Rajang Delta threatened by floods!!

This paper presents a case study of the Rajang Delta in Sarawak, Malaysia where peatland subsidence will cause flooding, rendering more than half of the Rajang Delta unsuitable for any agriculture cultivation due to severe floods in 50 years. The land area which will be inundated is 3 times the size of Singapore!! What a great loss!

Case study summary:

The case study reveals that about 87% of the Rajang Delta in Sarawak may be flooded within 100 years if current peatland management is continued. Presently substantial areas are already experiencing drainage problems. This will eventually take a toll on the local communities, the economy and biodiversity. Over time problems will escalate unless management and policies are changed.

Wetlands International therefore recommends that for long-term sustainable use of these peatlands, measures such as planting of alternative crops that do not require drainage of peatlands and rewetting of peatlands should be undertaken. We also call for conservation and sustainable management of peatlands in Malaysia.

A study commissioned by Wetlands International and executed by Deltares suggests that extensive drainage of peatlands for oil palm cultivation in the Rajang river delta results in massive land subsidence that will lead to extensive and devastating flooding incidents in the coming decades.

From the study done, it was projected that under a conservative peat soil subsidence rate of 3.5 cm yr-1 approximately 57% of peatlands in Rajang Delta will likely be subjected to severe flooding in year 2034 and 69% in year 2059 (see Figure 1).

Such extensive flooding is due to massive conversion of peat swamp forests to agriculture, mainly oil palm plantations. These valuable crops require drainage in order to be profitable. Currently only 16% of Sarawak's natural peat forests remain.

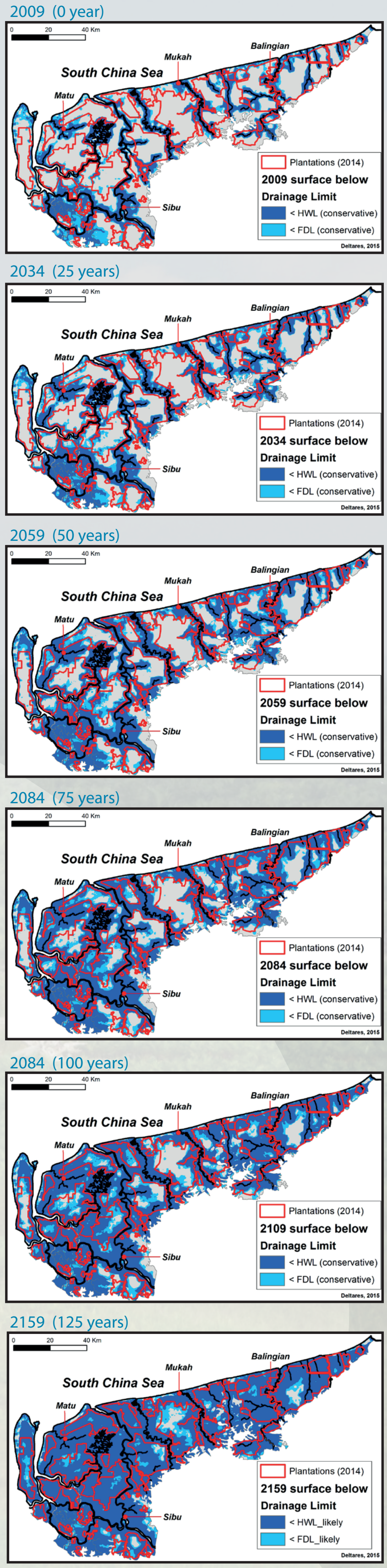

Figure 1: 'Conservative Impact' scenario flood extent projection for 0, 25, 50, 75 and 100 years, applying a conservative subsidence rate of 3.5 cm yr-1 and conservative flooding thresholds after year 2009.

The study confirms earlier assessments by the Department of Irrigation and Drainage Sarawak (2001). They reported that after the initial two years of drainage under a regulated drainage depth of 0.6m an average subsidence rate of 5 cm yr-1 will occur in Sarawak. Subsidence rates reported for a Johor oil palm plantation were 4.6 cm yr-1 between 14 to 28 years after drainage (Wösten et. al., 1997), and 3.7 cm yr-1 at 11 other locations (DID Malaysia, 1996). Another local study by Mohammed et. al. (2009) showed that on the basis of field monitoring in oil palm plantations on peat with 3 to 4 m in thickness, a subsidence rate stabilises at 4.3 cm yr-1 after 15 years under best management practice with average water depths of 0.4m. Therefore, the subsidence rates applied in the flooding projections in this study are close to most literature values found in local and foreign studies. In addition, in 1982 the Sarawak Department of Agriculture published a map showing the 'agriculture capability' stating that all peatland areas are "Land comprising organic soils with such severe limitations that agriculture is not feasible".

