

Green, Energy and Environment Audit Report 2022-2023



Gauhati University
Guwahati, 781014, Assam

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Designed by Sankar Kumar, G.U.



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গুৱাহাটী বিশ্ববিদ্যালয়
GAUHATI UNIVERSITY



FOREWORD

A key requirement of campus management is to maintain an ecologically balanced ecosystem. This can be achieved and monitored through a comprehensive audit system. Green Audit is one such process. It provides a complete record, logical documentation, accurate analysis and reporting of various environmental components of an institutional facility. In order to create and maintain an environmentally friendly atmosphere, Green Audit aims to analyse environmental practices within and outside the facility. It helps to identify and generate projections for improving environmental quality, expanding hygiene and health measures, improving environmental protection and enhancing sustainable development practices. Gauhati University is aware and attentive to the needs of Green Audit for the maintenance and overall development programme of the University. Gauhati University has also designed and adopted optimised methodologies to carry out the Green Audit on the campus in a futuristic manner.

It's my pleasure to share with you the Gauhati University Green Audit Report for 2022-2023. The report is the result of a comprehensive study, analysis and interpretation of the information of all the required parameters of the audit process. I would like to appreciate the sincere and methodical efforts of the Green Audit Team of the University of Gauhati. I thank Prof. Partha Pratim Baruah, Chairman and all the esteemed members of the Green Audit Committee for their determined efforts in preparing the Report. I hope that the Green Audit Report, 2022-2023 of Gauhati University will meet the basic necessities of not only the external agencies but also of internal stock-taking.

(Pratap Jyoti Handique)
Vice Chancellor
Gauhati University

Date: 08.07.2023

Acknowledgement

In its pursuit for improving environmental quality and to maintain a pristine environment for the future generation, Gauhati University has been undertaking a self-inquiry on environmental quality as well as the Energy auditing of the Gauhati University campus on a regular basis. A Green Audit Committee was therefore 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 Audit team looks forward to identify the current / emerging environmental and energy related issues and to monitor the environmental and energy 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 where a few suggestions were also made to take the environment protection to higher levels. It is hoped that the report will certainly receive due attention of university authority and also all stakeholders of the University as well.

I am indebted to Prof. P. J. Handique, Hon'ble Vice Chancellor of Gauhati University who consistently encouraged us and provided full administrative support to make the study a success. 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 thankful 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. P. K. Saikia and his Research team for their kind help in faunal study of the Campus. I am also extremely indebted to Prof. Dhruvajyoti Saharia for his help in preparing the GIS based map of the campus. I would also like to express my gratification to Prof. Eeshankur Saikia, Head, Department of Applied Sciences for his consistent support in preparing this Report. At last, but not the least, I would like to offer my heartfelt thanks to all the members of the GU Green Audit Committee for their untiring efforts in compiling the report.

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

Partha Pratim Baruah

Chairman

Green Audit Committee, 2022-2023

GU Green Audit Committee 2022-2023

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Introduction

Gauhati University at a glance

Gauhati University is the one of the pioneer Higher Educational Institute of the entire North Eastern Region of India. It was established in the year 1948 and presently celebrates the Platinum Jubilee. For its academic pursuits, Gauhati University was accorded as A-grade institution by NAAC in the last accreditation. The university comprises of 48 Departments, 1 constituent Law College, a Centre for Distance and Online Education (GUCDOE) and 6 Centres of Studies. The University render services towards 306 Colleges which are affiliated to its fold. Around 2400 students including research scholars were enrolled in the PG Departments during 2022-23 academic session.

Green Audit at Gauhati University

The University is developing in all aspects in recent year in terms of infrastructure, students and activities leading to tremendous pressure on the environment knowingly or unknowingly which need to be monitored thoroughly on a regular basis. In this context and in the line of sincere appeal of Honourable Prime Minister, Shri Narendra Modiji on ‘Swachch Bharat Abhiyan’, Gauhati University has therefore been taking part in the “Green Campus, Clean Campus” mission launched by University Grants Commission for all higher educational institutes. As it is also the mandate of The National Assessment and Accreditation Council (NAAC) to assess the ‘Environmental Consciousness’ of any educational institute, sustainable development policy was incorporated into the agenda of Gauhati University. The green audit, hence becomes an integral part of environmental management in the Gauhati University.

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

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

METHODOLOGY ADOPTED

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

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

AUDIT STAGE

Green auditing for the year 2022-23 in Gauhati University began with the assessment of the status of the green cover of the Institution followed by waste management practices and energy conservation strategies under the audit team members. The audit team monitored different facilities at the University campus, determined different types of appliances and utilities as well as measuring the usage per item and identifying the relevant consumption patterns and their impacts. The staff and the 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 and 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 finally collated and analysed to prepare this audit report.

POSTAUDIT STAGE

Land use and land cover

The Gauhati University has a huge sprawling campus spreading over an area of 508.8 acres along with two satellite locations one at Guwahati City and another at Jalukbari point. Topographically, the campus is surrounded by the Jalukbari hills on the south which is gradually flattened towards north interspersed with a number of wetlands thus making 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. Four segments of natural forests cover the southern hills. Organized plantations in the campus are mainly along the internal roads and residential units. There are a total of twenty wetlands of various sizes that are home to a wide diversity of aquatic flora and fauna. Majority of the wetlands have been observed to be growing overabundantly with *Eichhornia*, an exotic aquatic weed. The nine ponds located inside the Biodiversity Park are well maintained and has been used for fish rearing and maintenance of fish germ plasm and research.

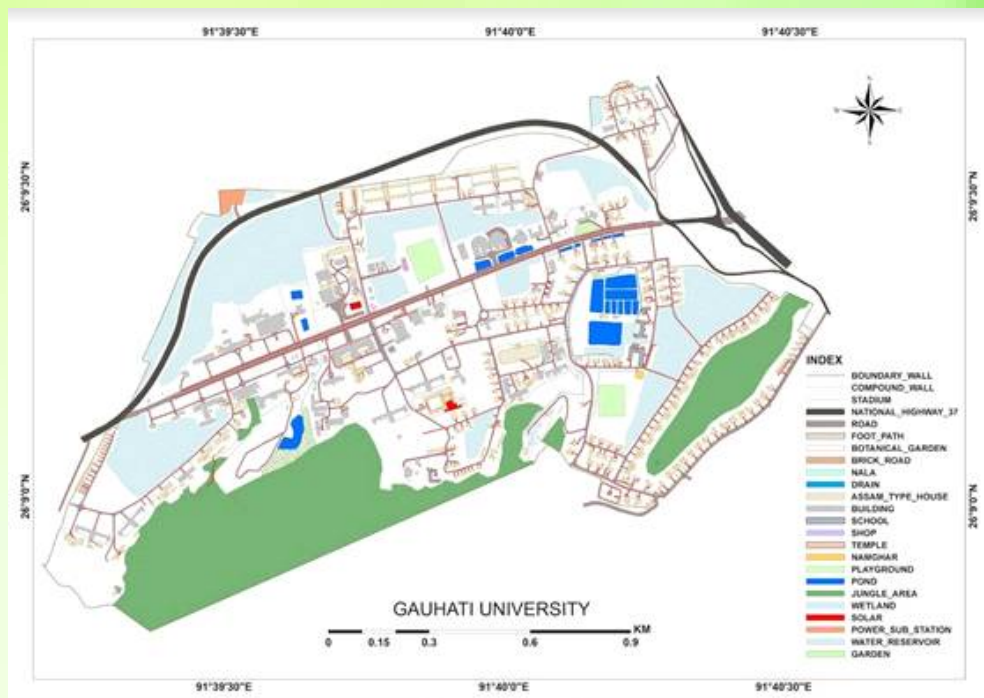


Fig 1 : The Map of Gauhati University campus
 (Courtesy: Prof. Dhrubajyoti Saharia, Dept. of Geography, GU)

It is found that a total of about 76.37 acres are under the built-up category which are mainly the residential units, hostels, academic and administrative units/blocks. In absence of available high ground, many of the wetlands are being filled up for new constructions. One 3- storied building has come up in the last year as a part of recent initiative of the GU administration for implementation of NEP-2020 within the campus as the building is dedicated to FYUGP to be initiated from 2023-24 academic session onwards. The campus is criss-crossed with roads which covered an estimated area of approximately 20 acres. The campus houses two-stadium covering an area of nearly 4 acres of land. One indoor stadium was inaugurated recently.

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

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

Observation

- Forested areas are found to be reducing.
- Roadside avenue trees lack attention. Weeding and clearing of rhizosphere soil of the avenue trees using mechanical heavy gadgets like JCB put a question mark on the survival of the trees. Uprooting of a few road side plants has been noticed in few locations within the campus.
- Drainage links were found to be missing.

