

TECHNICAL AUDIT REPORT

[Green & Energy Audits]



Submitted to
**SRI SARADHA COLLEGE FOR WOMEN,
PERAMBALUR - 621 113, TAMIL NADU,
INDIA**

Date of Audit: 10.03.2023



Submitted by

NATURE SCIENCE FOUNDATION
(A Unique Research and Development Centre for Society Improvement)
[ISO Certified and Ministry of MSME Registered Organization]
No. 2669, LIG-II, Gandhi Managar, Peelamedu
Coimbatore 641 004, Tamil Nadu, India
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Dr. S. RAJALAKSHMI, M.B.A., Ph.D., FNSF.,
Chairman

Mr. P. KANAGARAJ, FNSF.,
Secretary

Certificate of Declaration

The **Office of Nature Science Foundation**, Coimbatore, Tamil Nadu declare that

1. Nature Science Foundation has conducted onsite green audit at **Sri Saradha College for Women, Perambalur, Tamil Nadu, India** by deputing certified Lead Auditors and Technical Experts.
2. On the basis of audit observations by the auditors and pertinent data collected from the Auditee, the Technical Report has been prepared and being submitted.
3. Data presented in the Technical Report are verified and to best of our knowledge, the data are authentic and reliable.
4. Nature Science Foundation declares that data generated were not shared with any third parties and the soft copy of the report is available with Nature Science Foundation's Office till its validity.
5. Provided the Auditee desired to publish or share the data with other agencies, Nature Science Foundation has no conflict of interest.
6. We at Nature Science Foundation express our deep sense of gratitude to the Management for given an opportunity to conduct green audit at their premises in compliance with NAAC criteria and for whole hearted support extended at the time of onsite audit. Our sincere thanks to NAAC, IQAC Coordinator and Head of the Departments of the Organization for their intangible assistance and cooperation extended to the audit team at the time of physical facility verification.

Date:
Place: Coimbatore

Authorized signatory
Nature Science Foundation

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1. GENERAL INTRODUCTION

1.1. Introduction

Green campus is an area of the Organization or the Organization as a whole itself contributing to have an infrastructure or development that is structured/planned to incur less energy, less water, less or no CO₂ emission and less or pollution free environment (Aparajita, 1995). Green Campus Audit is a tool to evaluate environment management system which is systematically executed to protect and preserve the environment. Green campus audit constitutes the environmental friendly practices and education combined to promote sustenance of green environment by adopting user-friendly technology within the campus. It creates awareness on environmental ethics, resolves environmental issues and offers solutions to various social and economic needs (APHA, 2017). It strengthens the concept of “Green Building” and “Oxygenated Building” which in turn provides a healthy atmosphere to the stakeholders.

1.2. Importance of National Building Code

National Building Code of India has a set of rules and guidelines that regulates construction and as well as ecofriendly activities of the campus. In order to achieve the minimum standards of welfare and safety of stakeholders of a campus, the Governing body lays down a set of guidelines to offer sustainable environment. In 1970, the National Building Code (NBC) was first published in India and the significant provisions of the Indian Building Code involve: 1. Structural safety of the building, 2. Earthquake-resistant building design, 3. Fire and life safety, 4. Solid waste management, 5. Accessibility for differently-abled and senior citizens, 6. Use of alternative building techniques and 7. Environmentally compatible building construction techniques like the use of solar power, rainwater harvesting, etc.

National building codes not only offer a standard benchmark that constructors must meet, but they also establish safety standards along with ecofriendly atmosphere of a campus for years to come. As extreme weather conditions and fires are growing rapidly in the country, it becomes vital that buildings and structures be built and designed using the current building codes to allow for maximum safety sustainability and resilience. For instance, new and updated building codes put much emphasis on conservation as energy and the waste is the most expensive byproduct of older regions. This will not only offer environmental benefits to future generations but will also regulate indoor air pollution to protect the health.

Before the introduction of National Building Codes of India in the construction industry, building commercial and residential properties used a lot of energy which adversely affected the environment. Thus, enforcing building codes to create low-energy buildings offers a tangible way for the company to help decrease the greenhouse gas emissions of the nation and in this way National building code offers multiple environmental benefits to various stakeholders. While safety is the primary objective, new building codes are making significant contributions toward solving energy issues. National building codes contain provisions relating to the use of environmentally compatible construction techniques like planting trees, landscaping, rainwater harvesting and renewable and non-renewable energy sources. These provisions allow the constructors to use natural energy sources which reduces the energy bills to a greater extent

1.3. Role of Educational Institutions in natural resource conservation

In view of providing eco-friendly atmosphere to the stakeholders, educational institutions are focused on establishing and maintenance of green and eco-friendly campus without harming the environment. A clean and healthy surrounding in an organization determine the effective learning/teaching and provides a favorable learning environment to the students. Educational institutions are insisted by both Central and State Governments to provide green, healthier and eco-friendly atmosphere to the stakeholders. In addition, all the educational institutions are asked to save the environment for future generations and to solve the problems associated with environment through Environmental Education. Implementation of Swachh Bharath Abhiyan Scheme by the Indian Government through Educational Institutions imparted neat and clean environment at tribal, rural and urban areas across the country. Seminar, Conference, Workshop, training and awareness programmes on biodiversity conservation education, environmental awareness programmes, etc., may be conducted periodically by the Management and Administrative people of an organization for the benefit of the stakeholders.

1.4. Green Campus and Environment Policies

Green Campus Policy dealt with cleanliness of the campus maintained through proper disposal of wastes and steps to be followed to recycle the biodegradable wastes and utilization of eco-friendly supplies to maintain the campus free from hazardous wastes/pollutants. The concept of eco-friendly culture is disseminated among the students as well as rural community through various awareness programmes. Attempts are made to minimize the energy usage and substitute the non-renewable energy sources with renewable energy sources. Head of the Organization, Departmental Heads and Senior Managers/ Management Representatives are responsible for monitoring the “Go Green” initiatives of the Organisation and maintain a clean/green campus while each and every individual of the organization should adhere to the policy.

1.5. Environment Friendly Campus

As stated earlier, Organization is liable to provide an eco-friendly atmosphere along with good drinking water facility to all the stakeholders. Manuring the cultivated plants/grown within the campus may applied with organic manure, cow dung, farmyard manure and vermicompost instead of using chemical fertilizers. All non-compostable and single-use disposable plastic items, plastic utensils, plastic straws and stirrers should be avoided. Demonstration / awareness programme on establishing plastic-free environment and utility of organic alternatives for all incoming and current students, staff and faculty should be organized. Reduction of use of papers alternated with e-services, e-circulars, etc., and proper disposal of wastes, recycling and suitable waste management system should be considered to establish environment friendly campus.

The term ‘auditing’ is to examine the management practices and to evaluate performance of an organization in relation to environmental issues. World along with Associated Chambers of Commerce and Industry of India (ASSOCHAM), Green Building Code and Green Ratings Systems (GBCRS), Green Rating for Integrated Habitat Assessment (GRIHA), Bureau of Energy Efficiency (BEE), Leadership in Energy and Environmental Design (LEED), CII-GreenCo – Green System (CII-GRS), Food Safety Management System & Occupational Health

(FSMS), Swatch Bharath under India Clean Mission (SBICM) and International Standard Organization (ISO 2021) have formulated a series of standards in the field of environmental auditing. These standards are basically intended to guide organizations and auditors on the general principles common to the execution of environmental audits.

Environmental auditing concerned with following aspects:

- ✓ Assessing compliance with pertinent constitutional and internal requirements
- ✓ Providing management control over environmental activities
- ✓ Endorsing good environmental management
- ✓ Maintaining credibility with the public
- ✓ Creating awareness among the staff on their commitment towards environmental policy
- ✓ Enduring improved opportunities and
- ✓ Establishing the performance baseline for developing an Environmental Management System (EMS).

1.6. About Nature Science Foundation (NSF)

NSF is an ISO QMS (9001:2015), EMS (14001:2015), OHSMS (45001:2018) & EnMS (50001:2018) Certified and registered with Ministry of Micro, Small and Medium Enterprise (MSME), Government of India Organization functioning energetically towards the noble cause of nature conservation and environmental protection. NSF is managed by a Board of Trustees which is a Public Charitable Trust registered under the TN Societies registration Act 1975 (TN Act 27 of 1975) on 29th November, 2017 at Peelamedu, Coimbatore 641 004, Tamil Nadu, India with Certificate of Registration No. 114 / 2017. In addition, NSF has 12AA, 80G and Form 10AC certificates for income tax exemption and implanting various Government schemes. The main motto of the NSF is “Save the Nature to Save the Future” and “Go Green to Save the Planet”. NSF family is wide spread across India with over 115 State wise Lead Auditors to conduct Green Audit (Table 1).

NSF is functioning strenuously to conduct different awareness programmes and implement various schemes to public and school / college students towards the noble cause of nature protection. Some of the programmes are also being organized for the benefit of tribal communities to create the supply chain for biodiversity conservation studies. The objectives along with vision and mission are illustrated to promote educational and environmental awareness programmes through social activities for enhancing the quality of life and to conserve nature from environmental pollutants using traditional and modern technologies for sustainable land management. NSF is educating the tribal community children through social service and towards the upliftment of tribes as a whole and make them as entrepreneurs.

International Eco Club Student Chapter (IECSC) has been established for student volunteers and faculty members are encouraged to conduct National and International events pertinent to biodiversity and natural resource conservation. NSF is being released “Magazine” and “Quarterly Newsletter” to share the information about Environmental awareness programmes on biodiversity conservation in Western Ghats of Southern India. In order to encourage the students, faculty members, NGOs, scientists, entrepreneurs and industrial experts those who are in

protection and biodiversity conservation activities across the world, NSF tributes the deserved meritorious candidates with various awards/honours and these awards will be conferred to them during the Annual Meet and Award Distribution Ceremony which will be conducted every year.

Apart from the “Green Audit”, NSF has introduced various types of audits such as Hygienic Audit Water & Soil Audit, Plastic Waste Management Audit, Biomedical Waste Audit, Solid Waste Management Audit, E-Waste Management Audit, Academic & Administrative Audits including ISO certification process to Academic Institutions, R&D Organizations and Industries towards the accreditation process as well as maintaining a hygienic eco-friendly environment to the stakeholders in their campus. All audits will be conducted as per the Checklist prepared by the NSF in compliance with ISO 17020 Criteria and Government Law and Environmental Legislations including World / Indian Green Building Council and the concept of Swachh Bharath Abhiyan under Clean India Mission.

Table 1. Audit processes are being conducted through the certified Auditors as per the following list

Audit	Certified Course	Lead Auditors/ Technical Experts/ Observers
Green Audit	<ul style="list-style-type: none"> • GBCRS - Green Building Code and Green Ratings Systems • GRIHA - Green Rating for Integrated Habitat Assessment • ISO Green Audit (17020:2012) • ISO QMS (9001:2015) • IGBC – Indian Green Building Council 	Dr. S. Rajalakshmi (ILA) Dr. R. Mary Josephine (ILA) Dr. K. Suresh Babu (ELA) Dr. B. Mythili Gnanamangai (ILA) Er. N. Shanmugapriyan (ELA) Ms. V. Sri Santhya (ILA) Dr. Amzad Basha Kolar (ETE) Mr. B.S.C. Naveen Kumar (ETE) Mr. K. Sampath Kumar (ELA) Dr. Sreekala K Nair (Observer)
Environment Audit	<ul style="list-style-type: none"> • ASSOCHAM - Associated Chambers of Commerce and Industry • FSRS – Fire Safety & Rescue Services • ISO EMS (14001:2015) 	Ar. N.M. Pradeep Kumar (ELA) Er. S. Srinivash (ELA) Er. A. Karthik (ELA) Dr. Helen Roselene Thomes (ETE) Dr. S.J. Veeresh (ETE) Dr. D. Vinoth Kumar (ILA) Dr. P.V. Sreenivasan (Observer)
Energy Audit	<ul style="list-style-type: none"> • BEE - Bureau of Energy Efficiency • LEED - Leadership in Energy and Environmental Design • CII-GreenCo – GreenCo Rating System Felicitator 	Er. D. Dinesh Kumar (ELA) Er. P. Shanmugapriyan (ELA) Dr. D. Vinoth Kumar (ILA) Dr. N. Balasubramaniam (ELA) Ms. V. Sri Santhya (ILA) Dr. P. Thirumoorthi (ETE) Dr. G. Muruganant

	<ul style="list-style-type: none"> • ISO EnMS (50001:2018) 	Ms. T. Joys Ememmal (ITE) Dr. R. Raj Kumar (Observer)
Waste Management Audit	<ul style="list-style-type: none"> • Water & Soil Audit, Plastic Waste Management Audit, Biomedical Waste Audit, Solid Waste Management Audit, E- Waste Management Audit 	Mrs. Gaanappriya Mohan (ELA) Ms. B. Vijayalakshmi (ELA) Dr. D. Vinoth Kumar (ILA) Er. A. Karthik (ELA) Ms. V. Sri Santhya (ILA) Dr. K.S. Vinayaka (ETE)
Hygiene Audit	<ul style="list-style-type: none"> • ISO FSMS (22000:2018) • SBICM - Swatch Bharath under India Clean Mission • ISO OHSMS (45001:2018) 	Mrs. Gaanappriya Mohan (ELA) Ms. M. Nithya (ILA) Ms. R.S. Thulaja (ILA) Dr. N. Saranya (ETE)

Note:

ILA: Internal Lead Auditor, **ELA:** External Lead Auditor

ITE: Internal Technical Expert, **ETE:** External Technical Expert

1.7. About the Organization

Sri Saradha college for women, Perambalur is a unit under Sri Swamy Vivekananda Educational Trust. It was affiliated to the Bharathidasan University, Trichy. Our Founder and Chairman Dr. M. Sivasubramaniam, Sri Ramakrishna group of Educational Institutions, Perambalur started our college in the year of 2000 in order to uplift the children of the rural society of Perambalur district through Education. Women Empowerment is the main goal and objective of the trust. With the motto of LOVE, KNOWLEDGE AND STRENGTH, we consider it a foremost duty to transform the young aspirants into Worthy citizen by imparting a broad stream of advanced learning.

Vision

Empowering the rural students with quality education, equipping them with knowledge and skills in their chosen stream and mould them into globally competent individuals.

Mission

- Imparting value-based education
- Providing students with quality educational experiences for the completion of the course.
- Promoting innovative mode of teaching and learning
- To achieve excellence in Education through holistic development incorporating academic excellence,
- Professional competence, social responsibility, moral and ethical principles and spirituality

Geographical location: Sri Saradha College for Women, Perambalur - 621 113 located at Sri Saradha Nagar, NH - 45, Siruvachur, Perambalur Tamil Nadu is one of the popular colleges in India. At present, the campus is quite clean, green and with much less pollution when compared to the rest of the city. Dicot and monocot plants can be found on the campus considerably. In contrast, the campus is harboured a wide variety of birds and animals.

The campus occupies a total area of 325059.33 sq. ft in which total built area is estimated about 78535 sq.ft. (Table 2). The campus has covered parking area of 4000 sq.ft. Among the total built area, one sixth area has been installed with AC's. With regard to vegetation availability within the campus, 25% accounts for forest/natural vegetation while remaining 40% represents manmade, artificial vegetation (Table 2).

Table 2.: Sri Saradha college for women Campus facility details

S.No.	Details of Area	Total area
1.	Total Campus area	325059.33 sq. ft
2.	Total Built up area	78535 sq.ft
3.	Covered Car parking area	4000 sq.ft
4.	Forest vegetation	25%
5.	Planted vegetation	40%

1.8. Audit Team Details

Date / Day of Audit	: 10.03.2023
Venue of Audit	: Sri Saradha College for Women, Perambalur-621 113, Tamil Nadu, India
Audited by	: Nature Science Foundation Coimbatore, Tamil Nadu, India
Audit type	: Green, and Energy Audits
Name of the Auditing Chairman	: Dr. S. Rajalakshmi ISO QMS, EMS, OHSMS and EnMS Auditor Founder & Chairman of NSF
Name of the Auditing Team Leader	: Dr. D. Vinoth Kumar ISO QMS, EMS and EnMS Auditor Joint Director, NSF.
Name of the Lead Auditor	: Er. D. Dinesh Kumar Certified BEE, IGBC, ASSOCHAM, GRIHA & LEED Auditor
Name of the Green Auditor	: Dr. B. Mythili Gnanamangai Indian Green Building Council Auditor
Name of the Environment Auditor	: Er. S. Srinivash Tamil Nadu Fire and Rescue Services
Name of the Energy Auditor	: Dr. N. Balasubramanian Bureau of Energy Efficiency Auditor
Name of the Waste Management Auditor	: Er. A. Karthick Bureau of Energy Efficiency Auditor
Name of Technical Expert	: Mr. B.S.C. Naveen Kumar Senior Faculty, Mahatma Gandhi National Council of Rural Education, Hyderabad Ministry of Higher Education, New Delhi
Name of the Green Audit Observer	: Dr. Sreekala K Nair Research & Development, NSF
Name of the Environment Audit Observer	: Dr. R. Raj Kumar Advisor, NSF
Name of the Energy Audit Observer	: Dr. P.V. Sreenivasan Director, NSF
Name of the Waste Management Audit Observer	: Dr. B. Anirudhan Executive member, NSF

1.9. Procedures followed in auditing

Green audit is a structured process of documenting the credentials in terms of number of trees, herbs, shrubs, lawns, climbers and lianas reflected in reducing the environmental pollution and soil erosion and useful for biodiversity conservation, landscape management, natural topography and vegetation. Green audit projects the best environmental practices and initiatives taken in the organization at the prescribed site of audit that brings added value to the organization in maintaining the eco-friendly campus to the stakeholders. First step of the audit is ensuring that the organization has a central role in building the green campus in order to validate the same (Adeniji, 2018).

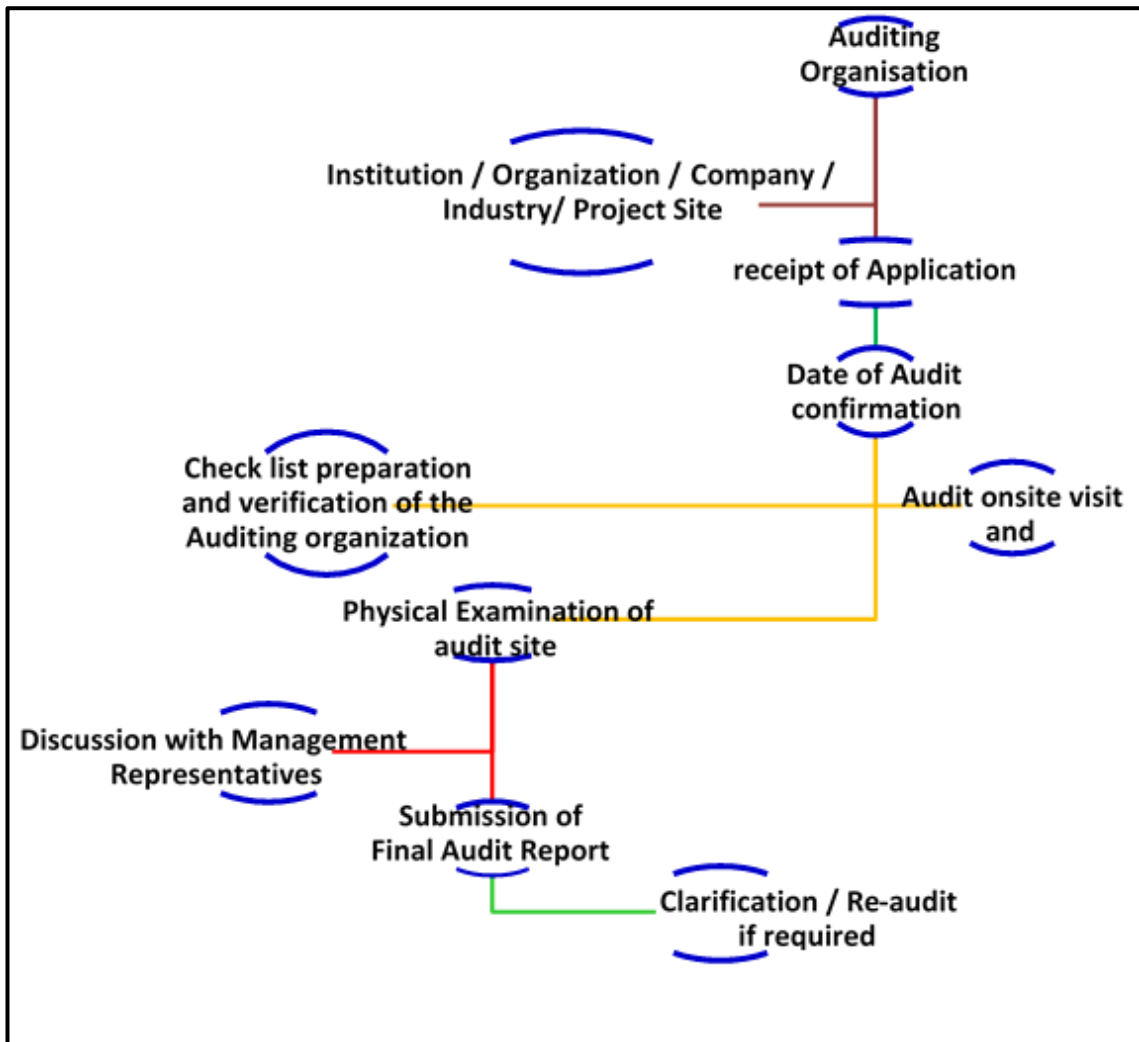
Green campus is not intended for the self-sustainability of the building alone, it also involves in propagation of the green campus initiatives so as to be adopted by any individuals and organization at a minimum cost. Green audit has been conducted as per the checklist based on National Building Code (NBC) Part 11 - Approach to Sustainability through the authenticated Professionals who have qualified to investigate and evaluate the campus for validating the best environmental practices.

During the audit, the nature of plants and animals / birds species thriving within the campus were recorded. Establishment of lawns, trees, herbs, shrubs and climbers and establishment of terrace / kitchen / herbal / zodiac / ornamental / medicinal gardens / aquarium and aquatic (hydrophytes) plants in the campus were documented. Labelling of common and botanical names of plants were observed. The operation of irrigation system, drip and sprinkler irrigation methods and utility of recycled water in the campus area were noted.

