



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

Concept Note

Global Symposium on Soil Biodiversity (GSOBI21) “Keep soil alive, protect soil biodiversity”

Co-organized by: the Food and Agriculture Organization (FAO) of the United Nations, the Global Soil Partnership (GSP), the Intergovernmental Technical Panel on Soils (ITPS), the Convention on Biological Diversity of the United Nations (CBD), the Global Soil Biodiversity Initiative (GSBI), and the Science-Policy Interface of the United Nations Convention to Combat Desertification (UNCCD-SPI)

2 – 5 February 2021 – Virtual meeting (Zoom platform)

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Introduction

Soil is the thin layer on the Earth’s surface that underpins a variety of services for both terrestrial and aquatic life, in managed and natural ecosystems. Soil biodiversity includes vertebrates, invertebrates, annelids, mollusks, nematodes, viruses, bacteria, fungi, lichens, bryophytes and plants that provide a multitude of ecosystem functions and services and deliver several social, economic and environmental benefits for all.

Essential services provided by this rich underground diversity include supporting agriculture and food security; regulating nutrient cycles; controlling the dynamics of soil organic matter; supporting soil carbon sequestration; regulating greenhouse gas emissions; modifying soil physical structure and soil water regimes; enhancing the amount and efficiency of nutrient acquisition by vegetation through symbiotic associations and nitrogen fixation by bacteria; as well as influencing plant, animal and human health through the interaction of pathogens and pests with their natural predators and parasites.

Soils are widely recognized as a major reservoir of global biodiversity (the majority are still unknown). Yet, the Status of the World’s Soil Resources (FAO, 2015) concluded that the loss of soil biodiversity is considered one of the major soil threats in many regions of the world. Despite the enormous scientific progress made to date, the protection and monitoring of soil resources at national and global levels face complex challenges, restricting the design and implementation of on-the-ground policies.

Unfortunately, there is insufficient global support for meeting these challenges, which vary widely by region. Links between research and practical management at production-system level need to be improved. Policies and other legal instruments to protect and value soil biodiversity are still at an early stage and need to be further developed. While traditional land and biodiversity policies that focus on conservation and protection measures continue to be important, there is a need to complement them with additional instruments to address specific concerns for soil biodiversity.

Why is soil biodiversity important?

On a global scale, there is increasing recognition of the important role that soil biodiversity plays in tackling global challenges, and in supporting life on Earth as a result of the ecosystem functions and services provided by it. Soil biodiversity also represents an important biological and genetic resource for biotechnological and medical innovation.

Many economic sectors interact and depend on soil biodiversity in a number of ways. For food systems, for instance, soil biodiversity is not only an essential engine for food production, but it also increases ecosystem resilience, food security, improves overall nutrition and manages agricultural externalities beyond farming.

Human nutrition depends on the availability and balance of nutrients in edible parts of plants, which depends on their concentration in the soil and their availability for plant uptake of those nutrients, which are linked to belowground interactions. In addition, soil biodiversity is important for food safety, where microbes play an important role on decontamination, remediation and contaminant buffering, contributing to reduce contamination of food by different soil pollutants.

Along this line, achieving food security, human health and biodiversity conservation should be seen as mutually supportive objectives. All terrestrial ecosystems, including agricultural systems, have a major role in supporting soil biodiversity and enhancing the sustainable use of its resources. Intensive agriculture, for example, can also reduce the diversity and types of functions performed by soil organisms (Tsiafouli et al., 2014).

Therefore, in addition to the myriad of ecosystem functions that soil biodiversity provides, it is also essential to sustain and restore the vitality of agricultural systems, increase productivity, guarantee a long-term profitability and shape the future of belowground and aboveground ecosystems.

What is the status of knowledge on soil biodiversity?

The Global Soil Biodiversity Atlas (Orgiazzi, A. et al., 2016) showed that the knowledge of soil life is growing due to recent technological advances and awareness of its value. There is substantial progress in current knowledge about the global distribution of soil biodiversity and its functions (Crowther et al. 2019; van den Hoogen, J. et al., 2019). However, it is estimated that only 1% of soil microorganisms have been identified.

