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COMMITTEE ON AGRICULTURE

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Reports of the Third and Fourth Session of the Plenary Assembly of the Global Soil Partnership, including “Draft Voluntary Guidelines for Sustainable Soil Management”

Executive Summary

The Committee on Agriculture (COAG) constitutes the parent body of the Global Soil Partnership (GSP), which came formally into being at the end of 2012, after endorsement of its Terms of Reference by the 145th session of the FAO Council. The Rules of Procedure adopted by its main governance body, the Plenary Assembly (PA), stipulate that the PA reports to COAG.

The PA has met twice since the last session of COAG, respectively on 22-24 June 2015 (3rd session) and 23-25 May 2016 (4th session). The main results and highlights of the above two sessions have been captured in the present document in order to facilitate consideration by COAG, while the full reports can be consulted at: <http://www.fao.org/3/a-az541e.pdf> and <http://www.fao.org/3/a-bl812e.pdf> respectively. It may be emphasized that several key GSP activities have been carried out by, or under the aegis of its main technical advisory body – the Intergovernmental Technical Panel on Soils (ITPS). The breadth of GSP achievements in the last two years, is summarized in this paper.

Suggested action by the Committee

The Committee is invited to:

- Take note of the reports of the 3rd and 4th GSP Plenary Assemblies, and the progress made in the fight against soil degradation and in promoting sustainable soil management.
- Note the importance of the Voluntary Guidelines for Sustainable Soil Management (VGSSM), which present scientifically based principles to promote sustainable soil management as adopted at the 4th GSP Plenary Assembly (Rome, 25 May 2016).
- Support the draft Voluntary Guidelines for Sustainable Soil Management, for consideration by the FAO Council in December 2016.

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I. Background

1. The Global Soil Partnership (GSP) was formally established at the end of 2012 with the endorsement of COAG to promote effective action for sustainable soil management and to facilitate active cooperation among all interested partners in order to tackle the threats to soil resources.
2. At its first meeting in June 2013, the main governance organ of the GSP, the Plenary Assembly (PA) adopted comprehensive Rules of Procedure, of which Rule IX specifies that: “the Plenary Assembly shall report, through the Secretariat, to the FAO’s Committee on Agriculture which may bring to the attention of the FAO Council any recommendation adopted by the GSP that may have policy implications, or could affect strategic programmes of FAO”.
3. The Plenary Assembly met twice since the 24th Session of COAG, respectively on 22-24 June 2015 (3rd session) and 23-25 May 2016 (4th session). Both meetings were well attended by FAO Members and other partners. Overall, the GSP has made further substantial progress in the achievement of its mandate and in generating momentum for soils via an effective partnership process at global, regional and national levels.
4. In line with the agreed Rules of Procedure, the reports of these sessions of the GSP Plenary Assembly are being presented to the 25th Session of COAG.¹

II. Highlights from the report of the 3rd session of the PA

5. The following key GSP activities and achievements are brought to the attention of COAG:

Plans of Action (PoAs) under the GSP Pillars²

6. The Terms of Reference of the GSP contemplate five “Pillars of Action”, while Rule VII of its Rules of Procedure specifies that corresponding Plans of Action (PoAs) should be developed following an inclusive and participatory process, and in accordance with agreed guidelines (cf. Annex 1 of the Rules of Procedure). Plans of Action for GSP Pillars 1, 2, 4 and 5 were adopted in 2014 and the process was completed in June 2015 by the adoption of the Pillar 3 PoA.

First edition of the report on “Status of the World’s Soil Resources” (SWSR)

7. The Assembly noted that the SWSR prepared by the Intergovernmental Technical Panel on Soils (ITPS), was the first major global assessment of soil status and trends, based on available data and information. It is structured in three parts: I - Global soil resources, II - Global soil change, and III - Regional assessments and identification of knowledge gaps requiring targeted research. The first version involved voluntary contributions from more than 200 soil scientists worldwide. Besides the full report, a 50-page Summary for Policy Makers was also prepared.

¹ The full texts can be consulted at: <http://www.fao.org/3/a-az541e.pdf> and <http://www.fao.org/3/a-bl812e.pdf> respectively. To facilitate consideration, the main highlights are summarized in the following two sections of the present document.

² The Pillars are recalled as follows:

- 1- Promote sustainable management of soil resources for soil protection, conservation and sustainable productivity
- 2- Encourage investment, technical cooperation, policy, education awareness and extension in soil
- 3- Promote targeted soil research and development focusing on identified gaps and priorities and synergies with related productive, environmental and social development actions
- 4- Enhance the quantity and quality of soil data and information: data collection (generation), analysis, validation, reporting, monitoring and integration with other disciplines
- 5- Harmonization of methods, measurements and indicators for the sustainable management and protection of soil resources

8. The final version of the report was launched on the World Soil Day (5th December 2015), as a contribution to the celebration of the International Year of Soils, 2015.

Concept note on sustainable management of soil resources

9. As per the request of the 24th session of COAG, a draft concept note developed by the ITPS on the preparation of technical guidelines for the sustainable management of soil resources was presented to the PA and approved. The process was aimed at a wide range of stakeholders, in order to complement and facilitate the implementation of the principles and guidelines for action contained in the updated World Soil Charter (WSC), unanimously endorsed by Members during the 39th FAO Conference. The concept note proposed the development of Voluntary Guidelines for the sustainable management of soil resources which was supported by PA Members, including the expectation that such guidelines would constitute an action-oriented framework for the promotion of sustainable soil management at all levels (including by Regional Soil Partnerships). The PA underlined that the guidelines should not be seen as political in nature but rather technical in scope, while the formulation process should be fully inclusive, allowing inputs from all GSP partners.

