



GREEN , ENERGY & ENVIRONMENT AUDIT REPORT 2021-2022

RAMNAGAR COLLEGE

DEPAL, PURBA MEDINIPUR

**REPORT PREPARED
BY
BLISS & INRC**





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Date-24/02/22

GREEN, ENERGY AND ENVIRONMENT AUDIT CERTIFICATE

ACADEMIC YEAR 2021-2022

This is to certify that BLISS and Institute of Nature Research and Conservation (INRC) has jointly conducted the Energy Audit, Green Audit and Environment Audit of Ramnagar College, Depal, Purba Medinipur for the Academic year 2021-2022 and submitted report under their policy for the Green Campus of the Institute. The initiatives that has been taken for the betterment environment and of the college campus by different stockholders of the college i.e. Honorable Principal Sir, IQAC members, Teachers, Teaching staff and also Students is highly commendable. BLISS and INRC jointly appreciate their all over support during the Audit programme.

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ACKNOWLEDGEMENTS

BLISS and INRC wish to express their appreciation to the esteemed Principal, Administration, and IQAC coordinator at Ramnagar College for assigning us the responsibilities related to Green, Environmental, and Energy auditing processes. Our gratitude extends to the entire auditing team, including Administrative Officers, Assistant Engineers, Heads of Departments, faculty and non-teaching staff, students, Research Scholars, and other stakeholders, for their enthusiastic involvement in data collection through surveys. We also want to acknowledge the office staff for their valuable assistance during the document verification process.

The audit was carried out by a committee comprising experts and scientists from various esteemed institutes on dated **18.01.2022**. The committee formulated a questionnaire aligning with both central and state regulatory and statutory requirements. After collecting and compiling essential data, the committee conducted a thorough analysis. Overall, the audit indicates a favorable environmental status within the Ramnagar College campus.

The committee has put forth recommendations encompassing short-term and long-term measures to elevate environmental conditions to higher standards. The college authorities and all stakeholders have affirmed their commitment to giving due attention and leveraging opportunities for the identified enhancements.

AUDIT COMMITTEE MEMBERS

An expert committee of 4 members was formed to conduct the Green, Environment and Energy Audit from different field of expertization such as Biodiversity and conservation biology, Taxonomy, Plant taxonomy, Phycology, Physics (Energy Science and management) and sustainable resource management.

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
2.	Dr. Amit Manna	Energy management, green synthesis of Nano particle and characterization, Spectroscopic analysis	Vice President Former Project Scientist Spectroscopic Analysis Team NASA
3.	Dr. MnojeetDebnath	Ecology and Taxonomy of Cryptogams	Assistant Professor HOD, Dept of Botany Panskura Banamali College (Autonomous)
4.	Mr. NilanjanSadhukhan	Molecular Taxonomy and Biodiversity	Faculty (SACT) Dept of Botany Moyna College

ABOUT THE COLLEGE

Ramnagar College traces its origins to the premises of Depal Baneswar Charubala Vidyamandir. In its formative years, the founding Principal, Sri Sripati Charan Pradhan, collaborated with philanthropic individuals, generous land donors, teachers, non-teaching staff, and local youths. Together, they embarked on initiatives imbued with a missionary spirit and a steadfast commitment to establishing the college.

The illustrious inception of the college is credited to the dedicated and dynamic leadership of the late Sri Sripati Charan Pradhan. He actively solicited cash donations and secured a 17-bigha land through the generosity of local benefactors, with special recognition accorded to Sri Sripati Charan Pradhan himself and the late Sri Prafulla Patra. The foundation stone for the college was laid on this land on the auspicious day of Rathajatra (July 2, 1973) by Dr. S. N. Sen, the former Vice-Chancellor of Calcutta University.

Situated in close proximity to Digha, the famed flat and firm beach along the Bay of Bengal's southernmost shores, the college boasts a picturesque, expansive, and environmentally friendly campus. This campus includes administrative offices, undergraduate departments dedicated to teaching, learning, and research, a modern computerized library, a canteen, a Distance Study Centre, a playground, and hostel facilities for both male and female students. Much of this expansion and development has transpired over the past two decades, addressing the essential requirements for higher education in the local area.

Presently, the college houses 10 departments in Arts, 9 departments in Science, and 1 in Commerce. Additionally, three vocational subjects are offered at the undergraduate level.

Academic departments-

SL NO	Department of Arts	Department of Science	Department of Commerce	Department of B.Voc.
1	Bengali	Aquaculture Management	Commerce	Fishery & Farm Management
2	Defense Study	Botany		Food Processing
3	English	Chemistry		Hospitality & Tourism Management
4	Geography	Industrial Fish & Fishery		
5	History	Mathematics		
6	Music	Nutrition		
7	Philosophy	Physics		
8	Political Science	Physiology		
9	Sanskrit	Zoology		
10	Sociology			

Arial View of the Ramnagar College Campus depicting the Canopy cover, Aquatic bodies and concrete and building Areas.



Purpose of Green and Environmental Audit

- **Environmental Compliance:** Ensure adherence to local, regional, and national environmental regulations, encompassing waste disposal, energy usage, and relevant standards to maintain the college's environmental integrity.
- **Resource Management:** Assess the effective utilization of resources on campus, including water, energy, and materials. Identify opportunities for conservation and implement sustainable resource management practices.
- **Waste Reduction and Recycling:** Evaluate waste management procedures and advocate for initiatives to minimize waste generation. Identify opportunities for recycling and proper disposal of waste materials.
- **Energy Efficiency:** Scrutinize campus energy consumption patterns and propose measures to enhance energy efficiency, incorporating the adoption of renewable energy sources.
- **Biodiversity and Green Spaces:** Examine 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:** Assess the environmental impact of campus transportation. Encourage sustainable transportation methods to reduce the carbon footprint associated with commuting.

- **Curriculum Integration:** Infuse 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, cultivating 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 minimize the college's contribution to climate change, assessing greenhouse gas emissions and implementing strategies to reduce the carbon footprint.
- **Cost Savings:** Identify cost-effective measures for enhancing environmental performance, leading to long-term financial benefits through energy savings, waste reduction, and sustainable practices.
- **Institutional Reputation:** Elevate the college's reputation as an environmentally responsible institution, positively impacting 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 Audit

- 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 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.
- 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.

METHOD OF GREEN, ENVIRONMENT AND ENERGY AUDIT

- A comprehensive campus walkthrough was executed to observe and document various environmental aspects, including waste disposal areas, energy infrastructure, green spaces, and water management systems.
- Enumeration of campus plant biodiversity was undertaken, involving the identification and photography of different floral and faunal species. The inspection extended to key areas such as the medicinal garden, playgrounds, canteen, library, all departments, office rooms, hostels, building, guest house, staff quarters, and parking grounds to collect relevant data.
- Stakeholder vehicle usage was systematically recorded, with verification of fuel consumption for each vehicle conducted in collaboration with users. The tally also included the number of LPG cylinders used in laboratories, the canteen, and hostel kitchens.
- A meticulous examination of water taps was carried out during the site inspection, leading to the identification of a few leaky taps and overflowing tanks.

Different types of Survey are conducted in College Campus:

Energy Consumption Analysis:

- Examine the patterns of energy usage across various campus buildings.
- Identify opportunities for enhancing energy conservation and efficiency.

Water Resource Assessment:

- Evaluate water sources, consumption patterns, and wastewater treatment facilities.
- Recommend measures to promote water conservation and sustainable usage.

Waste Generation and Management Assessment:

- Examine practices related to waste generation and disposal.
- Propose strategies for minimizing waste, implementing recycling, and ensuring proper disposal.

Transportation and Commuting Patterns Review:

- Analyze commuting habits of both students and staff.
- Provide recommendations for sustainable transportation options and improvements to transportation infrastructure.

Biodiversity and Green Spaces Evaluation:

- Assess the condition of green areas, gardens, and natural habitats.
- Propose measures to enhance biodiversity and conserve green spaces.

Curriculum Integration and Environmental Awareness Assessment:

- Evaluate the integration of environmental themes within the academic curriculum.
- Assess the level of environmental awareness among students and staff.

Infrastructure Development Sustainability Check:

- Examine the sustainability features of new construction projects.
- Ensure alignment with green building standards and sustainable design principles.

Community Engagement Evaluation:

- Assess the degree of engagement and participation in environmental initiatives within the campus community.
- Gather feedback on environmental awareness programs.

Regulatory Compliance Check:

- Financial Implications and Cost Savings Analysis:
- Assess the financial aspects of proposed environmental initiatives.
- Identify potential cost savings through measures promoting energy efficiency and waste reduction

Steps of data collection:

Initially, the audit team was organized into three groups, with the first group's expert members focusing on gathering data for the energy audit, while the experts from the second and third groups concentrated on accumulating data for the green and environmental audit.

- Each group visited various areas of the college campus, including gardens, playgrounds, canteens, kitchens, libraries, and all departments along with their respective laboratories.
- A comprehensive questionnaire covering all aspects of the Green, Environment, and Energy audit was developed and circulated to stakeholders to collect relevant data.
- A drone survey was conducted to measure the green area, concrete area, and aquatic land of the college campus.
- Data and information were gathered through observations, personal interviews, and group discussions with different stakeholders.
- Environmental assessments at various points on the college premises were conducted using electronic devices such as Atmospheric O₂ and CO₂ meters, TDS meters, etc.
- Diameter at Breast Height (DBH) measurements were taken for each tree, phenological conditions were studied, and GPS coordinates of various crucial monitoring points were recorded.
- Plant community structure was examined using the Quadrat method.
- During field visits, different species of mammals, birds, reptiles, amphibians, butterflies, and dragonflies were noted and identified. Wildlife habitats within the college campus were recorded, and data related to various wildlife were collected through group discussions and personal interviews.

Data analysis

- Quantification of the college campus's green area, concrete area, and aquatic land.
- Determination of energy consumption and the contribution of renewable energy sources to the overall energy generation.
- Examination of the ground and rainwater storage procedures, along with the assessment of water reuse practices.
- Assessment of waste generation and the arrangements in place for waste disposal.
- Measurement of atmospheric oxygen (O₂) and carbon dioxide (CO₂) levels across the college campus.
- Calculation of the Biodiversity index within the campus using established standard indices.

- Evaluation of Total Dissolved Solids (TDS) in the water bodies and tank water.
- Investigation of the density, frequency, abundance, relative density, relative frequency, and the Importance Value Index (IVI) of the plant community.

GREEN AUDIT

Significance of Environmental Evaluation at Ramnagar College:

In the contemporary global landscape, the importance of conducting an environmental assessment at Ramnagar College cannot be overstated. As societies worldwide confront the challenges posed by climate change, diminishing resources, and environmental deterioration, educational institutions hold a pivotal role in shaping sustainable attitudes and behaviors. Recognizing its role as a hub for knowledge dissemination and societal influence, Ramnagar College is keenly aware of its responsibility.

The environmental assessment, or Green Audit, functions as a comprehensive evaluation tool that scrutinizes the institution's impact on the environment, encompassing factors such as ecological footprint, resource utilization, and waste management. Through a methodical analysis of these aspects, the college endeavors to pinpoint areas for enhancement and implement sustainable practices that align with its commitment to environmental stewardship.