The State of the World's Biodiversity for Food and Agriculture report (FAO, 2019) concluded that many associated-biodiversity species living in and around production systems, particularly microorganisms and invertebrates, have never been documented. In many cases, there is a limited understanding of ecosystem functions and services and consequently, the contribution of specific biodiversity components to the production systems are poorly understood. There is also a poor knowledge of the biotic communities living in extreme environments –e.g. hypersaline, hyperacid soils-, and of the importance and potential of the genetic pool they are hosting.

In the era of great global challenges such as climate change, land degradation and biodiversity loss, soils are in the nexus of those concerns and have become one of the most vulnerable resources in the world.

Soil biodiversity is vulnerable to land use change, accelerated climate change, soil pollution, and the introduction of invasive species. Soil biodiversity tends to be greater in undisturbed natural lands compared to cultivated fields (Louwagie, 2009; Mujtar, 2019). On the other hand, traditionally managed agroforestry systems are more biodiverse than set-aside lands undergoing degradation processes as an example (Scherr and McNeely, 2007; Erisman et al., 2016). Despite some data gaps, there is growing evidence that unsustainable agricultural practices affect not only soil quality, but also the integrity and resilience of the ecosystem as a whole.

The need to increase agricultural yield through the overuse or misuse of some practices like mechanization, irrigation, application of chemical fertilizers and pesticides (including insecticides, herbicides, fungicides and nematicides) as well as the increase of monoculture-based systems have resulted in losses of soil biodiversity, and ecosystem functions and services essential for food production. The latter has only been partly minimized by the increasing utilisation of external inputs. The focus on crops yield has also led to a decreased nutritional value of food (Davis, 2009), which has been minimized by fortified food products such as flours with B-vitamin, zinc or iron (Engle-Stone et al., 2017).

Sustainable use of soil biodiversity is key in reinventing agricultural systems to become more resource- efficient, resilient and adaptive (Bommarco et al., 2013; Cunningham et al., 2013; Bender et al., 2016). Biodiverse soils enhance the capacity of farmers to reduce their dependence on external inputs, thereby increasing their autonomy. Therefore, a better understanding of the essential roles of soil organisms in mediating soil-based ecosystem services is central to guide biodiversity-friendly agricultural intensification pathways.

Additionally, soil microbes can provide tremendous benefits to human health (Wall et al., 2015). In order to have a better understanding of the effects of soil biodiversity management on human health, it is necessary to consider the links between soil biodiversity and the holistic One Health¹ approach (which includes animal, human and ecosystem health).

Although progress has been made, few monitoring programs exist to quantify soil biodiversity across regions. In addition, there is a need for standardization of methods in soil biodiversity studies so that multiple datasets can be synthesized, and benchmark values for global soil biodiversity may be established.

The Global Symposium on Soil Biodiversity: Keep soil alive, protect soil biodiversity

The Global Symposium on Soil Biodiversity (GSOBI21) will bring together worldwide experts to discuss the status of the world's soil biodiversity, trends and opportunities based on the best available scientific evidence, and other forms of knowledge such as indigenous and traditional knowledge.

The Symposium will provide a forum for country representatives, scientists, indigenous peoples, local communities, organizations and businesses to showcase applications of integrated land use planning and soil management, as well as solutions to reinstate soil ecosystem services and to ensure equitable and environmentally friendly approaches.

Scientists and researchers will have the opportunity to present the latest knowledge and the new developments on assessing and monitoring soil biodiversity. Farmers, indigenous peoples and local communities along with communities of practices will enrich the discussion by bringing forward biodiversity-friendly techniques, and traditional and indigenous practices that have been promoting soil biodiversity conservation and sustaining aboveground life for millennia.

The projected world population growth and the increasing food demand, as well as the current remaining need to eradicate poverty and malnutrition, rely on the effective use of soils and the ecosystem services. Reversing soil degradation and restoring soil functions and health offers considerable opportunity to address the importance of soil biodiversity in reversing the worldwide trend of degradation.

¹ One Health is an approach to designing and implementing programmes, policies, legislation and research in which multiple sectors communicate and work together to achieve better public health outcomes. The World Health Organization (WHO) works closely with the Food and Agriculture Organization of the United Nations (FAO) and the World Organisation for Animal Health (OIE) to promote multi-sectoral responses to food safety hazards, risks from zoonoses, and other public health threats at the human-animal-ecosystem interface and provide guidance on how to reduce these risks.

