Food and Agriculture Organization of the United Nations

European Commission

Soil atlas of Asia

Key messages and findings

Joint Research Centre

GLOBAL SOIL PARTNERSHIP

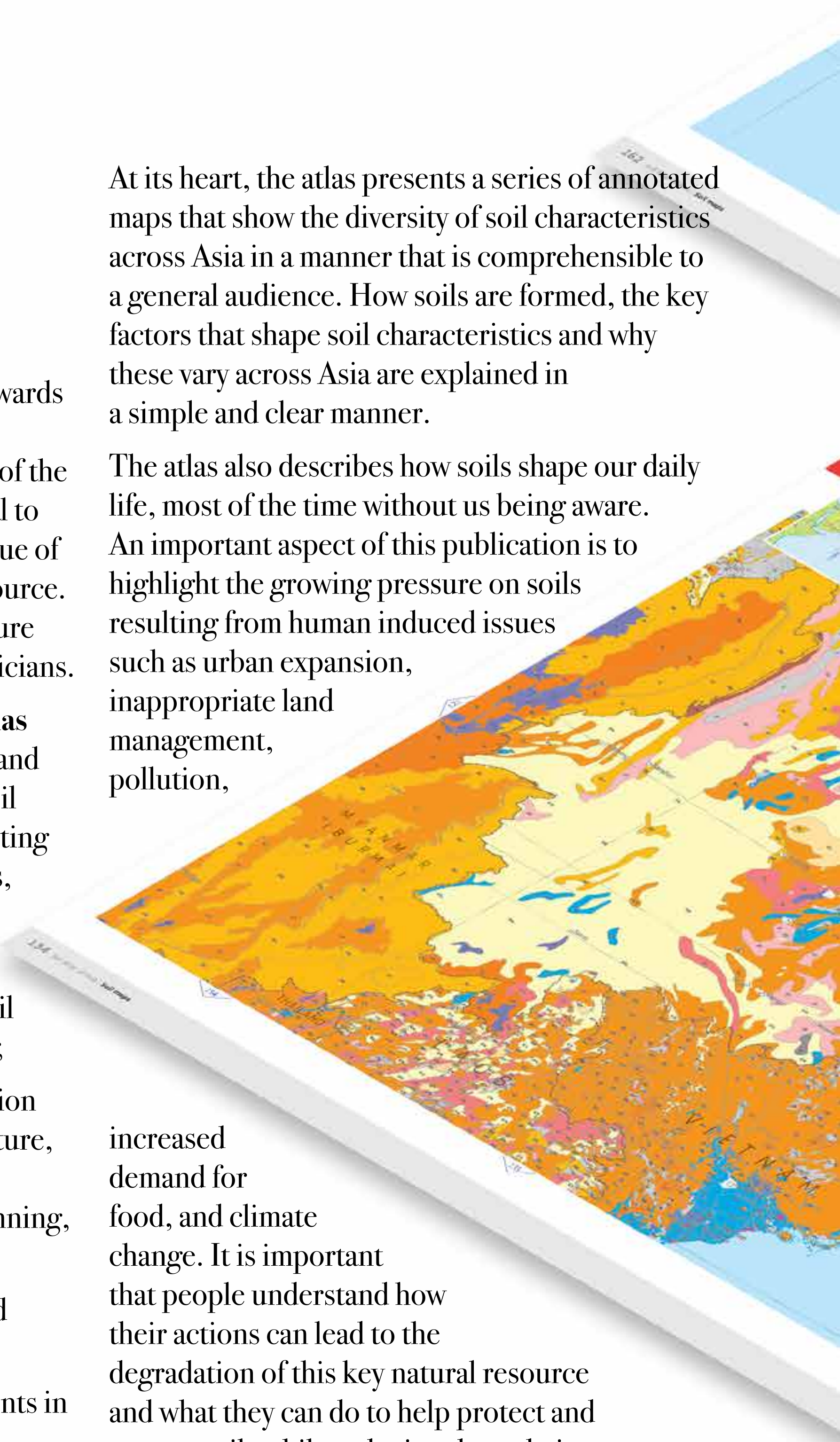
The first ever soil atlas of Asia

Most soil-related reading material is geared towards scientific journals or technical reports that are normally beyond the reach and understanding of the general public. This results in a lack of material to help interested stakeholders appreciate the value of soil or help them to preserve this precious resource. Consequently, as a topic, soil tends not to feature prominently in the minds of the public or politicians.

This flyer presents key facts from the "**Soil Atlas of Asia**", the first ever soil atlas for the region and an important tool to promote its sustainable soil management and preserve soil health. By targeting the general public, decisionmakers, politicians, teachers and even scientists in other disciplines, **the atlas aims to**:

- raise awareness about the crucial role of soil health among a wide range of stakeholders;
- support the development and implementation of policies and instruments around agriculture, environmental issues, climate change, development and aid assistance, urban planning, and more;
- provide educational material to schools and universities; and
- provide a baseline for further soil assessments in the region.

The preparation of the atlas started in 2018 and involved about 100 soil experts under the facilitation of the Global Soil Partnership (GSP-FAO) and the Joint Research Centre of the European Commission (JRC EC). Financial support was provided by the JRC and the Asian Food and Agriculture Cooperation Initiative (AFACI), managed by the Rural Development Administration of the Republic of Korea. The atlas forms part of a series initiated by the JRC-EC.



At its heart, the atlas presents a series of annotated maps that show the diversity of soil characteristics across Asia in a manner that is comprehensible to a general audience. How soils are formed, the key factors that shape soil characteristics and why these vary across Asia are explained in a simple and clear manner.

