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Fifty-first session
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Item X of the provisional agenda
Koronivia joint work on agriculture

Subsidiary Body for Implementation
Fifty-first session
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Koronivia joint work on agriculture

Improved soil carbon, soil health and soil fertility under grassland and cropland as well as integrated systems, including water management

Workshop report by the secretariat

Summary

The in-session workshop on improved soil carbon, soil health and soil fertility under grassland and cropland as well as integrated systems, including water management, was held in conjunction with the fiftieth sessions of the subsidiary bodies. Experts from Parties, international organizations, the private sector, research organizations, civil society and constituted bodies under the Convention as well as farmers presented on key opportunities and challenges and engaged in in-depth discussion on the potential and co-benefits of soil carbon sequestration, including on how to measure progress and catalyse action in that area. The workshop provided the opportunity to begin discussing options for increasing synergy and collaboration among stakeholders, while highlighting that farmers must be at the centre of all discussions and decision-making on climate change, agriculture and soils.

* Session dates are tentative.

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Contents

Abbreviations and acronyms

AFOLU	agriculture, forestry and other land use
ASEAN	Association of Southeast Asian Nations
CBD	Convention on Biological Diversity
COP	Conference of the Parties
CTCN	Climate Technology Centre and Network
GCF	Green Climate Fund
GEF	Global Environment Facility
GHG	greenhouse gas
GRA	Global Research Alliance on Agricultural Greenhouse Gases
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
IPCC	Intergovernmental Panel on Climate Change
KJWA	Koronivia joint work on agriculture
MRV	measurement, reporting and verification
NDC	nationally determined contribution
NGO	non-governmental organization
SB	sessions of the subsidiary bodies
SBI	Subsidiary Body for Implementation
SBSTA	Subsidiary Body for Scientific and Technological Advice
SDG	Sustainable Development Goal
UNCCD	United Nations Convention to Combat Desertification
WBCSD	World Business Council for Sustainable Development

I. Introduction

A. Mandate

1. The COP requested the SBI and the SBSTA to jointly address issues related to agriculture, including through workshops and expert meetings, working with constituted bodies under the Convention and taking into consideration the vulnerabilities of agriculture to climate change and approaches to addressing food security.[1]

2. The SBI and the SBSTA requested the secretariat, subject to the availability of supplementary resources, to organize six workshops between December 2018 and June 2020 under the KJWA,[2] as outlined in the Koronivia road map.[3] They encouraged admitted observers to participate in these workshops.

3. The SBI and the SBSTA requested the secretariat to organize the third workshop in conjunction with SB 50 on the subject of improved soil carbon, soil health and soil fertility under grassland and cropland as well as integrated systems, including water management. They also requested the secretariat to prepare a report on the workshop for their consideration at SB 51.[4] They further requested the secretariat to invite representatives of the constituted bodies to contribute to the work and attend the workshops.[5]

4. The SBI and the SBSTA invited Parties and observers to submit via the submission portal[6] their views on the subject of the workshop referred to in paragraph 3 above.[7] They took note of the importance of issues, including but not limited to farmers, gender, youth, local communities and indigenous peoples, and encouraged Parties to take them into consideration when making submissions and during the KJWA workshops.[8]

B. Possible action by the Subsidiary Body for Implementation and the Subsidiary Body for Scientific and Technological Advice

5. The SBI and the SBSTA may wish to consider this report at SB 51 when reviewing the KJWA and preparing a report to COP 26 (November 2020) on the progress and outcomes of the work, including on potential future topics.[9]

II. Proceedings

6. The workshop referred to in paragraph 3 above was organized by the secretariat and held in Bonn on 18 and 19 June 2019. It was open to all Parties and observers attending SB 50.

7. On behalf of the Chair of the SBI and the Chair of the SBSTA, the Chair of the SBI, Emmanuel Dumisani Dlamini (Eswatini), delivered opening remarks and detailed the mandate and objectives of the workshop. He invited Heikki Granholm (Finland) and Milagros Sandoval (Peru) to co-facilitate the workshop.

8. The workshop was organized in four sessions:

(a) Country presentations;

[1] Decision 4/CP.23, para. 1.
[2] FCCC/SBI/2018/9, para. 39, and FCCC/SBSTA/2018/4, para. 61.
[3] FCCC/SBI/2018/9, annex I, and FCCC/SBSTA/2018/4, annex I.
[4] FCCC/SBI/2018/9, para. 41, and FCCC/SBSTA/2018/4, para. 63.
[5] FCCC/SBI/2018/9, para. 42, and FCCC/SBSTA/2018/4, para. 64.
[6] https://www4.unfccc.int/sites/submissionsstaging/Pages/Home.aspx.
[7] FCCC/SBI/2018/9, para. 43, and FCCC/SBSTA/2018/4, para. 65.
[8] FCCC/SBI/2018/9, para. 40, and FCCC/SBSTA/2018/4, para. 62.
[9] As mandated in decision 4/CP.23, para. 4.

(b) Presentations on work undertaken by constituted bodies and financing entities;

(c) Expert panel discussion;

(d) Plenary discussion.

