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Seasonal Organic Carbon Variation in a Tropical Flood-plain Wetland of Lower Brahmaputra Valley, Assam, India

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Abstract

The study was aimed to assess depth-wise seasonal variability of bulk density (BD), soil organic carbon (SOC), SOC stock and soil organic matter (OM) in Deepor *beel* (a Ramsar site) located in lower Brahmaputra valley zone of Assam with a water spread area of about 40 km^2. Samples were collected during January to December, 2023 from six sites covering four seasons namely, pre-monsoon (March-May), monsoon (June-September), post-monsoon (October-November), and winter (late December-February). Samples were collected at depth intervals, 0–10 cm and 10–20 cm using a handheld metallic cylindrical core sampler measuring 200 cm in length and 2.5 cm in diameter. Results revealed that mean BD values in the wetland ranged between 0.46 ± 0.16 g cm^{-3} to 1.21 ± 0.07 g cm^{-3}. Sub-surface soil (10–20 cm) exhibited comparatively higher BD (0.56 ± 0.07 to 1.21 ± 0.07 g cm^{-3}) than surface soil (0–10 cm) (0.46 ± 0.16 to 1.16 ± 0.08g cm^{-3}). SOC content ranged from 1.03 to 3.16%. Surface soil layer exhibited higher SOC content (1.38–3.16%, with mean value of 2.22 ± 0.10%) than sub-surface soil (1.03–2.07%, with mean value of 1.86 ± 0.09%). SOC stock was found to fluctuate from 4.04 to 30.9 Mg C ha^{-1}, OM content ranged between 1.77 and 5.44%. One way ANOVA revealed significant seasonal differences between SOC stock and BD ($p < 0.05$) but SOC and OM did not show any significant seasonal variation. Results indicated that hydrological cycles strongly regulate soil organic carbon content, with enhanced accumulation during monsoon, post-monsoon and winter, and losses during pre-monsoon. The present study is the first known attempt to estimate soil carbon stocks across depths and seasons from Deepor *beel*, a Ramsar site of international importance. The findings of this study will help to establish a baseline dataset that may serve as a reference for future assessments of carbon storage capacity in this highly important peri-urban wetland as well as for similar ecosystems in the region.

Keywords: Deepor *beel*, wetland, soil organic carbon, carbon stock, organic matter, bulk density

Introduction

Soil carbon in wetlands plays a vital role in sustaining ecosystem services by regulating climate, water resources and biodiversity (Zedler & Kercher, 2005). Despite encompassing only 5–10% of global land area (Mitsch & Gosselink, 2007), these resources serve as major carbon sink (Intergovernmental Panel on Climate Change Working Group III, 2000) and store about 20–30% of global organic carbon (OC). In wetlands, carbon is stored as plant biomass carbon (PBC), particulate organic matter (POM), dissolved organic carbon (DOC), microbial biomass carbon (MBC) and gaseous forms (CO_2 and CH_4) in three main components which include sediments, biomass and water (Kayranli, Scholz, Mustafa, & Hedmark, 2010).

Both organic and inorganic carbon builds up substantial carbon pool in wetlands (Yu, Loisel, Brosseau, Beilman, & Hunt, 2010; Packalen, Finkelstein, & McLaughlin, 2014; Nahlik & Fennessy, 2016). OC in wetland soil is predominantly derived from biotic sources such as plant, debris and

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inorganic carbon originates from mineral inputs or biogenic processes that form compounds such as calcium carbonate. In carbon sequestration assessments, only OC is considered because inorganic carbon does not come from CO_2 fixed by photosynthesis (Saderne et al., 2019; Wang, Jiang, Li, Kong, & Xi, 2019).

Carbon present in wetland soils can be "autochthonous" which is generated within the wetland itself (*in situ*) or "allochthonous", which is transported to the system from external sources (*ex situ*) (Howard, Hoyt, Isensee, Telszewski, & Pidgeon, 2014; Van de Broek et al., 2018). Potential of wetland to store carbon is site specific and influenced by multiple factors such as wetland's age, management regime, environmental conditions like climatic and geographic location (Kayranli et al., 2010), hydrogeomorphology, plant community (Bernal & Mitsch, 2012), and human-induced disturbances (Lolu, Ahluwalia, Sidhu, & Reshi, 2019). Moreover, dry bulk densities (BD), carbon contents, soil depth, organic matter (OM) are important parameters for interpreting carbon accumulation in soil (Clymo, 1984; Ciais et al., 2013; Howard et al., 2014; Windham-Myers, Crooks, & Troxler, 2019).

