GREEN AUDIT REPORT
2020-2021

GAUHATI UNIVERSITY
Guwahati -781014| Assam | India

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গুৱাহাটী বিশ্ববিদ্যালয়
GAUHATI UNIVERSITY

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Foreword from Vice Chancellor

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 acomplete 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 of the site of establishment 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 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 2020-2021. 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 Green Audit Committee for their determined effort on the preparation of the report. I do hope the Green Audit Report, 2020-2021 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 2020-2021 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: 2020-2021", 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. Thanks are due to students and Research Scholars of Botany, Zoology and Animal Ecology & Wildlife Biology of GU 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, 2020-2021

Gauhati University Green Audit Committee
2020-2021

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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 48 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 3627 students enrolled in the PG courses at Gauhati University in the session 2020-2021 while as many as One lakh fifteen thousand students were enrolled in UG courses in the 306 affiliated colleges during 2020-2021. The University consistently ranks as one of the best universities in the region, ranking 45th among all Indian Universities (National Institutional Ranking Framework -2021).

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 73 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 ModiJi 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 also 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.

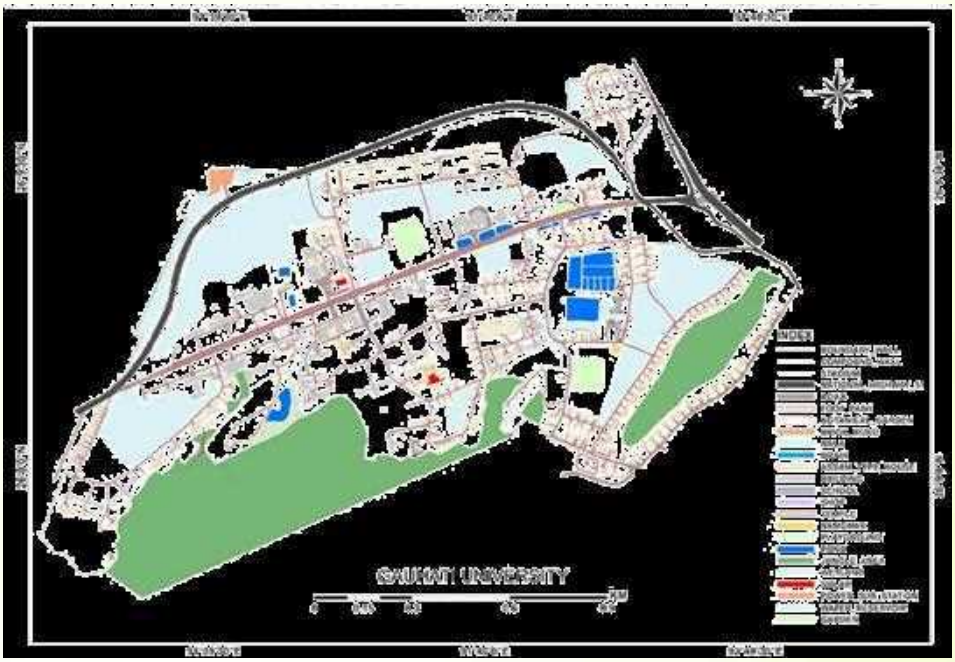


Fig 1: The Map of Gauhati University campus

It is found that a total of about 77.95 acres (~16.1% 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. One 6- storied residential quartersis coming up 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.
- While efforts have been made to restore the wetlands, further initiatives are required
- Roadside avenue trees lack attention and pruning should be carried out in a planned manner.
- 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 proper care and monitoring.

Water Audit

Auditing for Water Management

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 in the canpus. Water auditing is conducted for the evaluation of facilities of raw water intake and determining the facilities for water treatment and reuse. The concerned auditor investigates the relevant method that can be adopted and implemented to balance the demand and supply of water.

WATER QUALITY ASSESSMENT

The methodology adopted to conduct the Green Audit of the Institution had the following components. On site Visit Four day field visit was conducted by the Green Audit Team . Questionnaires were circulated in different stakeholders to know about the various uses of water. The water samples from main tanks were taken by PWD of GOVT of Assam and analysis were done in the scientific manner as prescribed by the standard procedures by them.

Water samples from storage tanks were collected at monthly intervals and analyzed for for various physio-chemical parameters in the PWD laboratory of Assam. The major parameters analyzed include dissolved oxygen, acidity, alkalinity, chloride, hardness, pH, conductivity, total dissolved solids and salinity. The results are presented in the Table 2. The results are comparable with the values of drinking water standards prescribed by different agencies.

Table2: Water quality assessment Chemical analysis report

Sl No	Parameters	Source River Brahmaputra
1	Iron (mg/l)	0.12-0.26
2	Alkalinity (mg/l)	76-156
3	Turbidity (N.T.U)	0
4	Calcium Hardness ()	10-14
5	Total Dissolved Solids(mg/l)	20-32
6	Sulphates (mg/l)	0
7	Chloride(mg/l)	1-8
8	Fluoride (mg/l)	0.18-0.30
9	Total Hardness (mg/l)	60-120
10	Residness 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

WATER MANAGEMENT

The main source of water use in the campus is the underground deep tube well. A total of 265000 L of water is pumped out from the well every day (Table 3). Wastage of water from the lab is reduced by adopting microscale analysis. An average of 2,13,000 L of water is used by the University per day.

