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Assessment of Soil Carbon Stock Potential in Different Soil Layers of Grassland Ecosystems

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Authors' contributions

This work was carried out in collaboration between both authors. Author LAP contributed by conceptualization, statistical analysis, supervision and writing of the manuscript. Author PVP contributed by field work, laboratory analysis and data collection. Both authors read and approved the final manuscript.

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ABSTRACT

Mostly soil carbon stock research is done in areas with natural vegetation, ignoring university campuses. This study assesses soil carbon stocks in different soil layers of grassland ecosystems within the Bharathiar University campus in Tamil Nadu, India. Soil samples were collected from grasslands in four sections (namely, East section, West section, North section, and South section) of the campus and analyzed for carbon content across depths of 0-10cm, 10-20cm, and 20-30cm. Results indicate soil carbon stocks in grassland ecosystems ranging from 1.36% to 2.26%, with notable variations observed among campus sections and soil layers. One-way ANOVA revealed that there is a significant variation in soil carbon stock values among the four sections in the 20-30cm layer ($F(3,16)=3.865$, $p<0.05$), but not for the 0-10cm layer ($F(3,16)=1.454$, $p>0.05$) and the

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10-20cm layer ($F(3,16)=3.011$, $p>0.05$). Pearson's Correlation analysis revealed that the soil carbon stock had no significant relationships with soil pH, Conductivity, and total dissolved solids at all four sections of the university campus, except for a positive correlation between soil carbon stock and total dissolved solids at the East section ($r=0.563$, $p<0.05$), and between soil carbon stock and soil pH at the South section ($r=0.550$, $p<0.05$). These findings underscore the complexity of soil carbon dynamics in grassland ecosystems of university campuses and emphasize the potential for localized assessments to inform sustainable land management strategies. This study contributes valuable insights into enhancing carbon sequestration efforts at the university campus, useful for global climate change mitigation. Integrating such localized findings into broader environmental policies can optimize carbon management strategies across similar ecosystems globally.

Keywords: Carbon sequestration; grassland ecosystems; soil carbon stock; soil layers; sustainable land management.

1. INTRODUCTION

Converting natural ecosystems to managed ecosystems increases susceptibility to soil degradation processes, leading to a depletion of soil carbon stocks and the release of carbon dioxide and other greenhouse gases into the atmosphere [1]. Effective soil management practices can mitigate carbon emissions, leveraging soil's substantial carbon fixation potential. Assessing soil carbon stock across various land covers is crucial for formulating sustainable land management strategies. These strategies are pivotal in carbon sequestration efforts and mitigating greenhouse gas emissions, particularly in addressing climate change concerns [1].

Globally, soils store approximately 2135 Gt of soil carbon stock [2], making them the largest terrestrial reservoir of carbon [3]. However, factors such as land use and management practices, exacerbated by rising temperatures from climate change, may potentially shift soils from being a carbon storage to a significant source of atmospheric carbon dioxide (CO_2) [4]. Given the vast size of this terrestrial carbon pool, even slight changes in soil carbon stocks, on the order of a few percentage points, could profoundly impact atmospheric CO_2 concentrations and the global carbon balance [5,6].

Addressing changing climatic conditions and escalating land-use conflicts necessitates the establishment of sustainable land-use systems that harmonize agricultural production with the provision of diverse ecosystem services [7]. Global estimates indicate that interventions in land use contribute significantly, potentially reducing emissions by approximately 30% through carbon sequestration. These efforts are critical for achieving the carbon reduction targets established during the COP-25 meeting [8].

Over recent decades, scientific research has prioritized strategies to enhance soil carbon levels to mitigate climate change [9] and enhance soil health [10]. Conversion of forests to alternative land uses [11] and unsustainable soil management practices, such as conventional tillage, removal of crop residues, in-field burning, excessive use of agrochemicals, and reduced application of external organic matter [12], have been shown to reduce soil carbon stocks [13].

The predominant factor driving the observed increase in global average temperatures is the steady rise in atmospheric CO_2 levels, as reported by IPCC [14]. Since the beginning of the industrial revolution in 1850, atmospheric CO_2 concentrations have risen from 280 parts per million (ppm) to 426 ppm in 2024 [15]. Predictions indicate that the mean global temperature could increase by 1.1°C to 6.4°C by 2100 [16,17].