Gohram (1995) estimated that wetlands store 350–535 Gt C globally, whereas Poulter et al. (2021) reported a range between 520 to 710 Pg C. Global carbon stock within top 100 cm of wetland soil, including peat lands, is estimated to vary from 375 to 723 Mg C ha^{-1} (Mitra, Wassmann, & Vlek, 2005). According to Gorte (2007), average carbon stock in wetlands is 306 Mg C ha^{-1}, of which 287 Mg C ha^{-1} is stored in wetland soil. Xiaonan, Xiaoke, Lu, and Zhiyun (2008) reported that wetlands can sequester more carbon (30.26 Gg C ha^{-1}) than swamps (0.22 Gg C ha^{-1}). According to Uhran et al. (2021) and Temmink et al. (2022), peat lands, mangrove ecosystems, salt marshes, and seagrass meadows exhibit maximum OC storage among coastal and freshwater ecosystems, with values reported as high as 2×10^3 Mg C ha^{-1}.

Inland wetlands serve as major reservoirs of terrestrial carbon (Köchy, Hiederer, & Freibauer, 2015; Kolka et al., 2018). Carbon storage in these ecosystems had been reported ten times higher than in tidal saltwater (Nahlik & Fennessy, 2016) facilitated by high primary productivity, anaerobic soils, accumulation of dissolved organic matter (DOM) and POM and precipitation from allochthonous sources (Nag, Nandy, Roy, Sarkar, & Das, 2019). Carbon burial in freshwater wetlands was found to vary between 20 and 30 g C cm^{-1} yr^{-1} which is more than the sequestration rate of terrestrial forest (10 g C cm^{-2} yr^{-1}) (Chmura, Anisfeld, Cahoon, & Lynch, 2003). Estimates of soil organic carbon (SOC) content and carbon sequestration in inland wetlands from multiple studies indicated considerable regional variation, with SOC values ranging from 18.6 ± 1.76 to 160 kg C m^{-2} and carbon sequestration rates varying from 60.7 ± 9.8 to 266 ± 47 g C m^{-2} yr^{-1} (Bernal & Mitsch, 2012; Nahlik & Fennessy, 2016; Carnell et al., 2018; Pearse, Barton, Lester, Zawadzki, & Macreadie, 2018; Xiao, Deng, Kim, Huang, & Tian, 2019; Yoo, Kim, Kim, Lim, & Kang, 2022).

Assam has a total of 3513 floodplain wetlands occupying an area of 0.101 million ha (Assam Remote Sensing Application Centre, 1997), representing about 20 percent of total floodplain wetland area of India (0.5 million hectares) (Sarkar et al., 2021). Floodplain wetlands are ecologically productive (Borah et al., 2022) and rich in ichthyofaunal diversity with around 96 fish species being reported from these resources (Sarkar et al., 2021). Floodplain wetlands can contain large carbon stocks in soil (Sutfin & Wohl, 2017). Organic carbon content in soil is a key energy source that fuels both plankton and detritus-based primary productivity in floodplain wetlands (Sugunan & Bhattacharjya, 2000). Thus, trophic interactions, food webs and overall biodiversity in floodplain wetland ecosystems are directly or indirectly influenced by organic carbon.

Despite their ecological significance, floodplain wetlands in Assam remain understudied with respect to soil carbon, which forms the base of food chains and food webs in these resources. Only a limited number of researchers (Sugunan & Bhattacharjya, 2000; Kalita, Sarma, & Devi, 2019; Sarkar & Das, 2020; Nath et al., 2023; Nag, Ghosh, Das, & Sarkar, 2025) estimated soil carbon in these ecosystems. It is to be noted that Deepor *beel* is home to rich diversity of fishes; with 55 species reported by Das et al. (2025) during 2023-2024, while 64 species were reported by Bhattacharjya, Saud, Borah, Saikia, and Das (2021) during 2016-18. The present study is the first known attempt to estimate soil carbon stocks across depths and seasons in this highly important peri-urban floodplain wetland. The study on carbon stocks of the wetland will contribute towards determining dominant food chains and will help fishery managers in identifying fish species that efficiently utilize these existing key energy pathways. Further, the findings of the study will help to establish a baseline dataset that may serve as a reference for future assessments of carbon storage capacity for this wetland as well as for similar wetlands located in the Eastern Himalayan region, at the same time highlighting its potential as a carbon sink towards mitigating climate change.

