GREEN , ENERGY & ENVIRONMENT AUDIT REPORT

2023-2024

RAMNAGAR COLLEGE
DEPAL,PURBA MEDINIPUR

REPORT PREPARED BY

INSTITUTE OF NATURE RESEARCH AND CONSERVATION (INRC)

INRC

Certificate of Energy, Green & Environment Audit

ENERGY & ENVIRONMENT MANAGEMENT SYSTEM

This is to certify that the EnMS & EMS of:

RAMNAGAR COLLEGE

Address: Depal, Purba Medinipur, West Bengal- 721453

has been assessed and found to comply with the requirements of:

ISO 50001:2018

(Energy Management System)

&

ISO 14001:2015

(Enmironment Management System)

Providing Educational Service to Students Pursuing General Degree course under Science, Commerce & Arts

Category: Building Complex & Institution Campus

Certificate no: INRC/EnMS/EMS/2023/01

Date of Approval : 16.02.2024 *Original Certification Date: 16.02.2024*

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INSTITUTE OF NATURE RESEARCH AND CONSERVATION (INRC)

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The certificate is vallid if the Annual Surveillance Mark is Signed by Auditors on Original

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ACKNOWLEDGEMENT

We, The Green, Environment and Energy Audit Team of Institute of Nature Research And Conservation (INRC) would like to show our indebt gratitude to the management of Ramnagar College for assigning us such an important work on Green & Environmental audit. Our special thanks go to Principal, Ramnagar College We appreciate the cooperation to our team for the assigned study, giving us necessary inputs to carry out audit activities. Our special thanks also go to IQAC members Teaching & supporting nonteaching staff without whose intricate involvement the present work cannot be possible.

AREAS OF CONCERN

GREEN AUDIT

- Floral Diversity
- Faunal Diversity
- Analysis of the community structure

ENVIRONMENT AUDIT

- Water Management
- Waste Management
- Air quality
- carbon footprint
- e-waste management

ENERGY AUDIT

- Energy consumption
- Energy management

RECOMMANDATIONS

- To reduce energy consumption and management
- Find out potential areas for environment management and green development
- Reduce biodiversity loss
- Find out potential areas for increase species richness in the campus

This Audit has been conducted by a committee constituted by the Experts & Scientists from different reputed Institutes. The Committee developed a questionnaire for audit based on the regulatory and statutory requirements of Centre as well State. The basic data was gathered and compiled, which the committee analyzed. By and large, the audit reveals a healthy environment inside the Ramnagar College campus. The committee has suggested short term as well as long-term suggestions for improved environmental conditions to a higher levels and authorities and all stakeholders of the College conforms that they will give due attention and utilize opportunities for identified improvements.

AUDIT COMMITTEE MEMBERS

An expert committee of 5 members was formed to conduct the Green, Environment and Energy Audit from different field of expertization such as Biodiversity, Taxonomy, Botany, Phycology, 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
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.	Dr. Mnojeet Debnath	Ecology and Taxonomy of Cryptogams	Assistant Professor HOD, Dept of Botany Panskura Banamali College (Autonomous)

4.	Mr. Kalipada Maity	Human Psychology and attitude towards Biodiversity	Associate Professor Dept. of Philosophy Moyna College
5.	Mr. Nilanjan Sadhukhan	Molecular Taxonomy and Biodiversity	Faculty (SACT) Dept of Botany Moyna College

The Audit team started the audit at the College Campus on 29 November, 2023

Important dates and of Initiative

SL NO	PURPOSE	DATE	REMARKS
1	Communication with College authority	22.09.2023	Discuss about term and condition
2	Opening Meeting		Submitted the survey schedule
3	Collection information about the College	27.11.2023	Introduced to Administrative Officer
4	Campus visit and observation	29.11.2023	Outdoor observation with Drown camera& Photo camera
5	Campus enquiry	29.11.2023	Physically enquiry with expert
6	Departments visit and enquiry	29.11.2023	Laboratory enquiry
7	Interview with other stake holder	29.11.2023	Meet with others stake holder
8	Interview with staff	29.11.2023	Collected different information
9	Review data and Assessment	29.11.2023	Data generate and drown figures
10	Pre-Closing meeting	29.11.2023	Meeting with IQAC

11	Closing Meeting	29.11.2023	Pre-submission of the Report
12	Submit audit report	10.02.2024	Submit of the Report

ABOUT THE RAMNAGAR COLLEGE

Ramnagar College had its beginnings in the premises of school building (Depal Baneswar Charubala Vidyamandir). During that crucial period, the founding Principal, Sri Sripati Charan Pradhan, collaborated with philanthropic individuals, generous donors of land, teachers, non-teaching staff, and local youths. Together, they undertook initiatives with a missionary spirit and a dedicated outlook to establish the college.

The college's illustrious inception can be attributed to the dedicated and dynamic leadership of the late Sri Sripati Charan Pradhan, the founding Principal. He actively collected cash donations and secured a 17-bigha land through the generosity of local donors, with special acknowledgment given 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.

Located in close proximity to Digha, the renowned flat and firm beach nestled on the shores of the Bay of Bengal in the southernmost part of our state, the college boasts a picturesque, expansive, and environmentally friendly campus. This campus encompasses 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 have occurred over the past two decades, responding to the essential requirements for higher education in the local area.

The college presently houses 10 departments in Arts, 9 departments in science and 1 in commerce. Three vocational subjects are also offered at the UG level.

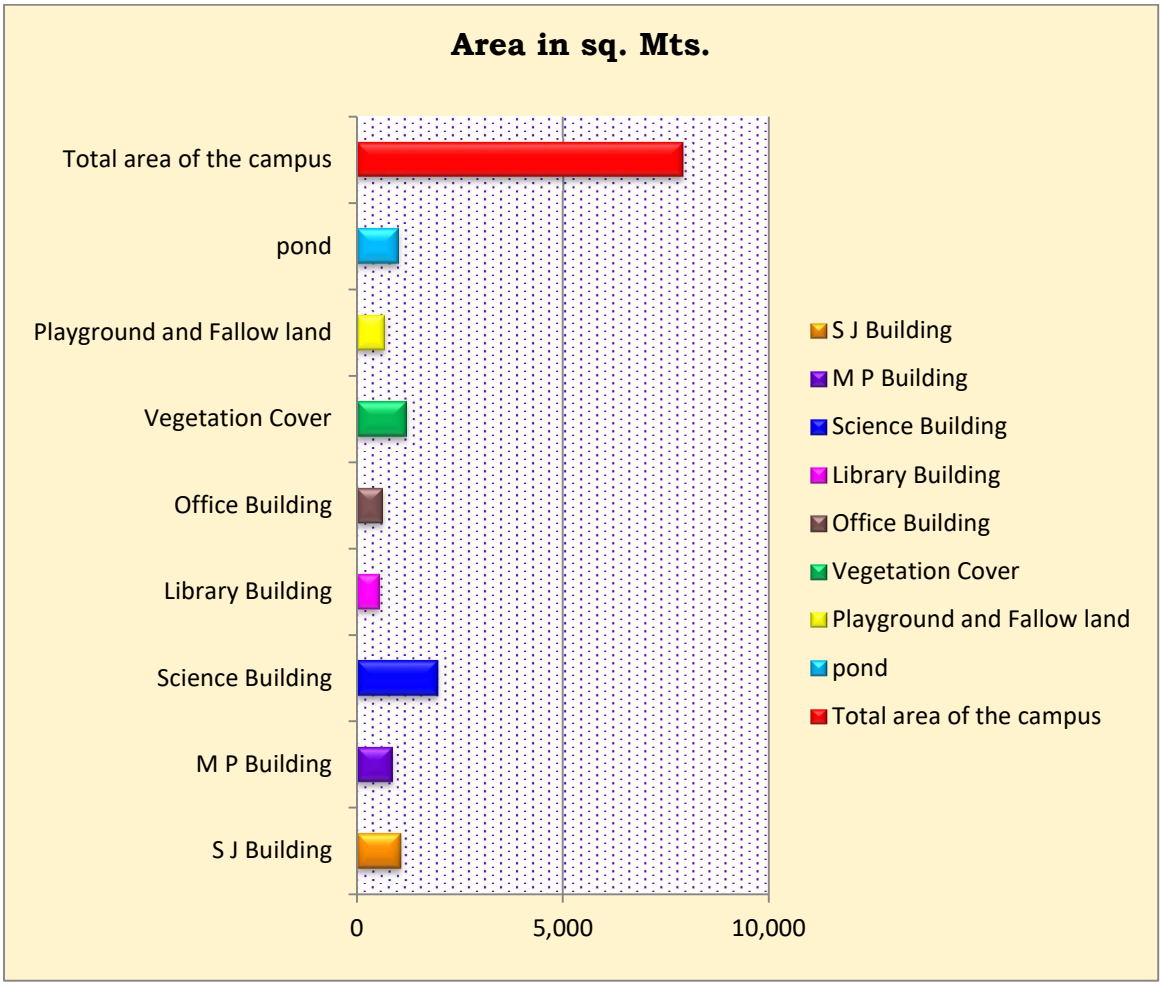
Academic departments-

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			

Area Coverage of the college Campus:

College campus	Area in sq. Mts.	Area in Percentage
S J Building	1,050	13.25
M P Building	859	10.83
Science Building	1,968	24.82
Library Building	549	6.93
Office Building	627	7.90
Vegetation Cover	1200	15.14

Playground and Fallow land	674	8.50
pond	1000	12.63
Total area of the campus	**7927**	**100**



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

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.

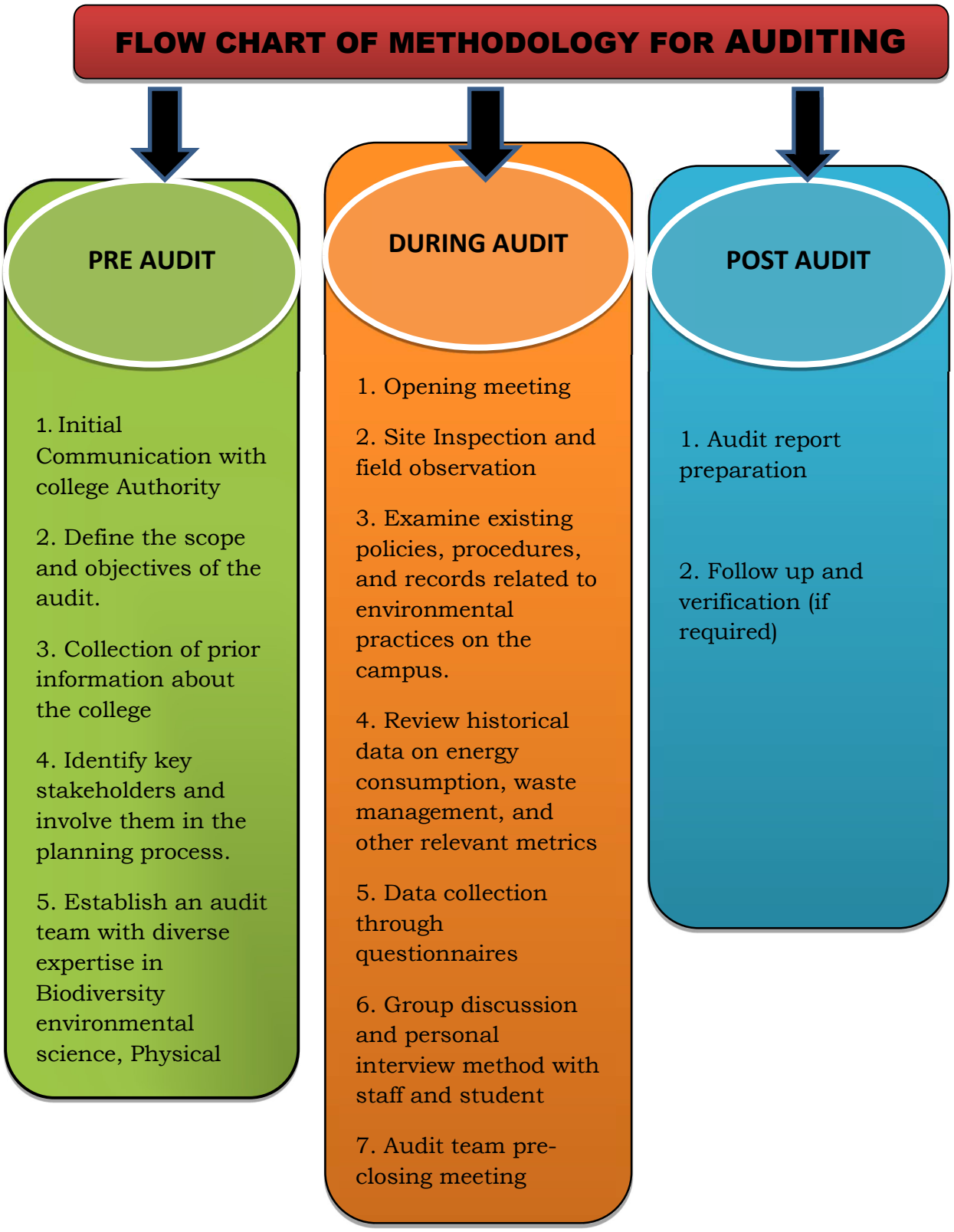
- This audit program facilitates a focused examination of variations in energy costs, the reliability of energy supply, decisions on an appropriate energy mix, identification of energy conservation technologies, and retrofitting for energy-efficient equipment. Essentially, the Energy Audit translates 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.
-
- 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.


