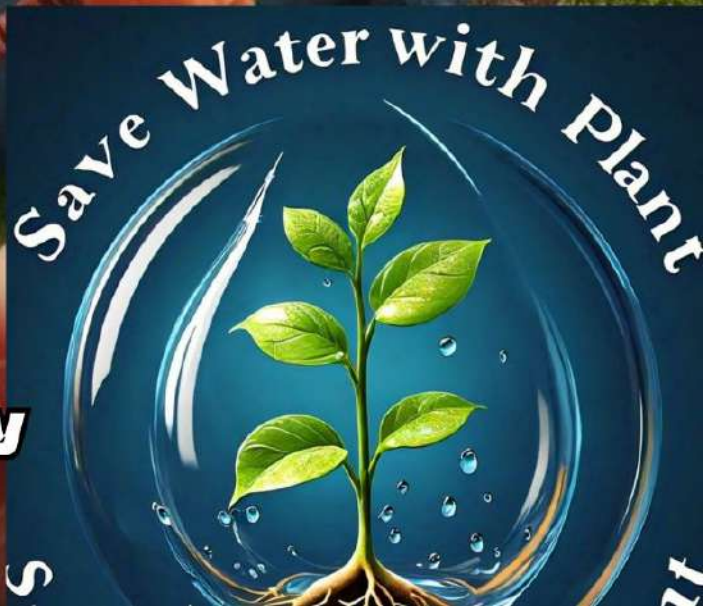
GREEN , ENERGY & ENVIRON MENT AUDIT REPORT

2022-2023

ASANNAGAR MADAN MOHAN TARKALANKAR COLLEGE



REPORT PREPARED BY

INSTITUTE OF NATURE RESEARCH AND CONSERVATION (INRC)

INSTITUTE OF NATURE RESEARCH AND CONSERVATION

INRC

SATYEN BOSE ROAD, BASUDEBPUR,
P.O.- BANIPUR, P.S.- SANKRAIL,
DIST.- HOWRAH, PIN- 711304,
WEST BENGAL, INDIA
website: www.inrc-india.org

Mob. No.: 7003988808/
7076154284
Email: inrc.org@gmail.com
Registration Number: 190100239/2023

Reference No: … *Date-07/12/2023*

GREEN, ENVIRONMENT AND ENERGY AUDIT CERTIFICATE

ACADEMIC YEAR 2023-2024

This is to certify that ***Asannagar Madan Mohan Tarkalankar College****, located at 56 Majhdia Road, Asannagar, Nadia, West Bengal, Pin-741161, has steadfastly strived to establish a robust and ecologically sustainable environment, dedicated to the preservation of nature and biodiversity. Institute of Nature Research and Conservation (INRC) expresses satisfaction following the successful completion of the Green, Environment, and Energy Audit for the academic year 2023-2024.*

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

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

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

DR. SUMIT MANNA
Lead Auditor EMS
UIN: 840180406937
INRC

Secretary
INRC
Satyen Bose Road, Sankrail
Howrah, W.B., 711304

DR. AMIT MANNA
Lead Auditor EnMS
UIN: 292286787454
VICE PRESIDENT
INRC

Vice-President
INRC
Satyen Bose Road, Sankrail
Howrah, W.B., 711304

INRC ★ Satyen Bose Road, Sankrail, Howrah, W.B., 711304 ★
Reg. No.- 0239/2023

INDEX

ACKNOWLEDGEMENT

We, the Green Environment and Energy Audit Team from the Institute of Nature Research and Conservation (INRC), would like to express our profound gratitude to the management of Asannagar Madan Mohan Tarkalankar College for entrusting us with the significant task of conducting a Green & Environmental audit. We extend our heartfelt thanks to the Principal of Asannagar Madan Mohan Tarkalankar College for his support and cooperation, which was essential for our team to carry out the audit activities successfully. We also wish to acknowledge the invaluable contributions of the IQAC members, as well as the teaching and non-teaching staff. Their dedicated involvement was crucial in making this project possible.

AREAS OF CONCERN

GREEN AUDIT

- Floral Diversity
- Faunal Diversity
- Mapping of Major Tree species (MTS) and wild habitats
- 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 was conducted by a committee of experts and scientists from various reputable institutes. The committee developed a questionnaire based on both central and state regulatory and statutory requirements. They gathered and compiled essential data, which was then thoroughly analyzed. Overall, the audit indicates a healthy environment within the Asannagar Madan Mohan Tarkalankar College campus. The committee has provided both short-term and long-term recommendations to enhance environmental conditions further. The higher authorities and all stakeholders of the college have affirmed their commitment to giving due attention to these suggestions and utilizing opportunities for identified improvements.

AUDIT COMMITTEE MEMBERS

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

The Committee members are listed below:

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

The Audit team started the audit at the College Campus from 05st Jun, 2023

Important dates and of Initiative

SL NO	PURPOSE	DATE	REMARKS
1	Communication with College authority	02.06.2023	Discuss about term and condition
3	Collection information about the College	05.06.2023	Introduced to Administrative Officer
4	Campus visit and observation	08.06.2023	Outdoor observation with Photo camera and GPS coordinates
5	Campus enquiry	08.06.2023	Physically enquiry with expert
6	Departments visit and enquiry	08.06.2023	Laboratory enquiry
7	Interview with other stake holder	27.07.2023	Meet with others stake holder
8	Interview with staff	27.07.2023	Collected different information
9	Review data and Assessment	21.08.2023	Data generate and drown figures
10	Pre-Closing meeting	21.08.2023	Meeting with IQAC
11	Closing Meeting	13.09.2023	Pre-submission of the Report
12	Submit audit report	07.12.2023	Submit of the Report

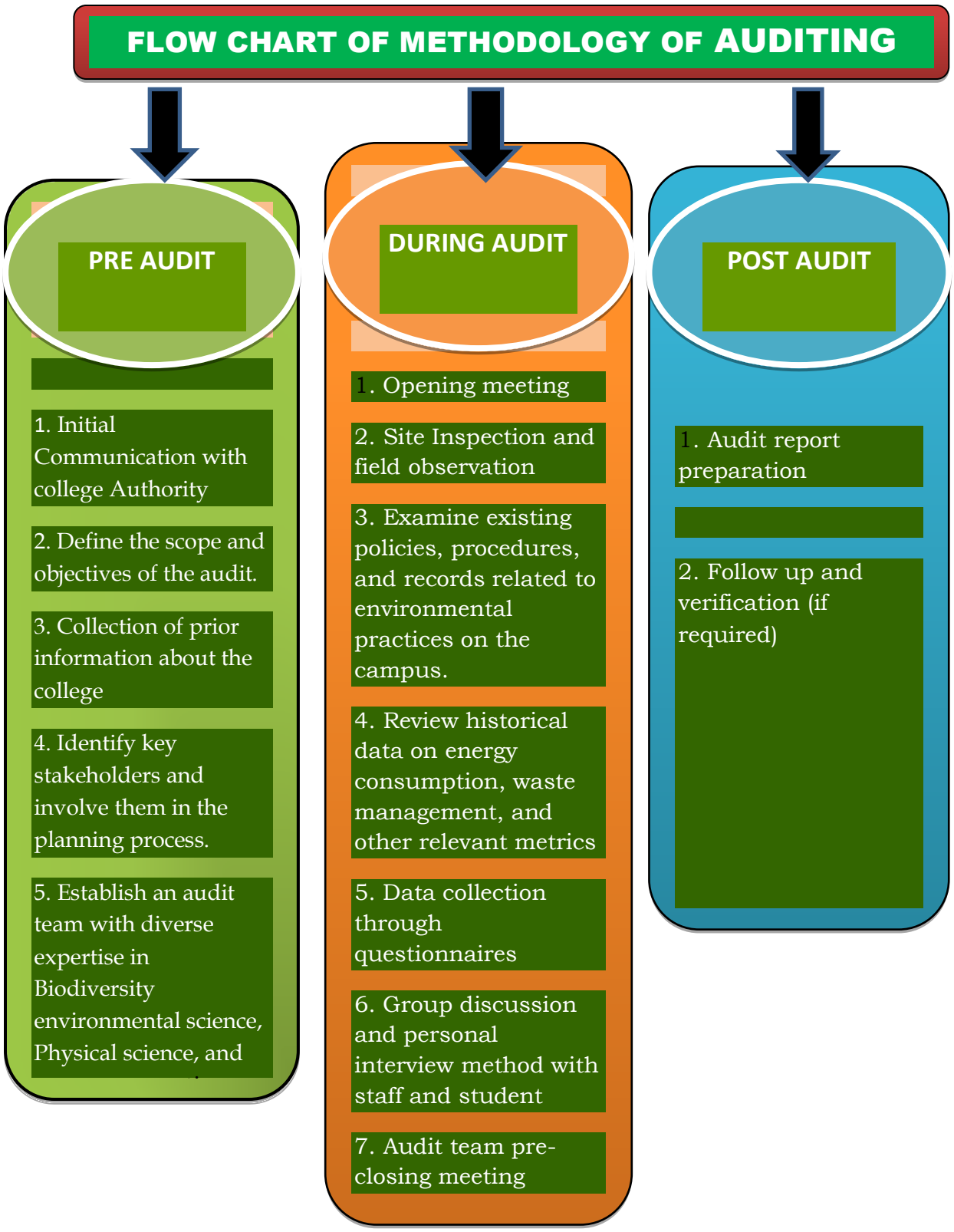
PURPOSE OF GREEN AND ENVIRONMENT AND ENERGY AUDIT

Purpose of Green and Environmental Auditing

- **Environmental Compliance**: Ensure the college adheres to local, regional, and national environmental regulations, including waste disposal, energy use, and other relevant standards.
- **Resource Management**: Assess the efficient use of resources such as water, energy, and materials on campus. Identify opportunities for conservation and sustainable management.
- **Waste Reduction and Recycling**: Evaluate current waste management practices and promote initiatives to minimize waste generation. Identify opportunities for recycling and proper disposal of waste materials.
- **Energy Efficiency**: Analyze the campus's energy consumption patterns and identify measures to improve efficiency, including the adoption of renewable energy sources.
- **Biodiversity and Green Spaces**: Evaluate the impact of campus development on local biodiversity. Promote the creation and preservation of green spaces, gardens, and natural habitats.
- **Transportation and Commuting**: Assess the environmental impact of transportation on campus. Encourage sustainable transportation methods and work to reduce the carbon footprint associated with commuting.
- **Curriculum Integration**: Incorporate environmental and sustainability themes into the academic curriculum. Increase awareness and understanding of environmental issues among students and staff.
- **Community Engagement**: Engage the campus community in environmental initiatives and awareness campaigns. Foster a sense of environmental responsibility among students, faculty, and staff.
- **Infrastructure Development**: Ensure new construction and infrastructure development adhere to 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 to improve 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 primary operating expenses usually include energy (both electrical and thermal), labor, and materials. When evaluating cost management or potential savings in these areas, energy often stands out as a significant factor, making energy management a key area for cost reduction.
- An Energy Audit is essential for understanding how energy and fuel are used within an institution, identifying areas prone to waste, and highlighting opportunities for improvement.
- The insights gained from an Energy Audit can help reduce energy costs, improve preventive maintenance, and enhance quality control programs, which are vital for production and utility operations.
- This audit program allows for a detailed examination of energy cost variations, the reliability of energy supply, decisions regarding the optimal energy mix, identification of energy conservation technologies, and retrofitting for energy-efficient equipment. Essentially, the Energy Audit turns conservation ideas into practical solutions, offering technically feasible recommendations while considering economic and organizational factors within a specified timeframe.
- The main goal is to develop strategies for reducing energy consumption per unit of product output or lowering operating costs. The Energy Audit serves as a benchmark for managing energy within the organization and forms the foundation for planning more effective energy use across the entire organization.
- The eco-campus concept focuses on the efficient use and conservation of energy, aiming for sustainable savings. It also targets the reduction of carbon emissions, involves calculating the carbon footprint, advocates for the procurement of star-rated equipment to ensure cost-effective and secure energy supply, promotes energy conservation in all buildings, aims to reduce overall energy consumption, minimizes landfill waste, and incorporates environmental considerations into all contracts and services with significant environmental impacts.
- Energy Management through auditing focuses on energy savings and identifying opportunities. While energy itself is invisible, its effects can be seen in wires, pipes, and other materials through heat, light, and power.
- Energy management indicators include energy consumption, energy sources, monitoring, lighting, vehicle movement, electrical and electronic appliances, and transportation. Energy usage is a crucial aspect of campus sustainability and must be included in assessments.
- Despite the widespread use of energy, attention to energy-saving opportunities remains essential. For example, a traditional incandescent bulb uses about 60W to 100W, while an energy-efficient LED uses less than 10W, demonstrating significant energy savings. Energy auditing is crucial for conservation efforts and implementing methods to reduce consumption, thereby mitigating environmental degradation.


FLOW CHART OF METHODOLOGY OF 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 science, and
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 thorough inspection of the campus was carried out to observe and document various environmental aspects, including waste disposal areas, energy infrastructure, green spaces, and water management systems.

 The biodiversity of campus plants was cataloged, with various floral and faunal species identified and photographed. Inspections for data collection were also conducted in the medicinal garden, canteen, library, all departments, office rooms, buildings, and parking areas.

 The types and numbers of vehicles used by stakeholders were recorded, and their fuel consumption was verified in consultation with the users. Additionally, the number of LPG cylinders used in laboratories, the canteen, and hostel kitchens was counted.

 An extensive inspection of water taps was conducted, identifying a few leaky taps and overflowing tanks during the site visit.

Different types of Survey are conducted in College Campus:

 Energy Audit:

Evaluate energy usage in various campus buildings.

Identify opportunities for energy conservation and efficiency improvements.

 Water Management:

Assess water sources, usage patterns, and wastewater treatment facilities.

Recommend strategies for water conservation and sustainable use.

 Waste Management:

Examine waste generation and disposal practices.

Suggest methods for waste reduction, recycling, and proper disposal.

 Transportation and Commuting:

Analyze the commuting habits of students and staff.

Recommend sustainable transportation options and infrastructure enhancements.

 Biodiversity and Green Spaces:

Evaluate the condition of green areas, gardens, and natural habitats.

Suggest measures to enhance biodiversity and preserve green spaces.

 Curriculum and Awareness:

Review the inclusion of environmental topics in the academic curriculum.

Assess the level of environmental awareness among students and staff.

 Infrastructure Development:

Inspect the sustainability features of new construction projects.

 Community Engagement:

Assess the level of participation in environmental initiatives.

Gather feedback from the campus community on environmental awareness programs.

