Submission by

the 4 per 1000 Initiative on Soils for Food Security and Climate,
the Intergovernmental Technical Panel on Soils and the Global Soil Partnership,
the Secretariat and the Science-Policy Interface of the United Nations Convention to Combat Desertification,
Drynet,
the World Agroforestry Centre (ICRAF) and
the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) East Africa

To the United Nations Framework Convention on Climate Change (UNFCCC)
In relation to the Koronivia Joint Work on Agriculture (decision 4/CP.23)

Views on
Topic 2(c) - Improved soil carbon, soil health and soil fertility under grassland and cropland as well as integrated systems, including water management

KEY MESSAGES

- Soil carbon sequestration is a carbon dioxide removal option with benefits for biodiversity, soil health, soil fertility and food security.
- The major cropping and grazing regions of the world represent hotspots for restoration and soil carbon sequestration.
- The full GHG balance of the agroecosystem in question determines the contribution of soil carbon sequestration to climate change mitigation.
- Soil carbon sequestration should be an additional effort for climate change mitigation and never as a substitute for urgently required, highly ambitious and immediate actions for reducing greenhouse gas emissions elsewhere.
- The signatories of this submission encourage the Koronivia negotiators to treat the maintenance and increase of soil carbon, health and fertility as an exemplary indicator of holistically improved agricultural systems in a changing climate with concomitant mitigation and adaptation benefits.
- In comparison with the biophysical potentials for soil carbon sequestration, there is a large gap in NDC commitments.
- The signatories of this submission offer their scientific expertise on soil carbon and soil-derived ecosystem services to the UNFCCC.
- A proposal for the agenda of the KJWA workshop, topic 2(c) is provided.

1. The signatories of this submission welcome and highly value the inclusion of improved soil carbon, soil health and soil fertility under grassland and cropland as well as integrated

systems, including water management, in the Koronivia Joint Work on Agriculture from the SBI and the SBSTA of the UNFCCC. **The latest Special Report on Global Warming of 1.5°C from the IPCC[1] listed land restoration and soil carbon sequestration as a carbon dioxide removal (CDR) option, already highlighting that the "restoration of natural ecosystems and soil carbon sequestration could provide co-benefits such as improved biodiversity, soil health, and local food security[2]."**

Due to its key role in beneficial soil functioning[3], soil organic carbon[4] is often considered a proxy for soil health and soil fertility, particularly with positive or synergistic effects on yields[5] and yield stability[6], biodiversity[7], water infiltration and storage[8], nutrient cycling and reduced erosion due to wind or water. However, soil organic carbon in most agricultural lands of the world has declined[9], with significant impacts on agricultural productivity. This has motivated several global and regional initiatives to tackle the issue of soil carbon loss and tap the potential of restoring it. Noteworthy are the Land Degradation Neutrality Framework under the UNCCD, the "4 per 1000" Initiative on Soils for Food Security and the Climate and the Global Soil Partnership (GSP) with its associated activities under the implementation of the "Unlocking the potential of soil organic carbon" outcome document[10]. Furthermore, the promotion of good agricultural practices in diverse initiatives and networks holds in many cases positive effects[11] for soil carbon.

The potential to maintain or improve the organic carbon stocks of the world's agricultural soils differs widely among different climate zones, soil types and associated land use as well as land governance systems. A recent publication estimated that cropland soils worldwide could have the potential to store an additional 0.9 to 1.95 petagrams carbon per year[12]. Soils can store carbon because they have lost huge amounts of carbon, historically. **The historic loss of soil carbon is estimated to be 116 petagrams[13] in agricultural land, the most affected regions matching the major cropping regions**