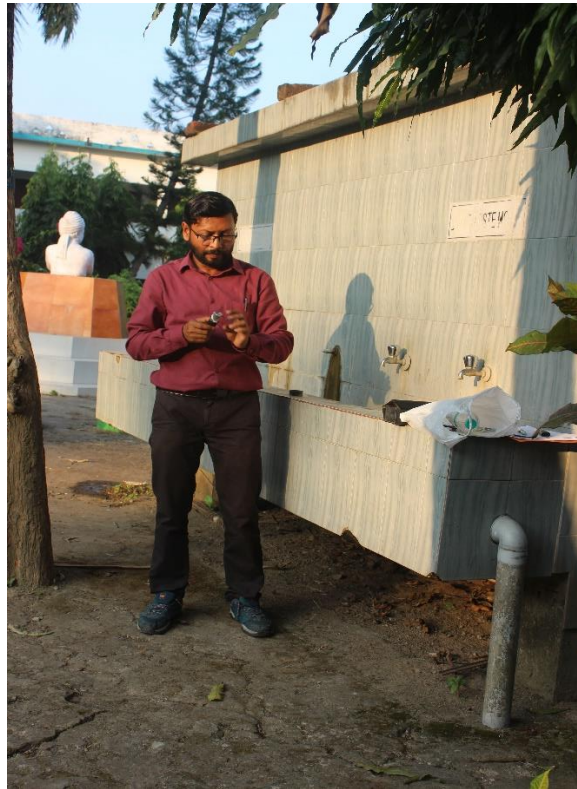
Moreover, the Green Audit at Ramnagar College transcends mere regulatory compliance; it acts as a catalyst for cultivating a culture of environmental consciousness among students, faculty, and staff. By integrating sustainable practices into the core values of the institution, the college not only contributes to the global sustainability agenda but also fosters a deep sense of responsibility towards the planet within its community.

METHODOLOGY EMPLOYED FOR THE GREEN AUDIT:

On the designated date, the Green Audit team conducted a comprehensive survey of the Ramnagar College campus, documenting all biodiversity components, including flora and fauna. Species were promptly identified on-site, and where further identification was necessary, specimens were collected. The majority of existing species were captured through field photography.

The flora within the campus was systematically categorized into Major Tree Species (MTS), shrubs and herbs, aquatic macrophytes, algae, fungi, and lichens. During the field visit,

butterflies, dragonflies, birds, and amphibians were sighted and identified. Additionally, wild habitats were thoroughly studied and documented, and information regarding wild animals was gathered through group discussions with teachers and students during the study.



FLORISTIC DIVERSITY IN RAMNAGAR COLLEGE CAMPUS

DIVERSITY OF MAJOR TREE SPECIES (MTS)

- During the investigation, a comprehensive record of 71 flowering plant species was documented. Among these, 42 were identified as Major Tree Species (MTS) with 249 individuals, 8 were categorized as shrubs, and 21 were classified as herbs. Notably, within this plant diversity, 34 species exhibited medicinal potential, as supported by existing literature (Table 1).
- An intriguing observation is that all 42 Major Tree Species belong to 23 different families, indicating a remarkably high level of taxonomic diversity within the college campus (refer to Table 1). Presence of *Terminalia arjuna*, *Cordia mixa* in the plant community are the relic evergreen wood forest representative which once prevailed in

this area and maintain the harmony with the climatic and edaphic condition of this geographical terrain (Table 1).

- Fabaceae followed by Myrtaceae and Arecaceae are the most dominant family of the major tree species present at the Ramnagar College Campus (Fig. 1).
- Around 92% of the MTS were found to be at their phenological stage during the study (Fig. 3).
- *Terminalia arjuna* shown its highest DBH followed by *Tamarindus indica* and *Ficus hispida* indicate their maximum control over the tree community.(Fig. 3).
- Apart from *Cocos nucifera*, *Thuja sp.* and *Polyalthia longifolia*, *Tectona grandis* have the highest frequency followed by *Azadiracta indica*. (Fig. 4).
- Considering the species richness and evenness when the Simpson's Diversity Index of the MTS was calculated using the formula (EQ-1)

$$D = 1 - (\sum n(n-1)/N(N-1)) \dots \dots \dots (EQ-1)$$

It was observed that the diversity of MTS in the Ramnagar college campus is so high (D =0.132) which depict the importance of the green belt of the college campus in biodiversity conservation.

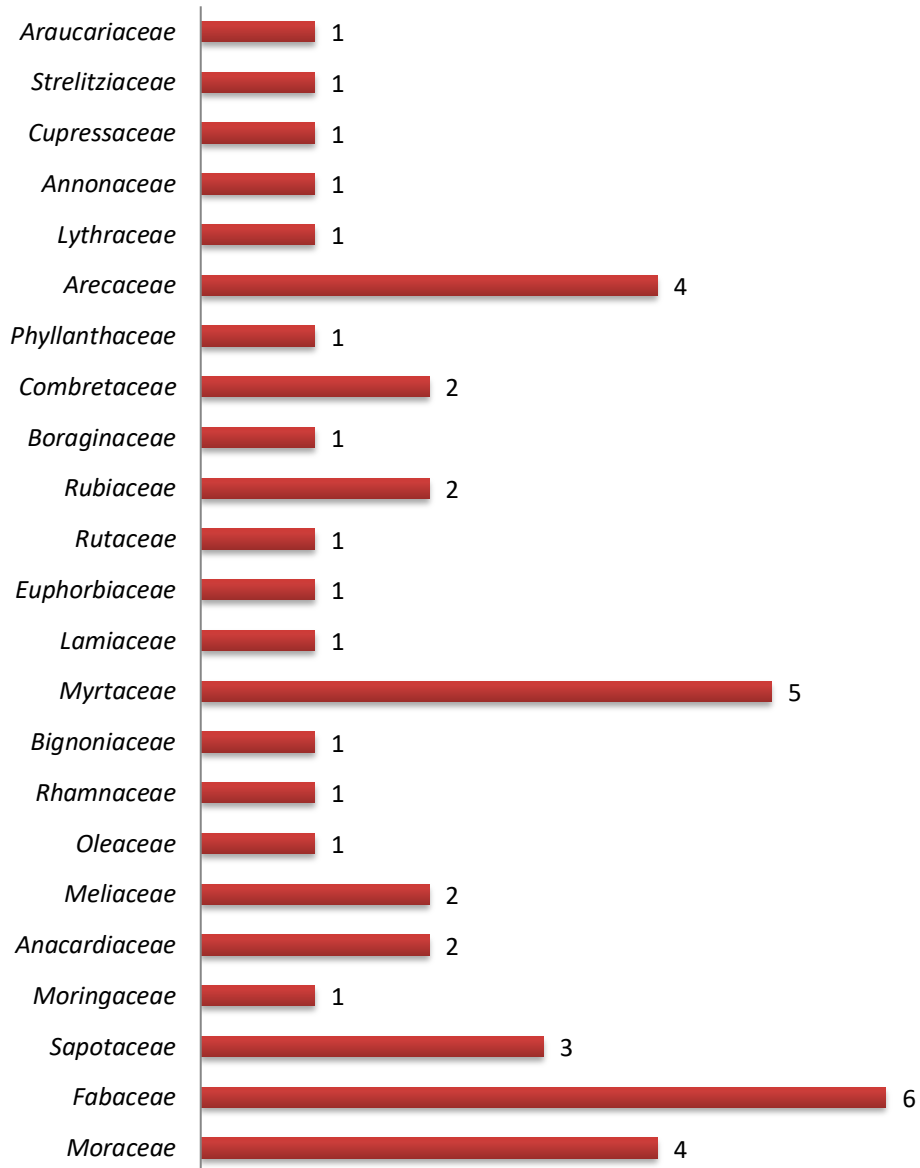
Table: 1 Diversity of MTS

Sl. No .	Name of the Species	Family	No. of Individual	Phen. Satge	Mean DBH (ft.)	Frequency %	Local Status	Habit
1	<i>Acacia auriculiformis</i>	Fabaceae	5	5M	3	2.008	C	T
2	<i>Aegle marmelos</i>	Rutaceae	1	1M	2.2	0.402	C	T
3	<i>Araucaria</i>	Araucariaceae	5	5M	2.2	2.008	LC	T
4	<i>Artocarpus heterophyllus</i>	Moraceae	1	1M	4	0.402	C	T
5	<i>Azadirachta indica</i>	Meliaceae	6	2M, 4J	1.3	2.410	C	T
6	<i>Bauhinia variegata</i>	Fabaceae	5	2M	3.1	2.008	C	T
7	<i>Borassus flabellifer</i>	Arecaceae	1	1M	3.9	0.402	C	T
8	<i>Cassia fistula</i>	Fabaceae	1	1M	0.9	0.402	C	T
9	<i>Cocos nucifera</i>	Arecaceae	20	18M, 2J	3.8	8.032	C	T
10	<i>Cordia myxa</i>	Boraginaceae	1	1M	1.1	0.402	LT	T
11	<i>Eucalyptus globulus</i>	Myrtaceae	2	2M	1.3	0.803	C	T
12	<i>Ficus cunia</i>	Moraceae	1	1M	0.8	0.402	C	T
13	<i>Ficus hispida</i>	Moraceae	3	3M	0.8	1.205	C	T
14	<i>Ficus hispida</i>	Moraceae	1	1M	6.3	0.402	C	T
15	<i>Hyophorbe lagenicaulis</i>	Arecaceae	5	5M	3.2	2.008	LC	T
16	<i>Lagerstroemia speciosa</i>	Lythraceae	2	2M	6	0.803	C	T
17	<i>Leucaena leucocephala</i>	Fabaceae	1	1M	1.8	0.402	C	UT
18	<i>Livistona chinensis</i>	Arecaceae	5	4M, 1J	3.1	2.008	C	T