Attempts made for water scarcity during summer season towards the maintenance of plants and frequency of watering of plantations in the campus were recorded. Biodiversity conservation education, projects, awareness programmes, etc., through Indian Biodiversity Act and Ministry of Environment, Forests and Climate Change, Government of India and the conduct of outreach programmes for dissemination of Green campus motto among the students and staff members including public domain were gathered (Venkataraman, 2009) besides signing of MoU with Government and Non-Governmental Organizations to ensure green campus activities.

Projects, dissertations and thesis are the academic effort credentials that always fosters the innovative ideas on thinking and implementation of new approaches towards the green campus through presentations and publications in social media. These efforts taken by the students and staff were deliberated while conducting the green audit. Green audit processes are taking place as per the following flow-chart starting from the scrutiny of application forms from the auditee (organization) and ending upon the submission official report to the concerned organization (Leal Filho *et al.*, 2015). In addition, supporting activities of the scholars and staff with regard to “Vision and Mission” of the greenery activities of the Organization is also evaluated and reported.

Flow-chart of Audit Procedures



1.9.1. Pre-Audit stage activities

A pre-audit meeting (opening meeting) is conducted with Management and Administrative people along with staff coordinators with regard to green audit process, wherein audit protocol and audit plan were discussed in brief. The purpose of this meeting is to provide a chance to emphasize the scope and objectives of the audit and discussions held on the feasibilities associated with the audit (Marrone *et al.*, 2018). Pre-audit stage activities are an essential prerequisite for the green audit to meet the auditee and to gather information about the campus and required documents were collected directly from the Organization before the start of the audit processes (Fachrudin *et al.* 2019).

1.9.2. Onsite audit activities

- Followed by opening meeting, onsite inspection will be conducted which is the second step in the audit where the audit team members visit different sites in the campus and required photographs were taken then and there for preparing the audit report.
- During the onsite visit, it is vivid how the various facilities made by the Management to the stakeholders without disturbing the natural topography and vegetation to ensure the green campus.

- It is also observe how the environment is protected in the campus and by what means an eco-friendly atmosphere is being given to the stakeholders. Assessment reveals the strengths and weaknesses of the Auditees Management controls and risks associated with their failure in creating green campus facilities.
- Collecting audit proofs i.e. data collection and information from the auditee as per the audit protocol were carried out.
- An exit meeting was conducted to describe the findings of the audit. Representatives and staff members.

1.10. List of Instruments used in the Inspection Process

Nature Science Foundation conducts audits by using the listed instruments

- Oxygen Meter
- Carbon Dioxide Meter
- Light (LUX) Meter
- Sound Level Meter
- pH Meter
- TDS Meter
- GPS Meter
- Deluxe Water and Soil Analysis Kit

1.10.1. Oxygen Meter

Oxygen meter is used in the audit process to measure the oxygen level in the organization. The instrument is calibrated after using 20 times. Suitability of the instrument are range between 0 to 30 % O₂, resolution of 0.1%, accuracy is $\pm$ (1% reading + 0.2 % O₂), response time is $\leq$ 15 seconds, environment pressure range is 0.9 to 1.1 atmosphere, temperature range is 0 °C to 50 °C, 32 °F to 122 °F, temperature resolution is 0.1-degree, temperature accuracy is °C - $\pm$ 0.8 °C & °F –



1.10.2. Carbon dioxide meter

Carbon dioxide meter is to measure the carbon level in the organization. The instrument is calibrated after using 20 times. Suitability of the instrument are range between 0 ~ 4000 ppm, resolution of CO₂ Meter is 1 ppm, accuracy is $\leq$ 1,000 ppm, repeatability is $\pm$ 20 ppm, temperature range between 0°C to 50°C, 32°F to 122°F, temperature Resolution is 0.1-degree, temperature accuracy is °C – 0.8°C, °F – 1.5°F.



1.10.3. Light (LUX) Meter

Light meter is to calculate the light intensity in the organization. Suitability of the instruments are, 5 ranges. ie. 40.00, 400.0, 4,000, 40,000, 400,000 Lux, operating temperature is 0 to 50 °C (32 to 122 °F), Operating humidity is less than 80% RH, Power consumption is DC 8 mA approximately. This Instrument will be calibrated yearly once or during non-functioning.



1.10.4. Sound Level Meter

Sound level meter is to measure the noise level in the organization. This instrument is calibrated yearly once or after using 20 times. Suitability of the instruments are measurement range is 30 – 130 dB, resolution is 0.1 dB, accuracy is $(23 \pm 5^\circ\text{C})$, Frequency of the instrument is 31.5 to 8,000 Hz, Operating temperature is 0 to 50 °C (32 to 122 °F), Operating humidity is less than 80% RH, Power consumption is DC 6 mA approximately.



1.10.5. pH Meter

pH meter is generally used to measure the pH level in water. It is calibrated 6 months once or after 20 times of its use. Suitability of the instrument are range of the pH meter is 0 – 14, accuracy is $\pm 2\%$, resolution of the instrument is 0.1 pH, operating temperature is 0 to 50 °C (32 to 122 °F)



1.10.6. TDS Meter

TDS meter is generally used to measure the TDS level in water. Suitability of the meter are range of TDS meter is 0 – 9990 ppm (mg/L), operating temperature is 0 to 80 °C (32 to 176 °F) and accuracy is $\pm 2\%$. This meter is calibrated six months once or 20 times after its use.



1.10.7. GPS Meter

GPS meter is subjected to know the latitude and altitude, location, etc.,. Suitability of the GPS meter are, dimension is 2.1" x 4.0" x 1.3" (5.4 x 10.3 x 3.3 cm), Display resolution is 128 x 160 pixels and GPS Map features included in Continental Europe. It is calibrated six months once or after 20 times of the usage.



1.10.8. Deluxe Water and Soil Analysis Kit

Deluxe water and soil analysis kit is used to analyze the pH, TDS, salinity, turbidity, alkalinity dissolved oxygen of water.



1.11. Use of Personal Protective Equipment (PPE)

Personal Protective Equipment (PPE) refers to protective clothing for the eyes, head, ears, hands, respiratory system, body, and feet. It is utilized to protect individuals from the risks of injury and infection while minimizing exposure to chemical, biological, and physical hazards. PPE serves as the final line of defense when engineering and administrative controls are insufficient in reducing risks. Nature Science Foundation safeguards all the auditors by supplying PPE during the conduct of audits. PPE used are safety jackets, ear plugs, goggles, face shield, hand gloves, shoes, etc.,

1.11.1. Safety jackets:

PPE includes safety vests and suits that can be used for inspection process which will protect body injuries from extreme temperatures, flames and sparks, toxic chemicals, insect bites and radiation.

**1.11.2. Goggles and Face shield:**

Goggles and face shield are used in the inspection process while inspecting items which would cause eye damage or loss of vision, spray or toxic liquids especially in chemistry labs, nearing the electric and electronic item.

**1.11.3. Helmet:**

PPE includes hard hats and headgears which will be required for tasks that can cause any force or object falling to the head. It also helps to resist penetration.

**1.11.4. Hand gloves:**

PPE includes safety gloves and should be used for tasks that can cause hand and skin burns, absorption of harmful substances, cuts, fractures or amputations. Selection of hand gloves is based on the application of use.

**1.11.5. Safety Boots:**

Foot protection is one of the most commonly used PPE and can differ depending upon the environment. Safety boots are used for tasks that can cause serious foot and leg injuries from falling or rolling objects, hot substances, electrical hazards, and slippery surfaces.

**1.11.6. Ear Plug:**

Ear plugs are used for tasks that can cause hearing problems and loss of hearing. Hearing protection devices reduces the noise energy reducing reaching and causing damage to the inner ear. This ear plug is mostly used near sound producing devices like power motors, genets, generators, etc.,

**1.12. Scope and Importance of National Building Code (Part -11 Approach to Sustainability)**

The National Building Code of India (NBC), a comprehensive building code, is a national instrument providing guidelines for regulating the building construction activities across the country. It serves as a model code for the adoption of all agencies involved in building construction works. It includes Public Works Department, other Government construction departments, local bodies or private construction agencies. Scope 11 covers the parameter required to be considered for planning, design, construction, operation and maintenance of building and those relating to land development from sustainable point of view.

1.12.1. Campus Details

S.No.	Details / Descriptions	Quantity
1.	Total strength of Students	1340
2.	Total strength of Employees	85
3.	Total number of Buses in the campus	21
4.	Number of Cars entering in the campus	04
5.	Number of Motorcycles entering in the campus	20
6.	Number of other vehicles (Lorry, Ambulance, Jeep, Trucks, Cranes, Poclain, and etc. entering in the campus)	02
7.	Number of E-Vehicles	Nil
8.	Number of RO Water Plants	01

2. GREEN AUDIT

2.1. Introduction

Green audit ensures the Organization's campus should have greenish with large diversity of trees, herbs, shrubs, climbers and lawns to reduce the environmental pollution and soil erosion; it is also useful in relation to biodiversity conservation, landscape management, irrigation/economic water utilization and maintenance of natural topography besides vegetation (Gowri and Harikrishnan, 2014, Aruninta *et al.*, 2017). For the benefit of stakeholders, solid waste management, recycling of water, disposal of sewage and waste materials (electronic and biomedical wastes), "zero" use of plastics, etc. should be followed consistently in the organization campus. Green Audit procedures includes the definition of green audit, methodology on how to conduct green audit at Educational Institutions and Industrial sectors as per the checklist based on National Building Code (NBC) Part 11 - Approach to Sustainability and assessment of risk at 360° scale (Arora, 2017; Rajalakshmi *et al.*, 2022).

2.2. Importance of green audit

The Management of the Organization (Auditee) should be exposed their inherent commitment towards making ecofriendly atmosphere through the green auditing and ready to encourage/follow all types of green activities (Suwartha and Sari, 2013). The administrative authorities should formulate "Green and Environment Policies" based on technical report of green auditing. A clean and healthy environment will enhance an effective teaching/learning process. They should create the awareness on the importance of greenish initiatives through environmental education among the student members and research scholars. Green audit is the most effective, ecological approach to manage environmental complications.

Green audit is a kind of professional care and a simple indigenized system about the environment monitoring in terms of planting more number of trees which is a duty of each and every individual who are the part of economical, financial, social and environmental factors. It is necessary to conduct green audit frequently at least once in three years because students and staff members should aware of the green audit which in turn support the institution to set environmental models ("icon") for the community. Green audit is a professional and useful measure for an Organization to determine how and where they are retaining the campus eco-friendly manner. It can also be used to implement the alleviation measures at win-win situation for the stakeholders and the planet. It provides an opportunity to the stakeholders for the development of ownership, personal and social responsibility.

2.3. Benefits of the green audit

There are several benefits on conduct of green audit by the Organization which may be definitely useful to improve the campus infrastructure significantly. The green audit contained the following both qualitative and quantitative measures.

- Know the status of development of internal and external green campus audit procedures and implementation procedures in the Organization.
- Establishment of green campus objectives in accordance with prevailing rules issued by the government/local authorities.

- Establishment of terrace, herbal, kitchen, zodiac, ornamental gardens, etc. for enhancing teaching and learning environment and for commercial exploitation.
- Generating the data on campus flora on total number of both terrestrial and aquatic plants (herbs, shrubs, climbers, twins and grasses) and documentation of number of oxygen releasing and carbon dioxide assimilating plants.
- The plants available in the campus must be tagged with their common name and botanical name and their economic importance for the benefit of the stakeholders
- Recommendation in use of biofertilizers, organic and green manures, cow dung manures and farmyard manures for the cultivation of plants to protect the soil health. Survey of campus fauna by conducting the number of living and visiting animals, insects, flies, moths and worms.
- To conserve economically important, rare and endangered plant and animal species in the campus ecosystem.
- Assigning the roles and responsibilities to the Environmental Engineers and Agriculture Staff who are all accountable to improve green initiatives and development
- Document the status of rain water harvesting system, water reservoirs, percolation ponds, etc., to increase the ground water level, irrigation methods (drip/sprinkler) to improve the water use efficiency
- Steps taken for organic, inorganic, toxic, e-waste, biomedical, food, sewage waste management, segregation of wastes and reuse methods.
- Campus facilities for disabled, special needs and/or maternity care including security, safety and health infrastructure facilities for stakeholder's wellbeing.
- Academic credentials like major and minor projects, dissertations and thesis work on green campus, environment protection and nature conservation by the students and staff members.
- Implementation of Government schemes (Swatch Bharath Abhiyan under Clean India Mission) to give pure and safe water to rural people and teach the importance of cleanliness.
- MoU may be signed with Government and non-governmental organizations to utilize the resources for nature conservation and environmental protection.

2.4. Target areas of green audit

There are several target areas listed in the Green audit process in which a few are taken into consideration as per the Indian scenario. Green audit concept mainly concentrate on the efficient use of energy and water; minimize waste generation or pollution and also improve the economic efficiency. Green audit process may be undertaken at frequent intervals and their results can demonstrate improvement or change over time. Green audit focuses on the reduction of carbon emissions, water consumption, wastes to landfill and enhance energy use conservation to integrate environmental considerations into all contracts and services considered to have significant environmental impacts (Choy and Karudan, 2016).

2.5. Aims and objectives of green audit

- To recognize the initiatives taken towards establishing the green campus in terms of availability of flora and fauna diversity within study area
- To assess the greenish nature of an Organization campus in terms of available vegetation which reflects on reducing the environmental pollution, soil erosion, biodiversity conservation, landscape management, natural topography and vegetation.
- To grow a more number of oxygen releasing and carbon dioxide assimilating plants in the campus to give a pure atmosphere to the stakeholders.
- To identify and provide baseline information to assess threat and risk to the ecosystem due to developmental activities of the organization and resolve the same
- To ensure proper utilization of resources available in the surrounding areas towards future prosperity of the humanity.
- To fix a couple of norms for disposal of all varieties of wastes and use green cover as a carbon sink.

2.6. Geology, topography and soil condition

The Sri Saradha College of Arts and Science for Women - SSCASFW consists of an environment with red loamy, alluvial and black soil, located 148 m above sea level, 78°52'42.0"E of longitude and 11°11'55.4"N latitude. In Perambalur District Minerals of Economic importance are mainly Gypsum, Kankar, varieties of black granites (Dimensional stones), rough stone (aggregates), limestone, fireclay and gravel/earth. Perambalur the non-crystalline limestone deposits occur over an area of 400 sq km in Cretaceous and Paleocene 4 sediments between River Coleroon in the south and Vellar in the north. (Table.3)

Table 3. Soil edaphic and environmental parameters of the Campus

S.No	Details of Parameters	Data collected
Soil Edaphic parameters		
1.	Soil pH	7.07
2.	Soil type	Red Loamy, Sandy Soil
3.	Total Organic carbon	4.68 - 5.52
4.	Electrical conductivity	0.05dSm-1 to 0.07 dSm -1
5.	Water holding capacity	430 ml/ kg
6.	Total Nitrogen	2564 ppm
Environmental parameters		
1.	Minimum Temperature	11.7°C
2.	Maximum Temperature	42.6°C.
3.	Minimum Relative humidity	23.5-64.2%
4.	Maximum Relative humidity	26.2-95.5%
5.	Annual Average Rainfall	645-720mm
6.	Annual Average Sunshine	4-6hrs/day
7.	Wind speed	17.5-22.6km

2.7. Identification of plant species

Various vascular plant species were collected across the campus and subjected to botanical identification (botanical name, family, habitat, and economic importance). Plant specimens were freshly collected and their digital photographs were taken. The collected plant specimens have been identified using “The Flora of the Tamil Nadu Carnatic” (Matthew, 1983). Further, their identification was confirmed by matching with authentic specimens in the Botanical Survey of India (BSI), Southern Circle, Coimbatore, Tamil Nadu and India.

2.8. Identification of mammals, birds, reptiles, amphibians and termites

Birds were observed by visual sightings and by calls also the avifaunal data were observed through the Nikon 8 x 40 binoculars and photographs were taken. The recorded data was noted in the field work note. Later, the birds were identified with the help of field guide, "Birds of Indian subcontinent" by Richard Grimmett and the IUCN category of the birds were also noted with the same. The point count and transect line methods were used to record the number of bird species in the study area in which regular visits and personal visits were carried out (Ferenc *et al.*, 2014). The surveys were conducted to understand the distribution of bird species in relation to habitats and nesting behaviour of birds in the study area. Based on survey, richness and abundance of bird species were calculated using Shannon-weaver diversity index. Based on available data and species were selected for nest site selection study. Selected species of birds was analysed for its nest site characteristics between the habitats and also plant species preference was enumerated and assessed. The number of breeding bird species and nests found in different habitats as depend variables such as biotic and biotic factors as the independent variable (Jayson and Mathew, 2000).

Reptiles and Amphibians are identified based on coloration, markings on the skin, background colour generally brown. Males often have a flecked pattern on back. Occasionally they are in green, leading to mistaken identification as sand lizard, males have thicker base to tail and brighter, speckled underside. Newborn young are dark in colour, almost black. A rare species, almost entirely confined to heathland sites in Dorset, Hampshire and Surrey, and sand dunes on the Mersey and Welsh Coast. The most common reptile found in a variety of habitats, including gardens, spends most of its time underground or in vegetation litter. They are most likely to be found underneath objects lying on the ground or in compost heaps. Snakes are identified based on cream, yellow or white collar behind the head, bordered to the rear by black marks. Body colour ranges from bright green to dark olive, but mostly the latter. Darker specimens can appear black from a distance. Truly black grass snakes are rare. Males are predominately brown, females are grey. Dark butterfly shape on top of head may be noted. Pairs of spots, sometimes fused as bars, running along back with black line running through eye are recorded. Males typically grey with a black zigzag stripe, females generally brown with a dark brown zigzag stripe (Beebee and Griffiths, 2000).

2.9. Green audit observations

As mentioned earlier, green audit covers both qualitative and quantitative measurements including physical verification. Establishment of different types of gardens in the campus, rainwater-harvesting system, operation of water supply and irrigation methods are adopted to improve the green campus (Table 4). Academic credentials like taking up major and minor Projects, Dissertations and Thesis work by the students and staff members may be taken into account towards green campus initiatives and planning efforts. Best practices followed on green campus initiatives in the organization and aspects to be followed for further improvements for greening are illustrated in the audit report.

Opening meeting with the Principal, IQAC Coordinator and Management Responsibilities of Sri Saradha College for Women and Audit Team of the Nature Science Foundation



Table 4. Qualitative measures of green audit

S.No.	Part 11 clause as per the National Building Code	Audit Checklist / Parameters	Audit Findings (C / NC/ PC)
1.	3.1 Need for Sustainable Development	What are all the biodiversity conversation activities adopted by the Institution? (Plantation programme, awareness on maintaining ecosystem, proper maintenance of plantation, etc.,)	C
2.	3.2. Elements of Sustainability	What are all the facilities implemented for person with disability? (Ramp, lift, wash room, library, canteen, etc.,)	C
3.	6.2.4. Reduced building foot print in multi storeyed building design	Whether at least 30% of open space is maintained	C
4.	7.1.1.2. External noise reduction / mitigation practices	Observation of noise reduction by planting more number of trees	C
5.	7.1.1.3. Building shadow considerations on landscape	Observation on vegetative structure (more number of trees in a particular area) to reduce energy consumption	C
6.	7.1.2.3. Post-occupancy maintenance	Observation of plant maintenance by using fertilizers	C
7.		Steps taken to avoid inorganic pesticides / fungicides (using Biofertilizers, cow dung, farmyard manure, vermicompost, etc.,)	C
8.	7.1.3.1. Preserving top soil	What are the initiatives taken to save the quality of top soil? (Maintaining soil using organic fertilizers instead of agro-chemicals)	C
9.	7.1.3.2. Ecological design / conserving biodiversity	Availability of native plants in the site	C
10.		Action plan for conservation of endangered and economically important plant species through awareness programmes and demonstrations.	C
11.		Projects and Dissertation works and Scholarly publications related to flora and fauna by students, scholars and staff members	C
12.	7.1.3.4. Vertical Landscaping and roof system	Whether the campus has roof /kitchen/ zodiac/ ornamental/ medicinal garden/ and green walls or vertical landscaping (vertical garden) and aquarium?	C

13.	7.1.3.5. Urban agricultural practices / social forestry	Availability of agricultural area (vegetables, fruits, nuts yielding plants)	C
14.	7.1.4. Bicycle lanes and pedestrian access - safety and comfort	Availability of plantation in the lanes / pedestrian pathway	C
15.		Availability of dustbins, leaf litter boxes and sign boards in the Pedestrians Pathway (clean and green campus, save nature, etc.,)	C
16.	9.1.2. Minimizing Green House Gas (GHG) Emission	Alternative methods adopted to reduce CO ₂ emissions (Indoor plants).	C
17.		Oxygen and CO ₂ levels in the campus atmosphere will be measured using oxygen and CO ₂ meters at the time of onsite audit.	C
18.	12.4.1. Soil monitoring	Whether health of the soil is checked periodically? (Soil analysis report, if any)	C
19.	12.4.5. Tree counting	Counting on existing tree species in the campus with nomenclature of plants	C
20.		Observation on existence of flora and fauna in campus (plants & animals)	C

2.10. Flora diversity plants in the campus

Ensuring the rich biodiversity in the green campus is an important parameter which reflects the real-time ecosystem. Plants are indicators for assessing the varying levels of environmental quality. In general, plants improve the outdoor air quality with increased oxygen levels and reduced temperature and carbon dioxide. The green and varying colour of the flowering plants improve the ambience of the Organization environment. The record on maintenance of the plant biomass and its management are important with respect to green campus initiatives. The existence of such plants and birds in the green campus may be recorded for the rich flora and fauna which are being considered as a value addition to the campus.

The observations indicated that the campus has more than 25% of forest vegetation (wild/native plant species) and 40% accounts for artificial plant species (ornamental plants/man made vegetation) (Table 5). Native plant traits promote the indigenous fauna at the site area. Hence, the accountancy of 25% of the wild traits are leveraged for the native animals and birds. The most probable natural vegetation of campus is the dry deciduous type. The remnants of this past vegetation are found in the campus.