Flooding and drainability conditions according to three subsidence scenarios (minimum, conservative, maximum) in 25 years steps are shown in Figure 2. In all scenarios, almost half (46-86%) of the peat area cannot be drained within 50 years and over two-third (61-99%) within a century (see Table 1).

Impact scenario	'minimum' scenario		conservative' scenario		'maximum' scenario	
Drainage limit	HWL+FDL (min.)		HWL+FDL (cons.)		HWL+FDL (max.)	
Subsidence rate	2 cm/yr		3.5 cm/yr		5 cm/yr	
Year	ha	%	ha	%	ha	%
Total area						
2009	307169	36.2	408152	48.1	503252	59.4
2034 (after 25 yrs)	364580	43.0	508482	60.0	629117	74.2
2059 (after 50 yrs)	421757	49.8	596559	70.4	730275	86.2
2084 (after 75 yrs)	478706	56.5	671655	79.2	791827	93.4
2109 (after 100 yrs)	532123	62.8	736652	86.9	826921	97.6
2159 (after 150 yrs)	623105	73.5	808971	95.4	832936	98.3
Peat area						
2009	230358	30.8	324593	43.5	417045	55.8
2034 (after 25 yrs)	287769	38.5	424923	56.9	542910	72.7
2059 (after 50 yrs)	344946	46.2	513000	68.7	644068	86.2
2084 (after 75 yrs)	401895	53.8	588096	78.7	705620	94.5
2109 (after 100 yrs)	455312	61.0	653093	87.5	740714	99.2
2159 (after 150 yrs)	546294	73.2	725412	97.1	746729	100.0
Plantation on peat area						
2009	72564	18.4	113377	28.8	163897	41.6
2034 (after 25 yrs)	95869	24.3	166031	42.2	241877	61.4
2059 (after 50 yrs)	122198	31.0	221280	56.2	313802	79.7
2084 (after 75 yrs)	153035	38.9	273735	69.5	360557	91.6
2109 (after 100 yrs)	184767	46.9	321482	81.7	388844	98.8
2159 (after 150 yrs)	244680	62.1	376857	95.7	393708	100.0

Table 1: Comparison of peatland that would be frequently flooded under the 'Minimum', 'Conservative' and 'Maximum' impact scenario projections, assuming all peatland would be drained as if it were oil palm plantation.

