



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



Report of the first International Network on Soil Biodiversity working group meetings (NETSOB)

Virtual meeting, February 7–10, 2022

NETSOB-2/22/Report

Report of the first NETSOB working group meetings

Virtual meeting, February 7–10, 2022

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
Rome, 2022

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Introduction

The first working group meetings of the International Network on Soil Biodiversity (NETSOB) took place from February 7 to 10, 2022. The working group meetings were organized virtually using the Zoom Video Communications® platform, and structured as follows:

- February 7, for technical working group one (WG-1) on measurement, assessment and monitoring of soil biodiversity;
- February 8, for technical working group two (WG-2) on sustainable use, management, and conservation of soil biodiversity;
- February 9, for technical working group three (WG-3) on the economics of soil biodiversity; and
- February 10, for technical working group four (WG-4) on policies and legal instruments related to soil biodiversity.

The meetings were held to discuss the table of contents (TOC) of the deliverables to be developed by each working group (WG), as per the decision at the [first NETSOB meeting](#), defining the lead and contributing authors for each activity and establishing the scientific committee for each WG.

As agreed in the [NETSOB launch meeting](#), the agreed deliverables of each WG were:

- WG-1: The development of guidelines for measuring, assessing and monitoring (MAM) soil biodiversity.
- WG-2: The development of a field manual on good management practices to conserve soil biodiversity and prevent soil biodiversity loss.
- WG-3: The development of the methodology for the economic valuation of ecosystem services provided by soil biodiversity.
- WG-4: The development of policy briefs on the state of knowledge, protection, conservation, and sustainable use of soil biodiversity at national, regional, and global levels.

Each meeting of the WG lasted two hours (see agenda in Annex I) and was attended by 475 participants from WG-1, 287 participants from WG-2, 160 participants from WG-3, and 125 participants from WG-4, respectively. The participants came from around the world.

Opening remarks

Mr Peter de Ruiter, Chair of NETSOB, opened each meeting by thanking the participants for their commitment to the network. Mr Ruiter emphasized that the objectives of the meetings were for

the members of each WG to discuss the TOC, provide inputs and suggestions in order to arrive at a final consensus version and elect the scientific committee.

Ms Rosa Cuevas, coordinator of NETSOB, explained the content of the agenda items in each WG, as well as restating the main agreements reached at the NETSOB launch meeting, including the deliverables to be developed by each working group.

Working group activities

The NETSOB Vice-Chairs presented and explained in detail the TOC for WG-1, WG-2, WG-3 and WG-4 respectively.

Mr George Brown (Vice-Chair of WG-1) presented the guidelines on measuring, assessing and monitoring (MAM) soil biodiversity. He described the contents for each section of the guidelines, emphasizing the strategies and issues related to the design and implementation of soil biodiversity monitoring programmes and the MAM methods for microorganisms, micro, meso, macro and megafauna. He also explained the soil functional MAM methods related to soil biodiversity and soil health and a synthesis session of the worldwide MAM of soil biodiversity and soil health (see Annex 2).

Ms Zoë Lindo (Vice-Chair of WG-2) presented the TOC of the field manual on good management practices to conserve soil biodiversity and prevent soil biodiversity loss. Ms Lindo went through the contents for each section of the field manual, underlining the mechanisms, overarching principles and proximal drivers that lead to soil biodiversity loss, its primary threats and stressors, the best practices for the prevention and reversal of soil biodiversity loss and the capacity building approaches to obtain these goals (see Annex 3).

Mr Gian Luca Bagnara (Vice-Chair of WG-3) presented the TOC for the methodology for the economic valuation of ecosystem services provided by soil biodiversity. Mr Bagnara began by describing each section of the methodology, highlighting the theoretical framework of biodiversity economic valuation and the conceptual model for understanding the linkage between soil ecology, soil biodiversity, and the economy (see Annex 4).

Ms Rosalina González (Vice-Chair of WG-4) presented the TOC of the report on the global status and regional trends in public policy on soil biodiversity. Ms González went over the contents for each section of the global report, stressing the regional trends in public policy on soil biodiversity of protection, conservation, and sustainable use, the international legal instruments to protect soil biodiversity and the national and regional priorities to protect soil biodiversity (see Annex 5).

After presenting the content of the TOCs, each Vice-Chair opened up the meeting for questions, comments and suggestions. Working group members provided recommendations on the different segments of the TOCs. Attendees were then reminded that the comments and suggestions made during the discussion session would be incorporated into the TOCs so that final consensus versions could be produced.

Self-nomination for the different sections of the table of contents

The NETSOB Vice-Chairs laid out the dynamics of participation in each deliverable and highlighted that an online survey would be sent through the GSP Secretariat with the TOC sections, so that any interested parties could put their name forward as a lead or contributing author for each section. The Vice-Chairs explained that the main selection criteria would be based on the expertise of the authors interested in the subject, with the selection being made through the evaluation of short CVs.

Establishment of the scientific committee

The NETSOB Vice-Chairs emphasized the importance of having a scientific committee in each WG to provide advice and scientific support for the NETSOB board decision making. They also shared a list of the WG members interested in being considered for the scientific committee (see Table 1, 2, 3 and 4). The Vice-Chairs explained that the selection criteria had been based on geographic and gender balance and experience in the field, as well as giving equal consideration to both senior and young scientists.