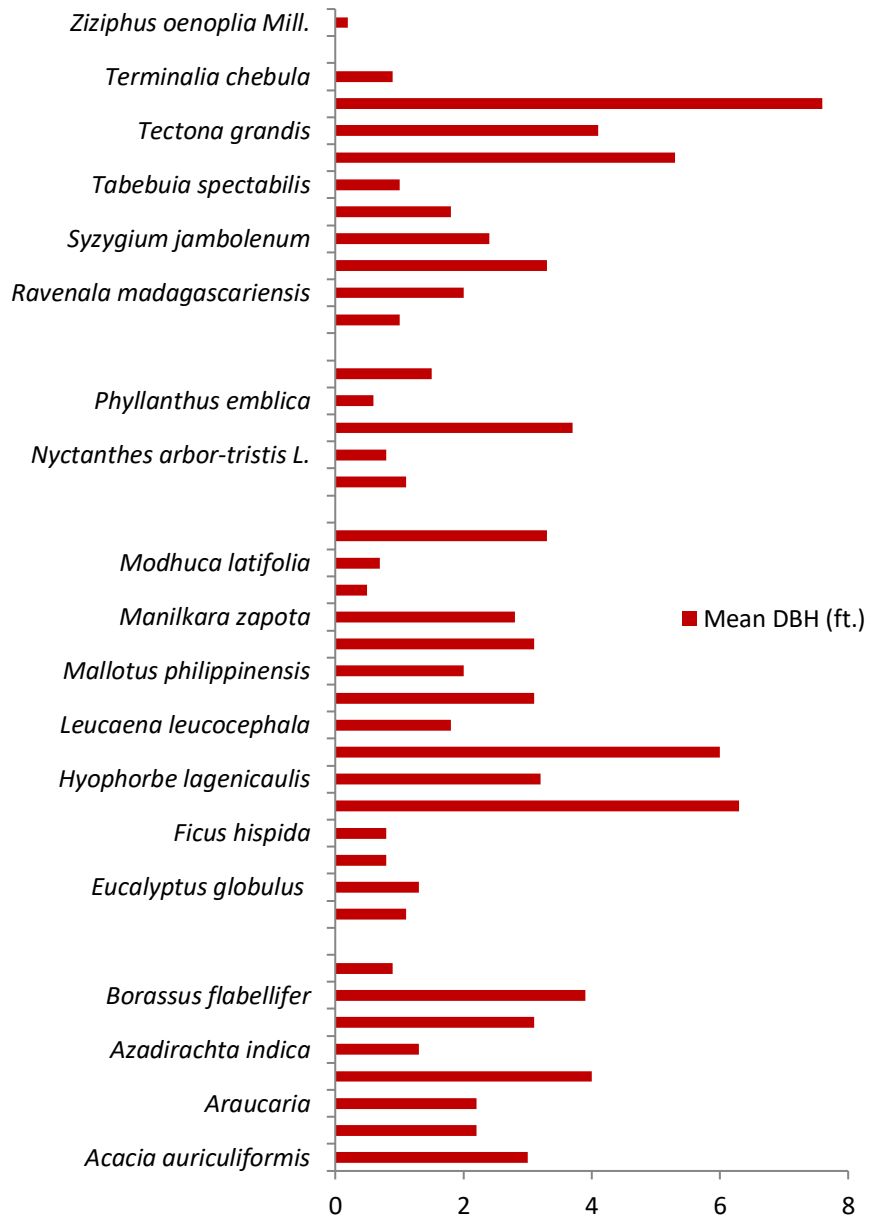
19	<i>Mallotus philippinensis</i>	Euphorbiaceae	2	2M	2	0.803	LC	T
20	<i>Mangifera indica</i>	Anacardiaceae	2	2M,	3.1	0.803	C	T
21	<i>Manilkara zapota</i>	Sapotaceae	2	2M	2.8	0.803	C	T
22	<i>Mimusops Elengi</i>	Sapotaceae	1	1J	0.5	0.402	LT	T
23	<i>Modhuca latifolia</i>	Sapotaceae	1	1J	0.7	0.402	LC	T
24	<i>Moringa oleifera</i>	Moringaceae	2	2M,	3.3	0.803	C	T
25	<i>Murraya paniculata</i>	Rubiaceae	70	70M	0.7	28.112	C	UT
26	<i>Neolamarckia cadamba</i>	Rubiaceae	1	1M	1.1	0.402	C	T
27	<i>Nyctanthes arbor-tristis</i>	Oleaceae	1	1M	0.8	0.402	C	UT
28	<i>Phoenix sylvestris</i>	Arecaceae	3	2M,1J	3.7	1.205	C	T
29	<i>Phyllanthus emblica</i>	Phyllanthaceae	2	2J	0.6	0.803	LC	T
30	<i>Pithecellobium Dulce</i>	Fabaceae	1	1M	1.5	0.402	LT	T
31	<i>Polyalthia longifolia</i>	Annonaceae	50	50M	1.8	20.080	C	T
32	<i>Psidium guajava</i>	Myrtaceae	1	1M	1	0.402	C	T
33	<i>Ravenala madagascariensis</i>	Strelitziaceae	1	1M	2	0.402	LC	T
34	<i>Swietenia mahagoni</i>	Meliaceae	4	3M, 1J	3.3	1.606	C	T
35	<i>Syzygium jambolenum</i>	Myrtaceae	2	1M,1J	2.4	0.803	C	T
36	<i>Syzygium samarangense</i>	Myrtaceae	1	1M	1.8	0.402	C	T
37	<i>Tabebuia spectabilis</i>	Bignoniaceae	4	2M, 2J	1	1.606	LC	UT
38	<i>Tamarindus indica</i>	Fabaceae	1	1M	5.3	0.402	C	T
39	<i>Tectona grandis</i>	Lamiaceae	8	6M, 2J	4.1	3.213	C	T
40	<i>Terminalia arjuna</i>	Combretaceae	1	1M	7.6	0.402	C	T
41	<i>Terminalia chebula</i>	Combretaceae	1	1M	0.9	0.402	LC	T
42	<i>Thuja occidentalis</i>	Cupressaceae	18	18M	0.9	7.229	LC	UT
43	<i>Ziziphus oenopia Mill.</i>	Rhamnaceae	3	1M, 2J	0.2	1.205	LC	S
			249	M=229				
				J=20				

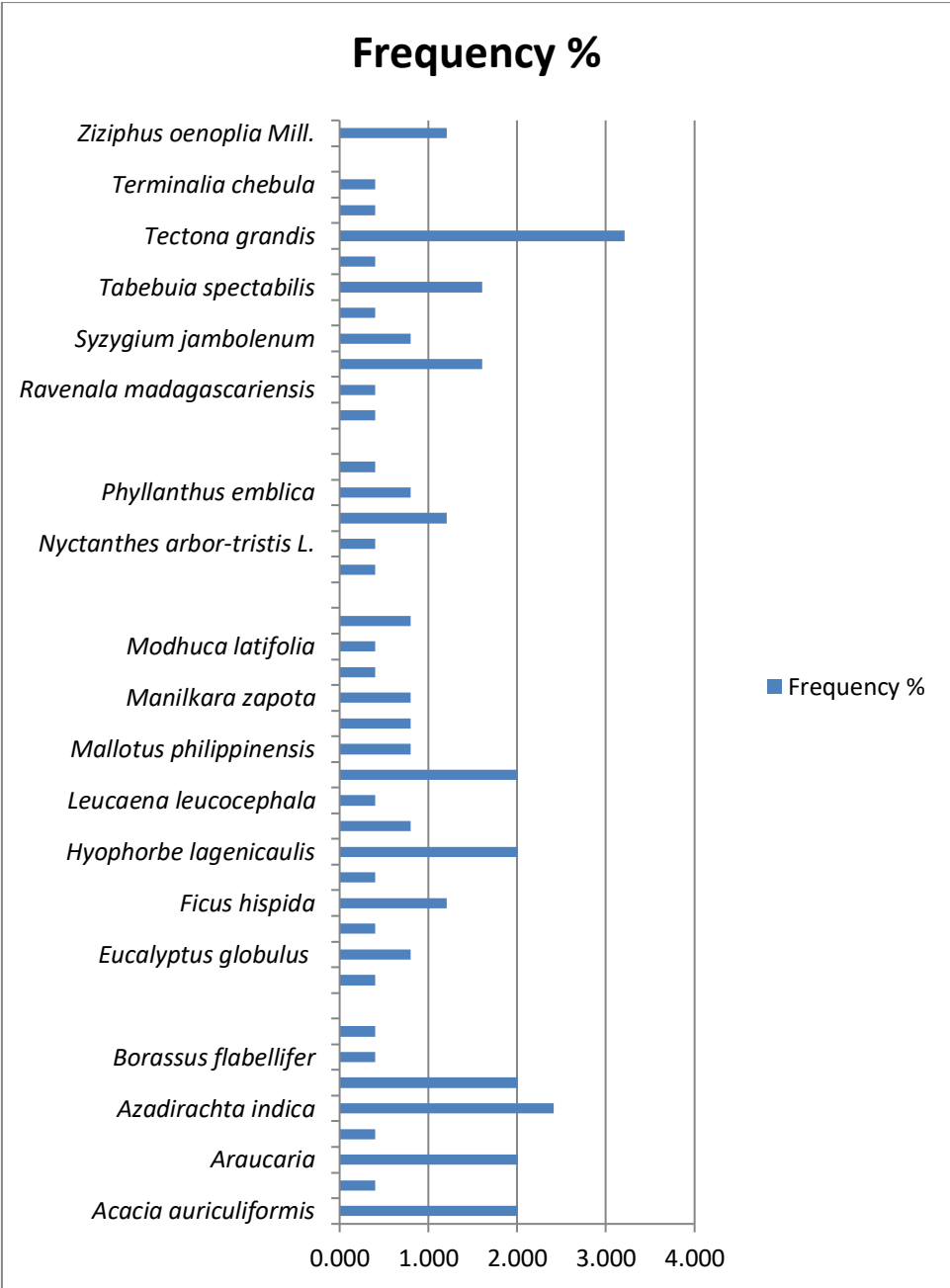
DOMINANT FAMILIES OF MTS

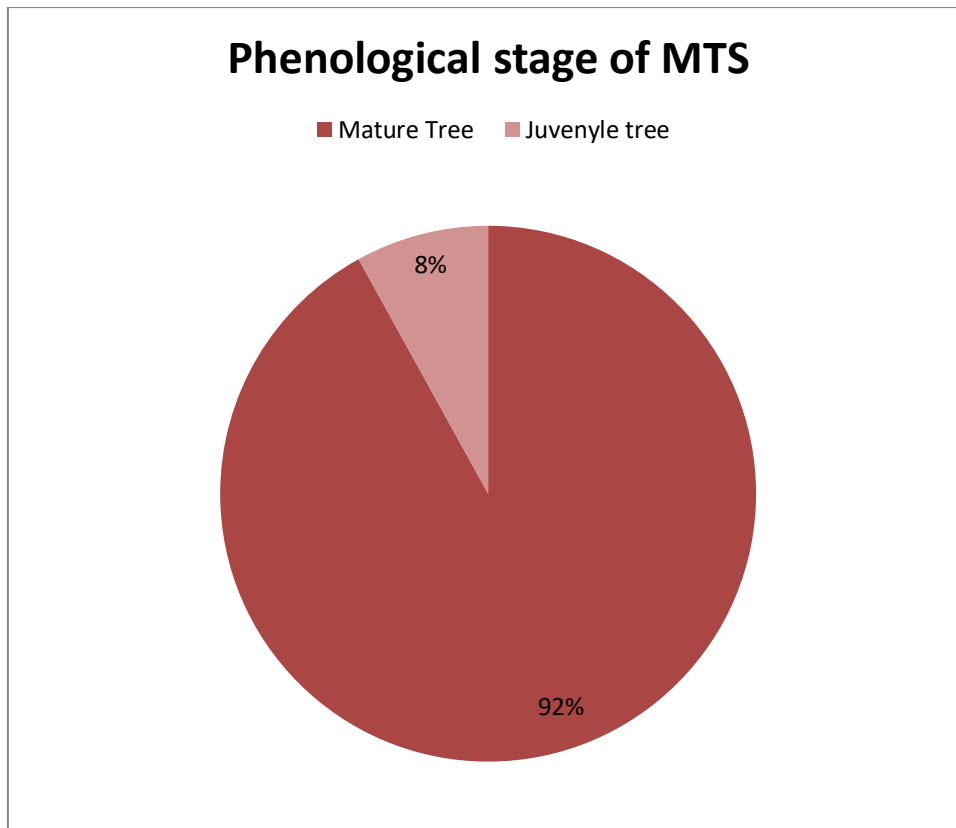
■ No



Mean DBH (ft.)







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).

Evolvulus elsinoides shown its highest Relative Density and Relative frequency followed by *Desmodium gangeticum* and *Eclipta alba* in this Forbs community shows their maximum

control and dominance over the community (Fig. 5). The same result was observed in Frequency% and Density also in this community of Ramnagar College (Fig. 6).

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 found that *Evolvulus alsinoides* shown its highest IVI value (27.2) followed by *Desmodium gangeticum* (22.7) and (table 2) (Fig. 7). These findings depict that these plants have maximum contribution in herbaceous plant community structure formation and thus have maximum control over the community (Table 2).