[1] Available online at: https://www.ipcc.ch/sr15/
[2] See paragraph C.3.5. of the Summary for Policy Makers of the IPCC SR1.5, available online at: https://www.ipcc.ch/sr15/chapter/summary-for-policy-makers/
[3] Wiesmeyer, M. et al., 2019 (available online at: https://doi.org/10.1016/j.geoderma.2018.07.026) list biomass production, water storage and filtration, nutrient recycling and storage, habitat provision and carbon storage as the main ecological functions of soils.
[4] The carbon contained in soil organic matter
[5] See Oldfield, E.E. et al., 2019. Available online at: https://doi.org/10.5194/soil-5-15-2019
[6] Xu, J. et al., 2019. Available online at: https://doi.org/10.1016/j.fcr.2018.12.016
[7] See IPES-Food, 2016. Available online at: http://www.ipes-food.org/_img/upload/files/UniformityToDiversity_FULL.pdf
[8] Dependant on texture and other soil characteristics. See Lal, R. 2018. Available online at: https://doi.org/10.1111/gcb.14054
[9] Based on literature reviews, soils in all regions of the world have been found to be in a poor or fair condition. See FAO and ITPS. 2015. Available online at: www.fao.org/3/a-i5126e.pdf
[10] Outcome Document "Unlocking the potential of Soil Organic Carbon" Online available at: http://www.fao.org/3/b-i7268e.pdf
[11] For example the global Conservation Agriculture Community of Practice (CA-CoP), led by FAO
[12] See Zomer, R.J. et al., 2017 (available online at: https://www.nature.com/articles/s41598-017-15794-8)
[13] See correction for Sandermann, J. et al., 2017 (available online at: https://www.pnas.org/content/115/7/E1700)

and degraded grazing lands of the world (see Figure 1). These can be considered as hotspots for restoration. In addition, the FAO's GSP is working with countries in the preparation of a Global Assessment of SOC Sequestration Potential based on the Global Soil Organic Carbon Map (GSOCmap[14]). The IPCC Special Report on Climate Change and Land[15] will gather the latest scientific evidence on hotspots for carbon sequestration in soils. The contribution to lowering global temperatures through soil carbon sequestration has been estimated to be 0.1°C between 2015 and 2100 when achieving a storage rate of 0.68 petagrams carbon per year[16], which could potentially be achieved with current management approaches and would not entail decreasing the area for food production.

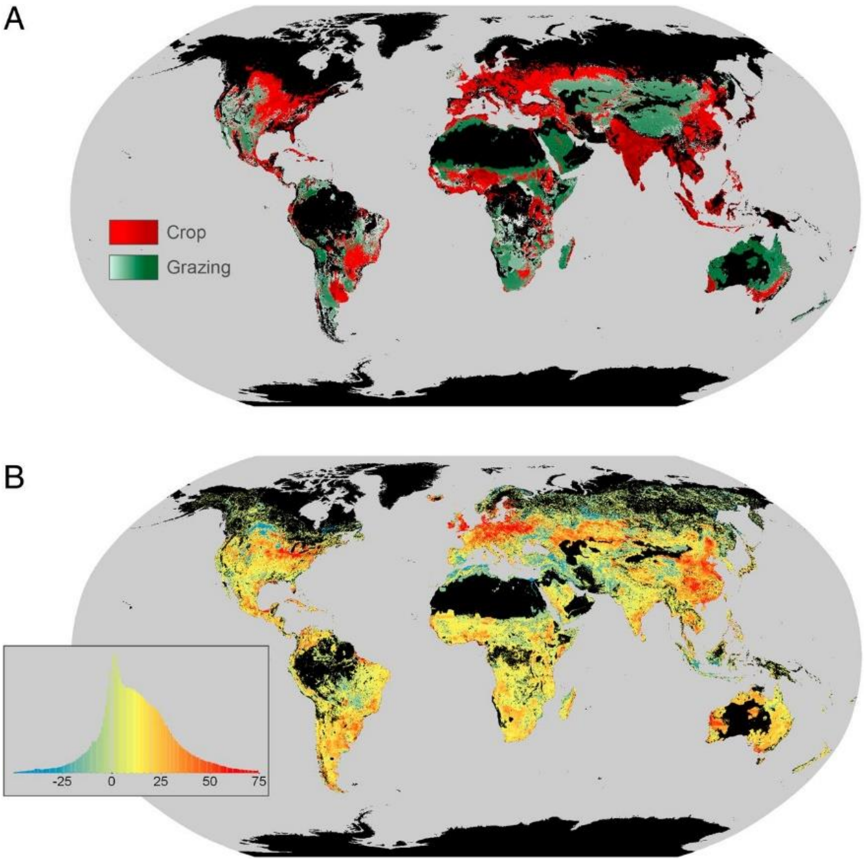

Fig.1: A) Global distribution of cropping and grazing land in 2010 and **B)** modelled soil carbon loss in the top 2 m over the past 12 000 years megagrams carbon per hectare (positive yellow, orange and red values indicate loss and negative green and blue values depict net gains). From: Sanderman, J. et al., 2017 (Available online at: https://doi.org/10.1073/pnas.1706103114)