Table 3: Data on Water source and used

Sl no	Parameters	Response	Remarks
1	Source of water	surface water from river **Brahmaputra**	Other source: Underground from Deep Tube well.
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	Water level		
7	Type of water tanks	Reserver	
8	Capacity of Tank/ reserver (Total)	941000 ltrs	
	Quantity of water pumped every day	265000 ltrs per day	
	Any water wastage/why?	Yes, wastage of water is seen mainly • *leakage in old pipes* • *overflow of water tanks* • *Leaked water taps* • *Lack of awareness for saving water - improper use of water taps , leaving tap running after use.*	
	Water usage for gardening	4200 ltrs per day	
	Use of waste water	For gardening and recharge of water bodiesl	
	Fate of wastewater from labs	Waste water from a few labs are neutralized and discharged into covered pits	
	Any wastewater treatment for lab water	No	
	Whether any green chemistry method practiced in labs	No	
	Rain water harvest available?	Yes	
	No of units and amount of water harvested	One ; 4500 ltrs	
	Any leaky taps	Few	Regular monitoring is a best practice
	Amount of water lost per day	500 liter	
	Any water management plan used?	Awareness and display of card	
	Any water saving techniques followed?	Substantially less	
	Are there any signs reminding peoples to turn off the water?	Yes	

KEYS FINDINGS AND OBSERVATION:

a. Main water uses in the campus

- Drinking purpose
- Toilets and wash areas hostels, canteens, departments, centre, offices,
- Labs
- Gardening and agriculture
- Construction purpose
- Cooking purpose in hostels and canteens

➢ No water treatment system in place

➢ Water cooler and drinking water filtration is installed (numbers 80)

➢ Nos. of urinal and toilets -250

➢ Nos. of waterless urinals - nil

➢ Nos. of water tap - 1625

➢ Nos. of ponds – 20

➢ Nos. of smaller water tanks for water storage – 420

Reasons for water hostage:

Leakage from tap

Over uses of water

Overflow of water from over uses of tanks

Table 4: Overall utilization of water in the university

Sections	Water use/day
Hostel	40000
Resident quarter	50000
Administrative block	4000
Canteen	8000
Departments	50500
Gardens	5000
Laboratories	12000
Drinking	5000
Leakage	2000
Construction work	8500
Urinals and Toilets	28000
Total	213000

SUGGESTIONS AND RECOMMENDATIONS

There is no water consumption monitoring system in the UNIVERSITY campus.

- The UNIVERSITY does not have waste water treatment for waste water generated from laboratories, canteen, hostel kitchen, toilets, bathrooms and office rooms.
- The waste water from laboratories, canteen and kitchens are not suitably controlled and are not fully for gardening.
- The UNIVERSITY has to take actions to strengthen rain water harvesting. Rain water harvesting for separate buildings are lacking. Measurement of quantity of water obtained from the rain water harvesting should be done.

Suggestions of the UNIVERSITY to save water

- Rain water harvesting systems should be implemented.
- Posters could be placed at the wash areas as well as toilets to make the students aware about the value of water resources.
- The water over flowing from the tank should be collected and reused for gardening or any ther purposes.

- Automated sensors can be installed in order to prevent the over flow of water from tanks.
- Awareness campaigns can be held in the campus for the students to save water.
- Automated taps could be used so that usage of water can be reduced.
- Awareness campaigns can be conducted among students.
- Periodical maintenance of water taps should be done in order to prevent the leakage of water through taps.

AUDITING FOR WASTE MANAGEMENT

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 to 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 be divided into three categories: bio-degradable, non-biodegradable and hazardous waste. 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 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 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.

SOLID-WASTE MANAGEMENT

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 suûcient data from the administrative oûces' section. On average, various stakeholders generate 224 kg of different types solid waste per week respectively. (Table 5)

SL.NO.	STAKEHOLDERS	TYPES OF SOLID WASTE	AVG WASTE GENERATED/WEEK (kg)	%
1	Academic department	Paper waste	10	36.40
		Plastic waste	5	18.18
		Organic waste	12	43.60
		E-waste	0.5	1.81
2	Administrative office	Paper waste	12	47.05
		Plastic waste	3	11.76
		Organic waste	10	39.21
		E-waste	0.5	1.96
3	Hostels	Paper waste	6	13.01
		Plastic waste	10	21.73
		Organic waste	30	65.20
		E-waste	0.1	0.22
4	Teacher flat/residential quarters	Paper waste	36	38.58
		Plastic waste	12	12.86
		Organic waste	45	48.23
		E-waste	0.3	0.32
5	Canteens	Paper waste	3	15.38
		Plastic waste	1.5	7.69
		Organic waste	15	76.92
		E-waste	-	-
		TOTAL	211.9 kg/week	

WASTE MANAGEMENT

In order to avoid the use of plastic in the campus, and to encourage the use of biodegradable materials as alternatives to achieve the goal of plastic free campus, a few steps were undertaken. A portion of the Leaf litters from the campus were effectively used for aerobic/ vermi composting, the composted material were used as manure. It is known that recycle of paper waste instead of incinerate or burning where an Institution can look into. Furhter, management of solid-waste is one area where every all stakeholders are more-or-less aware of the issues involved. Each of these sections/ stakeholders have 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 GUINES 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 dumping of organic wastes.

• 42% of the Academic departments and 50% of residential quarters maintain separate disposal systems for dry and wetwaste. • the culture of separating bio-degradable waste from non-biodegradable ones is prevalent in the teacher's quarters and in 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 is land ûlled and composted

• Similarly, only 50% of hostels have adopted land filling 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 practised 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 have been adopted by various 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

MANAGEMENT OF HAZARDOUS WASTES IN GAUHATI UNIVERSITY

This section identifies the problems encountered in managing hazardous waste from the various academic departments and residential quarters of Gauhati University and discusses the feasibility and availability of methods to manage such waste.

Problems related to hazardous waste handling

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:

1. 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)
2. The University has large numbers of independent hazardous waste generation points that produce variable waste streams.
3. Educational institutions are subject to budgetary and management constraints that limits the effectiveness of a waste handling system, which may be reflected in inadequate funds for waste management programs and staff.
4. 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.
5. The transient nature of student populations makes it difficult to educate students and to identify waste streams.
6. Failure to identify minor waste streams (for example, from commercial establishments within the campus)

Waste identification

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 Transboundary Movement) Rules, 2008" were promulgated. These rules were

further amended in the year 2009 & 2010 for proper management and handling of hazardous waste in the country (CPCB, 2010-2011).

