TECHNICAL REPORT OF

ENVIRONMENT AUDIT

Submitted to

SREE ABIRAAMI ARTS AND SCIENCE COLLEGE FOR WOMEN, GUDIYATTAM - 635803, VELLORE DISTRICT, TAMIL NADU, INDIA.

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1. Introduction

Environment (Eco) audit is quantitative and qualitative data to track air, soil and water waste, and to gain actionable insights to improve the operational performance in the atmosphere. This audit is generally used to observe the clean and green environment of an organization. It provides a 360˚ view of a surrounding campus and makes it easy for Owners / Managers / Environmentalists to collaborate, measure, control, and reduce environmental impacts. Finally, it leads to enhancing the quality of life for human beings, animals and plants. Eco audit initiatives are the need of the hour across the world due to changing environmental conditions and global warming due to increasing human population and anthropogenic activities (Maltby, 1995; Haahkim and Yunus, 2017). It aims to make a sustainable and friendly environment for the stakeholders.

In other words, Environment audit is a well-developed process of extracting information about an Organisation that provides a realistic assessment of how the Organizations take steps towards caring the environment. In this context, to conserve eco-friendly atmosphere of an organization, well-developed environmental objectives and targets should be undertaken to reduce the harmful effects to a greater extent. The audit process can remarkably minimize the environmental pollution in the campus which in turn reduces the impact of global warming scenario. As per the Government law, the environmental legislations should be followed by all the Institutions and Organizations and make sure that their activities should not degrade the environment (Ramachandra and Bachamanda, 2007). An environmental audit gained momentum, in order to create awareness on environmental compliance and implementation gaps in the management system, along with related corrective measures.

The environment audit involves systematic documentation of periodic objective review by a regulated entity on available facilities, their operations and practices related to resolve the environmental requirements. Environment audits include personnel observation, monitoring, data collection, recording/documentation and analysis of various components in an Organization related to the environment with cordial support of the management (Conde and Sanchez, 2017). In general, environmental audit is planned to achieve an optimum resource utilisation and improved process performance in the audit sites. Venkataraman (2009) stated that it is a ‘Common Sense Approach’ to identify the problems and solve those problems pertaining to curb eco-friendly atmosphere (APHA, 2017). Environmental audit enables an overall and complete overview at the audit sites to facilitate our understanding of flow of materials and to focus the priority areas where waste reduction is achieved thereby cost saving is made possible (Gowri and Harikrishnan, 2014).

Environmental audits ensure that the environment is not disturbed from its balanced existence, so that it provides an eco-friendly atmosphere to the stakeholders. Similar to that of Environmental audit, Green campus audit is also a type of assessment to ensure that the Institution and Organization campus should grow a large number of trees, shrubs, herbs, lawns, climbers, twins and lianas in their campus to enrich with oxygen and assimilate more amount of carbon dioxide to provide a healthy atmosphere to the stakeholders (Aparajita, 1995). Environmental audit provides vivid dimensions on how waste materials are being managed and the source of wastes along with the solutions for environmental degradation is managed. Environmental

Management System (ISO EMS 14001:2015) should be implemented by every Organization to ensure that the eco-friendly campus is being given to the stakeholders. Eco-friendly youth leadership programmes, green campus practices, social responsibility and Institutional values comprehending the relationship with the ecosystem for a sustainable environment are being evaluated (IGBC, 2020).

Environmental audit plays a vital role in keep tracking on organizations policy commitments with regard to environmental management and its performance. Audit reports can provide key information to the management in relation to risk areas, progress towards strategic objectives and targets (Adeniji, 2018). Purpose of the audit is to determine performance of the environmental management systems and equipment related to environmental safety. This is also to verify compliance with the appropriate national/local laws and regulations/norms of regulatory bodies to minimize the human exposure to risks from environmental-, health- and safety- aspects.

In order to satisfy the purpose of audit, it is essential that audits should be considered as the responsibility of the company/organisation. Audit work can be undertaken voluntary for the benefit/advantage of the company, and it can be executed with the help of environmental auditing authorities. As mentioned earlier, it helps in the proper natural resource utilization and on the whole, it improves environmental quality.

As stated earlier, environmental auditing is essential tool to monitor the effects of human activities on the environment with respect to set principles/standards. On the basis of various standards and focus of the audit, there are different types of environmental audit existed. At present most of the organisations/institutions recognised the importance of environmental issues and accepted to scrutinise their performance by recognised bodies to minimise the ill effects of their activities and to ensure their sustainable industrial developments.

An environmental auditor will study an organization's performance towards the environment sustainability in a systematic manner which in turn to document the activities carried out for environmental conservation. Environmental organization management systems and equipment are performing with the aims of:

i. Facilitating management control of environmental practices.
ii. Assessing compliance with company policies.
iii. Facilitating professional competence
iv. Implementing works without harming the environment
v. Practicing the environmental conservation
vi. Sustainability in energy utilization

2. Role of Educational Institutions in India

In view of providing eco-friendly atmosphere to the stakeholders, Educational institutions are focussed on establishing and maintenance of eco-friendly campus without harming the environment. A clean and healthy surrounding in an Organization determine the effective learning and provides a favourable learning environment to the students. Educational institutions are insisted by both Central and State Governments to provide 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 (recycling the of solid wastes and wastewaters, plastic free zone, napkin disposal, water consumption, rainwater harvesting and storage mechanisms, etc.) 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 to the stakeholders.

Similar to that of green campus auditing, environment auditing is a kind of professional tool to identify organization's environmental performance aligning with its policies and compliances of the Government guidelines. This audit process is definitely useful for the Educational institutions to maintain the eco-friendly campus in a sustainable manner and can give eco-friendly atmosphere to the students and staff members. Environmental audit is like an official examination of an organization's campus as per the Government guidelines. Audit report may be useful to improve the organization's campus significantly by following the recommendations and suggestions specified in the report. Conducting an environmental audit is no longer an option but a sound precaution and a proactive measure in today's heavily regulated conditions. There are some minor differences between green campus auditing and environment auditing with respect to natural and planted vegetation along with flora and fauna in the campus and carbon footprint in which carbon dioxide level is assessed in the campus in using the number vehicles, fossil fuel usage, electrical energy utilization efficiency and human population.

Environmental auditing concerned with following aspects: 1) Assessing compliance with pertinent constitutional and internal requirements, 2) providing management control over environmental activities, 3) Endorsing good environmental management, 4) Maintaining credibility with the public, 5) Creating awareness among the staff on their commitment towards environmental policy, 6) Enduring improved opportunities and 7) Establishing the performance baseline for developing an Environmental Management System (EMS).

3. Energy and Environment Policy

The energy and environment policies aims to afford an understanding/awareness on clean and green environment to the stakeholders in relation to environmental compliance. Scope of this policy applies to all employees and students of the Institution to establish and sustain an Eco-friendly atmosphere. Policy making dealt with cleanliness on the campus is maintained through proper recycling of wastes and/or disposal of hazardous wastes and utilization of eco-friendly supplies. Disseminating the concept of eco-friendly culture among the students and rural community through various awareness programmes (seminars / conferences, reuse and recycle the waste materials) is one of the environmental policies. Attempts are made to limit energy usage and also substitute non-renewable energy sources with renewable energy sources. The Head of the Organization, Department Heads and Senior Managers including Management Representatives are responsible for

monitoring the go green initiatives of the College / University and maintain a clean/green campus. In addition, the staff and student volunteers from Nature club, Eco clubs, Science club, Fine Arts club, Youth Red cross unit, Student Force, NCC and NSS units are committed to establish green campus and strictly follow the environmental policies in the Organization.

4. Environment friendly campus

Literally, Eco-friendly means earth-friendly/environment friendly or not hazardous to the environment. The term commonly refers to the products that contribute to green living or practices that help conserve the natural resources like water and energy. Environment friendly processes are sustainability and marketing terms referring to goods and services, laws, guidelines and policies that claim reduced, minimal, or no harm upon ecosystems. Companies and Educational Institutions use the ambiguous terms to promote goods and services including working atmosphere/learning conditions, at times with additional, more specific certifications (eco-labels). Their overuse can be referred to as “green washing”. To ensure the successful meeting of Sustainable Development Goals (SDGs) companies and Educational Institutions are advised to implement environmental friendly processes in their production as well as providing good ambience to the stakeholders in their work plACE. The International Organization for Standardization has developed ISO 14001:2015, 14020 and ISO 14024 to establish principles and procedures for environmental labels and declarations that certifies the environment friendly campus. Specifically, these standards communicate with avoidance of financial conflicts of interest, utility of sound scientific methods and accepted/standard test procedures and honest and transparent setting of standards.

Environment friendly campus is meant for providing eco-friendly as well as hygienic atmosphere to the stakeholders without harming the environment. In order to provide efficient eco-friendly atmosphere to the stakeholders, the organization should take responsibility in making good drinking water facility to the students and staff members, use of the organic manure, cow dung, farmyard manure and vermicompost for manuring the plants, avoidance of non-compostable, single-use disposable plastic items, single-use plastic utensils, plastic straws and stirrers, commitment to plastic-free alternatives to bags, boxes, containers and etc. and reduction of use of papers alternated with e-services and e-circulars, etc. and proper disposal of wastes, recycling and suitable waste management system. These parameters should be considered while implementing the environment friendly campus in an organization.

To set a pure atmosphere in an organization campus, waste disposal management should be proper which in turn to confine the environmental pollution. Waste management is an activity that starts from inception of waste to its final disposal. In other words, it includes a chain of action i.e. collection, transport, treatment and disposal of waste, together with monitoring and regulation. Dry waste includes paper, cardboard, glass, tin cans, etc., while wet waste refers to organic waste such as vegetable pods, left-over food, etc. Separation of waste material is necessary

for the accountability of amount of waste being generated followed by proper recycling through the composting process and used as a fertilizing material.

5. Environmental Management Plan (EMP)

A clean environment is required for progressive success of an organization to safeguard the upcoming generations to ensure in safe use of air, land and water resources. The management of any organization should attempt to continuously to improve the environmental performance and to prevent/minimise the pollution. All the stakeholders of the organization are expected to support our environmental goals while providing clean and environment friendly work culture. Main purpose of the EMP is to determine the environmental protection measures to be followed during in day-to-day's activities of the organization and confirm to minimize environmental effects are met. Environmental protection is an imperative component of overall preparation and execution of eco-friendly and green campus of an organization. It addresses the issues start from sanitation pertaining to human health/various stakeholders of an organization and protection of plants, animals and microorganisms including wildlife habitats. Environmental Management Plan (EMP) is an integrated document with various approvals, authorizations and specific components and/or activities that to be carried out in the campus without harming the environment. EMP is committed to regulate its assets with its core values to protect the health/safety of people/environment and to comply with Environment Health and Safety laws, regulations and Health and Safety standards. EMP should provide a reference document as per the legislative requirements for employees when planning and/or performing specific activities in the campus surroundings. In line with the Environment Policy, impact on the physical, chemical and biological environment should be determined along with statutory requirements and other environmental commitments.

Table 1. Environmental Management Plan and Execution in the Organization sites

S.No.	Monitoring areas	Parameters Monitored	Monitoring frequency	Reason for monitoring parameters
1.	Dredging	Erosion, landscape, sedimentation, vegetation, disposal of dredging	Continuous	Dredging results in disturbance of Benthic community and causes soil erosion and sedimentation
2.	Marine Ecology	Biodiversity survey and conservation	Continuous	Unmitigated operations may result in loss of biodiversity as per the Indian Biodiversity Act
3.	Vegetation (Flora and Fauna)	Survey of macro and micro plants, animals (mammals,	Continuous	Conservation of macro and micro plant, animals (mammals, birds,

		birds, moths, houseflies, reptiles, amphibians, termites) and soil and air microbial biodiversity		moths, houseflies, reptiles, amphibians, termites) and soild and air microbial biodiversity conservation for future generations through modern technology
4.	Air Emission	O_2, CO, CO_2, SO_2, NO_2 level in the open, car parking and indoor areas	Monthly monitoring	Unmitigated operations may result in deterioration of air quality
5.	Solid Waste	Solid waste quality and quantity, solid waste disposal, reuse, solid waste treatment	Monthly monitoring	Compliance of Environmental Laws and Legislative policy
6.	Wastewater	Primary, secondary and tertiary pollutants and their recycling, wastewater minimization, storage and handling, reuse, treatment before disposal	Monthly monitoring	Minimize the water pollution and to provide quality water as per the Central Pollution Board
7.	Soil	Soil contamination, soil edaphic parameters, soil, gravel and sand composition, water holding capacity, soil erosion	Half yearly	Soil surface and water pollution cause diseases as per the Compliance of Environmental Laws and Legislative policy
8.	Noise	Noise intensity, causes and impact, remedies, standard operating procedure	Monthly monitoring	Uncontrolled noise cause nuisance which affects the health
9.	Occupational Safety & Health	Safety, health and welfare of people at occupation, measures taken, Fire safety, First aid box, Safety protocol, Hospital facility	Continuous	Department of Occupational Safety & Health
10.	Land reclamation	Soil quality, soil micro and macro	Half yearly	Legal obligation and structure protection,

		elements, soil composition		prevention of soil erosion and sedimentation to the port
11.	Restoration of the sites	Forest vegetation, plant vegetation, visual analysis, Photographic records	Continuous	Maintain the soil fertility and soil original reclamation

6. Environmental health and safety management system

It is outlined the mitigate measures and the best management practices followed in the organization in terms of developing eco-friendly and green campus. It is suggested to perform complete assessment and control of entirely possible hazardous and risks arise in the organization without harming the environment (Rajalakshmi *et al*., 2020). It is to ensure that no significant adverse environmental health and safety impacts by carrying out various infrastructure facilities created to improve the human eco-system of the organization may be implemented. The facility should be designed to include fire protection equipment/system including flame, multiple gas, smoke and low- and high temperature detectors/ alarms and automated and manual shut-down systems in terms of planning and implementing the best practices of environmental health and safety management system.

High level of automation, periodical preventative maintenance and safeguards the environmental pollution besides the provision for safe emergency shut downs/exits should be maximized in the organization. In addition, all the employees and management people should be trained properly about environmental health and safety measurements which will be useful for protecting the environment without causing any adverse effect on the environment. All personnel should be advised to undertake an extensive workshop/training programmes to ensure safe operating practices.

7. Evacuation Plan in Human Eco-system of the Organization

The management of an Organization should ensure the safety measures to the stakeholders which in turn improve the human eco-system. The alarm signals such as Bells, Horns, Sirens, Verbal (i.e. shouting) may be used to begin evacuation of the facility in the organization if any unfavourable situation takes places like uncertain firing, explosion of acids and gasses, earth quake, electrical current circuits explorations and

etc. Evacuation map and important phone numbers (Police, Ambulance, Fire stations, State Office of Emergency Services, National Response Centre, Division of Occupational Safety and Health, Regional Water Quality Control Board, Pollution and threatened hazardous management & control board and Nearest Hospital) may be prominently displayed throughout the

facility. Internal facility alarms as well as communications systems, wherever applicable, to notify all facility personnel should be activated. Waste storage areas and waste disposal zone, polluted soil or surface water regions should be demarcated in the organization. The emergency equipment like fire extinguisher, emergency notification and first aid box should be placed in all the dangerous zones to minimize the major environmental impact and problems. It should be developed and practiced a spill clean-up procedure where to find emergency equipment and how to use it properly should be trained to all the stakeholders.

The chemicals/hazardous waste handlers and managers should be regularly trained properly thro' periodical training programmes, workshops, conferences and seminars in order to impart knowledge on the latest developments in chemicals disposal methodologies and hazardous management policies. Safe method of handling (including from storage to disposal) of hazardous materials, and personnel rescue procedures should be known by the chemical handlers, hazardous waste handlers and managers. An areas that are disturbed or polluted by means of discarding the wastewaters, effluents, solid wastes may be recovered and restored by clean-up procedures. This areas may be brought in use after a chain of actions like stabilisation, smoothening, mulching, seed sowing and fertilization as per standard practice. The temporary erosion controls may be removed and permanent landscaping and erosion control measures should be installed wherever required as part of final facility restoration. Restoration of disturbed facility includes planting of various vegetation (trees, shrubs, and herbs) and replanting may be performed in compliance with applicable environmental specifications.

8. Waste Management Plan of the Organization

Waste includes solid wastes, plant litres, bio-medicals, electronic, organic kitchen and food wastes, plastic wastes, wastes, wastewater, effluents, hazardous waste materials, acids and chemicals. Waste Management Plan (WMP) provide guidelines and streamline the process of waste collection, separation, quantification, storage, transportation and disposal/recycling of wastes within the organization without harming the environment. Waste management is one among the critical operating policies of the organisation. Designed procedures are to assist wide effort to safeguard the environment and to satisfy the laws/legislative policies and regulations regarding proper waste management.

Organization should examine/inspect waste management related facilities and activities which directly resulting in executing the scope and amendments of WMP. Guidelines for each and every step of waste management associated with organization may be undertaken. It should be taken into account while WMP in prepared and executed in the organization. It may be noted that abandoned materials and materials intended to be recycled are also considered as wastes. It is important to understand the above concept because even though something is going to be recycled, it must be managed until it is actually recycled. The wastes are categorized as hazardous and

non-hazardous wastes depending upon the quantum of causing the adverse effect to the environment. The hazardous waste should be disposed properly by ignitability, corrosivity, reactivity, irritability and toxicity behaviours.

All recommended safety and handling procedures must be followed appropriately not only by the Management and concerned individuals also follow the norms. Waste production should be eliminated regularly and the material only for its planned purpose should be stored. Attempts should be made to curtail waste production, reprocess/recycle the same and then properly dispose in accordance with the norms. All hazardous waste shall be segregated individually as well as non-hazardous wastes at the point of its generation. For the collection of waste, containers can be used and must be properly and clearly labelled. Also, if the waste is hazardous, it should be clearly labelled on the container along with its hazardous characteristics (e.g. flammable, toxic, radioactive, etc.). As depicted, containers with colour coding for easy identification should be kept to collect and segregate common wastes across the campus/at all the facilities organic food waste shall be collected in separate containers especially from hostel dining hall, canteen and food courts.

9. Methods of Disposal of wastes

Recycling and reuse methods may be adopted to minimize the quantity of wastes that are generated from the organization requiring proper ways of disposal. Quite a few waste materials can be reused within the facilities/campus while others can be recycled only in the specific sites. The recycling of used oils, acids, solvents and chemicals is possible in some of the laboratories; plastics and e-wastes including batteries may be revert back to manufacturer/authorised dealers/distributor while it should not be sold to the unauthorized contractors / companies, who may not have proper recycling facilities and to avoid misuse or to reduce associated liabilities

Coding system for different type of waste	
Waste material	(Colour or code)
Glass	(blue);
Metals	(green);
Plastic	(white);
Oily rags	(black);
Used oil	(red);
Rubbish / trash	(yellow)

On-site Disposal facilities: Burial pits may be created in which waste should be buried and covered with soil sufficiently as 'daily cover' to reduce the environmental issues like unpleasant odour from decaying / degrading waste, spreading of waste into nearby areas in response to blowing wind and to avoid vermin and disease spreading vectors, flies, mosquitoes, etc.

Reserve pits: Reserve pits are used temporarily to store drilling waste, chemical waste, oily sludge and contaminated soil. These pits should be appropriately designed and furrowed to eradicate soil-, groundwater-/surface water-contamination.

Incineration: Incineration is another type of waste disposal wherein incinerator are used. Prior to burning, items that are not to be burned should be segregated and incinerated ash shall be buried in the lined landfill as it may contain heavy metals.

Evaporation Ponds: Evaporation ponds are used to eradicate the produced water at some facilities. It may be noted that all evaporation ponds should be lined properly.

10. Aims and Objectives of Environment Audit

Primary objective of an Environment audit is to promote the environment safety management and preservation for future generations. The purpose of environmental audit is to recognise, enumerate, describe and arrange/organise the framework of sustenance of environment in compliance with the appropriate/valid rules, regulations and requirements. In general, environment audit can be achieved by creating awareness on the importance of safeguarding the environment among students, faculties and staff members, including public domain. Environmental audit programme conventionally designed and implemented judiciously which can boost the sustainable healthier environment of an organisation. It is helpful to monitor the optimum utilization of the resources and evaluating the company at National and International levels. Major objective of environment audit confined to:

a. Protecting the environmental health and minimise the threats posed to human safety by the performance of the Organization.
b. Create consciousness among the stakeholders about the importance of requirement of clean environment and conservation of the same as per the Environment Management Systems (ISO standard of 14001:2015) and Environmental Legislations by the Organization.
c. To establish a baseline information about the eco-friendly environment in the campus to the stakeholders for future sustainability.
d. Review the disposal of solid- and liquid-waste within the campus and ascertain the sources of waste generation to mitigate with possible solutions in relation to environmental compliance.
e. To conduct outreach programmes to the rural, tribal and urban community people on the environment damage and conservation.
f. To correlate the flora and fauna with environmental sustainability in the audit sites to provide a healthy atmosphere to the members of the Organization.
g. To take steps to minimize the environmental pollution and degradation by means of developing ‘Sanitation and hygiene policy’, ‘Water conservation policy’, ‘Waste management policy' and ‘Green campus and Environment policy’ by the Organization.
h. In accordance with legislative compliances, to adopt measures to reduce waste generation and both solid and water waste recycling.
i. Establishing plastic free campus/zone with the help of management and the stakeholders and to evolve health consciousness among the stakeholders.
j. Propose the utility of alternative energy for the conservation of conventional energy resources.
k. Evaluation and documentation of wastewater quality, its characteristics and their effects on the living system.
l. In order to classify the solid and hazardous wastes, their source of generation, quantities and characteristics with respect to prevent environmental hazards.
m. To introduce and implement the time saving technologies in production as well as providing eco-friendly ambience in an organization following the latest IT based techniques and to minimize the wastes through modern cleaner

technologies.

n. Maintenance of Labour/Occupational health & medicine followed by proper documentation of environmental compliance status.
o. Annual environmental auditing will render educated and technically sound personals with practical knowledge to overcome existing environment issues.

11. Importance of Environment Auditing

The generic term 'Environmental auditing' is to examine the management practices and to evaluate performance of an Organization in relation to environmental issues. World along with Indian Green building Council (IGBC), 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 – GreenCo Rating System (CII-GRS), Food Safety Management System & Occupational Safety & Health (FSMS), Swatch Bharath under India Clean Mission (SBICM) and International Standard Organization (ISO 2020) 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. In order to set a pure atmosphere free from pollution to the stakeholders in an organization campus, waste disposal management and recycling activities should be proper to restrict the environmental pollutions.

Management of the Organization (Auditee) should be shown their inherent commitment towards making eco-friendly atmosphere through the Environment auditing and ready to encourage all types of Environment related activities. They should promote all kinds of Environment related activities such as conduct of environment awareness programmes, campus farming, planting trees and maintenance of greening, irrigation, use of bio fertilizers and avoidance of chemical fertilizers and agrochemicals etc., before and after the environment auditing.

Environment audit may be beneficial to the campus in improving the greenery activities which in turn useful to save the planet for future generation. Environment audit is a kind of professional care and a simple indigenized system about the environment monitoring in terms of planting a large number of trees which is the responsibility of each and every individual. It is necessary to Environment audit frequently at least once in three years in campus because students and staff members should aware of the Advantages of Environment audit is to save the planet by means of 'Go green concept' and help the institution to set a "bench-mark" (icon) to the community. It provides an immense opportunity for the development of ownership, personal and social responsibility for the stakeholders.

Scope of an audit can vary from simple compliance testing to a more rigorous examination, depending on the apparent requirements of the management. Environment audit is applied not only to operational environmental, health and safety management monitoring, but increasingly applied to product safety and product quality management besides the areas like loss prevention. Environmental studies include the site history, storage of materials (above and below ground), the disposal of

liquid or hazardous wastes properly in onsite and offsite. It also pays attention in oil or chemical spill prevention. In the subset of safety it includes special procedures for confined space entry, work on electrical equipment, breaking into pipelines, having firefighting equipment's, conducting safety training programmes for the stakeholder's, etc. Waste disposal measures and methods have already detailed in this report.

12. Environmental Audit Schemes and their Components

Environmental audit schemes are useful to the entire management system in terms of its being an asset or a liability for the industry`s environmental performance besides with a broad spectrum of objectives for a green environment.

- The scheme renders ways and means to reducing all types of solid, water, electronic and biomedical wastes.
- It authenticate the assessing compliance with regulatory requirement.
- The system provides prevention control of effect of pollutant in water and soil.
- It promotes relationship among the qualified technicians, professionals and individuals,
- Central as well as State Pollution Control Boards, other public authorities, NGOs and industrial association etc. responsible for the conduct of environmental audit as well as environmental audit schemes
- Environmental Audit Scheme has three following important components.

Central and State Pollution Control Boards: The Board plays participatory role in implementing the environmental audit effectively by preparing format of audit report on all aspect of environmental protection. The board appoints internal auditors to prepare industries audit report and then evaluation followed by verification of audit reports. Initiating the action on evaluated report of environmental audit is also equally important in terms of implementation.

Internal Auditor: Team of selected auditor consist of experienced experts from various fields. A qualified internal auditor should be required as per the rules of State Pollution Control Board with well-equipped laboratory facility for analysis of water and air samples.

External Auditor: Experienced expertise were appointed as External Auditor appointed/approved by the State Pollution Control Board. Evaluated and verified reports along with their comments were sent to the State Pollution Control Board for further action.

13. Role of Environmental Audit and Environmental Management System

A vital role of an environmental audit (EA) is to recognise the areas for development, but an audit does not, in itself, provide the methods to implement changes. However, EA should set the agenda of an environmental management system. System of EA provides a mechanism for methodically handling the environmental matters of an Organization while EMSs provide a framework to 1) identify the environmental effects and document regulatory requirements, 2) set the objectives and targets for ensuing environmental performance/programmes, 3) implement protocols and procedures for achieving the objectives/ targets and 4)

undertake audits to measure environmental performance and its efficacy measures to attain the well-defined objectives/targets. All the events pertaining to environmental effects, regulations, objectives and targets and the procedures are usually documented. As far as stakeholders are concerned EMS usually rely heavily on documentation and verification.

14. Target Areas of Environmental Auditing

- Auditing for Water Management (Wastewaters and Industrial effluents)
- Auditing for Waste Management (Solid, Electronic and Biomedical)
- Auditing for Energy Management (Electrical energy and Fossil Fuel use)
- Auditing for Soil Analysis (Soil health, degradation and conservation)
- Auditing for Carbon Footprint (Electrical, vehicles and human population)
- Auditing for Green Campus facility (Correlated with Green Campus Audit)
- Auditing with the Organization's Management for financial allotment
- Auditing with the Stakeholders for their contribution on environment studies
- Environmental Education and Implementing Swachh Bharath Abhiyan Scheme

15. Procedures followed in Environment Audit

15.1. Environment Systems Audit

Environmental audit involves monitoring an Organization concerning about the green campus, environment, sanitation and hygiene policies. It is a regular process that is conducted periodically by a regulated entity to check whether an Organization meets the requirements of environmental compliance. The process of environmental audit includes examining, collecting, evaluating, documenting data and analyzing various components related to environmental aspects (IGBC, 2020; WGBC, 2020). Environmental audit was carried out as per the procedures mentioned of the Manual of Gnanamangai *et al*. (2020). The environmental audit possesses the following characteristic features in which various aspects of wastes generation and steps taken by the Organization to reduce both solid and liquid wastes without harming the environment.

- Identification of various sources to generate wastes and types of degradable and non-degradable wastes in the campus.
- Collection of information related to type of operations, use of various raw materials and products that generate wastes.
- Finding the highlights of inefficiencies in the process that generate wastes and areas that are to be monitored with extra care.
- Setting up the target for reduction of wastes and source of waste generation without affecting the environmental health.
- Steps taken to minimize the environmental pollution and degradation by means of developing internal policy methods.
- Suggestion of cost-effective waste management strategies and zero waste discharge in the Organization.
- Creation of awareness among stakeholders on the benefits of reducing wastes without damaging the ecosystem.
- Aids in increase of process efficiency and status report with regards to environmental compliance and management.
- Converting the waste materials into fertilizing materials by following the method of recycling and composting processes.

15.2. Carbon footprint by measuring Carbon dioxide level in the Campus

The level of Carbon dioxide is measured in different places across the Organization campus using a portable CO_2 Analyzer (Nondispersive infra-red gas analyser). In addition, CO_2 meter is also displayed the readings of atmospheric temperature, relative humidity and dew point in the places, where the level CO_2 is measured. The Carbon footprint per year is calculated (www.carbonfootprint. com) based on electricity usage per year in which CO_2 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/day and approximate distance covered by the vehicle / day (in km) with a coefficient (0.01) to calculate the emission of CO_2 in metric tons per year.

15.3. Steps involved in the Process of Environmental Audit

Step #1: Opening meeting among the audit team and auditees, discussed about the audit procedure and document verification.
Step #2: Visited the on-site of the audit along with the audit team and auditees.
Step #3: Walked around campus to check the facility as walk-through audit and took photographs for preparing the audit report.
Step #4: Monitor the components as per the environmental audit checklist (Sanitation and hygiene, water conservation, waste management and green campus and environment policies).
Step #5: Noted down what all components are present and what are all not available in the campus as of environmental audit components listed by NSF ISO- EMS checklist.
Step #6: Identified the issues in the campus with respect to the environmental compliance and merits/weaknesses of the Auditee's Management controls and risks associated with the audit.
Step #7: Looked into other items to be monitored as per the NSF checklist with respect to Ecology and Environment studies.
Step #8: Exit meeting held after the audit in which the audit findings with the members of the Organization was discussed.
Step #9: Prepared and distributed the findings as a Report and Certificate along with the recommendations including the best practices followed by the Auditee.
Step #10: Comparison between the last audit report with the present audit report in which the number of suggestions and recommendations were taken into consideration and rectified significantly by the Management.
Step #11: Observed the audit process undertaken by the certifying agency between the last audit and current audit processes, whether the same certifying agency has undertaken the audit process or not?

Meeting with the Principal and Management Representatives of SAWC with the Audit Team of the Nature Science Foundation

16. Benefits of an Environmental Audit

Environmental audit provides the following benefits to the Organization:

- Discover various issues related to the environment in the Organization.
- Compute the issues, identify and assess the impact of the issues.
- Provide suggestions to minimize the issues found in the Organization. On conducting an Environmental audit, it provides the following results:
- Conservation of resources and reduction of raw materials.
- Minimizing wastes, control of pollution and reduction of costs.
- Improvement in working conditions and improvement in process efficiency.
- Improved corporate image and marketing opportunities.
- Apprehensions about the environmental impact of the Organization.
- Progressive development of ownership, personal and social responsibility in relation to the organisation and its environment.
- Preparation of Environmental management plan and monitoring.
- Assessment of environmental input and risks to the ecosystem.
- Identifying areas of strength and weakness for improvements.
- Evaluation of pollution control status, verification of compliance with environment laws.
- Assuring safety aspects of all living organism in the ecosystem
- Improved production with minimum resource utilisation including manpower and development and marketing.
- Planning for pollution control, waste prevention, reduction/recycling/reuse methods.
- Providing an opportunity for management to give credit for good environmental performance.
- On the whole environmental audit minimize the environmental problem locally

which in turn accountable at regional, national and international level.

- Identification of various sources to generate wastes and types of wastes
- Types of degradable and non-degradable wastes in the campus.
- Setting up the target for reduction of wastes and source of waste generation without affecting the environmental health through policy.

17. Phases of an Environmental Audit

The environmental audit encompasses three phases viz., pre-audit, during- audit and post-audit. These phases involve various components to resolve the problems in the campus as well (Arora, 2017; Gnanamangai *et al*., 2020).

17.1. Pre-Audit

Pre-audit involves the following components:

- ✓ Planning the environmental audit
- ✓ Selecting the audit team based on experience and expertise
- ✓ Scheduling the audit facility and venue of audit
- ✓ Scrutinizing the audit application and checklist
- ✓ Opening meeting between audit team and auditee
- ✓ Acquiring the background information of the organization
- ✓ Visiting the site of audit by the audit team and coordinators
- ✓ Audit programme and briefing
- ✓ Collection of data and documents verification
- ✓ Discussion with the auditee for data verification

17.2. During-Audit

During the audit, the following components are involved:

- ✓ Understanding scope of the audit
- ✓ Analysing strength and weakness of the internal controls audit
- ✓ Conducting the on-site audit
- ✓ Appraising the onsite observations during audit
- ✓ Noting down the key observations and taking photographs
- ✓ Clarifications if required during the audit site and document verification

17.3. Post-Audit

Post-audit involves the following components:

- ✓ Identification of the best practices followed by the Organization
- ✓ Compiling a report of the data collected
- ✓ Distributing the report and certificate to the Organization
- ✓ Preparing an action plan to overcome the flaws
- ✓ Providing suggestions to implement the action plan
- ✓ Setting up the future environmental aims and objectives

18. Components of an Environmental Audit

Environmental audit has ten components, namely:

1) Sanitation and hygiene policy
2) Green and Environment policy
3) Water conservation policy

4) Water management policy
5) Waste management policy
6) Rainwater harvesting policy
7) Environment conservation policy
8) Waste management initiatives
9) Environment management policy
10) Environment monitoring policy

18.1. Sanitation and Hygiene Policy

In this component, the following are being considered:

- Physical appearance and overall ambience
- Adequacy of toilets (Student/Employee: toilet ratio)
- Gender balance and disabled-friendly toilets (Male: Women)
- Water taps and sanitation plumbing, adequacy and efficiency
- Adequate clean drinking water facilities
- Kitchen staff apparel and hygiene
- Canteen and hostel hygiene maintenance
- Kitchen hygiene and fly proof condition
- Cutlery, crockery and utensils hygiene
- Dining hall hygiene and bad odour free
- Cleaning equipment and consumables

18.2. Water Conservation Policy

In this component, the following are being considered:

- Know the source of the campus water availability
- Monitor overhead tanks for periodical cleaning
- Reuse of treated water, recycling, leakages etc.
- Drip irrigation / sprinkler irrigation system for watering to plants
- Water efficient dispensing mechanism in campus

18.3. Rainwater Harvesting Policy

In this component, the following are being considered:

- Implementation of rainwater harvesting system
- Functioning status of rainwater harvesting system
- Connectivity between rainwater harvesting and open wells and bore wells

18.4. Waste Management Policy

In this component, the following are being considered:

- Is the campus a 'Plastic free zone'?
- What are the methods adopted for waste segregation and storage?
- Disposal of solid wastes, reuse and recycling process
- Vermicompost, cow dung and organic manure units
- Availability of Biogas plant and its implementation status
- Installation of incinerators and their functioning status
- Adequate number of waste bins, separate bins for dry and wet wastes
- Food waste dumped status methods of disposal

18.5. Waste Management Initiatives

In this component, the following are being considered:

- Sign boards indicating energy / water conservation in respective places
- Awareness sign boards on usage of tobacco and tobacco free campus
- Awareness sign boards on plastic usage and plastic free campus
- Programmes related to waste segregation / waste disposal systems
- Sufficient ventilation facility
- Social responsible activities to rural, tribal and urban areas

18.6. A good environmental audit

- Defines waste generation sources and quantification of its types
- Collects information on raw material, unit operations, products, and water usage
- Highlights process efficiencies and areas to be focused
- Helps in planning targets for waste reduction, development of cost-effective waste management approaches and create awareness among the workforce regarding the benefits of waste reduction
- Helps to improve process efficiency
- Assess the quantity of water usage within the company.
- Find out various sources of organic and solid waste generation and mitigation possibilities.
- Document the waste disposal system
- Release of standing order report on environmental compliance.
- Waste minimization opportunities realized that contributes to reduction in operating price.
- Increased worker cognizance of environmental standards and responsibilities.
- Improve employee relations and morale.
- Improve the image of organization and its good will.
- Maintenance of sustainable stage of improvement.

19. About the Organizations

19.1. About Sree Abiraami Arts and Science College for Women

Sree Abiraami Arts and Science College for Women Science was established in the year 2016 with the aim of providing higher education to the socially and economically backward young women by Sree Abiraami Educational & Charitable Trust, which is approved by Government of Tamilnadu and affiliated to Thiruvalluvar University (Vellore). This is the first self-financing Women Institution in Gudiyattam located in Keelalathur on Katpadi main road. The college is situated in serene & Greenish atmosphere with sophisticated buildings, spacious classrooms with smart board, well equipped laboratories, advanced computer lab, large volume of digital library, (24/7) wifi and hygienic canteen. There are 30 Buses operated to cover 70 km radius from the college. The college offers 7 UG Programme and 2 PG Programme. The Trust has started a world class CBSE School named Sree Abiraami CBSE School up to VII Grade in the same campus in the year 2019. The main aim and motto of this institution are Knowledge, Discipline and Skill.

The vision is to offer quality education to the socially and economically backward young women of our country and impart values to make them responsible citizens. The mission to empower young women to face the challenges of life with courage and

commitment to become successful. To impart knowledge for improving the socioeconomic status and upliftment of the life. To strive continuously confer them to tackle the social issues in the society.

