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Submission by the Food and Agriculture Organization of the United Nations (FAO)
To the United Nations Framework Convention on Climate Change (UNFCCC)
In relation to the Koronivia joint work on agriculture (4/CP.23)
On Topics 2(b) and 2(c)

FAO welcomes the decision(4/CP.23) on Koronivia Joint Work on Agriculture (KJWA) and the opportunity to submit its views on the topics 2(b) – Methods and approaches for assessing adaptation, adaptation co-benefits and resilience, and 2(c) – Improved soil carbon, soil health and soil fertility under grassland and crop land as well as integrated systems, including water management. This submission builds on knowledge provided by earlier FAO submission on related topics including "Issues relating to agriculture" and the Gender Action Plan[1].

KJWA recognizes the risks and vulnerabilities of agricultural sectors and food security in a changing climate. The decision also recognizes the fundamental role of agricultural sectors in tackling climate change. In line with its mandate, FAO considers that gender-responsive adaptation, resilience and mitigation in agricultural sectors are essential to achieve its boarder objective of eliminating hunger, safeguarding food security and nutrition, reducing rural poverty, and making the agricultural sectors more productive and sustainable. Furthermore, healthy soils and sustainable water management are important for their contributions to food production, mitigation and adaptation to climate change. Yet, protection, monitoring and management of soils and water at national and global levels still face complicated challenges impeding effective on-the-ground policy design and regionally adapted solutions.

FAO is therefore committed to support countries to advance and implement KJWA, National Adaptation Plans (NAPs) as agreed upon under the Cancun Adaptation Framework, Nationally Determined Contributions (NDCs), and Enhanced Transparency Framework (ETF) under the Paris Agreement, as well as to reach long-term Sustainable Development Goals (SDGs) as part of the 2030 Agenda.

Given FAO's wealth of knowledge and technical expertise, and considering that climate change cuts across all its areas of work, FAO is underlining the importance of the topics of 2(b) and 2(c) and propose key points to be urgently addressed under these thematic areas as outlined in this submission.

2(b) Methods and approaches for assessing adaptation, adaptation co-benefits and resilience

FAO's efforts in assessing and monitoring progress on adaptation, adaptation co-benefits and resilience aim at the **acceleration and scaling up of coherent actions** to address the current and future climate threats, impacts on the agricultural sectors and to reduce vulnerability of affected people while building adaptive capacity and resilience. At the same time targets seek to achieve sustainable food systems, agricultural livelihoods, ensure food security and nutrition for most vulnerable people and countries. FAO has drawn on its multidisciplinary knowledge and experience to **propose coherent indicators framework** that can be used to effectively monitor progress towards the targets that countries have set in adaptation, adaptation co-benefits and resilience, as part of the overarching SDGs.

Need for coherent methodology and indicators in agricultural sectors

Adaptation to climate change and building resilience to the expected adverse impacts on the agricultural sectors, includes e.g. applying climate-resilient and sustainable management practices and technologies at local (community household), subnational (landscape) and supported by an enabling legal, policy and institutional environment at the national (policy) level. Large amounts of resources, both public and private, are being directed towards the purposes

of reducing vulnerability, enhancing adaptive capacity, and strengthening resilience. At the same time adaptation and resilience in agricultural sectors require a short, medium and long-term approaches. Tracking adaptation and resilience progress at local and national levels is increasingly urgent given that negative impacts of climate change continue to severely affect the livelihoods of the most vulnerable and ecosystems deteriorating to the point of no return. Furthermore, countries need to monitor and report on their progress with adaptation and resilience measures under the Paris Agreement as well as the Sendai Framework for Disaster Risk Reduction, the UN Convention to Combat Desertification (UNCCD), the Convention on Biological Diversity and the overarching 2030 Agenda.

Additionally, countries would also need to take into account possible future commitments under the UNFCCC COP24 decision[2] where it was requested to the Adaptation Committee and the Intergovernmental on Climate Change (IPCC) to prepare a technical paper on methodologies for assessing adaptation needs and their application, as well as on the related gaps, good practices, lessons learned, and guidelines, for consideration and further guidance by SBSTA 57 (November 2022). Other elements which are calling for the urgent action on the topic are upcoming global climate change deadlines such as: 2020 for countries to report on their NAPs Progress and to review NDCs ambition as well as the first 2023 Global Stocktake (Article 14 of the Paris Agreement) which will consider mitigation, adaptation and the means of implementation and support.

Financial mechanisms, including Green Climate Fund (GCF), Global Environment Facility (GEF), Adaptation Fund, Least Developed Countries Fund, as well as national climate finance must be aligned with the proposed indicators and measurement approaches to leverage action at the required scale. This would help to integrate related frameworks into the project planning and baseline indicators review as well as results assessment. FAO currently supports 69[a] countries through 76 projects, out of which five global, four regional and 67 country projects, funded by the GEF, GCF, and German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety and trust fund resources.

