of contaminants to the soil that might pose risk to human health or the environment.
**Fertilizer user**: persons who apply fertilizers for the specific purpose of making plant nutrients available for plant uptake. Fertilizer users can include farmers, land managers and food producers, public or private organizations maintaining parks, gardens and sporting facilities and persons using fertilizers for home gardening purposes.
**Green manure:** plants that are grown in order to provide soil cover and to improve the physical, chemical, and biological characteristics of soil. (FAO, 2011)
**Inorganic fertilizer:** a fertilizer produced industrially by chemical processes or mineral extraction. Note that though urea is technically an organic material, it is referred to within this Fertilizer Code as an inorganic fertilizer.
**Integrated soil fertility management (ISFM):** "the application of soil fertility management practices and the knowledge to adapt these to local conditions, which maximize fertilizer and organic resource use efficiency and crop productivity. These practices necessarily include appropriate fertilizer and organic input management in combination with the utilization of improved germplasm". (Sanginga and Woomer, 2009)
**International Organization:** includes intergovernmental organizations of the UN, UN Specialized Agencies and Programmes, Development Banks, International Agricultural Research Centers including CGIAR Member Centres, and international NGOs.
**Marketing:** the overall process of product promotion, including advertising, product public relations and information services as well as the distribution and sale on local and international markets.
**National Agriculture Research System (NARS):** cross section of stakeholders comprises of public agricultural research institutes, universities and other tertiary institutions, farmer groups, civil society organizations, private sector and any other entity engaged in the provision of agricultural research services.
**Nitrification inhibitor:** substance that inhibits biological oxidation of ammoniacal nitrogen to nitrate.
**Organic fertilizer**: a carbon-rich fertilizer derived from organic materials, including treated or untreated livestock manures, compost, sewage sludge and other organic materials used to supply nutrients to soils.
**Plant nutrients:** Elements essential for normal growth and reproduction of plants, generally not including carbon, hydrogen, and oxygen. The primary plant nutrients are nitrogen, phosphorus, and potassium. Secondary and micronutrients include sulfur, calcium, magnesium, boron, chlorine, copper, iron, manganese, molybdenum, zinc and others.
**Public interest group:** includes in this context (but is not limited to) scientific associations, farmer groups, civil society organizations, labour unions and non-governmental environmental, consumer and health organizations.
**Recycled nutrient:** plant nutrients applied to and taken up by growing plants that can be returned to the plant nutrient cycle after consumption by humans or animals, as by-products of food processing, or as plant residues returned to the soil.
**Risk:** the probability and severity of an adverse health or environmental effect occurring as a function of a hazard and the likelihood of exposure to fertilizers or to soil impacted by fertilizer applications.
**Sewage sludge:** solid materials removed from the wastewater stream originating from a public sewer system. May or may not be subject to additional treatment to reduce volume, pathogens, odors, and nutrient content. See biosolids.
**Soil fertility**: The ability of a soil to sustain plant growth by providing essential plant nutrients and favorable chemical, physical, and biological characteristics as a habitat for plant growth.
**Soil health:** is "the capacity of soil to function as a living system. Healthy soils maintain a diverse community of soil organisms that help to control plant disease, insect and weed pests, form beneficial symbiotic associations with plant roots, recycle essential plant nutrients, improve soil structure with positive repercussions for soil water and nutrient holding capacity, and ultimately improve crop production". (FAO, 2011)

**Struvite**: a phosphate fertilizer used in agricultural production as an alternative source of rock phosphate, that also contains nitrogen and magnesium. Struvite can come from recycled sources or waste residues such as wastewater or urine.

**Sustainable soil management (SSM):** ‘’soil management is sustainable if the supporting, provisioning, regulating, and cultural services provided by soil are maintained or enhanced without significantly impairing either the soil functions that enable those services or biodiversity. The balance between the supporting and provisioning services for plant production and the regulating services the soil provides for water quality and availability and for atmospheric greenhouse gas composition is a particular concern.’’ (FAO, 2017)

**Urease inhibitor:** substance that inhibits urease enzyme’s hydrolytic action on urea.

**Wastewater:** Water which is of no further immediate value to the purpose for which it was used or in the pursuit of which it was produced because of its quality, quantity or time of occurrence (FAO, 2018b).

**3. Soil fertility and plant nutrition**

3.1. In regards to fertilizer management decisions, strong consideration should be given to the capacity of soil to retain and supply plant nutrients and the ability to support plant growth, and crop demand for nutrients.

3.2. Soil considerations include its origin, composition and classification, as well as previous management practices that influence the chemical, physical and biological properties that contribute to its fertility.

3.3. Plant nutrition considerations include previous and anticipated crop demand for all nutrients, unique nutrient requirements of the crop and cultivar to be grown, and desired nutritional composition of the crop and cultivar to be grown. Further, the cultivar to be grown should be adapted to local environmental and soil fertility conditions.

3.4. There are many sources of plant nutrients available and they should be considered as complimentary rather than exclusive to one another. There are many benefits to providing one or more plant nutrients from multiple sources including, but not limited to, extended nutrient availability for plant growth and carbon additions to soil with the combination of organic and inorganic fertilizers.

3.5. Governments should:

3.5.1. Encourage land use and land tenure policies that incentivize farmers to improve soil fertility and soil health and, in some situations, indirectly discourage conversion of land from native ecosystems into agricultural production.

3.5.2. Encourage soil conservation through relevant policies and incentives to offset reductions in soil fertility due to the loss of fertile topsoil through erosion.

3.5.3. Ensure that the analytical means for assessing plant nutrient status and basic soil chemical properties such as pH and salinity, and other soil parameters, are available and utilized in making fertilizer recommendations based on the assessment of plant nutrient status and/or soil properties at a given location. Public and private laboratory services, or a combination, can be utilized to meet these needs. Analytical means can include traditional laboratory based (for example, wet-chemical) procedures, other field or laboratory-based modern methods, or properly calibrated field testing kits.

