



Overview: tropical peatland drainage, carbon loss, subsidence and flooding

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(<https://www.dataforsustainability.com/>)

Drained agriculture on tropical peatland not only results in high carbon emissions but also causes the peat surface to sink rapidly (subsidence) which will eventually result in flooding and crop production loss. Despite the resulting economic costs, governments, companies and communities have limited awareness of this issue and continue to develop drained agriculture on these vulnerable lands. So how certain is this damage, how fast is the land sinking, and what can be done to stop it?

Some considerations based on our experience and insights:

Does agriculture on peatland always require drainage?

Yes, usually. Peatland is basically a waterlogged swamp that took thousands of years to form. For common crops like Oil Palm, Acacia (for pulp wood) and Rubber the soil must be drained to allow roots to breathe. This requires draining the land, through a dense network of canals.

Why does draining peatlands cause more severe carbon loss and subsidence in the tropics?

It is sometimes said that drained agriculture on peatland has existed for centuries in Europe and the USA, and in some areas is still ongoing, so it can be sustainable. However, in these cooler regions the loss rate of drained peat by biological breakdown is much lower and subsidence rates are generally below 1 cm per year. In tropical climates, peat breakdown and emission rates are much higher and subsidence typically exceeds 3 cm per year.

Can subsidence and carbon emission in drained peatlands be reduced?

Yes, but the only way to do this is by raising water levels. And as long as water levels are low enough for common crops, subsidence and carbon emission rates will remain high. Subsidence reduction by more than 30% in productive cropland is not supported by scientific evidence. Based on history (mostly in Europe and USA), a full stop to subsidence may be achieved by bringing up water tables to natural levels again through canal blocking, and by restoring a permanent near-natural vegetation cover. However, this takes decades, so no restoration project in SE Asia has fully achieved this yet.

How quickly will subsidence result in flooding?

This depends - the higher the peat surface is above the drainage base i.e. sea- or river levels, or the lower the subsidence rate, the longer it will take for serious flood problems to develop (see Insight Report A.5). Many drained coastal peatland regions in SE Asia have already lost most peat, with the remaining mineral soil surface often being 2 m or less above mean sea level. Such areas already experience flood problems, causing production loss and in some cases abandonment. For areas that are still productive, lifespans for plantations are estimated between a few decades to around one century, also accounting for expected sea level rise.

D4S Insight Report A.1



Will the land surface always be flooded once it reaches the drainage base?

While it is technically possible to avoid flooding by implementing control measures involving dikes and pumping stations, this may not be feasible at a large scale in SE Asia. Complicating factors include soft soils that do not allow dike construction, high rainfall rates that would require exceptional pumping infrastructure, and tectonic activity.

Why is there only limited interest in this issue?

Actually, the RSPO (Round table for Sustainable Palm Oil) guidelines specify that plantations must cease production, and restore peatlands, once subsidence is projected to cause flooding within 2 crop cycles i.e. 40 years. However, most oil palm companies are not RSPO members, and it is not clear how strictly the guidelines are applied by members. And in general, there appears to be a persistent lack of awareness of this issue amongst companies, governments and also investors.

So what can be done to mitigate peatland loss and carbon emission due to drainage?

Part of any solutions will be to raise awareness of peat loss and subsidence as a threat to long term production, and to improve the quality and coverage of monitoring of water table depth and subsidence rate, involving both ground and satellite data (see Insight Report A.2). Another part of the solution will be to develop agricultural production systems that are tolerant to waterlogging and occasional flooding. This is often referred to as 'paludiculture' following European examples, but in a SE Asian context it can mean a return to traditional wetland crops like timber wood and sago palm, in an agroforestry setting without canal drainage. Ideally, such wetland agroforestry can be part of broader peatland restoration plans aiming to increase the area of natural peat swamp forest and be eligible for carbon crediting schemes (see Insight Report B.3).

SELECTED FURTHER READING (D4S PUBLICATIONS)

Subsidence and carbon loss in drained tropical peatlands (<https://bg.copernicus.org/articles/9/1053/2012/>)

Extent of industrial plantations on Southeast Asian peatlands in 2010 with analysis of historical expansion and future projections (<https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1757-1707.2012.01172.x>)

Flooding projections from elevation and subsidence models for oil palm plantations in the Rajang Delta peatlands, Sarawak, Malaysia (<https://www.deltares.nl/en/expertise/projects/flooding-projections-for-oil-palm-plantations-in-the-rajang-delta-peatlands-sarawak-malaysia>)

Hydrological and economic effects of oil palm cultivation in Indonesian peatlands (<https://www.ecologyandsociety.org/vol21/iss2/art52/>)

Benefits of tropical peatland rewetting for subsidence reduction and forest regrowth: Results from a large-scale restoration trial (<https://www.nature.com/articles/s41598-024-60462-3>)