[14] Global Soil Organic Map available online at: http://54.229.242.119/GSOCmap/, Technical report available online at: http://www.fao.org/3/i8891en/I8891EN.pdf
[15] To be released at the end of 2019. Further details available at: https://www.ipcc.ch/report/srccl/
[16] See Mayer, A. et al., 2018 (Online available at: https://doi.org/10.1126/sciadv.aaq0932)

2. **When discussing the potential of soil carbon sequestration to contribute to global climate change mitigation, it is important to consider the full greenhouse gas balance of the system in question**, as well as the net effects of additions and losses to the system, in its regional specificity and long-term behaviour. It is important to note that an increase in soil carbon stocks could also reduce the demand for mineral fertilizers, resulting in a double positive climate change mitigation effect. On the other hand, trade-offs may occur. While practices like reduced tillage may decrease the soil carbon loss due to reduced physical disturbance and thus preservation of the soil structure, a concomitant long-term increase in other GHG emissions in these systems (N_2O in the case of reduced tillage) may offset the sequestered soil carbon in temperate climates[17] and result in net higher emissions[18]. In addition, nitrogen amendments may be necessary to meet yield targets and build soil carbon in degraded soil. Nitrogen fertilization must be managed competently to avoid high N_2O emissions that offset or even exceed the amount of soil carbon sequestered, especially once soil organic carbon levels reach an equilibrium.

   Increases in soil organic carbon sequestration reflect the difference between gains and losses of carbon in the soil. Reducing the loss of soil organic carbon due to respiration and conversion to CO_2, for which agriculture is a major driver, or due to erosion is as important as increasing gains. Increasing soil organic carbon stocks through agricultural management is a reversible and slow process. Only long-term implementation of good practices can bring effective results. This needs to be taken into consideration when developing locally adapted solutions.

   It is known that soil organic carbon is a heterogeneous pool composed of fractions of distinct residence time in the soils. However, simple methods for identifying these fractions are not presently available to countries.

   Despite the common general guidance provided by the 2006 IPCC Guidelines for National Greenhouse Gas Inventories[19], **no standardized specific protocol exists yet for the monitoring of soil carbon stocks on a national or regional scale**. To this end, the FAO's GSP and partners are currently preparing feasible Guidelines for Measuring, Mapping, Monitoring and Reporting of SOC. The heterogeneity of countries' available technologies for chemical soil analyses remains one of the main challenges to tackle this issue in order to generate comparable data.

   These considerations should not however be used as justifications for inaction. Over one third of the global land and soil is categorized as "severely or moderately degraded"[20]. Through the rehabilitation and restoration of degraded soils, improved soil

[17] See Lugato, E. et al., 2018 (Online available at: https://www.nature.com/articles/s41558-018-0087-z)
[18] In subtropical agroecosystems of Brazil, N_2O emissions have been found to be similar under no-till and conventional tillage. See Jantalia, C.P. et al., 2018 (Online available at: https://link.springer.com/10.1007/s10705-008-9178-y)
[19] Online available at: https://www.ipcc-nggip.iges.or.jp/public/2006gl/
[20] See FAO and ITPS, 2015 (Online available at: www.fao.org/3/a-i5199e.pdf)

health and fertility can generate several benefits for plant growth and biodiversity[21]. Sustainable soil management, which generally leads to an increase of the carbon content of soils[22], can address simultaneously the impacts of climate change through mitigation and adaptation, including the reclamation of desert land, reduced susceptibility to erosion as well as increased resilience to drought through securing the quantity and quality of water resources[23].