Grasslands are defined as areas of land covered with grass and having less than 2% tree or shrub cover. According to the Food and Agriculture Organization (FAO), grasslands cover approximately 28% of the Earth's land surface. Grasslands provide multiple services in ecosystem functioning. They play a crucial role in livestock production, soil erosion control, biodiversity conservation, landscape maintenance, and carbon sequestration in climate change mitigation [18].

There are several studies available on soil carbon stocks worldwide, however, they are focused mostly on the natural forest [19-21]. Soil carbon stock research on university campuses is completely neglected in understanding their carbon sequestration potential. Hence, the present study aims to fill the knowledge gap. The main objective of this study is to estimate the soil carbon stock by different soil layers of grasslands in the Bharathiar University campus located in Coimbatore, India.

2. MATERIALS AND METHODS

2.1 Study Area

The present study was conducted in the grassland ecosystems within Bharathiar University campus, situated at the foothills of Maruthamalai, a mountain forest within the Western Ghats, in the Coimbatore district of Tamil Nadu state, India (Fig. 1). Covering a vast area of 1000 acres, the campus is located 15 km west of Coimbatore city, along Maruthamalai road. The Bharathiar University campus has different vegetation types such as natural forests, grasslands, and mono-species and multi-species plantations [22]. The campus is situated adjacent to the Marudamalai hills and its terrain is almost plain, and the elevation gradually varies from 482-512 m asl [23].

2.2 Climate

Based on climate data covering from 1991 to 2021, the study area at Bharathiar University received an average annual rainfall of 952 mm. Significantly, 77% of this rainfall occurred between June and November. The average monthly temperature throughout this period was 25°C. The lowest monthly temperature, 18°C, was recorded in January, while the highest, 35°C, was observed in April [24].

2.3 Field Survey

For the field survey, the Bharathiar University campus was divided into four sections: East, West, North, and South. A total of 60 soil samples from grassland ecosystems of the four sections were collected systematically. Within each section, five representative sampling spots were identified in the grasslands. From each spot, soil samples were collected from three layers: 0-10cm, 10-20cm, and 20-30cm depths.