Challenges to measure adaptation and resilience

In accord with other agencies, international organizations and Convention Bodies under the UNFCCC, FAO recognizes the lack of agreed methods, indicators and frameworks assessing progress towards adaptation and resilience at all levels. Nevertheless countries are already advancing on their national level Monitoring and Evaluation (M&E) frameworks to measure different aspects of adaptation and resilience processes and outcomes, based on their own targets and priorities stated in their climate change adaptation strategies, policies and plans. There are key hurdles in the harmonization of methods and indicators for measuring adaptation and resilience in the agricultural sectors, namely:

a. the country-specific nature of adaptation, which is context specific and cross-sectoral;
b. the reality that existing local and national adaptation M&E systems measure different aspects of adaptation, their results are generally not directly comparable and do not lend themselves to globally standardized indicators; and
c. the evolving objectives, scopes and purposes for assessing adaptation at various levels (local, national and global).

In light of the above, it should be recognized that **globally comparable metrics to track progress towards adaptation and resilience based on country-level information still pose a considerable challenge. Universal methods and metrics for adaptation M&E might encounter hindrances in their adoption and application**, whereas existing M&E frameworks can provide insights into opportunities for aggregating and synthesizing country-level data and information. Furthermore, the extent of progress made and measures implemented at these levels often cannot fully be captured by quantitative indicators solely as numeric values do not necessarily capture progress adequately and comprehensively. **Therefore, qualitative indicators can help to provide a more complete picture of outcomes.** In

[a] Out of the supported countries, 28 are Least Developed and 41 developing and transition countries.

this regard, strengthening M&E systems between the various levels, which complements the horizontal harmonization across the global frameworks at national level, is highly important.

Existing work on methodology and indicators in agricultural sectors

FAO has developed **approaches and frameworks linked to the subject as well as coordinated with several other relevant elements, including those for SDGs monitoring**[b] (listed in the Annex 2). Furthermore, FAO according to its mandate already supports member countries to collect agricultural data on adaptation and resilience from national sources, validating and harmonizing them, estimating regional and global aggregates as part of its ongoing SDGs indicators custodianship role. For many other indicators related to ecosystems and natural resource sustainability, FAO collects data from officially approved national authorities, such as those on plant and animal genetic resources for agriculture, sustainable water withdrawals and sustainable forest management.

The monitoring process requires improved capacity to assess adaptation, adaptation co-benefits and resilience across and within the agriculture and food security sectors, as well as to assess concrete resilience measures being implemented. FAO can support a shift in the methods and approaches that reduce silos and reinforce synergies, while promoting an integrated approach to design and implementation of NAPs and NDCs that "leaves no one behind."

For example, FAO already works at the national level with countries such as Colombia, Guatemala, Kenya, Malawi, Mozambique, Nepal, Thailand, the Philippines, Uganda, Uruguay, Viet Nam and Zambia on defining M&E frameworks for adaptation in the agricultural sectors that make use, integrate and enhance existing M&E mechanisms by fostering cooperation and coordination of relevant Ministries and agencies who are the implementers of NAPs, policies and initiatives and holders of key data and information. FAO builds their capacities to align their indicators to the existing instruments and international mechanism as outlined above[c].

FAO also works under the Capacity Building Initiative for Transparency Programme[3] and the ETF to ensure country support and create a set of stand-alone tools that assist developing countries to improve their technical and institutional capacity to comply with ETF in the Agriculture Forestry and Other Land Use (AFOLU) sectors.

The way forward

FAO **proposes to develop a coherent indicator framework** to monitor progress towards the targets that countries have set in adaptation, adaptation co-benefits and resilience, as part of the overarching 2030 Agenda for Sustainable Development and the Paris Agreement. To help achieve this, Parties may wish to consider the following:

- Strengthen the coordination and engagement with the Adaptation Committee on developing supplementary guidance for voluntary use by parties, and request to develop "agriculture specific" guidance[d];
- Consider the outcomes of the in-session workshop "*identification of adaptation measures, taking into account the diversity of the agricultural systems, indigenous knowledge systems and the differences in scale as well as possible co-benefits and sharing experiences in research and development and on the ground activities, including socioeconomic, environmental and gender aspects*", as well as the submissions provided by Parties and observers[4] on this workshop;
- Enhance statistical capacity development to countries on both technical and institutional aspects related to SDG indicators and others of relevance such as SDG 1 (e.g. target 1.5) and SDG 13 for the specific KJWA;

[b] FAO is the UN custodian agency to monitor at least 25 of around 230 SDG indicators of the Goals 2, 5, 6, 12, 14 and 15. The vision is to use and apply the existing SDGs indicators for tracking adaptation and resilience progress and its adaptation co benefits.

