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Food and Agriculture Organization
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FAOSTAT ANALYTICAL BRIEF 4

Drained organic soils 1990–2019

Global, regional and country trends

>> FAO Statistics Division

HIGHLIGHTS

→ **The Food and Agriculture Organization of the United Nations (FAO) updated the FAOSTAT datasets on greenhouse gas emissions from organic soils, 1990–2019. National statistics, generated from geospatial information, document an important disturbance to the global carbon cycle, linked to drainage for agriculture.**

→ **As of the year 2019, nearly 25 million hectares of organic soils globally had been drained for agriculture since 1990, generating annual greenhouse gas emissions of 830 million metric tonnes of CO_2eq, about eight percent of total emissions from agriculture.**

→ **The most critically endangered organic soils ecosystems are the tropical peatlands of South-East Asia, whose drainage, mostly for oil palm cultivation, contributed in 2019 nearly half of world total emissions from organic soils.**

→ **Indonesia contributed 20 percent of world total drainage area and 40 percent of world total emissions from drained organic soils. Drainage of tropical peatlands was second only to energy use as a national emissions source.**

FAOSTAT DRAINED ORGANIC SOILS

BACKGROUND

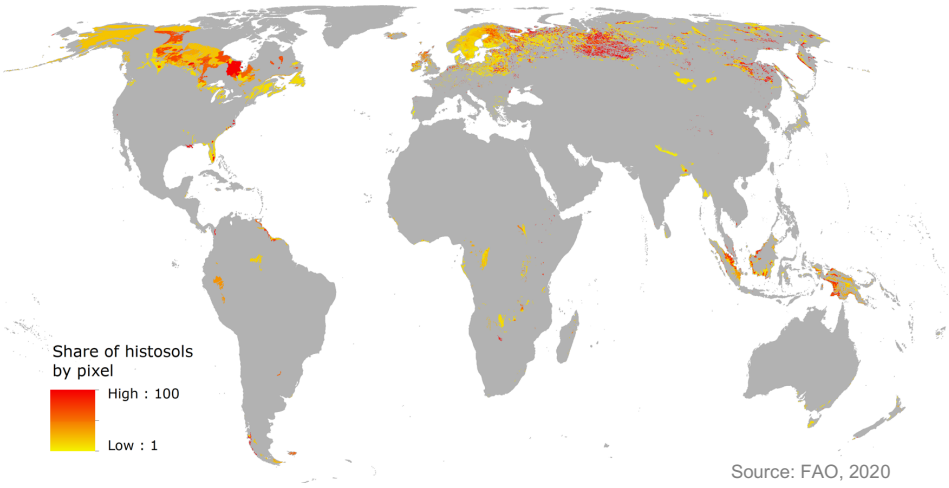
Organic soils are, generally speaking, wet soils ecosystems, characterized by high levels of organic matter, which accumulates under the anoxic conditions that exist in the presence of water. They include tropical and boreal peatlands, high-latitude bogs and mires. Indeed, while organic soils cover globally a mere three percent of the terrestrial land area, they represent up to 30 percent of the total soil carbon, playing an important role in maintaining the earth's carbon balance. Drainage of organic soils releases large quantities of carbon dioxide (CO_2) and nitrous dioxide (N_2O) into the atmosphere and for several decades after the drainage event, due to the increased oxydation rates of the underlying organic matter. Agriculture is a major cause of drainage of organic soils around the world, especially since 1990 for the cultivation of permanent crops such as oil palm and cacao.

Restoration of degraded organic soils is currently a priority in several countries as part of their commitments under the climate convention. Measuring current trends, globally and with country detail, is therefore important to identify and quantify existing and fast-developing new hotspots of degradation and to help reduce emissions from drained organic soils in future decades.

FAOSTAT statistics provide information on the area of drained organic soils for agriculture around the world and the resulting anthropogenic greenhouse gas (GHG) emissions to the atmosphere. Estimates of area drained and subsequent emissions are first computed at pixel level, using available geospatial information on soils characteristics, land cover, land use and climate conditions. In particular, the FAOSTAT estimates use histosols as proxy for presence of organic soils, in agreement with IPCC guidelines (Figure 1).

Data are aggregated at national level for 101 countries and four territories, representing the subset of FAOSTAT countries and territories where organic soils are present. Statistics are disseminated in three separate domains, over the period 1990–2019, in line with country reporting requirements to the Climate Convention, following the Intergovernmental Panel on Climate Change Guidelines (IPCC, 2006). Namely, statistics are disseminated by gas and land use class: emissions of N2O on cropland and grassland are disseminated under the domain Cultivation of Organic soils of FAOSTAT Emissions-agriculture; whereas emissions of CO_2 on Cropland and Grassland are disseminated within the FAOSTAT Emissions-Land use domain. These FAOSTAT statistics represent the only avaialble global dataset in the world today showing country, regional and global time series on drained organic soils.