Actions taken based on recommendation:

- Estate Office is maintaining and monitoring the sapling during post plantation period.
- Estate Office looks into managing the avenue plants also.

Recommendations

⇒ A task force is required to be constituted for landscape monitoring in the campus.

⇒ Plantation is suggested in the hilly portion as well as in the road side areas where thinning of forest has monitored.

⇒ It is suggested not to use JCB or any heavy machinery to manage the little undulation to topography particularly at the vicinity of any avenue tree.

⇒ Maintenance of avenue trees must be on the agenda of the University to enhance the aesthetic beauty of the campus.

Water Audit

Considering the importance of water in human health and activities, water auditing is must for an Institutional campus to understand the way of its uses, its availability and quality. The concerned auditor investigated on all aspects of potable and usable water in the university campus.

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 analysed for its quality parameters at monthly intervals and the results are presented in the Table below:

Table 2: Water quality report

Sl No	Parameters	Source River Brahmaputra
1	Iron (mg/l)	0.15-0.3
2	Alkalinity (mg/l)	79-150
3	Turbidity (N.T.U)	0.6
4	Calcium Hardness ()	11-17
5	Total Dissolved Solids (mg/l)	19-29
6	Sulphates (mg/l)	0
7	Chloride(mg/l)	1-7
8	Fluoride (mg/l)	0.15-0.23
9	Total Hardness (mg/l)	58-121
10	Residness Chlorine (mg/l)	0-0.2
12	Nitrate (mg/l)	Nil
13	pH	6.7-7
14	Arsenic (mg/l)	Nil
15	Manganese (mg/l)	0.2-0.28
16	Magnesium (mg/l)	10-21

Water Management

It was noted that out of the 275000 L of water pumped out from the PHE supported water tanks every day, around 227800 L of water is used by the University per day. Wastage of water from the lab is reduced by adopting microscale analysis.

Table 3

Sl no	Parameters	Response
1	Source of water	Surface water from river Brahmaputra
2	No of Wells	1
3	No of motors used	1
4	Horse power- motor	5 Hp
5	Depth of well- Total	90 M
6	Water level	
7	Number of water tanks	
8	Capacity of Tank (Total)	941000 L
	Quantity of water pumped every day	2655000 L per day

Any water wastage/why?	Yes, wastage of water is seen mainly <ul style="list-style-type: none"> • <i>leakage in old pipes</i> • <i>overflow of water tanks</i> • <i>Leaked water taps</i> • <i>Lack of awareness for saving water</i> • <i>Improper use of water taps, leaving tap running after use.</i>
Water usage for gardening	7000 L per day
Waste water sources	<ul style="list-style-type: none"> • Leakage in pipes, valves • Overflowing tanks • Residential quarters • Toilets & baths • Laboratories • Canteens, Hostels
Use of waste water	For gardening and recharge of water bodies
Fate of wastewater from labs	No mechanism exist
Any wastewater treatment for lab water	No
Whether any green chemistry method practiced in labs	
Rain water harvest available?	Yes
No of units and amount of water harvested	One; 4500 L
Any leaky taps	Few
Amount of water lost per day	1800 L
Any water management plan used?	Awareness and display of card
Any water saving techniques followed?	
Are there any signs reminding peoples to turn off the water?	Yes

Keys findings and observation:

- a. Water is used for
 - Drinking purpose
 - Toilets and wash areas hostels, canteens, departments, centres, offices,
 - Labs
 - Gardening and agriculture
 - Construction purpose
 - Cooking purpose in hostels and canteens
- b. No water treatment system in place
- c. Water cooler and drinking water filtration is installed (numbers 85)
- d. Nos. of urinal and toilets -260
- e. Nos. of waterless urinals - Nil
- f. Nos. of water tap - 1690
- g. Nos. of ponds – 20
- h. Nos. of 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 : Amount of water used:

Sections	Water use/day (L)
Hostel	40500
Resident quarter	51000
Administrative block	4500
Canteen	9000
Departments	50000
Gardens	7000
Laboratories	15000
Drinking	7000
Leakage	1800
Construction work	10000
Urinals and Toilets	32000
Total	2,27,800

Observation

- There is no water consumption monitoring system within 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 which need attention.
- The university has to take actions to strengthen the rain water harvesting.

Suggestions to save water

- ✓ Rain water harvesting could be installed in each and every building of the University.
- ✓ 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 other purposes.
- ✓ Automated sensors can be installed in order to prevent the over flow of water from tanks.

- ✓ Awareness campaigns should organise in the campus for the students and other stakeholders on judicious use of water.
- ✓ Automated taps could be used so that usage of water can be reduced.
- ✓ Periodical maintenance of water taps should be done in order to prevent the leakage of water through taps.

Auditing for Waste Management

Waste is produced by human activity and how it is handled, stored, collected and disposed of can have an impact on the environment and public health. Pollution from garbage causes a lot of litter in our communities, which can have a negative impact on our health and is unsightly. Biodegradable, non-biodegradable and hazardous waste are the three categories into which solid waste can be separated. Food crumbs, canteen scraps, bathroom leftovers and other wastes are examples of biodegradable waste. What is typically thrown away in homes and schools, such as plastic, tins, and glass bottles, etc., is considered a non-biodegradable trash. Waste that poses a risk to human health or the environment, such as cleaning agents, acids and gasoline, is referred to as hazardous waste. Unscientific methods of handling these wastes, such as burning them or dumping them in pits, may result in the release of dangerous chemicals into the soil and water supplies as well as the production of greenhouse gases that contribute to the global warming trend. The handling and management of hazardous waste produced by the college should get special attention. Anaerobic digestion technology can be used to successfully use biodegradable trash for energy generation purposes or composting technology can turn it into fertilizer. Recycling and reuse can be used to make use of non-biodegradable garbage. Therefore, reducing solid waste to the absolute minimum is crucial for a sustainable university. The auditor diagnoses the current waste disposal practices and makes recommendations for the most effective solutions to the issues.

Status of Waste generated in the campus

As tabulated below, on an average, the hostels and teacher flats/quarters account for the highest amount of solid waste generated in the campus. However, this conclusion could be an overstatement given the fact that this report hasn't yet processed sufficient data from the administrative offices' section. On average, various stakeholders generate 268.9 kg/week of different types solid waste.

Table 5: Solid waste generated in the campus per week

SL. NO.	STAKEHOLDERS	TYPES OF SOLID WASTE	AVG WASTE GENERATED/WEEK	PERCENTAGE
1	ACADEMIC DEPARTMENT	a. Paper waste	15 kg	5.58
		b. Plastic waste	6 kg	2.23
		c. Organic waste	12 kg	4.46
		d. E-waste	0.5 kg	0.19
2	ADMINISTRATIVE OFFICE	a. Paper waste	14 kg	5.21
		b. Plastic waste	4 kg	1.49
		c. Organic waste	7 kg	2.60
		d. E-waste	0.4 kg	0.15
3	HOSTELS	a. Paper waste	9 kg	3.35
		b. Plastic waste	11 kg	4.09
		c. Organic waste	45 kg	16.73
		d. E-waste	0.3 kg	0.11
4	TEACHER FLAT/RESIDENTIAL QUARTER	a. Paper waste	33 kg	12.27
		b. Plastic waste	15 kg	5.58
		c. Organic waste	49 kg	18.22
		d. E-waste	0.5 kg	0.19
5	CANTEENS	a. Paper waste	4 kg	1.49
		b. Plastic waste	2 kg	1.74
		c. Organic waste	41 kg	15.25
		d. E-waste	0.2 kg	0.07
		TOTAL	268.9 kg/week	

