Training of Trainers (TOT) on Peatland Assessment and Management

San Francisco, Philippines, 11-15 April 2023

– Peatland and Climate Change –

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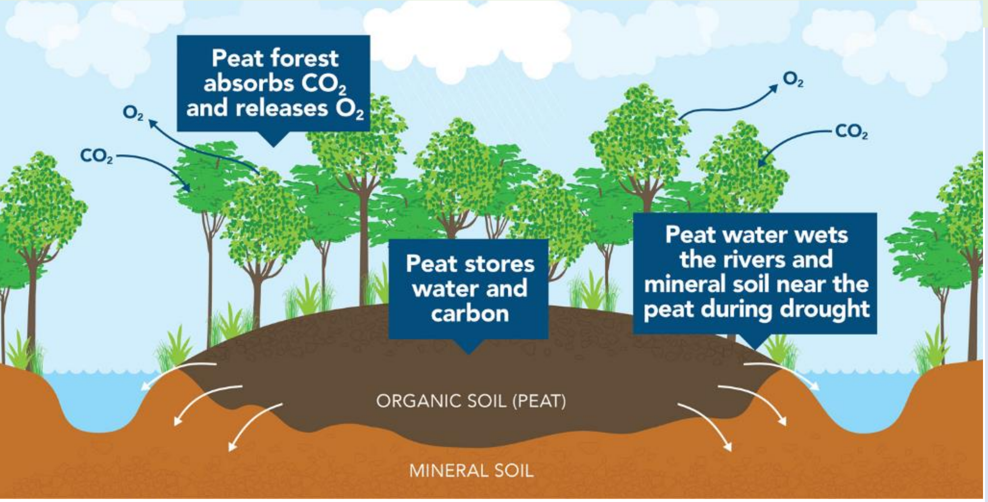
Outline

1. Overview
2. Relevant Issues
3. Estimation of absorbance and emission

1. Overview

- **Peatlands are known to cover at least 3% of global land surface.**
- **Peatlands play a crucial role in preventing and mitigating the effects of climate change, conserving biodiversity, mitigating flood risks, and providing water supplies.**
- **In their natural state, peatlands act as long-term sink for atmospheric carbon dioxide and the largest natural terrestrial carbon store.**
- **Damaged peatlands will release high amount of carbon dioxide emissions into the atmosphere.**
- **Peatland conservation and restoration can reduce emissions significantly.**
- **Their protection and restoration are vital in the transition to a zero-carbon society (! ?).**

2. Relevant Issues



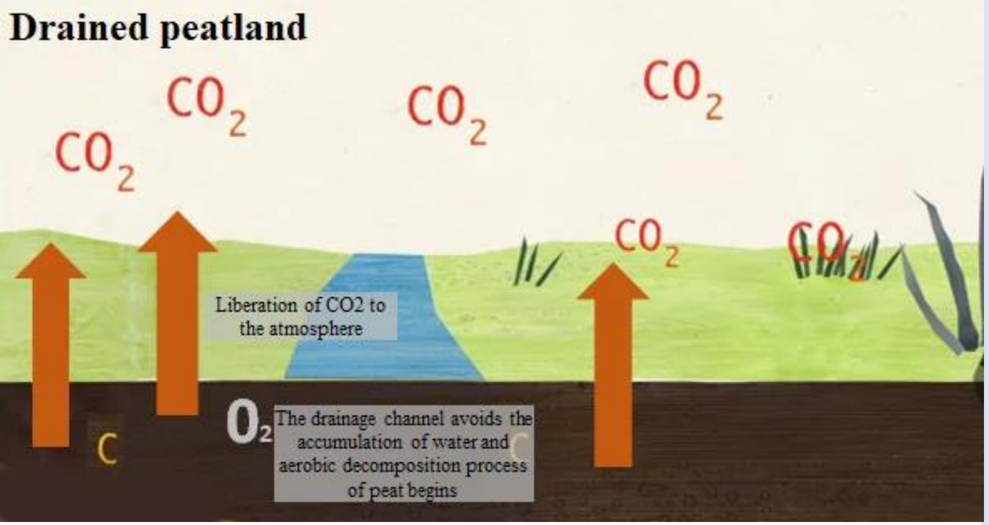
Forests absorb carbon dioxide and release oxygen into the atmosphere. Illustration by Winrock International.