 Regulatory Compliance:

Ensure compliance with environmental regulations and standards.

Identify areas needing adjustments to meet regulatory requirements.

 Financial and Cost Savings:

Evaluate the financial impact of proposed environmental initiatives.

Identify potential cost savings through energy efficiency and waste reduction measures

Steps of data collection:

 The audit team was initially divided into two groups. The first group began collecting data for the energy audit, while the second and third groups focused on gathering data for the green and environmental audits.

 Members of each group visited the entire college campus, including the garden, canteen, kitchen, library, and each department with their respective laboratories.

 A comprehensive questionnaire was developed covering all aspects of the Green, Environment, and Energy audits. This was distributed to stakeholders prior to the visits to gather initial data.

 Information and data were collected through observation, personal interviews, and group discussions with various stakeholders.

 Environmental parameters across different points of the college premises were assessed using electronic devices such as Atmospheric O2 and CO2 meters and TDS meters, with measurements recorded.

 The diameter at breast height (DBH) of each major tree species (MTS) was measured, their phenological conditions were studied, and the GPS coordinates of significant MTS were recorded.

 Plant community structure was analyzed using the Quadrat method.

 During field visits, various species of mammals, birds, reptiles, amphibians, butterflies, and dragonflies were identified and documented. The presence of wild habitats on the college campus was recorded, and historical data related to wildlife were gathered from stakeholders through group discussions and personal interviews.

Data Analysis:

- Calculation of green area, concrete area, and aquatic land in 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

Asannagar Madan Mohan Tarkalankar College stands as a venerable institution dedicated to academic excellence and holistic development. As the institution evolves in the recent decay, 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 Asannagar Madan Mohan Tarkalankar College:

The importance of a Green Audit at Asannagar Madan Mohan Tarkalankar 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. Asannagar Madan Mohan Tarkalankar 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 Asannagar Madan Mohan Tarkalankar 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 Asannagar Madan Mohan Tarkalankar College campus and recorded all the biodiversity components *i.e.* flora and fauna in the college premises. 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. Butterflies, Dragon flies, Birds, amphibians, reptilians and mammals were sited and identified during the field visit and wild habitats 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.

Visit of INRC team to the College campus

Wild Aquatic body of the college campus

VEGETATION MAPPING OF ASANNAGAR MADAN MOHAN TARKALANKAR COLLEGE (DEPICTING ON SCALE DISTRIBUTION OF MTS, GARDEN AREA, WATER BODIES, PLAY GROUND, OPEN LAND AND CONCRET & BUILDING AREAS)

FLORAL DIVERSITY AT ASANNAGAR MADAN MOHAN TARKALANKAR COLLEGECAMPUS

A total of 49 species of flowering plants has been recorded during the study out of which 20 species were considered as MTS, 9 species belongs from shrubs and 22 species were grouped in herbs. Out of 49 species of plants 31 wild species have medicinal potentiality, as evidenced by published literature. Apart from that 14 species of medicinal plants were also recorded from the medicinal plant garden situated within college campus.

It is interesting to note that all the 20 species of MTS belong from 11 different taxonomic families which represents that the taxonomic diversity of the college campus was very high (Table 1).

Table 1. Diversity of Major Tree Species (MTS) in Asannagar Madan Mohan Tarkalankar College

P. N	Name of the MTS	Family	No. of Individuals	Mature	DBH	F%	Local Status
1	*Acacia nilotica*	Fabaceae	35	35	4.2	33.3333	C
2	*Neolamarckia cadamba*	Rubiaceae	2	2	3.6	1.90476	C
3	*Mallotus nudiflorus*	Euphorbiaceae	20	5	5	19.0476	C
4	*Alstonia scholaris*	Apocynaceae	2	1	2	1.90476	C
5	*Mallotus philippensis*	Euphorbiaceae	1	1	3	0.95238	LT
6	*Phoenix sylvestris*	Arecaceae	2	1	3.4	1.90476	C
7	*Albizia lebbeck*	Fabaceae	2	1	4.5	1.90476	C
8	*Bombax ceiba*	Malvaceae	1	0	1.2	0.95238	LC
9	*Ficus hispida*	Moraceae	2	1	0.8	1.90476	C
10	*Suregada multiflorum*	Euphorbiaceae	2	1	0.7	1.90476	LC
11	*Annona squamosa*	Annonaceae	2	2	1.2	1.90476	C
12	*Swietenia macrophylla*	Meliaceae	5	2	5.6	4.7619	C
13	*Mangifera indica*	Anacardiaceae	18	6	5.1	17.1429	C
14	*Borassus flabellifer*	Arecaceae	2	1	4	1.90476	C
15	*Acacia auriculiformis*	Fabaceae	2	1	4.1	1.90476	C
16	*Streblus asper*	Moraceae	2	1	1.5	1.90476	C
17	*Delonix regia*	Fabaceae	1	0	0.2	0.95238	C

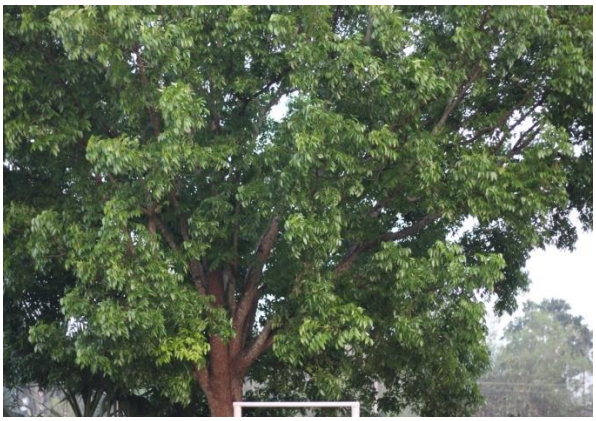
18	*Mimusops Elengi*	Sapotaceae	2	0	0.7	1.90476	C
19	*Azadirachta indica*	Meliaceae	1	0	0.3	0.95238	C
20	*Bauhinia variegata*	Fabaceae	1	1	1	0.95238	C

Most of these MTS are arborescent. *Acacia nilotica* is the most dominant species followed by *Mallotus nudiflorus*. Some MTS winch were less common in the local vicinity also recorded from the Asannagar Madan Mohan Tarkalankar College campus such as *Bombax ceiba*, *Suregada multiflorum*, *Mallotus philippensis* etc.

Acacia nilotica

Mimusops Elengi

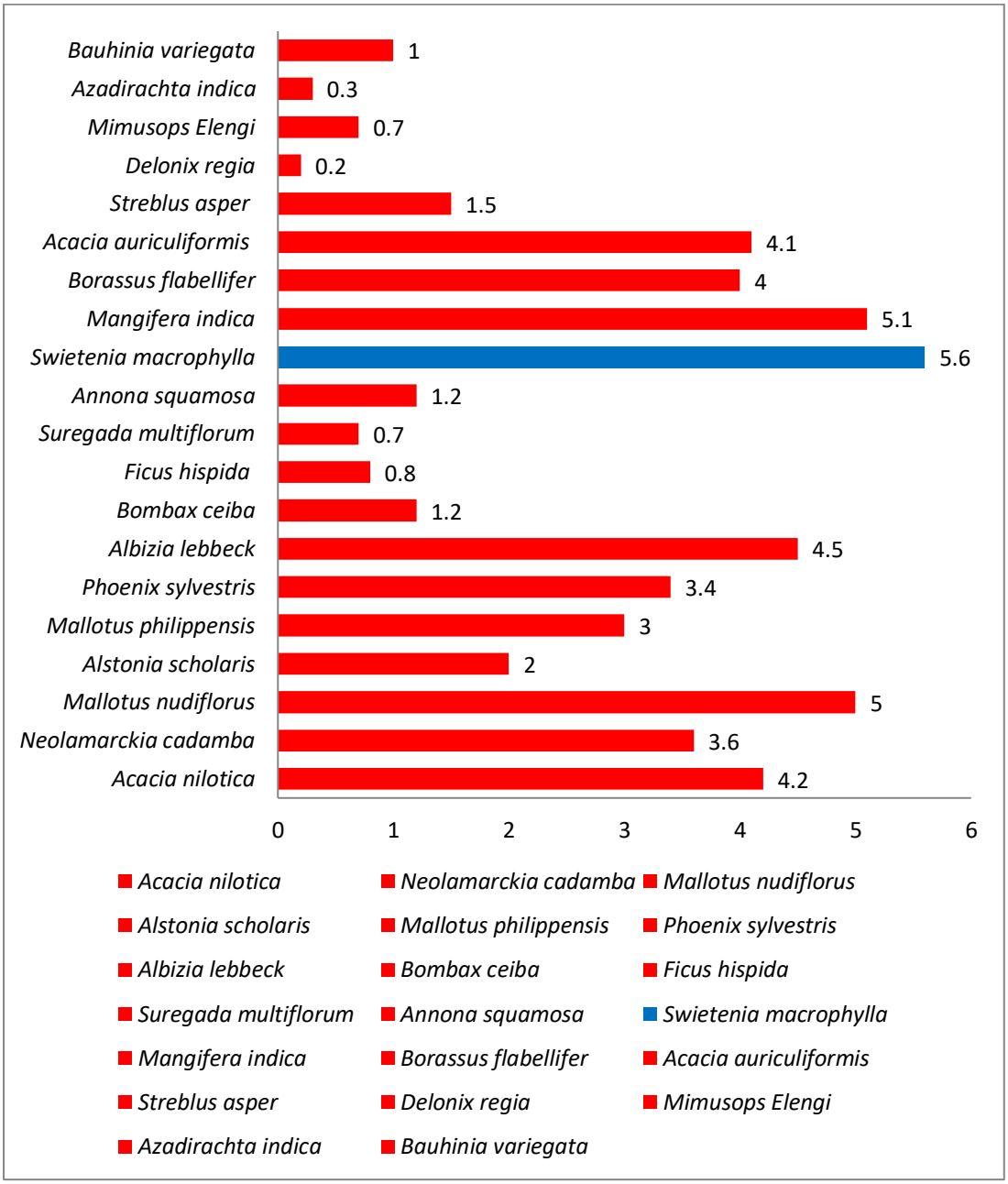
Albizia lebbeck



Swietenia macrophylla

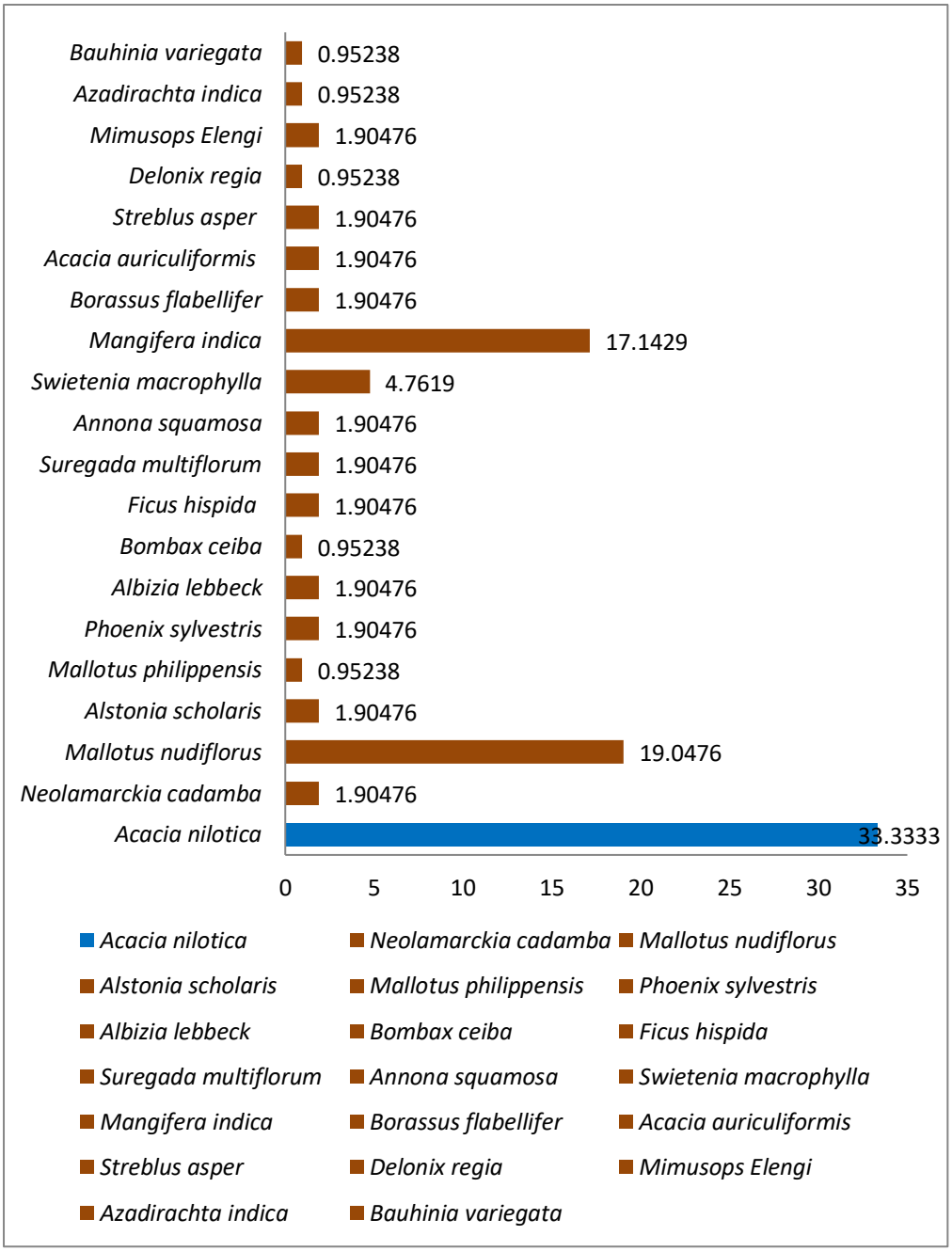
Out of these 20 MTS *Swietenia macrophylla* has shown its highest diameter at breast Height (DBH) (5.6 ft.) followed by *Mangifera indica* and *Mallotus nudiflorus.* (Fig. 1).