3.5.4. Promote the use of soil and plant tissue testing, and other means of assessing soil fertility status, by farmers and farmer advisors to determine fertilizer needs before applying fertilizers. Public campaigns, educational materials, and demonstrations are example promotion methods.

3.5.5. Develop and encourage the use of soil maps and other geospatial methods for efficient and effective use of fertilizers

3.5.6. Where necessary, provide government support for extension/outreach activities that develop evidence-based fertilizer recommendations based on relevant soil characteristics, existing nutrient pools, crop and cultivar to be grown, nutrient considerations for previous crop grown, expected yield and quality, local experience and other site-specific information.

3.6. Through their NARS, universities and AEAS, in collaboration with international research centers, and other research organizations, governments should:

3.6.1. Encourage Integrated Soil Fertility Management (ISFM) through the use of all relevant sources of plant nutrients including animal manures, compost, crop residues, and other materials, particularly those that are locally available.

3.6.2. Further through ISFM, encourage the use of crop rotations, legumes, cover crops, and other green manures as a means to enhance soil health and fertility.

3.6.3. Encourage the use of plant nutrition considerations such as the previous and anticipated crop demand for all nutrients, unique nutrient requirements of a crop and cultivar to be grown, and desired nutritional composition of the crop and cultivar to be grown in soil fertility management. Promote the use of cultivars that are adapted to local environmental and soil fertility conditions

3.6.4. Promote the correction or management of soil conditions that prevent crop response to plant nutrient additions. Such conditions would include extreme acidity or alkalinity, excessive salts or sodium, or lack of organic matter limiting nutrient cycling.

3.6.5. Establish evidence-based limits for phosphorus levels in soils above which additional phosphorus applications are prohibited or limited due to a low probability of a positive crop response and a high probability of negative environmental impacts on surface water resources.

3.6.6. Develop and refine evidence-based fertilizer recommendations at the local and regional levels based on relevant soil characteristics, crops to be grown, previous crops grown, expected yield and quality, and other site-specific information to promote balanced application of plant nutrients proportional to expected crop absorption and nutrient export from the production site.

3.6.7. Promote the use of soil and plant tissue testing, and other means of assessing soil fertility status, as a means for farmers and farmer advisors to make fertilizer application decisions.

3.6.8. Develop and refine adapted soil testing methods including local indicators of soil health in the interest of advancing the adoption and efficient use of fertilizers.

3.6.9. Develop and refine the use of geospatial methods and precision application equipment with the goal of advancing the efficient use of fertilizers.

3.6.10. Work with agricultural economists to define economically optimum fertilizer application rates and incorporate that information into outreach and extension programs.

3.7. The fertilizer industry should:

3.7.1. Encourage fertilizer recommendations that consider all nutrient requirements and that are based on site-specific information including relevant soil characteristics, crops and cultivars to be grown, previous crops grown, and expected yields, and if using soil test methods, that the methods are calibrated for the particular soil.

3.7.2. Promote the application of fertilizers at the proper time and amount, as well as use of the most appropriate fertilizer source and placement in accordance with global principles of plant nutrient management such as ISFM and 4R nutrient stewardship (IPNI, 2012).

3.7.3. Provide adequate training of retail sales and technical staff to promote proper soil testing and fertilizer best management practices that maximize the efficient use of plant nutrients while minimizing off-site environmental effects.

3.7.4. Develop and encourage the use of soil maps and other geospatial methods for efficient and effective use of fertilizers and identification of suitable fertilizer formulations.

3.7.5. Carefully develop and evaluate fertilizer additives (for example, nitrification inhibitors, urease inhibitors, biostimulants) and market only when demonstrated to be effective in increasing fertilizer use efficiency and/or for the reduction of off-site environmental impacts. Continue to seek innovations in fertilizers and technologies for providing adequate plant nutrition.

3.7.6. Promote the correction or management of soil conditions that prevent crop response to plant nutrient additions. Such conditions would include extreme acidity or alkalinity, excessive salts, carbonates or sodium, or lack of organic matter limiting nutrient cycling.

3.8. Fertilizer users should:

3.8.1. Correct or manage soil conditions that prevent crop response to plant nutrient additions. Such conditions would include extreme acidity or alkalinity, excessive salts or sodium, or lack of organic matter limiting nutrient cycling.

3.8.2. When available, utilize soil testing to identify soil conditions that might limit crop response to plant nutrient additions and for the determination of fertilizer recommendations.

3.8.3. Utilize fertilizer recommendations by local AEAS and outreach providers that are based on site-specific information including relevant soil characteristics, crop and cultivar to be grown, previous crop grown, and expected yields.

3.8.4. Apply fertilizers at the proper time and amount, as well as use of the most appropriate fertilizer source and placement in accordance with global principles of plant nutrient management such as ISFM and 4R Plant Nutrition.

3.8.5. Practice ISFM, as appropriate, through the use of all relevant sources of plant nutrients including animal manures, compost, crop residues, and other materials, particularly those that are locally available. Further through ISFM, encourage the use of crop rotations, legumes, cover crops, and other green manures as a means to enhance soil health and fertility.

**4. Fertilizer use and management**

4.1. Proper management and use of fertilizers is the responsible handling, storage, transportation, and application of fertilizers with the express goal of enhancing plant growth or attributes (nutritional content, color, flavor, and so on) to maintain or improve soil health and minimize any potential environmental impacts.