Table 1. Candidates for the WG-1 scientific committee

Working group	Name	Surname	Gender	Institution	Country
1	Alberto	Acedo	Male	Biome Makers Inc.	Spain
1	Eric	Palevsky	Male	Agricultural Research Organization, Ministry of Agriculture	Israel
1	Fatemeh	Bahreini	Female	Slovak Academy of Sciences	Slovakia
1	Anton	Potapov	Male	University of Göttingen	Germany
1	Hannah	Karuri	Female	University of Embu	Kenya
1	Luigimaria	Borruso	Male	Free University of Bozen-Bolzano	Italy
1	Samuel	Eziuzor	Male	Freiberg University of Mining and Technology	Germany
1	Isabel	Campos	Female	CESAM-UA	Portugal
1	Antonietta	La Terza	Female	University of Camerino	Italy

1	César	Marín	Male	Santo Tomas University	Chile
1	Maria	Tsiafouli	Female	Aristotle University of Thessaloniki	Greece
1	Punyasloke	Bhadury	Male	Centre for Climate and Environmental Studies, IISER Kolkata	India
1	Brian	Darby	Male	University of North Dakota	United States of America
1,2,3,4	Brajesh	Singh	Male	Western Sydney University/Global Initiative of Crop Microbiome and Sustainable Agriculture	Australia
1,2,3	Neha	Bhandari	Male	Delhi University	India
1,2,3	Neelam	Jain	Female	Amity University Rajasthan, Jaipur	India
1,3	Borbala	Biró	Female	Hungarian University of Agriculture and Life Sciences	Hungary
1,2	Javier	Peris	Male	Syngenta Crop Protection	Switzerland
1,2	Saeed	Karbin	Male	Soil and Water Research Institute (SWRI)	Iran
1,2	Maria	Hernandez	Female	John Innes Centre	United kingdom
1,2	Miriam	Muñoz	Female	UNSW Sydney	Australia
1,2	Katalin	Szlavec	Female	Johns Hopkins University	United States of America

Table 2. Candidates for the WG-2 scientific committee

Working group	Name	Surname	Gender	Institution	Country
2	Eric	Blanchart	Male	IRD	France
2	Jay Prakash	Verma	Male	Institute of Environment and Sustainable Development, Banaras Hindu University	India
2	Hamada	Abdelrahman	Male	Cairo University	Egypt
2	Roy	Neilson	Male	James Hutton Institute	Scotland
2	Pitchamuthu	Senthilvalavan	Male	Annamalai University	India
2	Carlos	Garbisu	Male	Basque Institute of Agricultural Research and Development	Spain
2	Lisa	Lumley	Female	University of Alberta	Canada
2	Narayan	Solanke	Male	Universal Versatile Society	India
2	Carolina	Masin	Female	Instituto de Desarrollo Tecnológico para la Industria Química	Argentina
2	Burhanuddin	Rasyid	Male	Hasanuddin University	Indonesia
2	Oğuz Can	Turgay	Male	Ankara University	Turkey
1,2,3,4	Brajesh	Singh	Male	Western Sydney University/Global Initiative of Crop Microbiome and Sustainable Agriculture	Australia
1,2,3	Neha	Bhandari	Male	Delhi University	India
1,2,3	Neelam	Jain	Female	Amity University Rajasthan, Jaipur	India
1,2	Javier	Peris	Male	Syngenta Crop Protection	Switzerland
1,2	Saeed	Karbin	Male	Soil and Water Research Institute (SWRI)	Iran
1,2	Maria	Hernandez-Soriano	Female	John Innes Centre	United kingdom

1,2	Miriam	Muñoz-Rojas	Female	UNSW Sydney	Australia
1,2	Katalin	Szlavec	Female	Johns Hopkins University	United States of America
2,4	Maria	Minor	Female	Massey University	New Zealand

Table 3. Candidates for the WG-3 scientific committee

Working group	Name	Surname	Gender	Institution	Country
3	Mostafa	Sherbiny	Male	International Union for Experts of Sustainable Development	Egypt
3	Mbogning	Genang	Male	University of Dschang	Cameroon
3	Lucilia	Parron	Female	Embrapa Florestas	Brazil
3	Ana	Ribeiro	Female	Instituto Superior de Agronomia	Portugal
3	Tania	Runge	Female	Thünen Institute of Rural Studies	Germany
3	Alejandro	Martínez-García	Male	Tecnológico Nacional de México	Mexico
1,2,3,4	Brajesh	Singh	Male	Western Sydney University/Global Initiative of Crop Microbiome and Sustainable Agriculture	Australia
1,2,3	Neha	Bhandari	Male	Delhi University	India
1,2,3	Neelam	Jain	Female	Amity University Rajasthan, Jaipur	India
1,3	Borbala	Biró	Female	Hungarian University of Agriculture and Life Sciences	Hungary