Figure 1. Mean DBH of the MTS



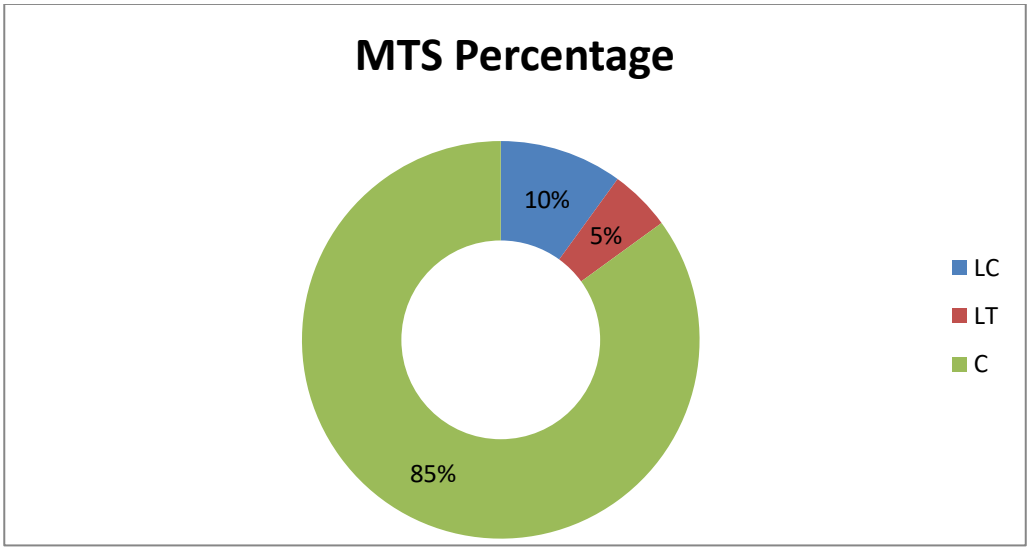
When the frequency percentage of these species was calculated it was observed that the F% of *Acacia nilotica* (33.33%) is highest followed by *Mallotus nudiflorus* (19.04%) and *Mangifera indica* (planted) (Fig. 2).

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



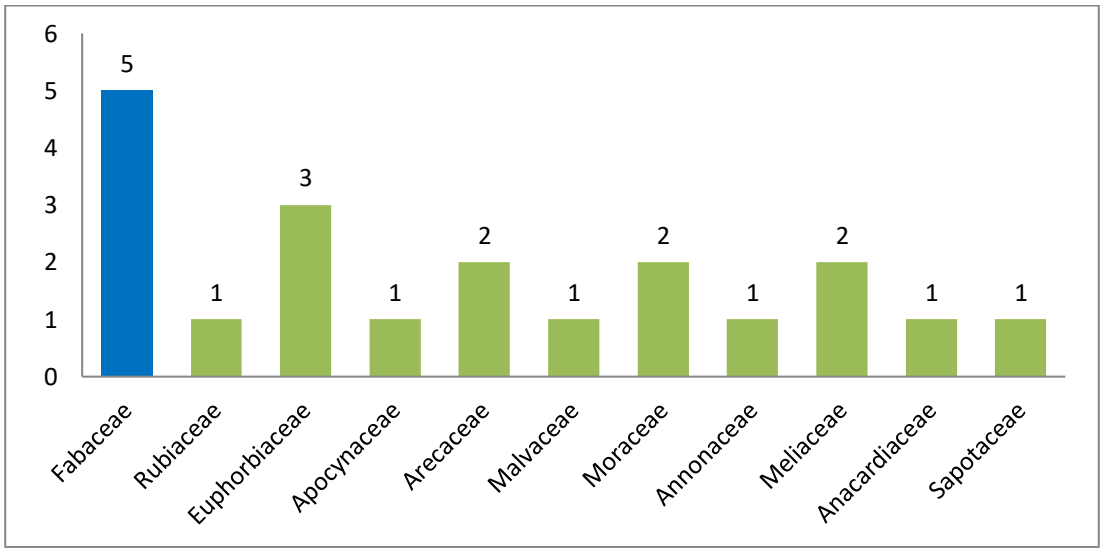
Out of these 20 Major Tree Species (MTS) 5% and 10% of them are locally threatened and less common in these region respectively (Fig. 3). Rest of the species represents the local tree diversity of this ecological region.

Figure 3. Local status of the MTS



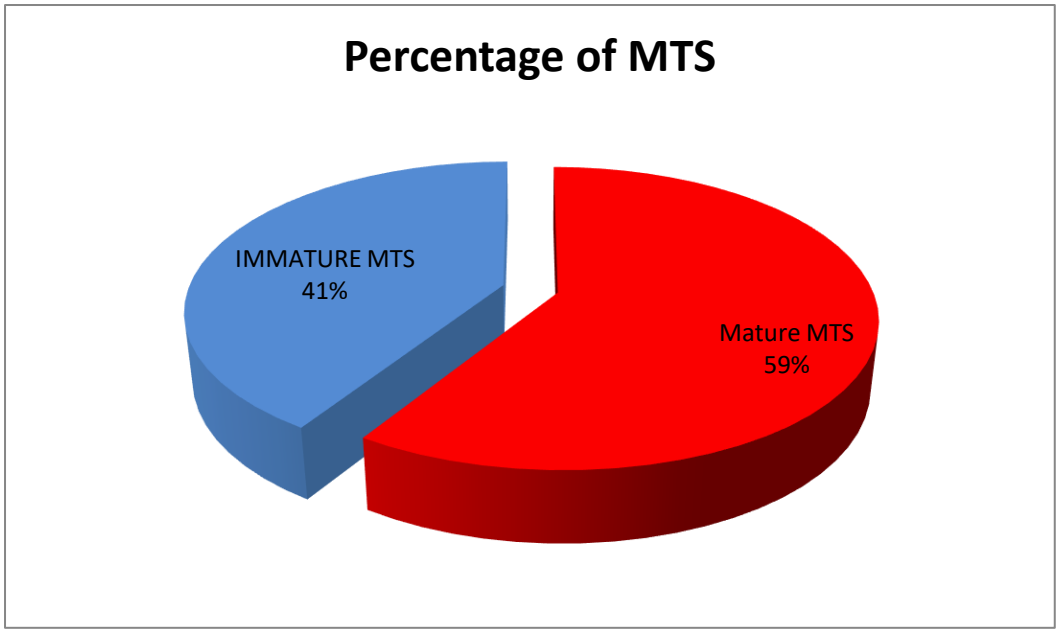
Out of 11 families under which these 20 MTS belongs from, Fabaceae is the most dominant family (5 species of MTS belongs from this family). Fabaceae was followed by Euphorbiaceae in this respect (3 species belongs from this family) (Fig 4).

Figure 4. Number of Genus under different Taxonomic Family



It was noted that 59.53 % of the MTS achieved their phenological stage which represents 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)

$$\mathbf{D = 1 - (\sum n(n-1)/N(N-1))} \ldots\ldots\ldots\ldots\ldots\ldots \text{(EQ-1)}$$

It was observed that the diversity of MTS in the Asannagar Madan Mohan Tarkalankar College campus was very high (**D =0.175**) which depict the importance of the green belt of the college campus in local biodiversity conservation.

Diversity of Shrubs in the College Campus

A total of 9 species of shrubby plants were recorded from College Campus which were found to be distributed from 6 different taxonomic families (Table 2). Among shrub plant community Rutaceae, Euphorbiaceae and Malvaceae were the most dominant family (Two species belongs from each of these three families). Some of the shrubby plants such as *Glycosmis pentaphylla,*

Gossypium herbacecum, are very important host and nectar plants for butterflies and took important role of its conservation and sustenance in the college campus.

Table 2 Diversity and Local status of shrubby plants in the college campus

Sl. No	Shrub Species	Family
1	*Clerodendrum infortunatum*	Lamiaceae
2	*Malachra capitata*	Malvaceae
3	*Xanthium strumarium*	Asteraceae
4	*Glycosmis pentaphylla*	Rutaceae
5	*Croton bonplandianus*	Euphorbiaceae
6	*Gossypium herbacium*	Malvaceae
7	*Citrus sp.*	Rutaceae
8	*Ricinus communis*	Euphorbiaceae
9	*Calotropis gigantea*	Apocynaceae

Study of Herbaceous plant community

To study the herbaceous plant community random quadrats 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 have been plotted and the individuals of each herbaceous species have 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) for each of the MTS was calculated using standard formulas (Table 3).

To know the maximum contribution in the formation of the structure of herbaceous plant community the Importance Value Index (IVI) was estimated for each species. It was found that *Ageratum conyzoides* sown its highest IVI value (183.566) followed by (110.07) and then *Scoparia dulcis* (145.754) (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 3). Species those have high IVI took important role in formation of specific niche for different other flora and fauna in the community.

Table 3. Community structure of herbaceous species

SL. No.	Plant Species	D	F	AB	RD	RF	IVI
Pouzolzia zeylanica	Urticaceae	37.500	37.500	1.000	17.202	3.488	20.690
polygonum lapathifolium	Polygonaceae	75.000	37.500	2.000	34.404	3.488	37.892
oplismenus hirtellus	Poaceae	225.000	62.500	3.600	103.211	5.814	109.025
Mikania scandens	Asteraceae	100.000	37.500	2.667	45.872	3.488	49.360
Colocasia esculenta	Araceae	50.000	25.000	2.000	22.936	2.326	25.261
Achyranthes aspera	Amaranthaceae	175.000	50.000	3.500	80.275	4.651	84.926
Ageratum conyzoides	Asteraceae	387.500	62.500	6.200	177.752	5.814	183.566
Pteris vittata	Pteridaceae.	25.000	25.000	1.000	11.468	2.326	13.793
Eleutheranthera ruderalis	Asteraceae	125.000	50.000	2.500	57.339	4.651	61.991
Evolvulus alsinoides	Convolvulaceae	37.500	37.500	1.000	17.202	3.488	20.690
Parthenium hysterophorus	Asteraceae	225.000	62.500	3.600	103.211	5.814	109.025
Heliotropium indicum	Boraginaceae	50.000	37.500	1.333	22.936	3.488	26.424
Scoparia dulcis	Plantaginaceae	300.000	87.500	3.429	137.615	8.140	145.754
Malus pumila	Rosaceae	87.500	50.000	1.750	40.138	4.651	44.789
Centella asiatica	Apiaceae	125.000	37.500	3.333	57.339	3.488	60.828
Solanum nigrum	Solanaceae	100.000	50.000	2.000	45.872	4.651	50.523
Oxalis sp	Oxalidaceae	150.000	62.500	2.400	68.807	5.814	74.621
Imperata cylindrica	Poaceae	150.000	62.500	2.400	68.807	5.814	74.621
Luffa Cylindrica	Cucurbitaceae	37.500	37.500	1.000	17.202	3.488	20.690
Stephania hernandifolia	Menispermaceae	25.000	25.000	1.000	11.468	2.326	13.793
Nicotiana plumbaginifolia	Solanaceae	162.500	75.000	2.167	74.541	6.977	81.518
Eclipta alba	Asteraceae	75.000	62.500	1.200	34.404	5.814	40.218

In the study it was observed that *Ageratum conyzoides* shown its highest relative density (RD) in the herbaceous plant community throughout the Asannagar Madan Mohan Tarkalankar College campus. In case of RD *Ageratum conyzoides* was followed by *Scoparia dulcis* (Fig. 6). Where as in case of relative Frequency *Scoparia dulcis* was followed by *Nicotiana plumbaginifolia* (Fig. 6). This findings represents a fabulous microhabitat for these species prevailing in the college campus which cover the ground of the open land and create a diverse form of ecological niche for different types of insects.