4.2. Fertilizer nutrients that are not taken up by plants or retained in soils may be transported to waterways, especially nitrogen and phosphorus, causing eutrophication and deterioration of water quality. Leaching of mobile forms of nitrogen to water used for human consumption has potential human health impacts. Excess nutrients may also be released from soils to the atmosphere through ammonia volatilization or as greenhouse gas emissions of nitrous oxide. In addition, excess fertilizer use and losses of nutrients due to the misuse of fertilizers can lower profits of farmers and in some cases can lead to crop failure.

4.3. Insufficient use of fertilizers entails adding nutrients at levels below crop requirement and results in opportunity costs for yield potential, nutritional content, return of carbon to the soil, and enhancement of soil health as well as net nutrient removal from the soil system.

4.4. A holistic approach must be taken when developing and implementing best management practices for fertilizer use recognizing that practices to reduce the negative impacts from one nutrient may increase the negative impacts from other nutrients. In this case, the best management practices that produce the most positive overall effect should be adopted.

4.5. Misuse of fertilizers can involve, but is not limited to:

4.5.1. Over or excessive use, that is, the application of one or more plant nutrients to the soil, foliage or water that would not reasonably be expected to produce a positive response in growth or composition for plants or crops growing in that soil, or to maintain soil health.

4.5.2. Improper or inappropriate use, such as the application of fertilizers to the soil surface when not appropriate, not suited to the soil type, soil properties or the landscape, crop requirement, or the prevailing weather and climatic conditions, thus resulting in nutrient losses to the environment;

4.5.3. Nutrient imbalance resulting from fertilizers composed of an incomplete or improperly balanced nutritional profile compared to what the target crop(s) in question requires for optimal growth and product quality;

4.5.4. The application of contaminants to the soil via fertilizers that might pose unacceptable risk to human health or the environment;

4.5.5. Improper storage of fertilizers; or

4.5.6. Fertilizer spills.

4.6. Entities addressed by the Code including governments, International Organizations, the fertilizer industry, academia, research organizations, agricultural extension and advisory services, civil society and end-users should consider all available facts on the negative impacts of the misuse of fertilizers and should promote responsible dissemination of information on fertilizers and their uses, risks and alternatives when available.

4.7. Governments should:

4.7.1. Develop policies that support sustainable soil management (SSM) and the responsible use of fertilizers in order to protect soil, improve degraded lands, optimize agricultural production on existing agricultural land, and minimize the conversion of land from native ecosystems into agricultural production.

4.7.2. Support and stimulate, through legislation and incentive measures, the development of holistic and integrated fertilizer solutions for a more balanced crop nutrition and make sure that these are available to the end users.

4.7.3. As needed, develop policies that facilitate affordable access to fertilizers by farmers and which are linked with appropriate and relevant fertilizer use policy, guidelines and rural AEAS programs.

4.7.4. Ensure that any fertilizer provided as a result of subsidies, direct or indirect, or donations are used in a responsible manner according to this code. Such fertilizers should not encourage or lead to excessive or unjustified use, cause the displacement of

management practices or use of other fertilizers that offer greater efficiency and/or with lower environmental impact, and should provide a balanced mix of nutrients for the intended crops.

4.7.5. Draft appropriate legislation to minimize the negative impacts of fertilizer applications to agricultural or other lands, including from the misuse of fertilizers.

4.7.6. Establish evidence-based application limits for nutrients from fertilizers, including inorganic and organic fertilizers, sewage sludge, animal waste and organic residues to avoid damaging effects on the environment, and on human and animal health.

4.7.7. Maintain databases and statistics on the environmental effects of fertilizers, in coordination with industry and relevant international agencies, such as FAO (FAO, 2018c). Suitably trained personnel and adequate resources should be made available to ensure the reliability and accuracy of data and information collected.

4.8. Through their NARS and national universities, and in partnership or collaboration with international centers and other relevant research institutions, governments should:

4.8.1. Carry out appropriate research to determine responsible fertilizer and other agronomic management for major soils and crops in their regions.

4.8.2. Evaluate new and existing products sold as fertilizers to validate their effectiveness and seek advancements in nutrient use efficiency. When possible and appropriate, such information should be shared with relevant stakeholders in other countries.

4.8.3. Develop fertilizer management tools to help provide fertilizer users with the information necessary for usage in order to avoid overuse and misuse (source, rate, timing, and method).

4.8.4. Create soil maps for the purpose of managing and monitoring fertilizer applications, as well as to identify zones that are vulnerable to the impacts of fertilizer misuse and/or environmental impacts.

4.9. Through national and regional rural AEAS, governments should:

4.9.1. Provide locally or regionally relevant and recognized training to fertilizer users and retailers on fertilizer use with the goal of maximizing the balanced and efficient use of plant nutrients to enhance sustainable agriculture, food safety and nutrition, and, to maximize the potential environmental benefits accrued from using fertilizers including reducing the conversion of land from native ecosystems into agricultural production through increased yields, increasing carbon storage in soils, and improvements in soil health.

4.9.2. Provide local or regionally relevant and recognized training to fertilizer users and fertilizer retailers to minimize the environmental impacts from the use of fertilizers including pollution by loss of nutrients via runoff, leaching, gaseous emissions, disruption of soil biological processes, and reducing the effects of contaminants on soil, animal, and human health.

4.9.3. Disseminate information on reducing risks to human and animal health associated with fertilizer handling and use.

4.10. The fertilizer industry should:

4.10.1. Develop strategies for more holistic integrated fertilizer solutions aiming at a more balanced crop nutrition, taking crop requirements and local soil conditions into account, and through improved fertilizer compositions and use of different fertilizer delivery mechanisms.

4.10.2. Develop, promote and distribute information on fertilizer best management practices to fertilizer retailers, salespeople, farmers and end-users that are based on the principles of nutrient stewardship and that maximize the efficient use of plant nutrients while minimizing off-site environmental effects.