9. Further information on the workshop, including the agenda and presentations, is available on the UNFCCC website.[10]

III. Summary of presentations

A. Keynote presentations

10. The first keynote presentation, made by a soil scientist,[11] provided scientific background information on soils and climate change. The scientist emphasized that the soil carbon pool is big, containing almost three times as much carbon as the atmosphere, and that soil organic matter provides essential ecosystem services such as retaining water and providing nutrients. She explained that improving soil carbon, soil health and soil fertility is important for reaching the SDGs and will lead to multiple benefits and synergies as part of efforts towards achieving the biodiversity objectives under CBD, the land degradation neutrality objectives under UNCCD and the climate change adaptation and mitigation objectives under the UNFCCC.

11. The scientist also explained that there are practices for increasing the soil organic carbon stocks of agricultural land, such as using mineral and organic inputs, reducing tillage and optimizing crop rotation. She added that there is large variation and uncertainty in available global data on soil carbon sequestration potential given the variability of pedoclimatic conditions, the influence of land-use practices and the complexity of biophysical barriers to soil organic carbon storage. Research involving farmer consultation has revealed that socioeconomic barriers play an important role in relation to adopting changes to agricultural practices.

12. It was further explained that carbon sequestration in soils is slow and limited to the point where soils reach equilibrium, but that sequestered carbon can be lost relatively rapidly. Also, increased carbon storage can lead to an increase in environmental risks and negative social impacts, such as increased nitrogen dioxide emissions and pressure on land tenure. However, the latest science suggests that 'no regrets' options for improving soil carbon, soil health and soil fertility exist; for example, using cover crops, agroforestry, restoring degraded land and not burning crop residues. The scientist concluded that protecting existing soil carbon stocks is the top priority; while increasing carbon stocks in agricultural soils is feasible, but also complex, locally specific and heterogenous, thus requiring a portfolio of practices adapted to local conditions.

13. The second keynote presentation was given by an expert from the Global Soil Partnership.[12] He highlighted the urgency of addressing soil carbon, soil health and soil fertility given that soil degradation leads to loss of soil functions and productivity and increased GHG emissions. According to the expert, one third of soils globally are currently assessed to be moderately to highly degraded, with global carbon stock amounting to 694 Pg soil organic carbon in the first 30 cm of top soil. He added that monitoring the long-term effects of agricultural practices on soil carbon sequestration requires national capacities to measure, map and monitor the implementation of policies for preventing soil organic carbon losses, particularly from soil types that contain large carbon stocks, and for enhancing soil organic carbon sequestration.

14. The expert provided an overview of the current state of MRV of soil organic carbon stocks and stock changes. Change in total soil carbon stocks is difficult to measure because

[10] https://unfccc.int/event/improved-soil-carbon-soil-health-and-soil-fertility-under-grassland-and-cropland-as-well-as.

[11] Claire Chenu.

[12] Ronald Vargas.

the change takes a long time. He explained that remote sensing can be used to provide proxies that can help to inform the planning of more efficient field surveys to measure carbon stocks, but it cannot replace field surveys and soil sampling because the concentration of soil organic carbon is diverse, complex and often not easily observed on the surface. Even new technologies such as spectroscopy require soil samples to calibrate and to scan complete soil samples representing soils in their three dimensions. He added that the IPCC provides three tiers of methodological options for countries' measurement of their soil carbon stocks, with the tier 2 and 3 methods requiring national data, which in many countries are not readily available. Thus, according to the expert, many countries are using a tier 1 method and global default data, which does not provide a good basis for decision-making on national soil management. He emphasized the importance of country ownership of the process and institutional arrangements for soil mapping and monitoring, which can help to overcome issues of confidentiality of raw data but may also lead to the need for compromise in terms of comparability of data and harmonization of methodologies across countries. The expert explained that countries are undertaking modelling efforts to identify the potential to sequester carbon and return soil organic carbon stocks up to previous levels because they want to use the resulting information in decision-making to start taking action while continually improving MRV. In his view, investment in sustainable soil management is essential for scaling up good practices and incentivizing farmers to employ them. He indicated a need to establish a global soil organic carbon monitoring system, especially for the key land-use systems; and emphasized that capacity development is the vehicle for bringing all stakeholders working on soils together.

B. Country presentations

15. Five country representatives made presentations, in which they responded to the following questions:

(a) What are your countries' experiences with improving soil carbon, soil health and soil fertility under grassland and cropland as well as integrated systems, including water management?

(b) How did your country address co-benefits and synergies with multiple objectives when improving soil carbon, soil health and soil fertility?

(c) How did your country set goals and measure progress in improving soil carbon, soil health and soil fertility?

(d) Which challenges did your country face in improving soil carbon, soil health and soil fertility, and how can the Koronivia joint work on agriculture and UNFCCC constituted bodies help to address these challenges?

16. A representative of Brazil described how the country transitioned from being a country with low agricultural production and yield before 1970 to a country that exports agricultural products 40 years later, achieving substantive socioeconomic benefits and improvements in national food security. He explained that the key to this development was substantive investment in science-based initiatives to improve tropical agriculture, such as the exploration of advanced soil conservation practices, biological nitrogen fixation and integrated production systems. He added that robust measurement of progress is essential for the development and implementation of science-based improvements over time, and explained that Brazil is incrementally enhancing its monitoring strategy and combining field sampling with remote sensing approaches. He emphasized that climate change is a challenge that cannot be solved by short-term investment; it requires long-term research to understand how transformational change can be achieved. In that sense, the UNFCCC process was fundamental to the development of Brazil's national strategy, including its national plan for low-carbon emissions in agriculture,[13] which involves the private sector, civil society and the banking system in addressing adaptation to climate change, reducing GHG emissions and increasing revenue for farmers. The representative emphasized that successful

[13] See http://www.agricultura.gov.br/assuntos/sustentabilidade/plano-abc/arquivo-publicacoes-plano-abc/download.pdf (in Portuguese).

implementation of such initiatives requires farmers' support, and that farmers need to see the positive opportunities in changing their practices.

