Methane (CH_4), Nitrous Oxide (N_2O), and Carbon Dioxide (CO_2) Gas Emissions from Mangrove Sediments, When Mildly Disturbed, Rekawa Lagoon, Sri Lanka.

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Mangroves are unique coastal ecosystems that serve as an important natural carbon sink. Emissions of methane (CH_4), nitrous oxide (N_2O), and carbon dioxide (CO_2) can reduce the overall effectiveness of the blue carbon ecosystem. This study aimed to quantify CH_4 and N_2O emissions from mangrove sediments while also assessing CO_2 fluxes under mildly disturbed sediment conditions in Rekawa Lagoon, Hambantota District, Sri Lanka. *In-situ* measurements of greenhouse gases were conducted to assess the effect of mild disturbance across the lagoon, middle, and landward zones. CH_4, N_2O, and CO_2 were collected using the chamber method. A 20ml-syringe was used to collect CH_4 and N_2O at 10, 20, 30, and 40 minutes after chamber deployment. CO_2 flux was monitored at 20, 35, 50, and 80 minutes using the alkali absorption method. Methane was detected in mildly disturbed sediments; however, the concentrations were below the lowest calibration standard (35 ng) of the *gas chromatography-flame ionization detector* (GC-FID) system and therefore could not be reliably quantified (0.0411 µmol CH_4 m^{-2} h^{-1}). N_2O concentrations were below the detection limit in all samples because they generally represent similar emission behaviour in mangrove sediments (0.015 µmol N_2O m^{-2} h^{-1}). CO_2 flux was significantly higher in disturbed conditions (134 ± 6 mmol m^{-2} h^{-1}). It increased and reached the peak shortly after the disturbance and then declined, suggesting a dynamic response. Total greenhouse gas flux was largely driven by CO_2, with CH_4 and N_2O contributing negligibly due to low detectable concentrations. Multivariate analysis indicated that total flux was more strongly associated with nutrient content. In disturbed sediments, Soil Organic Carbon (SOC) showed no significant relationship with total flux ($P > 0.05$). Overall, the findings suggest that mild disturbance and nutrient content may influence greenhouse gas emissions from mangrove sediments. Therefore, conserving the mangrove ecosystem is essential to mitigate climate change.

Keywords: *Mangrove sediments, Greenhouse gases, Gas chromatography-flame ionization detector, Rekawa Lagoon, Sediment disturbance*