Food and Agriculture Organization of the United Nations

ITPS SOIL LETTERS

INTERGOVERNMENTAL TECHNICAL PANEL ON SOILS

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A CALL TO PROTECT THE WORLD'S FOOD BASKET: BLACK SOILS

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INTERGOVERNMENTAL TECHNICAL PANEL ON SOILS

GLOBAL SOIL PARTNERSHIP

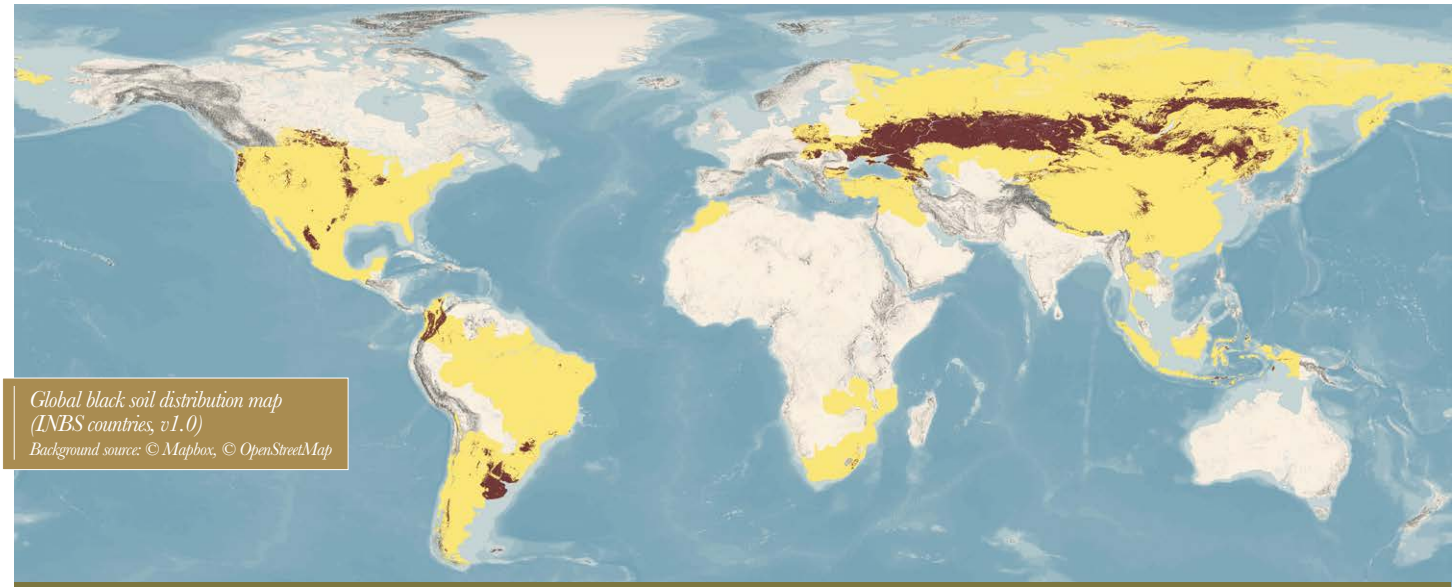
Soil organic carbon (SOC) sequestration provides multiple benefits to the environment and human health and is one of the most cost-effective options for climate change adaptation and mitigation, as well as for fighting food insecurity, land degradation, and desertification (Liu *et al.*, 2012; Lal, 2021). Globally, SOC stocks are estimated at an average of 680 petograms of carbon (PgC) in the topsoil (0 to 30 cm). Soil organic carbon hot-spots and bright spots are areas with high SOC content such as black soils, and constitute major zones of concern (FAO, 2018). The term "black soils" with moderate to high SOC content are most extensive in Eurasia, North America, and Latin America. Black soils contain 8.2 percent of the world's SOC stocks and can accommodate 10 percent of the global total SOC sequestration potential (FAO, 2022a, 2022b).

They play a crucial role in sustainable food production under climate change, owing to a high natural fertility and an elevated water retention capacity, which gives them a high resilience to external disturbance, including weather variability. They additionally provide a unique function of filtering and buffering soil contaminants.

WHAT AND WHERE ARE BLACK SOILS?

Although "black soils" is a term used in soil maps and classifications of some countries (influenced by national linguistic specifics), there has been no consistent definition for black soils at the global level. In terms of correspondence to international soil classification systems, in the World Reference Base for Soil Resources (WRB), the majority of black soils correspond to Chernozems, Kastanozems, and Phaeozems (IUSS Working Group WRB, 2022). However, other soil groups in the WRB and other international soil classification systems may also fit the definition of black soils, such as the Mollisol orders in the United States Department of Agriculture (USDA) soil taxonomy (USDA, 2022).