Materials and Methods

Deepor *beel*, the only Ramsar designated wetland in Assam, is an ecologically significant floodplain located at south-west of Guwahati city (latitudes: 26°05′26″ N and 26°09′26″ N; longitudes: 90°36′ E and 90°41′25″ E) in lower Brahmaputra valley (Fig. 1). Though earlier reports indicated 40 km^2 of wetland area, current total wetland area is likely to shrink due to rapid encroachment in the *beel* periphery. The wetland functions as a major natural water reservoir for greater Guwahati area and receives water inflows from Morabharalu rivulet, Basistha and Kalamoni rivers. The wetland is connected to Brahmaputra River through Khanajan canal, which serves as both an inlet and an outlet channel. The wetland remains one of the most ecologically significant wetlands of northeastern region due to its rich biodiversity, distinctive geomorphology and proximity to a major urban centre, which also makes it highly susceptible to anthropogenic influences.

Sediment samples were collected following procedures outlined by Intergovernmental Panel on Climate Change (IPCC, 1997). Composite samples (two samples per composite) were collected during January to December, 2023 from six sites (S1, 26°6′ 54.19" N, 91°40′12.90" E; S2, 26°6′54.09" N, 91°39′ 47.59" E; S3, 26°7′7.32" N, 91°39′33.43" E; S4, 26°6′ 55.77" N, 91°39′18.17" E; S5, 26°7′11.73" N, 91°39′ 7.50" E; S6, 26°7′12.32" N, 91°38′45.84" E). Sampling was carried out across four seasons namely, pre-monsoon (March-May), monsoon (June- first half of September), post-monsoon (end of September-November) and winter (late December-February) following Das et al. (2025). A handheld metallic cylindrical core sampler measuring 200 cm in length and 2.5 cm in diameter was used for sample collection. The corer was inserted vertically into the soil with minimal disturbance and carefully withdrawn to retain consistency of samples. After draining surface water and plant debris, soil core was sectioned into two depth intervals, 0–10 cm (surface soil layer) and 10–20 cm (sub-surface soil layer). An additional composite sample was also collected for bulk density (BD) measurements at each depth. After collection, samples were packed in pre-labelled polythene bags and brought to the laboratory, where samples were air-dried at ambient temperature, pulverized and sieved through a standard mesh sieve (<2 mm) and homogenized. Here, soil refers to sediments of the wetland (Hinshaw & Wohl, 2021).

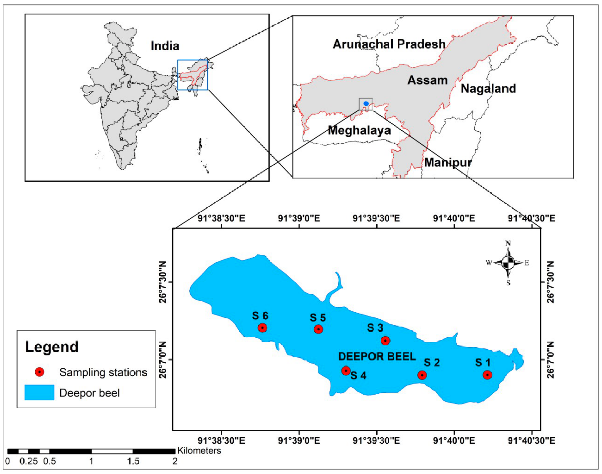

Fig. 1. Map of Deepor *beel* showing sampling sites

Bulk density (BD) (g cm^{-3}) of the soil sample was estimated as the ratio of dry mass (g) to the volume of the wet sample (cm^{-3}) by following the method described by Wilke (2005) as $\rho Sj = mj/vj$, where Sj is the BD of the j^{th} horizon (g cm^{-3}), mj is mass of soil sample (g) of j^{th} horizon dried at 105 °C and vj is volume of sediment sample (cm^{-3}) of the j^{th} horizon.