17. A representative of the California Department of Food and Agriculture explained that California is one of the biggest agricultural producers in the United States of America with a great diversity of agricultural products but is increasingly seeing the effects of climate change; for example, change in night-time temperatures, increased drought and, in particular, increased frequency and severity of wildfire. She presented on how State-funded land restoration and management activities to increase soil carbon sequestration are supporting California in reaching its GHG emission reduction goals and also helping to keep soils healthy and productive. California's carbon trade programme provides foundational revenue, which can be invested in incentivizing market-driven farmers, through the Healthy Soils Program,[14] to adopt voluntary soil improvement practices. California also invests in research and essential technical assistance, providing training to farmers and supporting experience and data exchange between them. The representative explained that farmers are encouraged to adopt practices and tools provided by the Natural Resources Conservation Service of the United States Department of Agriculture. She added that California uses a combination of modelling and satellite imagery to measure progress towards its goals, but also uses soil samples for establishing baselines and requires annual soil samples from participating farmers. She emphasized the importance of countries exchanging experience and concluded that ensuring the long-term productivity of soils for future generations is the basis for a healthy society.

18. A representative of the Philippines presented on the experience of the 10 ASEAN member States. She highlighted the particular vulnerability of ASEAN member States to climate change, and emphasized the importance of regional cooperation for improving soil and nutrient management and promoting climate-resilient crop production systems, including the reduction of activities that contribute to soil degradation such as deforestation, mining, destructive farming practices, urbanization and coastal pollution. For example, the ASEAN member States have developed guidelines on soil and nutrient management.[15] The representative added that soil and nutrient management is important for optimizing crop production, and the ASEAN member States use integrated systems to enhance crops' intake of nutrients and water, improve soil carbon storage, increase organic matter content and control pests and diseases. She explained that there is a need for more standardized quantification methodologies to measure effects as well as a need to establish more technology demonstration and learning sites across a variety of environments to provide more science- and evidence-based results. She added that the ASEAN member States are implementing national plans to examine natural and human-induced factors and existing frameworks relevant to sustainable land management and synergies among the three Rio Conventions. The representative concluded by emphasizing that the KJWA can help to address existing challenges in this area by facilitating the scaled-up mobilization and provision to developing countries of means of implementation for soil and water management.

19. A representative of the Russian Federation presented on the measures employed in the country to reduce risks and damage to agricultural production, such as using special crop varieties and preserving and restoring soil fertility on agricultural land. Work is under way to reduce the impacts of natural disasters such as drought, desertification, hurricane winds, heavy rain, soil salinization and erosion. The representative explained that planting afforestation belts has been effective at reducing such impacts, in particular related to soil erosion, since 1892, and that there is evidence that they lead to a long-term increase in groundwater levels, positively influence the microclimate, increase soil organic carbon, prevent water and wind erosion and also sequester carbon from the atmosphere, thus creating a more sustainable agricultural system. She also explained that the problem of soil salinization can be addressed by introducing groundwater-independent irrigation, placing paddy fields in lowlands, preventing flooding and installing protective dams, drains and

[14] See https://www.cdfa.ca.gov/oefi/healthysoils/.

[15] See https://www.asean-agrifood.org/download/asean-guidelines-on-soil-and-nutrient-management-final-draft/?wpdmdl=10618&refresh=5d35c7e0efaa21563805664.

catchwaters. Activities to reduce the impact of drought include using more drought-resistant and early-ripening wheat species and snow retention practices to keep fields moist. The representative highlighted that the KJWA presents an opportunity for the Russian Federation to consider the adaptation needs of its agriculture sector while also determining its mitigation potential and ensuring food security.

20. A representative of Senegal presented on the special challenges in African countries, where large land areas, particularly in West Africa, are nearly or completely infertile due to the lack and low-quality of the organic matter. Current agricultural practices include crop rotation with fallows, crop rotation with agroforestry, integration of crops and livestock, and input of organic matter. In Senegal, for instance, about 65 per cent of arable land is degraded, owing mainly to monoculture, decrease in tree cover, residue burning, soil erosion and salinization. The representative indicated that overuse of land by livestock can also lead to land degradation. He emphasized the need to restore soil fertility using different types of organic matter, while noting that the unavailability of sufficient organic matter can be a challenge, particularly for larger farms. According to the representative, restoring soil fertility will contribute to achieving the SDGs, the objectives of UNCCD and Senegal's NDC, especially where synergies are created with research institutions and existing intervention programmes for soils. He explained Senegal's national framework for strategic investment in sustainable land management, including that the roles and responsibilities of all stakeholders, including farmers, organizations, State governments, NGOs and research institutions, must be taken into account. He highlighted the importance of mapping, planning and monitoring surface water resource management in both watersheds and cropland, including to retain water in dry conditions and reduce water erosion and nutrient loss. He added that countrywide soil fertility and carbon monitoring with cost-efficient tools that provide information in a timely manner is a challenge given existing budget constraints. To date, mainly indirect or socioeconomic indicators have been used, but increasingly research institutions are being involved to measure the soil carbon content before and after interventions. Senegal is exploring the use of new and innovative MRV tools, such as modelling and near-infrared spectroscopy, but this necessitates substantive capacity-building.