III. Highlights from the report of the 4th session of the PA

Draft Voluntary Guidelines for Sustainable Soil Management (VGSSM)

10. The Assembly took due note that the draft VGSSM under consideration were the result of consultations and an inclusive formulation process.³

11. At its May 2016 meeting, the PA reiterated that the VGSSM were of voluntary nature and therefore not legally binding, while aiming to be an important source of reference for general and technical policy recommendations on sustainable soil management. Due attention was given to ensuring alignment with the revised World Soil Charter, and the “Status of the World’s Soil Resources” report issued at the end of 2015.

12. The full text of the draft VGSSM endorsed by the PA and submitted to COAG for endorsement, is reproduced in Annex.

Progress with regard to key dimensions of the GSP

13. Concrete implementation plans at global and regional levels: the PA appreciated that the agreed PoAs under the five GSP Pillars had led to an ongoing active phase of formulation, and in several instances early execution, of more concrete Global Implementation Plans (GIPs) and Regional Implementation Plans (RIPs) tailored to specific local needs. These GIPs and RIPs are to guide the collective and individual engagement of GSP partners at all levels. The PA encouraged the Secretariat to facilitate the execution of these plans and recommended particularly to move into the execution of Pillar 4 Plan for establishing the Global Soil Information System, including the development of a Global Soil Organic Carbon map by 2017 based on a bottom-up approach.

14. Network of Regional Soil Partnerships: the PA also appreciated the attention given by all interested partners to establish an effective network of Regional Soil Partnerships (RSPs), which was also key to the fulfillment of the GSP mandate. To date, eight regions and one sub-region⁴, have RSPs in operation, and a few of these still require a firmer consolidation phase. The PA acknowledged the

³ 24th session of COAG in 2014; approval of the concept note during the 3rd session of PA in 2015; FAO Council in December 2015; ITPS meeting of March 2016; and an Open-ended Working Group in April 2016.

⁴ Africa; Asia; Central America, Mexico and the Caribbean; Europe; South America; Pacific; Near East and North Africa; North America; Eurasia.

progress made in implementing various concrete activities such as capacity development on soils in the RSPs and recommended to pursue further.

15. **Mobilization of resources:** the PA also noted that some progress had been made in mobilizing extra-budgetary resources to support GSP work since the inception of the initiative. However, against the planned indicative target given in the programme document of the Healthy Soils Facility of USD 60 million, only approximately 10% - i.e. USD 6.3 million - has been obtained so far. Thus, the PA emphasized the urgency of generating much higher flows of resources (of both in-kind and financial nature), while it was clear that some regions needed more external support than others.

Implementation of the International Year of Soils 2015 and World Soil Day occurrences

16. The PA appreciated the range of events and activities which took place in connection with International Year of Soils (IYS) celebrations throughout the year and at all levels, from global down to local. Those activities involved a wide range of stakeholders and interested parties, i.e. not limited to government entities and civil society organizations or the media but also the general public, including substantial numbers of students in schools and other teaching institutions. The Secretariat was commended for the encouragements and advice provided for the organization of IYS activities. As per established practice in connection with International Years for which FAO was entrusted leadership, a full report would be submitted to the next session of the FAO Conference in 2017.

17. The Assembly expressed its strong hope that all stakeholders would pursue the awareness raising momentum acquired thanks to the IYS, leading to further concrete actions against soil degradation and for promoting sustainable soil management.

18. The Assembly took note of the successful celebration of World Soil Day (WSD) in 2015 with activities carried out in more than 100 countries. It stressed the particular significance of WSD 2015, as it was also the opportunity to close the International Year of Soils with events organized by the Secretariat in Rome, New York, Bangkok, Santiago and Accra. The Assembly also addressed plans for WSD occurrences in 2016 with the theme “Soils and pulses: symbiosis for life” and 2017 theme “Caring for the planet starts from the ground”.

Establishment of the Glinka World Soil Prize

19. The PA agreed on the modalities for establishing a World Soil Prize under the auspices of the GSP bearing the name of the reputed Russian soil scientist, K.D. Glinka. It recognized that its effective implementation would be subject to the availability of financial support from interested partners and acknowledged in this regard the commitment of the Russian Federation to finance the Prize for the first three years.

Work and functioning of the ITPS

20. Concerning the interface of the ITPS with other pertinent bodies and initiatives, the PA was pleased to note that structured collaboration arrangements had been established with the Science-Policy Interface (SPI) of United Nations Convention to Combat Desertification (UNCCD), Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) and the Intergovernmental Panel on Climate Change (IPCC). A number of joint activities and outputs had been agreed or were in the pipeline to put cooperation with these bodies on a concrete path including support to the Sustainable Development Goals implementation.

21. In addition, the PA approved a change of duration of the term of office of ITPS participants from two to three years, in order for the Panel to benefit from greater continuity of membership to address the extensive workload.