These regulations sometimes require detailed knowledge of constituents and properties of wastestreams so they can be managed properly. At the institutional level, this can be difficult because:

- The large number of sources of waste generation results in a variable multi-component waste stream.
- A detailed analysis of each waste container can become very costly, with analysis costs sometimes exceeding disposal cost.
- Also, such record-keeping requires a great deal of time and paperwork for both the Institution and the waste handler, because of the highly variable waste stream.

The above discussion assumes that the stakeholders know that the material generated is a hazardous waste. 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. 1**).

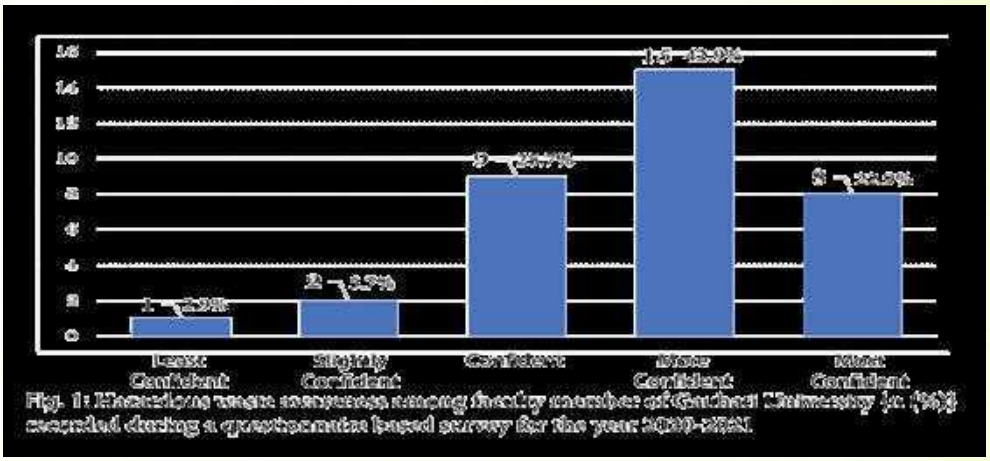
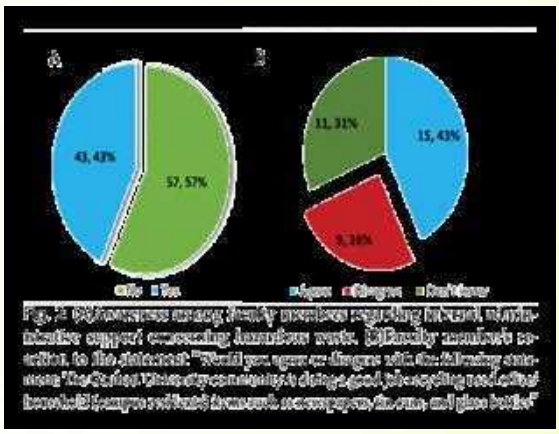


Fig. 1: Hazardous waste awareness among faculty members of Gauhati University (in %) recorded during a questionnaire based survey for the year 2020-2021.

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 disseminate information on hazardous materials being used in the facility. The dissemination of information can involve discussions on reactivity and potential health effects.



Data from the survey carried out by Gauhati University Green Audit Committee reveals that,despite understanding hazardous waste; a majority of the respondents were uncertain of relevant support in case they had queries regarding hazardous waste (**Fig. 2A**). Many respondents were also unaware(26.0%) of the green initiatives taken by Gauhati University to manage hazardous waste (**Fig. 2B)**. Awareness has improved in comparison to our previous report (2020-2021).

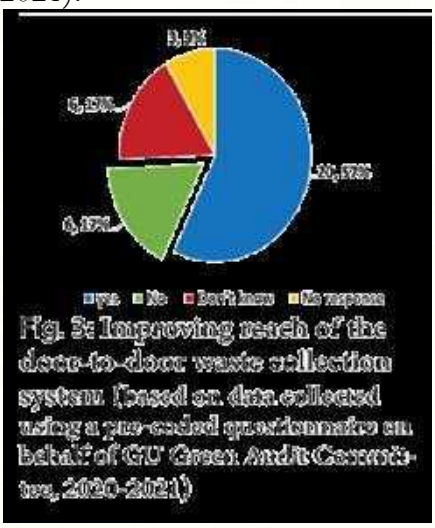


Fig. 3: Improving reach of the door-to-door waste collection system. (based on data collected using a pre-coded questionnaire on behalf of GU Green Audit Committee, 2020-2021)

The transportation of waste, including hazardous wastes, occurs within the and off the university property to an approved treatment facility. From the survey, it is evident that there is better collection and management of waste across the campus; but we must make improvements in the overall scenario (**Fig. 3**). Figure 3 shows that a considerable number of respondents (34%) feel that they either have no access or are unware 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. 4**)

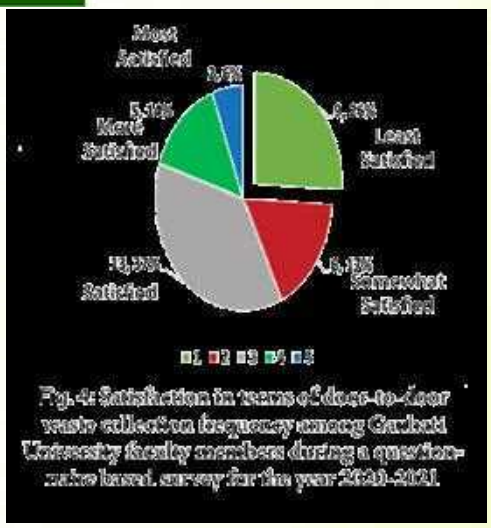


Fig. 4: Satisfaction in terms of door-to-door waste collection frequency among Garhwal University faculty members during a questionnaire based survey for the year 2020-2021.