As a result of the different classification systems, it is important to harmonize the definition of black soils to facilitate their sustainable management and international technical exchanges. In 2019, the Food and Agriculture Organization of the United Nations (FAO) and its scientific advisory body



Global black soil distribution map (INBS countries, v1.0)
Background source: © Mapbox, © OpenStreetMap

BOX 1. BLACK SOIL DEFINITION

Black soils are mineral soils which have a black surface horizon, enriched with organic carbon that is at least 25 cm deep. Two categories of black soils (1st and 2nd categories) are recognized. The categories are distinguished to recognise the higher value, and thus greater need for protection, of some soils (Category 1), while still including a wider range of soils within the overall Black Soil definition (Category 2).

1st category Black Soils (the most vulnerable and endangered, needing the highest rate of protection at a global level) are those having all five properties given below:

- The presence of black or very dark surface horizons typically with a chroma of ≤3 moist, a value of ≤3 moist and ≤5 dry (by Munsell colours);
- The total thickness of black surface horizons ≥25 cm;
- Organic carbon content in the upper 25-cm of the black horizons of ≥1.2% (or ≥ 0.6% for tropical regions) and ≤20%;
- CEC in the black surface horizons ≥25 cmol/kg; and
- A base saturation in the black surface horizons ≥50%.

Most but not all 1st category black soils: Have well-developed granular or fine sub-angular structure and high aggregate stability in the black surface horizons that are in a non- or slightly degraded state, or in the humus-rich underlying horizon which has not been subjected to degradation.

2nd category Black soils (mostly endangered at the national level) are those having all three properties given below:

- The presence of black or very dark surface horizons typically with a chroma of ≤3 moist, a value of ≤3 moist and ≤5 dry (by Munsell colours);
- The total thickness of the black surface horizons of ≥25 cm; and
- Organic carbon content in the upper 25-cm of the black horizons ≥1.2% (or ≥ 0.6% for tropical regions) and ≤20%.

Black Soils definition endorsed by the 11th Working Session of the Intergovernmental Technical Panel on Soils (21/11/2019, FAO HQ) (FAO, 2019).

Source: All text taken directly from FAO. 2019. DEFINITION | What is a black soil? Rome. *https://www.fao.org/global-soil-partnership/intergovernmental-technical-panel-soils/gsoc17-implementation/internationalnetworkblacksoils/more-on-black-soils/definition-what-is-a-black-soil/en/*

on soil issues, the Intergovernmental Technical Panel on Soils (ITPS), endorsed a definition of black soils (Box 1).

FAO's Global Soil Partnership and its International Network of Black Soils (INBS), along with INBS member countries then developed the Global Map of Black Soils (FAO, 2022a), launched in 2022, and was the first map to introduce black soil distribution at a global level. Together with the Global status of black soils report (FAO, 2022b) these documents present relevant information on black soils and clarified the priority areas and regions for black soil protection actions.

WHY ARE BLACK SOILS IMPORTANT?

Black soils have been cultivated for decades and play a key role in global agricultural production of cereals, tuber crops, oilseed, pastures, and forage systems. Despite representing only 5.6 percent of the global land area, the crops produced in black soils feed not only the 223 million people settled on them, but also the countries that import various black soils' commodities, thus contributing to the global economy. For example, 66 percent of sunflower seeds, 51 percent of small millet, 42 percent of sugar beet, 30 percent of wheat, and 26 percent of potatoes, were harvested in black soils around the world. Globally, approximately a third of black soils are covered by crops, a third by grasslands, and the remaining third by forests (FAO, 2022a, 2022b).

However, this non-renewable resource is under threat. Because of land use change (from natural grasslands and forest to cropland), unsustainable management practices and excessive use of agrochemicals, most of the black soils have already lost at least half of their carbon stocks and suffer from moderate to severe erosion processes, as well as nutrient imbalances, acidification, compaction, and soil biodiversity loss (Song *et al.*, 2015; Lee and Gill, 2015; Grekov *et al.*, 2011). There is an urgent need to adopt sustainable soil management (SSM) practices on black soils to halt degradation, reduce greenhouse gas (GHG) emissions, contribute to mitigating climate change, and enhance soil health for food production and security (FAO, 2022b).