Table 2: Community Structure of Herbs in Ramnagar College

SL. No.	Plant Species	D	F	AB	RF	RD	IVI
1	<i>Commilina benghalensis</i>	75.00	37.50	2.00	3.90	2.49	6.39
2	<i>Eleutheranthera ruderalis</i>	50.00	37.50	1.33	3.90	1.66	5.56
3	<i>Evolvulus alsinoides</i>	587.50	75.00	7.83	7.79	19.50	27.29
4	<i>Ipomoea indica</i>	50.00	12.50	4.00	1.30	1.66	2.96
5	<i>Oldenlandia corymbos</i>	275.00	75.00	3.67	7.79	9.13	16.92
6	<i>Eleusine indica</i>	75.00	12.50	6.00	1.30	2.49	3.79
7	<i>Parthenium hysterophorus</i>	87.50	50.00	1.75	5.19	2.90	8.10
8	<i>Coccinia grandis</i>	150.00	75.00	2.00	7.79	4.98	12.77
9	<i>Abutilon Indicum</i>	37.50	25.00	1.50	2.60	1.24	3.84
10	<i>Solanum nigram</i>	37.50	25.00	1.50	2.60	1.24	3.84
11	<i>Cyperus rotundus</i>	175.00	50.00	3.50	5.19	5.81	11.00
12	<i>Vitis trifolia</i>	150.00	62.50	2.40	6.49	4.98	11.47
13	<i>Desmodium gangeticums</i>	412.50	87.50	4.71	9.09	13.69	22.78
14	<i>Clerodendrum infortunatum</i>	87.50	25.00	3.50	2.60	2.90	5.50
15	<i>Phyllanthus niruri</i>	75.00	25.00	3.00	2.60	2.49	5.09
16	<i>Scoparia dulcis</i>	112.50	62.50	1.80	6.49	3.73	10.23
17	<i>Stephania hernandifolia</i>	200.00	62.50	3.20	6.49	6.64	13.13
18	<i>Mikania scandens</i>	100.00	25.00	4.00	2.60	3.32	5.92
19	<i>Cocculus hirsutus</i>	112.50	37.50	3.00	3.90	3.73	7.63
20	<i>Oxalis sp.</i>	37.50	25.00	1.50	2.60	1.24	3.84
21	<i>Eclipta alba</i>	125.00	75.00	1.67	7.79	4.15	11.94



Fig. 5: Density and Frequency of Forbs community

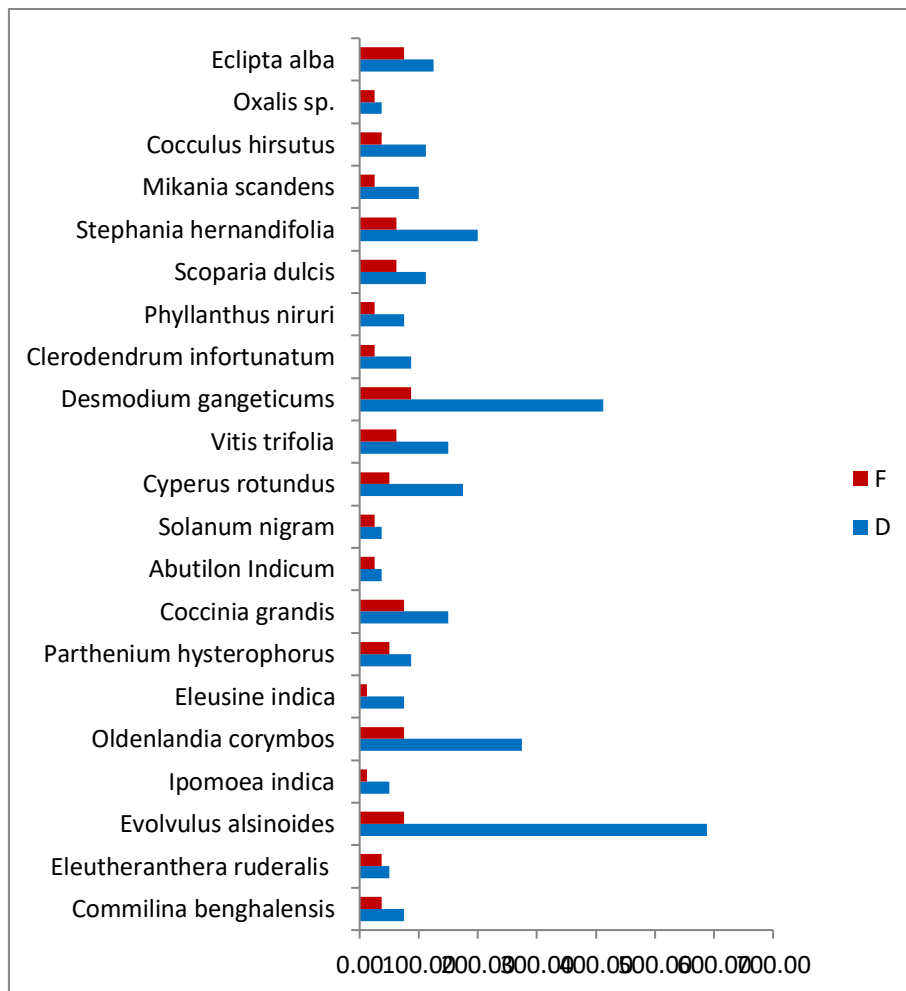


Fig. 6: Comparative RD and RF of the forbs of Ramnagar College

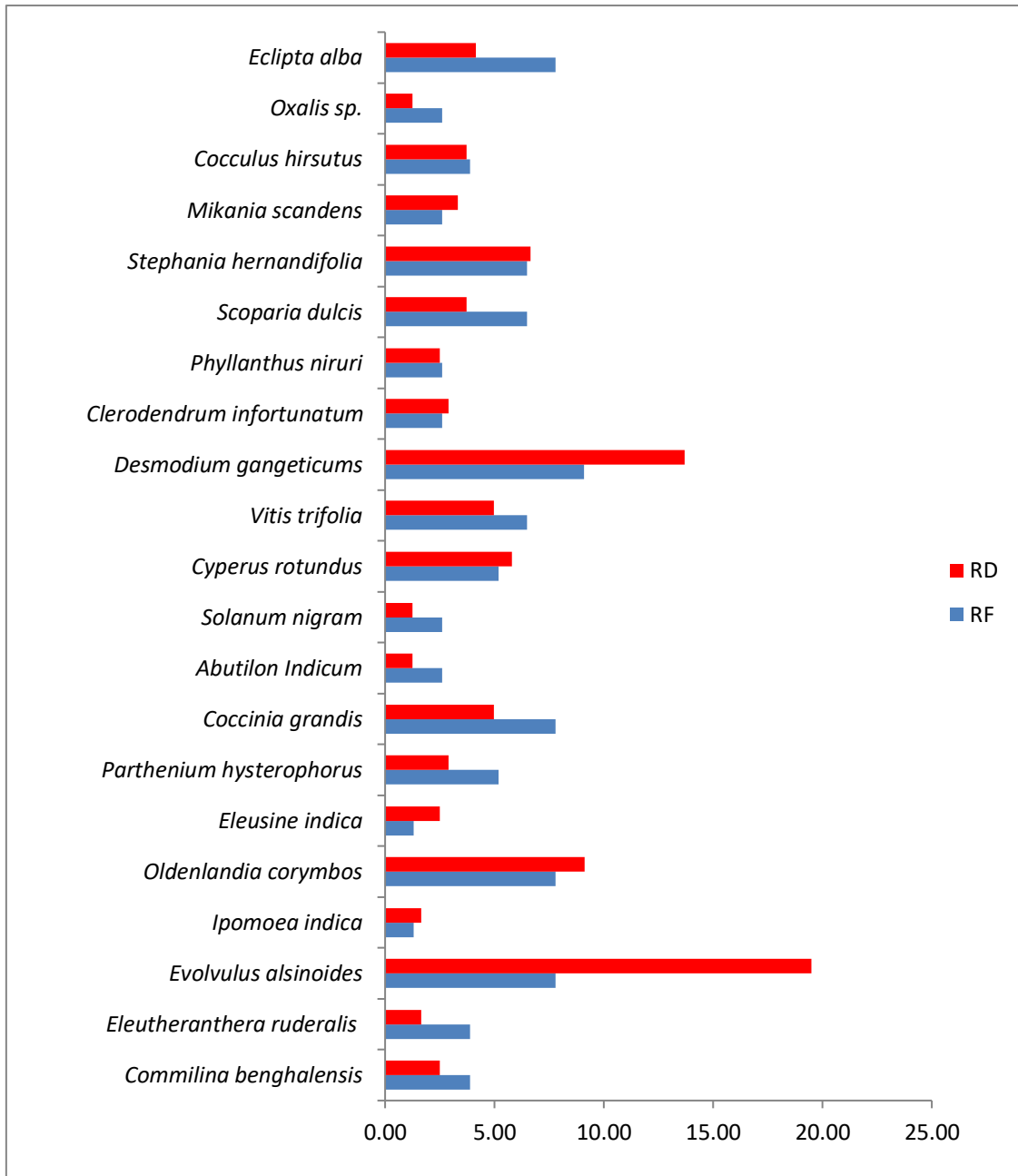
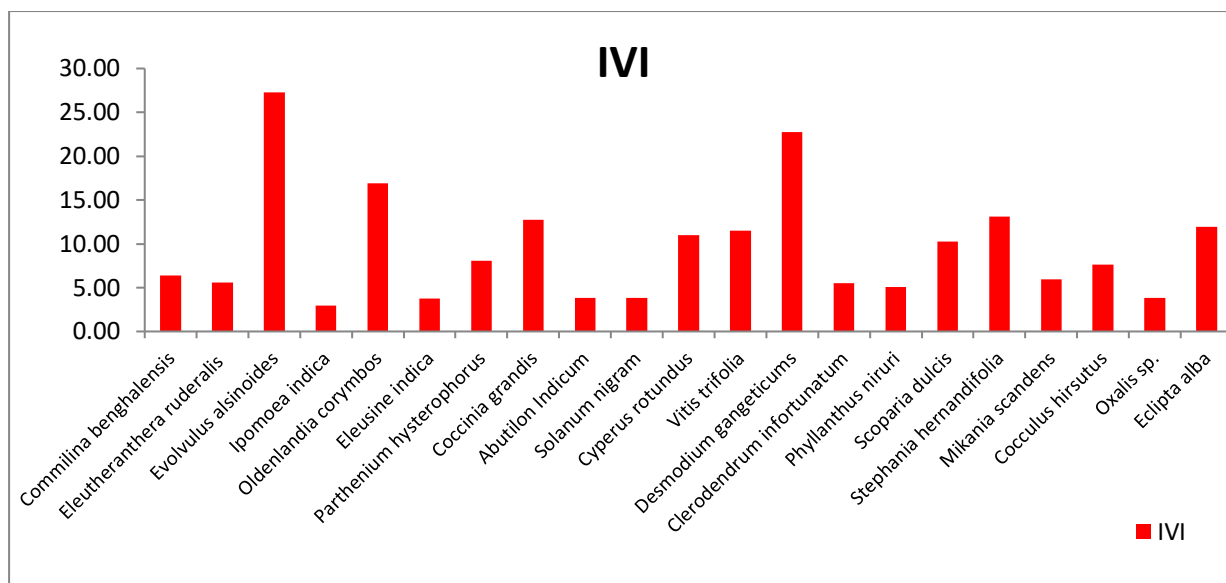


Fig. 7: Importance Value index of herbaceous species



FAUNAL DIVERSITY:

A detail list of birds, butterflies, dragon flies at the Ramnagar college campus was listed below with their common English name

Sl. No.	Name of the Butterfly species	Common name
1	<i>Catopsilia pomona</i>	Common Emigrant
2	<i>Catopsilia pyranthe</i>	Mottled Emigrant
3	<i>Eurema hecabe</i>	Common Grass Yellow
4	<i>Leptosia nina</i>	Psyche
5	<i>Cepora nerissa</i>	Common Gull
6	<i>Ixias pyrene</i>	Yellow Orange Tip
7	<i>Acraea violae</i>	Tawny Coster
8	<i>Ariadne ariadne</i>	Angled Castor
9	<i>Ariadne merione</i>	Common Castor
10	<i>Junonia almanac</i>	Peacock Pansy

Sl. No.	Name of the dragon fly Species	Common Name
1	<i>Brachythemis contaminata</i>	Ditch Jewel
2	<i>Crocothemis servilia</i>	Ruddy Marsh Skimmer
3	<i>Diplacodes trivialis</i>	Ground Skimmer
4	<i>Orthetrum Sabina</i>	Green Marsh Hawk

