BIDHANNAGAR COLLEGE

GREEN , ENERGY & ENVIRONMENT AUDIT REPORT

2022-2023

REPORT PREPARED BY
INSTITUTE OF NATURE RESEARCH AND CONSERVATION (INRC)

INSTITUTE OF NATURE RESEARCH AND CONSERVATION

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Reference No: *Date-25/06/24*

GREEN, ENVIRONMENT AND ENERGY AUDIT CERTIFICATE

ACADEMIC YEAR 2022-2023

This is to certify that ***Bidhannagar College*** *located at EB-2, Sector-I, Salt Lake, Kolkata, Pin-700064, West Bengal has steadfastly strived to establish a robust and ecologically sustainable environment, dedicated to the preservation of nature and biodiversity. Institute of Nature Research and Conservation (INRC) expresses satisfaction following the successful completion of the Green, Environment, and Energy Audit for the academic year 2022-2023.*

This accomplishment has been made possible through the active and moral support extended by the Honorable Principal, the IQAC Team, the dedicated teaching and support staff and the enthusiastic student body of Bidhannagar College. Their collective efforts have significantly contributed to the creation of a positive and eco-friendly atmosphere on the campus.

The commitment demonstrated by both faculty and students towards environmental improvement and the conservation of biodiversity is truly commendable. This proactive approach aligns with the highest standards of ecological stewardship, reflecting a genuine dedication to sustainable practices.

This certificate serves as recognition for the outstanding efforts undertaken by Bidhannagar College to foster a healthier and more environmentally conscious campus. We applaud their commitment to creating a positive impact on the environment and encourage the continuation of such admirable initiatives in the future.

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ACKNOWLEDGEMENT

On behalf of the Green, Environment, and Energy Audit Team of the Institute of Nature Research and Conservation (INRC), we extend our heartfelt gratitude to the management of Bidhannagar College for entrusting us with the vital task of conducting a Green and Environmental audit. Our sincere appreciation goes to the Principal of Bidhannagar College for their support.

We are grateful for the cooperation extended to our team throughout the audit process. The valuable inputs provided by the management were instrumental in facilitating our audit activities. We would also like to express our special thanks to the members of the Internal Quality Assurance Cell (IQAC), as well as the dedicated teaching and non-teaching staff. Without their intricate involvement and support, our work would not have been possible.

AREAS OF CONCERN

GREEN AUDIT

- Diversity of Flora
- Diversity of Fauna
- Diversity Index of MTS
- Community Structure Analysis and IVI

ENVIRONMENT AUDIT

- Water Management
- Air quality
- e-waste management
- Disaster management

ENERGY AUDIT

- Energy consumption
- Energy management
- Carbon footprint

RECOMMENDATIONS

- To reduce energy consumption and management
- To Find out potential areas for environment management and green development
- To protect Biodiversity
- To find out potential areas for increase species richness in the campus

A dedicated committee, comprising esteemed experts and scientists from various reputable institutes, conducted this audit. The committee meticulously devised a questionnaire based

on both central and state regulatory mandates. Subsequently, they collected and analyzed fundamental data.

Overall, the audit findings portray a favorable environmental landscape within the premises of Bidhannagar College. The committee has put forth a series of short-term and long-term recommendations aimed at enhancing environmental conditions to superior standards. The higher authorities and all stakeholders of the College have affirmed their commitment to diligently address these suggestions and seize opportunities for identified enhancements.

AUDIT COMMITTEE MEMBERS

An expert committee of 3 members was formed to conduct the Green, Environment and Energy Audit from different field of expertization such as Biodiversity, Taxonomy, Physics (Energy Science and management) and Conservation Biology.

The Committee members are listed below:

SL No.	NAME	Area of interest	Designation
1.	Dr. Sumit Manna	Ecology, Environment, Biodiversity Economics and Conservation	Assistant Professor HOD. Dept. of Botany and IQAC Coordinator Moyna College & Secretary INRC
2.	Dr. Amit Manna	Energy management, green synthesis of Nano particle and characterization, Spectroscopic analysis	Vice President Institute of Nature Research and Conservation & Former Project Scientist Spectroscopic Analysis Team NASA
3.	Prof. Nilanjan Sadhukhan	Molecular Taxonomy and Biodiversity	Faculty, Dept of Botany Moyna College

The Audit team started the audit at the College Campus on 18th June, 2024

Important dates and initiatives

SL NO	PURPOSE	DATE	REMARKS
1	Communication with College authority	15.06.2024	Discussion about term and conditions
3	Collection of information about the College	18.06.2024	Introduction to Administrative Officer
4	Visit of campus and observation	19.06.2024	Outdoor observation to capture photographs and GPS coordinates
5	Campus enquiry	19.06.2024	Physical enquiry with experts
6	Departmental visit and enquiry	19.06.2024	Laboratory enquiry
7	Interview with other stake holder	20.06.2024	Meeting with other stake holders
8	Interview with staff	20.06.2024	Collection of different information
10	Pre closing meeting	20.06.2024	Meeting with IQAC
11	Closing meeting	22.06.2024	Pre-submission of the Report
12	Submission of audit report	25.06.2024	Submission of the Report

ABOUT BIDHANNAGAR COLLEGE

Established in 1984, Bidhannagar College, under the Government of West Bengal, is located in Salt Lake (BF-142) with the mission to deliver quality education to students from Salt Lake and nearby areas.

Bidhannagar College embarked on its distinguished journey on June 25, 1984. It operates directly under the Department of Higher Education, Government of West Bengal. Initially, the college was situated in a modest building at BF-142, Salt Lake City. From its inception, the college has been dedicated to becoming a model of academic excellence. While it was initially affiliated with the University of Calcutta, since 2008, the college has been affiliated with the newly established West Bengal State University in Barasat, North 24 Parganas.

To address the space limitations of its original location and to facilitate the college's growth, a new building was constructed on 7.5 acres of prime land at EB-2, Sector I, Salt Lake. This three-storey structure is surrounded by a vast expanse of greenery and includes a spacious playground.

Currently, a new six-storey building is established. This building is intended to house the Humanities and Social Science departments, the library, the administrative section, and an auditorium. Presently, it accommodates the Geography department.

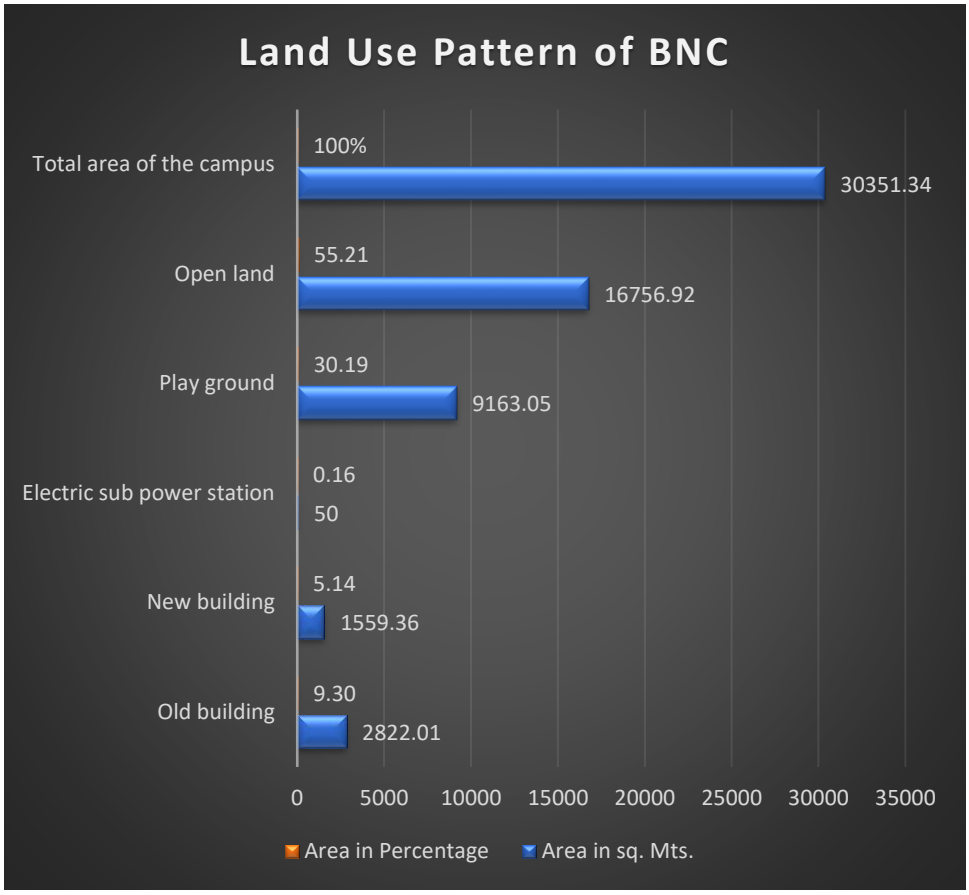
The college's peaceful environment and rich cultural ambiance foster various curricular and co-curricular activities. As greater Kolkata expands, Bidhannagar College will continue to play a pivotal role as a premier educational institution for thousands of students pursuing higher education. The college is consistently enhancing its facilities and academic and co-curricular programs for future students.

ACADEMIC DEPARTMENTS

SL NO	Department of Arts	Department of Science	PG
1	Bengali	Physics	Anthropology
2	Education	Chemistry	Botany
3	History	Mathematics	Chemistry
4	Political Science	Zoology	Microbiology
5	English	Botany	Zoology
6	Philosophy	Geography	Education
7		Anthropology	
8		Economics	
9		Statistics	
10		Microbiology	

AREA COVERAGE OF THE COLLEGE CAMPUS

College campus	Area in sq. Mts.	Area in Percentage
Old building	2822.01	9.30%
New building	1559.36	5.14%
Electric sub power station	50	0.16%
Play ground	9163.05	30.19%
Open land	16756.92	55.21%
Total area of the campus	**30351.34**	**100%**



Bidhannagar College Campus depicting the canopy cover, concrete and building areas and other land use pattern

Geographical position: 22°35'05"N 88°24'18"E

Aerial view of Bidhannagar college showing the concrete and open area

Newly constructed building of Bidhannagar College

PURPOSE OF GREEN AND ENVIRONMENT AND ENERGY AUDIT

Purpose of Green and Environmental Auditing

- **Environmental Compliance:** Ensure that the college complies with local, regional, and national environmental regulations, including waste disposal, energy usage, and other relevant standards.
- **Resource Management:** Evaluate the efficient use of resources within the campus, such as water, energy, and materials. Identify opportunities for conservation and sustainable resource management.
- **Waste Reduction and Recycling:** Assess waste management practices and promote initiatives to reduce waste generation. Identify opportunities for recycling and proper disposal of waste materials.
- **Energy Efficiency:** Evaluate the energy consumption patterns of the campus and identify measures to improve energy efficiency, including the adoption of renewable energy sources.
- **Biodiversity and Green Spaces:** Assess the impact of campus development on local biodiversity. Promote the creation and preservation of green spaces, gardens, and natural habitats within the campus.
- **Transportation and Commuting:** Evaluate the environmental impact of transportation within the campus. Encourage sustainable transportation methods and reduce the carbon footprint associated with commuting.
- **Curriculum Integration:** Integrate environmental and sustainability themes into the academic curriculum. Foster awareness and understanding of environmental issues among students and staff.
- **Community Engagement:** Involve the campus community in environmental initiatives and awareness campaigns. Foster a sense of environmental responsibility among students, faculty, and staff.
- **Infrastructure Development:** Ensure that new construction and infrastructure development align with green building standards and sustainable design principles.
- **Climate Change Mitigation:** Identify opportunities to reduce the college's contribution to climate change. This includes assessing greenhouse gas emissions and implementing strategies to minimize the carbon footprint.
- **Cost Savings:** Identify cost-effective measures for improving environmental performance, leading to long-term financial benefits through energy savings, waste reduction, and sustainable practices.
- **Institutional Reputation:** Enhance the college's reputation as an environmentally responsible institution. This can positively impact enrollment, partnerships, and community relations.
- **Regulatory and Funding Compliance:** Align the college's environmental practices with regulatory requirements and leverage environmentally friendly initiatives for potential funding opportunities.

Purpose of Energy Auditing

- In any organization, the three primary operating expenses typically comprise energy (both electrical and thermal), labour, and materials. When assessing the manageability of costs or potential savings in these components, energy consistently emerges as a prominent factor, making the energy management function a strategic area for cost reduction.

- An Energy Audit plays a crucial role in comprehending the utilization of energy and fuel within an an institute, pinpointing areas susceptible to waste and areas with potential for improvement.

- It provides valuable insights that contribute to a positive orientation towards reducing energy costs, enhancing preventive maintenance, and improving quality control programs, all of which are critical for production and utility activities.

- This audit program facilitates a focused examination of variations in energy costs, the reliability of energy supply, decisions on an appropriate energy mix, identification of energy conservation technologies, and retrofitting for energy-efficient equipment. Essentially, the Energy Audit translates conservation ideas into practical solutions, offering technically feasible recommendations with due consideration to economic and organizational factors within a specified timeframe.

- The primary objective is to devise strategies for reducing energy consumption per unit of product output or lowering operating costs. Serving as a benchmark, the Energy Audit establishes a reference point for managing energy within the organization and forms the basis for planning more effective energy utilization throughout the entire organization.

- The eco-campus concept primarily emphasizes the efficient utilization and conservation of energy, aiming for savings in a sustainable manner. Additionally, it targets the reduction of carbon emissions, involves the calculation of carbon footprint, advocates for the procurement of star-rated equipment to ensure cost-effective and secure energy supply, promotes and enhances energy conservation in all buildings, strives to diminish the organization's overall energy consumption, minimizes landfill wastes, and incorporates environmental considerations into all contracts and services that are deemed to have substantial environmental impacts.

- Examining Energy Management through auditing involves a focus on energy savings and potential opportunities. While energy itself remains imperceptible, its presence is evident in wires, pipes, and other inanimate materials through observable effects such as heat, light, and power.
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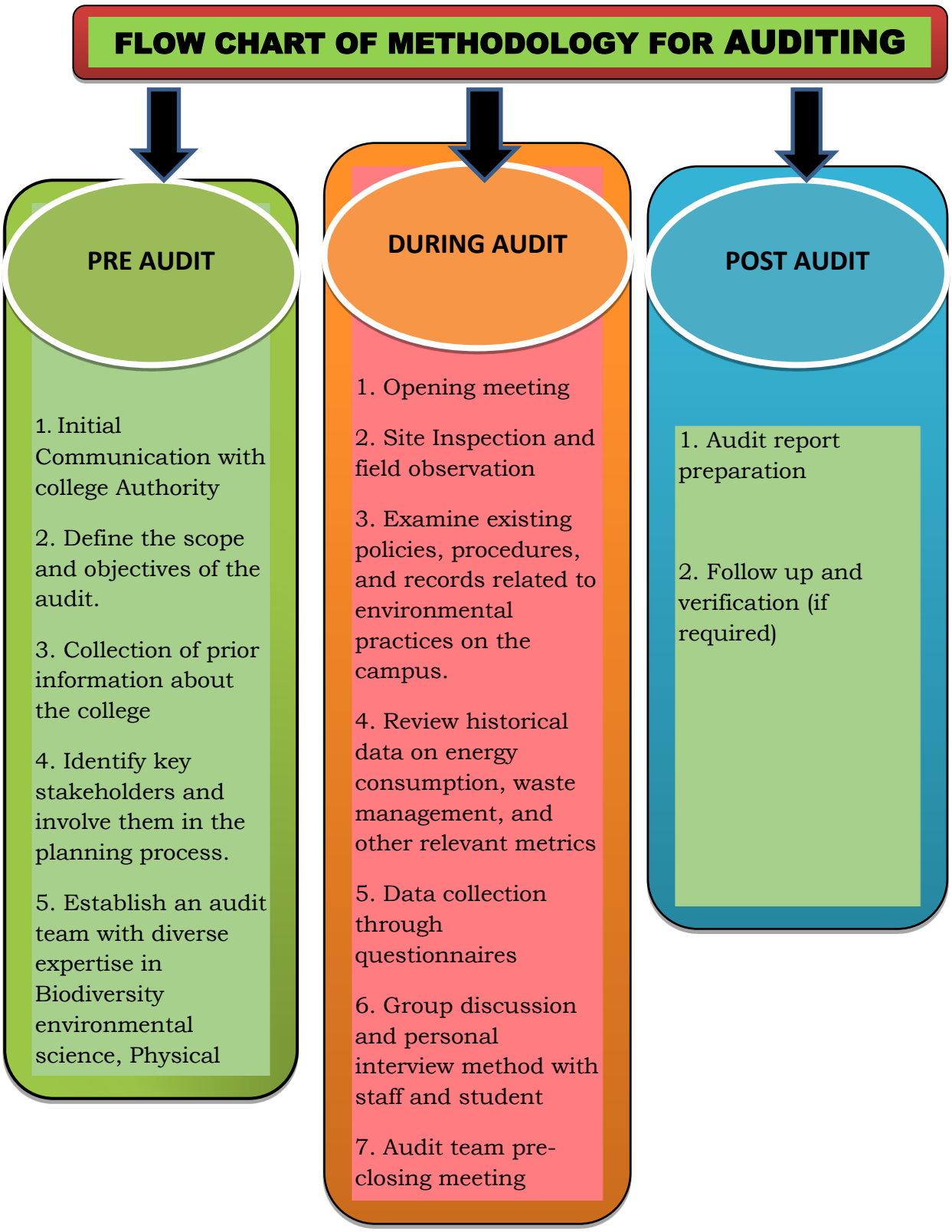
- The indicator for energy management encompasses considerations such as energy consumption, energy sources, monitoring, lighting, vehicle movement, electrical and electronic appliances, and transportation. Energy usage stands as a pivotal facet of campus sustainability, warranting its inclusion in assessments without further explanation.

- Despite the ubiquity of energy usage, attention to energy-saving possibilities remains crucial. For instance, a conventional incandescent bulb consumes approximately 60W to 100W, whereas an energy-efficient light-emitting diode (LED) uses less than 10W, highlighting the positive impact on energy savings. Energy auditing is integral to conservation efforts and the implementation of methods to curtail consumption, thus mitigating environmental degradation. Moreover, audits yield valuable suggestions and recommendations that contribute to effective energy-saving measures.

