

# LONG-TERM MONITORING OF NET ECOSYSTEM FLUX RATES OF CO<sub>2</sub> AND WATER VAPOUR IN A NATURAL RUBBER PLANTATION USING THE EDDY COVARIANCE TECHNIQUE

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Received: 13 August 2021

Accepted: 27 August 2021

Annamalaiathan, K., Jayasooryan, K.K., Satheesh, P.R. and Jacob, J. (2021). Long-term monitoring of net ecosystem flux rates of CO<sub>2</sub> and water vapour in a natural rubber plantation using the eddy covariance technique. *Rubber Science*, 34(2): 111-122.

Using the eddy covariance (EC) technique, flux of CO<sub>2</sub> and water vapour was continuously monitored for six years in a natural rubber plantation grown in central Kerala. The study period covered both immature and mature stages of the rubber trees (from 4<sup>th</sup> to 9<sup>th</sup> year of growth). The mean rate of CO<sub>2</sub> sequestration during the entire study period was 9.2g CO<sub>2</sub> m<sup>-2</sup> day<sup>-1</sup>, equivalent to 33.6 tons CO<sub>2</sub> ha<sup>-1</sup> yr<sup>-1</sup>. These rates were largely in agreement with the results obtained through the biomass inventory method. The highest rate was seen when the trees were in 5<sup>th</sup> to 7<sup>th</sup> year of growth, possibly indicating that this was the peak growth phase. As expected, it was evident that sequestration rates were the highest during those seasons of the year when sunlight was abundant and soil moisture was not deficient.

The mean rate of water loss through evapo-transpiration of water was 3.2 mm day<sup>-1</sup> and the ecosystem level mean water use efficiency (WUE<sub>NEP</sub>) was 3.0g CO<sub>2</sub> kg<sup>-1</sup> water. Implications of the high rate of CO<sub>2</sub> sequestration of rubber plantations are discussed in the context of mitigating climate change. Similarly, the relevance of high WUE of rubber trees is discussed in the context of expanding rubber cultivation to newer and non-traditional areas where annual rainfall is lower than in the traditional regions.

**Keywords:** Biomass, CO<sub>2</sub> flux, Carbon sequestration, NEE, Rubber plantation, Water use efficiency

## INTRODUCTION

Terrestrial ecosystems are major repositories of atmospheric CO<sub>2</sub> (Keenan and Williams, 2018) and there is much more carbon stored in the soil than in the biomass of vegetation (Ontl and Schulte, 2012). It has been shown that actively growing managed ecosystems can have higher rates of carbon

sequestration than many natural ecosystems (Sommer and Bossio, 2014; Epple *et al.*, 2016). For example, the Amazon forests normally have a carbon sequestration rate of 3-6 tons CO<sub>2</sub> ha<sup>-1</sup> yr<sup>-1</sup> while managed ecosystems such as farm forestry systems with multiple species of trees have a sequestration rate of 10-11 tons CO<sub>2</sub> ha<sup>-1</sup> yr<sup>-1</sup> (NASA, 2003; Chinsu

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