Food and Agriculture Organization of the United Nations

# RECARBONIZATION OF GLOBAL SOILS

## A TOOL TO SUPPORT THE IMPLEMENTATION OF THE KORONIVIA JOINT WORK ON AGRICULTURE

GLOBAL SOIL PARTNERSHIP

## SOIL: OUR HIDDEN ALLY!

As part of the natural functions and ecosystem services provided by soils, a healthy soil stores more carbon than that stored in the atmosphere and vegetation (Ciais *et al.*, 2013) combined (Figure 1a). Based on soil organic matter's stabilization mechanisms (i.e., physical, chemical, biochemical, microbial and ecological), **soil carbon can remain sequestered in the soil for thousands of years** (Stockmann *et al.*, 2013; Wiesmeier, 2019).

However, the world's cultivated soils have lost between 25 to 75 percent of their original carbon stock (Lal, 2018, 2004; Lorenz and Lal, 2018), which has been released into the atmosphere in the form of $CO_2$, mainly due to unsustainable management practices resulting in land degradation and amplifying climate change and its impacts. **Land degradation lowers a soil's ability to maintain and store carbon, contributing to global threats such as climate change, with an estimated cost of trillions of dollars every year** (Davies, 2017).

The implementation of proven soil organic carbon (SOC)-centred sustainable soil management (SSM) practices for maintaining carbon rich soils (peatlands, black soils, permafrost, etc.) and for sequestering more carbon in soils with such potential (croplands and degraded soils) would address the challenge of compensating global greenhouse gas (GHG) emissions (Figure 2).

SOC-centred SSM practices not only mitigate GHGs emissions but also provide multiple benefits such as enhancing food security and farm income, reducing poverty and malnutrition, providing essential ecosystem services (climate and hydrological regulation, biodiversity maintenance, and nutrient cycling, among others), contributing to the achievement of the Sustainable Development Goals (SDGs) and building resilience to extreme climatic events (Figure 3).

## GLOBAL GREENHOUSE GASES EMISSIONS: A RACE AGAINST TIME

Nationally determined contributions (NDCs) are the backbone of the Paris Agreement, with the main goal to limit warming to 1.5 to 2 °C above pre-industrial levels. NDCs reflect countries' climate change adaptation and mitigation priorities for the post-2020 period, including concrete targets and actions. In 2016, the Food and Agriculture Organization of the United Nations (FAO) analysed the Intended NDCs (INDCs) and found promising mitigation potential from the agriculture sectors for climate change adaptation and mitigation (FAO, 2016), considering all levels of socio-economic development and all regions (86 percent of developing, 88 percent in transition and 98 percent developed countries include agriculture and/or LULUCF in their mitigation contributions).

In contrast, according to the Intergovernmental Panel on Climate Change (IPCC) Special Report (IPCC, 2018) and the Emissions Gap Report by UN Environment (UNEP, 2018), current commitments expressed in the NDCs are inadequate to bridge the emissions gap in 2030. They affirm that it is still technically possible to bridge the gap to ensure global warming stays below the established levels, but if NDCs ambitions are not increased before 2030, exceeding the 1.5 °C goal will be unavoidable. On the other hand, global $CO_2$ emissions from energy and industry increased by 0.7 Gt $CO_2$e from 2016 to 2017, following a three years period of stabilization. The result of this increase produced a record total emission of 53 Gt $CO_2$e in 2017 (Figure 1a). The report also highlights that global GHGs emissions in 2030 should be approximately 25-55 percent lower than in 2017 to put the world on a least-cost way to limiting global warming below the established levels.