Table 5. Quantitative Measurements of Green Audit

S. No.	Details of Plant and Animal species	Numbers
1.	Total number of flowering plant species inside the campus	94 species belonging to 85 Genera under 60 families
2.	Total number of living animals inside the campus	4 such as Cats, Mice and Dog
3.	Total number of visiting animals inside the campus	15 Species belonging Rabbit, Squirrel and Monkey
4.	Total number of living birds inside the Campus	10 species belonging Common Myna, House Sparrow, King-crow, House Crow, Jungle Babbler, Honey bird
5.	Total number of visiting birds inside the campus	4 species belonging Koel Rose-ringed, Mangrove heron, Wood shrike
6.	Total number of aquarium	NA
7.	Total number of aquatic (hydrophytes) plant species	NA
8.	Percentage of forest vegetation	25%
9.	Percentage of planted vegetation	40%
10.	Percentage of water consumption to total human population	-
11.	Percentage of water consumption to total flora and Fauna	-

The most plants recorded are *Azadirachta indica* A. Juss., *Tamarindus indica*, *Pongamia pinnata*, *Cassia fistula* which are dominant trees species characteristic to the vegetation within the campus. Some of the shrub species like *Nerium oleander* L., *Nerium indicum* Mill, *Punica granatum* are also rather common in the campus.

Ground flora is comparatively sparse but fairly rich in undistributed areas. Some of the common weeds like *Euphorbia hirta* L., is found to be predominant. Species such as *Catharanthus roseus*, *Cynodon dactylon* are some common herbs in the campus.

Certain common climbers found among the shrubs are *Abutilon indicum* L., *Adhatoda vasica*, *Anisomeles malabarica*, *Coccinia grandis* L., *Cardiospermum halicacabum*, *Tinospora cordifolia* (wild.), *Toddalia asiatica* L. and *Citrullus landaus* (Thumb.),

This campus is rich in grass species like *Andropogon pumilis*, *Apluda mutica*, *Cenchrus ciliaris*, *Asparagus racemosus* Wild., and *Commelina benghalensis* L. Most of the species found are common in the campus, some of the species *Cucumis dipsaceus* Ehrenb, *Hybanthus*, *Bothriochloa compressa* (Hook.F.), and *Caralluma bicolor* Ramach., is the rare species. Some endemic grass species like *Andropogon pumilus* Roxb., *Panicum psilopodium* Trin., and *Perotis indica* (L.) are also

occurring in the campus. Number of above species decreased in number and a few face the danger of going extinct due to anthropogenic activities (regular clearing and construction activities). Hence in terms of conserving the available floral biodiversity, it is pertinent to set up a botanical garden within the campus and cultivate them while protect the ones that grow naturally on the grounds upon the vegetation maintenance.

Invasive species

The campus has invasive species such as Wild tamarind *Leucaena leucocephala* L., This is clearly indicated disturbances to the natural setting in the vegetated areas. The alien / exotic species viz., *Plumeria*, *Anthurium* and *Tecoma stans* (L.) Kunth are occur in the campus. Some of the species are utilized as fruit yielding like *Mangifera indica* L. (Maa), *Psidium guajava* L., (Koyya), *Moringa pterygosperma* Gaertn. (Murungai), *Phyllanthus emblica* L. (Nelli), *Artocarpus heterophyllus* (Jack fruit), *Phyllanthus acidus* (Amla) and Species such as *Bougainvillea glabra*, *Ixora coccinea* are exploited for their attractive flowers.

Distribution of flowering plants

The biodiversity of campus comprises a 94 species belonging to 85 genera under 60 families besides the lichens, mycoflora, pteridophytes and bryophytes. Among the documented higher plants, Dicots are dominating with 68.9 families followed by monocots (30.1 families). (Fig. 1 and Table 6). Among the documented dicots, Polypetalae formed a major proposition with 20 families, 33 genera and 30 species; Gamopetalae with 17 families, 22 genera and 21 species while Monochlamydeae with 13 families, 18 genera and 25 species. In monocots 10 families are spreading over 12 genera belonging to 18 species. (Fig. 3). Over all analysis revealed that herbs were dominating flora followed by trees.

Figure 1. Systematic groups of the plants in the campus

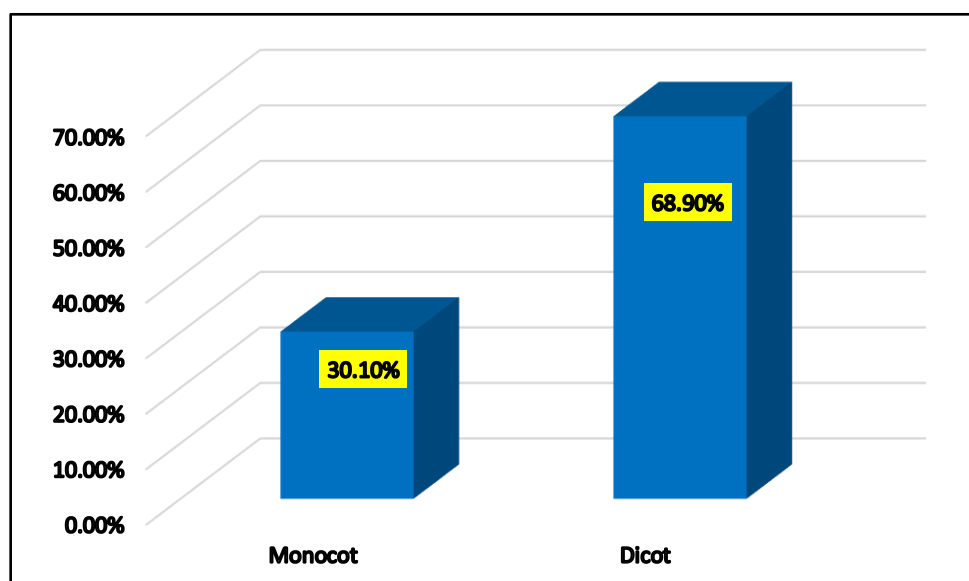


Figure 2. Analysis of habit-wise distribution of plant species in the campus

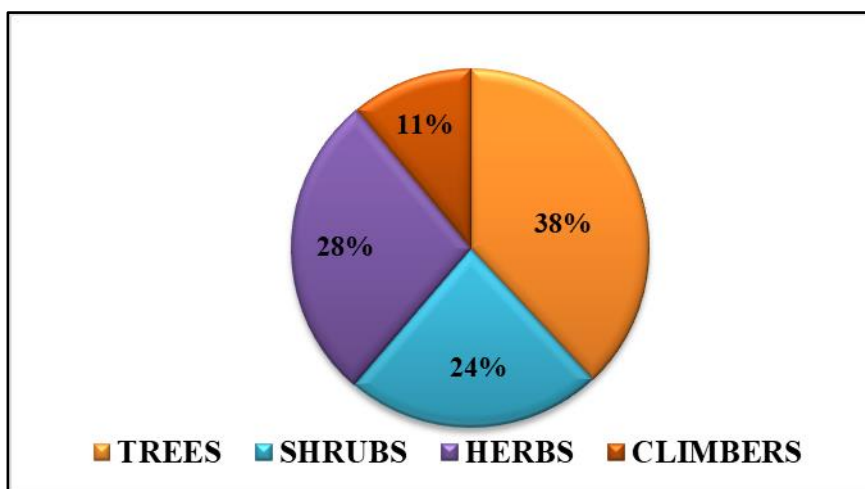


Figure 3. Plant families with higher number of species in the campus area

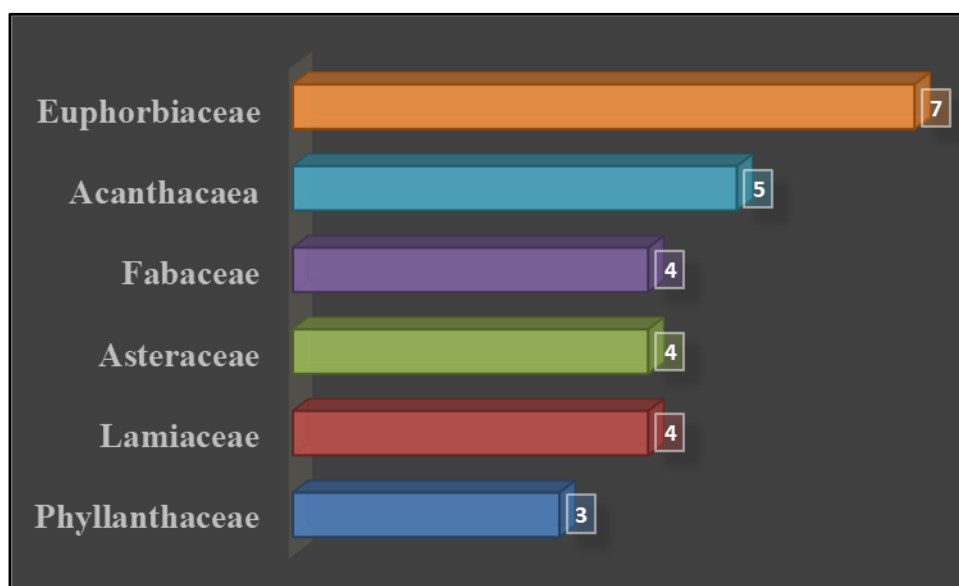


Table 6. List of Flowering plants in the Campus

S.No	Common Name	Botanical Name	Family	Habitat
1.	ladies finger	<i>Abelmoschus esculentus</i>	Malvaceae	Herb
2.	Monkey Bush	<i>Abutilon indicum</i>	Malvaceae	Herbs
3.	Blue weed	<i>Ageratum houstonianum</i>	Asteraceae	Shrub
4.	Aloe vera sis	<i>Aloe barbadense</i>	liliaceae	shrub
5.	Common needle grass	<i>Aristida pinnata</i>	Poaceae	herb
6.	Jack fruit	<i>Artocarpus heterophyllus</i>	Moraceae	Tree
7.	Jack fruit tree	<i>Artocarpus heterophyllus Lam.</i>	Moraceae	Tree
8.	Asparagus	<i>Asparagus officinalis</i>	Asparagaceae	Herb
9.	Ganges Primrose	<i>Asystasia gangetica</i>	Acanthaceae	Herb
10.	Neem Tree	<i>Azadiracta indica</i>	Meliaceae	Tree
11.	Toddy Palm	<i>Borassus flabellifer</i>	Arecaceae	Tree

12.	Paper flower	<i>Bougainvillea glabra</i> Choisy	Nyctaginaceae	Climber
13.	Great bougainvillea	<i>Bougainvillea spectabilis</i>	Nyctaginaceae	Tree
14.	Flame of the forest	<i>Butea monosperma</i>	Fabaceae	Tree
15.	Golden shower	<i>Cassia fistula</i> L.	Fabaceae	Tree
16.	Bright eyes	<i>Catharanthus roseus</i> L.	Apocynaceae	Herb
17.	Bamboo Palm	<i>Chamaedorea seifrizii</i>	Areaceae	Tree
18.	Lamb's quarters	<i>Chenopodium album</i> sp	Amaranthaceae	Herb
19.	Swollen finger grass	<i>Chloris barbata</i>	poaceae	herb
20.	Egyptian lime	<i>Citrus aurantiifolia</i>	Rutaceae	Tree
21.	Lemon	<i>Citrus limon</i>	Rutaceae	Tree
22.	Cherunaranja	<i>Citrus limon</i> (L.) Osbeck	Rutaceae	Shrub
23.	Pummelo	<i>Citrus maxima</i>	Rutaceae	Tree
24.	Aparajita climbing vine	<i>Clitoria ternatea</i>	Fabaceae	Climber
25.	Coconut palm	<i>Cocos nucifera</i>	Areaceae	Tree
26.	Coconut tree	<i>Cocos nucifera</i>	Areaceae	Tree
27.	Cocunut	<i>Cocos nucifera</i> L.	Areaceae	Tree
28.	Variegated Croton	<i>Codiaeum variegatum</i>	Euphorbiaceae	shrub
29.	Buffalo calf plant	<i>Combretum albidum</i>	Combretaceae	Climbers
30.	Broadleaf palm-lily	<i>Cordyline fruticosa</i>	Asparagaceae	Shrub
31.	Corriander	<i>Coriandrum sativum</i> L.	Apiaceae	Herb
32.	Cycas	<i>Cycas revoluta</i> L.	Cycadaceae	Shrub
33.	Queen Sago	<i>Cycas circinalis</i> L.	Cycadaceae	Tree
34.	Scutch Grass	<i>Cynodon dactylon</i> L.	Poaceae	Herb
35.	Vadanarayanan,	<i>Delonix elata</i>	Caesalpiniaceae	Tree
36.	Snake plant	<i>Dracaena trifasciata</i>	Asparagaceae	shrub
37.	Areca palm	<i>Dypsis lutescens</i>	Areaceae	Tree
38.	Areca palm	<i>Dypsis lutescens</i>	Areaceae	tree
39.	Money Plant	<i>Epipremnum aureum</i>	Araceae	Climber
40.	Asthma weed	<i>Euphorbia hirta</i> L.	Euphorbiaceae	Herb
41.	Weeping fig	<i>Ficus benjamina</i>	Moraceae	tree
42.	Silky Oak	<i>Grevillea robusta</i>	Proteaceae	Tree
43.	firebush	<i>Hamelia patens</i>	Rubiaceae	shrub
44.	Jerusalem artichoke	<i>Helianthus tuberosus</i>	Astraceae	Herb
45.	Redivy	<i>Hemigraphis alternata</i>	Acanthaceae	herb
46.	Hogweed	<i>Heracleum sphondylium</i>	Apiaceae	Herbs
47.	Black spear grass	<i>Heteropogon contortus</i>	Poaceae	Herbs
48.	Hibiscus	<i>Hibiscus rosa-sinensis</i>	Malvaceae	Shrub
49.	Hibiscus	<i>Hibiscus rosa-sinensis</i>	Malvaceae	Shrub
50.	Chinese ixora	<i>Ixora chinensis</i>	Rubiaceae	Shrub

51.	Scarlet Jungle Flame	<i>Ixora coccinea</i>	Rubiaceae	Tree
52.	Rubiaceae Ixora	<i>Ixora coccinea</i>	Rubiaceae	Shrub
53.	Common lantana	<i>Lantana camara</i>	Verbenaceae	Shrub
54.	Mango Tree	<i>Mangifera indica</i> L.	Anacardiaceae	Tree
55.	Bullet wood	<i>Manilkara elengi</i>	Sapotaceae	Tree
56.	Sapota	<i>Manilkara zapota</i>	Sapotaceae	Tree
57.	Arrowroot	<i>Maranta arundinacea</i>	Marantaceae	herb
58.	Chinaberry tree	<i>Melia azedarach</i>	Meliaceae	Tree
59.	Spearmint	<i>Mentha spicata</i>	Lamiaceae	herb
60.	Dog mercury	<i>Mercurialis perennis</i>	Euphorbiaceae	herb
61.	Champak	<i>Michelia champaca</i>	Magnoliaceae	Tree
62.	Elm-Leaf Grewia	<i>Microcos panicula</i>	Malvaceae	Shrub
63.	Indian Beech	<i>Millettia pinnata</i>	Papilionaceae	Tree
64.	Gaint sensitive Plant	<i>Mimosa pigra</i> L.	Fabaceae	Tree
65.	Shame plant	<i>Mimosa pudica</i>	Fabaceae	Creeper
66.	Indian mulberry	<i>Morinda citrifolia</i>	Rubiaceae	Tree
67.	Drumstick tree	<i>Moringa oleifera</i>	Moringaceae	Tree
68.	Curry Leaf Tree	<i>Murraya koenigii</i>	Rutaceae	Tree
69.	Dwarf banana	<i>Musa acuminata</i>	Musaceae	Tree
70.	Banana	<i>Musa paradisaca</i>	Musaceae	tree
71.	Arali	<i>Nerium indicum</i> Mill.	Apocyanaceae	Shrub
72.	Nerium, Arali	<i>Nerium oleander</i> L.	Apocyanaceae	Shrub
73.	Canary Island date palm	<i>Phoenix canariensis</i>	Arecaceae	Tree
74.	Miniature date palm	<i>Phoenix roebelenii</i>	Arecaceae	Tree
75.	Gooseberry	<i>Phyllanthus acidus</i> L.	Phyllanthaceae	Tree
76.	Indian Gooseberry	<i>Phyllanthus emblica</i> L.	Phyllanthaceae	Tree
77.	Pagoda-tree	<i>Plumeria alba</i>	Apocynaceae	Tree
78.	Frangipani	<i>Plumeria obtuse</i> L.	Apocynaceae	Tree
79.	Asoka tree	<i>Polyalthia longifolia</i>	Annonaceae	Tree
80.	Dinnerplate-aralia	<i>Polyscias scutellaria</i>	Araliaceae	tree
81.	Pungai	<i>Pongamia pinnata</i>	Fabaceae	Tree
82.	Pomegranate	<i>Punica granatum</i>	Lythraceae	shrub
83.	Bowstring hemp	<i>Sansevieria zeylanica</i>	Asparagaceae	Herb
84.	Peace lily	<i>Spathiphyllum wallisii</i>	Araceae	Herb
85.	Tamarind	<i>Tamarindus indica</i> L.	Fabaceae	Tree
86.	Cape honeysuckle	<i>Tecoma capensis</i>	Bignoniaceae	shrub
87.	Yellow Balls	<i>Tecoma stans</i> L.	Bignoniaceae	shrub
88.	Teak	<i>Tectona grandis</i>	Lamiaceae	Tree
89.	Kangaroo grass	<i>Themeda trianda</i>	Poaceae	Herb
90.	Bengal clock plant	<i>Thunbergia grandiflora</i>	Acanthaceae	Tree
91.	Guduchi	<i>Tinospora cordifolia</i> (Willd.)	Melastomaceae	Climber

92.	Croton	<i>Tradescantia spathacea</i>	Commelinaceae	Herb
93.	Coatbuttons	<i>Tridax procumbens</i>	Compositae	herb
94.	Red creeper	<i>Ventilago madraspatana</i>	Rhamnaceae	Climbers

Plants found in the Campus



Hibiscus Sps.



Phyllanthus niruri



Arabidopsis thaliana



Passiflora foetida



Acalypha indica



Coccinia grandis



Ixora coccinea



Manilkara zapota



Murraya koenigii



Adenanthera pavonina



Delonix regia



Cocos nucifera



Tridax procumbens



Parthenium hysterophorus



Crescentia cujete



Psidium guajava



Plumeria rubra



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2.10.1. Mushrooms diversity in the campus

Mushrooms, edible basidiomycete, represent white rot fungi which contained higher amount of proteins, rich in minerals with medicinal properties. At present three mushroom varieties (white mushroom, the paddy-straw mushroom and the oyster mushroom) are being cultivated in India. These are most popular, economically sound to grow and is extensively cultivated throughout the world. Due to moderate temperature requirement for luxuriant growth, its cultivation are restricted to the cool malgrowth yield is influenced by the type of compost, spawn, temperature, percentage of moisture and also affected by the pests and disease-causing agents. There has been extensively discussed in recent years, as far as the production of fungal protein from domestic, agricultural and industrial wastes. Since mushrooms have a very short life span, it should reach to consumers within a short time or immediately canned. Mushroom growth is determined by means of carbohydrate content in the substrates like paddy straw, sugarcane molasses, saw wood dust and other plant waste materials.

The campus has various mushroom types covering poisonous, edible and medicinal varieties such as white mushroom (*Agaricus bisporus*), the paddy-straw mushroom (*Volvariella volvacea*), oyster mushroom (*Pleurotus sajor-caju*), button mushroom (*Omphalotus olearius*) and other mushroom types such as *Ganoderma applanatum* and *Volvariella bombycina*.

2.10.2 An account of more oxygen releasing and carbon dioxide assimilating plants in the campus

There are quite a few plants are being considered as highly efficient in oxygen releasing and carbon dioxide assimilating (Carbon sinks) which in turn reflects on quality of the green campus. If more oxygen is made available in the campus naturally, the stakeholders may be free from various cardiovascular and pulmonary problems and breathing troubles. *Sansevieria zeylanica* (commonly known as snake plant or the mother-in-law's tongue plant) is unique for oxygen release during night time and it is able to purify the atmospheric air in terms of removal of toxic gases. Although options are available to enhance the level of oxygen by reducing CO₂ with the aid of oxygenators and air purifiers, there are certain alternatives to improve the air quality which is beneficial for both body and mind. Green audit at the audited organization revealed that the campus is well distributed with more oxygen releasing and CO₂ assimilating plants such as *Money plant*, *Neem tree*, *Tamarind tree*, *arali*, and *Pongam* trees.

There are 6 plant species which are able create an eco-friendly atmosphere in terms of reducing erosion, moderating the climate, improving air quality and supporting wildlife besides they are economically important and valued for different medicinal aspects. The ornamental plants such as Java Plum / Jamun (*Syzygium cumini*), Yellow Trumpet bush / Yellow Bells (*Tecoma stans*) are made available. In addition, medicinal plant such as *Tinospora cordifolia*, *Epipremnum aureum* and Medicinal garden is also available in the campus (Table 7).



Oxygen releasing and carbon dioxide assimilating plants in the Sri Saradha college for women Campus

Table 7. List of oxygen releasing and carbon dioxide assimilating, Ornamental / medicinal plants in the Organisation

S.No	Plant Name (Tamil)	Plant Name (English)	Scientific Name	Grouping / Nature	Characteristic Features of the plant
1.	Kuppaimeni	Copper leaf	<i>Acalypha wilkesiana</i>	Dicots	O ₂ releasing Plant
2.	Katralai	Aloe Vera	<i>Aloe barbadensis miller</i>	Dicots	O ₂ releasing Plant
3.	Vembu	Neem	<i>Azadirachta indica</i>	Dicots	O ₂ releasing Plant
4.	Munkil	Bamboo	<i>Bambusa vulgaris</i>	Monocots	O ₂ releasing Plant
5.	Kaatu panai	Areca Palm	<i>Dypsis lutescens</i>	Monocots	O ₂ releasing Plant
6.	Neenda maravagai	Weeping Fig	<i>Ficus benjamina</i>	Dicots	O ₂ releasing Plant
7.	Arasu	Peepal, Bot-tree	<i>Ficus religiosa</i>	Dicots	O ₂ releasing Plant
8.	Vetchi	Chinese ixora	<i>Ixora chinensis</i>	Monocots	O ₂ releasing Plant
9.	Sinduram	Sxarlet jungle flame	<i>Ixora coccinea</i>	Monocots	O ₂ releasing Plant
10.	Thulasi	Tulsi	<i>Ocimum tenuiflorum</i>	Dicots	O ₂ releasing Plant
11.	Puli	Tamarind	<i>Tamarindus indica</i>	Dicots	O ₂ releasing Plant
12.	Money Plant	Money Plant	<i>Epipremnum aureum</i>	Monocots	O ₂ releasing Plant

2.10.3. Measurement of carbon dioxide level in the campus

Climatic conditions of the earth changed now-a-days due to a massive increase in global warming and environmental changes including human population and human activities. In addition, primarily fossil fuel burning and an extensive usage enhances heat-trapping greenhouse gas levels in the atmosphere. Global warming is driven by human-induced emissions of greenhouse gases which resulted in paramount shifts in weather patterns. In general, a portable CO₂ Analyzer is used to measure the level of carbon dioxide in the atmosphere at different places across the campus. The observation showed that the concentration of CO₂ in the atmosphere is found to be optimal which did not exceed the critical limit of CO₂. It is further revealed that all the selected locations are having pure air without any air contaminants with good air exchange/circulation in the campus. Some of the places like Canteen and Class Rooms are recorded with high level of carbon dioxide level due to student mobilization and the maximum number of electrical items fixed from which the carbon dioxide emission were observed followed by all laboratories and seminar and auditorium halls (Table 8).