Sustainable soil management can be clearly identified as a crosscutting approach and it is at the heart of alignment of several global agendas and international policy frameworks, including the Sustainable Development Goals (SDGs) and multi-lateral environment agreements, in particular those related to biodiversity, desertification and climate change. Furthermore, soil biodiversity and ecosystem services will be pivotal for the success of the recently declared UN Decade on Ecosystem Restoration (2021-2030).

In 2002, the Conference of Parties (COP) to the Convention on Biological Diversity (CBD) decided, at its 6th meeting in Nairobi, to establish an *International Initiative for the Conservation and Sustainable Use of Soil Biodiversity*, as a cross-cutting initiative within the programme of work on agricultural biodiversity, and invited the Food and Agriculture Organisation of the United Nations (FAO), and other relevant organisations, to facilitate and coordinate this initiative.

The International Initiative has three main objectives:

- (i) the promotion of awareness raising, knowledge and understanding of key roles, functional groups and impacts of diverse management practices in different farming systems and agro-ecological and socio-economic context;
- (ii) the promotion of ownership and adaptation by farmers of integrated soil biological management practices as an integral part of their agricultural and sustainable livelihood strategies; and
- (iii) the strengthening of collaboration among actors and institutions and mainstreaming soil health and biological management into agricultural, land management and rehabilitation programmes.

Since then, many countries have been adopting policies and legal frameworks dedicated to the utilisation of agrochemicals, water protection, pollution prevention and waste management, which have contributed to some extent to soil protection and have indirect effects on the conservation of different soil biodiversity components by addressing specific threats (e.g. nitrates, pesticides and invasive alien species). However, it is necessary to have legal instruments focused on soil biodiversity, given its importance in multiples areas and in the provision of fundamental ecosystem services.

Eighteen years after the launch of the *International Initiative*, soil biodiversity remains poorly known and understood to decision-makers, farmers, and the general public. This reflects the lack of awareness on soil biodiversity and its value, as well as the complexity of the subject, which contributes to the current neglect of underground biodiversity.

In 2018, at the UN Biodiversity Conference held in Egypt, the CBD COP invited FAO to prepare a report on the state of knowledge on soil biodiversity covering the current status, challenges and potentialities. Additionally, the COP requested the Secretariat of the CBD, in consultation with FAO under the aegis of the Global Soil Partnership (GSP) as well as other interested partners, to review the implementation of the *International Initiative for the Conservation and Sustainable Use of Soil Biodiversity*.

In 2020, the Parties to the CBD will adopt a Post-2020 Global Biodiversity Framework towards the achievement of the 2050 Vision of "Living in harmony with nature". There is an urgent need for a more integrated and coherent policy framework, where soil biodiversity protection is incorporated into other sectoral policies. Managing soil biodiversity has different components and challenges, making this task considerably different from the management of aboveground biodiversity.

In this context, the Symposium outcomes will support the preparation of the revised plan of action for the implementation of the International Initiative and ultimately, contribute to the Post-2020 Framework. This

Symposium brings the opportunity to openly discuss and channel efforts to build bridges among actions of different stakeholders that can sometimes be seen as fragmented or overlapped.

Aim and objectives

The *State of the World's Biodiversity for Food and Agriculture report* highlights a growing interest from countries in biodiversity-friendly practices and approaches. This Symposium will build links between biodiversity-based solutions and the three previous global symposia hosted by FAO: Symposium on Soil Organic Carbon (held in 2017), Symposium on Soil Pollution (held in 2018) and Symposium on Soil Erosion (held in 2019).

The overall aim of the symposium is to review the role of soil biodiversity and ecosystem services in tackling environmental problems, and to drive actions towards the implementation of the World Soil Charter² along with the Voluntary Guidelines for Sustainable Soil Management³. Specifically, the symposium outcomes will provide evidence to support actions to protect soil biodiversity and promote its sustainable use and management by addressing the underlying causes of soil biodiversity loss and enhancing implementation of sustainable practices.