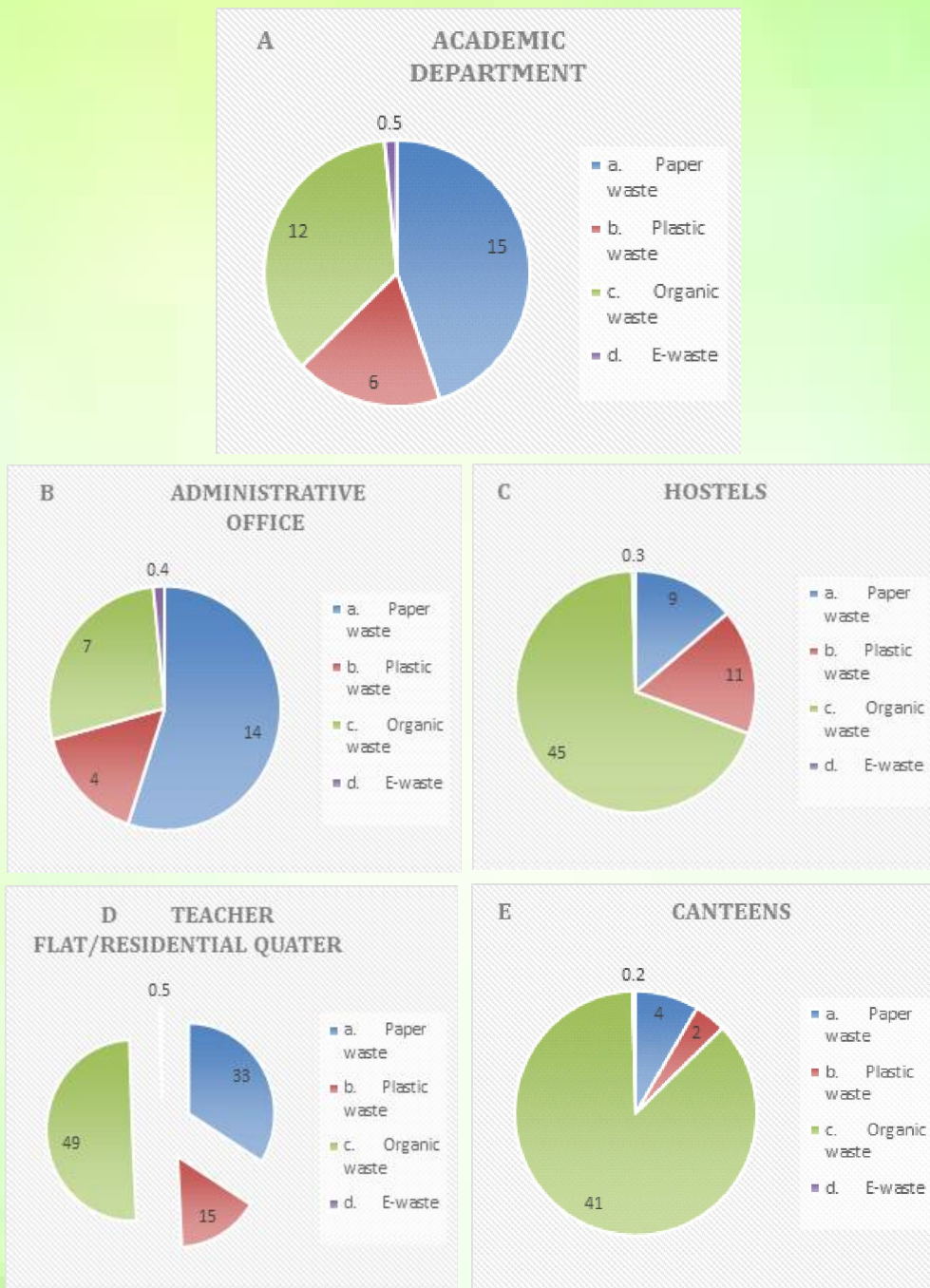


Fig 2 A-E: Different categories of waste produced by the various stakeholders per week

Waste Management

Every stakeholder is more-or-less aware of the problems associated in the management of solid waste. According to their convenience, requirements and resource availability, each of these groups or stakeholders has adopted their own set of solid-waste management procedures. 185 interior dustbins have been erected for the disposal of solid waste by 19 academic departments of the university, according to an investigation. These departments each have an average of 10 trash cans available. Facilities for vermicomposting and biodegradable materials are also maintained by the departments of Geology, Botany, HRDC and GENESIS. The teacher's residences typically have 2 personal trash cans for disposing of solid garbage and a pit for dumping organic waste.

- 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 in 42% of academic departments but is absent in the hostels.
- For 52.6% of academic departments, the accumulated solid waste is lifted by GMC, for 26% of departments it is land filled, 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 filled 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 some hostels, departments and quarters. However, the need for a formal and centralized system for land filling and composting ought to be adopted in the University. Moreover, the practice of recycling is another avenue that requires immediate operationalization.

SUGGESTION AND RECOMMENDATION

- To try to avoid the use of plastic in the campus and to encourage the use of biodegradable materials as alternatives.
- Try to achieve the goal of plastic free campus. Leaf litter from the campus can be effectively used for aerobic/ vermicomposting, so that the composted material can also be used as good manure.
- Recycle the paper waste instead of incinerate or burning.
- Hazardous Waste Management

Stakeholders' perception on 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 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 waste streams 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 recordkeeping requires a great deal of time and paperwork for both the Institution and the waste handler, due to 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.3: Hazardous waste awareness among faculty members of Gauhati University [n (%)] recorded during questionnaire-based survey for the year 2022-23

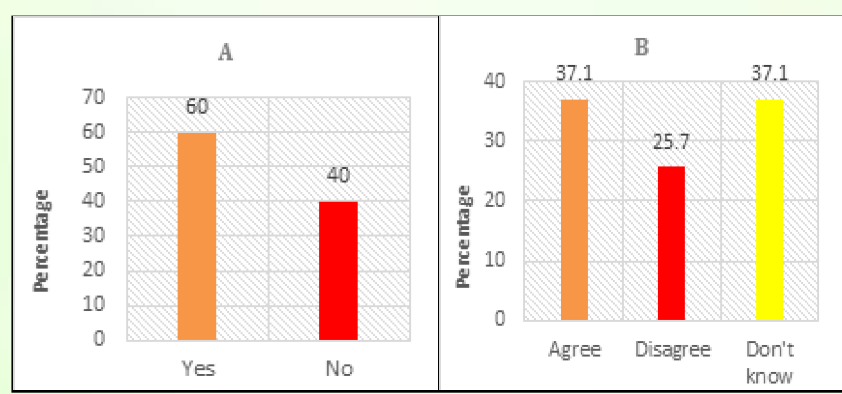


Fig. 4 (A) Awareness among faculty members regarding internal administrative support concerning hazardous waste. (B) Faculty member's reaction to the statement, "Would you agree or disagree with the following statement: The Gauhati University community is doing a good job recycling used office/household (campus residents) items such as newspapers, tin cans, and glass bottles."

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 the information can involve discussions on reactivity and possible health effects.

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

The transportation of waste including hazardous wastes occurs within the campus 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 improvements in the overall scenario must be made. 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.

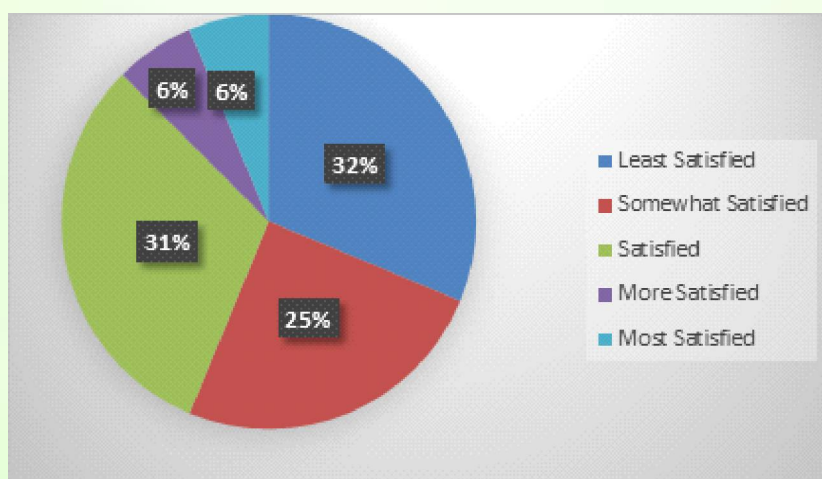


Fig.5: Satisfaction in terms of door-to-door waste collection frequency among Gauhati University faculty members during questionnaire-based survey for the year 2022-23.

The university faces several obstacles to ensure proper 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 departments and the residential is also a matter of concern. Data from the survey indicates 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 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.

Management of the Hazardous Waste

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

Suggestions and recommendations:

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

Actions taken:

- Installation of road side dustbins have been started.
- Plastic utensils are requested to reduced in the Departments and administrative meetings and conferences.

Health audit

Gauhati University has been always proactive in sensitizing the young generation within the campus and its neighbourhood by regularly organizing events like yoga day, environment day, plantation drives, fitness drives, Swachhta drives and nature camps to maintain the environmental health which has always reflected in the activities of the students and teachers. The university fraternity has supported flood victims during high flood in 2022 throughout the lower Brahmaputra valley. Faculty members of Gauhati University conducted various educational events and awareness programs in the neighbouring schools. The NSS and NCC wings of Gauhati University regularly organize blood donation camps in association with other stakeholders of the University.