Sl. No.	Name of bird species	English name
1	<i>Halcyon capensis</i>	Stork-billed Kingfisher
2	<i>Halcyon smyrnensis</i>	White-throated Kingfisher
3	<i>Centropus sinensis</i>	Greater Coucal
4	<i>Streptopelia chinensis</i>	Spotted Dove
5	<i>Amurornis phoenicurus</i>	White-breasted Waterhen
6	<i>Vanellus indicus</i>	Red-wattled Lapwing
7	<i>Egretta garzeta</i>	Little Egret
8	<i>Mesaphoyx intermedia</i>	Intermediate Egret

9	<i>Bubulcus ibis</i>	Cattle Egret
10	<i>Ardeola grayii</i>	Indian Pond Heron
11	<i>Dupetor flavicollis</i>	Black Bittern
12	<i>Dendrocitta vagabunda</i>	Rufous Treepie
13	<i>Corvus splendens</i>	House Crow
14	<i>Corvus macrorhynchos</i>	Large-billed Crow
15	<i>Oriolus xanthornus</i>	Black-hooded Oriole
16	<i>Dicrurus macrocercus</i>	Black Drongo
17	<i>Copsychus saularis</i>	Oriental Magpie Robin
18	<i>Acridotheres tristis</i>	Common Myna

ENVIRONMENT AUDIT

Campus Survey and Enquiry

Undertaking an Environmental Audit within the college premises represents a pivotal endeavor. This entails conducting a thorough evaluation of eco-friendly practices, resource consumption, and environmental impact across the campus. The primary objective of the audit is to assess and improve sustainability measures, thereby fostering a healthier and more environmentally conscious campus environment. The insights and recommendations gleaned from this audit play a crucial role in advancing the institution's commitment to environmental stewardship. The comprehensive data collected during the survey is meticulously documented in our report.

Establishing an eco-friendly college campus necessitates the adoption of sustainable practices aimed at mitigating environmental harm. This involves a range of initiatives geared towards reducing carbon emissions, conserving resources, and cultivating a more sustainable ecosystem. Fundamental components of an eco-friendly campus encompass the implementation of energy-efficient infrastructure, the implementation of waste reduction and recycling schemes, the promotion of eco-friendly transportation alternatives, and the integration of renewable energy sources. Furthermore, raising environmental awareness through educational initiatives and fostering eco-friendly behaviors among students and staff are integral to fostering a sustainable campus community. Such measures contribute not only to the well-being of the campus and its surroundings but also to the cultivation of a collective sense of environmental responsibility among its constituents.

The audit encompassed a comprehensive examination of the following key areas:

- Average Footfall
- Water Efficiency and Management
- Air Quality and Carbon Footprint Management
- Waste Generation and Management
- E-Waste Management
- Environmental Disaster Preparedness
- Biodiversity Conservation and Green Zone Management

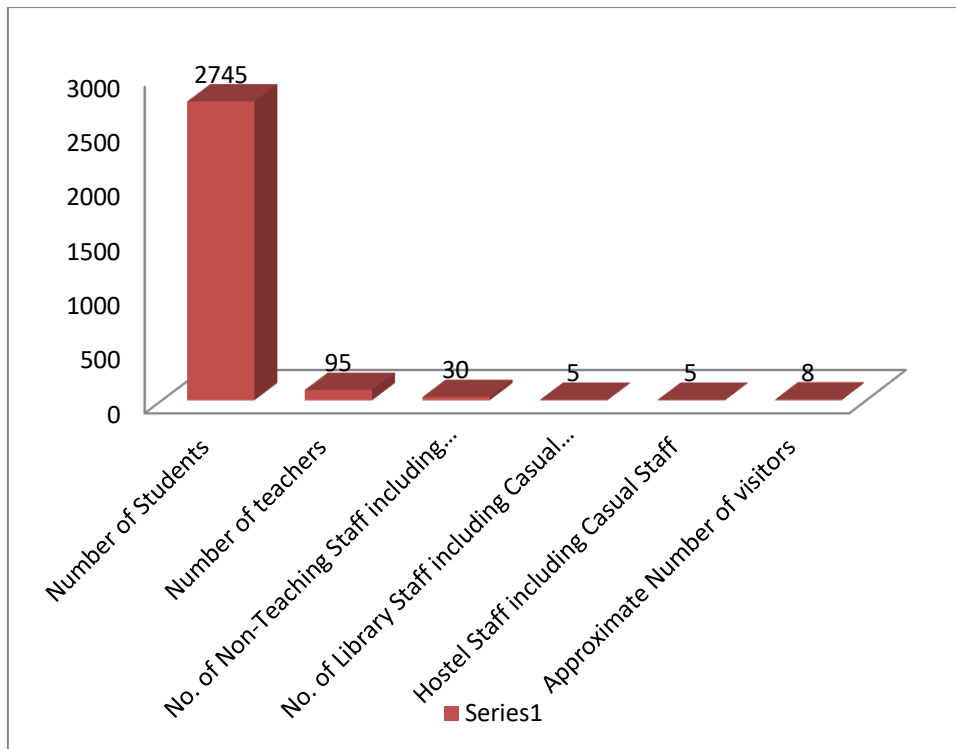
By addressing these crucial aspects, the college endeavors to uphold its commitment to environmental sustainability and pave the way for a greener future.

1. Total population of the college campus - Foot fall

Number of Students	2745
Number of teachers	95
No. of Non-Teaching Staff including Casual Staff	30
No. of Library Staff including Casual Staff	05
Hostel Staff including Casual Staff	05
Approximate Number of visitors	08
Total population	2888

Foot fall based on Total population

Around 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.



2. Water Efficiency and Water Management

Water plays a crucial role in our daily lives, whether at home, in educational institutions, or in business settings. Each instance of water usage presents an opportunity for conservation, considering the finite availability of fresh water and its significance for environmental well-being. With the growing population, expanding industries, increasing development activities, and the looming impacts of climate change, there is an escalating demand for water resources in the province.

Implementing water efficiency and effective water management practices on a college campus is paramount for environmental sustainability, cost savings, and fostering a culture of responsibility among students and staff. Conducting a water audit is instrumental in understanding the various areas of water usage across the campus, including academic buildings, dormitories, recreational spaces, and landscaping. This assessment of consumption patterns is essential for identifying specific areas where water conservation efforts can yield the most significant impact.

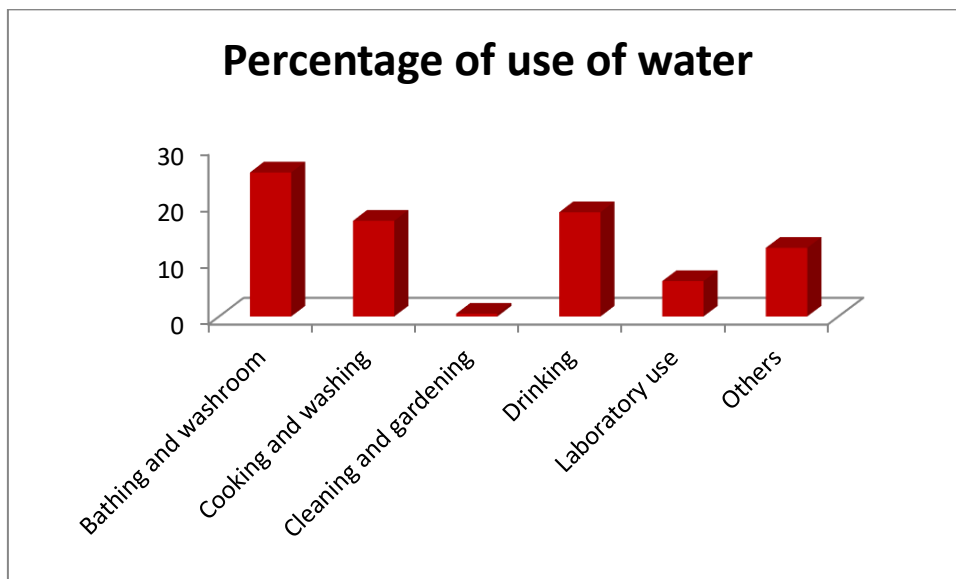
In our college, the majority of water usage was found to be attributed to cleaning and gardening activities (25.5%), followed by bathing and restroom facilities (20.5%). Approximately 18.5% of the total water consumption is allocated for drinking purposes after

undergoing proper purification processes. However, a small amount of water was observed to be wasted during these processes

Use of water in Different Purpose of College Premises

Use of water in Different Purpose Per Day	Use in Percentage
Bathing and washroom	25.5
Cooking and washing	17.0
Cleaning and gardening	0.5
Drinking	18.5
Laboratory use	6.3
Others	12.2

Percentage of use of water at Ramnagar College Campus



Factors	Weightage
Quality of Water	H
Re-use of water	L

Water Harvesting & Recharge	L
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%

After conducting examinations with the assistance of a Water pH meter and TDS meter, we concluded that the quality of drinking water meets the standards for human health. As a result, the rating for Water Quality is classified as high (H). However, our observations revealed that there are no operational Rechargeable units or water harvesting plants within the campus area. Additionally, the management of water reuse and the utilization of surface water on campus are not adequately addressed. Therefore, the effectiveness of the water management policy at the current level is rated as Low (L).

3. Air Quality and Carbon Footprints:

Amount of CO₂ (ppm) in different location of the college Campus

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**

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 CO₂ emissions from electricity are calculated using the formula:

$$\text{CO}_2 \text{ emission from electricity} = (\text{electricity usage per year in kWh} / 1000) \times 0.84$$

Substituting the given values: = $(21480 \text{ kWh} / 1000) \times 0.84 = 18.04 \text{ metric tons}$

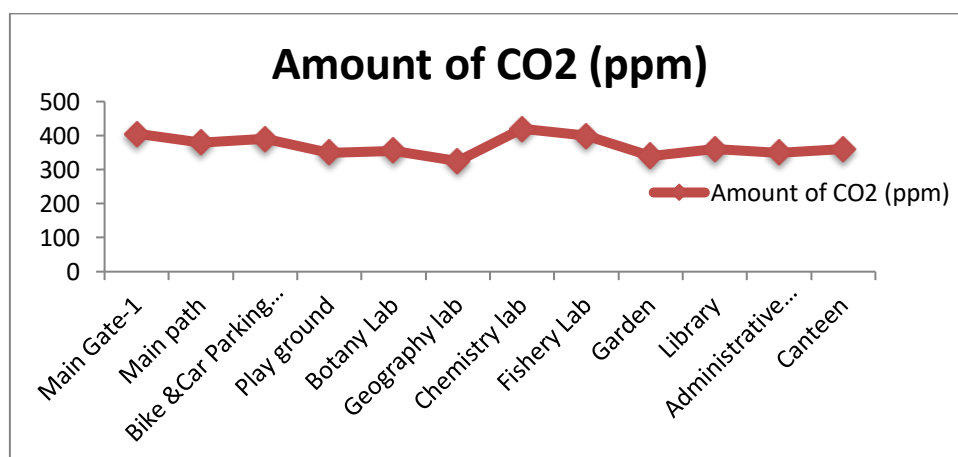
Note:

- Annual electricity usage: 21480 kWh
- 0.84 is the conversion coefficient from kWh to metric ton

Different location of the college campus	Amount of CO2 (ppm)
Main Gate-1	405
Main path	380
Bike & Car Parking Zone	390
Play ground	350
Botany Lab	355
Geography lab	325
Chemistry lab	420
Fishery Lab	400
Garden	340
Library	360
Administrative Office	350
Canteen	360

The concentration of CO₂ in the air serves as an indicator of air quality in a specific area, directly impacting human health. Evaluating air quality in areas with high foot traffic, such as schools, colleges, and universities, is crucial. Elevated levels of CO₂ can lead to symptoms such as headaches, fatigue, poor concentration, increased heart rate, and nausea. At Ramnagar College, atmospheric CO₂ levels were measured at various locations. It was observed that CO₂ levels are low in the garden and playground areas but high in the Chemistry and Fishery labs, as well as in front of Main Gate-1. However, these levels remain within permissible limits for human health.