C. Presentations on work undertaken by constituted bodies and financing entities

21. Four experts presented on the work of their respective body or organization, guided by the following questions:

(a) What work is your body or organization undertaking to improve soil carbon, soil health and soil fertility under grassland and cropland as well as integrated systems, including water management?

(b) How does your body or organization address co-benefits and synergies with multiple objectives when improving soil carbon, soil health and soil fertility?

(c) How does your body or organization set goals and measure progress in improving soil carbon, soil health and soil fertility?

(d) Which challenges did your body or organization face in improving soil carbon, soil health and soil fertility, and how could the Koronivia joint work on agriculture, UNFCCC constituted bodies or other actors help to address these challenges?

22. A representative of the World Bank highlighted that agriculture is highly vulnerable to climate change and the global food system is already not fit for purpose as the demand for food continues to grow rapidly. He described the challenge of increasing food production by 56 per cent to feed 10 billion people by 2050 within planetary boundaries. He added that agriculture is responsible for 25 per cent of GHG emissions and 60–70 per cent of biodiversity loss, while 2 billion people are undernourished, 2 billion people are overweight and one third of agricultural production is lost or wasted. He described soil health as a public, private and wider societal good, and emphasized that investing in healthy soils will make a big difference. In its work on soil health, the World Bank is aiming to increase value

generation through soils for farmers, providing tools for quantifying carbon emissions and removals, encouraging investment in soil health and promoting sustainable land management by small-scale farmers in developing countries. He suggested that the USD 570 billion in annual public support currently being dispersed to the sector could be repurposed towards incentivizing farmers to invest in healthy soils, promoting diversification of production systems, adding post-harvest value and building resilience. The World Bank screens projects using four assessments: climate and disaster risk screening; GHG accounting; value (using a shadow price of carbon of USD 40/t); and climate finance tracking (co-benefits). According to the representative, the World Bank projects have successfully prioritized soil health and achieved multiple benefits, such as increased perennial vegetation cover, enhanced protection of natural resources, more secure food supply and increased income and employment rates. He suggested that challenges in this area could be addressed by integrating soil health related targets into NDCs, realigning the public support provided to agricultural producers in such a way as to promote the improvement of soil health, and addressing technical and procedural bottlenecks around MRV of soil health and soil carbon.

23. A representative of the CTCN presented on the technologies used to enhance and monitor soil carbon in African countries. He explained that carbon sequestration is a win-win for mitigating climate change and increasing resilience. He highlighted that the CTCN conducted a workshop in January 2019 to develop a compendium of carbon-enhancing technologies, approaches and practices for African soils to facilitate knowledge-sharing on soil carbon sequestration, the latest technologies, carbon storage and climate change adaptation.[16] In his view, increasing carbon storage in soils is particularly relevant to developing countries because of the potential to enhance agricultural production, improve soil fertility and decrease GHG emissions. He introduced available methodologies such as biochar application; organic agriculture; area closure and reserves; conservation agriculture; and climate-smart agriculture with and without trees. He identified the need to undertake nationwide subnational measurement and monitoring of soil conditions and the potential to increase soil carbon sequestration by reducing land under cultivation by reversing deforestation and land degradation, including by increasing agricultural productivity. As a result of its work, the CTCN has already received requests for technical assistance in this area. The representative emphasized that knowledge-sharing is important and could be facilitated by holding such workshops in other regions.

24. A representative of the GEF explained that soils is an important cross-cutting area of work under multiple conventions for which the GEF serves as a financial mechanism, including the UNFCCC, UNCCD and CBD. Countries are increasingly addressing soils in an integrated fashion and the GEF supports integrated solutions for achieving multiple global environmental benefits, particularly in relation to soil degradation. Entry points to the GEF for agriculture exist through the focal areas on biodiversity and land degradation, as well as in the context of NDC preparation and implementation. The GEF Impact Programs on food, land use and restoration, to tackle the environmental impacts of commodities such as palm oil, rice, soy and coffee, and on sustainable forest management, focusing on globally important forests in the Amazon, the Congo basin and drylands, provide further opportunities for addressing agriculture. Further, the Least Developed Countries Fund and Special Climate Change Fund have historically invested about one quarter to one third of their total available amount of USD 2 billion in building the resilience of the agriculture sector. The GEF representative explained that targets for the global environmental benefits to be achieved in the AFOLU sector are set on the basis of past experience in the sector, increased level of ambition and consideration of the importance of the sector in countries' NDCs. He added that progress is measured following IPCC guidelines in terms of carbon benefits, and that hectares of productive landscape subject to improved management practices is another indicator used. He concluded by explaining challenges in this area, including cross-sectoral national coordination, integration across focal areas, limited resources compared with countries' needs, transboundary coordination between countries with shared biomes and ecosystems, and the role of the private sector.