19.2. About Nature Science Foundation (NSF)

NSF is a Non-Profit ISO 9001:2015 certified Organization and registered with NGO Darpan NITI Aayog and Ministry of Micro, Small and Medium Enterprise, Government of India functioning energetically towards the noble cause of nature conservation and environmental protection. NSF is managed by a board of trustees of NSF Public Charitable Trust 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 12A, 80G and Form 10AC certificates for income tax exemption. The main motto of the NSF is to "Save the Nature to Save the Future" and "Go Green to Save the Planet". NSF Branch Offices are also functioning effectively at Gorakhpur, Uttar Pradesh and Faridabad, Haryana, India to adopt the 'Go Green Concept'. NSF family is widespread across India with over 70 state-wise Lead auditors to conduct Green and Environment Audits.

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, Student Technical Symposium, Distinguished lecture programme, Environment Day celebration, Ozone Day celebration, Project model exhibition, Awareness programmes on Environmental pollution, Biodiversity and Natural resources conservation and etc. with the financial support of the Foundation. NSF is being released 'Magazine' and 'Newsletter' biannually to share the information about Environmental awareness programmes on biodiversity conservation, seminar on soil conservation, water management and solid waste management, restoration and afforestation programmes in Western Ghats of southern India.

In order to encourage the students, members of faculty, academicians, scientists, entrepreneurs and industrial experts those who are involving in nature protection and biodiversity conservation studies, NSF tributes the deserved meritorious candidates with various awards and honours such as 'Best Faculty Award', 'Best Women Faculty', 'Best Scientist Award', 'Best Student Award', 'Best Research Scholar Award', 'Best Social Worker Award', 'Young Scientist Award',

'Life-Time Achievement Award' and 'Fellow of NSF' will be given.

NSF has introduced various types of Audits such as 'Eco Audit', 'Green Audit', 'Energy Audit' and 'Hygienic Audit' 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 ISO EMS 14001:2015 criteria and in compliance with Government Law and Environmental Legislations including World / Indian Green Building Council and the concept of Swachh Bharath Abhiyan under Clean India Mission. Green campus and Environment Policy, Purchase Policy, MoU, International Eco Club Student Chapter Certificate will be given to get the maximum mark weightage in NAAC. Audit processes are being conducted through the certified Auditors as per the following.

Audit	**Certified Auditors**	**Certified Auditors**
Green Audit	• IGBC - Indian Green Building Council • GBCRS - Green Building Code and Green Ratings Systems • GRIHA – Green Rating for Integrated Habitat Assessment	➢ Mrs. S. Rajalakshmi ➢ Dr. R. Mary Josephine ➢ Dr. B. Mythili Gnanamangai ➢ Er. Ashutosh Kumar Srivastava ➢ Er. N. Shanmugapriyan
Energy Audit	• BEE - Bureau of Energy Efficiency • LEED - Leadership in Energy and Environmental Design • CII-GreenCo – GreenCo Rating System Felicitator	➢ Er. D. Dinesh kumar ➢ Er. N. Shanmugapriyan ➢ Dr. N. Balasubramaniam ➢ Dr. P. Thirumoorthi ➢ Dr. G. Murugananth
Environment Audit	• IGBC - Indian Green Building Council • ASSOCHAM - Associated Chambers of Commerce and Industry of India • FSRS – Fire Safety & Rescue Services	➢ Mrs. S. Rajalakshmi ➢ Dr. A. Geetha Karthi ➢ Dr. R. Mary Josephine ➢ Dr. B. Mythili Gnanamangai ➢ Er. Ashutosh Kumar Srivastava ➢ Er. N. Shanmugapriyan
Hygiene Audit	• FSMS – Food Safety Management System & • Occupational Safety & Health (ISO 22000:2018) • SBICM - Swatch Bharath under India Clean Mission	➢ Mrs. Gaanaappriya Mohan ➢ Er. Ashutosh Kumar Srivastava ➢ Dr. R. Sudhakaran ➢ Dr. N. Saranya
Waste Management Audits	• Water Audit, Soil Audit, Biomedical Waste Audit, Solid Waste Management Audit as per the IGBC,	➢ Mrs. Gaanaappriya Mohan ➢ Er. Ashutosh Kumar Srivastava ➢ Dr. R, Sudhakaran ➢ Er. N. Shanmugapriyan

	GRIHA and BEE	
Academic & Administrative Audits	• Academic & Administrative Audits as per the NAAC Criteria	➢ Dr. B. Anirudhan ➢ Dr. B. Shreeram

Table 2. Total Campus Area, Building Spread Area, Vehicles and human population

S.No.	Details of Area	Total area
1.	Total Campus area	42492 sq.m
2.	Total Built up area	20146 sq.m
3.	Covered Car parking area	500 sq.m
4.	Air-conditioned area	4000 sq.m
5.	Non Air-conditioned area	-
6.	Gross Floor Area	5000 sq.m
7.	Public area	-
8.	Service area	-
9.	Forest vegetation	4020 sq.ft
10.	Planted vegetation	
11.	Total number of Girl students	1057
12.	Total number of Boy students	-
11.	Total number of Teaching Staff	60
13.	Total number of Non-teaching staff	15
14.	Total number of College Vehicles	198

SAWC campus Infrastructure.

20. Audit Details

Date / Day of Audit	**: 07-12-2020 (Monday)**
Type of Audit Undertaken	**: Environmental Audit**
Venue of Audit	**: Sree Abiraami Arts and Science college for Women,Gudiyattam, Vellore – 635 803.** Tamil Nadu, India.
Audited by	**: Nature Science Foundation,** Coimbatore, Tamil Nadu, India.
Name of ISO EMS Auditor	**: Mrs. S. Rajalakshmi,** Chairman & ISO EMS Auditor, NS
Name of Subject Expert-I	**: Dr. R. Sudhakaran,** Board of Director, NSF North Zone, Haryana.
Name of IGBC AP Auditor	**: Dr. B. Mythili Gnanamangai,** IGBC AP, Indian Green Building Council.
Name of ASSOCHAM Auditor	**: Er. Ashutosh Kumar Srivastava,** Associated Chambers of Commerce and Industry
Name of the Energy Auditor	**: Dr. Antony Raj** Certified Lead Auditor
Name of the Eco Auditor	**: Dr. Tangavelu & Dr. Mary Agnes** Certified Lead Eco Auditor

Auditing Team of the Nature Science Foundation, Coimbatore, Tamil Nadu at the SAWC, Vellore.

21. Qualitative and quantitative measurements of Environment Audit

It covers both qualitative and quantitative measurements including physical observation of eco-friendly environment set-up. The qualitative and quantitative measurements such as achievement of environmental objectives and targets by implementing agency (Auditee), appointment of Environmental Engineers and Agriculture Staff working for environment monitoring, Drinking water / RO water / Borewell water / Open well water / Pond water / Municipal or Corporation water

facility to the stakeholders and periodical checking of drinking water quality through Physico-chemical properties analysis, Wastewater treatment facility, Hazardous and toxic material disposal facility, Solid waste management facility, Renewable energy utilization (Solar panel, wind mill, solar water heater, etc,), Air ventilation at Indoor / Outdoor auditorium, seminar / conference halls, classrooms, hostel, canteen, staff rooms, laboratories, restrooms, etc., Availability of Biogas plant, Rain harvesting system, water reservoirs, etc. Incinerator for napkin disposal use, Housekeeping, storage, areas, piping, plumping and etc. facility, Sign boards indicating plastic free campus, tobacco free campus, don't waste water, don't walk on the lawns, don't plug flowers, etc. The ratio of Environment sustainability courses (Environmental Science, Engineering, Technology, Management, Monitoring, Climate change, Global warming, etc.) to total courses / subjects to undergraduate and post graduate course students including research scholars, Per capita water consumption per day and carbon footprint in the Organization campus due to an extensive use of vehicles, electricity usage and human population load are also analysed during the environment audit. These qualitative and quantitative measurements are playing important role in environment sustainable development in the campus.

An account of a large number of Oxygen releasing and Carbon dioxide assimilating plants planted in the Campus are taken into consideration to give pure atmosphere to the stakeholders. Establishment of different types of gardens in the campus, rainwater harvesting system, operation of water irrigation, drip and sprinkler irrigation are a quite a few methods are already under implementation in the Institute in order to establish the green campus. Biofertilizers, organic and green manures, cow dung manures and farmyard manures may be used for the cultivation of plants which may be protected the environmental health that will not cause any air, water and soil pollution. The various Clubs, Forums, Cells, Associations and Student / Staff Chapters such as Eco club, Nature club, Science club, Fine Arts club, Flora and Fauna club, Youth Red Cross, SF and NSS bodies may be involved in green campus as well as eco-friendly atmosphere initiatives, planning and efforts among stakeholders. Outreach programmes may be conducted for dissemination of natural resources management, environmental pollution studies, green and eco-friendly atmosphere pledge initiatives to rural, tribal and urban people across the country. Signing of MoU with Govt. and NGOs to ensure ecofriendly campus maintenance, conduct of awareness programmes and cultural activities for environmental monitoring and ecosystem maintenance to the stakeholders.

Waste management methods, documentation of energy utilisation and carbon footprints were given due importance in the audit in relation to healthier environment under climate change and global warming scenario. In addition, academic credentials like taking up major and minor Projects, Dissertations, Thesis work and Scholarly publications on environmental science, engineering, technology and management domains carried out by students and staff members may be taken into account towards environment sustainability management. Best practices followed on green campus and eco-friendly set-up initiatives, planning and efforts in the Organization and recommendations for improvement are illustrated in the audit report as well.

Table 3. Qualitative Measurements of Environmental Audit

S.No	Requirements and checklists of the audit	Conformity		
		Yes	No	NA
1.	Have Internal Environment Audit procedures been developed and implemented in the Organization?	√		
2.	Have programmes for the achievement of environmental objectives and targets been established and implemented as on today?	√		
3.	Have responsibilities been assigned for programmes at each appropriate function and level? (Environmental Engineer and Agriculture Staff working for environment monitoring in the campus)	√		
4.	Are the following environmental aspects considered in sufficient detail?			
	a. Drinking water / RO water / Borewell water / Open well water / Pond water / Municipal or Corporation water use and to check quality of water through Physico-chemical properties analysis	Ro unit-7, Bore well - 1		
	b. Wastewater treatment facility	√		
	c. Hazardous and toxic material disposal facility			√
	d. Solid waste management facility	√		
	e. Renewable energy utilization (Solar panel, wind mill, solar water heater, etc.)	15 Panels-3KV		
	f. Air ventilation at Indoor / Outdoor auditorium, seminar / conference halls, classrooms, hostel, canteen, staff rooms, laboratories, restrooms, etc.	√		
	g. Acoustic proof in indoor auditorium, seminar / conference halls	√		
	h. Availability of Biogas plant		√	
	i. Rain harvesting system, water reservoirs, etc.	√		
	j. Incinerator for napkin disposal use	√		
	k. Housekeeping, storage, areas, piping, plumping and etc. in a proper way	√		
	l. Sign boards indicating plastic free campus, tobacco free campus, don't waste water, don't walk on the lawns, don't plug flowers, etc.	√		
	m. The ratio of Environment sustainability courses (Environmental Science, Engineering, Technology, Management, Monitoring, Climate change, Global warming,) to total courses / subjects			√
	n. Per capita water consumption per day	14.3		

		LD		
5.	Signing of MoU with Govt. and NGOs to ensure ecofriendly campus maintenance	√		
6.	Implementation of Government schemes (Swachh Bharath Abhiyan under Clean India Mission)	√		
7.	Functioning of Nature club, Eco club, Cell, Forum, Association, SF (NCC), NSS bodies and Social Service League for students and staff members on environment conservation, pollution control and nature protection.	√		
8.	Conduction of awareness programmes and cultural activities for environmental monitoring and ecosystem maintenance to the stakeholders	√		
9.	Conduction of outreach programmes for dissemination of natural resources and environmental pollution	√		
10.	Implementation of composting pits, vermicompost unit, recycling of kitchen wastes collected from hostels, canteens, and other places	√		
11.	Steps taken for organic, inorganic, toxic, e-waste, biomedical, food, sewage waste management, segregation of wastes and reuse methods	√		
12.	Public transport, low-carbon emitting vehicles, battery operated vehicles, bicycles, biofuel use and control of car smokes and exhaust with respect to routine FC services	√		
13.	Observation on the site preservation, soil erosion control and landscape management	√		
14.	Projects and Dissertation works and Scholarly publications on environmental science, engineering, technology and management carried out by students and staff members	√		
15.	Steps taken to take care of daylighting, AC machine heat and carbon dioxide emission & carbon sequestration*	√		
16.	Eco-friendly Refrigerants, instruments and materials use including Energy efficiency measures taken *	√		
17.	Mechanism of monitoring environmental parameters (Temperature, Relative humidity, Rainfall, Sunshine, Wind speed, dew point)*		√	
18.	Are the required resources (e.g. personnel skill development, procurement, finance, etc.) for implementation and control of the environmental management system provided by Management?	√		
19.	Any mosquitos and vectors and predators identified in the campus which are the root cause of various diseases spreading to students?		√	
20.	Any Digital / Automatic technology is adopted to reduce consumption of paper, gas, water, energy, etc.	√		

21.	Are all monitoring equipment appropriately maintained and calibrated?	√		
22.	Impactful Organization programmes on climate change, global warming, environmental protection, etc.	√		
23.	New initiatives to decrease private vehicles on campus to reduce carbon emission	√		

* Applicable for Industrial sectors
** A minimum of 50% criteria should be attained

Table 4. Quantitative Measurements of Environmental Audit

S.No	Requirements and checklists of the audit	Numbers / Percentage
1.	Number of RO water Plant in the campus for drinking water	3
2.	Number of Borewell water and Open well water facility	1
3.	Number of Percolation Pond and Check Dam facility	-
4.	Number of Wastewater treatment facility	1
5.	Number of Solid waste management facility	1
6.	Number of Renewable energy utilization (Solar panel and solar water heater)	15
7.	Number of Rain harvesting system and water reservoirs	6
8.	The ratio of Environment sustainability courses (Environmental Science, Engineering, Technology, Management, Monitoring, Climate change, Global warming) to total courses / subjects	1
9.	Functioning of Nature club, Eco club, Association, and NSS on environment conservation, environmental pollution, nature protection and natural resources maintenance.	2
10.	Signing of MoU with Govt. and NGOs to ensure ecofriendly campus maintenance	-
11.	Implementation of Government schemes (Swachh Bharath Abhiyan under Clean India Mission) programmes conducted	1
12.	Number of composting pits and vermicompost unit for recycling of kitchen wastes and plant leaf litters degradation	1
13.	Per capita water consumption per day	15000 lit/day
14.	Carbon footprint in the campus due to Electrical energy usage	307.21 m/t
15.	Carbon footprint in the campus due to Vehicles usage	103 m/t
16.	Carbon footprint in the campus due to Petroleum gas usage	9 m/t
17.	Carbon footprint in the campus due to Human population load	8.5 m/t
18.	Carbon footprint in the campus due to use of Petrol and Diesel for operating Generators for power generation	10 m/t

22. Observations of the Environment Audit

22.1. Plastics use and their impact on the environment

The Ministry of Environment, Forest and Climate Change, Government of India has advised the Plastic Waste Management Rules, 2016. A Central Pollution Control Board report specified that the total annual plastic waste generation is quite huge and accounts around 3.3 million metric tonnes/year for which the data were collected from 60 major cities in India. The country generates around 26,000 tonnes of plastic waste/day out of which 60% of plastic produced is recycled. It doesn't degradable, rot, like paper or organic waste like food and hence, it can hang around in the environment for hundreds of years. More than eight million tonnes of plastic escapes from the land cover and enters the world's oceans each year while only 9 per cent of the total plastic waste in the world is recycled. It is observed that 96% of plastic wastes are collected and segregated by the respective urban bodies in which the recyclable plastic waste are sold to the recyclers and non-recyclable plastic waste are sent for co-incineration in cement plants. People should be probed to use reusable substances and initiate models which allow up-cycling of waste for better use. This will help to reduce plastic waste from urban local bodies, as well as curb the value for waste among the citizens. Plastic waste management is very important, because plastic not only pollute the environment, it destroys food chains.

People use plastic bags and plastic ware items every day to hold objects like meals, clothes, grocery and stationary items, which can be bought from shops. Generally, the plastic items are non- degradable in nature that lead to soil pollution and affect the soil health significantly. Most of the plastic items are considered as solid waste and enhance the unwanted animal choking, water pollution, blockage of channels, rivers and streams, and landscape disfigurement. According to the World Health Organization (WHO) report, plastic items take at least 400 years to decompose completely in the soil which illustrates the subsequent effects on the environment. Plastic pollutants form a basis for damage to the healthier environment besides the living organisms in the ecosystem. It impacts all organisms in the food chain from tiny species to big ones. And hence, reduction of plastic usage is the need of the hour to protect at least the present-day natural resources. There is a need to reduce the plastic use to effectively limit plastic waste in the campus.

SAWC has taken sufficient attempts not to use plastics in the campus and ‘say no to plastics’ in places like canteen, hostel dining halls, seminar halls, corridors, etc. to the students, parents and public. The College Management insisted the people use eco-friendly bags made from organic materials like plant fibres which are easily decomposable in nature. These efforts are very much essential to keep the environment neat and clean to conserve nature.

22.2. Solid Waste Management Practices at the Sree Abiraami Arts and Science College for Women (SAWC)

The term, solid waste control refers to the method of accumulating and treating solid wastes by following eco- friendly methods. It also offers solutions for recycling objects that do not belong to garbage. In the solid waste management, the wastes are accrued from different parts and are disposed of based on degradability materials like paper and non-degradability materials like glasses, plastics and metals. Integrated Solid Waste Management (ISWM) is an activity that promotes reduction of waste, recycling, composting, and disposal besides offering methods/solution to manage stable wastes in the context of protect all living organisms in the ecosystem.

As per Solid Waste Management Rules, 2016 (Ministry of Environment, Forest and Climate Change, Government of India), solid waste refers to solid or semi-solid wastes generated from domestic, commercial, institutional, catering, and markets and other non-residential wastes (street sweepings, silt removed or collected from surface drains, horticulture/agriculture and dairy waste, bio-medical waste excluding industrial waste, and e-waste, battery/radio-active waste). According to the rules, the local authorities are responsible to collect, treat and dispose the solid wastes. The 'Central Board of Solid Waste Management' is the monitoring authority and is responsible for granting authorization to local bodies for processing and disposal of solid waste.

SAWC has a very good solid waste recycling unit which operates a few vehicles to collect wastes using compostable bags across the campus. Both degradable and non-degradable items are being collected from different Department laboratories, canteens, cafeteria, stationary shops and hostels every day and dumped in the place which is subsequently segregated based on the nature of degradability. The segregated items are neatly packed in eco-friendly covers and subjected to degradation without harming the environment. In addition, dust bins are kept in different places across the campus to provide a dust free atmosphere to the stakeholders. The dust bins are labelled properly for the indication of degradable and non-degradable items. These bio composts are utilized for cultivation of plants in the campus and enhance the health of soils and population density of beneficial microorganisms to a greater extend.

22.2.1. Waste Management Practices

Waste management has a common mandate that the "Producer Owns the Responsibility". The community that generates waste should develop more responsibility in handling the waste with more care thus reducing negative impact on the environment. In a study conducted in SAWC, had quantified a daily average of wastes in which food waste is about 37%, recyclable waste is about 27% and other organic waste is about 36%. The study revealed that the solid wastes need to be

professionally handled. The solid wastes are collected from different places of campus and segregated based on bio-degradable and non-degradable materials subsequently subjected for recycling and degradation processes like composting. Details of the waste management practices in college are 1) Bio-degradable waste handling, 2) Sewage Treatment Plant 3) Bio-gas plant, 4) Disposal of E-Waste and 5) Rainwater Harvesting System. Regarding the food wastes, a portion of food wastes being pulverized and used in the bio-gas digester and the balance quantity is sent to piggeries. Organic wastes like dry leaves, vegetable cuttings, etc. are sent for bio-composting.

22.2.2. Bio-degradable and non-degradable waste materials Management Practice

For segregation of waste (Organic, recyclable, non-recyclable and e-waste) at source and collecting the same 'Waste Bins' are placed at designated locations in the SAWC viz. Students Hostels and Staff rooms, Students Service Centre, Sports Complex and Guest rooms. A Contractor in Vellore is engaged for the collection and further process of waste generated within the campus where biodegradable wastes subjected to preparation of organic compost.

22.2.3. Disposal of e-Waste at the SAWC

According to E-Waste Management Rules, 2016 (Ministry of Environment, Forest and Climate Change, Government of India), electronic waste or e-waste includes old and non-functional electrical and electronic appliances (telephones, cellular telephones, computers, laptops, television sets, refrigerators, washing machines, air-conditioners, fluorescent and other mercury containing lamps etc.). As per the Rules, the producer of the electrical and electronic equipment shall be responsible to collect and channelize the e-wastes generated under the criteria Extended Producer Responsibility. E-waste Management Rules applicable not only to Manufacturer/Producer, it is also applicable to Consumers, Collection Centre/Dealer, Retailer, Dismantler and Recycler.

In compliance to the E-Waste Management Rules, 2016, Government of India, e-waste materials were collected from the SAWC are being segregated and then sold to Authorised Agencies which are approved by the Pollution Control Board (PCB) for handling e-waste. Due to this e-waste activity disposal, the e-waste pollution is significantly reduced in the College Campus. However, a proper method of e-waste disposal should be done in coming years in collaboration with Tamilnadu State Pollution Control Board as per the E-Waste Management Rules, 2016.

22.2.4. Construction & Demolition of Waste Management

The Ministry of Environment, Forest and Climate Change, Government of India has notified the Construction and Demolition Waste Management Rules, 2016 exclusively to manage waste (building materials, debris and rubble) from construction activities like new construction, re-modelling, repair and demolition. According to the Rules, the local authorities need to ensure proper management of construction and demolition wastes. State Pollution Control Board is to grant authorization for the waste processing facility and to monitor the implementation of these Rules. One of the

best waste management practices is rebuilding of construction waste into pillars, pathway road.

22.2.5. Hazardous Waste Management

According to the Hazardous and Other Wastes (Management and Trans Boundary Movement) Rules 2016 (The Ministry of Environment, Forest and Climate Change, Government of India) under Environment (Protection) Act, 1986 Harzardous waste refers to "any waste which by reason of characteristics such as physical, chemical, biological, reactive, toxic, flammable, explosive or corrosive, causes danger or is likely to cause danger to health or environment, whether alone or in contact with other wastes or substances". Hazardous waste generator shall follow various steps (minimising the utility of hazardous elements, prevention, recovery, reuse by co processing, recycling, and safe disposal) of hazardous waste. The State Board of 'Hazardous Waste Management' is taking operative steps in handling and management of hazardous wastes, its treatment and disposal in an environmentally safe manner.

SAWC has taken pioneering efforts to dispose the hazardous waste properly that are generated from various Department laboratories. Acids, solvents, salts, reagents and cancer-causing substances (carcinogens) like acetaldehyde, Acrylamide, Aristolochic acids, Arsenic and its derivatives, Azathioprine, Benzene, Ethidium bromide, Ethylene oxide, Formaldehyde, Hexachloroethane, Hydrazine sulfate, Hydrazobenzene, Lead compounds, Naphthalene, Naphthylamine, Selenium sulfide, Streptozotocin, Styrene, Sulfallate, Tetrachloroethylene, Urethane, Vinyl chloride, Vinyl fluoride and etc. will cause cancer to the stakeholders those who doing research and/or experiments.

The other carcinogenic materials such as Aflatoxins, Alcoholic beverages, Areca nut, Asbestos (all forms), Coal, indoor emissions from household combustion, Glass wool fibers (inhalable), Leather dust, Ionizing radiation, Solar radiation, X-ray and Gamma radiation, Iron and steel founding (workplace exposure), Tobacco smoke, Welding fumes, Wood dust, Painter (workplace exposure), Rubber manufacturing place, Salted fish (Chinese-style), Silica dust, Crystalline, in the form of quartz or cristobalite will cause various types of cancer to the students and staff members. Hepatitis B virus, Hepatitis C virus, Human immunodeficiency virus type 1 (HIV-1), Human papilloma virus (HPV) and Human T-cell lymphotropic virus type I act as carcinogenic to humans.

Acids and Reagents should be carefully mixed with 2 to 5 gallons of water and diluted solution poured slowly down the sink followed by flushing with large quantum of water without splashes. It's very important to note that always add the chemical to the water and not the water to the chemicals. Disposal of acids with very low pH (<2) found to be safely. If the acid doesn't contain heavy metals/toxic substances, neutralize the pH to a less acidic level (pH 6.6-7.4) allows to dispose of the substance in the standard sewer system.

Chemical wastes are regulated by the Environmental Protection Agency (EPA) through the Resource Conservation and Recovery Act (RCRA). Chemical waste

cannot be disposed of in regular trash or in the drainage system. Most chemical wastes must be disposed of safely without affecting the environment, soil health and water quality as per the directions of World Hazardous Waste Programme. Carcinogenic substances should not dispose of from the laboratories directly through drains or by evaporation into the atmosphere, nor should they be buried since they might be released later.

Carcinogenic substances should be treated strictly as per the protocol and the degraded products should be non-toxic and non- carcinogenic in nature. Procedures involved in treatment and disposal do not result in exposure to the personnel in charge of the work and the procedures on treatment and disposal do not end with contamination of equipment or workplace. Biological and animal wastes, human or animal blood and body fluids can be disseminated through drains (sanitary sewer), under running water after it has been decontaminated by autoclave or using chemicals. In addition, animal wastes and microorganisms including some biological waste materials should be disinfected with liquid detergents and disinfectant solution and then poured down the drainage after dilution with water (pH 6.6-7.4).

The campus has a certain protocol to dispose waste as well as expiry chemicals properly. But there is no proper record for disposing of acids, reagents, carcinogenic and hazardous chemicals as per the rule of Central Pollution Control Board.

22.2.6. Waste Disposal and Tracking Form

Name of the Organization : Sree Abiraami Arts and Science College for Women.
Address of the Organization : Gudiyattam
Vellore,
635 803, Tamilnadu.
Date of Waste Disposal : From April 2018 to March 2020
Reporting Team and details : IQAC and NAAC Teams

Table 5. Details of waste disposal and tracking form

S.No.	Types of Waste	Approximate Quantity / Unit Disposed	Disposal Location (On-site / Off-site)	Authorized Company responsible for recycling
1.	Acids and Bases	Data available with the Respective Departments	On-site	--
2.	Aerosol Cans (Empty)	Not Applicable	--	--
3.	Agriculture Waste	Not Applicable	--	--
4.	Aluminium, Metal Cans, Tins	Not Applicable	--	--
5.	Asbestos	Data available with the college Engineer Office	On-site	--

6.	Batteries (Dry)	No data available	--	--
7.	Batteries (Lead Acid)	8	Off site	--
8.	Biomedical Waste	Not Applicable	--	--
9.	Car exhaust	Not Applicable	--	--
10.	Charcoal	Not Applicable	--	--
11.	Clinical Waste	Data available in College Office	Off-site	Vellore Municipality
12.	Cloth Materials Waste	Data available with Textile Department	Off-site	-do-
13.	Construction Waste	Data available with the college Engineer Office	On-site	--
14.	Condensate Waste	Not Applicable	--	--
15.	Crude Oil	Not Applicable	--	--
16.	Descaling Acids	Not Applicable	--	--
17.	Drilling Fluids / Solids	Not Applicable	--	--
18.	Drums and Containers (Empty)	Not Applicable	--	--
19.	Effluents from major equipment	Not Applicable	--	--
20.	Electrical Waste (Wires, Switches, Fans, A/C machines, Holders, Meters, Coils, etc.)	6-5Kg	Off-site	Vellore Municipality
21.	Electronic Waste (Computer, Laptop, CD, Pen drive, Keyboards, Mouse, Printers, UPS)	6-5Kg	Off-site	-do-
22.	Fertilizer Waste	Not Applicable	--	--
23.	Filters	Not Applicable	--	--
24.	Fluorescent Light Tubes	10	Off-site	Vellore Municipality
25.	Food Waste	550Kg	On-site	Biogas
26.	Furniture Items	10-20Kg	Off-site	Vellore Municipality
27.	Garbage and Cardboards	-	Off -site	-do-
28.	Glass Bottles	5-10Kg	Off-site	Vellore Municipality
29.	Glassware items Waste	Data available with the Respective Departments	Off-site	-do-
30.	Glycols	Not Applicable	--	--
31.	Hazardous Waste	Not Applicable	--	--

32.	Household items	Not Applicable	--	--
33.	Human Waste	25-30Kg	On-site	--
34.	Inert Waste	Not Applicable	--	--
35.	Laboratory Wastes	-	On-site	--
36.	Lights and Bulbs	-	Off-site	Vellore Municipality
37.	Kitchen Waste	Data available with the Hostel Office	On-site	--
38.	Metal Waste	-	--	--
39.	Napkins	10Kg	On-site	--
40.	Oil Contaminated Soil	Not Applicable	--	--
41.	Oily Sludge & Rags (Used)	Not Applicable	--	--
42.	Packaging Waste	20Kg	--	--
43.	Paint Waste	Data available with the College Engineer Office	Off-site	Vellore Municipality
44.	Paper Waste	50Kg	Off-site	--
45.	Pathological Wastes	Not Applicable	--	--
46.	Pigging Wastes	Not Applicable	--	--
47.	Plant Wastewater	350 L	On-site	Wastewater treatment
48.	Plastic Waste	-	Off-site	Vellore Municipality
49.	Plasticware items Waste	-	Off-site	-do-
50.	Produced Water Waste	Not Applicable	--	--
51.	Radioactive Waste	Not Applicable	--	--
52.	Rinsate Waste	Not Applicable	--	--
53.	Rubber Waste	Not Applicable	--	--
54.	Salts used in Laboratories (Used & Expiry Chemicals)	Data available with the Respective Departments	On-site	--
55.	Sanitary Wastewater	Data available with the College Engineer Office	On-site	--
56.	Scale (Pipe and Equipment)	Data available with the College Engineer Office	Off-site	--
57.	Sewage Sludge	Data available with the College Engineer Office	On-site	--

58.	Solvents	Data available with the Respective Departments	On-site	--
59.	Sludge and allied	Not Applicable	On-site	--
60.	Trash (i) Glass (ii) Metal (iii) Plastic (iv) Oils (v) General Trash	Data available in appropriate places	Off-site	Vellore Municipality
61.	Synthetic Dyes, other items	Data available with Textile Department	Off-site	-do-
62.	Textile Waste	Data available with Textile Department	Off-site	-do-
63.	Used Engine Oil	No data available	--	--
64.	Wastewaters (Liquid Waste: Detergents, Soap, Oil, etc)	No data available	--	--
65.	Wood Waste	No data available	--	--

22.2.7. Auditing for Energy Conservation and Management

Energy cannot be seen but we recognise its existence because of its properties in the forms of heat, light and power. Energy use is clearly an important feature of campus sustainability and needs no explanation for it inclusion in the assessment. For example, an old incandescent bulb uses ~60 to 100W while light emitting diode (LED) uses <10 W. Energy auditing offers a guideline to save energy by adopting conservation methods which include1) Reducing the risk of energy scarcity, 2) Reducing the greenhouse gas emissions, 3) Renewables have overhead costs too and 4) Energy Management saves costs. An energy audit is a useful tool for developing and implementing comprehensive energy management plans. Scope of an energy audit is to identify the energy efficiency, conservation, and savings opportunities at the premises of the audit sites in a systematic manner. The audit process is carried out to review of energy saving opportunities and measures implemented in the audit sites and to identify the various energy conservation measures and saving opportunities. In addition, Implementation of alternative energy resources for energy saving opportunities and decision making in the field of energy management along with creating awareness among the stakeholders on energy conservation and utilization are being carried out.

Energy Conservation and Management Activities at SAWC, Vellore, Tamilnadu.

SAWC has a substantial the energy conservation initiatives with very good savings opportunities. Energy efficient lighting schemes, awareness created among stakeholders and necessary power backups are being practiced by the institution. There are some best Practices followed on Energy Audit in the Organization like Transformers, Generators and UPS are protected properly with fencing and kept awareness boards on 'Dangers' and 'Warnings'. It is observed that the most of places, sign board of 'Switch ON' and 'Switch OFF' are kept towards saving energy measures to the stakeholders. Electrical wires, switch boxes and stabilizers are properly covered without any damage which will cause any problems to the staff and student members. Adaptation of drip and sprinkler irrigation and solar streetlights in the campus to minimize the energy potential are well appreciated. Few recommendations, in addition, can further improve the energy savings of the Organization. This may lead to the flourishing future in the context of Energy Efficiency Campus and thus sustainable eco-
friendly environment and community development to the stakeholders in coming years to come.

22.3. Biogas plant facility at the SAWC

A biogas plant is the structure where it is produced by fermenting biomass (cow dung and plant waste products). This is done by developing methane-containing fuel that is usually present in energy crops like corn, or waste substances (manure or organic food waste). The fermentation residue left over from the substrates at the end of fermentation can be used as fertilizer. Biogas is produced by the microbial/bacterial decomposition of the substrate under anaerobic situations. This is implemented by pumping the substrate into the fermenters. The substrate is stored beneath anaerobic conditions and is periodically shifted *via* agitators to avoid the formation of surface scum and sinking layers which allows the biogas to rise greater effortlessly. Installing biogas in educational institutions and industries help in the waste management process, as the wastes accumulated in canteen, hostels, mess and restaurants can be

used for biogas plant, which in turn can be used for cooking. This fulfils two purposes simultaneously by energy saving and waste management. SAWC was in the initial development process for setting up biogas plant in the campus.

22.4. Vermicompost, 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 in the medicinal plant garden, kitchen garden and terrace garden 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. This will be a healthy way of solid litter waste management in the campus.

Minimal use of chemical fertilizers as part of integrated nutrient management system is acceptable but nil use of chemical fertilizers is highly appreciable and also helps to keep the campus more of an organic ecosystem. The soil, air, water and sunlight are the four major natural resources any campus gets. Proper use and conservation of these resources are mandatory in green campus audit sites. Biofertilizers such as Nitrogen fixing bacteria, Potassium and Phosphorus solubilizing bacteria, Potassium mobilizing fungi (VAM), farmyard manure, dried cow dung manure, vermicompost manures and biofungicides and biopesticides are extensively used in Campus to cultivate plants. Agrochemicals, chemical fertilizers, pesticides and fungicides are not used. 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. SAWC is at the initial level of this practice.

22.5. Recycling of Wastewaters at the SAWC

Wastewater recyclers are important features in any Organization or Industry. Once for all the implementations should follow the proper guidelines for wastewater treatment system discharge standards as per Central Pollution Control Board (CPCB). The main feature of these discharge standards is the treated water should not be harmful to the biodiversity, resources and the environment. If an industry or Organization has the wastewater treatment plan, proper records on the analysis of water input and output parameters including the running time of the wastewater treatment plant; its operation cost, its maintenance and the reuse records of the treated water should be well accounted. A typical wastewater treatment system should be based on the waste characterization and the treatment of wastes which can be modified so as to fit into the motto of treating the wastewater which in turn to release of safe water.

22.6. Establishment of Eco-friendly Campus at SAWC

Eco-friendly SAWC Campus – A Greener view

Eco-friendly environment is very essential to any Organization is concern in terms of protection of earth planet. Go green concept is the ideal way to conserve the environment. Eco-friendly products also prevent contributions to air, water and land pollution to a greater extent and designed to have little or no damage to the environment. Products, events, and services that are eco-friendly lead less cost without harming the earth as well as lead less pollution. Anthropogenic activities *viz*., deforestation, construction of new establishments, besides pollution, global warming are the major threat to the environment. Air pollution is instigated by solid and liquid particles and certain gases that are suspended in the air.

All natural products ensure safety from all dangerous chemicals and allows the humans to avoid risky additives. Overall using eco-friendly natural products improves quality of life without harmful effects. In order to save the environment, college has taken sufficient attempts by means of creating environment awareness programme to the rural, tribal and urban people across the country and also offering various core and elective courses to the students and scholars in their curriculum.

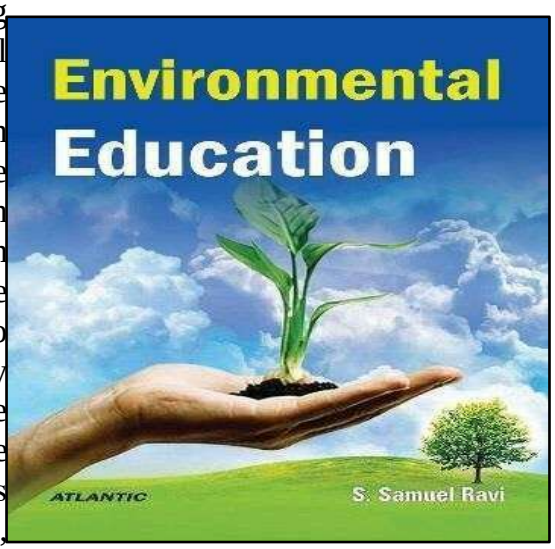
22.7. Napkin disposal facility

Menstrual Hygiene Management (MHM) is an indispensable part of the Swachh Bharath Mission Guidelines (SBM-G) for adolescent girls and ladies. As in step with MHM hints, ‘Safe disposal’ method making sure that the process of destruction of used and dirty materials is performed without human touch and with minimum environmental pollutants and ‘Unsafe disposal’ method throwing used material into ponds, rivers, or inside the fields exposes others inside the vicinity to decaying material and must be averted. Some of the unsafe practices of napkins include throwing them unwrapped into fields and rooftops, wrapping them in paper/ plastic bags and throwing them outdoors or in dustbins, burying them for de-composting, throwing them in latrine / toilets, burning it. These unsafe practices are to be avoided and rather health practices can be adopted.