Amount of CO₂ at different site of Ramnagar College

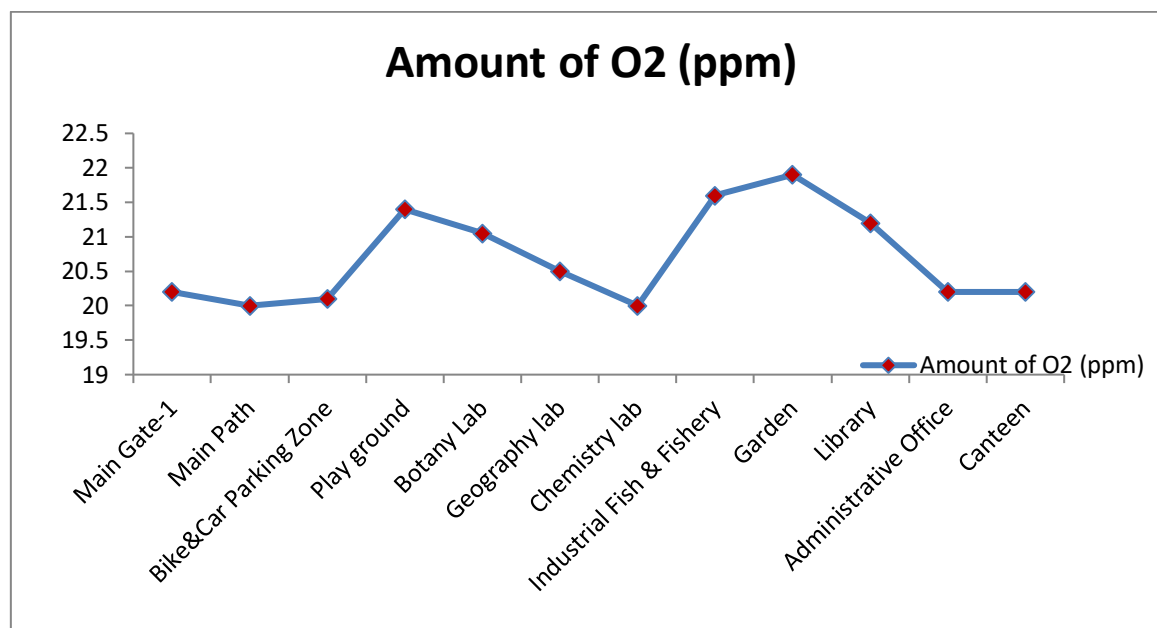


While the typical atmosphere near the Earth's surface contains 20.9% oxygen by volume, regulatory standards such as those set by the Occupational Safety and Health Administration and confined-space guidelines specify that an atmospheric oxygen concentration of at least 19.5% is necessary for safe entry into such spaces. At Ramnagar College, the oxygen (O₂) levels in the atmosphere range from 20.4 ppm to 21.9 ppm. The highest levels were recorded in the open spaces and garden areas, while the lowest levels were found in the office. Oxygen levels tend to decrease in crowded rooms and increase with proper ventilation and open spaces. The oxygen levels at Ramnagar College are moderately high and do not pose any adverse effects on human health.

Amount of O₂ (ppm) in different location of the college Campus

Different location of the college campus	Amount of O ₂ (ppm)
Main Gate-1	20.2
Main Path	20
Bike & Car Parking Zone	20.1
Play ground	21.4
Botany Lab	21.05
Geography lab	20.5
Chemistry lab	20
Industrial Fish & Fishery	21.6
Garden	21.9
Library	21.2
Administrative Office	20.2
Canteen	20.2

Amount of CO₂ at different site of Ramnagar College



Generation of Waste and Waste Management

Waste pertains to materials that are discarded or no longer useful, encompassing substances that are considered worthless, defective, or lacking in utility after their initial use. In contrast, a by-product refers to a material produced alongside the main product with relatively minor economic value. Waste products have the potential to be transformed into by-products, joint products, or valuable resources through innovative processes that increase their value.

Pollutants are substances introduced into ecosystems through human activities, leading to a degradation in air, water, soil, and food quality, thereby impacting the well-being of both human and non-human populations. Some pollutants are human-made or synthetic, such as chemical pesticides used in crop protection. Others originate directly from the environment, like heavy metals or fossil fuels extracted by humans. Human waste, including sewage and refuse, often contains pollutants capable of causing diseases in both humans and other organisms. Combustion of fossil fuels releases pollutants like sulfur dioxide (SO₂), nitrogen oxides (NO_x), and airborne particles such as soot, which degrade air quality and pose threats to life. Items like plastic bags, discarded ropes, mobile towers emitting electromagnetic fields, and strings can pose significant dangers to birds and other animals.

Waste management involves a series of processes and actions necessary to handle waste from its origin to its final disposal. This includes collection, transportation, treatment, and disposal, as well as monitoring and regulating waste-related activities, laws, technologies, and economic mechanisms.

Waste can exist in various forms—solid, liquid, or gas—each requiring distinct disposal and management methods. Waste management encompasses all types of waste, including industrial, biological, household, municipal, organic, biomedical, and radioactive wastes. Some forms of waste pose potential threats to human health, with concerns arising from the handling of solid waste and indirect exposure through water, soil, and food consumption.

Human activities, particularly the extraction and processing of raw materials, contribute to waste generation. The primary objective of waste management is to mitigate the adverse effects of waste on human health, the environment, planetary resources, and aesthetics. It involves a comprehensive approach to address the challenges associated with waste production and disposal, ensuring sustainable and responsible management of diverse waste streams.

Waste generation on college campuses is a significant aspect of waste management, requiring a comprehensive approach to minimize environmental impact and promote sustainability.

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.

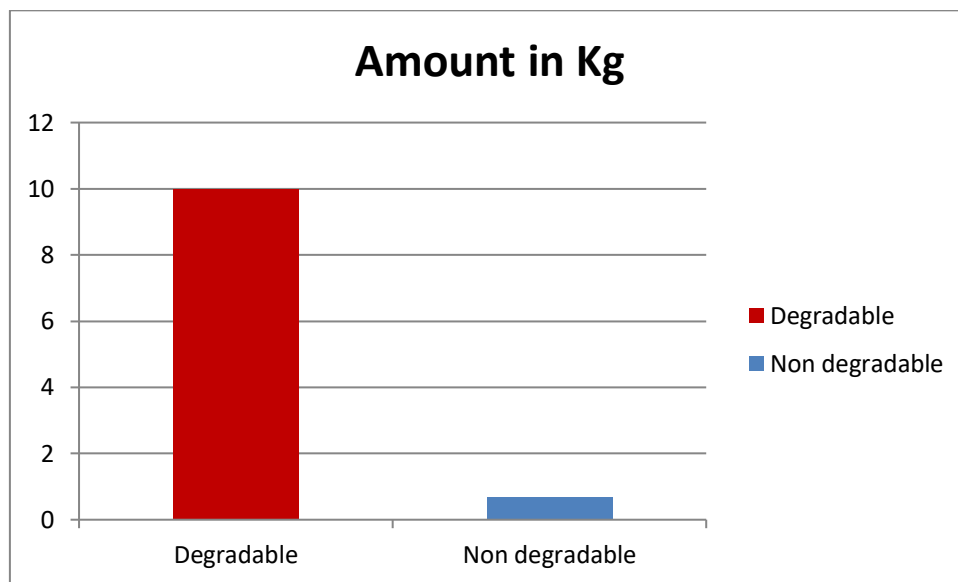
Plastic and Packaging Waste: From products, promotional materials, and campus events.

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	10.0
Non degradable	0.7

Amount of Waste (Degradable and Non degradable)



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
Laboratories	1	0.05
Office	0.8	0.08
Canteen	3	0.30
Garden	4.5	0.02
Others	0.2	0.04
Transfer from outside with students and staff	0.5	0.21

ENERGY AUDIT

1. Introduction: An energy audit entails a systematic examination of energy flows within an organizational context, with the overarching goal of energy conservation. This process involves the analysis of techniques and systems aimed at diminishing energy consumption within the organization while maintaining operational output. The audit encompasses recommendations for alternative approaches and methods to achieve more substantial energy savings. Traditionally, electrical energy is derived from fossil fuels, hydropower, and wind sources. Given the finite availability and depletion rate of fossil fuels, there is a pressing need to explore alternative energy systems and prioritize the conservation of electric energy. The fundamental objective of energy auditing and energy consumption management is to provide goods or services at the minimal feasible cost while minimizing environmental impact (Backlund and Thollander, 2015). The imperative for conducting an energy audit lies in the identification of potential savings and cost reduction methods, comprehension of fuel utilization patterns, pinpointing areas of waste, and delineating opportunities for enhancement. The initiation and execution of an energy audit are advocated to ensure the implementation and adherence to energy-saving practices in educational institutions and industrial sectors in a manner conducive to sustainability. The audit process encompasses the formulation and completion of a questionnaire, physical inspection of the campus, observation and scrutiny of documentation, interviews with key personnel, data analysis, measurements, and the subsequent provision of suggestions. The multifaceted nature of energy auditing includes considerations such as the potential for energy savings, energy management strategies, and the exploration of alternative energy sources (Cabrera et al., 2010). Guided by these considerations, the specific objectives of the audit include evaluating the efficacy of the sustainability management and control system, as well as assessing the degree of compliance of various departments with relevant regulations, policies, and standards. It is noteworthy that the outcomes of the audit have the capacity to exert a significant impact on the operational costs and environmental footprint of the organization (Singh et al., 2012). In 2017, the Energy Conservation Building Code (ECBC) was instituted, delineating the minimum requisites for the energy-efficient design and construction of buildings throughout India. Beyond these baseline requirements, ECBC introduces two additional tiers of incremental specifications, aiming to achieve heightened levels of energy efficiency (Gnanamangai et al., 2021). The Bureau of Energy

Efficiency (BEE), operational since 2002, is dedicated to implementing energy-saving practices within organizations. Energy-efficiency labels, conveying information on the energy performance of manufactured products, were introduced as part of this initiative (Ingle, 2014). BEE has devised a scheme for energy efficiency labelling of buildings, aligning with the star ratings assigned to buildings, to expedite energy efficiency endeavors. The BEE Star Rating Scheme evaluates the actual performance of both buildings and equipment, quantified in terms of specific energy usage, denoted as the 'Energy Performance Indicator,' through the use of labelled items with star ratings. This approach is instrumental in facilitating sustainable energy savings (Mishra and Patel, 2016). This approach takes into account economic considerations and other organizational factors (Asnani and Bhawana, 2015). Furthermore, the energy audit addresses the exploration of avenues to reduce operating expenses and decrease energy consumption per unit of production, thereby generating savings. Importantly, it establishes a "benchmark" or reference point for energy management within the organization, facilitating the planning of more energy-efficient practices across various facets (Cabrera et al., 2010). An Energy Audit is a methodical, documented, regular, and objective assessment of the elements comprising energy sources, conducted with the goal of preserving the environment and natural resources within its operational scope. Energy auditing serves as a mechanism for evaluating environmental performance, as indicated by Welford (2002). The process initiates with the systematic identification, quantification, recording, reporting, and analysis of energy source components at Ramnagar College under Vidyasagar University.