FLOW CHART OF METHODOLOGY FOR AUDITING
PRE AUDIT
1. Initial Communication with college Authority
2. Define the scope and objectives of the audit.
3. Collection of prior information about the college
4. Identify key stakeholders and involve them in the planning process.
5. Establish an audit team with diverse expertise in Biodiversity environmental science, Physical
DURING AUDIT
1. Opening meeting
2. Site Inspection and field observation
3. Examine existing policies, procedures, and records related to environmental practices on the campus.
4. Review historical data on energy consumption, waste management, and other relevant metrics
5. Data collection through questionnaires
6. Group discussion and personal interview method with staff and student
7. Audit team pre-closing meeting
POST AUDIT
1. Audit report preparation
2. Follow up and verification (if required)

Site Visit:

- A comprehensive walkthrough of the campus was conducted to observe and document environmental aspects such as waste disposal areas, energy infrastructure, green spaces, and water management systems.
- The campus plants biodiversity were enumerated and different floral and faunal species were identified and photographed. Additionally, the medicinal garden, playgrounds, canteen, library, all departments, office rooms, hostels, building, guest house, staff quarters, and parking grounds underwent inspection for data collection.
- The number and types of vehicles utilized by stakeholders were recorded, and the fuel consumption for each vehicle was verified in consultation with the users. The number of LPG cylinders used in laboratories, the canteen, and hostel kitchens was also tallied.
- A thorough examination of water taps was conducted, revealing the identification of a few leaky taps and overflowing tanks during the site inspection.

Different types of Survey are conducted in College Campus:

- **Energy Audit Survey:**

  Assess energy consumption patterns in different campus buildings.

  Identify opportunities for energy conservation and efficiency improvements.
- **Water Management Survey:**

  Evaluate water sources, consumption patterns, and wastewater treatment facilities.

  Recommend measures for water conservation and sustainable water use.
- **Waste Management Survey:**

  Waste generation and disposal practices.

  Propose strategies for waste reduction, recycling, and proper disposal.
- **Transportation and Commuting Survey:**

  Analyze commuting patterns of students and staff.

  Recommend sustainable transportation options and infrastructure improvements.
- **Biodiversity and Green Spaces Survey:**

  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.

  Ensure compliance with green building standards and sustainable design principles.

- **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:

- At first the audit team was divided into three groups. The expert member of first group started the collection of data for energy audit. Expert member of second and third group started to accumulate data for green and environment audit.
- Members of each group visited total area of the college campus, garden, playground, canteen, kitchen, library and each department with respective laboratories of the college.
- A Questionnaire was developed covering all aspects for Green, Environment and Energy audit and circulated to the stakeholders to get the data.
- Drone survey was arranged to measure green area, concrete area and aquatic land of the college campus.
- All the information and data are collected through observation personal interview and group discussion with different stakeholders.

- Assessment of different parameters of environment at different point of the college premises was done on the basis of different electronic devices such as AtmosphericO_2 and CO_2 meter, TDS meter etc. and measurement.
- DBH of each MTS were taken, Phenological condition was studied and GPS co-ordinates of different important MTS were recorded.
- Plant community structure was studied using Quadrat method.
- Different Species of Mammals, Birds, Reptiles, amphibians, Butterflies and dragon flies were noted and identified during field visit. Wild Habita in the college campus were recorded and recall data related to different wild life were taken from different stockholders through group discussion and personal interview method.

Data Analysis:

- Calculation of green area, concrete area, and aquatic land of the college campus.
- Calculation of energy consumption and energy generation from renewable energy sources.
- Analysis of ground water and rain water storage procedure and reused
- Waste generation & disposal arrangements.
- Measurement of O_2 and CO_2 level in college campus.
- Calculation of Biodiversity index in the campus using standard indices
- Measurement of TDS of water of the water bodies and tank water was taken into account
- Study of Density, F%, Abundance, Relative density, Relative frequency and the Importance Value index (IVI) of the plant community.

GREEN AUDIT

Ramnagar College stands as a venerable institution dedicated to academic excellence and holistic development. As the institution evolves in the 20st century, it recognizes the pressing need to align its operations with sustainable practices. In this pursuit, the initiation of a Green Audit has emerged as a pivotal step towards fostering environmental responsibility and resilience.

Importance of Green Audit at Ramnagar College:

The importance of a Green Audit at Ramnagar College cannot be overstated in the contemporary global context. As societies worldwide grapple with the challenges of climate change, resource depletion, and environmental degradation, educational institutions play a crucial role in shaping sustainable mindsets and practices. Ramnagar College, being a center of knowledge dissemination and societal influence, understands the gravity of its responsibility.

The Green Audit serves as a comprehensive evaluation mechanism that scrutinizes the institution's ecological footprint, resource utilization, waste management, and overall environmental impact. By conducting a systematic analysis of these factors, the college aims to identify areas for improvement and implement sustainable practices that align with its commitment to environmental stewardship.

Furthermore, the Green Audit at Ramnagar College goes beyond mere compliance; it serves as a catalyst for fostering a culture of environmental awareness among students, faculty, and staff. By integrating

sustainable practices into the institution's ethos, the college not only contributes to the global sustainability agenda but also instills in its community a sense of responsibility towards the planet.

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 Ramnagar College campus. 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 and herbs, aquatic macrophytes, algae, fungi and lichens. Butterfly, Dragon fly, Birds, amphibians were sited and identified during the field visit and. Wild habitat has also been studied and receded and wild animals were noted based on the group discussion with the teachers and the students during the study.

Floral Diversity at Ramnagar College Campus

A total of 71 species of flowering plants has been recorded during the study out of which 49 species were considered as MTS, 6 species belong from shrubs and 22 species were grouped in herbs. Out of 71 species of plants 31 species have medicinal potentiality, as evidenced by published literature.

It is interesting to note that all the 49 species of MTS belong from 22 families which represents that the taxonomic diversity of the college campus was very high (Table 1).

VEGETATION MAPPING OF RAMNAGAR COLLEGE (DEPICTING ON SCALE DISTRIBUTION OF MTS, WATER BODIES, PLAT GROUND AND CONCRET AND BUILDINGS)

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

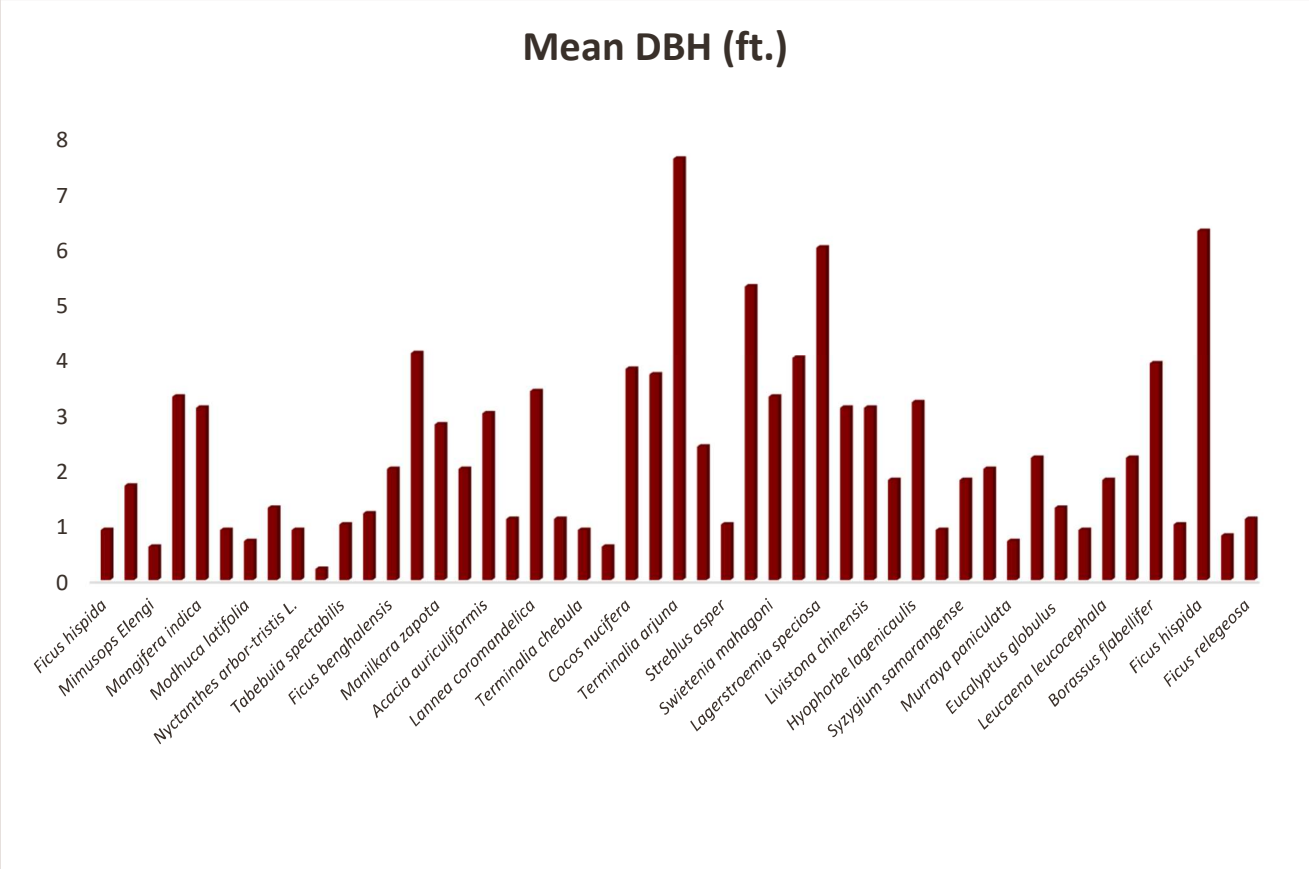
Sl. No.	Name of the Species	Family	No. ofIndividual	Phenological Stage	Mean DBH (ft.)	Frequency %	Local Status	Habit
1	*Ficus hispida*	Moraceae	3	3M	0.9	0.980		T
2	*Pithecellobium Dulce*	Fabaceae	1	1M	1.7	0.327	LT	T
3	*MimusopsElengi*	Sapotaceae	1	1J	0.6	0.327	LT	T
4	*Moringa oleifera*	Moringaceae	3	2M, 2J	3.3	0.980	C	T
5	*Mangifera indica*	Anacardiaceae	8	2M, 6J	3.1	2.614	C	T
6	*Cassia fistula*	Fabaceae	1	1M	0.9	0.327	C	T
7	*Modhuca latifolia*	Sapotaceae	1	1J	0.7	0.327	LC	T
8	*Azadirachta indica*	Meliaceae	6	2M, 4J	1.3	1.961	C	T
9	*Nyctanthesarbor-tristis L.*	Oleaceae	1	1M	0.9	0.327	C	UT
10	*Ziziphus oenoplia Mill.*	Rhamnaceae	3	1M, 2J	0.2	0.980	LC	S
11	*Tabebuia spectabilis*	Bignoniaceae	4	2M, 2J	1	1.307	LC	UT
12	*Syzygiumcumini L.*	Myrtaceae	2	2J	1.2	0.654	LC	T
13	*Ficus benghalensis*	Moraceae	3	3J	2	0.980	C	T
14	*Tectona grandis*	Lamiaceae	8	6M, 2J	4.1	2.614	C	T
15	*Manilkara zapota*	Sapotaceae	2	2M	2.8	0.654	C	T
16	*Mallotusphilippinensis*	Euphorbiaceae	2	2M	2	0.654	LC	T
17	*Acacia auriculiformis*	Fabaceae	5	5M	3	1.634	C	T
18	*Neolamarckiacadamba*	Rubiaceae	1	1M	1.1	0.327	C	T
19	*Lannea coromandelica*	Anacardiaceae	2	2J	3.4	0.654	C	T
20	*Cordia myxa*	Boraginaceae	1	1M	1.1	0.327	LT	T
21	*Terminalia chebula*	Combretaceae	1	1M	0.9	0.327	LC	T
22	*Phyllanthus emblica*	Phyllanthaceae	2	2J	0.6	0.654	LC	T
23	*Cocos nucifera*	Arecacear	26	18M, 6J	3.8	8.497	C	T
24	*Phoenix sylvestris*	Arecaceae	3	2M,1J	3.7	0.980	C	T
25	*Terminalia arjuna*	Combretaceae	1	1M	7.6	0.327	C	T
26	*Syzygiumjambolenum*	Myrtaceae	2	1M,1J	2.4	0.654	C	T
27	*Streblus asper*	Moraceae	1	1J	1	0.327	C	T
28	*Tamarindus indica*	Fabaceae	1	1M	5.3	0.327	C	T
29	*Swietenia mahagoni*	Meliaceae	4	3M, 1J	3.3	1.307	C	T
30	*Artocarpus heterophyllus*	Moraceae	1	1M	4	0.327	C	T
31	*Lagerstroemia speciosa*	Lythraceae	2	2M	6	0.654	C	T
32	*Bauhinia variegata*	Fabaceae	5	2M	3.1	1.634	C	T
33	*Livistona chinensis*	Arecaceae	5	4M, 1J	3.1	1.634	C	T
34	*Polyalthia longifolia*	Annonaceae	60	60M	1.8	19.608	C	T

