

LONG-TERM MONITORING OF NET ECOSYSTEM FLUX RATES OF CO₂ AND WATER VAPOUR IN A NATURAL RUBBER PLANTATION USING THE EDDY COVARIANCE TECHNIQUE

K. Annamalinathan, K.K. Jayasooryan*, P.R. Satheesh** and James Jacob

Rubber Research Institute of India, Kottayam-686 009, Kerala, India

Received: 13 August 2021 Accepted: 27 August 2021

Annamalinathan, K., Jayasooryan, K.K., Satheesh, P.R. and Jacob, J. (2021). Long-term monitoring of net ecosystem flux rates of CO₂ 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 CO₂ 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 4th to 9th year of growth). The mean rate of CO₂ sequestration during the entire study period was 9.2g CO₂ m⁻² day⁻¹, equivalent to 33.6 tons CO₂ ha⁻¹ yr⁻¹. 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 5th to 7th 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⁻¹ and the ecosystem level mean water use efficiency (WUE_{NEP}) was 3.0g CO₂ kg⁻¹ water. Implications of the high rate of CO₂ 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, CO₂ flux, Carbon sequestration, NEE, Rubber plantation, Water use efficiency

INTRODUCTION

Terrestrial ecosystems are major repositories of atmospheric CO₂ (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 CO₂ ha⁻¹ yr⁻¹ while managed ecosystems such as farm forestry systems with multiple species of trees have a sequestration rate of 10-11 tons CO₂ ha⁻¹ yr⁻¹ (NASA, 2003; Chinsu

Correspondence: Annamalinathan K. (Email: annamalai@rubberboard.org.in)

*Presently scientist, Central Water Resources Development and Management, Kozhikode-673 571, Kerala, India

**HSST Jr., Botany, Government Model Higher Secondary School, Muvattupuzha, Ernakulam-686 661, Kerala, India