- 2. Need for an Energy Audit:** 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 industry, 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. 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. Consequently, environmentally responsible institutions are encouraged to scrutinize their energy practices at least once every two years, employing both internal and external auditors. The implementation of energy audits, facilitated by both internal and external auditors, holds a significant role in organizational energy management. These audits effectively gauge the energy potential within an organization, enabling the

identification of more efficient methods to mitigate environmental impact. Beyond assessments of water, liquid and solid wastes, biomedical and electronic wastes, energy potential, and biodiversity, there is a need to measure the carbon footprint of the organization. This involves quantifying the carbon emissions generated by electrical appliances, vehicles, and the human population. The measurement encompasses the bulk of carbon dioxide equivalents emitted by the organization, forming the basis for carbon accounting. It is essential to ascertain the extent to which an organization contributes to sustainable development through its energy management practices. Therefore, it is recommended to conduct carbon footprint measurements in each organization, providing valuable insights for maintaining an eco-friendly campus and addressing the concerns of stakeholders.



3. Aims and Objectives of an Energy Audit: An energy audit serves as a valuable tool for the development and implementation of comprehensive energy management plans within an organization. The primary objective of an energy audit is to systematically identify opportunities for energy efficiency, conservation, and savings at the audit site premises. The audit process involves the following steps:

3.1 Reviewing implemented energy-saving opportunities and measures at the audit sites.

3.2 Identifying various additional energy conservation measures and opportunities for savings.

3.3 Implementing alternative energy resources to explore opportunities for energy savings and inform decision-making in the field of energy management.

3.4 Providing technical information on constructing an energy balance and offering guidance for specific applications.

3.5 Conducting a detailed analysis of energy consumption, scrutinizing the latest electricity bills for the campus, and understanding the tariff plans provided by the central and State Electricity Board.

3.6 Enumerating ways in which energy is utilized, including electricity, electric stoves, kettles, microwaves, LPG, firewood, petrol, diesel, and others.

3.7 Analysing electricity bill amounts for the last two to three years, expenditure on LPG cylinders for the past year, and costs associated with water consumption for human beings and plant watering.

3.8 Assessing the usage of various devices and equipment such as incandescent (tungsten) bulbs, CFL bulbs, fans, air conditioners, cooling apparatus, heaters, computers, photocopiers, inverters, generators, and laboratory equipment, with calculations based on factors like wattage and duration of use (e.g., 60-watt bulb x 4 hours x number of bulbs = kWh).

3.9 Examining the utilization of alternative energy sources/nonconventional energy sources within the organization, including photovoltaic cells for solar energy, energy-efficient stoves, biogas, etc. and Creating awareness among stakeholders regarding energy conservation and efficient utilization.

In essence, Energy Auditing in the College context is a multifaceted approach that not only aims at efficiency in resource utilization but also emphasizes the importance of sustainable practices, cost savings, and a shared responsibility for the welfare of the institution and its environment.

4. Campus Area and Infrastructure:

- Total area of the college campus: 6 acres.
- Building and concrete areas: 2 acres.
- Playground and fallow land area: 3 acres.
- Number of building blocks: 09

- Total number of class room: 37
- Total number of laboratories: 17 (All science department including music department)
- Number of common rooms: 02
- Number of administrative blocks/rooms: 01
- Total number of toilets: 16 (male-05 & female-11)
- Library: 01
- Reading room: 02 (For students & teachers)
- Auditorium/seminar hall: 01
- Garage: 01
- Open stage: 01



Group discussion with honourable Principal sir and other teachers of Ramnagar College



Arial view of Ramnagar College campus

5. Methodology and Survey Schedules:

To conduct an energy audit, various methods are employed at the audit sites, with a focus on a walk-through audit. The process entails balancing total energy inputs against total energy outputs and identifying all energy streams within a facility. The quantification of energy consumption for each energy stream follows the methodology outlined in the Manual of Gnanamangai et al. (2021). During the audit, a physical verification of various components such as lighting, ceiling, tables, exhaust fans, A/C machines, solar panels, heaters, generators, uninterrupted power supply machines, and ventilators load fixtures is conducted. This includes verifying the capacities of installed energy-efficient systems. Emphasis is placed on inspecting the cost or potential cost savings associated with each of these components, with energy consistently emerging as a key area for cost reduction. The energy management task becomes pivotal in achieving cost reduction goals.

The energy bill from the supply utility company collected for auditing. This assessment included an evaluation of load demand requirements and the efficient consumption of energy. Stakeholders were engaged during the audit to explore opportunities for improvement in energy management. Potential areas for energy conservation and saving opportunities were identified and recommended for implementation within the organization.

Energy Audit can be classified into the following types:

- I. Preliminary Energy Audit
- II. Detailed Energy Audit
- III. Potential and magnitude of Energy Audit
- IV. Comprehensive Energy Audit

6. Survey Form for data collection:

1. List ways that college uses energy (Electricity, electricstove, kettle, microwave, LPG, firewood, Petrol, diesel and others).
2. Electricity bill amount for the last two years.
3. Amount paid for LPG cylinders for last one year.
4. Amount spent for petrol/ diesel/ others for generators.
5. Number of CFL bulbs installed and also mention its working hour.
6. Energy used by each bulb per month.
7. How many LED bulbs are used inside college campus (in detail with working hour)

8. How many incandescent (tungsten) bulbs installed?
9. How many fans are installed (in detail with working hour)
10. How many air conditioners are installed (Hours used/day, for how many day in a month)
11. Energy used by each electrical equipment per month? (kwh)
12. How many computers are there in use? Mention the use (Hours used/day for how many days in a month)
13. How many photocopiers are installed?
14. How many cooling apparatuses are in installed?
15. Energy used by each inverter per month? (kwh)
16. How many electrical equipment are used in different laboratories along with its power rating.
17. How many heaters are used in the canteen. (Mention the use, hours used per day for how many days in a month)
18. Are any alternative sources of energy module installed? Give with detail specification.
19. Are computers and other equipment put on power-saving mode?
20. Does machinery (TV, AC, Computer, weighing balance, printers, etc.) run on standby mode most of the time? If yes, how many hours?
21. What are the energy conservation methods adapted by the college?
22. How many boards displayed for saving energy awareness?

To assess the environmental impact, the carbon dioxide levels were measured at various locations across the organization's campus using a portable CO₂ analyzer. This measurement aimed to calculate the carbon footprint and pinpoint areas with prominent carbon emissions, providing valuable insights for reduction strategies. The energy bill received from college was audited and studied to understand the kilowatt-hour (KWH) requirements and the efficiency of energy usage. Interactions with various stakeholders played a crucial role in familiarizing them with energy audit procedures, ensuring a successful and result-oriented energy audit. Energy conservation and saving opportunities were identified during the audit rounds, laying the groundwork for potential implementation measures. The assessment methodology involves gathering information through various means, including onsite visits, group discussions, campus surveys, inquiries, observations, perception studies, and opinions. All these elements contribute to the comprehensive auditing report.

7. Detailed Energy Audit Methodology:

A thorough audit offers a detailed energy project implementation plan for a facility by evaluating all significant energy-using systems.



Power supply with proper safety guidelines at Ramnagar College

This type of audit provides the most precise estimate of both energy savings and costs. It takes into account the interactive effects of all projects, considers the energy consumption of major equipment, and includes meticulous calculations for both energy cost savings and project costs. In a comprehensive audit, the energy balance is a key element, relying on an inventory of energy-using systems, assumptions about current operating conditions, and calculations of energy usage. This estimated usage is then compared to charges on utility bills. The initial site visit and preparation are essential steps preceding detailed auditing. An initial site visit typically spans a day, providing the Energy Auditor/Engineer with an opportunity to interact with relevant personnel, become acquainted with the site, and assess the procedures necessary for conducting the energy audit.

8. Source of Energy: Through the enquiry process it is noted that the mostly used energy source is conventional. Only 5.2% energy is consumed using photo-voltaic module. The detail is given below:



Solar Energy module of Ramnagar College

Energy Cost:

Total electricity consumption(conventional)- 21480 U (94.8%)

Total electricity consumption (non-conventional)-1178 U (5.2%)

Amount paid for conventional energy used: Rs. 204,060



Chemistry laboratory of Ramnagar College

Fossil fuel consumption per year-

- a. Number of LPG gas cylinders used for cooking (Canteen & Hostel)-70PCs
- b. Number of LPG used in Laboratories-05PCs
- c. Diesel used for green Generator- 50 litter

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



Emergency supply line at Ramnagar College

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

Source of energy	In Percentage
Conventional	94.8%
Non -Conventional	5.2%

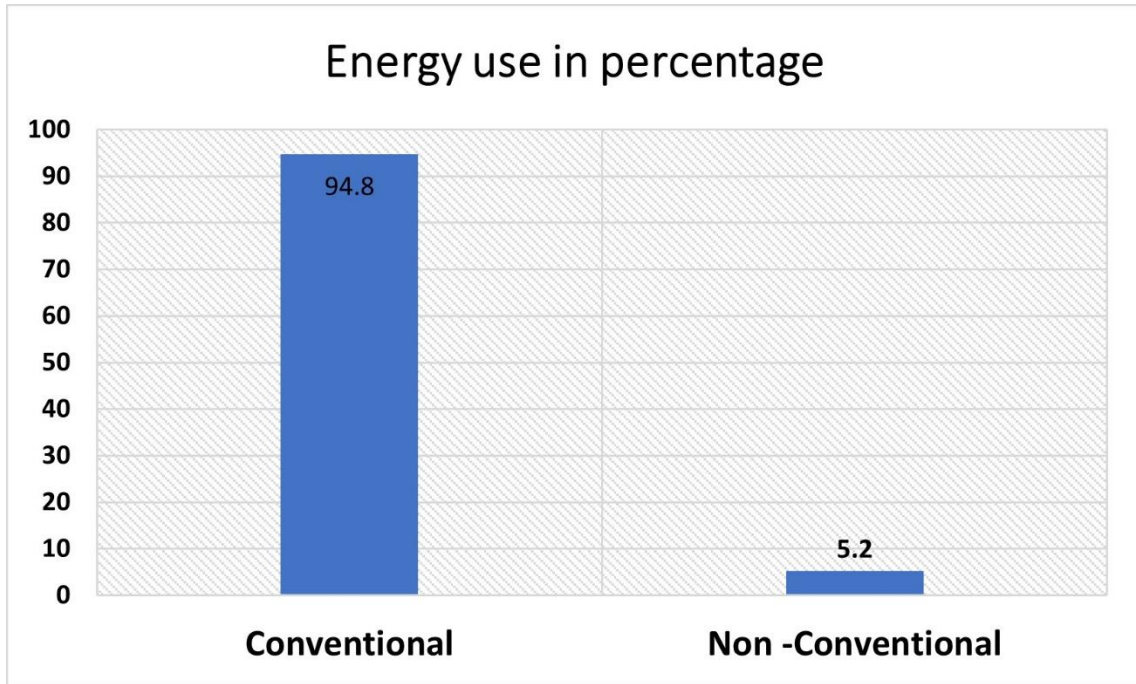


Figure:1 Mode of energy used in college campus (conventional and non-conventional)

During the survey different electrical appliances are recorded with its corresponding power rating. In table 2 the calculated daily consumption of electrical energy is shown below.



Laboratory instruments of Ramnagar College

Table 2: The detail calculation of energy consumption.

Sl.No	Particulars	Power consumption per hour	Quantity	Consumption (KWh/day)
1.	Tube/Bulb light	40W/100W	183	10.6
2.	LED light	20W	169	10.5
3.	Fan	50W	291	11.5
4.	Air Conditioner	1.5KW	12	5.4
5.	Computer	300W	62	18.6
6.	Xerox Machine	500W	01	2.0
7.	Printer	65W	25	2.0
8.	Projector	500W	04	4
9.	Electric kettle	850W	10	4.2
10.	Refrigerator	500W	06	24
11.	Water pump	1KW	05	10
12.	Sound system	50W	06	2
13.	Other Laboratory instruments	500W	28	28
14.	Streetlight	500W	07	12.6.

