



Green, Energy and Environment Audit Report 2021-2022

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GAUHATI UNIVERSITY



Foreword

Maintaining an ecologically balanced ecosystem is a prime requirement of campus management. This can be achieved and monitored through an all-inclusive audit system. Green Audit is such a process through which a complete recording, logical documentation, flawless analysis and reporting of various environmental components of an institutional setup can be made. Green audit aims to analyse ecological practices within and outside the establishment site so that an eco-friendly atmosphere can be created and maintained. It helps to identify and generate projections to boost environmental quality, expand hygiene and health measures, improve environmental protection and augment sustainable development practices. Gauhati University is aware and attentive to the needs of the green audit for the maintenance and entire development programme of the University. Gauhati University has designed and also adopted optimized methodologies to carry out the green audit on the campus in a futuristic way.

It's my pleasure to forward the Green Audit Report of Gauhati University for the year 2021-2022. The report is the result of a comprehensive investigation, analysis, and interpretation of the information of all the required parameters of the audit process. I appreciate the earnest and methodical effort of the green audit team of Gauhati University. I thank Prof Partha Pratim Baruah, Chairman and all the esteemed members of the Green Audit Committee for their determined effort in the preparation of the report. I do hope that the Green Audit Report, 2021-2022 of Gauhati University will fulfil the essential requirements.

Pratap Jyoti Handique
Vice Chancellor
Gauhati University

Acknowledgement

This Green Audit Report is a self-inquiry on environmental quality of the Gauhati University campus where a few faculty members are involved to collect the baseline data of environmental parameters so that environmental issues could be resolved before they become a problem. The Green Audit Committee always looks forward to identify the current / emerging environmental related issues and to monitor the environmental management practices adopted in the University along with subsequent impact of these on the university environment. Accordingly, a few suggestions were also made to take environment protection to higher levels in the campus. It is therefore hoped that the report will certainly receive due attention of university authorities and also all stake-holders of the University

During the preparation of the “Green Audit Report: 2019-2020”, Prof. P. J. Handique, Hon’ble Vice Chancellor of Gauhati University encouraged us and provided full administrative support aa and when required. I, on behalf of the entire Committee would like to express our sincere gratitude to Hon’ble Vice Chancellor for his nice gesture and support. I am indebted to the Registrar, Deans, HoDs, teachers, officers, all staff members and all the campus dwellers of GU for their kind support in collating data for the report. Thanks are due to Prof. P. K. Saikia and his Research team of Department of Zoology for their kind help in faunal study of the Campus. I am extremely indebted to Prof. Dhrubajyoti Saharia, Head, Department of Geography for his help in preparing the maps. I would also like to express my gratification to Prof. *Eeshankur Saikia, Head, Department of Applied Sciences for his consistent support in preparing this Report.* At last, but not the least, I would like to offer my heartfelt thanks to all the members of the GU Green Audit Committee for their untiring efforts in compiling the report.

I sincerely hope that the efforts made by the present Green Audit Committee will be helpful for Gauhati University to take one green step ahead.

Partha Pratim Baruah

Chairman

Green Audit Committee, 2021-2022

GU Green Audit Committee 2021-2022

Prof. Partha Pratim Baruah, Department of Botany, Gauhati University

Prof. Bhaben Tanti, Department of Botany, Gauhati University

Prof. Dwipen Bezbaruah, Department of Anthropology, Gauhati University

Prof. Anup Kumar Talukdar, Department of Chemistry, Gauhati University

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Dr. Debasish Borbora, Department of Biotechnology, Gauhati University

Dr. Manas Das, Department of Zoology, Gauhati University

Dr. Kumaresh Sarmah, Department of ECT, Gauhati University

Dr. Malabika Kakati Saikia, Department of Zoology, Gauhati University

Dr. Sourav Jyoti Borah, Department of Botany, Gauhati University

Mr. Sanjib Boruah, Superintending Engineer, Gauhati University

Mr. Himangshu Das, Estate Officer, Gauhati University

Dr. Arijit Bora, Deputy Secretary, Gauhati University

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Introduction

Gauhati University at a glance

With a huge sprawling campus spreading over an area of 508.8 acres, Gauhati University (a NAAC A-grade institution) comprises of 48 Departments, 1 constituent Law College, an Institute of Distance and Open Learning (IDOL) and 6 Centres of Studies. The University was established in 1948 which render services towards 306 Colleges affiliated to its fold. Around 2500 students including research scholars were enrolled in the PG Departments during 2021-22 academic session.

Green Audit at Gauhati University

Modernization has increased the amount of specialization and differentiation of structure in academic institutes which need to be monitored thoroughly on regular basis. In this context and in the line of sincere appeal of Honourable Prime Minister, Shri Narendra Modiji on ‘Swachh Bharat Abhiyan’, Gauhati University too has been taking part in the “Green Campus, Clean Campus” mission launched by University Grants Commission for all higher educational institutes. As it is also the mandate of The National Assessment and Accreditation Council (NAAC), to assess the ‘Environmental Consciousness’ of any educational institute sustainable development policy was therefore incorporated into the green agenda of Gauhati University. The green audit, thus, became an integral part of academic environmental management and its implementation is crucial in various aspects of the functionalities of Gauhati University.

Through the green auditing, the university supports the climate neutrality goals as outlined by the Government of India and routinely monitors the sustainability of the research and education mission through the Green Audit Committee constituted with the approval of Honourable Vice Chancellor, Gauhati University. Following are the policy goals of the Gauhati University Green Audit:

- Identification and documentation of the strengths and areas of improvement within sustainable operations of administrative, academic and research laboratories via gap analysis, and outlining actions that can be implemented to further targets.
- Increase environmental awareness throughout campus and motivate all the stakeholders for optimized sustainable use of available resources.

- The importance of the program is to collect baseline data of environmental parameters and resolve the environmental issue before they become a problem.

To achieve the aforementioned goals, Gauhati University Green Audit Committee endeavours towards the following objectives:

- To identify current and emerging environmental issues.
- To monitor the environmental management practices.
- To examine the current practices that can impact the environment.
- To create awareness among the various stakeholders of the University.
- To understand the energy utilisation pattern through associated 'Energy Audit'
- To prepare a Green Audit Report on green practices followed by different departments, support services and administration building.

METHODOLOGY ADOPTED

The methodologies adopted to conduct the Green Audit of Gauhati University are:

- Onsite field visits were conducted by the Green Audit Team as and when necessary.
- Questionnaires were circulated amongst different stakeholders to know about the various components in connection with water use, energy consumption and waste disposal etc.
- The water quality analysis was done at Plant Ecology Laboratory, Gauhati University.
- GIS tools were used to prepare the map of the campus for LULC survey.
- For air quality analysis in the University campus, the data of Gauhati University Station of State Pollution Control Board (SPCB, Guwahati) were used.
- The noise levels were measured using a Sound Level Meter.
- Different standard protocols were followed to document and estimate the floral and faunal account.