25. According to the GCF representative, the GCF agriculture portfolio is worth around USD 800 million with a growing pipeline of funding proposals. Projects deal mainly with

[16] See https://www.ctc-n.org/news/ctcn-workshop-technologies-soil-carbon-enhancement-africa.

cropland, integrated systems (including forest) and water management, and about three quarters of GCF investments in agriculture are in vulnerable countries. The representative explained that the GCF results areas related to agriculture are ecosystems and ecosystem services, health and well-being, and food and water security under adaptation, and forestry and land use under mitigation. The GCF uses a number of indicators to measure the progress of projects, such as percentage of food-secure households; area of agricultural land made more resilient; area of habitat rehabilitated; number and area of agroforestry projects, forest-pastoral systems or ecosystem-based adaptation; and GHG emissions reduced from forest and land use. At present, GCF projects focused on soils are more likely to be aimed at adaptation, such as improving climate resilience through, for example, promoting a landscape-level approach to ecosystem services, and soil and water conservation; enhancing soil conditions using organic fertilizers; and improving land quality through intercropping and nitrogen-fixing species. The GCF also has many projects on water management in agriculture, including irrigation or water schemes. For attracting direct financing for mitigation in the area of soil organic carbon, data availability is a challenge. The representative explained that it is important to show that the climate benefits of soil and water improvement measures support the theory of change of soil health and food security, and that the GCF activities also contribute to economic, social, health, gender, environmental and mitigation co-benefits to sustainable development. The representative presented the particular challenges for the GCF of ensuring the sustainability, replicability, scalability and paradigm shift potential of its projects. Furthermore, the GCF aims to achieve complementarity and coherence with other climate and development finance in a country, and synergies with other conventions (CBD and UNCCD).

D. Presentations by expert panellists

26. The expert panel discussion entailed five experts representing non-State actors responding to the following questions:

(a) What are the key challenges and barriers in achieving a transformation in agriculture which leads to improving soil carbon, soil health and soil fertility under grassland and cropland as well as integrated systems, including water management?

(b) How can the Koronivia joint work on agriculture and UNFCCC constituted bodies or other actors help to address these challenges?

27. The first panellist described the situation for a smallholder farmer in Zambia. Given the reliance on rain-fed crops, the low rainfall last season (350 mm compared with an average of 800–1,500 mm) was a challenge for smallholder farmers, in particular women. She explained that synthetic and chemical fertilizers have depleted soils and, in her experience, such depleted soils cannot cope with climate change. She explained that chemical fertilizers applied under insufficient rain cause the soil to harden and reduce its ability to retain water and the nutrient availability. She added that spraying herbicides removes vegetation cover and leaves the soils and living microorganisms exposed to the heat, also reducing soil fertility. She highlighted that fertilizers contain macronutrients but lack essential secondary nutrients and micronutrients. Agroecology, with techniques such as tree planting, crop rotation, mulching, use of green manure, minimum tillage, seed crop and animal diversity, use of animal manure and integrated systems, works on her farm in a sustainable manner and helps to fix nutrients in the soil. In her experience, agroecology also enhances adaptation and reduces the cost of production, using natural resources and pest management as well as water management and moisture retention techniques. She saw a need to promote agroecology, including by providing training for farmers, but 70 per cent of the budget for agriculture in Zambia is used to subsidize chemical inputs and herbicides, leaving little funding for areas such as extension services. In her view, farmers need to see the benefits of funding, such as that from the GCF, more directly, and also need to be involved in research in a participatory manner as they have knowledge about the soils and crops and their history.

28. The panellist representing environmental NGOs emphasized that the current industrial food systems are harming the climate, soil carbon, soil health and soil fertility. She explained that overuse of chemical fertilizers leads to soil degradation, reduced water retention

capacity, biodiversity loss and water pollution. According to IPBES,[17] current agricultural practices use one third of the available global land surface and 75 per cent of freshwater resources and are responsible for most of the biodiversity loss. The panellist indicated that AFOLU is responsible for about one quarter of global GHG emissions and that efforts in this area need to be holistic and take into account that one third of food is wasted and 821 million people face food insecurity. In her view, challenges arise from current trade and agricultural policies, which encourage the development of industrial-scale holdings and large-scale monocultures that are heavily dependent on chemical fertilizers. She added that the focus is on soil carbon and efforts to measure the tenuous, fluctuating resource, and on reforming the current system by increasing its efficiency rather than on transitioning to agroecology to meet the needs of soils, the climate and farmers. She recommended to measure the areas of land where appropriate methodologies are being used to build up soil health and biodiversity, or to use biodiversity indicators. She added that mitigation policies regarding agriculture should focus primarily on reducing absolute GHG emissions in an equitable way according to countries' historical responsibilities. She explained that offsetting industrial emissions through soil carbon sequestration is not an option; instead industrial emissions need to be decreased. In her view, it is important to consider policy frameworks for promoting agroecology and to reflect on the importance of farmers' and local communities' land rights, because nurturing soils requires long-term security in that regard.