Tools for the assessment of success in soil carbon sequestration exist[24]. For example, the 4 per 1000 initiative has developed a set of reference criteria and indicators for the assessment of actions[25] to reduce losses or increase stocks of soil carbon. Moreover, the Ex Act tool of the FAO and the tools from the Carbon Benefits Project[26] allow estimating a full greenhouse gas balance of agricultural systems and interventions.

Discussions on soil organic carbon are often centred on its potential to offset GHG emissions and thus mitigate climate change through carbon dioxide removal from the atmosphere. Nevertheless, the signatories of the present submission emphasize their view on **soil organic carbon sequestration as an additional effort and never as a substitute for urgently required, highly ambitious and immediate actions for reducing greenhouse gas emissions elsewhere** from the entire food system as well as from the energy, transport and industrial sectors.

Although increasing or maintaining soil carbon stocks may not often be the target of national and regional policies, several promoted actions and practices result in a positive effect for preserving and enhancing soil organic carbon. In our view, a higher recognition of the benefits of good practices for soil organic carbon maintenance and sequestration[27], as well as work towards the standardization of measurements[28] and global SOC monitoring[29] systems[30] would increase the public and private investments in its protection and restoration.

[21] See FAO, 2019 (Online available at: http://www.fao.org/state-of-biodiversity-for-food-agriculture/en/)
[22] See Branca, J. et al., 2013 (Available online at: https://doi.org/10.1007/s13593-013-0133-1)
[23] See Sanz, M.J. et al., 2017 (Available online at: https://www.unccd.int/sites/default/files/documents/2017-09/UNCCD_Report_SLM_web_v2.pdf)
[24] A compilation from tools for Greenhouse Gas and Carbon Accounting of Sustainable Land Management is available in this World Bank report:
http://documents.worldbank.org/curated/en/553171544165496697/Greenhouse-Gas-Accounting-for-Sustainable-Land-Management-Quick-Guidance-for-Users
http://documents.worldbank.org/curated/en/318251544164909341/Carbon-Accounting-Tools-for-Sustainable-Land-Management
[25] These criteria also encompass safeguard criteria beyond the climate mitigation effect, namely human rights, land tenure rights and poverty alleviation. Online available at:
https://www.4p1000.org/sites/default/files/content/consortium_3-3_-_4p1000_reference_criteria_and_indicators_for_project_assessment_from_stc.pdf
[26] See http://www.carbonbenefitsproject.org/
[27] as gathered in the upcoming Technical Manual of SOC Management (GSP-ITPS)
[28] As supported by the Global Soil Laboratory Network (GLOSOLAN). More information at:
http://www.fao.org/global-soil-partnership/pillars-action/5-harmonization/glosolan/en/
[29] Including supporting modelling schemes

3. The signatories of this submission, within and outside of the UN System, are dealing with improving soil organic carbon, soil health and soil fertility in agricultural and forest land with different priorities and focus areas, yet with common goals.

   *The **4 per 1000 Initiative** focuses on soil carbon sequestration on agricultural land for the three beneficial objectives of improving food security, progressing on adaptation of ecosystems and communities to climate change and contributing to the mitigation of climate change. 4 per 1000 represents a multi-stakeholder initiative of farmer organizations, research institutions, governments, the private sector and the civil society. The initiative aims to promote dialogue and stimulate investments and actions to achieve soil carbon preservation and storage on the ground[31]. The **Scientific and Technical Committee (STC)** of the "4 per 1000" Initiative provides scientific and technical guidance to the Consortium of the Initiative.*

   *The **Global Soil Partnership (GSP)** is a globally recognized mechanism established in 2012 by FAO's member countries. Its mission is to position soils in the Global Agenda through collective action. Its key objectives are to promote Sustainable Soil Management 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. The **Intergovernmental Technical Panel on Soils (ITPS)** provides scientific and technical guidance to the GSP and further institutions upon request. The GSP has a strong portfolio in Soil Organic Carbon, guided through the implementation of the recommendations of the Global Soil Organic Carbon Symposium 2017, where the main decision was to advocate for the maintenance and enhancement of soil organic carbon stocks for multiple societal benefits. Furthermore, the FAO's GSP is working on a number of tools to move the soil carbon agenda from ambitions into concrete actions.*