[c] This work is supported through the FAO-UNDP Programme on "Integrating Agriculture in National Adaptation Plans" and Trust Fund FAO projects.

[d] FAO is engaging with the Adaptation Committee, the Least Developed Country Group, the Paris Committee on Capacity Building and the work of Climate Technology Centre and Network, as well as IPCC, Organization for Economic Cooperation and Development, International Fund for Agricultural Development, World Food Programme, United Nations Development Programme and many other partners in order to provide sector-specific technical inputs.

- Support integrated planning and implementation of global frameworks (NAPs, Sendai Framework, NDCs and SDGs), including a common framework for designing, measuring and tracking mitigation and adaptation/resilience progress; and
- Ensure that climate finance reflects the vital importance of mitigation, adaptation and resilience in agricultural sectors e.g. by unlocking private sector investment providing access to innovation and technologies, particularly in the least developed countries. A key element in this action should be policies, technologies, and facilitation to de-risk private sector investments and allow market-based instruments to sustainably scale up their engagement.

FAO will continue with its efforts to strengthen and facilitate the coherence and aggregation of the numerous methods and approaches used for assessing and tracking of adaptation, adaptation co-benefits and resilience for the agricultural sectors and related food security tailored to country needs and gaps while keeping additional burden of reporting to a minimum. The KJWA under topics 2(b), relying on Parties and observer organization submissions, has, therefore, the **huge potential to move forward with a coherent set of methods and indicators in view of countries** assessing, tracking and reporting measures **for the agricultural sectors and food security** to ultimately increasing ambition and action.

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

The potential and challenge of healthy soils

Soils are a major carbon reservoir containing more carbon than the atmosphere and terrestrial vegetation combined. As an indicator for soil health, a high soil organic matter (SOM) content provides nutrients to plants and improves water availability, both of which enhance soil fertility and ultimately improve food productivity. Moreover, with an optimal amount of soil organic carbon (SOC), the water filtration capacity of soils further supports the supply of clean water.

The conservation and enhancement of SOC stocks is important in all soils used for food production to maintain soil functions that ensure and improve food security. This applies to grasslands used for grazing and is especially important in drylands, which have a large spatial extent but low SOC stocks per unit per land area. With climate change and unsustainable land management, these areas are likely to become net sources of greenhouse gas (GHG) emissions. However, if managed wisely, they have the potential to sequester large amounts of carbon in their soils, thus contributing to climate change mitigation and adaptation.

Unlocking the potential of SOC constitutes a viable and affordable response to the challenges of global warming and climate change. Furthermore, investing on sustainable soil management (centered on the maintenance of current SOC stocks and further sequestration) entails multiple benefits in terms of food security and nutrition, poverty reduction, climate change adaptation and mitigation, the provision of ecosystem services and overall SDG implementation (including SDG 15).

Additionally, unsustainable soil and land management are impacting global water resources. Estimates suggest that as much as 80% of the pollution loads in waters originate from land-based activities, which also include agricultural production. Furthermore, the levels of nitrogen and phosphorous use are excessive in terms of the capacity of the earth's ecosystems to absorb them without severe, detrimental effect to ecosystem functioning and resilience and the capacity of these ecosystems to absorb carbon dioxide and assist with adaptation efforts. These contaminants, as well as changes to naturally occurring loads of nutrients and sediments, affect the most productive areas of both fresh and the marine aquatic environments leading to degradation of habitat quality with consequent effects on species abundance and diversity and loss of provisioning and climate resilience services of wetlands and coastal waters. Nutrient pollution has a direct impact on soils and clean water, and therefore should also be considered when addressing thematic area 2(e) – Improved nutrient and manure management towards sustainable and resilient agricultural systems, under the KJWA.

Current work and initiatives

Considering the importance of sustainable soil management and particularly the potential of SOC, various initiatives and organizations are working towards fostering SOC sequestration. These include the following:

- Global Soil Partnership, hosted by FAO and implementing the agenda of "Unlocking the potential of soil organic carbon[5] and promoting sustainable soil management".
- The *4 pour 1000* initiative launched by France at COP21 catalyses ambitious actions to improve soil health and fertility and GHG mitigation co-benefits;
- Land Degradation Neutrality target established by the UNCCD; and

During the Global Symposium on Soil Organic Carbon (2017) organized by the Global Soil Partnership and partners (IPCC, ITPS, UNCCD and WMO), scientists and countries agreed that the main priorities of the SOC agenda are preventing further SOC losses and, where feasible, providing incentives to increase SOC stocks. The key recommendations that have been already implemented and should be considered when addressing the thematic areas 2(c) of the KJWA are listed below (see also Annex III)

- Launch of the Global Soil Organic Carbon Map through a country-driven process;
- Capacity building on SOC mapping and management in more than 100 countries;
- Launching Guidelines for Assessment, Measuring and Modelling Soil Organic Carbon Stocks and Stock Changes in Livestock Production Systems; and
- Establishing the Soil Doctors Programme and the International Network of Black Soils.