29. The panellist from GRA presented on the scope of soil carbon sequestration activity in the GRA integrative research group, which takes soil carbon knowledge from research to farm and the regional scale and develops policy-relevant information. Activities include (1) estimating potential soil carbon sequestration across spatial and temporal scales, and developing reliable and low-cost monitoring and verification methods; (2) understanding trade-offs and synergies with non-carbon-dioxide GHG emissions, as well as costs and barriers to adoption; (3) understanding the co-benefits of soil carbon sequestration for soil health and agricultural production; and (4) producing best practice guidance on monitoring soil organic carbon stocks over space and time. GRA is developing its research collaboration, in particular with the Coordination of International Research Cooperation on Soil Carbon Sequestration in Agriculture project,[18] with the objective of developing knowledge and capacity for estimating, monitoring and projecting GHG emissions within and across agricultural systems. The goal is to contribute to achieving the transformation needed in agriculture to increase carbon in soils and avoid loss of existing soil carbon. GRA activities focus on MRV and capacity-building, including activities in countries that included agriculture in their NDCs. The panellist explained the ongoing challenge of designing approaches to MRV of soil carbon stock changes that are sufficiently accurate but remain practical and useable while data are, at best, incomplete. The work of GRA through its members and partners is focused on improving efficiency, productivity, resilience and adaptive capacity across the agriculture sector and on practical on-farm measures to reduce GHG emission intensity. She added that GRA also undertakes activities that support decision-making at the national level in relation to GHG inventories and policies appropriate to regional circumstances and priorities, including for NDCs.

30. The panellist from WBCSD presented the perspectives of the private sector on soils in the context of the societal challenges of climate change and food security. He explained findings from the 2018 WBCSD report on the business case for investing in soil health,[19] including that opportunities for the business community include increasing crop productivity, securing supply chains and meeting the growing demand for food. He added that businesses can also help to reverse the impacts of climate change, improve water quality, protect biodiversity and improve the livelihoods of the one in three people around the world that

[17] Díaz S, Settele J, Brondízio E, et al. 2019. *Summary for policymakers of the global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services*. Advance unedited version. Bonn: IPBES. Available at https://www.ipbes.net/sites/default/files/downloads/spm_unedited_advance_for_posting_htn.pdf.

[18] See https://www.circasa-project.eu/.

[19] Burian G, Seale J, Warnken M, et al. 2018. *The Business Case for Investing in Soil Health*. Geneva: WBCSD. Available at https://docs.wbcsd.org/2018/12/The_Business_Case_for_Investing_in_Soil_Health.pdf.

work in agriculture. The panellist emphasized the need to help farmers affected by climate change and the role of strong partnerships across value chains, landscapes and sectors. In his view, the lack of uniform GHG-related guidance for dynamic, biological agricultural systems must be addressed, which will take a collective effort. He identified lack of incentive for farmers to adopt climate-smart practices as one of the greatest barriers to improving soil health and making sustainable changes.

31. The panellist representing the farmers constituency provided insights into the practice on his farm, where sustainability is built on five pillars: crop rotation using 18 different crops; a seed and weed strategy; fertilizer and nutrients using compost and green fertilizer, avoiding any chemical fertilizers and pesticides; energy efficiency; and economic viability. His 240-ha farm in Germany was switched to organic farming about 40 years ago and is working as an integrated system where livestock are fed with fodder produced on his own fields. Crop rotation is essential for soil carbon sequestration, and in the case of his farm the basis for soil health and milk production is the use of clover grass. He explained that herbicides are not used on his farm, but mechanical weeding is undertaken using best available technology, which has the benefit that, unlike with herbicides, the weeds do not develop a resistance. He emphasized the need to select the right seeds from organic breeders, which are often more resistant to pests and diseases. The combination of practices at his farm has resulted in a closed cycle of nutrients and the accumulation of humus. In concluding, the panellist emphasized the need to share such successful and proven practices.

IV. Summary of discussions and the way forward

A. Summary of discussions

32. The plenary discussions were guided by three questions:

(a) How could the constituted bodies be further involved and synergies be enhanced for improving soil carbon, soil health and soil fertility under grassland and cropland as well as integrated systems, including water management?

(b) Which modalities would be useful for the implementation of activities improving soil carbon, soil health and soil fertility under grassland and cropland as well as integrated systems, including water management?

(c) What are concrete examples and proposals for such modalities, and which gaps and challenges need to be addressed?

1. Potential and co-benefits of soil organic carbon sequestration

33. Several Party representatives explained that the KJWA presents an opportunity for their countries to update national adaptation and mitigation measures and goals in agriculture as well as to determine the mitigation potential of the agriculture sector while ensuring food security in the changing climate. It was added that soil carbon, soil health and soil fertility must be dealt with in a holistic and comprehensive manner to realize the full potential of increased productivity and climate change adaptation and mitigation effects. This would also contribute towards meeting rural development needs and achieving the SDGs.

34. Participants discussed the potential to sequester back carbon lost from soils over past centuries. They agreed that soil carbon sequestration potential varies between regions depending on pedoclimatic conditions and past soil management practices. While some participants stated that soils should be able to take in carbon up to previous stock levels, given a long enough time frame and appropriate soil management, others cautioned that the impacts of ongoing climate change are likely to have a negative effect on soils' capacity for carbon storage, for example because of more frequent and severe drought. There was also strong agreement that uncertainty regarding soil carbon sequestration potential should not prevent all relevant actors from improving soil management and ensuring that soils work sustainably for the good of production, farmers, resilience and the planet. Several experts highlighted that socioeconomic barriers reduce the actual potential for soil organic carbon sequestration significantly compared with the technical potential. Some participants discussed whether a

carbon price could help to address non-technical barriers to soil organic carbon sequestration and increase the actual share of the technical potential that could be realized.