Table 8. Measurement of CO₂ concentration in the Organisation

S.No.	Different locations of the Organization's Campus	Carbon dioxide level (ppm)*	Remarks
1.	Classroom	531 ±1.0	Within permissible limits
2.	Auditorium	482 ±1.0	Within permissible limits
3.	Seminar Hall	424 ±1.5	Within permissible limits
4.	Library	462 ±1.5	Within permissible limits
5.	Laboratory	453 ±1.5	Within permissible limits
6.	Canteen	431 ±1.0	Within permissible limits
7.	Open Area	493 ±1.0	Within permissible limits
8.	Car Parking area	428 ±1.0	Within permissible limits
	Mean	460.89%	
	SEC ±	1.10	
	CD at P=0.05%	1.96	

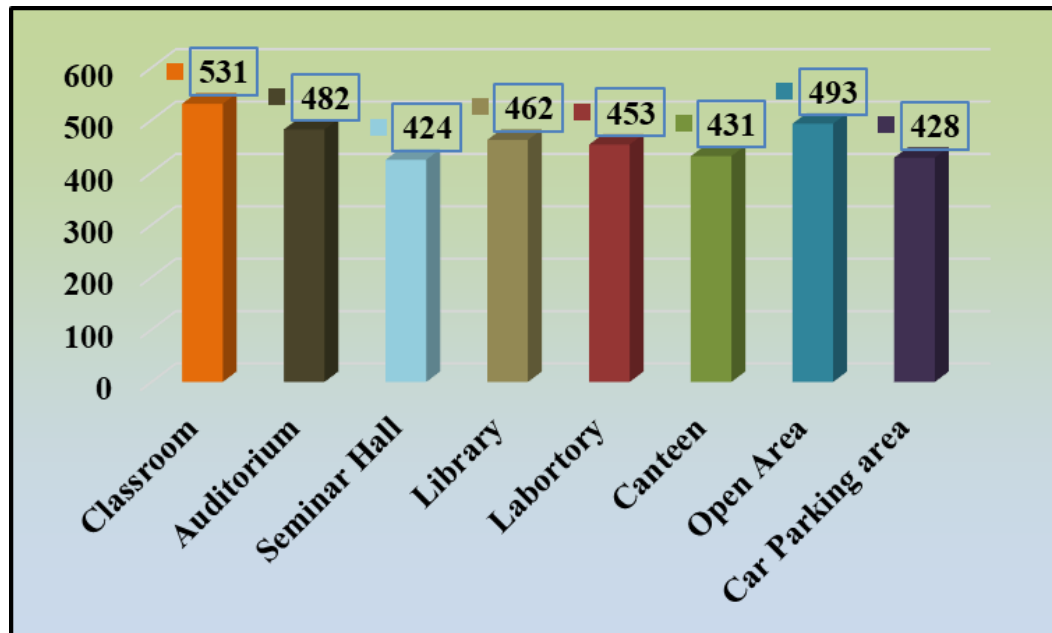
*Average of 3 Observations

Reference of Set values of CO₂ level

Remarks	Ranges
Normal outdoor level	350 - 450 ppm
acceptable levels	< 600 ppm
complaints of stuffiness and odors	600 - 1000 ppm
ASHRAE and OSHA standards	1000 ppm
general drowsiness	1000 - 2500 ppm
adverse health effects may be expected	2500 - 5000 ppm
maximum allowed concentration within a 8 hour working period	5000 - 10000 ppm
maximum allowed concentration within a 15 minute working period	30000 ppm

Source: [Carbon Dioxide Concentration - Comfort Levels \(engineeringtool\)](#)

Measurement of CO₂ concentration in the Organization



Measurement of CO₂ level at Sri Saradha College for Women Campus

2.10.4. Atmospheric oxygen level measurements analysis and interpretation

Oxygen level refers to the amount of oxygen available within the atmosphere or water bodies. Oxygen is produced/released as a by-product of photosynthesis, the metabolic activity of all green plants besides certain microbes. Oxygen plays a paramount role in metabolic activities like respiration and the energy-producing chemistry of all living organisms. In order to quantify the oxygen level, Oxygen Meter is used. The atmosphere contains 18-21% oxygen concentration, 75-78.5% nitrogen and 2-3% other gases like carbon dioxide, neon and hydrogen. The amount of oxygen level in the atmosphere is determined by abiotic factors like altitude, latitude and longitude and biotic factors like plantations in the surroundings. If oxygen level is low in the atmosphere lead to headaches and shortness of breath to human beings. If it excess, it causes oxygen toxicity and oxygen poisoning by creating coughing, breathing trouble and damage the lungs to human beings. The oxygen level of different places at the campus are monitored and presented (Table 9).

Table 9. The oxygen concentration at different places of audited organization

S. No	Location	Oxygen Level (%) *	Remarks
1.	Classroom	20.2±0.1	O ₂ level is good
2.	Auditorium	20.2±0.1	O ₂ level is good
3.	Seminar Hall	19.7±0.05	O ₂ level is good
4.	Library	19.3±0.15	O ₂ level is good
5.	Laboratory	20.3±0.05	O ₂ level is good
6.	Canteen	20.6±2.0	O ₂ level is good
7.	Open Area	20.4±0.5	O ₂ level is good
8.	Car Parking area	20.6±0.1	O ₂ level is good
	Mean	20.25 %	
	SEC ±	0.09	
	CD at P=0.05%	0.17	

*Average of 3 Observations

Acceptable Range of Oxygen level in atmosphere

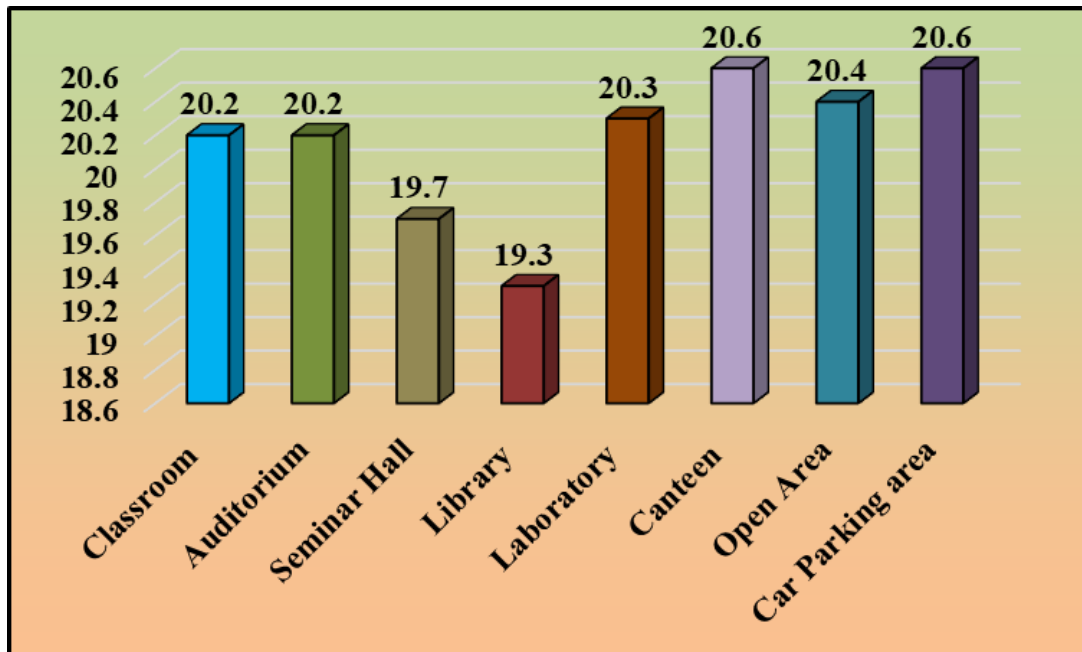
Remarks	Ranges
Normal outdoor level	Lesser than 19.5%
Acceptable levels	19.5 – 23.5%
Unacceptable Levels	Greater than 23.5%

Source:

<https://www.bing.com/images/search?view=detailV2&ccid=k3hbgxMG&id=668F691338AE02C81F0E45BC8844389178A222D6&thid=OIP.k3hbgxMGAFEnftDrSFJIKgHaFS&mediaurl=https%3A%2F%2Fblog.gooddayswork.ag%2Fhs-fs%2Fhubfs%2FOxygen%20Levels.png%3Fwidth%3D1515%26name%3DOxygen%20Levels.png&exph=597&expw=836&q=acceptable+values+oxygen+in+Atmosphere&simid=608025171854903257&form=IRPRST&ck=C93AD2003030E48674CE414B372525BA&selectindex=21&ajaxhist=0&ajaxserp=0&vt=0&sim=11>

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Figure 4. The oxygen concentration in the Organisation



Measurement of O₂ level at Sri Saradha College for Women Campus



2.10.5. Lawns, trees, herbs, shrubs, climbers and lianas in the campus

Lawns are gazing features of unutilized land made to cover the soil with green grass for the ambience of the place to have a greenish look. Lawn provides a hollow space among the building structures. The shaded trees in between the grass lawn, pathways and garden benches are meaningful lineaments to the green campus. The advantage of lawn is that it prevents the unintended weeds growth in the unutilized landscape areas. Trees that are native to land with medicinal value, ethnicity and environmental value add an advantage to green building. Purpose of trees is to provide shade and shelter to bird's diversity. Herbs are small plants with medicinal values and shrubs are small plants with thick stems and can hold soil to some extent and prevents soil erosion. Climbers can grow with the support of trees and the climbers can enhance the wall value with greeneries.

The campus has a huge number of trees, herbal plants, bushes, climbers, lianas, twiners and lawns. It is further observed that all the plants are growing profusely and showing healthier, free from pests and diseases attack. The commonly available native as well as wild shrub species in the campus are Kakithapoo (*Bougainvillea spectabilis*), Madhanakamaboo (*Cycas revolute*), Sembaruthi (*Hibiscus rosasinensis*), Vetchi (*Ixora coccinea*), Malli (*Jasminum sambac*) and Arali (*Nerium odorum*).

Similar to that of shrubs, there are three kinds of herbs available in the campus. The predominant species of herbs available in the audit site are *Tradescantia spathaceae* (Croton) and *Vinca rosea* (Bright eyes). The existence of climber, creepers, twiners and lianas species available which accounted more than seven species in the campus is Amirtaval (*Tinospora cordifolia*). The major grasses are Arugam Pullu (*Cynodon dactylon*), Korai Pullu (*Cyperus rotundus*) and Crowfoot grass (*Dactyloctenium aegyptium*). Weak stemmed creeper plants grow alongside the ground, depends another plant support or climb up a wall by means of extending stems or branches. Climbers include herbs or shrubs whose stems are weak which needs support to grow where it climb up trees and walls and grow vigorously without any pest and disease attack which are observed in the campus.

2.10.6. Establishment of aquarium and aquatic plant

Growing fishes in the small ponds will keep the environment pleasant. In the closed environment like corridors and the front offices, auditoriums and gallery classes placing the fish aquarium as well as plant aquarium will improve the scenic value of the place bringing peace to the people. The fish water waste also can be used as manure for growing potted indoor plants. Growing *Lotus*, *Lilly*, *Hydrilla* and other water plants will give a pleasant and calm environment and growing fishes like *Guppies* can keep the water clean and neat. The fountains and small ponds can be built in the frontages to give an aesthetic look and also growing water plants in these ponds will help to maintain the aesthetic sense of the environment in greenish. The audited organization has initiated to start a good aquatic site in which aquatic plants, fishes and birds are expected to live generously.

2.10.7. Establishment of different gardens in the campus

Growing many types of herbal plants having medicinal importance in the campus becomes more attractive and useful provided gardens are maintained. Rare Endangered Threatened (RET) plants are most useful in terms of economic importance. The tree garden / arborea can be planted based on the zodiac signs which would attract the public and educate them based on their uses. In the tree gardens, trees as linings all over the campus can act as oxygen corridors. Native trees along with trees like *Azadirachta*, *Pongamia* and *Ficus* species can be cultivated at the maximum as these plants are used to remove the dust particles and carbon from the air and purifies the air considerably. Similarly, the ornamental plants with beautiful flowers can be maintained in the frontage gardens to provide good ambience.

In the campus, they are planted ornamental plants for the display of appealing characteristic features including, varying types of leaves and their fragrance, fruit, stem and bark. In some places, plants unusual features to be of interest such as the prominent thorns of cactus and snake

many varieties of ornamentals plants are maintained in the surrounding of the Organisation campus. In front of Principal's room, cafeteria, grounds and many places planted ornamentals plants. These plants are making the campus green. No plant is cut unless it becomes dead. This environment makes campus green pleasant and lively.



Garden at Sri Saradha College of Arts and Science for Women campus

2.10.8. Natural topography and vegetation

Natural topography means the original geographical features of the campus, around 60-65% of the organization should have the natural features like rocks, water resources, slopes, landscape, pathways, etc. and the altered topography can be accounted for, it is facilitated. The vegetation in the land alone is considered as they are part of the natural topography. Vegetation in the artificially created structures are also accounted when it is reported more than 70% of the claimed green campus auditsite. Vegetation is the cultivation of a bunch of plants irrespective of the plant *taxa* for the covering of the area or ground topography. Natural topography is better appreciated with wild vegetation than the artificially created topography like pathways and parking areas. The observation at the campus indicated that more than 25% natural topography and vegetation have been maintained properly. Further, there was no anthropogenic activity in the campus.

2.10.9. Use of biofertilizers, organic and green manures

Natural or eco-friendly methods should be used to grow plants vigorously in the campus which could reduce the environmental pollution. Use of biofertilizers, organic manures (cow dung, vermicompost and plant wastes and litters) and green manures to grow healthy plants should be ensured to keep the campus organic. The plant waste such as fallen leaves, stems, fruits, nuts, seeds and other plant parts should be used to make green manures. A concrete or ground level green manure production unit and vermicomposting units will help to convert all the plant and animal-based wastes into green/organic manures. Minimal use of chemical fertilizers as part of integrated nutrient management system is acceptable but “zero use” of chemical fertilizers is highly appreciable. The soil, air, water and sunlight are considered as natural resources.

Management of the right way of utilization of these resources with the vision of sustainability should be carried out by framing a committee led by the Head of the Institution concerned. Biofertilizers such as nitrogen fixing bacteria, phosphorus solubilizing bacteria, farm yard manure, dried cow dung manure and vermicompost manures are extensively used in the audited organization to cultivate plants. These practices are very well appreciated because air, water and soil pollution due to use of agrochemicals is eradicated which in turn to improve the soil health significantly.

2.11. Fauna diversity in the campus

2.11.1. Birds diversity in the campus

The observations on fauna diversity indicated that the campus has a large number of living as well as visiting birds. A total number of 16 birds belonging to the 2 species were recorded from different habitats during winter and summer; out of which one was endemic to the Deccan Plateau like purple rumped sunbird. Totally 9 species of birds representing 2 families and 2 orders were observed during this study, passeiformes constituted the predominated group representing 7. Total number of 4 bird species, out of them 2 species were migrant, 2 species were local migrant during winter and summer season because of unfavorable environment and low availability of food resources. Migratory bird species like Mangrove heron, Common Wood shrike, Black-rumped flame back and Peacock (Tables 10 & 11).

Table 10. Birds Diversity in the campus

S.No	Scientific name	Common name
1.	<i>Accipiter</i> sps.	Shikra
2.	<i>Acridotheres tristis</i>	Common myna
3.	<i>Anthus rufulus</i>	Black kite-
4.	<i>Athene brama</i>	Spotted owlet
5.	<i>Bubulcus ibis</i>	Cattle egret
6.	<i>Corvus splendens</i>	House crow
7.	<i>Dendrocitta vagabunda</i>	Rufous Tree pie
8.	<i>Dicruridae macrocercus</i>	Black drongo
9.	<i>Egretta garzetta</i> sps.	Little egret
10.	<i>Elanus axillaris</i> sps	Black-shouldered kite

Table 11. Total number of visiting birds in the campus

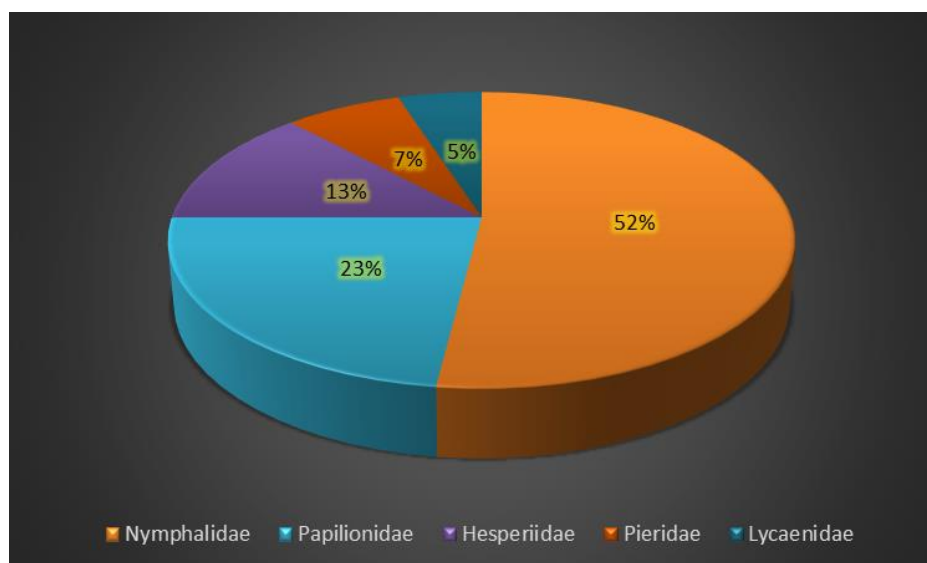
S.No	Common Name	Scientific Name
1.	Koel	<i>Eudynamis scolopacea</i>
2.	Rose-ringed	<i>Psittacula krameri</i>
3.	Mangrove heron	<i>Butorides striata</i>
4.	Wood shrike	<i>Tephrodornis pondicerianus</i>

2.11.2. Butterflies diversity in the campus

The campus has five family level diversities such as Papilionidae, Pieridae, Nymphalidae and Lycaenidae in which common butterflies species such as Mormon, Rose, Birdwing, Emigrant, Grass yellow, Gull Wanderer, Small Orange Tip, Plain Orange Tip, White Orange Tip, Yellow Orange Tip, Pioneer Chocolate, Pansy, Baron, Palmfly, Bush, Brown, Eggfly, Leopard, Sailer, Evening and Grey are commonly observed (Table 12).

Table 12. List of Butterflies recorded in the Campus

S.No.	Common Name	Scientific Name	Family
1.	Common hedge	<i>Actolepis puspa</i>	Lycaenidae
2.	Common Hedge Blue	<i>Acytolepis puspa</i>	Lycaenidae
3.	Pioneer	<i>Belenois aurota</i>	Pieridae
4.	Angled pierrot	<i>Caleta caleta</i>	Lycaenidae
5.	Common mpierrot	<i>Castalius rosimon</i>	Lycaenidae
6.	Tamil yeoman	<i>Cirrochroa thais</i>	Nymphalidae
7.	Rustic	<i>Cupha erymanthis</i>	Nymphalidae
8.	Plain tiger	<i>Danaus chrysippus</i>	Lycaenidae
9.	Common Tiger	<i>Danaus genutia</i>	Nymphalidae
10.	Common crow butterfly	<i>Euploea core</i>	Papilionidae
11.	African Marbled Skipper	<i>Gomalia elma</i>	Hesperiidae
12.	Tailed jay	<i>Graphium agamemnon</i>	Papilionidae
13.	Common banded	<i>Hasora chromus</i>	Hesperiidae
14.	Yellow Orange Tip	<i>Ixias pyrene</i>	Pieridae
15.	The Giant Owl	<i>Caligo memnon</i>	Nymphalidae
16.	Common cerulean	<i>Jamides celeno</i>	Lycaenidae
17.	Metallic Caerulean	<i>Jamides alecto</i>	Lycaenidae
18.	Lemon pansy	<i>Junonia lemonias</i>	Papilionidae
19.	Common Lascar	<i>Pantoporia hordonia</i>	Nymphalidae
20.	Lime Butterfly	<i>Papilio demoleus</i>	Papilionidae
21.	Red Pierrot	<i>Talicauda nyseus</i>	Lycaenidae
22.	Common Grass Dart	<i>Taractrocera maevius</i>	Hesperiidae
23.	Blue tiger	<i>Tirumala limniace</i>	Nymphalidae
24.	Dark blue tiger	<i>Tirumala septentrionis</i>	Nymphalidae
25.	Southern birdwin	<i>Triodes minos</i>	Papilionidae

Figure 5. Butterfly diversity in the campus

2.11.3. Mammals diversity in the campus

Mammals, a group of vertebrate animals (class: Mammalia), characterized by the presence of mammary glands (where females produce milk for feeding/nurturing their young), a neocortex (a region of brain), fur or hair and three middle ear bones. These characteristic features differentiate them from reptiles and birds. Observation on diversity of mammals in the campus of audited organization indicated that around 4 Mammal species are commonly distributed. The commonly found mammals are Black-naped Hare, Three-striped Palm Squirrel, Common or Grey Mongoose and Short-nosed Fruit Bat besides House Rat and Indian Mole-rat. (Table 13).