IV. Suggested action by the Committee

22. The Committee is invited to:
- a) Take note of the reports of the 3rd and 4th GSP Plenary Assemblies, and the progress made in the fight against soil degradation and in promoting sustainable soil management.
 - b) Note the importance of the Voluntary Guidelines for Sustainable Soil Management (VGSSM), which present scientifically-based principles to promote sustainable soil management, as adopted at the 4th GSP Plenary Assembly (Rome, 25 May 2016).
 - c) Support the draft Voluntary Guidelines for Sustainable Soil Management, for consideration at the FAO Council in December 2016.

Voluntary Guidelines for Sustainable Soil Management
Adopted by the Fourth GSP Plenary Assembly



Voluntary Guidelines for
Sustainable Soil
Management

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1. Introduction

These Voluntary Guidelines for Sustainable Soil Management (VGSSM) were developed through an inclusive process within the framework of the Global Soil Partnership (GSP). They aim to be a reference providing general technical and policy recommendations on sustainable soil management (SSM) for a wide range of committed stakeholders. The guidelines were adopted by the 4th GSP Plenary Assembly (Rome, 25 May 2016), approved by the ___th session of the FAO Committee on Agriculture (Rome, ___) and finally endorsed by the ___th session of the FAO Council (Rome, ___).

1.1 Background and rationale

Soils are an essential and non-renewable natural resource hosting goods and services vital to ecosystems and human life. Soils are fundamental for producing crops, feed, fibre, fuel, and they filter and clean tens of thousands of cubic kilometers of water each year. As a major storehouse for carbon, soils also help regulate emissions of carbon dioxide and other greenhouse gases, which is fundamental for regulating climate. SSM is an integral part of sustainable land management, as well as a basis for addressing poverty eradication, agricultural and rural development, promoting food security and improving nutrition.

Soil is the world's largest terrestrial pool of carbon^{5,6} and approximately 95% of global food is produced in soil⁷. SSM is a valuable tool for climate change adaptation and a pathway for safeguarding key ecosystem services and biodiversity. Due to the incalculable value soils provide to society through ecosystem services, SSM ensures a high return on investment by supporting and increasing these services. Widespread adoption of SSM practices generates multiple socio-economic benefits, especially for smallholder farmers and large scale agricultural producers worldwide whose livelihoods directly depend on their soil resources.

However, evidence recently provided in the Status of the World's Soil Resources (SWSR) report and other studies shows that about 33% of global soils are moderately or highly degraded^{8,9}, *i.e.* due to unsustainable management practices. On a global scale an annual loss of 75 billion tons of soil from arable land is estimated to cost about USD 400 billion each year in lost agricultural production¹⁰. This loss also significantly reduces the soil's ability to store and cycle carbon, nutrients, and water. Annual cereal production losses due to erosion have been estimated at 7.6 million tonnes.

Growing concerns about the state of global soils resulted, amongst others, in the establishment of the Global Soil Partnership, the proclamation of the International Year of Soils (2015) by the UN General Assembly and the adoption of the revised World Soil Charter by the FAO Conference. In a broader context, the 2030 Agenda for Sustainable Development adopted a number of related targets in 2015, *i.a.* those aimed at restoring degraded soil, striving to achieve a land degradation-neutral world and implementing resilient agricultural practices that progressively improve soil quality and minimize soil contamination. SSM strongly contributes to collective efforts towards climate change adaptation and mitigation, combating desertification and promoting biodiversity, and therefore has specific relevance to the United Nations Framework Convention on Climate Change (UNFCCC), United Nations

⁵ *Carbon sequestration in dryland soils*. FAO, 2004.

⁶ *Land use, land use change, and forestry. Summary for policy-makers*. IPCC, 2000 (pp. 3-4).

⁷ *Healthy soils are the basis for healthy food production*, FAO, 2015.

⁸ *Status of the World's Soil Resources (SWSR). Main Report*. FAO and ITPS, Rome, 2015 (p. xix).

⁹ *The state of the world's land and water resources for food and agriculture (SOLAW). Managing systems at risk*. FAO, Rome and Earthscan, London, 2011 (p. 113).

¹⁰ *The value of land: Prosperous lands and positive rewards through sustainable land management*. The Economics of Land Degradation (ELD) Initiative, 2015 (p. 80).

Convention to Combat Desertification (UNCCD) and United Nations Convention on Biological Diversity (UNCBD).

The revised World Soil Charter calls for the incorporation of SSM principles and practices into policy guidance. In response, the GSP decided to develop the present Voluntary Guidelines in line with its overall goal of promoting SSM.

1.2 Objectives

The objectives of the VGSSM are: to present generally accepted, practically proven and scientifically based principles to promote SSM and to provide guidance to all stakeholders on how to translate these principles into practice, be it for farming, pastoralism, forestry or more general natural resources management.

1.3 Nature and scope

The VGSSM are of voluntary nature and are not legally binding. They elaborate the principles outlined in the revised World Soil Charter, taking into account the evidence provided in the SWSR. The guidelines address technical aspects of SSM including core characteristics of sustainably managed soils, key challenges and potential solutions to address them. The VGSSM focus mostly on agriculture which is broadly defined as the production of food, fibre, feed, timber and fuel, although many of the principles described have a significant influence on ecosystem services provided by managed and unmanaged soil systems.

The guidelines are not expected to provide detailed recommendations, but are designed to inform strategic and context-specific decision-making at all relevant levels. They are intended to contribute to global, regional and national efforts towards the eradication of hunger and poverty due to the importance of soils in sustainable development.

