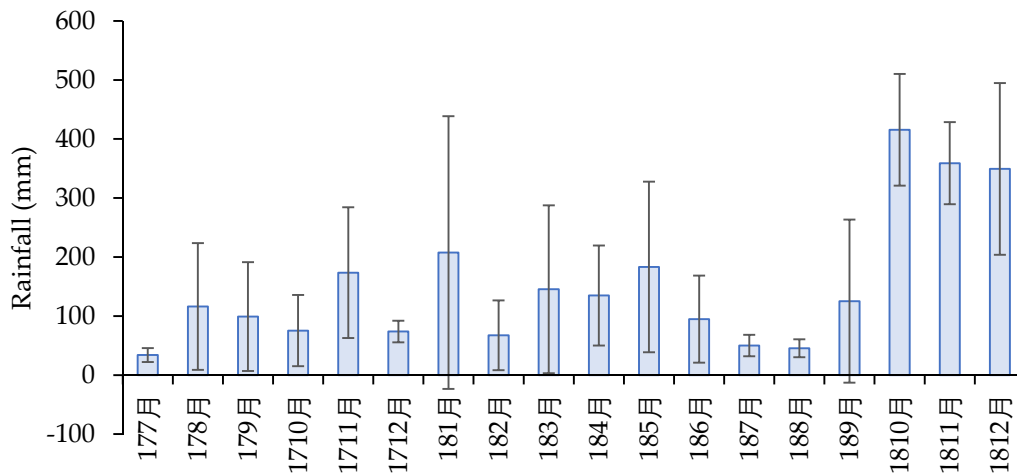


# Comparing GHG Emissions from Drained Oil Palm and Recovering Tropical Peatland Forests in Malaysia

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**Figure S1.** Rainfall data from 3 weather stations, Batang Berjuntai, Sungai Karang and Sungai Tenggi Kiri. Error bars represent standard error of the mean.

**Table S1.** GHGs emission of drained-agricultural in tropical peatlands, tropical mineral, and northern peatland by closed chamber and estimation from subsidence measurement. Reviews measurements from IPCC were included in the table.

Regions	Study sites/Ecosystem	Average emission (mg m <sup>-2</sup> h <sup>-1</sup> )						Annual emission (g m <sup>-2</sup> yr <sup>-1</sup> )					
		CO <sub>2</sub>		CH <sub>4</sub>		N <sub>2</sub> O		CO <sub>2</sub>		CH <sub>4</sub>		N <sub>2</sub> O	
		temp.	frag.	temp.	frag.	temp.	frag.	temp.	frag.	temp.	frag.	temp.	frag.
<b>Tropical/ Subtropical</b>	plantations, drained, or long rotations <sup>1</sup>							1500					
Tropical/ Subtropical	plantations, drained, short rotations, e.g., <i>Acacia</i> sp. <sup>1</sup>							2000					
Tropical/ Subtropical	Plantations, drained, oil palm <sup>1</sup>							1100				0.12	
Tropical/ Subtropical	plantations, shallow-drained (typically less than 0.3 m), typically used for agriculture, e.g., sago palm <sup>1</sup>							150				0.33	
Tropical/ Subtropical	Grassland, drained <sup>1</sup>							960				0.5	
Tropical peatland	smallholder systems <sup>2</sup>							5100					
Tropical peatland	commercial plantations (oil palm, industrial timber) <sup>2</sup>							5500					
Peninsular Malaysia	<b>OP [this study]</b>	<b>97.05</b>		<b>0.21</b>		<b>0.05</b>		<b>726.99</b>		<b>1.09</b>		<b>0.42</b>	
		<b>±84.42</b>		<b>±0.59</b>		<b>±0.06</b>							
Peninsular Malaysia	young OP <sup>3</sup>											29.1	
Regions	Study sites/Ecosystem	Average emission (mg m <sup>-2</sup> h <sup>-1</sup> )						Annual emission (g m <sup>-2</sup> yr <sup>-1</sup> )					
		CO <sub>2</sub>		CH <sub>4</sub>		N <sub>2</sub> O		CO <sub>2</sub>		CH <sub>4</sub>		N <sub>2</sub> O	
		temp.	frag.	temp.	frag.	temp.	frag.	temp.	frag.	temp.	frag.	temp.	frag.
Sarawak, Malaysia	matured OP <sup>4-6</sup>							693 to 4000				0.12	
Sarawak, Malaysia	young OP <sup>7</sup>											2.52 ± 17.8	
Sarawak, Malaysia	matured Sago plantation <sup>4,5</sup>							762				0.33	
Kalimantan Indonesia	matured OP <sup>8,9</sup>	580 ±0.04		0.013 ±0.7		4.33 ± 0.3		1380 to 6150		0.03		0.5	
Kalimantan Indonesia	young OP <sup>8</sup>							1170 to 17800					
Kalimantan Indonesia	matured Rubber plantation <sup>10</sup>	341.25 to 358.75						1408 to 3293					
Kalimantan Indonesia	other agriculture <sup>11-13</sup>					0.0072 - 0.012		1716		0.11		0.02	
Sumatra Indonesia	matured OP <sup>14,15</sup>							1217	3410 to 3820				
Sumatra Indonesia	young OP <sup>16,17</sup>							4575 to 12100					