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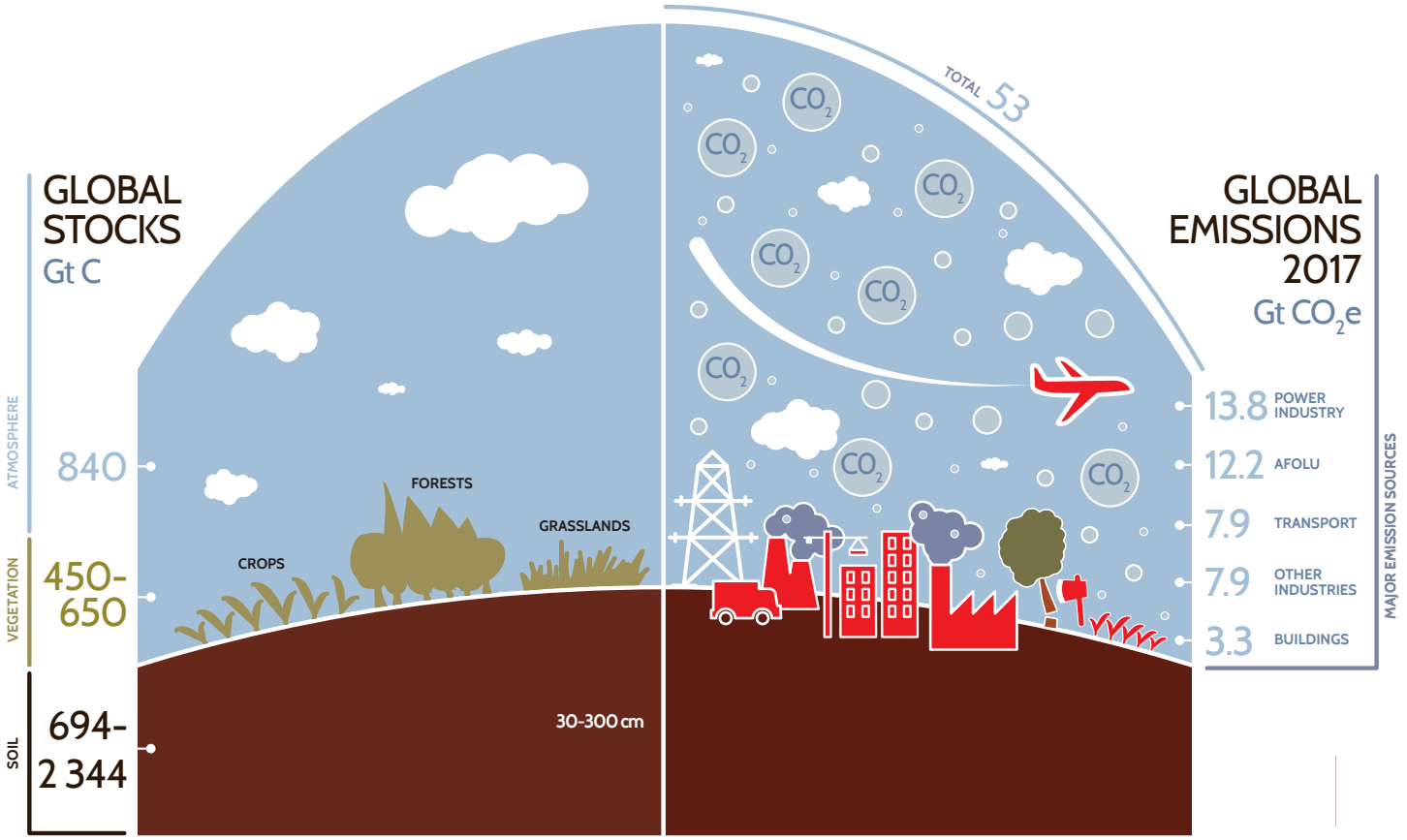



**Figure 1a.** Global carbon stocks and global emissions. Gt = gigatonne = $10^{15}$ g C = 1 petagram = billion tonnes. 1 Gt = 3.664 Gt $CO_2$

## THE CHALLENGE TODAY

After the publication of the Status of the World's Soil Resources report (FAO and ITPS, 2015), in which it is concluded that SOC loss is the second largest global threat to soil functions, the Global Soil Partnership (GSP) has been actively working towards measuring, monitoring, managing, maintaining and/or increasing SOC stocks, keeping in mind the threats of global warming and food insecurity.