The atlas also describes how soils shape our daily life, most of the time without us being aware. An important aspect of this publication is to highlight the growing pressure on soils resulting from human induced issues such as urban expansion, inappropriate land management, pollution, increased demand for food, and climate change. It is important that people understand how their actions can lead to the degradation of this key natural resource and what they can do to help protect and restore soils while reducing degradation processes.

The atlas forms part of a series initiated by the JRC-EC. https://esdac.jrc.ec.europa.eu/Atlas

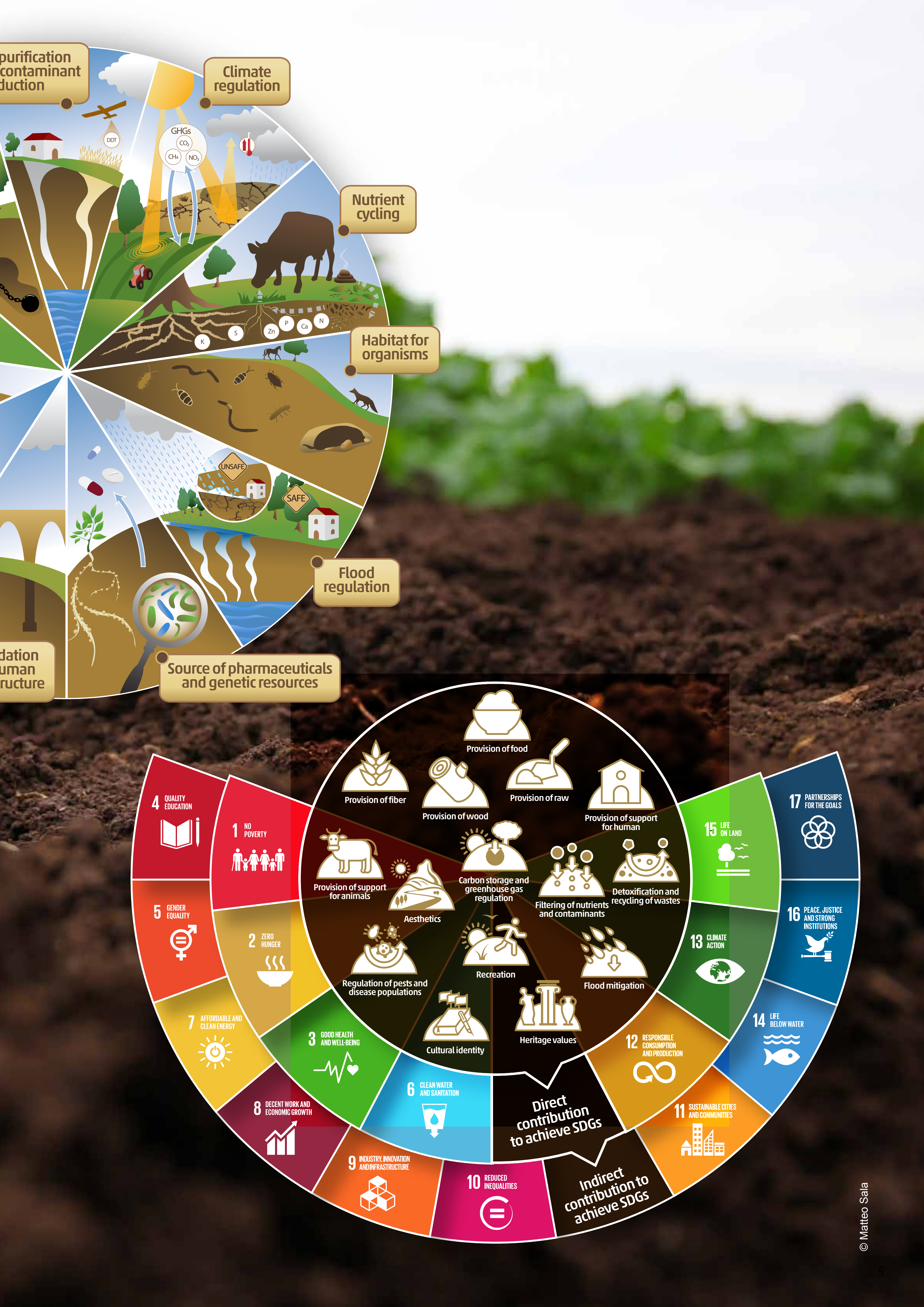
It builds on the considerable knowledge on soils across Asia that has been amassed through the substantial endeavors of many individuals and organizations. Without this significant effort, the production of this atlas would not have been possible.

INDIAN OCEAN
Lesser Sunda Islands
TIMOR-LESTE
Timor Sea
Mapping soils in Asia
Soil mapping in South Korea: a model for Asia?
South China Sea