Melaleuca forest in peatland of U Minh area (Vietnam)

- In peatlands, year-round water-logged conditions slow plant decomposition to such an extent that dead plants accumulate to form organic matter/peat.
  - ***Undisturbed peatlands accumulate carbon from the air at a rate of up to 0.7 tonnes per hectare per year (Pearce, 1994).***
  - ***The Wildlife Trusts in the UK have estimated that a 2m deep peatland stores 8,000 tonnes of carbon per hectare (Paul, 2008).***
- Peatland forests absorb carbon dioxide from the atmosphere and store mainly in trees and the soils after the plants die. This makes a significant contribution to the climate balance process.
- Degradation and overexploitation of peatland landscapes, particularly peatland forests, release huge quantities of greenhouse gasses.

2. Relevant Issues

Draining peatlands in Indonesia (Hans, 2022)



Simplified graphic to explain the effects of peatland drainage. (Illustration by Greifswaldmoor.de).

- **Emissions from drained peatlands largely through peat fires and oxidation of the buried carbon.**

  estimated at 1.9 gigatonnes (1,9 billion tonnes) of CO_2e annually, which is equivalent to 5% of global anthropogenic greenhouse gas (GHG) emissions.

- **Fires in Indonesian peat swamp forests in 2015:**

  emitted nearly 16 million tonnes of CO_2 a day

  (which is more than the entire economy of the United States)

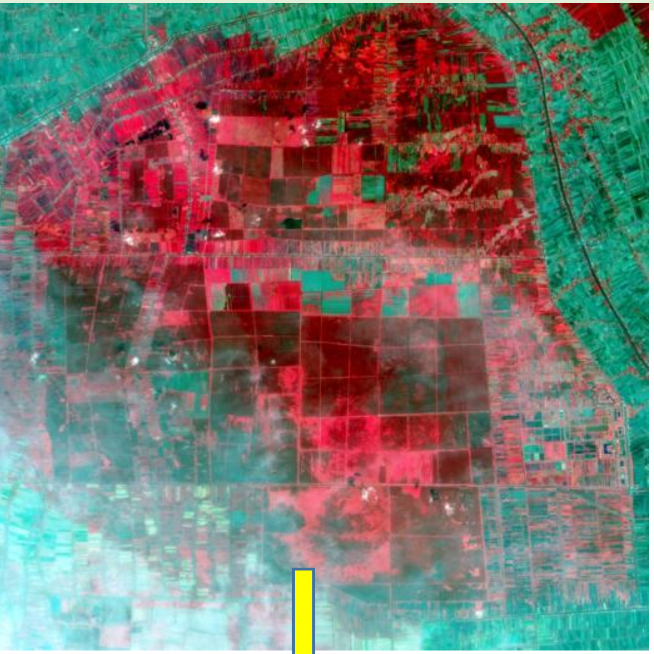
- **Damage to peatlands causes biodiversity loss.**

  The decline of the Bornean orangutan population by 60% within 60 years is largely attributed to the loss of peat swamp habitat.