The Campus Management is implementing the safe practices of disposing of napkins using small scale incinerators in ladies’ hostels. Disposal structures are in the

proper directions and other social stigmas connected to menstruation influences the sanitary waste disposal conduct of women within the campus is very much appreciated. The College is taking care of adolescent girls and ladies significantly in their personal hygiene.

22.8. Environmental Education



An environmental study is the learning principle of the ecosystem and how it will expand sustainable techniques to defend the surroundings. It enables people to develop an understanding of the environment in which we live and helps to overcome tough environmental troubles affecting nature. In addition, the physical aspects of the environment should be studied, it also emphasizes the need to conserve biodiversity and undertake an extra sustainable way of life and make use of sources in a responsible manner. To create attention amongst today's generation on pressing environmental troubles, the University Grants Commission (UGC) in India has made it mandatory for the Universities and Autonomous Colleges to introduce a course in 'Environmental studies' and teach to the students about the ecosystem, pollution and problems associated with the environment. Environmental education refers to structured efforts to deliver how natural environments function, how human beings can manage to protect the ecosystems in sustained manner. It is a multi-disciplinary field integrating Biology (Botany and Zoology), Chemistry, Physics, Ecology, Environmental Science &Engineering, Earth Science, Atmospheric Science, Mathematics, and Geography.

22.9. Public transport, Low emitting vehicles and Control of Car smokes.

A smart method is to pick out public transportation as much as feasible without polluting the environment by way of driving a car or bike. It additionally often is cheaper, and it leaves much tear in personal automobile expenses. Public transportation cars together with buses reduce carbon emissions which greatly decreases the development of smog within the towns. This means that human beings have healthy air to respire. Comparing a bus travelling with seven people to one single person using a vehicle, it's been observed that buses are the most effective by producing 1/5 the quantity of carbon gas emissions compared to the findings of the car effects. This is a huge decrease in discharge of natural resources per person. Public transportation is better for the surroundings which have been proven through research on emissions. Other than this, it also gives more benefits like less noise and traffic congestion. Whenever possible, try to take public transport in place of one's own vehicle. Fewer miles mean approaching fewer emissions.

SAWC operates some vehicles to pick up the students and staff members around Vellore city to enhance the teaching and learning processes. In addition, a few vehicles are operated to collect the garbage for day-to-day activities with respect to running of hostels, canteens, cafeterias, mechanical workshops and other departments like construction, plumbing and wiring. The vehicles are maintained properly by following periodical services, changing oil filters and belts, grease and lubricate, batteries, etc. It is observed that staff members and students are coming to college every day using their own vehicles (Cars and Bikes / Scooters) which accounted to be moderate in numbers. Some of the students and scholars are coming to the campus using their own bicycles and battery bikes which is highly appreciated in view of making pollution free environment in addition to that college is providing bicycle to maintain eco-friendly in the campus and to reduce carbon-di-oxide.

Buses parked at appropriate places in the SAWC, Vellore, Tamilnadu.

22.10. Ventilation and Exhaust systems in Buildings

Ventilation is necessary in the buildings and continuous air flow removes 'stale' air and replace it with 'fresh' air which facilitates to moderate internal temperatures, reduce the accumulation of moisture, odours and other gases. In addition, ventilation create air movement which improves the comfort of occupants. Mechanical (or 'forced') ventilation tends to be driven by exhaust fans to replace stable air with fresh air along with moderating the optimum temperature to the occupants. Natural ventilation is driven by pressure differences from one part of the building to another. Internal partitions may prevent the air paths, hence the creation of draughts adjacent to openings for adequate flow of air. Natural ventilation can be wind driven, or buoyancy driven. If air quality is poor, nature ventilation by means of opening windows may be adopted to use in the building. It may also be useful to reduce the noise level to a greater extent. It is recorded that the SAWC has a large number of ventilators for effective air circulation.

Ventilation and Exhaust system Facilities in SAWC Buildings

22.11. 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 which lead to assimilation of carbon dioxide. Global warming is driven by human-induced emissions of greenhouse gases which resulted in paramount shifts in weather patterns. It is playing an important role to act as a global indicator for checking the purity of the atmosphere. In general, a portable CO_2 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 CO_2 in the atmosphere is found to be low which did not exceed the critical limit of CO_2. 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 Bank, Post Office, ATM Centre and Examination Centre 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 and poor ventilation were observed followed by all laboratories and seminar and auditorium halls (Table 1).

Table 6. Measurement of CO_2 concentration in the SAWC

S.No.	Different locations of the Organization's Campus	Carbon dioxide level (ppm)	Remarks
1.	Chemistry Lab	550	CO_2 level is low
2.	Environmental lab	345	CO_2 level is low
3.	Canteen	450	CO_2 level is low
4.	Classroom	420	CO_2 level is low
5.	Auditorium	422	CO_2 level is low
6.	Parking	301	CO_2 level is low
7.	Open place	270	CO_2 level is low

Reference of Set values of CO_2 level

- 250-350 ppm: Usual level found in occupied spaces with good air exchange along with pure air. Normal Outdoor ambient concentrations.
- 350-600 ppm: Moderate level associated with complaints of drowsiness and poor air quality. Minimal air quality complaints.
- 600-1000 ppm: Inadequate ventilation and critical level complaints lead headaches, sleepiness, and stagnant, stale, stuffy air. Poor concentration, loss of attention, increased heart rate and slight nausea may present.

Measurement of CO_2 level at SAWC, Vellore, Tamilnadu.

22.12. 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. Production and burial of plant litres over a period resulted in rise in oxygen levels. 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 and it also records the ambient temperature.

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.

Measurement of O_2 level at SAWC, Vellore, Tamilnadu

Table 7. The Oxygen concentration in the SAWC

S.No	Location	Oxygen Level (%)	Remarks
1.	Canteen	17	O_2 level is good
2.	Board Room	18	O_2 level is good
3.	Class Room	20	O_2 level is good
4.	Principal Room	19	O_2 level is good
5.	Reception	19.3	O_2 level is good
6.	Open Place	21	O_2 level is good

22.13. Auditing for Carbon Footprint at Educational Institutions

Carbon footprint means of measuring/recording the greenhouse gases (GHG) emissions of an organization within its defined boundary. The carbon footprint is one of the components of Ecological Footprint since it is one competing demand for biologically productive space. Burning fossil fuel (such as petrol, diesel and kerosene) emits Carbon which accumulate in the atmosphere if there is not sufficient bio capacity dedicated to absorb the same. Commutation of stakeholders has an impact on the environment through the emission of greenhouse gases into the atmosphere consequent to burning of fossil fuels. The most common greenhouse gases are carbon dioxide, methane, nitrous oxide and ozone; among them, carbon dioxide is the prominent one, comprising 402 ppm in the atmosphere. An important aspect of doing an audit is to access the impact within defined boundary which can helpful to derive better ways to minimise its impact. It is necessary to assess the Carbon foot prints of an organisation to understand how far they contributing towards sustainable development. It is therefore essential that any environmentally responsible organizations should examine their carbon emission and subjected to calculate carbon footprint.

The observation on carbon footprint due to electricity usage per year at the college showed 307.21 metric tons. It is calculated based on CO_2 emission from electricity per year in kWh/1000 units. The carbon footprint due to transportation (Shuttle services) per year at campus showed 13.286 metric tons. It is calculated based on the number of the shuttle bus in the college multiplied with total trips for shuttle bus service each day and approximate travel distance of a vehicle each day inside campus (in kilometers), wherein, 365 is the number of working days per year is taken into account. Similar to that of the carbon footprint due to transportation in shuttle services, Carbon footprint due to car usage per year is calculated based on the number of cars entering into the campus multiplied with the approximate travel distance of a vehicle each day inside campus (in kilometers), wherein, 365 is the number of working days per year is taken into account. The recorded value of carbon footprint due to car usage per year is 4.088 metric tons. The Carbon footprint due to Motorcycles usage per year is 85.8 metric tons which is derived based on the number of motorcycles entering into the College multiplied with the approximate travel distance of a vehicle each day inside campus (in kilometres). The overall results indicated that total carbon emission at Campus per year is 1377.9 metric tons which is the sum of the carbon emission from electricity plus transportation (bus, car, motorcycle) per year. The carbon footprint

Calculation of Carbon Footprint Per Year at SAWC

The Carbon footprint calculation can be conducted based on the stage of calculation as stated in www.carbonfootprint.com, which is the sum of electricity usage per year and transportation (shuttle bus services and Car and Motorcycles) per year.

a. Electricity usage per year

The CO_2 emission from electricity
= (electricity usage per year in kWh/1000) x 0.84
= (365736kWh/1000) x 0.84
= 307.21 metric tons

Notes:

Electricity usage per year= 365736 kWh
0.84 is the coefficient to convert kWh to metric tons.

b. Transportation per year (Shuttle)

= (Number of the shuttle bus in the campus x total trips for shuttle bus service each day x approximate travel distance of a vehicle each day inside campus only (in kilometers) x 365/100) x 0.01
= [(26 x 2 x 7 x 365)/100)] x 0.01
= 13.286 metric tons

Notes:

365 is the number of working days per year
0.01 is the coefficient to calculate the emission in metric tons per 100 km for bus

c. Transportation per year (Car)

= (Number of cars entering the campus x 2 x approximate travel distance of a vehicle each day inside campus only (in kilometers) x 365/100) x 0.02
= [(4 x 2 x 7 x 365)/100)] x 0.02
= 4.08 metric tons

Notes:

365 is the number of working days per year
0.02 is the coefficient to calculate the emission in metric tons per 100 km car

d. Transportation per year (Motorcycles)

= (Number of motorcycles entering the campus x 2 x approximate travel distance of a vehicle each day inside campus only (in kilometres) x 365/100) x 0.01
= [(168 x 2 x 7 x 365)/100)] x 0.01
= 85.8 metric tons

Notes:

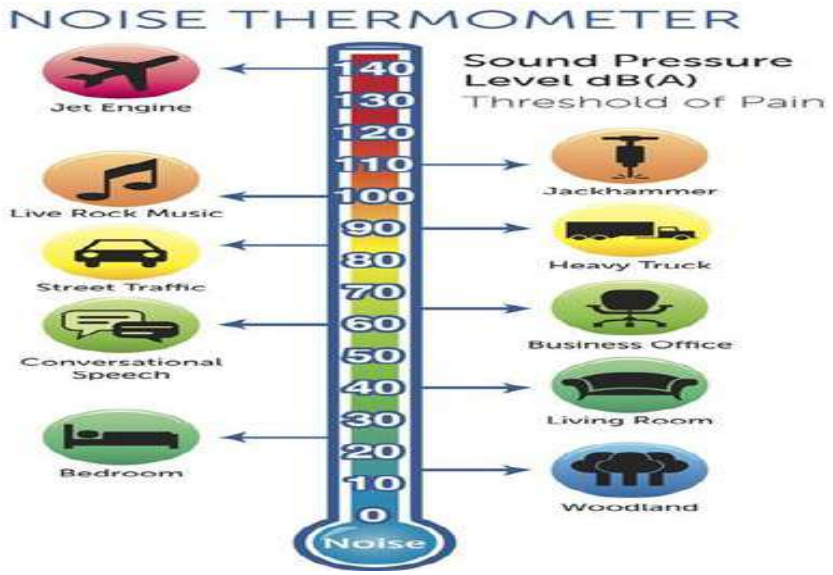
365 is the number of working days per year
0.01 is the coefficient to calculate the emission in metric tons per 100 km for motorcycles

e. Total Carbon emission per year

= total emission from electricity usage + transportation (bus, car, motorcycle)
= 307.21+ (13.286+ 4.088+85.8) / 0.81 (Constant Factor)
= 112.0 metric tons

22.14. Noise level Measurements, Analysis, and Interpretation

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 neighbourhood) 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 in various locations and working places

Level of noise are expected to be within 55 dB in residential areas, including institutions. Classroom noise levels are supposed to be around 50 dB. From the graph above, it is evident that most of the noise level values across campus are above the normal permissible range. Near the chapel however noise levels are within range and lowest at 55.4 dB. This is because minimum people are present near the chapel. 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 μPa.

Measurement of Noise level at various places in SAWC, Vellore .

Table 8. Noise level at the SAWC

S.No	Locations	Measurements (dB)	Major Noise Sources	Remarks
1.	Common Room	55	Celling and exhaust fans	No Noise Pollution
2.	Reception Room	40	Noise from people around	No Noise Pollution
3.	Library hall	29	Students and staff members	No Noise Pollution
4.	Conference hall	50	Speakers	No Noise Pollution
5.	Classrooms	58	Students	No Noise Pollution
6.	Staff Rooms	54	Staff members	No Noise Pollution

Table 9. Noise Level Standard Prescribed by Central Pollution Control Board, India Government

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

22.15. Auditing for Water Management at the SAWC

Water is a natural resource which is an essential element for all life organisms. It has been reported that on earth only 3% is of fresh water and two-thirds of the same is locked up as ice caps and glaciers. Of Out of remaining one percent, a fifth is available at remote areas and much seasonal rainfall and floods cannot easily be used. At present only about 0.08 percent of all the world's fresh water is exploited by mankind (in terms of sanitation, drinking, manufacturing, leisure and agriculture). Water management (management of water resources under set policies and regulations) is important since it helps determine future irrigation expectations. Once water is an abundant natural resource and becoming a more valuable commodity due to droughts and over exploitation. While freely available in many natural environments, in human settlements potable (drinkable) water is less readily available. At this juncture, it is time to use water wisely to ensure that drinkable water is available to all, at present and in the future.

Water supply units and treatment facilities at SAWC, Vellore, Tamilnadu.

22.15.1. Water Management Activities

In order to conserve water resources, it is essential that any environmentally responsible institution should examine its water use practices. Water auditing is conducted for the appraisal of facilities of raw water intake and determining the facilities for water treatment and reuse. Auditor concerned investigates the relevant method that can be adopted and implemented to balance the demand and supply of water. The college is taking enough attempt to manage wastewater that are coming out from various Department laboratories, hostels and canteens. In general, water management activities are very important in terms of conserving water and its resources for future generations which in turn useful to reduce the land contamination.

22.15.2. Role of Higher Education Institutions in Water Conservation

- Build unanimity on the need for water conservation within the campus (with students, administration, faculty and other internal stakeholders).
- Initiate unanimous water conservation measures in collaboration with nearby village residents, local administration/"Grama sabha" and internal/external stakeholder institutions (schools, self-help groups, health centres, and village panchayats).
- Facilitate strategic measures to become self-sufficient in water requirement and efficient water usage by adoption of suitable standards and accepted parameters.
- Facilitate specific methods for making the village as water sufficient and water efficient by following best available standards and accepted parameters
- Periodical monitoring of existing water management system in the campus with participation and transparency
- Development of a detailed guideline for conserving water on the campus and village
- Generate case studies on best water conservation practices adopted in the campus and in the villages. This can serve as models for other institutions and villages to adopt.
- The team that would be involved in all aspects of water management (exploring, surveying, fact-finding, recording, planning, taking action and monitoring) will also include all relevant stakeholders' viz., citizens, student teams, their teachers, village leaders apart from administrative officials concerned in both campuses and villages.
- A couple of environmentally-concerned-inclined faculty members or village

community leaders may be given the responsibility to lead the water conservation movement in the respective realms.

- Water Conservation Initiative can be a successful only if the Head of the Institution ignites the spirit of everybody in the organization. She/he needs to direct the departments, pay attention to the findings of student teams and ensure that their valuable suggestions are followed in letter and spirit by all students, faculty members as well as administrative, non-teaching and support staff.
- A motivated leader can bring a sea-change in the system and therefore she/he is the cornerstone of this campaign. An advisory committee may be constituted to guide the initiative on water conservation.

22.15.3. Physical Appearance and Overall Ambience on Water Conservation

Water Conservation

Water Conservation strategies broadly rely on a) adequacy of water, b) elaborate plumbing facilities with adequate, suitable water taps and sanitary fixtures, c) establishing water use efficient toilets with two levels of flushing facilities, d) well organised water usage, e) dedicated staff for water management including inspection, f) periodic service/repairs/corrective measure of leaks in taps and pipes, g) improved sanitization for cleanliness, h) use of carbonated water, i) planting and maintenance of indigenous variety of plants and less water consuming plants, and j) organising water conservation workshops to the faculty and students and conducting awareness programme on water conservation for the benefit of public.

Rainwater Harvesting

Rainwater harvesting programme concerned with a) installation of rain gauge rain recording system (equipment0, b) establishment of implements for rainwater harvesting within the campus, c) creating rainwater harvesting pits inside the campus and d) creating awareness on rainwater harvesting among the stakeholders and public through workshops and seminars.

Renovation of Traditional and other Water Bodies/Tanks

Renovation of Tanks and water bodies include a) groundwater recharge and maintenance of water balance, b) reuse and recharge structures and preservation of existing water bodies, c) watershed development and biomass management and finally d) adopting land and water management protocols.

Leakages

Leakage accounts a largest share of wastage of available water resource as well as unauthorized water use. Each source meter required to be tested for its accuracy, either by reviewing available meter test results or retesting the meter. System valves mandatorily reviewed periodically to detect malfunction. For instance, altitude control valves on storage tanks might be damaged or installed improperly, allowing the tank to overflow. These valves need periodic inspection, more so when there is observed leakage or overflow. Pressure relief valves set too low might cause spill when pressures reach the high range. These pressure relief valves need to be calibrated accordingly. When leakage problems are discovered during routine inspections, possible water losses need to be estimated and corrective action can be taken up immediately.

Other Interventions

Other interferences are given attention on priority basis that include i) technological and sociological interventions, ii) planning, preparing and reporting mechanisms, iii) appropriate display, publicity and sharing of knowledge, iv) treating personnel/concerned staff with respect and considering their welfare, v) adhering to reporting mechanisms and vi) more importantly, monitoring and taking corrective measures with respect to water management by enthusiastic designated staff

22.15.4. Water Quantity Estimation

The quantity of water required for municipal uses for which the water supply scheme has to be designed which requires data on a) Water consumption rate (Per Capita Demand in litres per day per head) and b) Population to be served.

Quantity = Per capita demand x Human population

22.15.5. Water Consumption Rate

Since several variables are influenced water consumption by various stakeholders of an organization, it is hard enough to precisely assess the water quantity demanded by the public. Water required by various set-ups, which a city may have, is listed hereunder:

Table 10. Water consumption for various purposes at the SAWC

S.No	Types of Consumption	Normal Range (lit/capita/day)	Average	Percentage
1.	Domestic Consumption at Hostel and Canteen	3000	160	35
2.	Industrial and Commercial Demand at Laboratories	45-450	135	30
3.	Public Uses including Fire Demand, Transport washes	2000	45	10
4.	Losses and Waste as routine consumption	1500	62	20
5.	Daily use (Day-to-day use)	3000	25	10

22.15.6. Estimation of Water requirements for drinking and domestic use

(Source: National Building Code 2016 BIS)

As a general rule the following rates per capita per day may be considered for domestic and non-domestic needs. For Communities with population 20,000 to 1,00,000 together with flushing the per capita per day rates may be considered for domestic and non-domestic needs ranges from 100 to 135 lphd.

Table 11. Water requirements calculation

S.No	Educational Institutions water requirements	Domestic use (lphd)	Flushing (lphd)	Total use (lphd)
1.	Without Boarding Facility	3000 Lit	2000 Lit	5000 Lit
2.	With Boarding Facility	6000 Lit	3000 Lit	9000 Lit

22.15.7. Fire Fighting Demand

The per capita fire protection demand is very less on an average basis but the quantum of water is required is very huge. The rate of fire demand is sometimes treated as a function of population and is worked out from following empirical formulae:

Table 12. Per capita fire demand calculation

S.No	Authority	Formulae (P in thousand)	Q for 1 lakh Population)
1.	American Insurance Association	Q (L/min)=4637 √P (1-0.01 √P))	41760
2.	Kuchling's Formula: per capita fire demand	Q (L/min)=3182 √P	31800
3.	Freeman's Formula: per capita fire demand	Q (L/min)= 1136.5(P/5+10)	35050
4.	Ministry of Urban Development Manual Formula	Q (kilo liters/d)=100 √P for P>50000	31623

22.15.8. Factors affecting per capita demand of water consumption

As stated earlier, so many factors affecting the precise calculation of per capita demand of water consumption which include, a) Size of the city: Per capita demand for big cities are generally huge when compared to that of smaller towns where big cities have skewered houses. b) Existence of number of industries. c) Prevailing environmental conditions. d) Habits of people and their economic status. e) Quality of water plays an important role in water consumption rate. If water is aesthetically and medically safe, the consumption will increase as people will not resort to private wells, etc. f) Pressure in the distribution system. g) Efficiency of water works administration: Leaks in water mains and services; and unauthorized use of water can be kept to a minimum by surveys. h) Cost of water and i) Policy of metering and charging method: Water tax is charged in two different ways: on the basis of meter reading and on the basis of certain fixed monthly rate.

22.15.9. Fluctuations in Rate of Demand/consumption of water

- Average Daily per Capita Demand = Quantity Required in 12 Months/ (365 x Population); If this average demand is supplied at all the times, it will not be sufficient to meet the fluctuations.

- Seasonal variation: The demand peaks during summer. Firebreak outs are generally more in summer, increasing demand.

- Daily variation in water demand depends on human activities. People draw out more water on Sundays and Festival days, thus increasing demand on these days.

- Hourly variations in water demand is widely varied. During active household working hours i.e. from six to ten in the morning and four to eight in the evening, the bulk of the daily requirement is taken. During other hours the requirement is

negligible.

- Adequate quantity of water must be available to meet the peak demand. To resolve all the fluctuation issues, the supply pipes, service reservoirs and distribution pipes must be properly proportioned. The water is supplied by pumping directly and the pumps and distribution system must be designed to meet the peak demand. Effect of monthly variation impacts the design of storage reservoirs and hourly variations influences the design of pumps and service reservoirs. It may be noted that as the population decreases, the fluctuation rate increases.

Maximum daily demand = 1.8 x average daily demand
Maximum hourly demand of maximum day i.e. Peak demand
= 1.5 x average hourly demand
= 1.5 x Maximum daily demand/24
= 1.5 x (1.8 x average daily demand)/24
= 2.7 x average daily demand/24
= 2.7 x annual average hourly demand

22.16. Auditing for Waste Management

Waste management reduces the effect of waste in the environment and improves the ecological conditions, so on. Auditing for waste management can helps in reuse/recycle resources, such as; paper, cans, glass, and so on. Pollution from waste is aesthetically unpleasing and results in large amounts of litter in the ecosystem which can cause health problems. The most important reason for audit for waste management is simply relies on environment protection and human health. Various type of waste management practices, from collection to disposal of solid, liquid, gaseous, or hazardous substances were illustrated in this report earlier (Section 22.2.). Particularly, information on waste management practices (Section, 22.2.1), biodegradable and non-biodegradable waste materials management (Section, 22.2.2.), disposal of e-waste (Section, 22.2.3.) and management of hazardous waste (Section, 22.2.5.) were detailed elaborately. It is needless to say production of waste to be minimised to ensure the sustainable environment of any organisation. In this connection, auditor diagnoses the prevailing was management/collection to disposal policies and suggests the possible ways to combat the issues related with waste management for adoption.

22.17. Biomedical Waste

The Ministry of Environment, Forest and Climate Change, Government of India has issued the Bio-Medical Waste Management Rules, 2016. As per the rules, bio-medical waste represents any waste materials which is generated during diagnosis, treatment or immunization of human beings or animals besides research activities pertaining to the production or testing of biological or in health camps. The biomedical waste generator and the operator of the common bio-medical waste treatment and disposal facility (CBMWTF) shall be responsible for safe handling and disposal of the same. The State Government of Health shall ensure for implementation of the rule in all health care facilities. SPCB shall issue authorization to the health care facilities and CBMWTF. It shall monitor the compliance of various provisions of the rules. Central Pollution Control Board has so far authorized 25426 Private and Government hospitals in the State under the rules. Hospitals have made agreement

with the CBMWTF for the collection, transport, treatment and scientific disposal of the biomedical waste. The CBMWTF consists of autoclave, shredder, incinerator and secured land fill facilities.

22.18. Climatic condition

Prevailing climatic conditions of the campus revealed that it experiences warm conditions almost most part of the year. Rise in day temperature starts after March and attains the peak during May where temperature maximum ranges between of 29 and 39°C with a daily record of 37°C. Mean minimum temperature ranges between 13 and 27°C. The Vellore district experienced the annual rainfall 40.71 inches/avg for the last two months. Since the district located on the dry pass, it experiences southwest monsoon from June to August. Southwest monsoon is irregular as the masses of clouds are intercepted only very little rains in September. After a warm, humid break in September, regular monsoon starts from October to; early November. Out of total rainfall, 25% received during southwest monsoon, 49% between October and November and remaining 21% during September.

Table 13. Soil edaphic and Environmental conditions of the SAWC

S.No	Details of Parameters	Data collected
Soil Edaphic parameters		
1.	Soil pH	6.5 – 7
2.	Soil type	Red loam soil
3.	Total Organic carbon	0.3%
4.	Electrical conductivity	2.16 ds/m
5.	Water holding capacity	70.23%
6.	Total Nitrogen	100- 300 Kg/hec
7.	Available Phosphorous	10 - 15 Kg/hec
8.	Exchangeable Potassium	100 – 200 Kg/hec
9.	Available Mg and Mn contents	2.5, 5ppm
10.	Available Zn and Fe contents	0.4, 6.0 ppm
Environmental parameters		
1.	Minimum Temperature	13- 27°C
2.	Maximum Temperature	29-39.4°C
3.	Minimum Relative humidity	41%
4.	Maximum Relative humidity	70%
5.	Annual Average Rainfall	40.71 inches /avg.year
6.	Annual Average Sunshine	109.3 hrs/avg.month
7.	Wind speed	8.7-11.4 miles/hr

22.19. Safety measures and Green building conservation code

Environmental safety measures are very important in college buildings as far as students, staff members and other stakeholders are concerned and it requires vigilance and awareness. Colleges and Universities work to foster safe environments, however, students honestly share equal responsibility. College/university Management should extend by issuing noble guidance and the best safety tools. The organization should have a police force, escort services, call boxes, first aid box, fire extinguishers, fire alarms, security systems and staffs towards the safety measures. SAWC has very good

safety measures as per the Green building conservation code such as fire extinguisher and fire bell and alarms in all the places. In addition, in all the places, 'Exit', 'Entry' and other sign boards kept across the places to give cent percent safety to the stakeholders.

Safety measures at SAWC, Vellore, Tamilnadu.

22.20. Implementing National Service Scheme and Swacch Bharath Abhiyan

National service Scheme and Swachh Bharath Abhiyan under Clean India Mission is the new initiative and a step towards sanitation, solid waste management and cleanliness to promote cleanliness across India. It is the country-wide campaign applied on a large scale in India for both the rural and urban places, producing needs for the bathrooms and providing hygienic atmosphere amongst the population by household members was the main purpose of this. This scheme is implemented by the Educational Institutions covering Universities, Colleges and Schools, Government Departments, Companies and Public sectors across the country to give a safe pollution free environment, eliminate the open defecation, improve solid waste management and sanitation and refining drinking water quality to the stakeholders. The initiative is easily attainable by the support of Government employees, management representatives, staff members and students. The students of SAWC conduct more awareness programmes on cleanliness, ill-effects of use of plastics, solid waste management and sanitation and importance of environment to the rural people, through NSS and Students Force units. The students collected and disposed of the wastes in the trash by using eco-friendly covers. They created awareness among the rural and urban people to keep the surroundings clean and hygiene. A sizable number of programmes and rallies are conducted periodically during the celebration of various events such as 'Independence Day', 'Republic Day', 'World Environmental Day' and 'Biodiversity Conservation Day' events.

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) otherwise known as Students Force (SF) units and NSS (National Service Scheme) units. 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. 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. SAWC has well developed SF, NSS, Swacht 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 Vellore. The Campus 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.

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. Innovative practices that add up credentials in implementing the green campus which needs to be promoted in the awareness programme to the students and staff members including public domain. 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 College has taken sufficient attempts to disseminate the green campus motto and green pledge as well as awareness programmes 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.

SAWC is implemented the Government schemes to provide pure and safe water to and teach the importance of cleanliness of toilets and restrooms to rural people living in nearby hills. These activities are very important in view of the immediate vicinity to undertake all developmental activities and conduct Participatory rural appraisal programmes which is associated with socioeconomic status of the inhabitants living nearby hills, natural resources, traditional knowledge systems, cropping patterns, etc. The College is also converging interest on the progressive development of women, youth, children and in particular, "dalits" and to identify the extension and training needs of the target group through the Department of Women Studies and Career Guidance. The Institute provides the vocational training on (goat farming, mushroom cultivation, vermicomposting, bee keeping, ornamental fisheries, organic farming and medicinal plant cultivation) to marginal farmers in order to overcome seasonal employment the problem.

The Campus helps to cultivate social commitment and to expose the students to get exposure to the social realities and to build a relation between student community and the other communities which in turn facilitate social interaction, inter-personal communication skills and develop emotional maturity of students. The Institution also supports the students to improve their personality. On the whole, the Institution accelerates the activity of preparing the students to face emerging tasks by developing qualities such as cooperation, team spirit, leadership, discipline and development of creative talents including to boost their self-confidence

SAWC under National service scheme conducted programmes like Yoga Day, Tree plantation activities and Retrieve rivers programme.

23. Best Practices on Environment Audit Initiatives followed in the Organization

1. 'Eco Club' and 'Nature Club' along with NSS Units are functioning well and conducting a large number of awareness programmes related to nature conservation and environmental protection.

2. It is observed that the Organization is created massive facilities for solid waste management and wastewater treatment to purify the wastewaters using activated-sludge to manage both solid wastes and wastewaters effectively without harming the environment.

3. The dust bins and ecofriendly trashes are kept in different places across the campus to provide a dust free atmosphere to the stakeholders which are labelled properly for the indication of degradable and non-degradable items.

4. There is a Reverse Osmosis (RO) water unit to produce RO water which is periodically tested for the physico-chemical properties and all water parameters with water quality analysis meter designed by SAWC.

5. The College is providing bicycle for campus students to maintain eco-friendly atmosphere in the campus and to reduce carbon-di-oxide.

6. The management has created a very good campus ecosystem for making a coexisting and sustainable environment which includes natural and planted vegetation supporting a rich biodiversity of flora and fauna.

7. A well-established Rainwater harvesting system s to recharge ground water status by collecting rainwaters from the campus coinciding with the contour of the terrain and natural drains.

8. National service schemes are implemented effectively towards solid waste management and refining drinking water quality to promote cleanliness to rural and tribal people across the Vellore District.

9. In addition to Natural Ventilation and Exhaust fans are made available in all buildings to replace 'stale' air with 'fresh' air which helps to create favourable microclimate during the occupied periods.

10. The carbon footprint with respect to the concentration of CO_2 in the atmosphere is found to be low which did not exceed the critical limit of CO_2 coinciding with pure air circulation without any contaminants in the campus.

11. NSS activities at SAWC conducted, Yoga day, River retrieve programmes, Awareness about Education to Government School Students and Planted the saplings in different places.

24. Recommendations for sustainable environment

- A proper step may be taken to minimize the environmental degradation by means of developing ‘Sanitation and hygiene policy’, ‘Water conservation policy’, ‘Waste management policy' and ‘Green campus and Environment policy’ in collaboration with Governmental and Non-Governmental Organizations.

- Helpline numbers for waste collection may be made available in the Campus which may be useful for door-to-door collection of wastes thus avoiding improper disposal by individuals.

- The concept of eco-friendly culture and sensitize the students to minimize the use of plastics, non-biodegradable materials and exploitation of natural resources which pose the environmental hazards may be carried out.
- Policy on paper usage may be initiated with certain guidelines to reduce the number of papers that are being used by the students for assignments, mini-projects and final year projects which in turn to reduce 60% usage of paper as a commitment to curb the environmental damage.

- Waste disposal management for both dry and wet wastes should be proper in which from collection to disposal of the waste, together with monitoring and regulation of the same may be undertaken.

- Attempts may be made to segregate the wastes and to convert organic wastes into fertilizing material through recycling and composting processes which may be used for vegetation purpose.

- The College can operate some battery cars for internal mobility for all stakeholders who wish to use it inside the Campus to minimize the car smokes and exhaust to a greater extend towards to minimize the carbon emission.

- A well-established Biogas plant for energy efficiency management and to reduce

the fossil fuel expenditure as well as impact on the environment may be created. The treated effluent from biogas plant may be diverted to the STP for storage and utilized for irrigation purpose.

- Students may be taken to some industrial areas including the waste management sites to teach about the recycling of wastewaters, solid wastes, natural ecosystem, pollution-free environment and environmental education.

- A commitment to keeping students in conducting various competitions *viz*., painting, pencil sketching, rangoli, paste the picture, wealth out of waste, debate on environmental days, essay writing, card making, etc., for the noble cause of environmental protection and nature conservation.

- To ensure Miyawaki Forest system, one student one plant concern to enrich the campus Green which provide an ecofriendly campus to the stakeholders.

25. Conclusion

Sree Abiraami Arts and Science College for Women, Vellore, Tamilnadu is a well-established Institute in India in terms of academic activities, efforts are continuously made in providing an eco-friendly atmosphere to the students, research scholars, parents and staff members. The environmental protection initiatives are substantial by means of creating solid waste management, wastewater treatment, sanitation, rainwater harvesting system and natural vegetation in the Campus without harming the environment. SAWC has ‘solid waste management and wastewater treatment facility to recycle the solid wastes and wastewaters; respectively. The Campus has some Technology Missions related to Green Campus and Environment sustainability as well. A campus ecosystem is supported a rich biodiversity of flora and fauna which is making a sustainable environment and eco-friendly campus. National service scheme is implemented effectively by the campus to promote sanitation and cleanliness to the rural/tribal people across the Vellore District, Tamilnadu. Environmental audit is carried out to provide an indication to company management about how the environmental Organization system and equipment’s are performing. As a result the best practicable means can be applied to preserve air, water, soil, plant and animal life from the adverse effect. To conclude an environment audit report, the SAWC is an eco-friendly campus and providing pure atmosphere to the stakeholders and supports the nation as a whole in future generations. Further, we hope this will boost the new generation to take care of the environment and propagate these views for many generations to come by the Organization.

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27. References

Abba, M., Said, R.M., Abdullah, A. and Mahat, F. 2018. The relationship between environment operational performance and disclosure of Nigerian listed companies. *Journal of Environmental Accounting and Management,* **6** (1): 1-15.

Adeniji, A.A. 2018. *Audit and Assurance Services. Lagos: Value Analyst Concept of Green Audit*. New Age International, New Delhi, India.

Aerts, W., Cormier, D. and Magnan, M., 2008. Corporate environmental disclosure, financial markets and the media: An international perspective. *Ecological Economics* **64** (3): 643-659.

Alba-Hidalgo, D., del Alamo, J.B. and Gutierrez-Perez, J. 2018. Towards a definition of environmental sustainability evaluation in higher education. **In**: *World Higher Education Policy*. Oxford University Press, London, UK, Vol. 31, pp. 447-470.

AOAC, 1990. *Official Methods of Analysis of the Association of Official Analytical Chemistry*, Ed, Helrich, K. 15th Edition, AOAC Inc., USA, Vol 1 & 2, pp. 2246-2248.

Aparajita, G. 1995. Environmental Audits- a Mean to Going Green. *Development Alternatives* **5** (4): 7-9.

APHA, 2017. *Standard Methods for the Estimation of Wastewaters*. Vol. II, 15th Edn, Washington, US.

Arora, D.P. 2017. Environmental Audit–need of the hour. *International Journal of Advanced Research in Engineering & Management* **3** (4): 25-31.

Aruninta, A., Kurazumi, Y., Fukagawa, K. and Ishii, J. 2017. The integration of human thermal comfort in an outdoor campus landscape in a tropical climate. *International Journal of GEOMATE* **14** (44): 26-32.

Astriani, N. 2016. Legal Policy of Water Resources Management by Local Governments: A Review of Right to Water in Indonesia. *Hasanuddin Law Review* **2** (2): 250-257.

Bae, S.H. and Seol, I. 2006. An exploratory empirical investigation of environmental audit programs in S&P 500 companies. *Management Research News* **29** (9): 573-579.