After 25 years - Year 2034

After 100 years - Year 2109

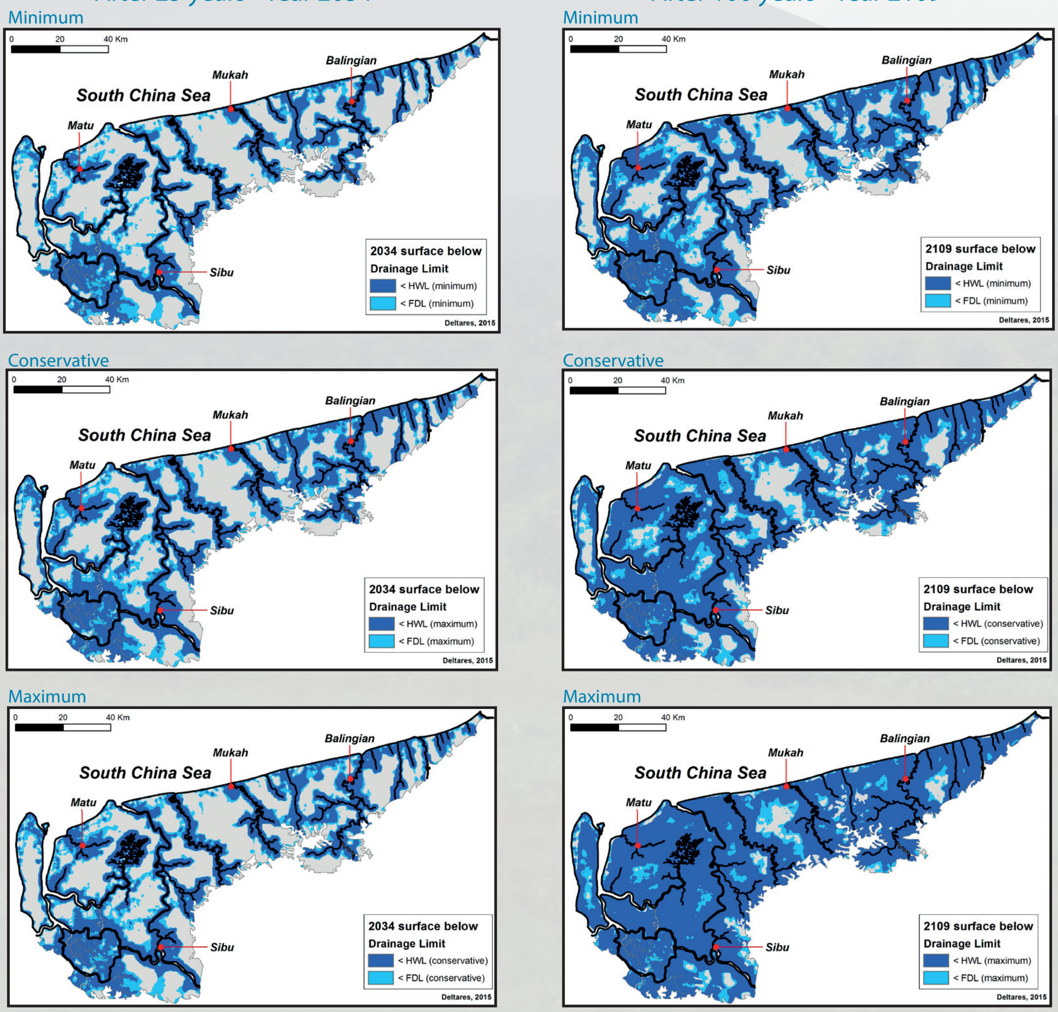

Figure 2: Comparison of flooding and drainability conditions according to the 'Minimum' (top), 'Conservative' (middle) and 'Maximum' (bottom) impact scenarios, after 25 (left) and 100 (right) years.

Soil subsidence and flooding in Southeast Asia

In Malaysia and in western Indonesia (i.e. Sumatra and Kalimantan) millions of hectares of peat swamp forests have been drained for oil palm or pulp wood plantations (see Figure 3). In the first five years after drainage, peatland subsidence is typically about 1 to 2 metres. In subsequent years, this stabilizes to a constant 3 to 5 cm per year, resulting in a subsidence of 2 to 3 metres in 25 years and 4 to 5 meters in 100 years.

