GREEN AUDIT REPORT

2019-2020

GAUHATI UNIVERSITY

Guwahati- 781014 | Assam | India

গুৱাহাটী বিশ্ববিদ্যালয়
GAUHATI UNIVERSITY

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Foreword from Vice Chancellor

Green Audit is a process of comprehensive recording, methodical documentation, flawless analysis and reporting of diverse environmental components of an institutional setup. It aims to analyse ecological practices within and outside of the site of establishment so that an eco-friendly atmosphere can be created and maintained. It helps to identify and generate prospects 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 the optimized methodologies to carry out the green audit in the campus with a futuristic way.

It's my pleasure to forward the Green Audit Report of Gauhati University for the year 2019-2020. 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 sincere and systematic effort of the green audit team of Gauhati University. I specially thank Prof. Partha Pratim Baruah, Chairman and all the esteemed members of Green Audit Committee for their untiring effort on the preparation of the report. I do hope the Green Audit Report, 2019-2020 of Gauhati University will fulfil the essential requirements.

P. J. Handique

(Pratap Jyoti Handique)
Vice Chancellor

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Acknowledgement

Gauhati University is committed to protect the natural environment by implementing eco-friendly practices. In its pursuit for improving environmental quality and to maintain a pristine environment for the future generation of students as well as of all campus dwellers, Gauhati University has been undertaking a self-inquiry on environmental quality of the campus since 2017. The University thus 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 time to time incorporating different faculty members 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.

The present report is the outcome of the laborious effort of each and every member of GU Green Audit Committee who brainstormed and designed a survey module and evolved a few questionnaires to gather information on every section of environment, from water to waste disposal, and Biodiversity to energy and then, the data were compiled, analyzed and finally this self enquiry report on green initiatives for the year 2019-2020 was prepared where a few suggestions were also made to take environment protection to higher levels. It is 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 at and when necessary. 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. Special thanks are due to Prof. H. P. Sarma for providing some information on air quality data. Thanks are due to Prof. P. K. Saikia and his Research team for their kind help in faunal study of the Campus. I am extremely indebted to Prof. Dhrubajyoti Saharia for his help in preparing the maps. 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, 2019-2020

Gauhati University Green Audit Committee
2019-2020

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Members: Prof. Bhaben Tanti, Department of Botany, Gauhati University

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Introduction

Gauhati University (a NAAC A-grade institution) is the oldest and largest university in North-East India. Founded in the year 1948 under the Gauhati University Act, 1947; the University was established at the southern bank of the Brahmaputra, towards the northern edge of the Shillong plateau (26.1543° N, 91.6632° E). With a sprawling campus spread over an area of 508.8 acres, Gauhati University comprises of 45 Departments, 1 constituent Law College, an Institute of Distance and Open Learning (IDOL) and 6 Centres of Studies. The University provides undergraduate and postgraduate courses across seven faculties namely Law, Medicine & Allied Health, Arts, Science, Commerce & Management, Sciences, Engineering and Technology. A total of 4118 students enrolled in the PG courses at Gauhati University in the session 2019-20 while as many as One lakh fifteen thousand students were enrolled in UG courses in the 306 affiliated colleges during 2019-2020. The University consistently ranks as one of the best universities in the region, ranking 47th among all Indian Universities (National Institutional Ranking Framework -2020).

Green Audit at Gauhati University

The accumulation of human capital has become a central policy goal for governments and policymakers as a means to enhance labour productivity and economic growth. Small advances to labour force skills can largely influence the future well-being of a nation, through substantial gross domestic product gains. This has led governments to devote huge amounts of resources towards improving the educational standards of their citizens and the 72 glorious years of Gauhati University is a testimony to that. Modernization has increased the amount of specialization and differentiation of structure in academic institutes, which has contributed to increased carbon dioxide emissions and subsequent global warming. Considering the present environmental scenario, Honourable Prime Minister, Shri. Narendra Modi Ji has declared the mission of 'Swachch Bharat Abhiyan', whose essence echoes through the "Green Campus, Clean Campus" mission launched by the University Grants Commission for all higher educational institutes. The National Assessment and Accreditation Council (NAAC), which is an autonomous body funded by the University Grants

Commission of Government of India, has made 'Environmental Consciousness' a mandatory criterion (Criterion VII) for grading educational institutes.

Today, sustainability and sustainable development policies are high on the agenda of Gauhati University. The green audit, therefore, becomes an integral part of academic environmental management and its implementation is crucial in various aspects of the functionalities of Gauhati University. Green auditing is the process of identifying and determining whether institutions' practices are eco-friendly and sustainable. It is an effective ecological tool that helps to create a culture of sustainability throughout an organization and is implemented through regular identification, quantification, documenting, reporting and monitoring of environmentally important components. Over the years, green auditing has helped the institute in preserving the rich floral and faunal diversity in and around the campus; garnering interest and creating awareness among the stakeholders.

Gauhati University is committed to responsible stewardship of resources and to demonstrate leadership in sustainable academic practices. 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. The policy goals of the Gauhati University Green Audit are :

- 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 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 environmental management practices.
- To examine the current practices that can impact the environment.
- To create awareness among the various stakeholders of the University.
- To prepare a Green Audit Report on green practices followed by different Departments, support services and administration.

METHODOLOGY ADOPTED

The methodology adopted to conduct the Green Audit of Gauhati University had the following components

- Onsite field visits were conducted by the Green Audit Team at 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 the District Water Analysis Laboratory under PHE, Govt. of Assam.
- 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 (Model: Envirotech SLM 100; Type II db (A). Noise level measurements were carried out at 10 selected sampling stations during the daytime within the campus.
- Different standard protocols were followed to document and estimate the floral and faunal account.

AUDIT STAGE

Green auditing in Gauhati University, Guwahati began with the assessment of the status of the green cover of the Institution followed by waste management practices and energy conservation strategies, etc. The audit team monitored different facilities at the University campus, determined different types of appliances and utilities (Water cooler, taps, toilets, lights, fan, ACs etc.) as well as measuring the usage per item (Watts indicated on the appliance or measuring water from a tap) and identifying the relevant consumption patterns (such as how often an appliance is being used) 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 also through questionnaires in different sectors such as water, energy, waste, biodiversity status. 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 collated and analyzed to prepare this audit report of GU.

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 several wetlands towards the north and thus, making it a picturesque landscape suitable for a wide spectrum of flora and fauna. The Academic Departments and residential units/hostels have come up at the foothills or in 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 (34.7%; Fig. 1). 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. It is a matter of concern that a few of the wetlands have been observed to be silted up and presently under a thick cover of grass and aquatic weeds.