1.4 Target audience

By providing an easily accessible and readily understandable reference to a wide range of stakeholders, the potential target audience of the VGSSM includes: government officials, policy makers, farmers, pastoralists, forest and land managers, extension services and agricultural advisors, development partners, civil society, private sector and, academia, etc.

1.5 Definition of sustainable soil management

In these guidelines, SSM is defined according to Principle 3 in the revised World Soil Charter as follows:

“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”.

The types of ecosystem services and the soil functions referred to in the definition can be elaborated as follows:

- Supporting services include primary production, nutrient cycling and soil formation;
- Provisioning services comprise the supply of food, fibre, fuel, timber and water; raw earth material; surface stability; habitat and genetic resources;
- Regulating services imply the regulation of aspects such as water supply and quality, carbon sequestration, climate regulation, control of floods and erosion; and
- Cultural services denote the aesthetic and cultural benefits derived from soil use.

SSM is associated with the following characteristics:

1. Minimal rates of soil erosion by water and wind;
2. The soil structure is not degraded (e.g. soil compaction) and provides a stable physical context for movement of air, water, and heat, as well as root growth;
3. Sufficient surface cover (e.g. from growing plants, plant residues, etc.) is present to protect the soil;
4. The store of soil organic matter is stable or increasing and ideally close to the optimal level for the local environment;
5. Availability and flows of nutrients are appropriate to maintain or improve soil fertility and productivity, and to reduce their losses to the environment;
6. Soil salinization, sodification and alkalization are minimal;
7. Water (e.g. from precipitation and supplementary water sources such as irrigation) is efficiently infiltrated and stored to meet the requirements of plants and ensure the drainage of any excess;
8. Contaminants are below toxic levels, i.e. those which would cause harm to plants, animals, humans and the environment;
9. Soil biodiversity provides a full range of biological functions;
10. The soil management systems for producing food, feed, fuel, timber, and fibre rely on optimized and safe use of inputs; and
11. Soil sealing is minimized through responsible land use planning.

2. Challenges for achieving sustainable soil management

Soils have diverse chemical, physical and biological properties. As a consequence, they differ in their responses to management practices, their inherent ability to deliver ecosystem services, as well as their resilience to disturbance and vulnerability to degradation. The Status of the World's Soil Resources report identified ten key threats that hamper the achievement of SSM. These threats are: soil erosion by water and wind, soil organic carbon loss, soil nutrient imbalance, soil salinization, soil contamination, acidification, loss of soil biodiversity, soil sealing, soil compaction and waterlogging. These different threats vary in terms of intensity and trend depending on geographical contexts, though they all need to be addressed in order to achieve sustainable soil management.

SSM shall contribute to addressing global challenges, and meeting international commitments, including:

- the 2030 Agenda for Sustainable Development, where SSM could directly or indirectly contribute to achieving several of the agreed goals and targets;
- the Zero Hunger Challenge (to end hunger and malnutrition and assure food security for a growing population);
- climate change adaptation and mitigation, especially in the light of the [Paris Agreement](#) adopted at the UNFCCC COP21, which embodies a strong commitment to address climate change and give agriculture a prominent role in that process;
- the commitment to combat desertification and mitigate effects of drought, especially the strive to achieve a land degradation neutral world, taking note of the potential benefits for all as per the last UNCCD COP12;
- the Aichi targets which underline an important agenda to preserve biodiversity and the provision of ecosystem services;

- securing land tenure under the Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security (VGGT).

This context points to major opportunities to promote SSM. Taking the above into account, an enabling environment for promoting SSM is fostered by the following core actions:

- Establishing or strengthening inclusive SSM-supportive agricultural/environmental policies

Where appropriate, inclusive policies to promote SSM should be linked to agricultural and environmental policies, so that their implementation provides multiple benefits. If existing, these policies can be reviewed, as appropriate, to mainstream SSM.

- Increasing responsible investment and positive incentives aimed at promoting sustainable soil management

Where appropriate, responsible investment in SSM according to the Principles for Responsible Investments in Agriculture and Food Systems (CFS-RAI) should be increased. Provision of positive incentives to those stakeholders who implement SSM principles while recognizing the value of ecosystem services could be envisaged.

- Promoting secure land tenure rights according to the VGGT

SSM is affected by secure land tenure rights being in place or not. Access and tenure rights are an important factor for SSM to be properly implemented by land users and to enable long-term planning.

- Fostering and strengthening targeted soil research

It is imperative that investment in soil research is increased to enable national research programs and their partners to work with land users to identify and address the constraints they face in increasing the ecosystem services provided by soils (i.e. soil productivity).

- Preventing or minimizing soil degradation and restoring/rehabilitating degraded soils (including historically degraded soils)

Soil degradation shall be minimized using SSM, especially through soil conservation approaches that proved to be successful. Soil rehabilitation and/or soil restoration should also be a priority, returning degraded soils to productivity, especially in historically sound agriculture or other production systems currently under threat.

- Promoting effective education programmes

Where appropriate, education on soils (formal or informal) should be strengthened. That could start with the reflection of their importance in the school's curricula and extending to more professional levels. Capacity development on SSM should be enhanced so that more professionals are brought up-to-date on "state of the art" methods and tools.

- Ensuring adequate inclusion of SSM in extension services

Agricultural extension services should promote SSM principles and practices.