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

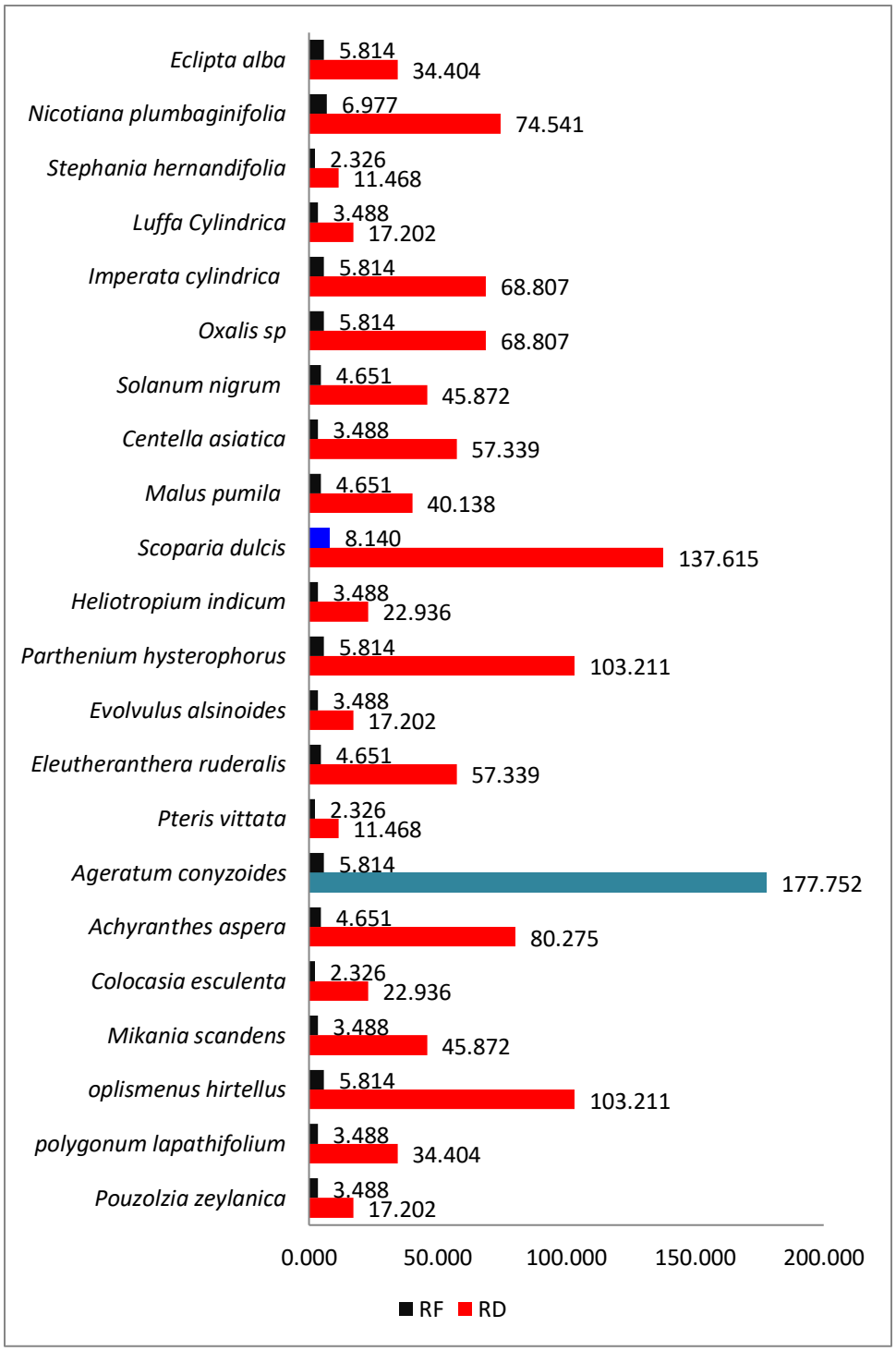
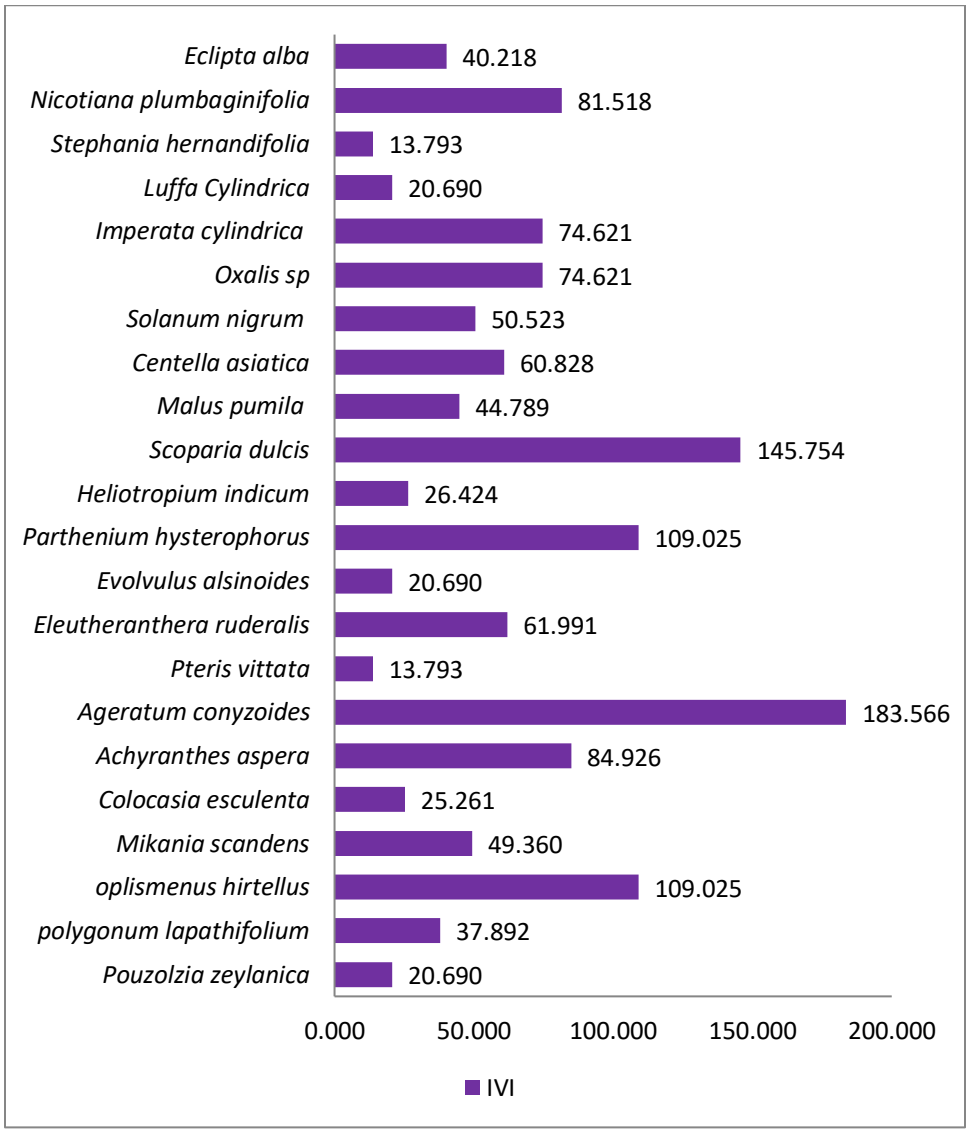


Fig. 7. Importance Value Index (IVI) of the herbaceous plant community



Apart from that a total of 14 different medicinal plants were recorded from the medicinal plant garden situated in the college campus. These 14 species of medicinal plants were found to be distributed under 13 different taxonomic families. Some very important locally threatened medicinal plants such as *Cissus quadrangularis, Stevia rebaudiana, Hemidesmus indicus* were also recorded to be present in a good and healthy condition in the well-maintained medicinal plant garden of the college.

Table 4. Medicinal plants in the college campus

Sl. No	Shrub Species	Family
1	*Cissus quadrangularis*	vitaceae
2	*Stevia rebaudiana*	Asteraceae
3	*Melastoma malabathricum*	Melastomataceae
4	*Andrographis paniculata*	Acanthaceae
5	*Hemidesmus indicus*	Apocynaceae
6	*Piper longum*	Piperaceae
7	*Asparagus sp.*	Asparagaceae
8	*Justicia adhatoda*	Acanthaceae
9	*Cassia sophera*	Fabaceae
10	*Agave sisalana*	Agavaceae
11	*Ocimum tenuiflorum*	Lamiaceae
12	*Hibiscus rosa-sinensis*	Malvaceae
13	*Rhoeo discolor*	Commelinaceae
14	*Gardenia jasminoides*	Rubiaceae

Field identification of different biodiversity components by the expert of INRS jointly with the college teachers

Suregada multiflorum

Ricinus communis

Heliotropium indicum

***Solanum* sp.**

Chrozophora rottleri

Parthenium hysterophorus

FAUNAL DIVERSITY AT ASANNAGAR MADAN MOHAN TARKALANKAR COLLEGECAMPUS

A total of 9 species of butterflies were recorded from the present study. Presence of different host plants like *Glycosmis pentaphylla, Gossypium herbacium* and nectar plants like *Tridax procumbens*, etc. in the college campus and its surroundings may be the reason of this high butterfly diversity (Table 5). The species may be increase if the diversity of butterflies were studied seasonally.

Table 5. Diversity of Butterfly and their common name

Sl. No.	Name of the species	Common name
1	*Papileo demoleus*	Lime Butterfly
2	*Catopsilia pomona*	Common Emigrant
3	*Catopsilia pyranthe*	Mottled Emigrant
4	*Leptosia nina*	Psyche
5	*Cepora nerissa*	Common Gull
6	*Appias libythea*	Striped Albatross
7	*Ariadne merione*	Common Castor
8	*Junonia lemonias*	Lemon Pansy
9	*Junonia almanac*	Peacock Pansy

In the college campus of Asannagar Madan Mohan Tarkalankar College campus of A total of 5 species of Dragon flies were also recorded. Though the species may increase if seasonal study was conducted (Table 6). These groups of insect play an important role in maintaining the ecological balance of the local ecosystem.

Table 6. Diversity of Dragonfly and their common name

Sl. No.	Name of the Species	Common Name
1	*Crocothemis servilia*	Ruddy Marsh Skimmer
2	*Diplacodes trivialis*	Ground Skimmer
3	*Neurothemis tullia*	Pied Paddy Skimmer

4	*Orthetrum Sabina*	Green Marsh Hawk
5	*Pantala flavescens*	Wandering Glider
6.	*Acisoma panprpoides*	Trumpet Tail
7.	*Brachythemis contaminate*	Ditch Jewel

During the study of Green Audit a total of 14 species of Birds has been recorded in and around the college campus and the nest of few species has also been observed. Most of the nest were noticed in the arborescent trees present in the college campus from the High diversity of MTS can be positively correlated with the high bird diversity in the college campus (Table 7). Undisturbed areas of the western side of the college campus with good number of MTS created a fabulous nesting and roosting site of different avifaunal species.

Table 7. Diversity of Birds and their common name

Sl. No.	Zoological Name	English name	Schedule Status in Wildlife Protection Act	Bengali Name
1	*Bubulcus ibis*	Cattle Egret	IV	Go Bok
2	*Ardeola grayii*	Indian Pond Heron	IV	Bok
3	*Corvus splendens*	House Crow	IV	Kak
4	*Oriolus xanthornus*	Black-hooded Oriole	IV	Bene Bou
5	*Dicrurus macrocercus*	Black Drongo	IV	Finge
6	*Copsychus saularis*	Oriental Magpie Robin	IV	Doyel
7	*Acridotheres tristis*	Common Myna	IV	Salik
8	*Dinopium benghalense*	Black-rumped Flameback	IV	Kath thokra
9	*Halcyon smyrnensis*	White-throated Kingfisher	IV	Sada bukh Machranga

10	*Eudynamys scolopacea*	Asian Koel	IV	Kokil
11	*Centropus sinensis*	Greater Coucal	IV	Harichacha
12	*Streptopelia chinensis*	Spotted Dove	IV	Ghugu
13	*Orthotomus sutorius*	Common Tailorbird	IV	Tunyuni
14	*Turdoides striatus*	Jungle Babbler	IV	Chatare

A total of 4 species of wild mammals were noted from the recall data of the college students and staff (Table 6). Presence of different wild habitats in the college surroundings helps to conserve of these locally threatened species.

Table 8 . 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	
3	*Urva edwardsii*	Mongoose	V
4	*Paradoxurus hermaphroditus*	Palm Civet	V
6	*Canis aureus*	Jackal	

Four species of reptiles was also recorded during the study (Table 7). Apart from that, habitat of Snake, Varanus, mongoose and Jackle was also notices in and around the college campus and in the bank of Pond of the second campus of the college.

Table 9. Diversity of Reptiles and their common name

Sl. No.	Zoological Name	English name	Schedule Status in Wildlife Protection Act
1	*Varanus bengalensis*	Monitor Lizard	IV
2	*Ptyas mucosa*	Daras Sap	
3	*Daboia russelii*	Russell Viper	
	Naja naja	Binocellate cobra	IV

Papilio demoleus

Catopsilia Pomona

Orthetrum Sabina

Brachythemis contaminate

Dicrurus macrocercus

Halcyon smyrnensis

Wild habitat for mammals at Asannagar Madan Mohan Tarkalankar College campus

CONCLUSION

The species richness in the college campus is high and the evenness is low. So, in conclusion it may be said that the Asannagar Madan Mohan Tarkalankar College campus is rich in Biodiversity and have huge potentiality to conserve local floral and faunal diversity in the campus area. A large number of wild habitats was also recorded in the present study site where more than 22 species of flowring plants (including herbs, shrubs and climbers) were present. The team of INRC has also recommended the college to conserve those wild patches and notify these local hotspot as "**Keep Wildness in Wild**".

The Green Audit at Asannagar Madan Mohan Tarkalankar 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 Asannagar Madan Mohan Tarkalankar 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

An environmental audit on a college campus is an indispensable initiative that delves deeply into the institution's ecological practices and resource utilization. This comprehensive examination is designed to pinpoint areas where sustainability efforts can be significantly improved, thereby diminishing the campus's environmental footprint and nurturing a pervasive culture of environmental responsibility among students, faculty, and staff. Through meticulous assessment of energy consumption patterns, waste management protocols, water usage efficiency, and transportation options, the audit exposes inefficiencies and offers actionable insights for substantive improvements.

Energy consumption analysis, for instance, involves scrutinizing the use of electricity, heating, and cooling systems to uncover opportunities for increased efficiency and the adoption of renewable energy sources. Waste management evaluation looks at current disposal methods, recycling rates, and potential for reducing single-use plastics, aiming to implement more sustainable practices. Water usage assessment examines consumption patterns, leakages, and the potential for water-saving technologies, ensuring that water resources are used judiciously. Additionally, reviewing transportation options encourages the promotion of greener alternatives such as biking, walking, and public transit, reducing the reliance on fossil fuels.

The implementation of the audit's recommendations can lead to a myriad of benefits. Financially, it can result in substantial cost savings through improved efficiency and reduced resource consumption. Environmentally, it helps the campus adhere to regulatory requirements, avoiding potential fines and enhancing compliance. Furthermore, it boosts the institution's reputation as a leader in environmental stewardship, attracting students, faculty, and partners who prioritize sustainability.

Ultimately, conducting an environmental audit is essential for fostering a healthier, more sustainable campus environment. This endeavor not only benefits the immediate college community by creating a more eco-friendly and efficient campus but also has far-reaching positive effects on the broader ecological landscape. By committing to continuous environmental improvements, the institution sets a powerful example and contributes meaningfully to global sustainability efforts.

The Audit covered the following major areas:

1. Average Foot fall

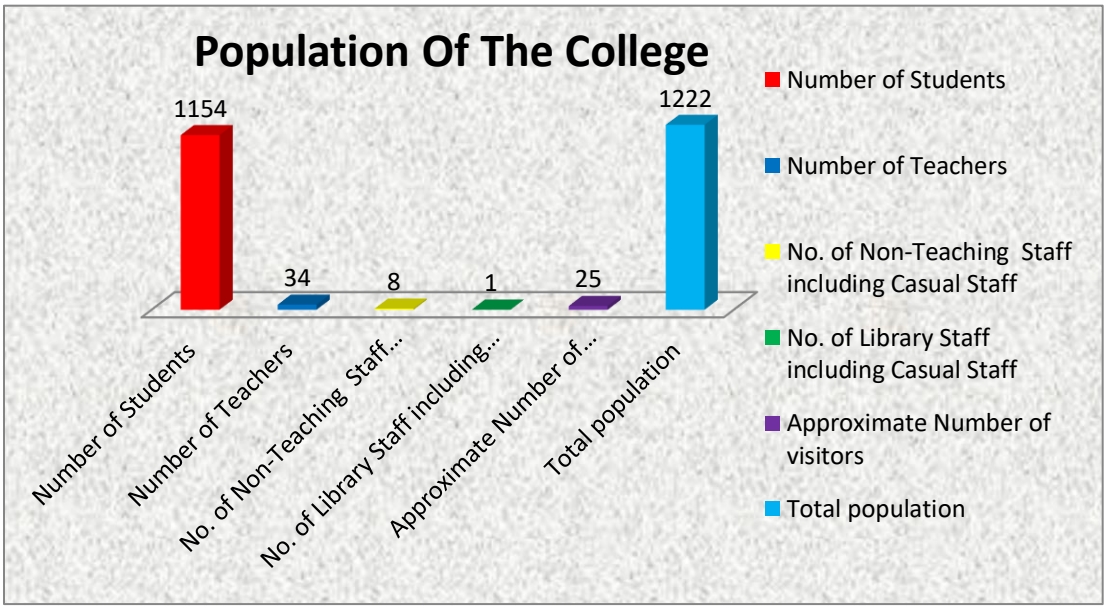
2. Water Efficiency and Water Management
3. Air Quality and Carbon foot print and Management
4. Waste and Waste Management
5. E-waste management
6. Environmental disaster management

1. Total population of the college campus – Foot fall

Number of Students	**1154**
Number of Teachers	34
No. of Non-Teaching Staff including Casual Staff	8
No. of Library Staff including Casual Staff	1
Approximate Number of visitors	25
Total population	1222

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 of Asannagar Madan Mohan Tarkalankar College



2. Water Efficiency and Water Management

Water holds such vital importance for sustaining life that envisioning existence without it is simply inconceivable. India, comprising 16% of the global population, possesses access to a mere 4% of the world's water reservoirs, and this fraction is dwindling swiftly. Freshwater is progressively becoming scarcer, particularly for routine tasks like drinking, bathing, and washing. Across numerous bustling cities worldwide, water scarcity serves as a catalyst for conflict, tension, and assorted disruptions. Hence, the efficient management of water resources emerges as an urgent imperative.