Celebration of World No Tobacco Day conducted on 31st May, 2023



Flood Relief Camp conducted on 3rd July, 2022



Celebration of World Environmental Day, 2023



Von Mahotsav celebrated on 31st June, 2023



Water Distribution at Ambubachi Mela in the Maa Kamakhya Dham on 25th June, 2023

Energy audit

Energy Audit is the verification, monitoring and analysis of the use of energy including submission of technical report containing recommendations for improving energy efficiency as mandated by the Energy Conservation Act, 2001. It includes not only cost benefit analysis of energy consumption but also prepare an appropriate action plan to reduce energy consumption by a Higher Educational Institute.

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

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

On an average, 2,51,9440 units per month of electricity was consumed by the University in the year 2022-23 including the residential quarters in comparison to 3,77,8246 units per month during the previous year i.e., 2021-22. It has also been observed that there is a slight decrease of around 33.0% in the monthly average electricity consumption during the current year which could be attributed to the installation of solar panels in some specific zones of the campus. GU has the capacity to generate 288000 KWH of electricity energy through solar panel, during the current audit it was observed that the production was reduced to 139000 KWH in the period 2022-23 due to maintenance failure of the panels which was brought to the notice of the concerned authority. In the current period, the GU campus was augmented with a 50 KWP new solar panel.

To minimize the power consumption within the campus, GU is taking the initiative of replacing the old high-power Halogen and CFL blubs with low power LED panels in phase 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 fans installed in the different academic and administrative blocks. On the other hand, on an average Rs. 10500/- worth of natural gas (LPG cylinders) per month has been utilized for cooking in the different hostels within the campus excluding the vacation periods. Building energy performance indices were

in-between 2.02 to 13.01 kwh/m²/year as calculated with the data provided by the Electrical Division.

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

Observation

- ◆ Separate Electricity meters were not found in the Hostels, Academic and Administrative blocks.
- ◆ Number of road-side solar panels were very less and few were non-functional too.
- ◆ Electricity consumption is increasing in the Departments due to installation of different electricity run gadgets.
- ◆ Signage for energy conservation is missing in some potent location.
- ◆ Awareness on energy conservation is poor among the stakeholders.

Suggestions and recommendations

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

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

⇒ Solar power installation is to be augmented.

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

⇒ The stakeholders be made aware on judicious use and conservation of energy as well.

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 (PM₁₀), Sulphur dioxide (SO₂) and nitrogen dioxide (NO₂) has been analyzed. The dataset for the University Campus of the study period is given in Table 1.

Table 6: Average Monthly variation of PM₁₀, SO₂ and NO_x

	PM ₁₀	SO ₂	NO ₂
Oct, 2022	50.2	5.80	13.2
Nov, 2022	90.2	6.80	14.3
Dec, 2022	150.4	6.50	14.2
Jan, 2023	145.5	6.40	13.6
Feb, 2023	155.3	6.45	13.7
Mar, 2023	180.4	6.60	13.9
Apr, 2023	145.3	6.65	13.2
May, 2023	150.4	6.40	12.7
Jun, 2023	90.3	6.30	12.5

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

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 50 µg/m³ to 180 µg/m³ which are higher than the permissible limits of CPCB Ambient Air Quality Standards (60µg/m³). It is also observed that the PM10 is comparatively on a higher range during the dry season. The concentration of PM₁₀ in the ambient air decreases as (the rains starts from April which continues till the end the June. The lowest PM₁₀ is observed during the peak monsoon season. The monthly variation of PM₁₀ is given in Fig 7.

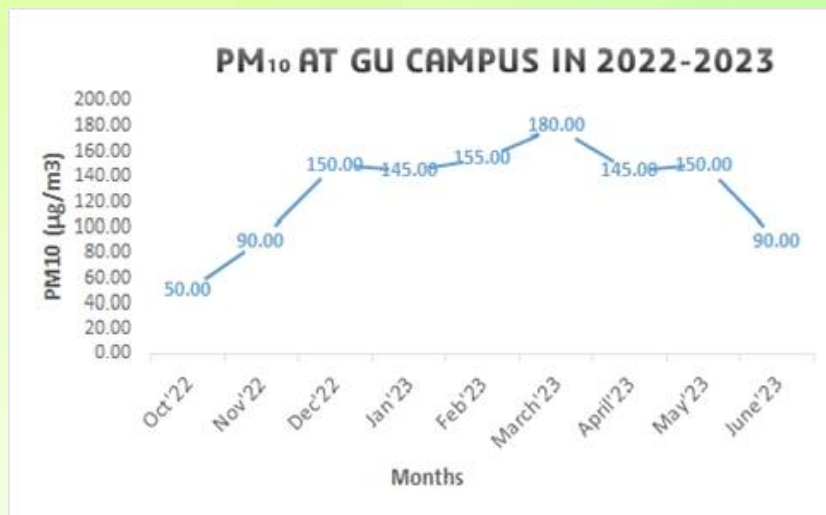


Fig 6: Monthly variation of PM₁₀ in the University Campus during the study period.

However, since PM₁₀ 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 ability to corrode organic and inorganic materials and is primarily of concern to children, the elderly and people with chronic lung disease. It also reduces visibility in some cases.

Sulphur Dioxide (SO₂):

SO₂ is the component of greatest concern and is used as the indicator for the larger group of gaseous sulfur oxides (SO_x). In the University Campus the SO₂ concentration during the study period varies between 5.8 µg/m³ to 6.8 µg/m³ which are much below the CPCB permissible limit of 50µg/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 in the absorption of SO₂ by these green members.

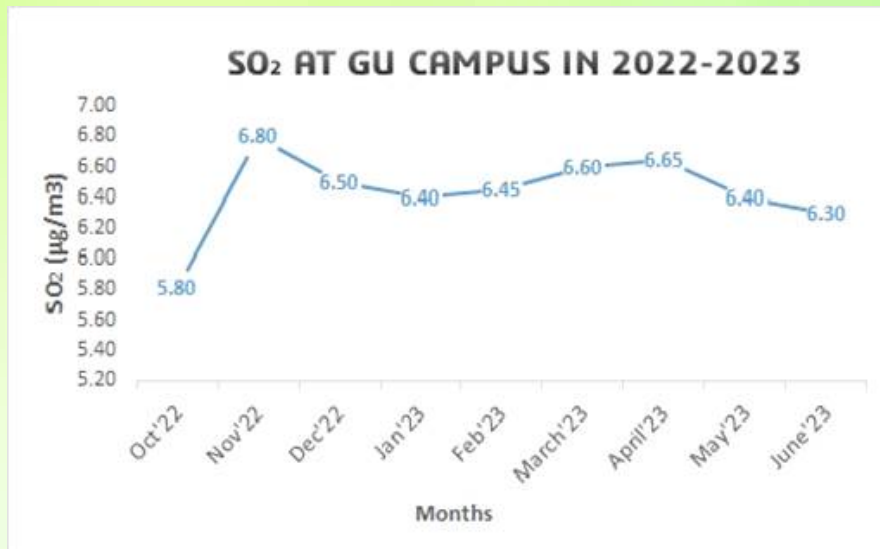


Fig 7: Monthly variation of SO₂ in the University Campus during the study period.

Nitrogen dioxide (NO₂):

NO₂ as a surrogate for this family of compounds because it is the most prevalent form of NO_x in the atmosphere that is generated by anthropogenic (human) activities. NO₂ is not only an important air pollutant by itself, but also reacts in the atmosphere to form ozone (O₃) and acid rain. During the study period, in the University campus the NO₂ varies between 12.5 µg/m³ to 14.3 µg/m³ which are much below the CPCB ambient air Quality permissible limit of 40 µg/m³

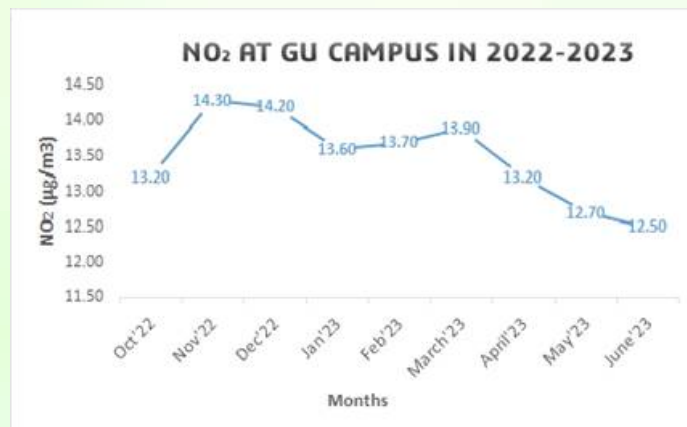


Fig 8: Monthly variation of NO₂ in the University Campus during the study period

Hence, we can conclude that except for PM_{10} , the concentration of SO_2 and NO_x was well within the permissible limits. The PM_{10} will subsequently subside as the construction works are completed.