Figure 1. Global extent of organic soils – histosols



Map conforms to United Nations 2018 map. July 2020.[1]

GLOBAL

In 2019, the world total area of drained organic soils reached 25 million hectares (ha), up from 23 million ha in 1990. Of this total, about 14 million ha were in temperate and boreal areas of the northern hemisphere, while the remainder were tropical peatlands, mostly in the southern hemisphere.

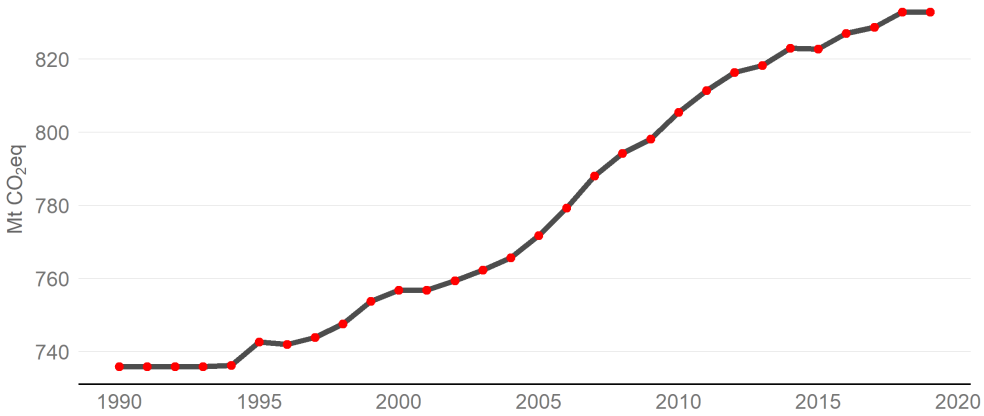
[1] The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of FAO concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers and boundaries. Dashed lines on maps represent approximate border lines for which there may not yet be full agreement.

The correspoding world total GHG emissions were 833 Mt CO_2eq, with CO_2 and N_2O gas contributing 87 percent and 13 percent ot this amount, respectively. Emissions from drainage of organic soils represented nearly eight percent of total agriculture emissions.

About three quarters of the global area of organic soils drained for agriculture was for cultivation of both temporary and permanent crops. The remainder one quarter was drained for livestock grazing.

The past two decades marked a significant increase in the area of drained organic soils, largely due to drainage of tropical peatlands in South-East Asia. Emissions were ten percent higher in 2019 compared to 2000 and 13 percent higher compared to 1990 (Figure 2).

Figure 2. Global emissions from drained organic soils, 1990 – 2019



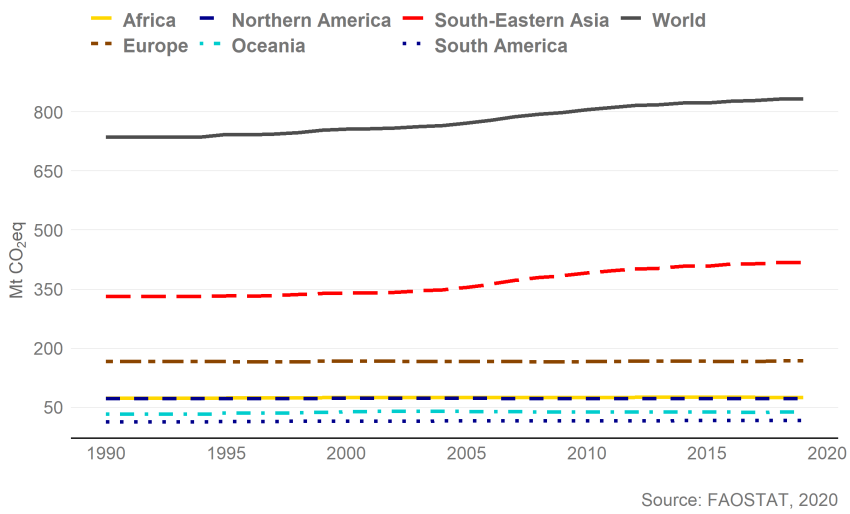
Source: FAOSTAT, 2020

REGIONAL

As of 2019, the area of drained organic soils for agriculture was largest in Eastern and Northern Europe (11 Mha in total), representing 45 percent of the world total. It was followed by Asia (eight Mha), with nearly 6 Mha were in South-East Asia alone. Smaller contributions came from North America (3 Mha), Africa, South America and Oceania (1 Mha).