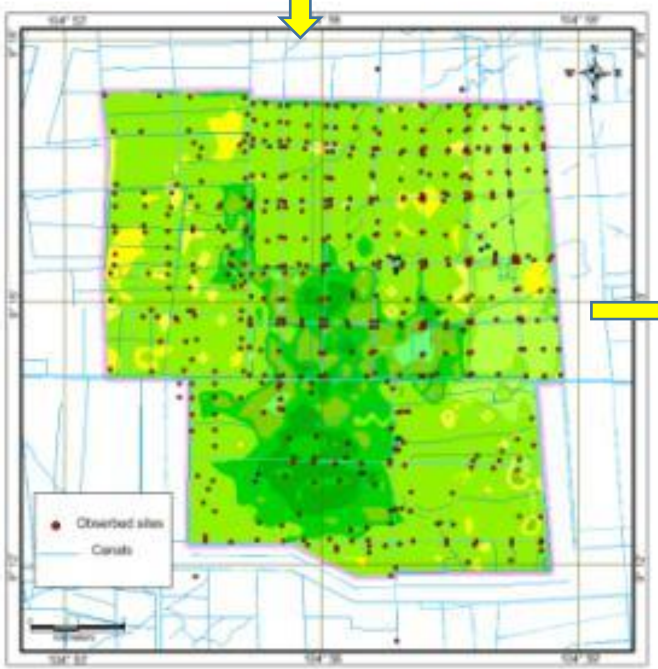
Main reasons: Lack of awareness of the benefits of peatlands including actions such as drainage, conversion for agriculture, burning, and mining for fuel or organic fertilizer production.

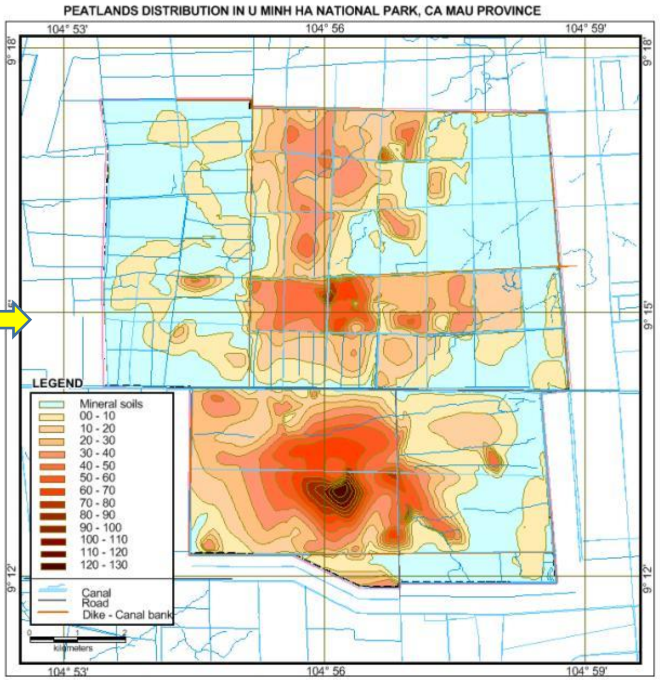
Source: IUCN Issues Brief: Peatland and Climate Change, 2020

3. Estimation of absorbance and emission of carbon dioxide



Thickness (cm)	Area (ha)
None	3,158.94
0 - 10	1,785.45
10 - 20	1,064.27
20 - 30	995.95
30 - 40	698.69
40 - 50	383.84
50 - 60	236.83
60 - 70	162.77
70 - 80	39.74
80 - 90	24.91
90 - 100	14.38
100 -110	10.25
110 - 120	9.35
120 - 130	5.49
Total area (ha)	**8,590.86**





To estimate the carbon accumulation in peat soil and the capacity to absorb carbon dioxide from forests, approaches can be used.

- Inventory of peatlands: Survey and map the area and thickness of the peat layer and land cover (forests).
  - *Satellite images will be used for interpretation to identify peatland areas and land cover.*
  - *Observed sites were established for filed check in peatlands.*
  - *Map of thickness of peat layers and distribution of peatlands*
- Forest assessment on peatland.

3. Estimation of absorbance and emission of carbon dioxide

Depth (cm)	Carbon (%)	OM (%)
0 - 20	35.62	61.41
20 - 40	40.85	70.42
40 - 60	28.73	49.53
60 - 80	31.13	53.67
80 -100	30.82	53.13
100 - 120	31.26	53.89

To be able to calculate the organic carbon content of peat soil, take samples for each representative soil horizon used for analysis.