35	*Hyophorbelagenicaulis*	Arecaceae	5	5M	3.2	1.634	LC	T
36	*Thuja occidentalis*	Cupressaceae	20	20M	0.9	6.536	LC	UT
37	*Syzygiumsamarangense*	Myrtaceae	1	1M	1.8	0.327	C	T
38	*Ravenalamadagascariensis*	Strelitziaceae	1	1M	2	0.327	LC	T
39	*Murrayapaniculata*	Rubiaceae	80	80M	0.7	26.144	C	UT
40	*Araucaria*	Araucariaceae	5	5M	2.2	1.634	LC	T
41	*Eucalyptus globulus*	Myrtaceae	2	2M	1.3	0.654	C	
42	*Ficus benjamina*	Moraceae	12	12J	0.9	3.922	C	T
43	*Leucaena leucocephala*	Fabaceae	1	1M	1.8	0.327	C	UT
44	*Aegle marmelos*	Rutaceae	1	1M	2.2	0.327	C	T
45	*Borassus flabellifer*	Arecaceae	1	1M	3.9	0.327	C	T
46	*Psidium guajava*	Myrtaceae	1	1M	1	0.327	C	T
47	*Ficus hispida*	Moraceae	1	1M	6.3	0.327	C	T
48	*Ficus cunia*	Moraceae	1	1M	0.8	0.327	C	T
49	*Ficus relegeosa*	Moraceae	2	2J	1.1	0.654	C	T

Presence of *Terminalia arjuna, Syzygiumcumini, Cordia mixa* in the plant community represents the relic reverine wood forest which once prevail in this area which maintain the harmony with the climatic and edaphic condition of this geographical terrain.

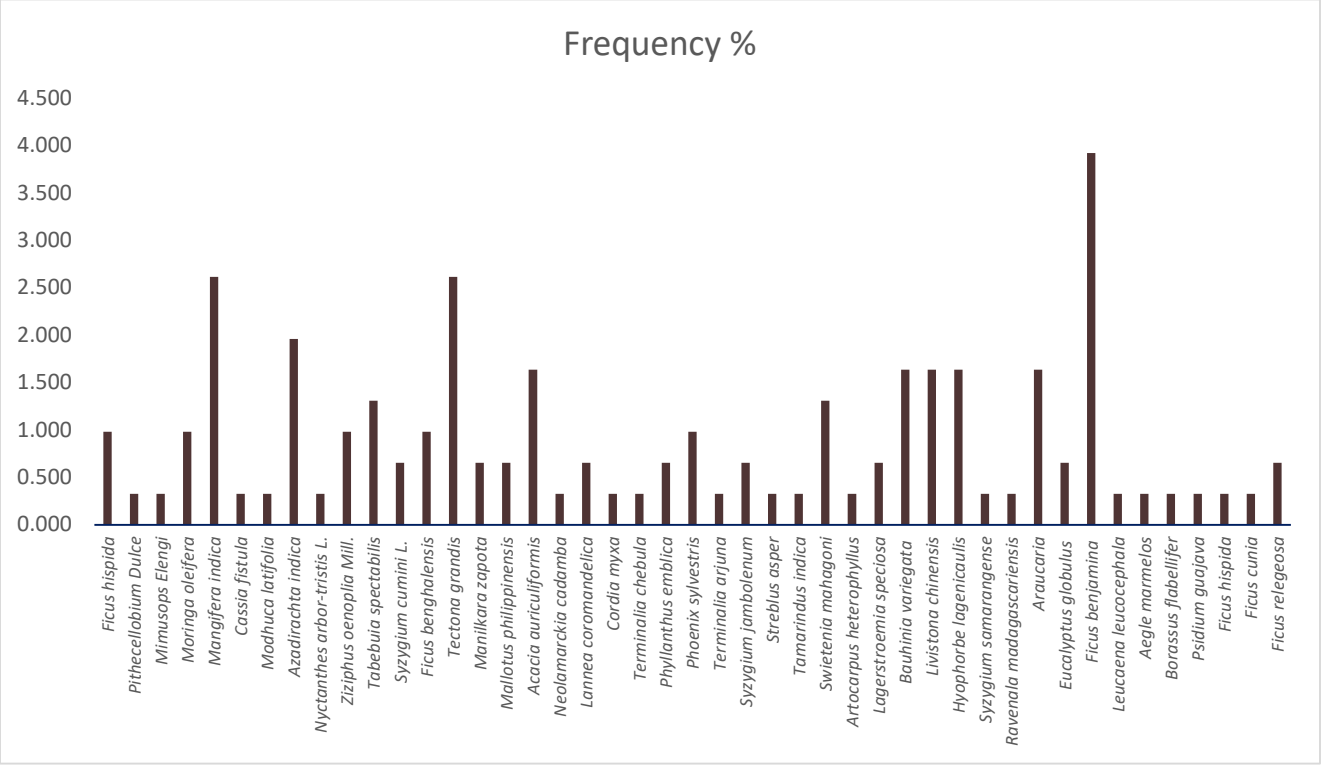
Out of these 49 MTS *Terminalia arjuna* has shown its highest diameter at breast Height (DBH) (8 ft.) followed by *Ficus hispida* and *Lagerstroemia speciosai.e.* 6ft (Fig. 1).

Figure 1. Mean DBH of the MTS



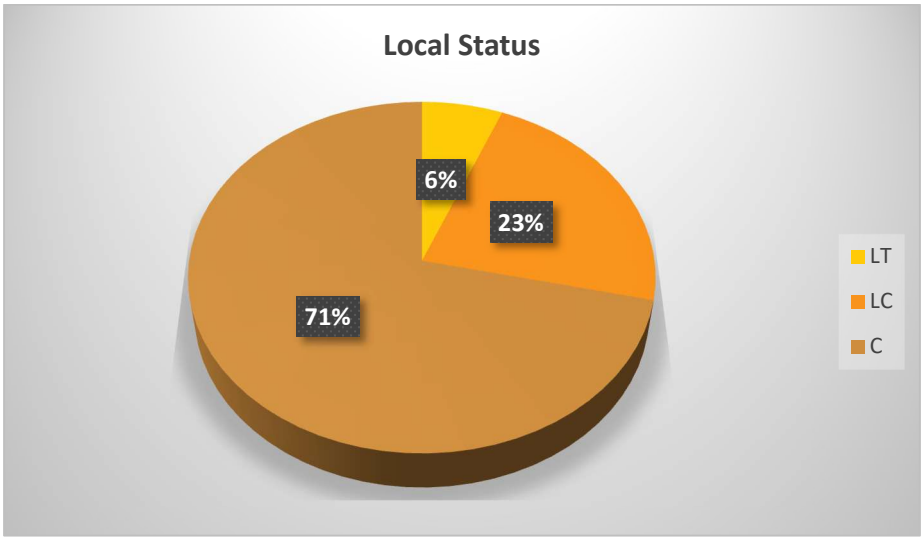
When the frequency percentage of these species was calculated leaving out some frequently planted commercial and ornamental plants in the college garden like *Cocos nucifera, Ficus benjamina and Polyalthia longifolia*, it was observed that the F% of *Tectona grandis* (2.61%) is highest (Though planted) followed by *Azadirachta indica* and *Acacia auriculiformis* (Fig. 2).

Figure 2. Frequency percentage of different Major Tree Species (MTS)



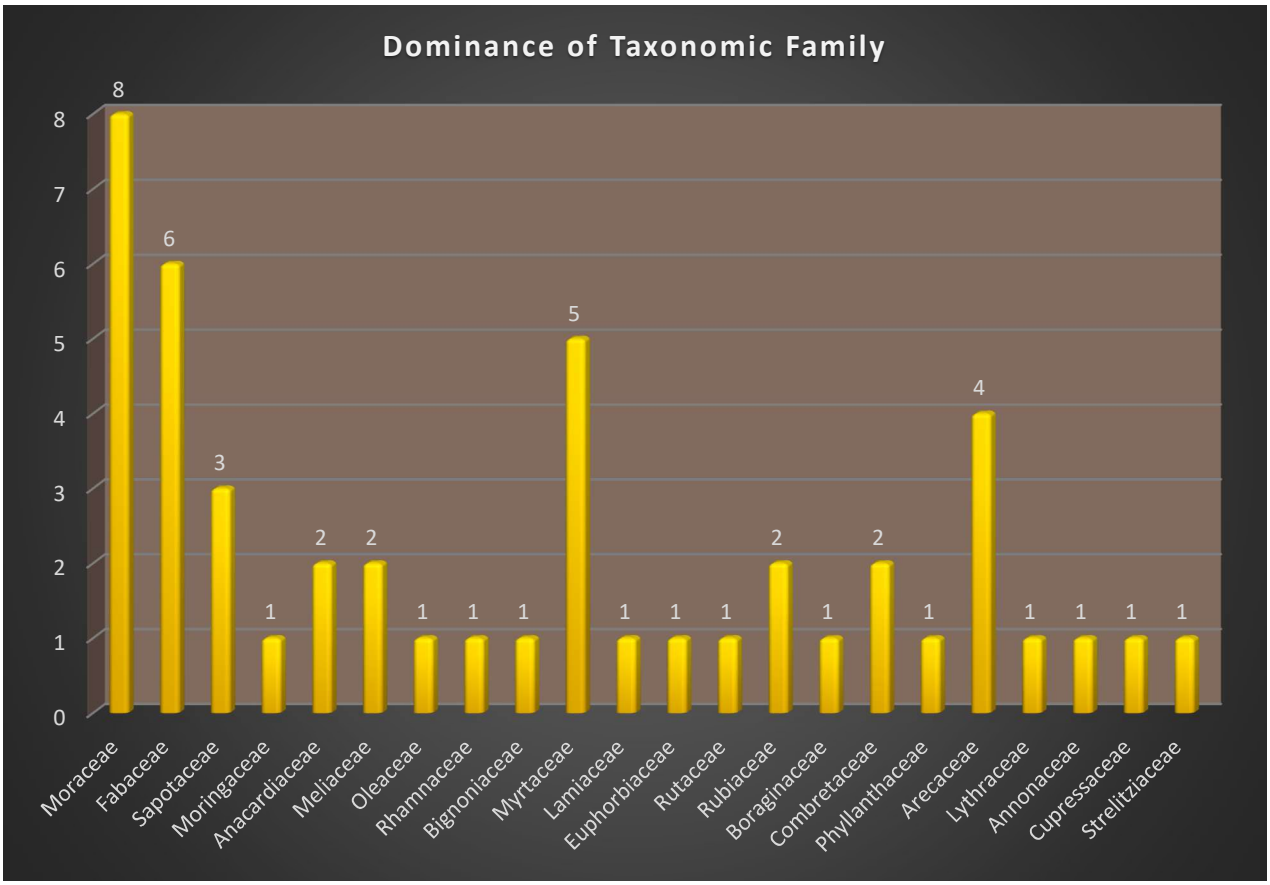
Out of these 22 Major Tree Species (MTS) 6% and 23% of them are locally threatened and less common in these regions respectively (Fig. 3).