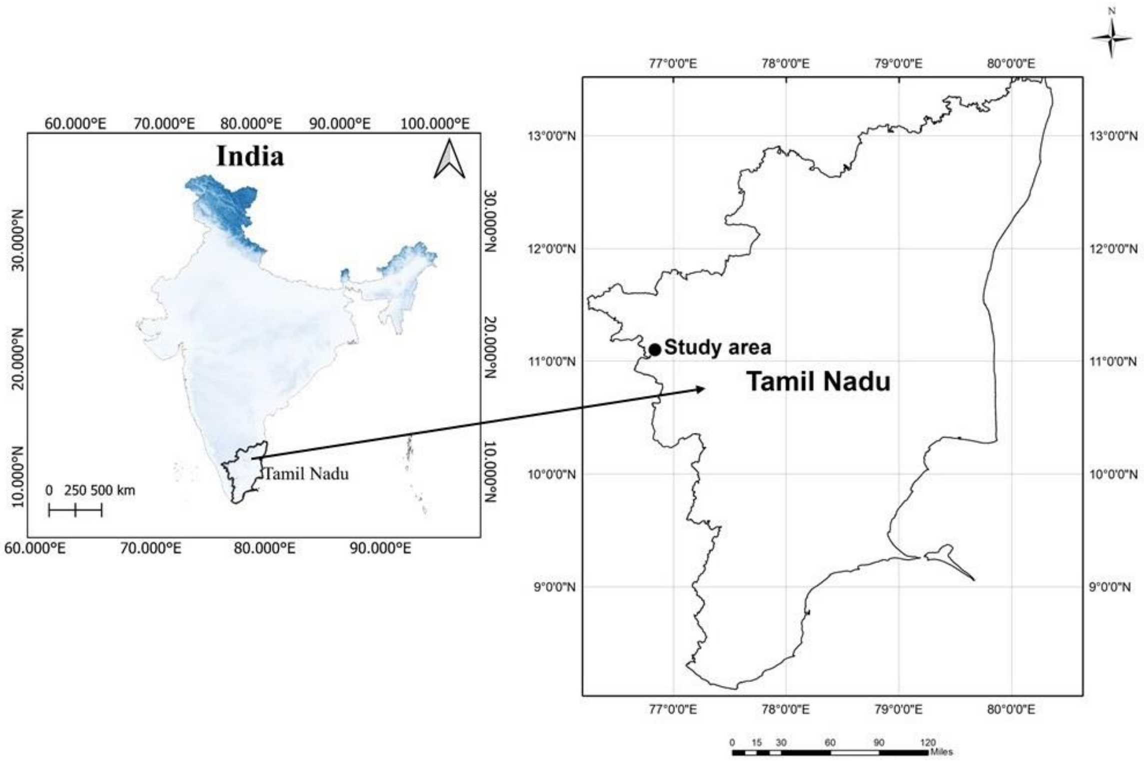

Fig. 1. Map showing the location of the study area

2.4 Laboratory Analysis

The collected soil samples were analyzed to determine the soil carbon stock across the campus. Soil pH influences nutrient availability and microbial activity, affecting plant growth. Conductivity indicates soil salinity, reflecting the soil health of the ecosystem. Total Dissolved Solids (TDS) measure the concentration of dissolved substances, providing insights into soil quality and potential impacts on water absorption by plants. We analyzed the soil parameters such as pH, conductivity, and TDS to understand their influence on soil carbon stock.

2.4.1 Determination of soil carbon stock

In the laboratory, the collected soil samples were dried in an oven at 105°C for 2 hours to obtain their dried weights. Subsequently, two grams of the oven-dried and ground soil samples were transferred into pre-weighed crucibles. These crucibles were then placed in a furnace and heated to 550°C for 1 hour. After heating, the crucibles were allowed to cool slowly inside the furnace. After cooling, the crucibles containing the ash samples were weighed to determine the percentage of carbon stock, following the methodology described by Allen et al. [25].

Estimation of carbon stock (C):

C (%) = (100 - ash %) x 0.58

Calculation of ash (%) for estimation of carbon stock

Ash (%) = (W3 – W1)/ (W2 – W1) x 100

Where, W1 is the weight of crucible

W2 is the weight of oven-dried grind sample + Crucible

W3 is the weight of ash + Crucible

2.4.2 Estimation of other soil parameters

pH indicates acidity or alkalinity on a scale of 0 to 14, with 7 being neutral. Each pH unit represents a tenfold change in acidity or alkalinity. Soil pH was measured using a pH meter in this study to compare samples accurately. Soil conductivity was measured using a conductivity meter. TDS analyzed per APHA [26] standard methods, involved filtering a 50 mL sample through filter paper. The filtrate was transferred to a pre-weighed silica crucible and evaporated in a hot air oven at 105°C until dry. The final weight (W2) of the crucible was recorded after cooling in a desiccator.

Calculation of TDS:

TDS (mg/L) = ((W2-W1) × F)/V

Where, W1 = Weight of the empty crucible

W2 = Weight of the crucible with dried residue after evaporation

F = Factor to convert weight to TDS

V = Volume of the sample filtered

2.5 Statistical Analysis

One-way analysis of variance (ANOVA) was performed to check for significant variation in soil carbon stock value for the different soil layers of the grasslands across the four sections (East, West, North, and South) in the Bharathiar University campus. Further, Pearson’s Correlation analysis was performed to understand the relationship between the carbon stock values and the soil parameters such as pH, conductivity, and total dissolved solids of the grasslands in the four sections of the university campus.

3. RESULTS AND DISCUSSION

3.1 Soil Carbon Stock and Other Soil Parameters

Soil carbon stock (%) and other soil parameters such as pH, Conductivity, and TDS varied among the grasslands in the four sections studied at the Bharathiar University campus. The highest carbon stock value was found in the South section (2.26%, 22.64 gC/kg of soil), followed by North (1.67%, 16.68 gC/kg of soil), West (1.39%, 13.91 gC/kg of soil), and East (1.36%, 13.65 gC/kg of soil) (Table 1). The pH values varied with the highest recorded in the West section (8.49), followed by East, South, and North (Table 1). Conductivity was highest in the East section (0.24 S/m), followed by West, North, and South (Table 1). Total Dissolved Solids (TDS) were also highest in the East section (0.15 mg/L), followed by West, North, and South sections (Table 1).