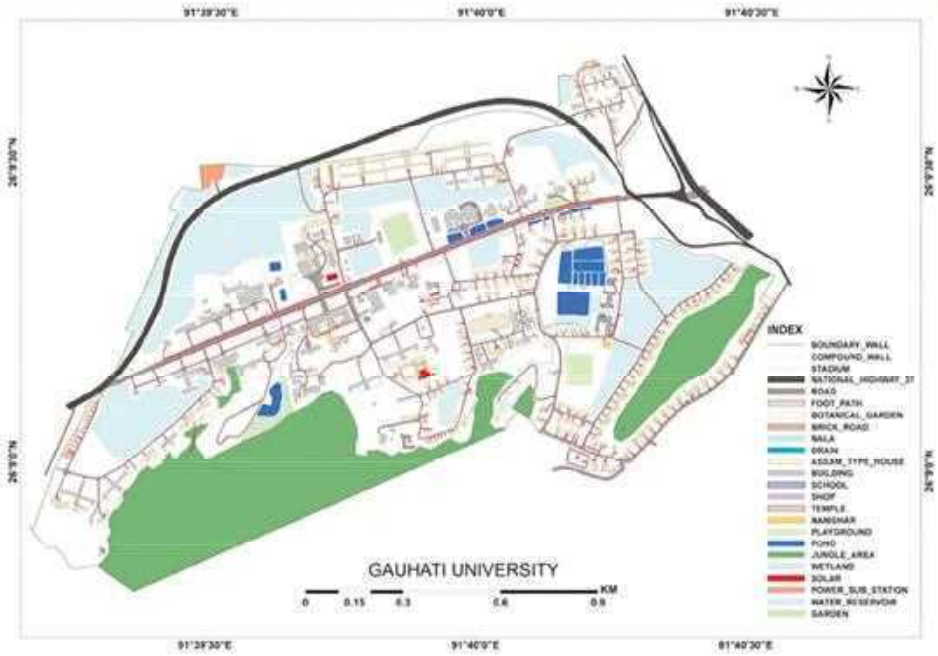

Fig 1: The Map of Gauhati University campus

It is found that a total of about 76.37 acres (~16.0% of total) are under the built-up category, of which Assam type residential units, hostels, and administrative units form a significant part. In absence of available high ground, many of the wetlands are being filled up for new constructions. Two 3- storied residential quarters have come up in the last two years as a part of a recent initiative of the GU administration for vertical expansion. The campus is criss-crossed with roads which covered an estimated area of approximately 20 Acres and the two stadiums covering an area of nearly 4 acres of land. Besides the main campus, The GU has two satellite blocks one at Jalukbari and the other one at the Ambari area of Guwahati city.

Table 1: Built-up categories in Gauhati University Campus

(Curtsey: Office of SE, GU)

Sl. No.	Land Use Category	Area (Acres)
1	GU Campus	483.713
2	Botanical Garden	2.04694
3	Road	20.1664478
4	Divider	0.617044
5	Road Unmetalled	0.186615
6	Foot Path	5.885191
7	Ring Well	0.00575
8	Sign Board	0.033346
9	OFC	0.001035
10	Oil Man Hole	0.000786
11	Rock	0.074877
12	Biofuel Unit	0.050387
13	Pump Station	0.00061
14	Car Track	0.870524
15	Brick Road	0.013168
16	Nala	0.360957
17	Protection Wall	0.001013
18	Drain	1.872992
19	Retaining Wall	0.053146
20	Bench	0.002516
21	Culvert	0.212044
22	ATM	0.00776
45	Foundation Stone	0.000212
46	Building Under Construction	0.006203
47	Overhead Tank	0.035068
48	Dust Bin	0.000603
49	EP Box	0.003566
50	Water Tank	0.270281
51	Car Parking	0.048694
52	Garage	0.325104
53	Bus Stop	0.019502
24	Building	17.88869

Sl. No.	Land Use Category	Area (Acres)
25	School	0.812026
26	Transformer	0.053045
27	Shop	0.217685
28	Generator	0.03877
29	Security House	0.025495
30	Temple	0.149728
31	Hut	1.31423
32	Namghar	0.12246
33	Water Pump	0.036395
34	Playground	4.00509
35	Septic Tank	0.400901
36	Pond	7.557342
37	Jungle Area	91.002504
38	Wet Land	75.299581
39	Solar	0.373466
40	Tin Shed	0.051762
41	Bathroom	0.006493
42	Power Sub Station	0.991229
43	Water Reservoir	0.267077
44	Toilet	0.202206
54	Garden	0.539414
55	Panel Board	0.001973
56	Electric Room	0.000595
57	Sahid Bedi	0.013919
58	Statue	0.008653
59	Cycle Stand	0.022548
60	Hut Area	0.620613
61	NH 37	5.34328

Observations

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

Suggestions and Recommendations

- A task force is to be constituted for landscape monitoring.
- Forested areas need to be conserved as a carbon sink.
- Post plantation of saplings needs to be monitored.

Water Audit

Water is a natural resource; all living organisms depend on water. While freely available in many natural environments, in human settlements potable (drinkable) water is less readily available. Groundwater depletion and water contamination are taking place at an alarming rate. Hence it is essential to examine the quality and usage of water on the University campus. Water auditing is conducted for the evaluation of facilities of raw water intake and determining the facilities for water treatment and reuse.

Uses and management

A total of 275000 L of water is pumped out from the PHE water storage tanks every day for the university dwellers as well to meet the daily demands of the academic and administrative Departments (Table 2). The daily use of the water during 2019-2020 was approx. 249500 L per day. There is one well which was constructed long back in the campus to manage a part of the daily requirement of the water (not for potable purpose).

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 the motors used	1
4	Horsepower- 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	
	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
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 forleakage in old pipes overflow of water tanksLeaked water tapsLack of awareness for saving water -improper use of water taps, leaving the tap running after use.
14 Water usage for gardening	4000 L per day
15 Wastewater sources	Leakage in pipes, valves Overflowing tanks Residential Qtrs Toilets & baths Laboratories Canteens, Hostels
16 Use of wastewater	nil
17 The fate of wastewater from labs	Wastewater 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 Rainwater 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 intervals and the results are presented in 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

- There is no proper water consumption monitoring system on the GU campus.
- The GU does not have a reusable water treatment facility for wastewater generated from laboratories, canteen, hostel kitchen, toilets, bathrooms and office rooms.
- Overflowing of overhead water tanks is a common sight.

Suggestions and Recommendations

- Rainwater harvesting systems could be augmented.
- A water conservation campaign could be initiated.
- Automated sensors can be installed to prevent the overflow from water tanks.
- Automated taps could be used so that usage of water can be reduced.

Waste disposal audit

Human activities create waste, and it is the way these wastes are handled, stored, collected and disposed of, which can pose risks to the environment and public health. Pollution from waste is aesthetically unpleasing and results in large amounts of litter in our communities which can cause health problems. Solid waste can into three categories: biodegradable, non-biodegradable and hazardous waste. Bio-degradable wastes include 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 waste that is likely to be a threat to health or the environment like cleaning chemicals, acids and petrol. Unscientific management of these wastes such as dumping in pits or burning them may cause the harmful discharge of contaminants into soil and water supplies, and produce greenhouse gases contributing to global climate change respectively. Special attention should be given to the handling and management of hazardous waste generated in the college. Bio-degradable waste can be effectively utilized for energy generation purposes through anaerobic digestion or can be converted to fertilizer by composting technology. Non-biodegradable waste can be utilized through recycling and reuse. Thus the minimization of solid waste is essential to a sustainable University. 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 average, the hostels and teacher flats/quarters account for the highest amount of solid waste generated on 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 224 kg of different types of solid waste per week respectively (Table 4).

Solid Waste Management

Management of solid waste is one area where all stakeholders are more-or-less aware of the issues involved. Each of these sections/ stakeholders has appropriated their own set of solid-waste management practices as per their convenience, requirements, and availability of resources. Investigation reveals that 19 Academic Departments of the University have a total of 185 numbers indoor dustbins installed for solid-waste disposals. In average terms, each of these departments has a provision of <"10 dustbins. The Departments of Geology, Botany, HRDC and GUINEIS further maintain bio-degradable and vermi-compost facilities.