The priceless value of soils

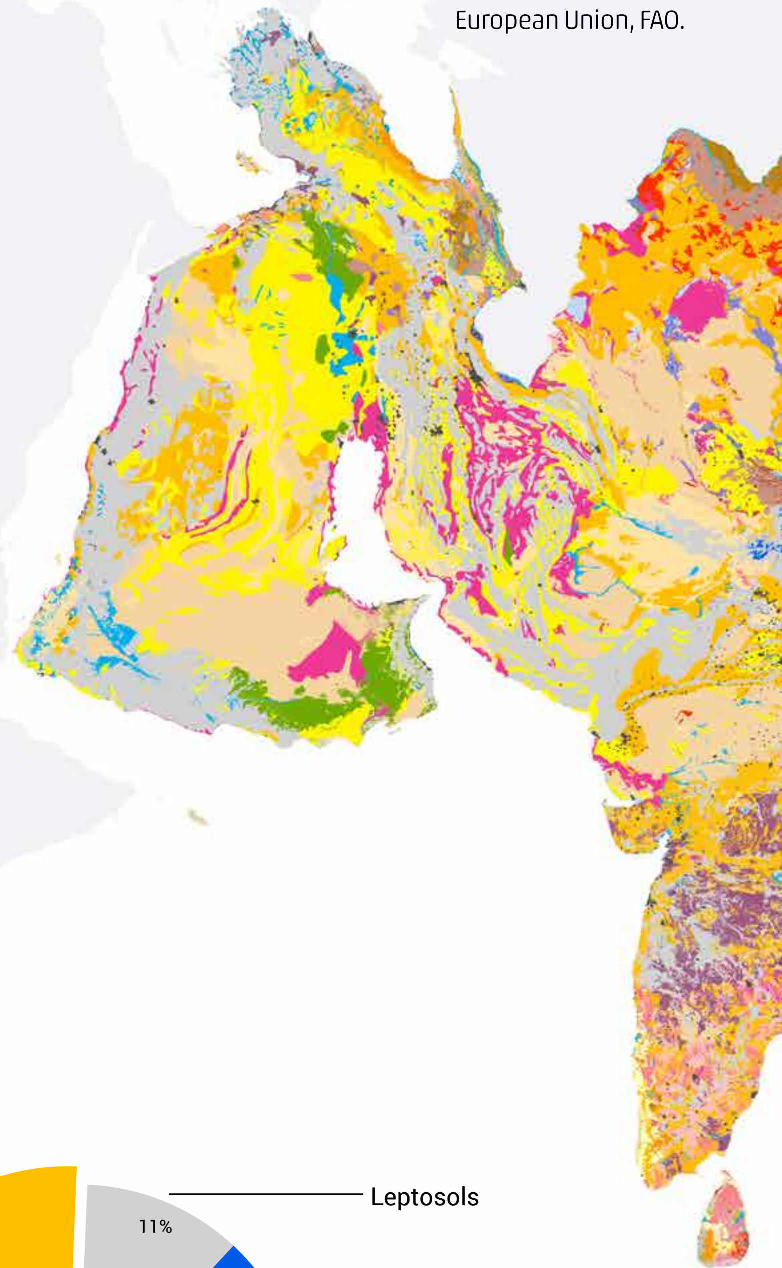
Human well-being is dependent on soils, as they generate a flow of goods and services to support human welfare and the environments that they live in. Soil functions support ecosystem services, which are important for a range of agricultural, environmental, nature protection, landscape architecture and urban processes. Healthy soils are essential for the biosphere, and yet soil is perhaps the most difficult and least understood matrix. The main functions of soil include nutrient cycling, carbon storage and turnover, water maintenance, soil structure arrangement, regulation of aboveground diversity, biotic regulation, buffering, and the transformation of potentially harmful elements and compounds. The importance of soils is such that they directly or indirectly contribute to the achievement of all the Sustainable Development Goals. Nevertheless, soil is a fragile, finite natural resource, taking up to 1 000 years to produce just a few centimetres of soil but only a few minutes for it to be degraded.

About 60 percent of the world's population live in Asia, which is expected to reach 5.3 billion people by 2050. Agriculture represents the main source of livelihood to more than 2.2 billion people in the region. Nevertheless, in 2020, an estimated 375.8 million people faced hunger and more than 1.1 billion people did not have access to adequate food in the Asian-Pacific region. 1.8 billion people are yet to have access to healthy diets. The rapid population growth that characterizes the region is putting growing pressure on soil resources as it comes with unprecedented rates of urbanization and an increasing demand for ecosystem services. If sustainable soil management practices are not implemented and soil degradation continues at this pace, hunger will be exacerbated in the future. More frequent extreme weather events, driven by climate change, will provide further pressures.


Climate regulation
GHGs
CO2
CH4
NO3
DDT
Nutrient cycling
K
S
Zn
P
Ca
N
Habitat for organisms
UNSAFE
SAFE
Flood regulation
Source of pharmaceuticals and genetic resources
Provision of food
Provision of fiber
Provision of wood
Provision of raw
Provision of support for human
Provision of support for animals
Aesthetics
Carbon storage and greenhouse gas regulation
Filtering of nutrients and contaminants
Detoxification and recycling of wastes
Regulation of pests and disease populations
Recreation
Flood mitigation
Cultural identity
Heritage values
Direct contribution to achieve SDGs
Indirect contribution to achieve SDGs
1 NO POVERTY
2 ZERO HUNGER
3 GOOD HEALTH AND WELL-BEING
4 QUALITY EDUCATION
5 GENDER EQUALITY
6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY
8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
16 PEACE, JUSTICE AND STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS

The soil map of Asia

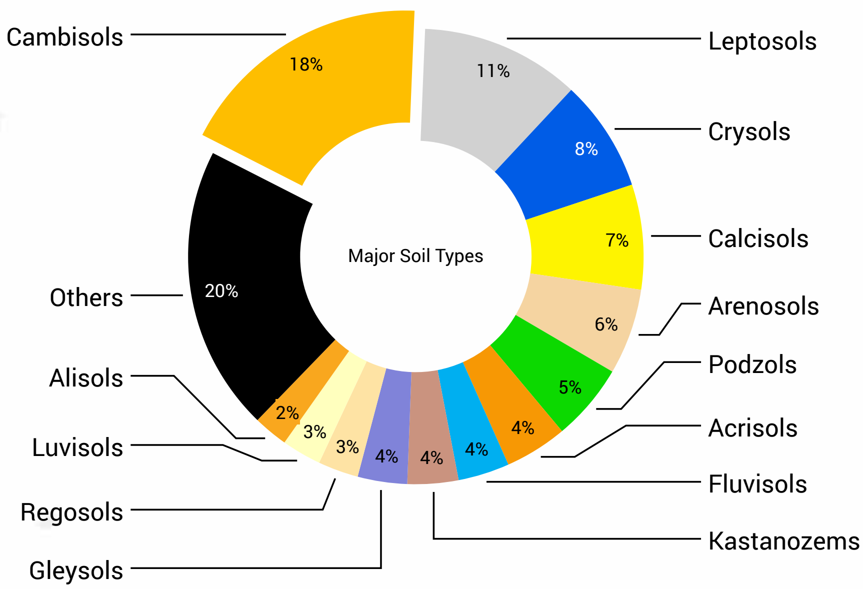
Map Source: EC-JRC & FAO, Soil Atlas of Asia. 2023. Luxembourg and Rome. Publication Office of the European Union, FAO.



Forty-five Asian countries harmonized their **national soil classification systems** with the World Reference Base (WRB) soil classification 2006 edition (to be comparable with previous soil atlases). Their efforts were compiled in a novel map portraying the distribution of the WRB Reference Soil Groups across Asia. The atlas compiles existing information on different soil types in easily understandable maps that cover the entire continent. While it is intended primarily for the educational sectors and policymakers, the atlas aims to bridge the gap between soil science and society at large.

The soil resources of Asia are diverse, reflecting a broad combination of climatic conditions and parent materials. These range from permafrost-affected Cryosols in the north to the extensive topical peatlands of southeast Asia. Fluvisols lie along the major waterways of western, southern and eastern Asia and are regarded as the birthplaces of agriculture, while volcanic Andodols denote the Pacific Ring of Fire.

Asia contains some of the most fertile soils on the planet. However, many soils are also inherently fragile, being low in nutrients and organic matter. A lack of water presents major constraint to their use in agriculture.




Soil Types
Reference Soil Groups
Albeluvisols
Acrisols
Alisols
Andosols
Arenosols
Anthrosols
Chernozems
Calcisols
Cambisols
Cryosols
Fluvisols
Ferralsols
Glaciers
Gleysols
Gypsisols
Histosols
Kastanozems
Leptosols
Luvisols
Lixisols
Nitisols
Phaozems
Planosols
Plinthisols
Podzols
Regosols
Solonchaks
Solonetz
Stagnosols
Technosols
Umbrisols
Vertisols
Water

Threats and potentials of asian soils

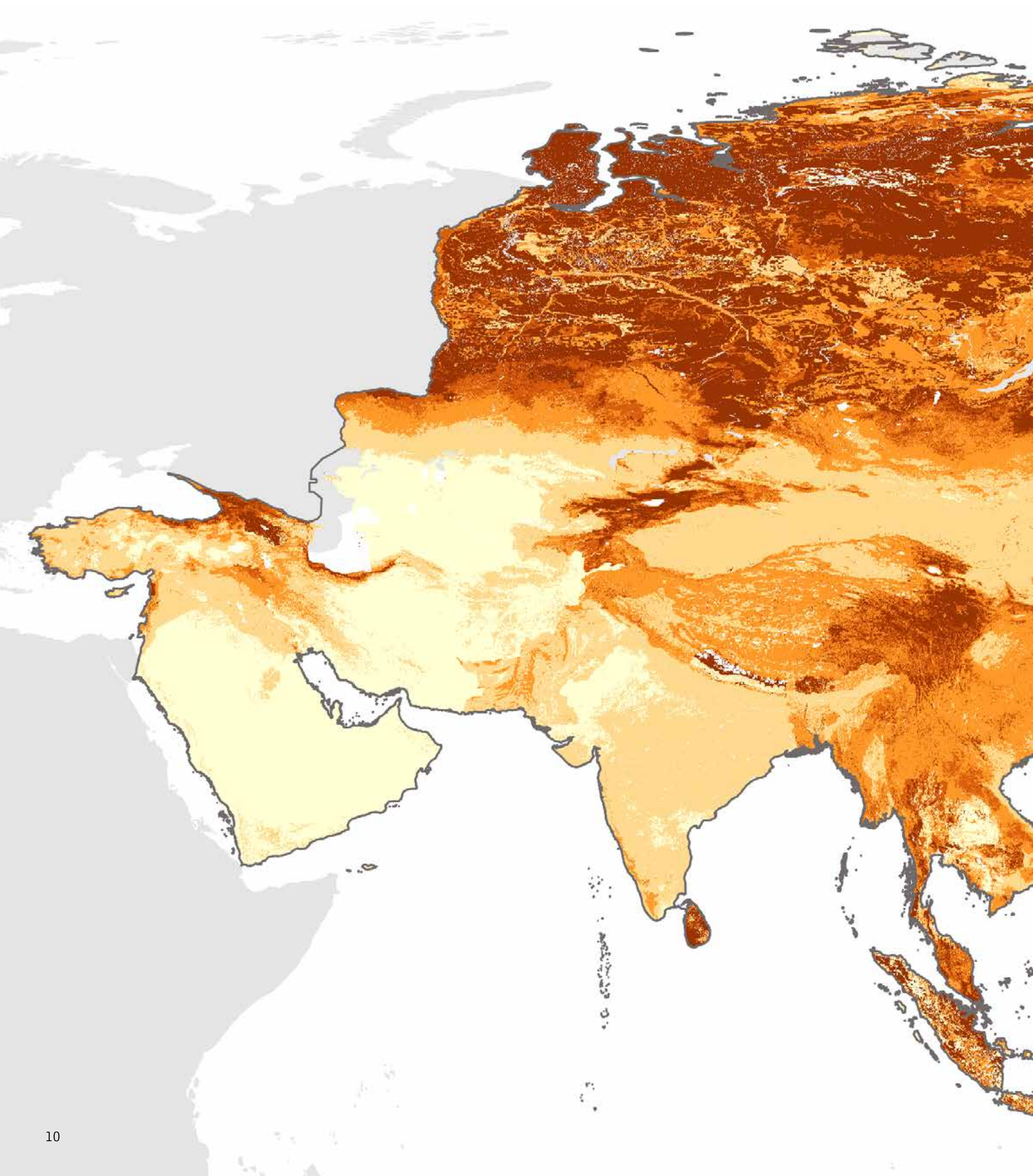
The atlas also discusses the main threats to soil across different parts of Asia and the steps being taken to protect them. The unsustainable use and management of land is leading to increased soil degradation and the loss of a key resource that is fundamental to life on the continent of Asia. Notable issues are a loss of nutrients and soil organic matter, contamination, erosion by wind and water, salinisation, biodiversity decline, compaction and sealing through urbanisation and infrastructure development.