Table 4. Candidates for the WG-4 scientific committee

Working group	Name	Surname	Gender	Institution	Country
4	Nishita	Ivy	Female	Nalanda University	India
4	Kabira	M'barki	Female	PhD student	Morocco
4	Bibiana	Betancur-Corredor	Female	Senckenberg Museum of Natural History	Germany
4	Helen	Imafidor	Female	University of Port Harcourt	Nigeria
4	Régia	Estevam-Alves	Female	Universidade Nova de Lisboa	Brazil
1,2,3,4	Brajesh	Singh	Male	Western Sydney University/Global Initiative of Crop Microbiome and Sustainable Agriculture	Australia
2,4	Maria	Minor	Female	Massey University	New Zealand

As a result of the selection process by the NETSOB board, it was established that the scientific committee would be:

For working group one on measurement, assessment and monitoring of soil biodiversity

- Mr Brajesh Singh, Western Sydney University/Global Initiative of Crop Microbiome and Sustainable Agriculture, Australia;
- Ms Hannah Karuri, University of Embu, Kenya;
- Ms Katalin Szlavecz, Johns Hopkins University, United States of America; and
- Ms Maria Tsiafouli, Aristotle University of Thessaloniki, Greece.

For working group two on sustainable use, management, and conservation of soil biodiversity

- Ms Miriam Muñoz-Rojas, UNSW Sydney, Australia;
- Mr Eric Blanchart, IRD, France;
- Mr Hamada Abdelrahman, Cairo University, Egypt; and
- Mr Roy Neilson, James Hutton Institute, Scotland

For working group three on the economics of soil biodiversity

- Mr Mbogning Genang, University of Dschang, Cameroon;
- Ms Tania Runge, Thünen, Institute of Rural Studies, Germany;
- Ms Neelam Jain, Amity University Rajasthan, Jaipur, India; and
- Mr Alejandro Martínez-García, Tecnológico Nacional de Mexico, Mexico.

For working group four on policies and legal instruments related to soil biodiversity.

- Ms Bibiana Betancur-Corredor, Senckenberg Museum of Natural History, Germany;
- Ms Régia Estevam-Alves, Universidade Nova de Lisboa, Brazil;
- Ms Maria Minor, Massey University, New Zealand; and
- Mr Brajesh Singh, Western Sydney University/Global Initiative of Crop Microbiome and Sustainable Agriculture, Australia.

Finally, the Vice-Chairs gave the floor to each member of the scientific committee to introduce themselves and express their interests and aspirations as part of NETSOB.

Establishment of the NETSOB–GLOSOLAN joint working group

Mr Filippo Benedetti (GSP Secretariat) introduced the work of the Global Soil Laboratory Network (GLOSOLAN), especially in the preparation and harmonization of global standard operating procedures (SOPs), expressing the importance of refining the analyses for biological parameters.

Mr Benedetti pointed out that GLOSOLAN was calling on NETSOB members to form a joint working group in order to decide the SOPs for the soil biological parameters that GLOSOLAN would be focusing on in 2022. The joint working group would also support GLOSOLAN experts during the harmonization process, organize training on soil biological analyses and raise awareness of the importance of their measurements.

Finally, Mr Benedetti proposed some activities to initiate cooperation in the joint working group:

- Revise and finalize the SOPs GLOSOLAN worked on in 2021;
- Decide which SOPs GLOSOLAN would harmonize every year;
- Lead the harmonization process;
- Prepare training materials (including videos) and organize webinars on the analysis of soil biological parameters;
- Provide technical support to GLOSOLAN members as needed; and
- Raise the awareness of laboratories on the importance of measuring soil biological parameters.