Soil organic carbon (SOC) in soil samples was estimated by oxidizing the soil with a mixture of 1 N potassium dichromate ($K_2Cr_2O_7$) and concentrated sulfuric acid (H_2SO_4), followed by back-titration of the excess potassium dichromate ($K_2Cr_2O_7$) with a standard ferrous ammonium sulfate solution using diphenylamine as an indicator, following the method of Walkley and Black (1934) outlined by Jackson (1973) and calculated by using the formula: SOC (%) = 10 x (B-S)/B x 0.003 x (100/ weight of soil), where B is reading of blank sample, S is reading of soil sample and 0.003 is milliequivalent weight of carbon in grams (g).

Soil organic carbon (SOC) stocks at each soil depth interval were estimated using the formula: SOC stock (Mg C ha^{-1}) = Soil organic carbon (SOC) content (%) x BD (g cm^{-3}) x depth (cm), where SOC stock is soil organic carbon stock, Mg is Megagram, ha is hectare and depth refers to thickness of soil layer (cm).

Organic matter (OM) content in soil samples was calculated by multiplying SOC content with 1.724 (Van Bemmelen factor) which assumes that carbon makes up 58% of OM (Allison, 1965).

Significant differences for soil quality parameters between seasons at different soil depths were tested using ANOVA. Duncan's Multiple Range Test (DMRT) analysis was conducted to compare means of all studied parameters. Statistical significance was tested at 5% level of significance. Assumptions of ANOVA viz., normality and homogeneity of variance were tested and analysis were carried out using SPSS and MS-Excel software following Das et al. (2023).

Results and Discussion

In the present study, BD values exhibited a wider range from 0.31 to 1.55 g cm^{-3} across different seasons and soil depths. One way ANOVA analysis ($p < 0.05$) revealed that there were seasonally significant differences between BD in both surface and sub-surface soil (Table 1). Maximum mean BD value in surface soil was 1.16 ± 0.08 g cm^{-3} during winter, which decreased to 0.46 ± 0.07 g cm^{-3} in monsoon season. In contrast, sub-surface sediment exhibited a significant seasonal increase in mean BD, ranging from 0.56 ± 0.07 g cm^{-3} (monsoon) to 1.21 ± 0.07 g cm^{-3} (winter) (Fig. 2).

BD is a key parameter influencing estimation of SOC content (Howard et al., 1995). Previous researchers (Kalita et al., 2019) reported that BD values in Deepor *beel* varied from 0.60 to 0.90 g cm^{-3}. Depth-wise, sub-surface layers generally showed higher BD than surface layer, likely due to increased soil compaction and lower organic matter content in deeper horizons (Kumar, Thomas, & Joseph, 2018). Higher organic matter (OM) content in surface soil enhances porosity, which in turn reduces BD (Brady & Weil, 1999). Nag et al. (2025) reported BD values ranging from 0.37 to 0.57 g cm^{-3} in wetlands of Assam, with higher values recorded at greater depths, which supports our findings.

On a temporal scale, pronounced reduction in BD during monsoon season in wetland soil could be attributed to expansion of pore space and reduced compaction caused by flooding and accumulation of organic matter (Bruland & Richardson, 2004; Brix, 2020). Conversely, higher BD values observed in pre-monsoon and winter seasons are associated with drying, soil consolidation and reduction in pore space (Kangabam, Kanagaraj, & Govindaraju, 2016). It is to be noted that BD changes temporally due to soil shrinkage and swelling processes (Hopkins et al., 2009).

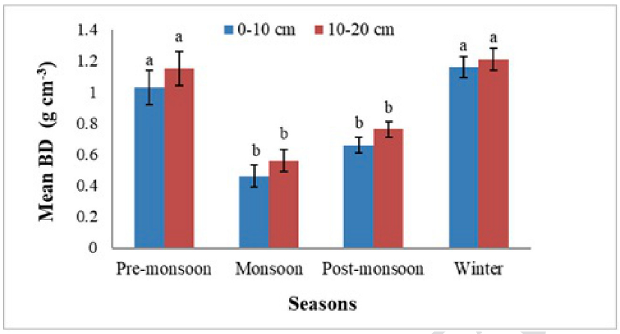

Fig. 2. Seasonal variability of bulk density (BD) (g cm^{-3}) at different depths of soil