The university faces several obstacles to ensuring disposal of hazardous wastes appropriately. 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 departments and the residential are also a manner of concern. Data from the survey shows that household batteries such as alkaline batteries were most frequently disposed (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 these waste was primarily through the garbage pickup, but occasionally such items were also stored for later disposal (9-12.5% in cases of household/office cleaners, paint products and pesticides). We must take caution while moving hazardous waste materials through campuses along public streets.

OBSERVATIONS

- There is an increasing awareness of hazardous wastes and their danger to environment and human health
- The incinerator is not working
- While there has been progress, disposal of biomedical waste is yet to be streamlined
- There is still rampant use of non-recyclable plastic in the campus.

Suggestions and Recommendations

- **Gauhati University campus is to be declared a plastic-free campus**
- The practice of using biodegradable materials should be encouraged
- Vermi composting facilities should be operationalized
- The incinerator installed in the campus is to be activated
- A centralized system for recycling paper could be adopted.

HEALTH AUDIT

A healthy ecosystem directly means a healthy livelihood. It aims to create awareness among more and more individuals to take certain actions against the growing strain on Earth's natural ecosystem. As such, the GU fraternity took the following initiatives through several events.

Awareness Programme on Swachhata on 16th -17th March, 2021 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 on 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 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, 2, 51,9440 units per month of electricity were consumed by the University in the year 2020-21 including the residential quarters. In the previous

year 2019-20, the average power consumption was 3, 77,8246 units per month. It has also been observed that there is a slight decrease of around33.0% in the monthly average electricity consumption during the current year which could be attributed to the lock down and the installation of solar panels in some specific zonesof the 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 but during the current audit it was observed that the production was reduced to 139000 KWH in the period 2020-21. In the current period, the GU campus was augmented with a 50 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 2260 numbers of LED bulbs and panels as compared to 272 numbers CFL and 6 numbers Halogen bulbs in various academic and administrative blocks. There were 264 numbers of AC (Air Conditioner) and 2414 numbers of Fan installed in the different academic and administrative blocks. On the other hand, on an average Rs. 1500/- 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.
- Solar Panels at GUIST and IDOL were partially functional.

Suggestions and Recommendations

- Separate provisions for the recording of energy consumption should be installed in Hostels, Departments and Administrative buildings
- Solar power generated should be connected to the grid for efficient utilization.
- 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

For the analysis of air quality in the University campus, the data of Gauhati University Station of State Pollution Control Board (SPCB, Guwahati) has been used. Three parameters namely Particulate Matter (PM_{10}), Sulphur dioxide(SO_2) and nitrogen dioxide (NO_2) has been analyzed. The dataset for the University Campus of the study period is given in Table 1.

	PM_{10}	$S0_2$	NO_2
Oct,2020	61.20	6.00	13.07
Nov,2020	92.28	6.68	13.46
Dec,2020	183.64	6.43	13.72
Jan,2021	142.67	6.08	14.28
Feb,2021	152.88	6.20	13.86
Mar,2021	202.64	6.54	13.91
Apr,2021	165.94	6.53	13.14
May,2021	141.85	6.35	14.32
Jun,2021	79.88	6.38	12.69

****All concentration units are in µg/m$_3$**

Table 6: Average Monthly variation of PM_{10}, SO_2 and NOx

Particulate Matter (PM10):

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 PM10 might be the dust from construction, motor vehicles and waste burning. The PM10 in the University campus in the study period varies between 61.20 µg/m^{3}to 202.64 µg/m^3 which are higher than the permissible limits of CPCB Ambient Air Quality Standards (60µg/m^3). It is also observed that the PM_{10} is comparatively on a higher range

during the dry season. The concentration of PM_{10} in the ambient air decreases as (the rains starts from April which continues till the end the June. The lowest PM_{10} is observed during the peak monsoon season. The monthly variation of PM_{10} is given in Fig 1.

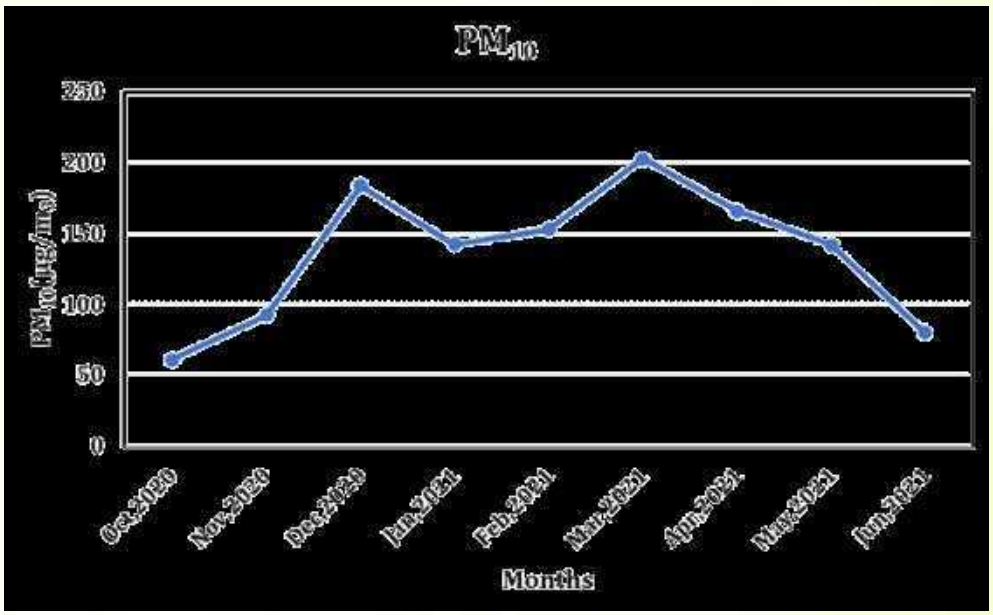


Fig 1: Monthly variation of PM10 in the University Campus during the study period.

