# Carbon storage in bamboo (*Schizostachyum dullooa*) forest of Barak Valley, southern Assam, India

The earth's mean atmospheric carbon dioxide ($CO_2$) concentration in 2018 was recorded at 410 ppm (parts per million), which is the highest in the past 800,000 years[1]. $CO_2$ is one of the important long-lived greenhouse gases (GHGs) that absorbs wavelengths of thermal energy and adds to the greenhouse effect in a unique way[1]. In January 2018, temperature across the earth's land and ocean surfaces was 0.71°C above the 20th century average of 12.0°C (ref. 2). In this regard, enhancing sinks for ever-increasing $CO_2$ concentration through promoting biotic reservoirs has been appreciated by the global scientific community as a strategy for climate change mitigation[3]. Further, identifying high carbon storage terrestrial ecosystems can advance our understanding on better management of $CO_2$ as organic carbon in vegetation and soil. The specific aim of the present study is to explore the organic carbon storage of *Schizostachyum dullooa* forest in Barak Valley part of North East India.

Bamboos play an important role in linking climate change mitigation to sustainable economic development in the developing world[3]. Bamboos can be combined into land use-based climate change mitigation activities such as afforestation/reforestation or avoided deforestation, as they are the fastest-growing plants on earth with high growth rate[4]. Bamboos possess high potential for biomass production and carbon sequestration[3–6], and have reduced harvest time (3–5 years) compared to most timber species (10–50 years).

*Schizostachyum dullooa* (Gamble) R. Majumder, commonly known as 'dolu bamboo', is a thin-walled, clump-forming species distributed in the moist semi-evergreen forests of NE India (Assam, Sikkim, Meghalaya, Tripura, Mizoram, Nagaland, Manipur), Bangladesh, and Myanmar[7] (Figure 1). It is among the 38 bamboo species listed by the International Network for Bamboo and Rattan (INBAR), Beijing, China and the International Plant Genetic Resources Institute (IPGRI)[8–10] as the priority species. Among the 78 species of bamboos distributed in NE India[11], *S. dullooa* is the one of the dominant forest bamboo species of Barak Valley.

Total biomass (above ground + below ground) carbon storage of *S. dullooa* was estimated at 34 Mg $ha^{-1}$ (ref. 11), which is less than other forest bamboo species (61 Mg $ha^{-1}$) reported from NE India[12] and elsewhere: 40 Mg $ha^{-1}$ in *Phyllostachys pubescens*[5]; 41 Mg $ha^{-1}$ in *Phyllostachys heterocycla*[13], 50 Mg $ha^{-1}$ in *Phyllostachys makinoi*[14], 37 Mg $ha^{-1}$ in *Gigantochloa ater* and *Gigantochloa verticilata*[15] and 69 Mg $ha^{-1}$ in *Phyllostachys bambusoids* forests[16] (Table 1). Although the carbon storage of *S. dullooa* forest is less, the potential of the species to grow in fallows after forest disturbances indicates its ecological significance in soil restoration and ecosystem management[11]. The soil organic carbon (SOC) stock in bamboo forest was 85 Mg $ha^{-1}$ (Table 2), of which 38.28, 26.58 and 20.25 Mg $ha^{-1}$ was confined to 0–10, 10–20 and 20–30 cm soil depth respectively. Therefore, the total SOC stock was estimated at 120 Mg $ha^{-1}$. The present study reveals that the soil contains two-thirds of the total SOC stock, signifying the role of soil under bamboo forest in carbon sink management.

The default biomass carbon stock for an equivalent land use in South Asia is estimated at 138 Mg $ha^{-1}$ (ref. 17), which is much higher than the vegetation carbon stock of the bamboo forest in the present study. Nevertheless, *S. dullooa* is an important raw material for household and industrial requirements in NE India. The potential to grow in fallows and on degraded lands[18], makes this an eco-efficient species for NE India. Due to its diverse social and ecological role, the species must be conserved in its natural habitat. Moreover, plantation of this species in degraded lands and its introduction in home gardens will diversify its habitat and in the long term may