- Establishing/strengthening soil information systems

Considering the living nature of soils, the assessment of their status should be a pre-condition to planning any SSM intervention. Soil data and information (including local knowledge) are essential for understanding soil conditions and trends in soil functions, as well as for targeting interventions to increase productivity. Where appropriate, national soil information systems should be established or strengthened in order to have solid monitoring capacities of soil condition in place. These systems would also contribute to the Global Soil Information System being promoted by the Global Soil Partnership.

- Fostering international cooperation/collaboration on soils

International cooperation on soils should foster the exchange of knowledge, technology and information. Various arrangements including “North-South”, “South-South” and “Triangular” cooperation could be used for that purpose.

- Promoting communication on SSM practices

Pursuing the efforts of the International Year of Soils 2015, SSM practices should be promoted and disseminated in view of their provisioning of important ecosystem services.

3. Guidelines for sustainable soil management

The following constitutes technical guidelines to address soil threats that hamper SSM. They should not be viewed as a full list of good practices, but rather a technical reference to be applied on a context specific basis. Specific technical manuals may be developed later to provide complementary tools.

3.1 Minimize soil erosion

The SWSR report identified soil erosion by water and wind as the most significant threat to global soils and the ecosystem services they provide. Soil erosion causes the loss of surface soil layers containing organic and mineral nutrient pools, partial or complete loss of soil horizons and possible exposure of growth-limiting subsoil, as well as off-site impacts such as damage to private and public infrastructure, reduced water quality and sedimentation. Soil erosion is accelerated by human activities through, amongst others, reduced plant or residue cover, tillage and other field operations, and reduced soil stability leading to soil creep and landslides.

- Land-use changes such as deforestation or improper grassland-to-cropland conversion that cause removal of surface cover and loss of soil carbon should be avoided or carefully planned and appropriately implemented if unavoidable;
- A cover of growing plants or other organic and non-organic residues that protects the soil surface from erosion should be maintained through implementation of appropriate measures such as mulching, minimum tillage, no-till by direct seeding with attention to reduced herbicide use, cover crops, agro-ecological approaches, controlled vehicle traffic, continuous plant cover and crop rotation, strip cropping, agroforestry, shelter belts, and appropriate stocking rates and grazing intensities;
- Erosion by water on sloping and relatively steep lands should be minimized by measures that reduce runoff rates and velocity such as strip cropping, contour planting, crop rotation, intercropping, agroforestry, cross slope barriers (e.g. grass strips, contour bunds and stone lines), terrace construction and maintenance, and grassed waterways or vegetated buffer strips;
- Where appropriate, riparian buffers, buffer strips, wetlands, water harvesting and cover crops should be used/installed to minimize export of soil particles and associated nutrients and contaminants from the soil system and protect the downstream areas from damaging impacts; and

- Erosion by wind, including dust storms, should be minimized and mitigated through vegetative (trees and shrubs) or artificial (stone walls) wind breaks to reduce wind velocity.

3.2 Enhance soil organic matter content

Soil organic matter (SOM) plays a central role in maintaining soil functions and preventing soil degradation. Soils constitute the largest organic carbon pool on the Earth and play a critical role in regulating climate and mitigating climate change through trade-offs between greenhouse gas emission and carbon sequestration. For this reason, SOM is strategic for climate change adaptation and mitigation, and global stores of SOM should be stabilized or increased. A loss of soil organic carbon (SOC) due to inappropriate land use or the use of poor soil management or cropping practices can cause a decline in soil quality and soil structure, and increase soil erosion, potentially leading to emissions of carbon into the atmosphere. On the other hand, appropriate land use and soil management can lead to increased SOC and improved soil quality that can partially mitigate the rise of atmospheric CO₂.

- Increase biomass production by increasing water availability for plants using methods (e.g., irrigation with drippers or microsprinklers; irrigation scheduling; monitoring of soil moisture or loss of water via evapotranspiration) that maximize water-use efficiency and minimize soil erosion and nutrient leaching, using cover crops, balancing fertilizer applications and effective use of organic amendments, improving vegetative stands, promoting agroforestry and alley cropping, and implementing reforestation and afforestation;
- Protect organic carbon-rich soils in peatlands, forests, pasturelands, etc.;
- Increase organic matter content through practices such as: managing crop residues, using forage by grazing rather than harvesting, practicing organic farming, applying integrated soil fertility management and integrated pest management, applying animal manure or other carbon-rich wastes, using compost, and applying mulches or providing the soil with a permanent cover;
- Fire should preferably be avoided, except where fire is integral to land management, in which case the timing and intensity of burning should aim to limit losses of soil functions. Where fire is a naturally occurring event, steps to minimize erosion and encourage re-vegetation after fire should be considered, where practical.
- Make optimum use of all sources of organic inputs, such as animal manure and properly processed human wastes;
- Management practices such as cover crops, improved fallow plant species, reduced- or no-tillage practices, or live fences should be adopted to ensure the soil has a sufficient organic cover;
- Decrease decomposition rates of soil organic matter by practicing minimum or no-tillage without increasing the use of herbicides; and
- Implementing crop rotations, planting legumes (including pulses) or improving the crop mix.