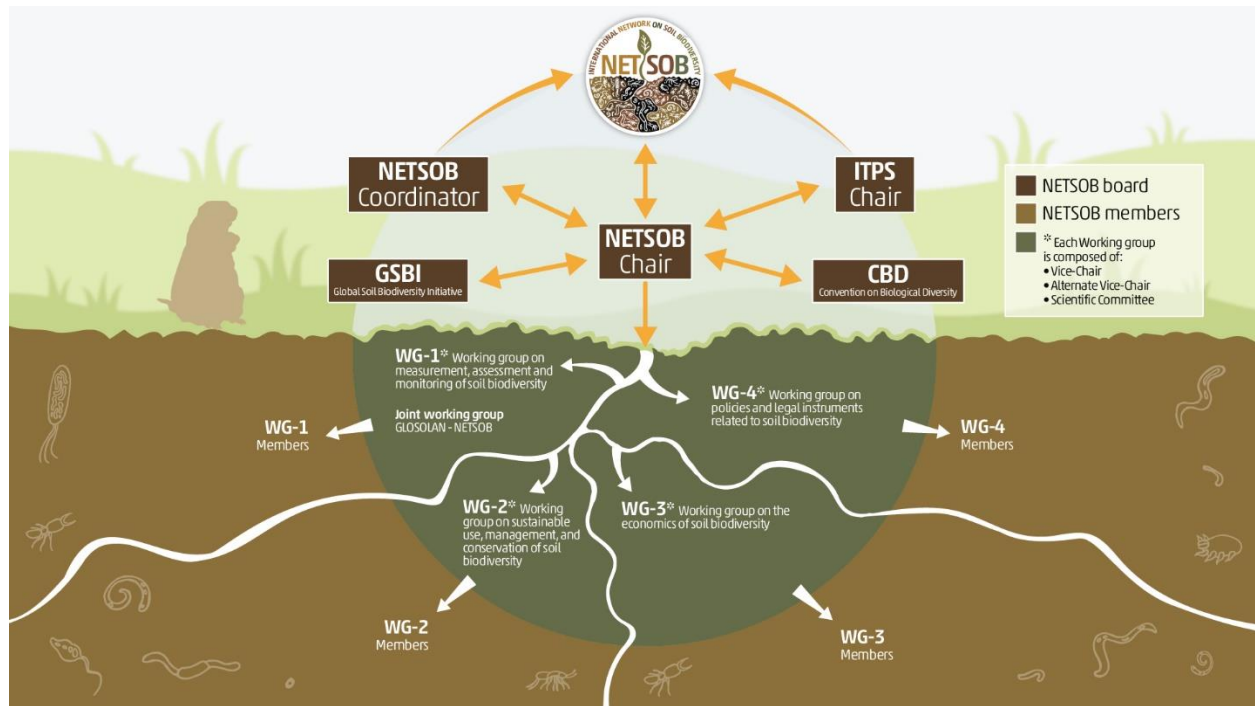
NETSOB's structure

Ms Rosa Cuevas reminded the audience that NETSOB brought soil biodiversity experts and existing initiatives together, all contributing to the implementation of the Global Soil Biodiversity Observatory (GLOSOLAN) as well as promoting the sustainable use and conservation of soil biodiversity. Ms Cuevas explained that the structure of the network was composed of the board and the WGs. The NETSOB board comprised of:

- a Chair: Peter de Ruiter, Wageningen University, The Netherlands;
- a coordinator: Rosa Cuevas, FAO's GSP Secretariat, Italy;
- a WG-1 Vice-Chair: George Brown, Embrapa, Brazil;
- a WG-1 Vice-Chair alternate: Carlos Guerra, SoilBON, Germany;
- a WG-2 Vice-Chair: Zoë Lindo, Western University; Canada;
- a WG-2 Vice-Chair alternate: Jeff Battigelli, University of Alberta, Canada;
- a WG-3 Vice-Chair: Gian Luca Bagnara, Agribusiness consulting and economics of territory, Italy;
- a WG-3 Vice-Chair alternate: Giulio Malorgio; Italy;
- a WG-4 Vice-Chair: Rosalinda Gonzalez; La Salle University, Colombia;
- a WG-4 Vice-Chair alternate: Luca Montanarella; JRC, EC; Italy;
- a special advisor: Diana Wall, GSBI, United States of America; and
- an observer: Rosa Poch, ITPS Chair, Spain.

Finally, Ms Cuevas explained that each working group was composed of the Vice-Chair, its alternate Vice-Chair and the newly elected scientific committee (see Figure 1).

Figure 1. NETSOB's structure



Conclusions and way forward

The NETSOB working group meetings were successfully organized from February 7 to 10, 2022. All participants committed to start working on the development of each of the activities defined for each WG. Over 886 scientists, researchers, international organizations, institutions, decision makers and farmers with expertise in the assessment, mapping, monitoring and sustainable use of soil biodiversity had enrolled in the network.

Main meeting agreements

Mr Peter de Ruiter closed the meeting by congratulating the new scientific committee of each working group on their new positions and thanked the participants for their attendance and active participation.

To summarize the meeting, Ms Rosa Cuevas stated that NETSOB members had agreed to the following:

- Complete the [online registration form](#) (if they had not already done so) to become an active member of one of NETSOB's working groups.
- Support the implementation of the Global Soil Biodiversity Observatory (GLOSOB) through participation in stocktaking exercises conducted by the FAO's Global Soil Partnership.
- Fill out the online survey that would be sent by the FAO's GSP Secretariat in order to choose which TOC section to participate in as a lead or contributing author.
- Participate in the first meeting of the NETSOB–GLOSOLAN joint working group.
- Define the timeline once the TOCs were finalized by every WG and endorsed by the NETSOB board.



Food and Agriculture
Organization of the
United Nations

Agenda

Working Group Meetings **International Network** **on Soil Biodiversity** **NETSOB**

7-10 February 2022



Working group meetings: first session

INTERNATIONAL NETWORK ON SOIL BIODIVERSITY

Technical working group 1 (WG 1)

7 February 2021

Opening remarks

14.00 -14:20	ITEM 1. Introduction to the meeting Mr Peter de Ruiter , NETSOB Chair
	ITEM 2. Endorsement of the Agenda and group picture Ms Rosa Cuevas Corona , NETSOB coordinator, FAO

Working group activities

14.20 -15:20	ITEM 3. Development of guidelines for measuring, assessing and monitoring (MAM) soil biodiversity
	* Objectives and expected outputs of the activity
	* Presentation of the table of contents (TOC)
	* Discussion session
	* Endorsement of the TOC
	Mr George Brown , NETSOB WG 1 Vice Chair
15.20 -15:30	ITEM 4. Self-nomination (lead/contributing authors) for the different sections of the guidelines for MAM soil biodiversity
	Mr Carlos Guerra , NETSOB WG 1 Vice Chair alternate