However, since PM_{10} is a larger particle than PM 2.5, it is less likely to be absorbed by the bloodstream and therefore less dangerous. Its effects are primarily of concern to children, the elderly, and people with chronic lung disease.reduces visibility and, in some cases, has the ability to corrode organic and inorganic materials.

Sulphur Dioxide (SO_2):

SO_2 is the component of greatest concern and is used as the indicator for the larger group of gaseous sulfur oxides (SOx). In the University Campus the SO_2 concentration during the study period varies between 5.9µg/$m^3$to 6.7µg/m^3 which are much below the CPCB permissible limit of 50µg/m3. So, the University campus can be called a zone which does not have SO_2 pollution. Moreover, the good green canopy cover which is present in the campus also contributes a lot in the absorption of SO_2 by these green members.

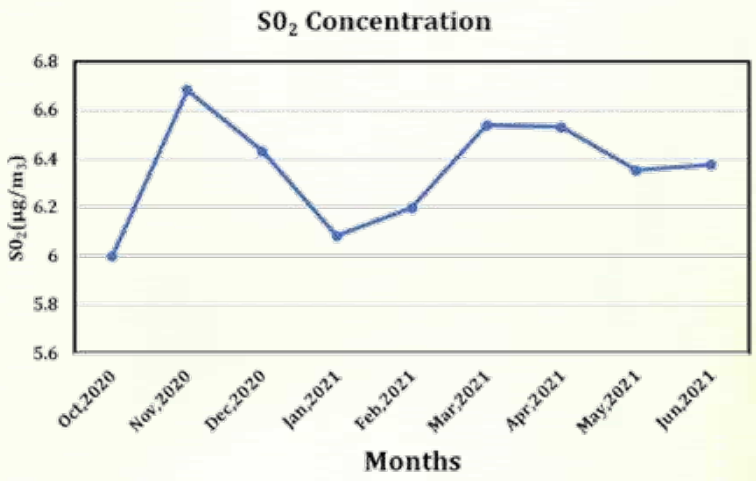


Fig 2: Monthly variation of SO_2 in the University Campus during the study period

Nitrogen dioxide (NO2):

(NO_2) as a surrogate for this family of compounds because it is the most prevalent form of NOx in the atmosphere that is generated by 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. During the study period, in the University campus the NO_2 varies between 12.69 µg/m^3 to 14.32 µg/m^3 which are much below the CPCB ambient air Quality permissible limit of 40 µg/m^3

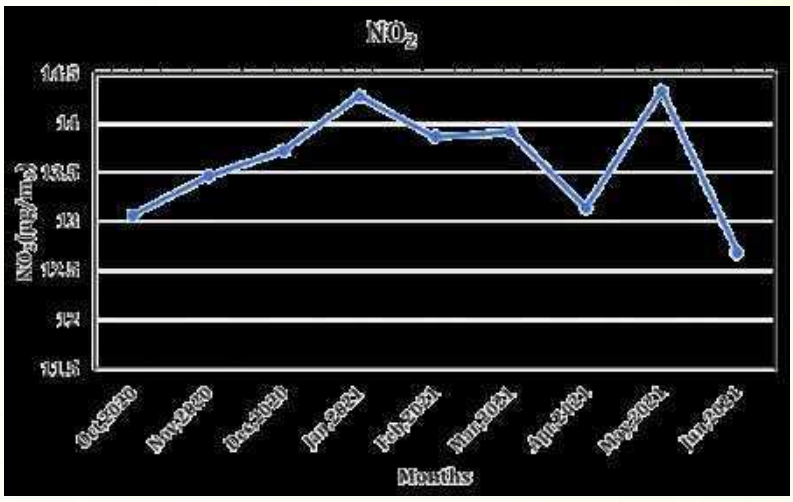


Fig 3: Monthly variation of NO_2 in the University Campus during the study period

Conclusion: Hence we can conclude that except for PM 10, the concentration of SO_2 and NOx was well within the permissible limits. The PM10 will subsequently subside as the construction works are completed.

VEHICULAR MOVEMENTS

It was estimated that around 30265 numbers of vehicles (including vehicles coming to Bank, Police station & Post Office) visited the GU Campus in general days per month during 2020-21 excluding the vehicles of campus dwellers.

The Highest numbers (about 32,567) were recorded in the peak academic months during September and October 2020. 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 mitigationof the air pollution in the campus. Visitors vehicular traffic was also restricted in the campus between 4.30 – 7.30 am and 5.00 pm-7.00 pm during the said period. It was observed that 42% officers/teachers/students were using bycycles for communication, while 22% used motocycles and 32% preferred to use four wheelers.