3.3 Foster soil nutrient balance and cycles

The concepts of sufficiency and utilization efficiency apply especially to nutrient dynamics in the soil-water-nutrients-plant root continuum. Plant nutrition should be based on crop needs, local soil characteristics and conditions, and weather patterns. Plant nutrition can be enhanced through nutrient recycling or additions including mineral (chemical) fertilizers, organic fertilizers and other soil amendments including primary sources (e.g. rock phosphate) and secondary sources (e.g. phosphorus from sewage sludge). It is crucial to select an appropriate plant nutrient management system and approach alongside assessing the suitability of the land for a given land use.

The benefits of sufficient and balanced nutrient supply for plant needs are well-established and include: production of food, feed, fibre, timber, and fuel at levels at, or close to, the optimum potential in the specific geographical context; reduced need for pest control measures, external application of organic

and inorganic amendments, and mineral fertilizers; less pollution resulting from inappropriate use of agro-chemicals; and enhanced soil carbon sequestration through biomass production and restitution to the soil.

The lack of basic nutrients leads to the underdevelopment of plants and decrease in yields and crop nutritional value. The consequences of excess nutrients in soils are a) the loss of excess nutrients (especially nitrogen and phosphorus) from agricultural fields, causing eutrophication and deterioration of water quality and terrestrial and aquatic ecosystems; b) increased release of the greenhouse gas nitrous oxide from soils to the atmosphere; c) leaching of mobile forms of nitrogen to water used for human consumption, with potential human health impacts; and d) crop failure.

- Natural soil fertility and natural nutrient cycles should be improved and maintained through the preservation or enhancement of soil organic matter. Improved soil fertility can be attained through soil conservation practices such as the use of crop rotations with legumes, green- and animal manures, and cover crops in combination with reduced- or no-tillage with attention to reduced herbicide use, as well as agroforestry. Nutrient cycles are best managed in integrated systems such as crop-livestock systems or crop-livestock-forest systems;
- Nutrient use efficiency should be optimized by adopting measures such as applying balanced and context adapted soil organic and inorganic amendments (e.g. compost and liming agents, respectively) and/or innovative products (e.g. slow and controlled release fertilizers), as well as the recycling and reuse of nutrients;
- Fertilizer application methods, types, rates and timing should be appropriate to limit losses and promote balanced crop nutrient uptake. This should be based on soil and plant analyses and be a long-term endeavor rather than short term action;
- The addition of soil micronutrients should be considered when planning soil fertilization;
- Practical sources of plant nutrients should be used, including the precise and judicious use of organic and mineral amendments, inorganic fertilizers, and agricultural bio-products. These amendments and bio-products include liquid, semi-solid or solid manures, crop residues, composts, green manures, household refuse, clean ash generated during bioenergy production, soil amendments and inoculants. In order to increase their efficiency, such measures should be combined with the mitigation of other limiting factors (such as water deficiency). Safe use (including tolerable levels of contaminants and pollutants, and worker health) of these amendments should be ensured;
- Soil and plant-tissue testing and field assessments should be adopted and used. This provides valuable guidance in diagnosing and correcting limiting factors in crop production related to plant nutrients, salinity, sodicity, and extreme pH conditions. Such guidance is key for making informed decisions and monitor progress;
- Where appropriate, livestock movement and grazing should be managed to optimize manure and urine deposition;
- Application of liming agents in acid soils is a prerequisite for optimal nutrient use efficiency in such soils, while application of organic amendments such as compost, as well as appropriate soil-crop management should be considered for alkaline and other soils; and
- Naturally occurring mineral fertilizer resources like rock phosphate or potash should be allocated efficiently and strategically to ensure the continued availability of adequate amounts of mineral inputs for future generations.

3.4 Prevent, minimize and mitigate soil salinization and alkalinization

Salinization is the accumulation of water-soluble salts of sodium, magnesium and calcium in the soil. It is the consequence of high evapotranspiration rates, inland sea water intrusion, and human-induced (e.g. improper irrigation) processes. Salinization reduces crop yields and, above certain thresholds, completely eliminates crop production.

- Surface cover should be optimized to reduce evaporation losses;
- Efficiency of irrigation water use should be increased through improved conveyance, distribution, and field application methods. Application methods should be used that operate with low pressure and apply the water directly to the soil. Automization of water supply and application of water on top of crops should be avoided to reduce evaporation losses;
- Irrigation management should ensure sufficient water for plant growth and efficient drainage to avoid problems of salinization;
- Irrigation water quality should be tested and monitored; when feasible, water desalination should be performed;
- Surface and sub-surface drainage systems should be installed and maintained to control rising groundwater tables and control soil salinity. The design of these systems needs to be based on a thorough understanding of the water balance in these areas; and
- If soils are already degraded and prevention is no longer an option, reclamation of saline soils can be achieved using a variety of techniques such as direct leaching of salts, planting salt tolerant varieties, domestication of native wild halophytes for use in agro-pastoral systems, chemical amelioration and the use of organic amendments.

3.5 Prevent and minimize soil contamination

Soil may filter, fix and neutralize, but also release pollutants when conditions change (e.g. heavy metal release with lowering pH). Therefore, prevention of soil contamination remains the best way to maintain healthy soils and food safety in accordance to the Sustainable Development Goals.

Contaminants can enter soils from a variety of sources including agricultural inputs, land application of by-products, atmospheric deposition, flood and irrigation water, accidental spills, inappropriate urban waste and wastewater management, and other means. Accumulation and contamination occur if the rate of addition of a given contaminant exceeds its rate of removal from the soil system. Negative consequences may include plant toxicities and subsequent productivity declines, contamination of water and off-site areas through sediment transport, and increased human and animal health risks through accumulation in the food-chain.