AUDIT STAGE

Green auditing for the year 2021-22 in Gauhati University began with the assessment of the status of the green cover of the Institution followed by waste management practices and energy conservation strategies under the audit team members. The audit team monitored different facilities at the University campus, determined different types of appliances and utilities as well as measuring the usage per item and identifying the relevant consumption patterns and their impacts. The staff and learners were interviewed through structured questionnaires to get details of usage, frequency or general characteristics of different appliances. Data collection was done by onsite visit and also through questionnaires in different sectors such as water, energy, waste, biodiversity status, etc. The environmental monitoring in the University campus to ascertain the status of the ambient quality of the campus was done through standard protocols. The data were finally collated and analyzed to prepare this audit report.

POST AUDIT STAGE

Land use and land cover

The Gauhati University campus is characterized by low lying residual hills towards the south which is gradually flattened interspersed with a number of wetlands towards the north and thus, making it a picturesque landscape suitable for a wide spectrum of flora and fauna. The emplacement of the Academic Departments and residential units/hostels are at the foothills which tend to be in the gradually filled lowlands. The present survey revealed a total of 484 acres of land in the main campus of which 75 acres are under wetlands, 91 acres under natural forests and 2 acres under the botanical garden that together constitutes 168 acres. Four segments of natural forests cover the southern hills. Organized plantations in the campus are mainly along the internal roads and residential units. There are a total of twenty wetlands of various sizes that are home to a wide diversity of aquatic flora and fauna. Majority of the wetlands have been observed to be infested with *Eichhornia*, an exotic aquatic weed. The nine ponds located inside the Biodiversity Park are well maintained and has been used for fish rearing.

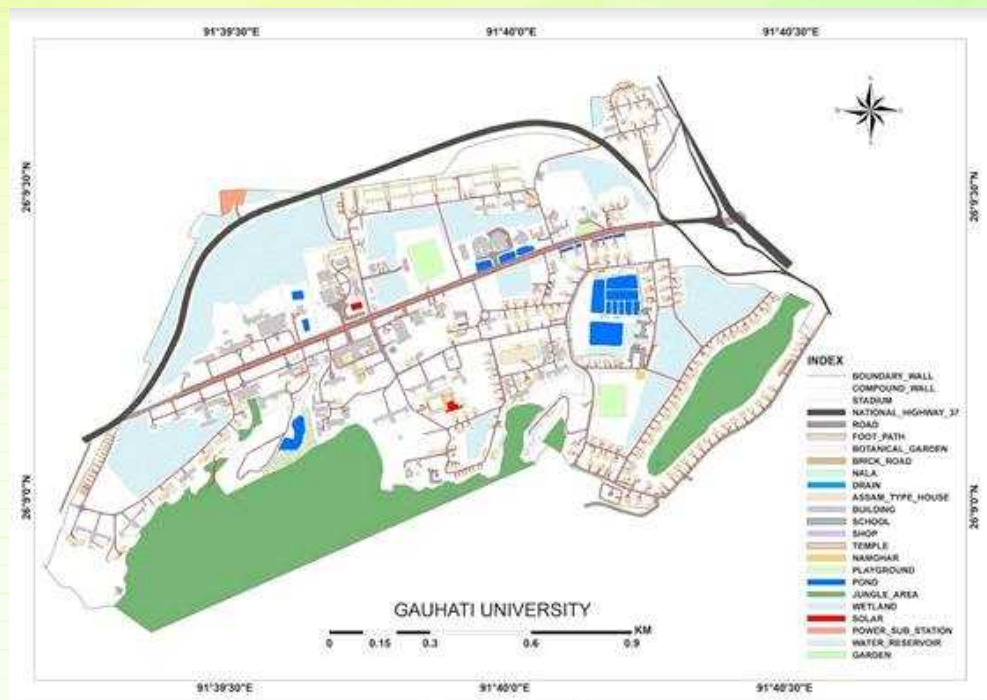


Fig 1 : The Map of Gauhati University campus
 (Courtesy: Prof. Dhrubajyoti Saharia, Dept. of Geography, GU)

It is found that a total of about 76.37 acres are under the built-up category which are mainly the residential units, hostels, academic and administrative units/blocks. In the absence of available high grounds, many of the wetlands are being filled up for new constructions. One 3- storied hostel has come up in the last few years as a part of the recent initiative of the GU administration for accommodating girl students within the campus. The campus is criss-crossed with roads which covered an estimated area of approximately 20 acres. The campus houses two-stadium covering an area of nearly 4 acres of land. One indoor stadium was inaugurated recently. Besides the main campus, the university maintains two satellite blocks, one at Jalukbari and other one is at Ambari area of Guwahati city.

**Table 1: Built-up categories in Gauhati University Campus
(Courtesy: Office of SE, GU)**

Sl. No.	Land Use Category	Area (Acres)	Sl. No.	Land Use Category	Area (Acres)
1	GU Campus	483.713	31	Hut	1.31423
2	Botanical Garden	2.04694	32	Namghar	0.12246
3	Road	20.1664478	33	Water Pump	0.036395
4	Divider	0.617044	34	Playground	4.00509
5	Road Unmetalled	0.186615	35	Septic Tank	0.400901
6	Foot Path	5.885191	36	Pond	7.557342
7	Ring Well	0.00575	37	Jungle Area	91.002504
8	Sign Board	0.033346	38	Wet Land	75.299581
9	OFC	0.001035	39	Solar	0.373466
10	Oil Man Hole	0.000786	40	Tin Shed	0.051762
11	Rock	0.074877	41	Bathroom	0.006493
12	Biofuel Unit	0.050387	42	Power Sub Station	0.991229
13	Pump Station	0.00061	43	Water Reservoir	0.267077
14	Car Track	0.870524	44	Toilet	0.202206
15	Brick Road	0.013168	45	Foundation Stone	0.000212
16	Nala	0.360957	46	Building Under Construction	0.006203
17	Protection Wall	0.001013	47	Overhead Tank	0.035068
18	Drain	1.872992	48	Dust Bin	0.000603
19	Retaining Wall	0.053146	49	EP Box	0.003566
20	Bench	0.002516	50	Water Tank	0.270281
21	Culvert	0.212044	51	Car Parking	0.048694
22	ATM	0.00776	52	Garage	0.325104
23	Assam Type House	15.634168	53	Bus Stop	0.019502
24	Building	17.88869	54	Garden	0.539414
25	School	0.812026	55	Panel Board	0.001973
26	Transformer	0.053045	56	Electric Room	0.000595
27	Shop	0.217685	57	Sahid Bedi	0.013919
28	Generator	0.03877	58	Statue	0.008653
29	Security House	0.025495	59	Cycle Stand	0.022548
30	Temple	0.149728	60	Hut Area	0.620613
			61	NH 37	5.34328

Observation

Forested areas are found to be reducing.
 Roadside avenue trees lack attention.
 Drainage links were found to be missing.