Table 4: Solid waste generated on the campus per Week

Sl.no.	Stakeholders	Types of solid waste	Average waste generated/week	% of waste
1	ACADEMIC DEPARTMENT	Paper waste	12 kg	16.9
		Plastic waste	5 kg	14.93
		Organic Waste	10 kg	8.47
		E-waste	0.5 kg	35.7
2	ADMINISTRATIVE OFFICE	Paper waste	12 kg	16.9
		Plastic waste	3 kg	8.96
		Organic Waste	8 kg	10.3
		E-waste	0.5 kg	35.7
3	HOSTELS	Paper waste	8 kg	11.27
		Plastic waste	12 kg	35.82
		Organic Waste	40 kg	33.90
		E-waste	0.1 kg	7.14
4	TEACHER FLAT/RESIDENTIAL QUARTER	Paper waste	36 kg	50.70
		Plastic waste	12 kg	35.82
		Organic Waste	45 kg	38.1
		E-waste	0.3 kg	21.42
5	CANTEENS	Paper waste	3 kg	4.22
		Plastic waste	1.6kg	4.48
		Organic Waste	15 kg	12.7
		E-waste	Nil	
		TOTAL	224Kg /week	

The teacher's quarters maintain on an average 2 personal dustbins for solid-wastes disposals and also a pit for the dumping of organic wastes.

- 42% of the Academic Departments and 50% of residential quarters maintain separate disposal systems for dry and wet waste.
- The culture of separating bio-degradable waste from non-biodegradable ones is prevalent in the teacher's quarters and 42% of Academic Departments but is absent in hostels.
- For 52.6% of Academic Departments, the accumulated solid waste is lifted by GMC, for 26% of departments; it is land ûlled while for the rest it is composted.
- For 75% of the teacher's quarters, the entire amount of non-biodegradable wastes accumulated is lifted by the GMC every alternate day in a week.
- For the remaining 25% of quarters, only 80% of the waste is lifted by GMC, while the remaining island ûlled and composted
- Similarly, only 50% of hostels have adopted land ûlling and composting processes, while the remaining 50% allow the wastes to be lifted by GMC only.
- Daily cleaning is in practice for all the departments and special cleaning drives are initiated periodically by the students and faculty of these departments to imbibe and foster GO-GREEN culture on the campus.
- Solid-waste recycling is not practiced in either of the sections, formally or informally.

While the centralized system of solid-waste management involves timely and periodic lifting of the disposed of wastes by the Guwahati Municipal Corporation, it is laudable that proper waste management including composting initiatives has been adopted by some hostels, departments, and quarters. However, the need for a formal and centralized system for land ûlling and composting ought to be adopted in the University. Moreover, the practice of recycling is another avenue that requires immediate operationalization.

Attention required disposing waste

Incinerator in the GU Campus

Waste segregation facility in GU Departments

Hazardous Waste

The Ministry of Environment, Forest and Climate Change, Government of India; promulgated Hazardous Waste (Management and Handling) Rules, 1989, under the provision of the Environment Protection Act, 1986. These rules were amended and new rules entitled "Hazardous waste (Management, Handling, and Trans-boundary Movement) Rules, 2008" were promulgated. These rules were further amended in the years 2009 & 2010 for proper management and handling of hazardous waste in the country (CPCB, 2010-2011). These regulations sometimes require detailed knowledge of the constituents and properties of waste streams so they can be managed properly.

Gauhati University, like other entities that generate and manage hazardous wastes, is faced with a range of problems. The following features create hazardous waste management problems unique to the University:

- Most departments do not generate large quantities of hazardous waste and can be classified as conditionally exempt small quantity generators (generators of less than 10 kilograms of hazardous waste per month)
- Stakeholders are not adequately aware of the regulations that may apply to them, or they may have chosen to ignore the regulations, believing they do not have to comply.

During a survey carried out among the faculty members of Gauhati University by the Green Audit Committee, a majority of the respondents (91.5%) were confident about their understanding of hazardous waste and their obligation in disposing of material (Fig. 2).

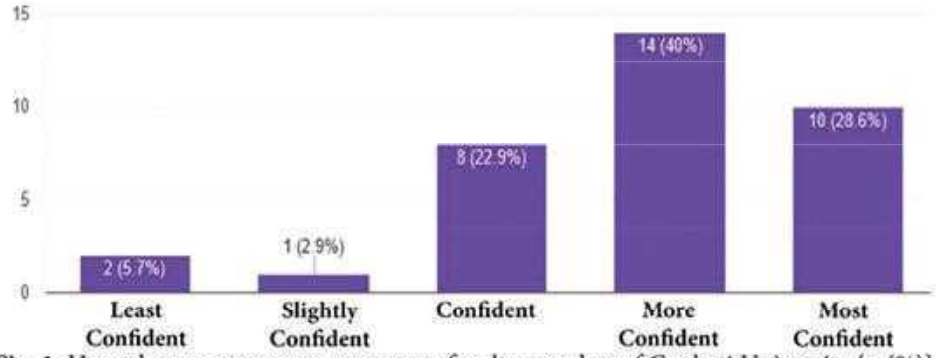

Fig. 1: Hazardous waste awareness among faculty member of Gauhati University {n (%)} recorded during a questionnaire based survey for the year 2019-2020

Handling, collection, and transportation Ideally, proper handling of chemicals begins with understanding the potential hazards related to their use. All stakeholders, especially from Academic Departments and laboratories should be responsible for disseminating information on hazardous materials being used in the facility. The dissemination of

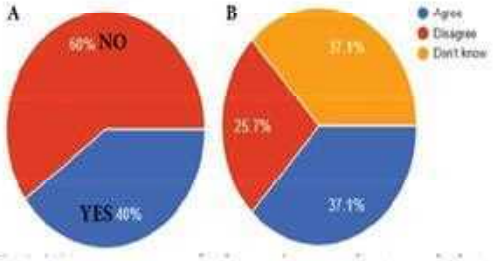

Fig. 3: (**A**). Awareness among faculty members regarding internal administrative support concerning hazardous waste. (**B**). Faculty member's reaction to statement "Would you agree or disagree with following statement: The Gauhati University community is doing good job recycling used official/household (campus residents) items such as newspapers, tin cans, and glass bottles"

information can involve discussions on reactivity and possible health effects.

Data from the survey carried out by Gauhati University Green Audit Committee reveals that despite having an understanding of hazardous waste; a majority of the respondents were uncertain of relevant support in case they had queries regarding hazardous waste (Fig. 3A). Many respondents were also unaware (37.1%) of the green initiatives taken by Gauhati University to manage hazardous waste (Fig. 3B).

Fig. 4: Improving reach of the door-to-door waste collection system (based on data collected using pre-coded questionnaire on behalf of GU Green Audit Committee, 2019-2020)

The transportation of waste including hazardous wastes occurs within and off the university property, to an approved treatment facility. From the survey, it is evident that there are better collection and management of waste across the campus, but improvements in the overall scenario must be made (Fig. 4). From the figure, it is evident that a majority of the faculties feel that they either have no access or are unaware of such provisions made by Gauhati University. Data also indicates that there is a need for more frequent door-to-door waste collection services across the campus (Fig. 5)

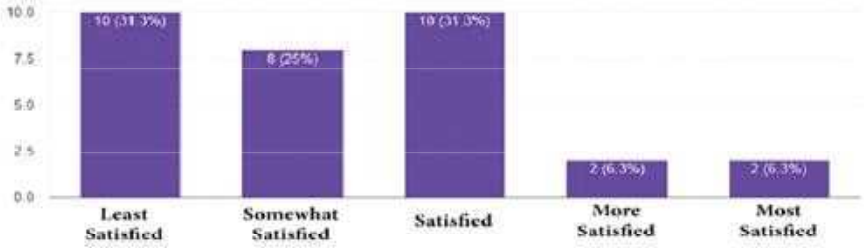

Fig. 5: Satisfaction in term of door-to-door waste collection frequency among Gauhati University faculty members during a questionnaire based survey for the year 2019-2020

The university faces several obstacles to ensuring the disposal of hazardous wastes in an appropriate manner. These include the need for funds to pay for an outside handler and on-site coordinator to manage the waste management program. The large variety and small quantities of wastes produced by the Academic Departments and the residential is also a manner of concern. Data from the survey indicates that household batteries such as alkaline batteries were most frequently disposed of (46.9%) as compared to household and office cleaners such as tiles and floor cleaners (26.5%), pesticides including fungicides (18.2%), wood preservatives such as varnishes (15.2%) and paint products (12.1%). The survey recorded that the disposal of this waste was primarily through the garbage pickup but on a few occasions, such items were also stored for later disposal (9-12.5% in cases of household/office cleaners, paint products and pesticides). Caution must be taken while moving hazardous waste materials through campuses along public streets.