Ballou, B., Chen, P.C., Grenier, J.H., and Heitger, D.L. 2018. Corporate social responsibility assurance and reporting quality: Evidence from restatements. *Journal of Accounting and Public Policy*, **37** (2): 167-188.

Bardati, D.R. 2006. The integrative role of the campus environmental audit: experiences at Bishop's University, Canada. *International Journal of Sustainability in Higher Education* **7** (1): 57-68.

Braam, G.J.M., Uit de Weerd, L., Hauck, M., and Huijbregts, M.A.J., 2016. Determinants of corporate environmental reporting: the importance of environmental performance and assurance. *Journal of Cleaner Production* **129**: 724-734.

Breiting, S. and Mogensen, F. 1999. Action competence and environmental education.

Cambridge Journal of Education **29** (3): 349-353.

Brindusa M., Sluser, Caliman, F.A., Betianu, C. and Gavrilescu, M. 2007. Methods and procedures for environmental risk assessment. *Environmental Engineering and Management Journal* **6** (6): 573-592.

Buckman, A.H., Mayfield, M. and Beck, S.B.M. 2014. What is a smart building?. *Smart Sustainable Built Environment* **3** (2): 92-109.

Carbon footprint calculation. www.carbonfootprint.com.

Cardenas, I.C. and Halman, J.I.M., 2016. Coping with uncertainty in environmental impact assessments: Open techniques. *Environment Impact Assessment Review* **60**: 24–39.

Cardozo, N.H., da Silveira Barros, S.R., Quelhas, O.L.G., Filho, E.R.M. and Salles, W. 2019. Benchmarks analysis of the higher education institutions participants of the Green Metric World University Ranking. Springer, Universities and Sustainable Communities: Meeting the Goals of the Agenda 2030, World Sustainability Series. pp. 667-683.

Choy, Er.A. and Karudan, R. 2016. Promoting campus sustainability: A conceptual framework for the assessment of campus sustainability. *Journal of Social Sciences and Humanities* **11** (2): 112-118.

Conde, M.C. and Sanchez, J.S. 2017. The school curriculum and environmental education: A school environmental audit experience. *International Journal of Environmental & Science Education* **5** (4): 477-494.

Costantino, F., Di-Gravio, G. and Tronci, M. 2018. Environmental Audit improvements in industrial systems through FRAM. *FAC PapersOnLine* **11**: 1155–1161.

Dagiliut, R. and Liobikien, G. 2014. University contributions to environmental sustainability: challenges and opportunities from the Lithuanian case. *Journal of Cleaner Production* **108**: 891-899.

Erol, G.H. and Gezer, K. 2006. Prospective of elementary school teachers attitudes toward environmental problems. *International Journal of Environmental and Science Education*, **1** (1): 65-77.

Fachrudin, H.T., Fachrudin, K.A. and Utami, W. 2019. Education activities to realize green campus. *Asian Social Science* **15** (8): 18-27.

Ferenc, M., SedlACEk, O., Fuchs, R., Dinetti, M., Fraissinet, M. and D. Storch 2014. Are cities different?. Patterns of species richness and beta diversity of urban bird communities and regional species assemblages in Europe. *Global Ecology and Biogeography* **23**: 479-489.

Freidenfelds, D., Kalnins, S.N. and Gusca, J. 2018. What does environmentally sustainable higher education institution mean?. *Energy Procedia* **147**: 42-47.

Ghaffarianhoseini, A., Berardi, U., AlWaer, H., Chang, S., Halawa, E., Ghaffarianhoseini, A. and Clements-Croome, D. 2016. What is an intelligent building? Analysis of recent interpretations from an international perspective. *Architectural Science Review* **59** (5): 338-357.

Ghaffarianhoseini, A., AlWaer, H., Ghaffarianhoseini, A., Clements-Croome, D. Berardi, U., Raahemifar, K. and Tookey, J. 2018. Intelligent or smart cities and buildings: a critical exposition and a way forward. *Intelligent Buildings International*, **10** (2): 122-129.

Gnanamangai, B.M., Murugananth, G. and Rajalakshmi, S. 2020. *A Manual on Environment Management Audits to Educational Institutions and Industrial Sectors*. Laser Park Publishing House, Coimbatore, Tamil Nadu, India, p. 127.

Gowri, S. and Harikrishnan, V. 2014. Green computing: Analyzing power consumption using local cooling. *International Journal of Engineering Trends and Technology* **15** (3): 105-107.

Goyal, E. and Gupta, M. 2014. Moving toward socially and environmentally responsible management education-Case study of Mumbai. *Journal Applied Environmental Education & Communication* **13**: 146-161.

Haahkim, W. and Yunus, A. 2017. Environmental audit as an Instrument for environnemental protection and management. *The Business and Management Review* **9** (2): 228-232.

Handy, S.L., Boarnet, M.G., Ewing, R. and Killingsworth, R.E. 2002. How the built environment affects physical activity: views from urban planning. *American Journal of Preventive Medicine* **23** (2S): 64–73.

Hertwich, E.G. 2005. Consumption and the rebound effect: An industrial ecology perspective. *Journal of Industrial Ecology*, **9** (1-2): 85-98.

Hoque, A.A. and Sultana, T. 2017. Environmental sustainability practices in South Asian university campuses: an exploratory study on Bangladeshi universities. *Springer Nature*, **19** (6): 2163–2180.

IGBC, 2020. Indian Green Building Council. https://igbc.in/igbc/

Irwansyah. 2017. Research-Based Environmental Law: The Debate Between Ecology Versus Development. *Sriwijaya Law Review* **1** (1): 44-66.

Irwansyah, Wardhani, H. and Ahsan, Y. 2017. Environmental audit for environmental protections and Management. *The Business and Management Review* **9** (2): 228-232.

ISO, 2020. International Organization for Standardization. https://www.iso.org/home.html.com

Kevin, O., Stanton, J., Bilderbeck, M. and Spinetto, J. 2017. Case study of a voluntary aviation safety and environmental accreditation programme. *Safety Science* **96**: 41-51.

Khoufi, N. and Khoufi, W. 2018. An empirical examination of the determinants of audit report delay in France. *Managerial Auditing Journal*, **33** (8/9): 700-714.

Kosajan, V., Chang, M., Xiong, X., Feng, Y. and Wang, S. 2018. The design and application of a Government environmental information disclosure index in China. *Journal of Cleaner Production* **202**: 1192-1201.

Lauder, A., Sari, R.F., Suwartha, N. and Tjahjono, G. 2015. Critical review of a global campus sustainability ranking: Green Metric. *Journal of Cleaner Production* **108**: 852–863.

Leal Filho, W., Muthu, N., Edwin, G. and Sima, M. 2015. *Implementing campus greening initiatives*. Springer, London, UK.

León-Fernandez, Y. and Dominguez-Vilches, E. 2015. Environmental management and sustainability in higher education: The case of Spanish Universities. *International Journal of Sustainability in Higher Education* **16**: 440-455.

Maltby, J. 1995. Environmental audit: theory and practices, *Managerial Auditing Journal*, **10** (8): 15-26. https://doi.org/10.1108/02686909510147372.

Marrone, P., Orsini, F., Asdrubali, F. and Guattari, C. 2018. Environmental performance of universities: Proposal for implementing campus urban morphology

as an evaluation parameter in Green Metric. *Sustainable Cities and Society* **42**: 226-239.

Marwa, M., Salhi, B. and Jarboui, A. 2020. Environmental Audit and Environmental Disclosure Quality. *Scientific Annals of Economics and Business* **67** (1): 1-DOI: 10.2478/saeb-2020-0007.

Murdifin, I., Pelu, M.F.A., Perdana, A.A.H., Putra, K., Arumbarkah, A.M., Muslim, M. and Rahmah, A. 2019. Environmental disclosure as corporate social responsibility: Evidence from the biggest nickel mining in Indonesia. *International Journal of Energy Economics and Policy* **9** (1): 115.

NCP, 2006. *National Environmental Policy-2006*, Government of India, Ministry of Environment and Forest, New Delhi, India.

Ningsih, D.F., Junaid, A. and Mursalim, M. 2020. Point of view research accounting and auditing. *Research Accounting and Auditing* **1** (3): 101-109.

Nunes, B.T., Pollard, S.J.T., Burgess, B.J., Ellis, G., de los Rios, I.C. and Charnley, F. 2018. University contributions to the circular economy: Professing the hidden curriculum: Professing the hidden curriculum. *Sustainability* **10** (8): 112-119.

Ounsaneha, W., Chotklang, N., Laosee, O. and Rattanapan, C. 2017. Predictors of behavior intention to develop a green university: A case of an undergraduate university in Thailand. *International Journal of GEOMATE*. **15** (49): 162-216.

Patten, D.M. 2002. The relationship between environmental performance and environmental disclosure: a research note. Accounting, Organizations and Society, **27** (8): 763-73.

Patriarca, R., Di Gravio, G., Costantino, F., Tronci, M., 2017. The Functional Resonance Analysis Method for a systemic risk based environmental auditing in a sinter plant: A semi-quantitative approach. *Environment Impact Assessment Review* **63**: 72–86.

Peters, G.F. and Romi, A.M. 2014. Does the voluntary adoption of corporate governance mechanisms improve environmental risk disclosures? Evidence from greenhouse gas emission accounting. *Journal of Business Ethics* **125** (4): 637-666.

Ponmurugan, P. 2018. *Biotechnology Techniques in Biodiversity Conservation*. New Age International, New Delhi, India.

Pradip, J.S. and Patil, P.D. 2014. Green Audit - A tool for attaining sustainable development and achieving competitive advantage. *IBMRD's Journal of Management & Research,* **3** (1): 85-93.

Pramanik A.K. 2013. Environmental Audit and Indian Scenario, Environmental Accounting and Reporting, Deep and Deep Publications, New Delhi, India p.312.

Prasad, M., Mishra, T. and Kalro, A.D. 2017. Environmental disclosure by Indian companies: an empirical study. *Environment, Development and Sustainability* **19** (5): 1999-2022.

Rajalakshmi, S., Kavitha, G. and Vinoth kumar, D. 2020. Energy and Environment Management Audits. AkiNik Publishing, New Delhi. 217p.

Ramachandra, T.V. and Bachamanda, S. 2007. Environmental audit of Municipal solid waste management. *International Journal Environmental Technology and Management*. 7 (3/4): 369–391.

Ramachandra T.V. and Saira Varghese K. 2003. Exploring possibilities of achieving sustainability in solid waste management. *Indian Journal Environmental Health* **45** (4): 255-264.

Ragazzi, M. and Ghidini, F. 2017. Environmental sustainability of universities: critical

analysis of a green ranking. *Energy Procedia*, **119**: 111-120.

Report of Green Audit, 2018. *Report of Green Audit Nitte Meenakshi Institute of Technology, Chennai, Tamil Nadu, India.* https://www.google.com/search?q= Green+Audit+Report +Nitte+ Meenakshi+Institute+Of+Technology&sxsrf.

Ribeiro, J.M.P., Barbosa, S.B., Casagrande, J.L., Sehnem, S., Berchin, I.I., da Silva, C.G., da Silveira, A.C.M., Zimmer, G.A.A., Faraco, R.A. and de Andrade Guerra, J.B.S. 2017. Promotion of sustainable development at universities: The adoption of green campus strategies at the University of Southern Santa Catarina, Brazil. Springer Nature, Handbook of Theory and Practice of Sustainable Development in Higher Education. pp. 471-486.

Sallis, J.F. 2009. Measuring physical activity environments: a brief history. *American Journal of Preventive Medicine* **36** (4 Suppl.): S86–S92.

Satean, G. 2017. The need to go beyond. Green University. ideas to involve the community at Naresuan University, Thailand. Springer Nature, Sustainability Through Innovation in Product Life Cycle Design. Thailand, pp. 841-857.

Shriberg, M. 2002. Institutional assessment tools for sustainability in higher education: strengths, weaknesses, and implications for practice and theory. *International Journal of Sustainability in Higher Education* **3** (3): 254-270.

Sharma, D.K. 2020. An Effective Implementation of Environmental Audit (A Case Study of Hindustan Copper Ltd.). *TEST Engineering and Management* **83**: 5370-5379.

Sharp, L. 2002. Green campuses: the road from little victories to systemic transformation. *International Journal of Sustainability in Higher Education* **3** (2): 128-145.

Setyowati, M., Kusumawanto, A. and Prasetya, A. 2017. Study of waste management towards sustainable green campus in Universitas Gadjah Mada. *Journal of Physics: Conference Series*, **1022**: 1547-1553.

Singhania, M. and Gandhi, G. 2015. Social and environmental disclosure index: Perspectives from Indian corporate sector. *Journal of Advances in Management Research*, **12** (2): 192-208.

Staniskis, J.K. and Katiliute, E. 2016. Principles, implementation and results of the new assessment and accreditation system 'Engineering education for sustainable industries'. Springer Nature, New Developments in Engineering Education for Sustainable Development. Thailand, pp. 283-294.

Suwartha, N. and Sari, R.F. 2013. Evaluating UI Green Metric as a tool to support green universities development: Assessment of the year 2011 Ranking. *Journal of Cleaner Production* **61**: 46–53.

Thompson, D. 2002. *Tools for Environmental Management*, New Society Publishers, Gabriola Island, BC.

Verma, S., Ahmad, M. and Parwal, R. 2012. Green audit - A Boom to human civilization. *International Journal of Trends in Economics Management & Technology*, **1** (6): 82-86.

Venkataraman, K. 2009. India's Biodiversity Act 2002 and its role in conservation. *Tropical Ecology* **50** (1): 23-30.

Vinothkumar, D., Sreenivasan, P.V., Rajalakshmi, S., Vanitha, S. and Gnanamangai, B.M. 2020. Environment and Green Campus Audits. AkiNik Publishing, New Delhi.

Wang, Y., Shi, H., Sun, M., Huisingh, D., Hanssonn, L. and Wang, R. 2013. Moving

towards an ecologically sound society? Starting from green universities and environmental higher education. *Journal of Cleaner Production* **61**: 1-5.

WGBC, 2020. World Green Building Council. https://www.worldgbc.org.

Woo, J. and Choi, K.S. 2013. Analysis of potential reductions of greenhouse gas emissions on the college campus through the energy saving action programs. *Environmental Engineering Research* **18** (3): 191-197.

York, R. and Rosa, E.A. 2003. Key challenges to ecological modernization theory: Institutional efficacy, case study evidence, units of analysis, and the pACE of eco-efficiency. *Organization and Environment* **16** (3): 273-288.

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Certificates of

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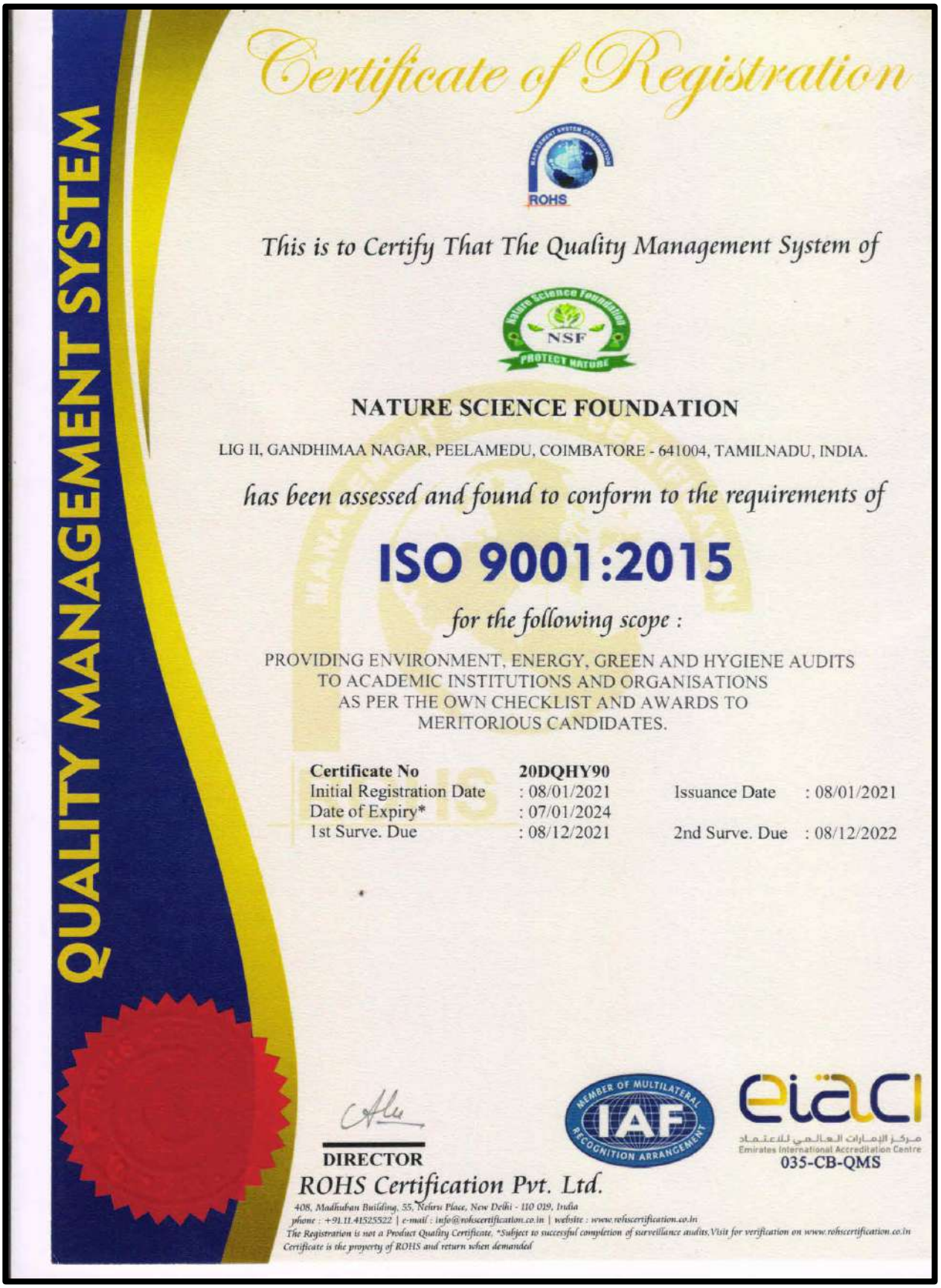

QUALITY MANAGEMENT SYSTEM

Certificate of Registration

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This is to Certify That The Quality Management System of

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NATURE SCIENCE FOUNDATION

LIG II, GANDHIMAA NAGAR, PEELAMEDU, COIMBATORE - 641004, TAMILNADU, INDIA.

has been assessed and found to conform to the requirements of

ISO 9001:2015

for the following scope :

PROVIDING ENVIRONMENT, ENERGY, GREEN AND HYGIENE AUDITS
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Certificate No	**20DQHY90**		
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UDYAM
REGISTRATION CERTIFICATE

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)

S.No.	Name of Unit(s)
1	Green Campus, Energy and Environment Management Audits

OFFICAL ADDRESS OF ENTERPRISE

Flat/Door/Block No.	LIG-II,2669	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:	chairmannsf@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)

SNo.	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

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 M/o 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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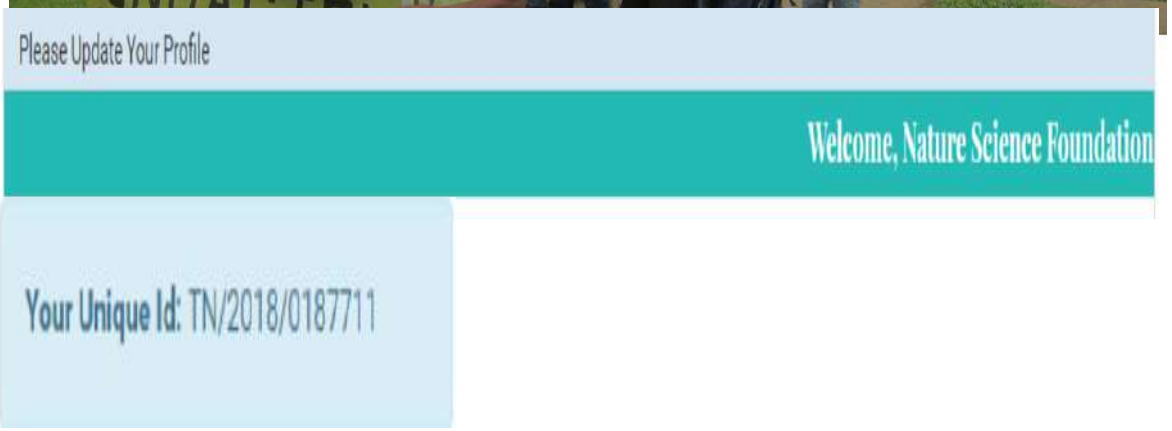
Please Update Your Profile
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Your Unique Id: TN/2018/0187711

PROCEEDINGS OF THE COMMISSIONER OF INCOMETAX (EXEMPTIONS),
III FLOOR, ANNEXE BLDG, NO.121, MAHATMA GANDHI SALAI, CHENNAI-34

Present : G.M.DOSS, I.R.S
Commissioner of Income Tax (Exemptions)

** URNo. AACTN7857J/05/18-19/T-1105 Dated:03/09/2018

Sub: Registration u/s. 12AA of the Income tax Act 1961 - in the case of

"Nature Science Foundation"
LIG-II, 2669, Gandhimaa Nagar, Peelamedu, Coimbatore – 641 004.

Ref : Application in form 10 A filed on 28/03/2018

ORDER UNDER SECTION 12AA OF THE INCOME TAX ACT 1961.

1. The above **Trust/Society/Association/ Company/ others/,** bearing PAN AACTN7857J was constituted by **Trust Deed / Memorandum of Association** dated **29/11/2017** registered with **Sub-Registrar's Office/ Registrar of Societies/**Registrar of Companies/others on **29/11/2017.**

2. ~~The Trust Deed / Memorandum of Association has subsequently been amended / modified / altered by a Codicil / Supplementary Deed / Amendment Deed / Alteration to Memorandum of Association/others dated XX/XX duly registered on XX/XX.~~

3. The above **TRUST** filed an application seeking Registration u/s 12 AA of the Income tax Act, 1961.

4. On going through the objects of the **TRUST** and its proposed activities as enumerated in the **Trust Deed / Memorandum of Association,** I am satisfied about the genuineness of the **TRUST** as on date.

5. The application has been entered at **Sl.No.1105** maintained in this office. The above Trust is accordingly registered as a **PUBLIC CHARITABLE TRUST** u/s 12 AA of the Income Tax Act, 1961 with effect from **29/11/2017**

6. It is hereby clarified that the Registration so given to the **Trust/Institution** is not absolute. Subsequently, if it is found that the activities of the **Trust/Institution** are not genuine or are not being carried out in accordance with the objects and clauses of the **Trust Deed / Memorandum of Association** submitted at the time of registration or modified with the approval of the **Commissioner of Income-tax (Exemptions), Chennai** or there is a violation of the provisions of Section – 13, the Registration so granted shall be cancelled as provided u/s 12 AA (3) or 12AA(4) of the Income Tax Act. Further, this approval is also subject to the **Trust/Society/Association/Company/ Others/** complying to the provisions of the proviso to sec 2(15) of the Income Tax Act 1961.

7. **Granting of Registration u/s 12AA** does not confer any automatic exemption of income from taxation. The **Trust/Institution** should conform to the parameters laid down in Sections 11, 12, 13 and 115 BBC of the I.T. Act, 1961, to claim exemption of its income on year to year basis before the Assessing Officer.

** This Unique Registration No. URNo. **AACTN7857J/05/18-19/T-1105** Should be mentioned in all your future correspondence.

Sd/-
(G.M.DOSS, I.R.S)
Commissioner of Income-tax(Exemptions), Chennai.

Copy to:
1. The Assessee.
2. The ACIT(Exemptions), Coimbatore Circle.
3. Office Copy.

//CERTIFIED TRUE COPY//

(N SRINIVASA RAO)
Asst. Commissioner of Income-tax (H.Qrs)(Exemptions),
Chennai.

F.2984

GOVERNMENT OF INDIA
INCOMETAX DEPARTMENT
OFFICE OF THE COMMISSIONER OF INCOME TAX (EXEMPTIONS)
Aayakar Bhawan, Annexe III Floor, 121 M.G. Road, Chennai 600 034

URNo. AACTN7857J/05/18-19/T-1105/80G — Date: 10.04.2019

Name of the Trust /~~Society~~ /~~Company~~/~~Institution~~	:	NATURE SCIENCE FOUNDATION
Address	:	LIG II 2669, GANDHIMAA NAGAR, PEELAMEDU, COIMBATORE - 641 004
PAN	:	AACTN7857J
Date of Application	:	12.11.2018

Received
17/07/19
17/07/2019

APPROVAL UNDER SECTION 80G(5)(vi) OF THE INCOME TAX ACT, 1961

The aforesaid Trust /~~Society~~/~~Company~~/~~Institution~~ has been registered u/s.12AA of the Income Tax Act with effect from **29.11.2017** vide **AACTN7857J/05/18-19/T-1105** dated **03.09.2018.** It is certified that donation made to **NATURE SCIENCE FOUNDATION** at **LIG II 2669, GANDHIMAA NAGAR, PEELAMEDU,COIMBATORE - 641 004** shall qualify for deduction u/s 80G(5)(vi) of the Income Tax Act, 1961, subject to the fulfillment of conditions laid down in clauses [i] to [v] of sub-section (5) of section 80G of the I.T Act, 1961.

2. This approval shall be valid in perpetuity with effect from **A.Y. 2019-20** unless specifically withdrawn. **The details and validity of the certificate is available @ office.incometaxindia.gov.in**

3. The Return of Income along with the Income & Expenditure Account, Receipts and Payments Account and Balance Sheet should be submitted annually **to** the Assessing Officer having jurisdiction over the case.

4. No change in the Trust Deed/~~Memorandum of Association~~ shall be effected without the prior approval of the undersigned i.e. **Commissioner of Income Tax (Exemptions), Chennai**.

5. Every receipt issued to a donor shall bear the **Unique Registration Number** i.e. **URNo. AACTN7857J/05/18-19/T-1105/80G** and date of this order i.e. **10.04.2019.**

6. Under the provisions of section 80G(5)(i)(a), the institution/fund registered u/s.12A, u/s.12AA(1)(b) or approved u/s.10(23C), 10(23C)(vi)(via), etc., shall have to maintain separate books of accounts in respect of any business activity carried on and shall intimate this office within one month about commencement of such activity.

Sd/-
(G.M.DOSS, I.R.S)
Commissioner of Income Tax (Exemptions)
Chennai.

Copy to:
1. The applicant
2. Guard File
3. The DCIT(Exemptions) Coimbatore Circle.

//Certified True Copy//

(N. SRINIVASA RAO)
Assistant Commissioner of Income-tax (Hqrs)
(Exemptions), Chennai.

Certificates of Environment Auditors

1. ISO Environment Management System (14001:2015) of Mrs. S. Rajalakshmi, Chairman of NSF.

2. ISO Environment Management System (14001:2015 TUV NORD) of Dr. A. Geethakarthi, NSF Environment Auditor.

3. Indian Green Building Council (IGBC AP) Accredited Professional of Dr. B. Mythili Gnanamangai, Vice-Chairman of NSF.

4. Associated Chambers of Commerce and Industry of India (ASSOCHAM), of Dr. B. Mythili Gnanamangai, and Er. Ashutosh Kumar Srivastava, Board of Directors (North Zone) of NSF.

5. Bureau of Energy Efficiency (BEE), LEED AP and GRIHA Certificates of Er. D. Dineshkumar, Energy and Environment Auditor of NSF.

6. Tamil Nadu Fire and Rescue Service Certificate of Er. S. Srinivash, Energy Auditors of NSF.

TÜV NORD

PR315: ISO 14001:2015 Lead Auditor (Environmental Management Systems) Training course

Certificate of Achievement

Geethakarthi Alagarsamy

has successfully completed the above mentioned course and examination.

23rd - 27th March 2019

COIMBATORE, INDIA

Certificate No. 35242817 02

Delegate No. 171136

for TÜV NORD CERT GmbH

Essen, 2019-04-26

The course is certified by CQI and IRCA (Certification No. 18125). The learner meets the training requirements for those seeking certification under the IRCA EMS Auditor certification scheme.

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THIRUVALLUR DISTRICT

THIRUVALLUR

CERTIFICATE

This is to certify that Mrs. / Mr S. SRINIVASH S/o B. SWAMIYAPPAN 4/855, ST. Xavier's Street, Pannur, Thiruvallur District has under gone the "Basic Fire Fighting & Rescue Operation" Training course conducted from 11.08.2016 to 26.08.2016 by Tamil Nadu Fire & Rescue Services Department at Thiruvallur District, Thiruvallur as per G.O.M.S. No.713, dated 17.08.2005 Home (Police XVII) Department, Government of Tamil Nadu.

Station: Thiruvallur.
Date: 20.9.16

District Officer, 20.9.16
Fire & Rescue Services
Thiruvallur District.
Thiruvallur

BUREAU OF ENERGY EFFICIENCY

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

Certificate Registration No. : 9176

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 (/) 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

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			

Regn. No. EA-7391

Certificate No. 5093

National Productivity Council

National Productivity Council

(National Certifying Agency)

PROVISIONAL CERTIFICATE

This is to certify that Mr. / Ms. N.Balasubramaniam

son / daughter of Mr. M.Nanjukuttigounder

has passed the National Certification Examination for Energy Auditors held in December - 2009, conducted on behalf of the Bureau of Energy Efficiency, Ministry of Power, Government of India.

He / She is qualified as Certified Energy Manager as well as Certified Energy Auditor.

He / She shall be entitled to practice as Energy Auditor under the Energy Conservation Act 2001, subject to the fulfillment of qualifications for the Accredited Energy Auditor and issue of certificate of Accreditation by the Bureau of Energy Efficiency under the said Act.

This certificate is valid till the issuance of an official certificate by the Bureau of Energy Efficiency.

Place : Chennai, India

Date : 11th February 2010

Controller of Examination

ENERGY IS LIFE

CONSERVE IT

ऊर्जा दक्षता ब्यूरो

BUREAU OF ENERGY EFFICIENCY

विद्युत मंत्रालय, भारत सरकार

MINISTRY OF POWER, GOVERNMENT OF INDIA

प्रमाणित किया जाता है कि

श्री/श्रीमती दिनेश कुमार ने ऊर्जा संरक्षण भवन निर्माण संहिता के लिए 7 दिसंबर '16 से 8 दिसंबर '16 तक ~~एमएनआईटी~~ / ~~सीईपीटी~~ /आईआईआईटी द्वारा आयोजित मास्टर ट्रेनर सर्टिफिकेट कार्यक्रम को सफलता पूर्वक सम्पन्न कर लिया है।

This is to certify that

Shri/Smt. Dinesh Kumar has successfully completed the Master Trainer Certificate Programme conducted by ~~MNIT~~ / ~~CEPT~~ / IIIT from 7 December '16 to 8 December '16 for the Energy Conservation Building Code.

नई दिल्ली, 11 JUL 2017

New Delhi,

महानिदेशक

Director General

LEED AP BD+C

GREEN BUSINESS CERTIFICATION INC. CERTIFIES THAT

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HAS ATTAINED THE DESIGNATION OF

LEED AP® Building Design + Construction

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PRESIDENT & CEO, GREEN BUSINESS CERTIFICATION INC.

GRIHA

GREEN RATING FOR INTEGRATED HABITAT ASSESSMENT

GRIHA CERTIFIED PROFESSIONAL CERTIFICATE

This is to certify that

Dinesh Kumar Dhanasekaran

has qualified as a **GRIHA** Certified Professional For V. 2015

Date of issue: 19th June 2020

Note : This certification is valid only for GRIHA version 2015.

Chief Executive Officer
GRIHA Council

REPORT OF ENERGY AUDIT

Submitted to

SREE ABIRAAMI ARTS AND SCIENCE COLLEGE FOR WOMEN, GUDIYATTAM - 635803, VELLORE DISTRICT, TAMIL NADU, INDIA.

Date of Audit: 07-12-2020 (Monday)

Submitted by

NATURE SCIENCE FOUNDATION
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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 extend. Conventionally, electrical energy is generated by means of fossil fuels, hydraulic and wind. The availability of fossil fuels and their depletion rate, insist the need for alternate energy systems and conservation of 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). The need for an energy audit is to identify the savings potential and cost reducing methods, understand the ways in which fuel is used, where, the waste occurs and find the scope for improvement.

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) With these facts in mind, the audit's specific objectives are to assess the competence of the sustainability management and control system, as well as the departments' compliance with applicable rules, policies, and standards. It has the potential to have a significant influence on the organization's operational cost as well as the environmental impact (Singh *et al*., 2012).

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 (Gnanamangai *et al*., 2021). 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, 2014). BEE has developed a scheme for energy efficiency labelling of buildings coinciding with the star ratings of the building at accelerating energy efficiency activities. 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 (Mishraand 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. In general, an energy audit process dealt with the driving

conservation concepts into reality by giving technically possible solutions within a specified time limit while also 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" (reference point) for managing energy in the organization for planning more energy-efficient use across the board (Cabrera *et al*., 2010).

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 energy and fuel are being used in any organization, and identifies the areas where wastes occur and the scope for improvement exists. The Energy Audit gives a positive orientation to the energy cost reduction, preventive maintenance quality control programmes and will help to keep focus on variations which occur in the energy costs, availability, and reliability of supply of energy. The main objective of Energy Audit is to find ways to reduce energy consumption per unit of product output. The Energy Audit provides a "bench-mark" (Reference point) and a basic planning for managing energy and for more effective use of energy throughout the organization.

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 of contribution to carbon emissions, carbon footprint calculation, use of star rated equipment, encouraging energy use conservation practices in all buildings, reduce the organization's energy consumption, reduce wastes to landfill, and integrating environmental considerations into all contracts and services considered to have significant environmental impacts.

Auditing for Energy Management may be studied in terms of energy savings and opportunities. In general, energy cannot be seen, but we know it is there in wire, pipes and other non-living materials because it shows visible effects in the forms of heat, light and power. 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 and requires no explanation for its inclusion in the assessment. However, energy saving, and opportunities may be taken into consideration while energy is extensively used. An old incandescent bulb uses approximately 50W to 100W while an energy efficient LED uses only less than 10W which shows the positive indication on energy savings. Energy auditing deals with the conservation methods to reduce its consumption related to environmental degradation. 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 or three years using internal and external auditors.

The conduct of energy audit using internal and external energy auditors is playing important role in any organization in terms of energy management. The Energy audit is able to measure the impact of energy potential in an organization so that it helps in determining the better ways to manage the impact on environment. In addition to liquid and solid wastes, biomedical and electronic wastes energy potential and biodiversity audits, 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 takes into consideration the measure of bulk of CO_2 equivalents exhaled by the organization by which the carbon footprint accounting is done. It is necessary to know how much the organization is contributing towards sustainable development in terms of energy management is being done. It is therefore recommended to measure the carbon footprint in each organization which may be useful for maintaining the ecofriendly campus to the stakeholders.

3. 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. The aim of an energy audit is to identify the energy efficiency, conservation, and savings opportunities at the premises of the audit sites in a systematic manner. The audit process is carried out as per the following.

- Review of energy saving opportunities and measures implemented in the audit sites.
- Identification of additional various energy conservation measures and saving opportunities.
- Implementation of alternative energy resources for energy saving opportunities and decision making in the field of energy management.
- Providing a technical information on how to build an energy balance as well as guidance to be sought for particular applications.
- Detailed analysis on the calculation of energy consumption, analysis of latest electricity bill of the campus, understanding the tariff plan provided by the central and State Electricity Board.
- List ways that the use of energy in terms of electricity, electric stove, kettle, microwave, LPG, firewood, Petrol, diesel and others.
- Analysis of electricity bill amount for the last two to three years, amount paid for LPG cylinders for last one year and amount paid for water consumption for human beings and watering to the plants.
- Use of 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 (for example- 60 watt bulb x 6hours x number of bulbs = kwh).
- 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.

4. Benefits of an Energy Audit

- **Reduced Energy Expenses:** The most obvious benefit is that the less energy the Organization uses, the less money that the Organization will have to spend on energy costs.
- **Identify Problems:** An energy audit can also help to identify any issues that the equipment might have. For example, the auditor could find small leaks in the compressed air system. These leaks would cost a significant amount of money if it is not noticed. Auditors can also detect dangerous health risks like the carbon monoxide that's emitted from equipment that hasn't been vented properly. With a regular energy audit, the organization will be able to address these kinds of issues promptly to help ensure the health and safety of the staff members.
- **Increased Employee Comfort:** During the audit, the Organization might learn about changes that have been made regarding insulation and air sealing. Completing these enhancements will help create a more reliable and more efficiently cooled or heated space for the employees. In turn, more comfortable employees tend to be more productive, so not only will the Organization save on energy costs, but may also improve overall well-being.
- **Personalized Recommendations:** Working with an energy expert can help learn about new energy-efficient technologies. The professional will customize a plan, recommending which upgrades will give the most return on investment. These might include updated lighting systems, a new HVAC system, weatherization measures like insulation and air sealing, and more. While some of the recommendations might have a substantial up-front cost that many of them will pay for themselves in a short period of time with significantly reduced energy expenses.
- **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 worth. Things like solar panels, high-efficiency LED lighting, and weatherization procedures are all things that contribute to a higher property value.
- **Longer Equipment Lifespan:** An energy auditor might recommend to update some of the equipment for maximum energy savings. If the Organization decide to upgrade, it will not only save on energy costs, but also expect the equipment to last a long time. This is because newer, more energy-efficient equipment doesn't have to work as hard as older, outdated units to provide the same level of performance.
- **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).
- **Energy audit Opportunities:** The audit will not only inform about the opportunities but also provide information with financial analysis. This will enable prioritization based on financial benefit and return on investment. It provides technical information regarding the proposed energy conservation measures.