Action taken based on recommendation:

Estate Office is maintaining and monitoring the sampling during post plantation period.

Recommendation

- ⇒ A task force is required to be constituted for landscape monitoring in the campus.
- ⇒ Plantation is suggested in the hilly portion where thinning of forest was monitored.
- ⇒ Maintenance of avenue trees is necessary to enhance the aesthetic beauty of the campus.

Water Audit

Considering the importance of water in human health and activities, water auditing is a must for an Institutional campus to understand the way of its uses, availability and quality of the potable water therein. The concerned auditor investigates the relevant method that can be adopted and implemented to balance the demand and supply of the water.

A total of 275000 L of water is pumped out from the PHE supported water tanks every day, out of which around 2,13,000 L of water is used by the University per day.

Table 2: Source and uses of water in the GU campus
(Source: Office of the SE, GU)

Sl No	Parameters	Information																										
1	Source of water	Surface water from river Brahmaputra																										
2	No of Wells	1																										
3	No of motors used	1																										
4	Horse power- motor	5 Hp																										
5	Depth of well- Total	90 M																										
6	Capacity of Tank (Total)	941000 L																										
7	Quantity of water pumped every day	275000 L per day																										
8	Quantity of water used in different sections of the Campus	<table border="1"><thead><tr><th>Sections</th><th>Water use (L/day)</th></tr></thead><tbody><tr><td>Hostel</td><td>25000</td></tr><tr><td>Resident quarter</td><td>30000</td></tr><tr><td>Administrative block</td><td>5000</td></tr><tr><td>Canteen</td><td>10000</td></tr><tr><td>Departments</td><td>39500</td></tr><tr><td>Gardens</td><td>5000</td></tr><tr><td>Laboratories</td><td>15000</td></tr><tr><td>Drinking</td><td>5000</td></tr><tr><td>Leakage</td><td>2000</td></tr><tr><td>Construction work</td><td>8500</td></tr><tr><td>Urinals and Toilets</td><td>28000</td></tr><tr><td>Total</td><td>249500</td></tr></tbody></table>	Sections	Water use (L/day)	Hostel	25000	Resident quarter	30000	Administrative block	5000	Canteen	10000	Departments	39500	Gardens	5000	Laboratories	15000	Drinking	5000	Leakage	2000	Construction work	8500	Urinals and Toilets	28000	Total	249500
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9	Main purposes of water use in the campus	Drinking and cooking purpose Toilets and wash areas Laboratory use Gardening Construction
10	Nos. of water tap (excluding households/ residential quarters)	1525
11	Water cooler and drinking water filtration facility (excluding households/ residential quarters)	80
12	Nos. of urinal and toilets (excluding households/ residential quarters)	250
13	Nos. of waterless /bio toilets	Nil
14	Any water wastage/why?	Yes, wastage of water is seen mainly in the Leakage of old pipes Overflow of water tanks Leaked water taps Lack of awareness as leaving tap running after use.
14	Water usage for gardening	4000 L per day
15	Waste water sources	Leakage in pipes, valves Overflowing tanks Residential qtrs. Toilets & baths Laboratories Canteens, Hostels
16	Use of waste water	Nil
17	Fate of wastewater from labs	Waste water from labs are neutralized and discharged into covered pits
18	Any wastewater treatment for lab water	No
19	Whether any green chemistry method practiced in Labs	No
20	No. of rain water harvesting unit and amount of water harvested	One; 4000 L

Water Quality assessment

The potable water of Gauhati University was supplied by the PHE Department, Govt. of Assam from the water tanks located in a hill hop within the University campus. Water samples from the storage tanks were collected and analyzed for its quality parameters at monthly interval and the results are presented in the Table 3:

Table 3: Potable water quality analysis report

Sl No	Parameters	Ranges
1	Iron (mg/l)	0.12-0.28
2	Alkalinity (mg/l)	76-152
3	Turbidity (N.T.U)	0
4	Calcium Hardness ()	10-15
5	Total Dissolved Solids (mg/l)	20-35
6	Sulphates (mg/l)	0
7	Chloride(mg/l)	1-8
8	Fluoride (mg/l)	0.18-0.30
9	Total Hardness (mg/l)	60-124
10	Residual Chlorine (mg/l)	0-0.2
12	Nitrate (mg/l)	Nil
13	pH	6.6-6.8
14	Arsenic (mg/l)	Nil
15	Manganese (mg/l)	0.19-0.30
16	Magnesium (mg/l)	11-22

Observations

- Water wastage is in higher side.
- Water consumption monitoring system in the GU campus is not up to date.
- GU does not have reusable water treatment facility for waste water generated from laboratories, canteen, hostel kitchen, toilets, bathrooms and office rooms.
- Overflowing of overhead water tanks is a common sight.
- Wastage of water from the laboratories is reduced by adopting microscale analysis.

Suggestions and recommendations

- ⇒ Rain water harvesting systems could be augmented.
- ⇒ More water conservation campaign be conducted.
- ⇒ Automated sensors can be installed in order to prevent the over flow from water tanks.
- ⇒ Automated taps could be used so that usage of water can be reduced.

WASTE DISPOSAL AUDIT

Any activity amounts to waste creation. The disposal of the wastes whether bio-degradable, non-biodegradable and hazardous waste is always a problem for any HEIs which is directly proportional to amount of waste generated. Bio-degradable wastes includes food wastes, canteen waste, wastes from toilets etc. Non-biodegradable wastes include what is usually thrown away in homes and schools such as plastic, tins and glass bottles etc. Hazardous waste is a waste that is likely to be a threat to the floral/faunal health or the environment.

As unscientific management of these wastes can cause harmful discharge of contaminants into soil and water, special attention should be given to the handling and management of all type of wastes including the hazardous waste generated in the University Campus. The auditor diagnoses the prevailing waste disposal policies and suggests the best way to combat the problems.

Status of Solid Waste Generation in the campus

As tabulated below, on an average, the hostels and teacher flats/quarters account for the highest amount of solid waste generated in the campus. However, this conclusion could be an overstatement given the fact that this report hasn't yet processed sufficient data from the administrative blocks. On average, various stakeholders generate 226.9 kg of different types solid waste per week respectively (Table.).

