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Potential impact of predicted sea level rise on carbon sink function of mangrove ecosystems with special reference to Negombo estuary, Sri Lanka

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Abstract

Unique location in the land-sea interface makes mangrove ecosystems most vulnerable to the impacts of predicted sea level rise due to increasing anthropogenic CO_2 emissions. Among others, carbon sink function of these tropical ecosystems that contribute to reduce rising atmospheric CO_2 and temperature, could potentially be affected most. Present study was undertaken to explore the extent of impact of the predicted sea level rise for the region on total organic carbon (TOC) pools of the mangrove ecosystems in Negombo estuary located on the west coast of Sri Lanka. Extents of the coastal inundations under minimum (0.09 m) and maximum (0.88 m) sea level rise scenarios of IPCC for 2100 and an intermediate level of 0.48 m were determined with GIS tools. Estimated total capacity of organic carbon retention by these mangrove areas was 499.45 Mg C ha^{-1} of which 84% (418.98 Mg C ha^{-1}) sequestered in the mangrove soil and 16% (80.56 Mg C ha^{-1}) in the vegetation. Total extent of land area potentially affected by inundation under lowest sea level rise scenario was 218.9 ha, while it was 476.2 ha under intermediate rise and 696.0 ha with the predicted maximum sea level rise. Estimated rate of loss of carbon sink function due to inundation by the sea level rise of 0.09 m is 6.30 Mg C $ha^{-1}y^{-1}$ while the intermediate sea level rise indicated a loss of 9.92 Mg C $ha^{-1}y^{-1}$ and under maximum sea level rise scenario, this loss further increases up to 11.32 Mg C $ha^{-1}y^{-1}$. Adaptation of mangrove plants to withstand inundation and landward migration along with escalated photosynthetic rates, augmented by changing rainfall patterns and availability of nutrients may contribute to reduce the rate of loss of carbon sink function of these mangrove ecosystems. Predictions over change in carbon sequestration function of mangroves in Negombo estuary reveals that it is not only affected by oceanographic and hydrological alterations associated with sea level rise but also by anthropogenic processes, therefore the impacts are site specific in terms of distribution and magnitude.