- *Organic carbon content.*
- *bulk density of peat soil (Bp)*

Parameters to be calculated:

Peatland volume (m^3)	$V = S * D$
Weight of peatland (tons/ha)	$W = V * Bp$
Carbon content (tons/ha)	$C \% = W * C \%$
Net CO_2 equivalent (capable CO_2 storage)	$tC\text{-}CO_{2\text{-}}e = C \times 3.67$

Of which:

S: area of peatland (m^2)

V: volume of peatland area (m^3)

D: thickness of peat layer

Bp: peat bulk density

Note: CO_2 emission factor for carbon: 3.67

3. Estimation of absorbance and emission of carbon dioxide

Carbon content and equivalent of CO_2 stored in peatland of UMHNP.

Thickness of peat layer	Area	Average Weight	Weight	Carbon content	Carbon content	t CO2e	t CO2e
(m)	(ha)	(tons/ha)	(tons/area)	(tons/ha)	(tons/area)	(tons/ha)	(tons/area)
1.3	25.09	2,760	69,248,40	1,185.70	29,749.11	4,351.50	109,179.24
1.0	14.38	2,660	38,250.80	1,155.24	16,612.32	4,239.72	60,967.22
0.9	24.91	2,380	59,285.80	1,033.63	25,747.82	3,793.44	94,494.51
0.8	39.74	2,025	80,473.50	892.62	35,472.72	3,275.92	130,184.88
0.7	162.77	1,755	285,661.35	773.60	125,919.52	2,839.13	462,124.65
0.6	236.83	1,320	312,615.60	594.92	140,895.85	2,183.37	517,087.77
0.5	383.84	1,080	414,547.20	486.76	186,836.42	1,786.39	685,689.67
0.4	698.69	875	611,353.75	378.35	264,349.36	1,388.54	970,162.16
0.3	995.95	625	622,468.75	270.25	269,155.49	991.82	987,800.64
0.2	1,064.27	360	383,137.20	164.23	174,787.19	602.73	641,468.99
Total	**3,646.47**		**2,877,042.35**		**1,269,525.81**		**4,659,159.74**

3. Estimation of absorbance and emission of carbon dioxide

Diameter at breast height (m)	$D_{1.3}$
Total height from ground to the tip (m)	Hbq
Cross-section of individual(m^2)	$g = \pi/4 * D^2$
Total cross section of tree in hectare (m^2)	$G = g * N$
Total stem volume from ground to tip (m^3/ha)	$V = G * H * 0.5$
Dry biomass (ton/ha)	$b = 0.5 * V$
Total above ground biomass (ton/ha)	$B = 1.33 * b$
Total biomass (ton/ha)	$Bt = 1.2 * B$
Carbon* (ton/ha)	$tC = 0.5 * D$
Amount of CO_2 absorption (ton/ha)	$tCO_2\text{-e} = E * 3.67$

(*) *Carbon content is assumed to be 50% (0.5) of total biomass,*

Where:

V : volume of tree (m^3) H : height of tree (m)