AMBIENT NOISE LEVELS

Ambient Noise Levels at GU Campus:

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 noise from the industrial sources.As far as community noise is concerned the WHO guidelines recommend less than 30 dB(A) in residential area and less than **35 dB(A) inclassrooms, which is important for good teaching and learning conditions.**

In GU campus, noise levels were measured using a Sound Level Meter (Model: Envirotech SLM 100; Type II dbA). Noise level measurements were carried out at 6 sampling stations on 10/11/2021 during the daytime. The sampling locations along with the Leqdata for each station is tabulated below:

Sampling Locations	Category Type	Leq (10-12noon	Leq (12 noon -2pm)	Leq (2pm -4pm)	Daytime limit of Leq
G.U. Entry Gate (Jalukbari)	Commercial	65.5	67	70	65
G.U. Market Area	Commercial	57.3	61.7	62.7	65
AT-8 Boys' Hall	Residential	50.1	48.3	57.1	55
Administrative Block	Silence	50.4	64.6	61	50
GU Hospital	Silence	45.8	44	45	50
K.K. Handiqui Library	Silence	46	46.3	46.1	50

Table 7: The sampling locations along with the Leqdata for each station

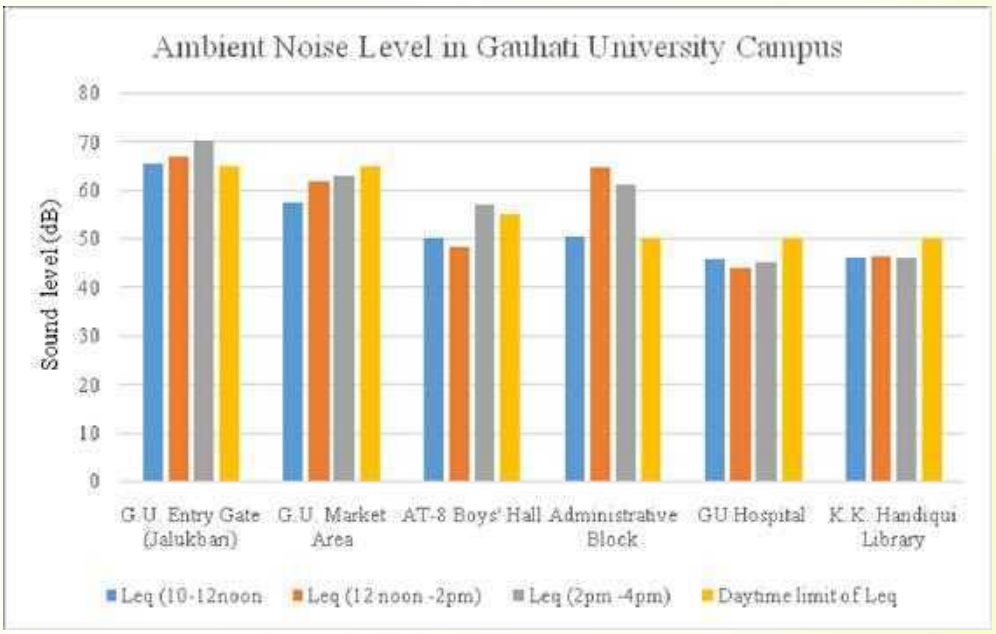
As per the CPCB guidelines, the maximum permissible limits in dB(A) Leq for day time and night time are as follows:

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

The Nosie Level of the six locations which were selected for the assessment are given in Table 1. It is observed that the highest noise level is found in GU Entry gate (70dB) followed by GU market (62.7 dB). The GU Entry Gate is a dense traffic area and also the junction point of flyovers. Thus the elevated noise can be attributed tovehicular movement. This is slightly higher than the CPCB permissible limit. 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 congregation of large number of people for official works alongwith large number of vehicular movements in and out

of the block. In rest of the sampling points, the sound level is well within permissible limit. The lowest is recorded in GU Hospital (45.8dB) and K.K. Handique Library (46.3 dB).



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.

Suggestions for mitigating noise pollution:

i. Noise attenuation by planting noise absorbing vegetation around buildings.

ii. Extensive plantation of trees on the roadsides, particularly the National Highway

iii. Use of noise-absorbent materials in the departments and offices

iv. Installation of adequate noise barriers around the University campus

Government authorities should be requested to monitor the use of loudspeaker, and noise producing sources outside the University campus so as to ensure compliance with prescribed rules.

BIODIVERSITY AUDIT

INTRODUCTION

Biodiversity audit of Gauhati University is a continuous process and has been done by the efforts of the faculty members, researchers, and the students to assess the living biota. Its conservation has been going on for a long time and also various conservation practices have been initiated in Gauhati University Campus and as well as in its' adjoining natural landscapes to minimize the anthropogenic impact on the biodiversity components and ecosystems. The scientific information and existing database are based on various systematic studies as well as research works done by students and research scholars of both Zoology and Wildlife Science course of the departments of Zoology and Department of Botany of 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 on the campus. Different conservation measures also have been taken for a better and self-sustaining ecosystem on the campus. 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 to check the new addition and analysis of biotic interactions amongst different components of biotic resources.Spread over approximately 508.8 acres of land (as per land record), the Gauhati University campus is home to different varieties of fauna as well as flora. A recent audit found increasing trends of most of the biotic components in the GU campus probably due to the

enhancement of suitability and succession of the habitat mosaic supported by the existing land cover. 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 reasonable number of **IUCN** threatened and **IWPA 1972** Schedule-I species and as well as endemic species. Detailed information has been incorporated within the report.

FAUNAL DIVERSITY OF GU CAMPUS

The present audit started from July **2020** and continued till March **2021** and study documented altogether 14 different major groups of animal components in the Gauhati University Campus. Of which, 33 species of mammals, 180 species of birds, 44 species of herpetofauna, 16 species of free ranging and 74 species of cultured fish, 180 species of butterflies, 58 species of Odonata, 50 species of Coleoptera, 30 species of Hymenoptera, 30 species of Orthoptera, 89 species of Arachnida (88 spiders and 1 scorpion), 9 species of crustacea and 7 species of Gastropods, 3 species of Chilipoda and 5 species of Annelida are recorded.

Major faunal groups	Recorded Species from July 2020 to June 2021	Recorded Species from July 2019 to June 2020	Total Incremental species	Percentage of species increase in each group
Mammal fauna	33	30	3	10
Avian fauna	180	170	10	5.88
Herpeto fauna	44	41	3	7.32
Free ranging fish	16	15	1	6.66
Cultured fish	74	70	4	5.71
Butterflies	180	160	20	12.5
Odonata	58	52	6	11.54
Coleoptera	50	40	10	25
Hymenoptera	30	20	10	50
Orthoptera	30	23	7	30.43
Arachnida	89	77	12	15.58
Crustacean	9	7	2	28.57
Gastropods	7	6	1	16.67
Chilipoda	3	0	3	100
Annelida	5	0	5	100

Table: 8: Table shows the comparisons of different groups of biodiversity in the Gauhati University campus between the year 2020-21.