   *The **UNCCD Science-Policy Interface** (SPI) promotes dialogue between scientists and policy makers on addressing desertification, land degradation and drought. The mandate of the SPI is to provide the Committee on Science and Technology (CST) with thematic guidance on knowledge requirements for implementing the UNCCD. One of the main strategies for implementing the UNCCD is to achieve Land Degradation Neutrality[32], which includes maintaining or increasing soil carbon as one of three indicators.*

   ***Drynet**[33] is a global civil society network that collaborates to promote sustainable use of land-based resources working with local communities in the global drylands to effectively counter degradation and enhance land-based livelihoods. Drynet members actively promote a range of appropriate technologies to retain and enhance soil organic carbon in*

[30] As supported by the establishment of a Global Soil Information System (GLOSIS). More information at: http://www.fao.org/global-soil-partnership/pillars-action/4-information-data/glosis/en/
[31] Rumpel, C. et al., 2019 (Available online at: https://link.springer.com/article/10.1007%2Fs13280-019-01165-2)
[32] https://www.unccd.int/actions/achieving-land-degradation-neutrality
[33] https://www.dry-net.org/

order to improve water retention and limit soil erosion. Drynet members actively promote the involvement of affected communities in decision-making at the national and international levels.

World Agroforestry (ICRAF)[34] *is a centre of science and development excellence that harnesses the benefits of agroforestry and develops knowledge practices, from farmers' fields to the global sphere, to ensure food security and environmental sustainability. ICRAF supports the growing political momentum for large-scale commitments to prevent land degradation, and to restore or regenerate degraded natural resources and ecosystem services. ICRAF's research in soil health and carbon restoration focusses on assembling the evidence base on the impacts of land and soil management, including agroforestry, on soil ecosystem services, and on how to include ecosystem services provided by soils in economic ex-ante and ex-post impact analysis of land restoration interventions. We also include further development and capacity building in rapid, low cost, light-based methods for soil-plant analysis, including soil carbon, and their application in targeting and impact monitoring of land restoration and sustainable agricultural intensification.*

The ***CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS***[35]***)****, which is carried out with support from the CGIAR Trust Fund and through bilateral funding agreements works on low emissions development aiming to reduce greenhouse gas emissions and increase carbon sequestration in the agriculture sector. Together with multiple partners, CCAFS conducts research to improve estimates of farm emissions, emission reductions, and carbon sequestration in smallholder systems; identify priorities and options for low emissions development that also support food security; and support widespread implementation of low emissions agriculture practices and policies. CCAFS through its regional program in* ***East Africa*** *(CCAFS EA) works on agricultural systems in the region that are mainly rain-fed and highly vulnerable to climate change and variability. The frequency and severity of climate shocks such as drought, floods, heat and cold stress have increased with negative impacts on agriculture and food security. CCAFS East Africa understands the multiple benefits of soil organic matter/soil carbon and works with CG centers, CRPs, as well as with national and international partners in the region to enhance soil carbon, soil health and soil fertility under cropland, grassland and other integrated systems to enhance agricultural productivity and food and nutrition security and where possible mitigate climate change.*

The signatories of this submission encourage the Koronivia negotiators to treat the maintenance and increase of soil organic carbon, health and fertility as an exemplary indicator of holistically improved agricultural systems in a changing climate with concomitant mitigation and adaptation benefits of equal importance.

[34] http://worldagroforestry.org/
[35] https://ccafs.cgiar.org/

4. Successful implementation and large-scale adoption of good soil management practices requires at least the following:

   I. solid scientific evidence;
   II. involvement of communities in improving organic matter management;
   III. awareness raising and advocacy on the benefits of action;
   IV. enhanced extension services;
   V. political will and institutional commitment to support the process;
   VI. co-creation of knowledge among policy makers, researchers and land users;
   VII. capacity development, technical advice and decision support for the land managers and owners on how to implement good land management practices,
   VIII. an economic motivation (added value in form of higher yields or incomes, Payment for Ecosystem Services, financial incentives including subsidies, risk reduction mechanisms or higher product value, potentially supported through certification schemes);
   IX. robust and cost-effective monitoring, reporting and verification of performance;
   X. harmonized SOC sampling, measurement and monitoring systems;
   XI. long-term investments.