The main objective is to fill some critical knowledge gaps and promote discussion among policy makers, food producers, scientists, practitioners and other stakeholders on solutions to live in harmony with nature, and ultimately, achieve the SDGs through the conservation and sustainable use of soil biodiversity. The specific objectives of the symposium are to:

1. Examine the current scientific, technical, indigenous and traditional knowledge on the role of soil biodiversity on food production, human health and on sustaining biodiversity aboveground;
2. Identify knowledge gaps and explore opportunities for collaborative research, capacity building and technical cooperation;
3. Identify limitations and opportunities to promote the sustainable use of soil biodiversity, knowledge sharing and capacity building;
4. Present effective and replicable methodologies, techniques, technologies and practices that promote sustainability, with a view to upscale those sustainable approaches to promote soil biodiversity conservation, the sustainable use of its resources and equitable participation in productive landscapes;
5. Identify policy options to protect soil biodiversity and encourage the adoption of practices that enhance it;
6. Present national, regional and global initiatives that support the effective design, planning, implementation, monitoring and reporting solutions and their contribution to the achievement of the SDGs.

Expected outcome

The symposium outcome document “Keep soil alive, protect soil biodiversity” will highlight the importance of soil biodiversity not only for food production, but for enhancing the benefits to all and in various ways and at multiple scales, including biodiversity-based solutions for global challenges, human

² Revised World Soil Charter <http://www.fao.org/3/a-i4965e.pdf>

³ Voluntary Guidelines for Sustainable Soil Management <http://www.fao.org/3/a-bl813e.pdf>

well-being, health and nutritional food and new medicinal discoveries, including the discovery of new antibiotics.

Symposium structure

The Symposium will be a science-policy meeting, held over a period of four (4) days, from 2 – 5 February 2021, with over 500 participants representing all regions of the world.

The meeting will be opened with high-level plenary addresses by representatives of the hosting organizations to present the policy context, the relevance of soil biodiversity and the outcomes sought from the symposium.

Keynote presentations will be given by invited leading experts in relation to the following main themes:

- Theme 1: State of knowledge on soil biodiversity
- Theme 2: Soil biodiversity in action
- Theme 3: Soil biodiversity shaping the future of food systems

Parallel sessions

Parallel sessions will be held for the above mentioned three themes. The format of the parallel sessions will be determined by the conveners (in close collaboration with the organizing and scientific advisory committees) to ensure the themes are sufficiently presented and discussed to compile the key aspects needed to achieve the expected outcomes. Regional status of soil biodiversity and solutions for the conservation and sustainable use of its resources will be discussed collectively during plenary sessions.

Abstracts, papers and best practices

Abstracts, papers and best practices for key topics (as identified by the Committees) will be invited to support the discussion on the three themes, including case studies from different countries. Guidelines for the submission of abstracts, papers, cases studies and best practices will be provided.

Participants

Participants will include representatives from FAO member states, CBD country Parties, scientists and practitioners working in related fields, representatives from NGOs, civil society, land users and representatives of indigenous peoples and local communities.

Additionally, the symposium has called the attention of the private sector working on sustainable agriculture and technology development related to soil.

Symposium committees

The following Committees have been established:

Organizing committee

This Committee is comprised of representatives from the co-organizing bodies (FAO/GSP/ITPS, the CBD, the GSBI, and the SPI-UNCCD). It oversees the overall organization of the symposium, guides the format of the parallel sessions, and will ensure the achievement of the expected outcomes.

Scientific committee

This Committee is comprised of representatives from the co-organizing organizations, as well as additional leading experts in the three main themes. This Committee is responsible for evaluating submitted abstracts and papers, as well as ensuring the scientific quality of the parallel sessions and symposium outputs.

Symposium themes and key questions to be addressed

Based on the listed objectives, the Symposium will focus on three themes to collate relevant information as elaborated below. In order to achieve the objectives, the main questions to be addressed during the Symposium are presented under each theme.

Theme 1. State of knowledge on soil biodiversity

Soil biodiversity is increasingly under threat, which results in changes in the composition of soil communities and loss of species and organisms as well as the benefits that they provide to all kinds of life on Earth. Rapid advancements in scientific research and technologies have supported the discovery of new species and taxonomy of soil biota, their distribution in soils around the world and the understanding of what they do for our well-being.

Biotechnological methods to describe impacts of agricultural practices on taxonomic and functional diversity of soil organisms are also advancing. New understanding of soil-plant interactions has provided novel insights into mechanisms by which soil organisms and plants co-regulate plant growth and defences, or affect food nutritional quality and safety (Mujtar, 2019).

Despite this progress, the importance of soil and the multitude of environmental services that depend on soil organisms are not well understood by society at large. **Theme 1** aims to bring to discussion the latest discoveries on taxonomic and genetic diversity of soil organisms, the benefits arising from soil biodiversity and the status of the world soil biodiversity to strength the dialogue between the soil scientific community, policymakers and the general public.

