WASWAC

HOT NEWS

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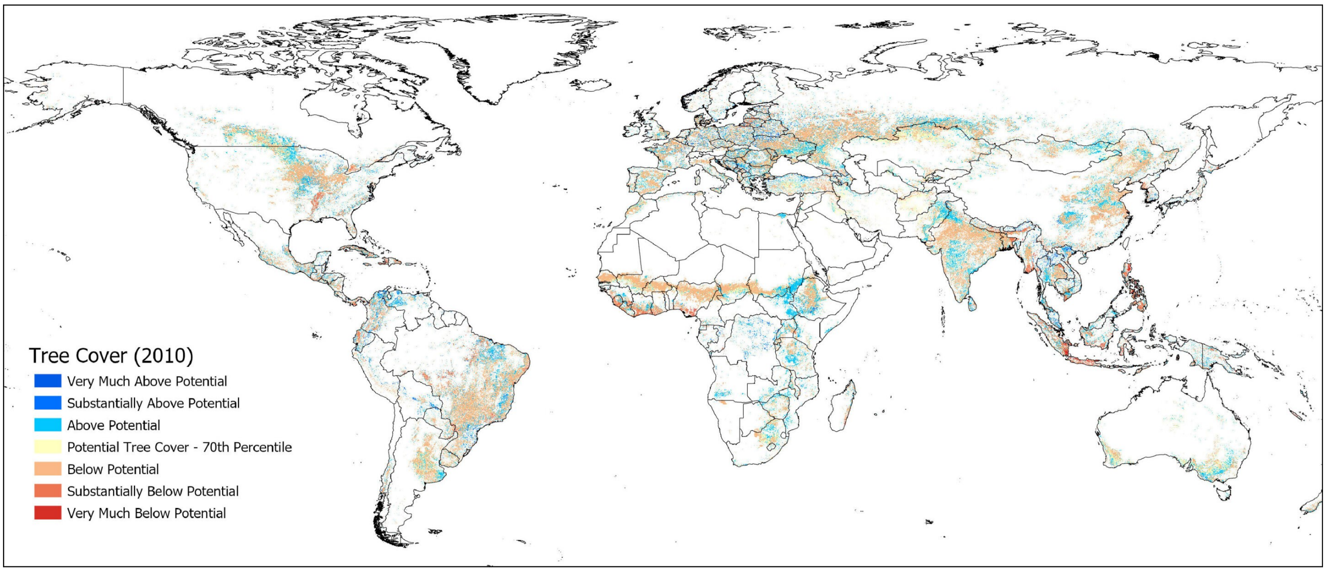
Editor: Pengfei DU

Carbon capture potential of agroforestry and trees on farms

By Zhang Nannan



Agricultural area with tree cover above and below the median tree cover value, within each grid cell's respective bioclimatic strata, i.e., carbon and aridity zone combination. Credit: KIB

Increased use of trees in agriculture can pave the way toward a transformation of the global food system, according to a new study released in May. Scientists have found that even small incremental increases in global tree cover on agricultural land could provide short-term respite to carbon accumulation in the atmosphere, benefiting the livelihoods of small landholder farmers, biodiversity, ecosystems, and ecosystem services.

Building on years of work quantifying the extent, geographic distribution, and carbon mitigation potential of agroforestry, the study—led by scientists from the Kunming Institute for Botany of the Chinese Academy of Science (KIB/CAS), the Center for International Forestry Research-World Agroforestry (CIFOR-ICRAF), The Nature Conservancy, and the Euro-Mediterranean Center of Climate Change (CMCC)—is a clarion call to policymakers and institutions to promote the widespread implementation of agroforestry practices to mitigate the effects of climate change while bolstering ecosystems, restoring degraded land and enhancing food security.

Published in Circular Agricultural Systems, the study represents the latest iteration of research on agroforestry, and its potential for carbon mitigation, over a 15-year period of interdisciplinary collaboration.

"Recently, there has been growing recognition in the land-use sector about the role of agroforestry as one of the top three Agriculture, Forestry and Other Land Use mitigation pathways, noting that it delivers multiple biophysical and socioeconomic co-benefits such as increased land productivity, diversified livelihoods, reduced soil erosion, improved water quality, and more hospitable regional climates, ultimately concluding there is "high confidence" in agroforestry's mitigation potential at field scale.

"The opportunity to achieve beneficial outcomes for both conservation and food production by increasing tree cover on farms and in farming landscapes, including building resilience and soil health benefits, cannot be overstated," said Deborah Bossio, lead scientist at the Nature Conservancy.

"Resilient agroforestry systems can therefore offer great opportunities to link adaptation and mitigation with climate change, and should be further stimulated within agriculture policy frameworks," added Antonio Trabucco, senior scientist at CMCC.

The research also plugs holes in carbon accounting schemes.