High sediment loads in the Yellow River at the Hukou Falls (China) due to soil erosion, a major concern in the region

A soil is regarded as saline if the salt concentration is around 2 500 parts per million. Soils affected by soluble salts occupy a significant part of Asia. Salt affected soils are especially prevalent in northern Asia, South Asia, and the less humid parts of central Asia.

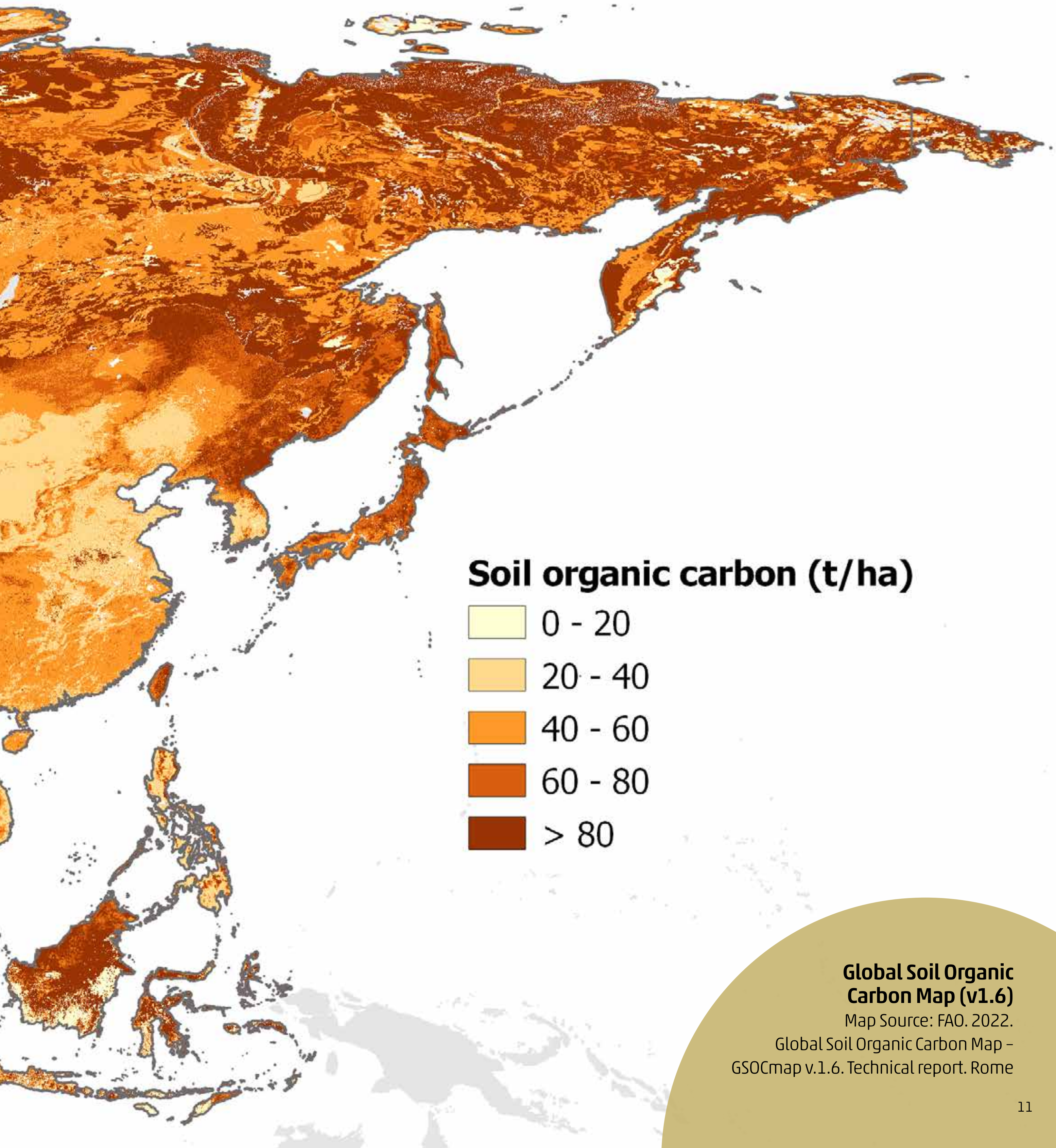
Soil organic carbon

As shown by the Global Soil Organic Carbon Map (GSOCmap v1.6), one of the most striking features of the soils of Asia is the huge range in values and the diversity in the distribution of soil organic carbon.