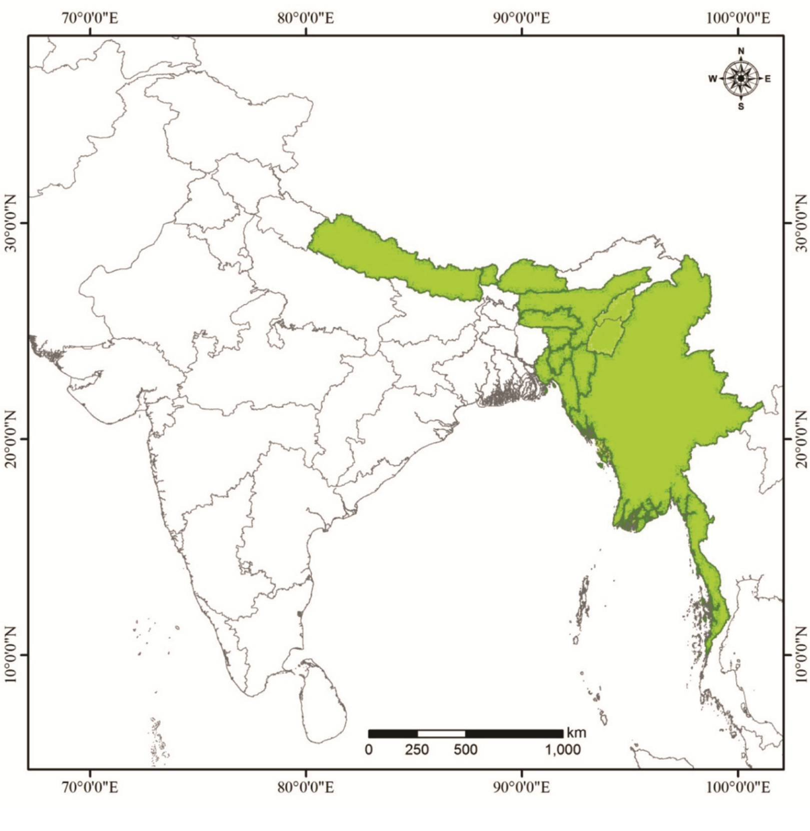


**Figure 1.** Map showing distribution of the species *Schizostachyum dullooa* in India, Bangladesh and Myanmar.

**Table 1.** Comparison of biomass carbon stock of bamboo forests in different parts of the world

| Bamboo species | Location | Ecosystem type | Density (ind. $ha^{-1}$) | Biomass carbon storage (Mg $ha^{-1}$) | Soil carbon storage (Mg $ha^{-1}$) | Reference |
|---|---|---|---|---|---|---|
| *Bambusa blumeana* | Philippines | Forest | 7,600 | 72 | | 19 |
| *Bambusa vulgaris* | Philippines | Forest | 9,000 | 53 | | 19 |
| *Gigantochloa levis* | Philippines | Forest | 9,300 | 73 | | 20 |
| *Phyllostachys bambusoides* | Japan | Plantation | 12,000 | 68 | | 21 |
| *Gigantochloa ater* and *Gigantochloa verticiliata* | Indonesia | Forest | 6,820 | 37 | | 15 |
| *Bambusa pallida* | India | Plantation | 35,000 | 160 | | 22 |
| *Phyllostachys pubescens* | Japan | Plantation | 7,100 | 69 | | 16 |
| *Bambusa bambos* | India | Plantation | 4,250 | 144 | | 23 |
| *Dendrocalamus strictus* | India | Plantation | 27,000 | 30 | | 18 |
| *Bambusa bambos* | India | Plantation | 8,000 | 121 | | 24 |
| *Yushania alpina* | Ethiopia | Forest | 8,840 | 55 | | 25, 26 |
| *Bambusa cacharensis*, *Bambusa vulgaris* and *Bambusa balcooa* | India | Plantation | 8,950 | 61 | 57.3 | 12 |
| *Phyllostachys makinoi* | Taiwan | Forest | 21,191 | 50 | | 14 |
| *Phyllostachys heterocucla* | Taiwan | Forest | 7,100 | 41 | | 13 |
| *Bambusa oldhami* | Mexico | Plantation | 10,101 | 51.5 | | 27 |
| *Guadua angustifolia* | Bolivia | Forest | 4,500 | 100 | | 27 |
| *Phyllostachys pubescens* | China | Forest | 3,968 | 40 | | 5 |
| *Schizostachyum pergracile* | India | Forest | 7,240 | 65 | 53.25 | 28 |
| *Schizostachyum dullooa* | India | Forest | 32,376 | 33.8 | 85.11 | Present study |

**Table 2.** Descriptive statistics of soil organic carbon (SOC) density of different soil depths in *Schizostachyum dullooa* forests (number of observation; $N = 81$)

| | SOC density (Mg $ha^{-1}$) | | | |
|---|---|---|---|---|
| | 0–10 cm | 10–20 cm | 20–30 cm | Total |
| Mean | 38.28 | 26.58 | 20.25 | 85.11 |
| Standard error | 1.53 | 1.70 | 1.36 | 4.01 |
| Median | 39.80 | 25.20 | 19.79 | 86.48 |
| Standard deviation | 7.97 | 8.83 | 7.05 | 20.86 |
| Sample variance | 63.45 | 78.04 | 49.70 | 435.21 |
| Range | 33.34 | 28.91 | 25.18 | 86.70 |
| Minimum | 21.84 | 11.71 | 9.67 | 43.96 |
| Maximum | 55.18 | 40.63 | 34.85 | 130.66 |
| *N* | 81.00 | 81.00 | 81.00 | 243.00 |
| Confidence level (95.0%) | 3.15 | 3.49 | 2.79 | 8.25 |

improve organic carbon storage of such systems and also help attain climate change adaptive and mitigative strategies.