Table 4: Solid waste generated on the campus per Week

SL.NO	STAKEHOLDERS	TYPES OF SOLID WASTE	AVG WASTE GENERATED/WE EK	PERCENTAGE
1	ACADEMIC DEPARTMENT	a. Paper waste b. Plastic waste c. Organic waste d. E-waste	16 kg 10 kg 5.5 kg 0.5 kg	16.9 14.93 8.47 35.7
2	ADMINISTRATIVE OFFICE	e. Paper waste f. Plastic waste g. Organic waste h. E-waste	12 kg 2 kg 9 kg 0.5 kg	16.9 8.96 10.3 35.7
3	HOSTELS	a. Paper waste b. Plastic waste c. Organic waste d. E-waste	8 kg 10kg 42 kg 0.1 kg	11.27 35.82 33.90 7.14
4	TEACHER FLAT/RESIDENTIAL QUARTER	a. Paper waste b. Plastic waste c. Organic waste d. E-waste	36 kg 11 kg 45 kg 0.3 kg	50.70 35.82 38.1 21.42
5	CANTEENS	a. Paper waste b. Plastic waste c. Organic waste d. E-waste	3 kg 1.kg 15 kg Nil	4.22 4.48 12.7 -
		TOTAL	226.9 kg/week	

Observation in connection with waste management

Dustbins installed	: 185
Road side Dustbin installation as per suggestion of last Green Audit Report during 2021-22	: 20
Vermicompost facility	: 04
Augmentation during 2021-22	: Nil
Segregation of waste	: Done during collection
Amount of solid waste lifted by the GMC	: 85%
Dumped for composting	: 12 %
Unattended	: 3 %
Recycling mechanism on card	: No
Frequency of waste/litter removal	: Every day from the Departments and every second day from residential areas
Monitoring system in waste disposal	: No yet in application



Attention required disposing waste



Incinerator in the GU Campus



Waste segregation facility in GU Departments

Management of the Hazardous Waste

In persuasion of the Ministry of Environment, Forest and climate Change, Government of India's Hazardous Waste (Management and Handling) Rules, 1989 under the provision of the Environment Protection Act, 1986; Gauhati University has been taking initiative in disposing hazardous waste and e-waste through a Registered Firm.

Suggestions and recommendations

- ⇒ The GU campus is yet to be declared as plastic free campus.
- ⇒ The use of biodegradable materials is to be encouraged as alternatives.
- ⇒ More vermicomposting units may be installed.
- ⇒ Centralized system of recycling of paper could be adopted.
- ⇒ Incinerator installed in the campus is to be activated.

Action Taken: Installation of road side dustbins have been started.

HEALTHAUDIT

In order to maintain and also to make the stakeholders aware in keeping the campus clean and green, as many as 25 programmes were conducted in collaboration with NSS Unit, NCC Unit, PGSU, GUTA and other stakeholders' association in and around the campus during 2021-22. Gauhati university students and teachers volunteered themselves as covid taskforce members to support Govt. initiative in managing pandemic situation. The university regularly organizes blood donation camps in association with NSS and NCC wings of Gauhati University. Gauhati University has been always proactive in sensitizing the young generation within the campus and its neighbourhood by regularly organizing events like yoga day, environment day, plantation drives, fitness drives, Swachhta drives and nature camps.

Awareness Programme on Swachhata on 16th -17th March, 2022 organised by Gauhati University NSS Cell, Guwahati, Assam.



Gandhi Jayanti Plog Run was organised at Gauhati University on 2nd October, 2021.



International Day of Yoga being celebrated by Gauhati University



Plan to carry out the development of Wetlands and Drainage System in the Gauhati University campus is under process with the GMC Authorities



ENERGY AUDIT

According to Energy Conservation Act, 2001, Energy Audit is the verification, monitoring and analysis of the use of energy including submission of technical report containing recommendations for improving energy efficiency with cost benefit analysis and an action plan to reduce energy consumption.

The Energy and electricity audit aimed to cover the aggregate consumption of Electrical and Natural gas energy within the Gauhati University campus including academic, administrative blocks and hostel premises. In different hostels LPG cylinders are primarily used for cooking purposes and number of uses were also counted. Domestic LPG connections are not included in the present study.

Moreover, Gauhati University is taking its initiative to utilize renewable energy such as solar power to compensate the necessity of electrical energy within the campus. To achieve that goal, numbers of Solar Panels were installed within different parts of the campus. On the other hand, to minimize the consumption of electrical energy highly efficient and low power consumable LED light panels are installed phase wise in different hostels, administrative and academic buildings.

On an average, 4, 20,853 units per month of electricity was consumed by the University in the year 2021-22 including the residential quarters in comparison to 3, 14, 853 during the previous year.

To compensate the rising power requirement, solar panels are installed within the GU campus. Annually, GU has generated 288000 KWH of electricity energy through solar panel. Though in the last two years, GU campus was augmented with 100 KWP new solar panel, during 2021-22 no fresh installation has been done.

Further, to minimize the power consumption within the campus, GU is taking the initiative of replacing the old high-power Halogen and CFL blubs with low power LED panels in phased manner. At present GU has 1978 numbers of LED bulbs and panels as compared to 100 numbers of CFL and 11 numbers of Halogen bulbs in various academic and administrative blocks. There were 315 numbers of AC (Air Conditioner) and 2291 numbers of fans installed in the different academic and administrative blocks. On the other hand, on an average Rs. 8500 worth of natural gas (LPG cylinders) per month has been utilized in the different hostels within the campus. Building energy performance indices were in-between 3.23 to 12.98 kwh/m²/year.

Activity monitoring study on electrical utility revealed that out of the 34 building which were taken into consideration for the present study, electricity uses in Academic and Administrative buildings were made for 8-9 hours for 6 days excluding the Science Departments. In hostel and residential areas, the same was for almost 18 hours for 7 days. In terms of percentage of loads, Science Departments particularly Physics, Chemistry, Botany, Zoology and Geography showed higher loads of user along with the Administration Building. Load as well as the consumption percentage were very poor in few Departments and centres.

Observation

Separate Electricity meters were not found in the Hostels, Academic and Administrative blocks.

A few road-side solar Panels were non-functional.

Electricity consumption is increasing in the Departments due to installation of different electrically maintained gadgets.

Suggestions and recommendations

⇒ Separate provisions for recording of energy consumption need to be installed in Hostels, Departments and Administrative buildings

⇒ Solar power generated road side poles need be installed very soon to reduce dependency on electricity.

⇒ Solar power installation is to be augmented.