   The signatories of this submission offer their scientific expertise on soil carbon and soil-derived ecosystem services to the UNFCCC gathered in the Scientific and Technical Committee of the 4 per 1000 initiative, the Intergovernmental Technical Panel on Soils of the GSP and the Science-Policy Interface of the UNCCD. **Compilations of best management practices are widely available**, including in the World Overview of Conservation Approaches and Technologies[36], knowledge products from TERRAFRICA[37], the Knowledge Hub of the UNCCD[38], the World Bank Sourcebook[39], CIAT's Soil Best Bets Compendium[40] and the Voluntary Guidelines for Sustainable Soil Management[41].

5. A major common goal from the signatories of this submission is the support of countries in establishing and achieving national targets for improving soil carbon, soil health and soil fertility. Currently, few commitments at the national level include explicit targets on soil carbon, soil health and soil fertility. **The alignment of national commitments with what is biophysically and economically possible in different regions would support the implementation of soil carbon maintenance and enhancement** in the NDCs, NAMAs and NAPAs, Land Degradation Neutrality national targets, decarbonisation strategies,

36 https://www.wocat.net/
37 http://www.nepad.org/publication/sustainable-land-management-practice-guidelines-and-best-practices-sub-saharan
38 https://knowledge.unccd.int/knowledge-products-and-pillars/best-practices-sustainable-land-management
39 http://documents.worldbank.org/curated/en/495041468338511373/pdf/448340PUB0Box3101official0use0only1.pdf
40 https://ciat.cgiar.org/soil-best-bets
41 www.fao.org/3/a-bl813e.pdf

bioeconomy/green economy/circular economy strategies, land management plans, agricultural productivity strategies, the GSP Regional Implementation Plans, etc. In the international context, the synergies related to good soil carbon management for all three Rio Conventions should always be recalled (see Figure 2).

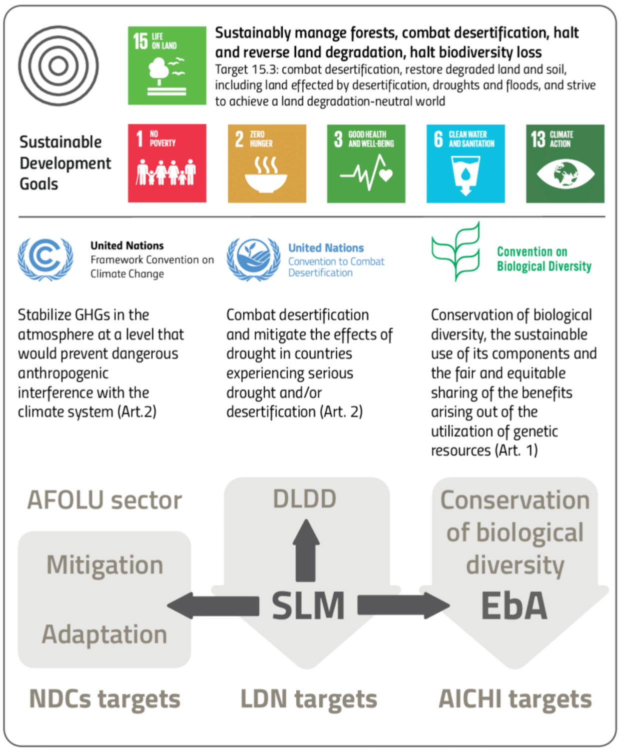

Fig.2: Linkages between the three Rio Conventions and SDGs supported by Sustainable Land Management (SLM) with benefits for soil carbon, soil health and soil fertility. From: **Sanz, M.J. et al., 2017. Available online at: https://www.unccd.int/sites/default/files/documents/2017-09/UNCCD_Report_SLM_web_v2.pdf**

To support increasing ambition on soil carbon in climate change strategies, **the 4 per 1000 initiative and CCAFS are conducting a study[42] summarizing current NDC commitments related to soil carbon sequestration and opportunities for enhancing goals, as well as constraints that countries face in setting targets in their NDCs.** Preliminary results will be presented during the SB 50 meeting as a side event and could also be discussed during the KJWA workshop. **In comparison with the biophysical potentials for soil carbon sequestration, there is a large gap in NDC commitments.** Only two (China and Canada) of the 20 countries with the highest potential for soil carbon sequestration included explicit soil carbon action in their NDCs. Overall, the NDCs of only 10 countries encompass explicit soil carbon targets.