Table 1. Soil carbon stock (%) of grasslands in the four sections studied at the Bharathiar University campus with other soil parameters

Section	Parameter	n	Average	±SD
East	Carbon stock (%)	15	1.36	0.54
	pH	15	8.15	0.26
	Conductivity (S/m)	15	0.24	0.02
	TDS (mg/L)	15	0.15	0.01
West	Carbon stock (%)	15	1.39	0.43
	pH	15	8.49	0.36
	Conductivity (S/m)	15	0.16	0.04
	TDS (mg/L)	15	0.10	0.02
North	Carbon content (%)	15	1.67	0.81
	pH	15	7.39	0.79
	Conductivity (S/m)	15	0.10	0.05
	TDS (mg/L)	15	0.05	0.02
South	Carbon content (%)	15	2.26	0.31
	pH	15	7.94	0.49
	Conductivity (S/m)	15	0.09	0.02
	TDS (mg/L)	15	0.05	0.01

3.2 Carbon Stock in the Soil Layer 0-10cm

The carbon stock in the 0-10cm soil layer of the grasslands at Bharathiar University campus averaged 16.80 gC/kg of soil, with values ranging from 13.60 gC/kg to 21.85 gC/kg across the four sections studied (Fig. 2). The South section exhibited the highest carbon stock, followed by North, West, and East sections (Fig. 2). However, single-factor ANOVA indicated that the carbon stock in the 0-10cm soil layer did not differ significantly among the sections at the Bharathiar University campus (Table 2). This suggests overall uniformity in soil carbon content for the 0-10cm soil layers across the grasslands at different sections despite observed variations in absolute values.

3.3 Carbon Stock in the Soil Layer 10-20cm

The carbon stock in the 10-20cm soil layer of the grasslands at Bharathiar University campus averaged 17.10 gC/kg of soil, with values ranging from 13.50 gC/kg to 23.51 gC/kg across the four sections studied (Fig. 3). The South section exhibited the highest carbon stock, followed by North, West, and East sections (Fig. 3). However, single-factor ANOVA indicated that the carbon stock in the 10-20cm soil layer did not show significant variation among the sections at Bharathiar University campus (Table 3). This suggests consistent carbon stock levels in the grasslands across different sections in absolute values observed within the 10-20cm soil layer.

Table 2. Results of single factor ANOVA to check the variation of carbon stock in the soil layer 0-10cm of grasslands in the four sections studied at Bharathiar University campus

SUMMARY						
Groups	***Count***	***Sum***	***Average***	***Variance***		
East	5	6.7976	1.35952	0.244577		
West	5	7.4066	1.48132	0.166806		
North	5	8.4448	1.68896	1.264934		
South	5	10.9272	2.18544	0.146744		
ANOVA						
Source of Variation	***SS***	***df***	***MS***	***F***	***P-value***	***F crit***
Between Groups	1.988627	3	0.662876	1.454423	0.264349	3.238872
Within Groups	7.292244	16	0.455765			
Total	**9.280871**	**19**				

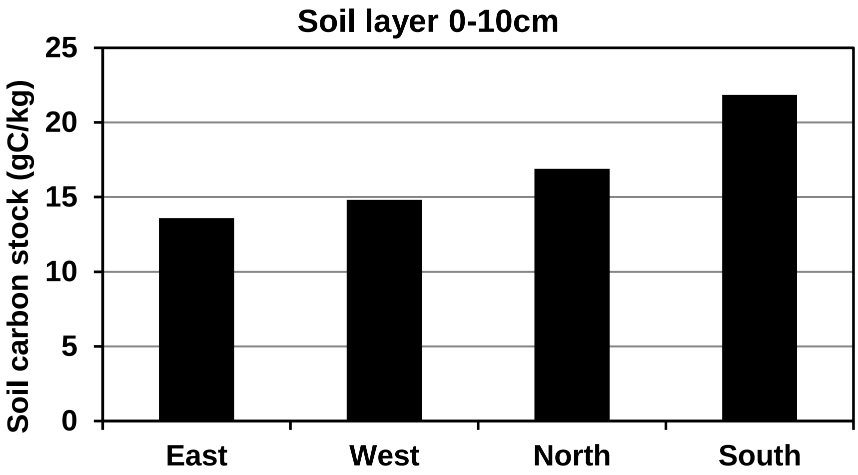

Fig. 2. Carbon stock in the soil layer 0-10cm of grasslands in the four sections studied at the Bharathiar University campus