Effective water management on college campuses extends beyond immediate environmental benefits and cost savings. It cultivates a culture of sustainability that influences the broader community. Educational institutions have a unique position to lead by example, demonstrating how thoughtful resource management can coexist with high standards of living and learning.

Water efficiency on college campuses involves implementing measures that reduce the amount of water used without compromising the needs of the community. This includes installing water-saving fixtures such as low-flow toilets and faucets, using drought-resistant plants in landscaping, developing infrastructure to capture and utilize rainwater and employing advanced irrigation systems that minimize water use. By adopting these practices, colleges can significantly cut down on their water consumption, leading to substantial cost savings and reduced environmental impact.

One of the key advantages of prioritizing water efficiency is the educational value it provides. When students witness and participate in sustainability initiatives, they gain practical knowledge and a deeper understanding of environmental issues. This hands-on learning equips them with skills and awareness that they carry into their future careers and personal lives, fostering a new generation of environmentally conscious leaders.

Moreover, the integration of water management practices into campus life supports interdisciplinary learning and research opportunities. Students from various fields such as environmental science, engineering, urban planning, and public policy can collaborate on projects that address real-world water challenges. This not only enriches their academic experience but also contributes valuable insights and innovations to the college's sustainability efforts.

Colleges can also leverage their water management success to build partnerships with local governments, non-profits, and businesses. By sharing best practices and collaborating on joint initiatives, these partnerships can amplify the impact of water conservation efforts. Furthermore,

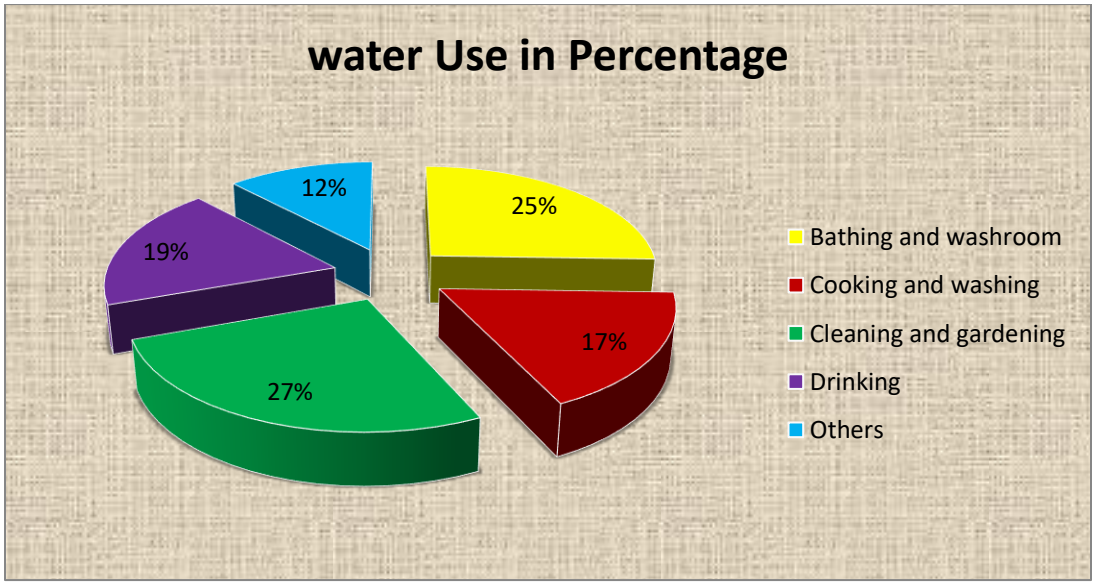
campuses can act as testing grounds for new water-saving technologies and strategies, providing a proving ground for solutions that can be scaled to larger communities.

In conclusion, water efficiency and effective water management on college campuses are critical not only for environmental and economic reasons but also for their educational and societal impact. By implementing sustainable practices and fostering a culture of conservation, colleges can reduce their water footprint, save costs, and serve as powerful examples of responsible stewardship. These efforts help shape environmentally responsible individuals who will contribute to a sustainable future, ensuring that the principles of water conservation and management extend beyond the campus into the broader world.

Use of water in Different Purpose of Asannagar Madan Mohan Tarkalankar College Premises

Use of water in Different Purpose Per Day	Use in Percentage
Bathing and washroom	25.50
Cooking and washing	17.50
Cleaning and gardening	26.50
Drinking	18.50
Others	12

Percentage Of Use Of Water At The Campus Of Asannagar Madan Mohan Tarkalankar College



At this college Maximum percentage of water was found to be used in cleaning and Gardening (27.00%) followed by Bathing and Washroom (25.00%). 19.00% of the total used water is used for drinking purpose after proper purification. Though a few amount was drained out in this process.

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%

Following examinations utilizing Water pH meters and TDS meters, we've established that the drinking water quality on campus is excellent for human health, earning a high rating (H) for Water Quality. However, our observations reveal a deficiency in operational Rechargeable units and a lack of water harvesting plants in the campus area. Moreover, there are shortcomings in managing water reuse and utilizing surface water within the campus premises. As a result, the effectiveness of the current water management policy is evaluated as Low (L).

3. Air Quality and Carbon Footprints:

In the pursuit of fostering a healthy and sustainable environment, evaluating air quality on college campuses becomes a crucial component of environmental audits. The importance of air quality assessments extends beyond protecting the well-being of campus inhabitants to promoting responsible environmental stewardship.

Within the dynamic ecosystem of a college campus—marked by diverse activities, facilities, and transportation systems—air quality assessments gain heightened significance. The close proximity of academic buildings, dormitories, laboratories, and recreational areas increases the potential for pollutant emissions and demands vigilant monitoring.

Poor air quality poses various health risks to students, faculty, staff, and visitors, including respiratory ailments, cardiovascular diseases, and the exacerbation of existing health conditions. Moreover, it negatively impacts the surrounding environment, affecting flora, fauna, and overall ecosystem health.

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

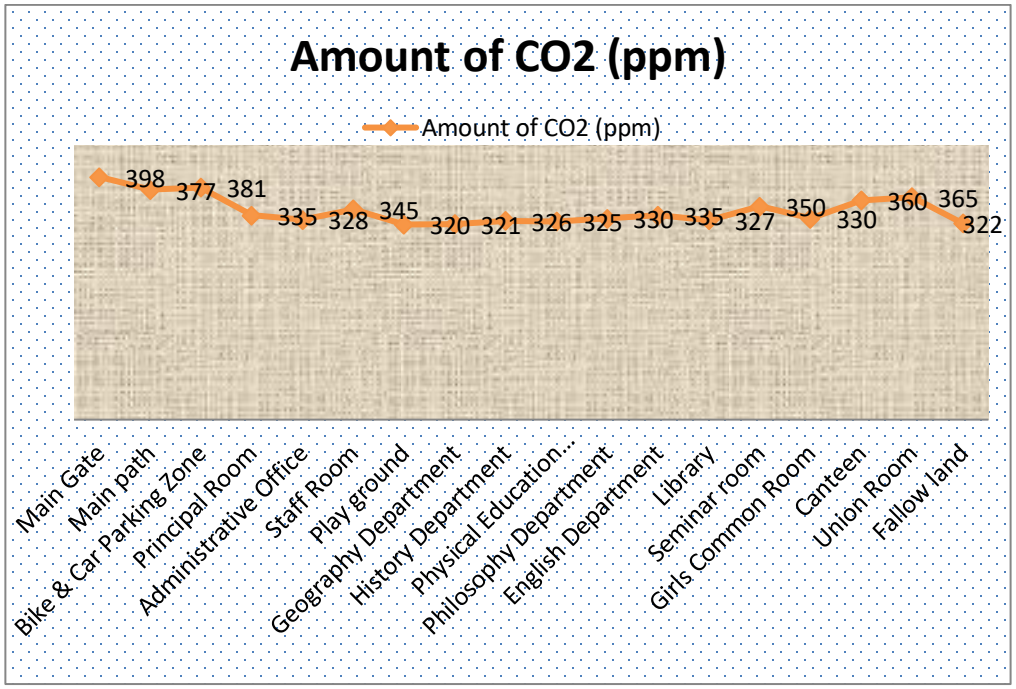
Different location of the college campus	Amount of CO2 (ppm)
Main Gate	398
Main path	377
Bike &Car Parking Zone	381
Principal Room	335
Administrative Office	328
Staff Room	345
Play ground	320
Geography Department	321
History Department	326
Physical Education Department	325
Philosophy Department	330
English Department	335
Library	327
Seminar room	350
Girls Common Room	330

Canteen	360
Union Room	365
Fallow land	322

The presence of carbon dioxide (CO2) in the air serves as an indicator of air quality within a specific area and is directly linked to human health. Assessing air quality holds particular importance in areas with high levels of foot traffic, such as schools, colleges, and universities. Elevated levels of CO2 can lead to various health issues including headaches, fatigue, stuffiness, poor concentration, increased heart rate, and nausea.

At Asannagar Madan Mohan Tarkalankar College, we conducted CO2 level assessments at various locations using atmospheric CO2 measurements. Our observations revealed that CO2 levels are low at the playground, but higher near the Main Gate. However, it is important to note that despite these variations, the CO2 levels remain within permissible limits for human health.

Amount of Co_2 at Different Site of Asannagar Madan Mohan Tarkalankar College



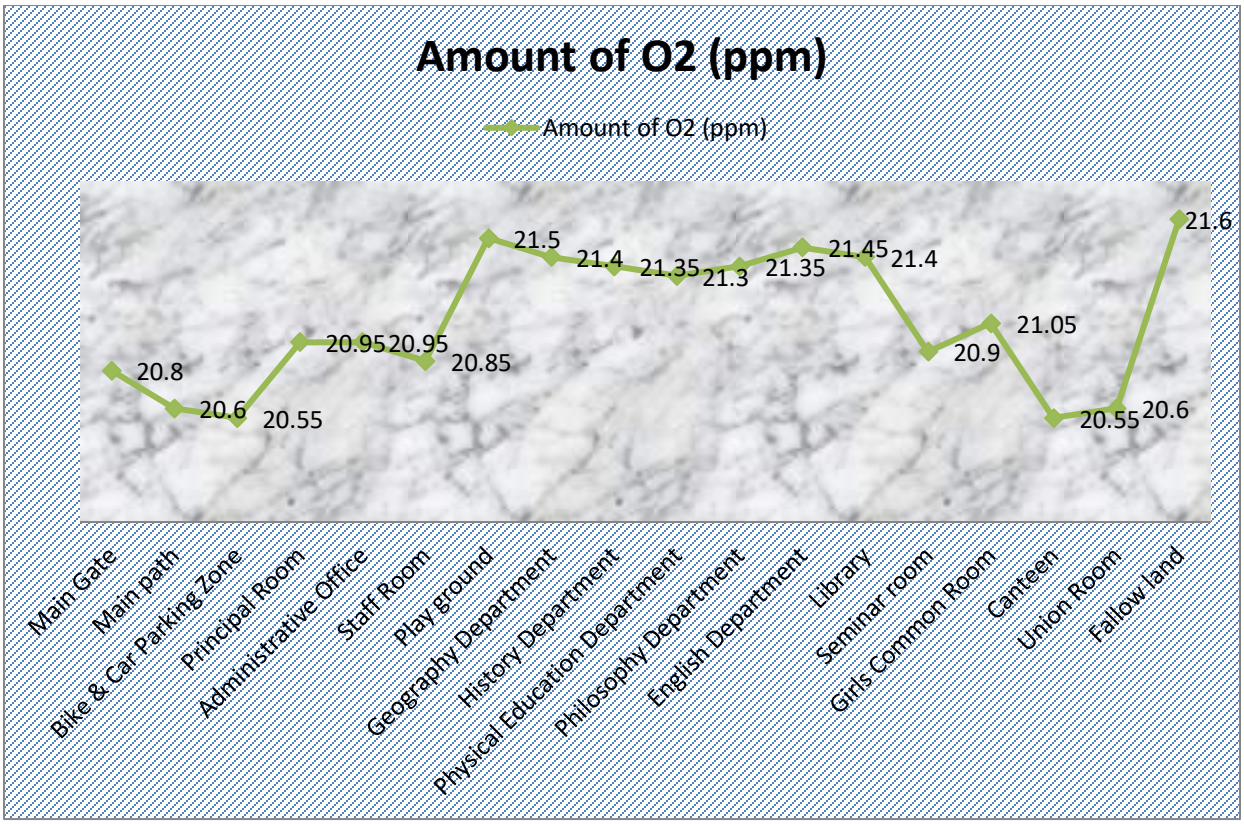
In the typical atmosphere near the Earth's surface, oxygen constitutes 20.9% of the volume. However, safety regulations established by the Occupational Safety and Health Administration and various confined-space guidelines require an atmospheric oxygen concentration of at least 19.5% for safe entry into such spaces. At Asannagar Madan Mohan Tarkalankar College, atmospheric oxygen levels range from 20.55% to 21.60%. The highest concentrations were recorded at the playground and fallow land, while the lowest levels were observed at the canteen and car parking zone. Oxygen levels are influenced by the number of people in a confined space, decreasing with higher congestion and increasing with proper ventilation and open areas. Overall, the oxygen levels at Asannagar Madan Mohan Tarkalankar College, are moderately high and do not pose any adverse effects on 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	20.80
Main path	20.60
Bike &Car Parking Zone	20.55
Principal Room	20.95
Administrative Office	20.95
Staff Room	20.85
Play ground	21.5
Geography Department	21.40
History Department	21.35
Physical Education Department	21.30

Philosophy Department	21.35
English Department	21.45
Library	21.40
Seminar room	20.9
Girls Common Room	21.05
Canteen	20.55
Union Room	20.60
Fallow land	21.60

Amount OfO_2 At Different Site Of Asannagar Madan Mohan Tarkalankar College



4. Generation of Waste and Waste Management

In every facet of human activity, waste generation is inevitable, making its management essential for environmental stewardship and sustainable development. Understanding waste generation and implementing effective waste management strategies are crucial to mitigating its negative effects on the environment and human health.

