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Guru Ghasidas University Campus Greenery for off setting Carbon Dioxide and Improving Students' Academic Performance

K. K. CHANDRA[1*], V. OMESH[1] and RAHUL BHADOURIA[2]

[1]Department of Forestry, Wildlife & Environmental Sciences, Guru Ghasidas vishwavidyalaya, Bilaspur, Chhattisgarh, India.

[2]School of Environmental Sciences Jawaharlal Nehru University, New Delhi, 110067, India.

Abstract

The greenery in academic institution reduces CO_2 and creates stress free environment to the students' learning. Guru Ghasidas Central University, Bilaspur, India, spread in 262 ha with ample green space, is an education hub for over 9000 students. The land use pattern, greenery, and tree CO_2 stock were assessed by laying out 54 sample plots (0.1 ha) across the university. Students' likelihood of greenery and its effects on students' behavior and academic performance were evaluated during 2019-20. The university has 2/3 green space, 10.64% area under water bodies, and a total built-up area restricted to 15.22%. A total of 61 tree species were identified with a population of 124662 trees on the campus with the highest abundance of *Peltophorumferrugineum* (17.31%), *Eucalyptus globulus* (13.69%) among planted tree species. In naturally occurring tree species, *Acacia niloticaoccupied* highest (88.35%) followed by *Buteamonosperma* (10.04%). The trees of the university campus stocked 10942.6 tons of CO_2. Analysis showed that students rated higher preference to campus greenery with 2.71 points in 0-4 points Likert scale, and improved student's academic performance.

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Keywords
Carbon stock; Environment; Forest trees; Students; University; Urban.

Introduction

University is a student-centric place where teaching-learning practices take place for producing future generations.[1-3] Students spend most of the time in a university environment to attend class, sit in examinations, and do other extra curricular activities. All these tasks demand direct attention and raise mental fatigue and stress in students.[4-6] The green campus allows a place as a pedagogy and enhances the environmental awareness among students

CONTACT K. K. Chandra kkckvk@gmail.com Department of Forestry, Wildlife & Environmental Sciences, Guru Ghasidas vishwavidyalaya, Bilaspur, Chhattisgarh, India

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by utilizing green practices on a day-to-day basis.[7,8] Students often use the university green space to relax and reduce stress.[9,10]

Numerous recent reports state that in students of the United Kingdom, psychological symptoms increase by 11% between the first years to the second year,[5] and cause anxiety and depression in university students.Similarly, 22% of university students in the Netherlands reported psychological issues.[11] These issues are common among students worldwide and can hurt their academic performance, physical health, and well-being.[12-14] In this condition, greenery relieves stress, improves attentiveness in students, and only a quick view of green trees from classrooms is found helpful in quick restoration of concentration with a decrease in fatigue.[7,15,16,17] Large green outdoor spaces boost physical activity in students and keep them active throughout the years.[18] Several studies have confirmed the importance of green campuses for stress reduction in university students,[19-21] maintaining happiness,[21,22,23] and improving academic performances.[8,17,24] Furthermore, green space in university campuses positively correlates with students, perceived quality of life[25] they feel relaxed and have more favorable attitudes with greenery than a campus without greenery.[26] As a result, it is believed that a green environment in a university would aid in the quick recovery of students' stress and academic pressure.[27] It seems that most universities do not yet adopt the concept of a green campus, and students are studying stressfully.[12,28,29] Thus, every effort to green university environment may benefit student development.[3,30,31] However, such studies highlighting role of green space in educational institutions are sparse in the country.