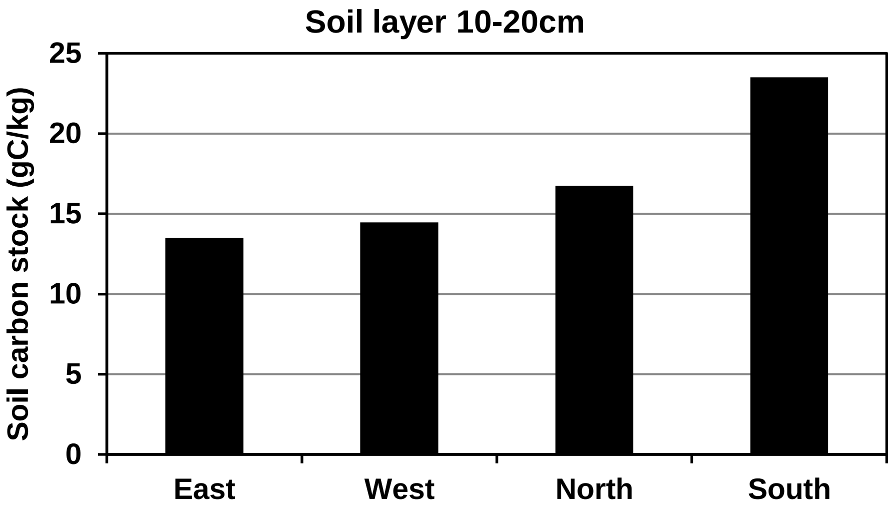

Fig. 3. Carbon stock in the soil layer 10-20cm of grasslands in the four sections studied at the Bharathiar University campus

Table 3. Results of single factor ANOVA to check the variation of carbon stock in the soil layer 10-20cm of grasslands in the four sections studied at Bharathiar University campus

Summary						
Groups	**Count**	**Sum**	**Average**	**Variance**		
East	5	6.7483	1.34966	0.313586		
West	5	7.2355	1.4471	0.222529		
North	5	8.3665	1.6733	0.753919		
South	5	11.7566	2.35132	0.063771		
ANOVA						
Source of Variation	**SS**	**df**	**MS**	**F**	**P-value**	**F crit**
Between Groups	3.057564	3	1.019188	3.011332	0.060935	3.238872
Within Groups	5.415216	16	0.338451			
Total	**8.47278**	**19**				

3.4 Carbon Stock in the Soil Sayer 20-30cm

In the soil layer 20-30cm of the grasslands at Bharathiar University campus, the carbon stock averaged 16.30 gC/kg of soil, with values ranging from 12.45 gC/kg to 22.55 gC/kg across the four sections studied (Fig. 4). The South section exhibited the highest carbon stock, followed by North, East, and West sections (Fig. 4). Further, single-factor ANOVA indicated that the carbon stock in the 20-30cm soil layer varied significantly among the four sections at the Bharathiar University campus (Table 4). These findings suggest consistent variation in carbon stock in the grasslands within the 20-30cm soil layers across the different sections of the Bharathiar University campus.

3.5 Relationship between Soil Carbon Stock and Other Soil Parameters

Pearson's Correlation analysis revealed that in the East section, soil carbon stock of the grasslands showed a positive correlation with TDS ($r=0.563$, $p<0.05$), but, no significant correlations with pH ($r=0.226$, $p>0.05$) or conductivity ($r=0.362$, $p>0.05$) was observed. For the West section, soil carbon stock did not correlate significantly with pH ($r=0.0005$, $p>0.05$), conductivity ($r=-0.341$, $p>0.05$), or TDS ($r=-0.354$, $p>0.05$). In the North section, soil carbon stock did not correlate significantly with pH ($r=-0.494$, $p>0.05$), conductivity ($r=0.212$, $p>0.05$), or TDS ($r=0.257$, $p>0.05$). However, in the South section, soil carbon stock showed a positive correlation with pH ($r=0.550$, $p<0.05$), but not with conductivity ($r=0.316$, $p>0.05$) or TDS ($r=0.327$, $p>0.05$). These findings reveal the variability in soil carbon stock and its relationships with pH, conductivity, and TDS of the grasslands, in the different sections of the Bharathiar University campus.