Core questions:

1. What recent discoveries have been made on soil organisms' taxonomic and genetic diversity, and their distribution patterns?
2. How have technological advances and traditional and indigenous knowledge supported soil biodiversity discoveries?
3. What is the latest knowledge on the ecosystem services delivered by soil biodiversity? (e.g. for shaping terrestrial and marine biodiversity, food quality and nutritional value, human-health and well-being, etc.)
4. What is the status and projected trends of soil biodiversity (global/regional/national levels)?
5. How can we best measure, map, monitor and report on soil biodiversity? What are the most useful indicators organisms?

Theme 2. Soil biodiversity in action

Theme 2 aims to review the role and the application of soil biodiversity in the field. Experts will present effective and replicable methodologies, techniques, technologies and practices that are promoting the conservation and sustainable use of soil biodiversity, with a view to upscale those

sustainable approaches to improve productivity, accelerate biodiversity conservation and sustainable use of its resources, as well as guarantee equitable participation in productive landscapes.

This theme will present the main drivers of soil biodiversity loss and promote the discussion on the consequences of those losses as well as responses to avoid or reverse them.

Sustainable use of soil biodiversity is key to reinventing agricultural systems that are more resource- efficient, resilient and adaptive. Along these lines, concerns regarding resource depletion and off-farm negative externalities on different components of soil biodiversity is encouraging the development of models and pathways towards more sustainable agricultural systems.

Apart the ecosystem services related to food production, soil biodiversity also provides support to human and animal health related discoveries, such as microbial research. Soil serves as a reservoir for antimicrobial resistance genes and as well as innovative antimicrobial agents. It is necessary not only to better understand the microorganisms' role in the ecosystems, but also their utilization on the development of solutions for antimicrobial resistance (AMR), food safety and pests and diseases control.

Core questions:

1. What are the main drivers of soil biodiversity loss and what are the consequences? How do losses vary across environments? Can loss of soil biodiversity be reversed?
2. How can soil biodiversity support the transformation of agricultural systems toward achieving sustainable intensification?
3. How can soil biodiversity support the One Health approach?
4. What are the currently successful methodologies, techniques, technologies and practices in place to promote soil biodiversity conservation, sustainable use of its resources and equitable participation in productive landscapes? How can we upscale biodiversity-based solutions and other sustainable approaches?
5. What kind of actions should be taken to prevent and control the introduction of non-indigenous plants, animals, microorganisms, genes and diseases that could negatively impact the different components of soil biodiversity?
6. What are the most effective knowledge sharing and capacity building approaches to raise awareness on the better use of soil biodiversity into agricultural practices?
7. What are the methodologies, techniques, technologies and practices in place to monitor antimicrobial residues in soil and their impact on biodiversity and antimicrobial resistance?

Theme 3. Soil biodiversity shaping the future of food systems

Theme 3 aims to discuss legislation, policies, international frameworks and financial mechanisms to mainstreaming soil biodiversity across government and society, reducing the direct pressures and promoting sustainable use and improving the status of soil biodiversity through safeguarding ecosystems, genetic diversity and the functions and services provided by them.

Soil biodiversity is critical for soil functioning and food production but it has been largely ignored in global, regional and national policies including the ones that address land management, food security, climate change, biodiversity conservation and land degradation. This is largely because of the differences between belowground and aboveground biodiversity; policies aimed at aboveground biodiversity can not do enough for the protection of soil biodiversity. Therefore,

policies and legal frameworks to specifically, protect and value soil biodiversity are urgently needed.

The management of soil biota provides common ground for achieving the SDGS, and could form the basis for the conservation of many endangered plants and animals. This aspect could be considered or highlighted in future biodiversity policies and initiatives.

Core questions:

1. What are the economic incentives and subsidies that could support soil biodiversity and sustainable production? Can they be realigned, and how?
2. What are the contributions of soil biodiversity to implement policies facing key sustainability challenges and to support countries to achieve the SDGs and other global commitments?
3. What are the available financial mechanisms that could support the conservation and sustainable use of soil biodiversity?
4. How to include soil biodiversity concerns into agricultural sectors and cross-sectoral mainstreaming approaches (such as land tenure, landscape management, ecosystem rehabilitation, food security and nutrition, small holders and family farmers, public health, forestry)?

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