Rubber Plantations as a Carbon Sink for Thailand's Net-Zero Goals

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As the world's largest natural rubber producer, Thailand is transforming its extensive rubber sector—covering approximately 3.8 million hectares of plantations—into a major carbon sink to help offset industrial emissions, while advancing low-carbon manufacturing to comply with evolving global trade regulations. Rubber plantations function as natural carbon sinks by storing carbon in both vegetation and soil. In 2022, Thailand's rubber vegetation contributed to a net CO_2 removal of 91,486.96 ktCO_2eq, representing around 85% of total net removals in the LULUCF sector and offsetting nearly 24% of the country's total emissions [1]. Although soil carbon sequestration in rubber plantations is also expected to be substantial, it has not yet been officially quantified or reported.

However, carbon losses associated with rubber wood harvesting could become a major source of future CO_2 emissions, as a large proportion of existing plantations is projected to be harvested within the next 25 years. This potential challenge to Thailand's net-zero targets could be reduced through the adoption of low-frequency tapping systems, which extend the rotation age of rubber plantations and enhance long-term carbon storage. Furthermore, carbon absorbed during the lifespan of rubber trees can remain sequestered in harvested wood products such as timber, furniture, and construction materials, thereby keeping CO_2 stored outside the atmosphere for decades.

To better understand the physiological processes underlying carbon sequestration in rubber plantations and their potential responses to climate change, our study measured CO_2 and water fluxes across three major rubber-growing regions using the eddy covariance technique. Annual net carbon removal, expressed as net ecosystem production (NEP), averaged 37 tons of CO_2 per hectare per year.

Net ecosystem production (NEP) of rubber plantation measured by eddy covariance method.

Plantation age (year)	4	5	6	7	8	9	17	18	19	20	21	22	23	24	25	
NEP (Kg CO_2/rai/yr)	1,843	4,078	5,487	3,555	7,760	5,444	7,643	5,027	4,485	6,496	6,900	5,621	8,122	8,181	8,176	Kg CO_2/rai/yr
NEP (Tons CO_2/ha/yr)	11.5	25.5	34.3	22.2	48.5	34.0	47.8	31.4	28.0	40.6	43.1	35.1	50.8	51.1	51.1	Tons CO_2/ha/yr
Site: Bungkan	29.3															Tons CO_2/ha/yr
Site: NakonSritammaracha							39.6									Tons CO_2/ha/yr
Site: Chachengsao									42.8							Tons CO_2/ha/yr
Site: Chachengsao									36.7				51.0			Tons CO_2/ha/yr
All 3 sites (15 years)	37.0															Tons CO_2/ha/yr

Reference 1) Biennial Transparency Report. 2024. https://unfccc.int/documents/645098