- **Analysing the quality of Energy Audit:** A good quality audit will investigate the historical energy usage and find the essential issues using statistical methods. It Provides information with emissions analysis to help understand the benefits of the decisions from an environmental standpoint. The audit provides benchmark information to help compare the energy use performance with others.

5. Procedures followed in an Energy Audit

In order to conduct an energy audit, several methods are adopted in the audit sites in which walk-through audit is conducted. 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 Manual of Gnanamangai *et al*. (2020). The top three operating expenses of the Organization are typically observed to be energy (both electrical and thermal), labour and materials. During the audit, physical verification of Lighting, Ceiling, Table and Exhaust Fans, A/C machines, Solar panels, Heaters, Generators, Uninterrupted power supply machines and ventilators load fixtures and verification of installed energy efficient system's capacities are carried out. Inspection of when the cost or prospective cost savings in each of the above components are considered, energy always wins, and the energy management task becomes a key cost reduction area. The energy audit assisted in better understanding how energy and fuel are used in the Organization as well as identifying waste factors and development potential towards energy savings opportunities. 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).

The audit involved visiting the campus and physical verification of the loads and sources installed. The entire campus is divided into different sections and those sections are audited in which electrical fittings and energy supply are monitored. 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 is observed as per the regulation of Indian Green Building Council (IGBC, 2020) and World Green Building Council (WGBC, 2020). The energy bill from the supply utility company (Example: Tamil Nadu Electric Generation and Distribution Corporation Limited, Chennai) is audited and assessed for the load demand requirement and efficient consumption of energy. Stakeholders are interacted with the scope for improvement and energy management during the audit. Potential areas in which the scope of energy conservation and saving opportunities available in the current context have been identified and suggested for implementation to the Organization. The level of carbon dioxide might be measured in different places across the Organization campus using a portable CO_2 Analyzer to calculate the carbon footprint. It may be useful to check where carbon emission is prominent which could be taken into account to reduce.

The audit involves visiting physical position of load & carry out inventory of load. Due measurement of electrical load of equipment & circuit is carried out. Energy bill received from TNEB is audited & studied for KWH requirement & how efficiently energy is used. Various positions are interacted, familiarized with energy

audit & involved for successful & result oriented energy audit. Energy conservation & saving opportunities are identified during round & measurement for implementation.

6. Types of Energy Audit

The Energy Audit types depends on the following factors:

- Industry/ Organization type 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.

1) Preliminary Energy Audit
2) Detailed Energy Audit
3) Potential and magnitude of Energy Audit
4) Comprehensive Energy Audit

6.1. Preliminary Energy Audit Methodology

Preliminary energy audit gives a quick access to:

- Estimating and establishing energy consumption in the organization
- Estimate the scope of audit
- Identify the areas of maximum energy consumption
- Identify the areas of improvement
- Setting benchmark
- Performing Preliminary energy audit uses existing data.

6.2. Detailed Energy Audit Methodology

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

Phase I - Pre -Audit Phase
Phase II - Audit Phase
Phase III - Post Audit Phase

6.3. 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 Auditing

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: -

- Discussing the aims of the energy audit with the audit study site's management.
- Discussing the economic factors associated with the recommendations of the audit.
- Analysing the major energy consumption data with the concerned person.
- Obtaining the available audit site drawings – building layout, electricity distribution, steam distribution, compressed air distribution, etc.
- Conducting Walk-through audit around site.

The main aims of this visit are:

- Finalising the Audit team members
- Identifying and analysing the main energy consuming areas during the audit.
- Identifying existing instrumentation/ additional metering required.
- To decide if any meters will have to be installed prior to the audit eg. kWh, steam, oil or gas meters.
- Identifying the instruments required for carrying out the audit.
- Planning the time management
- Collecting the macro data on major energy consuming areas.
- Conducting awareness meetings/ programmes.

6.4. 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, 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 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 collecting the macro data from energy consuming areas. The audit report is definitely useful for energy management.

The information to be collected during the detailed audit includes:

1. Energy consumption by type of energy, by department/area, by type of process equipment, by end-use
2. Energy cost and tariff data
3. The distribution and generation of site services (eg. Electricity, Compressed air, steam).

4. Sources of energy and its supply (e.g. electricity from the grid or self-generation)
5. Potential alternative for fuel substitution, process modifications, and the use of co-generation systems (combined heat and power generation).
6. Energy conservation and management awareness training programs within the Organization.

   The audit team collects the following baseline data:
   - Major Equipment details, process/technology used
   - Water consumption
   - Fuel usage
   - Capacity utilisation
   - Electrical energy consumption
   - Steam consumption
   - Yield/ Efficiency

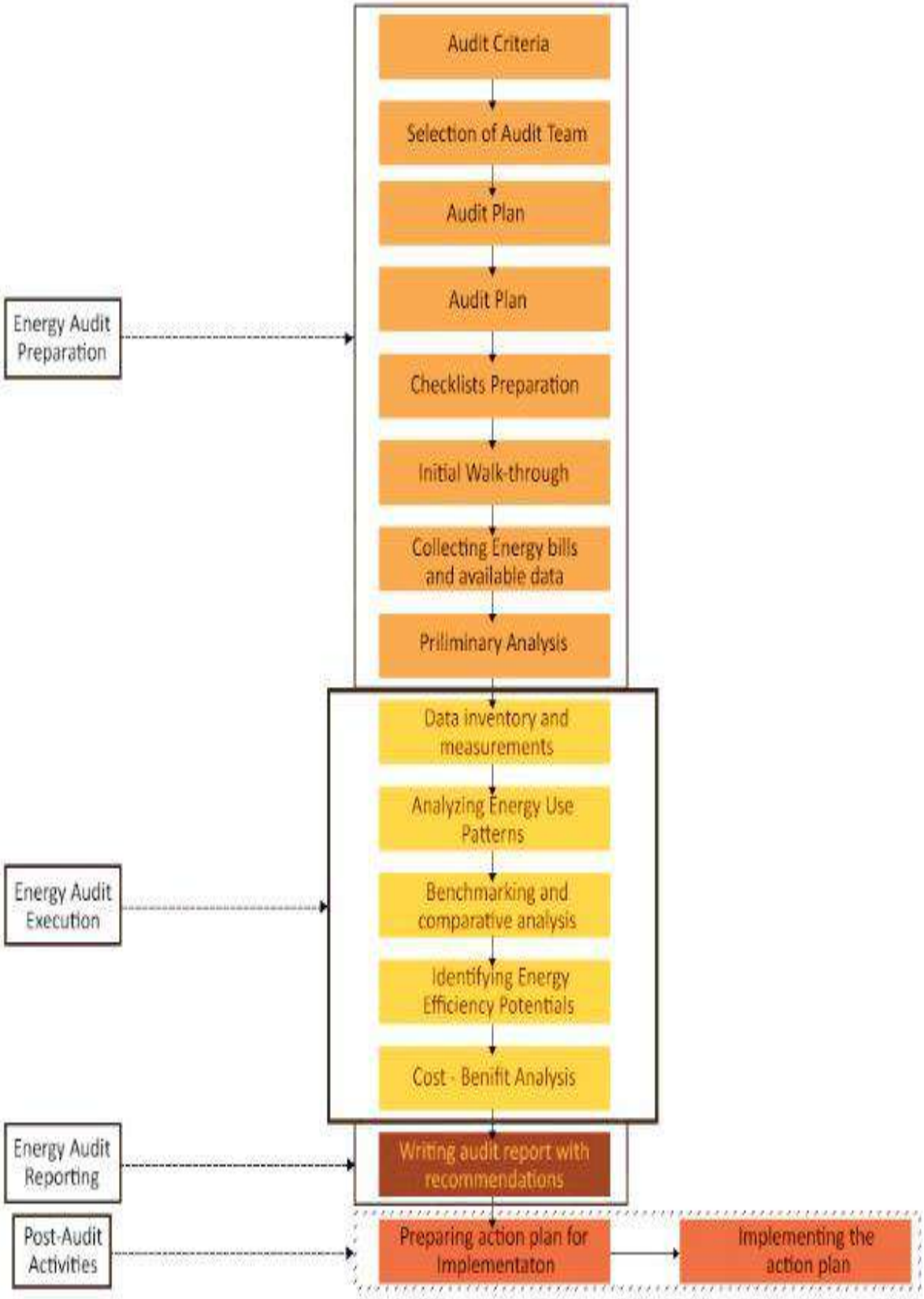
7. Carbon footprint by measuring Carbon dioxide level in the Campus

The level of Carbon dioxide is measured in different places across the Organization campus using a portable CO_2 Analyzer (Non dispersive infra-red meter). In addition, CO_2 meter is also displayed the readings of atmospheric temperature, relative humidity, and dew point in the places, where the level CO_2 is measured. The meter started measurements of CO_2 level in the atmosphere after powered ON and updated the readings every second in the display screen. If the operating environment is changed (example from high to low temperature) which took 30 seconds for CO_2 sensor to respond and 30 minutes for flexibility in relative humidity. The meter features an audible alarm to give warnings when CO_2 concentration exceeds the set limit. It emits beeps (Abt.80Db) when CO_2 level goes over the set value and stops when any key (except SET) is pressed, or the readings fall below the set values.

The Carbon footprint per year is calculated (www.carbonfootprint.com) based on electricity usage per year in which CO_2 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 CO_2 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 (CH_4) 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.

The Methodology of the Audit is presented in the following chart



Flow chart of Energy Audit Methodology

Calculating Carbon footprint

8. Energy Audit Process

Energy audit is a sequence of tasks performed in a planned manner. It requires discussion, survey, collection of data, analysis, and reporting

Opening Meeting for the conduct of Energy audit

8.1. Steps involved in an Energy Audit

Step 1: Opening meeting among the audit team and auditees
Step 2: Planning and organizing the energy audit
Step 3: Conduct a walk-through audit at different sites
Step 4: Macro data collection and observation
Step 5: Analysis of data collected from the Organization
Step 6: Best practices followed in the Organization towards energy savings
Step 7: Recommendations for further improvement
Step 8: Exit meeting after the audit to discuss about the audit findings

8.2. Systems studied during the Energy Audit

- Physical verification of lighting, fan a/c machines, ventilators load fixtures.
- Verification of installed energy efficient systems.
- Inspection of Solar panel, Generators, Uninterrupted power supply machines.
- Inspect and verify the maintenance aspects of installed Generators and additional backup power sources.
- Analyse the electricity consumption through the supply utility company (Example: Tamil Nadu Electric Generation and Distribution Corporation Limited, Chennai).
- Review the potential usage of alternative energy resources.
- Review the energy conservation awareness among the stakeholders for optimum use of electricity and its savings.

8.3. Planning and organizing the Energy Audit

Planning and organizing are the integral part of the energy audit. An initial visit to the audit sites is organized and the areas to be inspected are listed. Following the listing, information on the energy consumption of various blocks in the recent past is obtained, and a planned analysis is carried out.

8.4. Walk-through Audit Process

Simple audit, screening audit or visual audit are the other names, by which walk-through audits are addressed. The main purpose of the walk-through audit is to obtain general information about the sites in which electrical energy is being used at the maximum. More specific information have been obtained from the maintenance and operational people during the time walk-through audit. It also included a walk-through of the facility to become familiar with the building's operation and a brief evaluation of facility utility bills (amount paid for electricity) and other operating data. During the audit the primary problem areas are discovered.

8.5. Macro Data collection and observation

Current level operation and practices within the campus are assessed and then the data regarding the number of electrical loads connected in each section are collected. The power ratings of each component and their respective hours of operation are also observed and documented for preparing the recommendations to the Organization.

8.6. Measurements in the Energy Audit process

An energy audit required measurements, such as the energy identification and quantification, and these quantities necessitate the instruments used in a consistent way. Some of the basic electrical parameters are monitored during the energy audit such as Voltage (V), Current (I), Power factor, active power (Kw), apparent power (demand in Kva), reactive power (Kvar), energy consumption (Kwh), frequency (Hz), harmonics, illumination level, etc. Temperature and heat flow, radiation, air and gas flow, liquid flow, speed, air velocity, noise and vibration, dust concentration, TDS, Ph, moisture content, relative humidity, flue gas analysis – CO_2, O_2, CO, SO_2, NO_2, combustion efficiency are the mechanical, thermal and other parameters that are analysed during the audit depending upon the requirements

9. About the Institution

9.1. About Sree Abiraami Arts and Science College for Women

Sree Abiraami College of Arts and Science for Women was established in the year 2016 with the aim of providing higher education to the socially and economically backward young women by Sree Abiraami Educational & Charitable Trust, which is approved by Government of Tamilnadu and affiliated to Thiruvalluvar University (Vellore). This is the first self-financing Women Institution in Gudiyattam located in Keelalathur on Katpadi main road. The college is situated in serene & Greenish atmosphere with sophisticated buildings, spacious classrooms with smart board, well equipped laboratories, advanced computer lab, large volume of digital library, (24/7) wifi and hygienic canteen. There are 30 Buses operated to cover 70 km radius from the college. The college offers 7 UG Programme and 2 PG Programme. The Trust has started a world class CBSE School named Sree Abiraami CBSE School up to VII Grade in the same campus in the year 2019. The main aim and motto of this institution are Knowledge, Discipline and Skill.

The vision is to offer quality education to the socially and economically backward young women of our country and impart values to make them responsible citizens. The mission to empower young women to face the challenges of life with courage and commitment to become successful. To impart knowledge for improving the socioeconomic status and upliftment of the life. To strive continuously confer them to tackle the social issues in the society.

9.2. About Nature Science Foundation (NSF)

NSF is a Non-Profit ISO 9001:2015 certified Organization and registered with NGO Darpan NITI Aayog and Ministry of Micro, Small and Medium Enterprise, Government of India functioning energetically towards the noble cause of nature conservation and environmental protection. NSF is managed by a board of trustees of NSF Public Charitable Trust 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 12A, 80G and Form 10AC certificates for income tax exemption. The main motto of the NSF is to “Save the Nature to Save the Future” and “Go Green to Save the Planet”. NSF Branch Offices are also functioning effectively at Gorakhpur, Uttar Pradesh and Faridabad, Haryana, India to adopt the ‘Go Green Concept’. NSF family is wide

spread across India with over 70 state-wise Lead auditors to conduct Green and Environment Audits.

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, Student Technical Symposium, Distinguished lecture programme, Environment day celebration, Ozone day celebration, Project model exhibition, Awareness programmes on Environmental pollution, Biodiversity and Natural resources conservation and etc. with the financial support of the Foundation. NSF is being released 'Magazine' and 'Newsletter' biannually to share the information about Environmental awareness programmes on biodiversity conservation, seminar on soil conservation, water management and solid waste management, restoration and afforestation programmes in Western Ghats of southern India.

In order to encourage the students, members of faculty, academicians, scientists, entrepreneurs and industrial experts those who are involving in nature protection and biodiversity conservation studies, NSF tributes the deserved meritorious candidates with various awards and honours such as 'Best Faculty Award', 'Best Women Faculty', 'Best Scientist Award', 'Best Student Award', 'Best Research Scholar Award', 'Best Social Worker Award', 'Young Scientist Award', 'Life-Time Achievement Award' and 'Fellow of NSF' will be given.

NSF has introduced various types of Audits such as 'Eco Audit', 'Green Audit', 'Energy Audit' and 'Hygienic Audit' 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 ISO EMS 14001:2015 criteria and in compliance with Government Law and Environmental Legislations including World / Indian Green Building Council and the concept of Swachh Bharath Abhiyan under Clean India Mission. Green campus and Environment Policy, Purchase Policy, MoU, International Eco Club student Chapter Certificate will be given to get the maximum mark weightage in NAAC. Audit processes are being conducted through the certified Auditors as per the following.

Audit	**Certified Auditors**	**Certified Auditors**
Green Audit	• IGBC - Indian Green Building Council	➢ Mrs. S. Rajalakshmi ➢ Dr. R. Mary Josephine

	• GBCRS - Green Building Code and Green Ratings Systems • GRIHA – Green Rating for Integrated Habitat Assessment	➢ Dr. B. Mythili Gnanamangai ➢ Er. Ashutosh Kumar Srivastava ➢ Er. N. Shanmugapriyan
Energy Audit	• BEE - Bureau of Energy Efficiency • LEED - Leadership in Energy and Environmental Design • CII-GreenCo – GreenCo Rating System Felicitator	➢ Er. D. Dinesh kumar ➢ Er. N. Shanmugapriyan ➢ Dr. N. Balasubramaniam ➢ Dr. P. Thirumoorthi ➢ Dr. G. Murugananth
Environment Audit	• IGBC -Indian Green Building Council • ASSOCHAM - Associated Chambers of Commerce and Industry of India • FSRS – Fire Safety & Rescue Services	➢ Mrs. S. Rajalakshmi ➢ Dr. A. Geetha Karthi ➢ Dr. R. Mary Josephine ➢ Dr. B. Mythili Gnanamangai ➢ Er. Ashutosh Kumar Srivastava ➢ Er. N. Shanmugapriyan
Hygiene Audit	• FSMS – Food Safety Management System & • Occupational Safety & Health (ISO 22000:2018) • SBICM - Swatch Bharath under India Clean Mission	➢ Mrs. Gaanaappriya Mohan ➢ Er. Ashutosh Kumar Srivastava ➢ Dr. R, Sudhakaran ➢ Dr. N. Saranya
Waste Management Audits	• Water Audit, Soil Audit, Biomedical Waste Audit, Solid Waste Management Audit as per the IGBC, GRIHA and BEE	➢ Mrs. Gaanaappriya Mohan ➢ Er. Ashutosh Kumar Srivastava ➢ Dr. R, Sudhakaran ➢ Er. N. Shanmugapriyan
Academic & Administrative Audits	• Academic & Administrative Audits as per the NAAC Criteria	➢ Dr. B. Anirudhan ➢ Dr. B. Shreeram

10. Audit Details

Date/Day of Audit **: 07-12-2020**

Venue of Audit **: Sree Abirami Arts and Science College for Women, Gudiyattam, 635803, Vellore**

Audited by **: Nature Science Foundation**
Coimbatore, Tamil Nadu, India.

Audit type **: Energy Audit**

Name of ISO EMS Auditor **: Mrs. S. Rajalakshmi,**
Chairman & ISO EMS Auditor, NSF.

Name of Lead Auditors **: Dr. R. Mary Josephine,**
Board of Directors, NSF.

Name of Energy Auditors **: Dr. Antony Raj**

Certified Lead Auditor

Name of IGBC AP Auditor : Dr. B. Mythili Gnanamangai

IGBC AP, Indian Green Building Council.

11. Observations of the Energy Audit

11.1. Facilities visited during the Energy Audit

Date	Section where Energy Audit is conducted
07.12.2020	Administrative Block
	Power House
	Faculty Rooms
	Classrooms
	Seminar Halls
	Auditorium
	Laboratories
	Computer Centres
	Well, Sump and pumps.
	Sewage Treatment Plant
	Hostel
	Library

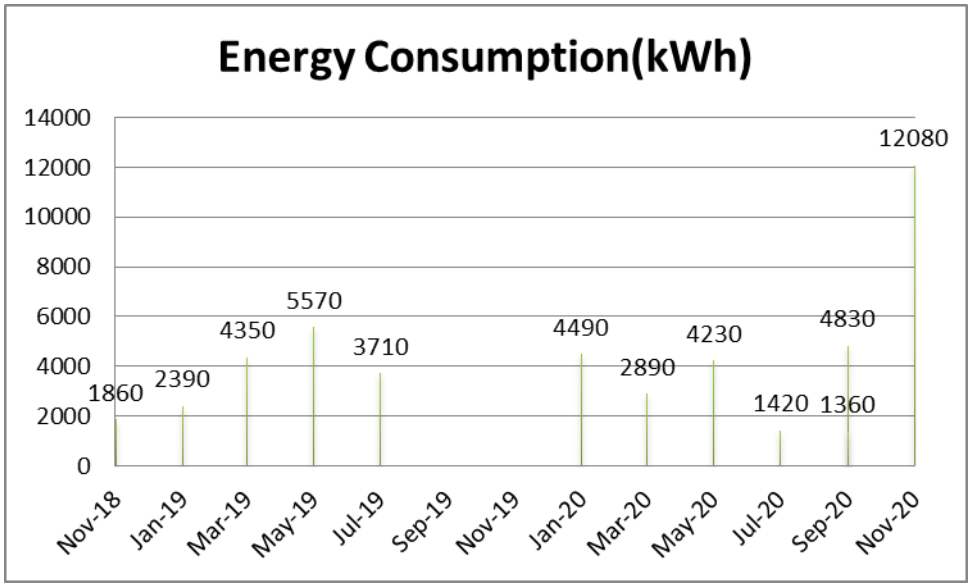
In the sections, the services offered are monitored, verified, and analysed on the aspects of energy consumption. In all these areas lighting systems forms the major consumer of electrical energy. Three phase electricity service connections available in the campus are provided by Southern Power Distribution Company of TS Limited (TSSPDCL Consumer No. MCL923). The electricity consumption charges are audited and studied for the load demand requirement and efficient consumption of energy. Stake holders are interacted and the scope for improvement has been discussed. Potential areas in which scope of energy conservation and saving opportunities available have been identified and suggested for implementation.

11.2. Systems Studied during the Energy Audit

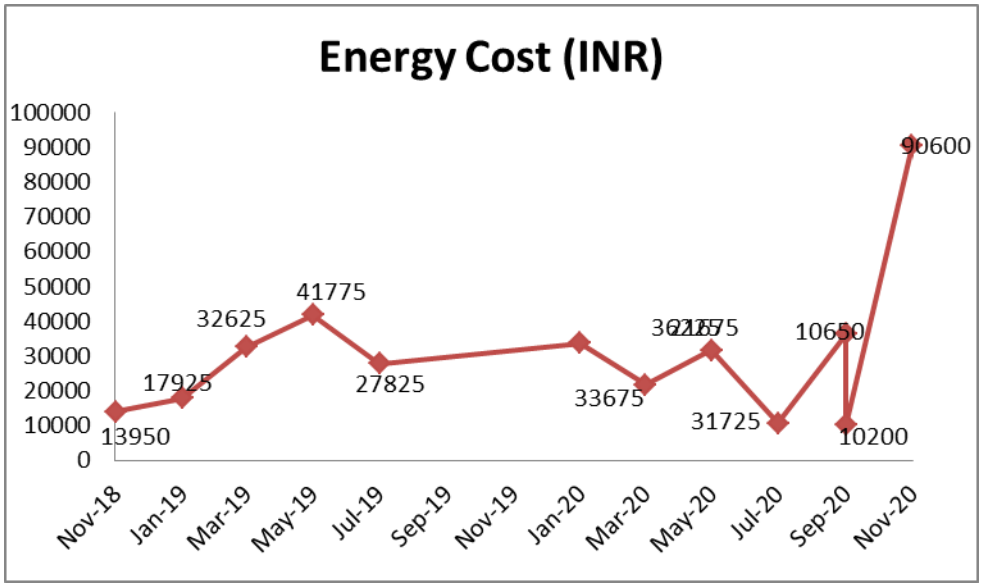
1. Lighting fixtures are verified physically.
2. Installation of energy efficient lighting systems are verified.
3. Installation of safety systems are verified
4. Installation of power backup systems (generators and UPS) are verified on the aspect of maintenance and consumption.
5. Electricity consumption through the TSSPDCL bills was analysed.
6. The energy conservation awareness among the stakeholders for optimum use of electricity and its savings are reviewed.

11.3. Energy Consumption and Cost Profile

The following chart shows the profile of energy consumed and the cost for one year by the stakeholders.



Energy Consumption Profile



Energy cost profile

Average energy consumption per stakeholder per month: 1.84 kWh.

11.4. Power supply Equipment and Major Loads

Table 1. Major Equipment related to Electrical energy utilization

S.No	Equipment/ Utility	Rating/ Capacity	Quantity
1	LED Tube Lights	25w	23
2	Flouresecent Lamps	-	-
3-a	CFL	-	2
3-b	CFL	-	-
4	LED Focusing Light	50W	5
5	LED Bulb	30W	28

6	Solar Water Heater	-	-
7	Solar Panel	-	8
8	UPS	12V	27
9	LCD Projectors	-	2
10	Refrigerators	-	1
11	Varanda Light load	400V	4
12	Lift	-	-
13	Water Doctors	80W	6
14	Water Purification System	-	1
15	AC (Split, Window and Centralized AC)	3 Rating	27
16	Air Cooler	-	1
17	Celling Fans	2.5 W	331
18	Generators	120KV/60KV	2
19	Pumps	-	-
20	Motors	16HP	3
21	Vacuum Cleaner	-	-
22	Drip & Sprinklers Irrigation	-	-
23	Ventilators	-	10
24	Exhaust Fans	2.5 W	14
25	Automatic Lights	-	-
26	Internet Connectivity	-	2
27-1	Podium containing Mike,	-	2
27-2	Speakers	15W	34
27-3	Amplifiers	100W	3
27-4	Camera,	-	71
27-5	Sensors	-	-
28	Computers	12 W	113
	Dot-matrix Printer	-	1
	Laser printers	240W	3
	Xerox Machines	-	2
	Scanners	240W	3

Table 2. Annual Energy Consumption of Fuels

S.No	Month	Units Consumed (kWh)	Diesel Consumption (Liters)	Petrol Consumption (Liters)	LPG Consumption (kg)
1	January	-	3000	-	**760**
2	February	-	3000	-	**750**
3	March	-	2900	-	**780**

4	April	-	3000	-	**770**
5	May	-	1500	-	**750**
6	June	-	2500	-	**720**
7	July	-	3000	-	**710**
8	August	-	3050	-	**725**
9	September	-	2950	-	**740**
10	October	-	3000	-	**750**
11	November	-	2900	-	**755**
12	December	-	6670	-	**670**

Table 2: Energy Consumption and Cost Profile

SL. No	Months	Cost in Rs.	Rating / Capacity units in kWh
1.	Nov- 2018	13950	1860
2.	Jan - 2019	17925	2390
3.	Mar - 2019	32625	4350
4.	May - 2019	41775	5570
5.	July- 2019	27825	3710
6.	Sep- 2020	36225	4830
7.	Jan - 2020	33675	4490
8.	Mar - 2020	21675	2890
9.	May - 2020	31725	4230
10.	July - 2020	10650	1420
11.	Sep - 2020	10200	1360
12.	Nov - 2020	90600	12080

The sum of electricity usage per year = 83,410

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

= (83,410/1000) x 0.84 = 70.0644

Table 3. Transportation Facilities available in the campus

S.No	Type of Vehicle	Fuel Used	No. of Vehicles	Non Pollution Certified (Y/N)
1.	Bus	Diesel	26	Yes, all busses have pollution certificate
2.	Car	Diesel	1	
3.	Two wheeler	Diesel	2	

11.5 Quantitative and Qualitative Measurement

S.No.	Requirements and checklists of the audit	Conformity		
		Yes	No	NA
1.	Have internal Energy audit procedures been developed and implemented in the Organization?	✓		
2.	Have programmes for the achievement of energy efficiency and conservation objectives been established and implemented as on today in the campus?	✓		
3.	Has a Management Representative, Electrical Engineer, Staff in charge been assigned for energy savings on power consumptions?	✓		
4.	Have programmes for the achievement of prescribed financial outlay for current bills for each building in the campus towards power consumptions?		✓	
5.	Has the organization ensured that personnel performing environmental specific tasks have the required knowledge on energy audit (e.g. education, training programme, seminar, workshop, camp, etc.)?	✓		
6.	Are objectives and targets documented towards energy audit periodically and any Register is made?	✓		
7.	Any analysis of energy flows for energy conservation in terms of the amount of energy input into the system without negatively affecting the output in buildings	✓		
8.	Implications of alternative energy efficiency measures sufficient to satisfy the financial criteria of sophisticated investors	✓		
9.	Identification of the most efficient and cost-effective Energy Conservation Opportunities (ECOs) or Measures (ECMs) taken by the Management	✓		
10.	Are the following energy efficiency and conservation aspects considered in sufficient detail?	✓		
	a. Fluorescent (tube) lights, Incandescent lamp and sodium vapour lights are replaced with CFL / LED	✓		
	b. Number of Uninterruptible power supply (UPS) and Power generators for power back-up to alternative current supply facility in each building	✓		
	c. Number of solar panels, solar lights, solar water heaters, electric water heater installed			
	d. Automatic sprinkler system used for irrigation purpose			

	e. Ultra-violet lights and any other harmful lights used with safety precautions	✓		
	f. Attempt in reducing the energy expense and carbon footprint	✓		
	g. Disposal facility for hazardous arise from electrical gadgets, equipment and installation	✓		
	h. Renewable energy utilization (solar panel, wind mill)	✓		
	i. Natural / Mechanical air ventilation at Indoor / Outdoor auditorium, stadium, seminar halls, etc.	✓		
	j. Sign boards indicating Switch OFF / ON, Danger at Electrical equipment and Power transformers in the campus	✓		
11.	Signing of MoU with Govt. and NGOs to ensure about the energy conservation and efficiency in the campus	✓		
12.	Conduction of awareness programmes and outreach programmes on the energy conservation and efficiency	✓		
13.	The details of public transport, battery operated / electric vehicles, biofuel use, exhaust fans, boiling water system, chillers and geysers on energy savings mode	✓		
14.	Projects and Dissertation works on the energy conservation and efficiency carried out by students and staff members		✓	
15.	Steps taken to take care of daylighting, AC machines heat emission and ecofriendly Refrigerators, etc.	✓		
16.	Use of water metering, IoT based energy efficiency practices, remote waterlines, automation of electrical fittings and gadgets to save energy		✓	
17.	Are all monitoring electrical equipment appropriately maintained and calibrated?	✓		
18.	Are any energy conservation technologies and retrofit for energy conservation equipment being implemented?	✓		
19.	Skylight roof ratio, fenestration plan and Daylight illuminance in building construction towards energy efficiency*		✓	
20.	Any Automatic Lighting Shutoff with occupancy Sensors and Timers, Exterior / Interior lighting control facility*		✓	
21.	Have any rooms and guest suites a master control device at the main room entry that controls all permanently installed luminaires and switched receptacles*	✓		

22.	Total electricity usage divided by total campus' population (kWh per person)	✓		
23.	The ratio of renewable energy production divided by total energy usage per year	✓		
24.	Total carbon footprint divided by total campus' population (metric tons per person)		✓	
25.	Elements of green building implementation as reflected in all construction and renovation policies		✓	
26.	Greenhouse gas emission reduction awareness programme to the stakeholders	✓		
27.	Computers, Lap tops, Ipad, Dot matrix Printer, Laser printers, Xerox Machines, Scanners, Server, Fax machine, Inverter with UPS	✓		
28.	**Equipment, Instruments and Machineries related to Life Sciences and Biological Sciences including Biotechnology, Nanotechnology, Food Technology, etc** Electronic Balances, pH Meter, Hot-air-oven, Microwave oven, Laminar Air Flow, Autoclave, Microscopes, Electophonic, Apparatus, Chromatography devices, Grinders, Mixers, Deep Freezers, BOD incubators, COD digester, Extraction apparatus, Incubators, CO_2 incubators, Heating Mantle, Vaccum pump, Vortes Mixer, Magnetic stirrer, Gel rocker, Somicator, Growth chambers, Air curtains, Acrators, Spectrophotometers, Calorimeters, Turbidity meter, Colony counter water bath, Dry bath, Thermocycler, Gene gun, Gel documentation system, Trans illuminator, Ice maker, ELISA reader & Water, Aquarium, zebra fish/animal house facility, Mechanical & Orbital Shakers, cyclo mixer, Lyophilizer, Incinerators, Fermenters, Reactors, Particle size Analyser, XRD, FTR, Muffle furnace	✓		
29.	**Chemical Sciences and Engineering Equipment/Machines** Distillation unit, Flow through straight pipe, packed bed distillation, Roll crusher, jaw crusher, sieve analysis machine, Shell and tube heat exchangers, plate and frame filter press, Fume hood, Fluorimeter, Venturimeter, Orifice meter, Nephelometer, Membrane Filtration Apparatus, Sieve set Machine, Jar test apparatus		✓	
30.	**Electrical, Electronics and Communication Engineering Equipment/Machines** DC Shut motor, DC Series motor, DC Compound	✓		

	motor, DC Shunt motor, DC Compound generator, Dc series generator, Single phase & Three phase transformers, Loading rheostat, Single phase & three phase, inductive & capacitive load, Power electronics trainer kits, Three phase squirrel cage indication motor, Three phase slip ring induction motor, AC generator, Stabilizers, synchronizer, Half and fully controlled converters, Buck, Boost and buck-boost converters, Single phase and three phase inverters, synchros, CRO, DS, CRO.			

11.6. Measurement of Carbon dioxide level in the Campus

Despite a massive increase in global warming, environmental changes and human population including many commercial activities now-a-days, the amount of carbon in Earth's atmosphere is playing an important role which act as a global indicator for checking the purity of the atmosphere. Using a portable CO_2 Analyzer, the level of carbon dioxide was measured in different places across the **Sree Abirrami Arts and Science College For Women, Gudiyattam, 635803, Vellore, Tamil Nadu, India.** The observation showed that the concentration of CO_2 in the atmosphere is found to be low which did not exceed the critical limit of CO_2. It is further revealed that all the selected locations are having pure air with good air exchange which are free from pollutants (Table 6).

Carbon footprint, amount of CO_2 emissions associated with all the activities of the College or other entities like building construction and anthropogenic activity by human beings includes direct emissions, such as those that result from fossil-fuel combustion from direct burning, transportation, industrial activities, as well as emissions from electricity generation. In addition, the carbon footprint also contributes to the greenhouse emission.

Table 6. Measurement of CO_2 Concentration Sree Abirrami Arts and Science College for Women, Gudiyattam, 635803, Vellore

S.No.	Different locations of the Organization's campus	Carbon dioxide level (ppm)	Remarks
1.	Chemistry Lab	550	CO_2 level is low
2.	Open Auditorium	422	CO_2 level is low
3.	B.Sc chemistry class room	580	CO_2 level is low
4.	Staff Room	480	CO_2 level is low
5.	Seminar hall	785	CO_2 level is low
6.	C.Sc. Lab	674	CO_2 level is low
7.	Library	696	CO_2 level is low

Reference of Set values of CO_2 level

- 350-1000 ppm: Typical level found in occupied spaces with good air exchange along with pure air.
- 1000-2000 ppm: Moderate level associated with complaints of drowsiness and poor air quality.
- 2000-5000 ppm: Critical level associated with headaches, sleepiness, and stagnant, stale, stuffy air. Poor concentration, loss of attention, increased heart rate and slight nausea may present.

Calculation of Carbon Footprint at Sree Abirrami Arts and Science College For Women, Gudiyattam, 635803, Vellore The Carbon footprint calculation can be conducted based on the stage of calculation as stated in www.carbonfootprint.com, which is the sum of electricity usage per year.

The CO_2 emission from electricity

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

= (365736 kWh/1000) x 0.84

= 307.21 metric tons

Notes:

Electricity usage per year = 365736 kWh

0.84 is the coefficient to convert kWh to metric tons.

CO_2 level measurement at various locations of Sree Abirrami Arts and Science College For Women, Gudiyattam, 635803, Vellore, Tamil Nadu, India

11.7. Ways to reduce Carbon Footprint

Evaluating and understanding the CO_2 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.

Food

- Consumption of local and seasonal products.
- Limiting the consumption of meat and beef.
- Adopting sustainable fishing.
- Avoiding plastic packaging and practising the use of reusable bags.
- Sense of buying only necessary things.

Clothing

- Taking good care of clothes.
- Buying second hand products or borrowing
- Using the clothes made from recycled products with eco label

Transport

- Adopting carpooling practice, using cycles and public transport
- Usage of No Pollution certified vehicles.

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
- Reduce and recycle of wastes.

11.8. Light Intensity Measurement

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 (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/ space.