We observed that the soil carbon stocks of the grasslands varied from 1.36% to 2.26% in the Bharathiar University campus. While, it was from 1.26% to 1.56% at Tezpur University, India [27], from 0.64% to 1.05% at Pondicherry University, India [28], from 1.4% to 2.33% at the University of Lampung, Malaysia [29], and from 1.03% to 1.37% in Chittagong University, Bangladesh [30]. Here we observe that the soil carbon stocks in universities range from 0.64% to a maximum of 2.33%. However, the ranges can vary widely across the nations.

Statistical analysis revealed that there was no significant correlation between the soil carbon stock and the soil pH, TDS and electrical conductivity for the grassland ecosystems in the Bharathiar University campus, except for soil carbon stock with pH for the South section ($p<0.05$), and with TDS for the East section ($p<0.05$). It was reported earlier that the correlation between soil carbon stock and electrical conductivity can vary, showing positive and negative relationships [31].

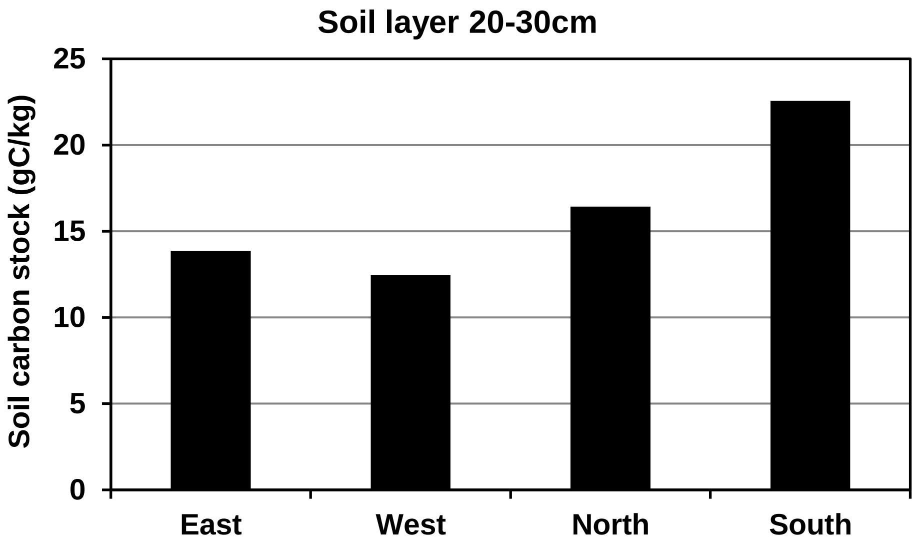

Fig. 4. Carbon stock in the soil layer 20-30cm of grasslands in the four sections studied at the Bharathiar University campus

Table 4. Results of single factor ANOVA to check the variation of carbon stock in the soil layer 20-30cm of grasslands in the four sections studied at Bharathiar University campus

Summary						
Groups	**Count**	**Sum**	**Average**	**Variance**		
East	5	6.9281	1.38562	0.444668		
West	5	6.2234	1.24468	0.215815		
North	5	8.2099	1.64198	0.273175		
South	5	11.2752	2.25504	0.099468		
ANOVA						
Source of Variation	**SS**	**df**	**MS**	**F**	**P-value**	**F crit**
Between Groups	2.994991	3	0.99833	3.865282	0.029631	3.238872
Within Groups	4.132502	16	0.258281			
Total	**7.127494**	**19**				

Worldwide numerous measures have been implemented to mitigate the increasing concentration of atmospheric carbon [32]. Initiatives such as Clean Development Mechanism (CDM) forestry projects, which started in 2006 to achieve carbon offsetting targets, have been complemented by the establishment of frameworks like the Climate Action Reserve (CAR), Verified Carbon Standard (VCS), and the American Carbon Registry (ACR) [33]. The United Nations Framework Convention on Climate Change (UNFCCC) holds regular meetings with nations to combat global warming and climate change. Future agreements are expected to introduce incentives aimed at reducing fossil fuel usage. These negotiations include provisions for Clean Development Mechanisms under the IPCC and facilitate carbon trading in national and international markets. Despite implementing policies such as carbon taxes, subsidies, and the growth of carbon markets, the increase in atmospheric carbon concentration and its consequential impacts remain alarming [17].