Figure 3. Local status of the MTS



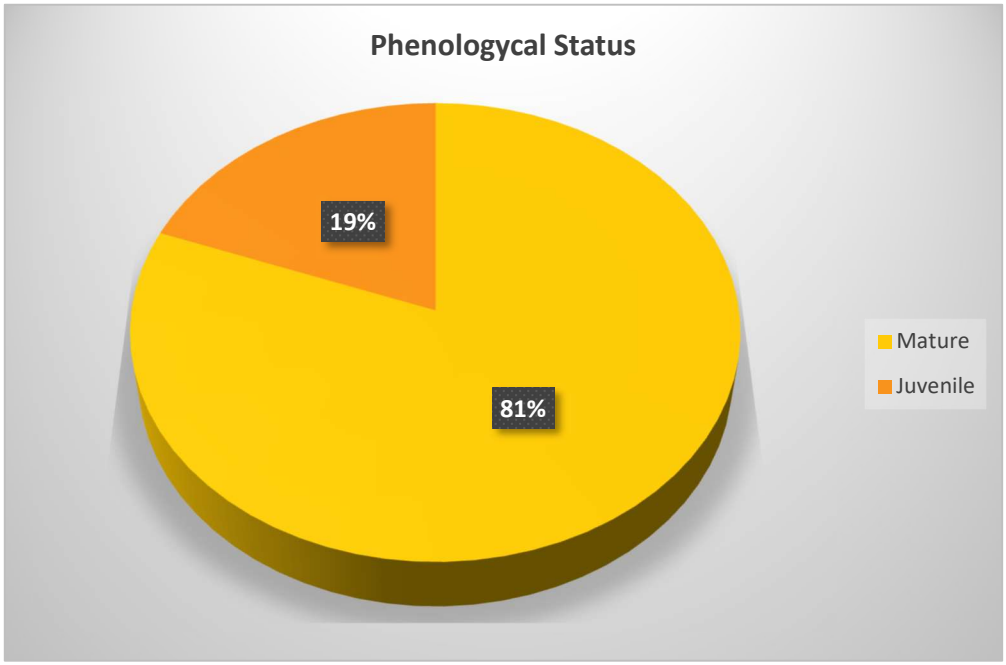
Out of 22 family on which these 22 MTS belongs from, Moraceae if the family from which most of the MTS belongs (8 species). Moraceae was followed by Fabaceae and Myrtaceae in this respect (6 and 5 species respectively) (Fig 4).

Figure 4. Number of Genus under different Taxonomic Family



It was noted that 81% of the MTS achieved their phonological period which represent that the MTS community is considerable mature and causes high carbon sequestration and their control over different niche of the ecosystem (Fig. 5).

Figure 5. Phenological status of different MTS



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 Ramnagar college campus is so high (D =0.121) which depict the importance of the green belt of the college campus in biodiversity conservation.

Study of Herbaceous plant community

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 9 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).

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 *Evolvuluselsinoides* shown its highest IVI value (14.2) followed by *Desmodiumgangeticum* (12.7) and *Vitis trifolia* (9.4) (table 2). 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 herbaceous species

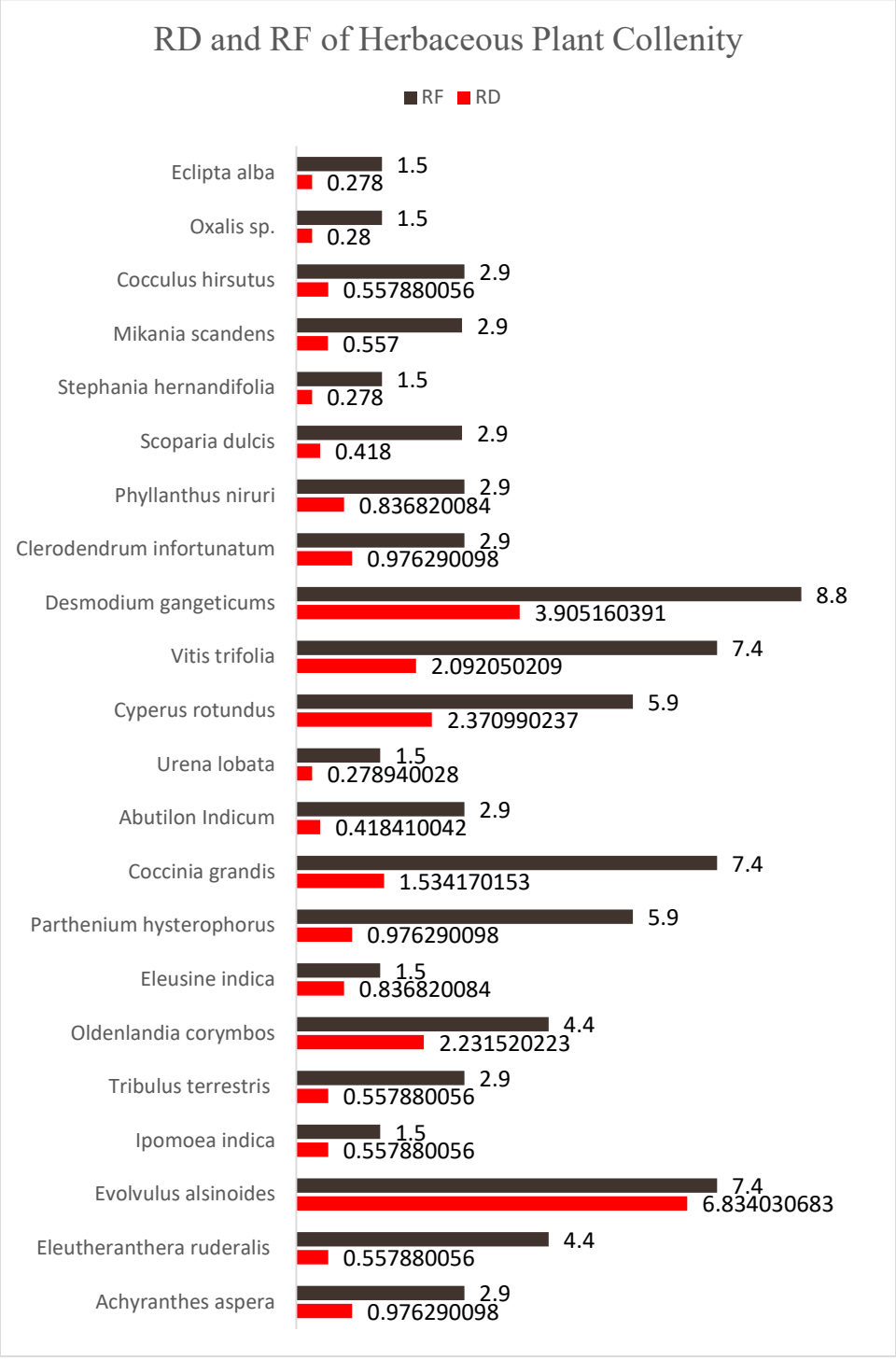
No.	Name of the Species	D	RD	FQ%	AB	RF	IVI
1	*Achyranthes aspera*	9.51	0.976	25	3.5	2.9	3.9
2	*Eleutheranthera ruderalis*	5.43	0.557	37.5	1.333	4.4	5.0
3	*Evolvulus alsinoides*	66.58	6.834	62.5	9.80	7.4	14.2
4	*Ipomoea indica*	5.43	0.557	12.5	4	1.5	2.0
5	*Tribulus terrestris*	5.43	0.557	25	2	2.9	3.5
6	*Oldenlandia corymbos*	21.74	2.231	37.5	5.33	4.4	6.6
7	*Eleusine indica*	8.15	0.836	12.5	6	1.5	2.3
8	*Parthenium hysterophorus*	9.51	0.976	50	1.75	5.9	6.9
9	*Coccinia grandis*	14.95	1.534	62.5	2.2	7.4	8.9
10	*Abutilon Indicum*	4.08	0.418	25	1.5	2.9	3.4
11	*Urena lobata*	2.72	0.278	12.5	2	1.5	1.7
12	*Cyperus rotundus*	23.10	2.370	50	4.25	5.9	8.3
13	*Vitis trifolia*	20.38	2.092	62.5	3	7.4	9.4
14	*Desmodium gangeticums*	38.04	3.905	75	4.67	8.8	12.7
15	*Clerodendrum infortunatum*	9.51	0.976	25	3.5	2.9	3.9
16	*Phyllanthus niruri*	8.15	0.836	25	3	2.9	3.8
17	*Scoparia dulcis*	4.08	0.418	25	1.5	2.9	3.4
18	*Stephania hernandifolia*	2.72	0.278	12.5	2	1.5	1.7
19	*Mikania scandens*	5.43	0.557	25	2	2.9	3.5
20	*Cocculus hirsutus*	5.43	0.557	25	2	2.9	3.5
21	*Oxalis sp.*	2.72	0.280	12.5	2	1.5	1.7
22	*Eclipta alba*	2.72	0.278	12.5	2	1.5	1.7

In the study it was observed that *Desmodiumgangeticum* shown its highest relative frequency and relative density throughout the Ramnagar College campus. In case of relative frequency *Desmodiumgangeticum* was followed by two climber*i.e.Vitis trifolia*, *Coccnia grandis*and*Evolvuluselsinoides* (Fig. 6). Where as in case of relative density *Desmodiumgangeticum* was followed by *Evolvuluselsinoidesand Cyperus rotundus* (Fig. 6). In case of both relative density and relative frequency *Evolvuluselsinoides* showed almost equal result. This finding represents the fabulous microhabitat for these species which cover the ground of the open land of the college campus and create a diverse form of ecological niche for different types of insects.

Mikania scandens, Ailanthus sp.* and *Phyllanthus emblica ***Striblus asper* and *Glycosmis pentaphylla***

Terminalia chebula ***Rauwolfia tetraphylla***

Figure 6. Relative Density and Relative Frequency of the Herbaceous plant community



Faunal Diversity at Ramnagar College Campus

A total of 16 species of butterfly was recorded from the presentstudy. Presence of different host plants like *Glycosmis pentaphylla* and nectar plants like *Tridax procumbens*, *Eupatorium odoratum* etc. in the college campus may be the reason of this high butterfly diversity (Table 3).

Table 3. Diversity of Butterfly and their common name

Sl. No.	Name of the species	Common name
1	*Papileo polytes*	Common Mormon
2	*Papileo demoleus*	Lime Butterfly
3	*Catopsilia pomona*	Common Emigrant
4	*Catopsilia pyranthe*	Mottled Emigrant
5	*Eurema hecabe*	Common Grass Yellow
6	*Eurema blanda*	Three-spot Grass Yellow
7	*Leptosia nina*	Psyche
8	*Cepora nerissa*	Common Gull
9	*Appias libythea*	Striped Albatross
10	*Ixias pyrene*	Yellow Orange Tip
11	*Acraea violae*	Tawny Coster
12	*Ariadne ariadne*	Angled Castor
13	*Ariadne merione*	Common Castor
14	*Junonia lemonias*	Lemon Pansy
15	*Junonia almanac*	Peacock Pansy
16	*Junoniaatlites*	Grey Pansy

A total of 7 species of Dragon fly also recorded from the Ramnagar College campus. Though the species may increase if seasonal study was conducted (Table 4).