Light Intensity Measured at various locations of Sree Abirrami Arts and Science College for Women, Gudiyattam, 635803, Vellore, Tamil Nadu, India

S.No	Location	Light Intensity (Lux)	Recommended Level (as per NBC 2016) (Lux)
1.	Principal office (1st floor)	295 – 310	200 – 500
2.	Reception area	58 – 70	150 – 300
3.	Faculty room	178 – 190	200 – 500
4.	Library & Information Centre	300 – 340	200 – 500
5.	Auditorium (500 capacity – ground floor)	450 – 500	200 – 500
6.	lab	320 – 360	300 – 750
7.	Seminar Hall	125 – 127	300 – 750

12. Best Practices followed in the Organization

- Transformer, Generators and UPS are protected properly with fencing and kept awareness boards on ‘Dangers’ and ‘Warnings’.
- Most of places, sign board of ‘Switch ON’ and ‘Switch OFF’ are kept towards saving energy measures to the stakeholders.
- Electrical wires, switch boxes and stabilizers are properly covered without any damage which will cause any problems to the staff and student members.
- Installed roof top solar power plant.
- Installed automatic switches with sensors.
- HVLS Fans are fitted in the auditorium.
- Water level controllers are used.
- Power factor is maintained near to unity with APFC.
- STP is used for water recycling which is functioning well.
- Replaced old generation computers and TVs with LED monitors.
- Promoting ECON awareness and practice among the stakeholders are being conducted periodical through Association, Clubs, Forums and Chapters.

- Usage energy efficient light-emitting diode (LED) bulbs instead of incandescent and CFL bulbs.
- Maintenance of appliances and replaced old appliances in all laboratories

Best Practices followed by the Institution

- Value added / Non-formal / Certificate / Diploma course on 'Energy and Environment Management Audits' are being conducted for the benefit of students and research scholars to become a certified Lead Auditor.
- 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.
- Switching off the lights, fan, air conditioners, equipment and instruments when they are not in use.

Walk-through Audit Conducted at various Sree Abirrami Arts and Science College For Women,Gudiyattam, 635803, Vellore, Tamil Nadu, India and the Energy Equipment were inspected

13. Recommendations for improving the energy efficiency and energy Conservation in the Organization

The energy audit included suggestions for energy cost reduction, preventive maintenance, and quality control activities, all of which are critical for utility operation in the audit sites.

- Procurement of equipment with energy efficiency (4-5 star rated equipment) during replacement may be considered.
- 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.
- Turn off electrical equipment when not in use
- Use computers and electronic equipment in power saving mode.
- Installation of Biogas plant for hostel kitchen as well canteen.
- Automatic switches with occupancy sensors in common areas
- Inclusion of on campus e-vehicle.
- Monthly use of electricity in the College may be reduced to a greater extent by means of undertaking a periodical energy audit.
- There are fans of older generation and non-energy efficient which can be phase out by replacing with new energy efficient fans.
- Regular monitoring of equipment in all laboratories and immediate rectification of any problems.

14. Recommendations on Carbon Footprint in the Organization

- Encourage students and staff members to use bicycles and battery operated vehicles to reduce fuel consumption and carbon emission.
- 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.
- Large number of ventilation and exhaust systems may be placed in auditorium, seminar and conference halls to reduce the carbon dioxide level among the participating students, scholars and staff members.

Closing meet of the conduct of Energy audit

15. Conclusions

Considering the fact that the organization is a well-established, long time run establishment with good reputation, 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. Energy efficient lighting schemes, awareness created among stakeholders and necessary power backups are being practiced by the institution. There are some best Practices followed on Energy Audit in the Organization like Transformers, Generators and UPS are protected properly with fencing and kept awareness boards on 'Dangers' and 'Warnings'. It is observed that the most of places, sign board of 'Switch ON' and 'Switch OFF' are kept towards saving energy measures to the stakeholders. Electrical wires, switch boxes and stabilizers are properly covered without any damage which will cause any problems to the staff and student members. Few recommendations, in addition, can further improve the energy savings of the Organization. This may lead to the prosperous future in context of Energy Efficiency Campus and thus sustainable environment and community development to the stakeholders in coming years to come.

16. Acknowledgement

Nature Science Foundation, Coimbatore, Tamil Nadu, India is grateful to the Management and Principal of **Sree Abirami Arts and Science College For Women, Gudiyattam, 635803, Vellore** for providing us necessary facilities and co-operation during the energy audit process. This helped us in making the audit a success. Further, we hope that the best practices on sustainability followed by the Organization and recommendations and suggestions given by the NSF will boost the new generations to take care of the Electrical energy conservation, Energy saving measures and sustainability incompliance with the applicable regulations, policies and standards in the College Campus.

17. References

Asnani, J. and Bhawana, S. 2015. Study of awareness and habits among home makers during purchasing electrical household equipment. *International Journal of Applied Home Science***2** (7&8): 201-206.

Backlund, S. and Thollander, P. 2015. Impact after three years of the Swedish energy audit programme. *Energy*, **82**: 54-60.

Bae, S.H. and Seol, I. 2006. An exploratory empirical investigation of environmental audit programs in S&P 500 companies. *Management Research News* **29** (9): 573-579.

Buckman, A.H., Mayfield, M. and Beck, S.B.M. 2014. What is a smart building?. *Smart Sustainable Built Environment* **3** (2): 92-109.

Cabrera, E., Pardo, M.A., Cobacho, R. and Cabrera, Jr, E. 2010. Energy audit of water networks. *Journal of Water Resources Planning and Management*. **136** (6): 669-677.

Cardozo, N.H., da Silveira Barros, S.R., Quelhas, O.L.G., Filho, E.R.M. and Salles, W. 2019. Benchmarks analysis of the higher education institutions participants of the Green Metric World University Ranking. Springer, Universities and Sustainable Communities: Meeting the Goals of the Agenda 2030, World

Sustainability Series. pp. 667-683.

Choy, Er.A. and Karudan, R. 2016. Promoting campus sustainability: A conceptual framework for the assessment of campus sustainability. *Journal of Social Sciences and Humanities* **11** (2): 112-118.

Gnanamangai, B.M., Murugananth, G. and Rajalakshmi, S. 2020. *A Manual on Environment Management Audits to Educational Institutions and Industrial Sectors*. Laser Park Publishing House, Coimbatore, Tamil Nadu, India, p. 203.

Fachrudin, H.T., Fachrudin, K.A. and Utami, W. 2019. Education activities to realize green campus. *Asian Social Science* **15** (8): 18-27.

IGBC, 2020. Indian Green Building Council. https://igbc.in/igbc/

Ingle, A., Moezzi, M., Lutzenhiser, L. and Diamond, R. 2014. Better home energy audit modelling: incorporating inhabitant behaviours. *Building Research &Information***42** (4): 409-421.

Lauder, A., Sari, R.F., Suwartha, N. and Tjahjono, G. 2015. Critical review of a global campus sustainability ranking: Green Metric. *Journal of Cleaner Production* **108**: 852–863.

Leon-Fernandez, Y. and Dominguez-Vilches, E. 2015. Environmental management and sustainability in higher education: The case of Spanish Universities. *International Journal of Sustainability in Higher Education* **16**: 440-455.

Mishraand, U. and Patel, S. 2016. Awareness regarding energy efficiency star labelling on household appliances amongst the consumers of Vadodara city. *International Journal of Applied Home Science***3** (9&10): 330-338

Padmini, E. 2007. *Biocharacterization Calculations and Biostatistics*. Books and Allied (P) Ltd, Kolkata, India.

Peters, G.F. and Romi, A.M. 2014. Does the voluntary adoption of corporate governance mechanisms environmental risk disclosures? Evidence from greenhouse gas emission. *Journal of Business Ethics* **125** (4): 637-666.

Pramanik A.K. 2013. *Environmental Audit and Indian Scenario, Environmental Accounting and Reporting*. Deep and Deep Publications, New Delhi, India. p.312.

Rajalakshmi, S., Kavitha, G. and Vinoth kumar, D. 2020. *Energy and Environment Management Audits*. AkiNik Publishing, New Delhi. 217p.

Shriberg, M. 2002. Institutional assessment tools for sustainability in higher education: strengths, weaknesses, and implications for practice and theory. *International Journal of Sustainability in Higher Education* **3** (3): 254-270.

Singh, M., Singh, G. and Singh, H. 2012. Energy Audit: A case study to reduce lighting cost.*Asian Journal of Computer Science and Information Technology***2** (5): 119-122.

WGBC, 2020. World Green Building Council. https://www.worldgbc.org.

Certificates of Nature Science Foundation,

Coimbatore, Tamil Nadu.

1. ISO Certificate
2. MSME Certificate
3. NGO Darpan NITI Aayog
4. 12A Certificate
5. 80G Certificate
6. 10AC Certificate

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NATURE SCIENCE FOUNDATION

LIG II, GANDHIMAA NAGAR, PEELAMEDU, COIMBATORE - 641004, TAMILNADU, INDIA.

has been assessed and found to conform to the requirements of

ISO 9001:2015

for the following scope :

PROVIDING ENVIRONMENT, ENERGY, GREEN AND HYGIENE AUDITS
TO ACADEMIC INSTITUTIONS AND ORGANISATIONS
AS PER THE OWN CHECKLIST AND AWARDS TO
MERITORIOUS CANDIDATES.

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Date of Expiry*	: 07/01/2024		
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MSME
सूक्ष्म, लघु एवं मध्यम उद्यम
MICRO, SMALL & MEDIUM ENTERPRISES

UDYAM
REGISTRATION CERTIFICATE

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)

S.No.	Name of Unit(s)
1	Green Campus, Energy and Environment Management Audits

OFFICAL ADDRESS OF ENTERPRISE

Flat/Door/Block No.	LIG-II,2669	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:	chairmannsf@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)

SNo.	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

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 M/o 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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Please Update Your Profile
Welcome, Nature Science Foundation
Your Unique Id: TN/2018/0187711

PROCEEDINGS OF THE COMMISSIONER OF INCOMETAX (EXEMPTIONS),
III FLOOR, ANNEXE BLDG, NO.121, MAHATMA GANDHI SALAI, CHENNAI-34

Present : G.M.DOSS, I.R.S
Commissioner of Income Tax (Exemptions)

** URNo. AACTN7857J/05/18-19/T-1105 Dated:03/09/2018

Sub: Registration u/s. 12AA of the Income tax Act 1961 - in the case of

"Nature Science Foundation"
LIG-II, 2669, Gandhimaa Nagar, Peelamedu, Coimbatore – 641 004.

Ref : Application in form 10 A filed on 28/03/2018

ORDER UNDER SECTION 12AA OF THE INCOME TAX ACT 1961.

1. The above **Trust/Society/Association/ Company/ others/,** bearing PAN AACTN7857J was constituted by **Trust Deed / Memorandum of Association** dated **29/11/2017** registered with **Sub-Registrar's Office/ Registrar of Societies/**Registrar of Companies/others on **29/11/2017.**

2. ~~The Trust Deed / Memorandum of Association has subsequently been amended / modified / altered by a Codicil / Supplementary Deed / Amendment Deed / Alteration to Memorandum of Association/others dated XX/XX duly registered on XX/XX.~~

3. The above **TRUST** filed an application seeking Registration u/s 12 AA of the Income tax Act, 1961.

4. On going through the objects of the **TRUST** and its proposed activities as enumerated in the **Trust Deed / Memorandum of Association,** I am satisfied about the genuineness of the **TRUST** as on date.

5. The application has been entered at **Sl.No.1105** maintained in this office. The above **Trust** is accordingly registered as a **PUBLIC CHARITABLE TRUST** u/s 12 AA of the Income Tax Act, 1961 with effect from **29/11/2017**.

6. It is hereby clarified that the Registration so given to the **Trust/Institution** is not absolute. Subsequently, if it is found that the activities of the **Trust/Institution** are not genuine or are not being carried out in accordance with the objects and clauses of the **Trust Deed / Memorandum of Association** submitted at the time of registration or modified with the approval of the **Commissioner of Income-tax (Exemptions), Chennai** or there is a violation of the provisions of Section – 13, **the** Registration so granted shall be cancelled as provided u/s 12 AA (3) or 12AA(4) of the Income Tax Act. Further, this approval is also subject to the **Trust/Society/Association/Company/ Others/** complying to the provisions of the proviso to sec 2(15) of the Income Tax Act 1961.

7. **Granting of Registration u/s 12AA** does not confer any automatic exemption of income from taxation. The **Trust/Institution** should conform to the parameters laid down in Sections 11, 12, 13 and 115 BBC of the I.T. Act, 1961, to claim exemption of its income on year to year basis before the Assessing Officer.

** This Unique Registration No. URNo. **AACTN7857J/05/18-19/T-1105** Should be mentioned in all your future correspondence.

Sd/-
(G.M.DOSS, I.R.S)
Commissioner of Income-tax(Exemptions), Chennai.

Copy to:
1. The Assessee.
2. The ACIT(Exemptions), Coimbatore Circle.
3. Office Copy.

//CERTIFIED TRUE COPY//

(N SRINIVASA RAO)
Asst. Commissioner of Income-tax (H.Qrs)(Exemptions),
Chennai.

F.2984

GOVERNMENT OF INDIA
INCOMETAX DEPARTMENT
OFFICE OF THE COMMISSIONER OF INCOME TAX (EXEMPTIONS)
Aayakar Bhawan, Annexe III Floor, 121 M.G. Road, Chennai 600 034

URNo. AACTN7857J/05/18-19/T-1105/80G Date: 10.04.2019

Name of the Trust-/Society /Company/Institution	:	NATURE SCIENCE FOUNDATION
Address	:	LIG II 2669, GANDHIMAA NAGAR, PEELAMEDU, COIMBATORE - 641 004
PAN	:	AACTN7857J
Date of Application	:	12.11.2018

Received
Raju 17/07/2019
E. Ponnal 17/07/19

APPROVAL UNDER SECTION 80G(5)(vi) OF THE INCOME TAX ACT, 1961

The aforesaid Trust-/~~Society/Company/Institution~~ has been registered u/s.12AA of the Income Tax Act with effect from **29.11.2017** vide **AACTN7857J/05/18-19/T-1105** dated **03.09.2018.** It is certified that donation made to **NATURE SCIENCE FOUNDATION** at **LIG II 2669, GANDHIMAA NAGAR, PEELAMEDU,COIMBATORE - 641 004** shall qualify for deduction u/s 80G(5)(vi) of the Income Tax Act, 1961, subject to the fulfillment of conditions laid down in clauses [i] to [v] of sub-section (5) of section 80G of the I.T Act, 1961.

2. This approval shall be valid in perpetuity with effect from **A.Y. 2019-20** unless specifically withdrawn. **The details and validity of the certificate is available @ office.incometaxindia.gov.in**

3. The Return of Income along with the Income & Expenditure Account, Receipts and Payments Account and Balance Sheet should be submitted annually **to** the Assessing Officer having jurisdiction over the case.

4. No change in the Trust Deed/~~Memorandum of Association~~ shall be effected without the prior approval of the undersigned i.e. **Commissioner of Income Tax (Exemptions), Chennai**.

5. Every receipt issued to a donor shall bear the **Unique Registration Number** i.e. **URNo. AACTN7857J/05/18-19/T-1105/80G** and date of this order i.e. **10.04.2019.**

6. Under the provisions of section 80G(5)(i)(a), the institution/fund registered u/s.12A, u/s.12AA(1)(b) or approved u/s.10(23C), 10(23C)(vi)(via), etc., shall have to maintain separate books of accounts in respect of any business activity carried on and shall intimate this office within one month about commencement of such activity.

Sd/-
(G.M.DOSS, I.R.S)
Commissioner of Income Tax (Exemptions)
Chennai.

Copy to:
1. The applicant
2. Guard File
3. The DCIT(Exemptions) Coimbatore Circle.

//Certified True Copy//

(N. SRINIVASA RAO)
Assistant Commissioner of Income-tax (H.qrs)
(Exemptions), Chennai.

Certificates of Energy Auditors

1. ISO Environment Management System (14001:2015) of Mrs. S. Rajalakshmi, Founder & Chairman of NSF.

2. Indian Green Building Council (IGBC AP) Accredited Professional of Dr. B. Mythili Gnanamangai, Vice-Chairman of NSF.

3. Associated Chambers of Commerce and Industry of India (ASSOCHAM), of Dr. B. Mythili Gnanamangai, and Er. Ashutosh Kumar Srivastava, Board of Directors (North Zone) of NSF.

4. Bureau of Energy Efficiency (BEE), LEED AP and GRIHA Certificates of Er. D. Dinesh kumar, Energy Auditor of NSF.

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Confederation of Indian Industry

GreenCo

CERTIFICATE

This is to Certify that

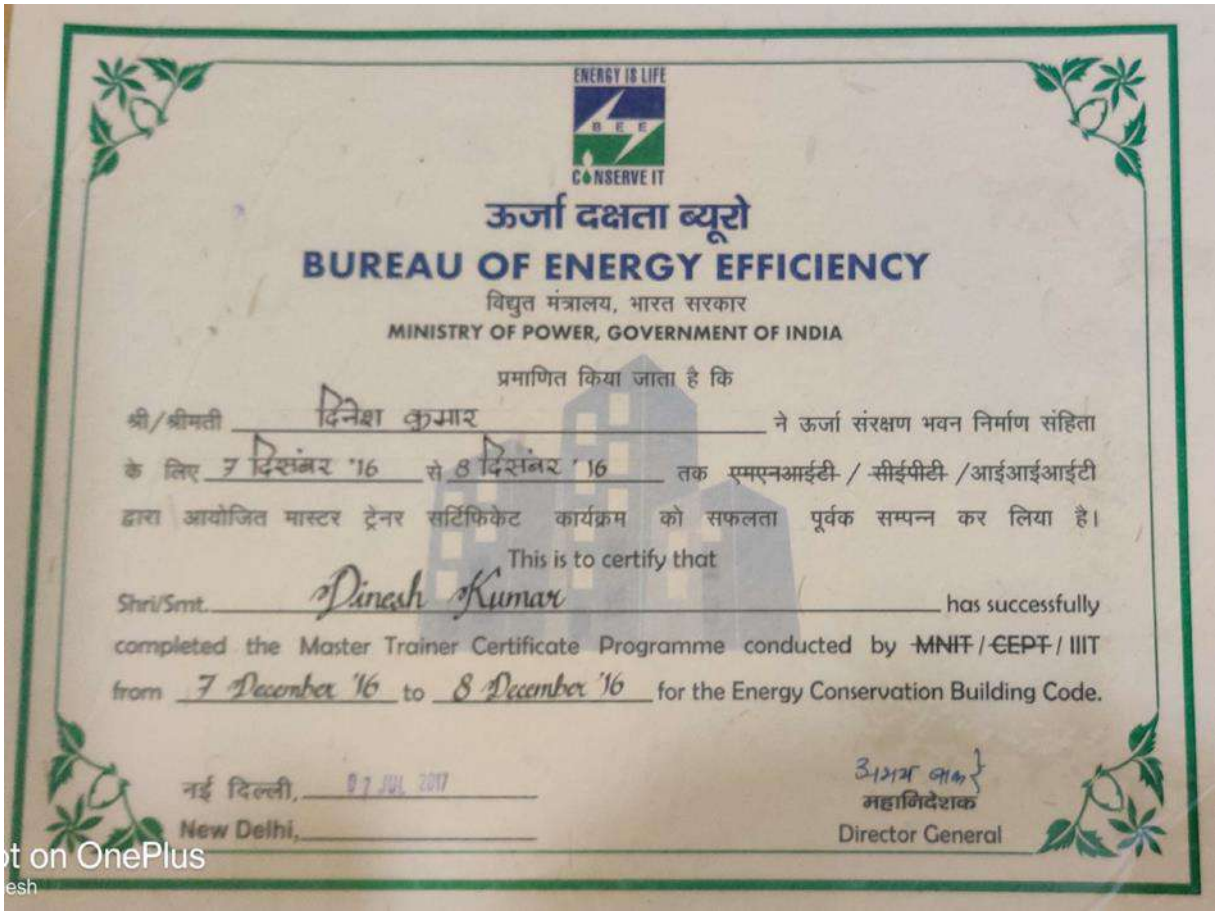
A K Srivastava

Is a "**CII-Certified Facilitator on GreenCo Rating System**",
upon successful completion of
"**3rd Edition of Facilitator Development Workshop on GreenCo Rating System**"
during 27 - 29 October 2021.

L S Ganapati
CHAIRMAN
CII GREENCO ASSESSOR PANEL

K S Venkatagiri
EXECUTIVE DIRECTOR
CII GODREJ GBC

Certificate No: CII/GCRF/002/2021; Issued date : 5 Nov 2021; Valid till: 5 Nov 2024



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BUREAU OF ENERGY EFFICIENCY

विद्युत मंत्रालय, भारत सरकार
MINISTRY OF POWER, GOVERNMENT OF INDIA

प्रमाणित किया जाता है कि

श्री/श्रीमती दिनेश कुमार ने ऊर्जा संरक्षण भवन निर्माण संहिता के लिए 7 दिसंबर '16 से 8 दिसंबर '16 तक ~~एमएनआईटी~~ / ~~सीईपीटी~~ /आईआईआईटी द्वारा आयोजित मास्टर ट्रेनर सर्टिफिकेट कार्यक्रम को सफलता पूर्वक सम्पन्न कर लिया है।

This is to certify that

Shri/Smt. Dinesh Kumar has successfully completed the Master Trainer Certificate Programme conducted by ~~MNIT~~ / ~~CEPT~~ / IIIT from 7 December '16 to 8 December '16 for the Energy Conservation Building Code.

नई दिल्ली, 07 JUL 2017
New Delhi,

महानिदेशक
Director General

BUREAU OF ENERGY EFFICIENCY

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

Certificate Registration No. : 9176

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 (*l*) 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

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			

GRIHA

GREEN RATING FOR INTEGRATED HABITAT ASSESSMENT

GRIHA CERTIFIED PROFESSIONAL CERTIFICATE

This is to certify that

Dinesh Kumar Dhanasekaran

has qualified as a **GRIHA** Certified Professional For V. 2015

Date of issue: 19th June 2020

Note : This certification is valid only for GRIHA version 2015.

Chief Executive Officer
GRIHA Council

LEED AP BD+C

GREEN BUSINESS CERTIFICATION INC. CERTIFIES THAT

DINESH KUMAR D

HAS ATTAINED THE DESIGNATION OF

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by demonstrating the knowledge and understanding of green building practices and principles needed to support the use of the LEED® green building program.

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CREDENTIAL ID

26 DEC 2016
ISSUED

25 DEC 2022
VALID THROUGH

MAHESH RAMANUJAN
PRESIDENT & CEO, U.S. GREEN BUILDING COUNCIL
PRESIDENT & CEO, GREEN BUSINESS CERTIFICATION INC.

TECHNICAL REPORT OF GREEN CAMPUS AUDIT

Submitted to

SREE ABIRAAMI ARTS AND SCIENCE COLLEGE FOR WOMEN, GUDIYATTAM - 635803, VELLORE DISTRICT, TAMIL NADU, INDIA.

Date of Audit: 07.12.2020 (Monday)

Submitted by

NATURE SCIENCE FOUNDATION
(A Unique Research and Development Centre for Society Improvement)
An ISO 9001:2015 Certified Organization
LIG-II, 2669, Gandhi Managar, Peelamedu
Coimbatore - 641 004, Tamil Nadu, India.
Phone: 0422 2510006, Mobile: 9566777255, 9566777258
Email: director@nsfonline.org.in, directornsf@gmail.com

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1. Introduction

Green campus is an area of the Organisation or the Organisation as a whole itself contributing to have an infrastructure or development that is structured/planned to incur less energy, less water, less or no CO_2 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 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 strengthen the concept of "Green building" and "Oxygenated building" which in turn provides a healthy atmosphere to the stakeholders.

Green Campus Audit ensures the Organization's campus should be 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 utilisation and maintenance of natural topography and vegetation (Gowri and Harikrishnan, 2014, Aruninta *et al*., 2017). The maintenance of an eco-friendly campus ensures a neat and clean environment. 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 Campus 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 of Environment Management Systems and International Standards on ISO 14001:2015, Indian Green Building Council, Swachh Bharath Scheme under Clean India Mission to understand the principles and importance of various audits in the context of the organization and risk assessment at 360˚ views (Gnanamangai *et al*., 2020). Green campus audit helps the educational institutions/ industries to maintain eco-friendly environment, assures personal hygiene to various stakeholders and supports the nation; on the whole for the noble cause of environmental protection and nature conservation which in turn enhances the quality of life of all living beings (Arora, 2017).

2. Role of Educational Institutions in India

Educational institutions are playing important role in a nation's growth and development which starts from maintenance of green campus without harming the environment. A clean and healthy environment in an Organization determine effective learning skills and offers a conducive learning environment to the students. Educational institutions are insisted by both Central and State Governments to offer eco-friendly atmosphere to the stakeholders. In addition, all the Educational institutions are asked to save the environment for future generations and to resolve the environmental problems (accumulating solid wastes and wastewaters/effluents and their careless disposal, enormous utility of plastics, uneconomical consumption of water, irresponsible in water harvesting and storage procedures, etc.) through

Environmental Education. Implementing Swachh Bharath Abhiyan Scheme launched by the Indian Government thro' the Educational institutions plays a major role in terms of giving neat and clean environment to tribal, rural and urban people across the country, besides the regular and conventional activities carried out by NSS, NCC/Student Force, Nature club, Eco club, Science club, Fine Arts club, Flora and Fauna club, Youth Red cross unit, etc. 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 to the stakeholders.

Green campus auditing is a systematic method whereby an organization's environmental performance is checked against its environmental strategies and compliances of the Government guidelines. This audit process is definitely useful for the Educational institutions to maintain the campus neatly and can give pure atmosphere to the students and staff members including Management people. It is like an official examination of the environmental effects on an organization's campus as per the Government guidelines. The audit report may be useful to improve the organization's campus significantly by following the recommendations and suggestions given in the report. The green campus audit processes are being undertaken by World / Indian Green Building Council (IGBC), Green Building Code and Green Ratings Systems (GBCRS), Green Rating for Integrated Habitat Assessment (GRIHA), Conideration of Indian Industry GreenCo Rating System (CII-GreenCo) and Associated Chambers of Commerce and Industry of India (ASSOCHAM) along with ISO EMS 14001:2015 criteria and the concept of Swachh Bharath Abhiyan under Clean India Mission

3. Green Campus and Environment Policy

Green campus and environment policy aims to provide an education and awareness in a clean and green environment to the stakeholders with regard to environmental compliance. Scope of the policy applies to all employees and students of the Institution/organisation to provide an ecofriendly atmosphere. 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 minimise 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 College/University and maintain a clean/green campus while each and every individuals of the organisation should adhere to the policy.

4. 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 (students and staff members). 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 oganic alternatives for all incoming and current students, staff and faculty should be organised. 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.

5. Aims and Objectives of Green Campus Audit

- To recognise the initiatives taken towards establishing the green campus in terms of gardening.
- To grow a large 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 Organization development.
- To recognise and resolve different environmental threats of the Organization.
- 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 for pollution free air.
- To assess the greenish nature of an Organization campus in terms of trees, herbs, shrubs, climbers, twins, lianas, lawns and reflected in reducing the environmental pollution soil erosion, biodiversity conservation, landscape management, natural topography and vegetation.

6. Importance of Green Auditing

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. They should promote all kinds of green activities such as conduct of environment awareness programmes, in-campus farming, planting trees and maintenance of greening, irrigation, use of biofertilizers and avoidance of chemical fertilizers and agrochemicals, etc., prior to and after the green campus auditing (Suwartha and Sari, 2013). The administrative authorities should formulate ‘Green and Environment Policies’ based on technical report of green ampus auditing. A clean and healthy environment will enhance an effective teaching/learning process and creates a favorable learning green environment to the scholars. 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 campus audit may be beneficial to the campus in improving the greenery activities which in turn useful to save the planet for future generation. Green campus audit is a kind of professional care and a simple indigenized system about the environment monitoring in terms of planting a huge 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 in campus because students and staff members should aware of the green

audit and its beneficial effects in order to save planet by means of ‘Go green concept’ 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.

7. Benefits of the Green Auditing

There are several benefits on conduct of green audit by the Organization which may be definitely useful to improve the campus significantly based on the audit report. The green campus audit contained methodology followed and both qualitative and quantitative measurements including physical observation of greeneries in terms of growing of terrestrial and aquatic plants, animals and microflora in the campus. The natural and planted vegetation and their maintenance are also considered in the organization campus through topography, landscape management design and soil erosion control in environment sustainable development. The following are the major benefits of the green auditing.

- Know the status of development of internal and external Green campus audit procedures and implementation scenario in the Organization.
- Establishment d Green campus objectives and targets as on today as per the ‘Green and Environment Policy’, ‘Indian Biodiversity Act’ and ‘Wildlife Protection Act’ of the Ministry of Environment, Forests and Climate Change, New Delhi and World & Indian Green Building Council concepts in accordance with prevailing rules issued by the government/local authorities
- Assigning the roles and responsibilities to the Environmental Engineer and Agriculture Staff who are all responsible to improve green initiatives.
- Development of ownership, personal and social responsibility for the Organization and its environment and developing an environmental ethic and value systems to young generations.
- Enhancement of the Organization profile and reach the global standards in proving the green campus and eco-friendly atmosphere to the stakeholders
- Suggested of availability of Biogas plant to the management to restrict the usage of fossil fuel in cooking purposes.
- Implementing status of the rain harvesting system, water reservoirs, percolation pond, etc. in the campus to increase the ground water level.
- Establishment of terrace garden, herbal garden, kitchen, zodiac, ornamental gardens, etc. for enhancing teaching and learning and commercial exploitation.
- Treated water consumption towards plant cultivation, canteen, hostel, machinery cleaning, transport, toilet use and etc. on water consumption and per capita water consumption per day calculation.
- Studying the campus flora by making a complete data on total number of both terrestrial and aquatic plants, herbs, shrubs, climbers, twins and grasses.
- Survey of campus fauna by conducting the number living and visiting animals, insects, flies, moths and worms in the campus.
- Documentation of the number of oxygen releasing and carbon dioxide assimilating plants planted in the campus to give pure atmosphere to the

stakeholders.

- Operation of water irrigation, drip and sprinkler irrigation methods to improve the green campus.
- Studying the biodiversity conservation through Life Sciences and Biological Sciences people to conserve economically important, rare and endangered plant and animal species in the campus ecosystem.
- Recommendation in use of biofertilizers, organic and green manures, cow dung manures and farmyard manures for the cultivation of plants to protect the environmental health
- Conduct of outreach programmes for dissemination of Green Campus motto and Green pledge initiatives to rural, tribal and urban people through Eco club, Nature club, Science club, Fine Arts club, Youth Red Cross unit, NCC/Student Force and NSS bodies.
- 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.
- The plants available in the campus must be tagged with their common name and Botanical name for the stakeholders to impart the knowledge on medicinal and ornamental, economic and food values of plant varieties.
- MoU may be signed with Government and non-Governmental Organizations (NGOs) to utilize the resources for nature conservation and environmental protection.
- 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 of toilets and restrooms.
- Conduction of awareness programmes and cultural activities on global warming, environmental changes and ecosystem maintenance to the stakeholders.
- Steps taken for organic, inorganic, toxic, e-waste, biomedical, food, sewage waste management, segregation of wastes and reuse methods.
- Public transport, low-emitting vehicles and control of car smokes and exhaust towards carbon accumulation in the campus by carbon footprint studies.
- Implementation of advanced methods for watering plantations (Drip irrigation, Sprinkler irrigation, etc.) and use of metering for water utility, IoT based watering, automation, water device, remote water lines, etc.
- Percentage of Organization’s budget for environment sustainability efforts and green campus initiatives planning and efforts.
- Campus facilities for disabled, special needs and/or maternity care including security, safety and health infrastructure facilities for stakeholder’s wellbeing.
- High degree of resource management offers the basis for improved sustainable and creation of plastic free campus to evolve health consciousness among the stakeholders.
- Impart of knowledge on environment through systematic management approach and improving environmentally friendly standards by creating a benchmark for environmental protection initiatives
- Best practices followed on green campus initiatives in the Organization listed and disseminated among the stakeholders.

- Recommendations for improving the green initiatives, planning and efforts in the campus after audit report to improve further.

8. About the Organization

8.1. Sree Abiraami Arts & Science College for Women

Sree Abiraami Arts and Science College for Women (SAWC) was established in the year 2016. The aim of the institution is to "Empower Women through Quality Education" to the socially and economically backward female students of this region. The college is run by Sree Abiraami Educational and Charitable Trust, Gudiyattam approved by Government of Tamil Nadu and affiliated to Thiruvalluvar University, Vellore. This is the first women institution in Gudiyattam located in Keelalathur Village on Gudiyattam to Katpadi main road, just about 30 Km from Vellore, a health and educational hub.

The college is situated in serene and greenish atmosphere with high-tech infrastructure and spacious class rooms enabled with ICT facility, well equipped laboratories, computer lab, digital library, 24 X 7 Wi-Fi accessibility and hygienic canteen. 30 buses are operated covering 70 Km radius from the college for the benefit of the students.

The college offers 8 UG Programs and 2 PG Programs. The management and the faculty members are dedicated in creating the environment which supports the vision of the college. In order to achieve this goal, the institution conducts seminars, guest lectures, conferences, symposium and other activities in regular intervals.

8.2. About Nature Science Foundation (NSF)

NSF is a Non-Profit ISO 9001:2015 certified Organization and registered with NGO Darpan NITI Aayog and Ministry of Micro, Small and Medium Enterprise, Government of India functioning energetically towards the noble cause of nature conservation and environmental protection. NSF is managed by a board of trustees of NSF Public Charitable Trust 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 12A, 80G and Form 10AC certificates for income tax exemption. The main motto of the NSF is to "Save the Nature to Save the Future" and "Go Green to Save the Planet". NSF Branch Offices are also functioning effectively at Gorakhpur, Uttar Pradesh and Faridabad, Haryana, India to adopt the 'Go Green Concept'. NSF family is wide spread across India with over 70 state-wise Lead auditors to conduct Green and Environment Audits.

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, Student Technical Symposium, Distinguished lecture programme, Environment day celebration, Ozone day celebration, Project model exhibition, Awareness programmes on Environmental pollution, Biodiversity and Natural resources conservation and etc. with the financial support of the Foundation. NSF is being released 'Magazine' and 'Newsletter' biannually to share the information about Environmental awareness programmes on biodiversity conservation, seminar on soil conservation, water management and solid waste management, restoration and afforestation programmes in Western Ghats of southern India.

In order to encourage the students, members of faculty, academicians, scientists, entrepreneurs and industrial experts those who are involving in nature protection and biodiversity conservation studies, NSF tributes the deserved meritorious candidates with various awards and honours such as 'Best Faculty Award', 'Best Women Faculty', 'Best Scientist Award', 'Best Student Award', 'Best Research Scholar Award', 'Best Social Worker Award', 'Young Scientist Award', 'Life-Time Achievement Award' and 'Fellow of NSF' will be given.

NSF has introduced various types of Audits such as 'Eco Audit', 'Green Audit', 'Energy Audit' and 'Hygienic Audit' 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 ISO EMS 14001:2015 criteria and in compliance with Government Law and Environmental Legislations including World / Indian Green Building Council and the concept of Swachh Bharath Abhiyan under Clean India Mission. Green campus and Environment Policy, Purchase Policy, MoU, International Eco Club student Chapter Certificate will be given to get the maximum mark weightage in NAAC. Audit processes are being conducted through the certified Auditors as per the following

Audit	**Certified Auditors**	**Certified Auditors**
Green Audit	• IGBC - Indian Green Building Council • GBCRS - Green Building Code and Green Ratings Systems • GRIHA – Green Rating for Integrated Habitat Assessment	➢ Mrs. S. Rajalakshmi ➢ Dr. R. Mary Josephine ➢ Dr. B. Mythili Gnanamangai ➢ Er. Ashutosh Kumar Srivastava ➢ Er. N. Shanmugapriyan
Energy Audit	• BEE - Bureau of Energy	➢ Er. D. Dinesh kumar

	Efficiency • LEED - Leadership in Energy and Environmental Design • CII-GreenCo – GreenCo Rating System Felicitator	➢ Er. N. Shanmugapriyan ➢ Dr. N. Balasubramaniam ➢ Dr. P. Thirumoorthi ➢ Dr. G. Murugananth
Environment Audit	• IGBC - Indian Green Building Council • ASSOCHAM - Associated Chambers of Commerce and Industry of India • FSRS – Fire Safety & Rescue Services	➢ Mrs. S. Rajalakshmi ➢ Dr. A. Geetha Karthi ➢ Dr. R. Mary Josephine ➢ Dr. B. Mythili Gnanamangai ➢ Er. Ashutosh Kumar Srivastava ➢ Er. N. Shanmugapriyan
Hygiene Audit	• FSMS – Food Safety Management System & • Occupational Safety & Health (ISO 22000:2018) • SBICM - Swatch Bharath under India Clean Mission	➢ Mrs. Gaanaappriya Mohan ➢ Er. Ashutosh Kumar Srivastava ➢ Dr. R. Sudhakaran ➢ Dr. N. Saranya
Waste Management Audits	• Water Audit, Soil Audit, Biomedical Waste Audit, Solid Waste Management Audit as per the IGBC, GRIHA and BEE	➢ Mrs. Gaanaappriya Mohan ➢ Er. Ashutosh Kumar Srivastava ➢ Dr. R, Sudhakaran ➢ Er. N. Shanmugapriyan
Academic & Administrative Audits	• Academic & Administrative Audits as per the NAAC Criteria	➢ Dr. B. Anirudhan ➢ Dr. B. Shreeram

Table 1. The SAWC Campus facility details

S.No.	Details of Area	Total area
1.	Total Campus area	42492 sq.m
2.	Total Built up area	20146 sq.m
3.	Covered Car parking area	500 sq.m
4.	Air-conditioned area	4000 sq.m
5.	Non-Airconditioned area	-
6.	Gross Floor area	5000 sq.m
7.	Public area	-
8.	Service area	-
9.	Forest vegetation	4020 sq. ft
10.	Planted vegetation	

9. Audit Details

Date / Day of Audit	**: 07.12.2020 (Monday)**
Venue of Audit	**: Sree Abiraami Arts and Science College for Women,** Katpadi Road, Keelalathur, Gudiyattam - 635803, Vellore District, Tamil Nadu, India.
Audited by	**: Nature Science Foundation,** Coimbatore - 641 004, Tamil Nadu, India.
Audit type	**: Green Campus Audit**
Name of ISO EMS Auditor	**: Mrs. S. Rajalakshmi,** Chairman, ISO QMS & EMS Auditor, NSF.
Name of Subject Expert-I	**: Dr. D. VinothKumar** Joint Director, NSF
Name of IGBC AP Auditor	**: Dr. B. Mythili Gnanamangai,** IGBC AP, Indian Green Building Council. **Ms. Burra Hema Malini** IGBC AP, Indian Green Building Council.
Name of ASSOCHAM Auditor	**: Er. Ashutosh Kumar Srivastava,** Associated Chambers of Commerce and Industry
Name of Eco & Green Officer	**: Ms. V. Sri Santhya,** Eco & Green Council Programme Officer, NSF.