Waste consists of materials discarded after their primary use, while by-products are co-produced materials with minor economic value. Though transforming waste into valuable resources through innovative methods is possible, pollutants—waste substances introduced into ecosystems—pose significant challenges. These pollutants degrade air, water, soil, and food quality, impacting both human and non-human well-being.

From household waste to industrial byproducts and agricultural residues, waste generation encompasses a broad range of materials, posing significant global challenges. Additionally, evolving consumption patterns, technological advancements, and economic development further complicate waste management efforts by altering waste compositions.

Effective waste management involves systematic methods for the collection, transportation, treatment, and disposal of waste, aimed at minimizing environmental pollution, conserving resources, and safeguarding public health. Various approaches, including recycling, composting, landfilling, and waste-to-energy technologies, address different waste streams and their environmental impacts.

Amid concerns over resource depletion, pollution, and climate change, sustainable waste management is imperative. Innovative solutions, collaborative partnerships, and proactive policies are needed to foster a resilient and resource-efficient society.

Within the dynamic environment of college campuses, waste generation and management present unique challenges and opportunities. From food waste to electronic waste, campuses witness diverse waste streams that reflect the consumption patterns of students, faculty, and staff.

Effective waste management on college campuses involves a comprehensive approach that includes waste reduction, recycling, proper disposal of hazardous materials, and the promotion

of sustainable consumption practices. It also serves as an opportunity for education and engagement, fostering environmental responsibility among students and the wider campus community.

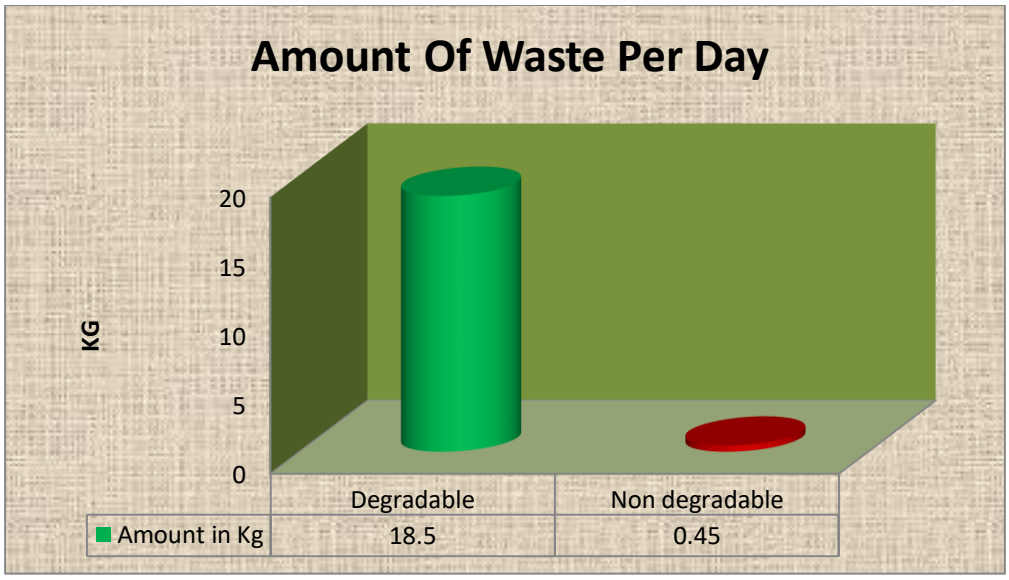
In conclusion, waste management encompasses processes to handle waste from its origin to disposal, addressing health concerns and promoting sustainability. Addressing waste generation on college campuses requires a comprehensive approach to reduce environmental impact and promote sustainability.

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:

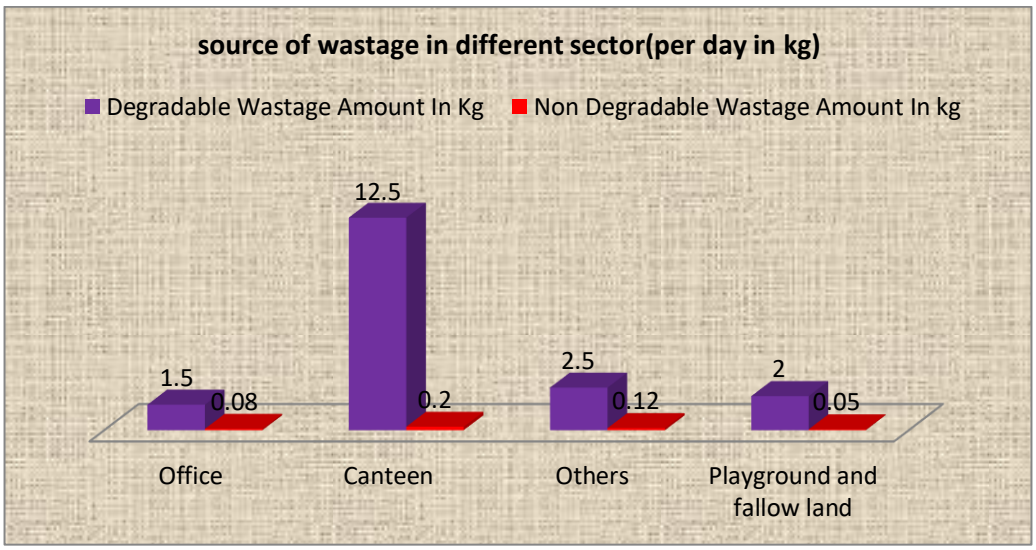
Type of Wastage in Per Day	Amount in Kg
Degradable	**18.5**
Non degradable	**0.45**



Source of Wastage in Different Sector (per day in Kg):

Source of Wastage in Different Sector(per day in Kg)	Degradable Wastage Amount In Kg	Non Degradable Wastage Amount In kg
Office	**1.5**	**0.08**
Canteen	**12.5**	**0.20**
Others	**2.5**	**0.12**
Playground and fallow land	**2.0**	**0.05**

Source of Wastage in Different Sector (per day in Kg):



Performance audit of waste issues:

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

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

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

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

- No e waste management in the college was recorded
- No such disaster management cell and infrastructure was noted at the Asannagar Madan Mohan Tarkalankar College

Energy Audit

Introduction: A comprehensive assessment involves a detailed review of power usage within a facility, aiming to reduce energy consumption. It requires examining methods and systems to lower energy use while maintaining functionality. Recommendations for various strategies to enhance energy efficiency are provided. With conventional energy sources like fossil fuels dwindling, there is a need to seek alternatives and prioritize energy conservation. The primary goal is to deliver products or services at the lowest possible cost while minimizing environmental impact. Conducting an energy audit helps identify potential savings, understand fuel usage patterns, pinpoint inefficiencies, and uncover opportunities for improvement. It is crucial for educational institutions to implement sustainable energy-saving practices. The audit process includes designing surveys, inspecting facilities, reviewing records, conducting interviews, analyzing data, taking measurements, and providing recommendations. Energy assessment evaluates the potential for energy savings, management practices, and alternative

energy options. Specific objectives include evaluating sustainability management systems and ensuring compliance with regulations. The results of the audit significantly affect operational costs and environmental impact. Initiatives like the Energy Conservation Building Code and the Bureau of Energy Efficiency promote energy-efficient practices. Energy ratings and labels enable consumers to make informed decisions. The Energy Audit serves as a benchmark for energy management, helping to develop more efficient strategies. It is a systematic evaluation of energy sources aimed at protecting the environment and conserving natural resources. At Asannagar Madan Mohan Tarkalankar College comes under Kalyani University, the audit begins with identifying, measuring, recording, reporting, and analysing energy components. One of the easier available options for survival is 'Energy Conservation' thereby saving environment and cost reduction through strategic energy management. It also gives a positive orientation to energy cost reduction, preventive maintenance, and quality control programs. This is the translation of conservation ideas into reality by blending techno- economically feasible solutions within a specified time frame. In this college, solar panel (20 KVA) has been installed earlier.

Need for an Energy Audit: In every organization, the three main operational expenses typically include energy (both electrical and thermal), labour, and materials. Among these, energy consistently stands out as a critical factor in cost management and potential savings, making energy management essential for cost reduction. An Energy Audit is crucial for comprehending energy and fuel usage within an industry, identifying inefficient areas and those with potential for improvement. It provides insights that help reduce energy costs, enhance preventative maintenance, and refine quality assurance programs, all vital for manufacturing and utility operations. This examination allows for a detailed analysis of energy cost variations, energy supply reliability, decisions regarding energy sources, identification of energy-saving strategies, and retrofitting for energy-efficient equipment. Essentially, the Energy Audit translates conservation ideas into practical solutions, offering technically feasible recommendations that consider financial and organizational factors within a specific timeframe. The primary goal is to develop strategies for reducing energy consumption per unit of product output or lowering operational costs. Serving as a benchmark, the Energy Audit lays the foundation for managing energy within the organization and sets the stage for planning more efficient energy use throughout the establishment. The concept of an environmentally conscious campus

emphasizes efficient energy use and conservation, aiming for sustainable savings. It also focuses on reducing carbon emissions, involves calculating the carbon footprint, encourages procuring energy-efficient equipment for cost-effective and safe energy supply, promotes energy conservation in all buildings, aims to reduce overall energy consumption, decrease waste sent to landfills, and integrates environmental considerations into contracts and facilities with significant environmental impact. Evaluating Energy Management through audits focuses on energy savings and potential opportunities. While energy itself is intangible, its presence is evident in wires, pipes, and other materials through observable effects like heat, light, and efficiency. Energy management evaluations cover energy consumption, sources, monitoring, lighting, transportation, electrical devices, and distribution. Energy use is a crucial aspect of campus sustainability, requiring inclusion in evaluations without further elaboration. Despite the widespread use of energy, attention to energy-saving potential remains crucial. For example, a traditional incandescent bulb uses 60W to 100W, whereas an energy-efficient LED uses less than 10W, highlighting significant energy savings. Energy auditing is essential for conservation efforts and the adoption of techniques to reduce consumption, thereby mitigating environmental damage. Moreover, audits provide valuable recommendations and suggestions for effective energy-saving practices. Environmentally aware institutions are encouraged to review their energy practices at least once every two years, using both internal and external auditors. Conducting energy assessments, facilitated by both internal and external auditors, plays a significant role in organizational energy management. These assessments effectively evaluate the energy potential within an establishment, identifying more efficient methods to reduce environmental impact.

Aims and Objectives of an Energy Audit: An energy audit is a vital tool for developing and implementing comprehensive energy management plans within an organization. Its primary objective is to systematically identify opportunities for improving energy efficiency, conservation, and cost savings at the audit site. The evaluation process includes the following steps:

1. Assessing the energy-saving initiatives and measures currently implemented at the audit locations.

2. Identifying various opportunities for energy conservation measures and additional paths for financial savings.
3. Exploring alternative energy sources to gauge potential energy savings and guide decision-making in energy management.
4. Providing technical advice on establishing an energy balance and presenting precise, application-oriented recommendations.
5. Conducting a thorough examination of energy consumption, analyzing recent electricity bills for the site, and understanding the tariff structures offered by central and state electricity boards.
6. Enumerating the various ways energy is consumed, including electricity for devices such as stoves, ovens, microwaves, and other sources like LPG, diesel, and beyond.
7. Evaluating the use of different devices and equipment, including incandescent (tungsten) bulbs, CFL bulbs, fans, air conditioners, cooling devices, heaters, computers, photocopiers, inverters, generators, and laboratory equipment. This assessment involves calculations based on factors such as wattage and duration of use (e.g., 60-watt bulb x 5.5 hours x number of bulbs = kWh).
8. Assessing the adoption of non-traditional energy sources/alternative energy sources within the organization, such as solar panels for solar power, energy-efficient devices, biogas, etc. Additionally, initiating efforts to raise awareness among stakeholders about energy conservation and efficient use.

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

Methodology and Survey Schedules: To conduct an energy assessment, a diverse array of approaches is employed at the inspection sites, primarily focusing on a comprehensive site survey. This process involves aligning extensive energy inputs with overall energy outputs and mapping all energy flows within a facility. Physical validation of various components, including lighting, roofing, workstations, ventilation fans, cooling systems, solar panels, heaters, generators, uninterruptible power supply units, and air circulation mechanisms, occurs

during the assessment. This entails verifying the effectiveness of deployed energy-efficient frameworks. The examination emphasizes analysing the costs or potential financial savings associated with each of these elements, with energy consistently emerging as a critical area for cost reduction. Energy management is essential for achieving cost-saving objectives. Additionally, the energy bill from the utility company is collected for review. This evaluation involves assessing load requirements and efficient energy usage. Stakeholders participate in the assessment to explore opportunities for improving energy management. Potential areas for energy conservation and cost-saving measures are identified and recommended for implementation within the facility. Energy assessments can be categorized as follows: I. Initial Energy Assessment II. Comprehensive Energy Assessment III. Scope and Scale of Energy Assessment IV. Detailed Energy Assessment.

Survey Form for data collection:

- List the methods through which energy is utilized by the college (Electricity, electronic ranges, cooking utensils, microwaves, LPG, timber, petrol, diesel, and others).
- Synopsize the total electric invoices for the prior two/three years.
- Log the overall expenditure on LPG canisters during the antecedent year.
- Compute the expense of petrol/diesel/alternative fuels for power generators.
- Specify the quantity of CFL bulbs installed and detail their operational lifespan.
- Ascertain the energy consumed by each bulb on a monthly basis.
- Identify the count of LED bulbs utilized within college premises (with specified operational duration).
- Tally the number of incandescent (tungsten) bulbs affixed.
- Aggregate the quantity of fans in operation (with specified operational lifespan).
- Document the count of air conditioners in operation (Hours used per day, for how many days monthly).
- Compute the energy consumed by each electronic device monthly (kWh).
- Outline the number of operational computers and their usage (Hours used per day, for how many days monthly).
- Specify the quantity of photocopiers installed.
- Tally the number of cooling devices affixed.
- Determine the energy consumed by each inverter on a monthly basis (kWh).

- Enumerate the number of electronic appliances utilized in various laboratories along with their power ratings.
- Detail the usage of heaters in the cafeteria (with usage details, hours used per day, and number of days monthly).
- Validate if any alternative energy source modules are installed and provide detailed specifications.
- Confirm whether computers and additional devices are configured to energy-saving mode.
- Identify whether machines (TVs, ACs, computers, weighing scales, printers, etc.) frequently operate on standby mode and specify the duration in hours if applicable.
- Summarize the energy conservation methods adopted by the college.
- Calculate the number of displays advocating energy conservation awareness.