(Biodiversity data have been compiled by **Dr. Malabika Kakati Saikia & Prof. Prasanta Kumar Saikia.** Fish data has been provided by **Prof. Dandadhar Sarma & Mr. Hrishikesh Chaudhury**)

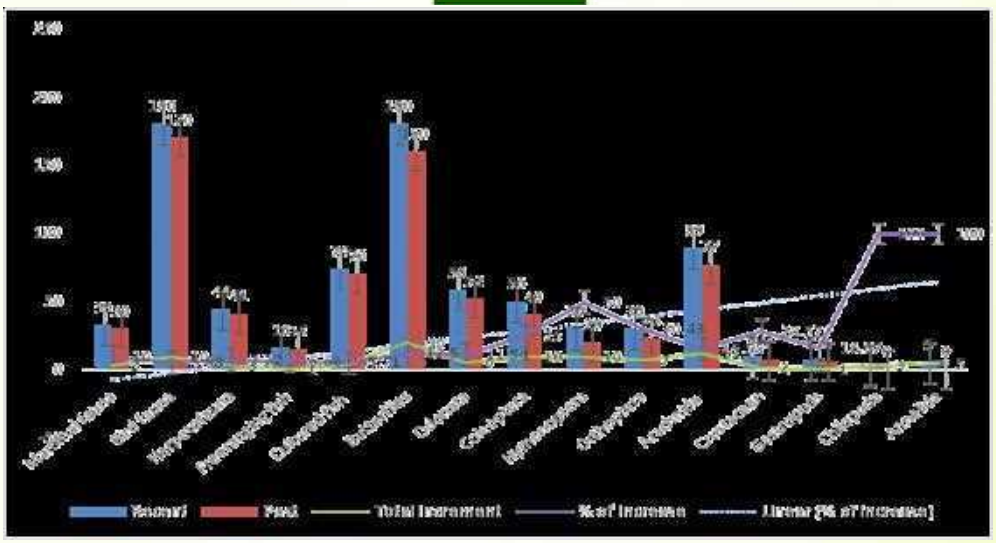


Figure.1: Graph shows the comparison of various biodiversity groups, total incremental species and their groupwise percentage of increase in the Gauhati University campus in the year 2019-20 and 2020-21 (analysis was done based on year-wise data collection).

In addition to past data of 30 mammal species, present study added three incremented species that includes **Crab-eating Mongoose, Golden Jackal** and **Yellow throated martin.** In case of avian fauna, altogether 10 new additions to the bird species list of GU campus. The notable species are such as Blue-bearded bee-eater, Pale headed wood packer, Dusky warbler, Bluethroat, Pheasant tailed Jacana, Common Coot, Rosy pipit, little spider hunter, Red headed marlin, Black Winged kite, Eastern Marsh Harrier, Hen Harrier, Pallid harrier, Griffon Vulture, Red-headed Vulture.

Among herpetofaunal diversity, 11 amphibians, 12 snakes, 13 lizards and five turtle species were recorded so far in the past report, whereas,recently, three new incremented species were found **viz**., Himalayan keel-back, Banded Krait and Assam Day Geckoo. Presently, altogether 15 indigenous fish species have been successfully breeding in captive condition at the aquaculture and biodiversity canter of GU, these are such as *China Andrea*, *Channa stewartii*, *Danio dangila*, *Esomusdanrica*, *Garraannandalei*, *Garragotyla*, *Pethiashalynius*, *Puntius chola*, *Ctenops nobilis*, *Devarioaequipinnatus*, *Microphisdeocata*, *Tariqilabeolatius*, *Ompokpabda*, *Clariasmagur*, *Heteropneustesfossilis*. Among butterflies, 20 new species were included in the report **viz**., Pasha, Common batwing, Hairstreaks, Blue Pansy, Angle red forester, blue admiral, Orchid Tit, Common banded Owl, Banded Ace, Tiger Hooper, Stripped Dawn fly, Rice swift and Small Dart let. Among Odonata, 6 new species, in Coleopteran, 10 new species, in Arachnidan, 12 spider species, Hymenoptera, 10 new species, Crustacean, 2 new species, Gastropods, 1 new species, Chilipoda, 3 new species, Annelid 5 new specieswere incorporated in the present report.

PHOTO PLATE:1: SOME REPRESENTATIVE MAMMAL AND BIRDS SPECIES PRESENT IN GU CAMPUS

Yellow Throated Martin(**Schedule-II**)

Common Iora- *Aegithina tiphia* Rose Ringed Parakeet-*Psittaculakrameri*

Large Cormorant-*Phalacrocorax carbo* Lesser Adjutant Stork-*L. javanicus*

Schedule -I sp. Fulvous-whistling teal **Schedule -I sp. Hill Myna**

Photoplate :2: Some representativesp of reptiles present in GU Campus

Garden Lizard-*Calotes versicolor Lygosomaalbopunctata*

Red-necked Keelback-*Rhabdophissubminiatus* Common Wolf Snake-*Lycodonaulicus*


Indian Eyed Turtle-*Moreniapetersi* Spotted Pond Turtle–*Geoclemyshamiltonii*


Assam Roofed Turtle

Peacock soft shell -Nilssoniahurum


Pierre's Cricket frog-*Fejervaryapierrei Common Tree Frog-Polypedatesteraiensis*

REPRESENTATIVE FISH SPECIES IN GU (ENDEMIC SPECIES)