35. Participants agreed that maintaining existing soil carbon stocks is a priority, especially where stocks are high (e.g. in peatlands, primary forests and natural grassland), and that carbon stock should be enhanced where feasible. One participant stated that this requires integrated land-use planning, ensuring that municipal planning, agricultural planning and conservation planning are conducted together to optimize the response to all the competing demands for the same land resources.

36. Soil organic matter provides essential ecosystem services. Many participants emphasized the importance of the co-benefits of improving soil organic carbon, such as increased water holding capacity. At the same time, it was highlighted that these co-benefits are usually quite complex, site-specific and poorly documented, which makes it difficult to estimate their monetary value and include them in cost–benefit analyses. Several participants emphasized the need for further data collection and research to quantify the co-benefits, recognizing that investing in sustainable soil management will almost certainly result in co-benefits. It was noted that soil health depends on soil biodiversity, which also enhances the resilience of agricultural soils. One participant indicated that large-scale ecosystem and soil restoration is an effective contribution to a 1.5 ºC pathway. Another participant highlighted that studies show a return on investment of 2:1 rising to 5:1 for activities to address land degradation in different locations, which indicates that land restoration can also contribute to poverty alleviation.

37. Some participants noted that soil organic carbon sequestration is limited by the amount of carbon that soils can store, and a plateau effect is expected once soils are saturated. They highlighted that soil organic carbon sequestered over long time frames can potentially be released in a very short time period, including as a result of extreme weather effects. One participant highlighted the essential role of water, especially for countries in arid and semi-arid areas, and that more comprehensive coverage of water management is needed when discussing agriculture and climate change.

2. Measurement, reporting and verification of soil organic carbon

38. Another challenge that participants discussed was the measurement of soil organic carbon. Some highlighted the value of annual soil samples, in particular as they provide data for continuous research and learning. Others discussed that a very high frequency of sampling is less important than a consistent and continuous approach; large-scale soil sampling every 10 years would also be useful. Some experts highlighted that a standardized global protocol for soil sampling would be useful, but that such a level of harmonization seems unrealistic in the short term. Several participants explained that the cost of MRV for countries is generally too high, and it should be considered whether the benefits would be greater if the respective funding could be spent directly on agriculture and extension, involving local communities and looking at their social and environmental needs, including for adaptation. Some participants considered that soil biodiversity could be a useful indicator of soil health and IPBES biodiversity indicators could be used, while others noted that soil biodiversity was excluded from use as an indicator for the SDGs because of lack of data, and that IPBES indicators are only relevant to above-ground biodiversity and information on below-ground biodiversity is not available.

39. Participants discussed the potential to use new technologies, in particular satellite imagery, drones and metadata analysis, to complement or replace the use of costly soil samples. Combinations of remote sensing and modelling approaches can be very useful, but the results become increasingly complex to analyse and interpret. Experts highlighted that satellite images can be used to help plan soil sampling efforts by modelling soil formation, especially as it relates to land-use practices, vegetation and land-cover changes, and this can also lead to useful proxy indicators. However, for measuring soil organic carbon, remote sensing can only provide a proxy estimate of vegetation change on the surface and cannot be used to measure soil organic carbon stored deeper inside the soil. Therefore, in the view of most experts, soil surveys and samples will remain essential.

3. Approaches and methodologies

40. Several participants highlighted the long-term benefits of agroecology and the application of its 10 elements: diversity; co-creation and sharing of knowledge; synergies; efficiency; recycling; resilience; human and social values; culture and food traditions; responsible governance; and the circular and solidarity economy.[20] In their view, the application of fertilizers in particular leads to long-term negative effects on soil health, biodiversity and resilience and should be avoided. It was added that agroecology improves food quality, nutrition, human health and resilience of agricultural systems and is therefore especially relevant to family farming and enabling food sovereignty.

41. Several participants suggested focusing on the desired outcome and employing good practices that contribute to enhancing soil health and human health, while taking into account local context, such as rainfall patterns and traditional practices. They cautioned against focusing on terminology, since it is often not easy to find applicable and unique definitions for terms such as agroecology, sustainable agriculture and climate-smart agriculture. Some participants emphasized that focusing on terminology or ideology may cause potentially useful tools to be disregarded, and that they prefer to leave the decision on which tools to use to the farmers.

42. It was considered how government and other partners can ensure that subsidies contribute towards achieving desired outcomes, noting that agricultural subsidies can have environmentally harmful effects. Some participants shared their observation that the performance of agriculture in the past has often been measured by the produced outputs, while there is now a trend towards looking more at the balance between outputs and the efficient use of inputs, including water. One expert suggested that subsidies could be reallocated from fertilizers to funding water harvesting, irrigation, capacity-building and extension services. Other participants highlighted the benefits of fertilizer application, especially for degraded or nutrient-deficient soils. Several participants added that in many countries ensuring food security might depend on fertilizer use, in which case organic matter should be used as much as possible but could be supplemented by chemical fertilizers if needed. One participant added that the benefits of fertilizer use can be increased by employing the right nutrient sources and application rate, time and place.