The carbon stored in the soil in the form of organic matter (soil organic carbon or SOC) is key to soil health, fertility and ecosystem services but it is of even greater importance to climate regulation. The uppermost 30 cm of Asian soils already store 248 petagrams of carbon (FAO, 2022a).

However, **they have the potential to sequester a further 180 metric tonnes of carbon per year if high carbon-input sustainable soil management practices are adopted** (FAO, 2022b).



Global Soil Organic Carbon Map (v1.6)
Map Source: FAO. 2022. Global Soil Organic Carbon Map – GSOCmap v.1.6. Technical report. Rome

Soil organic carbon sequestration

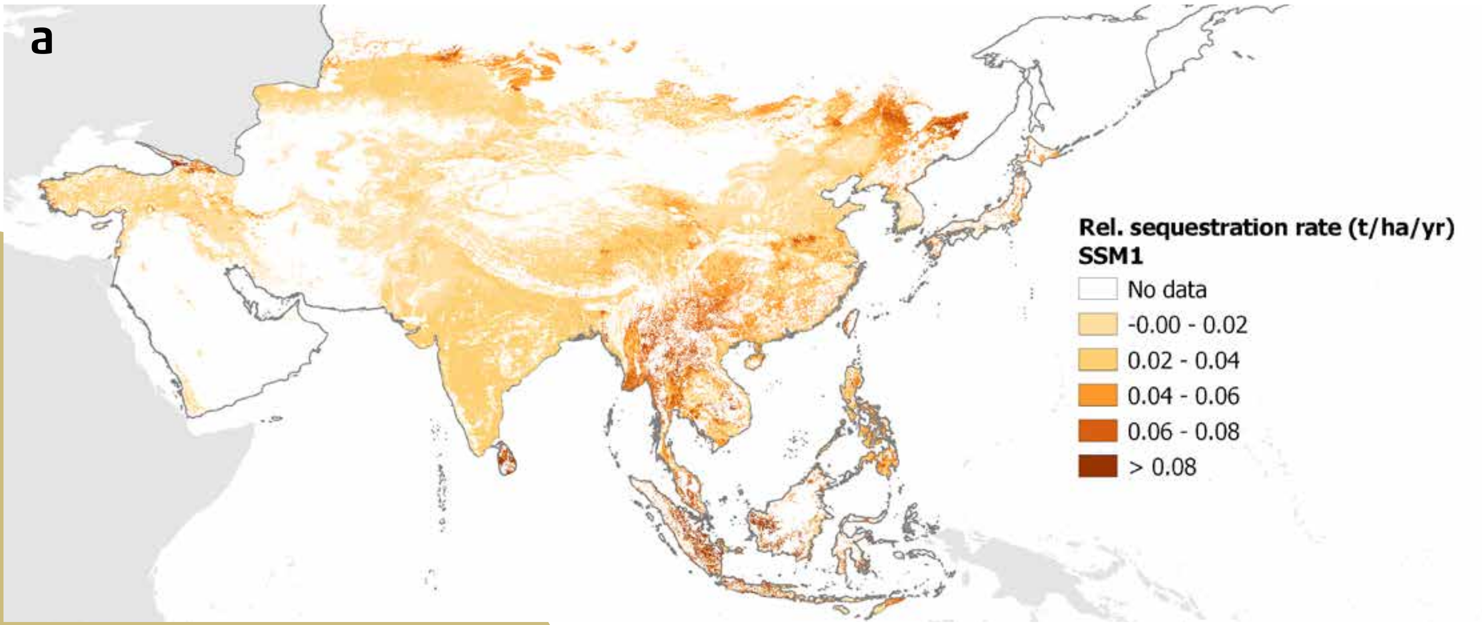
Sustainable soil management (SSM) practices centred on SOC sequestration are one of the most cost effective options for climate change adaptation and mitigation, for combating desertification, land degradation and food insecurity. SOC sequestration is also an important strategy to improve soil health and the provision of ecosystem services. A better management of soils can offset 5 to 20 percent of current global greenhouse gas (GHG) emissions (IPCC, 2019).

