D4S Q&A #1

Tropical peatland plantation drainage, carbon loss, subsidence and flooding

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(https://www.dataforsustainability.com/contact.html)

It is well known that drained agriculture on tropical peatland not only results in high carbon emissions but also causes the peat surface to sink rapidly (subsidence) which will result in flooding and crop production loss. Despite the economic costs, companies continue to develop plantations on these 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 dried out to allow roots to breathe. This requires draining the land, through a dense network of canals.

Why does draining peatlands cause more severe problems in the tropics?
It is sometimes said that drained agriculture on peatland has existed for some 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 rates are much higher and subsidence rates typically exceed 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 forest 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. 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 currently experience severe flood problems, already causing production loss and in some cases actual 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.

Will the land surface always be flooded once it reaches the drainage base?
It is technically possible to avoid flooding by implementing control measures involving dikes and pumping stations. However, flood protection by dikes and pumping is currently hardly implemented in SE Asian peatlands and may not be feasible at a large scale. Complicating factors include soft soils that do not allow dike construction, high rainfall rates that would require exceptional pumping infrastructure, tectonic activity and often low budgets.

Why does the plantation industry not pay more attention to 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?
The key to 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. 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.

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 (link: 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)