METHODOLOGY AND SURVEY SCHEDULES



SITE VISIT:

- We embarked on an extensive campus exploration to meticulously observe and document various environmental elements, encompassing waste management zones, energy infrastructures, verdant landscapes, and water conservation systems.
- Our survey delved into the rich biodiversity of campus flora, meticulously cataloging diverse floral and faunal species, accompanied by detailed photographic documentation. Furthermore, we gathered valuable data from the medicinal garden, cafeteria, library, all academic departments, administrative offices, edifices, and parking facilities.
- Methodically, we recorded the quantity and diversity of vehicles utilized by stakeholders, meticulously examining fuel consumption for each vehicle in collaboration with users. Additionally, we scrutinized the usage of LPG cylinders in laboratories, the cafeteria, and residential kitchen facilities.
- During our thorough assessment of water fixtures, we uncovered several instances of leaky taps and overflowing reservoirs, highlighting areas for immediate attention during the site visit.

DIFFERENT TYPES OF SURVEY ARE CONDUCTED IN COLLEGE CAMPUS:

- **Energy Efficiency Assessment:**
- Investigate energy consumption trends across various campus structures. Identify avenues for enhancing energy conservation and efficiency.
- **Water Resource Management Analysis:**
- Assess water origins, usage trends, and wastewater treatment capabilities. Offer suggestions for water preservation and fostering sustainable water practices.
- **Waste Handling Evaluation:**
- Examine waste production rates and disposal methodologies. Propose tactics for diminishing waste output, fostering recycling initiatives, and ensuring proper disposal practices.
- **Transportation and Commute Analysis:**
- Scrutinize commuting behaviors among students and faculty. Suggest eco-friendly transportation alternatives and enhancements to infrastructure.
- **Biodiversity and Greenery Enquiry:** Assess the condition of green areas, gardens, and natural habitats. Propose measures to enhance biodiversity and preserve green spaces.

- **Curriculum Integration and Awareness Survey:**
- Evaluate the integration of environmental themes in the academic curriculum. Assess the level of environmental awareness among students and staff.
- **Infrastructure Development Survey:**
- Examine the sustainability features of new construction projects.
- **Community Engagement Survey:**
- Evaluate the level of engagement and participation in environmental initiatives. Collect feedback from the campus community on environmental awareness programs.
- **Regulatory Compliance Survey:**
- Verify compliance with environmental regulations and standards. Identify areas where adjustments are needed to meet regulatory requirements.
- **Financial and Cost Savings Survey:**
- Assess the financial implications of proposed environmental initiatives. Identify potential cost savings through energy efficiency and waste reduction measures.

STEPS OF DATA COLLECTION:

- Initially, the audit team was divided into two separate units. The seasoned members of the first unit commenced data collection for the energy audit, while those in the second and third units concentrated on gathering information pertinent to the environmental and sustainability assessments.
- Each team member traversed through diverse sections of the college premises, encompassing gardens, dining areas, culinary spaces, the library, and every academic department along with its respective laboratories.
- A thorough questionnaire was devised and disseminated among stakeholders to procure comprehensive data relevant to the environmental, sustainability, and energy evaluations ahead of on-site visits.
- Information and data were amassed through a blend of direct observation, individual interviews, and collective deliberations with various stakeholders.
- Environmental parameters across different spots on the college grounds were evaluated utilizing an array of electronic devices such as atmospheric oxygen and carbon dioxide gauges, alongside total dissolved solids (TDS) meters, with readings meticulously recorded.

- The diameter at breast height (DBH) of significant tree species was gauged, phenological states were scrutinized, and GPS coordinates of notable trees were logged.
- The plant community makeup was dissected using the quadrat technique.
- During field excursions, an array of fauna including mammals, birds, reptiles, amphibians, butterflies, and dragonflies were observed, cataloged, and identified. Moreover, the untamed habitats within the college perimeter were documented, with wildlife-related data garnered through collective discussions and one-on-one interviews with stakeholders.

DATA ANALYSIS:

- Determination of the extent of green space, paved areas, and water bodies within the college grounds.
- Estimation of energy consumption alongside the generation capacity from sustainable energy sources.
- Evaluation of groundwater resources and the protocol for rainwater harvesting and reuse.
- Assessment of waste generation rates and the protocols for disposal and management.
- Monitoring and recording of atmospheric oxygen and carbon dioxide levels across the college campus.
- Computation of the Biodiversity Index within the campus utilizing recognized metrics.
- Examination of Total Dissolved Solids (TDS) levels in water bodies and storage tanks.
- Analysis of plant community attributes including density, frequency, abundance, relative density, relative frequency, and Importance Value Index (IVI).

GREEN AUDIT

IMPORTANCE OF GREEN AUDIT AT BIDHANNAGAR COLLEGE

The significance of a Green Audit at Bidhannagar College is immense in today's global scenario. As communities around the world face the challenges of climate change, dwindling resources, and environmental harm, educational institutions have a pivotal role in fostering sustainable attitudes and actions. Bidhannagar College, as a hub of knowledge and societal impact, recognizes the importance of this duty.

The Green Audit acts as a thorough evaluation tool that examines the college's environmental footprint, resource consumption, waste management, and overall ecological impact. Through this detailed analysis, the college seeks to pinpoint areas needing improvement and adopt sustainable practices in line with its dedication to environmental care.

Moreover, the Green Audit at Bidhannagar College transcends mere regulatory compliance; it acts as a driving force in promoting environmental consciousness among students, faculty, and staff. By embedding sustainable practices into the institution's core values, the college not only supports the global sustainability movement but also nurtures a sense of environmental responsibility within its community

METHODOLOGY ADAPDTED FOR GREEN AUDIT

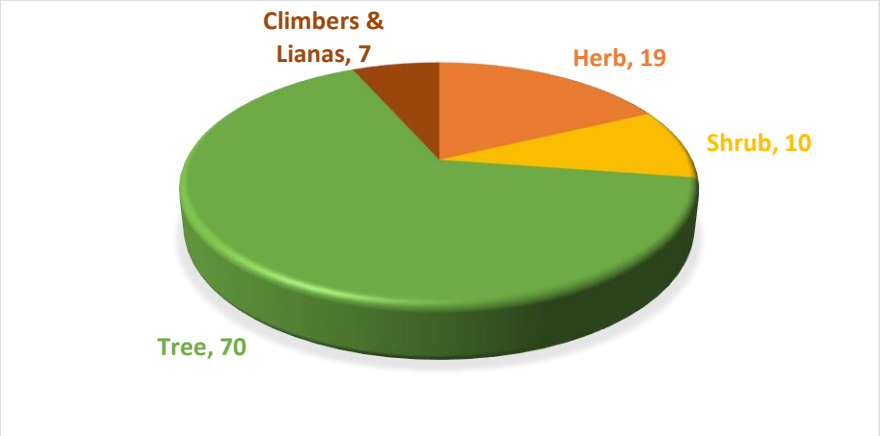
The Green Audit team has surveyed the college campus and recorded all the biodiversity components *i.e.* flora and fauna in the campus of Bidhannagar College. Species were identified on the spot and specimen was collected where farther identification is needed. Most of the existed species were photographed on the field. Flora has been categorized into Major Tree species (MTS), Shrubs, herbs. Insects, soil fauna, Butterfly, Dragon fly, Birds, amphibians, reptilians and mammals were sited and identified during the field visit.

FLORAL DIVERSITY AT THE CAMPUS OF BIDHANNAGAR COLLEGE

A total of 106 species of flowering plants and has been recorded during the study out of which 70 species were considered as Major Tree Species (MTS), 10 species belong from shrubs, 19 species grouped into herbs and 7 species were considered as climbers and lianas. Out of 106

species 42% plants species have medicinal potentiality (Fig. 1), as evidenced by published literature

Fig.1 Classification of flora of Bidhannagar College based on habit



It is interesting to note that a total of 356 individuals under 70 species of (Major Tree Species) MTS belong from 35 different taxonomic families which represents that the taxonomic diversity of the college campus was very high (Table 1). As the open area in the college campus is high, most of the MTS were found to be distributed in these open spaces in a low competitive environment and thus proliferate almost to their maximum with high canopy spread.

Diversity of MTS in the college campus

Table 1. Diversity of Major Tree Species (MTS) in the Campus of Bidhannagar College

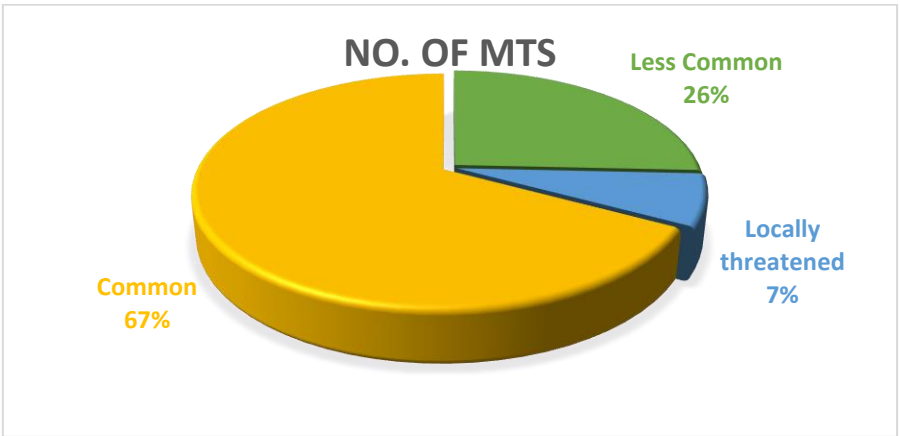
P. N	Name of the MTS	Family	Vernacular name	No. of Individuals	Mean DBH (ft)	F%	Local Status
1	*Neolamarckia cadamba*	Rubiaceae	Kadam	6	8.00	1.685	C
2	*Alstonia scholaris*	Apocynaceae	Chatim	1	2.50	0.281	C
3	*Mallotus philippensis*	Euphorbiaceae	Dhapol	1	4.00	0.281	LC
4	*Phoenix sylvestris*	Arecaceae	Khejur	2	2.50	0.562	C
5	*Albizia lebbeck*	Fabaceae	Siris	4	6.00	1.124	C
6	*Ficus hispida*	Moraceae	Dumur	6	2.80	1.685	C
7	*Swietenia macrophylla*	Meliaceae	Mehogini	19	6.00	5.337	C
8	*Mangifera indica*	Anacardiaceae	Aam	55	4.00	15.449	C
9	*Acacia auriculiformis*	Fabaceae	Akashmoni	9	2.60	2.528	C
10	*Streblus asper*	Moraceae	Saora	1	2.80	0.281	C
11	*Mimusops elengi*	Sapotaceae	Bokul	1	3.50	0.281	C
12	*Azadirachta indica*	Meliaceae	Nim	7	7.50	1.966	C

13	*Bauhinia purpurea*	Fabaceae	Kanchan	1	3.00	0.281	LC
14	*Thespesia populnea*	Malvaceae	Indian Tulip	1	5.50	0.281	C
15	*Pithecellobium dulce*	Fabaceae	Jilabi	2	4.20	0.562	C
16	*Spathodea campanulata*	Bignoniaceae	Rudra palas	4	6.20	1.124	C
17	*Melia azedarach*	Meliaceae	Ghora nim	2	4.70	0.562	LC
18	*Peltophorum pterocarpum*	Fabaceae	Radhachura	1	9.20	0.281	C
19	*Artocarpus heterophyllus*	Moraceae	Kanthal	16	5.90	4.494	C
20	*Moringa oleifera*	Moringaceae	Sojne	7	4.10	1.966	C
21	*Ficus religiosa*	Moraceae	Asottho	1	1.00	0.281	C
22	*Syzygium samarangense*	Myrtaceae	Jamrul	9	3.00	2.528	C
23	*Barringtonia acutangula*	Lecythidaceae	Hijol	1	3.00	0.281	LC
24	*Ficus rumphii*	Moraceae	Pakur	2	1.00	0.562	LC
25	*Ficus benghalensis*	Moraceae	Bot	2	2.00	0.562	C
26	*Putranjiva roxburghii*	Putranjivaceae	Putranjiva	2	3.40	0.562	C
27	*Mitragyna parvifolia*	Rubiaceae	Keli kadam	1	2.00	0.281	LC
28	*Cinnamomum tamala*	Lauraceae	Tej pata	1	3.40	0.281	LC
29	*Nyctanthes arbor-tristis*	Oleaceae	Siuli	3	0.90	0.843	C
30	*Cordia myxa*	Boraginaceae	Boali	1	2.30	0.281	LT
31	*Psidium guajava*	Myrtaceae	Peyara	9	2.70	2.528	C
32	*Senna siamea*	Fabaceae	Casia	1	4.00	0.281	C
33	*Cascabela Thevetia*	Apocynaceae	Kolke	2	1.10	0.562	C
34	*Phyllanthus emblica*	Phyllanthaceae	Amloki	1	4.80	0.281	LC
35	*Polyalthia longifolia*	Annonaceae	Debdaru	33	1.00	9.270	C
36	*Cassia fistula*	Fabaceae	Amaltas	2	3.70	0.562	LC
37	*Syzygium jambolanum*	Myrtaceae	Jam	9	8.10	2.528	C
38	*Artocarpus lacucha*	Moraceae	Dapor	2	4.10	0.562	LT
39	*Cocos nucifera*	Arecaceae	Narkel	31	4.80	8.708	C
40	*Trema orientalis*	Cannabaceae	Trema	11	3.00	3.090	C
41	*Terminalia arjuna*	Combretaceae	Arjun	7	4.00	1.966	C
42	*Musa paradisiaca*	Musaceae	Kala	10	1.30	2.809	C
43	*Saraca asoca*	Fabaceae	Ashok	4	4.00	1.124	LT
44	*Ficus racemosa*	Moraceae	Jogyo dumur	2	5.20	0.562	LC
45	*Delonix regia*	Fabaceae	Gulmohor	1	6.00	0.281	C
46	*Dillenia indica*	Dilleniaceae	Chalta	1	4.00	0.281	LC
47	*Roystonea regia*	Arecaceae	Bottle palm	3	6.00	0.843	LC
48	*Tabebuia chrysantha*	Bignoniaceae	Basanti	1	3.90	0.281	C
49	*Areca catechu*	Arecaceae	Supari	4	1.80	1.124	C
50	*Ziziphus mauritiana*	Rhamnaceae	Kul	1	3.50	0.281	C
51	*Manilkara zapota*	Sapotaceae	Sopeda	1	4.90	0.281	C
52	*Averrhoa carambola*	Oxalidaceae	Kamranga	1	2.80	0.281	LT

53	*Aegle marmelos*	Rutaceae	Bel	1	3.60	0.281	C
54	*Casuarina equisetifolia*	Casuarinaceae	Jhau	1	6.90	0.281	LC
55	*Caryota mitis*	Arecaceae	Fish tail palm	2	4.00	0.562	C
56	*Couroupita guianensis*	Lecythidaceae	Naglingam	1	1.40	0.281	LC
57	*Terminalia bellirica*	Combretaceae	Boera	1	1.10	0.281	LC
58	*Bambusa tuldoides*	Poaceae	Ghoti Bans	18	0.70	5.056	C
59	*Thuja occidentalis*	Cupressaceae	Thuja/Jhau	10	0.90	2.809	C
60	*Ficus benjamina*	Moraceae	Biliti Bot	1	2.00	0.281	C
61	*Hevea brasiliensis*	Euphorbiaceae	Para rober	1	4.00	0.281	C
62	*Lagerstroemia Indica*	Lythraceae	Jarul	1	2.00	0.281	C
63	*Cycas rumphii*	Cycadaceae	Cycas	5	3.00	1.404	C
64	*Butea monosperma*	Fabaceae	Palas	1	2.00	0.281	LC
65	*Bixa morellana*	Bixaceae	Sinduri	1	2.70	0.281	LT
66	*Ciba pentandra*	Malvaceae	Simul	1	5.00	0.281	LC
67	*Dalbergia sissoo*	Fabaceae	Sisu	2	4.00	0.562	C
68	*Shorea robusta*	Dipterocarpaceae	Shal	1	2.80	0.281	C
69	*Terminalia cattapa*	Combretaceae	Bakso Badam	1	4.00	0.281	LC
70	*Samanea saman*	Fabaceae	Bilaiti Khiris	1	7.00	0.281	C

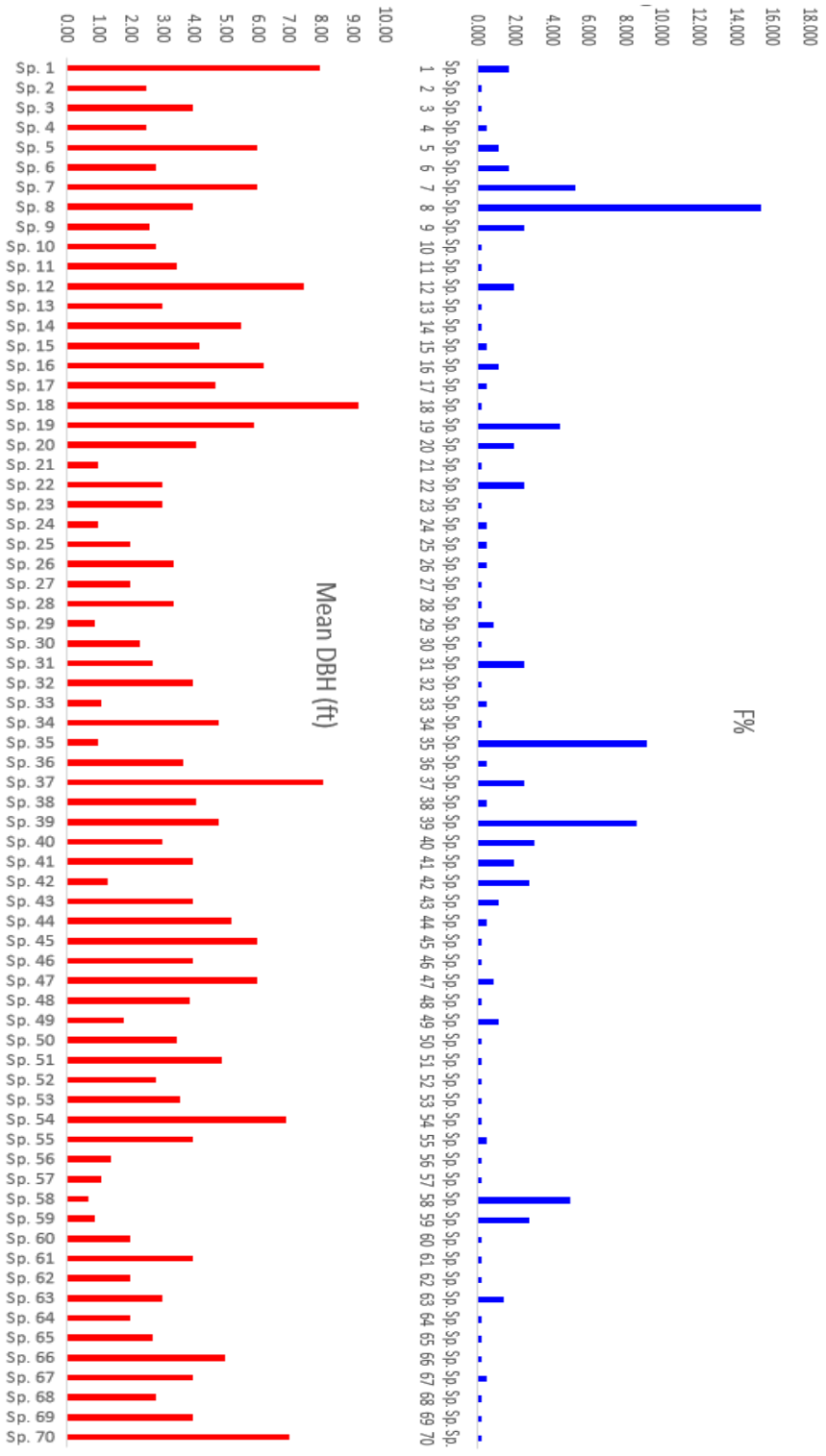
Around 96% of these MTS are arborescent in nature to their growth form. *Mangifera Indica* is the most dominant species (56 individuals) followed by *Polyalthia longifolia* (33 individuals) though planted. In respect to the canopy cover *Mangifera Indica, Azadirachta indica, Casuarina equisetifolia, Peltophorum pterocarpum, Neolamarckia cadamba, and Pithecellobium dulce* are the most arborescent in the college campus with high canopy coverage. Around 68% of the MTS were observed to be attend to their phenological stages. A good number of MTS were found to be planted in recent dates at the left side and front of the administrative building which is a great initiative towards development of green campus by the college authority.