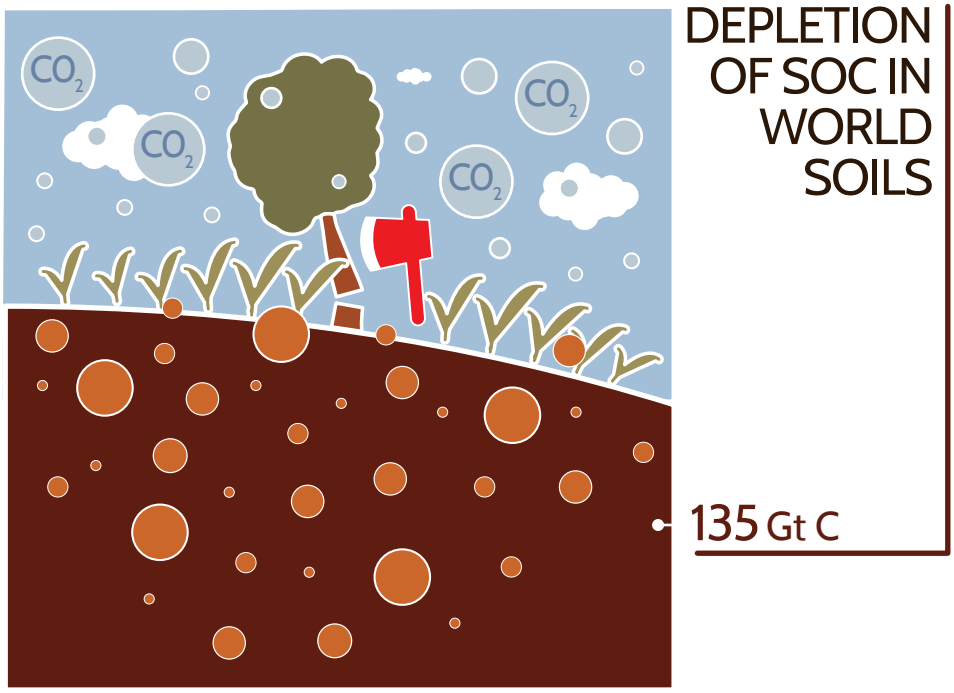
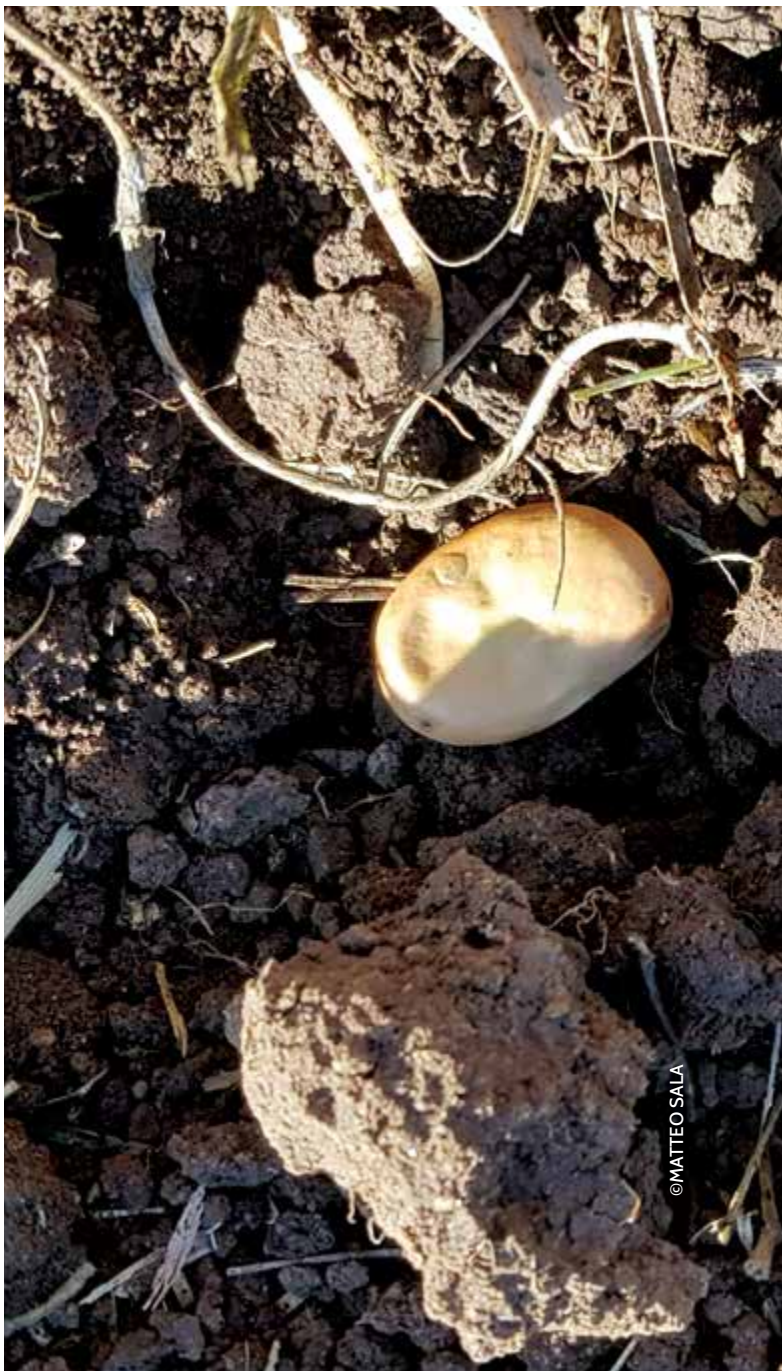