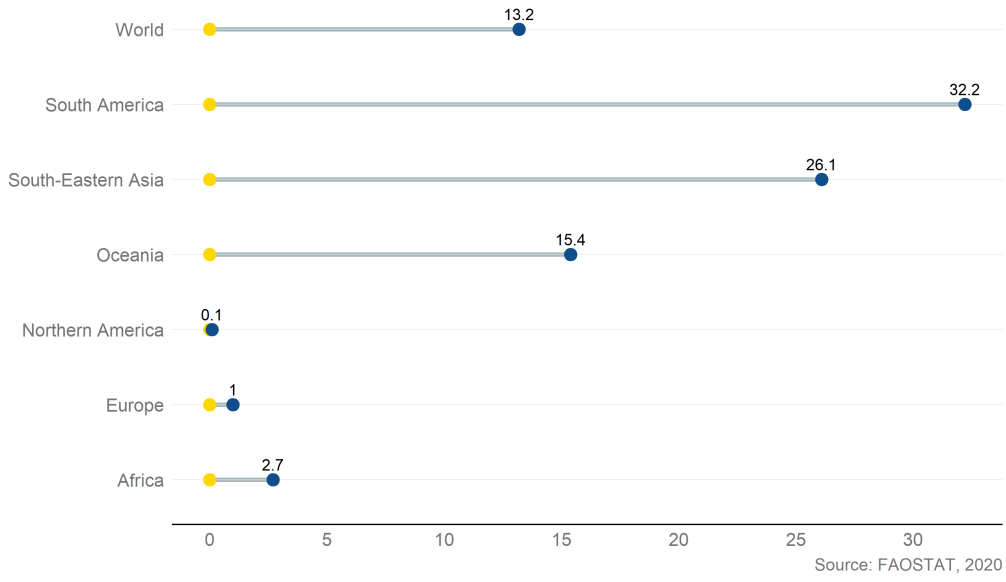
Conversely, GHG emissions were larger in tropical Asia, due to the fact that carbon loss from oxydation is faster in warmer climates. In 2019, drained organic soils in Asia were responsible for emissions of 466 Mt CO_2eq, more than half of the world total, followed by emissions from Europe (167 Mt CO_2eq), Africa and North America (71 and 74 Mt CO_2eq, respectively). Drained tropical peatlands in South-East Asia were the world single largest emission source (417 Mt CO_2eq) (Figure 3).

Figure 3. Regional and subregional emissions from drained organic soils, 1990-2019



Since 1990, emissions from drained organic soils increased mainly in South-East Asia, by more than 100 Mt CO2eq, representing a relative growth of 25 percent over the period 1990–2010. Albeit starting from much lower absolute values, relative growth was also strong in South America (30 percent) and Oceania (15 percent). As shown in Figure 4, emissions increases were instead quite small in Africa (3 percent), North America and Europe (where they remained virtually unchanged). While still poorly studied, the estimated growth rates in South America, Oceania and Africa are consistent with recent literature on recent degradation of organic soils due to agriculture in these regions. The low growth rates in Europe and North America reflect the fact that organic soils in these regions have already been drained.

Figure 4. Percent change in emissions from drained organic soils (1990–2019), by region and subregion