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# 28 August 2018 ($M_w$ 4.5) Bengal Basin earthquake highlights active basement fault beneath the sediments

The India Meteorological Department (IMD) reported an earthquake of magnitude 4.8 at IST 18 h 33 min and 29 sec on 28 August 2018. The epicentre of the earthquake was located in the Bengal Basin (lat. 22.6°N, long. 87.7°E) at a distance of ~67 km west of the city of Kolkata (Figure 1). Strong to moderate ground shaking was felt in the epicentral zone and in surrounding districts of East Midnapore, West Midnapore, Jhargram and Bankura. Given the moderate size of the event, there was neither loss of life nor cases of injury due to the earthquake. However, some buildings close to the epicentral region, developed cracks from the shaking. Albeit the moderate size of the earthquake, we consider this to be a significant one given its location in the intra-plate region of the Bengal Basin. The epicentre of the earthquake is located between the mapped Pingla Fault, to its west, and the Garhmayna Khanda Ghosh Fault, to its east[1,2]. Farther east the Eocene Hinge Zone marks the paleo continent-ocean boundary of the eastern margin of India, and transit northeastward into the active Dawki Fault, along the southern margin of the Shillong Plateau[3]. These faults form an en-echelon pattern of passive continental margin growth faults and remain buried below the sediment cover[4]. However, changes in the stress patterns within the continental interior and flexural loading of the sediments along the basin margin can

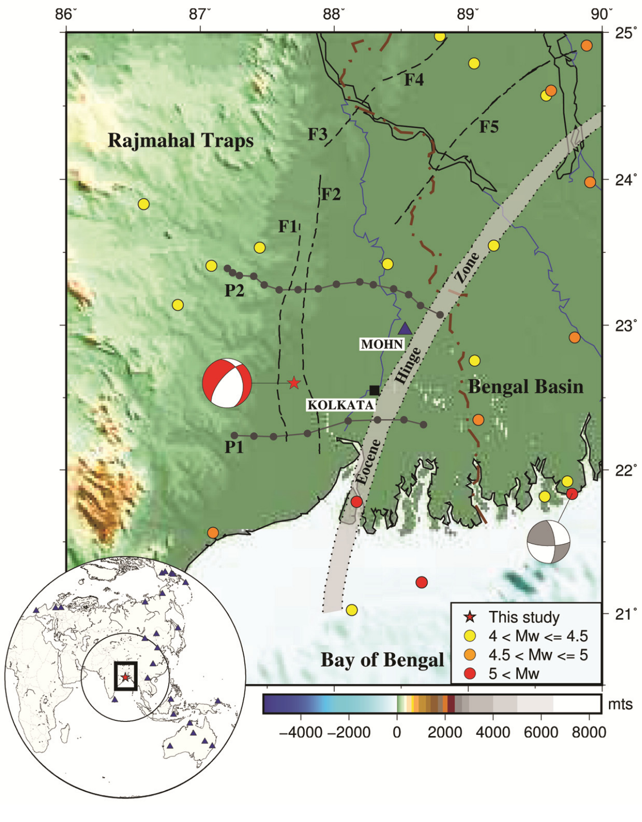


**Figure 1.** Topographic map of the Bengal Basin (boxed in the inset map) with plot of the 28 August 2018 $M_w$ 4.5 earthquake epicentre (red star) taken from IMD and the source mechanism computed in this study (red focal sphere). Previous earthquakes in this region (from ISC reviewed catalogue) are plotted as circles (colour coded by magnitude) and the mechanism (from Global CMT catalogue) plotted as grey focal sphere. Sub-surface faults are plotted as dashed black lines and labelled F1, Pingla Fault; F2, Garhmayna Khanda Ghosh Fault; F3, Jangipur Fault; F4, Gaibandha Fault; F5, Debagram Bogra Fault[18]. The two Deep Seismic Sounding (DSS) profiles are labelled as P1 and P2 (refs 1, 2). Inset map plots the GDSN stations (blue triangles) from which data has been used for the source mechanism computation (Figure 3).