Furthermore, FAO's work to improve nutrient use efficiency include soil and water quality protection in better agriculture management and nutrient capture through nature-based solutions. This also include participating in the global nutrient management partnership to improve global nutrient use efficiency and urban reclaimed water for irrigation.

The way forward

Through its technical work, FAO is closing the knowledge gap by improving the understanding of the costs, benefits, trade-offs and synergies related to soil health and fertility and water management. FAO proposes to capitalize on the expertise and knowledge captured under the various initiatives. To raise awareness of the SOC potentials in relation to climate change and to help advancing the KJWA, Parties may wish to address the following aspects during the upcoming in-session workshop:

- Establishing a Global SOC Monitoring System based on a feasible and contextualized Guidelines for measuring, mapping, monitoring and reporting on soil organic carbon. The Global Soil Organic Carbon Map could be used as the preliminary assessment for further in-depth stock take;
- Establishing an operational facility (RECSOIL) for materializing the soil component of the KJWA. The tool aims to scale up concrete actions at policy level and especially on the ground for maintaining SOC stocks and sequestering SOC where feasible under the framework of the Voluntary Guidelines for Sustainable Soil Management;
- Contributing to the generation of updated information on carbon sequestration in different regions and countries through the development of the global assessment of soil organic carbon sequestration potential (GSOCseq);
- Facilitating country-to-country knowledge exchange and capacity development for implementing sustainable soil and water management at the national and local levels. This may include, implementation of integrated systems in the agricultural sectors to improve soil health and soil fertility, as well as water availability and quality such as integrated crop-livestock, rice-fish, food-energy, integrated watershed management, and agroforestry systems;
- Convening the Water Scarcity for Agriculture platform in sustainable agriculture water use, drought preparedness, saline agriculture, and wastewater nutrient recovery and reuse for irrigated agriculture;
- Accessing to research, analysis and tools of sustainable soil and water management that respond to the adaptation and mitigation needs of countries; and
- Facilitating access to finance and investment in sustainable soil and water management (centered on the maintenance of current SOC stocks and further sequestration) to help achieve multiple benefits in terms of food

security and nutrition, poverty reduction, climate change adaptation and mitigation, the provision of ecosystem services and overall sustainable development.

Conclusions

FAO is taking a leading role in advocating for food security and sustainable agriculture in the face of climate change and it offers support to countries seeking to undertake climate action in sustainable soil and water management, assessment of adaptation, adaptation co benefits and resilience, as well as the other thematic areas of the KJWA.

FAO will continue to support countries and promote the development of an coherent set of approaches for assessing, tracking and measuring indicators, and addressing synergies of agriculture adaptation, adaptation co-benefits and resilience altogether. Furthermore, through the Global Soil Partnership, FAO will raise awareness, generate knowledge and strengthen capacities of countries in relation to the SOC potentials for addressing climate change and food security, including the establishment and implementation of RECSOIL.

In line with its *Climate Change Strategy*, FAO is providing the following support to countries in the agricultural sectors:

- Coherent and enabling policy, legal and institutional frameworks for climate action;
- Research, analysis and tools that respond to the needs of countries;
- Knowledge sharing and capacity development for implementation and action;
- Access to finance to scale up climate investment; and
- Support in monitoring and reporting progress in climate action.

FAO will continue to provide this support and looks forward to working in partnership with other actors in the climate and development fields to advance the implementation of the KJWA, in a coherent way, towards 2020 and beyond.

