IMPACT OF FOREST CONVERSION TO RUBBER PLANTATIONS ON SOIL NUTRIENTS AND CARBON STORAGE IN THE WESTERN GHATS, KERALA

Phebe Joseph, M.D. Jessy and Mahesh Mohan[1]

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

[1]School of Environmental Science, Mahatma Gandhi University, Kottayam-686 560, Kerala, India

Received: 19 November 2025 Accepted: 02 December 2025

Joseph, P., Jessy, M.D. and Mohan, M. (2025). Impact of forest conversion to rubber plantations on soil nutrients and carbon storage in the Western Ghats, Kerala. *Rubber Science*, **38**(2): 178-192.

Changes in land use systems fundamentally alter global biogeochemical cycles and significantly affect the Earth's climate regulation. The impact of converting natural forests into rubber plantations on soil properties, nutrient dynamics and carbon sequestration in the Western Ghats region of Kerala, a biodiversity rich and ecologically sensitive area was assessed. The variations in soil properties across the different land use systems such as natural forest and rubber under first and second cycle of cultivation were compared. The results revealed that rubber cultivation accelerated soil acidification and led to a significant reduction in cation exchange capacity (CEC) as well as the availability of essential nutrients such as potassium (K), calcium (Ca) and magnesium (Mg) in soil. As the planting succession increased the same trend was observed. The indiscriminate land conversion activities resulted in more than 50 per cent reduction in total nitrogen (TN), total carbon (TC) and organic carbon (SOC) in the soil. The SOC stock in rubber plantations was two times lower than the forest, indicating a substantial decline in soil carbon storage. In all the land use systems, recalcitrant C (carbon) fractions predominated over the labile C, with the highest values recorded under the natural forest. Lower values of the carbon management index (CMI), coupled with a reduced carbon pool index (CPI) in the rubber plantations indicated a marked deterioration of soil quality in these systems. As the number of rubber planting cycles increased, gradual recovery of carbon and nitrogen levels was observed, indicating that rubber ecosystems can conserve nutrients and restore carbon over time. Therefore, despite the initial losses in soil quality and carbon stocks due to forest conversion, rubber plantations can function as a substitute for forests in terms of conserving and replenishing soil nutrients and carbon pools. These findings highlight the need for sustainable land management practices in rubber plantations to minimize soil degradation, enhance carbon sequestration and maintain ecological integrity.

Keywords: Deforestation, *Hevea brasiliensis*, Land use changes, Soil carbon pools, Soil nutrient status, Water stable aggregates

INTRODUCTION

The conversion of forest to rubber plantation is one of the major land use changes in the tropical region. The indiscriminate felling of trees from 1990 to 2020 has led to a decline in 4.1 per cent of the world's forest area (FAO, 2020). Chakraborty *et al.* (2018) reported that in

Correspondence: Phebe Joseph (Email: phebe@rubberboard.org.in)