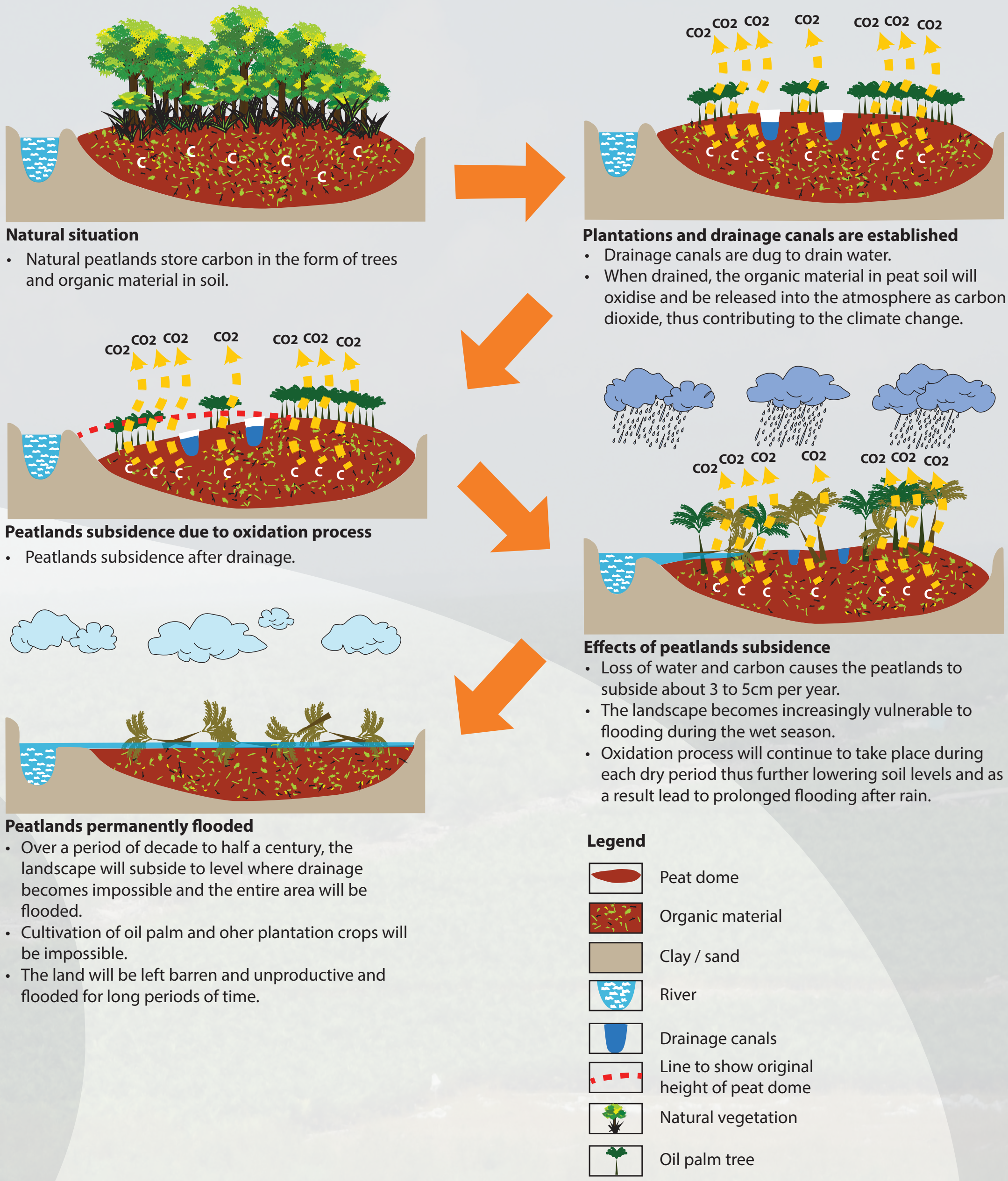

Figure 3: Pictorial illustration explaining the consequence of peatland subsidence after drainage.

What is peat soil emissions and subsidence

Peat consists of 90% water and 10% carbon from dead plant materials that have accumulated for thousands of years. Deforestation and drainage of peatlands results in the decomposition of the organic plant material – turning the peat carbon into CO2 (a greenhouse gas). The soil thus literally evaporates into thin air! Peatland subsidence is the loss of carbon and physical compaction of the peat resulting in lowering of the soil surface (see Figure 4). Under tropical circumstances this can result in a soil subsidence of several centimeters per year. In lowland areas, peat landscapes can subside to a level (i.e. river or sea levels) at which drainage is no longer possible; this will result in frequent and prolonged flooding.

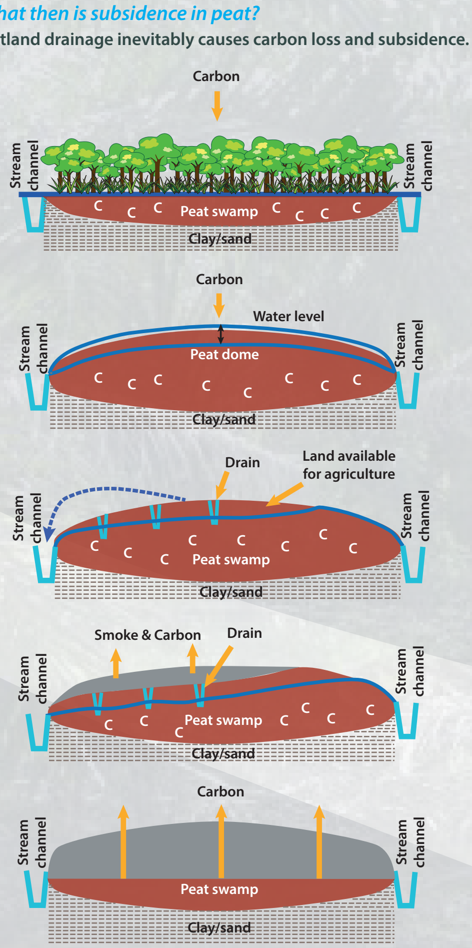

Figure 4: Pictorial to explain peatsoil emissions and subsidence

Fire risk in dry peatlands

Another notable consequence after drainage is the increasing fire risk in dry peatlands. Dry peat is extremely prone to fires. In the event of dry season, it is difficult to put out and release a huge amount of additional carbon thus leads to the formation of thick haze due to the lack of oxygen. The carbon loss further reduces the peat volume and thus causes the peat soil to subside at a rate of between 3 and 6 cm/yr. This process continues as long as drainage is continued and until the soil surface reaches sea or river levels constraining the outflow of water by gravity and therefore, leading to flooding and loss of productive land. Despite the fact that Rajang Delta receives more rainfall than most coastal areas in SE Asia and rarely experiences dry months, yet, fires have occurred in the area at a large scale as shown in Figure 5. It is remarkable that fire hotspots have to date been concentrated almost entirely in plantation areas. Judging from the clear patterns with different groupings in different years, they appear to be a regular and well-coordinated land clearing tool but not accidental occurrences.