⇒ Proper monitoring of energy use is the need of the hour to avoid loss of energy. Hence, time table for switch on /off for the road side lights be properly maintained and monitored.

ENVIRONMENTAL QUALITY AUDIT

Data from the Gopinath Nagar Station of the State Pollution Control Board (SPCB, Guwahati) were utilized to analyze the air quality on the university campus. Particulate matter (PM10), Sulphur dioxide (SO₂) and Nitrogen dioxide (NO₂) have been studied as three parameters. Table 1 contains the data set for the University Campus during the research period.

Table 5: Average Monthly variation of PM₁₀, SO₂ and NO_x

	PM ₁₀	SO ₂	NO ₂
April,2021	162.87	6.53	13.10
May, 2021	141.85	6.35	14.32
June,2021	79.88	6.38	12.69
July,2021	64.25	6.35	13.02
August,2021	65.68	5.84	12.34
September,2021	84.86	6.13	13.87
October,2021	108.72	6.72	17.37
Novemebr,2021	149.45	7.10	22.64
Decmber,2021	225.63	6.59	17.84
January, 2022	184.58	6.67	16.40
February, 2022	183.54	6.44	15.25
March,2022	191.30	7.41	15.59

****All concentration units are in µg/m³**

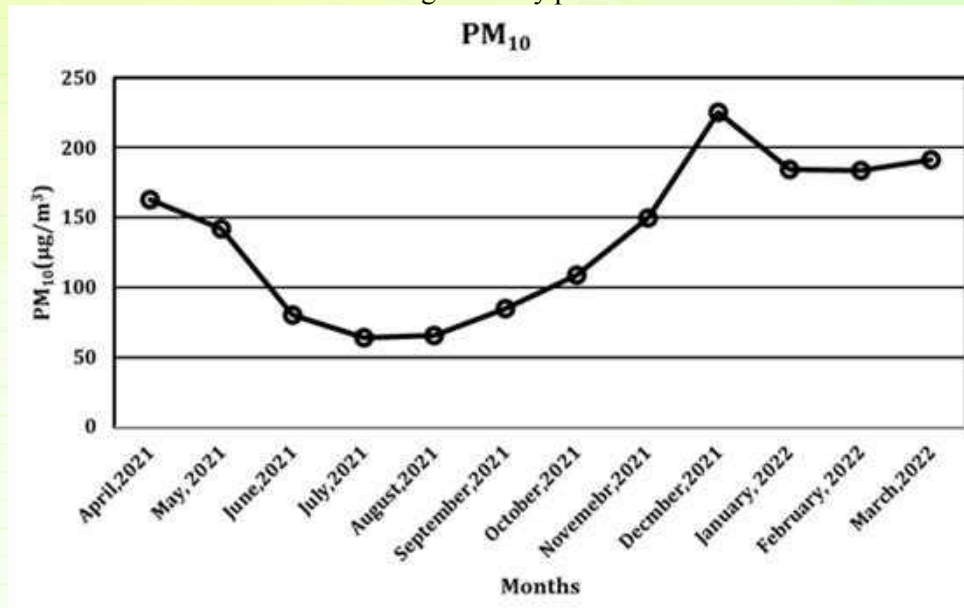
Particulate Matter (PM₁₀):

Smoke, dust, soot, salts, acids, metals and suspended particulate matter (PM₁₀) with a diameter of 10 micrometres or less are referred to as PM₁₀. When gases generated from automobiles and industry encounter chemical interactions in the atmosphere, particulate matter can also be created indirectly.

Construction, driving and trash burning dust may be the main sources of PM₁₀ in the vicinity of the university campus. The PM₁₀ levels on the university campus throughout the study period ranged from 64.25 µg/m³ to 225.63 µg/m³, which are higher than the CPCB Ambient Air Quality Standards' permitted limits (60 µg/m³). Additionally, it has been noted that during the dry season, PM10 levels are generally on the higher side. As the rainy season commence in April and lasts through September, the amount of PM10 in the surrounding air decreases. The peak monsoon season is when PM₁₀ levels are lowest. Figure 1 shows the monthly variation of PM₁₀.

PM₁₀ is less harmful since it is less likely to enter the bloodstream than PM2.5 because of its bigger particle size. Children, the elderly and those with chronic lung illness should be particularly concerned about its effects as it lowers the visibility and, in some situations, is capable to corroding both organic and inorganic materials.

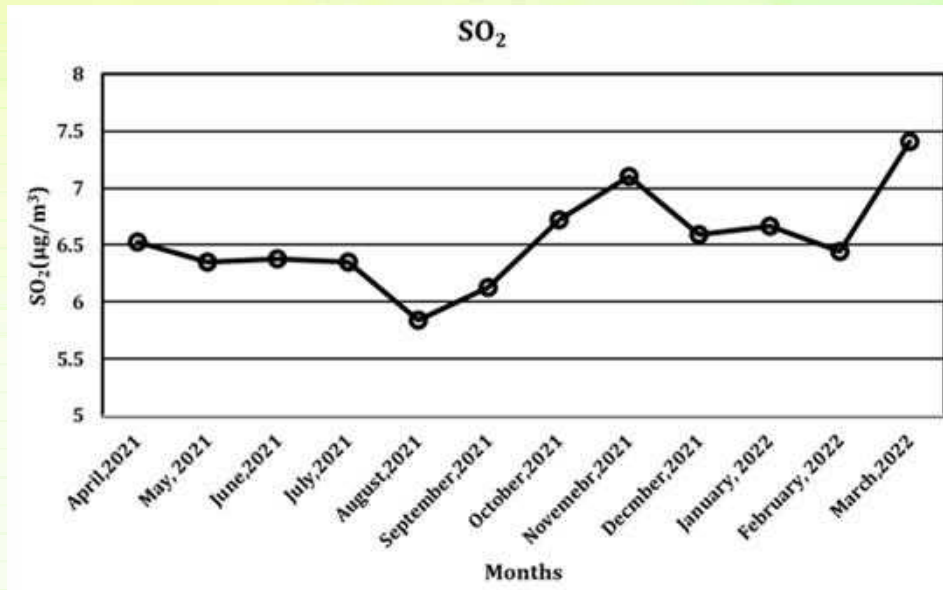
Fig 2: Monthly variation of PM₁₀ of the University Campus during the study period.