4.10.3. Generate knowledge and provide information to fertilizer users on the health and safety aspects of handling and using fertilizers, and how to protect humans, and animals, from possible adverse effects including impacts of low-level chronic exposure.

4.10.4. Provide users and environmental authorities with information on appropriate remediation measures in case of fertilizer spills.

4.11. Fertilizer retailers, salespersons, farmers organizations, analytical laboratories, consultants, and/or end-users should:

4.11.1. Familiarize themselves and comply with locally applicable regulations and limits and follow guidelines relevant to fertilizer use.

4.11.2. Provide correct information and/or adhere to best management practices for fertilizer use including proper handling, storage, transportation, and disposal, and follow locally relevant fertilizer recommendations.

4.11.3. Keep records of fertilizer sales and/or fertilizer applications along with other agronomic practices, data and farm records to support governments for the purpose of statistical information on fertilizer use.

**5. Nutrient reuse and recycling**

5.1. Potential nutrient sources of reused or recycled materials include wastewater, sewage sludge, biosolids, animal manure, urban wastes, composts, digestates, biochar, inorganic or organic by-products such as struvite, ammonium sulfate and residues from food and agro-industries.

5.2. The use of nutrients from reused and recycled sources should be encouraged, however consideration should be given to quality, safety and environmental and biosecurity risks associated with managing and using recycled nutrients.

5.3. Governments should:

5.3.1. Encourage, through advocacy, dialogue, policy, financial mechanisms and the provision of resources, cross-sectorial innovation and co-creation and sharing of knowledge in nutrient reuse and recycling technologies for use as fertilizers across relevant sectors including agriculture, water, energy and health to encourage the reuse and recycling of nutrients.

5.3.2. Develop policies that encourage the reuse, recycling and utilization of locally-available sources of plant nutrients through the use of animal manures, compost, crop residues, and other materials suitable for application to soil as a source of plant nutrients and which may also contribute to soil quality in terms of organic matter or other soil benefits such as a liming effect.

5.3.3. Set appropriate guidelines and limits on contaminants in reused and recycled nutrients sources that pose an unacceptable risk to human health and the environment.

5.4. Through their NARS, universities and rural AEAS, supported by collaboration with international research centers and other research organizations, governments should:

5.4.1. Lead and facilitate sharing of information and co-creation of knowledge on reusing and recycling nutrients for agricultural and other plant production purposes between actors in government, industry, academia, research organizations and end-users including land managers and farmers.

5.4.2. Test sources of and products made from reused and recycled nutrients to ensure that they provide nutritional and other agronomic benefits to plants and soil without compromising human and environmental health and safety.

5.4.3. Encourage and promote nutrient recycling and the use of reused and recycled materials for application to soil as a source of plant nutrients and to enhance soil health and fertility.

5.4.4. Encourage and promote the use of crop rotations, legumes, cover crops, and other green manures as a means to enhance soil health and fertility.

5.4.5. Ensure available and appropriate information, such as nutritive and non-nutritive contents, of reused and recycled nutrients sources for use as fertilizers is made available and accessible to the public, including to farmers and other end-users.

5.5. The fertilizer industry, and/or relevant entities from the private sector, should:

5.5.1. Encourage and drive innovation, as well as provide resources, to develop technologies for reuse and recycling of nutrients for use as fertilizers.

5.5.2. Work with NARS, universities, research organizations and farmers in developing and testing innovative and safe methods, techniques and uses for reusing and recycling waste and other materials for use as fertilizers.

5.5.3. Work with NARS, universities, research organizations to research and develop ways to decontaminate sewage sludge and other sources of recycled nutrients.

5.5.4. Actively engage in dialogue, co-creation of knowledge and knowledge-exchange with and between governments, industry, academia, research organizations and clients/end-users (land managers and farmers) on the reuse and recycling of nutrients as fertilizers.

5.6. Fertilizer users should:

5.6.1. Familiarize themselves and comply with locally-appropriate regulations and guidelines relevant to the use of reused and recycled materials for use as plant nutrients, including allowable limits on nutrient application rates and contaminant loadings.

5.6.2. Adjust application rates of inorganic fertilizers, as appropriate, in consideration of the nutrients that are being recycled.

5.6.3. Utilize application rates, timing, and placement that maximize the availability of recycled plant nutrients to growing crops and minimize potential negative impacts such as nutrient leaching, odors, runoff, or any other undesirable off-site effects.

**6. Composition, limits and testing**

6.1. The onus of testing and ensuring that fertilizers and sources of recycled nutrients are compliant with quality and safety standards lies with both the government, who should oversee, set standards and regulate, and the fertilizer industry who should ensure that fertilizers produced, marketed and sold are compliant, effective and safe.

6.2. Relevant intergovernmental bodies, in partnership with the government and the fertilizer industry, should assist development of harmonized fertilizer sampling and testing procedures.

6.3. Governments should:

6.3.1. Be responsible for regulating the composition of fertilizers in terms of:

6.3.1.1. nutrient content;

6.3.1.2. heavy metals linked to the production process and source of raw material;

6.3.1.3. harmful microbes;

6.3.1.4. other dangerous or toxic materials; and

6.3.1.5. additives such as sand, ground rocks and other materials used to dilute the original product.

6.3.2. Set and regulate evidence-based safety standards, limits and guidelines on harmful contents of fertilizer products, taking into consideration the different pathways of contamination and their impacts on humans and animals.

6.3.3 Ensure the availability and capability of testing facilities for quality control.

6.4. Through their NARS, universities and rural AEAS, supported by international research centers, other research organizations, and the fertilizer industry, governments should:

6.4.1. Oversee and support the field-testing of fertilizers for their efficacy in providing nutrients to match plant nutrient deficiencies and/or improve soil fertility.