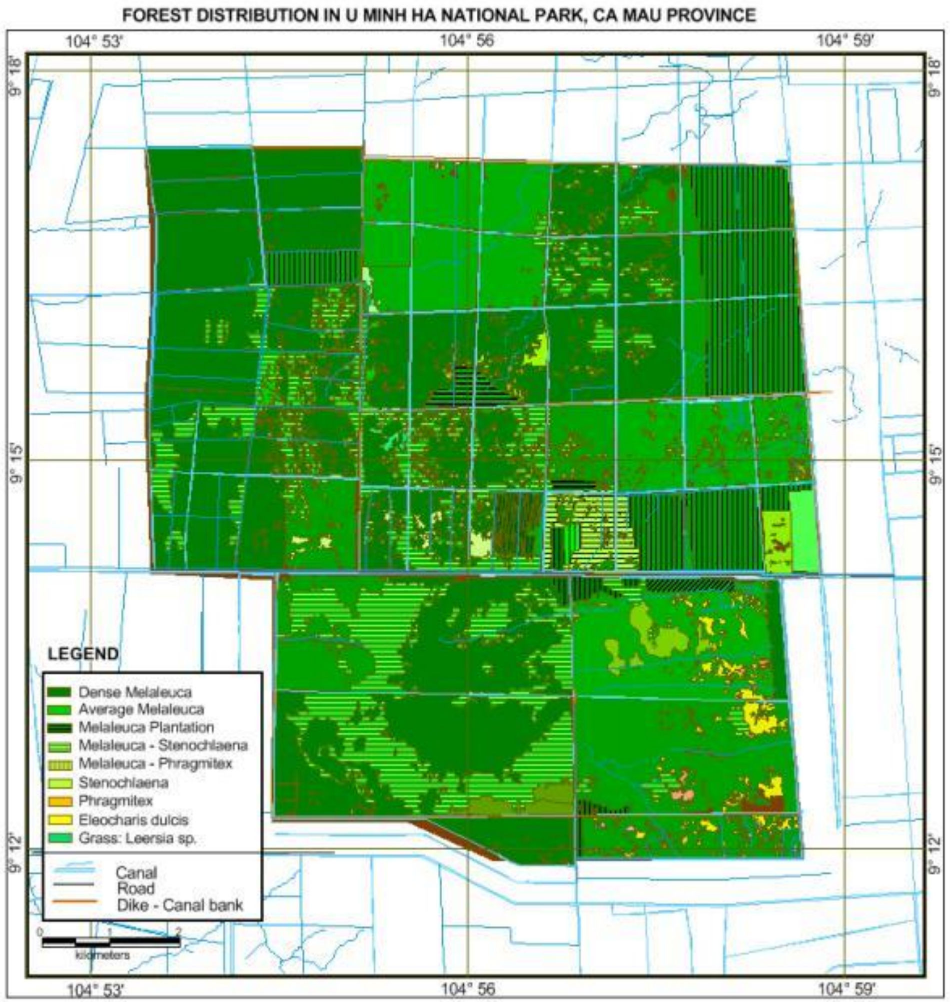
D : diameter of tree (cm) G : cross sectional area of tree (m^2)

Absorption of carbon dioxide from the atmosphere by forests.

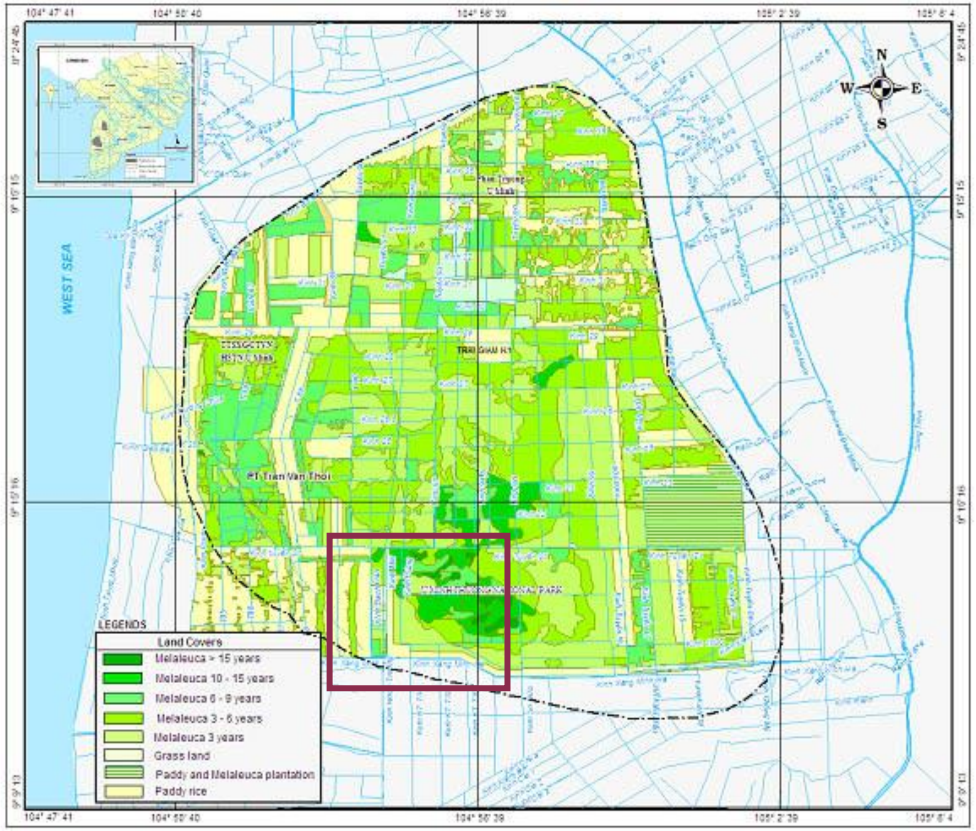
- **Inventory of the area and classification of forest types in the peatland area.**
- **Using satellite images combined with ground truthing to survey and classify forests.**
- **Measure parameters of trees to calculate biomass for each type of forest.**