Vehicular movements

It was estimated that around 30265 nos. of vehicles (including vehicles coming to Bank, Police station & Post Office) visited the GU Campus in general days per month during 2022-23 excluding the vehicles of campus dwellers. The highest numbers (about 32,567) were recorded in the peak academic months during September and October 2021. The University has four designated parking places, still, vehicular congestion was a common sight everywhere which needs intervention. Except 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. Visitors vehicular traffic was also restricted in the campus between 4.30 a.m. – 7.30 a.m. and 5.00 p.m. - 7.00 p.m. during the said period. It was observed that 42% officers/ teachers/ students were using bicycles for communication, while 22% used motor cycles and 32% preferred to use four wheelers.

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) in classrooms, which is important for good teaching and learning conditions.

In the GU campus, noise levels were measured using a Sound Level Meter (Model: Envirotech SLM 100; Type II dB (A). Noise level measurements were carried out at 6 sampling stations on 10/11/2021 during the daytime. The sampling locations along with the L_{eq} data 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	75.1	70	70	73
G.U. Market Area	Commercial	65.3	61.7	62.7	70
AT-8 Boys' Hall	Residential	50.1	48.3	57.8	55
Administrative Block	Silence	65.4	70.2	61.8	50
GU Hospital	Silence	40.2	42.4	43.4	48.2
K.K.Handiqui Library	Silence	40.3	43.3	40	42

As per the CPCB guidelines, the maximum permissible limits in dB(A) L_{eq} 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 Noise 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 (70 dB) followed by GU market (65 dB). The GU Entry Gate is a dense traffic area and also the junction point of flyovers. Thus, the elevated noise can be attributed to vehicular 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 along with 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 (42 dB) and KK Handiqui Library (40 dB).

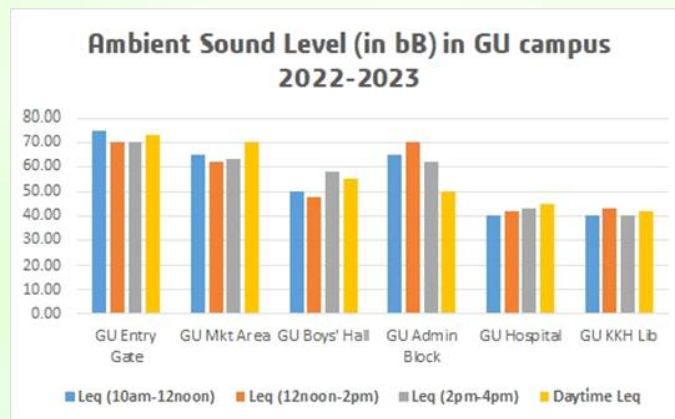


Figure 9: Ambient noise level at six (06) different locations of GU campus at different times of the day for the 2022-2023 session.

However, it is important to note that the average noise level, considering all sampling stations within the campus, is found to be higher than the maximum permissible limit of 50 db(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.

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.

Observations

- Noise attenuation is missing around campus.
- Plantation is less along the roadsides, particularly along the National Highway
- Ambient condition is sound.
- No restriction vehicular traffic in the working hours in the campus.
- No signage for No Horn zone.

Suggestions and recommendations

- ⇒ Noise attenuation may be done by planting vegetation around buildings and Highway nearby.
- ⇒ Some potent spaces may be declared as “No Horn Zone”
- ⇒ Government authorities be requested to monitor the use of loudspeaker and noise producing sources within the 100m radius of outside the University campus in compliance with prescribed rules.
- ⇒ Separate bicycle lane may be created for the residential stakeholders.
- ⇒ Some restrictions may be opted for the control of vehicular traffic particularly in the Office/Class hours.

Actions taken:

- ⇒ Vehicular account is now maintaining in the campus.
- ⇒ Burning of litters etc., has been banned and now is under control.
- ⇒ A few sound barricades have been erected through planting trees along few buildings.

BIODIVERSITY AUDIT



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

The recent biodiversity audit found that most of the biodiversity components of the GU campus are in increasing trends and it happens probably due to the enhancement of suitability and succession of the habitat mosaic supported by the prevailing land use and land cover. It is also worth mentioning to state that the Gauhati University

campus has also supported good numbers of IUCN-threatened species, Schedule-I species of Indian Wildlife protection (Act) 1972, as well as endemic species. Detailed updated information related to the GU biodiversity components has been incorporated in this report.

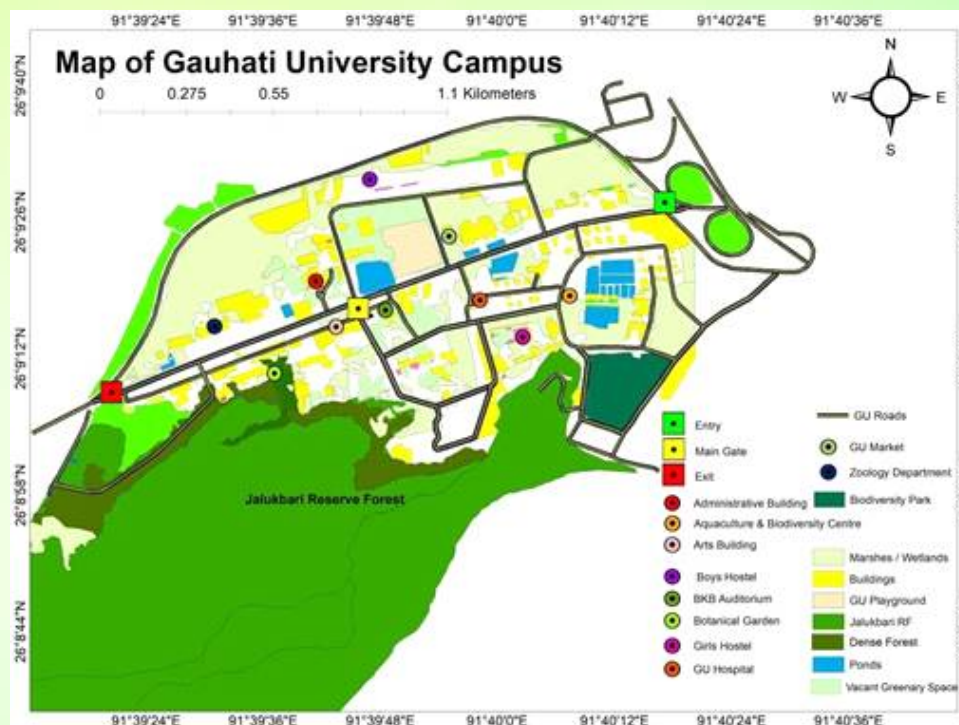


Figure 10: Shows the Biodiversity study area and its land use pattern in the GU campus (Map prepared by Mr. Rupjyoti Nath).

Faunal diversity

The present audit was done from the month of July 2022 to June 2023. The study documented altogether 17 different major groups of faunal components within the Gauhati University premises. Among the vertebrate fauna, altogether 218 species of birds, followed by 49 species of herpetofauna, 36 species of mammalian fauna, 16 species of naturally occurring, and 76 species of cultured fish species exist (Plate-3 for representative cultured fish). Again, among the invertebrates, a maximum of 233 species of butterflies have been recorded followed by 91 species of Arachnida (90 species of spiders and 1 species of the scorpion), 60 species of Odonata, 60 species of Coleoptera, 35 species of Hymenoptera, 34 species of Orthoptera, 30 species of moths, 9 species of Crustacea, 7 species of Gastropods, 5 species of Annelida and 3 species of Chilopoda.

The analysis of annual increments of the faunal biota of GU Campus shows that there were no increments of naturally occurring fish species, cultured free-ranging fish species, and Crustaceans, Gastropoda, Chilopoda and annelids in the GU. Whereas, in the case of Moth and Ant Groups, 100% increments were seen. The study revealed that there were altogether 30 species of Moths and 14 species of ants recorded on the GU campus during this year.