"This recent report noted a discrepancy in anthropogenic land-based carbon accounting between the numbers countries submit in their national GHG inventories and what global modeling assumes," said Meine van Noordwijk, lead scientist at CIFOR-ICRAF, "suggesting the need for finer representation of trees outside forests. The updated dataset we present here helps address this gap in the literature."

The researchers used updated carbon density maps to estimate biomass carbon present on agricultural land. It then posed the question: how much additional carbon would be sequestered if tree cover were increased? Two ecologically reasonable land-use scenarios were generated to answer this question.

The first scenario modeled changes in biomass carbon if just small incremental changes were adopted. "Incremental changes" were defined as practices that increased tree cover within existing or slightly modified agricultural systems, such as adding trees to field edges, along roadsides and canals, or as windbreaks and hedgerows.

The second scenario modeled changes in biomass carbon if systems change was adopted. "System changes" were defined as wide-scale adoption of agroforestry or other practices that integrate trees within the production system.

Incremental change in existing agricultural landscapes increased biomass carbon from 4–6 PgC (petagrams of carbon), and up to 12–19 PgC for a systemic change to tree-based systems.

Increasing tree cover on agricultural land by just 10% globally, that is, by 1% per year for the next ten years, would sequester more than 18 PgC. By comparison, aboveground losses due to tropical land use conversion have been estimated at 0.6–1.2 Pg yr-1, with net emissions from land use, land-use change, and forestry for the year 2020 estimated to be 1.6±0.7 PgC yr-1.

Given the numerous ways to integrate trees and shrubs with crops and/or livestock, agroforestry practices can be implemented around the world. The researchers also used geospatial modeling techniques to show which regional bioclimatic conditions were most suitable to increasing tree cover on agricultural land. They concluded that South America, Southeast Asia, West and Central Africa, and North America had the most potential to increase biomass carbon given their large land areas and tropical/humid conditions that facilitate plant growth.

"Increasing on-farm tree cover is not a panacea for runaway carbon emissions," said Xu Jianchu, corresponding author of the study, "however, it can help blunt the most severe effects short-term while laying the groundwork for future political and financial support, as part of the long-term transformation of our global food system."

Sources:

https://phys.org/news/2022-06-carbon-capture-potential-agroforestry-trees.html

Green focus helps tackle changing climate

Saihanba afforestation (2017 UN Champion of Earth award) in northern China

China's efforts in afforestation and nature conservation have substantially increased carbon storage, mitigating climate change in the first two decades of this century, according to an international research team.

From 2000 to 2020, the country's contribution to climate mitigation via Natural Climate Solutions amounted to 600 million metric tons of carbon dioxide equivalents each year, offsetting 8 percent of the mean annual fossil CO_2 emissions in the same period, according to a recent study published in the journal Nature Climate Change.

The Natural Climate Solutions include carbon reduction strategies, such as planting trees, and restoring grasslands, wetlands and farmland.

For the first time, scientists from China, France, the United States and the United Kingdom have estimated China's historical mitigation capacity of its conservation projects in the 2000-2020 period.

The results echoed a 2019 finding published in Nature Sustainability showing that at least 25 percent of the foliage expansion since the early 2000s globally came in China, based on data from NASA satellites.

China's contribution to the global greening trend comes significantly from its forest conservation and expansion initiatives, accounting for about 42 percent of the contribution to greening.

About 64 million hectares of trees have been planted in China over the past decade. The country's forest coverage has now reached 23.04 percent, up 2.68 percentage points from 2012.

In the recent study, the researchers also predicted the potential future during 2020-2030 and 2020-2060 by conservation, restoration and improvement of the management of forests, croplands, grasslands and wetlands.

China's achievable mitigation potential in the 2020s is estimated to be as high as 600 million tons, a level similar to that in the US and much higher than in Canada, according to the study.

It added that from 2020 to 2060, Natural Climate Solutions in China might help seal up 1 billion tons more CO_2 equivalents.

Some initial measures adopted by China to prevent soil erosion and increase grain yields turned out to be beneficial for climate mitigation, says Lyu Nan, with the Chinese Academy of Sciences, who is the paper's first author.

Irrigation management in rice paddies has reduced methane emissions and the economizing of nitrogen fertilizer has cut nitrous oxide emissions, Lyu adds. Both methane and nitrous oxide are important greenhouse gases.

"The potential of carbon reduction by technology is narrowing as its cost continues to rise," says Fu Bojie, the paper's corresponding author from the Chinese Academy of Sciences.

"However, Natural Climate Solutions can play an increasingly significant role in achieving the goal of carbon neutrality," Fu adds.

China has announced that it will strive to peak carbon dioxide emissions by 2030 and achieve carbon neutrality by 2060.