Annex I: Definitions used by FAO in the submission

Adaptation assessment	The practice of identifying options to adapt to climate change and evaluating them in terms of criteria such as availability, benefits, costs, effectiveness, efficiency, and feasibility[6].
Adaptation co-benefits	The environmental, social and economic co-benefits of adaptation in the agriculture sectors are generated through a complex web of context-specific feedbacks, synergies and tradeoffs. Around one-third of all countries, and almost half of Least Developed Countries (LDCs), refer to significant environmental and socio-economic co-benefits from climate actions in the agriculture sectors in their NDCs, including conservation of ecosystems and biodiversity, climate change mitigation, rural development and health, poverty reduction and job creation and improving gender equality, amongst others[7]. Sustainable food and agriculture systems carry the greatest potential for generating synergies between adaptation efforts and enhancing adaptation co-benefits. Addressing the root causes of risks, increasing the resilience of livelihoods and food systems to lessen the impacts of natural and man-made disasters and enhancing adaptive capacity can also introduce co-benefits for climate change mitigation.
Adaptation	The process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects[8].
Agriculture or the **agricultural sectors**	Agriculture or the agricultural sectors, when used by FAO, comprises the sub-sectors of crops, livestock, fisheries and aquaculture and forestry. The terms agriculture or the agricultural sector in the UNFCCC domain are defined in accordance with IPCC terminology and cover emissions from enteric fermentation, manure management, rice cultivation, prescribed burning of savannas and grassland, and from soils (i.e. agricultural emissions). Emissions and removals from grassland and cropland are covered under LULUCF (Land Use Land Use Change and Forestry). In the IPCC 2006, the two sectors (i.e. agriculture and LULUCF) are treated together in the AFOLU sector.
Food security	Food security exists when all people, at all times, have physical and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life. Four main dimensions of food security are identified: food availability, food access, utilization and stability[9].
Resilience	The ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a hazardous event in a timely and efficient manner, including through ensuring the preservation, restoration, or improvement of its essential basic structures and functions[10]. The notion of *Climate Resilience* is linked to the capacities of a system to anticipate, absorb and reshape ahead of climate risks.

Annex II: A stock take of existing metrics, methodologies and indicators

Concepts, frameworks, methods and indicators to measure adaptation, adaptation co-benefits and resilience developed by FAO.

Conceptual frameworks	
Tracking Adaptation in Agricultural Sectors (TAAS) [11]	TAAS includes qualitative and quantitative indicators for four different categories, which also include some elements of adaptation co-benefits and resilience: 1. Natural Resources and Ecosystems Category: a. Availability of and access to water resources for the agriculture sector, through water accounting of both surface and groundwater, using a landscape management approach Availability and access to quality agricultural land and forest. b. Status of ecosystems and their functioning. c. Tracking and assessment of SDG indicators (6.4, 14.4.1 and 15.1). 2. Agricultural Production System Category: a. Agricultural production and productivity. b. Sustainable management of agricultural production systems. c. Impact of extreme weather and climate events on agricultural production and livelihoods. d. Projected impact of climate change on crops, livestock, fisheries, aquaculture and forestry. e. Status of diversity of genetic resources in agriculture monitored through existing platforms, such as World Information and Early Warning System on Plant Genetic Resources for Food and Agriculture and Domestic Animal Diversity Information System. f. Tracking and assessment of SDG indicators (2.3, 2.4.1, 2.5.1, 2.5.2 and 12.3.1). 3. Socio-economics Category: a. Vulnerability towards food insecurity and nutrition. b. Access to basic and financial services, credit, insurance and social protection in rural areas. c. Agricultural value addition, income and livelihood diversification. d. Resilience and exposure of the poor and those in vulnerable situations. e. Assessment of SDG indicators (2.1, 2.c.1 and 5.a.1). 4. Institutions and Policy Making Category: a. Institutional and technical support services. b. Institutional capacity and stakeholder awareness. c. Development of cross-sectoral and multi-stakeholder platforms for adaptation. d. Mainstreaming of climate change adaptation priorities in agricultural policies and vice versa. e. Financing for adaptation and risk management. f. Assessment of SDG indicators (2.a.1 and 14.6.1).
Strengthening M&E for adaptation planning in the agriculture sectors[12]	This Technical Guidance Note focuses on how adaptation can be integrated into existing agriculture sectors M&E frameworks, whilst recognizing the importance of considering how agriculture sectors themselves can be integrated into national adaptation M&E frameworks, where these exist. The document provides an overview of the potential steps needed in designing an adaptation M&E framework and plan for the agriculture sectors. It is accompanied by a Training Package composed of several modules, presentations, exercises and case studies to be delivered during a three- to four-day workshop.
Cost-benefit analysis for climate change adaptation policies and investments in the agriculture sectors[13]	This briefing note illustrates the role and logic of Cost-Benefit Analysis (CBA) in the evaluation of climate change adaptation policies and projects in the agriculture sectors and describes the main analytical steps for conducting it, providing practical examples. The note describes the standard CBA methodology but highlights the peculiarities related to its implementation in the context of climate change adaptation in the agriculture sectors.
Impact evaluation to improve policymaking for climate change adaptation in the agriculture sectors[14]	This briefing note provides an overview of Impact Evaluation (IE) tools that programme managers and policymakers can use to address key elements of the NAPs. It is intended for stakeholders involved in the formulation and implementation of NAPs and technical staff in ministries of agriculture, forestry, fisheries and the environment. By institutionalizing the capacity to use IE methods, governments can promote a shift towards evidence-based policymaking.
Tools and methodologies for assessing mitigation co-benefits in line with IPCC Guidelines for the AFOLU sector	
Estimating Greenhouse Gas Emissions in Agriculture. A Manual to address Data Requirements for Developing Countries[15]	Countries report their greenhouse gas (GHG) emissions and removals from all sectors via national GHG Inventories, submitted to the United Nations Framework Convention on Climate Change (UNFCCC) in accordance with international climate policy agreements and technical guidelines developed by the Intergovernmental Panel on Climate Change (IPCC). The manual provides countries with a tool and methodology to help identify, build and access he minimum set of activity data needed for GHG estimation in agriculture sector.