Table: 8: The table shows the comparison of various faunal groups year-wise (between **2020- 2021** and **2022-2023**) and the percentage of species increase in each group recorded on the GU campus

S. N.	Major faunal groups Studied	Recorded Species from July 2022 to June 2023	Recorded Species from July 2020-June, 2021	Total Incremental species	Percentage of species increase in each group
1	Mammalian Fauna	36	33	3	09.09
2	Avian fauna	218	180	38	21.11
3	Herpetofauna	49	46	3	06.52
4	Naturally occurring fish	16	16	0	0.0
5	Cultured Free-ranging Fish	76	76	0	0.0
6	Butterflies	233	180	53	29.44
7	Odonata	60	58	2	03.45
8	Coleoptera	55	50	5	14.29
9	Hymenoptera (except ants)	35	30	5	16.66
10	Orthoptera	34	30	4	13.33
11	Arachnida (Spider& Scorpion)	91	89	2	02.26
12	Crustacean	9	9	0	0.0
13	Gastropoda	7	7	0	0.0
14	Chilipoda	3	3	0	0.0
15	Annelida	5	5	0	0.0
16	Moth	30	0	30	100
17	Ant Group	14	0	30	100

(All the Biodiversity data have been compiled by Dr. Malabika Kakati Saikia and Prof. P. K. Saikia & Fish data have been compiled by Prof. Dandadhar Sarma and Mr. Hrishikesh Chaudhury).

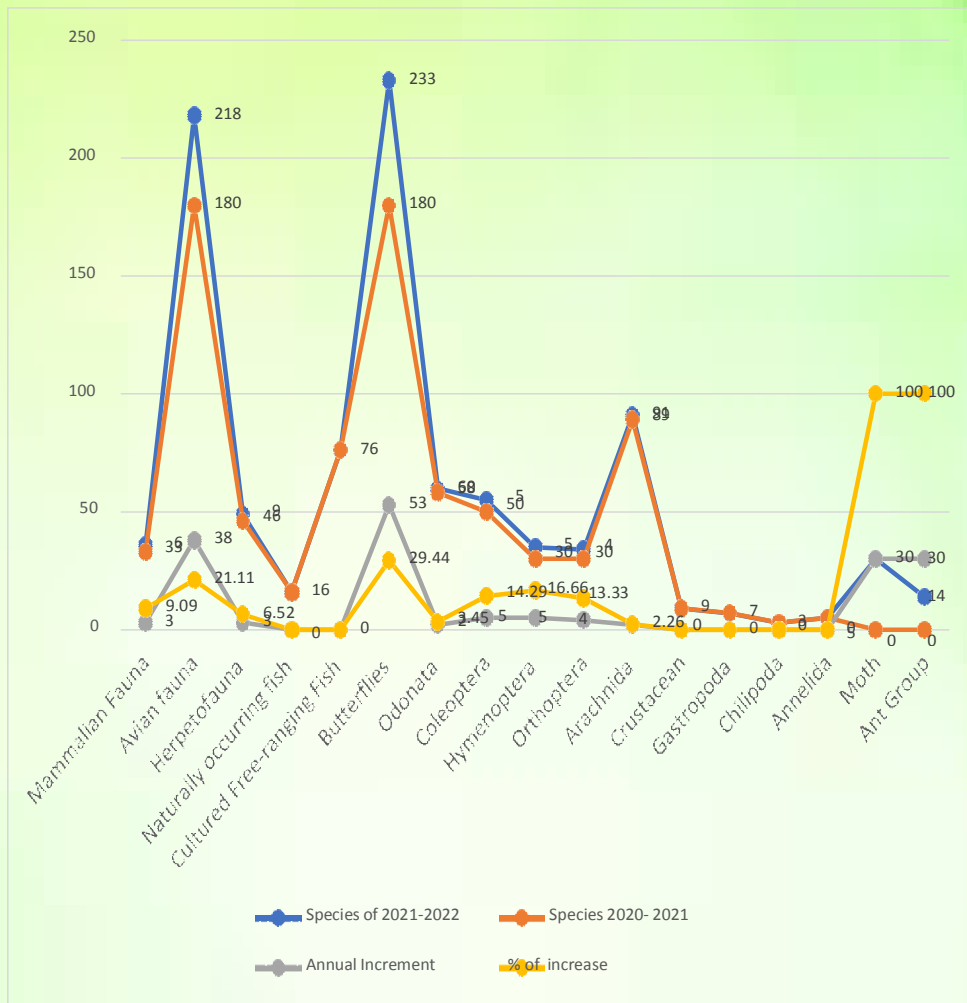


Figure 11: The graph shows the group-wise increase of different biodiversity groups and the percent of increment of various observed species in the GU campus between the year 2020-21 and 2022-23.

New achievements of current biodiversity audit

Gauhati University Biodiversity audit of **2022-2023** has successfully uncovered a total number of **38** endemic butterfly species, **2** endemic species of birds (Marsh Babbler & White-napped Yuhina), **2** endemic Lizard species (*Cnemespis assamensis* and *Cyrtodactylus urbanus*) within a comparatively very small area of 508.8 acres of land covers of the Institution (see the **Plate-2** for representative endemic lizards). To date, we have covered the survey of **17 groups** of different biodiversity components (See Appendix-1).

WPA Scheduled Species

Again, as per the Wildlife Protection (Act) of 1972, the Gauhati University Campus has supported altogether five **schedule-I** species of mammals **viz.**, Slow loris, Fishing cat, Common leopard, Leopard cat and Chinese pangolin, two species of **Schedule-I** Bird faunas **viz.**, Hill Myna and Fulvous Whistling teal, **five** species of **schedule -I** Chelonian fauna, **7** species of **schedule-I** butterfly fauna, 33 species of **schedule- II** butterflies so far till date (See Appendix-1).

Butterfly diversity

During **2022-2023** biodiversity audits' investigations and documentation, it was shown that the Gauhati University estate habitats supported overall **233** species of butterflies belonging to six different families. Surprisingly, the study exposed altogether **38** endemic butterflies out of a total of 233 butterflies recorded till the preparation of this report (Plate-4 for representative endemic butterflies of GU). Details of this have been documented in a recently published book volume of "Butterflies" in the precinct of Gauhati University (Saikia & Saikia, 2022b). These species are distributed among 5 distinct families **viz.**, Papilionidae supports 28 species, of which four were endemic, Nymphalidae supports 117 species, of which 25 species were endemic, Pieridae supports 21 species, of which, three were endemic, Lycaenidae supports 34 species, of which three species were endemic, Hesperidae supports 32 of which three species were endemic. Compared with the total global butterflies' diversity of 18,000 species as well as 1,500 species of the Indian sub-continent and 1,318 species in India alone (Varshney and Smetacek, 2015), the northeast support 962 species (Evans, 1932). Thus, the existence of 233 butterfly species within a very small area of the GU campus **viz.**, 508.8 acres of land, indicated a high degree of habitat potentiality for the butterfly community and reflects the fact that the GU campus is one of the most important strongholds for the conservation of Butterflies within the range of the Indian Sub-continent (Appendix-I).