Fig. 2 Local status of MTS present at Bidhannagar College



It was important to note that 26% of the plants present in the college campus are less common in the locality even 7% of the MTS are locally threatened. These findings indicate the importance of the college campus in conservation of Major Tree Species (Fig. 2).

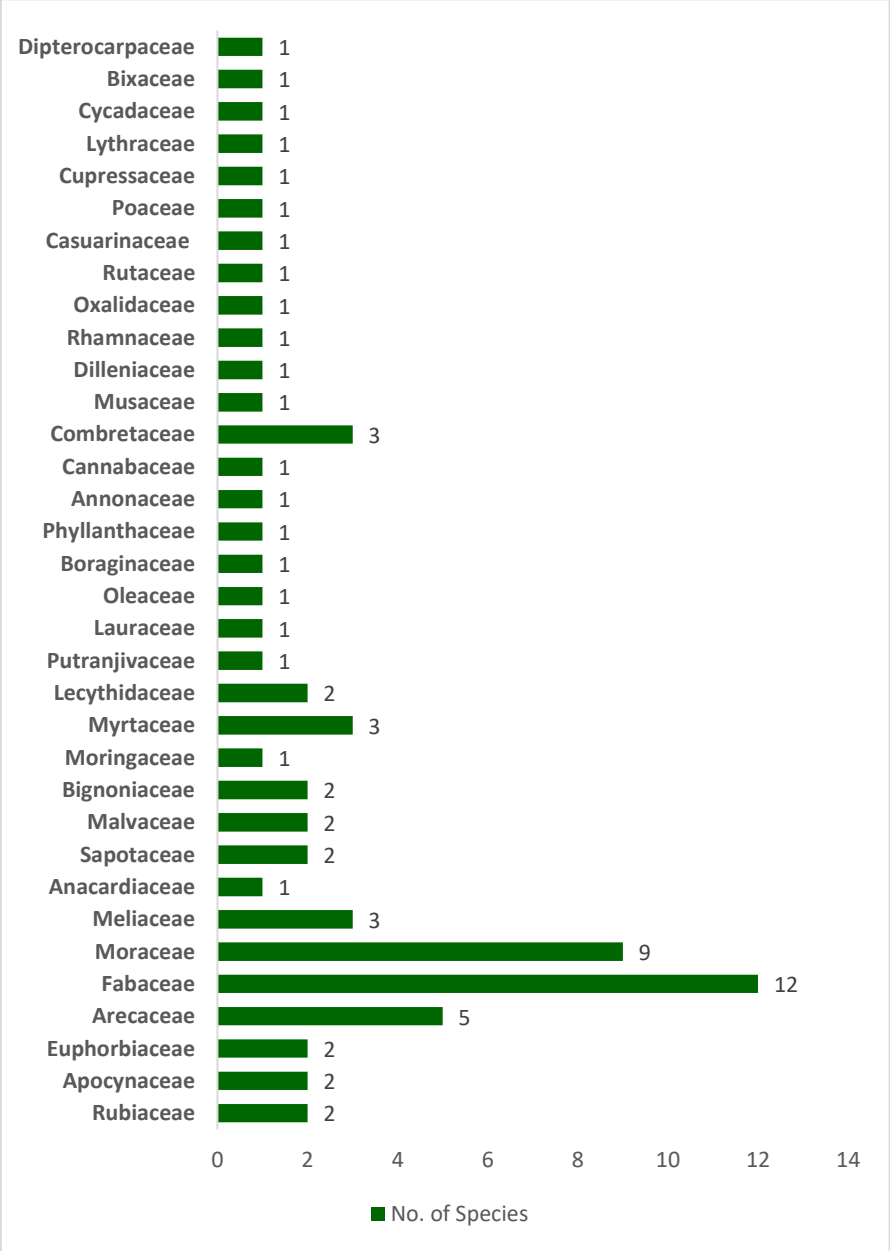
Figure 3. Mean DBH (ft) and F% of MTS



In respect of Frequency *Mangifera indica* shown its highest F% followed by *Polyalthia longifolia* and *Cocos nucifera* where as in case of mean DBH, *Peltophorum pterocarpum* its highest diameter (9.20 ft) followed by *Neolamarckia cadamba and Syzygium jambolanum*. These findings represent that these species have maximum community control over MTS present in the college premises (Fig. 3).

Out of 35 taxonomic families under which these 70 MTS belongs from, Fabaceae is the most dominant family (12 species of MTS belongs from this family). Fabaceae was followed by Moraceae and Arecaceae (9 and 5 species belongs from these families respectively) (Fig 4).

Figure 4. Number of species under different Taxonomic Family



Considering the species richness and evenness, when the Simpson's Diversity Index of the MTS was calculated using the formula (EQ-1)

D =1- $(\sum n(n-1)/N(N-1))$……(EQ-1)

It was observed that the diversity of MTS in the campus of Bidhannagar College very high in MTS diversity (**D =0.0028**). As the college possess a large portion of open area and the college authority shown a positive attitude towards green campus thus the Simpson's Diversity Index for the MTS community was very high in the college premises.

Phyllanthus emblica and *Streblus asper*

Spathodea campanulata

Casuarina equisetifolia

Azadirachta indica

Neolamarckia cadamba

Syzygium jambolanum and canopy of other MTS

Ficus rumphii, Mangifera indica and *Azadirachta indica*

Butea monosperma

Diversity of Shrubs, Herbs, Climbers and Lianas in the Bidhannagar College Campus

A total of 36 species of Shrubs, Herbs, Climbers and Lianas were recorded from College Campus which were found to be distributed under 21 different taxonomic families (Table 2). Around 63% of these plants belongs from these groups have potential medicinal importance as per the published literature. Taxonomic diversity of these herbs, shrubs, climbers & lianas was found to be very high in the college campus

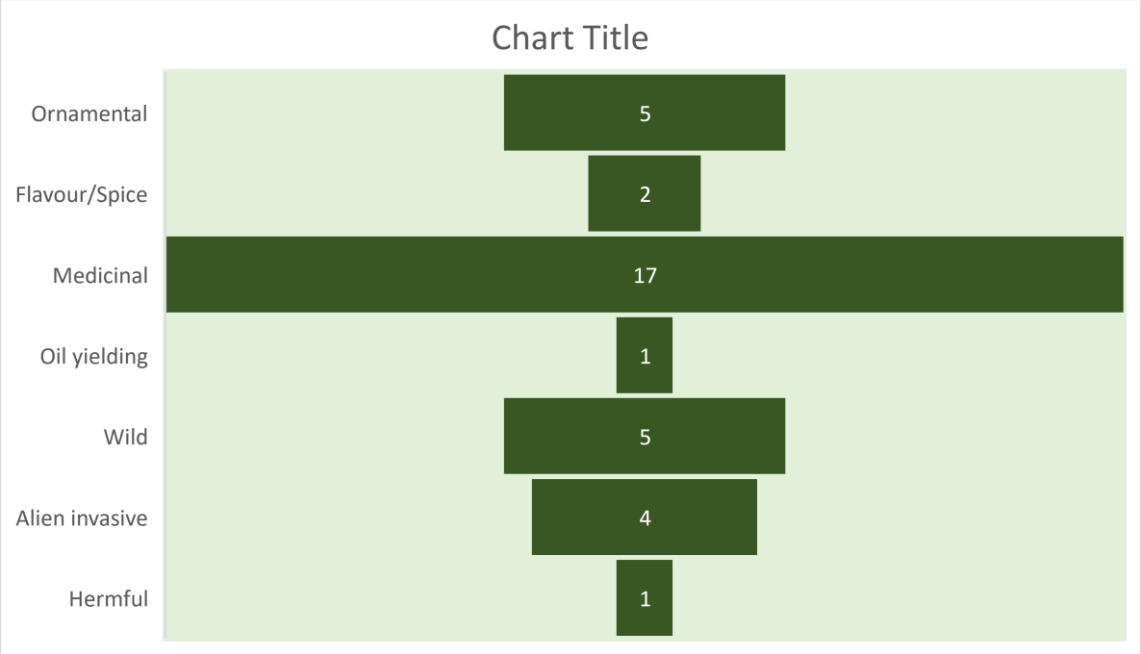
Table 2 Diversity and use of herbs, shrubs, climbers and trees in the college campus

Sl. No.	Shrub species	Family	Use as/ Use in/Other information
1	*Tabernaemontana divaricata*	Apocynaceae	Ornamental
2	*Murraya paniculata*	Rutaceae	Ornamental
3	*Citrus aurantiifolia*	Rutaceae	Flavour/spice
4	*Abroma Augusta*	Sterculiaceae	Medicinal
5	*Murraya koenigii*	Rutaceae	Flavour/Spice

6	*Ricinus communis*	Euphorbiaceae	Oil yielding
7	*Crotalaria sp.*	Fabaceae	Medicinal
8	*Cestrum diurnum*	Solanaceae	Ornamental
9	*Caesalpinia pulcherrima*	Fabaceae	Ornamental
10	*Hibiscus rosa-sinensis*	Malvaceae	Ornamental
Sl. No.	**Herbaceous species**	**Family**	**Use as/ Use in/Other information**
1	*Phyllanthus niruri*	Phyllanthaceae	Medicinal
2	*Cyperus rotundus*	Cyperaceae	Medicinal
3	*Eragrostis tenella*	Poaceae	Wild Grass
4	*Parthenium hysterophorus*	Asteraceae	Harmful
5	*Eleutheranthera ruderalis*	Asteraceae	Wild
6	*Oplismenus hirtellus*	Poaceae	Wild
7	*Cleome gynandra*	Cleomaceae	Medicinal
8	*Oxalis stricta*	Oxalidaceae	Medicinal
9	*Chrozophora plicata*	Euphorbiaceae	Wild
10	*Nicotiana plumbaginifolia*	Solanaceae	Wild tobacco
11	*Commelina benghalensis*	Commelinaceae	Medicinal
12	*Andrographis paniculata*	Acanthaceae	Medicinal
13	*Aloe vera*	Asphodelaceae	Medicinal
14	*Acalypha indica*	Euphorbiaceae	Medicinal
15	*Achyranthes aspera*	Amaranthaceae	Wild
16	*Tridax procumbens*	Asteraceae	Alien invasive
17	*Brachiaria mutica*	Poaceae	Alien invasive
18	*Euphorbia hirta*	Euphorbiaceae	Wild
19	*Cymbopogon citratus*	Poaceae	Medicinal
Sl. No.	**Climbers and lianas species**	**Family**	**Use as/ Use in/Other information**
1	*Coccinia grandis*	Cucurbitaceae	Medicinal
2	*Asparagus racemosus*	Asparagaceae	Medicinal
3	*Tinospora cordifolia*	Menispermaceae	Medicinal
4	*Tinospora sinensis*	Menispermaceae	Medicinal
5	*Vitis trifolia*	Vitaceae	Medicinal
6	*Hemidesmus indicus*	Apocynaceae	Medicinal
7	*Mikania micrantha*	Asteraceae	Alien invasive

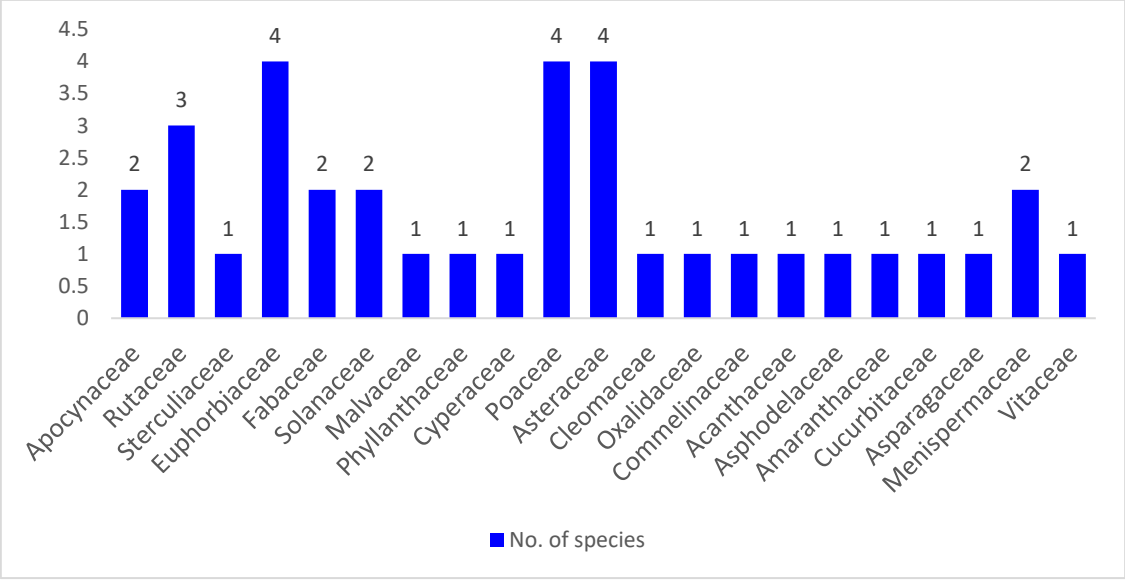
Apart from medicinal importance, 5 of the plant species commonly use as ornamental in gardening, 2 plants are used as spice, 5 are wild in habitat, 4 are alien invasive in nature and one plant *i.e. Parthenium hysterophorus* is harmful in nature and should be eradicated from the college premises. (Fig 5)

Fig. 5 Floral diversity recorded to be used as/used in and their nature in the habitat



It was interesting to note that these 36 species of Shrubs, Herbs, Climbers and Lianas recorded from College Campus were belonged from 21 different taxonomic families which represent that the taxonomic diversity is very high in the college campus. Out of these 21 taxonomic families Euphrbiaceae, Poaceae and Asteraceae were the most dominant families (Eace contain 4 species each). These families were followed by Rutaceae (Fig 6).

Figure 6. Number of species under different Taxonomic Family



Nicotiana plumbaginifolia, Oplismenus hirtellus and other herbs community.

Cleome gynandra and other grasses

Acalypha indica and other herbs

Community structure of herbaceous plants

To study the herbaceous plant community random quadrat of (4 X 4) ft. size has been plotted in the open areas of the college campus. Prior to that minimum size of the quadrat has been determined (4X 4) ft. A total of 8 quadrats has been plotted and the individual of each herbaceous species has been counted. Farther to study the community structure Density, Frequency, Abundance, Relative density and Relative frequency was estimated using standard protocol. After that the Importance Value Index (IVI) was also calculated using standard formula (Table 2).

Eragrostis tenella shown its highest Relative Density (207.182) followed by *Parthenium hysterophorus* and *Cyperus rotundus* in this grass and forbs community (Table 3 and Fig 7). On the other hand, two alien invasive species *i.e. Tridax procumbens* (RF =14) followed by *Parthenium hysterophorus* (Table 3) shown their highest relative frequency in the herbaceous plant community. (Fig. 7).

To know the maximum control in the formation of herbaceous plant community structure the Importance Value Index (IVI) was estimated for each species. It was observed that *Eragrostis tenella* followed by *Parthenium hysterophorus* shown their highest IVI value (217.182 and 205.37

respectively) (Table 3 and Fig. 8). This finding depict that these plants have maximum contribution over the herbaceous plant community structure formation and thus have maximum control over the community producing a diverse niche for different other soil fauna (Table 3).