Observations

- The incinerator is not working.
- Disposal of biomedical waste generated in the GU laboratories is no streamlined.
- The plastic waste amount was on the higher side, hence needs intervention

Suggestions and Recommendation

- The GU campus is to be declared as a plastic-free campus.
- The practice of using biodegradable materials should be encouraged as alternatives.
- Vermi composting facilities could be augmented.
- A centralized system of recycling paper could be adopted.
- The incinerator installed in the campus is to be activated.

Health audit

In order to encourage students to respect the environment and think about conservation, altogether 5 Environmental Awareness/Plantation Programmes were organised during 2019-2020. World Environment Day was celebrated by Different Academic Departments with their students.

A Swachhata Program was organized jointly by Gauhati University and Indian Oil Corporation, Noonmati with the following schedule:

Venue : Birinchi Kumar Baruah Auditorium, Gauhati University
Date : 24th August, 2019
Time : 10:00 am

His Excellency Prof. Jagdish Mukhi, Hon'ble Governor, Assam and Chancellor, Gauhati University was the Chief Guest of the program. The program was started with the National Anthem followed by the University Anthem. The other dignitaries present in the program were Prof. P.J. Handique, Hon'ble VC, Gauhati University, and Sri Sanjay Manchanda ED, Guwahati Refinery

The programme was started with a pledge taking ceremony on Swachhata where more than 1400 students and 200 faculty members and officers participated. A few sanitary napkin incinerators to girls' hostels' and dustbins to all the hostels' were handover in the programme which was followed by a plantation drive in the entire GU campus. Approximately 300 saplings were planted by the students. Sanitary napkin incinerators were donated by IOCL.

Hon'ble Chancellor of Gauhati University took part in the tree plantation in the campus

Inauguration of "Swachhata Program" at GU

Dustbins distribution to hostels

Girl students offered thanks for proving the sanitary napkin incinerator in the hostel

Energy audit

According to Energy Conservation Act, 2001, Energy Audit is the verification, monitoring, and analysis of the use of energy including submission of a 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 and administrative blocks. In different hostels, LPG cylinders are primarily used for cooking purposes and the number of uses was also counted. Domestic LPG connections were not included in the present study.

Moreover, Gauhati University is taking its initiative to utilize renewable energy such as solar power to compensate for the necessity of electrical energy within the campus. To achieve that goal, a number of Solar Panels are installed in 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 being installed phase-wise in different hostels, Administrative and Academic buildings.

On average, 3, 14,853 units per month of electricity were consumed by the University in the year 2019-20 including the residential quarters. In the previous year 2018-19, the average power consumption was 3, 17,362 units per month. It has also been observed that there is a slight decrease of around 0.4% in the monthly average electricity consumption during the current year which could be attributed to the installation of solar panels in some specific zones (Fig. 6,7,8) of the campus.

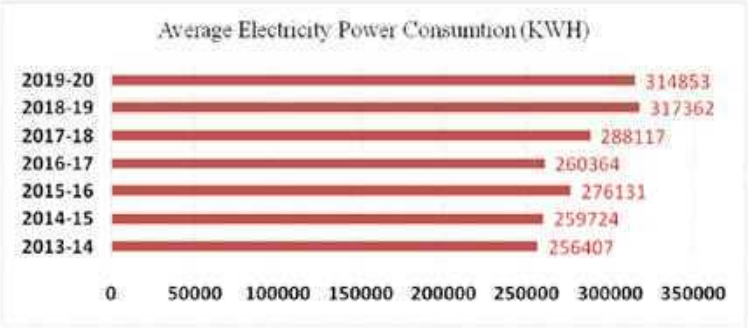

Fig. 6: Average electricity consumption in the GU campus from 2013-14 to 2019-20

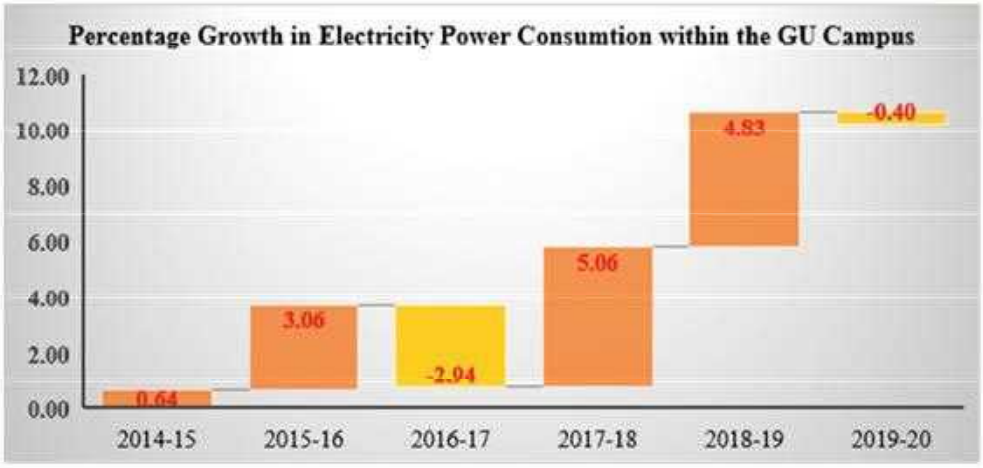

Fig. 7: Percentage of growth in Electric power consumption with the GU campus

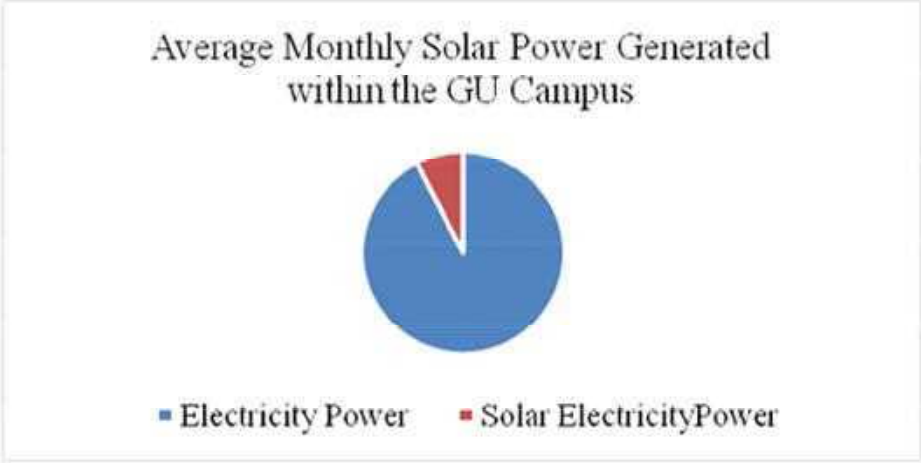

Fig. 8: Monthly Solar power generated within GU campus

To compensate for the rising power requirement, solar panels are installed within the GU campus. Annually, GU has generated 288000 KWH of electrical energy through the solar panel. In the last two years, the GU campus was augmented with a 100 KWP new solar panel.