Pethiagelius

Monopturuscuchia

Channa aurantimaculata

Danionellapriapus

REPRESENTATIVE SPECIES OF SPIDERS IN GU CAMPUS

Argeopesp. Neoosconanautica

Leucauge decorate

Camaricusformosus

REPRESENTATIVE OF BUTTERFLIES

Knight Butterfly Small Green Awlet- *Buraraamara*

Photo-credits:
Prof. P. K. Saikia, Dr. M. K. Saikia, Mr. Hrishikesh Chaudhury & Chiranjib Bora

ENDEMIC, IUCN THREATENED & IWPA-SCHEDULE-I SPECIES IN GU

Among all the vertebrate species found in Gauhati University campus, **3 are found to be critically endangered, 7 endangered, 4 vulnerable, 4 near threatened and 10 are least concern** as per IUCN Red list **Category**, whereas, are **18 schedule-I,** 4 schedule-II and 2 are Schedule-IV species as per the wildlife (Protection) Act, 1972. Again, there are **7** endemicnimalspecies have been recorded in Gauhati University campus till date(see table 2).

Table: 9. 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	Vulnerable	Schedule-I	
2		Chinese Pangolin	Critically Endangered	Schedule-I	
3		Himalayan Crestless Porcupine	Least concern	Schedule-II	
4		Slow Loris	Endangered	Schedule-I	
5		Small toothed ferret Badger	Least concern	Schedule-II	
6		Jungle Cat	Least concern	Schedule-II	
7		Leopard Cat	Least Concern	Schedule-I	
8		Fishing Cat	Vulnerable	Schedule-I	
9		Large Indian Civet	Least concern	Schedule-II	
10		Spotted Linsang	Least concern	Schedule-I	
11		Crab-eating Mongoose	Least Concern	Schedule-II	
12	Birds	Greater Adjutant Stork	Endangered	Schedule-IV	
13		Lesser Adjutant Stork	Vulnerable	Schedule-IV	
14		Marsh Babbler	Vulnerable	Schedule-I	Endemic
15		Slender-billed Vulture	Critically Endangered	Schedule-I	
16		White Backed Vulture	Critically Endangered	Schedule-I	
17		Hill Myna	Least concern	Schedule-I	
18		Large Whistling Teal	Least concern	Schedule-I	
19	Reptiles	Bengal Monitor Lizard	Near threatened	Schedule-I	
20		*Python molurus*	Near threatened	Schedule-I	
21		Indian tent Turtle	Least concern	Schedule-I	
22		Indian Soft-shelled Turtle	Endangered	Schedule-I	
23		Peacock Softshelled Turtle	Endangered	Schedule-I	
24		Spotted Pond Turtle	Endangered	Schedule-I	
25		Indian Eyed Turtle	Endangered	Schedule-I	
26	Fish	Frail Gourami	Near Threatened	---	Endemic
27		Fresh water Pipe Fish	Near threatened	--	Endemic
28		*Clariasmagur*	Endangered	--	
29		*Pethia shalynius*	--	--	Endemic
30		*Channa aurantimaculata*	-	-	Endemic
31		*Danionellapriapus*	-		Endemic
32		*Pethiagelius*	-	-	Endemic

RECOMMENDATION

1. The existing wet-grassland areas of GU campus are very suitable for endemic and as well as other residential and migratory bird species. Thus, it should be conserved in a properway to support more biodiversity in near future.
2. The existing forest habitat and aquatic ecosystem should be intact without any further alteration. Cutting down of any natural/ indigenous tree species and vegetations and filling up of the wetlands should be stopped to protect the biodiversity and pristine landscape.
3. Dead trees should not be cut down and allow them to use by the wild animals as their available roosting, nesting and food sources of various wild animals.
4. Open garbage damp/offering provisional food should not be allowed within GU campus to reduce Human wildlife conflict (**e.g.**Human-Monkey conflict) and to reduce various disease vectors.
5. Non-biodegradable/ Plastic materials should be cleaned from the low laying areas/wetlands within GU campus to maintain eco-friendly & healthy environment.

ACKNOWLEDGMENT

We like to acknowledge the students of Zoology especiallyAnimal Ecology and Wildlife Biology specialization and Wildlife Science in the Department of Zoology, GU and all faculty members, research scholars, who have contributed a lotduring the process of animal data collections during Biodiversity audit.

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 forth "Green Audit" for the year 2020-2021 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 77.95 acres (~16.1% 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 265000 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 2020-2021

was approx. 213000 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 211.9 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 (26.0%) 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, four programs were conducted by Gauhati University including *Awareness Programme on Swachhata on 16th -17th March, 2021 organised by Gauhati University NSS Cell, Guwahati, Assam; Gandhi Jayanti Plog Run was organised at Gauhati University on 2nd October, 2020; and* International Day of Yoga.

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, 2, 579,440 units per month of electricity was consumed by the University in the year 2020-21 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. However production was reduced to 139000 KWH in the period 2020-21. Solar capacity of GU campus was augmented with a 50 KWP new solar panel.

To monitor the air quality in the University campus, three parameters namely Particulate Matter (PM10), sulphur dioxide (SO_2) and nitrogen dioxide (NO_2) were considered. The PM 10 in the University campus varied between 61.20 μg/m^3 to 202.64 μg/m^3 with an annual average of 139.21 μg/m^3, which is higher than the permissible limits of CPCB Ambient Air Quality Standard (60 μg/m^3). In the University Campus, the SO_2 concentration varied between 5.9 μg/m^3 to 6.7 μg/m^3 with the annual average of 6.32 μg/m^3 which was much below the CPCB permissible limit of 50 μg/m3. NO2 varied between 13.1 μg/m^3 to 14.3 μg/m^3 with an annual average of 13.7 μg/m^3. This is much below the CPCB ambient air Quality permissible limit of 40 μg/m^3.

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.