

## ACCURACY IN MANGROVE CARBON STOCK ASSESSMENT: EVALUATING THUMB-RULE ASSUMPTIONS VERSUS ANALYTICAL DATA IN THE INDIAN SUNDARBANS

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### ABSTRACT

Planet Earth faces a sharp rise in atmospheric CO<sub>2</sub>, triggering climate change. Producer communities, particularly mangroves, act as vital carbon sinks, storing carbon in their biomass. However, conventional carbon stock estimation methods, relying on general assumptions (e.g., 50% of dry biomass as carbon), generate significant inaccuracies. Our study on five dominant mangrove species in Jharkhali, Indian Sundarbans (during 20–26 January 2025), using 350 trees across 35 quadrats, revealed deviations of 12.80–45.60% compared to CHN analyser-based empirical carbon content. *Avicennia officinalis* exhibits the highest deviation in carbon stock value when the two methods are compared. We advocate CHN analyser-based species-specific, standardized measurements to improve carbon accounting, ensuring credibility in climate finance and carbon credit markets.

**Keywords** Mangrove carbon stock, Above ground biomass, 50% Thumb Rule, CHN Analyser, Indian Sundarbans

### 1. INTRODUCTION

The surge in atmospheric CO<sub>2</sub> originating from fossil fuels and deforestation has intensified climate challenges, making nature-based solutions (NbS) like mangroves vital for mitigation (Agarwal et al. [1]; Dutta et al. [2]). Mangroves store “blue carbon” in above-ground biomass (AGB) and under lying anaerobic soils, supporting climate action and aligning with multiple SDGs (Mitra [3]; Ahmed et al. [4]). Accurate biomass estimation, often based on allometric equations using DBH, height, and wood density, is essential for credible carbon stock assessment. Incorporating CHN analyser-based carbon content (in %) in the standard formula also generates reliable results. However, the common 50% carbon assumption is inaccurate, as actual content varies by species and conditions. Species-specific models and empirical calibration based on the output data of CHN analyser are crucial for reliable carbon accounting, ensuring the integrity of mangrove-based carbon markets.

### 2. METHODOLOGY

The study was conducted in the intertidal mudflats of Jharkhali, Indian Sundarbans, a vital blue carbon ecosystem at the apex of the Bay of Bengal, during low tide from January 20–26, 2025.

Thirty-five randomly placed 10 m × 10 m quadrats were established, covering approximately 350 trees of five dominant mangrove species, namely *Avicennia alba*, *Avicennia marina*, *Sonneratia apetala*, *Avicennia officinalis*, and *Excoecaria agallocha*.

Above-ground biomass was estimated non-destructively using DBH, height, and volume ( $V = \pi \times H \times R^2$ ), with biomass ( $BS = G \times V$ ) derived from specific gravity ( $G$ ). Carbon content was estimated using both 50% dry biomass assumption (M1) and CHN analyser measurements (M2).

### 3. RESULTS

The above-ground biomass (AGB) components of five mangrove species show notable variations across stems, branches, and leaves, expressed in tonnes per hectare (t/ha). For stems, the recorded values are 19.82 t/ha for *Sonneratia apetala*, 5.89 t/ha for *Excoecaria agallocha*, 20.24 t/ha for