10. Procedures followed in Green Campus Audit

Green campus 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. It is a kind of a professional tool for assessing the green campus. Green audit projects the best environmental practices and initiatives taken in the organisation at the prescribed site of audit that brings added value to the organisation in maintaining the eco-friendly campus to the stakeholders. First step of the audit is ensuring that the organisation has a central role in building the green campus, in order to validate the same (Adeniji, 2018).

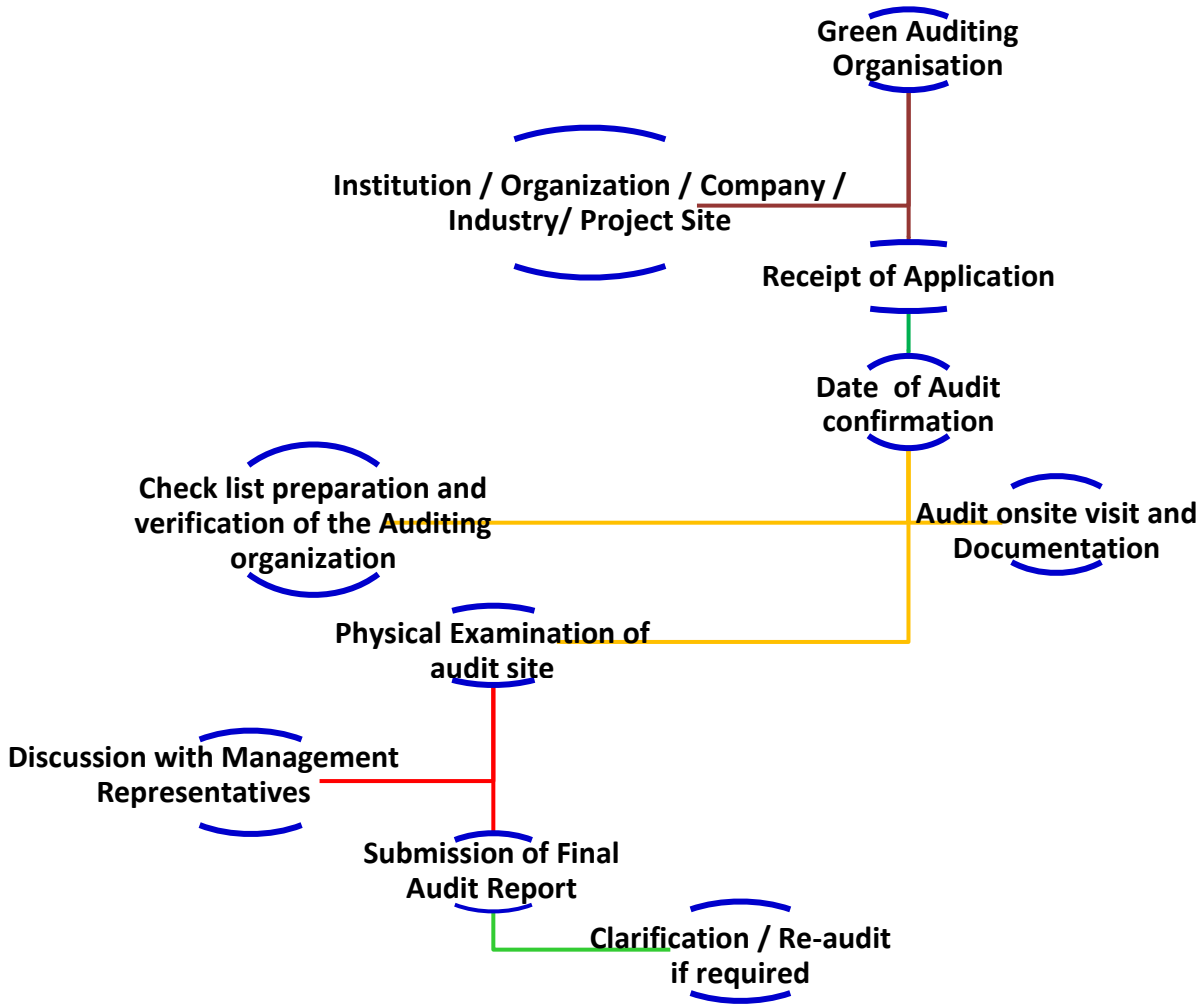
Green campus is not intended for the self-sustainability of the building alone, it also involves in propagation of the green campus initiatives so as to be adopted by any individuals and organization at a minimum cost. Green campus audit has been conducted as per the checklist of Nature Science Foundation, Coimbatore, Tamil Nadu, India (www.nsfonline.org.in) through the authenticated Professionals for people qualified to investigate and evaluate the campus for validating the best environmental practices (Staniskis and Katiliute, 2016, SCSR, 2018). Professional team of ISO Environment Management Audit (14001:2015), Indian Green Building Council Accredited Professionals, Experts of Green campus Lead Auditors and Botanists / Zoologists / Biotechnologists were selected to conduct the Green campus audit process.

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 garden / aquarium and aquatic (hydrophytes) plants in the campus were recorded. Labelling of common names and Botanical names of plants were observed. The operation of the water irrigation system, trip and sprinkler irrigation methods and use of recycled water for irrigation purpose or any other purpose in the campus area were noted. The number of water wells, bore wells and water reservoir facilities in the campus were also noted as per the Audit Manual of Gnanamangai *et al*. (2020).

Attempts made for water scarcity during summer season towards the maintenance of plants and frequency of watering for plantations in the campus were noted. 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 were recorded (Venkataraman, 2009). Conduct of outreach programmes for dissemination of Green campus motto to the students and staff members including public domain and signing of MoU with Government and Non-Governmental Organizations to ensure green campus activities for future generation were noted (Lauder *et al*., 2015; Brindusa *et al*., 2007). Technology driven solutions initiated by the Green campus organization can also be disseminated and documented successively for propagating the attitude of the Green campus in wider masses.

Projects, Dissertations and Thesis are the academic effort credentials that always fosters the innovative ideas on thinking and implementation of new innovative approaches towards the green campus. These should be disseminated through presentations and publications in social media, books, magazines and journals so as to spread the innovative ideas and methods to the broad public. These efforts taken by the students and staff were deliberated while conducting the Green campus audit. Green audit processes are taking place as per the following flow-chart starting from the receipt of application forms from the auditee (organization) and ending upon the submission of final report to the concerned organization (Leal Filho *et al*., 2015). During the audit process, the best environmental / greenery practices followed and new initiatives undertaken in the organisation to reduce the environmental pollution and steps taken for nature conservation that brings added value to the organisation in maintaining the eco-friendly campus were assessed (IGBC, 2020; WGBC, 2020). 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.



Flow-chart of Green Campus Audit Procedures

10.1. Onsite Green Campus Audit activities

1. Opening meeting is the first step between the audit team and auditee along the Management Representatives where the purpose of the audit, procedures to be adopted for the conduct of the audit, verification of the documents and the time schedules were discussed, in brief.
2. Followed by opening meeting, onsite inspection will be conducted which is the second step in the audit where the Audit team members visited different sites in the SAWC Campus and required photographs were taken then and there for preparing the audit report.
3. During the onsite phase of visit, it is vivid how the various facilities made by the SAWC Management to the stakeholders without disturbing the landscape, natural topography and vegetation to ensure the green campus.
4. It is observed how the environment is protected in the campus and by what means an eco-friendly atmosphere is being given to the stakeholders. The assessment reveals the strengths and weaknesses of the Auditee's Management controls and risks associated with their failure in creating Green campus facilities.

5. Collecting audit proofs *ie*, data collection and information from the auditee as per the audit protocol were carried out.
6. An exit meeting was conducted to describe the findings of the audit with Management Representatives and staff members along with the audit team in brief.

10.2. Pre-Audit stage activities

A pre-audit meeting (opening meeting) is conducted with Management and Administrative people along with staff coordinators of Energy and Environment 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). Audit team was selected by the Nature Science Foundation as per the checklist comprised of Lead Auditor of ISO (EMS 14001:2015), Botanist, Agriculture and Horticulture Scientists from Conventional and Technical Universities across India, Accredited Professionals from Indian Green Building Council, Hyderabad and Associated Chambers of Commerce and Industry of India, New Delhi.

Opening meeting with the College Principal, IQAC Coordinator, Staff Coordinators and Audit Team of the Nature Science Foundation, Coimbatore, Tamil Nadu

Enery and Environment audit activity at the SAWC Campus by the NSF Audit Team

10.3. Target Areas of Green Auditing

Green campus audit is nothing but a professional tool to assess the greenery activities in the educational institutions and give a value addition to the campus and considered as a resource management process. Eco-campus concept mainly concentrate on the efficient use of energy and water; minimize waste generation or pollution and also improve the economic efficiency. Green campus audit process may be undertaken at frequent intervals and their results can demonstrate improvement or change over time. Eco-campus 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).

There are several target listed in the Green audit process in which a few are taken into consideration as per the Indian scenario is concerned. They are water use efficiency, energy use efficiency, solid, e-waste biomedical, food, sewage waste management and reuse methods, planting of oxygen releasing and carbon dioxide assimilating plants, landscape management, topology, vegetation, soil erosion control, carbon footprint due to use of vehicles, electricity and fossil fuels (León-Fernández and Domínguez-Vilches, 2015). drinking water quality supply, Biogas plant, rain harvesting system, water reservoirs, percolation pond, establishment of various herbal, terrace and ornamental, gardens, campus and flora fauna, water irrigation, implementation of Government schemes, conduction of awareness programmes management, public transport, low-emitting vehicles and control of car smokes and exhaust, Organization's budget for greenery activities, campus facilities for disabled, persons needs special attention and or maternity care, security, safety and health infrastructure facilities for stakeholder's wellbeing (Nunes *et al*., 2018).

10.4. Flora and Fauna diversity of study area

The SAWC Campus is situated at Gudiyattam, Vellore. The campus is planted with many flowering and non- flowering plants. The green vegetation is also utilized in growing farm animals. The campus is also enriched with many birds and butterflies. Thereby the campus provided the stakholders with clean and green environment. Study/documentation of biodiversity provides a useful measure of the quality of the environment and the ecological studies are important aspects of environment, in view of the consideration of environmental quality and natural flora and fauna conservation.

10.4.1. Topography

The SAWC coordinates at 78° 52′ E of longitude and 12° 56' N latitude. SAWC is located at Gudiyattam which is a municipalty in Vellore district in the state of Tamil Nadu in India. It lies between Bangalore and Chennai.

10.4.2. Geology and Soil condition

Vellore district (in Tamil Nadu State) is bound by Andhra Pradesh State towards its North, Thiruvannamalai district (Tamil Nadu) in the South, Tiruvallur district in the North East, Kancheepuram district in the South East while Krishnagiri district in the Southwest. Major towns in the district are Ambur, Arcot, Wallajapet,

Arakonam, Jolarpet and Sholinghur. Soil found in Vellore is chiefly red loam soil. However, other type of soils are also found in some regions which include gravelly, stony, sandy loam soil, black loam soil and sand clay loam. The type of soil found on the banks of Palar river includes Alluvium soil.

10.4.3. Climatic conditions

Vellore experiences low rainfall (996.7 mm annual rainfall) is throughout the year with semi-arid climate. It lies in the Eastern Ghats region, on the banks of Palar river. It is not rich in mineral resources and its topography is almost plain with slopes from East to West. Located just 135 kms. (85 miles) from Chennai, the city encounters high temperature throughout the year. During summers, humidity ranges from 40%–63% while during winters, it ranges between 67%–86%. Temperature in Vellore ranges from a maximum of 40.5°C (104.9°F) to a minimum of 18.4°C (65.1 °F). Vellore receives of rainfall every year due to southwest monsoon which brings scanty rainfall between the months of June and August.

Table 2. Soil edaphic and environmental parameters of the SAWC Campus

S.No	Details of Parameters	Data collected
Soil edaphic parameters		
1.	Soil pH	6.5 – 7
2.	Soil types	Red loam soil
3.	Total organic carbon	0.3%
4.	Electrical conductivity	2.16 ds/m
5.	Water holding capacity	70.23%
6.	Total Nitrogen	100- 300 Kg/hec
7.	Available Phosphorous	10 - 15 Kg/hec
8.	Exchangeable Potassium	100 – 200 Kg/hec
Environmental parameters		
1.	Minimum Temperature	13- 27°C
2.	Maximum Tempearure	29-39.4°C
3.	Minimum Relative humidity	41%
4.	Maximum Relative humidity	70%
5.	Annual Average Rainfall	40.71 inches /avg.year
6.	Annual Average Sunshine	109.3 hrs/avg.month
7.	Wind speed	8.7-11.4 miles/hr

11. Identification of Plant Species

11.1. Identification of Flowering Plant Species

Various vascular plant species were collected across the SAWC Campus and subjected to botanical identification (botanical name, family, habitat, and economic importance) and anthropogenic disturbances to the natural vegetation in campus. Plants were freshly collected and their digital photographs were also taken. The collected plant specimens have been identified using taxonomic literatures (Gamble and Fischer, 1972; Matthew, 1983; Nair and Henry, 1983; Henry *et al*., 1989; Chandrabose and Nair, 1988). Further, their identification was confirmed by matching with authentic specimens in the Madras Herbarium (MH), Botanical Survey of India (BSI), Southern Circle, Coimbatore, Tamil Nadu, India.

11.2. Identification of Non-Flowering Plant Species

11.2.1. Lichen Identification

Lichen specimens were collected from SAWC Campus and then identified based on the lichen identification key of Awasthi (2007). Representative lichen specimens were identified based on thalli morphology such as rhizine, cilia and pseudocephellae and reproductive structures (fruiting bodies) such as apothecia, perithecia, soredia, soralia, conidia and isidia embedding on the thalli surface using a stereo microscope (CZM4, Labomed, India). In the present study, Anatomy of the thallus were carried out in order to document micro morphological features such as medulla thickness, upper and lower surface of thallus, lobes, size and shape of spores. Thin section of apothecia and perithecia was made to observe the nature ascus spores and the arrangement of the algal and fungal layers in the thallus; respectively. Spot tests featured the use of chemical reagents to detect lichen substances by appearances of the characterized colour changes on lichen thallus was noted. The lichen chemistry was analyzed according to Culberson and Kristinson (1970) methods. The colour spot test was done on medulla of lichen thallus using test reagents of potassium hydroxide (K), calcium hypochlorite (C) and paraphenylene di amine (PD). Lichen was identified based on colour spot test using the procedure defined by Orange *et al*. (2001).

To authenticate the identified lichen samples, the representative samples were compared with the voucher specimens at the Lichen Herbarium Centre of National Botanical Research Institute (NBRI), Lucknow, Uttar Pradesh, India and Department of Botany, Bharathiar University, Coimbatore, Tamil Nadu. The lichen species might be confused with other species unless their morphological, biochemical and anatomical features were closely monitored. Therefore, apart from microscopic observation, spot tests, chemical profiling and TLC tests, attempts were made to compare the representative samples with voucher specimens.

11.2.3. Identification of Algae Genera

Algae are the members of a group of predominantly aquatic photosynthetic organisms of the kingdom *Protista* followed by terrestrial algae found in freshwater and slump areas. Algae are non-flowering and lower group of plants which are green in colour because of presence of chlorophyll pigments in the body called thallus. Algae adopt diverse life cycles, and by size, they range from microscopic *Microsomonas* to giant kelps that reach 60 metres (200 feet) in length. Their photosynthetic pigments highly varied when compared to that of higher plants; their cells have features not found among plants and animals. In addition to their ecological roles as oxygen producers, they serve as food base for almost all aquatic life; algae are economically important as a source of crude oil and as sources of food and a number of pharmaceutical and industrial products for humans. Algae are defined as eukaryotic (nucleus-bearing) organisms that photosynthesize. They lack specialized multicellular reproductive structures of plants, but they always contain fertile gamete-generating cells surrounded by sterile cells. Algae also lack true roots, stems, and leaves features they share with the avascular lower plants (e.g., mosses, liverworts, and hornworts). Algae identification key consists of couplets of characteristics using algal description of the specimen based on morphological

characterization from 58 Genera to species level identification as per the comprehensive key.

12. 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 by Canon 600 D camera (55 – 250 mm). 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 analyses 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 abiotic factors as the independent variable (Jayson and Mathew, 2000).

Reptiles and Amphibians are identified based on colourtion, 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. 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).

13. Green Campus Audit Observations

It covers both qualitative and quantitative measurements including physical observation of greeneries in terms of growing of terrestrial and aquatic plants, animals and microflora in natural and planted vegetation and their maintenance. Topography, landscape management design and soil erosion control are playing important role in environment sustainable development in the campus. An account of a large number of Oxygen releasing and Carbon dioxide assimilating plants planted in the Campus are taken into consideration to give pure atmosphere to the stakeholders. Establishment of

different types of gardens in the campus, rainwater harvesting system, operation of water irrigation, drip and sprinkler irrigation methods may be adopted to improve the green campus. Similarly, biodiversity conservation strategies are very essential to conserve a variety of plant and animal species in the campus ecosystem. Biofertilizers, organic and green manures, cow dung manures and farmyard manures may be used for the cultivation of plants which may be protected the environmental health that will not cause any air, water and soil pollution. The various Clubs, Forums, Cells, Associations and Student / Staff Chapters such as Eco club, Nature club, Science club, Fine Arts club, Flora and Fauna club, Youth Red Cross, NCC/Student Force and NSS bodies may be involved in green campus initiatives, planning and efforts among stakeholders. Outreach programmes may be conducted for dissemination of Green Campus motto and Green pledge initiatives to rural, tribal and urban people. 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, planning and efforts. Best practices followed on green campus initiatives in the Organization and recommendations for greening are illustrated in the audit report as well.

Table 3. Qualitative Measurements of Green Auditing

S.No	Requirements and checklists of the audit	Conformity		
		Yes	No	NA
1.	Have internal Green campus audit procedures been developed and implemented in the Organization?	✓		
2.	Have programmes for the achievement of Green campus objectives and targets been established and implemented as on today?	✓		
3.	Whether Green campus audit and Environment audit are simultaneously carried out or separately carried out?	✓		
4.	Whether Indian Biodiversity Act as per the Ministry of Environment, Forests and Climate Change, New Delhi, Wildlife protection act and World & Indian Green Building Council concepts followed?	✓		
5.	Have responsibilities been assigned for programmes at each appropriate function and level? (Environmental Engineer & Agriculture Staff working for environment monitoring)	✓		
6.	Are the following environmental aspects considered in sufficient detail?			
	a. Drinking water / RO water / Borewell water / Open well water / Pond water / Municipal or Corporation water use and to check quality of water through Physico-chemical properties analysis		✓	
	b. Wastewater treatment facility		✓	
	c. Sufficient number of trees, shrubs, herbs and lawns	✓		
	d. Solid waste management facility		✓	
	e. Availability of Biogas plant		✓	
	f. Rain harvesting system, water reservoirs, etc.		✓	

	f. Aquarium and aquatic (hydrophytes) plants		✓	
	g. Establishment of terrace garden, herbal garden, kitchen, zodiac, ornamental gardens, etc.		✓	
	h. Natural Topography or Forest, Planted vegetation		✓	
	i. Water well, Bore well, lake, water reservoir facility	✓		
	j. Water consumption towards plant cultivation, canteen, hostel, machinery cleaning, transport, toilet use	✓		
	k. Treated water consumption towards plant cultivation, machinery cleaning, transport, toilet use and etc.		✓	
	l. Per capita water consumption per day calculated (45L/P/C/D)		✓	
7.	Whether plants are tagged properly with their common name and Botanical name for stakeholders?		✓	
8.	Signing of MoU with Govt. and NGOs to disseminate Green campus motto and pledge	✓		
9.	Biodiversity conservation of plants, animals and wildlife, genetic resources (Endangered and endemic species) at each appropriate function and level?		✓	
10.	Are any biofertilizers, organic manures, farmyard manures, vermicompost, green manures and chemical fertilizers used for maintaining plants?	✓		
11.	Establishment of herbal garden, zodiac garden, medicinal garden, kitchen garden, terrace garden and ornamental plants garden in the campus		✓	
12.	Implementation of Government schemes (Swatch Bharath Abhiyan under Clean India Mission)	✓		
13.	Functioning of Nature club, Eco club, Cell, Forum, Association, NCC/Student Force, NSS bodies and Social Service League for students and staff members on biodiversity conservation, green campus development, etc.	✓		
14.	Conduction of awareness programmes and cultural activities on global warming, environmental changes and ecosystem maintenance to the stakeholders	✓		
15.	Conduction of outreach programmes for dissemination of green campus initiatives, natural resources, environmental pollution and biodiversity conservation to rural, tribal and urban people	✓		
16.	Implementation of composting pits, vermicompost unit, recycling of kitchen wastes collected from Hostels, Canteens, Cafeteria, Food court and other places	✓		
17.	Maintenance of plantations in the campus and steps taken for water scarcity during summer season to maintain plants	✓		
18.	Steps taken for organic, inorganic, toxic, e-waste, biomedical, food, sewage waste management, segregation of wastes and reuse methods	✓		

19.	Public transport, low-emitting vehicles and control of car smokes and exhaust towards environment monitoring	✓		
20.	Observation on the site preservation, soil erosion control and landscape management	✓		
21.	Projects and Dissertation works and Scholarly publications on environmental science and management carried out by students and staff members	✓		
22.	Implementation of advanced methods for watering plantations (Drip irrigation, Sprinkler irrigation, etc.)	✓		
23.	Use of metering for water utility, IoT based watering, automation, water device, remote water lines, etc.	✓		
24.	Percentage of Organization's budget for environment sustainability efforts	✓		
25.	Campus facilities for disabled, special needs and or maternity care including security, safety and health infrastructure facilities for stakeholder's wellbeing	✓		

Table 4. Quantitative Measurements of Green Auditing

S.No.	Details of Plant and animal species	Numbers / Percentage
1.	Total number of Flowering plant species inside the Campus	198 species belonging to 35 Genera under 27 families
2.	Total number of Non-Flowering plant species inside the Campus	8 species belonging to Lichens, Pteridophytes, Bryophytes and Mycoflora
3.	Total number of living Mammals inside the Campus	20 such as Cats, Cow, Dog, Goat and Squirrel
4.	Total number of visiting Mammals inside the Campus	2 species of bat, 5 species of Bonnet Macaque, 4 species of Indian Grey Mongoose
5.	Total number of living Birds inside the Campus	9 species including Common Myna, Barrow's Golden eye, Roch Pigeon, House crow Little Erget, Asian Koel and hens.
6.	Total number of visiting Birds inside the Campus	2 species including Coppersmith Barbet and Black – winged stilt
7.	Total number of Aquarium	One with 5 -6 Golden fish Varieties
8.	Total number of Aquatic (hydrophytes) plant species	Tow species belonging to *Lotus and Water Hyacinth,*
9.	Total number of Grasshopper and Termites	Grasshopper: 4 species Termites: 3 species
10.	Total number of Amphibians and Reptiles	Amphibians: 7 species Reptiles: 7 species
11.	Total number of Butterflies and Mosquitos	Butterflies : 48 species Mosquitos: 02 species

12.	Percentage of Forest Vegetation	55%
13.	Percentage of Planted Vegetation	45%
14.	Percentage of Water consumption to total human population	-
15.	Percentage of Water consumption to total flora and fauna	-
16.	Per capita water consumption per day	3000 lit/day

13.3. Flora and Fauna diversity in the SAWC Campus

13.3.1. Flora diversity in the SAWC Campus

13.3.1.1. Flowering plants diversity in the SAWC 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 SAWC Campus has more than 55.10 % of wild as well as native plant species and the other 48.89 % plant species are ornamental in nature coming under the planted vegetation. Native plant traits promote the indigenous fauna at the site area. Hence, the accountancy of 55.10 % of the wild traits are leveraged for the native animals and birds. The most probable natural vegetation of SAWC campus is the semi – arid climate. The remnants of this past vegetation are found in the campus.

The most plants recorded are *Mangifera indica, Plumeria obtuse, Phoenix roebelenii, Dypsis lutescens, Cocus nucifera, Dracaena reflexa, Tecoma stans, Cordia sebestena, Terminalia catappa, Cycas revoluta, Azadirachta indica, ficus benjamina, Artocarpus heterophyllus, Psidium guajava, citrus limon, Citrus reticulata* and *Manilkara zapota* are the dominant trees species characteristic to the vegetation within the campus. Some of the shrub species like *Rhapis excelsa, Furcraea foetida, Agave desmettiana, Aloe arborescens, Plectranthus amboinicus, Hibiscus rosa-sinensis, Lingustrum lucidum, Prunus cerasifera, Hamelia patens* and *Duranta erecta* are also rather common in the campus.

Ground flora is comparatively sparse, but fairly rich in undistributed areas. The campus was found to be free from weeds. Species such as *Cleome viscosa, Tradescantia spathaceae, Euphorbia hirta, Tephrosia purpurea* and *Aristida adcensionis* are some common herbs in the campus.

The common climbers found among the shrubs are *Epipremnum aureum* (Money plant) and *Jasmiun officinale* (Common Jasmine). The lawns at different sites were found to of *Aristida adcensionis* (Common needle grass). Number of above

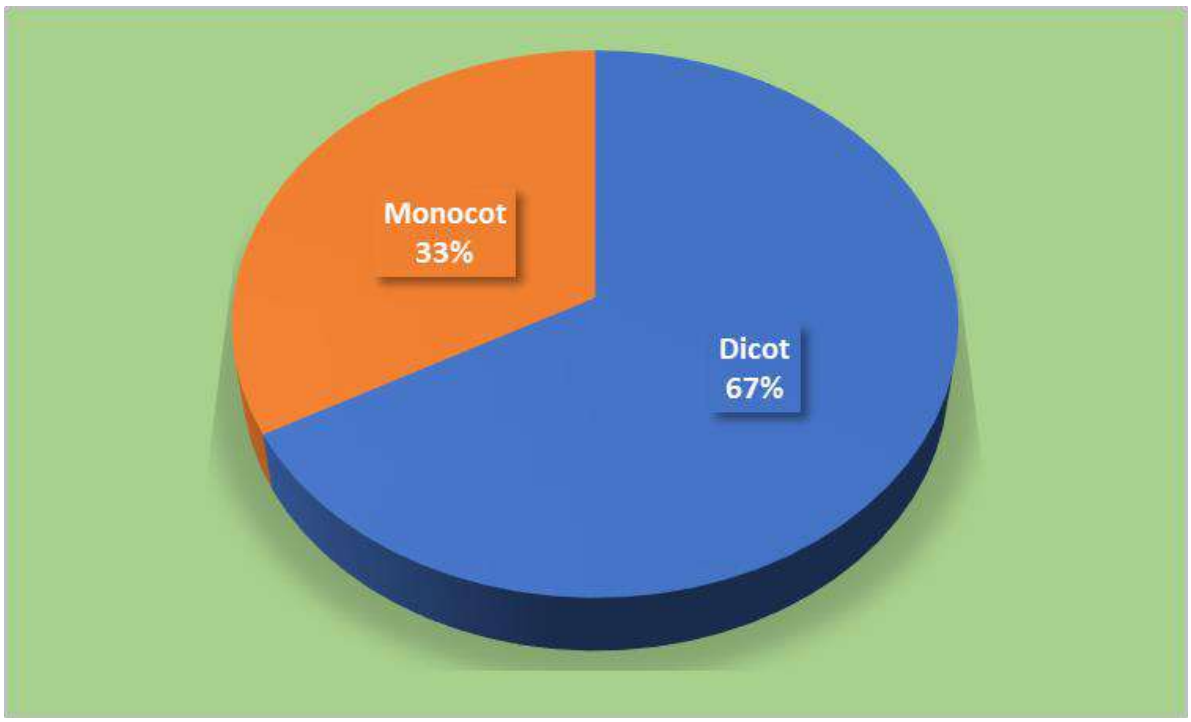
species of trees and shrubs are decreased in number and a few face the danger of going extinct due to anthropogenic activities (regular clearing and construction activities). Hence in terms of conserving the available floral biodiversity, it is pertinent to set up a botanical garden within the campus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

Invasive species

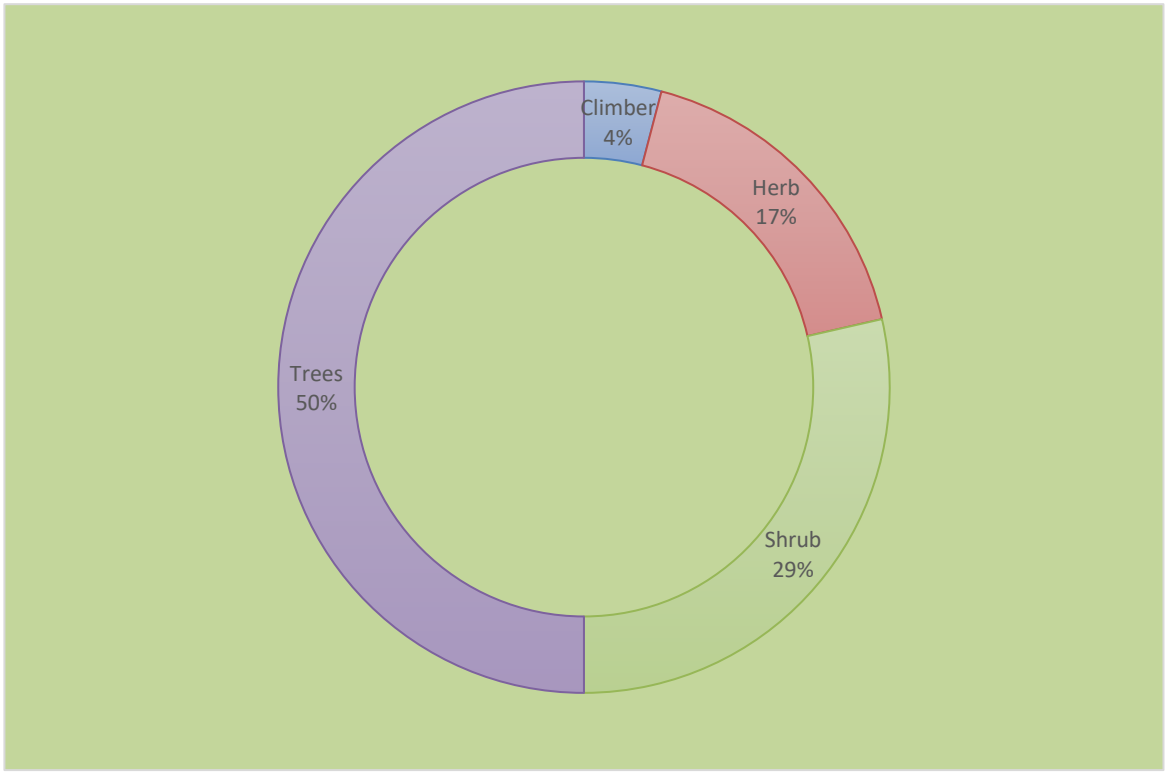
The campus has 16 invasive species such *asTaxus canadensis, Cycas revoluta, Euphorbia hirta, Lingustrum lucidum, Hamelia patens, Duranta erecta, Mangifera indica, Plumeria obtuse, Tecoma stans, Terminalia catappa, ficus benjamina, Psidium guajava, Manilkara zapota, Furcraea foetida, Dracaena reflexa* and *Cleome viscosa*. Invasive species are found to be disturbances to the natural setting in the vegetated areas.

The plantation species in the campus is of *Jasmiun officinale, Tephrosia purpurea, Rhapis excelsa, Plectranthus amboinicus, Hibiscus rosa-sinensis, Prunus cerasifera, Cordia sebestena, Azadirachta indica, Artocarpus heterophyllus, citrus limon, Citrus reticulata, Epipremnum aureum, Tradescantia spathaceae, Aristida adcensionis, Agave desmettiana, Aloe arborescens, Phoenix roebelenii, Dypsis lutescens, Cocus nucifera* and *Tabernaemontana divaricate.*

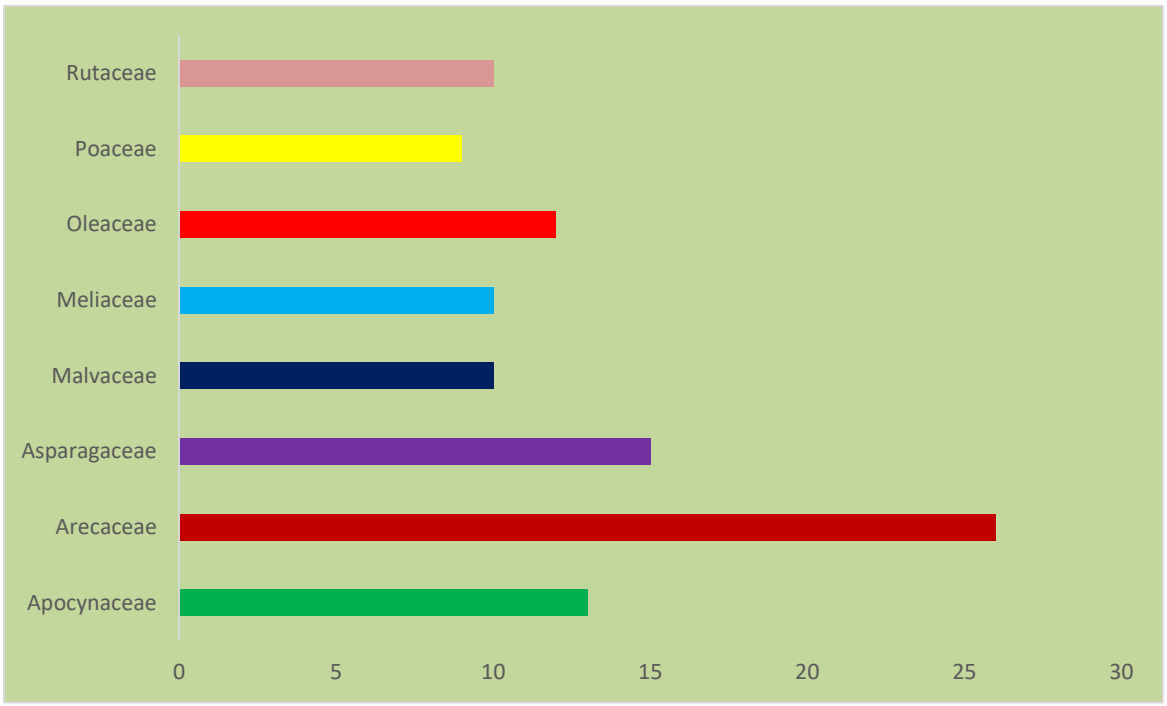
Some of the species are utilized as fruit yielding like *Mangifera indica, Psidium guajava, Manilkara zapota, Artocarpus heterophyllus, citrus limon, Citrus reticulata, Phoenix roebelenii, Cocus nucifera* and *Terminalia catappa* were found in the campus. Some of the medicinal plants like *Tabernaemontana divaricate, , Phyllanthus niruri, Azadirachta indica* and *Euphorbia hirta* were also found in the campus.