Establishment of the WG 1 Scientific Committee

15:30 -15:40	ITEM 5. Selection process results Mr George Brown , NETSOB WG 1 Vice Chair
	ITEM 6. Presentations of the selected candidates for the Scientific Committee (3 minutes each) Mr George Brown , NETSOB WG 1 Vice Chair
15:50 -16:10	ITEM 7. NETSOB - GLOSOLAN joint working group Ms Lucrezia Caon , GLOSOLAN coordinator, FAO Mr Filippo Benedetti , GLOSOLAN coordinator alternate, FAO
	ITEM 8. NETSOB's structure Ms Rosa Cuevas Corona , NETSOB coordinator, FAO
16:20 -16:30	ITEM 9. Closure of the meeting and next venue Mr George Brown , NETSOB WG 1 Vice Chair

Technical working group 2 (WG 2)

8 February 2021

Opening remarks

14.00 -14:20	ITEM 1. Introduction to the meeting Mr Peter de Ruiter , NETSOB Chair
	ITEM 2. Endorsement of the Agenda and group picture Ms Rosa Cuevas Corona , NETSOB coordinator, FAO

Working group activities

14.20 -15:20	ITEM 3. Development of a field manual on good management practices to conserve soil biodiversity and prevent soil biodiversity loss
	* Objectives and expected outputs of the activity
	* Presentation of the table of contents (TOC)
	* Discussion session
	* Endorsement of the TOC
	Ms Zöe Lindo , NETSOB WG 2 Vice Chair
15.20 -15:30	ITEM 4. Self-nomination (lead/contributing authors) for the different sections of the field manual on good management practices to conserve soil biodiversity and prevent soil biodiversity loss Mr Jeff Battigelli , NETSOB WG 2 Vice Chair alternate

Establishment of the WG 2 Scientific Committee

15:30 -15:40	ITEM 5. Selection process results Ms Zöe Lindo , NETSOB WG 2 Vice Chair
15:40 -15:50	ITEM 6. Presentations of the selected candidates for the Scientific Committee (3 minutes each) Ms Zöe Lindo , NETSOB WG 2 Vice Chair
15:50 -16:00	ITEM 7. NETSOB's structure Ms Rosa Cuevas Corona , NETSOB coordinator, FAO
16:00 -16:10	ITEM 8. Closure of the meeting and next venue Ms Zöe Lindo , NETSOB WG 2 Vice Chair

Technical working group 3 (WG 3)

9 February 2021

Opening remarks

14.00 -14:20	ITEM 1. Introduction to the meeting
	Mr Peter de Ruiter , NETSOB Chair
	ITEM 2. Endorsement of the Agenda and group picture
	Ms Rosa Cuevas Corona , NETSOB coordinator, FAO

Working group activities

14.20 -15:20	ITEM 3. Development of the methodology for the economic valuation of ecosystem services provided by soil biodiversity
	* Objectives and expected outputs of the activity
	* Presentation of the table of contents (TOC)
	* Discussion session
	* Endorsement of the TOC
	Mr Gian Luca Bagnara , NETSOB WG 3 Vice Chair
15.20 -15:30	ITEM 4. Self-nomination (lead/contributing authors) for the different sections of the methodology for the economic valuation of ecosystem services provided by soil biodiversity
	Mr Giulio Malorgio , NETSOB WG 3 Vice Chair alternate

Establishment of the WG 3 Scientific Committee

15:30 -15:40	ITEM 5. Selection process results
	Mr Gian Luca Bagnara , NETSOB WG 3 Vice Chair
15:40 -15:50	ITEM 6. Presentations of the selected candidates for the Scientific Committee (3 minutes each)
	Mr Gian Luca Bagnara , NETSOB WG 3 Vice Chair
15:50 -16:00	ITEM 7. NETSOB's structure
	Ms Rosa Cuevas Corona , NETSOB coordinator, FAO
16:00 -16:10	ITEM 8. Closure of the meeting and next venue
	Mr Gian Luca Bagnara , NETSOB WG 3 Vice Chair

Technical working group 4 (WG 4)

10 February 2021

Opening remarks

14.00 -14:20	ITEM 1. Introduction to the meeting Mr Peter de Ruiter , NETSOB Chair
	ITEM 2. Endorsement of the Agenda and group picture Ms Rosa Cuevas Corona , NETSOB coordinator, FAO

Working group activities

14.20 -15:20	ITEM 3. Development of policy briefs on the state of knowledge, protection, conservation, and sustainable use of soil biodiversity at national, regional, and global levels
	* Objectives and expected outputs of the activity
	* Presentation of the table of contents (TOC)
	* Discussion session
	* Endorsement of the TOC
	Ms Rosalina González , NETSOB WG 4 Vice Chair
15.20 -15:30	ITEM 4. Self-nomination for the development of policy briefs on the state of knowledge, protection, conservation, and sustainable use of soil biodiversity
	Mr Luca Montanarella , NETSOB WG 4 Vice Chair alternate

Establishment of the WG 4 Scientific Committee

15:30 -15:40	ITEM 5. Selection process results Ms Rosalina González , NETSOB WG 4 Vice Chair
	ITEM 6. Presentations of the selected candidates for the Scientific Committee (3 minutes each) Ms Rosalina González , NETSOB WG 4 Vice Chair
15:40 -15:50	
15:50 -16:00	ITEM 7. NETSOB's structure Ms Rosa Cuevas Corona , NETSOB coordinator, FAO
16:00 -16:10	ITEM 8. Closure of the meeting and next venue Ms Rosalina González , NETSOB WG 4 Vice Chair



The Global Soil Partnership (GSP) is a globally recognized mechanism established in 2012. Our mission is to position soils in the Global Agenda through collective action. Our key objectives are to promote Sustainable Soil Management (SSM) and improve soil governance to guarantee healthy and productive soils, and support the provision of essential ecosystem services towards food security and improved nutrition, climate change adaptation and mitigation, and sustainable development.