Table 13. List of Mammals diversity in the campus

S.No.	Common Name	Scientific Name	Common Name
1.	Black-naped Hare	<i>Lepus nigricollis</i>	Muyal
2.	Three-striped Palm Squirrel	<i>Funambulus palmarum</i>	Anil
3.	House Rat	<i>Rattus rattus</i>	Sundeli
4.	Indian Mole-rat	<i>Bandicota bengalensis</i>	Peruchali

2.11.4. Amphibians diversity in the campus

Amphibians (class: Amphibia) are ectothermic, tetrapod vertebrates. All living amphibians represent the group Lissamphibia and they inhabit a wide variety of habitats. Most of them living within terrestrial, fossorial, arboreal or freshwater aquatic ecosystems. Amphibians naturally start out as larvae living in water but some species bypass this by developed behavioural adaptations.

Historically, amphibians evolved in the Devonian period from sarcopterygian fish with lungs and bony-limbed fins, which were helpful them to adapt to dry land conditions. Their spread was higher and predominant during Carboniferous and Permian periods and they were later displaced by reptiles and mammals. Over a period, amphibians shrank in size and their diversity decreased drastically. The modern subclass Lissamphibia. Modern amphibian orders include

frogs), Urodela (the salamanders) and Apoda (the caecilians). Generally amphibians undergo metamorphosis from larva with gills to air-breathing adult with lungs. Skin of the Amphibians served as a secondary respiratory organ while very few terrestrial salamanders and frogs lack lungs and they rely entirely on their skin for respiration. With their complex reproductive needs and permeable skins, amphibians are often ecological indicators. In recent decades, there has been a drastic decline in populations of many amphibian species around the globe. Known amphibian species is frogs which accounts for nearly 60% of amphibian species. Observation made on diversity of Amphibians in the campus indicated that around 6 species are Amphibians are commonly distributed. Observation made in the campus on diversity of Amphibians revealed that around 3 species are commonly disseminated.

2.11.5. Grasshopper diversity in the campus

Grasshoppers, a group of insects belonging to the suborder Caelifera and they are probably most ancient living group of chewing herbivorous insects. They are typically ground-dwelling insects with powerful hind legs which allow them to escape from threats by leaping dynamically. As a Hemimetabolous insects, they do not undergo complete cycle of metamorphosis. In other words, they hatch from an egg into a nymph or "hopper" which undergoes five moults, to become identical to that of an adult. Grasshoppers hear through the tympanal organ which can be found in the first segment of the abdomen attached to the thorax; its sense of vision is compound eyes. Under certain environmental conditions, some grasshopper species at high population densities can change colour and behaviour besides form swarms. Grasshoppers are plant-eaters; few species at times become as a serious pests of cereals, vegetables and pasture, especially when they swarm to destroy the crops over huge contiguous areas.

2.11.6. Termites diversity in the campus

Termites are most successful groups of insects on earth, colonising most landmasses. Their colonies range in size from a few hundred individuals to enormous societies with several million individuals. Eusocial insects, commonly termites are taxonomically ranking as infraorder. Isoptera, or alternatively as epifamily Termitoidae within the order Blattodea (along with cockroaches). Although termites are habitually known as "white ants", they are not ants and they are not closely related with them. Earlier, termites were classified as a separate order from cockroaches. Recent phylogenetic studies revealed that they evolved from cockroaches, as they are deeply nested within the group and the sister group found to wood eating cockroaches of the

genus *Cryptocercus*. More recent estimates suggest that they have originated during the late Jurassic period evidenced with the first fossil records in the early Cretaceous. Termites mostly nourish on cellulose based dead plant material (wood, leaf litter), soil and animal dung. Two species of termites (*Odontotermes anamallensis*, *Trivitermes fletcheri*) recorded during onsite green campus audit at the organization and they are belonging to the Genera *Odontotermes*, *Trivitermes* and *Nasutitermes*.

2.12. Landscape design and soil erosion control

Landscape management is the maintenance of land to make sure that backgrounds can fulfil the needs and objectives in an effective and sustainable manner for current and future members. Landscape design is an important feature for any disasters to control especially with respect to the soil erosion. In general, soil erosion occurs if the design of the land is not altered so as to prevent the slope features by strong vegetation and use of a plant buffer zone as safe for escape of nutrients or fertilizers entering the streams. When the slope features are altered, adequate vegetation can alone be enough to prevent soil erosion.

Observation revealed that the audited site has very good landscape design without disturbing the natural vegetation. Contour ploughing is being done at right angles to the slope wherever possible and ridges and furrows are properly maintained to break the flow of water down to the empty land. These activities are widely adopted to control soil erosion in the campus.

2.12.1. Pedestrian path facility at the campus

The concept of pedestrian path is to give safe space to walk freely by the pedestrian. It is very important in the green campus in terms of freely walk pedestrians or people going on foot without any obstacles. The pedestrian path is otherwise called as zebra crossing by the combination of black and white stripes remained to characterize the zebra. This path is specially designed space to the stakeholders to walk freely without any disturbance. It is useful for cross walk and easy to recognize to walk by means of wide black and white colour combination of lines and authorize to walk while crossing and walking on the foot. In addition, pedestrian path is created in the green campus along with road side which meant for walking only using special cement bricks and stones.



The pedestrian path aims to end circulation not only cars, buses, vans, trucks and other vehicles but also giving safe space to the pedestrians, where cross and pass through blocks and also forcing vehicles to comply with it. The audited organization is having very good facility in creating pedestrian path for stakeholders.

2.13. Rainwater harvesting system and percolation pond

Rainwater harvesting system is a traditional old practice not only in drought prone areas and also in areas having seasonal rainfall. The Indian traditional rainwater harvesting is being practiced in various parts of the country to improve the ground water status. Now the threatening features of the lower ground level of water has created a revamp of newly featured rainwater harvesting systems. Indian traditional rainwater harvesting systems are constructed based on three modes either direct pumped, indirect pumped or by both modes. In addition, lakes, ponds, water, and other water reservoir methods are considered as the rainwater harvesting system.

The green campus should have adopted any of the above said modes of rainwater harvesting or any new methods that has the benefit of conserving the water resource as well. A small square shaped pit containing gravels and sands constructed near the building for rainwater harvesting and connected with pipes from the roof tops of the building to pit. During the audit it has been observed that the organization has well developed and maintained rain water harvesting system. Rainwater harvesting structures have been commissioned at different locations of the audited organization's campus.



Rainwater harvesting system Found in the Campus

2.13.1. Operational water supply thro' drip and sprinkler system

Maintaining the green campus, water conservation mechanisms should be applied efficiently in the campus. Well planned water irrigation systems like sprinkler and drip should be implemented in the entire green area of the campus for an effective water management system. This can be implemented only when the plantations are well planned. The tree growing areas can be connected with medicinal plants growing areas and flower gardens can be connected with sprinkler irrigation. Vegetative area of the audited organization has taken sufficient efforts to maintain the plants greenish and frequency of watering to the plants. A register is maintained to note down the timing of watering the plants and quantity of water irrigated every time. Internal auditing of time of plantation, number of times the plants are watered and growth parameters of the plants in the campus is being carried out.

2.13.2. Biodiversity Park

The campus should be a mini biodiversity conservation area wherein more greenery due to native plant species, medicinal plant garden, concept gardens, flowering plants that attract bees, birds, beetles and other animals like squirrels in the ecosystem. Shade giving trees in the paths, flowering trees in the avenues and fruit trees at the back yards also would attract birds and squirrels. The campus of audited Organisation is free of exotic plants that cause threat to the natural vegetation. It is like mini bio-reserve rich in native species and endemic plants. A complete data on the soil type, water holding capacity and soil nutrition in the campus is being thoroughly studied internally or with the Government Agriculture Departments. It is useful for cultivation of various native and wild plant species and also helps in choosing the proper irrigation system which in turn facilitate water conservation.

2.14. Conduct of outreach programmes for dissemination of green campus initiatives

Professional implementation of all the Eco plans in the campus should be done through the Eco clubs, Nature clubs, Science clubs, Youth Red Cross units, Fine Arts clubs, Women cell, Associations, Forums, SSL, NCC (National Cadet Corps) and NSS (National Service Scheme). All the students, members of staff and employers should be mandatory members of the club and should do tree planting and maintenance of greenery in the campus periodically. Conducting frequent seminars, conferences, workshops, awareness rallies, etc. on topics relevant to the environment is necessary to educate and create awareness among the students and staff members. Awareness programmes on the green campus initiatives and dissemination of green motto and pledges are accounted in a sustainable manner. Its benefits and self-sustainability are being projected for wider centric on earth and ecology conservation. In addition, student's associations, cells, clubs and forums should be the first-hand receivers of all the new plans proposed by the Government such as Swachh Bharath Abhiyan and Jal Shakti Abhiyan under Clean India Mission and implement the same in the campus.



The Organisation has well developed NCC/Student Force, NSS, Swatch Bharath Abhiyan under Clean India Mission. These bodies are actively involved in tree planting programmes and cleaning the surrounding areas of tribal, rural and urban people across Chennai. The Organisation is conducting a large number of activities to conserve the nature and to teach about the importance of environment to rural, tribal and urban people. Technology driven solutions initiated by the green campus organization are periodically disseminated and documented successively for propagating the attitude of the green campus in wider masses. The Organisation has taken sufficient attempt to disseminate the green campus motto and green pledge such as “Don’t cut trees”, “Don’t use plastic bags”, “Don’t waste waters”, “Plastic Free Zones” and “Preserve the Natural Resources”, etc. among the students and staff members in the campus.

The Organisation has implemented the Government schemes (Swatch Bharath Abhiyan under Clean India Mission) to give pure and safe water to rural people and teach the importance of cleanliness of toilets and restrooms to people living in Perambalur Districts. These activities are very important in view of the instantaneous vicinity to undertake progressive programmes and conducted participatory rural appraisal programmes. The organization is also focusing on the development of women, youth, children and to identify the extension and training needs of the target group. It provides the vocational training to marginal farmers to overcome the problem of seasonal employment. Some of the areas identified are goat farming, mushroom cultivation, vermicomposting, bee keeping, ornamental fisheries, organic farming and medicinal plant cultivation.

The college helps to develop social commitment and to expose the students to get sensitized to social realities and to build a link between the student community and the wider community. It enhances the social interaction, inter-personal communication skills and develop emotional maturity of students. It also helps students in total and integrated personality development. The college facilitates to prepare the students for future life, by developing qualities such as cooperation, team spirit, leadership, discipline and development of creative talents including to boost the self-confidence of students.

2.14.1. Academic credentials: projects, dissertations and thesis work

Project, Dissertation and Thesis works are academic effort credentials that always fosters the innovative ideas on thinking and implementation of new innovative approaches. Applied research work of the faculties, staff and student members should be implemented within the campus owing to the credential of the research. Those works indicating the significance of empowering the green campus can be implemented or adopted in other organizations. If the innovation is capable of developing into entrepreneurship, then it is highly appreciable. The report of projects and dissertations which are productive in methodologies should be disseminated through presentation and publication in social media, books, magazines and journals so as to spread the innovative ideas and methods to the broad public. The Organization's faculty members and students from various subject domains are doing extensive project work related to nature conservation, environmental pollution and conservation of natural resources.

2.15. Compliances

1. It is observed that the Organization is maintaining more than 65% of green cover after building construction as per the guidelines of World Green Building Council and Indian Green Building Council and it is calculated that the natural vegetation accounts for 25% and planted vegetation was 40%.
2. The campus provides pure atmosphere to the stakeholders in terms of without disturbing the natural vegetation along with the artificially created topography like pathways and parking areas.
3. In view of floral biodiversity in the campus of audited Organisation, a sum 94 species belonging to 85 Genera under 60 families and all are growing profusely and free from pests and diseases.
4. The campus has a greater number of oxygen releasing and carbon dioxide assimilating plants.
5. Considering the faunal biodiversity, variety of mammals, birds, grasshoppers, termites, amphibians, reptiles and butterflies are recorded besides visiting birds
6. The campus has well established rainwater harvesting models, percolation pond to recharge the bore wells by collecting rainwaters from the building roofs, open areas and playgrounds including unexplored areas which are channelized properly.
7. In nut shell, the nature conservation measures are well implemented and maintained by the organization.

2.16. Endorsements for further greening

- Honey bee hives may be kept in isolated areas within the campus where from student's mobilization is restricted.
- Irrigation facilities should be implemented.

- Complete data on physic-chemical properties of soils may be documented time to time which may be useful for the cultivation of various native and wild type plant species.
- A time to time water quality parameters should be monitored which may be useful for the benefit of stakeholders and to cultivate healthier plants.
- “Green Campus”, “Energy” and “Environment Policies” and “Purchase Policy” for not allowing the non-degradable plastic covers during the packing of goods may be developed with respect to nature conservation and environmental protection.
- Management of the audited Organisation has to take smart initiatives towards creating a green campus in the areas of green computing and waste management. The desktop infrastructure is virtualized through VMW virtualization technology.
- Use of fossil fuels has to be reduced for the sake of community health and to conserve natural resources.
- Exotic grassland can be replaced by growing native grasses which will yield revenue.
- Plants may be subjected with White Wash upto 3 feet height with a mixture of Limestone and Neem Oil.

2.17. Conclusion

The organisation has made significant progressive contributions with respect to teaching learning, research and consultancy, innovation and transfer of technology, community service and value education, *in toto*. It imparts quality education to rural, tribal and urban people across the Nation which is excellent in terms of academic activities and providing an eco-friendly atmosphere to the stakeholders. The organization has taken enormous efforts to maintain green campus in a sustainable manner. It has conducting a large number of activities for the benefit of rural and tribal community people without disturbing the natural environment. The installation of a rainwater harvesting system and irrigation system to conserve rainwater and improve the ground water levels are noteworthy. The Organization has created medicinal, herbal and ornamental gardens at small scale level for establishing a massive reforestation / afforestation programme in which a large number of trees and shrubs species were planted together for providing an eco-friendly atmosphere to the stakeholders in a sustainable manner.

Annexure - I

Methodology for Flora and Fauna Identification

I. Identification of Flowering Plant Species

Various vascular plant species were identified based on the following identification key by adopting the polyphasic taxonomic approach

Key to Plant Families Identification

1a. Seeds enclosed in fruit wall, Perianth Present.....	2
b. Seeds not enclosed in fruit wall, perianth absent.....	Gymnosperm
2a. Leaves usually net veined seeds-2.....	3
b. Leaves parallel veined, seeds-1.....	66
3a. Petals free	4
b. petals connate	41
4a. Corolla and calyx present.....	5
b. Corolla and calyx absent.....	24
5a. calyx of united sepals; ovary inferior.....	31
b. Calyx of distinct or unit sepals; ovary syncarpous.....	6
6a. Sepals imbricate in bud.....	7
b. Sepals valvate in bud.....	24
7a. Sepals more or less united at the base.....	19
b. Sepals free	8
8a. Stamens more than 12.....	9
b. Stamens 10 or fewer.....	13
9a. Sepals 2-3.....	11
b. Sepals 4 or more	10
10a. Stamens inserted on the disk.....	Cleomaceae
b. Stamens inserted of the gynophore.....	Capparaceae
11a. Trees, Petals more or like the sepals; carpels free.....	Magnoliaceae
b. Herbs, petals coloured unlike the sepals; carpels united	12
12a. Plants with yellow sap, Flowers pedicelled	Papaveraceae
B. Plants with watery sap, Flowers sessile	Portulacaceae
13a. Flowers unisexual, gynoecium apocarpous.....	Menispermaceae
b. Flowers bisexual, gynoecium Syncarpous.....	14
14a. Petals 4, Stamens 6.....	Brassicaceae
b. Petals 5, Stamens ∞	15
15a. Ovary 1, loculated.....	16
b. Ovary 2-more loculated.....	17
16a. Flowers actinomorphic, placentas free- central.....	Caryophyllaceae
b. Flowers zygomorphic, placentas parietal.....	Viloiaceae
17a. Filaments of anthers more or less united	Polygalaceae
b. Filaments of anthers more or less united	18
18a. Leaves stipulate; stamens 5 or 10	19
b. Leaves exstipulate; stamens usually 8	Sapindaceae
19a. Style 5; stamen 5.....	Oxalidaceae
b. Style many; stamens 10	10
20a. Leaves pellucid-gland dotted.....	18
b. Leaves not gland dotted	21

21a. Placentas parietal; Fruit elongated.....	Moringaceae
b. Placentas axile; Fruits not elongated.....	22
22a. Ovules and seeds pendulous; sometimes horizontal.....	Meliaceae
b. Ovules and seeds erect or ascending	23
23a. Stamens alternate with the petals.....	Anacardiaceae
b. Stamens opposite the petals	Vitaceae
24a. Leaves simple; Flowers 3-merous	Annonaceae
b. Leaves compound; Flowers 4-6 merous.....	25
25a. Filaments of anther united into a columnar toothed cup	26
b. Filaments of anther free; rarely connate at the base in ring.....	28
26a. Stamens 15; anther united	Sterculiaceae
b. Stamens 2; anther free.....	27
27a. Anther unilocular; pollen muricate	Malvaceae
b. Anther bilocular; pollen smooth.....	Bombacaceae
28a. Stamens 4-5; usually embraced and adnate to the base of the petal.....	29
b. Stamen many; atleast twice as many as and free from the petals	30
29a. Shrub	Lythraceae
b. Straggler	Rhamnaceae
30a. Anther dehisce by slits; fruits capsule	Tiliaceae
b. Anther dehisce by spores; fruits drupe	Elaeocarpaceae
31a. Ovary syncarpous; placentas 3-5, parietal	32
b. Ovary 1 or more free, placentas basal... ..	33
32a. Climbing herbs tendril.....	Passifloraceae
b. Erect shrubs or trees with tendril.....	Turneraceae
33a. Ovules arising from the inner angles or from base of the carpels or loculi... ..	34
b. Ovules pendulous form the apex of the carpels or locules... ..	Combretaceae
34a. Carpels solitary; fruits legume.....	35
b. Carpels more than 1; fruits otherwise.....	37
35a. Flowers zygomorphic; petals imbricate	36
b. Flowers actinomorphic; petals valvate	Mimosaceae
36a. Upper petals outermost stamens monodelphous or diadelphous	Fabaceae
b. Upper petals innermost stamens always free	Caesalpiniaceae
37a. Flowers unisexual	Cucurbitaceae
b. Flowers bisexual.....	38
38a. Ovary 1-celled	Cactaceae
b. Ovary more than 1 celled... ..	39
39a. Carpels free if ultimately united the styles distinct	40
b. Carpels and styles united throughout.....	Myrtaceae
40a. Flowers in dichasial – polychasial cyme.....	Molluginaceae
b. Flowers in clustered, cymes or solitary	Aizoaceae
41a. Ovary inferior, stamens as many as the corolla lobes	42
b. Ovary superior, stamens numerous	43
42a. Anther free; ovary 2-loculed; stipulate	Rubiaceae
b. Anther syngenesious; ovary 1-loculed, exstipulate.....	Asteraceae
43a. Ovary 1-loculed; placentation free central.....	Plumbaginaceae
b. Ovary 2-many loculed; placentation axile or parietal... ..	44
44a. Ovary 3 or more carpelled.....	45
b. Ovary 2-carpelled	46
45a. Corolla actinomorphic.....	46

b. Corolla zygomorphic	50
46a. Plants leafless; parasitic.....	Cuscutaceae
b. Plants leafy ; not parasitic	47
47a. Leaves opposite; stamens 2.....	-
48 b. Leaves alternate; stamens 4 or more.....	49
48a. Leaves not scabrid, corolla tube white: fruits berry	Oleaceae
b. Leaves scabrid; corolla tube orange; fruits capsules	Nyctanthaceae
49.a. Anther inseperatable; corona present.....	Asclepidiaceae
b. Anther seperatable; corona absent.....	Apocyanaceae
50a. Corolla lobes imbricate ;fruit drupe.....	Boraginaceae
b. Corolla lobes plicate; fruit capsule	Convolvulaceae
51.a Ovary cells many ovulated	Solanaceae
b. Ovary cells 1-4 ovuled... ..	52
52.a Carpels 2 or more ovulated ; fruits dehiscent.....	53
b. Carpels 1 –ovulated ; fruits indehiscent.....	57
53.a Fruits dehiscent; seeds supported on reticulae	Acanthaceae
b. Fruits indehiscent; seeds not supported on reticulae... ..	54
54.a. Leaves compound; fruits elongated; seeds winged	Bignoniaceae
b. Leaves simple;fruits not elongated, seeds not winged	55
55.a. Ovules many on swollen placentas; seeds albuminous	Scropulariaceae
b. Ovules 2 lobed placenta ; seeds not albuminous... ..	56
56.a Flowers solitary; axile placentation	Pedaliaceae
b. Flowers raceme; axile placentation... ..	Marytiniaceae
57.a Ovary entire, style terminal	Verbinaceae
b. Ovary 4 –lobed, style gynobasic	Lamiaceae
58.a Flower bisexual.....	59
b. Flower unisexual	62
59.a. Ovary inferior	60
b. Ovary superior	61
60.a Ovary 4-6 loculated; ovules many	Aristolochiaceae
b. Ovary 1-loculated; ovules 1-4.....	Santalaceae
61.a Perianth not tubular.....	Amarathaceae
b. Perianth trubular	Nyctaginaceae
62a. Leafless trees; brachlets ribbed and joined at the nodes... ..	Casuarinaceae
b. Leaves well developed ; brachlets not ribbed and not joined at the nodes.....	63
63 a. Ovary 1- loculed; ovules 1-2 in each loule	64
b. Ovary 2 or more loculed;ovules 1 or 2 in each locule.....	65
64a. Leaves glandular	Euphorbiaceae
b. Leaves eglandular	Urticaceae
65a. Filaments inflexed in bud with reversed anther.....	Moraceae
b. Filaments not inflexed in bud, not with reversed anther	Ulmaceae
66. a. terrestrial or ephiphytic	67
b. Aquatic, marsh or riparian.....	Cyperaceae
67a. Arbrorescent woody; leaf blade many nerved articulate with sheath.	Bambusaceae
b. Herbs with herbaceous culms; leaf blade sessile not articulate with sheath... ..	68
68a. Perianth 0 or reduced to scale.....	MOHAN SUBALAKSHMI
b. Perianth present	69
70a. Plant armed... ..	71

b. Plant unarmed.....	72
71a. Plants Xerophytic; leaves fibrous	Agavaceae
b. Plants not xerophytic; leaves nor fibrous.....	Lilliaceae
72 a. Perianth segments connate	Amaryllidaceae
b. Perianth segments free... ..	73
73a. Outer perianth calycine; inner coroline.....	Commelinaceae
b. Outer and inner perianth... ..	74

II. Identification of Non-Flowering Plant Species

Lichen samples were identified based morphological, biochemical and anatomical features and representative samples were compared with the voucher specimens at the Lichen Herbarium Centre of National Botanical Research Institute (NBRI), Lucknow, Uttar Pradesh, India.