Table 3. Community structure of herbaceous plants of Bidhannagar College

SL. No.	Plant Species	D	F	AB	RD	RF	IVI
1	*Euphorbia hirta*	137.500	75.000	1.833	75.967	12.000	87.967
2	*Phyllanthus niruri*	112.500	37.500	3.000	62.155	6.000	68.155
3	*Cyperus rotundus*	287.500	50.000	5.750	158.840	8.000	166.840
4	*Eragrostis tenella*	375.000	75.000	5.000	207.182	10.000	217.182
5	*Parthenium hysterophorus*	350.000	87.500	4.000	193.370	12.000	205.370
6	*Tridax procumbens*	62.500	50.000	1.250	34.530	14.000	48.530
7	*Eleutheranthera ruderalis*	137.500	50.000	2.750	75.967	8.000	83.967
8	*Oplismenus hirtellus*	112.500	37.500	3.000	62.155	4.000	66.155
9	*Cleome gynandra*	75.000	25.000	3.000	41.436	8.000	49.436
10	*Oxalis stricta*	37.500	25.000	1.500	20.718	6.000	26.718
11	*Acalypha indica*	75.000	25.000	3.000	41.436	4.000	45.436
12	*Nicotiana plumbaginifolia*	137.500	25.000	5.500	75.967	4.000	79.967
13	*Commelina benghalensis*	37.500	25.000	1.500	20.718	4.000	24.718

Euphorbia hirta

Parthenium hysterophorus

Fig. 7 Comparative study of RD and RF of the herbaceous plant community in the study site

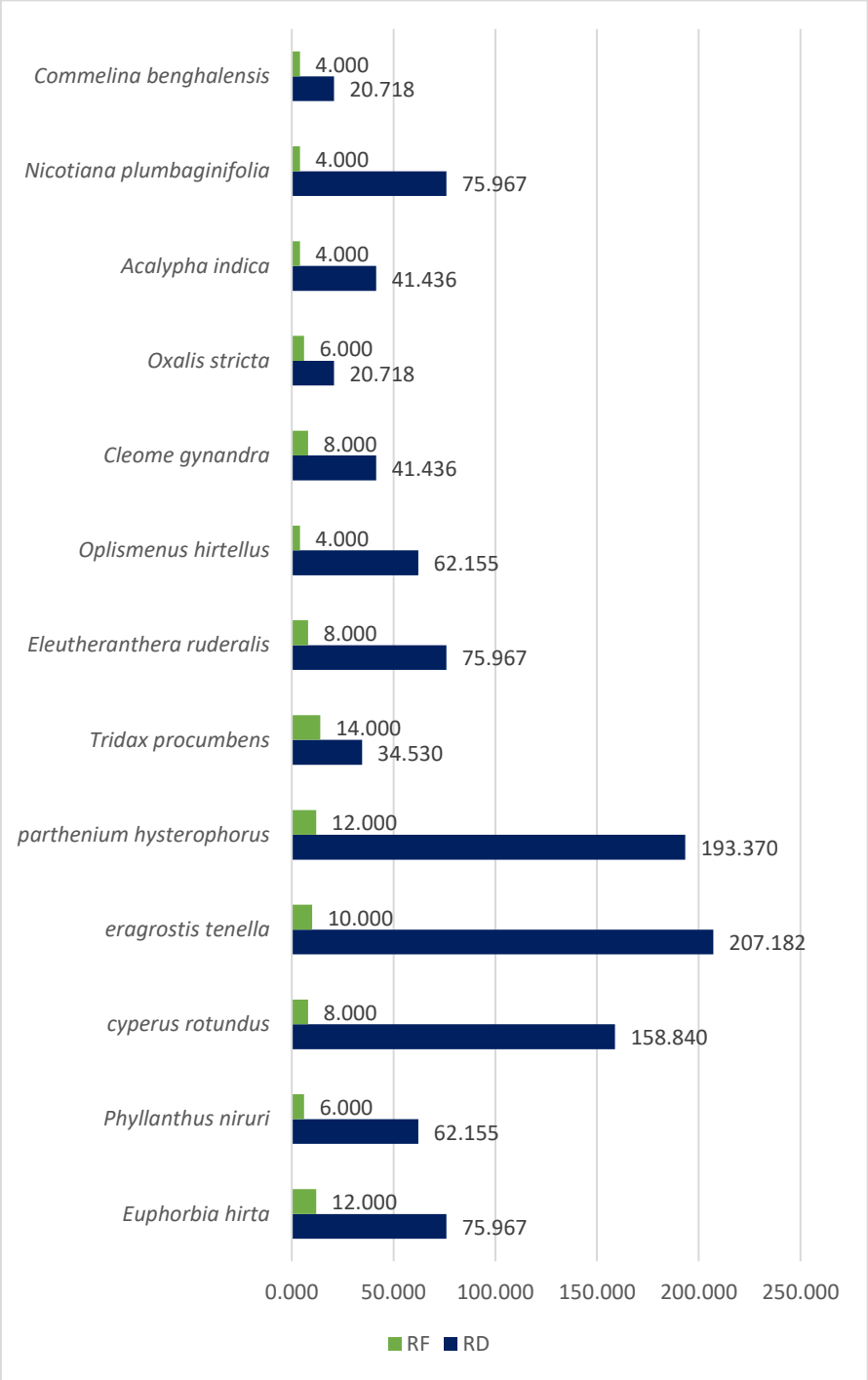
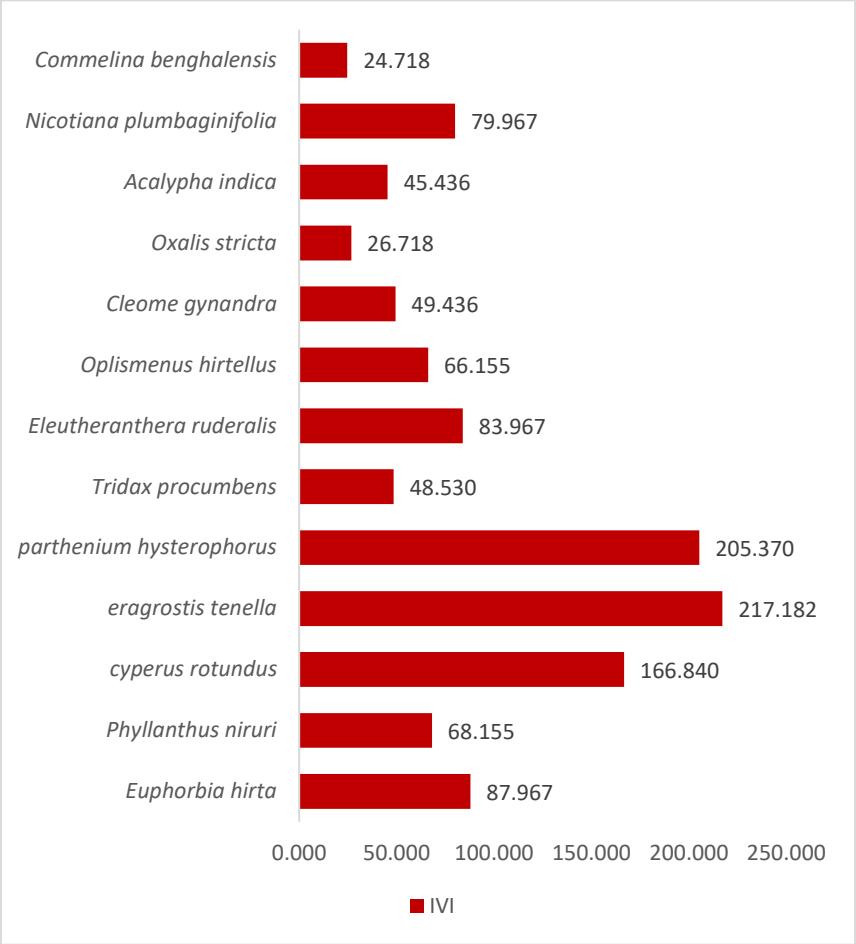


Fig. 8 Importance Value Index (IVI) of different herbaceous species in the college campus



Eragrostis tenella, Oplismenus hirtellus and other plants in the herbaceous community and Quadrat study

FAUNAL DIVERSITY AT THE CAMPUS OF BIDHANNAGAR COLLEGE

As the college is situated at the most congested area of Calcutta, there is no such wild habitat present in the college campus. Here in this green audit the total fauna of the college campus has been categorized into **1. Soil fauna 2. Butterflies and Dragon flies and other 3. Birds 4. Reptiles and Mammals.**

A total of 19 species soil fauna and fauna on and within wooden furniture and books were recorded from the Bidhannagar College campus (Table 1). The diverse array of soil fauna detailed in the table highlights the intricate web of life that sustains soil health and ecosystem functionality. From nematodes and annelids to soil arthropods, insects, and reptiles, each group plays a vital role in processes such as decomposition, nutrient cycling, and soil aeration. This biodiversity is crucial for maintaining fertile and productive soils, which are foundational to both natural ecosystems and agricultural systems.

Understanding and preserving the diversity of soil fauna is essential for sustainable land management and environmental conservation. As these organisms collectively contribute to soil structure, fertility, and overall ecosystem health, their protection and study should be prioritized. This knowledge can inform practices that enhance soil quality, support biodiversity, and ensure the resilience of ecosystems in the face of environmental challenges.

Table 1. Soil Fauna of Bidhannagar College

Name of the of the soil fauna and fauna on and within wooden furniture and books	Family
Camponotus compressus	Formicidae
Apogonia ferruginea	Scarabaeidae
Calotes versicolor	Agamidae
Camponotus compressus	Formicidae
Cornu aspersum	Helicidae
Deroceras reticulatum	Agriolimacidae
Eutyphoeus incommodus	Octochaetidae
Hypogastrura nivalis	Hypogastruridae
Lampito mauritii	Lumbricidae

Metaphire postuma	Megascolecidae
Nopoiulus kochii	Blaniulidae
Odontotermes feae	Termitidae
Oniscus asellus	Oniscidae
Scolopendra hardwickii	Scolopendridae
Solenopsis invicta	Formicidae
Stemmiulus vagans	Stemmiulidae
Suncus murinus	Soricidae
Odontotermes feae	Termitidae
Periplaneta americana	Blattidae

A total of 22 species of Butterflies, Moth, Dragon flies and other flies were noted during the survey at the Bidhannagar College campus (Table 2). High diversity of butterflies was noted due to presence of a number of host and nectar plant species in the college campus like.

Table 3 Diversity of Butterflies, Moth, Dragon flies and other flies

Sl. No.	Name of the species	Common name
2	*Papileo demoleus*	Lime Butterfly
3	*Catopsilia pomona*	Common Emigrant
4	*Catopsilia pyranthe*	Mottled Emigrant
5	*Eurema hecabe*	Common Grass Yellow
6	*Ariadne merione*	Common Castor
7	*Junonia lemonias*	Lemon Pansy
8	*Junonia almanac*	Peacock Pansy
9	*Papilo demoleus*	Lemon butterfly
10	*Papilio polytes*	Common Mormon
11	*Plodia interpunctella*	Indian meal moth
12	*Omocestus viridulus*	common green grasshopper
13	*Corduligaster* sp.	Spiketails
14	*Apis indica*	Indian honey bee
15	*Vespa sp.*	Hornets

16	*Tabanus sp.*	House fly
17	*Musca domestica*	House fly
18	*Lucilia sp.*	common green bottle fly
19	*Anophelese sp.*	marsh mosquitoes
20	*Culex porcellus*	mosquitoes
21	*Drosophila sp.*	lesser fruit fly
22	*Gryllus sp.*	Syrphid-flies

A total of 18 species of birds were recorded from the college campus (Table 4). Each bird species listed has a unique role in its ecosystem. Owls and crows help control pest populations, Mynas and parrots assist in seed dispersal, and pigeons contribute to nutrient cycling in urban environments. Birds like the owl and parrot have significant cultural and symbolic meanings.

Table 4 Diversity of Birds in the college campus

Sl. No.	Zoological Name	English name	Schedule Status in Wildlife Protection Act	Bengali Name
1	*Acridotheres tristis*	Common Moyna	IV	Salik
2	*Acridotheres tristis*	Common Myna	IV	Salik
3	*Bubo bengalensis*	Owl	IV	Pencha
4	*Centropus sinensis*	Greater Coucal	IV	Harichacha
5	*Columba domestica*	Pigeon	IV	Payra
6	*Copsychus saularis*	Oriental Magpie Robin	IV	Doyel
7	*Corvus domesticus*	Crow	IV	Kak
8	*Corvus splendens*	Crow	IV	Kak
9	*Dicrurus macrocercus*	Black Drongo	IV	Finge
10	*Dinopium benghalense*	Black-rumped Flameback	IV	Kath thokra
11	*Eudynamys scolopacea*	Asian Koel	IV	Kokil
12	*Halcyon capensis*	Stork-billed Kingfisher	IV	Machranga
13	*Halcyon smyrnensis*	White-throated Kingfisher	IV	Sada bukh Machranga
14	*Oriolus xanthornus*	Black-hooded Oriole	IV	Bene Bou

15	*Orthotomus sutorius*	Common Tailorbird	IV	Tuntuni
16	*Psittacula sp.*	Parrot	IV	Tia
17	*Streptopelia chinensis*	Spotted Dove	IV	Ghugu
18	*Turdoides striatus*	Jungle Babbler	IV	Chatare

While these birds are common and adaptable, they still face threats from habitat destruction, pollution, and human activities. Conservation efforts should focus on preserving their habitats and mitigating the negative impacts of urbanization.

- **Urban Wildlife Management**: Cities need to implement strategies that allow coexistence with these bird species, such as creating green spaces and ensuring safe nesting sites.
- **Public Awareness**: Educating the public about the ecological roles and importance of these birds can foster a sense of stewardship and encourage conservation actions. Bidhannagar College may take an important role in this awareness programme.

High diversity of birds in premises of Bidhannagar College may be due to high diversity of arborescent tree species (356 individuals) in the campus which are chosen by different bird species as their roosting and nesting site. This finding indicates that the floristic diversity of Bidhannagar college campus play a pivotal role in conservation of different avifauna which are declining day by day due to habitat loss specifically from the city like Kolkata.

6 species of mammals were recorded from the college campus of which 1 is domestic. *Craseonycteris thonglongyal* was noted to be dwell in some arborescent trees of the college campus. Chip-munk was also found to be occur in the two arborescent tree species present at the college campus.

Table 5 Diversity of mammals at the college campus

Mammals	Common name/English name/ Vernacular name
Bandicoota bengalensis	Rat
Mus booduga	Mice
Craseonycteris thonglongyal	Bat
Funambulus palmarum	Chip-munk
Felis domesticus	Cat

Urban colleges like Bidhannagar College have the potential to be powerful advocates and practitioners of fauna conservation. Through education, research, habitat creation, community engagement, sustainable practices, and strategic collaborations, these institutions can significantly contribute to preserving and enhancing urban biodiversity. By fostering a culture of environmental stewardship among students and the community, This Urban college can help ensure a sustainable future for both people and city wildlife.

Junonia lemonias

Eurema hecabe

Apis indica

Papilio polytes

Corvus domesticus

Acridotheres tristis

Columba domestica

Eudynamys scolopacea

Dicrurus macrocercus

Dinopium benghalense

CONCLUSION

The Green Audit at Bidhannagar College is not merely a procedural requirement but a strategic commitment towards building a greener and more sustainable future. It reflects the college's dedication to being a responsible global citizen and preparing its stakeholders to navigate the challenges of a rapidly changing environmental landscape. A considerable area of green canopy and opens paces has been recorded in the college campus which harbours diverse floral and faunal composition and their undisturbed shelters which is unique for an educational institute situated in a highly congested metropolitan city (Kolkata). As Bidhannagar College embarks on this transformative journey, it sets an example for other educational institutions to follow, fostering a collective effort towards a more sustainable and resilient world.

ENVIRONMENT AUDIT

CAMPUS SURVEY AND ENQUIRY

Conducting an environmental audit on a college campus is vital for fostering sustainability, ensuring regulatory compliance, and achieving financial savings. By pinpointing inefficiencies in resource use and waste management, the college can introduce measures to cut consumption and boost recycling, leading to a more sustainable campus environment. Regular audits help the institution stay compliant with environmental laws and regulations, preventing legal issues and securing necessary permits. Financially, reducing energy and resource inefficiencies lowers operational costs and creates opportunities for sustainability grants. Moreover, a proactive environmental strategy enhances the college's reputation, attracting students and funding while building positive relationships within the community.

Environmental audits also offer valuable educational opportunities, allowing real-world data to be integrated into the curriculum and involving students in sustainability projects. Additionally, they contribute to the health and well-being of the campus community by identifying and addressing environmental hazards. Regular audits enable the college to benchmark its performance, set improvement goals, and adopt innovative practices, thus improving overall efficiency and sustainability. Finally, these audits help identify environmental risks and improve crisis preparedness, ensuring the campus is well-equipped to handle potential environmental challenges responsibly.

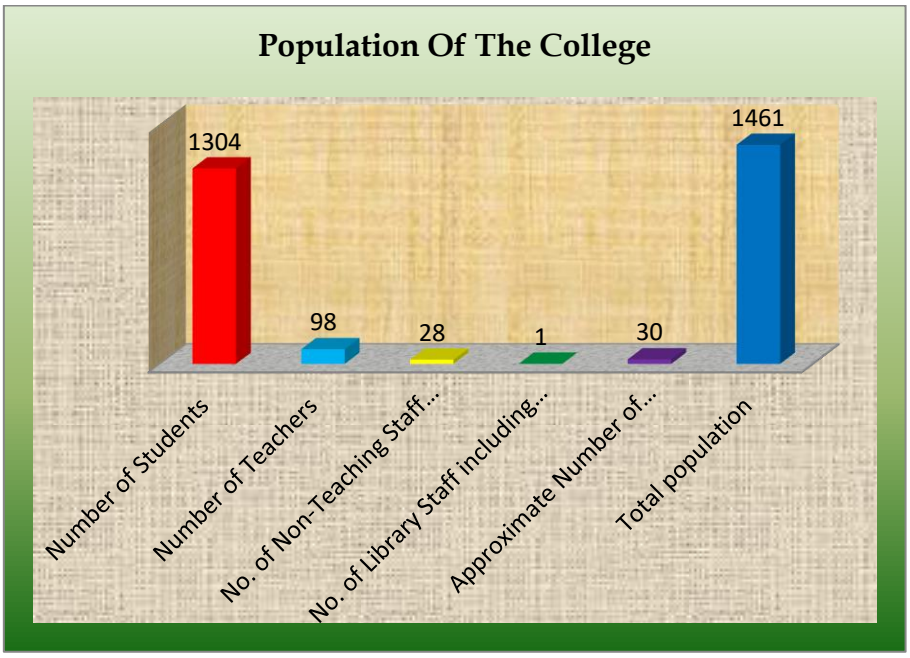
The Audit covered the following major areas:

- Average Foot fall
- Water Quality and Efficiency of Water Management
- Air Quality and Carbon foot print and Management
- Waste and Waste Management
- E-waste management
- Environmental disaster management

TOTAL POPULATION OF THE COLLEGE CAMPUS – FOOT FALL

NUMBER OF STUDENTS	1304
NUMBER OF TEACHERS	98
NO. OF NON-TEACHING STAFF INCLUDING CASUAL STAFF	28
NO. OF LIBRARY STAFF INCLUDING CASUAL STAFF	1
APPROXIMATE NUMBER OF VISITORS	30
TOTAL POPULATION	**1461**

FOOT FALL BASED ON TOTAL POPULATION



75% of the footfall of the total population may be considered as the average footfall in the college per day. This represent the footfall is moderate considering the total space of the college campus.