Developing countries, particularly vulnerable populations in these regions, are expected to face significant adverse effects from climate change. Despite India not being the top carbon emitter, its increasing emissions from fossil fuel combustion highlight the need for reduction to curb rising atmospheric carbon concentrations. Besides soil, forests and oceans are crucial carbon sinks in mitigating climate impacts.

4. CONCLUSION

From the findings of our study, we conclude that the soil carbon stocks of the grasslands in the Bharathiar University campus ranged from 1.36% to 2.26%, with notable variations observed across the campus's sections and soil layers. While significant differences were found in carbon stocks among sections for the 20-30cm soil layer, uniformity was observed in the 0-10cm and 10-20cm layers. Interestingly, correlations between soil carbon stocks and soil parameters such as pH, electrical conductivity, and total dissolved solids were generally insignificant, except for a positive correlation ($p<0.05$) between carbon stock and pH in the South section, and between carbon stock and total dissolved solids in the East section. The novelty of our study lies in its focused investigation of soil carbon stocks of grasslands within a university campus environment which is often overlooked in broader soil carbon research.

Our study underscores the importance of localized assessments in understanding soil carbon dynamics in grassland ecosystems within university campuses. They highlight the potential for sustainable land management practices to enhance carbon sequestration efforts, contributing to global climate change mitigation strategies. Further, integrating such findings into broader climate policies and management frameworks can optimize carbon management strategies in similar ecosystems worldwide.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Saha A, Handique S. Variation of soil organic carbon in a university campus in temperate north-eastern India. Environmental Challenges. 2022;7: 100493.
2. Wang M, Guo X, Zhang S, Xiao L, Mishra U, Yang Y, Zhu B, Wang G, Mao X, Qian T, Jiang T. Global soil profiles indicate depth-dependent soil carbon losses under a warmer climate. Nature Communications. 2022;13(1):5514.
3. Terrer C, Phillips RP, Hungate BA, Rosende J, Pett-Ridge J, Craig ME, van Groenigen KJ, Keenan TF, Sulman BN, Stocker BD, Reich PB. A trade-off between plant and soil carbon storage under elevated CO2. Nature. 2021;591(7851): 599-603.
4. Rodrigues L, Hardy B, Huyghebeart B, Fohrafellner J, Fornara D, Barančíková G, Bárcena TG, De Boever M, Di Bene C, Feizienė D, Kaetterer T. Achievable agricultural soil carbon sequestration across Europe from country-specific estimates. Global Change Biology. 2021; 27(24):6363-80.
5. Smith P, Soussana JF, Angers D, Schipper L, Chenu C, Rasse DP, Batjes NH, Van Egmond F, McNeill S, Kuhnert M, Arias-Navarro C. How to measure, report and verify soil carbon change to realize the potential of soil carbon sequestration for atmospheric greenhouse gas removal. Global Change Biology. 2020;26(1):219-41.
6. De Rosa D, Ballabio C, Lugato E, Fasiolo M, Jones A, Panagos P. Soil organic carbon stocks in European croplands and grasslands: How much have we lost in the past decade? Global Change Biology. 2024;30(1): e16992.
7. Sharma H, Pant KS, Bishist R, Gautam KL, Dogra R, Kumar M, Kumar A. Estimation of biomass and carbon storage potential in agroforestry systems of north western Himalayas, India. Catena. 2023;225: 107009.
8. Aynekulu E, Suber M, Van Noordwijk M, Arango J, Roshetko JM, Rosenstock TS. Carbon storage potential of silvopastoral systems of Colombia. Land. 2020;9(9):309.
9. Smith P, Martino D, Cai Z, Gwary D, Janzen H, Kumar P, McCarl B, Ogle S, O'Mara F, Rice C, Scholes B. Greenhouse gas mitigation in agriculture. Philosophical transactions of the royal Society B: Biological Sciences. 2008;363(1492):789-813.
10. Post WM, Kwon KC. Soil carbon sequestration and land-use change: processes and potential. Global change biology. 2000;6(3):317-27.
11. Brahma B, Pathak K, Lal R, Kurmi B, Das M, Nath PC, Nath AJ, Das AK. Ecosystem carbon sequestration through restoration of degraded lands in Northeast India. Land Degradation & Development. 2018;29(1): 15-25.
12. Chenu C, Angers DA, Barré P, Derrien D, Arrouays D, Balesdent J. Increasing organic stocks in agricultural soils: Knowledge gaps and potential innovations. Soil and Tillage Research. 2019;188:41-52.
13. Mishra G, Sarkar A, Giri K, Nath AJ, Lal R, Francaviglia R. Changes in soil carbon stocks under plantation systems and natural forests in Northeast India. Ecological Modelling. 2021;446:109500.
14. IPCC. Land use, land-use change and forestry. Summary for policymakers. A Special Report of the Intergovernmental Panel on Climate Change; 2000.
15. NOAA. National oceanic and atmospheric administration, US; 2024. Available:http://www.esrl.noaa.gov/gmd/ccgg/trends/
16. IPCC. Climate Change– Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the IPCC; 2007.
17. Pragasan LA. Assessment of carbon stock of tree vegetation in the Kolli Hill forest located in India. Applied Ecology and Environmental Research. 2016;14(2):169-83.
18. Pergola M, De Falco E, Cerrato M. Grassland ecosystem services: Their economic evaluation through a systematic review. Land. 2024;13(8):1143.
19. Lorenz K, Lal R, Lorenz K, Lal R. Soil carbon stock. In: Carbon sequestration in agricultural ecosystems. 2018:39-136.
20. Okolo CC, Gebresamuel G, Zenebe A, Haile M, Orji JE, Okebalama CB, Eze CE, Eze E, Eze PN. Soil organic carbon, total