To assess the ecological impact, CO_2 levels were measured at different locations across the campus using a portable CO_2 analyser. This assessment aimed to evaluate the carbon footprint and identify areas with significant carbon emissions, providing valuable insights for reduction strategies. The university's energy bill was scrutinized and analysed to understand kilowatt-hour (kWh) requirements and the effectiveness of energy usage. Engaging with diverse stakeholders was crucial in familiarizing them with energy assessment procedures, ensuring a successful and results-oriented energy review. Opportunities for energy conservation and cost savings were identified during the examination, laying the groundwork for potential implementation steps. The evaluation methodology involved gathering information through various channels, including on-site visits, collaborative discussions, campus surveys, inquiries, observations, perception analyses, and feedback. All these elements contributed to the comprehensive assessment report

Detailed Energy Audit Methodology: A thorough analysis formulates a comprehensive energy management plan for a facility by scrutinizing all significant energy-consuming systems. This kind of analysis offers the most accurate evaluation of both energy efficiency and costs. It takes into account the combined impact of all measures, considers the energy usage of key equipment, and involves precise calculations for both energy savings and project costs. In a detailed analysis, the energy balance is a crucial component, relying on an inventory of energy-

consuming systems, assumptions about current operational conditions, and calculations of energy consumption. This estimated consumption is then compared with utility bill charges. Initial site visits and preparations are critical steps before detailed analysis. A preliminary site visit usually lasts a day, allowing the Energy Auditor/Engineer to interact with relevant staff, become familiar with the environment, and determine the procedures needed for the energy evaluation.

7. Source of Energy: Through the enquiry process it is noted that the mostly used energy source is conventional but institution has taken notable steps to develop non-conventional energy sources in terms of solar energy module and it is found to be nearly 20% of the total unit consumption.

Figure 1. Power house and energy distribution module of Asannagar Madan Mohan Tarkalankar College.

The work was conducted, and the following areas have been covered in the study.

1. Electricity Bill
2. Distribution Network
3. DG Sets
4. Lights, Fans, Projectors
5. Air Conditioning Load
6. Water supply source and distribution

7. Renewable energy possibilities
8. Fire Fighting

Energy Sources:
Electricity is the major energy sources of the college. Electricity is supplied by WBSEDCL. Diesel oil is being used in the DG sets for in-house generation of electricity during power cut.

Energy Consumption
For the Unit / college, the applicable WBSEDCL electrical tariff is in two parts i.e. a fixed cost (Demand Charges) and unit (kWh) rate. The average monthly unit consumption of the college is KVAH and the average monthly electricity bill amount is around Rs. 2772/- (2022- 2023)

DG Sets
There is three DG set Kirloskar make of capacity 15 KVA installed in the college.

Solar Module: The solar panel of (20 KVA) is installed.

Energy Cost:

Total electricity consumption (conventional)- 31191.3 U (80%)

Total electricity consumption (non-conventional)-7797.8 U (20%)

Fossil fuel consumption per year-

Diesel used for green Generator- 220(Approx.) litter

Table 1 represents the percentage use of conventional and non-conventional uses of energy and its corresponding plot is depicted in figure 2.

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

Source of energy	In Percentage
Conventional	**80%**
Non -Conventional	**20%**

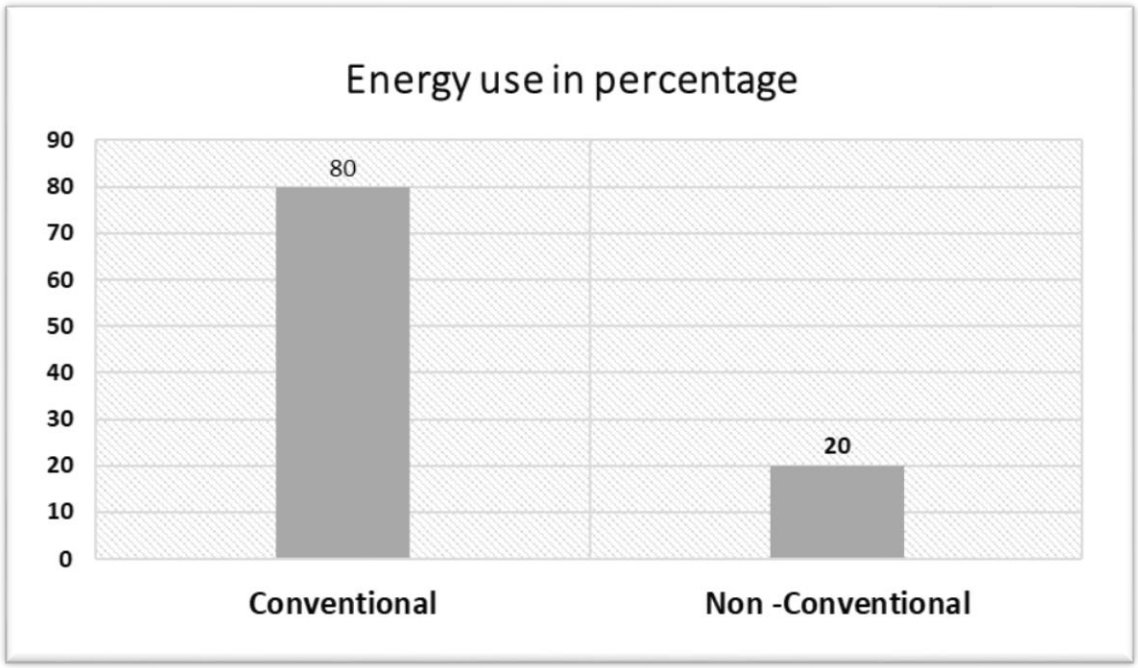


Figure 2. Mode of energy used in college campus (conventional and non-conventional)

Figure 3. D.G and Solar energy module at Asannagar Madan Mohan Tarkalankar College.

Figure 4. LED enabled well-equipped conference hall and A.C., installed at Asannagar Madan Mohan Tarkalankar College.

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

Table 2: The detail calculation of energy consumption.

SlNo	**Particulars**	Power consumption per hour	Quantity	Consumption (KWh/day)
1.	Tube/Bulb light	18W/100W	110	15.56
2.	LED light	09W	45	3.5
3.	Fan	60W	126	9.2
4.	Air Conditioner	1.5/2KW	09	5.5
5.	Computer	550W	21	3.5
6.	Xerox Machine	600W	03	2.0
7.	Printer	600W	08	0.2
8.	Projector	200W	05	0.1
9.	Electric kettle	850W	02	0.1
10.	Vapour Lamp	500W	02	5
11.	Water pump	1KW	03	12
12.	Sound system	50W	04	0.2
13.	R.O Water	10W	01	0.5
14.	Streetlight	50W	02	4.6
15.	CCTV	1W	24	0.4
16.	T.V	60W	01	0.1

17.	CCTV monitor	60W	03	4.3
18.	Water Purifier	220W	05	1.1

Figure 5. Data collection at Asannagar Madan Mohan Tarkalankar College

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

The corresponding plot of energy consumption from calculation is depicted in figure 6.

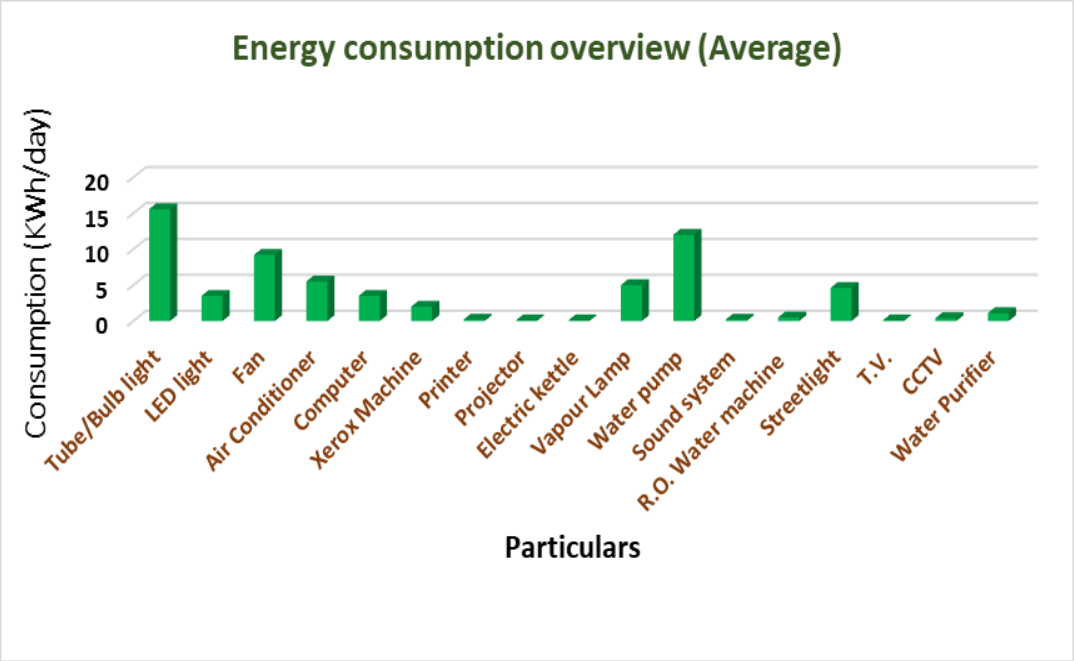
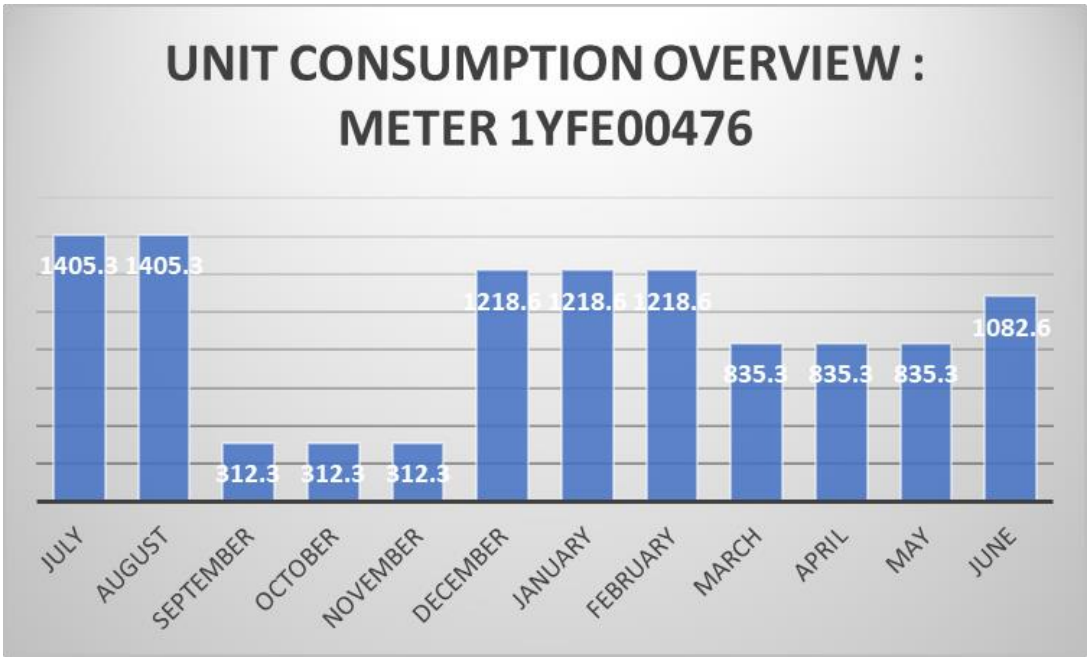


Figure 6: Bar diagram to represent the energy consumption rate.



METER NO- 1: YFE00476	CONNECTED LOAD 11.63KVA
Month	**UNIT**
July	1405.3
August	1405.3
September	312.3
October	312.3
November	312.3
December	1218.6
January	1218.6
February	1218.6
March	835.3
April	835.3
May	835.3
June	1082.6

Figure 7: Unit consumption overview for the academic year 2022-23

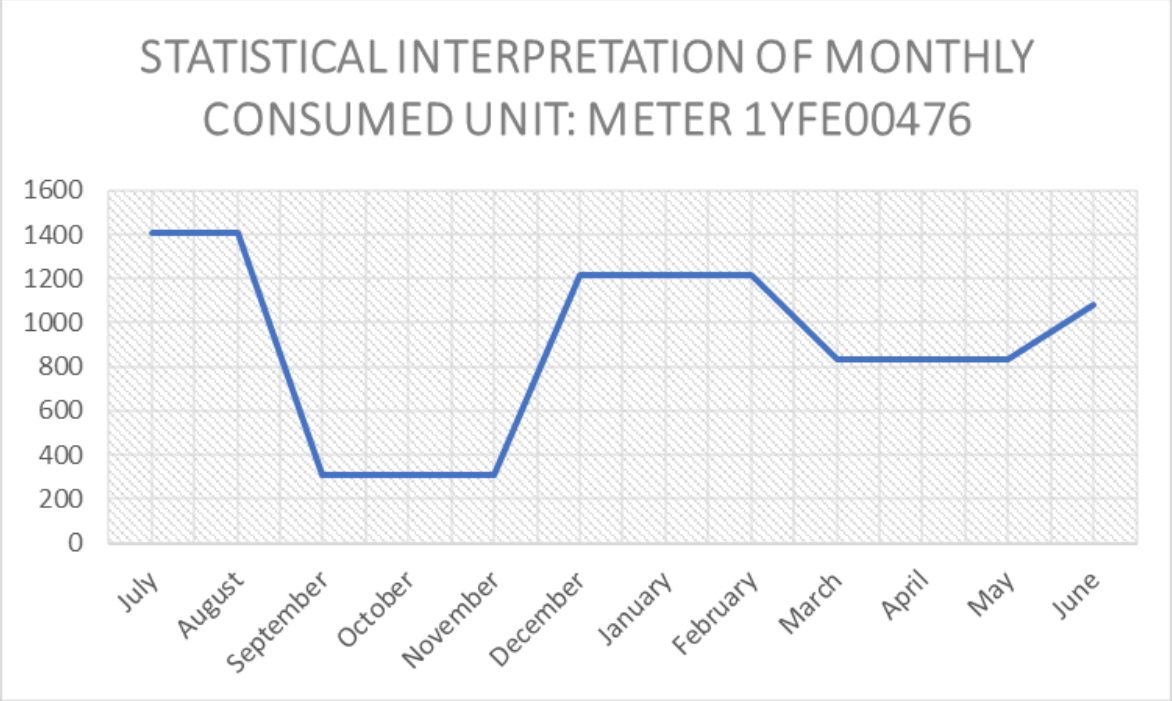


Figure 8. Statistical interpretation of unit consumption for the academic year 2022-23