Sources:

https://www.chinadaily.com.cn/a/202208/27/WS630977e1a310fd2b29e748c8.html

Scientists exposed plants to a yearlong drought. The result is worrying for climate change

By Elizabeth Pennisi

This year, drought scorched these soccer fields in London and stressed shrubs and grasses across the globe.CARLOS

Europe and many other parts of the world are currently grappling with extreme drought—and that could be bad news for efforts to curb climate change, concludes a new global study of how shrubs and grasses respond to parched conditions.

Grasslands and shrublands cover more than 40% of Earth's terra firma, and they remove hefty amounts of carbon dioxide from the air. But by deliberately blocking precipitation from falling at 100 research sites around the world, researchers found that a single year of drought can reduce the growth of vegetation by more than 80%, greatly diminishing its ability to absorb carbon dioxide. Overall, plant growth in the artificially drought-stricken grassy patches fell by 36%, far more than earlier estimates. But the study, presented last week at the annual meeting of the Ecological Society of America in Montreal, also found great variability: Vegetation at 20% of the sites continued to thrive despite the lack of water.

Last week, the researchers reported initial results from 100 shrubby and grassy sites. At some, such as plots of shortgrass prairie in Colorado, there was "catastrophic loss," reported Kate Wilkins, a grassland ecologist now at the Denver Zoo who worked with Smith. Plant productivity in the water-starved area declined by 88%. "What surprised me was just how dead it was," Wilkins said.

In contrast, in a temperate grassland in Germany the simulated drought "did not have any significant effect," says disturbance ecologist Anke Jentsch-Beierkuhnlein from the University of Bayreuth. In general, the climate at the German site was wetter and the drought less severe than on the prairie. Overall, plants in wetter environments withstood this short-term drought better than those in drier climes, and shrub-dominated plots fared better than those dominated by grasses, Wilkins reported. Shrubs tend to have more extensive roots that can reach moisture deep in the soil. The average decline seen in the grassy plots—36%—is "almost twice as much of a reduction as other studies have shown," notes Elsa Cleland, an ecologist at the University of California, San Diego. But she and others think the data are believable because the study used standard methods across a wide variety of sites.

Many researchers have continued to monitor their plots, with some planning to collect data for four or more years, in part to simulate prolonged droughts. The additional data could help climate modelers sharpen estimates of how much less carbon is absorbed by shrub- and grasslands in a drought, says Sarah Evans, an ecologist at Michigan State University's W.K. Kellogg Biological Station. IDE results could also help ecologists forecast which ecosystems are most at risk during dry spells, as well as broader ecological ripple effects. Less plant matter can mean less food for grazing animals such as rodents and for their predators, Evans notes. "The health of many ecosystems and their biodiversity relies on plant production," she says.

Farmers, ranchers, and land managers might also benefit. Jentsch-Beierkuhnlein notes that during the current European drought, intensively managed grasslands with relatively few species, such as hayfields, have been hard hit. Planting more diverse assemblages might enable such grasslands to "keep delivering ecosystem services even under severe drought," she says.

That's an important insight, says Andrew Hector, an ecologist at the University of Oxford, given the extreme heat and drought of recent years. "The main message of these extreme conditions is that climate change … is happening already," he says. They "show just how relevant [the IDE] is."

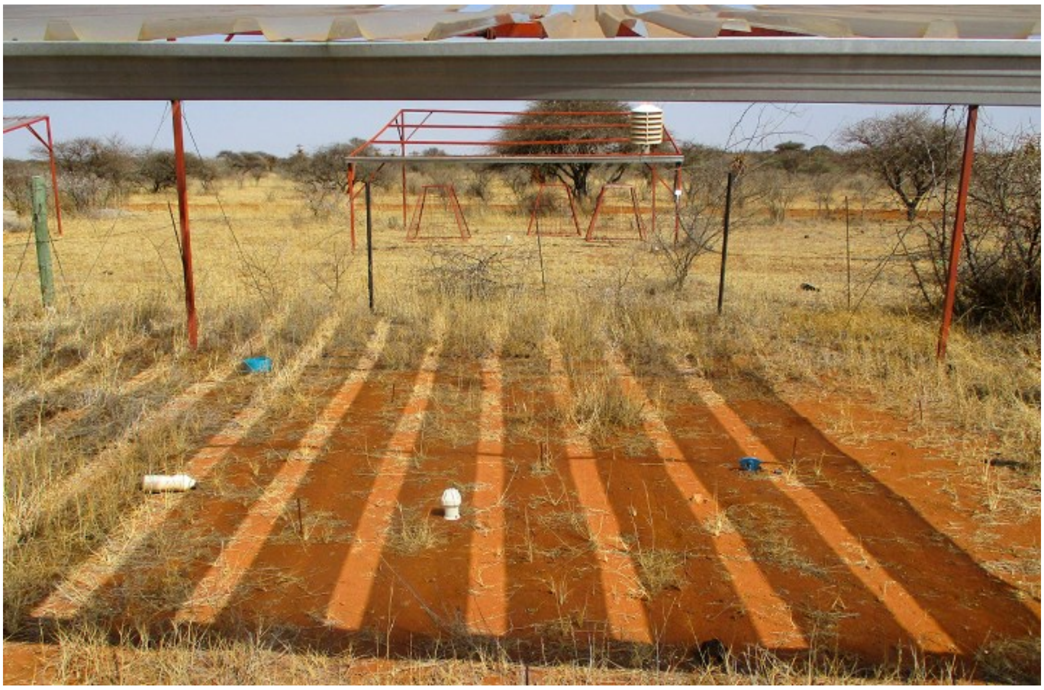
Source: *https://www.science.org/doi/epdf/10.1126/science.ade5540*