National greenhouse gas inventory for agriculture (e-learning course)[16]	The free online course provides knowledge to build a sustainable national GHG inventory and to assess emissions from the agriculture sectors. It offers not only an overview of the processes behind the production of GHG emissions from agriculture-related activities, but also comprehensive guidance for calculating GHG emissions using the IPCC default method and emissions factors (Tier 1).
National greenhouse gas inventory for land use (e-learning course)[17]	The free online course provides the necessary knowledge to build a sustainable National Greenhouse Gas Inventory and assess GHG emissions and removals from the land use sector. It focuses on the biological and physical process that lead to GHG fluxes from land use-related activities.
Ex-Ante Carbon-balance Tool (EX-ACT)[18]	EX-ACT is a land-based accounting system, estimating carbon stock changes (i.e. emissions or sinks of CO_2) as well as GHG emissions per unit of land, expressed in equivalent tonnes of CO_2 per hectare and year. The tool helps countries and project designers to estimate and prioritize project activities with high benefits in economic and climate change mitigation terms.
Tools and methodologies for assessing other socio-economic and environmental co-benefits	
Global Livestock Environmental Assessment Model (GLEAM)[19]	GLEAM is a GIS framework for life-cycle assessment of natural resource use and environmental impacts associated with livestock value chain and for identifying environmental impacts of livestock in order to contribute to the assessment of adaptation and mitigation scenarios to move towards a more sustainable livestock sector.
Global Forest Resources Assessment (FRA)[20]	FRA provides remote sensing data for assessing the extent of forest resources, their condition, management and uses, as well as tracking and reporting SDG 15 - Life on Land (targets 15.1 and 15.2). The data and knowledge can be used to draw recommendations for governments, civil society and the private sector.
Collect Earth[21]	Collect Earth is a free and open source application for land monitoring. By customizing the inputs of Collect Earth, such as the data collection form, sampling design and plot size, users can easily configure Collect Earth to address specific monitoring purposes, such as landscape restoration, reporting for REDD+, national forest inventories, disaster assessments and humanitarian work, livestock and rangeland management, etc. with a multi-temporal and multi-scale approach.
Assessing Climate-Smart Agriculture practices	
CSA Sourcebook[22]	The Climate-Smart Agriculture Sourcebook presents a wide range of knowledge and expertise on the concept of Climate-Smart Agriculture, includes a module on assessment, monitoring and evaluation.
DaTUM report	The forthcoming *"DaTUM report A Literature Review of M&E Frameworks for Agriculture and Climate Change"* report, that reviews and summarizes the M&E frameworks, tools and guidance documents that are available for Climate-Smart Agriculture, and in particular for pillar two on adaptation and resilience.
Operational Guidelines for the Design of M&E systems for CSA	Forthcoming guidelines based on expertise and input provided by stakeholders across all sectors on M&E for CSA. The guidelines will provide recommendations for actions to be taken at the government and project-level to design effective M&E systems for CSA that also account for international monitoring and reporting obligations under the UNFCCC and SDGs in order to alleviate reporting burden on countries.
Climate Smart Agriculture and the SDGs	A forthcoming report that will highlight the potential of the CSA approach to create synergies between SDGs and to advance the 2030 Agenda. Several SDG targets and indicators relate to climate change, agricultural production and food security. CSA can play an important role in addressing challenges due to its wide reach across three pillars and is well suited to support the achievement of relevant SDGs.
Climate resilience	
State of Food Security and Nutrition in the World (SOFI) 2018[23]	To enhance, monitor and assess converging interventions on Disaster risk reduction (DRR), Climate Change Adaptation (CCA) and Climate Disaster Emergency response for "climate resilience" see chapter 2.4 of SOFI 2018 report on climate resilience, thus addressing climate risk in the agricultural sector.
Multi-risk, multi-sector, context, and hazard specific tools used by FAO.	**1. Climate risk assessments, monitoring and early warning systems**: a. Global, regional and national climate risk vulnerability mapping and risk monitoring and early warning systems b. Development of methodologies and tools for improved climate assessments, with focus on rangelands and pastoralists, forests and forest dependent people, as well as fishing and fish farming communities c. Provision with the Global Information and Early Warning System on Food and Agriculture. FAO monitors the condition of major food-crops across the globe to assess production prospects and assesses he stand of soil, biodiversity and land use changes. **2. Climate risk and disaster governance:** a. Strengthening of the inclusion of immediate and long-term agriculture, food security and nutrition considerations into climate policies, legislation and the larger enabling environment for climate risk governance. b. Mainstreaming of climate risk considerations into national agriculture, food security and nutrition policies, strategies and plans and vice versa (including on sustainable development and investment plans for agriculture sector at large –crop, livestock, forestry, fisheries, aquaculture and natural resources such as water and soil)[24]