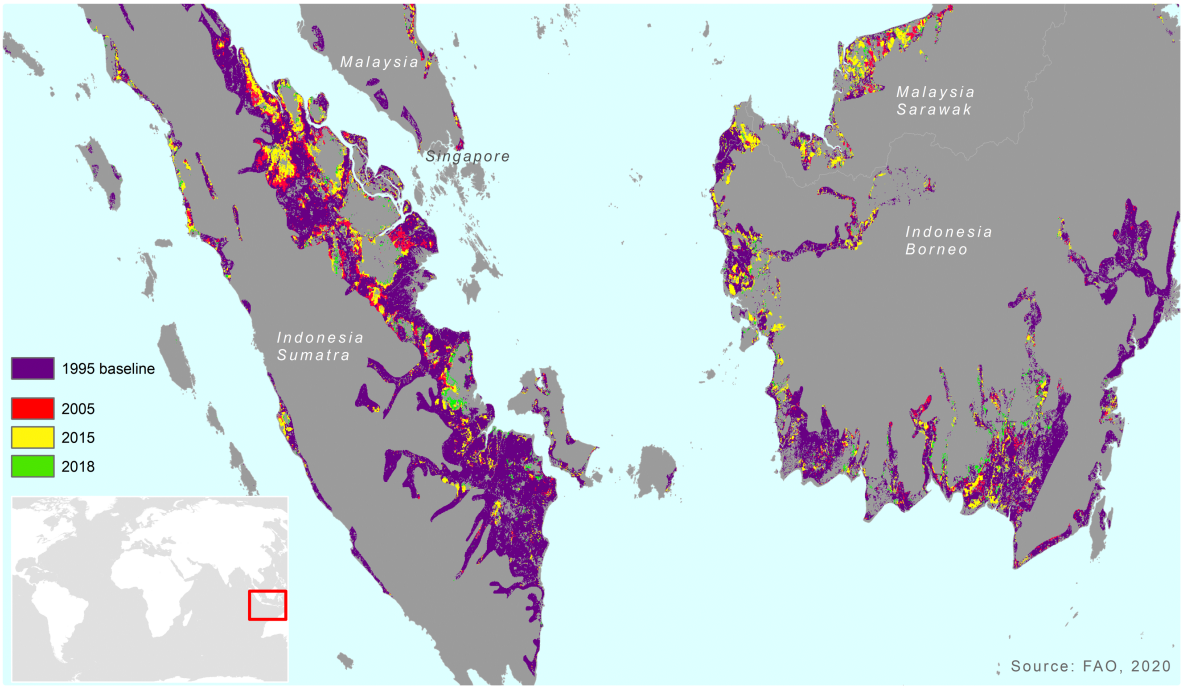
COUNTRY

In 2019, Indonesia had the world largest annual emissions from drained organic soils, totaling 343 Mt CO_2eq (41 percent of the world total). These emissions are from about 5 Mha of drained tropical peatlands, largely for oil palm cultivation. Substantial contributions were estimated for Malaysia (48 Mt CO_2eq), the United States of America (47 Mt CO_2eq), Russian Federation (35 Mt CO_2eq) and Belarus (27 Mt CO_2eq).

Indonesia also had largest absolute increase in emissions from drained organic soils during the 1990–2019 period, corresponding to 273 Mt CO_2eq (26 percent relative increase). Malaysia had a smaller yet still significant increase over the same period, of 31 Mt CO_2eq, representing the highest relative increase among large emitters (54 percent). Figure 5 illustrates the increase over time in the area of drained organic soils in both countries.

Finally, the world highest relative increases were computed for Peru (+150 percent drainded area; +100 percent emissions), although these changes happened with respect to low initial values.

Figure 5. Extent of drained organic soils in Indonesia and Malaysia over time, showing total drained area in 1995 and successive additions by 2005, 2015 and 2018.



Map conforms to United Nations 2018 map. July 2020.[2]

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EXPLANATORY NOTES

- The FAOSTAT domains "Cultivation of Organic soils," ''Cropland Organic Soils'' and ''Grassland Organic Soils'' contain estimates of nitrous oxide (N_2O) and CO_2 emissions associated with the drainage of organic soils for agriculture. Data is computed geospatially, using the Tier 1 default factors defined by the Intergovernmental Panel on Climate Change (IPCC, 2006). Estimates are available by country, with global coverage and relative to the period 1990–2019.

- Disseminated information includes emissions, implied emission factors and the underlying activity data, *i.e.* area of histosols (in ha) drained in agricultural areas. GHG estimates are available in Gg of N_2O and in corresponding Gg of CO_2 equivalents. Conversion to CO_2eq is made via Global Warming Potentials (GWP) coefficients, from: *a)* Second Assessment Report (SAR)(IPCC, 1996); *b)* IPCC Fourth Assessment Report (AR4) (IPCC, 2007); and *c)* IPCC Fifth Assessment Report (AR5)(IPCC, 2014). Data are estmated for the 101 countries and 4 territories where organic soils exist according the the world soil map used in this analysis. Estimates are available by country, by FAOSTAT regional aggregation and special group, including the Annex I and Non-Annex I Parties to the United Nations Framework Convention on Climate Change (UNFCCC).

- Geospatial data are obtained through the stratification of the following spatial datasets:

    I. Map derived from the Harmonized World Soil Database (HWSD-FAO *et al.*, 2012), with percentages of the pixel area with *histosols* (both as dominant and secondary soil type). The area covered by *histosols* is used as proxy, as per IPCC guidelines, for organic soils. Methods relevant to the development and use of this spatial layer are discussed in Tubiello *et al.* (2016) for previous comparable GHG estimates.

    II. Annual land cover maps (for the period 1993–2018) produced by the Catholic University of Louvain Geomatics as part of the Climate Change Initiative of the European Spatial Agency (vesion 2.0, CCI UCL Geomatics, 2017) and version 2.1 updates under the European Copernicus program (2019). Cropland area is identified from the CCI-LC yearly maps, applying specific proportions to pixel area in the relevant land cover categories. The approach follows primarily a land cover perspective as in the FAOSTAT "Land Cover" domain. The cropland area is identified from the CCI-LC yearly maps, applying specific proportions to pixel area in the relevant land cover categories.

    III. For grassland, the trampling of grazing animals on organic soils is associated with drainage, and N_2O and C release from degraded organic soils. The presence of livestock is derived from the spatial distribution of cattle, goats and sheep from the FAO Gridded Livestock of World (Robinson *et al.*, 2014).

- A methodological note of each domain "Cultivation of Organic soils," ''Cropland Organic Soils'' and ''Grassland Organic Soils'' is available in FAOSTAT.

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