"I was surprised at how much drought impacts varied," says Drew Peltier, a physiological ecologist at Northern Arizona University who was not involved in the study. "This suggests there is some resilience in these systems; the question is how much and for how long."

A decade ago, with droughts forecast to become more frequent and severe in a warming world, three ecologists—Melinda Smith of Colorado State University; Osvaldo Sala of Arizona State University, Tempe; and Richard Phillips from the University of Indiana, Bloomington—grew frustrated with their field's inability to come up with consistent results about how dry weather affects plant productivity, particularly in grasslands and shrublands. So, they and their colleagues hammered out a standardized procedure for creating artificial droughts in the field and put out a call for researchers willing to participate in what they dubbed the International Drought Experiment (IDE).

"We expected to have about 20 sites," Smith recalls, but what's called Drought-Net has grown to 139. Some are in places, such as Iran and parts of South America, where scientists had conducted little drought research. Most are in shrub- and grasslands, where it's easier to erect structures to block precipitation.

Each team tallied the kinds and numbers of plants in the covered areas, as well as in similar plots left open for comparison. After a year of treatment, the researchers surveyed the plants again and harvested, dried, and weighed all of the aboveground plant material in the roofed and open plots.

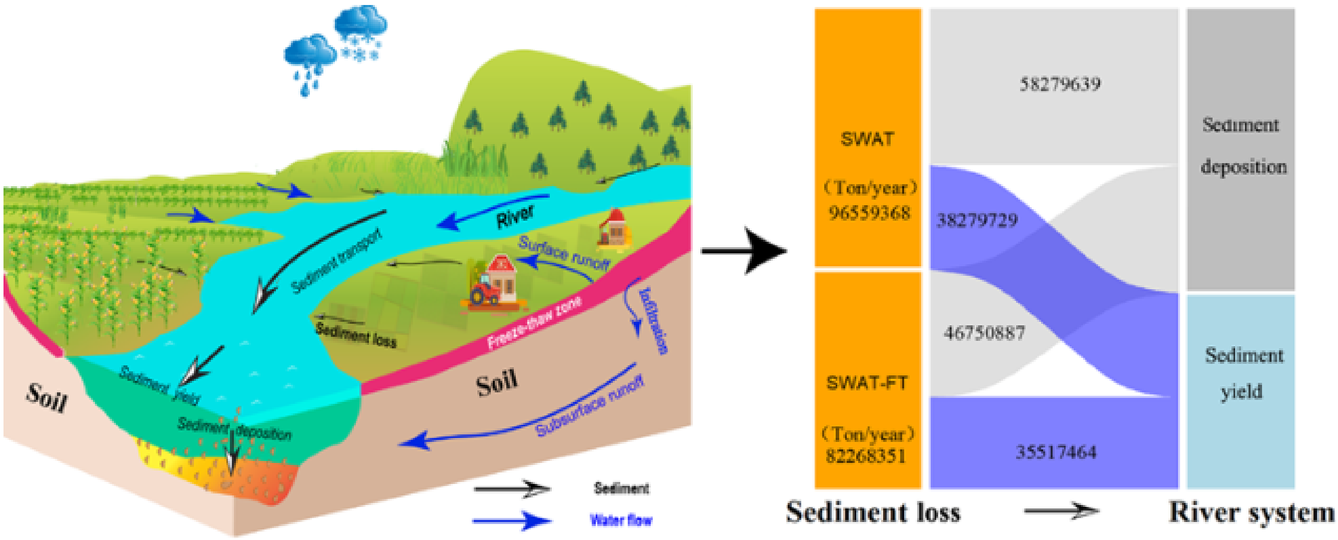


Around the world, drought shelters like this one in South Africa helped reveal how vulnerable grasslands are to yearlong droughts.KAI BEHN

Climate Change Can Intensify Soil Erosion and Sediment Deposition

In the paper titled "Pronounced Increases in Future Soil Erosion and Sediment Deposition as Influenced by Freeze–Thaw Cycles in the Upper Mississippi River Basin", the researchers aimed to project future soil erosion and sediment deposition in the Upper Mississippi River Basin (UMRB) using climate projections by five Global Circulation Models (GCMs) under the Representative Concentrations Pathway (RCP) 8.5 scenario. To account for freeze-thaw cycles (FTCs), this study compared two Soil and Water Assessment Tool (SWAT) models with different representations of the FTCs.