Further, to minimize the power consumption within the campus, GU is taking the initiative of replacing the old high-power Halogen and CFL bulbs with low power LED panels in a phased manner. At present, GU has 1778 numbers of LED bulbs and panels as compared to 315 numbers CFL and 11 numbers Halogen

bulbs in various academic and administrative blocks. There were 255 numbers of AC (Air Conditioner) and 2291 numbers of Fan 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.

Observations

- Separate Electricity meters were not found in the Hostels, Academic, and Administrative blocks.
- Roadside solar Panels were non-functional.

Suggestions and Recommendations

- Separate provisions for the recording of energy consumption should be installed in Hostels, Departments and Administrative buildings
- Solar power generated roadside poles need to be installed in specific locations.
- Solar power dependency is to be augmented.
- Proper monitoring of energy use is the need of the hour to avoid loss of energy. Hence, the timetable for the switch on /off for the roadside lights be properly maintained and monitored.

Environmental quality audit

Air quality assessment

Three parameters namely Particulate Matter (PM 10), sulphur dioxide (SO2), and nitrogen dioxide (NO2) were considered to monitor the air quality in the University campus. PM10 is suspended particulate matter, either solid or liquid, with a diameter of 10 micrometers or less, including smoke, dust, soot, salts, acids, and metals. Particulate matter can also be formed indirectly when gases emitted from motor vehicles and industries undergo chemical reactions in the atmosphere.

In the University Campus, the major source of PM 10 might be the dust from construction, motor vehicles, and waste burning. The PM 10 in the University campus varied between 31.864 µg/m3 to 111.432 µg/m3 with an annual average of 70.23 µg/m3, which is higher than the permissible limits of CPCB Ambient Air Quality Standards (60 µg/m3). It was also observed that the PM 10 showed a higher range during the dry season (October to March). The concentrations of

PM 10 in the ambient air were recorded to be decreased as the rains started in April. The lowest PM 10 is observed during the peak monsoon season (Fig 9).

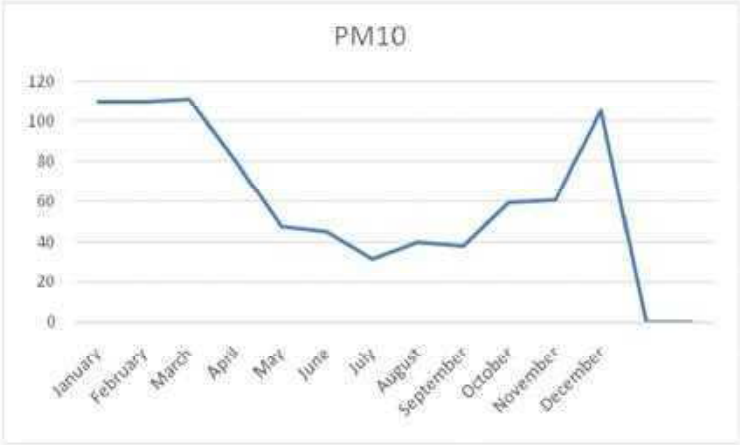

Fig. 9: Monthly variation of PM 10 in the University Campus.

SO2 is the component of greatest concern and is used as the indicator for the larger group of gaseous sulphur oxides (SOx). In the University Campus, the SO2 concentration varied between 5.8 µg/m3 to 7.9 µg/m3, with an annual average of 6.86 µg/m3 (Fig.10). This is much below the CPCB permissible limit of 50 µg/m3. So, the University campus can be called a zone which does not have SO2 pollution. Moreover, the good green canopy cover which is present in the campus also contributes a lot to the absorption of SO2 by these green members.

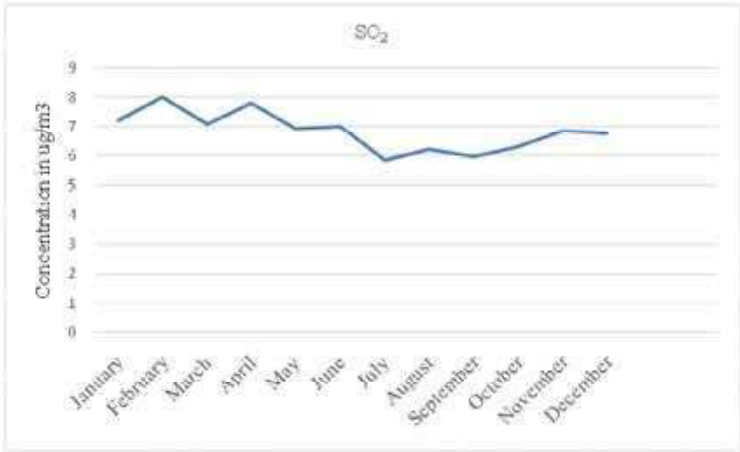

Fig. 10: Monthly variation of SO2 in the GU Campus

NO_2 is the most prevalent form of NOx in the atmosphere which is generated from different anthropogenic (human) activities. NO_2 is not only an important air pollutant by itself but also reacts in the atmosphere to form ozone (O_3) and acid rain. In the University campus, the NO_2 varies between 12.9 μg/m³ to 19.03 μg/m³ with an annual average of 15.54 μg/m³ (Fig. 11). This is much below the CPCB ambient air Quality permissible limit of 40 μg/m³

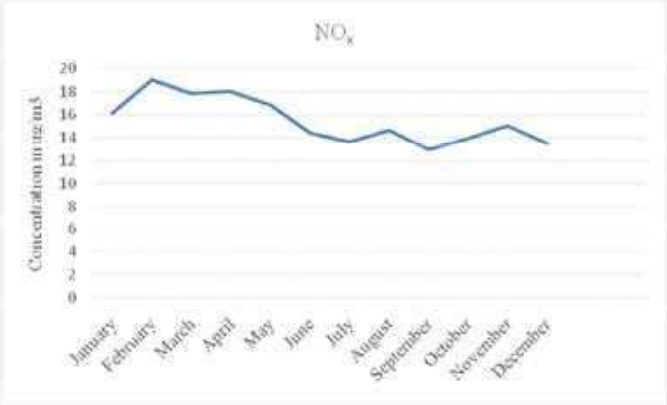

Fig. 11: Monthly variation of NO_2 in the GU campus

Vehicular movements

It was estimated that around 26550 nos. of vehicles (including vehicles coming to Bank, Police station & Post Office) visited the GU Campus in general days per month during 2019-20 excluding the vehicles of campus dwellers. The Highest numbers (more than 32,000) were recorded in the peak academic months during July and August 2019. The University has four designated parking places; still, vehicular congestion was a common sight everywhere which needs intervention. Accept 30 percent of the vehicles, rest are visiting for a while; hence, correlation study could not be undertaken with the air quality parameters. The intermittent rainfalls during July/August help in the natural mitigation of the air pollution in the campus.

Ambient Noise Levels

Under the Air (Prevention and Control of Pollution) Act, 1981, noise is regarded as a pollutant. There are two major settings where noise mostly occurs; these are - community noise and industrial noise. Community noise is also called environmental noise and is defined as the noise emitted from all the sources

except the noise from the industrial sources. As far as community noise is concerned the WHO guidelines recommend less than 30 dB(A) in bedrooms during the night which is essential for good quality sleep. Again, it should be less than 35 dB(A) in classrooms which is important for good teaching and learning conditions.