III. Identification of Major Groups of Mushrooms

Mushrooms are belonging to fungal kingdom which are edible and non-edible innature. They represented in various colours starting from white, black, brown, red and pale yellow rot fungi. They are identified based on the following characterization key

3. ENERGY AUDIT

3.1. Introduction

An energy audit is a survey in which the study of energy flows for the purpose of conservation is examined at an organization. It refers to a technique or system that seeks to reduce the amount of energy used in the Organization without impacting the output. The audit includes suggestions of alternative means and methods for achieving energy savings to a greater extent. Conventionally, electrical energy is generated by means of fossil fuels, hydraulic and wind energy. The availability of fossil fuels and their depletion rate, insist the need for alternate energy systems and conservation of conventional electric energy. In general, the primary objective of an energy auditing and management of energy consumption is to offer goods or services at the lowest possible cost and with the least amount of environmental impact (Backlund and Thollander, 2015).

Energy Conservation Building Code (ECBC) is established in the year 2017 which provides minimum requirements for the energy-efficient design and construction of buildings across India. It also provides two additional sets of incremental requirements for buildings to achieve enhanced levels of energy efficiency that go beyond the minimum requirements. Bureau of Energy Efficiency (BEE) came into force in 2002 towards implementation of energy saving practices in an organization. Energy-efficiency labels are information affixed to manufactured products and usually communicate the product energy performance (Ingle *et al.*, 2014).

BEE Star Rating Scheme is based on actual performance of the building as well as equipment in terms of specific energy usage termed as 'Energy Performance Indicator' by means of star ratings labelled items used which will be useful for energy savings in a sustainable manner (Mishra and Patel, 2016). Energy audit programme provide aid in maintaining a focus on energy price variations, energy supply availability and efficiency, determining an appropriate energy mix, identifying energy-saving technology, retrofitting for energy-saving equipment and so on (Gnanamangai *et al.*, 2021, 2022; Rajalakshmi *et al.*, 2019). In general, an energy audit process dealt with the driving energy conservation concepts into reality by giving technically possible solutions within a specified time limit while considering the economic and other organizational issues (Asnani and Bhawana, 2015). It also dealt with the uncover ways to cut operating expenses or reduce energy use per unit of production in terms of savings. It serves as a "benchmark" for managing energy in the organization for planning more energy-efficient use across the board (Cabrera *et al.*, 2010).

3.2. Need for an Energy Audit

In an organization, the top three operating expenses are energy, labour and materials. Relating the manageability of the cost or potential cost savings in each of the above components, energy management is found to be the top ranker and thus energy management constitutes the essential part in reducing the cost. Energy audit helps in understanding the ways of energy and fuel are being used in any organization and identifies the areas where wastes occur and the scope for improvement exists. Energy audit gives a positive orientation to the energy cost reduction, maintenance quality control programmes and will help to keep the operations which occur in the energy costs, availability and reliability of supply.

The ecofriendly campus concept essentially focuses on the efficient use of energy conservation and its savings opportunities in a sustainable way. It also gives importance for reduction in carbon emissions, carbon footprint calculation, use of star rated equipment, encouraging energy use conservation practices, reduce the organization's energy consumption, reduce wastes to landfill. Of course integrating environmental considerations into all contracts and services considered to have significant environmental impacts (Anirudhan *et al.*, 2023). The energy consumption, energy sources, energy monitoring, lighting, vehicle movement, electrical and electronics appliances and transportation are addressed by this indicator.

Energy usage is an important aspect of campus sustainability (Shriberg, 2002), however, energy saving and opportunities may be taken into consideration while energy is extensively used (Choy and Karudan, 2016). In addition, suggestions and recommendations might be given after auditing which in turn useful for energy savings. Thus, it is essential for any environmentally responsible institution to examine its energy use practices at least once in two years using internal and external auditors (Sri Santhya *et al.*, 2022). Attempts may be made to measure the carbon footprint in the organization based on the amount of carbon emissions created by the electrical appliances, vehicles and human population. It is therefore recommended to measure the carbon footprint in each organization which may be useful for maintaining the environmental friendly campus for the benefit of stakeholders (Sreekala *et al.*, 2023).

3.2.1. Aims and Objectives of an Energy Audit

An energy audit is a useful tool for developing and implementing comprehensive energy management plans of an organization. As mentioned earlier, aim of an energy audit is to identify the energy efficiency, conservation and savings opportunities at the audit sites in a systematic manner. The audit process involves following steps.

- Review of energy saving opportunities and measures implemented in an audit site.
- Identification of various energy conservation measures and saving opportunities.
- Implementation of alternative energy resources for energy saving opportunities and decision making.
- Providing a technical information on how to build an energy balance as well as guidance to be sought for particular application.
- Detailed analysis on energy consumption based on latest electricity bills and understanding the tariff plan provided by the Central and State Electricity Board.
- The utility of energy in terms of electricity, LPG, firewood, petrol, diesel and other resources to calculate carbon foot print analysis with in the campus.
- Utility of number if incandescent (tungsten) bulb and CFL bulbs, fans, air conditioners, cooling apparatus, heaters, computers, photo copiers, inverter, generators and laboratory equipment and instruments installed in the organization to calculate the energy utilization.
- Alternative energy sources / nonconventional energy sources are employed / installed in the organization (photovoltaic cells for solar energy, windmill, energy efficient stoves, Biogas, etc.).
- Creating awareness among the stakeholders on energy conservation and utilization.

3.2.2. Benefits of an energy audit

- **Reduced energy expenses:** Less energy used by an organization, reduced the energy costs.
- **Identify problems:** Energy audit can help to identify any issues that the equipment might have.
- **Increased employee comfort:** Insulation and air sealing is an important criteria which enhances more reliable and more efficiently cooled or heated space for the employees. More comfortable employees tend to be more productive, in turn, it is not only savings on energy costs, but will improve overall productivity.
- **Personalized recommendations:** The professional will customize a plan, recommending which upgrades will give the most return on investment which includes updated lightings, new HVAC system, weatherization measures like insulation and air sealing and more.
- **Show environmental concern:** By taking steps to be more energy efficient, the Organization will be showing the employees and clients that the organization cares about the impact on the environment.
- **Increased property value:** Using the recommendations of an energy auditor to make facility more energy efficient could also help to increase its overall property value and longer equipment lifespan.
- **Energy audit evaluation:** Energy audits will evaluate the Organization “as a whole”, the aim is to consider a wide range of available alternatives (electrical, mechanical, thermal water and transportation). The audit will not only inform about the opportunities but also provide information with financial analysis.
- **Analyzing the quality of energy audit:** It provides information with emissions analysis to help understand the benefits of the decisions from an environmental standpoint.

3.2.3. Types of energy audit

The energy audit types depends on the following factors:

- ✓ Industry/ Organization and its function
- ✓ Intense and the extent to which final audit is required and
- ✓ The magnitude of cost reduction

Thus, energy audit can be classified into the following types.

Preliminary energy audit: Preliminary energy audit gives a quick access to 1) estimating and establishing energy consumption in the organization, 2) estimate the scope of audit, 3) identify the areas of maximum energy consumption, 4) identify the areas of improvement, 5) setting benchmark on the basis of existing data.

Detailed energy audit: The detailed energy audit offers the most accurate estimation of energy savings and cost. A comprehensive audit provides a detailed energy implementation plans for a facility, as it evaluates all major energy consumption systems. It considers the effects of all projects, accounts for the energy use of all major equipment and includes detailed energy cost saving calculations and project cost. Energy balance is the key element in detailed energy audit. The estimated use is compared to utility bill charges. There are three phases in detailed energy audit which include Phase I: pre-audit phase, Phase II: audit phase and Phase III: post-audit phase.

Potential and magnitude of energy audit: A systematic and structured method is necessary for an efficient working of energy audit process. An initial site study is carried out for planning the procedures necessary for an audit.

Initial site study and preparation for detailed audit

An initial site study visit might take one or two days and gives the energy auditor an opportunity to meet the concerned person (Auditee) to familiarize with the site and to assess the procedures necessary to carry out the energy audit. During the initial site visit the Energy Auditor carries out the following actions: a) discussion on the aims and scope of the energy audit b) economic factors associated with the recommendations of the audit, c) analysing the major energy consumption data with the concerned person, d) obtaining the available audit site drawings (building layout, electricity distribution, steam distribution, compressed air distribution, etc.) and e) walk-through audit around site.

Comprehensive energy audit: A comprehensive audit can take from several weeks to several months depending on the nature and complexity of the site to complete the audit process. Detailed study is carried out to establish and investigate the energy and material balances for specific departments. Possible checks of plant operations were carried out over extended periods of time, at nights and at weekends as well as during normal daytime working hours, to ensure that nothing is overlooked.

The information to be collected during the detailed audit includes

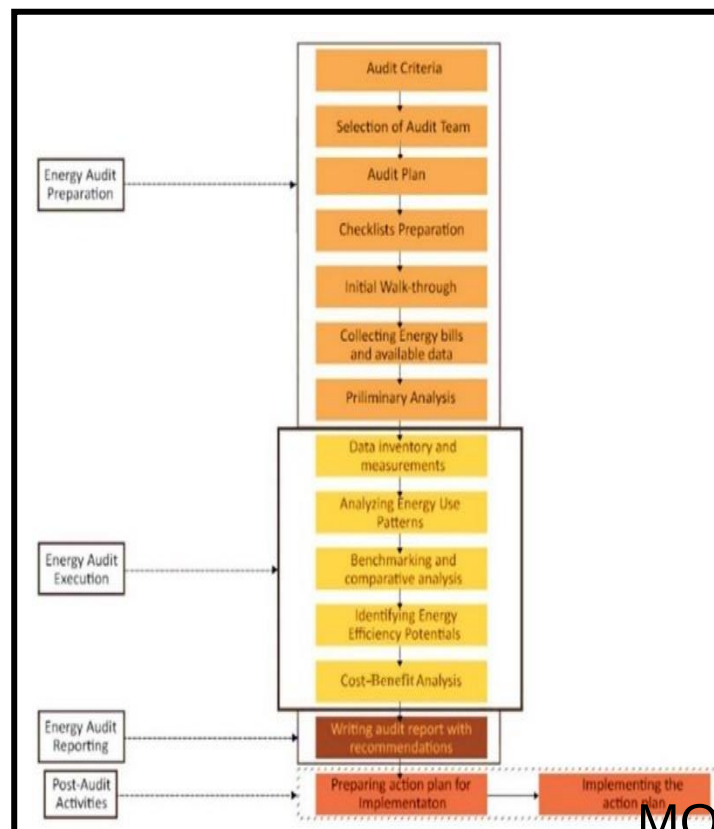
- Energy consumption by type of energy, by department/area, by type of process equipment, by end-use
- Energy cost and tariff data
- The distribution and generation of site services (eg. electricity, compressed air, steam).
- Sources of energy and its supply (e.g. electricity from the grid or self-generation)
- Potential alternative for fuel substitution, process modifications and the use of co-generation systems (combined heat and power generation).
- Energy conservation and management awareness training programs within the Organization.
- Besides audit team collects a) major equipment details, process/technology used, b) water/fuel/steam, electrical energy consumption and c) yield efficiency.

The audit report includes list of energy inputs and product outputs by major department or by major processing function and estimates the efficiency of each step of the Organization. The methods for improving the efficiency will be listed and it also includes preliminary assessment of the cost of the improvements and expected payback on any capital investment needed. The audit report concludes with specific recommendations for detailed engineering studies and feasibility analysis. The comprehensive energy audit is useful in identifying the major energy consuming areas to be surveyed during the audit and to identify any existing instrumentation/ additional metering required. Proper care should be taken while identifying the instrumentation required for carrying out the audit and to plan the time management for the macro data from energy consuming areas.

3.3. Procedures followed in an energy audit

Several methods are adopted in the energy audit, walk-through audit is one among them. The balance of total energy inputs with total energy outputs and identification of all energy streams in a facility are taken into account. The amount of energy used by each of its energy streams are calculated as per the methodology mentioned in the audit Manual. The production process flow is studied and electricity consumption are measured. Location of the electrical machines, conditions of them and their accessories are inspected through physical verification as per the regulation of Indian Green Building Council and World Green Building Council (IGBC, 2021). Physical verification of installed electrical appliances and when considering the cost or prospective cost savings in each of the above components, energy always wins and the energy management task becomes a key cost reduction area.

An energy audit is proposed and conducted to ensure that energy saving practices are implemented and followed in Educational Institutions and Industrial sectors in a sustainable way. Preparation and completion of a questionnaire, physical examination of the campus, observation and examination of documentation, key person interviews, data analysis, measurements and suggestions are all part of the audit process. Energy audit involves several facts including energy savings potential, energy management, finding alternatives, etc. (Cabrera *et al.*, 2010; Rajalakshmi *et al.*, 2021; Leon- Fernandez and Dominguez-Vilches, 2015; Bae and Seol, 2006; Singh *et al.*, 2012). It may be useful to check where carbon emission is prominent which could be taken into account to reduce. Finally, after the audit process, the energy audit included suggestions for energy cost reduction, preventive maintenance and quality control activities, all of which are critical for the utility operations in the auditee (Organization).

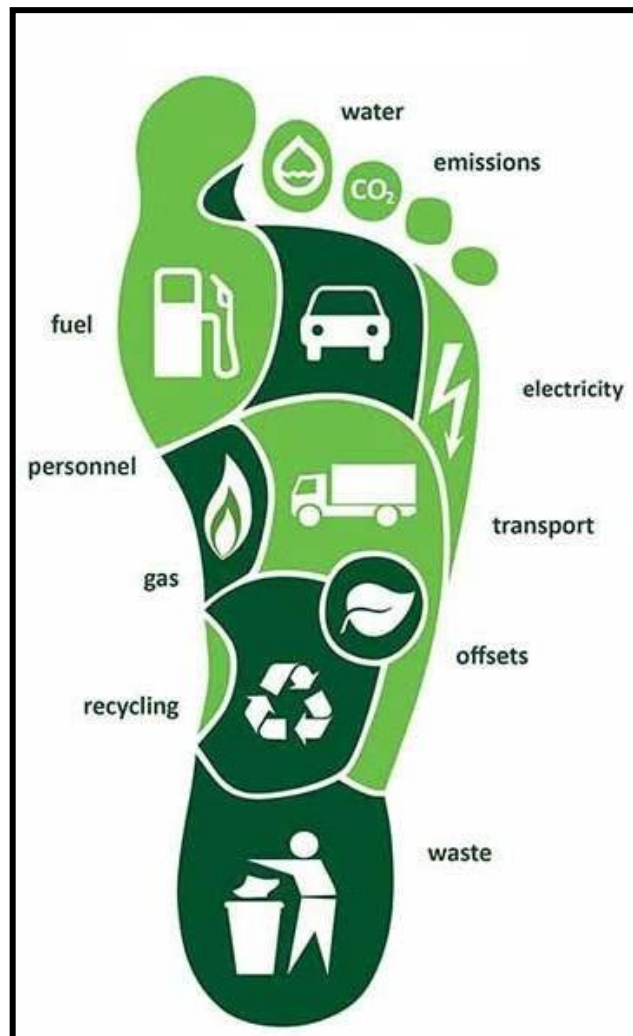


Flow chart of energy audit methodology

3.4. Carbon footprint

The carbon footprint per year is calculated (www.carbonfootprint.com) based on electricity usage per year in which CO₂ emission from electricity and the sum of transportation per year in terms of number of the shuttle buses service operated by the Organization and number of cars, motorcycles and trucks entering in the Organization campus. These factors are multiplied with total number of trips in each day and approximate travel distance of vehicles covered in each day with a coefficient (0.01) to calculate the emission of CO₂ in metric tons per year.

Humans contribute to a massive increase of carbon dioxide emissions by burning fossil fuels, deforestation, and other industrial activities. Methane (CH₄) is largely released by coal, oil and natural gas industries. Anthropogenic activities are responsible for almost all of the increase in greenhouse gases in the atmosphere over the last 150 years. The largest source of greenhouse gas emissions from human activities is from burning fossil fuels for electricity, heat and transportation (Peters and Romi, 2014).



Components of Carbon Foot Print

3.5. Observations of the energy audit

3.5.1. Facilities visited

During onsite audit following departments were verified for physical facility availability (Table 20).

Table 14. Facilities visited during the onsite energy audit

Date	Section where Energy audit is conducted
10.03.2023	Administrative Block
	Power House
	Faculty Rooms
	Classrooms
	Seminar Halls
	Auditorium
	Laboratories
	Computer Centers
	Well, Sump and pumps.
	Sewage Treatment Plant
	Hostel
	Library

In all these areas lighting systems forms the major consumer of electrical energy. In all the sections lighting fixtures, installed energy efficient lighting systems/ safety systems were verified besides installed power backup systems (generators and UPS) were verified. The electricity consumption charges are audited and studied for the load demand requirement and efficient consumption of energy. The scope for improvement has been discussed with the auditees. Potential areas in which scope of energy conservation and saving opportunities available have been identified and suggested for implementation.

3.5.2. Qualitative measures available at the campus according to the checklist

It has been observed that except a criteria, all others are satisfied the checklist prepared in accordance with National Building Code (Part - 11) (Table 21).

Table 15. Qualitative measures available at the Institute

S. No .	Part 11 clause as per the National Building Code	Audit Checklist / Parameters	Audit Findings (C / NC/ PC)
1.	3.5. Energy efficient design and process	Use of non-fossil fuel energy for all needs at the campus (solar, wind, etc.,)	C
2.		Examine the natural lighting, cooling and ventilation facilities	C
3.	6.2.8. Optimal day lighting	Whether the building ensures 25% of day lighting which will be measured using Lux meter during onsite audit.	C

4.	7.1.3.3. Landscape design for controlling solar gain	Observation on energy conservation activities through vegetation (more number of trees)	C
5.	7.4.2. Long term public and private transportation plan	Availability of electric vehicles	C
6.		Use of public transport by the stakeholders to reduce air pollution	C
7.	8.3.1. Integration of solar thermal technologies	Availability of solar panel, solar street light and solar water heater.	C
8.	11.3. Natural and mechanical ventilation strategies	Availability of spatial cooling techniques through windows	C
9.	11.8. HVAC system	Whether the campus has air cooler, air conditioners, refrigerants, exhaust air fans, ceiling, pedestal fans and provision of separate server room / data centre facilities.	C
10.	11.9. Electrical system	Availability of appropriate metering for energy consumption and replacing old electrical items with latest star rated gadgets / appliances	C
11.		Replacement of fluorescent (tube) lights, incandescent lamp, insect traps and sodium vapour lights with CFL / LED lamps, insect traps towards energy saving opportunities.	C
12.		Whether transformer, generators and UPS are protected properly with fencing and kept awareness boards as 'Dangers' and 'Warnings'	C
13.		Use of Ultra-violet lights and any other harmful lights with safety precautions in the campus	C
14.		Sign boards indicating Switch OFF / ON, Danger at Electrical equipment and Power transformers	C
15.	12.3.4. Establishing	Database on annual energy consumption using cost profile	C
16.	energy consumption and creating bench marks	Database on annual energy consumption of fuels (Diesel, petrol and LPG)	C
17.	12.4.4. Noise monitoring	Measure the noise level using Sound level meter during onsite audit	C

18.	13.3. Operation and maintenance programme	Calculate carbon foot print using electrical energy and fuel consumptions.	C
19.	Energy saving opportunities	Availability of transformer, generators, UPS convertor, inverter, compressor, stabilizers, etc.,	C

3.6. Quantitative measures

In this section, quantitative measures observed/verified and secondary data obtained from the management representative/ IQAC coordinator are presented.

3.6.1. Energy consumption and cost profile

The following chart shows the profile of energy consumed and the cost for one year by the auditee (Figs.8 & 9; Table 16).