Annex 2

GUIDELINES FOR MEASURING, ASSESSING AND MONITORING SOIL BIODIVERSITY

TABLE OF CONTENTS

Foreword (invited person + FAO)

Preface (Editors)

Session 1. Introduction

1. Soil biodiversity and the need for its measurement, assessment and monitoring (general about SBD, reasoning behind the need and this publication, relationships between soil biodiversity and soil health/quality)

Editors

2. Principles of monitoring soil biodiversity (long-term sites, choice of methods, taxa, LUS, funding and statistical issues, infrastructure, additional variables that need to be measured like environmental conditions with time, soil chemical attributes, management practices including pesticides and other agrochemicals, soil tillage, etc.)

Authors

Session 2. Strategies and issues related to the design and implementation of soil biodiversity monitoring programs

3. Sampling design and data analysis issues related to monitoring soil biodiversity (choice of field sites, locations, replicates, number of samples)

Authors

4. Legal, ethical and logistical issues related to monitoring soil biodiversity (include reference to the impacts on the soil/disturbance and its biodiversity, regional issues regarding technological and financial capabilities to monitor, etc.)

Authors

5. Data management, storage, etc. (interaction with Glosis)

Authors

Session 3. Soil Biodiversity: Measurement, Assessment and Monitoring Methods for Micro-organisms

Overall idea for each chapter: main methods used, with proposal for BEST (comparable, compatible, feasible worldwide) and any (one or 2 max) alternate methods depending on available conditions/infrastructure, but that still provide the necessary information and that are comparable. Step-by-step method, like a SOP, with lab and field equipment needed, timing, people, etc. When identification keys are available, provide at different levels, at higher (order) or lower (genus, species) taxonomic ID level, when possible. Molecular vs. morphological techniques for each group.

6. Measuring and assessing soil microbial diversity: Overall microbial communities
7. Measuring and assessing soil microbial diversity: Mycorrhizal fungi (ecto and endo)
Authors
8. Measuring and assessing soil microbial diversity: Other fungi
Authors
9. Measuring and assessing soil microbial diversity: Archaea
Authors
10. Measuring and assessing soil microbial diversity: OTHERS TBD?
Authors
11. Measuring and assessing soil microbial diversity: Algae
Authors
12. Measuring and assessing soil microbial diversity: Protozoa
Authors
13. Measuring and assessing soil microbial diversity: Nematodes
Authors
14. Measuring and assessing soil microbial diversity: Tardigrades
Authors
15. Measuring and assessing soil microbial diversity: Rotifers
Authors

Session 4. Soil Biodiversity: Macro, Meso and Megafauna Measurement, Assessment and Monitoring Methods

Overall idea for each chapter: main methods used, with proposal for BEST and any (one or 2 max) alternate methods depending on available conditions/infrastructure, but that still provide the necessary information and that are comparable. Step-by-step method, like a SOP, with lab and field equipment needed, timing, people, etc. When identification keys are available, provide at different levels, at higher (order) or lower (genus, species) taxonomic ID level, when possible.



1. Measuring and assessing soil fauna diversity: Epigeic or litter-dwelling animals
Authors
2. Measuring and assessing soil fauna diversity: Overall macrofauna communities
Authors
3. Measuring and assessing soil fauna diversity: Earthworms
Authors
4. Measuring and assessing soil fauna diversity: Ants
Authors
5. Measuring and assessing soil fauna diversity: Termites
Authors
6. Measuring and assessing soil fauna diversity: Myriapoda (Diplopoda and Chilopoda)
Authors
7. Measuring and assessing soil fauna diversity: Overall mesofauna communities
Authors
8. Measuring and assessing soil fauna diversity: Collembola
Authors
9. Measuring and assessing soil fauna diversity: Acari
Authors
10. Measuring and assessing soil fauna diversity: OTHERS TBD?
Authors
11. Measuring and assessing soil fauna diversity: Soil-dwelling vertebrates
Authors

Session 5. Soil Functional Measurement, Assessment and Monitoring Methods Related to Soil Biodiversity and Soil Health/Quality

Overall idea for each chapter: main methods used, with proposal for BEST and any (one or 2 max) alternate methods depending on available conditions/infrastructure, but that still provide the necessary information and that are comparable. Step-by-step method, like a SOP, with lab and field equipment needed, timing, people, etc.