The corresponding plot of energy consumption from calculation is depicted in figure 2.

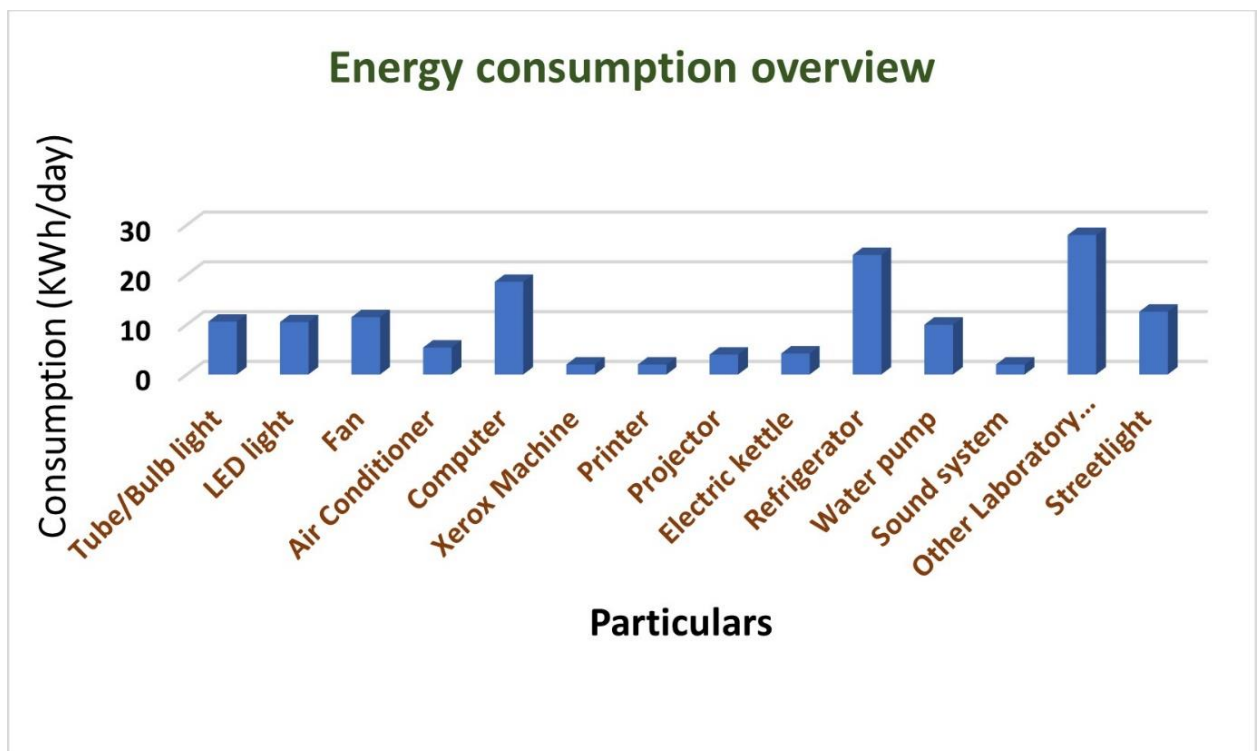
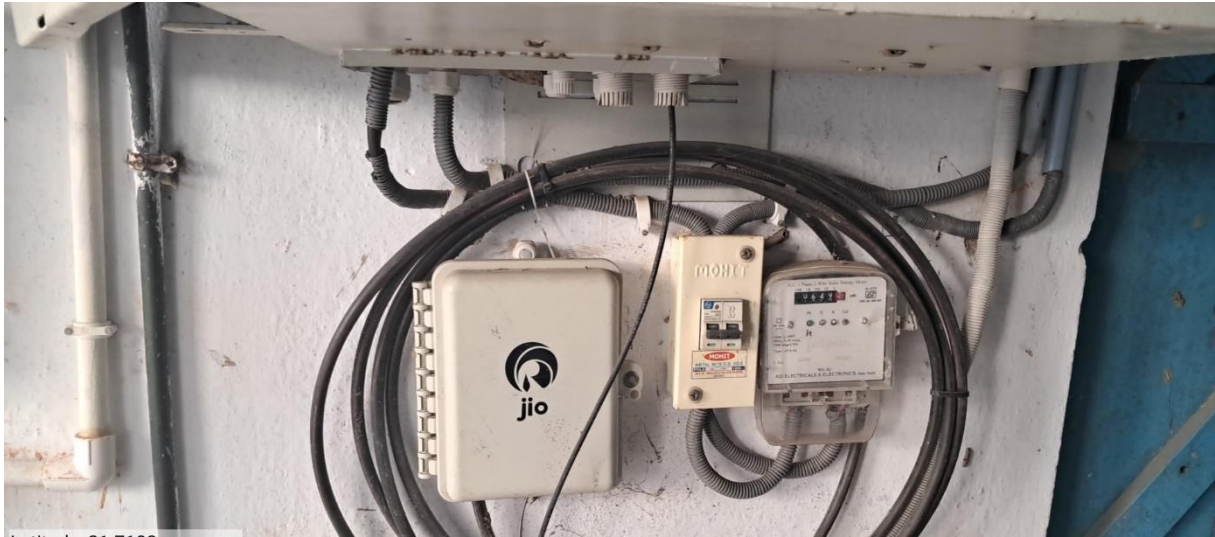


Figure 2: Bar diagram to represent the energy consumption rate.



Insulated electric meter at Ramnagar College



Laboratory instruments

9. 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%

10. Best Practices followed in the Organization

- Transformers, generators, and UPS systems are securely fenced and accompanied by awareness boards indicating 'Dangers' and 'Warnings'.
- 'Switch ON' and 'Switch OFF' signs are strategically placed throughout most areas to promote energy-saving practices among stakeholders.
- Electrical wires, switch boxes, and stabilizers are adequately protected to prevent any potential hazards to staff and students.
- A rooftop solar power plant has been installed.
- LED lights and solar street lights are employed.
- Power factor is maintained close to unity with Automatic Power Factor Correction (APFC).
- Variable Frequency Drives (VFDs) are used for lifts and air conditioners.
- Old generation computers and TVs have been replaced with LED monitors.
- E-vehicles are available within the campus.
- Star-rated equipment is used where applicable.



Computer laboratory of Ramnagar College

11. Energy Conservation Proposals: The energy audit provided recommendations for reducing energy costs, implementing preventive maintenance measures, and enhancing quality control activities, all crucial for the efficient operation of utilities at the audit sites.

- Consider purchasing energy-efficient equipment (4-5 star rated) during replacements.
- It is advised to install sub-meters in all buildings for energy monitoring to track energy load and consumption per building.
- Utilize optimal water usage and temperature settings through automatic processes to achieve energy savings.
- Plan for continuous monitoring and analysis of energy consumption with a dedicated team on campus.
- Periodically conduct awareness campaigns on energy conservation (ECON) among stakeholders through associations, clubs, forums, and chapters.
- Encourage turning off electrical equipment when not in use.
- Ensure maintenance and replacement of old appliances in all laboratories.
- Use power-saving mode on computers and electronic devices.
- Install a Biogas plant for the hostel kitchen and canteen.
- Implement automatic switches with occupancy sensors in common areas.

- High monthly electricity consumption in the college can be significantly reduced through regular energy audits.
- Replace older generation and non-energy-efficient fans with new energy-efficient models.
- Regularly monitor equipment in all laboratories and promptly address any issues.
- Offer value-added, non-formal, certificate, or diploma courses on 'Energy and Environment Management Audits' to benefit students and research scholars seeking certification as Lead Auditors.

Introducing Energy-Saving Circuits for Air Conditioners: These circuits intelligently reduce compressor operating hours through timing or temperature difference logic, while ensuring human comfort remains unaffected. This innovation can result in electricity savings ranging from 15% to 30%, contingent upon weather conditions and temperature settings. With a total of 7 split-type air conditioners, it is advisable to gradually replace older units with new, energy-efficient models labelled with a minimum of 3 Stars by the Bureau of Energy Efficiency (BEE). Given an average compressor ON time of 5 hours per day, this transition promises significant energy conservation.

12. Recommendations on Carbon Footprint in the Organization:

Implement a more efficient cooking system in the hostel kitchen and canteen to conserve gas.

- Discourage excessive use of generators, inverters, and UPS systems on a daily basis.
- Ensure lights, fans, air conditioners, equipment, and instruments are switched off when not in use.
- Install a substantial number of ventilation and exhaust systems in auditoriums, seminar halls, and conference halls to lower carbon dioxide levels among students, scholars, and staff members.

RECOMMENDATION

TO REDUCE ENERGY CONSUMPTION AND MANAGEMENT

The organization's well-established reputation and long-standing presence provide ample opportunities to bolster energy conservation initiatives and steer the campus towards self-sufficiency. The institution has already made significant progress in this regard by implementing energy-efficient lighting, raising awareness among stakeholders, and ensuring reliable power backups. Furthermore, the organization adheres to best practices in energy auditing, which includes adequately securing transformers, generators, and UPS systems with fencing and informative boards highlighting potential hazards. Prominent signage promoting energy-saving practices, coupled with diligent maintenance of electrical infrastructure, further reinforces energy conservation efforts and safeguards the well-being of staff and students.

While the adoption of sprinkler irrigation on campus to reduce energy consumption is commendable, there are additional recommendations that could amplify the organization's potential for energy savings. These measures can pave the way for a more prosperous future characterized by an energy-efficient campus and sustainable environmental and community development for stakeholders in the years to come.

POTENTIAL AREAS FOR ENVIRONMENT MANAGEMENT

Implementation of rainwater harvesting systems and their utilization for garden irrigation, as well as for washroom and cleaning purposes, can be achieved through the development of green projects. These initiatives will reduce the reliance on groundwater to some extent. Additionally, rainwater recharge projects can be undertaken by the college to replenish groundwater levels.

Bioremediation plants should be established to treat wastewater from bathrooms and laboratories, where various chemicals and heavy metals may be present, before discharge into surface water bodies. Some wastewater was observed to be directly discharged into Pond No. 1 through certain drainage systems, which should be redirected through water treatment or bioremediation plants.

Automatic regulating devices should be installed with submersible pumps to prevent overflow from rooftop tanks.

Automatic regulating sprinklers can be installed to ensure adequate garden irrigation, even during the summer months.

Separate bins for biodegradable and non-biodegradable waste should be provided on each floor of all buildings for proper waste management. Biodegradable waste can be transferred to a processing plant to produce organic fertilizer for application as green manure in the garden.

Given the college's proximity to the Bay of Bengal and the high likelihood of cyclone occurrences in the area, it is essential to establish a natural disaster management committee and center on the campus. This will aid in mitigating adverse situations that may arise in the future.

Establishing a dedicated e-waste management center with proper documentation within the college campus is crucial for the effective management of electronic waste

FOR BETTER CONSERVATION OF BIODIVERSITY

- It is highly recommended to plant indigenous tree species in the college campus, which will also help in restoring the native bird population of the area.
- Certain wild habitats within the Fishery campus of the college have been identified and should be conserved, promoting the concept of "Preserve wilderness in its natural state."
- A center for the rescue and conservation of wild indigenous fish can be developed within the Fishery campus. This center can house various aquatic plants and wildlife, including soft-shell turtles.
- An area adjacent to Pond 1 can be designated for an indigenous tree library, serving both educational and conservation purposes for locally threatened tree species.
- A medicinal plant library can be established in the garden area of the main campus, along with a butterfly garden dedicated to conserving host and nectar plants for various butterfly species.
- Name plates for all existing MTS (Multi-Tree Species) should be installed for educational purposes.