Sulphur Dioxide (SO₂):

The one of the most concerning components, SO₂, serves as a marker for the larger group of gaseous Sulphur oxides (SO_x). Sulphur dioxide (SO₂) is a reactive, colorless air pollutant with a pungent smell. Human, animal and plant health are all under risk from this gas. Sulfur dioxide emissions are primarily produced by the burning of fossil fuels. The primary component of acid rain is sulfuric acid, which is formed when sulphur dioxide reacts with water and oxygen. In the vicinity of the University Campus, SO₂ concentration ranged from 5.84 µg/m³ to 7.41 µg/m³ over the study period, which is significantly less than the CPCB's acceptable limit of 50 µg/m³. Therefore, the university campus can be considered as a zone free of SO₂ pollution. Additionally, the campus's excellent green canopy cover plays a significant role in the absorption of SO₂. The monthly variation of SO₂ is given in **Fig 2**.

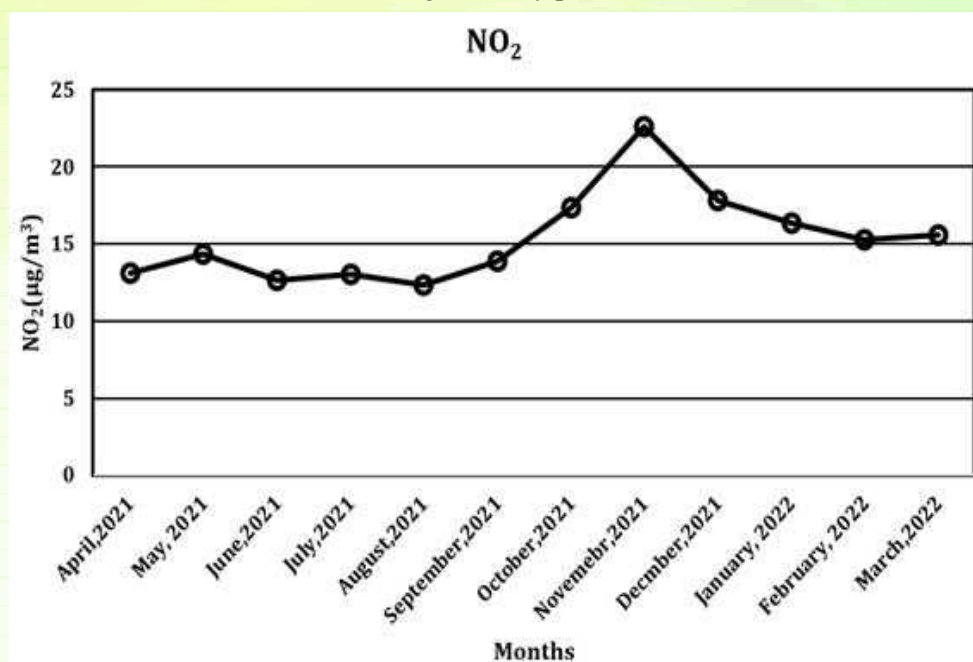
Fig 3: Monthly variation of SO₂ in the University Campus during the study period



Nitrogen dioxide (NO₂):

Nitrogen dioxide (NO₂) is one of six common air pollutants with outdoor air pollution limits set by national air quality standards. Increases in mortality and hospital admissions for respiratory diseases are also linked to elevated nitrogen dioxide levels in the air. Nitrogen dioxide can weaken the lungs' antibacterial defences, rendering them more vulnerable to infections. It may make asthma symptoms worse. NO₂ is the most prevalent form of NO_x in the atmosphere that is generated by anthropogenic (human) activities. Along with being a significant air pollutant itself, NO₂ combines with other elements in the atmosphere to produce ozone (O₃) and acid rain. In the University campus during the study period, NO₂ levels ranged from 12.34 µg/m³ to 22.64 µg/m³, which is significantly less than the CPCB permitted limit for ambient air quality of 40 µg/m³. The monthly variation of NO₂ is given in **Fig 3**.

Fig 4: Monthly variation of NO₂ in the University Campus during the study period



Conclusion: Thus, we can draw the conclusion that with the exception of PM₁₀, the concentrations of SO₂ and NO₂ were well within the permitted limits. As the construction is finished, the PM₁₀ will eventually decrease.

Ambient Noise Levels at GU Campus:

Under the Air (Prevention and Control of Pollution) Act, of 1981, noise is considered a pollutant. There are two key settings where noise frequently arises; these are - community noise and industrial noise. Community noise is also called environmental noise and is defined as the noise produced from all sources except the noise from industrial sources. As far as community noise is troubled the WHO guidelines endorse less than 30 dB(A) in a residential area and less than **35 dB(A) in classrooms, which is important for good teaching and learning conditions.**

Noise levels were measured using a Sound Level Meter (Model: Envirotech SLM 100; Type II dbA) on Guwahati University, campus. Noise level measurements were carried out at 8 different points at Guwahati university in 2021-2022. The selection locations along with the Leq data for each station are tabulated below in **Table 2:**

Table 6: The sampling positions along with the Leq data for each station

Sampling Positions	Category Type	Leq (10-12noon)	Leq (12 noon - 2pm)	Leq (2pm - 4pm)	Daytime limit of Leq
G.U. Entry Gate I- (Jalukbari)	Commercial	66.3	70.1	71	65
G.U. Entry Gate -II- (7 th mile)	Commercial	71.1	69	70.1	65
Environmental Science Department	Silence	49	50.1	50	50
G.U. Market Area	Commercial	58.2	60.8	61.1	65
AT-8 Boys' Hall	Residential	53.1	55.4	56.3	55
Administrative Block	Silence	50.5	50.6	51.1	50
GU Hospital	Silence	48.7	48.3	47	50
K.K. Handiqui Library	Silence	47.9	49.5	49.5	50

As per the CPCB guidelines, the maximum permissible limits in dB(A) Leq for daytime and nighttime are as follows in **Table 3**:

Table 7: CPCB guidelines, the maximum permissible limits in dB(A)

Category of Area/Zone	Limits in dB (A) L_{eq}	
	Day Time	Night Time
Industrial Area	75	70
Commercial Area	65	55
Residential Area	55	45
Silence Zone	50	40

It was to be noted that CPCB categorizes Universities and other educational campuses as Silence Zone. However, owing to the vastness of the GU campus and the segregated nature of the sampling stations in the present assessment, the sampling stations within the GU campus were categorized as the commercial residential, and silent zone.

The noise level of the eight sites in Gauhati University was selected for the assessment as shown in **Table 2**. It was detected that the highest noise level is found in GU Entry gate (71dB) followed by the 7th-mile entry gate of GU (70.1 dB) (**Fig. 4**). The GU Entry Gate (Jalukbari) is a dense traffic area and also the junction point of flyovers.