6.4.2. Conduct appropriate testing of recycled nutrient sources and products intended for use in plant production to ensure they meet appropriate guidelines for nutritive quantity and quality, as well as safety in terms of limits on contaminants such as heavy metals, harmful microbes, and other dangerous or toxic materials.

6.4.3. Educate stakeholders and fertilizer users on the use of information pertaining to the composition, quality, and purity of fertilizers offered for sale, and on means to remain compliant with relevant regulations and guidelines.

6.5. The fertilizer industry, or relevant private entity, should:

6.5.1. Assist governments to set standards, regulations and guidelines on the composition and testing of fertilizer products.

6.5.2. Develop and adopt own company quality management to support self-regulation by the industry, where appropriate, and subject to legal obligations.

6.5.3. Test sources of products containing reused and recycled nutrients and marketed as fertilizers so that they comply with relevant quality and safety standards.

6.5.4. Ensure fertilizer products comply with government standards and that end-users are supplied with safe and high-quality products that have been tested by recognized standards and comply with appropriate regulations.

6.5.5. Ensure products marketed and sold as fertilizers are effective in providing nutrients for plant production purposes, based on scientific evidence.

6.5.6. Only market fertilizer additives for which scientific evidence supports enhanced crop response, nutrient use efficiency, soil health or environmental quality.

6.5.7. Verify the quality and purity of fertilizers offered for public sale.

6.6. Fertilizer users should:

6.6.1. Purchase or apply fertilizers that have evidence of appropriate and proper testing for composition, quality, and purity.

6.6.2. Follow appropriate guidelines and regulations, as well as application limits for nutrients and maximum allowable concentrations for contaminants.

6.6.3. Inform the relevant authorities when suspecting an issue with a fertilizer product.

**7. Access, distribution and labelling**

7.1. Governments should:

7.1.1. Have the overall responsibility for facilitating the access and availability, and regulating the distribution and use of fertilizers in their countries and should ensure the allocation of adequate resources for this mandate.

7.1.2. Implement a fertilizer policy, quality control, and registration system when appropriate, which includes penalties for non-compliance when deemed necessary and wherever possible. Governments are encouraged to harmonize policies at the global level, particularly in relation to quality assurance methods.

7.1.3. Ensure locally or regionally relevant and recognized training relating to the retail sale of fertilizers, so as to ensure that those involved are capable of providing end-users with sound advice on fertilizer use and management and on the environmental and health risks associated with the misuse of fertilizers.

7.1.4. Develop, and maintain transportation infrastructure to improve access and reduce logistical costs associated with fertilizer trade and distribution.

7.1.5. Ensure that the proposed use, label claims and directions, packages, safety data sheets, technical literature, and advertising of products sold as fertilizers is based on scientific evidence.

7.1.6. Ensure products sold as fertilizers are clearly, legibly and accurately labeled. Governments are encouraged to harmonize labelling requirements at the global level. At minimum, labels should include:

7.1.6.1. net weight of the product;

7.1.6.2. information on the fertilizer grade/content of plant available nutrients;

7.1.6.3. information on the content of contaminants as required by national regulations;

7.1.6.4. potential environmental and health impacts;

7.1.6.5. release date of the lot of batch of fertilizer and expiry date, if appropriate;

7.1.6.6. relevant information on the storage, safe handling, and where to find information on recommended rates, time of application and placement of fertilizers.

7.2. The fertilizer industry should:

7.2.1. Ensure that persons involved in the sale of fertilizers along the fertilizer value chain are trained adequately to be capable of providing relevant information to the related actors in the supply chain, such safety information, advice on risk reduction, and information on the responsible and efficient use of the fertilizer products.

7.2.2. Ensure that persons involved in the sale of fertilizers to users are trained adequately and are capable of providing sound advice on the use of the fertilizer products they are selling, and on the environmental and health risks associated with the misuse of fertilizers.

7.2.3. Ensure that technical literature provides sufficient information on adequate practices for different contexts consistent with nutrient stewardship, including the observance of right rate, right source, right placement, and right timing.

7.2.4. Provide fertilizers in a range of pack sizes consistent with national, sub-regional or regional requirements, and appropriate for the needs of small-scale farmers, households and other local users, in order to reduce costs as well as any environmental risks associated with misuse or inappropriate storage, and to discourage sellers from repackaging products in unlabeled or inappropriate containers.

7.2.5. Clearly, legibly and accurately label fertilizers in line with Article 7.1.6 and according to relevant regulations/guidelines on good labelling practices and that are consistent with those of the relevant authorities in the country of sale.

7.2.6. Ensure that advertising materials, statements and promotional activities:

7.2.6.1. are technically justifiable and ethically correct;

7.2.6.2. do not encourage the use of the fertilizers for uses other than those specified on the approved label;

7.2.6.3. do not contain recommendations other than/or varying from any existing applicable regulations;

7.2.6.4. make no guarantees or imply results unless explicit evidence to authenticate such claims are available;

7.2.6.5. do not include any inappropriate incentives or gifts to encourage the purchase of fertilizers.

7.3. Fertilizer users should:

7.3.1. When and where possible, obtain fertilizers from officially recognized or licensed dealers and that are properly and clearly labelled.

7.3.2. Follow appropriate guidelines and instructions regarding the safe handling and use of fertilizers according to the labelling and other technical materials and advice from suitably recognized and qualified individuals providing the product.

7.3.3. Recycle and/or dispose of fertilizer containers where appropriate.

7.3.4. Contact the relevant authorities when the quality of the product does not correspond to the claims made on the label, or when they experience issues with the product.

**8. Information, Extension and Outreach**

8.1. Governments should:

8.1.1. Encourage collaboration and coordination between NARS, rural AEAS, NGO's, farmer cooperatives and organizations, and universities to provide education programs, technology development and technology transfer as needed within a country without creating underserved areas.