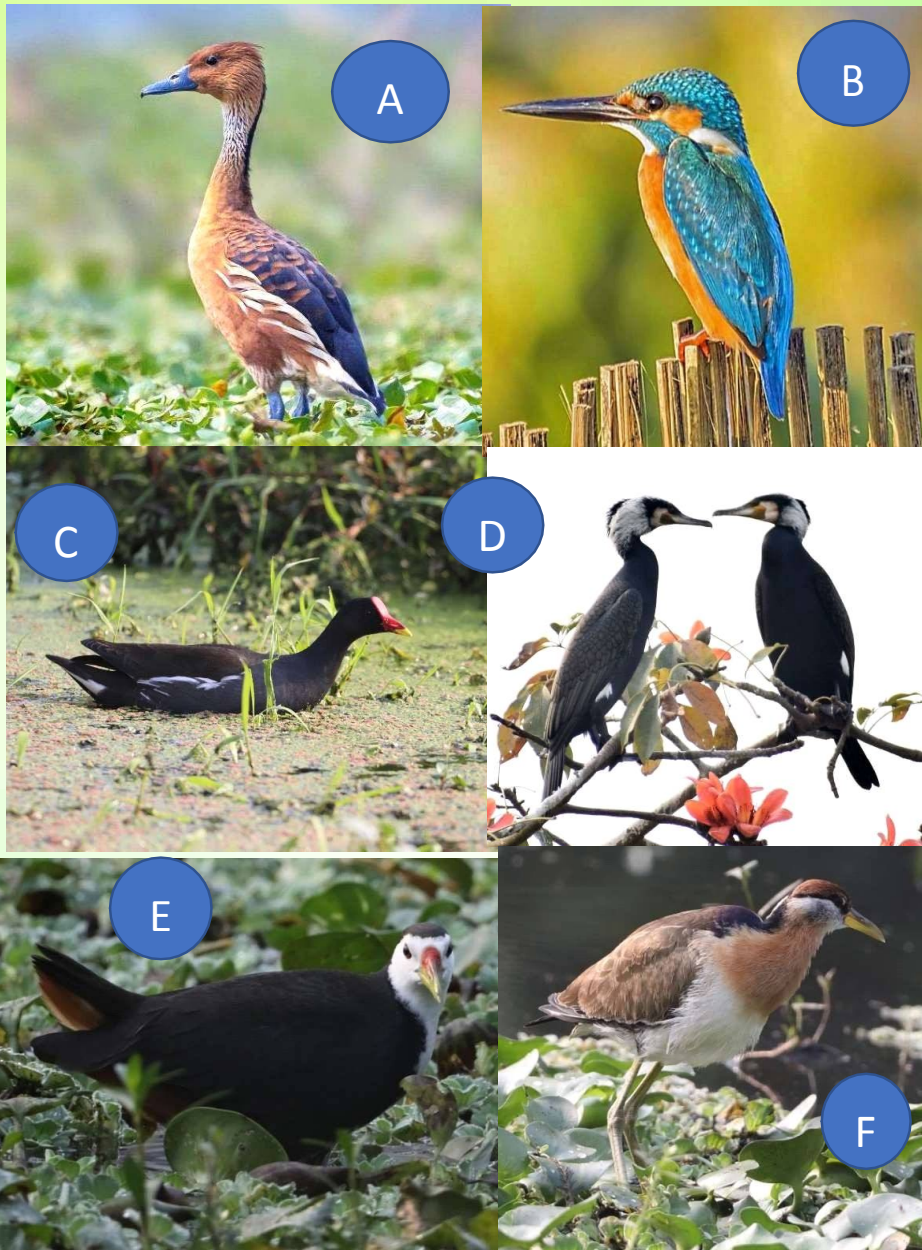
Diversity of Ant Species

Gauhati University Campus has supported high diversity of Ant fauna. The study encountered altogether 14 Species of ants belonging to four sub-families such as Formicidae (60%), Myrmicinae (33%) and Pomarine (5.5%) The findings of the study showed that 14 genera representing sub-families Formicine (60%), Myricanone (33%), Pomarine (5.5%) and Pseudo-myrmicine (1.5%) (Figure 2 & Table 1).

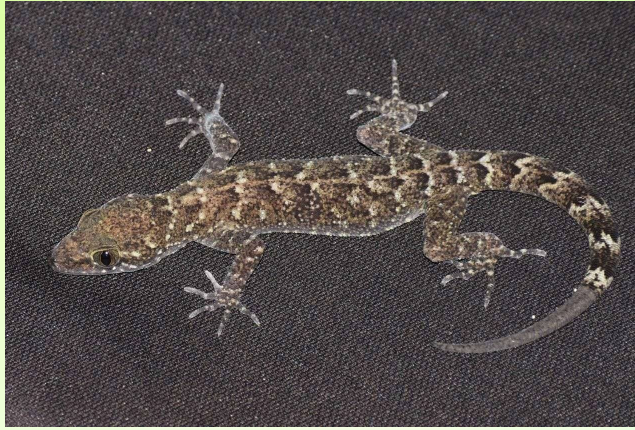
Diversity of Bees and Wasps

The study observed altogether 33 species of Bees and Wasps on the Gauhati University campus during the current year which indicates the suitability of habitats for two important groups of Hymenopteran species. The existing 33 species were represented by the seven different families such as Apidae, Vespidae, Braconidae, Eumenidae, Sphecidae, Torymidae and Ichneumonidae. Among the group of Honey bees, the presently encountered seven species of bees were such as *Apis cerana indica*, *Apis florea*, *Apis laboriosa*, *Xylocopa koptortosoma*, *Apis mellifera*, *Xylocopa Virginia* and *Xylocopa latipes*.

Among the wasps, the single-family Vespidae represented by 15 species viz., *Vespa tropica*, *Vespa affinis*, *un-identified Vespa sp.*, *Ropalidia stigma*, *Ropalidia jacobsoni*, *Ropalidia fasciata*, *Ropalidia marginata*, *Ropalidia sp.*, *Phimenes flavopictus*, *Phimenes sp.*, *Polistes olivaceus*, *Parapolybia varia*, *Allo rhynchium*, *Lavo marginatum*, *Rhynchium brunneum* and *Mischocyttarus mexicanus*. Whereas, the family Braconidae represented two species such as *Braconidae wasp* and *Aphidius sp.* Again, the families Eumenidae and Ichneumonidae have represented by three species each such as Eumenidae: *Antodynerus flavescens*, *Antodynerus limbatus* and *Eumenes petiolatus*. and Ichneumonidae: *Ichneumon wasp sp*, *Xanthopimpla flavolineata* and *Xanthopimpla punctata*. Whereas, the family Torymidae has contained only one species, i.e., *Megastigmus transvaalensis*. The other family Sphecidae have represented two species *Sceliphron destillatorium* and *Chalybion californicum*.



Representatives of the breeding resident bird fauna of the Gauhati University Campus (A: Great Cormorant; B: Common Kingfisher; C: Common Moorhen; D: Barn Swallow; E: White-Breasted Waterhen; F: Bronze-winged Jacana (Juvenile) (Photo-credit: Prof. PK Saikia, Dr. Nilotpal Mahanta, Imon Abedin, Anubhab Bhuyan).



Cyrtodactylus urbanus (Endemic NER)

Cnemaspis assamensis(endemic)



Gekko geck



Fowlea piscator



Naja kaouthia



Lycodon aulicus



Python bivittatus(Schedule-I)

Photo-plate shows the representative species of snakes on the GU campus habitats
(Photo Credit: Sanath Bohra).



Danionella_priapu



Juvenile_cuchia



Channa aurantimaculata.

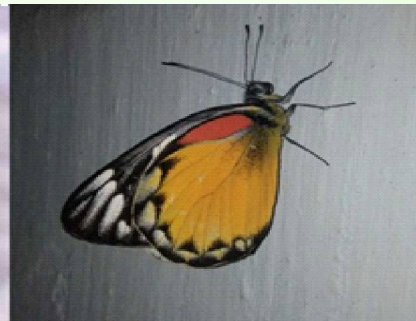


Pethia gelius

The cultured fish species Aquaculture and Biodiversity Centre
(Photo- credit: Mr. Hrishikesh Chaudhury)



Yellow Helen



Common Duffer



Tiger Hooper



Red Spot Jezebel

Representative Endemic Butterflies found in GU Campus.
(Photo credit: Prof. P K Saikia, Dr. M. K. Saikia, Vivek Chetry)



Fig 1 : *Apis cerana*



Fig 2 : *Xylocopa Virginia*



Fig 3: *Vespa tropica leefmansi*



Fig 4: *Parapolybia varia*



Fig 5 : *Allorhynchium argentatus*



Fig-6: *Labus pusillus*



Fig 7 : *Ropalidia cyathiformis*



Fig 8: *Phimenes flavopictus*

Shows the recorded species of Bees & Wasps fauna of the GU campus in 2021-2022 (Photo-credit: Briyanka Kashyap, Jinti Das, Priyanka Bharali)

Appendix- I: IUCN Threatened, IWPA Scheduled species and endemic animal fauna of GU Campus.

SI No	Faunal Groups	Species	IUCN Status	IWPA Status	Endemic Species
1	MAMMALS	Common Leopard	Near Threatened	Schedule-I	
2		Chinese Pangolin	Critically Endangered	Schedule-I	
3		Himalayan Crestless 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	
9		Small Indian Civet	Least Concern	Schedule-II	
10		Large Indian Civet	Vulnerable	Schedule-II	
11		Spotted Linsang	Vulnerable	Schedule-II	
12		Common palm Civet	Lower Risk	Schedule-II	
13		Golden Jackal	Least Concern	Schedule-II	
14	BIRDS	Greater Adjutant Stork	Endangered		
15		Lesser Adjutant Stork	Vulnerable		
16		Grey Headed Fish eagle	Near Threatened		
17		Marsh Babbler	Vulnerable		Endemic
18		White-napped Yuhina	-----		Endemic
19		Slender-billed Vulture	Critically Endangered		
20		White Ramped Vulture	Critically Endangered		
21		Himalayan Griffon Vulture	Threatened		
22		Hill Myna	-----	Schedule-I	
23		Large Whistling Teal	-----	Schedule-I	
25		Pallid Harrier	Near Threatened	
26	REPTILES	Bengal Monitor Lizard	-----	Schedule-I	
27		Burmese Python	-----	Schedule-I	