**Figure 1b.** Global historical soil organic carbon depletion since the nineteenth century.

It is well known that SOC is the main indicator of soil health, and is responsible for many soil functions, providing many ecosystem services, and constituting the largest terrestrial carbon pool. SOC therefore plays a crucial role in the global carbon balance by regulating dynamic biogeochemical processes and the exchange of GHGs. It is estimated that we have released considerable amounts of $CO_2$ into the atmosphere caused by land use change and unsustainable agricultural practices, translated into historical SOC depletion of 115-154 (average of 135 Gt C) (Lal, 2018) (Figure 1b). For this reason, **we must take advantage of the vast existing knowledge about SOC and the soil's inherent capacity to sequester carbon and mitigate $CO_2$ emissions**.

It is estimated that the global technical potential of SOC sequestration is of 1.45-3.44 Gt C (5.3-12.6 Gt $CO_2$) per year (Lal, 2018). This represents between 38-91 percent of the global power industry fossil emissions, 67-100 percent of the global transport fossil emissions (Muntean *et al.*, 2018), and 9-23 percent of the global total emissions (53 Gt $CO_2$) from all sectors in 2017 (UNEP, 2018).

**Climate change constitutes a serious global threat, which requires immediate action from all relevant stakeholders, especially from the main GHGs emitters.** The main challenge remains in identifying cost-effective options for climate change mitigation and for enhancing adaptation to climate change. Maintaining existing SOC stocks and enhancing SOC sequestration through SSM practices (Figure 2), constitutes a feasible solution to offset global emissions while providing a vast set of multiple benefits for the environment, people and the economy.