Figure 8. Electrical energy consumption profile

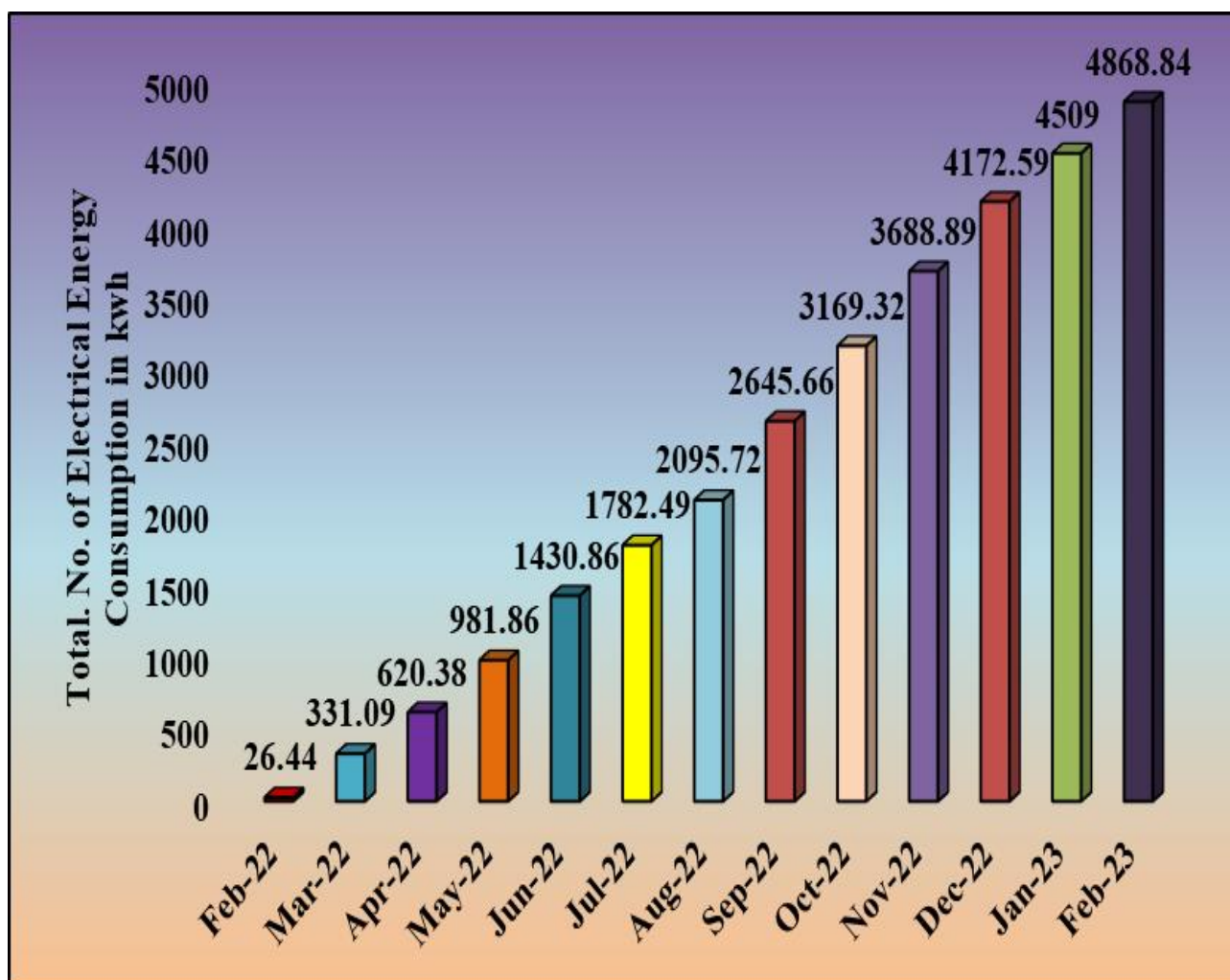


Figure 9. Overall electrical energy consumption and cost profile

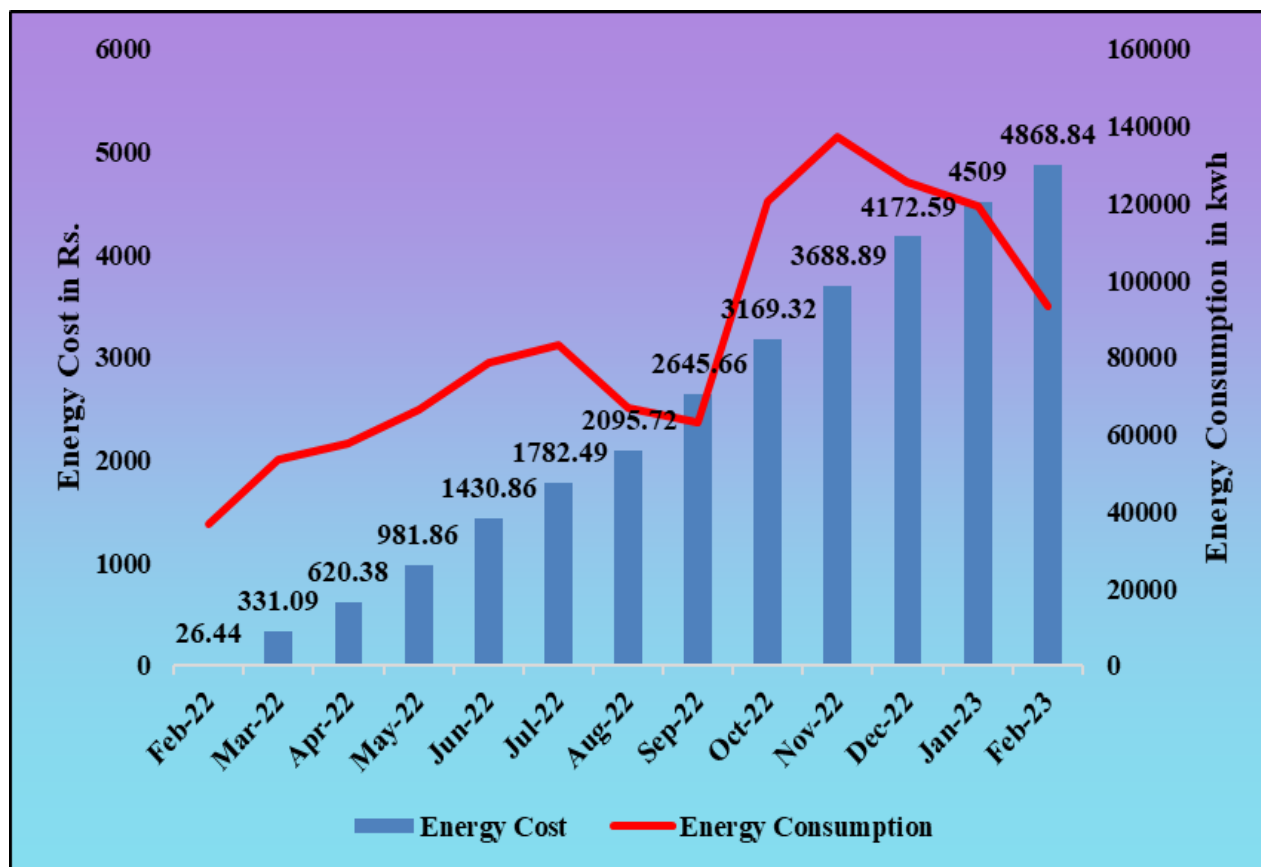


Table 16. Electrical energy consumption and cost profile in the Institution

S. No	Months	Rating / Capacity units in kWh	Cost in Rs.
1.	February -2022	26.44	36707
2.	March -2022	331.09	53565.6
3.	April -2022	620.38	57794
4.	May -2022	981.86	66634.9
5.	June -2022	1430.86	78677.9
6.	July -2022	1782.49	83160
7.	August -2022	2095.72	67025
8.	September-2022	2645.66	63122.4
9.	October-2022	3169.32	120318
10.	November-2022	3688.89	137274
11.	December-2022	4172.59	125320
12.	January-2023	4509	119011.2
13.	February-2023	4868.84	93172.2

3.6.2. Power consuming equipment and electrical appliances

Other than electrical energy from grid, energy generated using fossil fuels for the year 2022 are presented in Table 17.

Table 17. Annual Energy Consumption of Fuels in the College

S.No	Month	Diesel Consumption (Liters)	Petrol Consumption (Liters)	LPG Consumption (kg)	Mean Consumption
1.	February -2022	78	25	13	2.03
2.	March -2022	10608	25	7	9.09
3.	April -2022	12740	25	7	9.69
4.	May -2022	9708	25	13	8.83
5.	June -2022	8425	25	13	8.47
6.	July -2022	7776	25	12	8.29
7.	August -2022	9840	25	12	8.87
8.	September-2022	9633	25	18	8.81
9.	October-2022	NIL	25	6	6.08
10.	November-2022	9852	25	6	8.87
11.	December-2022	9700	25	21	8.83
12.	January-2023	10288	25	12	9.00
13.	February-2023	10600	25	12	9.09

3.6.3. Energy consuming vehicles

Institution run the e-vehicles for the benefit of its stakeholders. Details of the same are presented in Table 18.

Table 18. Transportation Facilities available in the Campus

S. No	Type of Vehicle	Fuel Used	No. of Vehicles	Non-Pollution Certified (Y/N)
1.	Bus	Diesel	21	Y
2.	Car	200 L	1	Y
3.	Jeep	Nil	Nil	Nil
4.	Bike	325 L	1	Y
5.	Lorry	200 L	1	Y
6.	Trucks	400 L	1	Y

3.6.4. Calculation of carbon footprint

The carbon footprint analysis can be calculated based on the earlier reports as stated in www.carbonfootprint.com which is the sum of electricity usage per year (Padmini, 2007). According to the data provided by the Management, carbon emission due to electricity consumption and fossil fuels are presented hereunder.

The CO₂ emission from electricity

$$\begin{aligned}
 &= (\text{electricity usage per year in kWh}/1000) \times 0.84, \text{ where } 0.84 \text{ is the coefficient to convert kWh to metric tons} \\
 &= (30323.14 \text{ kWh}/1000) \times 0.84 \\
 &= 25.47 \text{ metric tons}
 \end{aligned}$$

According to the above calculations, carbon emission due to electricity accounts for 25.47 metric tons.

Transportation per year (Shuttle)

$$\begin{aligned}
 &= (\text{Number of the shuttle vehicle in the campus (2)} \times \text{total trips for shuttle bus service each day} \times \text{approximate travel distance of a vehicle each day inside campus only (20 km)} \times 365/100) \times 0.01 \\
 &= ((21 \times 20 \times 1 \times 365)/100) \times 0.01 \\
 &= 15.33 \text{ metric tons}
 \end{aligned}$$

365 is the number of days per year

0.01 is the coefficient to calculate the emission in metric tons per 100 km for bus

a. Transportation per year (Car)

$$\begin{aligned}
 &= (\text{Number of cars entering the campus} \times 2 \times \text{approximate travel distance of a vehicle each day inside campus only (in kilometers)} \times 365/100) \times 0.02 \\
 &= ((4 \times 20 \times 1 \times 365)/100) \times 0.02 \\
 &= 5.84 \text{ metric tons}
 \end{aligned}$$

365 is the number of days per year

0.02 is the coefficient to calculate the emission in metric tons per 100 km car

b. Transportation per year (Motorcycles)

$$\begin{aligned}
 &= (\text{Number of motorcycles entering the campus} \times 2 \times \text{approximate travel distance of a vehicle each day inside campus only (in kilometers)} \times 365/100) \times 0.01 \\
 &= ((20 \times 20 \times 1 \times 365)/100) \times 0.01 \\
 &= 14.6 \text{ metric tons}
 \end{aligned}$$

365 is the number of days per year

0.01 is the coefficient to calculate the emission in metric tons per 100 km for motorcycles.

c. Total Carbon emission per year

$$\begin{aligned}
 &= \text{total emission from electricity usage} + \text{transportation (bus, car, motorcycle)} \\
 &= (25.47 + 15.33 + 5.84 + 14.6) \\
 &= 61.24 \text{ metric tons}
 \end{aligned}$$

3.6.5. Ways to reduce carbon footprint

Evaluating and understanding the CO₂ emission can reduce the negative impact on the environment. Tiny changes can bring good impacts like when it comes to transportation, food, clothing, waste, etc., the following tips helps in reducing the carbon footprint (Vinoth Kumar *et al.*, 2021).

Food: Consumption of local and seasonal food products, limiting the consumption of meat, adopting sustainable fishing, avoiding plastic packed food products and practicing the use of reusable bags and sense of buying only necessary things that can impact on carbon emission.

Clothing: Taking good care of clothes, avoid buying second hand products or borrowing and using the clothes made from recycled products with eco-friendly dyes improves the reduction in carbon emission.

Transport: Adopting carpooling practice, using cycles and public transport and usage of “No Pollution” certified vehicles also contribute reduction in carbon emission.

Energy and waste: Turning down the heating, short showers, proper usage of water while brushing teeth or cleaning the dishes, proper care while charging the batteries, selecting star rated equipment and EU Energy labelled products and reduce and recycle of wastes can also contribute reduction in carbon emission.

3.7. Noise level measurements

Noise is all unwanted sound or set of sounds that causes annoyance or can have a health impact and noise level is measured in decibels (dB). Noise pollution is defined as consistent exposure to elevated sound levels that may cause adverse effects in humans or other living organisms. World Health Organization (WHO) defined environmental noise (sound produced by transport, industrial activities, construction sites, public works and services, cultural, sporting and leisure activities and neighborhood) as noise from all sources with the exception of workplace noise and recognizes that noise pollution is an increasing problem. Prolonged exposure to loud noises (>75 dB (A) over eight hours a day for years) can lead to hearing loss.

The body can also respond to lower noise levels. Level of noise are expected to be within 55 dB in residential areas, including institutions. Class room noise levels are supposed to be around 50 db (Table 19). From the graph, it is evident that most of the noise level values across campus are above the normal or permissible range. Within the auditorium the noise levels were within range. Sound levels in other areas of campus are largely due to the interactions of people on campus than any other causes like construction or traffic. Sound Level Meter / Noise Thermometer are used to measure the noise level in the surroundings which converts the sound signal to an equivalent electrical signal and the resulting sound pressure level in decibels (dB) referenced to 20 μ Pa. Noise level prescribed by Central Pollution Control Board was presented in (Table 20).

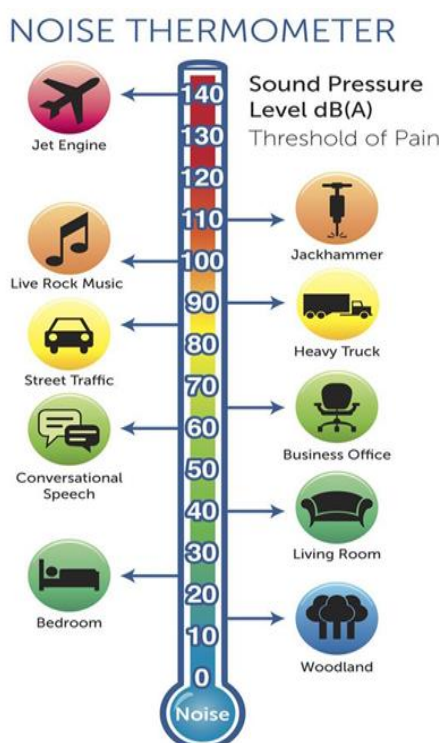
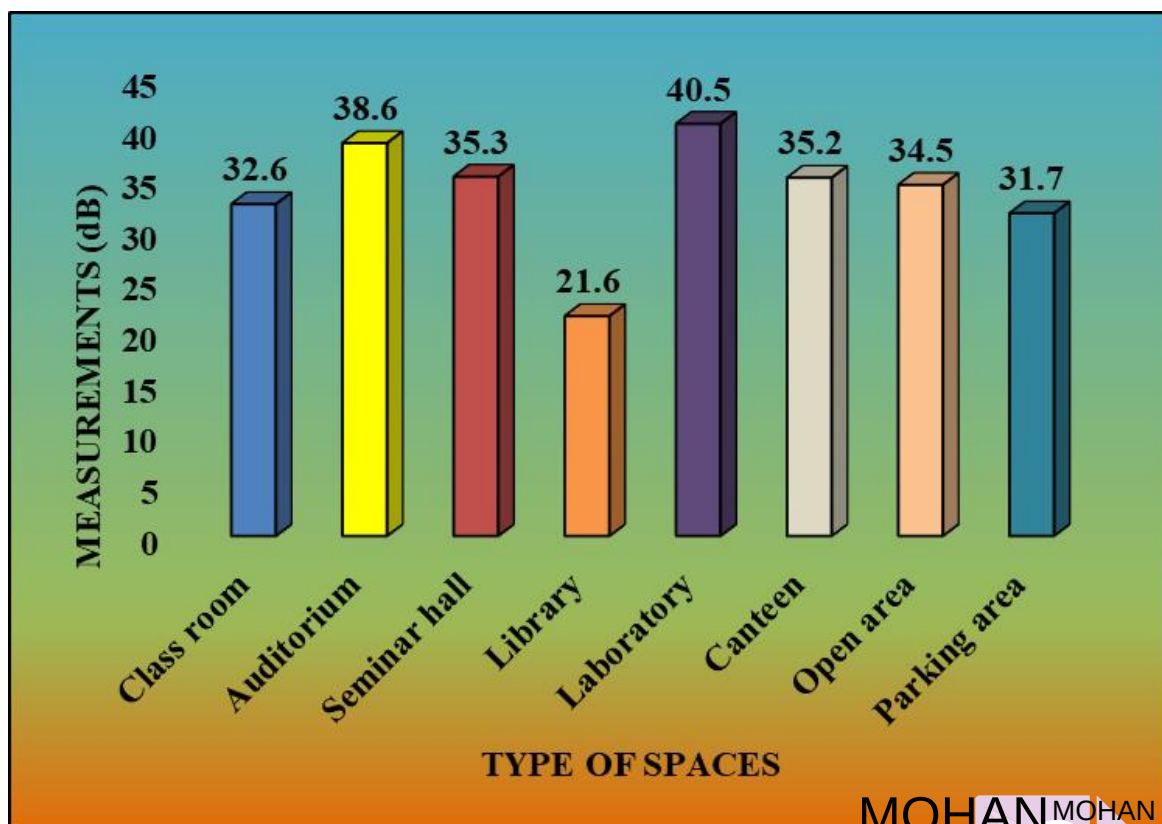


Table 19. Noise level at various location in the campus

S.No	Locations	Measurements (dB)	Major noise sources	Remarks
1.	Class room	32.6 $\pm$ 0.4	Students and Staff	No Noise Pollution
2.	Auditorium	38.6 $\pm$ 0.6	Students	No Noise Pollution
3.	Seminar hall	35.3 $\pm$ 0.3	Students	No Noise Pollution
4.	Library	21.6 $\pm$ 0.3	Staff members	No Noise Pollution
5.	Laboratory	40.5 $\pm$ 0.3	Students	No Noise Pollution
6.	Canteen	35.2 $\pm$ 0.8	Students and Staff	No Noise Pollution
7.	Open area	34.5 $\pm$ 2.0	Students and staff	No Noise Pollution
8.	Parking area	31.7 $\pm$ 0.5	Vehicles	No Noise Pollution
	Mean	31.2		
	SE	0.76		
	CD	1.36		

Table 20. Noise level standard prescribed by Central Pollution Control Board, Government of India

Area Code	Zone	Limits in dB (A) Leq	
		Day Time	Night Time
A	Industrial	75	70
B	Commercial	65	55
C	Residential	55	45
D	Silence	50	40

Figure 8. Noise level at various location in the campus

3.8. Light intensity measurement at the campus

Light intensity or light output is used to measure whether a particular light source provides enough light for an application needed. There is a well-established light level recommendation for a wide range of applications in lighting industry and also for the type of space. Understanding the light intensity helps to properly evaluate whether the space has adequate lighting conditions or not. Light intensity is measured in terms of lumens per square foot (foot-candles) or lumens per square meter (Table 21) (lux). Measuring the amount of light that falls on a surface allows to evaluate if the particular space has sufficient light to perform the tasks. A light meter (lux meter) is used to measure the amount of light in a space/on a particular work surface. The light meter consists of a sensor that measures the light falling on it and provides the user with a measurable illuminance reading. Light meters are an especially useful tool for measuring light for safety or over-illumination. The light intensity is usually measured by taking initial reading, where the lightings are turned off (Baseline measurement) and the final reading is taken by turning on the lights in the particular space (illuminated level) Subtracting the baseline measurement from illuminated level gives the light intensity of the particular room (Table 22).

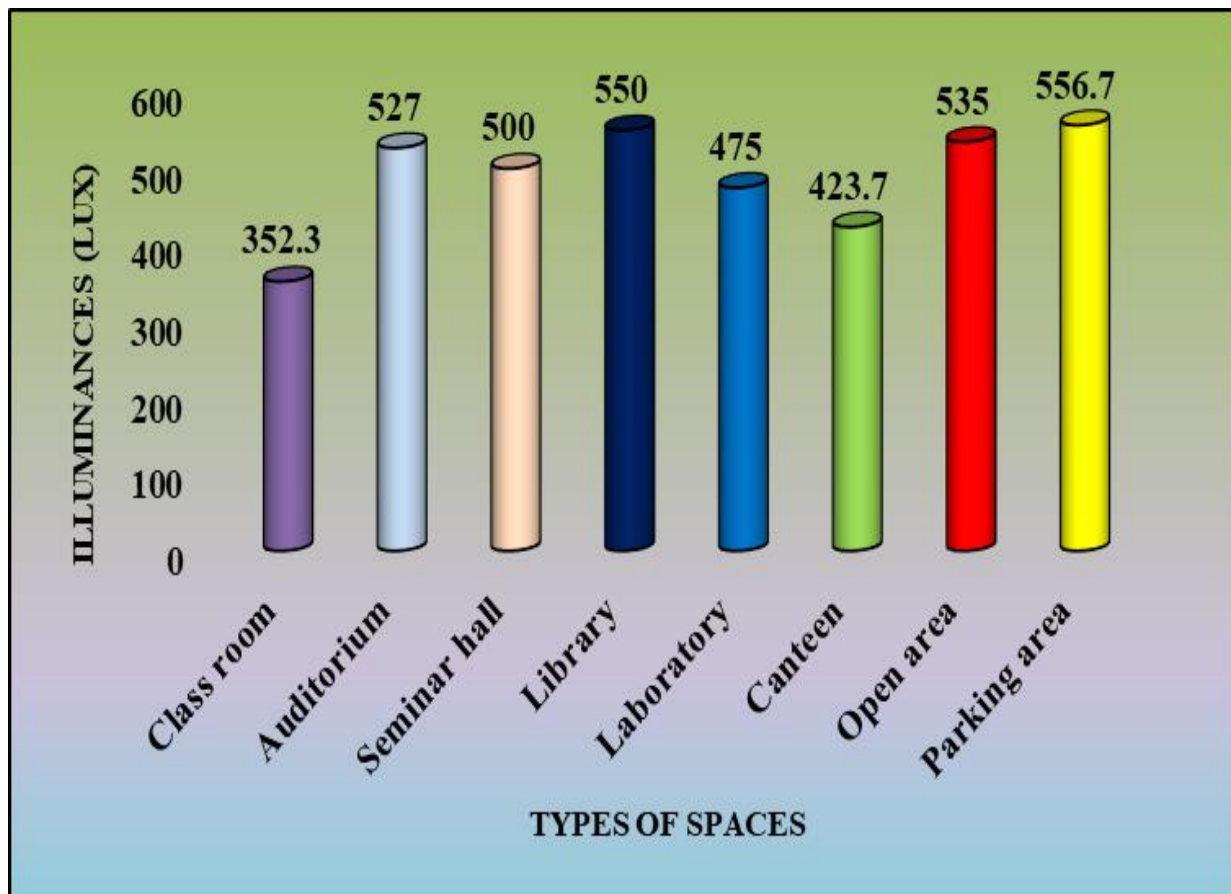
Table 21. Recommended level as per (ASHARE 62-2019) Illuminance (LUX)

S.No	Building Type	Space Type	Illuminances (LUX)
1.	Barracks / Dormitories	Bed Rooms	300
		Laundry Rooms	
2.	Educational Buildings	Play Room, Nursery, Classroom, Lecture Hall	400
		Computer Practice Rooms	300
3.	Office Buildings	Single Offices, Open plan Offices	400
		Conference Rooms	300
4.	Hospitals	General ward Lighting	300
		Simple Examination	500
		Examination and Treatment Ward	1000
5.	Hotels and Restaurants	Kitchen	500
		Buffet	100
6.	Sports Facilities	Sports halls	300
7.	Circulation areas	Corridors and Stairs	500
		Cloak Rooms, Wash Rooms,	
		Bath Rooms, Toilets	300
8.	Industrial areas	Metal working / Welding	300
		Simple Assembly	300
		Difficult Assembly	1000
		Exacting Assembly	3000-10000

Reference set of values for LUX

Table 22. Light intensity measured at various locations in the Institute

S.No	Type of Spaces	Illuminances (LUX)
1.	Class room	352.3±4.7
2.	Auditorium	527±6.6
3.	Seminar hall	500±12.5
4.	Library	550±3.6
5.	Laboratory	475±8.0
6.	Canteen	423.7±3.0
7.	Open area	535.0±3.6
8.	Parking area	556.7±5.5
	Mean	487.07
	SE	5.93
	CD	10.56

Figure 9. Light intensity measured at various locations in the Institute

3.9. Other facilities

Within the auditee's premises, there are other facilities are available that are depicted as glimpses of photographs



Transport Facility available in Sri Saradha College for Women



**Solar Panel are Observed in
Sri Saradha College for Women**



Light Intensity (LUX) Analysis in Sri Saradha College for Women

MOHAN MOHAN
SUBALAKSHMI
SUBALAKSHMI
AKSHMI
2024.06.18
09:32:53+05'30'



**Energy Audit towards Generator and Power Room
Facility available in the Campus**



UPS System Facility at Sri Saradha College for Women

MOHAN
SUBALAKSHMI
I
2024.06.18
09:32:53+05'30'



Auditorium at Sri Saradha College for Women



Noise Level Analysis in the Campus

3.10. Compliances

- Transformer, generators and UPS are protected properly with fencing and kept awareness boards.
- Most of places, sign board of 'Switch ON' and 'Switch OFF' are kept towards saving energy measures to the users.
- Electrical wires, switch boxes and stabilizers are properly covered which will cause any problems to the staff and students.
- Solar power plants were installed on roof top of two buildings and power generated through solar power plant is exported.
- Usage energy efficient light-emitting diode, bulbs instead of incandescent and CFL bulbs and replaced old generation computers and TVs with LED monitors.
- Maintenance of appliances and replaced old appliances in all laboratories
- HVLS fans are fitted in the auditorium.
- Water level controllers are used besides STP is used for water recycling which is functioning well.
- Establishment of a system of carpooling among the staff members and students to reduce the number of four wheelers coming to the College.
- Discouraging the students and research scholars using two wheelers for their commutation in the campus.
- Promoting ECON awareness and practice among the stakeholders are being conducted periodical through Association, Clubs, Forums and Chapters.
- Value added / Non-formal / Certificate / Diploma course on 'Energy and Environment Management Audits' are being conducted for the benefit of students and research scholars.