Universities are mainly located near the city where air pollutants come from industry and traffic. Cities are the centers of economic development and growth. Although urban regions now account for about half of India's GDP, growing urbanization is a primary driver of global change, including land-use changes, habitat loss, biodiversity reduction, climate change, and pollution both within and beyond the city. Moreover, the air quality inside the classroom may be poor when students share a small space, which causes an increase in CO_2 levels. The green cover can help improve the air quality of the university environment, benefiting overall health in the long term.[32] Green plants fix atmospheric CO_2 and maintain ambient levels.[33,34] Van Duijn *et al.*[35] showed that the plants inside the classrooms may reduce the CO_2 by 10-20%. Plants are also able to cut airborne volatile organic compounds by 50%.[36] Worldwide, millions of educational institutes and universities are engaged in sustainable education to cater to manpower. They have to utilize their vast area lands for dual objectives first to attract diverse minds and a better environment of teaching-learning practices and second to absorb CO_2 from the atmosphere and climate change.

In India, 760 universities, 38,498 colleges, 20 Indian Institute of Management, [23] Indian Institute of Technology, 23 National Law Universities, and 31 National Institute of Technologies serve the nation and occupy a vast land area[37] for a future world. In addition, several research institutes such as the Indian Agriculture Research Institute, Tata Institute of Fundamental Research, Indian Space Research Organization, Bhabha Atomic Research Centre, etc. also contribute to the country's holistic development. All these institutions have a vast area of land that offers plantations and greenery to better the researcher, students and to protect the fragile environment from climate change. If these lands are promoted to a green education approach, it will undoubtedly enhance the confidence level in educational systems in many countries and improve its overall capability.[38] Therefore, the main objective of the present study is to assess greenery in university, tree abundance, and CO_2 stocks, and students' likelihood of restoration of perceived knowledge, academic performance, and students' connectedness to nature.

Material and Methods

Location of Study Area

The study was conducted at Guru Ghasidas Central University (GGU), Bilaspur (22.1293◦N, 82.1360◦E), spreads over an area of 262 ha area, in Chhattisgarh State of Central India (Fig. 1). The area's climate is tropical, with an extended dry season during the winter. The city's minimum temperature reaches 10◦C during January, and the maximum temperature touch 46◦C during the middle of May. Mean annual rainfall in the city for 2019-20 was recorded 1280 mm $year^{-1}$ with the onset of South-West and South-East monsoon.

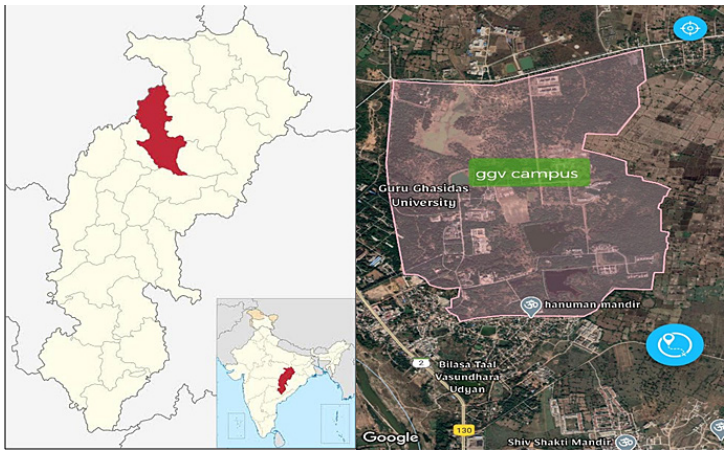

Fig. 1: a). Location map of Bilaspur in Chhattisgarh, India. b) Google Earth map depict university campus.

Greenery in the university environment was analyzed, and land use pattern was determined using Google earth map. Fifty-four sample plots of 50 ×50 m (0.25 ha) were laid out randomly in different locations across the University on a map, transact for a field visit, and enumerated tree population and measurement. The geographical coordinates for each plot were identified with the help of a Global positioning system (GPS). Trees encountered in the sample plot were measured DBH, tree height. The tree's relative abundance (RA) was calculated by counting trees above 20 cm diameter at breast height occurring in sample plots, divided by the total number of trees in all sample plots, and multiplied by 100. The tree's height was determined using Abney's level and DBH by measuring tape. Data on individual trees were used to estimate the volume of the trees using equation $V = \pi r^2 \times h$. Above-ground biomass (AGB) was computed by formula AGB (t) = V (m^3) × SG (kg m^3). The specific gravity (SG) value of individual tree species was obtained from FSI.[39] The below-ground biomass (BGB) was estimated by multiplying the AGB by 26%.[40] Total biomass was calculated by adding ABG and BGB, and carbon stocks were estimated by multiplying the total dry biomass with the default carbon fraction (0.475). The estimated carbon stock was converted into CO_2 stock by multiplying the carbon stock by 3.666.[41,42]