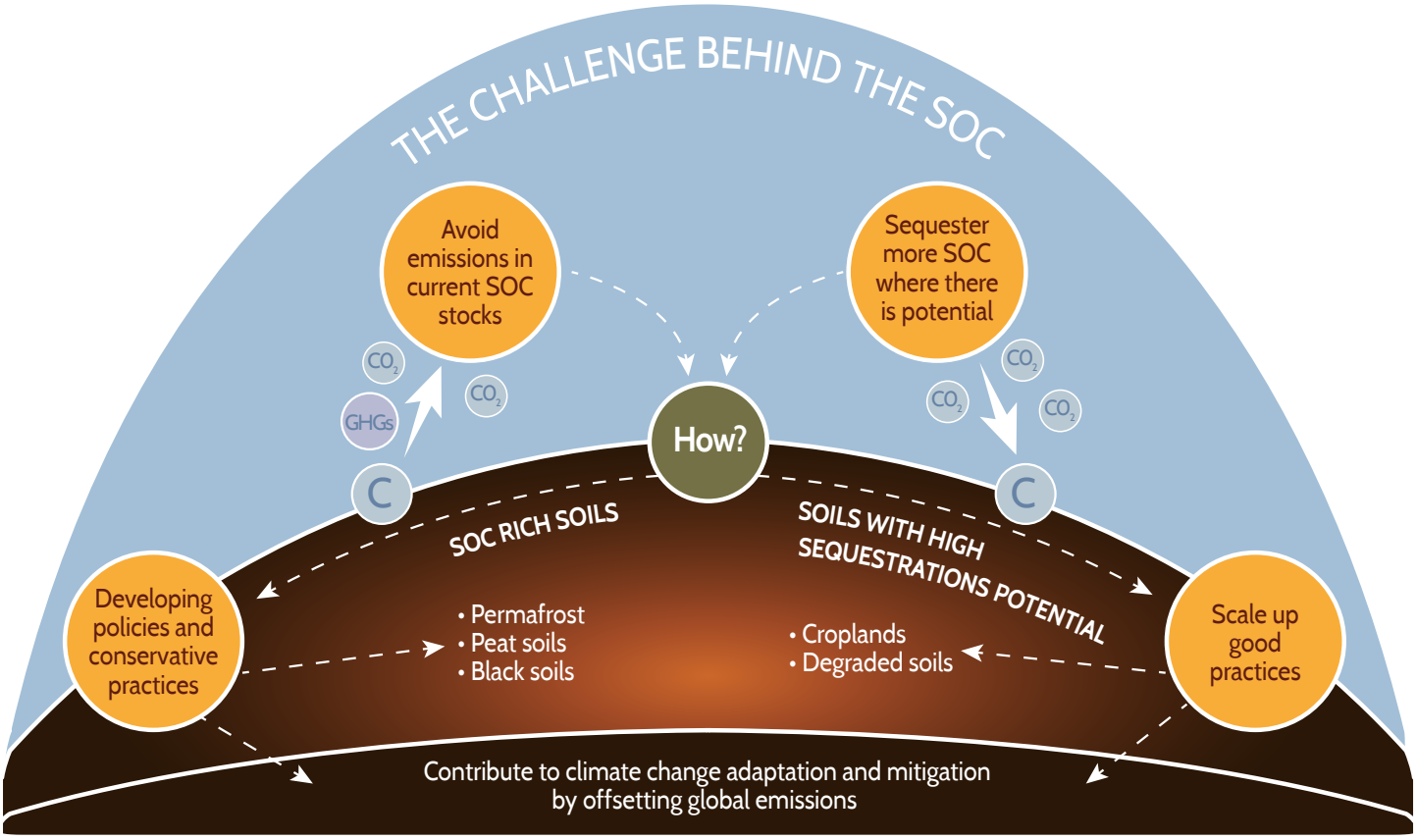



**Figure 2.** The challenge behind SOC and SOC-centred sustainable soil management practices.

## LET US PUT ACTIONS AND SOLUTIONS ON THE GROUND!

The 23rd Conference of the Parties (COP 23) to the United Nations Framework Convention on Climate Change (UNFCCC) marked a milestone for negotiations on agriculture, by establishing the Koronivia Joint Work on Agriculture (KJWA). The decision requests the Subsidiary Body for Implementation (SBI) and the Subsidiary Body for Scientific and Technological Advance (SBSTA) to jointly address topics related to agriculture and its linkages to climate change and food security. This decision was the first substantive outcome and COP decision in the history of the agenda item on agriculture that has been under negotiation since 2011. It was also the first time that soils were included as a key topic on agriculture under the UNFCCC framework through the following action: "Improved soil carbon, soil health and soil fertility under grassland and cropland as well as integrated systems, including water management".

As stated by FAO Climate and Environment Division, it is expected that the country-driven NDC implementation and action processes could be an integral part of KJWA discussions by emphasizing not only the needs, but also the gaps and opportunities that exist within the agriculture sector. This means that KJWA could lead to more committed adaptation and mitigation contributions at the national level in 2020, when Parties will be submitting their next NDCs (FAO, 2018).

Considering the inherent capacity of soils to store carbon and the existent gap in one third of the world's soils for sequestering SOC (FAO and ITPS, 2015), the KJWA provides us with the framework for implementing actions on the ground. There is vast scientific evidence that affirm that maintaining current SOC stocks and fostering SOC sequestration where potential exists, could greatly contribute to mitigating the impacts of climate change. However, **SSM happens on the ground, which calls for an increase in soils investments and for concrete actions at the field level to unlock the potential of SOC.** Recently, the IPCC published a Special Report on Climate Change and Land (IPCC, 2019), highlighting that increased **SOC content is one of the most cost-effective options for climate change adaptation and mitigation, and to combat desertification, land degradation and food insecurity**.

Now more than ever, countries and regions from the whole world need to make urgent commitments and take concrete actions at different levels to fight against global warming and all associated risks to human well-being and the environment.

**It is a race against time and soils can be our ally!**

## SOIL ORGANIC CARBON-CENTERED SUSTAINABLE SOIL MANAGEMENT – AN AFFORDABLE SOLUTION

While the soil's capacity to sequester carbon is very variable in space and time (Paustian *et al.*, 2016; Wiesmeier *et al.*, 2019), one aspect that all soils have in common is the emission of SOC stocks due to unsustainable management practices. Avoiding SOC loss, through SSM, is therefore crucial, and is often the easiest option. SOC sequestration is usually a medium-term process and total carbon gains by SSM practices can only be detected after some years (from one to 20 years depending on the organic matter fraction measured and soil type). The speed of SOC sequestration greatly depends on local climate conditions, land cover/land use, soil type and adoption of SOC-centered SSM practices, as well as their scale of implementation through various incentives. Extensive research has shown that SSM practices can enhance SOC stocks in agricultural soils (See Box 1) with practices including minimum and zero tillage, mulching, cover cropping, crop diversification, agroecology, addition of organic matter and manures, soil fertility management, agroforestry, rotational grazing, and control of soil erosion by water and wind.