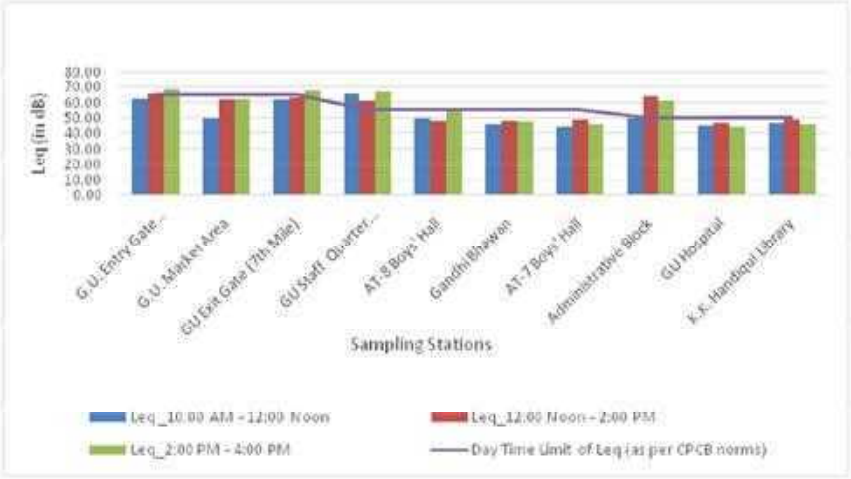

Fig. 12: Ambient Noise Levels within G.U. Campus

In GU campus, noise levels were measured using a Sound Level Meter (Model: Envirotech SLM 100; Type II db (A) at 10 sampling stations during the daytime (Fig. 12). From the data obtained, it was found that the noise levels in and around the GU Staff quarters were above the maximum permissible limit during the peak hours. Similar was the case for the sampling stations located near the main entry gate at Jalukbari and exit gate near the 7th Mile area. The exceeding of maximum permissible limits in these two areas can be attributed to the noise emerging from vehicular movements and traffic-related owes near the Bhupen Hazarika Samadhi Kshtera and the National Highway along with the University campus. Additionally, the noise levels near the GU exit gate might be due to contributions from construction activities of the Tikhor Park. Another location where the ambient noise levels were above the permissible limits was near the Administrative Block. The noise levels were high here because of obvious reasons of the congregation of a large number of people for official works along with large no. of vehicular movement in and out of the block. In most of the other sampling stations, the Leq levels were within permissible limits. Due to the reduced population on the campus, the community noise levels at most locations have subsided compared to previous years.

However, it is important to note that the average noise level, considering all sampling stations within the campus, was higher than the maximum permissible limit of 50db(A) as recommended by the CPCB. Also, the same was much above the WHO recommended value of 35 dB(A) which is suitable for classroom teaching-learning environment.

Observations

- Numbers of Bicycle rider have been increasing in recent years on the campus. It is estimated that 40 percent of campus dwellers own a bicycle.
- Noise is a disturbing factor on campus, particularly in Examination and Admission periods.

Suggestions and Recommendations

- A separate Bicycle lane may be created to encourage students and staff.
- The vehicular account should be maintained for the campus dwellers and staff members.
- Noise attenuation be done by planting vegetation around buildings and Highway nearby
- Govt. authorities are requested to monitor the use of loudspeaker and noise producing sources within the 100m radius outside the University campus in compliance with prescribed rules.

Biodiversity audit

Biodiversity audit of Gauhati University is a continuous process and efforts of the faculty members, researchers, and the students to assess the living biota and its conservation have been going on for many years. Various conservation practices are going on in Gauhati University Campus and as well as in its' associated natural ecosystems 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 work done by Botany, Zoology and Wildlife Science programmes of the departments of Zoology and Botany, Gauhati University. Despite various limitations, data have been compiled to prepare authentic documentation that provides an insight into 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.

The main objective of biodiversity audit is to provide documentation of biodiversity components within the institutional area, to observe ecosystem structures and functions along with regular biodiversity monitoring in order to check the new addition and analysis of biotic interactions amongst different components of biodiversity.

Spread over approximately 508.8 acres of land, the Gauhati University campus is 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 into the report.

Faunal diversity

The present audit started from July 2019 and continued till June 2020 and the study documented altogether 12 different major groups of animal components of the biodiversity in Gauhati University Campus (Fig. 13). Of which, 30 species of mammals, 170 species of birds, 41 species of herpetofauna, 15 species of naturally occurring and 70 species of cultured fish, 174 species of butterflies, 52 species of Odonata, 40 species of coleoptera, 20 species of Hymenoptera, 23 species of Orthoptera, 77 species of Arachnida (76 spiders

and 1 scorpion), 7 species of crustacea and 6 species of Gastropods are recorded (Table 5).

Table 5: Faunal diversity in the GU campus during 2018-19 and 2019-20

Major faunal groups	Recorded Species from July 2019 to June 2020	Recorded Species from July 2018-June, 2019	Total Incremental species	Percentage of species increase in each group
Mammalian fauna	30	22	8	26.66
Avian fauna	170	149	21	12.35
Herpetofauna	41	38	3	7.32
Naturally occurring fish	15	15	0	0.0
Cultured fish species	70	70	0	0.0
Butterflies	160	147	27	16.87
Odonatan fauna	52	48	4	7.69
Coleoptera	40	21	19	47.5
Hymenoptera	20	Data not available	20	100
Orthoptera	23	Data not available	23	100
Arachnida (Spider & Scorpion)	77	40	37	48.05
Crustacean	7	7	0	0.0
Gastropods	6	Data not available	6	100

In addition to earlier 22 mammalian sp, the present study added another eight species that include Jungle cat, Pangolin, three species of Microchiroptera, Leopard Cat, Small toothed ferret badger and common otter. In the case of avian fauna, 21 new additional bird species have been recorded. The notable species are such as Gray-headed fishing eagle, Blue- bearded bee- eater, Pale headed wood packer, Dusky warbler, Bluethroat, Taiga flycatcher, Cotton Pygmy Goose, Wood sandpiper, Pheasant tailed Jacana, Common Coot, Rosy pipit, Little spider hunter, Red headed marlin, Black winged kite, Eastern Marsh Harrier, Hen Harrier,

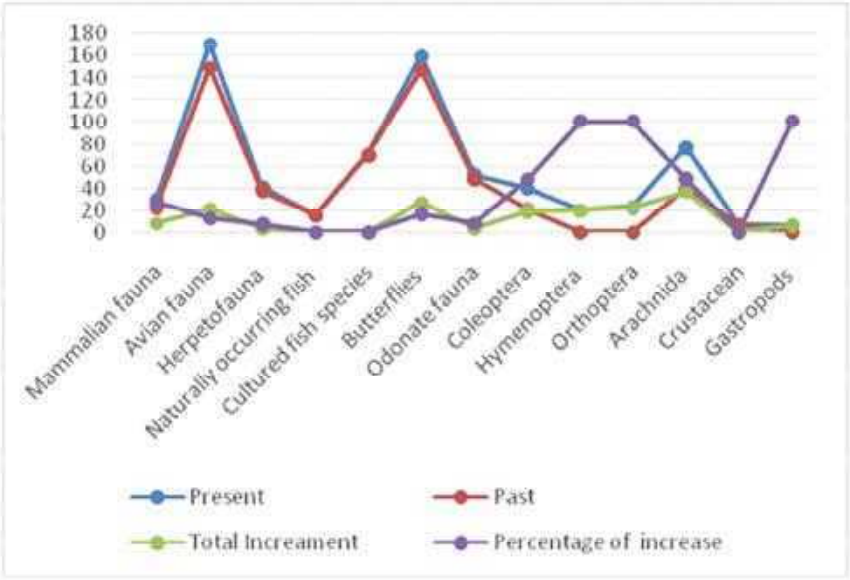

Fig. 13: Graph shows the comparison of different faunal groups, total incremental species and their percentage in the GU campus during 2018-19 and 2019-20.