Student Participants for Data Collection and Analysis Students Likelihood

In this study, the role of the green university for offsetting CO_2 and students' likelihood and connectedness to greenery for restoring perceived knowledge, academic performance was analyzed following methods Bogerd*et al.*[43] Data were collected through questionnaires served through online internet mode to students during February-March 2019. A total of 480 students who completed the questionnaire were included in the analysis. For the investigation, six departments, namely Forestry, Wildlife & Environmental Sciences, Life Sciences, Mathematical Sciences, Pharmacy, Institute of Technology, and Social Sciences, were chosen randomly, and 80 students from each department were voluntarily selected. The sample comprised 56.25% female (N=270) and 46.56% male (N=210) between the age group from 20 to 22 years. The questionnaire contained 15 questions related to greenery and student's preference, knowledge restoration likelihood, etc., as simple as anyone can understand, took approximately 10 minutes to complete.

Students' preference was assessed following suggested methods[43,44,45] consist aesthetic values and behavioral characteristics. Students rated the items on a five-point Likert scale such as 0 (strongly disagree-SD), 1 (disagree-D), 2 (somehow agree-SHA), 3 (agree -A), and 4 (strongly agree-SA). The score points rated by students were averaged, and scores reflecting higher in 0 to 4 point scale indicate a stronger likelihood preference. All the questions asked were related to the outdoor greenery of the university (plantations, naturally growing species, departmental gardens, water bodies, etc.). The item assessed likelihood preference, restoration

of perceived knowledge, academic performance, attentive concentration, reduction in mental stress and fatigue, etc., were given in questionnaire.[44,46] and also tried to include a question to determine students' connectedness to nature, level of awareness on environmental protection, etc.

Statistical Analysis

To validate the study data, statistically SPSS 16.0 version were employed. Data were analyzed for clustering of students' observations with different departments of the university.[47] Effect sizes are expressed as mean score values with 95% confidence intervals (95% CI). Similarly, students, connectedness with nature, awareness, and interest in plant care and protection are also assessed at CI 95% among university students representing different departments.

Results

Greenery in University Environment and CO_2 stocks

The results show that the university has utilized land appropriately, focusing long term greenery and conservation of nature. Green space estimated in 2/3 area consists 66.07% of the total geographical area of the university, and 10.64% area is utilized as artificial ponds for water conservation (Fig. 2). The total built-up area, including buildings, roads, sports complex, covered 15.22%. A total of 61 tree species were identified across the university, where *Acacia nilotica* and *Buteamonosperma* were the most abundant naturally occurring tree species with the highest abundance of 88.55% and 10.04%, respectively, out of total natural trees populations (109801 trees) (Fig.3a). Among plantations, *Peltophorumferrugineum* was the most abundant (17.31%), followed by *Eucalyptus globulus*(13.69%), *Tectonagrandis* (9.42%), *Cassia siamia* (6.78%), *Dalbergiasissoo* (5.04%) with the populations of 14861 trees under plantation category (Fig. 3b). These plantations were aged 40-50 years, while naturally occurring tree species aged 4 to 60 years. The tree volume determined the highest 5237.75 m3 for A. *nilotica* under naturally occurring trees with 97176 population while *P. ferrugineum* scored second-most volume holding trees (666.10 m^3) with 2573 population (Table 1). These tree species also stocked higher CO_2 than the other species, as 70.36% CO_2 stock was found in A. *nilotica* and 8.21% CO_2 in *P. ferrugineum* in the entire greenery of the university. There was a significant difference in the CO_2 stocks of tree species at $p < 0.05$. The naturally occurring trees, mainly A. *nilotica* was well adopted in the area, germinate profusely, form greenery rapidly, and render all the benefits of trees without extra cost and care. However, the presence of thorns is the only negative point restricting the trees near departments where students visit and sit regularly. The total number of trees, estimated at 7786.72 m^3 in the university, formed a luxurious green campus with 6383.97 tons of biomass and 10942 tons of CO2 stocks (Fig. 4). Greenery coupled with water bodies was found to reduce the temperature by 1-2° C of the university compared to adjacent cities and favor the habitat of a diverse group of flora, migratory birds, and other wildlife communities on the campus.