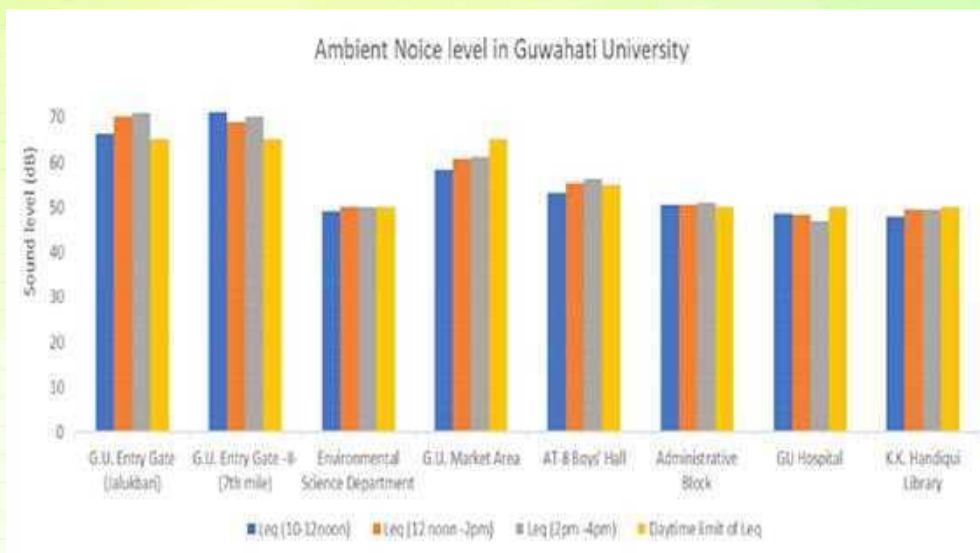


Fig 5: Shows noise level (dB) at Guwahati University

Thus, the raised noise can be attributed to the vehicular movement and also the road connected to Goalpara, Dhubri, the airport, etc. Similarly, G.U. Entry Gate - II- (7th mile) is also connected toward Goalpara, Dhubri, the airport, etc. That is why it crosses the limits of CPCB. In the administration block, ambient noise levels were slightly higher than the permissible limit. The noise levels were high because of the obvious reasons of the congregation of a large number of people for official works along with a large number of vehicular movements in and out of the block. One of the busiest places inside the Gauhati University, in the rest of the sampling points, the sound level is well within the permissible limit. Similarly, at 8 Boys' Hall, the noise level is slightly higher than the permissible limit which is because of the crowded area. The noise level is not uniform in the Administration block and at 8 Boy's Hall where the highest noise level was recorded. The lowest was recorded in GU Hospital (47 dB) followed by KK Handiquii Library (49.5 dB).

Recommendations For Reducing Noise Pollution:

Planting noise-absorbing vegetation around buildings can reduce noise.

Extensive tree planting along the sides of the roadways, especially along the National Highway

Utilization of noise-cancelling materials in offices and departments

Installing sufficient sound proofing around the university campus

Government in order to ensure adherence to the established standards, authorities should be asked to monitor the usage of loudspeakers and other noise-producing sources away from the university campus.

It is significant to note that the campus-wide average noise level exceeded the CPCB-recommended maximum allowable limit of 50 dB (A) when taking into account all sampling sites. Additionally, the level was significantly higher than the 35 dB (A) WHO recommendation, which is appropriate for classroom teaching and learning environments.

Observations

- Ambient air quality is found to be standard.
- Noise is a disturbing factor in campus particularly in Examination and Admission periods.

Suggestions and recommendations

- ⇒ Noise attenuation may be done by planting vegetation around buildings and highway nearby
- ⇒ Government authorities may be requested to monitor the use of loudspeaker and noise producing sources within the 100m radius of outside the University campus in compliance with prescribed rules.
- ⇒ Separate Bicycle Lane may be created for the residential stakeholders.

Actions taken:

- ⇒ Vehicular movement is now maintained in the campus.
- ⇒ Burning of litters etc. has been banned and now is under control.

BIODIVERSITY AUDIT



Located on the foothills of Jalukbari Hills with a good number of waterbodies, the Gauhati University Campus is a hub for biodiversity. The biodiversity audit of university campus is therefore a continuous process and efforts of the faculty members, researchers and the students to assess the living biota. Conservation is reflected in maintenance of a huge Botanical Garden and Aquaculture/ Biodiversity Park within the campus for many years. Various conservation practices are going on in Gauhati University Campus and as well as in its' associated natural ecosystems so as to minimize the anthropogenic impact on the biodiversity components and ecosystems. The scientific information and existing database are based on various studies as well as research works done by Botany, Zoology and Wildlife Science programmes of the departments of Zoology and Botany, Gauhati University. In spite of various limitations, data have been compiled to prepare an authentic documentation that provide an insight of the status of the biodiversity and natural ecosystem in the campus. Different conservation practices also have been applied for a better and sustainable campus ecosystem.

Spread over approximately 508.8 acre of lands, the university campus is a home to different varieties of fauna as well as flora. It is also worth mentioning to state that, if we see the IUCN/ IWPA threatened category of biodiversity components, the Gauhati University campus supports a good number of IUCN threatened animal species, Schedule-I species and as well as endemic species. Detailed information has been incorporated within the report.

Faunal diversity

The present audit study documented altogether 14 different major groups of animal components of the biodiversity in Gauhati University Campus. Of which, 35 species of mammals, 189 species of birds, 43 species of herpetofauna, 15 species of naturally occurring and 70 species of cultured fish, 1194 species of butterflies, 52 species of Odonata, 40 species of Coleoptera, 20 species of Hymenoptera, 23 species of Orthoptera, 80 species of Arachnida (79 spiders and 1 scorpion), 7 species of Crustacea and 6 species of Gastropods are recorded.

Gauhati University premises and its surrounding natural habitat supports varieties of habitat mosaics including foothill zones and terrain zones habitats, primary and human- modified habitats, marshy land habitats, hills and plains, open water habitats, vegetated wetlands, grasslands (both dry and wet grasslands, etc.), human residential and farmland habitats and as well as riparian wetland and habitats. The existence of sufficient wildlife trees on the campus attracted varieties of hole-nesting birds like IUCN-threatened and IWPA- endangered Hill Myna. Apart from that, owing to the presence of habitat mosaics in the GU Campus, it has supported a number of Endemic species, IUCN threatened and IWPA Schedule -I species of vertebrates and invertebrate fauna. This is a very good scope for the conservation of Wildlife and Biodiversity within an urban setup institution in India. Thus, we have to take care of the present sets of habitats for future upgradation. If the GU authority has taken any steps of cleaning all the existing wetlands present within the campus, then it will become a very good habitat for migratory waterfowl because the GU campus is situated within the Hotspot areas of Migratory birds (all migratory birds are visiting the waterbodies within the 10 km distance of River Brahmaputra only). Therefore, there is a very good scope for recognizing the GU campus as a bird watching destination in near future.