SOC content in soil exhibited different patterns across seasons and depth in the studied wetland as illustrated in Fig. 3. During the study period, content of carbon in wetland soil across four seasons and both soil depths was estimated to range from 1.03 to 3.16%. Seasonally, SOC contents values varied from 1.03 to 2.26% in pre-monsoon, 1.12 to 2.86% in monsoon, 1.25 to 3.16% in post-monsoon and 1.10 to 2.67% in winter. At 0–10 cm and 10–20 cm depths of soils, it varied from 1.03 to 2.67% and 1.38 to 3.16% respectively. In top soil layer, mean SOC content ranged from 1.90 ± 0.15% to 2.52 ± 0.24% with maximum value observed during post-monsoon and lowest during pre-monsoon season. A similar pattern was also observed in sub-surface layer with highest value in post-monsoon season (mean = 2.12 ± 0.20%) and lowest in pre-monsoon season (mean = 1.60 ± 0.16%). Seasonal distribution of SOC content appeared in the order of post-monsoon > monsoon > winter > pre-monsoon at different depth of soils. In this study, SOC declined from winter to pre-monsoon followed by an increase during monsoon season and reached maximum during post-monsoon season. However, SOC did not show any significant seasonal variation ($p < 0.05$) in both surface and sub-surface layers (Table 1).

Nag et al. (2025) reported that SOC in wetlands of Assam varied from 5.94 to 6.61% in Chatla, 4.12 to

Table 1. Seasonal variability of BD, SOC, SOC stock and OM at different depths of soil in Deepor *beel*

Depths of soil (cm)	Seasons	BD (g cm^{-3})	SOC (%)	SOC stock (Mg C ha^{-1})	OM (%)
0 – 10 cm	Pre-monsoon	$1.03^{a} \pm 0.11$	$1.90^{a} \pm 0.15$	$20.03^{a} \pm 3.07$	$3.27^{a} \pm 0.26$
	Monsoon	$0.46^{b} \pm 0.07$	$2.32^{a} \pm 0.20$	$11.11^{b} \pm 2.41$	$3.99^{a} \pm 0.35$
	Post-monsoon	$0.67^{b} \pm 0.05$	$2.52^{a} \pm 0.24$	$16.96^{ab} \pm 2.42$	$4.33^{a} \pm 0.41$
	Winter	$1.16^{a} \pm 0.08$	$2.15^{a} \pm 0.16$	$24.32^{a} \pm 1.29$	$3.69^{a} \pm 0.28$
10 – 20 cm	Pre-monsoon	$1.15^{a} \pm 0.11$	$1.60^{a} \pm 0.16$	$18.67^{a} \pm 3.03$	$2.74^{a} \pm 0.28$
	Monsoon	$0.56^{b} \pm 0.07$	$1.89^{a} \pm 0.20$	$11.15^{b} \pm 2.30$	$3.25^{a} \pm 0.35$
	Post-monsoon	$0.76^{b} \pm 0.05$	$2.12^{a} \pm 0.20$	$16.21^{ab} \pm 2.13$	$3.64^{a} \pm 0.35$
	Winter	$1.21^{a} \pm 0.07$	$1.83^{a} \pm 0.18$	$21.76^{a} \pm 1.99$	$3.14^{a} \pm 0.26$

Values are presented as mean ± SE (n=6). Means with different superscript letters differ significantly at $p < 0.05$ according to Duncan's Multiple Range Test (DMRT)

5.24% in Urmal, 2.80 to 3.60% in Charan, 1.66 to 2.75% in Jaluguti and 1.00 to 1.30% in 47-Morakolong. Thus, value of soil carbon content estimated in Deepor *beel* during the present study aligned with the lower range of values reported by Nag et al. (2025). Sugunan and Bhattacharjya (2000) reported earlier that carbon content varied from 0.34 to 3.90% in different soils of wetlands of Assam. Deka (2011) observed SOC across eight beels in Assam and found that SOC varied between 1.5 and 2.5%. Kumar and Sharma (2025) reported SOC of 0.84 to 2.04% in 0–10 cm and 0.26 to 1.74% at 10–20 cm soil depth in a semi-arid wetland of India. Gafur and Abujam (2012) reported mean SOC values of 2.44 ± 0.78% in Kapla and 2.25 ± 0.31% in Amguri beels of Assam which was consistent with the present findings. SOC content was found to be maximum in surface soil layer in this study across all seasons compared to sub-surface layer which can be due to plant litter, macrophyte roots and microbes which add more organic matter near the surface. SOC tends to decline with rising temperature, as higher temperatures accelerate microbial respiration and decomposition processes (Kirschbaum, 1995; Albrecht & Rasmussen, 1995; Schlesinger, 1997; Hartel, 2005). During dry season, SOC decreases due to accelerated decomposition rates of soil and reduced litter input, whereas under wet conditions, SOC tends to increase as a result of enhanced plant growth, greater litter accumulation, and slower decomposition under waterlogged or anaerobic environments (Chauhan & Jain, 2025). Salim, Kumar, Gupta, and Kumar (2015) observed that higher SOC content in sub layer soil after monsoon was due to downward movement of DOM and deeper root activity. The present study showed that wetlands act as carbon sinks, particularly after monsoon, but SOC is susceptible to degradation during dry pre-monsoon periods.