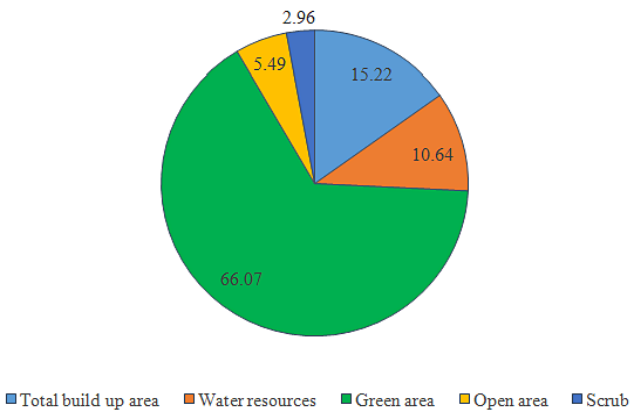

Fig. 2: Land use pattern of University (study area) indicating 2/3 area under green space, and more than 10% area allocated for water conservation bodies and built up areas.

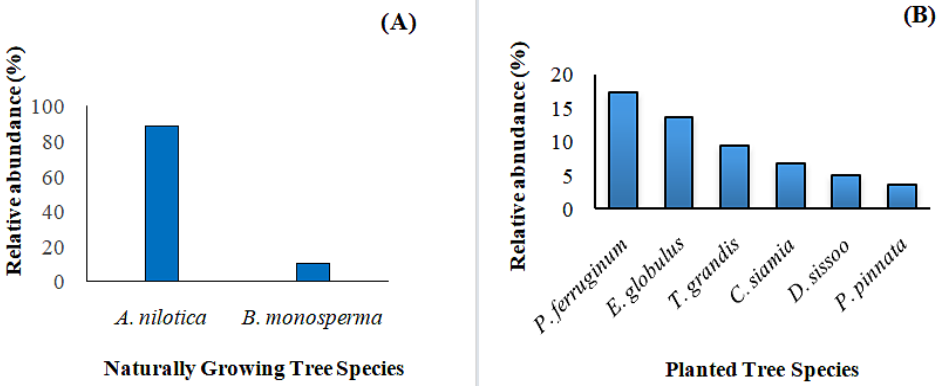

Fig. 3: Relative abundance of greenery forming trees in university environment, (a) naturally occurring tree species, (b) planted tree species.

Table 1: Tree populations in GGV campus, its volume and CO_2 stocks.