8.1.2. Provide support for extension/outreach activities for farmers, to provide advice and assistance in the responsible use of fertilizers and other sources of plant nutrients.

8.1.3. Provide government funded research, extension and outreach programs to meet needs not covered by NARS, NGO's, farmer cooperatives and organizations, and universities.

8.1.4. Facilitate the importation, co-creation and adoption of new technologies that will enhance soil fertility, farm productivity and quality, improve fertilizer use efficiency, or minimize off-site impacts of fertilizers.

8.1.5. Promulgate appropriate safety regulations for the storage, handling, transport, and application of fertilizers.

8.1.6. Use science-based regulations and guidelines to regulate new technologies (that will enhance soil fertility, farm productivity and product quality, improve fertilizer use efficiency, and/or minimize off-site impacts of fertilizers).

8.1.7. Collaborate with industry, NARS, NGO's, universities, farmer cooperatives and organizations, and AEAS to facilitate the use of appropriate machinery and technology to support the enhancement of soil fertility, improvement of fertilizer use efficiency, and/or the minimizing of off-site impacts of fertilizers.

8.1.8. Governments, whose programs for regulating fertilizers are well developed should, to the extent possible, provide technical assistance, including training, to other countries in developing their infrastructure and capacity to manage fertilizers throughout their life-cycle.

8.1.9. Ensure that all analytical laboratories doing soil and crop testing and analysis have proper quality controls to ensure that they provide reliable results in a timely manner.

8.2. The fertilizer industry should:

8.2.1. Collaborate with governments, NARS, public extension service providers, farmer cooperatives and organizations, and NGOs to provide education programs and technology transfer as needed within a country without creating underserved areas.

8.2.2. Collaborate in sharing relevant information and data to governments, NARS, NGOs, public extension service providers, farmer cooperatives and organizations, and universities to facilitate the delivery of complete and objective education programs that promote fertilizer best management practices that maximize the efficient use of plant nutrients while minimizing off-site environmental effects.

8.2.3. Work with governments, NARS, NGOs, public extension service providers, farmer cooperatives and organizations, and universities voluntarily to take corrective actions when problems occur with fertilizers, and when requested by governments, help find solutions to difficulties.

8.2.4. Collaborate with other industries, NARS, NGOs, governments, farmer cooperatives and organizations, universities and public extension services to develop and facilitate the use of appropriate machinery and technology to support the enhancement of soil fertility, improvement of fertilizer use efficiency, and/or the minimization off-site impacts of fertilizers.

8.3. Agricultural extension and advisory services and outreach providers (NARS, NGOs, farmer cooperatives and organizations, and universities) should:

8.3.1. Commit to continual professional development to remain current on technological advances and innovation processes that encourage co-creation and sharing of knowledge aiming to maximize the impact of educational and research efforts.

8.3.2. Collaborate with governments, NARS, public extension service providers, farmer cooperatives and organizations, and NGOs to provide educational programs on adherence to safety regulations for the storage, handling, transport, and application of

fertilizers at the local level, compliance with national legislation as regards children's involvement, and work toward identifying and solving safety issues for which regulations have yet to address.

8.3.3. Collaborate with governments and fertilizer industry to provide education programs and technology transfer as needed within a country without duplication of efforts or creating underserved areas.

8.3.4. Seek out collaborations with other disciplines such as economics, engineering, sociology, plant breeding, plant pathology and other relevant areas to identify and overcome barriers to the responsible use of fertilizers and the adoption of practices that maximize the efficient use of plant nutrients while minimizing off-site environmental effects.

8.3.5. Work with governments and industry to take corrective actions when problems occur with fertilizers, and when requested, help find solutions to difficulties.

## 9. Monitoring and Observance

9.1. To ensure the accessibility and availability of the Fertilizer Code and any relevant supporting materials, it is made available on the FAO website in the six official languages of the United Nations, and as required translated into other languages.

9.2. FAO, and all other relevant international organizations, should give their full support to the Fertilizer Code and its objectives, and supporting guidelines.

9.3. The Fertilizer Code should be made available and brought to the attention of all stakeholders referred to within: governments, the private sector, actors in the fertilizer supply chain, actors in the nutrient recycling industry, supporting academic and research institutions, analytical laboratories, farmer organizations and end-users.

9.4. Governments are encouraged to take on the responsibility for overseeing the implementation of the Fertilizer Code within their countries and promoting its objectives regarding the sustainable and responsible use of fertilizers and other nutrient sources for agriculture and other plant production purposes in order to avoid negative impacts on human and animal health and the environment.

9.5. The stakeholders addressed in this Code, and all others dealing directly or indirectly with fertilizers should understand their responsibility in adhering to and promoting its objectives.

9.6. Governments and policy makers should consider the Fertilizer Code when drafting regulations, laws, policies or other instruments related to fertilizers used for agriculture and other plant production purposes.

9.7. Governments and other entities addressed by this Fertilizer Code, including the private sector, NGOs and supporting academic and research institutions, with the help of FAO, are strongly encouraged to monitor their progress on the observance of this Code and report back all relevant information on their progress to FAO within 4 years of the launch of this Code, if applicable.

9.8. As stated in Article 1.5, this is a living document, and any changes to the Fertilizer Code due to new information or developments related to fertilizers and their impacts will be made by FAO through consultation with relevant technical experts and approval of the appropriate FAO governing bodies. Any changes and their implications will be communicated to all the entities addressed by this Code.

9.9. This Fertilizer Code of Conduct should be reviewed, and if necessary, revised every 5 years in order to keep up with any emerging needs and advances in technology.