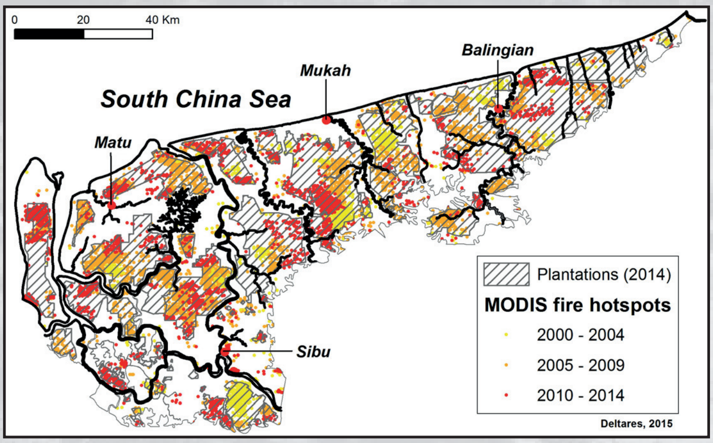

Figure 5: Extent of current (June 2014) industrial plantations and fires in the study area.

Conclusion

It is predicted that crop production will gradually decline. Drainage will be a challenge not only during the wet period but also dry period. To counter the effects of subsidence will require huge investments in remedial and management costs. This will make palm oil production unprofitable. Other factors such as fires may speed up the subsidence rates. This, coupled with the rise in sea level and peak flood conditions will further aggravate the flooding and subsidence issue in Rajang Delta. To elevate this problem it is recommended that alternative agriculture methods that do not require drainage of peatlands be introduced and also to promote sustainable use and best management practices in order to protect the Rajang Delta from further degradation for the benefit man and nature.

Recommendations for sustainable peat landscapes

- No (new) drainage based plantations on peat. A Moratorium on conversion of peatlands and other forests as practiced in Indonesia should be introduced in Malaysia;
- All remaining tropical peat swamp forests should be conserved in view of their valuable ecosystem services (including carbon storage, water regulation and biodiversity);
- All drained peatlands are susceptible to fire during dry season as peat is a fuel and not normal soil, therefore only non-drainage based plantations on peat can end fires;
- Governments in the region should issue and enforce regulations limiting and eventually stopping drainage in forest and plantation concessions on peatlands;
- Existing agriculture and plantations should minimize drainage, elevate the water table, curb the application of fertilizers and maintain a permanent soil cover to reduce the rate of peat soil degradation and enhance peat soil protection;
- Degraded peatlands should be rewetted and rehabilitated, either to natural habitat or to alternative land-uses such as paludiculture (cultivation of crops on rewetted peatlands). Indigenous peatland species like Tengkawan (Ilipe Nut), Jelutung (Asian latex) and Sago (starch) can yield an income for local people and provide opportunities for global marketing;
- Plantation companies will eventually have to abandon their peat-based plantations or change their production systems: they can either move to suitable mineral soils areas, or should switch to crops that require no drainage;
- Environmental and social safeguards must be implemented in peatland development, restoration and conservation.

Join our efforts

Wetlands International works with local and international partners, from government, industry, scientists and NGOs, to raise awareness on the issues of unsustainable peatland development and management. We advocate the conservation of the remaining peat swamp forests in view of their tremendous value in terms of water regulations, food security, biodiversity and natural productivity.

"We safeguard and restore wetlands for people and nature"

Stay in touch
www.wetlands.org

Global: Marcel Silvius, marcel.silvius@wetlands.org
Indonesia: Nyoman Suryadiputra, nyoman@wetlands.or.id
Malaysia: Lee Shin Shin: shin@wetlands.org.my

donate http://www.wetlands.org/GetInvolved/SupportOurWork/tabid/3465/Default.aspx

Wetlands International

@WetlandsInt

Wetlands International

Supported by Norad

Wetlands INTERNATIONAL