3.11. To improving the energy efficiency within the Organization

- Procurement of equipment with energy efficiency (4-5 star rated equipment) during replacement may be considered.
- Daylight sensors can be implemented in future Star rated fan can be used and DG set Automatic syne can be implemented
- Optimal water usage and temperature settings may be used which are coming under automatic process towards energy savings.
- Continuous monitoring and analysis of energy consumption by dedicated team may be planned within the campus.
- Internal energy policy such as preventive maintenance and breakdown maintenance policy should be implemented.
- Energy meter in each building to be implemented
- Establish a more efficient cooking systems like biogas operated machineries to save fossil gas in hostel kitchen and canteen.
- More use of generators, inverters, and UPS every day should be discouraged which could save electrical energy.

3.12. Conclusion

Considering the fact that the organization is a well-established, there is significant scope for conserving energy and make the campus as self-sustained in it. The energy conservation initiatives taken up by the institution are substantial. There are some best practices followed as listed above. Consideration provided in this report can further improve energy savings of the organization which in turn will reduce carbon emissions effectively. This may lead to the prosperous future in terms of Energy Efficiency Campus and thus sustainable environment and community for the stakeholders in coming years to come.

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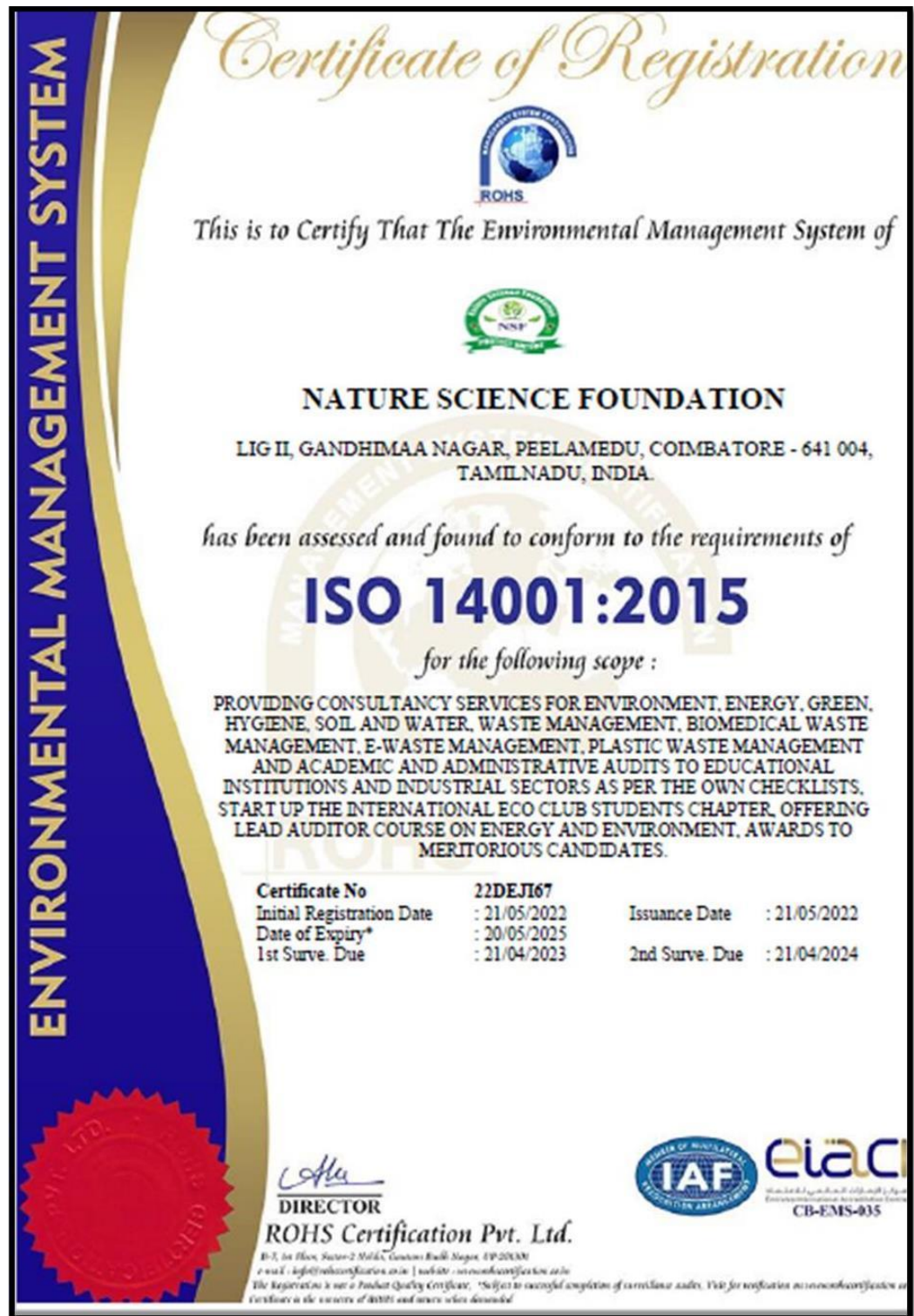
5. Certificates of Nature Science Foundation

1. ISO Certificate (QMS 9001:2015)
2. ISO Certificate (EMS 14001:2015)
3. ISO Certificate (OHSMS 45001:2018)
4. ISO Certificate (EnMS 50001:2018)
5. MSME Certificate



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Re-certification Due Date : 02/08/2025



Partha Bagchi
(Managing Director)

Validity of this Certificate is subject to Surveillance Audits to be conducted before scheduled due dates of surveillance audits as mentioned on the certificate, failing which the certificate will stand to be withdrawn and need to be treated as an initial certification process to reactivate its continuity on the register of EUAS and QCS. This Certificate is valid when confirmed by data listed on the (Euro Universal Accreditation Systems) EUAS" www.euas-ac.org. The authenticity & validity of this certificate may be re-affirmed by referring to our company website - www.qcspl.com. Lack of fulfillment of conditions as set out on the 'Certification Contract' (Annex 13) may render this certificate invalid. Any alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of law. This certificate remains the property of QCS and to be returned on request.

REGISTERED OFFICE: 37E/1(310) 2nd STREET, MODERN PARK, GREENAGE APARTMENT - 2nd FLOOR,
SANTOSH PUR, KOLKATA - 700075, WEST BENGAL, INDIA.
Email: info@qcspl.com Call: +91 8697724963, +91 8902447427. Website: www.qcspl.com

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Certificate of Registration

This is to certify that

NATURE SCIENCE FOUNDATION

LIG II, GANDHIMAA NAGAR, PEELAMEDU, COIMBATORE - 641 004,
TAMILNADU, INDIA.

has been independently assessed by QRO
and is compliant with the requirement of:

ISO 50001:2018

Energy Management Systems

For the following scope of activities:

PROVIDING CONSULTANCY SERVICES FOR ENVIRONMENT, ENERGY, GREEN, HYGIENE, SOIL AND WATER, WASTE MANAGEMENT, BIOMEDICAL WASTE MANAGEMENT, E-WASTE MANAGEMENT, PLASTIC WASTE MANAGEMENT AND ACADEMIC AND ADMINISTRATIVE AUDITS TO EDUCATIONAL INSTITUTIONS AND INDUSTRIAL SECTORS AS PER THE OWN CHECKLISTS, START UP THE INTERNATIONAL ECO CLUB STUDENTS CHAPTER, OFFERING LEAD AUDITOR COURSE ON ENERGY AND ENVIRONMENT, AWARDS TO MERITORIOUS CANDIDATES.

Date of Certification: 9th August 2022

1st Surveillance Audit Due: 8th August 2023

2nd Surveillance Audit Due: 8th August 2024

Certificate Expiry: 8th August 2025

Certificate Number: 305022080903EN



Chunant...

Head of Certification

Validity of this certificate is subject to annual surveillance audits to be done successfully on or before 365 days from date of the audit.
(In case surveillance audit is not allowed to be conducted: this certificate shall be suspended / withdrawn).

The Validity of this certificate can be verified at www.grocet.org

This certificate of registration remains the property of QRO Certification LLP, and shall be returned immediately upon request.

India Office : QRO Certification LLP

142, IIInd Floor, Avtar Enclave, Near Paschim Vihar West Metro Station, Delhi-110063, (INDIA)

Website : www.grocet.org, E-mail : info@grocet.org

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भारत सरकार
Government of India
सूक्ष्म, लघु एवं मध्यम उद्यम मंत्रालय
Ministry of Micro, Small and Medium Enterprises



UDYAM REGISTRATION CERTIFICATE



Our small hands to make you LARGE

UDYAM REGISTRATION NUMBER	UDYAM-TN-03-0073706																						
NAME OF ENTERPRISE	M/S NATURE SCIENCE FOUNDATION																						
TYPE OF ENTERPRISE *	MICRO																						
MAJOR ACTIVITY	SERVICES																						
SOCIAL CATEGORY OF ENTREPRENEUR	GENERAL																						
NAME OF UNIT(S)	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th>S.No.</th> <th colspan="3">Name of Unit(s)</th> </tr> <tr> <td>1</td> <td colspan="3">Green Campus, Energy and Environment Management Audits</td> </tr> </table>			S.No.	Name of Unit(s)			1	Green Campus, Energy and Environment Management Audits														
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OFFICIAL ADDRESS OF ENTERPRISE	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td>Flat/Door/Block No.</td> <td>LIG-IL2609</td> <td>Name of Premises/ Building</td> <td>GANDHIMAA NAGAR</td> </tr> <tr> <td>Village/Town</td> <td>Gandhimaanagar S.O</td> <td>Block</td> <td>LIG-II</td> </tr> <tr> <td>Road/Street/Lane</td> <td>Peelamedu</td> <td>City</td> <td>Coimbatore South</td> </tr> <tr> <td>State</td> <td>TAMIL NADU</td> <td>District</td> <td>COIMBATORE , Pin 641004</td> </tr> <tr> <td>Mobile</td> <td>9566777255</td> <td>Email:</td> <td>chairmansf@gmail.com</td> </tr> </table>			Flat/Door/Block No.	LIG-IL2609	Name of Premises/ Building	GANDHIMAA NAGAR	Village/Town	Gandhimaanagar S.O	Block	LIG-II	Road/Street/Lane	Peelamedu	City	Coimbatore South	State	TAMIL NADU	District	COIMBATORE , Pin 641004	Mobile	9566777255	Email:	chairmansf@gmail.com
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State	TAMIL NADU	District	COIMBATORE , Pin 641004																				
Mobile	9566777255	Email:	chairmansf@gmail.com																				
DATE OF INCORPORATION / REGISTRATION OF ENTERPRISE	28/11/2017																						
DATE OF COMMENCEMENT OF PRODUCTION/BUSINESS	12/03/2020																						
NATIONAL INDUSTRY CLASSIFICATION CODE(S)	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>S.No.</th> <th>NIC 2 Digit</th> <th>NIC 4 Digit</th> <th>NIC 5 Digit</th> <th>Activity</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>69 - Legal and accounting activities</td> <td>6920 - Accounting, bookkeeping and auditing activities; tax consultancy</td> <td>69201 - Accounting, bookkeeping and auditing activities</td> <td>Services</td> </tr> <tr> <td>2</td> <td>85 - Education</td> <td>8542 - Cultural education</td> <td>85420 - Cultural education</td> <td>Services</td> </tr> <tr> <td>3</td> <td>85 - Education</td> <td>8549 - Other education n.e.c.</td> <td>85499 - Other educational services n.e.c.</td> <td>Services</td> </tr> </tbody> </table>			S.No.	NIC 2 Digit	NIC 4 Digit	NIC 5 Digit	Activity	1	69 - Legal and accounting activities	6920 - Accounting, bookkeeping and auditing activities; tax consultancy	69201 - Accounting, bookkeeping and auditing activities	Services	2	85 - Education	8542 - Cultural education	85420 - Cultural education	Services	3	85 - Education	8549 - Other education n.e.c.	85499 - Other educational services n.e.c.	Services
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DATE OF UDYAM REGISTRATION	26/02/2022																						

* In case of graduation (upward/reverse) of status of an enterprise, the benefit of the Government Schemes will be availed as per the provisions of Notification No. S.O. 2119(E) dated 26.06.2020 issued by the Mo MSME.

Disclaimer: This is computer generated statement, no signature required. Printed from <https://udyamregistration.gov.in> & Date of printing: - 26/02/2022

For any assistance, you may contact:

1. District Industries Centre: COIMBATORE (TAMIL NADU)

2. MSME-DI: CHENNAI (TAMIL NADU)

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MSME

6. Certificates of Lead Auditors

1. Bureau of Energy Efficiency (BEE), LEED AP and GRIHA Certificates of Er. D. Dineshkumar, Energy and Environment Auditor of NSF.
2. Indian Green Building Council (IGBC AP) Accredited Professional of Dr. B. Mythili Gnanamangai, Vice-Chairman of NSF.
3. Tamil Nadu Fire and Rescue Service Certificate of Er. S. Srinivash, Energy Auditors of NSF.
4. Energy Management System ISO 50001:2018 Certificate of Dr. D. Vinoth Kumar, Joint Director of NSF.
5. ISO 17020:2012 certificate of Ms. V. Sri Santhya, Assistant Director of NSF.



BUREAU OF ENERGY EFFICIENCY



Examination Registration No. : **EA-14056** Serial Number **9176**

Certificate Registration No. : **9176**

[Signature]

Certificate For Certified Energy Manager

This is to certify that Mr./Mrs./Ms. **Dinesh Kumar D**
Son/Daughter of Mr./Mrs. **R M Dhanasekaran** who has passed the National
Examination for certification of energy manager held in the month of **October 2011** is
qualified as certified energy manager subject to the provisions of Bureau of Energy Efficiency
(Certification Procedures for Energy Managers) Regulations, 2010.

This certificate shall be valid for five years with effect from the date of award of this certificate
and shall be renewable subject to attending the prescribed refresher training course once in every
five years.

His /Her name has been entered in the Register of certified energy manager
at Serial Number **9176** being maintained by the Bureau of Energy Efficiency under the
aforesaid regulations.

Mr./Mrs./Ms. **Dinesh Kumar D** is deemed to have qualified
for appointment or designation as energy manager under clause (i) of Section 14 of the Energy
Conservation Act, 2001 (Act No.52 of 2001).

Given under the seal of the Bureau of Energy Efficiency, this **7th** day
of **February, 2013**

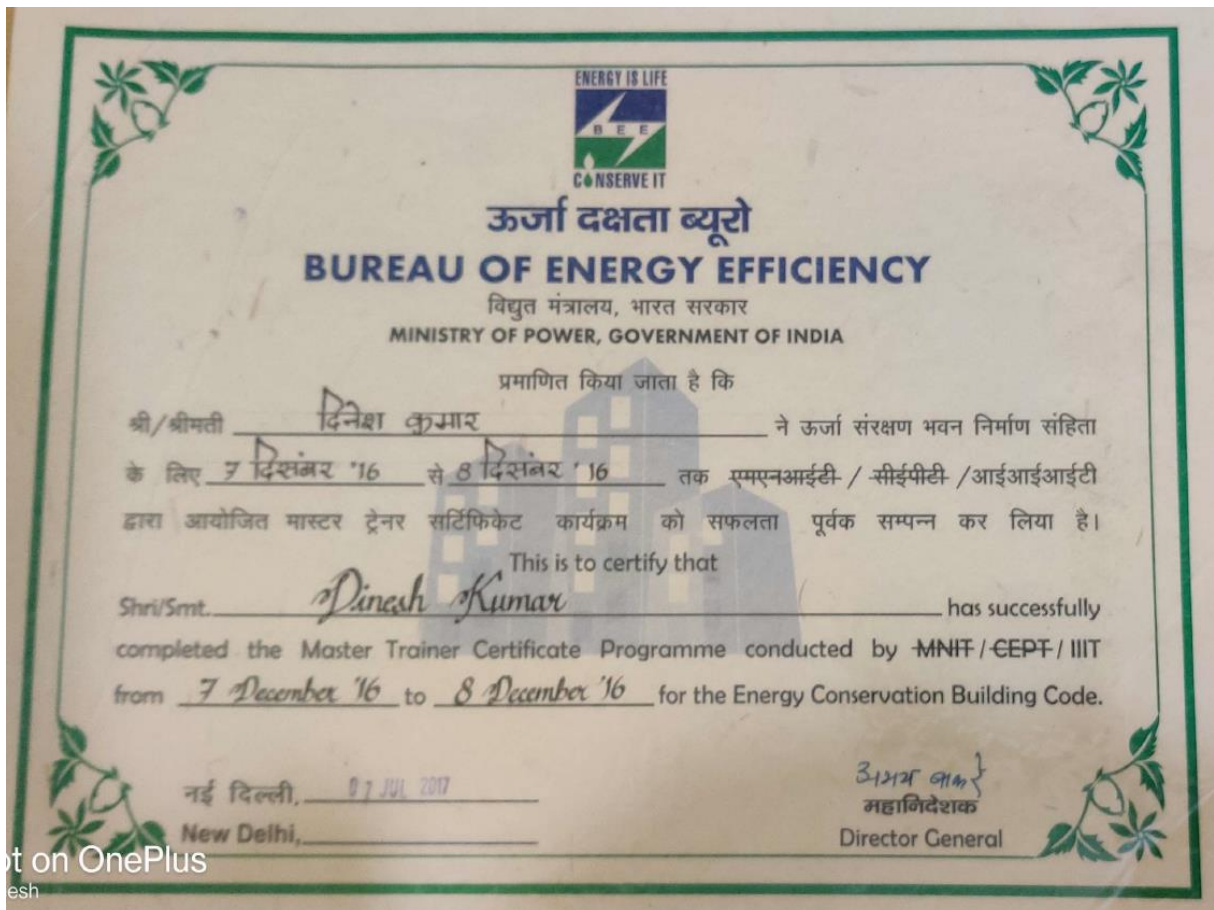
[Signature]

Digitally Signed: RAKESH KUMAR RAI
Sun Mar 01 10:58:55 IST 2020
Secretary, BEE New Delhi

Secretary
Bureau of Energy Efficiency
New Delhi

Dates of attending the refresher course	Secretary's Signature	Dates of attending the refresher course	Secretary's Signature
22.12.2019	<i>[Signature]</i>		

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Certificate of Successful Attainment

This is to certify that

DR. D. VINOTH KUMAR

HAS SUCCESSFULLY COMPLETED THE FIVE DAYS (40 HOURS)

LEAD AUDITOR COURSE

BY PASSING THE WRITTEN EXAMINATION BASED ON

ISO 50001:2018

ENERGY MANAGEMENT SYSTEMS

Examination Date: 15/07/2022

Certificate issue Date: 22/07/2022

Certificate registration number: QCS/TR/C/0056

Total Course duration: 40 hours CPD Credits Earned: 32

Remarks: Roughly one hour of study time equals to 1 CPD Credit.

This certificate can be validated online from the industry wide Global Professional Register at www.qcspl.com.


Partha Bagchi
(Managing Director)

QCS MANAGEMENT PVT LTD

Accredited by "CPD Accreditation Office UK"

H.O: 37E/1(310) 2ND STREET, MODERN PARK, SANTOSH PUR,
KOLKATA-700075, WEST BENGAL, INDIA

BRANCHES: INDONESIA, BANGLADESH, QATAR, SAUDI ARABIA,
TURKEY, UAE

WHATS APP: +918697724963/+918902447427,

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