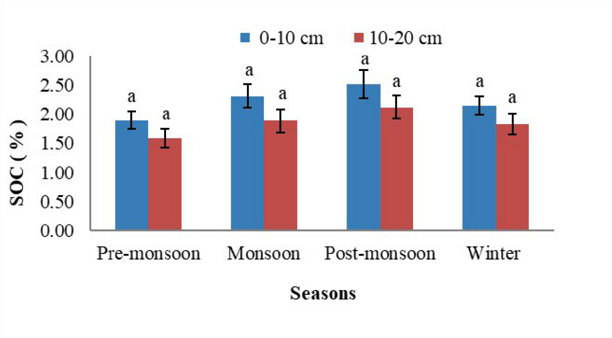

Fig. 3. Seasonal variability of SOC (%) at different depths of soil

Fig. 4 illustrates the seasonal and depth-wise variations in SOC stock across the studied wetland. In the present study, seasonal fluctuation of SOC stock in soil of Deepor *beel* was 14.30 to 29.16 Mg C ha^{-1}, 9.23 to 30.9 Mg C ha^{-1}, 4.04 to 18.61 Mg C ha^{-1}and 9.99 to 24.71 Mg C ha^{-1} during winter, pre-monsoon, monsoon and post-monsoon respectively. Average SOC stock of soil ranged from 11.11 ± 2.41 Mg C ha^{-1} to 24.32 ± 1.29 Mg C ha^{-1} at a soil depth of 0–10 cm while at 10–20 cm, it ranged from 11.15 ± 2.30 Mg C ha^{-1} to 21.76 ± 1.99 Mg C ha^{-1}. The present study revealed that SOC stock in the wetland declined with increasing depth. With regard to seasonal variation, carbon stock in soil was found to be maximum during winter and least during monsoon. ANOVA results ($p < 0.05$) showed a significant influence of seasons on both SOC stock in surface and sub-surface soil layer (Table 1).

Higher carbon accumulation in winter could be due to lower temperatures and relatively stable soil moisture, litter deposition and root derived inputs which limit microbial decomposition and enhance carbon retention in surface and sub-surface layers (Jobbágy & Jackson, 2000; Yang, Luo, & Wu, 2005; Yang, Mohammat, Feng, Zhou, & Fang, 2007; Zhu et al., 2010). A similar observation was also made by Dayathilake, Lokupitiya, and Wijeratne (2021) in Kolonnawa wetland.

Sharp decline in SOC stock during monsoon season with less difference in carbon accumulation between surface and sub-surface layers can be attributed to increased water logging which promotes vertical mixing, leaching, and redistribution of organic matter within soil profile. During post-monsoon period, SOC stock increased again due to deposition of fresh organic matter and its stabilization under conditions of moderate moisture and improved aeration. Similar trend in seasonal variation of carbon content was also reported by Kumar and Sharma (2025) in a forested freshwater wetland of India.

SOC stocks were calculated using soil depth, BD, and SOC concentration. Although SOC stock values are computed as product of SOC concentration and BD, the latter exerts a proportional and linear effect on final carbon stock estimates (Walter, Don, Tiemeyer, & Freibauer, 2016) as higher BD increases accumulation of carbon per unit volume of soil. In this study, though SOC content was highest in post-monsoon period, SOC stock reached its maximum during winter, primarily because of higher BD. Highest SOC stock in the study area during winter as observed in the present study is consistent with earlier findings reported by Liu, Zhou, Qin, and Zhou (2007) and Zhou et al. (2015). When compared with reference values provided by Penman et al. (2003), SOC stocks in the present study area were lower than those documented for tropical wet forests (44–66 t C ha^{-1} in the upper 30 cm) and tropical dry forests (31–38 t C ha^{-1} in the upper 30 cm).