12. Measuring, assessing and monitoring soil health/quality using soil microbial biomass and respiration
Authors
13. Measuring, assessing and monitoring soil health/quality using soil enzymes
Authors
14. Measuring, assessing and monitoring soil health/quality using other soil microbial variables related to soil quality and biodiversity (e.g., glomalin, mycorrhizal fungi colonization, N₂ fixation)
Authors
15. Measuring, assessing and monitoring soil health/quality using soil bioturbation and biological aggregation



Authors

16. Measuring, assessing and monitoring soil health/quality using soil organic matter decomposition (teabags, litterbags, bait lamina)

Authors

17. Measuring, assessing and monitoring soil habitat quality through ecotoxicological tests with soil microorganisms

Authors

18. Measuring, assessing and monitoring soil habitat quality through ecotoxicological tests with soil mesofauna

Authors

19. Measuring, assessing and monitoring soil habitat quality through ecotoxicological tests with soil macrofauna

Authors

20. OTHERS TBD?

Synthesis session. Worldwide Measurement, Assessment and Monitoring of Soil Biodiversity and Soil Health/Quality: The International Network on Soil Biodiversity (NETSOB)

Overall idea of chapter: Reasoning behind the proposal, and summary/table of main methods proposed for monitoring worldwide, with description of minimum assessments needed for overall syntheses/comparisons worldwide, and proposal of basic LUS for assessment, as well as orientations on getting the work done within country and in collaboration with worldwide labs; identification of needs for capacity building and infrastructural or resource allocations in order to do the work; list of partners and participating institutions/labs.

Editors and invited authors

Annex 3

BEST PRACTICES TO CONSERVE SOIL BIODIVERSITY AND PREVENT SOIL BIODIVERSITY LOSS

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Foreword (invited person + FAO)

Preface [Editors]

Objective: The development of a field manual that identifies, explains and demonstrates good management practices to conserve soil biodiversity and limits soil biodiversity loss.

- The manual introduces a set of principles, practices, and case studies that address conservation of biodiversity in consideration of the main threats to soil biodiversity.
- The manual will present a range of soil conservation practices to maintain or restore soil biodiversity.

Section 1: Introduction

1.1. Mechanisms that lead to soil biodiversity loss (overarching principles and proximal drivers):

- 1.1.1. Physical disturbance to soil structure, compaction and erosion (loss of pore space; reduce oxygen, change in soil temperature, disruption of fungal networks, change in community composition/structure, reduced decomposition, change in soil horizon structure and development)
- 1.1.2. Loss of soil organic matter (loss of nutrients and moisture holding capacity; soil structure)
- 1.1.3. Pollution and other chemical changes (e.g., pH, ions, fuel and hydrocarbons, overuse of chemical fertilizers, pesticides, microplastics, metals, salts, irrigation)
- 1.1.4. Reductions in bioregulation (invasive species, pests and pathogens; loss of mutualisms)

[Editors]

1.2. Primary Threats and Stressors



Threats are actions with potentialities, and many interrelated distal and proximal effects, while stressors may not be acute, but rather chronic; leading to time lags, feedbacks, etc. This section includes regional and unique ecozonal perspectives. Primary threats include:

- 1.2.1 Intensive agriculture and agricultural intensification;
- 1.2.2 Livestock and ranching
- 1.2.3 Forestry and deforestation
- 1.2.4 Other resource extraction (e.g., mining, linear features, oil & gas, pipelines, etc.)
- 1.2.5 Urbanisation

[Authorship team-1]

1.3 Indirect effects, cascading threats and interactions among stressors

May include changes in fire regimes; increases in slides and erosion; climate change, atmospheric deposition of pollutants, invasive species, etc.

[Authors-2; or Editors to add to 1.2]

Section 2: Best Practices for the prevention and reversal of soil biodiversity loss

Successful methodologies, techniques and practices to enhance conservation of soil biodiversity. This section forms the main text; is divided into four sections that align with the primary drivers of soil biodiversity loss, but provide alternative and best management practices, tools and techniques. 1-2 case studies for each are proposed *that would incorporate a regional perspective*.

2.1 Reduce soil disturbance, maintain soil structure, and prevent erosion

2.1.1 Reduced, conservation tillage and no-till systems

2.1.1.1 Case study [Authors-3]

2.1.2 Reductions to mechanized 'traffic', compaction, and soil sealing

2.1.2.1 Case study [Authors-4]

2.1.3 Use of cover crops and mulching to increase moisture, reduce erosion, reduce temperature increase, nutrient input

2.1.3.1 Case study [Authors-5]

2.1.4 Physical configurations (terracing, hedgerows) to reduce erosion

2.1.4.1 Case study [Authors-6]

2.1.5 Integrated crop-livestock systems; alternative grazing strategies/practices i.e., multi paddock systems

2.1.5.1 Case study [Authors-7]

2.2 Maintain, enhance and diversify soil organic matter (SOM) inputs

2.2.1 Use of cover crops, inter / multi / poly cropping, rotational cropping systems

2.2.1.1 Case study [Authors-8]

2.2.2 Organic and topsoil amendments (brown mulching), compost, biochar, biosolids, manure

2.2.2.1 Case study [Authors-9]



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2.2.3 Agroforestry (successional agroforestry)

2.2.3.1 Case study (syntropic farming) [Authors-10]

2.3 Reduce fertilizer, pesticide and other chemical changes to soil systems

2.3.1 Bioinoculants and biofertilizers

2.3.1.1 Case study [Authors-11]

2.3.2 Mycotrophic cropping and symbiotic nutrient uptake crops

2.3.2.1 Case study [Authors-12]

2.3.3 Phytoremediation

2.3.3.1 Case study [Authors-13]

2.3.4 Maintenance of soil moisture to avoid irrigation-induced salinization and sodification

2.3.4.1 Case study [Authors-14]

2.4 Prevent and control invasive species, pests, pathogens, and soil-borne diseases

2.4.1 Use of polycropping/intercropping, and rotational cropping systems

2.4.1.1 Case study [Authors-15]

2.4.2 Use of beneficial organisms and bioinoculants

2.4.2.1 Case study [Authors-16]

Section 3: Capacity building approaches to obtain these goals

Harmonized content.