28		Indian Roofed Turtle	-----	Schedule-I	
29		Indian flap-shell turtle	-----	Schedule-I	
30		<i>Trionyx hurum</i>	-----	Schedule-I	
31		<i>Geoclemys hamiltoni</i>		Schedule-I	
32	BUTTERFLIES	<i>Chain Sordtail</i>	----	Schedule-II	
33	Papilionidae	Great Zebra	-	-	Endemic
34		Assam Spotted Zebra	--	Schedule-II	
35		Great Jey	---	Schedule-II	
36		Common Duffer	----	Schedule-I	Endemic
37		White Dragontail	---	----	Endemic
38		Common Mime	--	Schedule-I	----
39		Yellow Helen	--	--	Endemic
40		Common Raven	--	--	Endemic
41	Nymphalidae	Spotted Palmfly	--	Schedule-II	---
42		Peal's Palmfly	--	Schedule-I	Endemic
43		Common Red Forester	-	--	Endemic
44		Dusky Diadem	--	--	Endemic
45		White-Bar Bushbrown	-	Schedule-II	----
46		Chinese Bush brown	-	Schedule-II	Endemic
47		Yellow Rajah	-	Schedule-II	----
48		Tawny Rajah	-	Schedule-II	----
49		Scarce Tawny Rajah	-	Schedule-II	---
50		Variegated Rajah	-	Schedule-II	---
51		Black Rajah		Schedule-II	Endemic
52		Pallid Nawab	-	----	Endemic
53		Jewel Nawab	-	Schedule-II	Endemic
54		Stately Nawab	-	Schedule-II	---
55		Courtesan	-	Schedule-II	Endemic
56		Pasha	-	Schedule-II	Endemic
57		Blue Admiral	-	---	Endemic
58		Wizard	-	Schedule-II	Endemic
59		Autumn Leaf	-	Schedule-I	-----
60		Wavy Maplet	-	Schedule-II	Endemic
61		Sullied Sailer	-	---	Endemic

62		Dingiest Sailer	-	-	Endemic
63		Plain Sailer	--	-----	Endemic
64		Perak Lascar	-	-	Endemic
65		Black Vein Sergeant	-	Schedule-II	-
66		Studded Sergeant	-	Schedule-II	-
67		Green Commodore	-	-	Endemic
68		Clipper	-	Schedule-II	
69		Grey Count	-	Schedule-II	-
70		Plain earl	-	Endemic-II	Endemic
72		Powdered Baron	-	-	Endemic
73		Streaked Baron	-	-	Endemic
74		Red Spot Duke	-	Schedule-II	Endemic
75		Dark Archduke		Schedule-II	Endemic
76		Yellow Coster			Endemic
77		Striped Tiger	-	Schedule-I	
78		Striped Blue Crow		Schedule-IV	
79		Blue Spotted Crow		Schedule-II	
80		Magpie Crow		Schedule-IV	
81	Pieridae	Chocolate Albatross		Schedule-II	
82		Stripped Albatross			Endemic
83		Red Spot Jezebel			Endemic
84		Tree yellow			Endemic
85	Lycaenidae	Ceantaur Oakblue		Schedule-II	
86		Common Onyx		Schedule -II	
87		Chocolate Royal			Endemic
88		Spotted Royal			Endemic
89		Orchid Tit		Schedule-I	
90		Green Flash		Schedule-II	
91		Indian Red Flash			Endemic
92		Pointed Ciliate Blue		Schedule-II	
93		Common Ciliate Blue		Schedule-II	
94		Common Line Blue		Schedule-II	
95		Common Pierrot		Schedule-I	
96		Pea blue		Schedule-II	
97		Long banded Silverline		Schedule-II	

98	Hesperiidae	Coon		Endemic
99		Tiger Hopper		Endemic
100		Light Straw Ace		Endemic

Floral Diversity in Gauhati University Campus

Gauhati University campus with various topographic features like small hillock to aquatic and swamp habitat provide an ideal habitat for growth of various kinds of plant species. These species support overall biodiversity of starting from microbial diversity to animal diversity. Most of the plant species specially the herbs and shrubs were growing naturally inside the campus. The Botanical Garden in the university campus spread over an area of about 62 acres situated in the hills and valleys of Jalukbari hills. The garden harbours a number of evergreens, semi-evergreen, deciduous, aquatic and coniferous trees along with some grasses. The Botanical Garden of the University is maintaining a good numbers of plant species of rare, endangered and threatened categories as ex-situ conservation and serves as a resource centre for various plant Germplasm. The aquatic and swamp habitate inside the Gauhati University campus supports growth of different aquatic species. They plays a very important role in the ecosystem as they are the primary producer in the food chain and source of food like tubers and fruits for aquatic animals, helps in removing toxic compounds and heavy metals from water, helps in erosion control and also provide habitat for the faunal diversity.

Table 9: Summary of Floral diversity in Gauhati University campus

Sl. No.	Habit	Number of Species
1	Tree	131
2	Shrub	57
3	Herb	134
4	Climber	35
5	Epiphytes	8
6	Aquatic	7

Table 10: RET Plants maintained

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

Table 11 : The plants added to the GU campus flora during 2022-23

Sl. No.	Family	Name	Habit
1	Asteraceae	<i>Enydra fluctuans</i> DC.	Aquatic
2	Asclepiadoideae	<i>Hoya verticillata</i> (Vahl) G. Don	Climber
3	Plumbaginaceae	<i>Plumbago zeylanica</i> L.	Climber
4	Annonaceae	<i>Artabotrys hexapetalus</i> (L.f.) Bhandari	Climber/Straggler
5	Asteraceae	<i>Acmella ciliata</i> (Kunth) Cass.	Herb
6	Asteraceae	<i>Acmella uliginosa</i> (Sw.) Cass.	Herb
7	Aspleniaceae	<i>Blechnum insigne</i> (Hook.) C.M.Kuo	Herb
8	Costaceae	<i>Chamaecostus cuspidatus</i> (Nees & Mart.) C.D.Specht & D.W.Stev.	Herb
9	Araceae	<i>Colocasia affinis</i> Schott	Herb
10	Zingiberaceae	<i>Curcuma caesia</i> Roxb.	Herb
11	Poaceae	<i>Eleusine indica</i> (L.) Gaertn.	Herb
12	Acanthaceae	<i>Lepidagathis incurva</i> Buch.-Ham. ex D.Don	Herb
13	Poaceae	<i>Poa annua</i> L.	Herb

Observations

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

Suggestions and recommendations

- ⇒ Wetlands still need maintenance.
- ⇒ Early removal of uprooted trees in the road side areas is suggested.
- ⇒ *Parthenium* patches should be destroyed with proper scientific technique.
- ⇒ Regular weeding in the gardens and road side areas are necessary.
- ⇒ Plantation of fruit trees is suggested to avoid Man-Monkey conflict.
- ⇒ The existing wet grassland areas of the GU campus are very suitable for endemic, residential, and migratory avian fauna and native flora. But it needs to be designed accordingly using proper scientific and ecological viewpoints. If we do this then it would be helpful to implement scientifically designed mode-based research for the conservation and management of our Biodiversity components.
- ⇒ We may also conserve the recently threatened endemic wet grassland birds like Marsh babbler and Swamp Francolin along with endemic threatened and wetland-inhabited medicinal plants.
- ⇒ Proper scientific way of design for the management of the wetlands also helps to mitigate the waterlogging problems and as well as increase the biodiversity on the campus.

SUMMARY AND RECOMMENDATIONS

- The audit process was conducted by the team constituted for the purpose.
- The academic year of 2022-2023 were considered for the present audit.
- Little change has been observed in Land Use and Land Cover section. One new building has been inaugurated.
- Potable water quality is within the standard limits.
- No management strategies for Laboratory waste water were seen, on which the concerned authority may look into.
- Wastage of water is still prominent which needs action to reduce the same.
- Awareness campaign on water conservation is suggested amongst the stakeholders.
- Waste disposal mechanism is standard. Frequency of garbage collection may be enhanced.
- There is a strict policy for removal of hazardous waste under Estate Office, GU. Strengthening of the execution mechanism is necessary.
- Vermicomposting facilities and rain water facilities may be augmented.
- Quantification of organic waste may be helpful to design the composting units.
- Energy use is on the higher side which could be attributed to the volume of research laboratory, residential areas including the facilities like GU Press, Guest House etc.
- There is a scope for enhancement of non-conventional energy sources, for which a separate policy must be formulated.
- Building Energy performance indices were within the prescribed limit.
- Green building concept may be introduced.
- Environmental quality is sound.
- Sound barricade through plantation may be installed towards the National Highway to avoid disturbances
- Green campus of the Gauhati University houses as many as 600 species of Plants and as many as 35 species of mammals, 189 species of birds, 43

species of herpetofauna, 15 species of naturally occurring and 70 species of cultured fish, 1194 species of butterflies. Majority of which are under IUCN/ IWPA category.

- A few suggestions put forwarded during the previous year's audit process have been materialised to improve the overall environment of the Gauhati University Campus.
- The audit team looks forward to seek the implementation of the suggestions mentioned in this Green Audit Report of Gauhati University prepared for the year 2022-2023.