- Governments are encouraged to establish and implement regulations to limit the accumulation of contaminants below established levels to safeguard human health and well-being, and facilitate remediation of contaminated soils that exceed these levels;
- Management of local soil contamination requires establishing background levels, followed by testing, monitoring and assessing contaminant levels to identify sites that are likely to be contaminated. Risk assessment, including total cost assessment, and remediation should be applied to reduce risks to humans and ecological systems;
- Identification of soils that are the most susceptible to the harmful effects of diffuse pollutants is needed. Appropriate attention should be given to reduce contaminant loads in these soils;
- Information on contaminated soil sites should be available to the public;
- Contaminated soils should not be used for food and feed production;
- Recycled nutrients originating from treated waste water or other waste materials that are used as soil amendments should be properly processed and tested to ensure they contain safe levels of contaminants and plant available nutrients. For instance, organic xenobiotics can pose a serious, incalculable and irreversible threat to soil fertility and human health; and
- Outflows of flood water from paddy rice cultivation after applying fertilizers and pesticides should be minimized to avoid off-site effects.

3.6 Prevent and minimize soil acidification

Human-induced acidification of agricultural and forest soils is primarily associated with removal of base cations and loss of soil buffering capacity or increases in nitrogen and sulfur inputs (e.g. legume pastures fertilizer inputs, atmospheric deposition). Soils with low pH-buffering capacity and/or high aluminium content are most prevalent when they have a low content of weatherable minerals (e.g. ancient, strongly weathered soils, and soils developed from quartz-rich parent materials).

- Monitoring soil acidity and minimizing surface and sub-surface soil acidity by using proper amendments (such as lime, gypsum and clean ash);
- Balanced fertilizer and organic amendment applications; and
- Appropriate use of acidifying fertilizer types.

3.7 Preserve and enhance soil biodiversity

Soils provide one of the largest reservoirs of biodiversity on earth, and soil organisms play key roles in the delivery of many ecosystem services. Little is known about the degree of biodiversity required to maintain core soil functions, but new tools for biochemical techniques and DNA analysis suggest significant progress in this area is possible.

- Monitoring programs for soil biodiversity, including biological indicators (e.g. community ecotoxicology) and *in-situ* early warning signals, should be undertaken;
- Soil organic matter levels supporting soil biodiversity should be maintained or enhanced through the provision of sufficient vegetative cover (e.g. cover crops, multiple crops), optimal nutrient additions, addition of diverse organic amendments, minimizing soil disturbance, avoiding salinization, and maintaining or restoring vegetation such as hedgerows and shelterbelts;
- The authorization and use of pesticides in agricultural systems should be based on the recommendations included in the [International Code of Conduct on Pesticide Management](#) and relevant national regulations. Integrated or organic pest management should be encouraged;
- The use of nitrogen fixing leguminous species, microbial inoculants, mycorrhizas (spores, hyphae, and root fragments), earthworms and other beneficial micro-, meso- and macro- soil organisms (e.g. beetle banks) should be encouraged where appropriate, with attention to limiting the risk of invasive processes by promoting the use of local biodiversity and avoiding the risk of disturbance in soil services;
- Restoring plant biodiversity in ecosystems, thereby favouring soil biodiversity;
- In-field crop rotation, inter-cropping, and preservation of field margins, hedges and biodiversity refuges should be encouraged; and
- Any land use change in areas with high biodiversity should be subject to land use planning and in line with the UNCBD, UNCCD and other relevant international instruments and with national law.

3.8 Minimize soil sealing

Land conversion and subsequent soil sealing for settlements and infrastructure affect all soils, but are of particular concern on productive, arable soils because of their importance for food production and food security and nutrition, and circular economy targets. In many places, urban sprawl affects the most productive soils adjacent to the cities and settlements. Soil sealing and land conversion causes a largely irreversible loss of some or all soil functions and the ecosystem services they provide.

- Considering the total value of soils and to ensure the preservation of productive, arable soils, existing policies, relevant laws and land use planning procedures for the development of settlements and infrastructure should be reviewed as appropriate;
- Where policy and legislation aim to minimize land conversion, measures should be implemented to encourage densification and re-use of existing urban or industrial areas such as abandoned areas and brownfields, and restoring degraded neighbourhoods after appropriate reclamation measures have been implemented. Ecological restoration of quarries and mining sites should be encouraged; and
- Soils with significant ecosystem services including high soil carbon stocks, high biological diversity or high agricultural suitability should be protected from land conversion for settlements and infrastructure by special legislation.

3.9 Prevent and mitigate soil compaction

Soil compaction is related to the degradation of soil structure due to imposed stresses by machinery and livestock trampling. Soil compaction (reduced or disrupted pore continuity) reduces soil aeration by destroying soil aggregates and collapsing macropore density, and reduces water drainage and infiltration, generating higher runoff. Compaction limits root growth and seed germination by high mechanical impedance, affecting soil biodiversity and causing surface soil crusting.