Modeling results show that future climate change can significantly intensify soil erosion and increase sediment deposition, and the impacts are sensitive to how FTCs are represented in the model. The standard SWAT projected an increase in soil erosion by nearly 40% by the end of the 21st century, which is much lower than the projected over 65% increase in soil erosion by SWAT-FT. For sediment deposition, the projected percent changes by the standard SWAT and SWAT-FT also deviate from each other.



Soil erosion and sediment deposition modeling are sensitive to how freeze-thaw cycles (FTCs) are represented in the SWAT model.

Overall, these results demonstrate the important roles of FTCs in projecting future soil erosion and sediment deposition and underline the need to consider the effects of conservation practices on FTCs to realistically assess the effectiveness of those measures.

Source:

https://news.essic.umd.edu/climate-change-can-intensify-soil-erosion-and-sediment-deposition/

Ugandan Soils Increasingly Losing Fertility-FAO

By Taddewo William Senyonyi

Uganda should invest heavily in sustainable soil management practices if food production and productivity is to be guaranteed.

Dr. Janet Nabwami, a Soil Management Specialist at Food and Agriculture Organization (FAO) Uganda, says their research shows that Ugandan soils are increasingly losing fertility, thus leading to lower agricultural production.

Dr. Nabwami made the remarks in an exclusive interview with Business Focus on the sidelines of the ongoing week-long digital soil -mapping training course titled: "Capacity Development on Sustainable Soil Management for Uganda". The training is taking place at Makerere University.

The training that is organized by FAO-Uganda in collaboration with Makerere University has attracted about 30 participants including students, extension officers, agricultural officers, lecturers, technicians and researchers.

Dr. Nabwami says FAO has analyzed soil samples from Eastern Uganda and the results are worrying.

"We analyzed 500 soil samples from Kumi district and the results show that soils are in a decline situation. They are very low in organic matter. Ugandan soils are no longer fertile and we need to do something before we are in jeopardy," Nabwami says.

She urges farmers to carryout proper agronomic practices that promote sustainable soil management.

"We need to look at the inputs, we need to look at how we improve soil fertility and conserve it. The farmer has to look at the fertilizers they apply, apply it in the right amount and apply it at the right time," she said, urging farmers to start testing their soils to know what's exactly missing.

She says farmers should take soil conservation seriously which calls for good agronomic practices.

"Farmers need to control soil erosion, conserve soil water and conserve the biodiversity. All this is important for soil productivity," she says, adding that the ongoing training will go a long way in creating awareness about soil testing and the need to have more soil testing laboratories so as to have services easily accessible by farmers.

She says there's also need to update the soil policy as the current one was lasted updated 20 years ago.

"We also need to get the soil institutes up and running," she says, adding: "There's need to revisit the national fertilizer policy and operationalize the national fertilizer strategy as this will assist in dealing with major challenges hindering fertilizer use along the fertilizer value chain."

Speaking at the same event, FAO Representative, Dr. Querido Antonio said too often people take soils for granted.