S. No.	Scientific name	No of Trees	Volume (m_3)	AGB(T)	BGB(T)	Total Biomass (T)	Total CO2 (T)
1	*Acacia auriculiformis*	340	9.78	6.55	1.70	8.25	14.37
2	*Acacia catechu*	5	0.16	0.11	0.03	0.14	0.24
3	*Acacia leucopholea*	40	1.08	0.73	0.19	0.92	1.59
4	*Acacia nilotica*	97176	5237.75	3509.29	912.42	4421.71	7699.74
5	*Aeglemarmelos*	15	0.87	0.77	0.20	0.97	1.69
6	*Ailanthus excelsa*	70	5.76	2.05	0.53	2.58	4.50
7	*Albizialebbeck*	335	49.64	26.51	6.89	33.40	58.16
8	*Albiziaprocera*	250	15.07	9.64	2.51	12.15	21.16
9	*Alstoniascholaris*	250	43.86	15.83	4.12	19.95	34.74
10	*Anacardiumoccidentale*	70	4.08	1.91	0.50	2.41	4.19
11	*Annonasquamosa*	80	4.66	2.56	0.67	3.23	5.62
12	*Neolamarckiacadamba*	50	2.83	1.74	0.45	2.20	3.82
13	*Artocarpusheterophyllus*	20	1.21	0.66	0.17	0.84	1.46
14	*Azadirachtaindica*	530	96.29	66.73	17.35	84.08	146.41
15	*Bauhinia variegata*	30	1.75	1.22	0.32	1.54	2.69
16	*Bombaxceiba*	120	7.77	4.78	1.24	6.02	10.48
17	*Buteamonosperma*	11034	654.01	304.11	79.07	383.18	667.26
18	*Cassia fistula*	45	3.01	2.25	0.58	2.83	4.93
19	*Cassia siamea*	1009	102.06	62.77	16.32	79.09	137.72
20	*Casuarinaequisetifolia*	15	0.88	0.54	0.14	0.68	1.19
21	*Ceibapentandra*	60	5.80	1.62	0.42	2.05	3.56
22	*Citrus limon*	30	1.68	1.31	0.34	1.65	2.87
23	*Cleistanthuscollinus*	310	5.65	3.96	1.03	4.99	8.68
24	*Dalbergiasissoo*	750	128.62	83.34	21.67	105.01	182.87
5	*Delonixregia*	300	63.45	39.02	10.15	49.17	85.62
26	*Diospyrosmelanoxylon*	12	0.71	0.48	0.13	0.61	1.06
27	*Eucalyptus globulus*	2035	99.47	67.24	17.48	84.73	147.54
28	*Ficusbenghalensis*	15	4.93	3.03	0.79	3.82	6.66
29	*Ficusglomerata*	15	3.45	2.12	0.55	2.67	4.65

30	*Ficusracemosa*	20	8.95	5.50	1.43	6.93	12.08
31	*Ficusreligiosa*	12	3.68	2.26	0.59	2.85	4.97
32	*Gmelinaarborea*	76	2.01	1.12	0.29	1.42	2.46
33	*Halesiadiptera*	5	0.29	0.12	0.03	0.15	0.27
34	*Lagerstroemia parviflora*	45	2.94	1.88	0.49	2.37	4.13
35	*Leucaenaleucocephala*	415	24.77	14.89	3.87	18.76	32.66
36	*Madhucalatifolia*	5	0.32	0.24	0.06	0.30	0.52
37	*Mangiferaindica*	320	68.75	39.94	10.39	50.33	87.64
38	*Meliaazadirach*	55	3.20	1.79	0.47	2.26	3.94
39	*Mimusopselengi*	70	4.08	3.26	0.85	4.11	7.16
40	*Morus alba*	5	0.29	0.18	0.05	0.22	0.39
41	*Murrayakoenigii*	40	2.33	1.58	0.41	2.00	3.48
42	*Peltophorumferrugineum*	2573	666.10	409.65	106.51	516.16	898.82
43	*Phyllanthusemblica*	68	3.98	3.19	0.83	4.02	6.99
44	*Pithecellobiumdulce*	55	8.90	5.47	1.42	6.89	12.00
45	*Plumeriarubra*	35	2.08	1.04	0.27	1.31	2.28
46	*Polyalthialongifolia*	43	3.08	1.90	0.49	2.39	4.16
47	*Pongamiapinnata*	537	34.52	21.23	5.52	26.75	46.59
48	*Populusdeltoides*	10	0.58	0.23	0.06	0.29	0.51
49	*Psidiumguajava*	90	5.25	3.23	0.84	4.07	7.09
50	*Putranjivaroxburghii*	650	39.87	24.52	6.37	30.89	53.79
51	*Roystonearegia*	40	2.56	1.57	0.41	1.98	3.45
52	*Samaneasaman*	10	0.67	0.41	0.11	0.52	0.90
53	*Santalum album*	2	0.12	0.08	0.02	0.10	0.18
54	*Saracaasoca*	120	7.08	3.51	0.91	4.42	7.70
55	*Streblusasper*	2	0.17	0.12	0.03	0.15	0.27
56	*Syzygiumcumini*	410	98.95	64.02	16.65	80.67	140.47
57	*Tamarindusindica*	15	0.63	0.47	0.12	0.59	1.03
58	*Tectonagrandis*	1401	82.50	52.56	13.66	66.22	115.31
59	*Terminaliaarjuna*	330	79.18	49.25	12.80	62.05	108.06
60	*Terminaliacatappa*	10	3.46	2.13	0.55	2.68	4.67
61	*Ziziphusmauritiana*	1182	69.16	47.03	12.23	59.25	103.18