The loss of soil carbon stock can be curbed through sustainable farming, while taking advantage of the soil's enormous storage capacity. **More importantly, sustainable farming practices have multiple benefits for the environment, producers and consumers.** Furthermore, investing in SSM (centered on the maintenance of current SOC stocks and further sequestration) entails multiple benefits in terms of food security and nutrition, poverty reduction, provision of ecosystem services and sustainable development (Figure 3). It is also interesting to note that this leads to many co-benefits and synergies and that no adverse side effects are associated with increasing SOC stocks.

Indeed, SOC-centered SSM practices can effectively store more carbon in the soil over the short to medium term, thus improving food production and livelihoods, and contributing to the achievement of the Sustainable Development Goals (SDGs) by 2030 (Figure 3).

### BOX 1. EVIDENCE FROM HONDURAS

The Quesungual system involves an integration of cropping and the preservation of trees, shrubs and grasses (agroforestry); maintenance of vegetation cover, as well as clearance of vegetation by hand instead of by fire; incorporation of organic matter into the soils, and minimum soil tillage. As a result of adopting these sustainable soil management practices, yields almost doubled and soil organic matter content increased from 2 to 3.3 percent over 20 years (FAO, 2005, 2015). This is equivalent of an increase from 15 to 25 tonnes of carbon per hectare in the first 10 cm of the soil (assuming a bulk density of 1.3 g per $cm^3$).

Overall, soil health and management were improved through this new low-cost system, which replaced the previous unsustainable form of slash and burn agriculture. Simultaneously, soil moisture increased by 20 percent and resistance towards erosion and landslides was improved, thus enhancing resilience of the rural communities against extreme weather events such as droughts and intense rainfall, which are expected to become more frequent as a consequence of climate change.