Pallid Harrier etc. Among herpetofauna, 10 amphibian species, 11 snakes, 12 lizards and five turtles were recorded in previous report and now Assam Roofed Turtle, Himalayan keelback and Banded krait are three new species added to the list. Presently, altogether 15 indigenous fish species have been successfully breed in captive condition at the aquaculture and biodiversity canter of GU, these are such as Channa andrao, Channa stewartii, Danio dangila, Esomus danrica, Garra annandalei, Garra gotyla, Pethia shalynius, Puntius chola, Ctenops nobilis, Devario aequipinnatus, Microphis deocata, Tariqilabeo latius, Ompok pabda, Clarias magur, Heteropneustes fossilis. Among butterflies, 13 new species were included in the report viz., Golden birdwing, Common batwing, Yellow helen, Blue Pansy, Angle red forester, Blue admiral, Orchid Tit, Common banded Owl, Banded Ace, Tiger Hooper, Stripped Dawnfly, Rice swift and Small Dartlet. Among Odonata, four new species, in Coleoptera, 19 new species, in Arachnidae one Scorpion and 36 spider species, were newly incorporated in the present report. Orthoptera, Hymenoptera and Gastropodan species were not observed earlier and presently 23, 20 and six species were recorded respectively.

Photoplate:1: Some representative wildlife species present in GU Campus

Common palm Civet
(Camera Trapped)

Small Indian Civet Cat
(Camera Trapped)

Black-crowned Night heron

Lesser caucal

Pheasant tailed Jacana

White Rumped Vulture

Grey-headed Fish eagle

Oriental darter

Photoplate:2: Some representative wildlife species present in GU Campus

Flat tailed Gecko

Burmese Python

Ctenops nobilis

Pipe Fish

Menemerus bivittatus

Oxyopes birmanicus

Oxyopes Shweta

Striped Blue Crow

Angle Pierrot

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 a vulnerable category of IUCN Red List. Whereas, 4 endemic species and 17 schedule-I species of wildlife (Protection) Act 1972 are also been recorded till date (Table 6).

Table: 6. 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	
26		Python Molurus	Lower Risk	Schedule-I	
27		Indian tent Turtle	Least concern	Schedule-I	

28		Indian Softshelled Turtle	Vulnerable	Schedule-I	
29		Peacock Softshelled	Vulnerable	Schedule-I	
30		Spotted Pond Turtle	Endangered	Schedule-I	
31	Fish	Frail Gourami	Near Threatened	---	Endemic
32		Fresh water Pipe Fish	Near threatened	--	Endemic
33		Clarius magur	Endangered	--	
34		Shalyni	--	--	Endemic

Floral diversity

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

Recently introduced plants in the GU Botanical Garden

Sl. No.	Name	Family
1	*Costus igneus* N.E.Br.	Costaceae
2	*Musa rubra* Wall. ex Kurz	Musaceae
3	*Dendrobium densiflorum* Lindl.	Orchidaceae
4	*Dendrobium fimbriatum* Hook.	Orchidaceae
5	*Rhynchostylis retusa* (L.) Blume	Orchidaceae
6	*Arundina graminifolia* (D.Don) Hochr.	Orchidaceae
7	*Aerides odoratum* Reinw. ex Blume	Orchidaceae
8	*Codariocalyx motorius* (Houtt.) H.Ohashi	Papilionaceae

RET Plants maintained

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

The plants added to the GU campus flora during 2019-20

Sl. No	Family	Name	English Name	Vernacular Name	Habit
1	Orchidaceae	*Dendrobium densiflorum* Lindl.	Pineapple orchid		Epithytes
2	Orchidaceae	*Dendrobium aphyllum* (Roxb.) C.E.C.Fisch.			Epithytes
3	Orchidaceae	*Dendrobium fimbriatum* Hook.			Epithytes
4	Orchidaceae	*Rhynchostylis retusa* (L.) Blume	Foxtail orchid	Kopou	Epithytes
5	Orchidaceae	*Arundina graminifolia* (D.Don) Hochr.			Epithytes
6	Orchidaceae	*Aerides odoratum* Reinw. ex Blume			Epithytes
7	Orchidaceae	*Cymbidium aloefolium* Blume			Epithytes
8	Orchidaceae	*Papilionanthe teres* (Roxb.) Schltr.			Epithytes
9	Costaceae	*Costus igneus* N.E.Br.			Herb
10	Taxaceae	*Taxus baccata* L.			Tree
11	Euphorbiaceae	*Trewia nudiflora* L.			Tree
12	Lecythidaceae	*Couroupita guianensis* Aubl.		Nag Champa	Tree
13	Papilionaceae	*Butea monosperma* (Lam.) Taub.	flame-of-the-forest	Polakh	Tree
14	Bignoniaceae	*Spathodea campanulata* P.Beauv.	African tulip tree, fountain tree, pichkari or Nandi flame		Tree
15	Balsaminaceae	*Impatiens tripetala* Roxb. ex DC.	balsam	Dem-deuka	Herb
16	Musaceae	*Musa rubra* Wall. ex Kurz			Herb
17	Mimosaceae	*Albizia procera* (Roxb.) Benth.		Koroi	Tree
18	Papilionaceae	*Codariocalyx motorius* (Houtt.) H.Ohashi	Telegraph Plant		Shrub
19	Acanthaceae	*Justicia adhatoda* L.	Malabar nut, adulsa	Vasaka	Shrub
20	Acanthaceae	*Thunbergia coccinea* Wall.			Climber
21	Asparagaceae	Sansevieria trifasciata Prain	Snake plant		Herb
22	Anacardiaceae	Semecarpus anacardium L.f.	marking nut tree, phobi nut tree and varnish tree		Tree
23	Apiaceae	*Centella asiatica* (L.) Urb.	Indian pennywort or Asiatic pennywort	Bor Manimuni	Herb
24	Araceae	*Caladium bicolor* (Aiton) Vent.			Herb
25	Arecaceae	*Caryota urens* L.	solitary fishtail palm		Tree

Existing snags (wildlife tree) in GU campus and their use by different wild animals

Snags mean dead trees found in natural habitat, which is also known as a wildlife tree. It has great importance as it is the home for various wild animal species starting from wild mammals to insects. Dying trees, standing dead trees(snags) and downed woody material have numerous ecological functions and contribute to structural complexity and biodiversity within forests (Harm et al., 1986; Franklin, 1988).

An extensive survey in Gauhati University campus found altogether 48 Snags of which 14 were observed in Aquaculture and biodiversity Centre and the neighboring area, 3 in Girl's hostel campus, 21 in roadside areas like near GU main gate, GU market area, in front of GU SBI, Infront of GU Arts Building, in front of +Law department, in K.K. Henrique Library garden, in front of the Commerce Department, in Zoology department garden, in front of Statistics department & in front of Bodo department) and 10 snags in Botanical Garden.

All these available snags area home of different animal species like Hoary-bellied Squirrel, Spotted Owlet, spotted dove, Common myna, Rose ringed parakeet, Grey headed Myna, Blue throated barbet, Lesser Himalayan Flame backed Woodpecker, Gecko, House lizard, different species of Snakes, spiders, scorpions, ants, termites, moths, beetles' caterpillars etc.

Different snags present in GU campus

Different snags present in GU campus

Existing ficus trees in GU campus and their use by different wild animals

The study found altogether 109 individuals of Ficus plants belonging to 7 different species viz., *Ficus religiosa*, *Ficus benghalensis*, *Ficus rumphii*, *Ficus altissima*, *Ficus elastica*, *Ficus racemosa* and *Ficus hispida*. distributed throughout the Gauhati University Campus (see distribution map of Ficus tree; Fig. 14) . Study found altogether 42 different species of birds species in 109 different individual Ficus trees. The main activities of the birds are feeding, roosting, nesting etc. throughout the days and season.