Kalimantan, Indonesia	recovery forest <sup>13,21–23</sup>	490 ± 123	0.0022 to 0.58			5240 ± 41	2.144 ± 7.46	0.0 to 4.38					
Kalimantan, Indonesia	recovery scrubs <sup>23</sup>	599 ± 150				4290 ± 13.6	3.955 ± 15.02	0.451 ± 4.35					
Regions	Study sites/Ecosystem	Average emission (mg m <sup>-2</sup> h <sup>-1</sup> )						Annual emission (g m <sup>-2</sup> yr <sup>-1</sup> )					
		CO <sub>2</sub>		CH <sub>4</sub>		N <sub>2</sub> O		CO <sub>2</sub>		CH <sub>4</sub>		N <sub>2</sub> O	
		<i>temp.</i>	<i>frag.</i>	<i>temp.</i>	<i>frag.</i>	<i>temp.</i>	<i>frag.</i>	<i>temp.</i>	<i>frag.</i>	<i>temp.</i>	<i>frag.</i>	<i>temp.</i>	<i>frag.</i>
Kalimantan, Indonesia	drained forest <sup>6,11,12</sup>	94 to 241	0.01 - 0.91		0.0001 to 0.112		2809 to 7283		-0.37 to 0.28		0.07 to 1.58		
Northern peatlands	drained sites as permanent grassland <sup>20</sup>						500 to 880	-0.15 to 0.15					

Frequencies of GHGs measurement are categorized into two; *temp.* is continuously measurement for a year or > a year e.g., monthly measurement, while *frag.* referring to the selective duration of measurement e.g., selected months for wet and dry seasons RF: rewetting-restored forest in this study.

**Table S3.** GHGs emission of natural forest system in tropical and northern peatlands by closed chamber and estimation from subsidence measurement.

Regions	Study sites/ Ecosystem	Average emission (mg m <sup>-2</sup> h <sup>-1</sup> )						Annual emission (g m <sup>-2</sup> yr <sup>-1</sup> )					
		CO <sub>2</sub>		CH <sub>4</sub>		N <sub>2</sub> O		CO <sub>2</sub>		CH <sub>4</sub>		N <sub>2</sub> O	
		<i>temp.</i>	<i>frag.</i>	<i>temp.</i>	<i>frag.</i>	<i>temp.</i>	<i>frag.</i>	<i>temp.</i>	<i>frag.</i>	<i>temp.</i>	<i>frag.</i>	<i>temp.</i>	<i>frag.</i>
Peninsular Malaysia	NF (this study)	68.33 ±59.31		5.99 ±9.85		0.01 ±0.02		481.93		24.57		0.08	
Peninsular Malaysia <sup>3,24</sup>	tropical PSF		949-971		-0.01 to 2						-0.09 to 17.52		4.1
Sarawak Malaysia <sup>4,25,26</sup>	tropical PSF				-0.00034 to 0.0197		891 to 926		2.8 to 3.92				
Kalimantan, Indonesia <sup>8,9,27</sup>	tropical PSF		0.188 ± 0.7		0.03 ± 0.03		1290 ± 0.3		1.4		0.52		
Sumatra, Indonesia	tropical PSF <sup>16,17</sup>						4000	6100					
Sumatra, Indonesia	tropical mineral forest <sup>19</sup>	186.64 to 195.93		-0.002 to - 0.04									
Panama	tropical PSF		0.56 to 1.2				162 to 1693 <sup>28</sup>		-18 to 363				
Northern peatlands	Bog <sup>20,29</sup>				2			500 to 880		-0.15 to 0.15		0.15 to 3.77	

Frequencies of GHGs measurement are categorized into two; *temp.* is continuously measurement for a year or > a year e.g., monthly measurement, while *frag.* referring to the selective duration of measurement e.g., selected months for wet and dry seasons. PSF: peat swamp forest, NF: natural peat swamp forest in this study.

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