Geopolitical crises in black soil regions and the COVID-19 pandemic pose more challenges to black soil countries and present an increasing obstacle to technical cooperation and capacity building for the sustainable management of black soils and their conservation. Overcoming the impact of the pandemic and regional crises while tackling the other transboundary challenges that predominately affect countries with black soils require coordinated and collective actions. Efforts should focus on strengthening the capacities of black soil countries to adopt appropriate technologies and knowledge (FAO, 2022b).

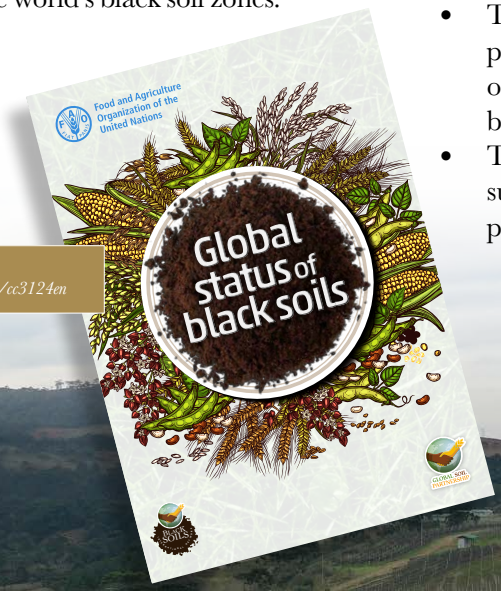
Conceptually, black soils are suitable for most cropping systems – such as rotation, perennial, and organic – with any crops in both small- and large-scale farmlands (Ryan *et al.*, 2008; Zentner *et al.*, 1990; Stupakov *et al.*, 2019). A diversified cropping system on black soils can provide better ecosystem services that maintain productivity and mitigate negative impacts of monocropping (Entz *et al.*, 2002; Ryan *et al.*, 2018). By targeting measures or available practices that minimize soil threats such as reduced or zero-tillage and nutrients, water, and biomass management, it is possible to address SOC loss, nutrient imbalance, biodiversity loss, compaction, and erosion (FAO, 2022b). These issues are fundamental to addressing the issue of black soil protection, especially when considering sustainable crop production (Merante *et al.*, 2017; Poeplau and Don, 2015; Gao et al., 2018; Ding *et al.*, 2016). However, it is difficult to find research that addresses soil acidification, salinization and soil pollution while also being specifically tailored for black soils. The reason for this knowledge gap could be that not all black soil areas are recognized as endangered by those soil threats, although they can hinder black soils' productivity and health in the longer term.

Black soils (Chernozems) where soybeans are grown, China

AN INTERNATIONAL NETWORK TO PROTECT BLACK SOILS

In March 2017, FAO's Global Soil Partnership (GSP) established the INBS with the main purpose of promoting the conservation and sustainable management of world's black soils (FAO, 2017). Since then, a series of working sessions and workshops have been organized to discuss (among other aspects), a general definition of black soils and to provide a platform for member countries to discuss common problems, and highlight research gaps in the conservation, sustainable management, assessment, and monitoring of black soils. In December 2022, the INBS and its members launched the Global Status of Black Soils report: the first global report to address the status and challenges of black soil resources (FAO, 2022b).

The INBS members highlighted the extent and importance of black soils to agricultural production and the need to manage them sustainably to address the global threat of rising atmospheric carbon levels and climate change that would result from their degradation. It is hoped that the many examples of beneficial soil management practices and governance approaches contained in the Global status of black soils report (FAO, 2022b) can serve as an inspiration for the adoption of improved management approaches and regulations throughout the world's black soil zones.



Download: https://www.fao.org/documents/card/en/c/cc3124en

The report identified the main challenges in terms of sustainable management, protection, and conservation of black soils, which are listed as follows:

- The loss of SOC and erosion from cultivated black soils continues, leading to increasing GHG emissions and the loss of their natural fertility.
- Acidification, salinization, and contamination of black soils have not been yet sufficiently investigated nor have conclusive findings.
- Due to rapid urban sprawl, soil sealing is a constant threat to the protection and conservation of black soils.
- Large areas of black soils are heavily threatened by various types of degradation and pollution, including those resulting from armed conflicts, which make it difficult to implement policies for their sustainable use and management.
- Adoption of SSM practices by farmers remains limited due to a lack of technical support, knowledge exchange, and provision of financial incentives toward better production systems enabling environment protection.
- Black soils share similarities in management, although SSM practices should be tailored to local and specific edaphoclimatic and socioeconomic conditions.
- The list of measures for the protection and conservation of black soils will differ at different scales (from local to global).
- There are various national soil policies that include the protection and sustainable management of soils, but only one (adopted by the Chinese Government) is specific for black soils.
- There is a lack of an agreement for fostering the sustainable management of black soils (for conservation, protection, and production).