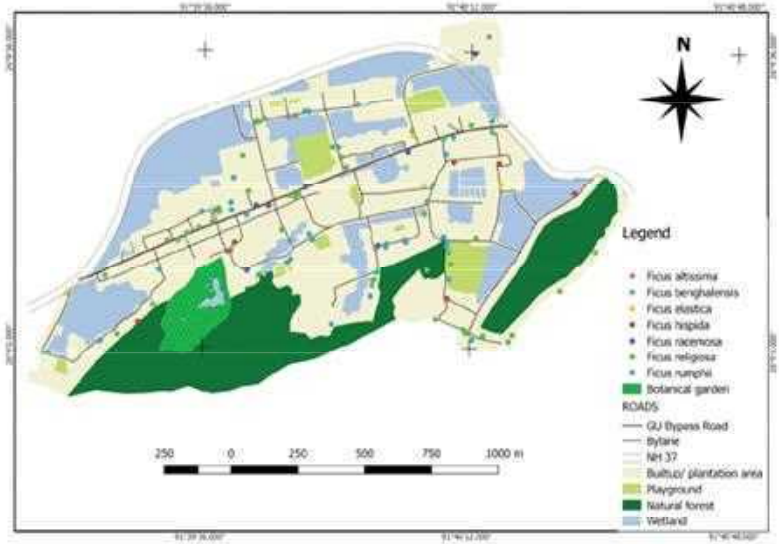

Fig. 14: Distribution map of different *Ficus* trees in Gauhati University campus
Photo plate-4: Representative *ficus* species present in GU campus




Observations

- A lush green environment with rich floral and faunal diversity is the fascinating characteristic of the Gauhati University Campus
- Non-scientific plantation as well as trimming of existing trees was observed.
- Increasing of invasive species was a matter of concern.

Suggestions and Recommendations

- A green environment is to be maintained.
- Wetlands be conserved and maintained.
- More organized plantation program with continuous monitoring is to be organised to increase total greenery in the campus.

Summary

Green auditing is the process of identifying and determining whether the practices of the Institution are eco-friendly and sustainable. The Gauhati University hence, conducted the third "Green Audit" for the year 2019-2020 with a primary objective to prepare a statement on the green practices followed by the university and to conduct a well-formulated audit report.

Green auditing 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 etc. The audit team monitored different facilities at the University campus, determined different types of appliances and utilities (Water cooler, taps, toilets, lights, fan, ACs etc.) as well as measuring the usage per item (Watts indicated on the appliance or measuring water from a tap) and identifying the relevant consumption patterns (such as how often an appliance is being used) 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 also through questionnaires in different sectors such as water, energy, waste, biodiversity status. 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 collated and analyzed to prepare this audit report of GU.

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. It was found that a total of about 76.37 acres (~16.0% of total) were under the built-up category, of which Assam type residential units, hostels, and administrative units form a significant part. It is a matter of concern that a few of the wetlands have been observed to be silted up and presently under a thick cover of grass and aquatic weeds. Forested areas are also found to be reducing.

Water auditing is conducted for the evaluation of facilities of raw water intake and determining the facilities for water treatment and reuse. A total of 275000 L of water is pumped out from the PHE water storage tanks every day for the university dwellers as well to meet the daily demands of the academic and administrative Departments. The daily use of the water during 2019-2020 was approx. 249500 L per day. The potable water quality is within the standard limits. Though the potable water supply system was suitable, the GU does not have a reusable water treatment facility for wastewater generated from laboratories, canteen, hostel kitchen, toilets, bathrooms and office rooms which need attention.

The auditor diagnosed the prevailing waste disposal policies and suggested the best way to combat the problems. It has been estimated that on average, various stakeholders generate 224 kg of different types of solid waste per week respectively. The investigation also revealed that 19 Academic Departments of the University have a total of 185 numbers indoor dustbins installed for solid-waste disposals. In average terms, each of these departments has a provision of <"10 dustbins. The Departments of Geology, Botany, HRDC and GUINEIS further maintain bio-degradable and vermi-compost facilities. The teacher's quarters maintain on an average 2 personal dustbins for solid-wastes disposals and also a pit for the dumping of organic wastes. Daily cleaning is in practice for all the Departments and special cleaning drives are initiated periodically by the students and faculty of a few departments to imbibe and foster GO-GREEN culture on the campus. It was also noted that solid-waste recycling was not practiced in either of the sections, formally or informally. While the centralized system of solid-waste management involves timely and periodic lifting of the disposed of wastes by the Guwahati Municipal Corporation, it is laudable that proper waste management including composting initiatives has been adopted by some hostels, Departments and residential quarters. However, the need for a formal and centralized system for land ûlling and composting ought to be adopted in the University.

During a survey carried out among the faculty members of Gauhati University by the Green Audit Committee, a majority of the respondents (91.5%) were confident about their understanding of hazardous waste and their obligation in disposing of material, but, many respondents were also unaware (37.1%) of the green initiatives taken by Gauhati University to manage hazardous waste. The survey recorded that the disposal of this waste was primarily through the garbage pickup but on a few occasions, such items were also stored for later disposal (9-12.5% in cases of household/office cleaners, paint products and pesticides). It could be mentioned here that the Incinerator installed in the Campus is not working at present.

In order to encourage students to respect the environment and think about conservation, a Swachhata Program was organized jointly by Gauhati University and Indian Oil Corporation along with other 5 Environmental awareness/plantation programmes during 2019-2020. WED was celebrated by Different Academic Departments with their students.

The Energy and electricity audit was also conducted with an aim to cover the aggregate consumption of Electrical and Natural gas energy within the Gauhati University campus including academic and administrative blocks. On average, 3, 14,853 units per month of electricity was consumed by the University in the year 2019-20 including the residential quarters which is slightly lesser of around 0.4% monthly average electricity consumption

from the last year. To compensate for the rising power requirement, solar panels are installed within the GU campus. Annually, GU has generated 288000 KWH of electrical energy through the solar panels. In the last two years, GU campus was augmented with a 100 KWP new solar panel.

To monitor the air quality in the University campus, three parameters namely Particulate Matter (PM 10), sulphur dioxide (SO2) and nitrogen dioxide (NO2) were considered. The PM 10 in the University campus varied between 31.864 μg/m3 to 111.432 μg/m3 with an annual average of 70.23 μg/m3, which is higher than the permissible limits of CPCB Ambient Air Quality Standard (60 μg/m3). In the University Campus, the SO2 concentration varied between 5.8 μg/m3 to 7.9 μg/m3 with the annual average of 6.86 μg/m3 which was much below the CPCB permissible limit of 50 μg/m3. NO2 varied between 12.9 μg/m3 to 19.03 μg/m3 with an annual average of 15.54 μg/m3. This is much below the CPCB ambient air Quality permissible limit of 40 μg/m3.

Regarding average noise level, all sampling stations within the campus showed higher values than the maximum permissible limit of 50db(A) as recommended by the CPCB as well as by the WHO (35 dB) which is suitable for classroom teaching-learning environment in any Institution.

A lush green environment with rich floral and faunal diversity is the fascinating characteristic of the Gauhati University Campus. The biodiversity audit of Gauhati University hence is a continuous process to assess the living biota for many years. Various conservation practices are going on in the Gauhati University campus and as well as in its' associated natural ecosystems to minimize the anthropogenic impact on the biodiversity components and ecosystems. Spread over approximately 508.8 acres of land, the Gauhati University campus is 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. The increase of invasive species is a matter of concern in the Gauhati University campus in recent days.

In the end, it could be anticipated that this Green Audit Report will certainly assist in the process of attaining an eco-friendly approach to the sustainable development of the Gauhati University Campus. The results presented in the report contain some specific recommendations to be implemented to improve the existing environment-related practices of Gauhati University.

GREEN AUDIT REPORT

2019-2020

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