[42] In partnership with the Thuenen Institute, Staff Unit Climate Protection (https://www.thuenen.de/en/about-us/structure/staff-unit-climate-protection/) and FAO's GSP

6. For a fruitful KJWA workshop on the topic 2c) Improved soil carbon, soil health and soil fertility under grassland and cropland as well as integrated systems, including water management, the signatories of this submission recommend the following content and structure (assuming a duration of 2 sessions of 180 minutes each):

--- 1. session ---

I. Scientific presentation on state of the art of best practices for improving soil carbon, health and fertility including benefits for erosion control and water availability and storage across different agricultural areas as well as possible risks and trade-offs and how to reduce them (20 min.)[43]

II. Scientific presentation on robust and cost-effective monitoring systems at national level, e.g. from Belgium (Prof. Steven Sleutel[44]), Ethiopia[45], the EU (from the European Soil Data Centre at the Joint Research Centre[46]), France (Dr. Antonio Bispo or Dr. Dominique Arrouays[47]) (20 min.)

III. Questions from the floor (20 min.)

IV. Scientific presentation by Dr. Lini Wollenberg [48] of current NDC commitments, opportunities and barriers for increasing ambition based on the study by the 4 per 1000 initiative and CCAFS (20 min.)

V. Five case studies of countries presenting already undertaken policy actions for improving soil carbon, health and fertility in relation to climate change adaptation and mitigation and discussing land users perceptions and implementation success and challenges including economic costs and benefits (15 min. each, 75 min. in total)

VI. Open floor discussions for countries, including the views of farmers, with identified needs for improving soil carbon, soil health and soil fertility, yet hampered through knowledge, technology, implementation or financial barriers (25 min.)

--- 2. session ---

VII. Presentation by the UNCCD and the CBD on soil carbon, soil health and soil fertility as one common indicator to fulfil the three Rio Conventions, implemented through Land Degradation Neutrality, the NDCs and the Aichi targets (30 min. incl. questions from the floor)

[43] e.g. from Joa Carlos de Moraes Sa, University of Ponta Grossa, Brazil (jcmsa@uepg.br)
[44] https://biblio.ugent.be/person/801001540135
[45] https://www.ata.gov.et/programs/highlighted-deliverables/ethiosis/
[46] For instance, Dr. Alberto Orgiazzi, alberto.orgiazzi@ec.europa.eu)
[47] Antonio.Bispo@inra.fr ; Dominique.Arrouays@inra.fr
[48] CCAFS Flagship Leader for Low Emissions Development and member of the Scientific and Technical Committee of the 4 per 1000 initiative (Lini.Wollenberg@uvm.edu, https://ccafs.cgiar.org/about/who-we-are/our-staff/researchers/theme-leader/lini-wollenberg#.XKHieMSYNu8)

VIII. Scientific presentation by FAO's GSP about Unlocking the potential of soil organic carbon: GSOCmap update process, Technical Manual on SOC management, Global SOC sequestration potential, Global SOC monitoring system, International Network of Black soils (INBS) and GLOSOLAN (30 min. incl. questions from the floor).

IX. Presentation of practical examples of joint scientific research and implementation of sustainable soil management for carbon sequestration through civil society[49] (20 Min. incl. questions from the floor).

X. Statements from the floor sharing views on how to foster soil organic carbon preservation and additional storage within the framework of the Koronivia Joint Work on Agriculture including how to increase investments and financial support for this purpose (60 Min.)

XI. Final discussion, decision on the way forward and possibly finalization of a joint statement on improved soil carbon, soil health and soil fertility under grassland and cropland as well as integrated systems, including water management (40 Min.)

[49] For example from the Congo Basin Conservation Society (https://www.cbcscongobasin.org)