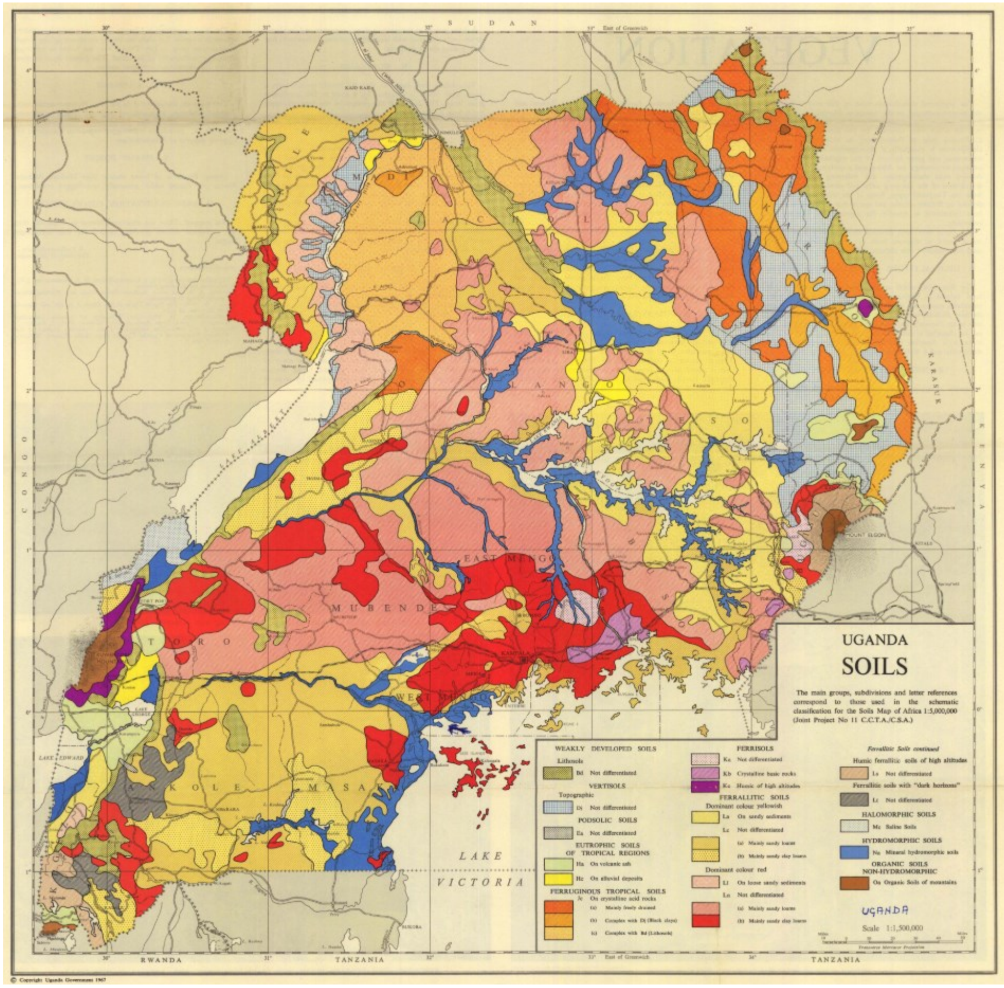
He said many Ugandans think soils are fertile and therefore anything you throw in the soil will grow which is not true.

"We do not know what is in our soil. The results from the research centers and what farmers are getting show a big discrepancy. Farmers will yield about 2.5tones of maize in a season from a hectare and research trials from NARO or Makerere will yield over 10 tonnes," he said.

He added: "We want farmers to be able to use the same parameters to get such yields and the quality of our soil and how we manage it is critical. As we look at food systems transformation and agricultural transformation, we need to look at and improve soils."

He says there's need to recognize soil as part of the global fight on climate change.

"We will not achieve our goals if we do not



Uganda Soils

improve the quality of soil. The global fight on climate change should include soil," he said.

Speaking at the same event, Ye Anping, FAO Rome- Director, South-South and Triangular Cooperation Division, FAO, said under the South to South Cooperation, FAO plays an active role in facilitating cooperation between countries to exchange information, knowledge and technologies to promote agriculture, reduce food insecurity and malnutrition.

" In the context of Uganda, in Agriculture sector, FAO has facilitated cooperation arrangements between Uganda and Peoples Republic of China. One of the ongoing cooperation arrangements with Uganda, in particular through Ministry of Agriculture, Animal Industry and Fisheries (MAAIF), is sharing of knowledge and experiences on sustainable soil management," Anping said.

He added that by cherishing and nurturing soils, "we can achieve better production, better nutrition, a better environment and a better life for all, leaving no one behind in Uganda." He added that there's need to improve soil productivity in order to improve agricultural production.

"Soil is one of four important factors for agriculture development. The four are: Soil, good management, water and quality seed. We also need political will. Without political support, we cannot afford strong discussion on soil and place it in a relevant position in agriculture development," he said.

On his part, Prof. Yazidhi Bamutaze, the Deputy Principal College of Agricultural and Environmental Sciences (CAES)-Makerere University, who represented the Principal of the College, said Uganda and Africa at large cannot divorce soils from the realization of SDGs.

"…We need to reflect on the importance of soils in our progress at the global level. We also need to recognize importance of soils at national level. NDP III cannot be implemented void of looking at soils and soil management. We are therefore in a central position in looking at soils. Degradation is widespread but there are aspects we can look at in a different way. In terms of soil mapping, Africa is poorly mapped. There is a lot that we do not know. At continental level, we need to develop databases even in Uganda, to understand what exists. We have a challenge in terms of improving the geography of mapping soils and understanding the qualities of soil and its properties. That is why this training is very important," he said.

Source: *https://businessfocus.co.ug/ugandan-soils-increasingly-losing-fertility-fao/*

Map from: *https://esdac.jrc.ec.europa.eu/content/uganda-soils*

LUCAS 2018 TOPSOIL dataset

Topsoil data for 18,984 samples from LUCAS 2018 are available as a CSV file and, to facilitate use of the data, an ESRI shapefile containing the theoretical points to which the taken samples should be associated; you may preview the file (*https://esdac.jrc.ec.europa.eu/public_path/shared_folder/dataset/75-LUCAS-SOIL-2018/readme_LUCAS-SOIL-2018-29_07_2022.docx*) to find a description of these data.