Table 4. Diversity of Dragonfly and their common name

Sl. No.	Name of the Species	Common Name
1	*Acisoma panprpoides*	Trumpet Tail
2	*Brachythemis contaminate*	Ditch Jewel
3	*Crocothemis servilia*	Ruddy Marsh Skimmer
4	*Diplacodes trivialis*	Ground Skimmer
5	*Neurothemis tullia*	Pied Paddy Skimmer
6	*Orthetrum Sabina*	Green Marsh Hawk
7	*Pantala flavescens*	Wandering Glider

During the study for Green Audit a total of 35 species of Birds has been recorded in and around the college campus. And the nest of few species has also been observed. Out of 35species 1 schedule I bird species i.e. *Acccipter badius* was also observed during the study. High diversity of MTS can be positively correlated with the high bird diversity in the college campus (Table 5)

Table 5. Diversity of Birds and their common name

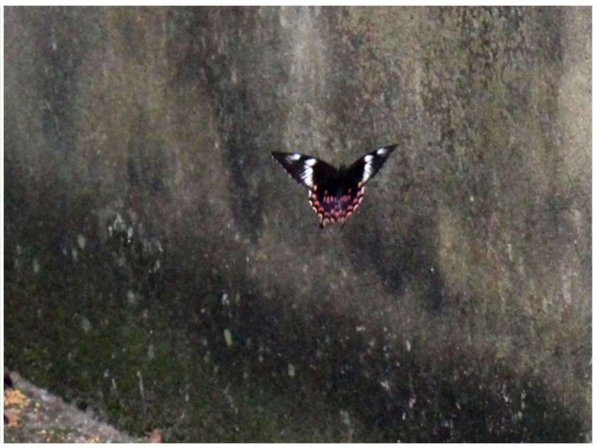
Sl. No.	Zoological Name	English name	Schedule Status in Wildlife Protection Act
2	*Dinopium benghalense*	Black-rumpedFlameback	IV
4	*Halcyon capensis*	Stork-billed Kingfisher	IV
5	*Halcyon smyrnensis*	White-throated Kingfisher	IV
6	*Eudynamys scolopacea*	Asian Koel	IV
7	*Centropus sinensis*	Greater Coucal	IV
9	*Streptopelia chinensis*	Spotted Dove	IV
10	*Amaurornis phoenicurus*	White-breasted Waterhen	IV
12	*Vanellus indicus*	Red-wattled Lapwing	IV
14	*Acccipter badius*	Shikra	I
15	*Phalacrocorax niger*	Little cormorant	IV
16	*Phalacrocorax fuscicollis*	Indian Cormorant	IV
17	*Egretta garzeta*	Little Egret	IV
18	*Mesaphoyx intermedia*	Intermediate Egret	IV
19	*Bubulcus ibis*	Cattle Egret	IV
20	*Ardeola grayii*	Indian Pond Heron	IV
23	*Dupetor flavicollis*	Black Bittern	IV
25	*Dendrocitta vagabunda*	Rufous Treepie	IV
26	*Corvus splendens*	House Crow	IV
27	*Corvus macrorhynchos*	Large-billed Crow	IV
29	*Oriolus xanthornus*	Black-hooded Oriole	IV
30	*Dicrurus macrocercus*	Black Drongo	IV
31	*Copsychus saularis*	Oriental Magpie Robin	IV
32	*Acridotheres tristis*	Common Myna	IV
34	*Orthotomus sutorius*	Common Tailorbird	IV
35	*Turdoides striatus*	Jungle Babbler	IV

Two species of mammals was also recorded during the study (Table 6). Apart from that, habitatof Snake, Varanus and Jackle was also notices in and around the college campus and in the bank of Pond 2 in near the fishery Department of the college.

Table 6. Diversity of mammals and their common name

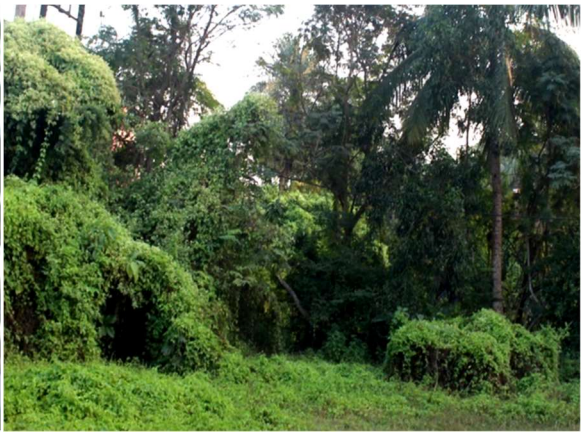
Sl. No.	Zoological Name	English name	Schedule Status in Wildlife Protection Act
1	*Bandicota indica*	Large Bandicoot-rat	V
2	*Funambulus pennantii*	striped palm Squirrel	--

Butterfly in *Thuja* plant



Common mormon butterfly

Monarch butterfly



Wild habitat

The species richness in the college campus is high and the evenness is low. So, in conclusion it may be said that the Ramnagar College campus is rich in Biodiversity.

CONCLUSION

the Green Audit at Ramnagar 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. As Ramnagar 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

Performing Environmental audit within the college campus is a crucial initiative. This involves a comprehensive assessment of eco-friendly practices, resource utilization, and environmental impact within the campus premises. The audit aims to evaluate and enhance sustainability measures, promoting a healthier and greener environment for the college community. Findings and recommendations from this audit contribute to the overall effort of fostering environmental responsibility within the educational institution. The data obtained from this survey is thoroughly documented in our report.

Creating an eco-friendly college campus involves implementing sustainable practices to minimize environmental impact. This encompasses various initiatives aimed at reducing the carbon footprint, conserving resources, and promoting a healthier environment. Key elements of an eco-friendly campus include energy-efficient buildings, waste reduction and recycling programs, green transportation options, and the incorporation of renewable energy sources. Additionally, fostering environmental awareness through educational programs and encouraging eco-friendly behaviors among students and staff are essential components of building a sustainable college community. Such initiatives contribute to the overall well-being of the campus and its surroundings while instilling a sense of environmental responsibility among its members.

The Audit covered the following major areas:

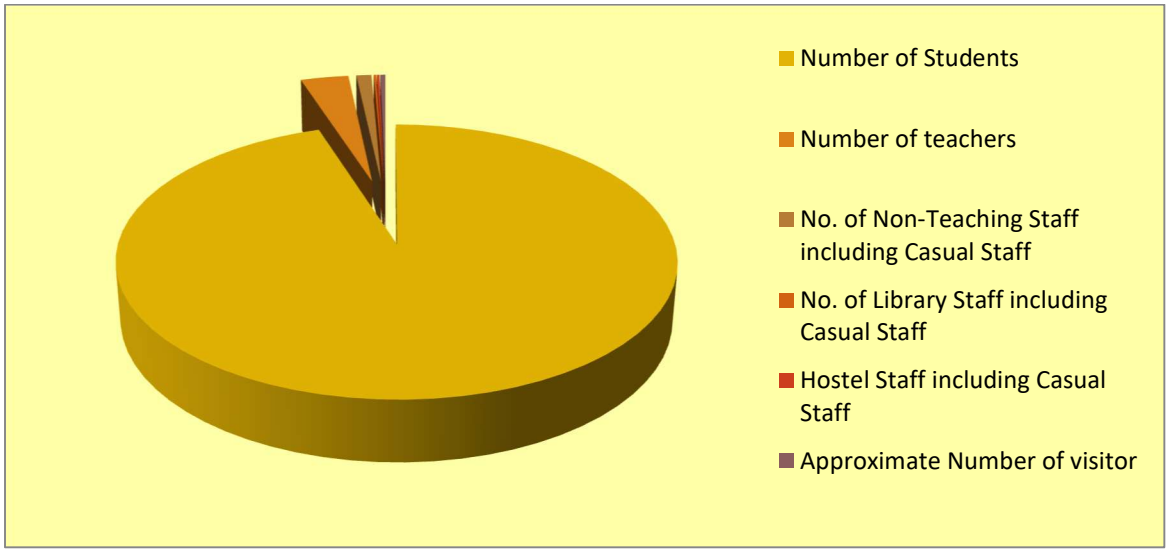
1. Average Foot fall
2. Water Efficiency and Water Management
3. Air Quality and Carbon foot print and Management
4. Waste and Waste Management
5. E-waste management
6. Environmental disaster management
7. Biodiversity and Green Zone and management

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	10
Total population	**2890**

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.

Foot fall based on Total population



2. Water Efficiency and Water Management

Water plays a vital role in our daily routines. Whether at home, Institution or in business, every instance of water usage presents an opportunity for conservation. The availability of fresh water is finite, emphasizing the significance of water conservation for environmental well-being. As the population grows, industries expand, development activities increase, and the potential impacts of climate change loom, there is a rising demand for the province's water resources.

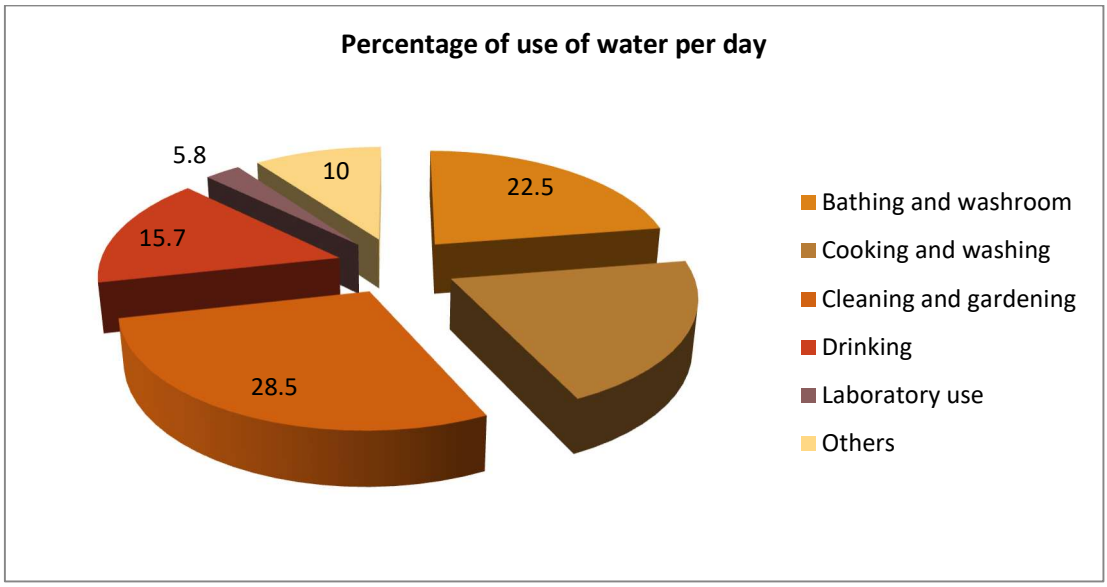
Implementing water efficiency and effective water management on a college campus is essential for environmental sustainability, cost savings, and promoting a culture of responsibility among students and staff. A water audit helps in understanding how water is used in different areas of the campus, including academic buildings, dormitories, recreational spaces, and landscaping. This identification of consumption patterns is crucial for targeting specific areas where water conservation efforts can be most effective.

At this college Maximum percentage of water was found to be used in cleaning and Gardening (28.5%) followed by Bathing and Washroom (22.5%). 15.7% of the total used water is used for drinking purpose after proper purification. Though a few amount was drained out in this process.

Use of water in Different Purpose of College Premises

Use of water in Different Purpose Per Day	Use in Percentage
Bathing and washroom	22.5
Cooking and washing	17.5
Cleaning and gardening	28.5
Drinking	15.7
Laboratory use	5.8
Others	10

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%

Through the examination conducted with the assistance of Water pH meter and TDS meter, we determined that the quality of drinking water is significantly conducive to human health. Consequently, the rating for the Water Quality is designated as high (H). On the flip side, our observation revealed that no such

Rechargeable units are operational within the campus area, and there are no water harvesting plants present. However, it is noted that the management of water reuse and utilization of surface water in the campus is not adequately handled. Therefore, the rating for the effectiveness of the water management policy at the current level is deemed as Low (L).