	c. Supporting enabling policy frameworks for the implementation of climate-smart agriculture and effective food security policies d. Strengthening institutions to manage effectively multiple hazards and risks e. Developing methodologies and tools to foster adaptation best practices and natural resources adaptive management **3. Vulnerability reduction measures** a. Promote climate-smart agricultural practices, innovation and technologies that maintain healthy soils and manage water efficiently, such as conservation agriculture, and adapted varieties or breeds for the sustainable intensification of agricultural production Provide information assisting decision making for improved agricultural production practices and natural resource use (Crop Calendar, Hortivar, Aquastat, etc.) b. Support climate-proofed infrastructures (climate risk sensitive grey infrastructures) c. Support nature-based solutions (green and blue infrastructures) for ecosystem DRR and Adaptation, also through protecting and restoring inland and coastal wetlands d. Agricultural value addition on the food chain, focusing on agricultural diversification, income and livelihood diversification e. Promoting sustainable forest management and integrated landscape approaches to increase resilience of forests and forest dependent people to climate change f. Support conservation and utilization of genetic resources to provide solutions for adapting agricultural production to the impacts of climate change and maintain access over time and in post-disaster situations. g. Vertical/horizontal expansion of social protection programmes (including cash) and insurance schemes for vulnerable small scale farmers. **4. Effective emergency preparedness and response to climate extreme events** a. Measures include contingency planning, establishment of multi-sectoral and sectoral emergency humanitarian coordination mechanisms, allocation of food, feed and forages, provision of seed and other productive inputs; strategic reserves for seed and fodder, establishment of safe storage facilities for seeds. Harvest and feed, livestock shelters and safe and hygienic food preparation facilities. b. Early Warning / Early Action system, and needs assessments targeted to specific sectors (SSA for seed security; post-disaster needs assessment). c. SAFE- Safe Access to Fuel and Energy in post disaster situations. d. Facilitating risk transfers mechanisms, implementation of forecast-based financing mechanisms and shock-responsive social protection schemes (including cash).
Tracking progress on climate resilience for agriculture and food systems at national, subnational and local levels	The study analyses concrete existing indicators relevant for agriculture and food systems in line with the main categories of interventions, from 125 policy frameworks, initiatives/ programmes and academic studies. It highlighted various limitations & gaps and recommendations: 1. Conducted within the context of the UN Climate Resilience Initiative (A2R) and its three essential capacities for climate resilience (Anticipate, Absorb and Reshape) in early 2019, recommends to track progress on the implementation of a set of concrete interventions or measures for achieving climate resilience across sectors and in particular for the agriculture and food systems. 2. Outlines a comprehensive set of existing core indicators, which are linked to those national and global indicators that countries have obligations to report on, including the e.g. SDGs, Sendai Framework for DRR and Paris Agreement and recommends the use of existing indicators as much as possible. 3. Recommends that qualifiers are added to improve existing indicators to support the assessment of progress on climate resilient agriculture & food systems at all levels, therefore capturing actions from production to consumption (system approach). 4. Proposes additional qualifiers to existing local, sub-national and national indicators: a) Ensure coverage of agriculture and food system specific aspects b) Captures different types of interventions to enhance the climate resilience of agriculture and food systems (people, farm, landscape, institution, etc.)
Resilience Index Measurement and Analysis (RIMA)[25]	The resilience tool provides a framework for understanding the most effective combination of short and long term strategies for lifting families out of cycles of poverty and hunger. By using this quantitative approach, decision makers can objectively target their actions and measure their results over time.
Self-evaluation and Holistic Assessment of climate Resilience of farmers and Pastoralists (SHARP)[26]	A tool is designed as an instrument to assess the resilience of farmer and pastoralist households to climate change. Following a survey-based evaluation of households' climate resilience (Phase 1), gaps and weaknesses in the response of farmers and institutions to climate variability are analysed (Phase 2). Finally, information gathered through the first two phases is integrated with broader-level climatic data, with the aim of assisting farmers in prioritising actions to build the resilience of their agro-ecosystems – as well as orienting institutions towards the best possible policy approaches in order to strengthen climate resilience (Phase 3).