Documentation: these data are accompanied by a report (*https://esdac.jrc.ec.europa.eu/public_path/shared_folder/dataset/75-LUCAS-SOIL-2018/JRC_Report_2018%20LUCAS_Soil_Final-v2.pdf*) describing the 2018 dataset.

Geographical extent: European Union plus UK.

Format: CSV (with soil property data) + shapefile (theoretical sampling points, based on LUCAS Grid)

Measured properties: pH (CaCl2 and H2O), organic carbon content, CaCO3, nitrogen, phosphorous, potassium, EC (Electrical conductivity), Oxalate extractable Fe and Al .

Clay, silt, sand content and coarse fragments have been measured in previous surveys - these data will be made available in a single file in the very near future).

Reference Year: samples taken in 2018 .

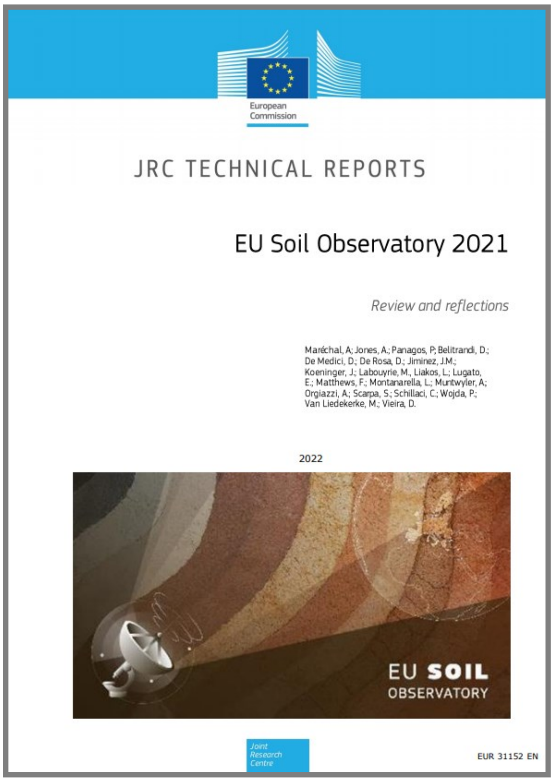
Previous LUCAS campaigns topsoil data are found here (*https://esdac.jrc.ec.europa.eu/content/lucas-2009-topsoil-data*) (2009/2012) and here (*https://esdac.jrc.ec.europa.eu/content/lucas2015-topsoil-data*) (2015)

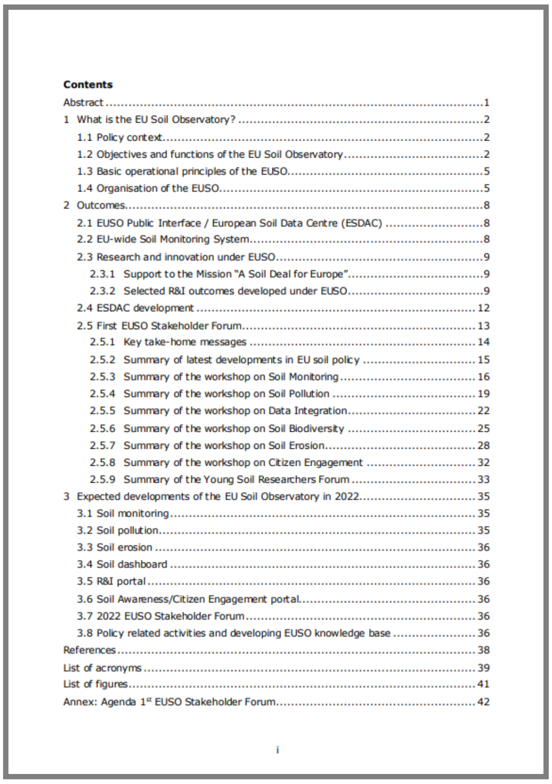
Note that for this dataset of basic soil properties, data of physical and chemical properties were analysed in samples taken at various depths in 18,984 LUCAS points as follows:

- Samples taken from 0-20 cm depth in 18,744 points (in 141 of these points, all taken in Portugal, OC and CaCO3 were also analysed in additional samples taken from 20-30-cm depth)
- Samples taken from 0-10 cm depth in 232 points
- Samples taken from 10-20 cm depth in 8 points