WATER QUALITY AND EFFICIENCY OF WATER MANAGEMENT

Water, the lifeblood of our planet, is a finite and invaluable resource crucial for sustaining ecosystems, livelihoods, and human health. Its importance to human life cannot be overstated, as it is integral to maintaining overall health and well-being. As a core component of our bodies, water is vital for various physiological functions such as digestion, nutrient absorption, circulation, and temperature regulation.

Moreover, water is indispensable for preserving ecosystems, supporting a wide array of plant and animal species, and promoting biodiversity. It is essential for maintaining the natural habitats that sustain wildlife and ensure the balance of ecological processes. In essence, water is not just a necessity for human survival but also a cornerstone for environmental health and sustainability.

However, in our modern world, marked by population growth, urbanization, and climate change, water sources are under increasing strain. This situation calls for a collective effort to adopt water-efficient practices and effective water management strategies to address contemporary water challenges.

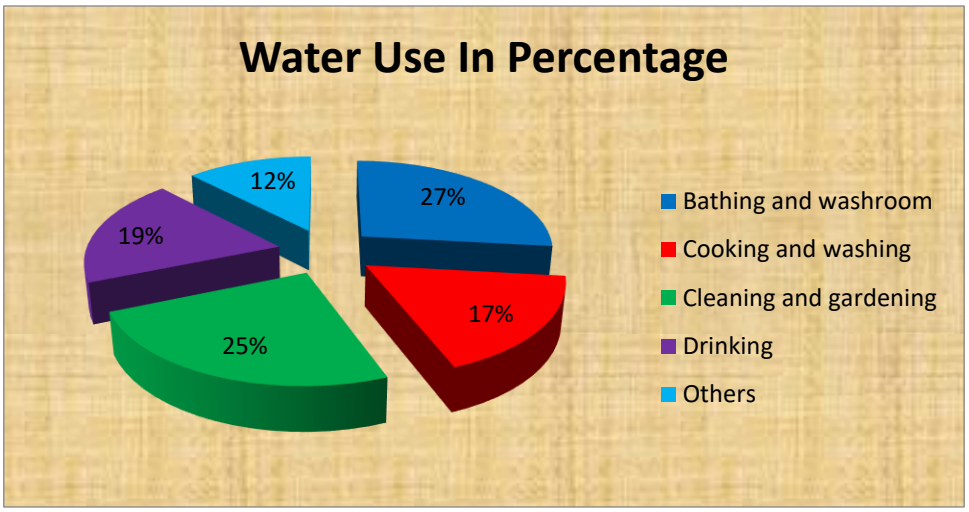
For college campuses, implementing water management and conducting water audits are crucial to ensuring the efficient and sustainable use of this vital resource. By managing water effectively, colleges can significantly reduce waste and lower operational costs, thereby enhancing both environmental and financial sustainability. Regular water audits help identify inefficiencies, leaks, and areas of excessive use, enabling timely interventions that conserve water and save money. These practices also ensure compliance with regulatory standards, preventing legal issues and showcasing the institution's commitment to environmental stewardship.

Additionally, proper water management supports the health and hygiene of the campus community by ensuring a safe and reliable water supply. It also provides educational opportunities, integrating practical learning experiences into the curriculum and raising awareness about water conservation among students and staff. Overall, water management and audits foster a sustainable, cost-effective, and health-conscious campus environment, setting a positive example for the broader community.

USE OF WATER IN DIFFERENT PURPOSE OF COLLEGE PREMISES

USE OF WATER IN DIFFERENT PURPOSE PER DAY	USE IN PERCENTAGE
BATHING AND WASHROOM	26.75
COOKING AND WASHING	17.35
CLEANING AND GARDENING	24.65
DRINKING	19.00
OTHERS	12.25

PERCENTAGE OF USE OF WATER AT THE COLLEGE CAMPUS



In this college maximum percentage of water was found to be used in bathing and washroom (26.75%) followed by cleaning and gardening (24.65%). 19.00% of the total used water is used for drinking purpose after proper purification. Though a few amount was drained out in this process.

WATER QUALITY IN COLLEGE CAMPUS

Drinking water is vital for maintaining health and supporting bodily functions. It hydrates the body, aids in digestion, regulates body temperature, and facilitates nutrient absorption.

However, the quality of drinking water is crucial to ensure it is safe for consumption and free from harmful contaminants.

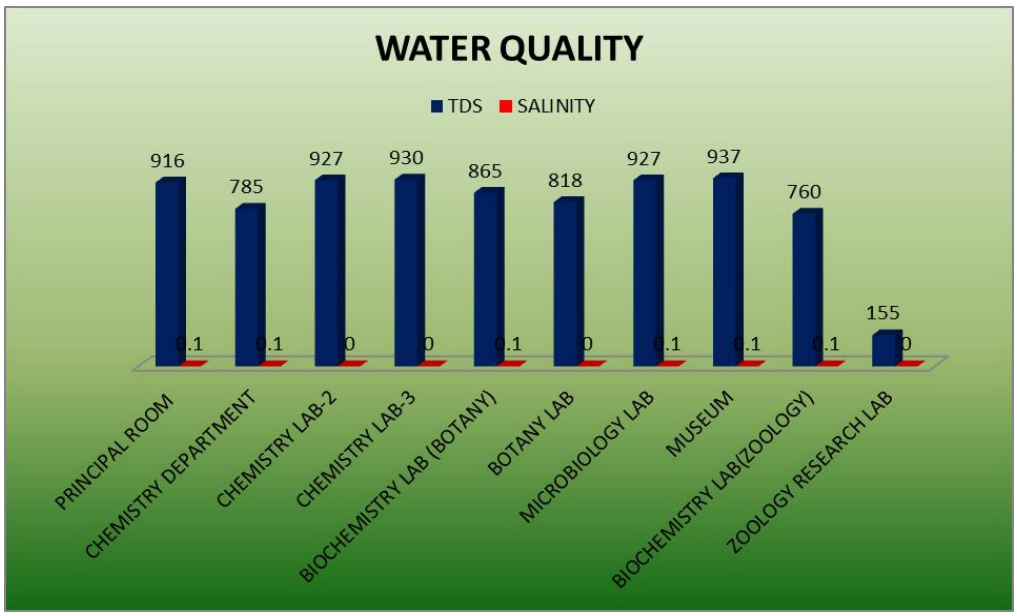
The water we drink today is often treated with hazardous chemicals at various water treatment plants, which can strip the water of its natural minerals. To ensure safety, it is essential to employ proper filtration processes that remove contaminants while preserving beneficial minerals. One significant contaminant in water is total dissolved solids (TDS), which remain even after standard filtration. TDS consists of particles larger than 2 microns, originating from various sources. Effective filtration should target these contaminants, often using filters fine enough to remove particles as small as 0.45 microns.

By addressing these contaminants through advanced filtration methods, we can ensure that drinking water is not only safe but also of high quality, promoting better health and well-being.

WATER TDS AND SALINITY LEVEL AT DIFFERENT REGION OF COLLEGE CAMPUS

ROOMS	TDS	SALINITY
PRINCIPAL ROOM	916	0.1
CHEMISTRY DEPARTMENT	785	0.1
CHEMISTRY LAB-2	927	0
CHEMISTRY LAB-3	930	0
BIOCHEMISTRY LAB (BOTANY)	865	0.1
BOTANY LAB	818	0
MICROBIOLOGY LAB	927	0.1
MUSEUM	937	0.1
BIOCHEMISTRY LAB(ZOOLOGY)	760	0.1
ZOOLOGY RESEARCH LAB	155	0

GRAPH OF WATER TDS AND SALINITY LEVEL AT DIFFERENT REGION OF COLLEGE CAMPUS



REFERENCE RANGE OF TOTAL DISSOLVED SOLIDS (TDS)

TDS LEVEL	COLOUR BAR	HAZARD LEVEL	REMARKS
<50	Orange	Serious	Unacceptable as it lacks essential minerals
50-150	Green	Very safe	Excellent for drinking. The TDS level is ideal for areas where the water polluted by sewage or industrial waste
151-250	Light green	Safe	Good. The water is ideal for people with cardiovascular disease
251-350	Yellow	Normal	Good. The water is ideal for people with cardiovascular disease
351-500	Light orange	Medium	Fairly acceptable
501-900	Orange	Serious	Less acceptable
901-1200	Light red	Danger	Least acceptable. Avoid drinking water that has a tds level of 900
1201-2000	Red	Danger	Water is not acceptable for drinking.
Above 2000	Dark red	Danger	Unacceptable

Water salinity, the concentration of dissolved salts in water, significantly impacts both human life and ecosystems. In terms of human health, salinity levels are crucial for drinking water

quality. High salinity in drinking water can cause health issues such as hypertension, cardiovascular diseases, and kidney problems.

Salinity also affects agriculture, as many crops are sensitive to salt levels. Excessive salinity in irrigation water can decrease crop yields and soil fertility, threatening food security. Moreover, industries that depend on water, like food processing and manufacturing, require water with controlled salinity levels to ensure product quality and maintain operational efficiency.

In ecosystems, salinity profoundly influences the distribution and health of aquatic life. Many freshwater organisms are highly sensitive to changes in salinity and may experience physiological stress or even mortality if exposed to elevated salt levels. This can result in a decline in biodiversity and disrupt aquatic food webs. In estuarine environments, where freshwater and seawater mix, salinity gradients are crucial for the survival of various species adapted to specific salinity ranges. Mangroves, salt marshes, and seagrass beds, which provide vital habitats for numerous species, also rely on stable salinity conditions.

Salinity also affects soil health and plant communities. High soil salinity can hinder plant growth by impacting water uptake and nutrient availability, leading to reduced agricultural productivity and loss of vegetation cover. This, in turn, affects wildlife habitats and soil erosion patterns.

Overall, maintaining appropriate salinity levels in water bodies is essential for human health, agricultural productivity, industrial processes, and the well-being of both aquatic and terrestrial ecosystems. Addressing salinity issues requires integrated water management strategies that consider the needs of diverse stakeholders and the complex interactions within ecosystems.

REFERENCE RANGE OF WATER SALINITY

SALINITY STATUS	SALINITY (%)	SALINITY (PPT)	COLOR BAR	HAZARD LEVEL	USE
FRESH	< 0.05	< 0.5	BLUE	SAFE	Drinking and all irrigation
MARGINAL	0.05 – 0.1	0.5 – 1	DEEP BLUE	NORMAL	Most irrigation, adverse effects on ecosystems become apparent
BRACKISH	0.1 – 0.2	1 – 2	DARK BLUE	LIGHT	Irrigation certain crops only; useful for most stock

SALINE	0.2 – 1.0	2 – 10	LIGHT ORANGE	MEDIUM	Useful for most livestock
HIGHLY SALINE	1.0 – 3.5	10 – 35	ORANGE	SERIOUS	Very saline groundwater, limited use for certain livestock
BRINE	> 3.5	> 35	RED	DANGER	Seawater; some mining and industrial uses exist

The data indicates variability in TDS and salinity levels across different rooms on campus. Most rooms exhibit moderate to high TDS levels, with the Museum showing the highest at 937. Salinity is consistently low across all rooms, with some rooms showing no measurable salinity. The Chemistry labs, Microbiology Lab, and the Museum have notably high TDS levels, which may suggest higher concentrations of dissolved substances, possibly from chemicals or materials used in these environments. The Zoology Research Lab, with the lowest TDS, indicates a relatively lower concentration of dissolved solids. These findings suggest a need for regular monitoring and potential treatment of water sources to maintain safe and acceptable TDS levels, ensuring the health and safety of the campus community.

Collection of different parameters related to water quality from different points of the college

PERFORMANCE AUDIT OF WATER MANAGENENT

Factors	Weightage
Quality of Water	L
Re-use of water	L
Water Harvesting & Recharge	M
Use of Surface Water	M

* H denote- Taken management policy level above 60%

** M denote- Taken management policy level 40%-60%

*** L Denote-Taken management policy level below 40%

Following examinations utilizing Water salinity meters and TDS meters, we've established that the drinking water quality on campus is not good for human health, earning a Low rating (L) for Water Quality. A single water harvesting unit was also noticed in the college campus which was found to be performed efficiently. This rain water harvesting infrastructure provides supply of water for the purpose of cleaning and gardening in the institution. Here we can access that the effectiveness of the current water management policy is Medium (M).

Moreover, there is Low in managing water reuse and utilizing surface water within the campus premises. As a result, the effectiveness of the current water management policy is evaluated as Low (L).

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AIR QUALITY LEVEL IN THE COLLEGE CAMPUS

Air quality on college campuses is crucial for the health and well-being of students, faculty, and staff. Poor air quality can stem from various sources, including vehicle emissions, nearby industrial activities, construction projects, and indoor pollutants like mold, dust, and chemicals used in cleaning or laboratories. Effective air quality management involves monitoring pollution levels, identifying contamination sources, and implementing strategies to maintain and improve air purity.

To monitor air quality, campuses often install sensors and conduct regular assessments to track pollutants such as particulate matter (PM2.5, and PM10), formaldehyde (HCHO), carbon monoxide (CO), and total volatile organic compounds (TVOCs). These sensors provide real-time data, enabling campus authorities to respond promptly to air quality issues.

Vehicle emissions significantly contribute to outdoor air pollution on campuses. To mitigate this, colleges can promote alternative transportation options like biking, walking, and public transit. Implementing carpooling programs, providing electric vehicle charging stations, and encouraging the use of campus shuttles can also reduce vehicle emissions. Additionally, establishing no-idle zones and restricting vehicle access to certain areas can further enhance air quality.

Indoor air quality is equally important and can be managed through various measures. Ensuring proper ventilation in buildings helps reduce indoor pollutant concentrations. Regular maintenance of HVAC systems, using air purifiers, and selecting low-emission materials and furnishings contribute to healthier indoor environments. Managing indoor humidity levels prevents mold growth, while strict protocols for handling chemicals in laboratories and cleaning supplies minimize exposure to harmful substances.

Construction activities on campus can also impact air quality by releasing dust and other pollutants. Effective management includes scheduling construction during off-peak times, using dust suppression techniques, and installing barriers to contain construction-related emissions. Engaging in green building practices, such as using environmentally friendly materials and ensuring proper site management, further supports air quality goals.

Educational initiatives play a vital role in air quality management. Raising awareness about the importance of air quality and encouraging the campus community to adopt sustainable practices can lead to long-term improvements. Programs that educate about the health

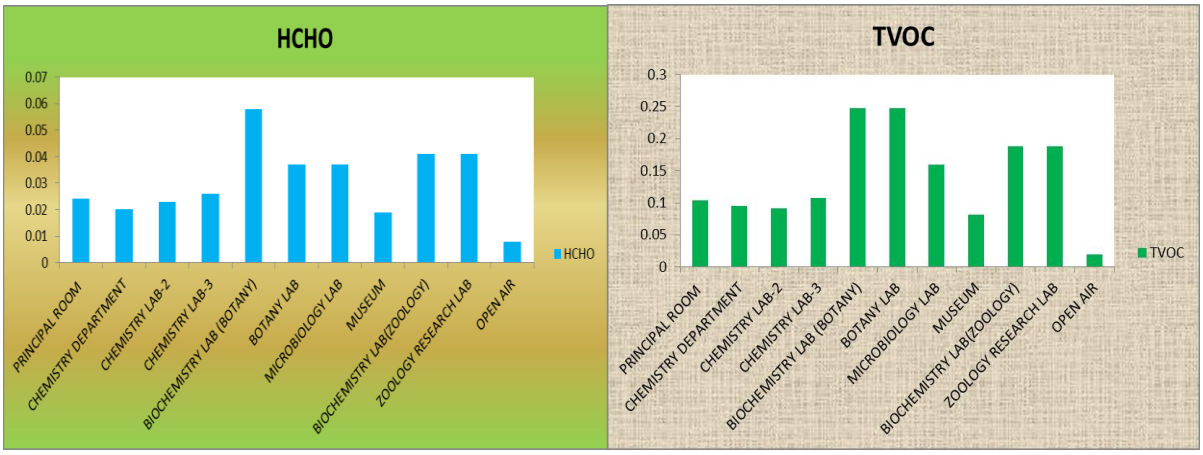
impacts of poor air quality and promote actions like reducing energy consumption, planting trees, and maintaining clean surroundings can significantly contribute to better air quality.

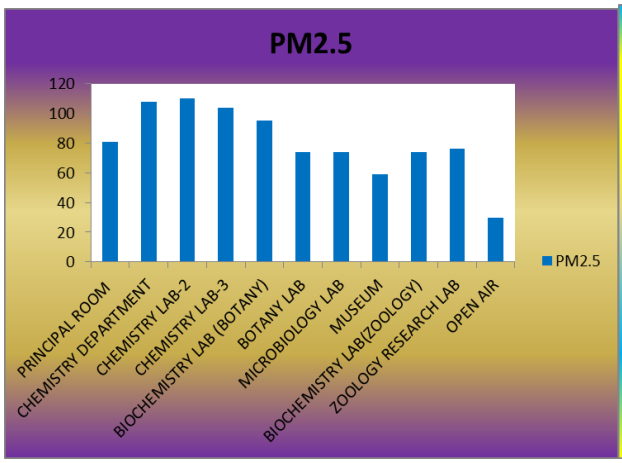
Managing air quality on college campuses involves a combination of monitoring, mitigating sources of pollution, and promoting sustainable behaviors. By addressing both outdoor and indoor air quality, implementing effective transportation and construction policies, and engaging the campus community, colleges can create a healthier and more sustainable environment for everyone.