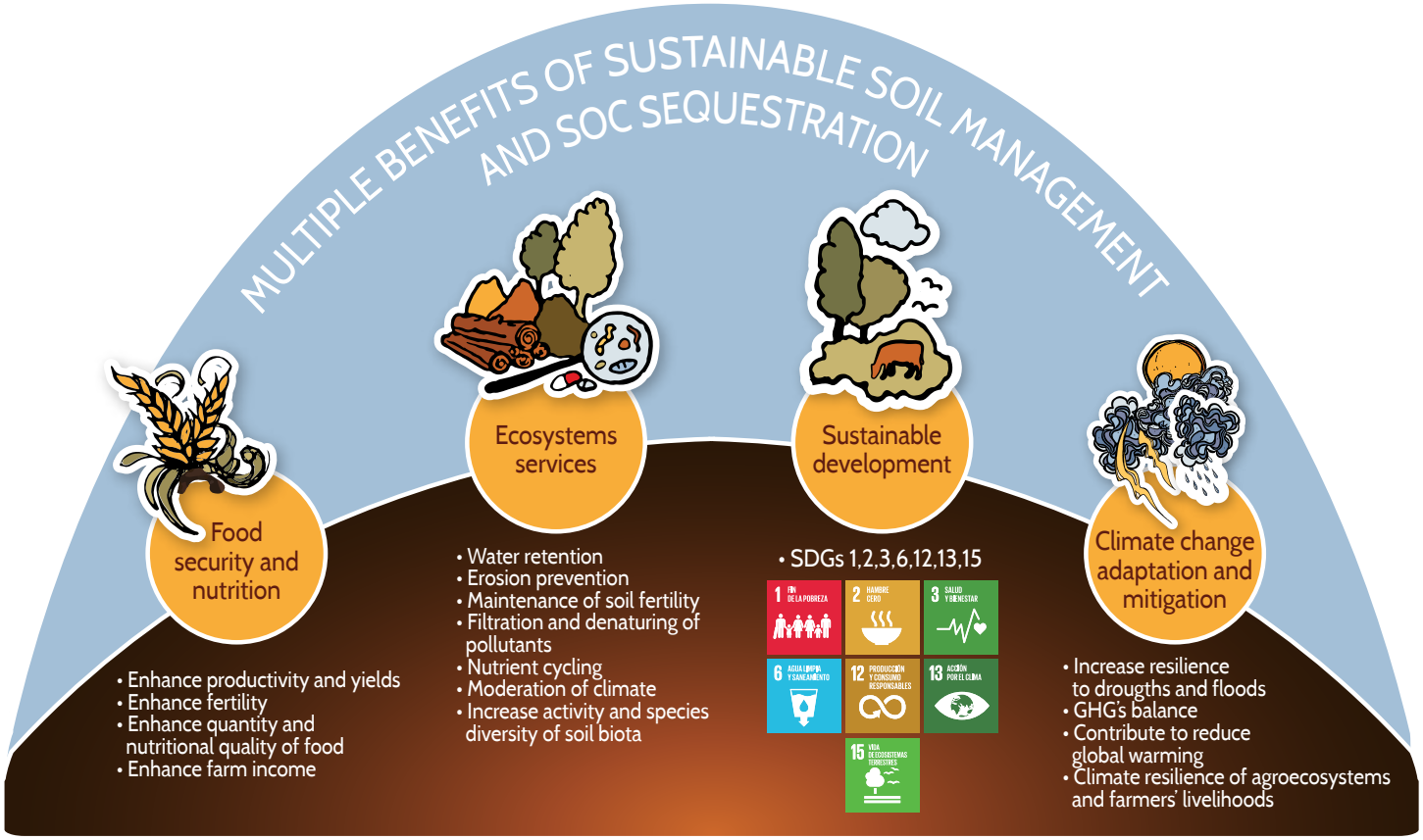



**Figure 3.** Multiple benefits provided by sustainable soil management practices based on SOC.

## RECARBONIZATION OF GLOBAL SOILS (RECSOIL): A FEASIBLE SOLUTION TO DECARBONIZE OUR ATMOSPHERE

A promising offsetting option in the framework of KJWA could be achieved by supporting the implementation of such actions through **RECSOIL (Recarbonization of Global Soils)**, which constitutes an implementation tool for scaling up SOC-centered SSM, based on collaborative efforts under the GSP (Figure 4). The main priorities of RECSOIL and associated multiple benefits are: a) to prevent further SOC losses from carbon-rich soils (peatlands, black soils and permafrost) and, where feasible (in agricultural and degraded soils), to increase SOC stocks; b) to enhance farmer income by increasing soil productivity; c) to contribute to improved food security and nutrition; and d) to mitigate climate change through NDCs of Parties within the framework of the UNFCCC. RECSOIL will also contribute to the growth of corporate social responsibility (CSR) in all economic sectors.

Considering that a third of the world's agricultural soils are degraded, there is a technical potential to recarbonize them through sustainable soil management practices.

# HOW DOES RECSOIL WORK?

RECSOIL is designed to address the key challenges humanity faces today within an enabling framework integrated by a series of institutions and commitments related to climate change and sustainability. The main objective of the program is to support and improve the national and regional GHG mitigation and carbon sequestration initiatives.

The proposal shown in Figure 4 entails a scheme whereby qualifying projects will be awarded credits for GHGs mitigated and carbon sequestered. The program will include financial incentives for carbon mitigation and sequestration that are real, additional, permanent (in the case of mitigation), verifiable, quantifiable and unique, in accordance with industry standards and in line with the "1 credit = 1 t $CO_2e$" standard.

This will be achieved by establishing a robust methodology that allows carbon credits to be traded. The Marketplace & Clearinghouse will enable and promote a liquid, generic market for soil-based credits, and others.

As a result, additional and multiple benefits can be achieved; yields can increase, biotic and abiotic resilience of crops improves, and carbon and ecosystem services lost through traditional farming recover. Thus, carbon sequestered due to sustainable soil management produces additional relevant benefits to the farmer.

The chart in Figure 4 presents an initial and very schematic design of this innovative tool. It is composed of various components that will be defined and designed with detail according to each country's situation and in agreement with local authorities.