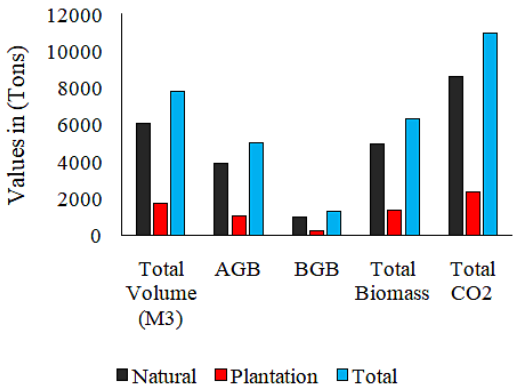

Fig. 4: Growing stock, biomass and CO2 stocks in green trees of the University campus.

Students' Likelihood to Greenery and its Impact on Academic Performance

The results of the preference likelihood and restoration of perceived knowledge of university students to greenery are given in Table 2. The extensive greenery of the university received the higher preference ratings of 2.71 (95% CI 1.46–3.05) points and perceived knowledge restoration with 2.19 points (Table 2). Students rated the highest score of 3.12 (95% CI 2.53-3.67) points to the greenery needs for concentration and 2.10 points for enhancing their academic performance. Students are convinced and satisfied significantly with the green space for reducing mental stress and fatigue, particularly during examinations and intensive classroom teaching when sitting with plantations adjacent to their departments (Mean score 2.33 points, CI 1.66-2.82). Greenery was also found beneficial in creating an attractive and congenial learning environment than the campus without green space. Overall, 30.89% of respondents agreed with greenery, and 31.97% of students rated the somehow agreed scale. The percent of strongly agreed students was 19.22%, while strongly disagreed students to the greenery in university environment were 7.11%. These demonstrate that the majority of the students require green space for restorative likelihood, maintaining concentration during intensive studies, and reducing mental stress.

Table 2: Analysis of student's likelihood on preference and perceived restoration knowledge and academic performances to green space of a university. (Students rated on scale from 0-strongly disagree to 4-strongly agree). (N=480).

S. No.	Particulars	Students Likelihood Responses (%)					Mean Score value (SD)	Cluster Interval (CI) 95%
		SD	D	SHA	A	SA		
1	Students, Preference (Attractiveness of green campus)	3.57	10.20	17.91	48.33	20.00	2.71 (0.62)	1.46- 3.05*
2	Improve perceived knowledge restoration	8.33	14.58	36.66	30.00	10.41	2.19 (0.73)	1.78-2.66*
3	Reduce fatigue and mental stress	5.62	10.20	44.16	24.58	15.41	2.33 (0.55)	1.60- 2.82*
4	Enhance academic performance	14.16	10.62	36.04	29.16	10.00	2.10 (0.77)	1.75-2.71*
5	Feel attentive/ concentrate viewing greenery	6.45	3.33	12.5	30.20	47.50	3.12 (0.82)	2.53-3.67**
6	Create attractive learning environment	4.58	16.25	44.58	23.12	11.45	2.20 (0.48)	1.48-2.88*
	Overall	7.11	10.86	31.97	30.89	19.12		