4. Support

43. Several participants considered that the KJWA and constituted bodies under the Convention can help to address existing challenges in soil management by facilitating the scaled-up mobilization, access to and actual provision of means of implementation for soil and water management for developing countries. This could also help to improve soil carbon and fertility assessment and implementation of proven practices, such as ecosystem-based soil organic carbon management, integration of crops and livestock, agroforestry and integrated watershed management. Lack of finance for investment in changing practices and methodologies was identified as a barrier to the implementation of sustainable soil improvement practices. The participants discussed ways to create incentives for the transformation of the agriculture sector and for farmers to adopt new practices and a new paradigm. Cost-effective and rapid assessment tools that can be used to give a quick estimate of current carbon stocks for the purpose of requesting technical or financial assistance were considered useful.

44. One source of finance could come out of recognition of soil carbon sequestration in carbon markets. An expert expressed the view that soil carbon sequestration cannot offset industrial emissions, but it can nevertheless contribute to addressing climate change; in particular the co-benefits of increasing soil carbon make it an interesting option. Other experts highlighted examples of issued carbon credits through the Australian Government's Emissions Reduction Fund and under the Verified Carbon Standard. In a discussion on the costs of MRV for the Verified Carbon Standard project it was clarified that they were relatively high because of the pilot nature of the project, but technological advances would be expected to lead to decreasing costs of sampling and MRV for such projects. It was added that reliable estimations of soil organic carbon take at least five years, which may be too long

[20] See http://www.fao.org/3/i9037en/I9037EN.pdf.

and uncertain for carbon markets. One participant highlighted that high levels of scientific uncertainty of soil organic carbon measurements led to the exclusion of soil carbon from the clean development mechanism, while another suggested that proxy indicators of soil carbon sequestration could be used.

45. Some developing country experts highlighted the need to make technology more affordable and allow better access to technology that is relevant to different regions and local conditions. Some participants added that it would be important to consider how to build such technologies on traditional practices. Other experts emphasized the need for science-based decision-making, and that evolving technology can be part of the solution for improving soil carbon, soil health and soil fertility.

46. Participants agreed that training and capacity-building in soil management are essential to realize the potential for soil carbon sequestration in developing countries, especially in the least developed countries, small island developing States and African countries. Several participants highlighted that there is potential for countries to make use of improved tillage, perennial crops, cover crops and improved animal manure application, and a strong interest in increasing MRV and soil monitoring capacity, including through remote sensing and modelling. They also saw a need to explore how national systems can be strengthened to improve the provision of robust data. Several participants welcomed the role that constituted bodies under the Convention are already playing in technology transfer and capacity-building related to agriculture.

5. Cooperation, research and partnerships

47. Several participants emphasized the important role of partnerships in improving soil health and the need for all stakeholders to act on climate change, including farmers, the research community, governments, conservation bodies and businesses. The most can be achieved from the KJWA by working with partners and international agencies. It was also noted that improving soil carbon, soil health and soil fertility presents a great opportunity for realizing synergies between the UNFCCC, CBD, UNCCD and the SDGs.

48. Participants highlighted the value of and need for more research, in particular in the areas of soil carbon measurement and the assessment of co-benefits of soil carbon sequestration. At the same time, they acknowledged the challenges of properly communicating the outcomes of research and making them understandable to farmers and the general public. Knowledge-sharing was considered important by many participants and should involve farmers and indigenous communities. It was highlighted that the transfer of knowledge from research to farm often proves difficult, and thus it would be useful to co-construct new or adapted cropping systems through cooperation between researchers and farmers.

49. Many participants highlighted the role of farmers and that they must be at the centre of considerations under the KJWA, including in all discussions and decision-making. Farmers must be recognized as part of the solution and more on-farm activity is needed. Many participants noted that farmers generally have an intrinsic understanding of soil carbon dynamics but will primarily look for concrete incentives, including practices that increase soil carbon while simultaneously increasing their income and food security. It was added that it will be essential to properly communicate the benefits associated with adopting more sustainable practices, and that a rights-based and gender-responsive approach would be required.

B. The way forward

50. Participants identified an opportunity for challenges to be addressed under the KJWA by considering policies and measures and formulating policy recommendations that would help with implementing climate action in the agriculture sector and prioritizing soil carbon, soil health and soil fertility, building on existing plans such as NDCs and national adaptation plans. Several participants expressed that the KJWA could promote international cooperation and financial support, including through technology transfer and capacity-building. They added that it would be useful to identify relevant constituted bodies and financing entities

that could support implementation of activities. Some participants noted that the KJWA could provide a framework and safeguards for the GCF and other financing entities. One participant added that the GCF is currently developing an agriculture strategy, and that it would be very useful for other institutions such as the GEF and Adaptation Fund to collaborate in these efforts in order to create one single strategic framework.

51. Participants were of the view that a coordinated and consistent approach to developing quantified baselines for soil carbon and for identifying other tools and methods for improving soil management could be explored under the KJWA. Some participants added that support could be provided to countries under the KJWA, for example for creating jurisdictional baselines for soil carbon that are combined with regional emission factors to determine changes in soil carbon content.

52. Participants recognized that further research is needed, but emphasized that enough is already known about ‘no regrets’ options for improving soil carbon, soil health and soil fertility to enable actors to advance to implementing activities and catalysing action. They recognized that farmers are the agents of change for agricultural soils and can help to identify and address key challenges but require support to develop appropriate solutions and take action. Participants appreciated the existing integrated work on soils undertaken by organizations and bodies and encouraged them to do more, in particular the constituted bodies under the Convention.