Link to monitoring schemes (WG-1) that can promote conservation, and other cost-effective bioassays, gene markers, bioindicators, etc. Is there any thought of including a section on the lack of baseline data/information on what the soil biodiversity might have been? How do we know what has been lost rather than just the current state of things?

Link to incentives (economic, social and other) (WG-3) and governmental and intergovernmental policies and agendas (WG-4). Is there any current legislation that indicates soil biodiversity is needed? Examination of soil conservation acts with federal governments (does it includes the study of soil ecology in agricultural soils, for instance)

[Editors]



Annex 4

ECONOMIC VALUATION OF ECOSYSTEM SERVICES PROVIDED BY SOIL BIODIVERSITY

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Foreword

Acknowledgements

Summary

1. Introduction
 - a. Why is biodiversity valuable
 - b. Soil biodiversity, soil organic matter and soil organic carbon: overview
 - c. The importance of soil biodiversity for ecosystem services
 - d. Ecosystem services and disservices provided by soil organisms in agroecosystems
2. Theoretical framework on biodiversity economic valuation
 - a. Delivering biodiversity values on land
 - b. Methods for integrating biodiversity valuation into economics
 - c. Market-based techniques
 - d. Revealed preference techniques
 - e. Cost-benefits
 - f.
3. How to measure indicators affecting biodiversity in the soil and calculation (water, agricultural input, agronomic practices, etc.): a tentative of input-output matrix (linked to WG1 e WG2)
4. Conceptual model for understanding the linkage between soil ecology and biodiversity and economy: Choice modelling or contingent choice method
 - a. Soil ecosystem services (nutrient cycling; soil structure; pest control;..)
 - b. Plant health and quality
 - c. Yield at farm: level, variation, etc..
 - d. Farm management and farmer decision
 - e. Marketed goods and markets
 - f. Environmental benefits



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- g. Calculation of variables: provide tools to farmers
- h.
- 5. Case studies and applications
- 6. Outlook:
 - a. Investing in soil biodiversity and soil organic carbon
 - b. Integrating soil biodiversity and ecosystem services into the Economic Analysis of Agricultural & Livestock Systems
 - c. Policy integration: schemes, etc.
 - d. Communication

References

DRAFT



Annex 5

REPORT ON THE GLOBAL STATUS AND REGIONAL TRENDS IN PUBLIC POLICY ON THE SOIL BIODIVERSITY

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Executive summary

Acknowledges

Acronyms and abbreviations

Glossary

Chapter 1: Overview

- a) Introduction
- b) NETSOB
- c) Objectives
- d) Process of elaboration

Chapter 2: Regional trends in Public Policy on the Soil Biodiversity (protection, conservation, and sustainable use)

- a) Regional extent of soil biodiversity
- b) Status of soil Biodiversity in Asia and the Pacific
- c) Status of soil Biodiversity in Eastern Europe, Caucasus and Central Asia
- d) Status of soil Biodiversity in Europe
- e) Status of soil Biodiversity in Latin America and the Caribbean
- f) Status of soil Biodiversity in Near East and North Africa
- g) Status of soil Biodiversity in North America
- h) Status of soil Biodiversity in sub-Saharan Africa

Chapter 3: International legal instruments to protect soil biodiversity

- Existing key global and regional commitments / conventions
- a) Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal
- b) Rotterdam Convention on Prior Informed Consent for Hazardous Chemicals and Pesticides in International Trade
- c) Stockholm Convention on Persistent Organic Pollutants



- d) International voluntary agreements to tackle soil pollution
- e) The Global Soil Partnership
- f) Voluntary Guidelines for Sustainable Soil Management
- g) International Code of Conduct for the Sustainable Use and Management of Fertilisers
- h) International Code of Conduct on Pesticide Management
- i) Global Action Plan on Antimicrobial Resistance
- j) Codex Alimentarius
- k) International Nitrogen Initiative
- l) Challenges and gaps at the national level for compliance with international agreements
 - o Ethical - Bioethical

Chapter 4: National and regional priorities to protect soil biodiversity

Chapter 5: National and regional actions different from the policy area to protect soil biodiversity
Include actions that intuitions make (e.g. NGOs)

Chapter 6: Knowledge and infrastructure gaps by region

- a) Main constraints by region
- b) Lack of awareness/consumer choices
- c) Lack of political will/leadership
- d) Infrastructure and capacity gap
- e) Risks that are run in terms of social cost and capacity of the States
- f) Assessment of critical factors to face

Chapter 7: Main health problems associated with soil biodiversity by region

- include case studies
- food contamination cases
- and so, on

Chapter 8: How to move on

- a) Tackling soil biodiversity as a pathway to achieving the SDGs
 - Preventing soil pollution
 - Ensuring food safety
 - Towards a safe environment
- b) Conclusions and way forward

References