During the study period, OM content in the wetland exhibited significant variation across seasons and soil depths (Fig. 5). OM content ranged from 2.37 to 5.44% (mean = 3.27 ± 0.26 to 4.33 ± 0.41%) in top soil (0–10 cm) and 1.77 to 4.59% (mean = 2.74 ± 0.28 to 3.64 ± 0.35%) in sub-surface soil layer (10–20 cm) (Table 1). Seasonal mean OM followed the trend of pre-monsoon < winter < monsoon < post-monsoon, with maximum mean value observed during post-monsoon season and least in pre-monsoon in both surface and sub-surface soil.

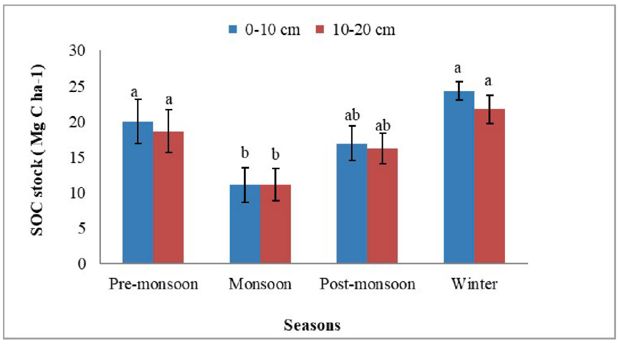

Fig. 4. Seasonal variability of SOC (Mg C ha^{-1}) stock at different depths of soil

Organic matter inputs serve as a primary source of carbon and form the basis for biogeochemical processes and food web dynamics in both aquatic and terrestrial ecosystems (Allan & Castillo, 2007). Increase in OM at both top and sub-soil during monsoon and post-monsoon periods could be attributed to enhanced organic inputs through sediment accumulation during monsoonal inundation, litter deposition, runoff, dense macrophyte cover and reduced decomposition under waterlogged anaerobic conditions (Duan et al., 2018; Mandol et al., 2023; Saha et al., 2023; Tak et al., 2023). Kalita et al. (2019) recorded total organic matter content in the range of 3.2 to 9.5% at 0–10 cm depth in Deepor *beel*. Lowest organic matter accumulation during pre-monsoon period could be attributed to enhanced microbial decomposition and oxidation under dry and aerobic conditions. Organic matter concentration was highest in surface layer, while a progressive decline with depth was observed, likely due to reduced organic inputs and diminished root biomass in deeper soil horizons. A comparable vertical distribution pattern in soil organic matter was reported by Mitsch and Gosselink (2015).

Wetlands play a crucial role in global carbon cycling and climate change mitigation owing to their capacity for long-term carbon sequestration. However, these ecosystems are increasingly threatened by anthropogenic pressures such as pollution, unsustainable resource use, and hydrological alterations, and Deepor *beel* is no exception. The

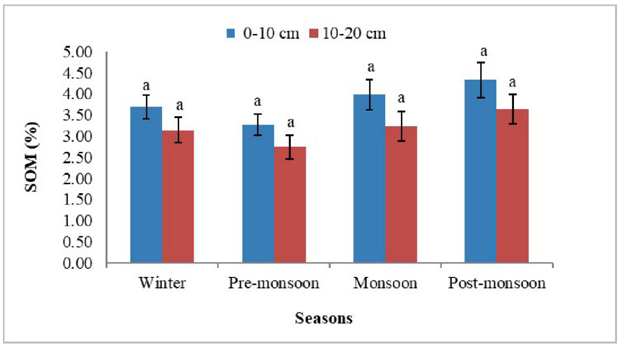

Fig. 5. Seasonal variability of OM (%) at different depths of soil.

estimated soil organic carbon (SOC) stock of 4.04 to 30.9 Mg C ha^{-1} of Deepor *beel* highlights its importance to act as a carbon sink and contribute to regional and global climate mitigation.

Furthermore, baseline information on carbon stocks provides valuable insights into the dominant food webs within the wetland, enabling the identification of fish species that efficiently utilize these energy pathways. Such knowledge is essential for informed and sustainable management of floodplain wetland fisheries. Given its critical ecological functions, rich ichthyological diversity, the livelihood support it offers to marginal fishers, there is an urgent need for well-panned and integrated conservation strategies to safeguard this vital ecosystem in the face of ongoing climate change.

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