ENDEMIC, IUCN THREATENED & IWPA-SCHEDULE-I SPECIES

Among all the vertebrate species found in the Gauhati University campus, 3 are found to be critically endangered, 3 endangered and 9 are vulnerable category of IUCN Red list. Along with, 4 endemic species and 17 schedule-I species of wildlife (Protection) Act 1972 have also been recorded till date in the table below.

Table 8: IUCN Threatened, Wildlife (Protection) Act-Schedule-I and Endemic species of different vertebrate fauna recorded in GU campus.

Sl No.	Group	Species	IUCN Status	IWPA Status	Endemic Status
1	Mammals	Common Leopard	Near Threatened	Schedule-I	
2		Chinese Pangolin	Critically Endangered	Schedule-I	
3		Himalayan Cresless Porcupine	Vulnerable	Schedule-II	
4		Slow Loris	Vulnerable	Schedule-I	
5		Small toothed ferret Badger	Vulnerable	Schedule-II	
6		Jungle Cat	Lower Risk	Schedule-II	
7		Leopard Cat	Least Concern	Schedule-I	
8		Fishing Cat	Lower Risk	Schedule-I	
10		Large Indian Civet	Vulnerable	Schedule-II	
11		Spotted Linsang	Vulnerable	Schedule-I	
14	Birds	Greater Adjutant Stork	Endangered	Schedule-IV	
15		Lesser Adjutant Stork	Vulnerable	Schedule-IV	
17		Marsh Babbler	Vulnerable	Schedule-I	Endemic
18		Slender-billed Vulture	Critically Endangered	Schedule-I	
19		White Backed Vulture	Critically Endangered	Schedule-I	
21		Hill Myna	Least concern	Schedule-I	
22		Large Whistling Teal	Least concern	Schedule-I	
25	Reptiles	Bengal Monitor Lizard	Least concern	Schedule-I	
		Python Molurus	Lower Risk	Schedule-I	
		Indian tent Turtle	Least concern	Schedule-I	
		Indian Softshelled Turtle	Vulnerable	Schedule-I	
		Peacock Softshelled	Vulnerable	Schedule-I	
		Spotted Pond Turtle	Endangered	Schedule-I	
	Fish	Frail Gourami	Near Threatened	---	Endemic
		Fresh water Pipe Fish	Near threatened	--	Endemic
		Clarius magur	Endangered	--	
		Shalyni	--	--	Endemic

Floral diversity

Table 9: Summary of Floral diversity in Gauhati University campus

Sl. No.	Habit	Number of Species
1	Tree	128
2	Shrub	55
3	Herb	127
4	Climber	32
5	Epiphytes	8
6	Aquatic	4

Table 10. Recently introduced plants in the GU Botanical Garden

Sl#	Name	Family
1	<i>Costus igneus</i> N.E.Br.	Costaceae
2	<i>Musa rubra</i> Wall. ex Kurz	Musaceae
3	<i>Dendrobium densiflorum</i> Lindl.	Orchidaceae
4	<i>Dendrobium fimbriatum</i> Hook.	Orchidaceae
5	<i>Rhynchostylis retusa</i> (L.) Blume	Orchidaceae
6	<i>Arundina graminifolia</i> (D.Don) Hochr.	Orchidaceae
7	<i>Aerides odoratum</i> Reinw. ex Blume	Orchidaceae
8	<i>Codariocalyx motorius</i> (Houtt.) H.Ohashi	Papilionaceae

Table 11: Plants maintained at the Dr. H. K. Baruah Regional Botanical Resource Centre:

Sl. No.	Name	Family	Status
1	<i>Taxus baccata</i> L.	Taxaceae	Rare
2	<i>Nepenthes khasiana</i> Hook.f.	Nepenthaceae	Endemic
3	<i>Mesua assamica</i> (King & Prain) Kosterm.	Clusiaceae	Endemic
4	<i>Phoebe goalparensis</i> Hutch.	Lauraceae	Endemic
5	<i>Aquilaria malaccensis</i> Lam.	Thymelaeaceae	Critically endangered
6	<i>Calamus nambariensis</i> Becc.	Arecaceae	Critically endangered

Observations

- Clearing of water bodies were done twice in the year.
- Lush green environment with rich floral and faunal diversity is the lucrative characteristic of the Gauhati University Campus
- Plantation and maintenance avenue trees has been done with the initiative of Estate Office
- Proliferation of a few invasive species particularly *Eichhornia* in the water bodies and *Parthenium* in roadside areas seem to be a matter of concern, hence need management intervention.

Suggestions and recommendations

- ⇒ Wetlands still need maintenance.
- ⇒ Early removal of uprooted trees in the road side areas is suggested.
- ⇒ *Parthenium* patches should be destroyed with proper scientific technique.

SUMMARY AND RECOMMENDATIONS

- The audit process was conducted by the team constituted for the purpose.
- The academic year of 2021-2022 were considered for the present audit.
- Little change has been observed in Land Use and Land Cover section
- Completion of new Girls Hostel during the period is seen, where the construction started almost 3 years back. One block of Teachers residential flat is also under construction.
- Potable water quality is within the standard limits.
- No management strategies for Laboratory waste water were seen, which the concerned authority may look into.
- Wastage of water is still prominent which needs action to reduce the same.
- Awareness campaign on water conservation is suggested amongst the stakeholders.
- Waste disposal mechanism is standard. Frequency of garbage collection may be enhanced.
- There is a strict policy for removal of hazardous waste under Estate Office, GU. Strengthening of the execution mechanism is necessary.
- Vermicomposting facilities and rain water facilities may be augmented.

- Energy use is on the higher side which could be attributed to the volume of research laboratory, residential areas including the facilities like GU Press, Guest House etc.
- There is a scope for enhancement of non-conventional energy sources, for which a separate policy must be formulated.
- Building energy performance indices were within the prescribed limit.
- Green building concept may be introduced.
- Environmental quality is sound.
- Sound barricade through plantation may be installed towards the National Highway to avoid disturbances.
- Green campus of the Gauhati University houses as many as 600 species of plants and as many as 35 species of mammals, 189 species of birds, 15 species of naturally occurring and 70 species of cultured fish, 43 species of herpetofauna and 1194 species of butterflies. Majority of which are under IUCN/IWPA category.
- A few suggestions put forwarded during the previous year's audit process have been materialised to improve the overall environment of the Gauhati University Campus.
- The audit team fervently awaits for the implementation of the suggestions mentioned in this Green Audit Report of Gauhati University prepared for the year 2021-2022.