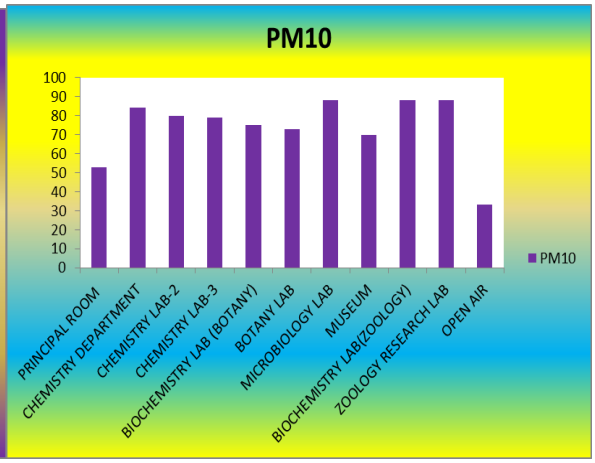
DIFFERENT PARA METERS OF AIR QUALITY LEVEL AT DIFFERENT REGION OF COLLEGE CAMPUS

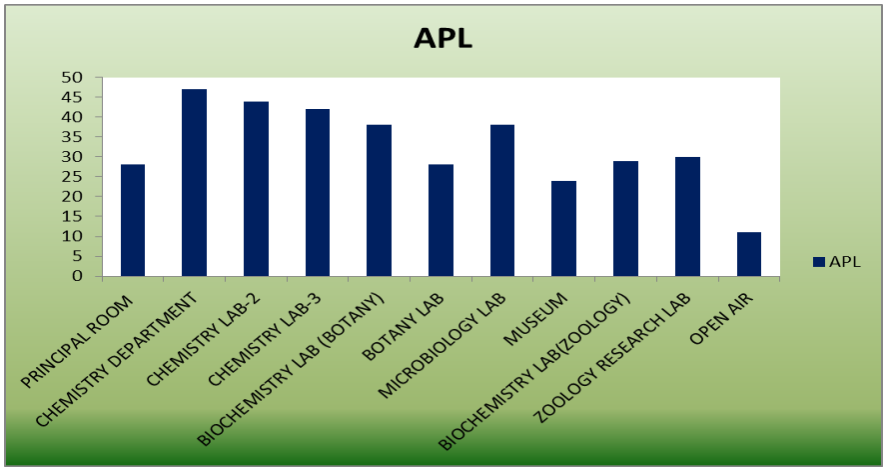
ROOMS	HCHO	TVOC	PM2.5	PM10	APL
PRINCIPAL ROOM	0.024	0.104	81	53	28
CHEMISTRY DEPARTMENT	0.02	0.095	108	84	47
CHEMISTRY LAB-2	0.023	0.091	110	80	44
CHEMISTRY LAB-3	0.026	0.108	104	79	42
BIOCHEMISTRY LAB (BOTANY)	0.058	0.248	95	75	38
BOTANY LAB	0.037	0.248	74	73	28
MICROBIOLOGY LAB	0.037	0.16	74	88	38
MUSEUM	0.019	0.082	59	70	24
BIOCHEMISTRY LAB(ZOOLOGY)	0.041	0.188	74	88	29
ZOOLOGY RESEARCH LAB	0.041	0.188	76	88	30
OPEN AIR	0.008	0.02	30	33	11

GRAPHICAL REPRESENTATION OF DIFFERENT PARAMETER OF AIR QUALITY LEVEL







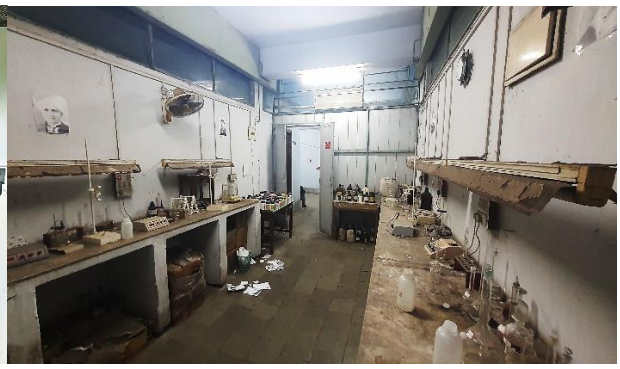


The data highlights those indoor environments, particularly in labs, have significantly higher levels of pollutants compared to the open air. The Biochemistry Lab (Botany) and Chemistry labs exhibit the highest levels of HCHO and TVOC, indicating a need for improved ventilation and air purification systems. The elevated PM2.5 and PM10 levels across various labs suggest

that particulate matter is a common issue, potentially impacting respiratory health. The Principal's Room and the museum show relatively lower pollution levels but still higher than the open air, underscoring the importance of air quality management across all campus facilities. Enhanced air quality monitoring and targeted interventions are essential to ensure a healthier environment for students, faculty, and staff.

Collection of different parameters related to air quality from different points of the college





REFERENCE RANGE OF DIFFERENT PARAMETERS TO MEASURE AIR QUALITY

HCHO RANGE	TVOC RANGE	PM2.5 RANGE	PM1.0 RANGE	PM10 RANGE	APL RANGE	COLOR BAR	AIR POLLUTION LEVEL	Hazard Level
<0.061	<0.3	<35	<10	0-50	0-50	GREEN	SAFE	LIVABLE (FRESH)
<0.100	0.3-1.0	<75	<20	51-100	51-100	LIGHT GREEN	NORMAL	TEMPORARY STAY(NORMAL)
<0.370	1.0-3.0	<115	<30	101-150	101-150	YELLOW	LIGHT	DON'T STAY LONG(POOR)
<0.775	3.0-6.0	<150	<40	151-200	151-200	LIGHT ORANGE	MEDIUM	SHOULD NOT STAY(HARMFUL)
<1.181	6.0-10	<250	<50	201-300	201-300	ORANGE	SERIOUS	LEAVE ASAP(SERIOUS)
>1.181	>10	>250	>50	301-400	>300	RED	DANGER	LEAVE NOW(DANGER)

Generation of Waste and Waste Management

Effective waste management on college campuses is crucial for promoting sustainability and environmental health. Colleges generate various types of waste, including municipal solid waste (MSW), which includes everyday items like food waste, packaging, and paper. Recyclable waste, such as paper, cardboard, glass, metals, and certain plastics, requires robust recycling programs and educational efforts to ensure proper segregation and recycling. Organic waste, mainly food scraps and yard waste, can be managed through composting initiatives, turning waste into valuable fertilizer for campus landscaping.

Hazardous waste, including chemicals, batteries, and electronic waste (e-waste), demands strict disposal protocols and partnerships with specialized disposal services to mitigate risks to health and the environment. Construction and demolition waste, generated from campus building projects, can be reduced by on-site segregation and reuse of materials. Laboratory waste, including chemical reagents and biological materials, must be handled with stringent safety measures and secure disposal methods.

To manage these waste types effectively, campuses implement various strategies such as source reduction, recycling programs, composting, and waste audits to monitor and improve waste management practices. Educational campaigns are crucial in raising awareness and promoting sustainable behaviors among students, faculty, and staff. Additionally, sustainable procurement and green building practices help minimize waste generation and enhance campus sustainability.

Through these comprehensive efforts, colleges can significantly reduce their environmental footprint and foster a culture of environmental responsibility within the campus community. By integrating these strategies, colleges can not only promote environmental health but also create a model of sustainability that can inspire other institutions and communities.

Different source of waste Generation in College Campuses:

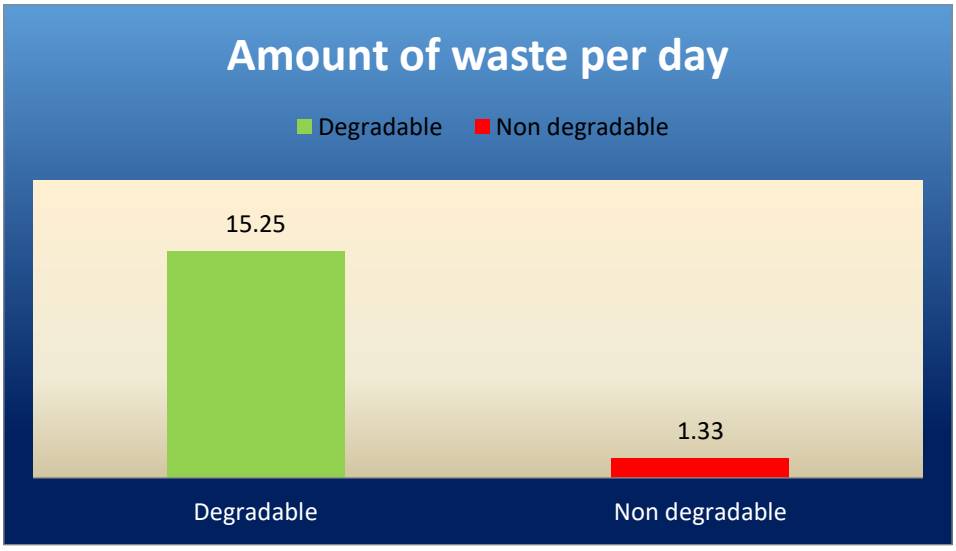
- **Academic Waste:** Includes paper waste, discarded textbooks, notebooks, and other educational materials.
- **Food Waste:** Generated from dining facilities, cafes, and student activities.
- **E-waste:** Arises from the use and disposal of electronic devices in computer labs and personal electronics.

- **Plastic and Packaging Waste:** From products, promotional materials, and campus events.
- **General Waste:** Includes everyday waste from offices, maintenance activities, and residential areas.

TYPES OF WASTES:

TYPE OF WASTAGE IN PER DAY	AMOUNT IN KG
DEGRADABLE	15.25
NON-DEGRADABLE	1.33

GRAPH OF AMOUNT OF WASTE PER DAY IN COLLEGE CAMPUS

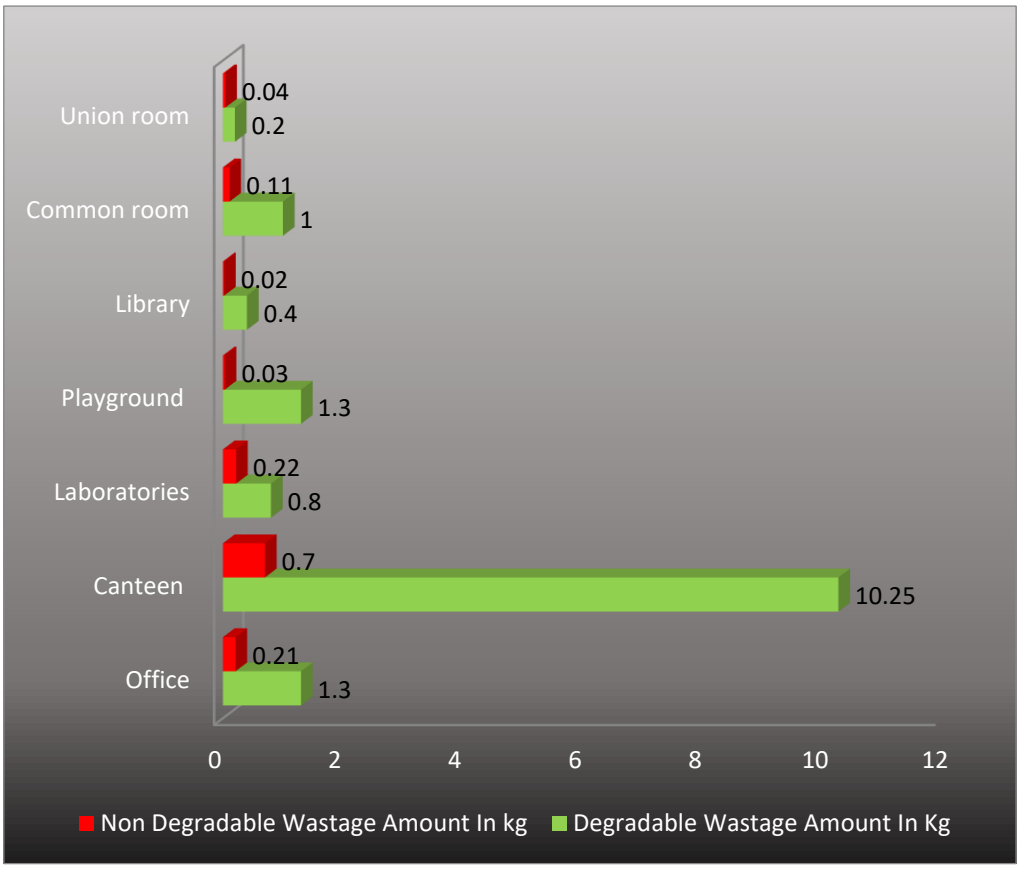


SOURCE OF WASTAGE IN DIFFERENT SECTOR (PER DAY IN KG):

SOURCE OF WASTAGE IN DIFFERENT SECTOR (PER DAY IN KG)	DEGRADABLE WASTAGE AMOUNT IN KG	NON-DEGRADABLE WASTAGE AMOUNT IN KG
OFFICE	1.3	0.21
CANTEEN	10.25	0.7

LABORATORIES	0.8	0.22
PLAYGROUND	1.3	0.03
LIBRARY	0.4	0.02
COMMON ROOM	1	0.11
UNION ROOM	0.2	0.04

SOURCE OF WASTAGE IN DIFFERENT SECTOR (PER DAY IN KG):



The data indicates that the canteen is the largest producer of both degradable and non-degradable waste on campus, highlighting the need for targeted waste management strategies in this area. Offices, playgrounds, and common rooms also generate significant amounts of waste, suggesting a broader approach is needed to manage waste effectively across these sectors. The relatively low waste output from libraries, laboratories, and union rooms still warrants attention to ensure efficient waste segregation and disposal practices. Overall, the

diverse waste generation patterns across different sectors call for customized strategies to enhance sustainability and waste reduction on the campus**.**

PERFORMANCE AUDIT OF WASTE ISSUES:

Implemented wastes management		
Sl.no	Factors/Indicators	Weightage
1	Plastic and Polythene free	H
2	Re-use of papers	H
3	Hazardous effect waste management	M
4	Removal of E-Wastes	M
5	Organic & food waste	M
6	Others solid wastes	M

*** H denote- Taken management policy level above 60%**

**** M denote- Taken management policy level 40%-60%**

***** L denote-Taken management policy level below 40%**

No E-waste management in the college was recorded

No such disaster management cell and infrastructure were noted at the Bidhannagar College.

ENERGY AUDIT

A comprehensive review involves a detailed analysis of power usage within a facility, with the goal of reducing energy consumption. This process includes evaluating methods and systems to lower energy usage while maintaining performance. Recommendations for various strategies to improve energy efficiency are provided. As conventional energy sources like fossil fuels diminish, there is a need to investigate alternatives and prioritize energy conservation. The primary aim is to deliver products or services at the lowest possible cost while minimizing environmental impact. Conducting an energy audit helps identify potential savings, understand fuel usage patterns, pinpoint inefficiencies, and uncover opportunities for improvement. It is crucial for educational institutions to implement sustainable energy-saving practices. The audit process includes designing surveys, inspecting buildings, reviewing documents, conducting interviews, analysing data, taking measurements, and making recommendations. Energy audits evaluate the potential for energy savings, management practices, and alternative energy options. Specific objectives include assessing sustainability management systems and ensuring compliance with regulations. The results of the audit significantly affect operational costs and environmental impact. Programs like the Energy Conservation Building Code and the Bureau of Energy Efficiency promote energy-efficient practices. Energy ratings and labels help consumers make informed decisions. The Energy Audit serves as a benchmark for energy management, assisting in developing more efficient strategies. It is a systematic evaluation of energy sources aimed at protecting the environment and conserving natural resources. At Bidhannagar College, under the University of Calcutta, the audit involves identifying, measuring, recording, reporting, and analysing energy factors.

Need for an Energy Audit: In every organization, the three primary operational expenses typically include energy (both electricity and heating), labour, and materials. Among these, energy consistently stands out as a crucial factor in cost management and potential savings, making energy management essential for minimizing expenses. An Energy Audit is vital for understanding energy and fuel usage within an industry, identifying areas of waste and opportunities for improvement. It provides insights that help reduce energy costs, enhance preventive maintenance, and refine quality control programs, all of which are critical for manufacturing and utility operations. This assessment initiative allows for a detailed analysis

of energy cost variations, energy supply reliability, decisions about energy sources, identification of energy conservation methods, and retrofitting for energy-efficient equipment. Essentially, the Energy Audit translates conservation concepts into actionable solutions, offering technically feasible recommendations that consider financial and organizational aspects within a given timeframe. The main goal is to develop strategies for reducing energy consumption per unit of product output or lowering operational costs. Serving as a benchmark, the Energy Audit lays the groundwork for managing energy within the organization and sets the stage for planning more efficient energy use throughout the establishment. The environmentally friendly campus concept emphasizes efficient energy use and conservation, striving for sustainable economies. Additionally, it focuses on reducing carbon emissions, involves calculating the carbon footprint, promotes acquiring energy-efficient equipment for cost-effective and reliable energy supply, advocates energy conservation in all buildings, aims to decrease overall energy consumption, reduce waste sent to landfills, and integrates environmental considerations into contracts and facilities with significant environmental impacts. Assessing Energy Management through audits concentrates on energy savings and potential opportunities. While energy itself is intangible, its presence is evident in wires, pipes, and other materials through noticeable effects like heat, light, and efficiency. Energy management evaluations cover energy consumption, sources, monitoring, lighting, transportation, electrical devices, and distribution. Energy use is a crucial aspect of campus sustainability, requiring inclusion in evaluations without further elaboration. Despite the widespread use of energy, attention to energy-saving potential remains vital. For example, a traditional incandescent bulb uses 60W to 100W, whereas an energy-efficient LED uses less than 10W, highlighting significant energy savings. Energy auditing is essential for conservation efforts and the adoption of techniques to reduce consumption, thus mitigating environmental damage. Furthermore, audits provide valuable recommendations and suggestions for efficient energy-saving practices. Environmentally conscious institutions are encouraged to review their energy practices at least every two years, using both internal and external auditors. Conducting energy assessments, facilitated by both internal and external auditors, plays a significant role in organizational energy management. These assessments effectively evaluate the energy potential within an establishment, identifying more efficient methods to reduce environmental impact.