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# Annex 2:

# International Network of Soil Information Institutions (INSII) Annual Report by the INSII Chair

## Introduction

The Fifth Session of the Global Soil Partnership Plenary Assembly clarified arrangements for establishing the Global Soil Information System (GLOSIS). The Plenary Assembly, amongst other things:

- endorsed the GSP Soil Data Policy
- endorsed the legal basis for a fully functioning GLOSIS
- established the International Network of Soil Information Institutions (INSII) as proposed in the Pillar Four Plan of Action
- appointed the Chair of INSII (CSIRO Australia)
- appointed the GSP Soil Data Facility (GSP SDF) (ISRIC - World Soil Information).

More specifically, the Fifth Plenary Assembly determined that the INSII will:

- convene an annual meeting to monitor progress on Pillar Four implementation and the relationships to the regional soil partnerships shall be regularly addressed and developed
- appoint a Chair for a period of 2 years, extendable via INSII decision to a second term - the chair will moderate the annual workshop and the Pillar Four Working Group (P4WG)
- contribute to the execution of the Pillar Four Implementation Plan by serving as its strategic decision making body, within the constraints of the Pillar Four Plan of Action approved by the GSP Plenary Assembly
- oversee the P4WG and the GSP SDF
- delegate tasks to the P4WG, as needed, to support the efficient implementation of Pillar Four
- provide access to soil geographic information in order to populate the products of the Global Soil Information System under specified conditions (Pillar Four code of ethics and IP policy)
- support the implementation process by providing overall guidance and advising on matters related to funding and actions
- endorse a code of ethics for privacy, data sharing, and data use, and submit this to the GSP Plenary for approval
- report on progress and outstanding issues at each GSP Plenary Assembly.

This report fulfils the last item for the period June 2017 to May 2018.

## Recap on purpose

The success of GLOSIS depends on the degree to which it satisfies the three primary functions outlined in the Pillar Four Plan of Action, namely:

1. supply fundamental data sets for understanding Earth-system processes
2. provide the global context for more local decisions
3. answer critical questions at the global scale.

Examples of critical questions include:

- Is there enough arable land with suitable soils to feed the world?
- Are soil constraints partly responsible for the often large gaps between actual and potential crop yields?
- Can changes to soil management have a significant impact on the seemingly unsustainable global demand for nutrients?
- To what extent and cost can changes to soil management contribute to climate change adaptation, particularly at the scale of smallholder agriculture?
- Can changes to soil management have a significant impact on atmospheric concentrations of greenhouse gases without jeopardizing other functions such as food and fibre production?
- How will the extent and rate of soil degradation threaten food security and the provision of ecosystem services in coming decades?
- Can water-use efficiency be improved through better soil management in key regions facing water scarcity?
- How will climate change interact with the distribution of soils to produce new patterns of land use?

The technical and institutional complexity of GLOSIS is substantial. It will be essential over coming months and years to make sure that the key measure of success is the degree to which GLOSIS fulfils these functions.

## June to December 2017

### Global Soil Organic Carbon Map

The initial part of the reporting period was dominated by the development of the Global Soil Organic Carbon Map. This project provided a valuable proof of concept for the design and operation of the GLOSIS. The basic premise of GLOSIS is that member countries provide soil information into a federated global system. The positive response and contributions from a large number of countries indicated that a distributed system is not only viable but welcomed by member countries. The project also demonstrated the practical value of capacity development and training, much of it facilitated by the FAO.

### Launch of the GSP Soil Data Facility

The GSP Soil Data Facility (GSP SDF) was launched at a side-event during the Wageningen Soil Conference in September 2017. This event provided an opportunity to build bridges with other significant communities involved in soil information and sustainable soil management. Meetings with representatives from the former *GlobalSoilMap* Consortium led to consensus on how harmonised technical specifications can be developed for fine-resolution global soil grids (a core product of GLOSIS).

### INSII 3

The first official meeting of INSII under the new arrangements[2] was held at FAO Headquarters from the 31st of October to the 1st of November, 2017. More than 50 representatives from national soil information institutions attended. The meeting provided the P4WG with guidance and an overall work plan for 2018. The work plan was derived from a prioritisation of the full list of actions in the Pillar Four Implementation Plan. INSII 3 agreed to the following activities being implemented during 2018 with the P4WG having responsibility for operational oversight during the year.

- Prepare a concept note for Soil STAT including feasibility and design principles for soil monitoring. The concept note will be approximately 20 pages in length and pay particular

[2] The first and second INSII meetings were held in 2015 and 2016 as part of the development of the Pillar Four implementation process.

attention to current monitoring activities undertaken by the UN and OECD. The Pillar Four Working Group is to ensure that input is obtained from relevant GSP partners and specific input will be sought from the IUSS Working Group on Soil Monitoring.
- Develop a promotional brochure on Pillar Four that can be shared with current and potential resource partners to ensure sufficient funds are raised to enable full implementation.
- Develop technical specifications for the Tier 1 and Tier 2 databases
- Prepare Version 2 of the GSOCmap and follow the recommendations from the GSOC17 Symposium in relation to establishing a working group for guidelines/protocol for the measurement, mapping, reporting, verifying and monitoring of SOC stocks.
- GSP SDF to supply web services to ensure easy online access to the GSOCmap and subsequent updates (initial data transfer originally scheduled for 3rd week of November 2017).
- Develop a proposal for the Global Soil Polygon coverage with a view to testing demand for the product. Close consultation will be necessary with technical teams that supply related products at present (e.g. the European Commission's JRC and their implementation of SOTER for various regions).
- Clarify whether an updated version of the Harmonised World Soil Database is still required. Originally conceived in the Implementation Plan as an interim product, the availability of new products (e.g. GSOC, Global Grids) may have satisfied the demand. Check with members of the HWSD Consortium to determine the preferred approach.
- Ensure regular and active communication with INSII members.
- Support the Regional Soil Partnerships and, in particular, determine the need for the development and hosting of national data products for countries that do not have sufficient capacity and resources.
- Facilitate updating of the technical specifications for the fine resolution grid products in collaboration with the IUSS Working Group on *GlobalSoilMap* (Key contact: Mr Dominique Arrouays, INRA, France).
- Provide an update on progress to the 6th Plenary of the GSP in June 2018.