3. Air Quality and Carbon Footprints:

Amount of CO_2 (ppm)in different location of the college Campus

Amount of CO_2 in the air depict the air quality of a particular area. It is directly associated with the human health. Assessment of the air quality of a particular area is important specifically where a high percentage of foot fall occur regularly like Schools, Colleges and Universities. High level of CO_2 may cause Headaches, fatigue, stagnant, stuffiness, poor concentration, loss of focus, increased heart rate, nausea Level of CO_2 at different location of Ramnagar College has been taken through atmospheric CO_2 and it was observed that the CO_2 level is low at the garden and play ground and high at the Chemistry, Fishery lab and in the front of Main Gate-1. Though it presents in permissible level for human health.

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

Table 3. Amount of CO2 (ppm) in different places

Locations inside college campus	CO2 (ppm) in air	Remarks
Class room (Block 1)	460	CO_2 level is low
Class room (Block 2)	500	CO_2 level is low
Class room (Block 3)	485	CO_2 level is low

Female Staff Room	460	CO_2 level is low
Male Staff Room	520	CO_2 level is low
Library	430	CO_2 level is low
Office	534	CO_2 level is low
Laboratories	607	CO_2 level is low
Conference Hall	497	CO_2 level is low
Canteen	620	CO_2 level is low
Parking	398	CO_2 level is low

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

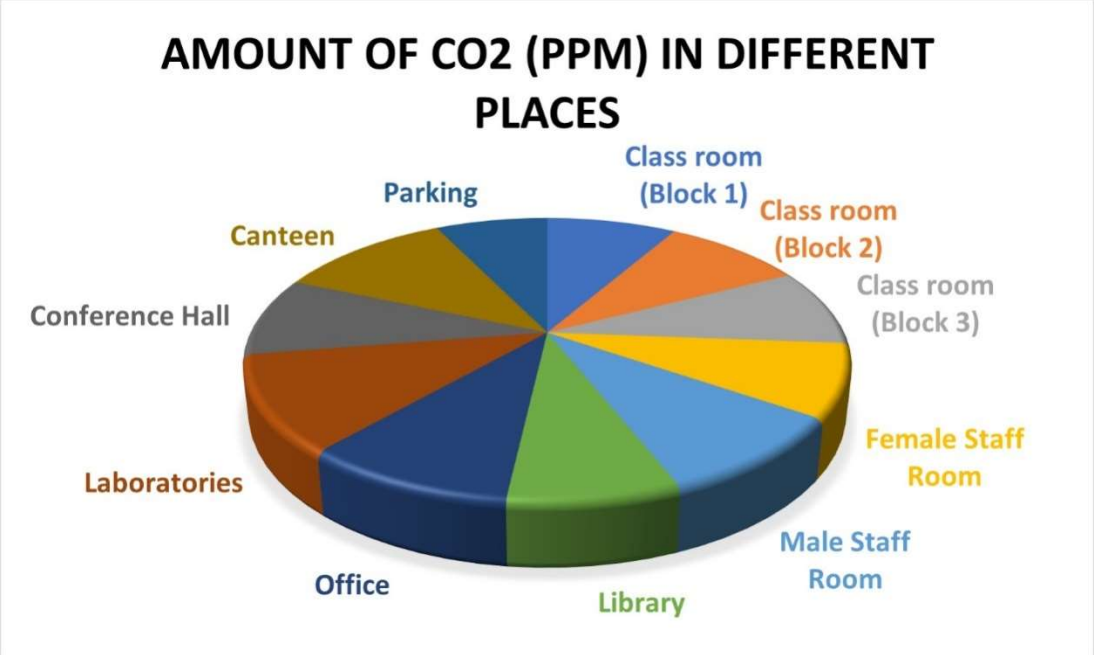


Figure 3. Amount of CO_2 (ppm) of the Air in Different location of the college Premises.

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: = (31492 kWh / 1000) x 0.84 = 26.45 metric tons

Note:

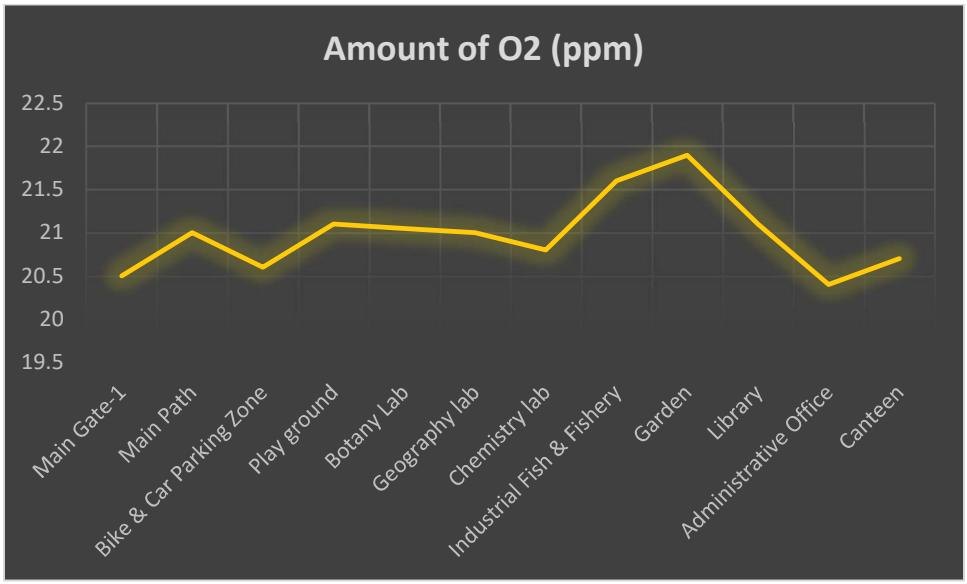
- Annual electricity usage: 31492.33 kWh
- 0.84 is the conversion coefficient from kWh to metric ton

Normal atmosphere close to earth contains 20.9% of oxygen by volume, the Occupational Safety and Health Administration regulation and many confined-space guidance documents indicate that an atmospheric oxygen concentration of 19.5% is the lowest level acceptable for entry into such spaces. At Ramnagar College the amount of O_2 present in the atmosphere varies from 20.4 ppm to 21.9 ppm. It was highest at the open space and garden area and lowest at the office. Its level is inversely proportional with the person present in a congested room and directly proportional with the proper aeration and open space. The level of O_2 at Ramnagar College is moderately high and thus does not make any adverse effect to human health.

Amount of O_2 (ppm)in different location of the college Campus

Different location of the college campus	Amount of O2 (ppm)
Main Gate-1	20.5
Main Path	21.0
Bike&Car Parking Zone	20.6
Play ground	21.1
Botany Lab	21.05
Geography lab	21.00
Chemistry lab	20.8
Industrial Fish & Fishery	21.6
Garden	21.9
Library	21.1
Administrative Office	20.4
Canteen	20.7

Amount of CO_2 at different site of Ramnagar College



Generation of Waste and Waste Management

Waste refers to materials that are unwanted or no longer usable. It encompasses any substance discarded after its primary use, characterized by being either worthless, defective, or devoid of utility. In contrast, a by-product is a co-produced material with relatively minor economic value. A waste product has the potential to transform into a by-product, joint product, or resource when an innovation increases its value above zero.

Pollutants refer to waste substances introduced into ecosystems through human activities, leading to a decline in the quality of air, water, soil, and food, consequently impacting the well-being of both human and non-human populations. Certain pollutants are human-made or synthetic, like chemical pesticides employed for safeguarding crops against insects. Additionally, pollutants can originate directly from the environment, such as heavy metals or fossil fuels extracted by humans from the Earth. Human waste, encompassing sewage and refuse, frequently harbors pollutants capable of causing diseases in both humans and other organisms. The combustion of fossil fuels emits various pollutants that degrade air quality and pose a threat to life, particularly sulfur dioxide (SO2), nitrogen oxides (NOx), and airborne particles like soot. Items like plastic bags, discarded ropes, mobile towers (emitting electromagnetic fields), and strings can pose significant dangers to birds and other animals.

Waste management, or the disposal of waste, encompasses a series of processes and actions necessary to handle waste from its origin to its ultimate disposal. This involves the entire cycle, including the collection, transportation, treatment, and disposal of waste. The management process also involves monitoring and regulating waste-related activities, laws, technologies, and economic mechanisms.

Waste can exist in various forms—solid, liquid, or gases—each requiring distinct disposal and management methods. The scope of waste management extends to all types of waste, such as industrial, biological, household, municipal, organic, biomedical, and radioactive wastes. Some forms of waste pose potential threats to human health. Health concerns are integral to the entire waste management process, arising directly from the handling of solid waste and indirectly through the consumption of water, soil, and food.

Human activities, notably the extraction and processing of raw materials, contribute to the generation of waste. The primary goal of waste management is to mitigate the adverse effects of waste on human health, the environment, planetary resources, and aesthetic aspects. It is a comprehensive approach aimed at addressing the challenges associated with waste production and disposal, ensuring a sustainable and responsible management of diverse waste streams.

The generation of waste in college campuses is a notable aspect of waste management, and addressing this issue requires a comprehensive approach to reduce 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.

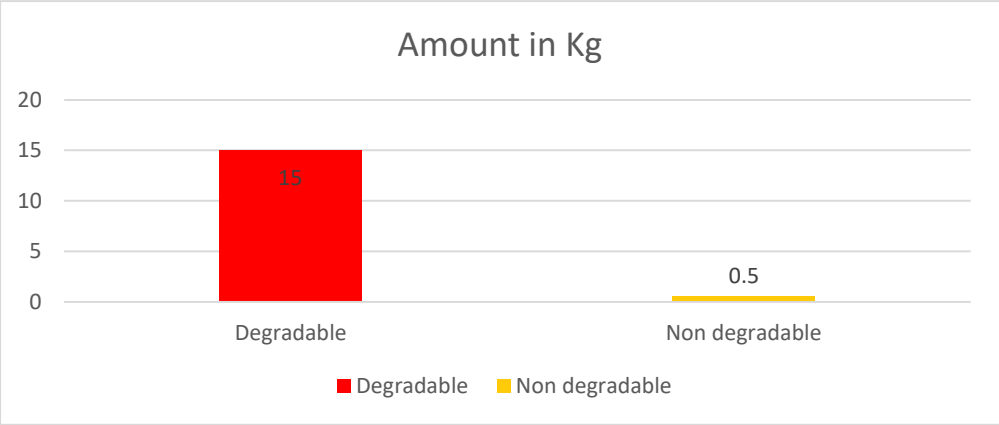
E-waste: Arises from the use and disposal of electronic devices in computer labs and personal electronics.

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

General Waste: Includes everyday waste from offices, maintenance activities, and residential areas.