Note: SD (strongly disagree), D (disagree), SHA (somehow agree), A (agree), SA (strongly agree)
* significant at <0.05, ** significant at <0.01

Table 3 present the students, connectedness to nature, awareness of environmental benefits, and nature care habits. Students rated the highest of 2.89 points (CI 1.72-3.51) to green covers helps maintenance of ecosystem followed by coolness and thermal comfort during summer (2.05 points, CI 0.88-2.90), indicative that students feel the benefits of trees and greenery and are well aware of environmental conservation. However, their connectedness to nature and plant care and protection was weak, with scores 1.83 (CI 0.80-2.67) and 1.08 (CI 0.62-1.60), respectively. These demonstrate that university students need more encouragement and integration of activities that connect and increase their involvement in nature, such as planting, care, protection, etc.

Table 3: Assessment of students, connectedness to nature and environmental awareness with regard to university environment. (The rating was on a scale 0 strongly disagree to 4 strongly agree). (N=480).

S. No.	Particulars	Students Likelihood Response (%)					Mean Score (SD)	Cluster Interval (CI) 95%
		SD	D	SHA	A	SA		
1	Connectedness to nature (nature lover)	9.79	13.50	62.70	11.00	3.01	1.83 (0.73)	0.80-2.67*
2	You care plants of the University	30.30	41.50	19.80	7.33	1.25	1.08 (0.62)	0.62-1.60*
3	Increase coolness and thermal comfort during summer	00.00	6.00	70.50	15.60	7.90	2.05 (0.77)	0.88-2.90*
4	Climate smart/ resilient campus	12.70	18.12	44.37	22.70	2.11	1.83 (0.69)	0.72-2.05
5	Greenery invites birds and helps ecosystem	1.04	5.00	8.54	74.37	11.04	2.89 (0.94)	1.70-3.51*
	Overall	10.76	16.82	41.18	26.20	5.06		

Note: SD (strongly disagree), D (disagree), SHA (somehow agree), A (agree), SA (strongly agree)
* p-value significant at <0.05, data in parenthesis represent standard deviation.

Discussion

Greenery in universities and other higher educational institutes is a good choice for students' quality of life as it impacts positive health and well-being.[3,6,8,17,43] The current literature indicates the increasing psychological issues in university students' worldwide[3,4,5,11,12,13,14] greenery could relieve stress and improve students concentration to restore perceived knowledge.[7,8,16] Students prefer trees aesthetically pleasing[48] and therefore landscape development in educational institutions should be linked to the psychological restoration of students to harness the enhanced benefit of tree species over other vegetation.[49]

Land use Status and Tree Species in GGV Campus

Land use pattern of the university indicated that about 2/3 of geographical areas of the campus maintains green space which makes the campus attractive and aesthetic. The native species such as A. *nilotica* and B. *monosperma* occurred naturally without any extra efforts and care, formed a significant area of greenery in the university, and sequestered the highest amount of CO_2 may also be given preference during selection. The only drawback of the species is the presence of thorns, which restrict students' preference near departments. Among planted species, *P. ferrugineum* and *E. globulus* were most abundant in the university developed all around different departments to provide green space to students during their time on the campus. There was significant variation in growing stock and CO_2 stock in these species due to fluctuation in population, growth, and the varied rate of carbon fixation. Similar variation in tree carbon stock was reported with a difference in the rate of photosynthesis of the species, and carbon fixation potential[35,50-53] also supports the results. Overall, more than 0.1 million trees in the university campus made the campus luxurious, full of greenery, and aesthetically attractive.