Aims and Objectives of an Energy Audit: An energy audit is a crucial tool for creating and implementing comprehensive energy management plans within an organization. Its primary

objective is to systematically identify opportunities to improve energy efficiency, conservation, and cost savings at the audit site. The evaluation process involves the following steps:

- **Evaluating Existing Energy-Saving Measures:** Assessing the energy-saving initiatives and measures currently implemented at the audit sites.
- **Identifying Opportunities for Energy Conservation:** Identifying various opportunities for energy conservation measures and additional avenues for cost savings.
- **Exploring Alternative Energy Sources:** Investigating alternative energy sources to gauge potential energy savings and inform decision-making in energy management.
- **Providing Technical Guidance:** Offering technical advice on establishing an energy balance and presenting accurate, practical recommendations.
- **Conducting a Comprehensive Energy Consumption Analysis:** Conducting a thorough analysis of energy consumption, reviewing recent electricity bills for the site, and understanding the tariff structures offered by the central and state electricity boards.
- **Enumerating Energy Usage:** Listing the various ways energy is used, including electricity for appliances such as stoves, pots, microwaves, and other sources like LPG, diesel, and beyond.
- **Evaluating Device and Equipment Usage:** Assessing the use of different devices and equipment, including incandescent (tungsten) bulbs, CFL bulbs, fans, air conditioners, cooling devices, heaters, computers, photocopiers, inverters, generators, and laboratory equipment. This evaluation includes calculations based on factors such as wattage and duration of use (e.g., 60-watt bulb x 5.5 hours x number of bulbs = kWh).
- **Assessing Non-Traditional Energy Sources:** Evaluating the adoption of non-traditional energy sources and alternative energy options within the organization, such as solar panels, energy-efficient devices, biogas, etc.
- **Raising Awareness:** Initiating programs to raise awareness among stakeholders about energy conservation and efficient usage.

In essence, energy auditing in an institutional setting is a multifaceted approach that not only seeks efficiency in resource utilization but also emphasizes the importance of sustainable practices, cost savings, and collective responsibility for the well-being of the organization and its environment.

Figure 1: Group discussion before survey for energy audit with professors and Principal sir.

Methodology and Survey Schedules: To conduct an energy audit, various methodologies are employed at the audit sites, focusing primarily on a comprehensive site investigation. This process involves aligning overall energy inputs with total energy outputs and mapping all energy flows within an organization. Physical verification of different components, such as lighting, roofing, desks, fans, air conditioning systems, solar panels, heaters, generators, uninterruptible power supplies, and ventilation systems, is carried out during the audit. This includes verifying the effectiveness of implemented energy-efficient systems. The audit emphasizes analysing the costs or potential savings associated with each of these components, with energy consistently emerging as a critical area for cost reduction. Energy management becomes essential in achieving cost-saving goals. Additionally, the utility company's energy bill is collected for analysis. This evaluation involves assessing load requirements and efficient energy use. Stakeholders are engaged during the audit to explore opportunities for improvement in energy management. Potential areas for energy conservation and cost-saving opportunities are identified and recommended for implementation within the organization. Energy audits can be classified into the following categories:

I. Preliminary Energy Audit II. Detailed Energy Audit III. Scope and Extent of Energy Audit IV. Comprehensive Energy Audit.

Survey Form for Data Collection:

- **Survey Form for data collection:** Identify the ways in which energy is utilized by the college (Electricity, electronic stoves, cooking appliances, microwaves, LPG, wood, petrol, diesel, and others).
- **Summarize Electric Bills**: Provide a summary of the total electricity bills for the past two to three years.
- **Log LPG Expenditure:** Record the overall expenditure on LPG canisters for the previous year.
- **Calculate Fuel Costs**: Determine the cost of petrol, diesel, or alternative fuels for power generators.
- **Specify CFL Bulbs:** Note the quantity of CFL bulbs installed and their operational lifespan.
- **Ascertain CFL Energy Consumption:** Determine the energy consumed by each CFL bulb on a monthly basis.
- **Identify LED Bulbs:** Count the number of LED bulbs used within the college premises (including specified operational duration).
- **Tally Incandescent Bulbs:** Count the number of incandescent (tungsten) bulbs installed.
- **Aggregate Fans:** Count the number of fans in use (including their operational lifespan).
- **Document Air Conditioners:** Record the number of air conditioners in operation (hours used per day, number of days used per month).
- **Compute Device Energy Use:** Calculate the energy consumed by each electronic device monthly (kWh).

- **Outline Computer Usage:** List the number of operational computers and their usage (hours used per day, number of days used per month).
- **Specify Photocopiers:** Count the number of photocopiers installed.
- **Tally Cooling Devices:** Count the number of cooling devices installed.
- **Determine Inverter Energy Use:** Calculate the energy consumed by each inverter on a monthly basis (kWh).
- **Enumerate Lab Appliances:** List the electronic appliances used in various laboratories along with their power ratings.
- **Detail Heater Usage:** Describe the usage of heaters in the cafeteria (hours used per day, number of days used per month).
- **Validate Alternative Energy Modules:** Confirm if any alternative energy source modules are installed and provide detailed specifications.
- **Confirm Energy-Saving Configurations:** Verify whether computers and other devices are set to energy-saving mode.
- **Identify Standby Mode Usage:** Determine whether machines (TVs, ACs, computers, printers, etc.) frequently operate on standby mode and specify the duration in hours if applicable.
- **Summarize Energy Conservation Methods:** Outline the energy conservation methods adopted by the college.
- **Calculate Awareness Displays:** Count the number of displays promoting energy conservation awareness.

Environmental Impact Evaluation:

- **Measure CO2 Levels:** Carbon dioxide levels were measured at various points across the campus using a portable CO2 analyser to assess the carbon footprint and identify areas with significant carbon emissions, providing valuable insights for reduction strategies.
- **Analyse Energy Bills:** The college's energy bills were examined to understand kilowatt-hour (kWh) requirements and the efficiency of energy use.

- **Engage Stakeholders:** Engaging with various stakeholders was essential to familiarize them with energy evaluation procedures, ensuring a successful and result-oriented energy audit.
- **Identify Conservation Opportunities:** Opportunities for energy conservation and savings were identified during the audit, laying the groundwork for potential implementation measures.
- **Evaluation Methodology:** The evaluation methodology included collecting information through various means, such as on-site visits, group discussions, campus surveys, interviews, observations, perception analyses, and feedback. All these elements contributed to the comprehensive audit report.

Detailed Energy Audit Methodology: A comprehensive evaluation provides a detailed energy management strategy for a facility by examining all major energy-consuming systems. This type of evaluation delivers the most accurate assessment of both energy efficiency and costs. It considers the cumulative effects of all initiatives, takes into account the energy consumption of key appliances, and involves meticulous calculations for both energy cost savings and project expenses. In an in-depth evaluation, the energy balance is a vital element, relying on an inventory of energy-consuming systems, assumptions about current operational conditions, and calculations of energy usage. This estimated usage is then compared with charges on utility bills. Preliminary site visits and preparations are essential stages before detailed analysis. An initial site visit typically lasts a day, allowing the Energy Auditor/Engineer to interact with relevant personnel, familiarize themselves with the surroundings, and assess the procedures necessary for conducting the energy evaluation.

7. Source of Energy: Through the enquiry process it is noted that the mostly used energy source is conventional but institution has taken notable steps to develop non-conventional energy sources in terms of solar energy module and it is found to be nearly 2% of the total unit consumption.

Energy consumption:

Total electricity consumption: 2020-21 (conventional)- 438759 U (98%)
Total electricity consumption: 2021-22 (conventional)- 473478 U (98%)
Total electricity consumption: 2022-23 (conventional)- 511627 U (98%)
Total electricity consumption: 2020-23 (non-conventional)-29058 U (2%)

Power distribution module and energy cost per academic year (last three years) of Bidhannagar College is shown in figure 2 and figure 3 respectively.

Figure 2. Power house and energy distribution module of Bidhannagar College

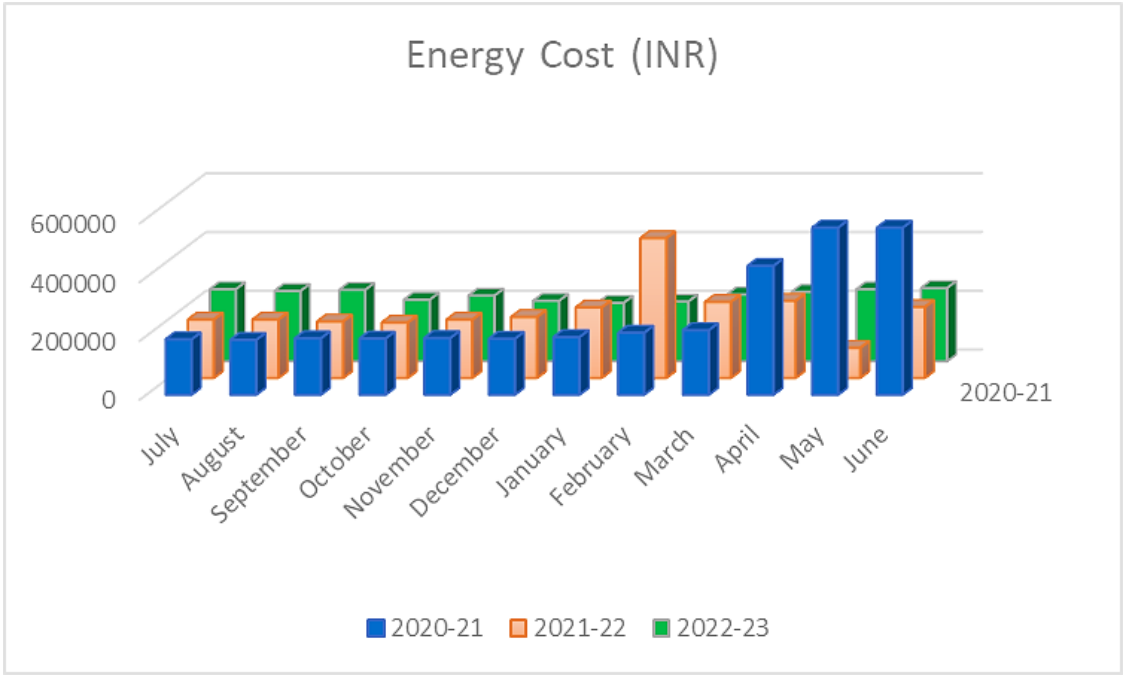


Figure 3: Energy cost (monthly) for the academic sessions 2020-23

Fossil fuel consumption per year-

a. Number of LPG gas cylinders used for cooking (Canteen)-120PCs (Approx.)

b. Number of LPG used in Laboratories-42PCs (Approx.)

Table 1 represents the percentage use of conventional and non-conventional uses of energy and its corresponding plot is depicted in figure 4.

Table 1: Percentage use of conventional and non-conventional sources of energy.

Source of energy	In Percentage
Conventional	98%
Non -Conventional	2%

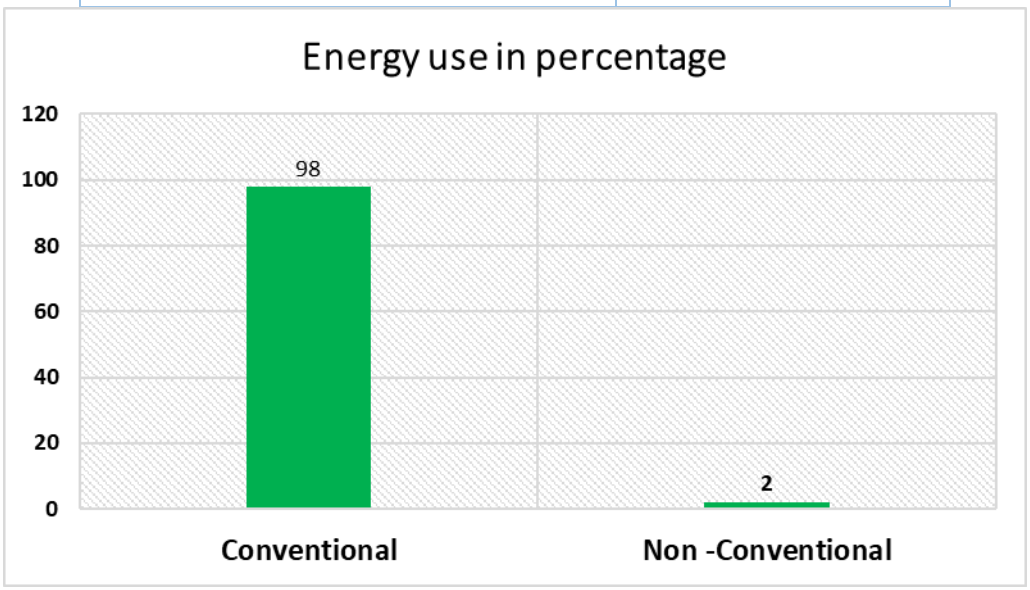


Figure 4. Mode of energy used in college campus (conventional and non-conventional)

Area covered during energy audit and its corresponding figure is depicted below.

Figure 5. Solar energy module at Bidhannagar College

Figure 6. A.C. & CFL installed at Bidhannagar College seminar hall.

During the survey different electrical appliances are recorded with its corresponding power rating. For precaution, a maximum Demand Controller (DC) can be installed at the main LT panel to avoid the maximum demand penalty. In case the running maximum demand increases, the demand controller will switch off some non-essential load like Air-conditioning load etc. and simultaneously it will also give alarm for further action.

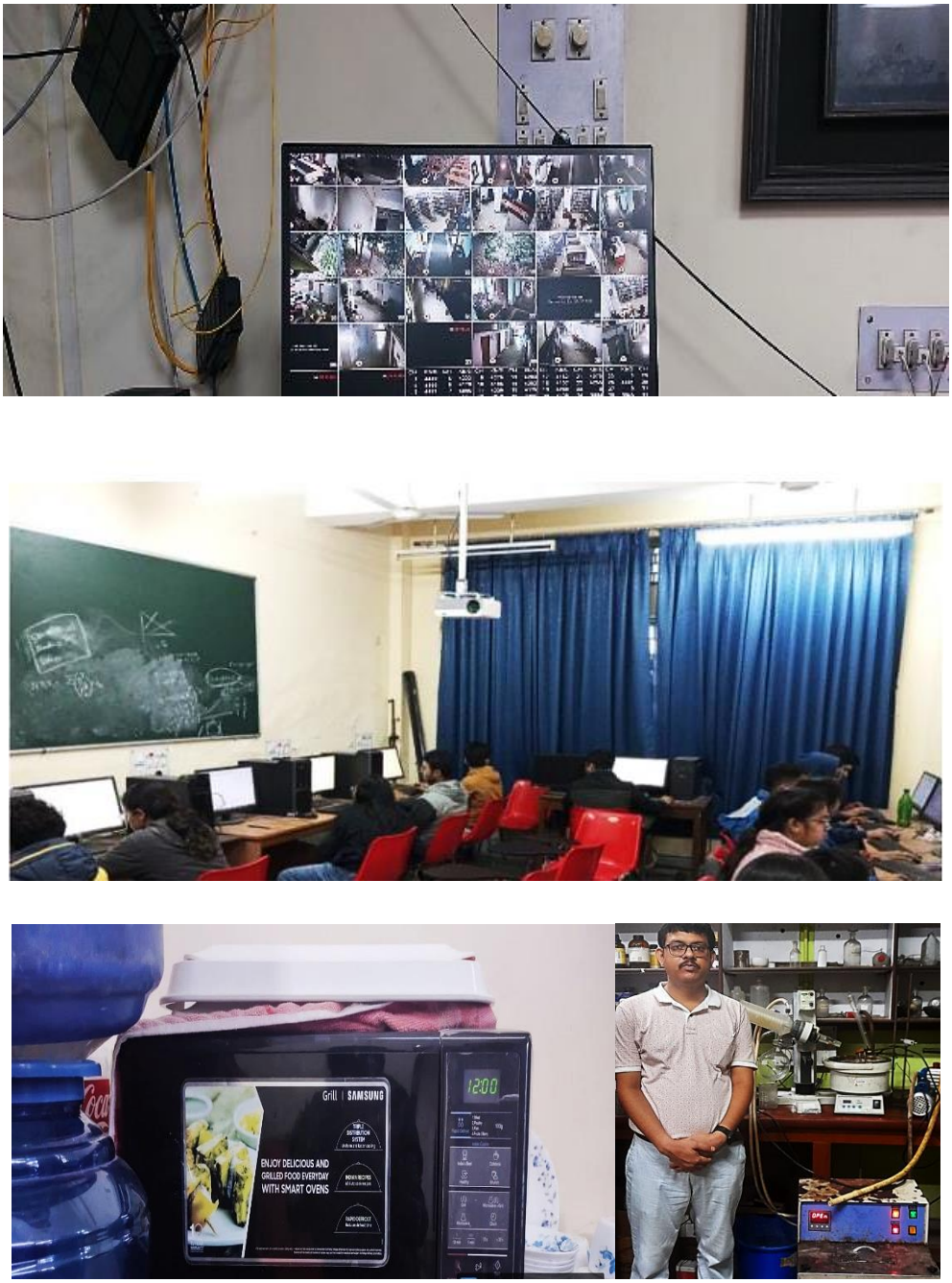


Figure 7: Survey pictures during energy audit of different places at Bidhannagar college

In table 2 the calculated daily approximate consumption of electrical energy is shown below.

Table 2: The detail calculation of energy consumption.