Annex III: Existing knowledge materials for soil and water management

	Status
Global Soil Organic Carbon Map (GSOCMap)[27]	The GSOCmap provides users with very useful information to monitor the soil condition, identify degraded areas, set restoration targets, explore SOC sequestration potentials, support the greenhouse gas emission reporting under the UNFCCC and make evidence based decisions to mitigate and adapt to a changing climate.
Guidelines for measuring, mapping, monitoring and reporting on SOC	The forthcoming guidelines will compile strategies to develop feasible and regionally contextualized methods for measuring, mapping, monitoring and reporting on SOC that can be adapted locally to monitor SOC stocks and stock changes to support management decisions.
Guidelines for Assessment, Measuring and Modelling Soil Organic Carbon Stocks and Stock Changes in Livestock Production Systems[28]	The guidelines aim to give a harmonized, international approach for estimating soil organic carbon (SOC) stock and stock changes in livestock production systems. Despite the attention given to SOC, current knowledge remains fairly limited regarding SOC baselines and changes, the detection of vulnerable hot spots for SOC losses and opportunities for SOC gains under both climate and land management changes.
International Network of Black Soils[29]	The network provides a platform for knowledge sharing and technical cooperation on Black Soil Management among countries, and to comprehend the status and productivity in black soils.
Global Soil Laboratory Network[30]	The Global Soil Laboratory Network facilitates the sharing of experience among laboratory managers. Regional networks have been established in Latin America and South East Asia.
International Code of Conduct for the Use and Management of Fertilizers[31]	The conduct will support stakeholders to advance the efficient and effective use of fertilizers. It is expected that the Conduct will be endorsed by FAO Conference in June 2019
International Code of Conduct on Pesticide Management[32]	The main objective of the Conduct is to maximize the benefits of pesticides to effectively control pests in public health and agriculture, while protecting human and animal health and the environment (including water and soil) from their harmful effects.
Soil Doctors Programme[33]	The programme educates farmers on soil science principles for practices of sustainable soil management by providing them with a set of tools for preliminary soil analysis.
Guidelines for the safe use of wastewater, excreta and greywater[34]	The *Guidelines* reflect a strong focus on disease prevention and public health principles. It responds to a growing demand from countries for guidance on the safe use of wastewater, excreta and greywater in agriculture and aquaculture. Its target audience includes environmental and public health scientists, engineers, policy-makers responsible for developing standards and regulations.
Wealth of Waste: the economics of wastewater use in agriculture [35]	The report addresses the economic and financial issues and the methodology and procedures involved in the analysis of water recycling projects as part of a comprehensive water planning process. The report has a strong focus on success factors in reuse projects from Case Studies in Spain and Mexico.
Global Framework on Water Scarcity in Agriculture (WASAG)[36]	WASAG brings together key players across the globe and sectors to tackle the challenge of using water better in agriculture to ensure food security for all. It is an initiative for partners from all fields and backgrounds to collaborate in supporting countries and stakeholders in their commitments and plans related to the 2030 Agenda and the Paris Climate Agreement.
Nature-Based Solutions for agricultural water management and food security[37]	The paper evaluated twenty-one Nature-Based Solutions case studies using a non-representative sample, to learn from successful and failed experiences and to identify possible causalities among factors that characterize the implementation of NBS. The case studies give a minor role to valuation of ecosystem services, an area for which the literature is still developing guidance.
Water Productivity through Open access of Remotely sensed derived data (WaPOR)[38]	WaPOR provides a solid and validated pixel based methodological framework to assess and monitor land and, more specifically, water productivity. The methodological framework offers service-providers to assist farmers in obtaining more reliable yields and improving their livelihoods; irrigation authorities- access to information to modernize their irrigation schemes; and government agencies-using the information to promote and increase the efficient use of their natural resources.
AQUASTAT[39]	AQUASTAT is the FAO global information system on water resources and agricultural water management. It collects, analyses and provides free access to over 180 variables and indicators by country from 1960.
Land Degradation Assessment in Dryland[40]	LADA is a scientifically-based approach to assessing and mapping land degradation at different spatial scales – small to large – and at various levels – local to global. LADA's main objective is to identify and understand the causes of land degradation and the impacts of land use, in order to enable adequate and sustainable land management solutions to be devised.
World Overview of Conservation Approaches and Technologies[41]	WOCAT is a global network on Sustainable Land Management (SLM) that promotes the documentation, sharing and use of knowledge to support adaptation, innovation and decision-making in SLM.

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