INSII 3 also considered the activities of the GSP Soil Data Facility. The role of the GSP SDF is to:

- host, develop and maintain elements of the GLOSIS
- provide components for INSII members who choose not to develop their own services
- actively participate in P4WG
- support technical elements of the GLOSIS
- support the design and implementation of GLOSIS
- support the delivery of SoilSTAT
- connect to GEOSS.

INSII 3 agreed with the work plan proposed by the GSP SDF. It involves focussing initially on the Tier-1 and Tier-2 soil profile databases and Version 0-1 grids. It was also agreed that the GSP SDF is primarily concerned with the provision of the technical infrastructure and the delivery of GLOSIS products as web services using the ISRIC managed servers to ensure long-term stability.

The GSP SDF work plan for 2018-2020 has three main elements:

1. Technical specifications of GLOSIS (2018): develop technical specifications of data portal and its data products.
2. GLOSIS data portal (2019): build the data portal and data products.
3. Population of the GLOSIS data portal (2019 – 2020): facilitate population of the Tier-1 and Tier-2 soil profile databases with national and regional contributions.

The meeting report for INSII 3 is available on the GSP website.

## January to June 2018

The Pillar Four Working Group is now meeting regularly and three of the eight meetings scheduled for 2018 have been held via teleconference. There will be an in-person meeting prior to INSII 4 in October 2018. Detailed agenda papers, minutes and audio recordings of meetings are published on the GSP webpage and members are encouraged to keep up-to-date via this channel.

All outcomes from the work of the P4WG will be considered at INSII 4. The most significant will be:

- Draft technical specifications for various components of GLOSIS (e.g. profile databases, grid mapping products, spatial data infrastructure) – these will require detailed review by national soil information institutions and international agencies to ensure feasibility and compatibility with their own systems.
- Draft specifications for SoilSTAT. This system is intended to become a key component of the FAO statistical system and the basis for global monitoring of soil condition. Again, widespread review and consultation will be undertaken to ensure the best possible outcome.
- Draft investment case to support the implementation of Pillar Four.
- Revision of the schedule of activities specified by the Pillar Four Implementation Plan (primarily timing changes caused by limited resources).

Resolutions from INSII 4 will be submitted to the Seventh GSP Plenary Assembly for consideration and decision where appropriate.

## Immediate challenges and factors controlling success

The process of developing detailed agenda papers and drafting of design documents for the GLOSIS has revealed some significant institutional issues.

### Development of the Spatial Data Infrastructure

A core function of the GSP SDF is to develop the spatial data infrastructure (SDI) to support the GLOSIS. However, at the 5th GSP Plenary Assembly (see Agenda Item 3, page 9, footnote 5) the FAO signalled that it is currently developing a corporate SDI, which will also be aimed at supporting the requirements for the Global Soil Information System. It was indicated that finalisation of the overall SDI for GLOSIS will be discussed and agreed with the P4WG and INSII, clarifying respective involvement as well as ownership, accountability and responsibility for the infrastructure and services to be provided.

It is proving difficult to resolve the roles and responsibilities for developing the SDI. While it is acknowledged that the development of SoilSTAT will need to be fully integrated with FAO's corporate SDI, other aspects of the SDI for GLOSIS have to meet the requirements of all INSII members. An efficient and effective arrangement for developing the SDI for GLOSIS is yet to be established.

### Support for regional soil information systems

It has always been recognized during the development of Pillar Four that a significant number of countries will require assistance from other countries or international institutions in relation to the development of GLOSIS. The FAO is starting to take on this role for some countries. Other countries have expressed interest in approaching the GSP SDF to obtain the necessary support. Having two providers may result in unnecessary duplication and prevent economies of scale in the development of GLOSIS.

### Institutional support and engagement

The Pillar Four Plan of Action recognized the need to achieve net benefit for all partners involved in GLOSIS. One measure of this is the level of participation in the INSII and activities associated with the regional partnerships of the GSP. Only 50 representatives attended INSII 3. Likewise, only a few

regions are being adequately represented in the P4WG meetings. The degree of participation has to increase significantly for the GLOSIS to succeed.

### Resourcing

As noted earlier, the Pillar Four Implementation Plan conservatively estimated that funding of $8.6M over six years was required to establish the GLOSIS. Despite some significant investments by the FAO and other agencies (e.g. ISRIC, CSIRO), such a level of funding has not been achieved. INSII 4 will consider a proposal for increasing funding and this will submitted to the 7th GSP Plenary Assembly in June 2019. However, funds are needed now.

### Ingredients for success

The INSII, P4WG and GSP SDF are in their early stages of development. It is inevitable that issues such as those outlined above will emerge. However, the seriousness of several issues (e.g. roles and responsibilities, resourcing) has the potential to undermine years of preparatory work. It should be noted that the arrangement for developing the GLOSIS agreed at the 5th Plenary Assembly of the GSP provides a workable framework for establishing the system. Success in the coming year depends on more intangible factors, most notably:

- building confidence that the GLOSIS can achieve its purpose
- improving understanding and achieving consensus on the processes for decision making
- developing greater trust between individuals and institutions involved in the design and implementation of GLOSIS.

## Actions

The Plenary Assembly may wish to:

- Acknowledge the progress being made in the implementation of Pillar Four and the GLOSIS
- Discuss solutions to the factors currently constraining the work of the P4WG and the INSII
- Provide guidance on how to strengthen institutional support and resourcing.

Neil McKenzie (CSIRO Australia)

INSII Chair