Soil and water conservation techniques with permanent cover, Brazil

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HOW TO PROTECT BLACK SOILS

The future of black soils protection faces a great challenge, in that substantial increases in food demand must be met while mitigating soil threats. The sustainable use of black soils with beneficial field practices and the building of suitable cropping systems are essential strategies towards meeting this challenge, but they must be combined with awareness raising, education, extension and monitoring. Therefore, it is vital that independent policies and agricultural development programmes must address the threats to black soils through good practices and cropping systems.

Looking forward towards the sustainable use and management of black soils, stakeholders should consider the following recommendations (FAO, 2022b):

No-till strip tillage, China

- **Actions needed to fill knowledge gaps in the threats to black soils (from identification and monitoring to management):**
  - Identify soil information related to black soils in national soil information systems and surveys.
  - Establish and strengthen national black soil monitoring systems to identify, assess, and monitor degradation of black soils and support preventive actions.
  - Promote the establishment of the Global Black Soil Information and Monitoring System.
  - Build scientific evidence to support and promote the development of good practices for the sustainable management of black soils.
  - Establish and foster national research programmes focused on the sustainable management and restoration of black soils, especially on acidification and salinization.
- **Actions needed to strengthen legislative frameworks and technical actions:**
  - Advocate for a global commitment towards the protection and sustainable use of black soils.
  - Contribute to the refinement of the definition of black soils by providing relevant information and clarification.
  - Identify the black soil areas needing protection according to the definition and the national black soil distribution map.
  - Foster the adoption of proven SSM practices to protect black soils by empowering farmers through training and national financial incentives.
  - Advocate for the establishment of laws and regulations for the sustainable management of the world's black soils from sectors in agriculture, forestry, and grassland.
  - Promote the Recarbonization of global agricultural soils (RECSOIL) initiative in countries with black soils.
  - Maintain or even increase SOC stocks through proven SSM practices, such as conservation or reduced tillage, strip tillage, organic fertilization, manure addition, returning biomass to the soil, organic mulch, perennial crops, amendment with biochar, cereal–forage rotation, and heavy machinery traffic control.
  - Reduce GHG emissions through proven SSM practices, such as cover crops, a crop and livestock farming system, the judicious use of fertilizers, and conservation tillage.
  - Develop and include black soil targets and indicators related to the achievement of the Sustainable Development Goals in national reporting mechanisms.
- **Actions needed to improve awareness and communication:**
  - Launch a global awareness-raising campaign on black soils aimed at the general public to explain why black soils matter to everyone and how black soils can be part of the solution for food security and climate change.
  - Promote awareness raising on the challenges of black soils, especially acidification, salinization, and contamination, and invest in research activities in terms of nitrate nitrogen replacement, straw amendment, rotation with legumes, halophytes and non-conventional crops, and nutrient use efficiency improvement practices.
  - Advocate for black soil topics to be included in general studies at schools and higher education institutions in black soil countries.
- **Actions needed to foster international cooperation among black soil countries:**
  - Facilitate the transfer of scientific knowledge through international events and promote the publication of information in open access sources.
  - Advocate for technology transfer and cross-capacity building through prevention, monitoring, and management, from regions and countries with high expertise and experience on black soils to developing countries with less or no expertise in the topic, to enable sustainable black soil management.
  - Establish a global training programme for developing capacities on sustainable black soil management.
  - Advocate for the establishment of a global agreement for the sustainable management of the world's black soils that addresses their conservation and protection, while valuing their productive role.

Mulching the soil with winter wheat straw, Ukraine

Wheat under conservation tillage, Argentina

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INTERGOVERNMENTAL TECHNICAL PANEL ON SOILS

The Intergovernmental Technical Panel on Soils (ITPS) is composed of 27 top soil experts representing all the regions of the world. ITPS members have a 3-year mandate and provide scientific and technical advice and guidance on global soil issues to the Global Soil Partnership primarily and to specific requests submitted by global or regional institutions. Created in 2013 at the first Plenary Assembly of the Global Soil Partnership held at FAO Headquarters, the ITPS advocates for addressing sustainable soil management in the different sustainable development agendas.

GLOBAL SOIL PARTNERSHIP

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