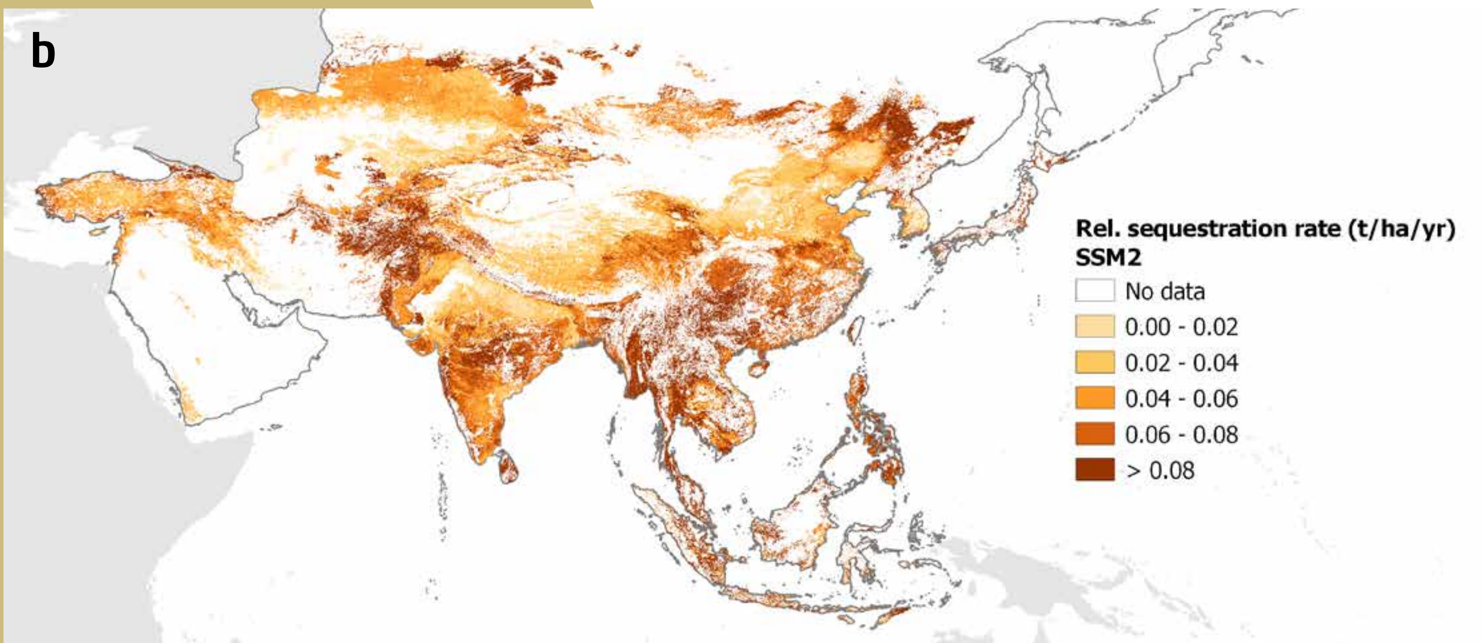
Relative soil organic carbon sequestration rates in Asia (Global Soil Organic Carbon Sequestration Potential Map, GSOCseq v1.1)

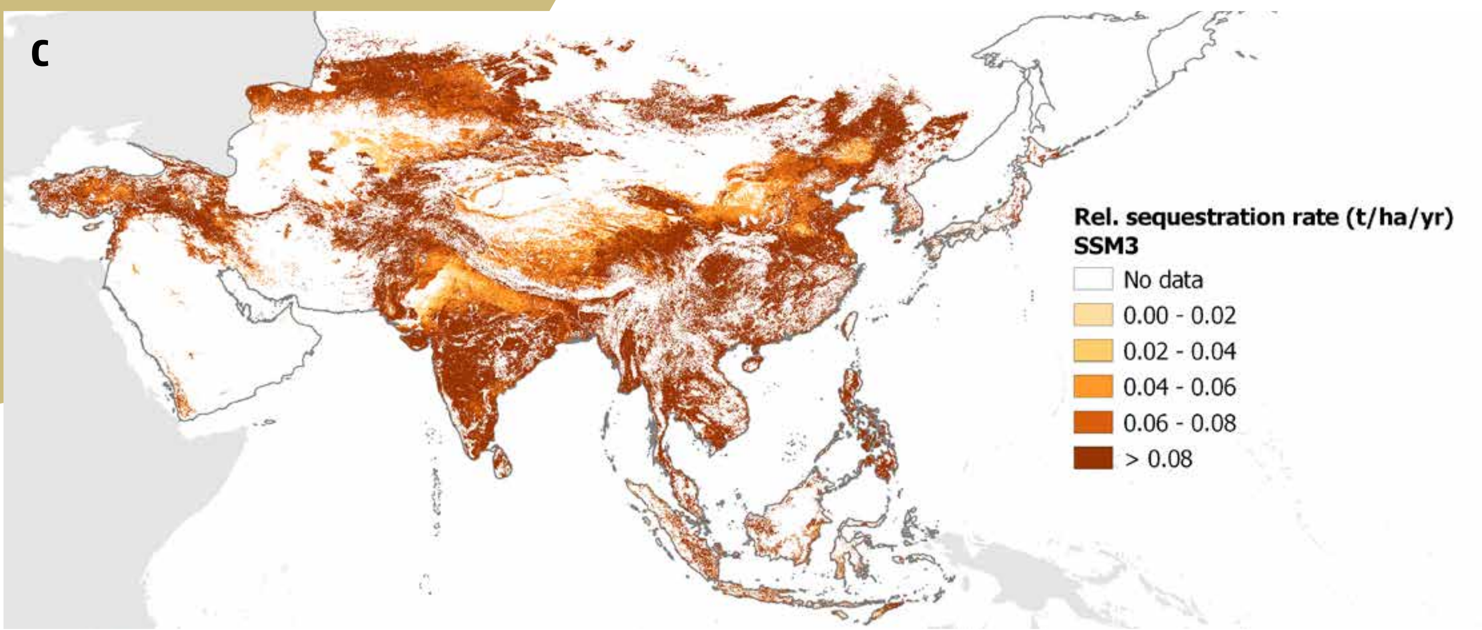
a) Average annual rate of soil organic carbon stock change (tonnes/ha/year) after 20 years of implementation of sustainable soil management (SSM) practices that generate a 5 percent increase in carbon inputs (SSM Scenario 1) compared to business as usual (BAU) management, at a soil depth of 0–30 cm.

b) Average annual rate of soil organic carbon stock change (tonnes/ha/year) after 20 years of implementation of sustainable soil management (SSM) practices that generate a 10 percent increase in carbon inputs (SSM Scenario 2) compared to business as usual (BAU) management, at a soil depth of 0–30 cm.

c) Average annual rate of soil organic carbon stock change ((tonnes/ha/year) after 20 years of implementation of sustainable soil management (SSM) practices that generate a 20 percent increase in carbon inputs (SSM Scenario 3) compared to business as usual (BAU) management, at a soil depth of 0–30 cm.