3. Estimation of absorbance and emission of carbon dioxide

Forests in U Minh Ha National Park



Forest types	Carbon (ton/ha)	CO_2-e (ton/ha)
Dense Melaleuca forest	15.724	57.707
Average Melaleuca forest	21.895	80.356
Spare Melaleuca forest	44.609	440.850
Average	**27.409**	**192.971**



Land cover in U Minh Ha Peatlands

3. Estimation of absorbance and emission of carbon dioxide

Example: calculating CO_2 from peatlands in U Minh Ha National Park, Vietnam

	Density of Melaleuca Forest												Melaleuca - Grass	
	Dense	Dense	Dense	Dense	Dense	Average	Average	Average	Spare	Spare	Spare	Spare	Very spare	Very spare
	5,250	4,600	4,200	3,750	2,900	2,500	2,300	1,100	950	800	700	600	400	360
	0.058	0.064	0.067	0.069	0.071	0.084	0.093	0.102	0.142	0.152	0.186	0.201	0.278	0.278
	5.310	5.500	5.650	6.100	6.100	6.830	7.520	9.680	9.260	9.370	10.215	10.421	12.812	12.792
	0.003	0.003	0.004	0.004	0.004	0.006	0.007	0.008	0.016	0.018	0.027	0.032	0.061	0.061
	13.864	14.791	14.800	14.015	11.476	13.847	15.616	8.984	15.122	14.433	19.011	19.029	24.267	21.840
TTL (m^3/ha) (A)	36.809	40.674	41.811	42.746	35.001	47.289	58.715	43.482	70.016	67.619	97.096	99.150	155.456	139.692
Dried biomass (ton/ha) (B)	18.404	20.337	20.905	21.373	17.501	23.644	29.358	21.741	35.008	33.809	48.548	49.575	77.728	69.846
Total above ground biomass (ton/ha) (C)	24.478	27.048	27.804	28.426	23.276	31.447	39.046	28.915	46.560	44.967	64.569	65.935	103.378	92.895
Total biomas (ton/ha) (D)	29.373	32.458	33.365	34.112	27.931	37.737	46.855	34.699	55.872	53.960	77.483	79.122	124.054	111.474
Carbon (ton/ha) (E)	14.687	16.229	16.682	17.056	13.966	18.868	23.427	17.349	27.936	26.980	38.741	39.561	62.027	55.737
CO_2 (ton/ha) (F)	53.900	59.561	61.225	62.595	51.253	69.247	85.979	63.672	102.526	99.016	142.181	145.188	227.638	204.555
Area (ha)	372.580	1,053.840	332.510	886.500	1,371.050	857.650	584.420	352.610	43.840	64.940	500.780	42.350	1,197.090	399.090
Carbon content (ton/total area)	5,471.94	17,102.81	5,547.08	15,119.95	19,147.42	16,182.36	13,691.44	6,117.52	1,224.72	1,752.07	19,400.89	1,675.40	74,251.61	22,244.0
CO_2 (ton/total area)	20,082.04	62,767.34	20,357.79	55,490.24	70,271.05	59,389.27	50,247.59	22,451.30	4,494.73	6,430.11	71,201.29	6,148.72	272,503.4	81,635.6

THANK YOU

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ASEAN Haze Portal (https://hazeportal.asean.org/programmes/mahfsa/)


Thanks for attention