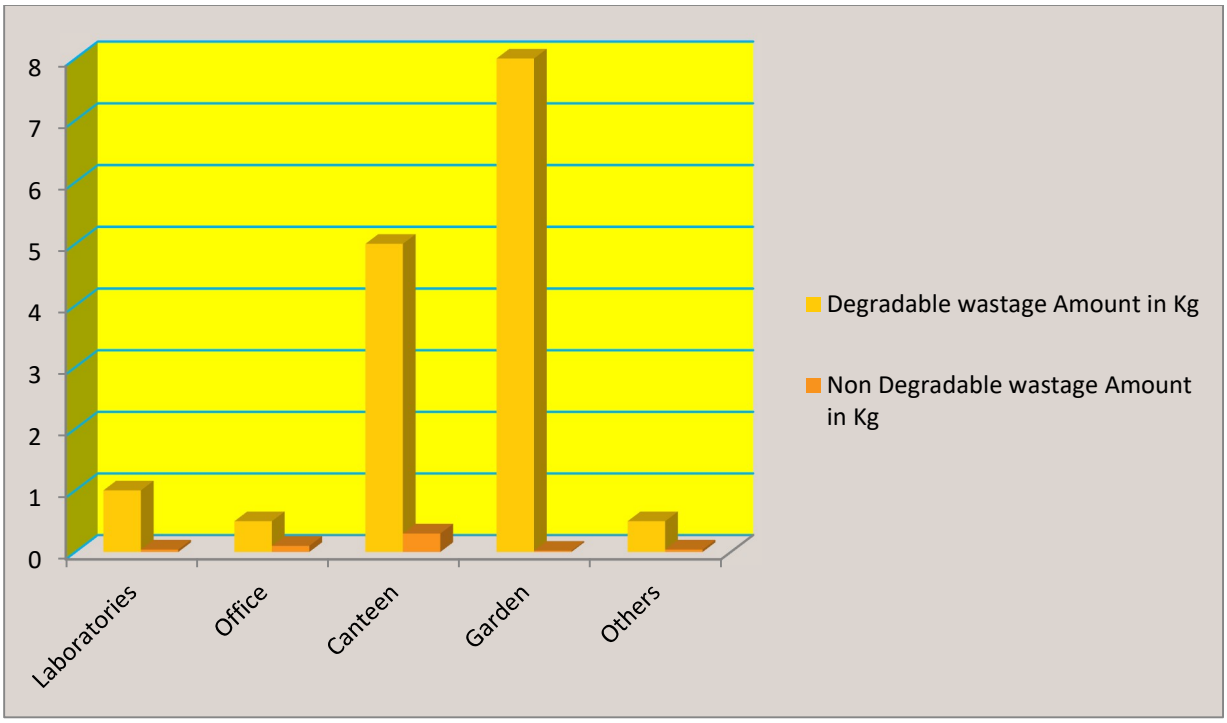
Types of wastes:

Type of Wastage in Per Day	Amount in Kg
Degradable	**15**
Non degradable	**0.5**



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	0.04
Office	0.5	0.10
Canteen	5	0.30
Garden	8	0.02
Others	0.5	0.04


8
7
6
5
4
3
2
1
0
Laboratories
Office
Canteen
Garden
Others
Degradable wastage Amount in Kg
Non Degradable wastage Amount in Kg

ENERGY AUDIT

Energy Audit

1. **Introduction**: An energy audit involves a structured analysis of energy usage within an organization, aiming to conserve energy. It includes evaluating techniques and systems to reduce energy consumption while maintaining operations. Recommendations for alternative approaches to achieve greater energy savings are provided. With traditional energy sources like fossil fuels facing depletion, there's a need to explore alternatives and prioritize energy conservation. The main goal is to provide goods or services at minimal cost while reducing environmental impact. Conducting an energy audit helps identify potential savings, understand fuel usage patterns, pinpoint waste areas, and find improvement opportunities. It's crucial for educational and industrial sectors to adopt energy-saving practices sustainably. The audit process includes questionnaire formulation, campus inspection, documentation review, interviews, data analysis, measurements, and suggestions provision. Energy auditing considers energy savings potential, management strategies, and alternative energy sources. Specific objectives include evaluating sustainability management systems and departmental compliance with regulations. Audit outcomes significantly impact operational costs and environmental footprint. Initiatives like the Energy Conservation Building Code and Bureau of Energy Efficiency promote energy-efficient practices. Energy labels and star ratings help consumers make informed choices. The Energy Audit establishes a benchmark for energy management, aiding in planning more efficient practices. It's a systematic assessment of energy sources aimed at preserving the environment and natural resources. At Ramnagar College under Vidyasagar University, the audit begins with identifying, quantifying, recording, reporting, and analyzing energy components
2. **Need for an Energy Audit:** In any organization, the three primary operating expenses typically include energy (both electrical and thermal), labour, and materials. Among these, energy consistently stands out as a significant factor when evaluating cost manageability or potential savings, making energy management a strategic area for cost

reduction. An Energy Audit plays a crucial role in understanding energy and fuel utilization within an industry, identifying areas prone to waste and those with potential for improvement. It offers insights that contribute to reducing energy costs, enhancing preventive maintenance, and improving quality control programs, all essential for production and utility activities. This audit program enables a focused examination of energy cost variations, energy supply reliability, decisions regarding energy mix, identification of energy conservation technologies, and retrofitting for energy-efficient equipment. Essentially, the Energy Audit translates conservation ideas into practical solutions, providing technically feasible recommendations considering 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 across the organization. The eco-campus concept emphasizes efficient energy utilization and conservation, aiming for sustainable savings. Additionally, it targets carbon emissions reduction, involves calculating carbon footprint, advocates procuring star-rated equipment for cost-effective and secure energy supply, promotes energy conservation in all buildings, aims to diminish overall energy consumption, minimize landfill wastes, and integrate environmental considerations into contracts and services with significant environmental impacts. Examining Energy Management through auditing focuses on energy savings and potential opportunities. While energy itself is invisible, its presence manifests in wires, pipes, and other materials through observable effects like heat, light, and power. Energy management indicators cover energy consumption, sources, monitoring, lighting, vehicle movement, electrical appliances, and transportation. Energy usage is a crucial aspect of campus sustainability, warranting inclusion in assessments without further explanation. Despite the widespread use of energy, attention to energy-saving possibilities remains critical. For instance, a conventional incandescent bulb consumes 60W to 100W, while an energy-efficient LED uses less than 10W, highlighting significant energy savings. Energy auditing is integral to conservation efforts and implementing methods to reduce consumption, thereby

mitigating environmental degradation. Moreover, audits yield valuable suggestions and recommendations for effective energy-saving measures. Environmentally responsible institutions are encouraged to review their energy practices at least once every two years, utilizing both internal and external auditors. The implementation of energy audits, facilitated by both internal and external auditors, plays a significant role in organizational energy management. These audits effectively assess the energy potential within an organization, identifying more efficient methods to mitigate environmental impact. Beyond assessments of water, liquid and solid wastes, biomedical and electronic wastes, and biodiversity, there is a need to measure the organization's carbon footprint. This involves quantifying carbon emissions from electrical appliances, vehicles, and the human population, forming the basis for carbon accounting. It is crucial to ascertain the extent to which an organization contributes to sustainable development through its energy management practices. Therefore, conducting carbon footprint measurements in each organization is recommended, providing valuable insights for maintaining an eco-friendly campus and addressing stakeholder concerns.

3.Aims and Objectives of an Energy Audit: An energy audit is an invaluable tool for crafting and executing thorough energy management strategies within an organization. Its main goal is

to methodically pinpoint opportunities for enhancing energy efficiency, conservation, and cost savings at the audit site. The audit procedure encompasses the following steps:

3.1 Assessing the energy-saving initiatives and measures implemented at the audit sites.

3.2 Identifying diverse opportunities for energy conservation measures and additional avenues for cost savings.

3.3 Deploying alternative energy sources to explore potential energy savings and guide decision-making in the realm of energy management.

3.4 Offering technical guidance on constructing an energy balance and providing specific application-oriented advice.

3.5 Performing an in-depth analysis of energy usage, examining recent electricity bills for the campus, and comprehending the tariff plans offered by the central and State Electricity Boards.

3.6 Listing various ways in which energy is utilized, including electricity for appliances such as stoves, kettles, microwaves, as well as other sources like LPG, firewood, petrol, diesel, and more.

3.7 Analysing electricity bill amounts over the past two to three years, expenditures on LPG cylinders for the previous year, and costs related to water consumption for both human usage and plant watering.

3.8 Evaluating the utilization of different devices and equipment, including incandescent (tungsten) bulbs, CFL bulbs, fans, air conditioners, cooling units, heaters, computers, photocopiers, inverters, generators, and laboratory equipment. This assessment involves calculations based on factors such as wattage and duration of use (e.g., 60-watt bulb x 4 hours x number of bulbs = kWh).

3.9 Assessing the adoption of alternative energy sources/nonconventional energy sources within the organization, such as photovoltaic cells for solar energy, energy-efficient stoves, biogas, etc. Additionally, conducting initiatives to raise awareness among stakeholders regarding energy conservation and efficient utilization.

In essence, Energy Auditing in the institute context is a multifaceted approach that not only strives for efficiency in resource utilization but also underscores the significance of sustainable practices, cost savings, and a collective responsibility for the well-being of the institution and its environment.

4.Campus Area and Infrastructure:

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

5. Methodology and Survey Schedules: To conduct an energy audit, various methods are utilized at the audit sites, primarily focusing on a walk-through audit. This process involves balancing total energy inputs with total energy outputs and identifying all

Group discussion with honorable Principal sir: Ramnagar College

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). Physical verification of various components such as lighting, ceilings, tables, exhaust fans, A/C machines, solar panels, heaters, generators, uninterrupted power supply machines, and ventilators load

fixtures is carried out during the audit. This includes confirming the capacities of installed energy-efficient systems. The audit emphasizes inspecting the costs or potential cost savings associated with each of these components, with energy consistently emerging as a key area for cost reduction. The task of energy management becomes pivotal in achieving cost reduction goals. Additionally, the energy bill from the supply utility company is collected for auditing. This assessment includes evaluating load demand requirements and efficient energy consumption. Stakeholders are engaged during the audit to explore opportunities for improvement in energy management. Potential areas for energy conservation and saving opportunities are 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, electric stove, 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 along with 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 days in a month)
11. Energy used by each electrical equipment per month? (kwh)
12. How many computers are there in use? Mention the use (Hoursused/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 evaluate the environmental impact, carbon dioxide levels were measured at multiple locations across the organization's campus using a portable CO2 analyzer. This measurement aimed to assess the carbon footprint and identify areas with significant carbon emissions, offering valuable insights for reduction strategies. The energy bill from the college was audited and analyzed to understand the kilowatt-hour (KWH) requirements and the efficiency of energy usage. Engaging with various stakeholders played a crucial role in acquainting them with energy audit procedures, ensuring a successful and result-oriented energy audit. Opportunities for energy conservation and savings were identified during the audit process, 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 form of audit offers the most accurate assessment of both energy savings and costs. It considers the combined effects of all projects, accounts for the energy consumption of major equipment, and involves meticulous calculations for both energy cost savings and project costs. Within a comprehensive audit, the energy balance is a critical component, relying on an inventory of energy-consuming systems, assumptions about current operating conditions, and calculations of energy usage. This estimated usage is then compared to charges on utility bills. Initial site visits and preparation are crucial steps preceding detailed auditing. An initial site visit typically lasts a day, allowing the Energy Auditor/Engineer to interact with relevant personnel, familiarize themselves with the site, and assess the procedures required 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)- 31492.33 U (93.6%)

Total electricity consumption (non-conventional)-2153.32 U (6.4 %)

Amount paid for conventional energy used: Rs. 287525.00

Chemistry laboratory of Ramnagar College

Emergency supply line at Ramnagar College

Fossil fuel consumption per year-

a. Number of LPG gas cylinders used for cooking (Canteen & Hostel)-75PCs

b. Number of LPG used in Laboratories-08PCs

c. Diesel used for green Generator- 65 litter

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

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

Source of energy	In Percentage
Conventional	**93.6%**
Non -Conventional	**6.4%**

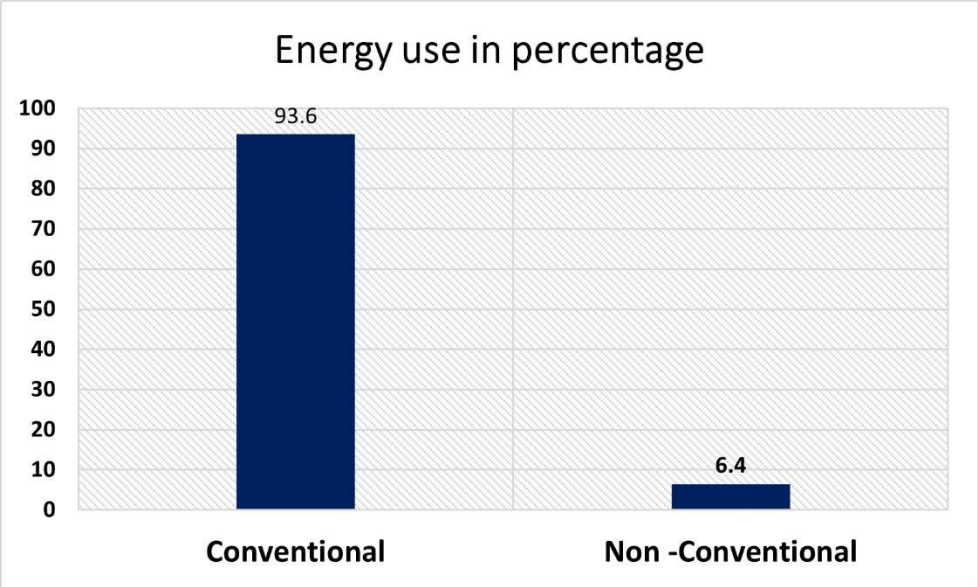


Figure:1 Mode of energy used in college campus (conventional and non-conventional)

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	18.6
2.	LED light	20W	169	12.5
3.	Fan	50W	291	25.5
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.