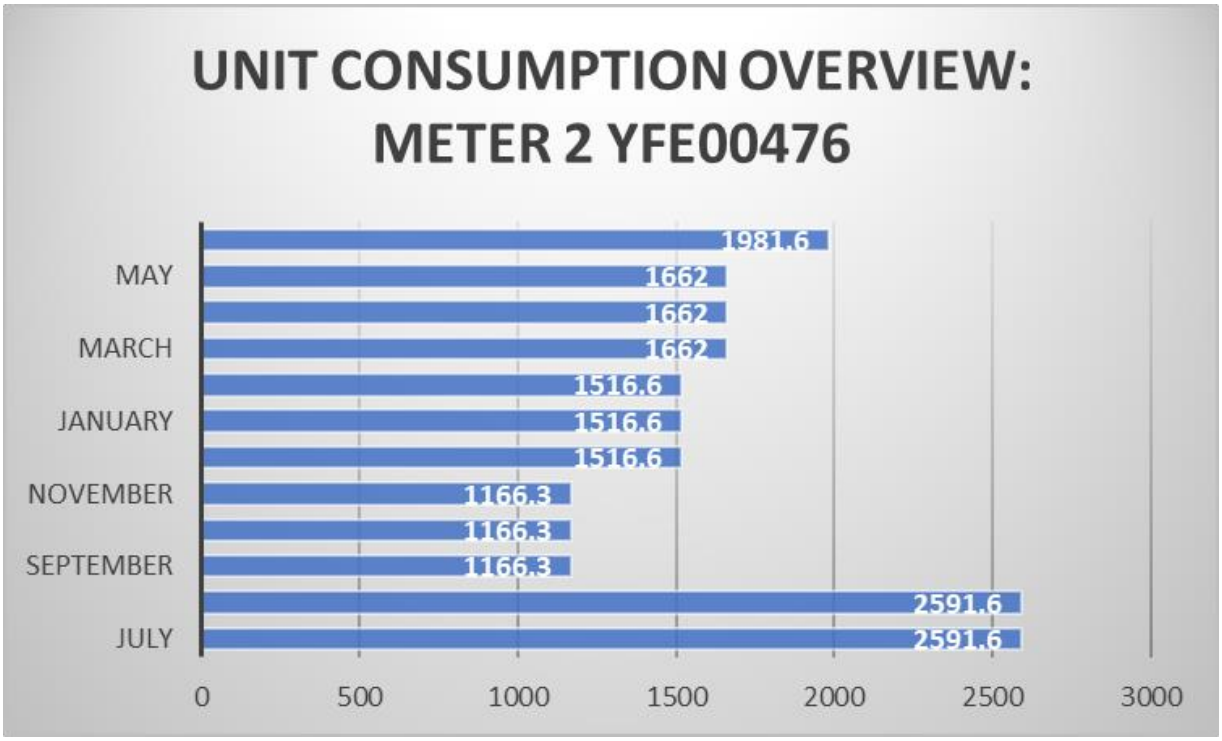


Figure 9. Unit consumption overview for the academic year 2022-23

METER NO- 2: YFE00476	CONNECTED LOAD 11.63KVA
Month	**UNIT**
July	2591.6
August	2591.6
September	1166.3
October	1166.3
November	1166.3
December	1516.6
January	1516.6
February	1516.6
March	1662
April	1662
May	1662
June	1981.6

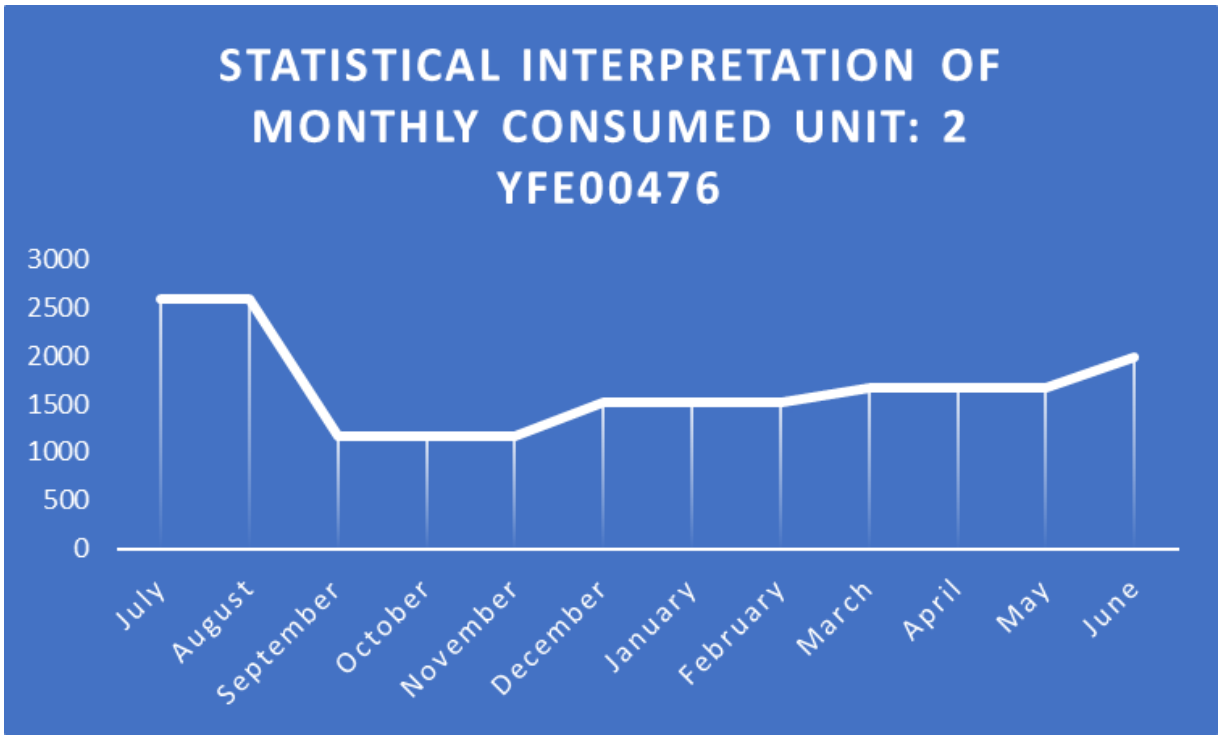


Figure 10. Statistical interpretation of unit consumption for the academic year 2022-23

The amount of CO_2 (ppm) in different places is depicted in table 3 and its corresponding pie diagram is shown in figure 11.

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

Locations inside college	CO2 (ppm) in air
Class room (Sample1)	399
Class room (Sample 2)	400
Class room (Sample 3)	450
Staff Room	465
Office (New)	400
Library	350
Office 2	456
Ground	320
Conference Hall	300
Canteen	680
Parking	356

Thermometer

Solar radiation measuring unit

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

Different instruments to measure CO2 (ppm) in different places

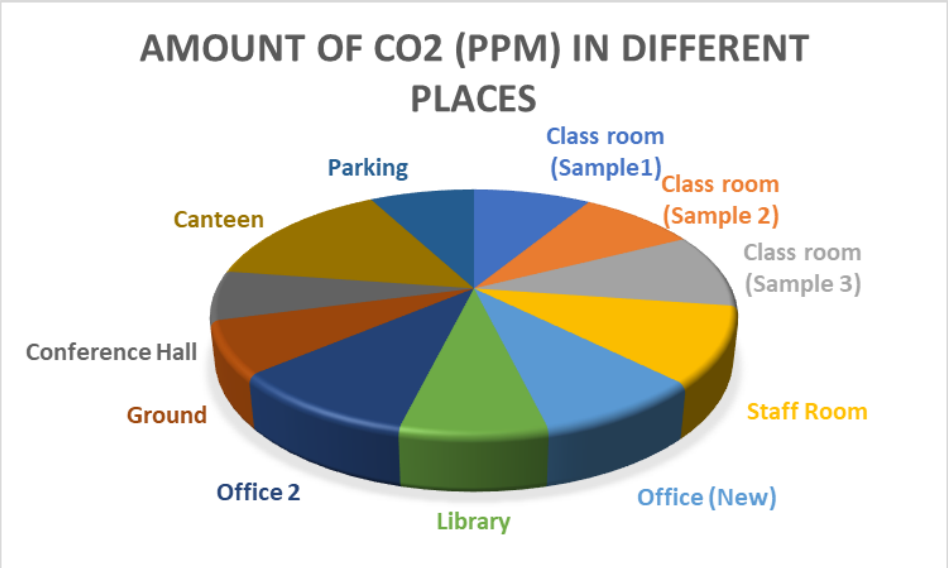


Figure 11. Amount of CO_2 (ppm) of the Air in Different location of the college Premises.

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: = (31191.3 kWh / 1000) x 0.84 = 26.2 metric tons

Note:

- Annual electricity usage: 31191.3 kWh
- 0.84 is the conversion coefficient from kWh to metric ton

Major audit observation:

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

 # H denotes management policy level > 25%

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

 # L denotes management policy level< 15%

Best Practices followed in the Organization

- ✓ Converters, alternators, and battery backup systems are securely enclosed and marked with warning placards displaying 'Caution' and 'Alert' signs.
- ✓ 'Activate' and 'Deactivate' indicators are strategically placed in most areas to encourage energy-saving practices among users.
- ✓ Electrical cables, control panels, and voltage stabilizers are properly insulated to prevent potential hazards to staff and students.
- ✓ LED lights and solar street lights are installed.
- ✓ The energy efficiency ratio is maintained close to unity using Automated Power Efficiency Adjustment (APEA).
- ✓ Variable Frequency Drives (VFDs) are used for elevators and air conditioning units.
- ✓ Outdated monitors and televisions have been replaced with LED screens.
- ✓ Electric vehicles are available on-site.
- ✓ Star-rated equipment is used wherever applicable.

Recommendations on Carbon Footprint in the Organization:

- ➢ Upgrade the kitchen and dining facilities in the dormitory to save gas.
- ➢ Encourage efficient use of generators, inverters, and uninterruptible power supplies (UPS).
- ➢ Foster the habit of turning off lights, fans, air conditioners, devices, and equipment when not in use.
- ➢ Install adequate ventilation and exhaust systems in auditoriums, classrooms, and conference rooms to reduce carbon dioxide levels for students, faculty, and staff.

Conclusions: Given the establishment's renowned reputation and resilience, there is a significant opportunity to enhance energy-saving efforts and move towards self-sufficiency. The organization has already made commendable progress in this area by incorporating energy-efficient lighting, raising stakeholder awareness, and ensuring reliable backup power systems. Additionally, the establishment adheres to strict energy evaluation standards, including properly securing transformers, alternators, and UPS systems with enclosures and warning

signs. Prominent signage promotes energy-saving practices, complemented by diligent electrical infrastructure maintenance, which supports energy conservation efforts and prioritizes the well-being of staff and students. The use of sprinkler irrigation on campus to reduce energy consumption is commendable. However, additional recommendations could further boost the establishment's energy-saving capabilities, leading to a future characterized by an environmentally conscious campus and sustainable community development.

RECOMMENDATIONS

Energy Conservation Proposals

The energy audit provided recommendations for reducing energy costs, implementing preventive maintenance measures, and improving quality assurance activities, all essential for the efficient operation of utilities at the audit locations.

- Consider investing in energy-saving equipment (4-5 star rated) when replacing outdated machinery.
- Install sub-meters in all buildings to monitor energy consumption and usage per building.
- Implement efficient water use and temperature control through automated systems to achieve energy savings.
- Establish continuous monitoring and analysis of energy usage with a dedicated campus team.
- Regularly conduct energy conservation awareness programs (EPA) among stakeholders through unions, societies, assemblies, and departments.
- Encourage the practice of turning off electrical devices when not in use.
- Ensure maintenance and replacement of outdated appliances in all laboratories.
- Activate power-saving mode on computers and electronic devices.

- Set up a biogas plant for the dormitory kitchen and cafeteria.
- Install automatic switches with occupancy sensors in common areas.
- Significantly reduce high monthly electricity consumption in the college through regular energy audits.
- Upgrade old and inefficient fans with new energy-efficient models.
- Consistently monitor equipment in all laboratories and promptly address any issues.
- Offer value-added, informal, certification, or diploma courses on 'Energy and Environment Management Audits' to benefit students and researchers seeking accreditation as Lead Auditors.

Introducing Energy-Saving Circuits for Air Conditioners: These systems intelligently reduce compressor operating time by using timing or temperature variation logic while maintaining human comfort. This innovation can result in electricity savings of 15% to 30%, depending on climatic conditions and temperature settings. With a total of 7 split air conditioners, it is recommended to gradually replace older units with new, energy-efficient models rated 5 Stars by the Bureau of Energy Efficiency (BEE). Considering an average compressor operation time of 5.5 hours per day, this change ensures significant energy savings.

Potential areas for environment management and green development.

- Installation of rain water harvesting units and use of the same for irrigation in garden along with the wash room use and clinging purpose may be done through developing some green project mode which reduce the consumption of ground water to some extent.
- Auto regulating device should be attached with the submersible pump so that overflow of the roof top tank may be checked.
- Auto regulating sprinkler may be installed for adequate irrigation in the medicinal garden even in the summer period.
- A ground water recharge unit may also be installed which may be taken into account by the college authority under a specific environment project mode.

- Some waste water was directly found to be admixed in the natural water bodies through some drainage system which should be carried on after passing through the water treatment plant.
- In each and every floor of the building more separate degradable and non degradable waste been should be installed for proper management of the waste and the degradable waste may be transferred in the plant through which organic fertilizer can be produced and applied as green manure in the medicinal plant garden.
- As the college is situated at lower Bengal and the chance of hitting of cyclone to that area is 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.
- An e-waste management center with proper documentation of the e waste is essential for the proper management of e waste.

For better conservation of Biodiversity

- Some wild habitats in the 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 develop in the pond where wild aquatic plants along with different aquatic wild life like soft skin turtle may be conserved
- Some portion 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.
- A **'Wild Relatives Rescue Center'** may be formed where different wild relatives of the cultivated crops from different families like Cucurbitaceae, Solanace etc. may be rescued from the local vicinities and grow in the centre.
- Name plate of All existing MTS should be done and install for education purpose.