- Deterioration of soil structure due to inappropriate or excessive tillage should be prevented;
- Vehicular traffic should be minimized to the absolutely essential, particularly on bare soils, by reducing the number and frequency of operations, creating controlled traffic systems, and by performing agriculture/forestry operations only when the soil moisture content is suitable down to deeper depth;
- Machines and vehicles used in the field should be adjusted to soil strength and should be equipped with tyre pressure control systems or other means to reduce surface pressure (e.g. contact area), and use of heavy machinery should be avoided. During forestry operations, machine traffic should be restricted (e.g. controlled traffic) and brush mats used to help protect exposed soils from physical damage; on agricultural soils, controlled traffic and drive rows should be established, where possible;
- Cropping systems should be selected that include crops, pasture plants and, where appropriate, agroforestry plants with strong tap roots (dense and fibrous root systems) able to penetrate and break up compacted soils;
- An adequate amount of soil organic matter should be maintained to improve and stabilize soil structure;
- Macrofauna and microbial (especially fungal) activity should be promoted to improve soil porosity for soil aeration, water infiltration, heat transfer and root growth; and
- In grazing systems, a sufficient cover of growing plants should be maintained to protect the soil from trampling and erosion; livestock management should take into account grazing intensity and timing, animal types and stocking rates.

3.10 Improve soil water management

A sustainably managed soil has rapid water infiltration, optimal soil water storage of plant available water and efficient drainage when saturated. However, when these conditions are not met, waterlogging and water scarcity problems arise. On the one hand waterlogging, which is related to the saturation of soil with water, creates rooting problems for many plants, thereby reducing yields, and can cause contaminants such as arsenic and methylmercury to become mobile in the soil. On the other hand, water scarcity occurring in areas where water is lost by evaporation, surface runoff and percolation, can cause crop failure.

- In humid areas where precipitation exceeds evapotranspiration, additional drainage systems are needed to provide aeration for root functions like nutrient uptake. This is a concern especially in fine-textured soils which have high water retention capacity.
- Surface and sub-surface drainage systems should be installed and maintained to control rising groundwater tables in order to mitigate potential waterlogging;
- The efficiency of irrigation water use by plants should be increased through improved conveyance, distribution, and field application methods (e.g. scheduled drip or microsprinkler irrigation) that reduce evaporation and percolation losses of irrigation water, as well as through better soil water reserve estimation, better species or variety choices, and better computing of water loading periods and amounts;
- In dryland cropping systems, measures should be implemented to optimize water-use efficiency such as the management of soil cover (e.g. previous crops, forage and fallow) and water harvesting to increase soil water availability at sowing; reduction of runoff and evaporative losses from the soil surface; and ensuring that there is adequate water available at each stage of crop development. These measures often involve trade-offs and risks that should be recognized and managed;
- Optimal soil water extraction by the crop through the selection of appropriate cultivars and careful timing of agronomic operation should be promoted; and
- Regularly monitor irrigation water quality for nutrients and potential harmful substances.

4. Dissemination, use and evaluation of the VGSSM

Without prejudice to the voluntary nature of the present guidelines, all stakeholders are encouraged to promote, support and use the guidelines according to their respective individual or collective needs, mandates, abilities, and relevant national contexts. The successful use of the guidelines needs a collective action of multiple stakeholders in an inclusive, participatory, gender sensitive, cost-effective and sustainable manner. In doing so, evidence-based scientific knowledge as well as local knowledge should be used as appropriate.

Acknowledging that States have the primary responsibility for achieving food security and nutrition of their population, they are encouraged to:

- Take the lead in promoting the use and evaluation of the VGSSM;
- Set up relevant platforms and frameworks, as appropriate, for collective action at local, national and regional levels, or use the existing facilities to promote these voluntary guidelines;
- Promote effective extension services that rely on proper research and education institutions and mainstream SSM in their activities; and
- Evaluate their use and the impact of improved soil management on food security, ecosystem services related to soil functions and on the efforts towards achieving the Sustainable Development Goals.

In this endeavour, States may seek technical support from FAO or other international and regional bodies, as appropriate. The Regional and Sub-Regional Soil Partnerships are instrumental in disseminating and promoting the use of the VGSSM.

Development partners, relevant specialized agencies and programmes of the United Nations, international financial institutions and regional organizations are encouraged to:

- Support the dissemination and implementation of these voluntary guidelines; and
- Facilitate, as appropriate, technical cooperation, financial assistance, capacity development, knowledge sharing and transfer of technology aimed at promoting SSM.

For other stakeholders, the following is suggested:

- Private sector enterprises involved in soil management are invited to promote the use of the guidelines with a focus on managing risks to maximize positive and minimize negative impacts on SSM, relevant to their context and circumstances;
- Civil society organizations with relevance to soil management are invited to integrate the guidelines in their policies and programmes, advocate for the appropriate use of the guidelines and assist with building capacity of their members with the aim of contributing to SSM; and
- Research organizations, universities, academia, extension organizations and/or programmes are invited to promote integration of the guidelines in their own policies, and facilitate knowledge exchange and skills development to contribute to SSM.

The GSP, hosted by FAO, presents a global forum where different stakeholders learn from each other's experiences and assess progress toward the implementation of these guidelines and their relevance, effectiveness and impact. The GSP Secretariat and the Intergovernmental Technical Panel on Soils (ITPS) as its advisory body will report to the GSP Plenary Assembly on the progress in the implementation of the guidelines, as well as evaluate their impact and their contribution to the improvement of soil management.

Dissemination and promotion of the guidelines at the regional level should be supported by all stakeholders, particularly through the Regional Soil Partnerships.

In promoting the use of the VGSSM, possible synergies and collaboration with other relevant initiatives related to sustainable soil management could be explored.