nitrogen stocks and CO2 emissions in top and subsoils with contrasting management regimes in semi-arid environments. Scientific Reports. 2023;13(1): 1117.
21. Singh G, Mishra D, Singh K, Shukla S, Choudhary GR. Geographical settings and tree diversity influenced soil carbon storage in different forest types in Rajasthan, India. Catena. 2022;209: 105856.
22. Karthick A, Pragasan LA. Stand structure and above-ground biomass of two tree plantations at Bharathiar University, Coimbatore. Indian Forester. 2014;140(1): 29-33.
23. Pragasan LA, Madesh M. Species diversity and abundance of birds on Bharathiar University Campus, Tamil Nadu, India. Journal of Threatened Taxa. 2018;10(6):11725-31.
24. Pragasan LA, Kalaiselvi M. Carbon stock potential of coconut plantations in university campus: a case study from Coimbatore, India. Asian Journal of Research in Agriculture and Forestry. 2024;10(2):140-6.
25. Allen SE, Grimshaw HM, Rowland AP. Chemical analysis. Methods in plant ecology. Blackwell Scientific Publications. 1986:285-344.
26. APHA. Standard methods for the examination of water and wastewater, 21sted. Washington, DC, New York: American Public Health Association. 2005.
27. Saha A, Handique S. Variation of soil organic carbon in a university campus in temperate north-eastern India. Environmental Challenges. 2022;7: 100493.
28. Sundarapandian SM, Amritha S, Gowsalya L, Kayathri P, Thamizharasi M, Dar JA, Srinivas K, Gandhi DS, Subashree K. Soil organic carbon stocks in different land uses in Pondicherry university campus, Puducherry, India. Tropical Plant Research. 2016;3(1):10-7.
29. Banuwa IS, Utomo M, Yusnaini S, Riniarti M, Sanjaya P, Suroso E, Hidayat W. Estimation of the above-and below-ground carbon stocks in University of Lampung, Indonesia. Biodiversitas Journal of Biological Diversity. 2019;20(3): 676-81.
30. Akhtaruzzaman M, Roy S, Mahmud MS, Shormin T. Soil Properties Under Different Vegetation Types in Chittagong University Campus, Bangladesh. Journal of Forest and Environmental Science. 2020;36(2): 133-42.
31. Saha A, Handique S. Variation of soil organic carbon in a university campus in temperate north-eastern India. Environmental Challenges. 2022;7: 100493.
32. Pragasan LA, Dhanavel P. Innovative seed treatment for cassia siamea lam. germination and carbon stock analysis in varied stem sizes for sustainable land management and climate change mitigation. Asian Journal of Research in Agriculture and Forestry. 2024;10(3):13-20.
33. Pearson TR, Brown S, Sohngen B, Henman J, Ohrel S. Transaction costs for carbon sequestration projects in the tropical forest sector. Mitigation and Adaptation Strategies for Global Change. 2014;19:1209-22.

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