Soil organic carbon (SOC) is the carbon that remains in the soil after partial decomposition of any material produced by living organisms. It constitutes a key element of the global carbon cycle through atmosphere, vegetation, soil, rivers and the ocean. Soils represent the largest terrestrial organic carbon reservoir. Depending on local geology, climatic conditions and land use and management (amongst other environmental factors), soils hold different amounts of SOC. The largest amounts of SOC have been estimated to be stored in the northern permafrost region with around 190 Pg C in the first 30 cm of the soil (0-30cm)\(^1\), mostly in peat soils. There, carbon accumulates in soils in huge quantities due to the low temperatures leading to low biological activity and slow SOM decomposition. The corresponding soil type is called *Histosol* and is characterized by a SOC content of 12 to 18%\(^2\). In contrast, in dry and hot regions such as the Sahara Desert, plant growth is naturally scarce and only very little carbon enters the soil. *Arenosols*, the typical soils of these areas, have mostly less than 0.6% SOC\(^3\). Black soils, such as *Chernozems*, are inherently fertile because of their relatively high SOC content (over 1%\(^2\)) and optimal plant growth conditions in terms of nutrient exchange capacity and a well-developed structure enabling sufficient water provision. Unsustainable management practices such as excessive irrigation or leaving the soil bare endanger these soils, causing SOC loss and massive erosion.

FIG. 1: SOC IN THE GLOBAL CARBON CYCLE

SOC is the main component of soil organic matter (SOM) and as such constitutes the fuel of any soil. SOM supports key soil functions as it is critical for the stabilization of soil structure, retention and release of plant nutrients, and allowing water infiltration and storage in soil. It is therefore essential to ensuring soil health, fertility and food production. The loss of SOC indicates a certain degree of soil degradation.

FIG. 2: ROLE OF SOC IN THE BIOSPHERE
Caring for these soils and preserving the SOC they contain can be achieved through sustainable soil management, including mulching, planting cover crops, judicious fertilization and moderate irrigation.

**Loss of SOC** negatively affects not only soil health and food production, but also exacerbates climate change. When SOM is decomposed, carbon-based greenhouse gases are emitted to the atmosphere. If this occurs at too high rates, soils can contribute to warming our planet. On the flip side, *many soils have the potential to increase their SOC stocks*, thus mitigating climate change by reducing the atmospheric CO₂ concentration.

The **Global Soil Organic Carbon Map (GSOCmap)**, a country driven **endeavour**, allows the estimation of SOC stock from 0 to 30 cm. It represents a key contribution to **SDG indicator 15.3.1** which defines the area of degraded land. The GSOCmap represents the first ever global soil organic carbon assessment produced through a participatory approach in which countries developed their capacities and stepped up efforts to compile all the available soil information at national level.

In many cases, this is paving the way to establishing national soil information systems and represents the first step toward introducing a soil monitoring program.

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.

KICK-OFF
GSOCmap as a contribution to the SDG indicator 15.3.1: proportion of land that is degraded over total land area.

NATIONAL SOIL DATA COMPILATION AND HARMONIZATION
Database creation bringing together recovered soil legacy data from different institutions, projects and archives; and also harmonization of lab methods and units.

MAPPING BY COUNTRIES
Assessment of different methodologies to predict SOC stock distribution and estimate uncertainty.

CAPACITY DEVELOPMENT
Over 150 experts from 110 countries trained in digital soil organic carbon mapping.

GLOBAL DATA HARMONIZATION
including quality control, mosaicking, border harmonization and gap filling.

WHAT’S NEXT?
• GSOCmap V2.0 with new and updated national SOC maps
• Full establishment of the Global Soil Information System based on National Soil Information Systems
• Towards a Global SOC Monitoring System based on the GSOCmap
• Feasible Guidelines for measuring, mapping, monitoring and reporting SOC stocks to be adapted locally.

GSOCmap: A COUNTRY-DRIVEN PROCESS

GSOCmap
With more than 1 Million sampling points behind the GSOCmap, the country-driven SOC mapping approach has proved to be successful.

GLOBAL DATA HARMONIZATION
including quality control, mosaicking, border harmonization and gap filling.

PREPARATORY WORK

WORK BY AND WITH COUNTRIES

2016

2017

2018

15

1 Million

GSOCmap

With more than 1 Million sampling points behind the GSOCmap, the country-driven SOC mapping approach has proved to be successful.
GLOBAL SOIL ORGANIC CARBON MAP (GSOCmap v1.2.0)

GLOBAL SOIL ORGANIC CARBON STOCK
0-30 CM: 680 Pg C

10 COUNTRIES HOLD MORE THAN 60% OF THE TOTAL SOC STOCK
1 Pg (Petagram) = 1 Billion Metric Tonnes

STOCKS BY CLIMATE ZONES
- Arctic
- Boreal
- Temperate
- Subtropics
- Tropics

SOIL TYPES (tonnes per hectare)
- Arenosols, Solonchaks and Calcisols
- Aluvial Cambisols and Phaeozems
- Chernozems, Gleysols and Podzols
- Histosols

SOIL TYPES (tonnes per hectare)
- Arenosols, Solonchaks and Calcisols
- Aluvial Cambisols and Phaeozems
- Chernozems, Gleysols and Podzols
- Histosols

LAND COVER (petagrams)
- Forests
- Savannas and shrublands
- Croplands and grasslands
- Mosaic of natural vegetation, shrublands and grasslands
- Barren or sparsely vegetated lands
- Permanent wetlands

Background image sources: ESRI, USGS, NOAA
Contact: GSP-Secretariat@fao.org

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