Electrical appliences	Consumption(KWh/day)	Total No. Used
Tube/Bulb light	157	1536
CCTV	50	50
Fan	200	1132
Air Conditioner	200	27
Computer	82	131
Xerox Machine	5	2
Printer	8	44
Projector	2	8
Microwave	2	2
Induction	3	1
Water pump	300	4
Sound system	2	2
R.O. Water machine	8	21
Streetlight	100	40
Refrigerator	90	15
Other Lab instruments	400	56

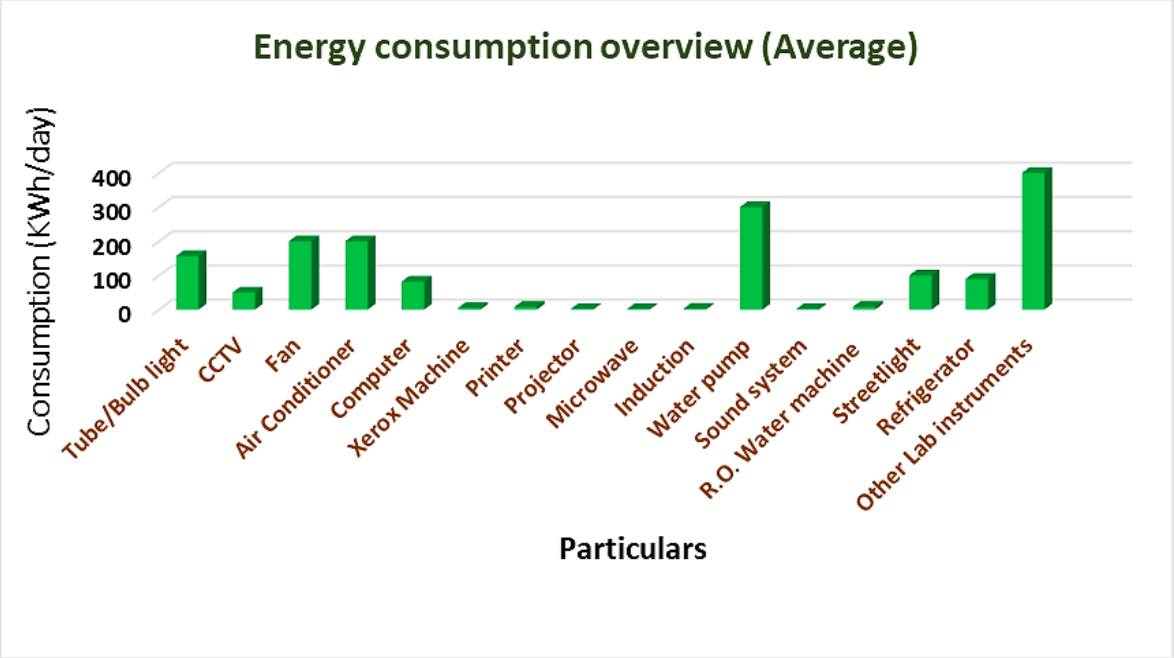


Figure 8. Bar diagram to represent energy consumption at Bidhannagar College

Yearly electrical energy consumption table and its statistical interpretation is depicted below (Table 3) in figure 9.

Table 3: Yearly electrical energy consumption.

Month	2020-21	2021-22	2022-23
July	28677	31576.5	48109
August	27801	32071	46776
September	27312	30079.5	45788
October	30758	29633	36978
November	29843	31288.5	41424.5
December	30669.5	36127.5	36847.5
January	32296.5	43572	35591
February	33758.5	42886.5	35847.5
March	102407	50025.5	42835
April	33072	53418	45140
May	31082.5	46003.5	48180
June	31082.5	46796.5	48111
Total	438759.5	473478	511627.5

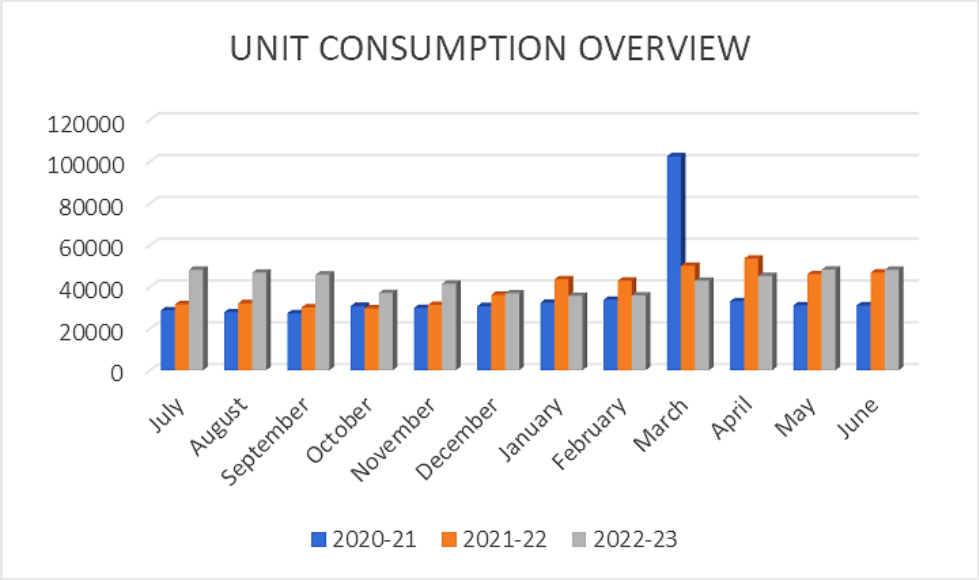


Figure 9: Bar diagram of Unit consumption and its corresponding plot for the academic year 2020-21, 2021-22 & 2022-23

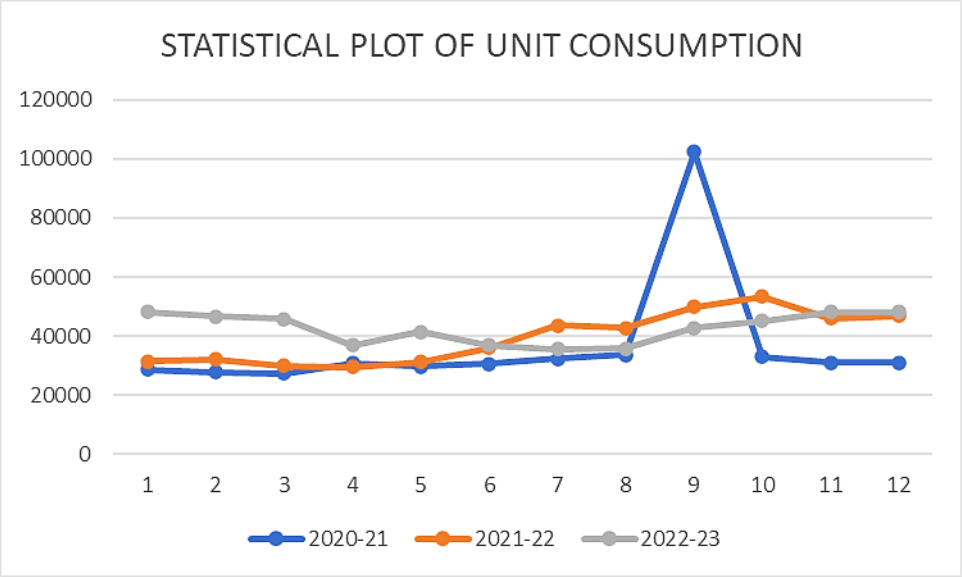


Figure 10. Statistical interpretation of unit consumption for the academic year 2020-21, 2021-22 & 2022-23

CO_2 Emission and Carbon Foot Print

The amount of CO_2 (ppm) in different places is depicted in table 3 and its corresponding pie diagram is shown in figure 12.

Table 4. Amount of CO_2 in different places

Locations inside college	CO2in air
Class room (Sample1)	400
Class room (Sample 2)	450
Class room (Sample 3)	470
Staff Room	478
Office (New)	520
Library	400
Office 2	456
Ground	350
Conference Hall	356
Canteen	700
Parking	356

CO2 Level Reference Ranges:

- 350-1000 ppm: Typical levels found in occupied spaces with efficient air exchange and clean air.

- 1000-2000 ppm: Moderate levels associated with reports of drowsiness and diminished air quality.
- 2000-5000 ppm: Critical levels linked to symptoms such as headaches, sleepiness, and a sensation of stagnant, stale air. Additionally, reduced concentration, attention span, elevated heart rate, and mild nausea may occur

Thermometer CO2 Measuring

Figure 11. Different instruments to measure CO_2 (ppm) and temperature

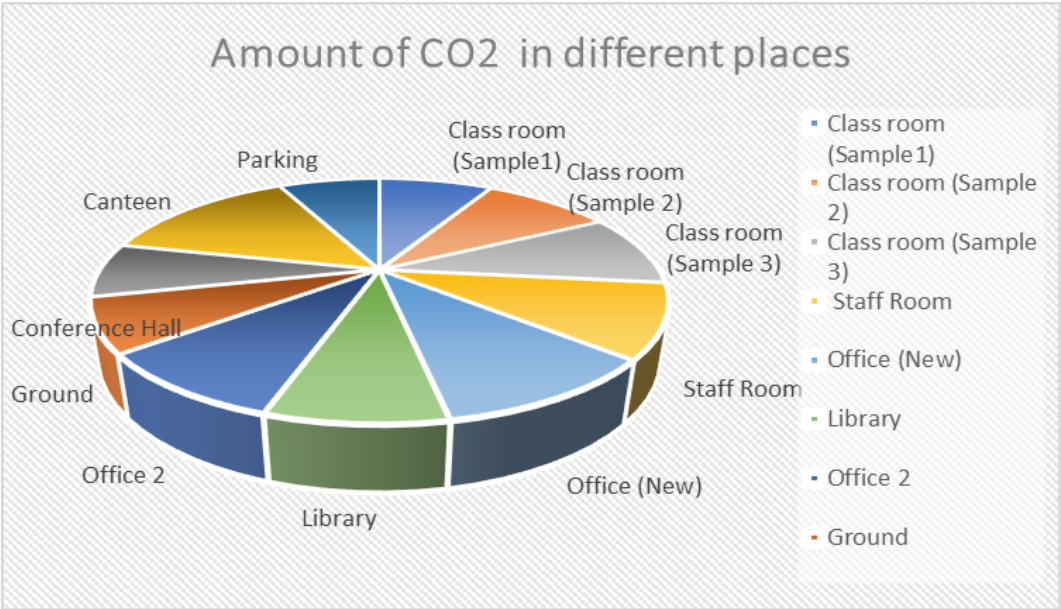


Figure 12. Amount of CO_2 of the Air in Different location of the college Premises.

The calculation of carbon footprint can be carried out according to the method outlined on www.carbonfootprint.com, which involves summing the annual electricity usage. The CO_2 emissions from electricity are calculated using the formula:

CO_2 emission from electricity = (electricity usage per year in kWh / 1000) x 0.84

Substituting the given values: = (438759 kWh / 1000) x 0.84 = 368.55 metric tons

Note:

- Annual electricity usage: 438759 kWh (Average)
- 0.84 is the conversion coefficient from kWh to metric ton

Major audit observation:

SL. No.	*Sectors*	*Weightage*
1	Applied to NCE	L
2	Tendency to use LED and CFL bulb	M
3	Reduce of AC Uses	H
4	Awareness	L
5	Management of CHG_s	H

 # H denotes management policy level > 25%

 # M denotes management policy level > 15%--25%

 # L denotes management policy level< 15%

Best Practices followed in the Organization

- Inverters, generators, and uninterruptible power supplies are safely housed and marked with warning signs displaying 'Caution' and 'Alert' notices.
- 'On' and 'Off' indicators are placed strategically in key areas to encourage energy-saving practices among users.
- Electrical wires, control boards, and voltage regulators are well-insulated to prevent potential hazards to staff and students.
- LED lighting and solar-powered streetlights are installed.
- The energy efficiency ratio is maintained close to one using Automated Power Efficiency Adjustment (APEA).
- Variable Frequency Drives (VFDs) are used for elevators and air conditioning systems.
- Old monitors and televisions have been replaced with LED screens.
- Electric vehicles are available on-site.
- Equipment with energy star ratings is used wherever possible

Energy Conservation Proposals: The energy audit provided recommendations for reducing power costs, implementing preventative maintenance actions, and enhancing quality control processes, all essential for the smooth operation of utilities at the audit sites. Consider investing in energy-efficient devices (4-5 star rated) when replacing old equipment. Install additional meters in all buildings to monitor energy consumption and usage per building. Implement efficient water use and temperature controls through automated systems to achieve energy savings. Establish continuous monitoring and analysis of energy consumption with a dedicated campus team. Regularly conduct energy conservation awareness programs (EPA) among stakeholders through clubs, societies, meetings, and groups. Encourage the habit of turning off electrical devices when not in use. Ensure maintenance and replacement of outdated appliances in all labs. Activate power-saving mode on computers and electronic devices. Set up a biogas plant for the dormitory kitchen and cafeteria. Install automatic switches with occupancy sensors in common areas. Significantly reduce high monthly electricity bills in the college through regular energy audits. Replace outdated and inefficient fans with new energy-efficient models. Consistently monitor equipment in all labs and promptly address any issues. Offer value-added, informal, certification, or diploma courses on 'Energy and Environment Management Audits' to benefit students and researchers seeking accreditation as Lead Auditors.

Introducing Energy-Saving Circuits for Air Conditioners: These systems intelligently reduce compressor run time by utilizing timing or temperature variation logic while maintaining human comfort. This innovation can result in electricity savings of 15% to 30%, depending on climate conditions and temperature settings. With a total of seven split air conditioners, it is advised to gradually replace older units with new, energy-efficient models rated 5 Stars by the Bureau of Energy Efficiency (BEE). Considering an average compressor run time of 5.5 hours per day, this transition ensures significant energy savings.

Recommendations on Carbon Footprint in the Organization:

- Improve the kitchen and dining area setup in the dormitory to conserve gas.
- Encourage efficient usage of generators, inverters, and uninterruptible power supplies (UPS).
- Foster the habit of turning off lights, fans, air conditioners, devices, and equipment when not in use.

- Install adequate ventilation and exhaust systems in auditoriums, classrooms, and conference rooms to reduce carbon dioxide levels for students, faculty, and staff.

Conclusions: Given the establishment's renowned reputation and resilience, there is a significant opportunity to enhance energy-saving efforts and move the campus towards self-sufficiency. The organization has already made commendable progress in this area by implementing energy-efficient lighting, raising stakeholder awareness, and ensuring reliable backup power systems. Additionally, the establishment adheres to strict energy evaluation standards, including properly securing transformers, generators, and UPS systems with enclosures and warning signs. Prominent signage promotes energy-saving practices, supported by diligent maintenance of the electrical infrastructure, which strengthens energy conservation efforts and prioritizes the well-being of staff and students. The use of sprinkler irrigation on campus to reduce energy consumption is commendable. However, additional recommendations could further boost the establishment's energy-saving capabilities, leading to a future characterized by an eco-friendly campus and sustainable community development.

DIFFERENT GREEN, ENVIRONMENT AND ENERGY EFFICIENT MEASURS TAKEN BY THE COLLEGE

- The principal and his office as well as all the departments of the college has one electric point (either light or fan) with the solar energy plant (4 KW) which is installed in the terrace of the college.
- Bidhannagar College (with the initiative of the Department of Botany) has constructed rain water harvesting infrastructure which provides supply of water for the purpose of cleaning and gardening in the institution.
- There is a Medicinal Garden – 'Parasar Udyan' maintained by the Department of Botany which is not only integral to the study of the UG syllabus but also an important instrument for environment consciousness.
- "Prakriti Porichoy" under the aegis of WWF was initiated from the year 2013.
- One vermicompost unit was installed in the college campus and found in functional condition.

RECCOMMANDATION

To reduce energy consumption and management

- Given the organization's established reputation and longevity, there is ample opportunity to enhance energy conservation efforts and transition the campus towards self-sustainability. The institution has already made significant strides in this direction through initiatives such as implementing energy-efficient lighting, raising awareness among stakeholders, and ensuring essential power backups. Additionally, the organization follows best practices in energy auditing, including properly protecting transformers, generators, and UPS systems with fencing and awareness boards highlighting potential hazards. Prominent signage promoting energy-saving practices, as well as the careful maintenance of electrical infrastructure, further contribute to energy conservation efforts and ensure the safety of staff and students.
- The adoption of sprinkler irrigation on campus to minimize energy usage is commendable. However, there are further recommendations that could enhance the organization's energy savings potential. These measures can lead to a more prosperous

future, characterized by an energy-efficient campus and sustainable environmental and community development for stakeholders in the years ahead.

Potential areas for environment management and green development

1. **Rainwater Harvesting:**
    - Increase the number of rain-water harvesting units by two. Use the collected water for garden irrigation, washroom usage, and cleaning. This green project will help reduce groundwater consumption.
2. **Submersible Pump Regulation:**
    - Install auto-regulating devices on submersible pumps to prevent overflow in rooftop tanks.
3. **Garden Irrigation:**
    - Install auto-regulating sprinklers to ensure adequate garden irrigation, even during summer.
4. **Groundwater Recharge:**
    - Utilize the large roof area of Bidhannagar College buildings to collect rainwater during the rainy season. Transfer this water to a groundwater recharge system. This can be taken as part of an environmental project initiated by the college authority.
5. **Wastewater Treatment:**
    - Ensure that wastewater is treated in a water treatment plant before being discharged into natural water bodies through drainage systems.
6. **Waste Management:**
    - Install separate bins for degradable and non-degradable waste on every floor of all buildings. Degradable waste can be processed to produce organic fertilizer for garden use.
7. **Natural Disaster Management:**
    - Form a Natural Disaster Management Committee and establish a center on campus to help the local community prepare for and respond to cyclones, as the college is located in a cyclone-prone area of lower Bengal.
8. **E-Waste Management:**
    - An E-waste management unit with proper documentation is highly recommended in the college campus.
9. **Bio-Remediation Units:**

- Set up at least three bio-remediation units for the Chemistry, Microbiology, and Biochemistry laboratories to prevent metals and heavy metals from contaminating natural water sources through drainage systems, as recommended by INRC.

These changes will enhance sustainability and environmental responsibility at Bidhannagar College

For better conservation of Biodiversity

1. **Wildlife Conservation:**
   - Designate certain areas on the college campus as protected wildlife habitats, labeled as "Keep Wildness in Wild."
2. **Indigenous Fish Rescue Centre:**
   - Develop a rescue centre for native fish species on campus, including the conservation of wild aquatic plants and wildlife such as soft-shelled turtles.
3. **Aboriginal Tree Library:**
   - Allocate areas for Multiple Tree Species to create an aboriginal tree library to study and conserve locally threatened tree species.
4. **Medicinal Plant Library:**
   - Establish a medicinal plant library within the existing medicinal plant garden.
5. **Butterfly Garden:**
   - Utilize the open spaces on campus to create a butterfly garden, featuring a variety of host and nectar plants to support different butterfly species.
6. **Enhanced Medicinal Plant Garden:**
   - Enrich the medicinal plant garden by planting a wider variety of medicinal plants and ensuring regular maintenance.
7. **Educational Name Plates:**
   - Install name plates for all existing MTS (Major Tree Species) to enhance learning opportunities.

These initiatives will promote conservation, education, and biodiversity on the Bidhannagar College campus