Moreover, trees contribute to CO_2 load reduction from the university environment and make the university cool by modifying thermal comfort and becoming a habitat for a variety of birds and wildlife animals. Other researchers also showed that plants might reduce the CO_2 concentration of classrooms and outdoor by 0-20% compared to class without plants.35Gromke *et al.*[54] have been reported that shade trees help maintain thermal comfort during

warmer weather by releasing water vapor from the leaf surface and reducing the air temperature to 1-2ºC than the area without green cover. Thus the green trees contribute to the outdoor climate of the campus, and students' wellbeing as well.[6,15]

Greeneryand its impact on Academic Performance

The study also illustrates the student's preferences, the likelihood of restoring knowledge, and its impact on academic performance. The result showed that university students need green environments and gave a higher rating to the restoration likelihood than those without. Students rated highest to green space for enhanced concentration and somehow agreed with other likelihoods such as reduced fatigue, creating attractive teaching-learning practices, etc. It supports the findings of other researchers showing that respondents of Europe, North American, and Asia like trees and parks to reduce stress and maintain their attentiveness.[3,35,43,55,56,57] In contrary to other studies, the present study was undertaken to find the students likelihood who are directly benefitted from the university's green space than showing nature posters, which is a more reliable observation.

Moreover, Stress Recovery Theory[58] and Attention restoration theory[59] also suggest that after interaction with a green environment, emotional response triggers instantly and initiates a positive affective response, which induces physical and psychological behavior. The person quickly recovers from mental fatigue. The present results are also similar to the findings from another study, which demonstrate higher ratings of restoration likelihood to greenery.[60] Students agreed that green space in academic institutes improves academic performance by maintaining concentration and attentiveness during exams and helps in creating an attractive learning environment around the year. Markevych *et al.*[61] also studied the relationship of greenery on students' academic performance. The green space acts as an academic booster for students who spend time with greenery[62] by reducing mental fatigue,[63] increasing concentration,[64] and increasing self-discipline[65] through classroom engagement.66 Some other literature contrasts the relationship between green space and academic achievement[3,17,67] and extended exposure to greenery from classrooms[24,68] but few studies differ the hypothesis that greenery helps writing test scores.[6,69] This highlights the need for more research on the impact of greenery on students writing and perform better on tests.

Students Involvement in Plant Care Activities

The findings show that university students are well aware of the benefits of greenery on environmental conservation and also rated higher points. They feel that trees on the campus tend to decrease the temperature during summer and make the campus relaxed and comfortable. However, students seem reluctant in plant care and connectedness to nature at the same time. Students rated weak points to these attributes and identified it as a severe issue for university students who are poorly involved in planting and protection activities. Several studies concluded that students' connectedness to nature can vary with the respondents' demographic profile, which can modify the associations between environmental stimuli and likelihood.[70,71] Bogerd *et al.*[43] reported that students with higher connectedness to the green environment rated strong preference and restoration likelihood than the students with poor connectedness to green space, but the present result differs from these findings. Therefore, to encourage the students towards strong connectedness to nature and their involvement in plant care, a program such as "one student one plant", memory planting, green army, and nature lover groups may be initiated and promoted. Moreover, some credit scores may also be allotted in the curriculum to attract and motivate university students on a mandatory basis to environment and greenery.

Conclusions

The campus greening of educational institutions improves knowledge restoration and academic performances. However, this needs a holistic approach of land use patterns for sustainable education to the future generation. The present study deals with the tree species population in the University campus and their impact on students' academic performance considering 54 sample plots and 480 students for judging students' academic performance following a five-point Likert scale. That indicates that campus greening helps the environment in terms of CO2 absorption and pollution free and improves the students' performances. The results show that about 66.07% of greening stocked 10942 tons of CO2

and a 3.12 point score for students' concentration. However, the student's involvement in plant care activities was found weak. To attract students towards nature building, activity-based programs may be initiated. Further experimental research is needed to consolidate a deep understanding of the greenery in the academic performance of university students. Furthermore, a long-term study to assess the C sequestration potential of individual species available in educational institutes to formulate policies to mitigate greenhouse gas may suffice the need of the future generation.

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