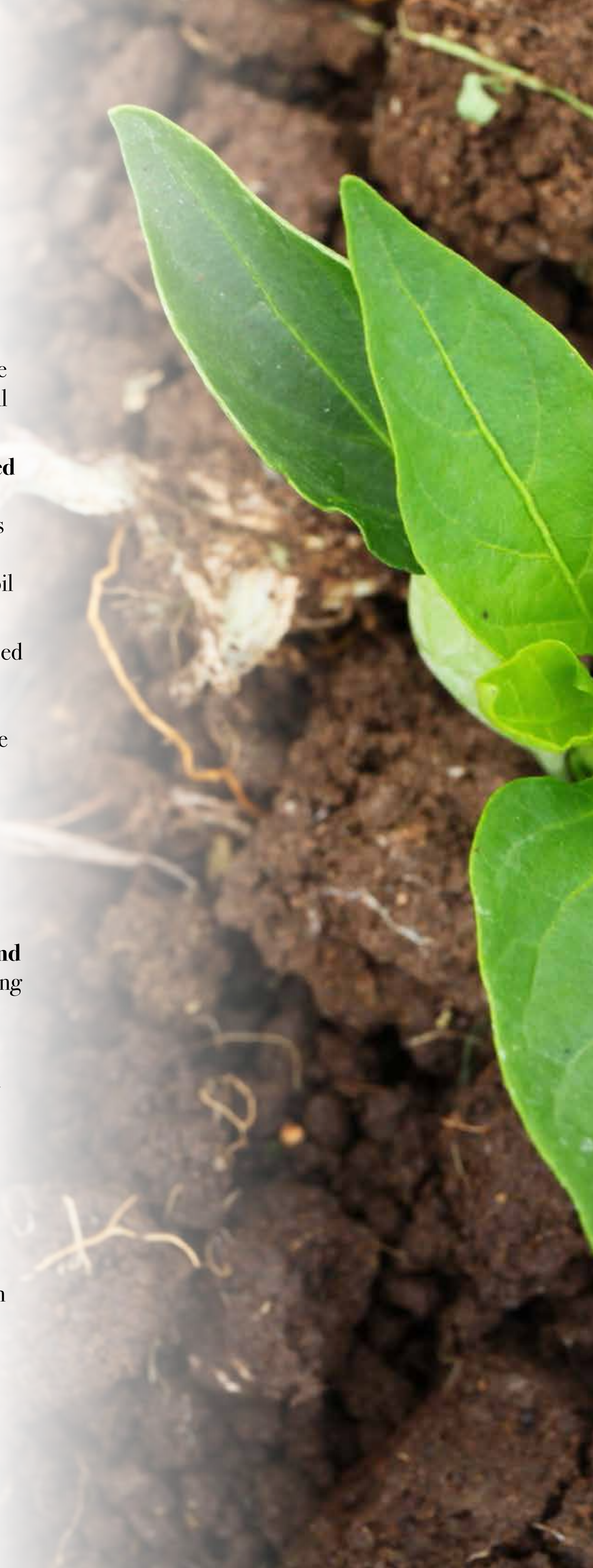


Map Source: FAO. 2022. Global Soil Organic Carbon Sequestration Potential Map – GSOCseq v.1.1. Technical report. Rome.

Protect soils: act now!

To ensure the sustainable management of soil resources, Asian countries are recommended to:

- develop **awareness-raising strategies** to highlight the importance of soil to everyday life and thus promote the good management of soil for future generations;
- **assess the current state of soils and associated pressures** across their territories (this might involve implementing soil sampling campaigns and **harmonizing national and regional datasets** on soil to complement the existing soil legacy data);
- develop systems for the collection of harmonised soil information and long-term monitoring of trends in soil functions and characteristics. **National Soil Information Systems** should be developed and harmonized under the Global Soil Information System (GLOSIS). Their development should go hand in hand with the preparation of soil property maps;
- develop action programmes to deal with the main issues of local concern, including strategies for the **remediation of degraded and contaminated land and applications** including soil fertility management recommendation services;
- support the **networking of soil scientists and land use experts** from across Asia in order to improve information exchange and develop a more comprehensive knowledge-base to underpin sustainable soil management policy development and practices; and
- assess the impacts of current **policies and land use practices** on soil quality in areas such as agriculture, waste, urban development, or mining, and adopt preventative measures to ensure the sustainable use of soil and maintenance of soil functions and services.



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The JRC's EU Soil Observatory supports the implementation of the European Green Deal through the provision of policy-relevant knowledge and reference data relating to soil. The atlas will be available for download in early 2023.

GLOBAL SOIL PARTNERSHIP

The Global Soil Partnership (GSP) is a globally recognized mechanism established in 2012. Our mission is to position 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.

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