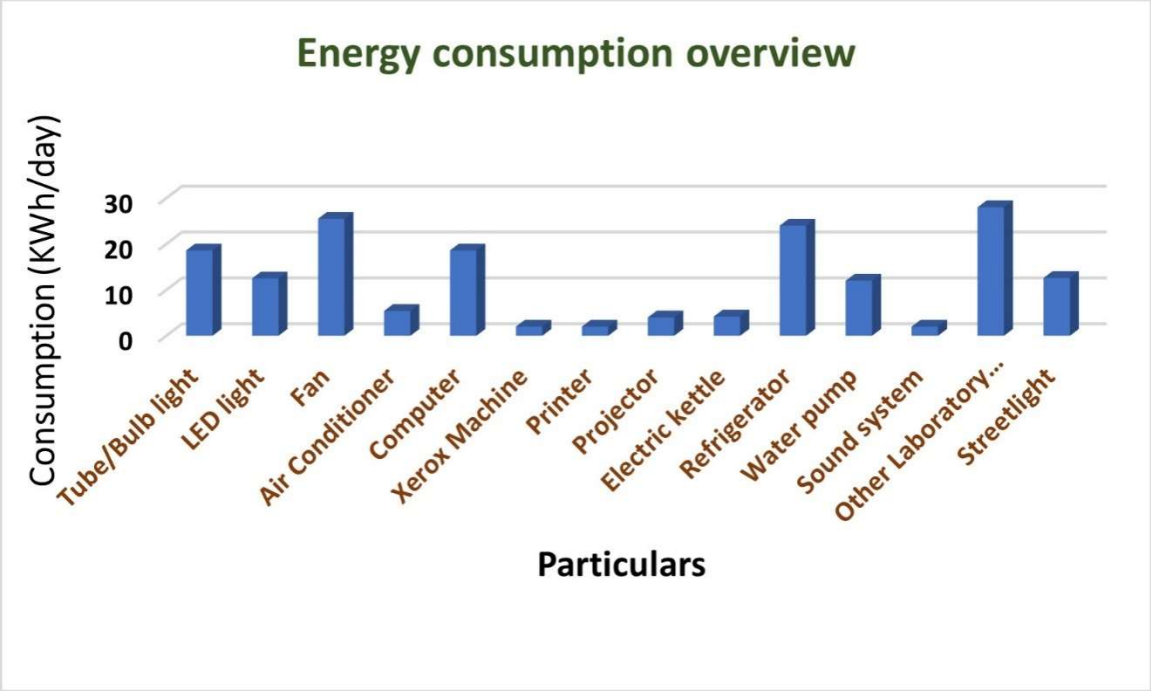


Figure 2: Bar diagram to represent the energy consumption rate.

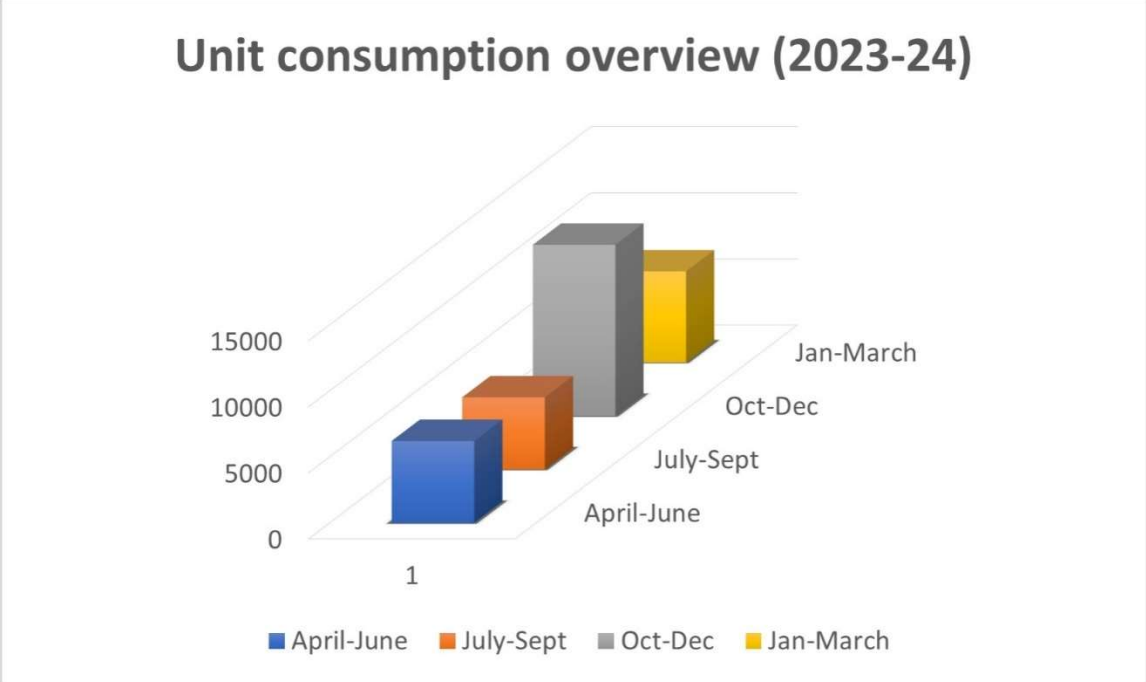


Figure 3: Unit consumption overview

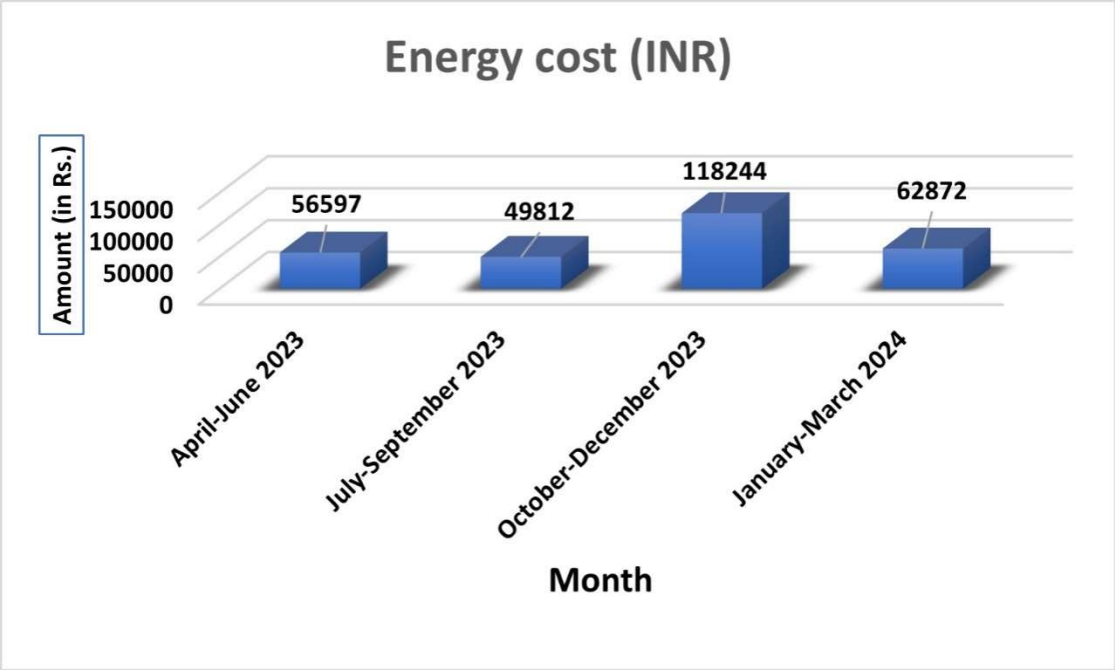


Figure 4: Energy cost profile

Insulated electric meter at Ramnagar College

Laboratory instruments and Computer laboratory of Ramnagar College

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 CHGs	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.

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:

- Upgrade the cooking system in the hostel kitchen and canteen for gas conservation.
- Encourage moderation in the daily use of generators, inverters, and UPS systems.
- Enforce the practice of switching off lights, fans, air conditioners, equipment, and instruments when not in use.
- Install adequate ventilation and exhaust systems in auditoriums, seminar halls, and conference halls to reduce carbon dioxide levels among students, scholars, and staff.

13. Conclusions: Given the organization's well-established reputation and longevity, there exists significant opportunity to bolster energy conservation endeavors and propel the campus towards self-sufficiency. The institution has already taken commendable steps in this direction by implementing energy-efficient lighting, fostering awareness among stakeholders, and ensuring reliable power backups. Furthermore, the organization adheres to best practices in energy auditing, including the proper safeguarding of transformers, generators, and UPS systems with fencing and awareness boards highlighting potential hazards. Prominent signage promoting energy-saving habits, along with meticulous maintenance of electrical infrastructure, further bolster energy conservation efforts and ensure the safety of faculty and students.

The adoption of sprinkler irrigation on campus to minimize energy consumption is praiseworthy. However, there are additional recommendations that could augment the organization's potential for energy savings. These measures hold the promise of a brighter future, characterized by an energy-efficient campus and sustainable environmental and community development for stakeholders in the years to come.

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.

- Rain water harvesting and use of the same for irrigation in garden along with the wash room use and chinning purpose may be done through developing some green project mode which reduce the consumption of ground water to some extent.
- Bioremediation plant of the waste water from the bathroom and from the laboratory (where different chemicals and heavy metals may present) should be done before it releases to the surface water
- Auto regulating device should be attached with the submersible bump so that overflow of the roof top tank may be checked.
- Auto regulating sprinkler may be installed for adequate irrigation in the garden even in the summer period.
- The Ramnagar College has a considerable area of building blocks so, during rainy season huge amount of water from the roof top may be transfer to Ground water recharge system which may be taken into account by the college authority in a specific environment project mode.
- Some waste water was directly found to be admixed with the pond no. 1 through some drainage system which should be carried on after passing through the water treatment plant.
- In each and every floor of all building separate degradable and non-degradable waste been should be installed for proper management of the waste and the degradable waste

may be transfer in the plant through which organic fertilizer can be produced and applied as green manure in the garden.

- As the college is situated near Bay of Bengal and the chance of hitting of cyclone to that area is very high, A natural disaster management committee and a center should be formed in the college campus to overcome the locals from the adverse situation if arise in near future.
- As the college is conducting the B. Voc. on fishery, a bio-gas and phosphine rich organic manure plant may be established in the college campus from the dead fishes. The dead fishes may be collected from the nearby areas associated with the line departments. This initiative will help to reduce methane production (one of the potential greenhouse gas). Check bad odor and disease to human being due to open decomposition of dead fishes and the Biogas which will produce may be used in laboratory and canteen. The bio fertilizer may be sold to the local farmers promoting organic farming and can generate economy for its self-sustenance.
- A Proper e-waste management center with proper documentation in the college campus is essential for the proper management of e waste.

For better conservation of Biodiversity

- Some wild habitat in the Fishery campus of the college were recorded which may be conserved and can be denoted "Keep wildness in wild"
- A wild indigenous fish rescue center may be developed in the Fishery campus where wild aquatic plants along with different aquatic wild life like soft skin turtle may be conserved
- Some portion beside the Pond 1 may be allotted for aboriginal tree re library which can be used both for study and conservation of some locally threatened tree species
- A medicinal plant library may be established at the garden area of the main campus along with a butterfly garden where a number of host and nectar plants for different species of butterfly may be conserved.
- Name plate of All existing MTS should be done and install for education purpose.