## ENABLING FRAMEWORK OF RECSOIL

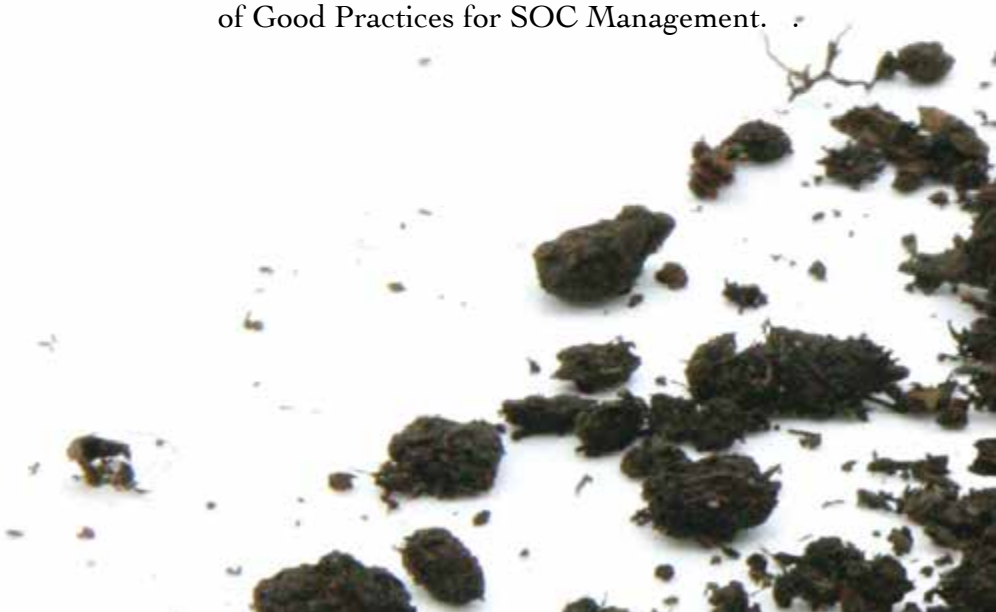
- The **KJWA** emphasizes the importance of agriculture and food security in the climate change agenda.
- **National Governments** implement their policies in order to adapt and mitigate to the causes and effects of climate change and in accordance with the Paris Agreement and their **NDCs**. Government policies in a series of countries have set GHG emissions limits and have allowed an emissions trading scheme or market based mechanism to stimulate mitigation actions at the most competitive cost. These are known as the **Compliance Carbon Markets**.
- Aligned with these multilateral and national commitments and structures some private actors have decided to mitigate GHG emissions voluntarily. These voluntary mitigations are formalized in the form of the **Voluntary Carbon Markets** (carbon credits) and the Green Financial Instruments (green bonds).

## GLOBAL SOIL PARTNERSHIP CARBON TOOLKIT:

The Global Soil Partnership developed a carbon toolkit that consists of:

- Global Soil Organic Carbon Map (GSOC map).
- Global Soil Organic Carbon Sequestration Potential Map (GSOC seq).
- Voluntary Guidelines for Sustainable Soil Management (VGSSM).
- Technical Manual on SOC management including a Set of Good Practices.
- Guidelines for measuring, mapping and monitoring SOC stocks and verifying SOC stocks changes at farm scale.

The VGSSM should be followed by farmers in order to access financial incentives. Farmers that accept to participate in the RECSOIL Program will also receive technical support for adopting the proven Set of Good Practices for SOC Management.



## STRATEGIC PARTNERS

Partners are the key stakeholders, that enable financial and carbon credit flows, strategic overview and other benefits for RECSOIL implementation and development.

## SUPPORT TO FARMERS

Farmers that commit themselves to climate change mitigation and sequester carbon will be potential beneficiaries of financial or commercial benefits. Always in accordance with national implementation. There is some consensus that climate change market -based mechanisms — where credits equate to either one tonne of carbon dioxide, or other designated greenhouse gases with the equivalent global warming potential (or "1 t $CO_2e$") — are the most likely tool to achieve fast soil recarbonization in practical manner.

## GHG MITIGATION AND CARBON SEQUESTRATION

Committed farmers are key, they will mitigate GHGs and sequester carbon in their soils, participating in projects and adopting the GSP Toolkit. Farmers that commit themselves to mitigate GHGs and sequester carbon will be potential beneficiaries of financial or commercial benefits.

## GHG EMISSIONS

According to the GHG Inventories, presented by every country to the IPCC, main anthropogenic emitting activities must move in the direction of a low carbon economy. The Paris Agreement and other negotiations define how each country, activity, industry and individual company should mitigate their emissions. All of these stakeholders will benefit by mobilizing resources and participating in projects of their interest in accordance with national programs.


**Figure 4.** How does RECSOIL work?

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GLOBAL SOIL PARTNERSHIP

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