Details at: *https://esdac.jrc.ec.europa.eu/content/lucas-2018-topsoil-data*

JRC Technical Reports: EU Soil Observatory 2021 & LUCAS 2018 Soil Module





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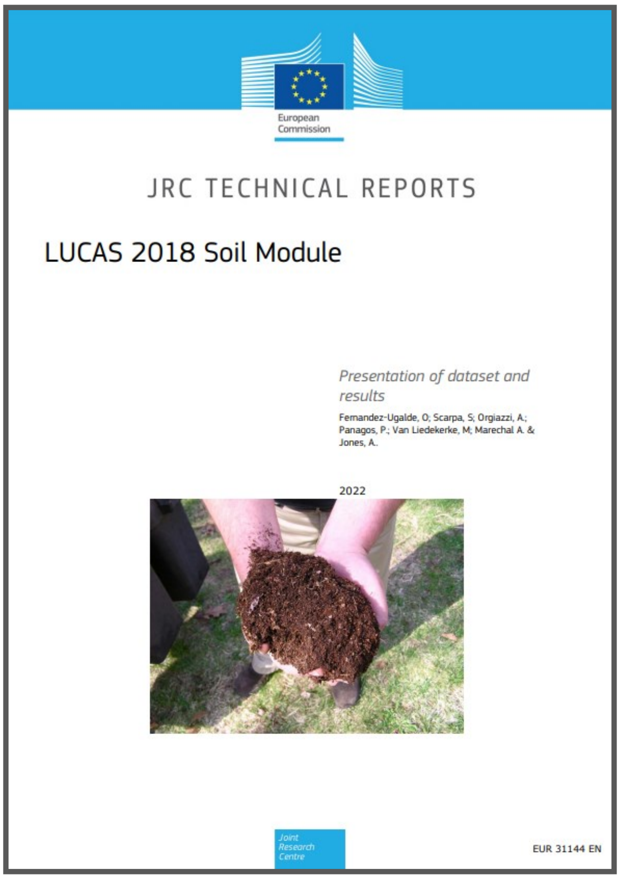
EU Soil Observatory 2021 presents the soil dataset collected as part of the 2018 Land Use/Cover Area frame statistical Survey' (generally referred to as LUCAS Soil Module). It presents an overview of the various laboratory analyses and describes the spatial variability of soil properties by land cover (LC) class and a comparative analysis of the soil properties for NUTS 2 regions. This is the 3rd iteration of LUCAS Soil, covering all EU Member States in a six month window of 2018. The LUCAS Soil module is the only mechanism that currently provides a harmonised and regular collection of soil data for the entire territory of the EU.

Download here:

https://esdac.jrc.ec.europa.eu/public_path/shared_folder/doc_pub/EUR31152.pdf



European Commission

JRC TECHNICAL REPORTS

LUCAS 2018 Soil Module

Presentation of dataset and results

Fernandez-Ugalde, O; Scarpa, S; Orgiazzi, A.; Panagos, P.; Van Liedekerke, M; Marechal A. & Jones, A.

2022

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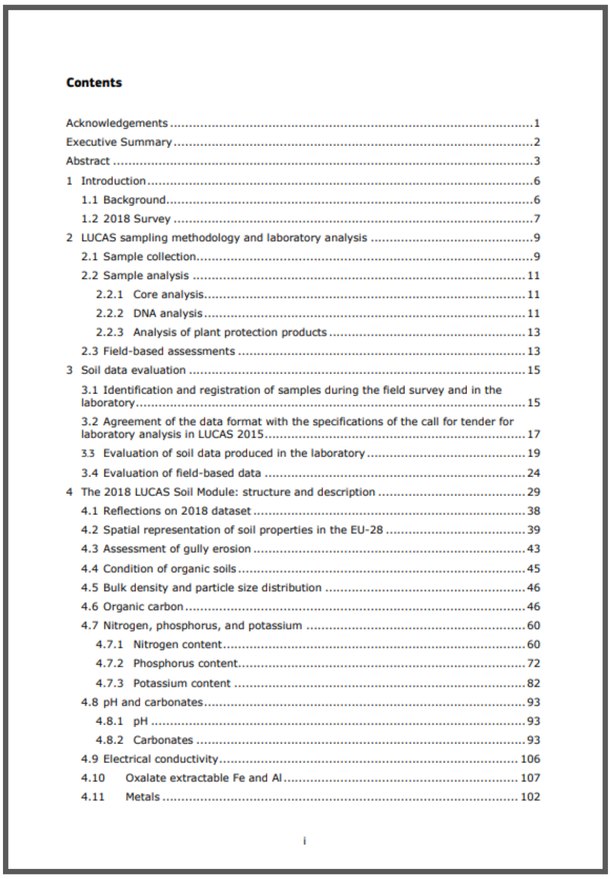

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LUCAS 2018 Soil Module presents the soil dataset collected as part of the 2018 Land Use/ Cover Area frame statistical Survey' (generally referred to as LUCAS Soil Module). It presents an overview of the various laboratory analyses and describes the spatial variability of soil properties by land cover (LC) class and a comparative analysis of the soil properties for NUTS 2 regions. This is the 3rd iteration of LUCAS Soil, covering all EU Member States in a six month window of 2018. The LUCAS Soil module is the only mechanism that currently provides a harmonised and regular collection of soil data for the entire territory of the EU.

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