Systematic groups of the plants in the SAWC Campus



Analysis of habit-wise distribution of plant species in the campus area



Plant families with higher number of species in the campus area

The biodiversity of SAWC Campus comprises a sum of 196 species belonging to 35 genera under 27 families besides the lichens, mycoflora, pteridophytes and bryophytes. Among the documented higher plants, Dicots are dominating with 22 families followed by monocots (5 families). Over all analysis revealed that trees

were dominating flora (50%) followed by herbs, shrubs and climbers which accounts 28. 57%, 17.34% and 4.08%, respectively. Among the documented dicots, Polypetalae formed a major proposion with 11 families, 11 genera and 67 species; Gamopetalae with 7 families, 9 genera and 52 species while Monochlamydeae with 3 families, 3 genera and 11 species. In monocots 5 families are spreading over 10 genera belonging to 64 species. Arecaceae is the first dominant family with 26 species followed by Asparagaceae with 15 species, Apocynaceae with 13 species, Malvaceae, Meliaceae and Rutaceae with 10 species, Oleaceae with 12 species and Poaceae with 9 species. At the time of green campus audit at SAWC Campus campus, a total of 74 invasive floral species were recorded. This clearly specified as the disturbances to the natural setting in the vegetated sector.

Table 5. List of Flowering plants in the SAWC Campus

S.No	Common Name	Botanical Name	Family
1.	Dwarf century plam	*Agave desmettiana*	Asparagaceae
2.	Candelabra aloe	*Aloe arborescens*	Asphodelaceae
3.	Jack fruit	*Artocarpus heterophyllus*	Moraceae
4.	Common needle grass	*Aristida adcensionis*	Poaceae
5.	Neem tree	*Azadirachta indica*	Meliaceae
6.	Lemon	*citrus limon*	Rutaceae
7.	Mandarian orange	*Citrus reticulata*	Rutaceae
8.	Asian spiderflower	*Cleome viscosa*	Capparidaceae
9.	coconut tree	*Cocus nucifera*	Arecaeae
10.	Geiger tree	*Cordia sebestena*	Boraginaceae
11.	King sago	*Cycas revoluta*	Cycadaceae
12.	Song - of - India	*Dracaena reflexa*	Asparagaceae
13.	Golden dewdrops	*Duranta erecta*	Verbenaceae
14.	Areca palm	*Dypsis lutescens*	Arecaceae
15.	Money plant	*Epipremnum aureum*	Araceae
16.	Asthma palnt	*Euphorbia hirta*	Euphorbiaceae

17.	Weeping fig	*ficus benjamina*	Moraceae
18.	Mauritius -hemp	*Furcraea foetida*	Asparagaceae
19.	Red Head	*Hamelia patens*	Rubiaceae
20.	Hawaiian hibiscus	*Hibiscus rosa-sinensis*	Malvaceae
21.	Common Jasmine	*Jasmiun officinale*	Oleaceae
22.	Lingustrum lucidum	*Lingustrum lucidum*	Oleaceae
23.	Mango	*Mangifera indica*	Anacardiaceae
24.	Sapodilla	*Manilkara zapota*	Sapotaceae
25.	Roebelin palm	*Phoenix roebelenii*	Arecaceae
26.	Cuban-oregano	*Plectranthus amboinicus*	Lamiaceae
27.	Frangipani	*Plumeria obtusa*	Apocynaceae
28.	Cherry plum	*Prunus cerasifera*	Rosaceae
29.	Common guava	*Psidium guajava*	Myrtaceae
30.	Bregu	*Rhapis excelsa*	Arecaceae
31.	Crape jasmine	*Tabernaemontana divaricata*	Apocynaceae
32.	Ground - hemlock	*Taxus canadensis*	Taxaceae
33.	Yellow bells	*Tecoma stans*	Bignoniaceae
34.	Purple tephrosoa	*Tephrosia purpurea*	Leguminosae
35.	Tropical almomd	*Terminalia catappa*	Combretaceae
36.	Boat lily	*Tradescantia spathaceae*	Commelinaceae

Dracaena reflexa

Dypsis lutescens

Manilkara zapota,

Duranta erecta

Hibiscus rosa-sinensis

Mangifera indica

Tecoma stans,

Phoenix roebelenii

Tradescantia spathacea

Cycas revoluta

Ficus benjamina

Citru reticulata

Agave desmettiana

Artocarpus heterophyllus

Citrus limon

Cleome viscosa

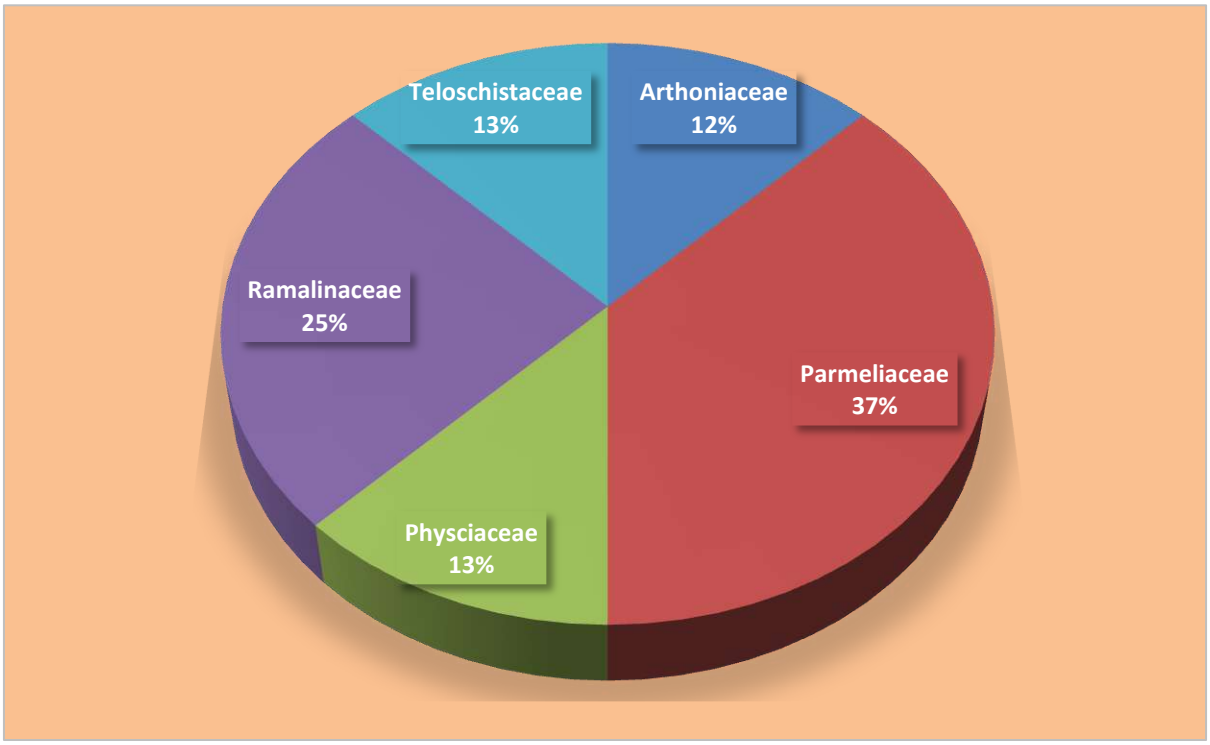
Cocos nucifera

Cordia sebestema

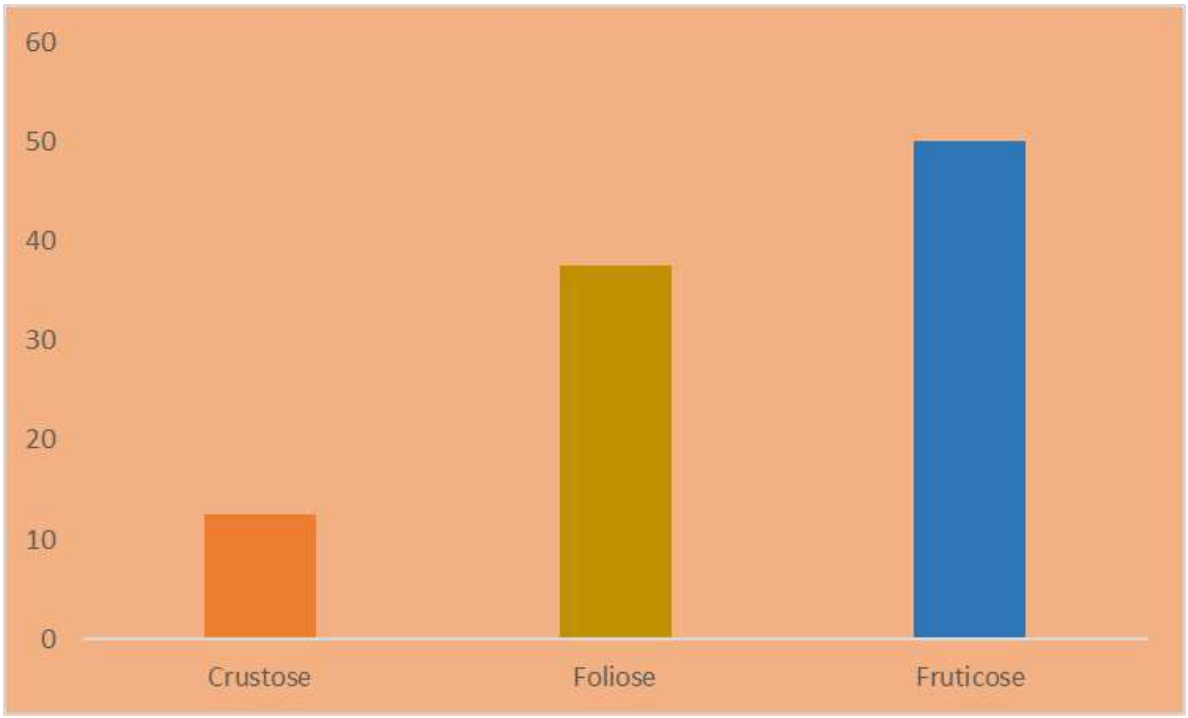
13.3.1.2. Lichen diversity in the SAWC Campus

Lichens are one of the most fascinating symbiotic organisms found worldwide. The lichens species are ubiquitous and common inhabitants of the bark of the tree, rock surface, soil etc. They are a lower group of plants coming under non-flowering plants that live in a variety of substrates under a wide range of environmental conditions with or without causing harm to the hosts. Ecologically, lichen plays important roles in soil formation; re-establishes life on earth; fixes atmospheric nitrogen; plant's health, ecology distribution, and in the formation of organic matter of habitat which in turn benefitting mosses in nutrient availability. A unique synergetic association between a fungal and an algal species results in lichens and occupied in plant kingdom. In this relationship both the organisms are mutually benefited. The algal partner may be cyanobacteria or the blue green algae and this is responsible for the process of photosynthesis. The algae thus provide food or nutrition for the fungi too. The fungal partner in turn provides space and protection for the algae. The lichen is an autotrophic organism in the sense that they can produce their own food by the process of photosynthesis. Even though the lichen is made up of two different organisms, the characteristics of the lichen are entirely different from the original characteristics of the algal and the fungal partner. Lichens are classified as micro lichens and macro lichens in which the microlichens cover the substrate on which they grow in the form of a crust whereas macro lichens grow in the form of a bush or a leaf like structure. The major forms of lichens are a) Foliose lichens exhibit a flat leaf like thallus, b) Fruticose lichens exhibit erect, pendulous and bushy thallus c) Squamulose lichens exhibit thallus with minute, scale like squamules and d) Crustose lichens exhibit flat crust shaped thallus.

Lichen diversity recorded in the SAWC Campus showed a total of 8 different lichens species representing 7 genera and 5 families. Four species of Fruticose growthforms which includes *Usnea subfloridana, Usnea stigmatoides, Ramalina fastigiate* and *Ramalina farinacea* were accounted for 50% of total available lichen diversity and identified up to species level. Three species of Foliose growth forms which includes *Physcia adscendens, Xanthoria parietina* and *Cercopithecidae* accounted for 37.5 % and one species of Crustose growth form *Arthonia recedens* accounted for remaining 12.5 % of the total lichen diversity observed.



Species Diversity of SAWC Campus



Growth form Diversity in the SAWC Campus

Table 6. Lichen diversity of the SAWC Campus with respect to family, substratum and growth forms in genus and family wise classification

S.No	Lichen diversity of the SAWC Campus	Family	Growth forms
1.	*Arthonia recedens*	Arthoniaceae	Crustose
2.	*Cercopithecidae*	Parmeliaceae	Foliose
3.	*Physcia adscendens*	Physciaceae	Foliose
4.	*Ramalina farinacea*	Ramalinaceae	Fruticose
5.	*Ramalina fastigiata*	Ramalinaceae	Fruticose
6.	*Usnea stigmatoides*	Parmeliaceae	Fruticose
7.	*Usnea subfloridana*	Parmeliaceae	Fruticose
8.	*Xanthoria parietina*	Teloschistaceae	Foliose

13.3.3. Algal diversity in the SAWC Campus

Chlamydomonas, Scytonema, Oscillatoria, Oedogonium, Spirogyra, Volvox, Microcystis and *Cladophora spp.* belonging to the class of Cyanophyceae, Chlorophyceae and Bacillariophyceae are the predominant species found in the campus. The families Chlorellaceae, Closteriaceae, Desmidiaceae, Radiococcaceae, Ulotrichaceae, Uronemataceae and Oedogoniaceae were represented by single genus and species. Chlorophyceae plays an important role in both terrestrial and aquatic ecosystem as most of the members are found to be ecologically important. The highest diversity of Chlorophyceae indicated relatively good health of atmosphere. The presence of these algal species in abundance can be concluded that the SAWC Campus ecosystem has high amount of organic nutrients in soil and rock. Generally, occurrence of abundant algal flora at a place indicates the availability of abundant nutrients along with conducive favourable environmental conditions.

13.3.1.3. Mushrooms diversity in the SAWC 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 high temperature in Thiruchirappalli the climate is found to be unfavourable for the growth of Mushrooms. Mushroom growth 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 extensive 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.

13.3.2. Fauna Diversity in the SAWC Campus

13.3.2.1. Birds Diversity in the SAWC Campus




The observations on fauna diversity indicated that the SAWC Campus has a large number of living as well as visiting animals, birds, reptiles and insects including termites. A total number of 21 birds belonging to the 9 species were recorded from different habitats during the observation. Totally 21 species of birds representing 10 genera under 8 families were observed during this study. Passeriformes and Galliformes constituted the predominated group representing 2 species each. The other order including Anseriformes, Columbiformes, Pelecaniformes, Cuculiformes and Charadriiformes constituted with one species each. Total number of visiting birds were found to be Coppersmith Barbet, Black-winged stilt and Pied Bushchat. They migrate during winter and summer season in search of favourable environment and availability of food resources.

Table 7. Birds Diversity in the SAWC Campus

S.No	Common Name	Scientific Name
1.	Common Myna	*Acridotheres tristis*
2.	Barrow's Goldeneye	*Bucephala islandica*
3.	Roch Pigeon	*Columba livia*
4.	House Crow	*Corvus splendens*
5.	Little Erget	*Egretta garzetta*
6.	Asian Koel	*Eudynamys scolopaceus*
7.	Chicken	*Gallus domesticus*
8.	Black-winged stilt	*Himantopus himantopus*
9.	Wild Turkey	*Meleagris gallopavo*

Table 8. Total number of visiting birds in the SAWC Campus

S.No	Common Name	Scientific Name
1.	Black-winged stilt	*Himantopus himantopus*
2.	Coppersmith Barbet	*Psilopogon haemacephalus*
3.	Pied Bushchat	*Saxicola caprata*

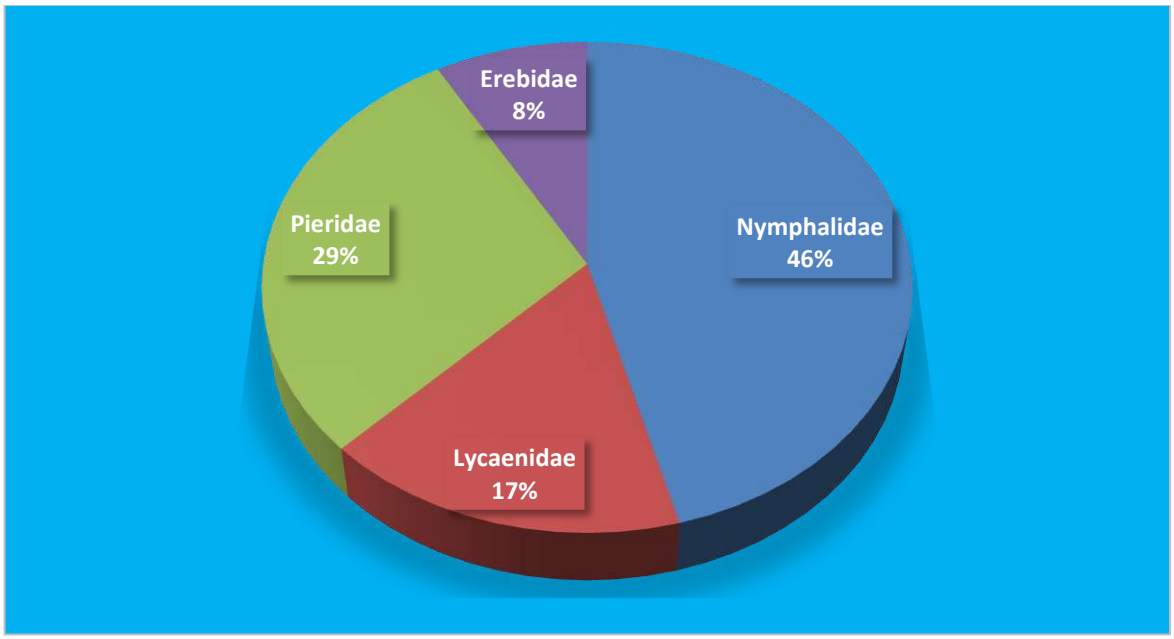
13.3.2.2. Butterflies diversity in the SAWC Campus

The SAWC campus was found to have 48 species of Butterflies under four family level diversities such as Pieridae, Nymphalidae, Lycaenidae and Erebidae in

which Common Sailer, Plain Tiger Butterfly, Lesser Grass Blue, Indian Wanderer, Forget-me-not, Common Crow Butterfly, Dot-underwing Moth, Common Grass Yellow, Yellow orange Tip, Lemon Pansy, Chocolate Pansy, Plain Orange-Tip and Dark Blue Tiger Butterfly are commonly found.

Table 9. List of Butterflies recorded in the SAWC Campus

S.No.	Common Name	*Scientific Name*	Family
1.	Common Sailer	*Neptis hylas*	Nymphalidae
2.	Plain Tiger Butterfly	*Danaus chrysippus*	Nymphalidae
3.	Lesser Grass Blue	*Zizina otis*	Lycaenidae
4.	Indian Wanderer	*Pareronia hippia*	Pieridae
5.	Forget-me-not	*Catochrysops strabo*	Lycaenidae
6.	Common Crow Butterfly	*Euploea core*	Nymphalidae
7.	Dot-underwing Moth	*Eudocima materna*	Erebidae
8.	Common Grass Yellow	*Eurema hecabe*	Pieridae
9.	Yellow orange Tip	*Ixias pyrene*	Pieridae
10.	Lemon Pansy	*Junonia lemonias*	Nymphalidae
11.	Chocolate Pansy	*Junonia iphita*	Nymphalidae
12.	Plain Orange-Tip	*Colotis aurora*	Pieridae



Butterfly Diversity in the SAWC Campus

13.3.2.3. Mammals diversity in the SAWC Campus



Mammals, a group of vertebrate animals (class: Mammalia), characterized by the presence of mammary glands (where females produce milk for feeding/nursing 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 SAWC campus indicated that around 34 Mammal species are commonly distributed. The commonly found mammals are Domestic cow, Dog, Goat, Cats, Three -stripped Palm Squirrel, Schneider's Roundleaf Bat, Bonnet Macaque, Common Indian Field Mouse Indian Grey Mongoose.

Table 10. List of Mammals diversity in the SAWC campus

S.No.	Common Name	Scientific Name
1.	Domestic cow	*Bos taurus*
2.	Dog	*Canis familiaris*
3.	Goat	*Capra hircus*
4.	Cats	*Felis catus*
5.	Three -stripped Palm Squirrel	*Funambulus palmarum*
6.	Schneider's Roundleaf Bat	*Hipposideros speoris*
7.	Bonnet Macaque	*Macaca radiata*
8.	Common Indian Field Mouse	*Mus booduga*
9.	Indian Grey Mongoose	*Urva edwardsii*

13.3.2.4. Amphibians diversity in the SAWC 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. Observation made on diversity of Amphibians in the MAM indicated that around 7 species are Amphibians are commonly distributed. The commonly found amphibians are listed.

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.

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 other vertebrates. Over a period, amphibians shrank in size and their diversity decreased drastically, leaving only the modern subclass Lissamphibia. Modern amphibian orders include Anura (the frogs), Urodela (the salamanders) and Apoda (the caecilians). Number of known amphibian species is nearly 90% are frogs. Observation made in the SAWC Campus on diversity of Amphibians revealed that around 11 species of Amphibians are commonly disseminated. The commonly found amphibians are *Uperodon taprobanicus* (Sri Lankan Bullfrog) and *Euphlyctis cyanophlyctis* (Common Skittering frog).

13.3.2.5. Grasshopper diversity in the SAWC 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 word, 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. Surveillance audit at SAWC campus on diversity of Grasshoppers demonstrated that 6 species of Grasshoppers are commonly distributed which includes *Eyprepocnemis alacris, Cyrtacanthacris tartarica, Crucinotacris decisa, Aulacobothrus luteipes, Acrotylus humbertianus* and *Sathrophyllia rugosa.*

13.3.2.6. Termites Diversity in the SAWC 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. Three species of Termites (*Odontotermes anamallensis, Trivitermes fletcheri* and *Nasutitermes indicola)* recorded during on-site Green Campus audit at SAWC campus and they are belonging to the Genera *Odontotermes, Trivitermes* and *Nasutitermes*.

13.4. An account of more Oxygen releasing and Carbon dioxide assimilating plants in the SAWC campus

There are some plants which are being considered highly efficient in oxygen releasing and carbon dioxide assimilating (Carbon sinks) which in turn reflected the 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) and Gerbera Daisy (*Gerbera jamesonii*) plants are unique for oxygen release during night time and they are 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 CO_2 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 campus audit at SAWC campus revealed that the campus is surrounded by *Azadirachta indica* (Neem), *Terminalia catappa* and *Ficus religiosa* are found to be oxygen releasing plant. *Hibiscus rosa-sinensis, Aloe vera* and *Tabernaemontana divaricate* are CO^2 assimilating plants found in the campus.

Table 12. List of Oxygen releasing and Carbon dioxide assimilating, Ornamental / Medicinal plants in the SAWC campus

S.No	Plant Name (English)	Scientific Name	Grouping / Nature	Characteristic Features of the plant
1.	Neem	*Azadirachta indica*	Dicots	O_2 releasing Plant
2.	Almond	*Terminalia catappa*	Dicots	O_2 releasing Plant
3.	Areca palm	*Dypsis lutescens*	Monocot	O_2 releasing Plant
4.	Money plant	*Epipremnum aureum*	Monocot	O_2 releasing Plant
5.	Weeping fig	*Ficus benjamina*	Dicot	O_2 releasing Plant
6.	Chinese hibiscus/Shoe Flower	*Hibiscus rosa-sinensis*	Dicots	CO_2 assimilating Plant / Ornamental Plant
7.	Coconut tree	*Cocos nucifera*	Dicots	Ornamental Plant / Nut yielding Plant
8.	Aloe vera	*Aloe vera*	Monocots	CO_2 assimilating Plant / Medicinal Plant
9.	Crape Jasmine/ Pinwheel Flower	*Tabernaemontana divaricata*	Dicots	CO_2 assimilating Plant / Ornamental Plant

13.5. Lawns, Trees, Herbs, Shrubs, Climbers and Lianas in the SAWC 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, atmospheric CO_2 sequestration and supply of oxygen that serves the purpose of a green campus. Herbs are small plants with medicinal values and shrubs are small plants with thick stems and can hold soil to some extent than the herbs and serve the purpose of soil erosion. Climbers can grow with the support of wall structures and the climbers can enhance the wall value with greeneries.

The SAWC campus were found to have sufficient number of trees, herbal plants, bushes, climbers 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 SAWC campus are *Rhinacanthus nasutus, Tabernaemontana divaricate, Calotropis gigantea, Ixora coccinea, Ixora chinensis, Euphorbia milii, Alternantera Loropetalum, Ficus stenophylla, Furcraea foetida, Aloe barbadensis* and *Hibiscus rosa sinensis.*

Similar to that of shrubs, the predominant species of herbs available in the SAWC campus are *Ruellia tuberosa, Plectranthus hadiensis, Solanum americanum, Phyllanthus niruri, Sporobolus indicus* and *Tridax procumbens.*

The existence of climbers *Dregea volubilis* and *Syngonium angustatum* whose stems are weak, which needs support to grow, where it climb up trees and walls and grow vigorously without any pest and disease attach which are observed in the SAWC campus.

13.6. Establishment of different Gardens in the SAWC campus

Growing many types of herbal plants having medicinal importance in the campus becomes more attractive and useful if concept gardens are maintained. Medicinal plant gardens can contain the locally available medicinal plants, RET (Rare Endangered Threatened) listed plants and those 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 students, faculties, staff members, employees 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 lead from the air and purifies the air considerably. Similarly, the ornamental plants with beautiful flowers can be maintained in the frontage gardens of campus for attraction and good ambience. This will give an overall aesthetic look and also provide fresh air for healthy respiration to the stakeholders.

In SAWC campus, they are planted ornamental plants for the display of appealing characteristic features including: varying types of leaves and their texture, flowers and their fragrance, fruit, stem and bark. In some places, plants of unusual features also planted to be of interest, such as the prominent thorns of cactus and snake cactus. There are 6 varieties of ornamentals plants we are maintaining surrounding of our college campus. These plants are making the college campus pleasantly and decoratively. Every year they try to plant new varieties with help of Environmental department. Once in three months the unwanted barks of the plants are cut it down, to make the beautification of their campus. No plant is cut unless it becomes dead. Not only can visitors enjoy seeing the ornamentals plants and also humming birds, butterflies shelter in that. This environment makes campus greenish and pleasant.

13.7. Natural Topography and Vegetation

Natural topography means the original geographical features of the campus, around 25- 30% 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. The vegetation in the artificially created structures are also accounted for when it is reported more than 25% of the claimed green campus audit site. 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 SAWC campus indicated that more than 25% natural topography and vegetation have been maintained properly. Further, there was no anthropogenic activity in some of the interior side of the campus.

13.8. 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 gravity alone in the campus. In addition, lakes, bonds, water channels and any 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 of the building to pit. During the audit, there are two well developed rain harvesting systems such as 1) Pond, 2) square shaped pit containing gravels and sands and 3) water channels connected with a square shaped pit observed with the SAWC campus. Rainwater harvesting structures and recharge wells have been commissioned in the campus at different locations.

13.9. 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. It is an action that forms a perception of viable expansion, to ensure the preservation of a panorama, in order to help and harmonize alterations which are supplemented through social, monetary and environmental methods. 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. The observation revealed that the SAWC campus 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.

13.10. Operation of Water irrigation, Drip and Sprinkler Irrigation methods

Maintaining the green campus and water conservation mechanisms should be applied efficiently in the campus. Well planned water irrigation systems like sprinklers 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 drip irrigation and medicinal plants growing areas and flower gardens can be connected with sprinkler irrigation. The SAWC campus 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 poured 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 beings carried out.

13.11. Importance of Biodiversity Conservation

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 should be monitored as ecosystems. Shade giving trees in the paths, flowering trees in the avenues and fruit trees at the back yards also would attract birds, bees, butterflies and squirrels. The SAWC campus is free of exotic plants that cause threat to the natural vegetation. 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.

13.12. Pedestrian Path facility at the SAWC 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 are 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 SAWC campus is having very good facility in creating pedestrian path for stakeholders.

13.13. 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 in the medicinal plant garden, kitchen garden and terrace garden 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. This will be a healthy way of solid litter waste management in the campus. Minimal use of chemical fertilizers as part of integrated nutrient management system is acceptable but nil use of chemical fertilizers is highly appreciable and also helps to keep the campus more of an organic ecosystem. The soil, air, water and sunlight are the four major natural resources any campus gets. Proper use and conservation of these resources are mandatory in green campus audit sites. The available resources and their utilization should be accounted for from time to time. 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, Potassium and Phosphorus solubilizing bacteria, Potassium mobilizing fungi (VAM), farm yard manure, dried cow dung manure, vermicompost manures and biofungicides and biopesticides are extensively used in the SAWC campus to cultivate plants. Agrochemicals, chemical fertilizers (urea, murate of potash, sulphate of potash, rock phosphate, etc.), pesticides and fungicides are not used. 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.

13.14. Conduct of Outreach programmes for dissemination of Green Campus motto and Green pledge initiatives by Eco club, Nature club, Associations, Cells, Forums, NCC/Student Force and NSS bodies in 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. 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 SAWC campus 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 SAWC campus 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.

13.15. Establishment of Aquarium and Aquatic plants

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 SAWC campus has a open Aquarium in which fiches golden fishes along with Guppies were also living generously.

13.16. 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 SAWC campus faculty members and students from various subject domains are doing extensive project work related to nature conservation, environmental pollution, soil and water analysis.

14. Best practices followed on Green Campus initiatives in the Organization

1. It is observed that the SAWC campus is maintaining more than 25% of the green cover area after building construction as per the guidelines of World Green Building Council and Indian Green Building Council to provide a healthy environment and ecofriendly atmosphere to the stakeholders. It is calculated that the natural vegetation was 55% and planted vegetation was 45%.

2. The SAWC Campus is situated at Gudiyattam, Vellore. The campus is planted with many flowering and non- flowering plants. The green vegetation is also utilized in growing farm animals. The campus is also enriched with many birds and butterflies. Thereby the campus provided the stakholders with clean and green environment. Study/documentation of biodiversity provides a useful measure of the quality of the environment and the ecological studies are important aspects of environment, in view of the consideration of environmental quality and natural flora and fauna conservation.

3. In view of floral biodiversity in the SAWC campus, a sum 198 species belonging to 35 Genera under 27 families covering trees, herbs, shrubs, climbers, lianas, twiners and lawns and 10 species belonging to Lichens, Pteridophytes, Bryophytes and Mycoflora like Mushrooms were recorded. It is observed that all the plants are growing profusely and showing healthier free from pests and diseases.

4. In view of faunal biodiversity in the SAWC campus, a total of 20 living Mammals, 11 species of birds, 4 species of Grasshopper, 3 species of Termites, 11 species of Amphibians, 7 species of Reptiles, 48 species of Butterflies and two species Mosquitos were recorded and documented.

5. The campus has a maximum number of more oxygen releasing and carbon dioxide assimilating plants *Azadirachta indica* (Neem), *Terminalia catappa* and *Ficus religiosa* are found to be oxygen releasing plant. *Hibiscus rosa-sinensis, Aloe vera* and *Tabernaemontana divaricate* are CO^2 assimilating plants including some of the shrub and herbal plants.

6. The SAWC campus, Departments of Electrical & Electronics Engineering, Electronics and instrumentation Engineering, Information Technology, Mechanical Engineering, Civil Engineering, Computer Science and Engineering and Agricultural Engineering are offering various courses in Regulation 2020 related to Environment Studies, Natural Disaster Management and Waste Management to the students and research scholars.

15. Recommendations for Greening

- The name board may be kept in each plant species in which the common name along with binomial name may be mentioned. The year of planting and economic importance with medicinal values if any may be mentioned in some plants so that the oldest as well as useful herbal plants may be identified in the campus.

- The matured trees may be subjected to do white wash upto 3 feet height with limestone and neem oil mix to prevent the pests and diseases attack.

- Honey Bee hives may be kept in the campus which is free from student's mobilization. Honeybees are natural pollinators help to increase the yield potential of plants (flowers, fruits and vegetables) upto 33%.

- A complete data on the soil parameters such as pH, electrical conductivity (EC), water holding capacity (WHC), total organic carbon, available nitrogen, exchangeable potassium, available phosphorus in the campus may be studied which may be useful for the cultivation of various native and wild type plant species.

- A complete data on the water quality parameters such as pH, TSS, BOD, COD, dissolved oxygen and dissolved carbon dioxide and macro and micro elements like iron, nickel, chromium, ferric and ferrous ion concentrations may be studied for which bore well, open well, corporations, municipal RO, Aquaquad, Millipore. Distilled water rain water and may be used. It may be analysed which may be useful for the plant growth as well as to the stakeholders.

- Vermicompost production may be increased substantially using tree leaf litter, kitchen wastes and biodegradable waste materials available in the campus. The vermicompost manure can be used for plant cultivation and the excess amount of vermicompost may be sold in the local market as consultation work.

- It is recommended to develop 'Green Campus Policy', 'Energy and Environment Policy' and 'Purchase Policy' for not allowing the non-degradable plastic covers during the paking of goods with respect to nature conservation and environmental protection.

- SAWC Management 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.

- Eco club student chapters, forums, cells, etc. may be established to among the students from which a large number of programmes on nature conservation and environmental protection may be conducted to rural, tribal and urban people.

- To ensure Miyawaki Forest system, one student one plant concern to enrich the campus Green which provide an ecofriendly campus to the stakeholders.

16. Conclusion

After the establishment of SAWC Campus, in the past three decades, it 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*. The SAWC Campus is a well-established selfsupporting Institution in Vellore District which imparts quality education to rural, tribal and urban people across the Nation. This Organization 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 to the students, research scholars, staff members and parents in a sustainable manner which reflects the importance of the environment and stakeholders. It is conducting a large number of activities for the benefit of rural and tribal community people without disturbing the natural environment, topology, landscape management and vegetation. The SAWC Campus is maintaining more than 25% of the green cover area after building construction along with 55% of natural vegetation and 45% planted vegetation.

The natural topography and very good landscape design without disturbing the natural vegetation are being maintained by the SAWC. A maximum number of more oxygen releasing and carbon dioxide assimilating plants are being maintained to provide pure atmosphere to the stakeholders. The installation of a rainwater harvesting system, percolation ponds and drip irrigation system to conserve rainwater and ground water are noteworthy in the campus. The Organization has grown many medicinal, herbal and ornamental plants for providing an eco-friendly atmosphere to the stakeholders in a sustainable manner.

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18. References

Adeniji, A.A. 2018. *Audit and Assurance Services. Lagos: Value Analyst Concept of Green Audit*. New Age International, New Delhi, India.

Aparajita, G. 1995. Environmental Audits- a Mean to Going Green. *Development Alternatives* **5** (4): 7-9.

APHA, 2017. *Standard methods for the estimation of water and wastewater*. Vol. II, 15th edn, Washington, US.

Arora, D.P. 2017. Environmental Audit–need of the hour. *International Journal of Advanced Research in Engineering & Management* **3** (4): 25-31.

Aruninta, A., Kurazumi, Y., Fukagawa, K. and Ishii, J. 2017. The integration of human thermal comfort in an outdoor campus landscape in a tropical climate. *International Journal of GEOMATE* **14** (44): 26-32.

Awasthi, D.D. 2007. *A Compendium of the macrolichens from India, Nepal and Sri Lank*. Bishen Singh Mahendra Pal Sin, Dehradun, Uttar Pradesh, India, 278p.

Beebee, T.J.C. and Griffiths, R.A. 2000. Amphibians and Reptiles. A Natural History of the British Herpetofauna. The New Naturalist Library, London, UK.

Brindusa M. Sluser, Caliman, F.A., Betianu, C. and Gavrilescu, M. 2007. Methods and procedures for environmental risk assessment. *Environmental Engineering and Management Journal* **6** (6): 573-592.

Carbon footprint calculation. www.carbonfootprint.com.

Cardozo, N.H., da Silveira Barros, S.R., Quelhas, O.L.G., Filho, E.R.M. and Salles, W. 2019. Benchmarks analysis of the higher education institutions participants of the Green Metric World University Ranking. Springer, Universities and Sustainable Communities: Meeting the Goals of the Agenda 2030, World Sustainability Series. pp. 667-683.

Chandrabose, M. and Nair, N.C. 1988. Flora of Coimbatore, Bishen Singh and Mahendra Pal Singh, Dehra Dun, India.

Choy, Er.A. and Karudan, R. 2016. Promoting campus sustainability: A conceptual framework for the assessment of campus sustainability. *Journal of Social Sciences and Humanities* **11** (2): 112-118.

Culberson, C.F. and Kristinsson, H.D. 1970. A standardized method for the identification of lichen products. *Journal of Chromatography A*. **46**: 85-93.

Fachrudin, H.T., Fachrudin, K.A. and Utami, W. 2019. Education activities to realize green campus. *Asian Social Science* **15** (8): 18-27.

Ferenc, M., Sedlacek, O., Fuchs, R., Dinetti, M., Fraissinet, M. and D. Storch 2014. Are cities different?. Patterns of species richness and beta diversity of urban bird communities and regional species assemblages in Europe. *Global Ecology and Biogeography* **23**: 479-489.

Freidenfelds, D., Kalnins, S.N. and Gusca, J. 2018. What does environmentally sustainable higher education institution mean?. *Energy Procedia* **147**: 42-47.

Gamble, J.S. and Fischer, C..E.C 1972. *The Flora of the Presidency of Madras*. Vols. 1 - 3. Rep. Ed. 1957. Adlard and Sons Ltd., London, UK.

Gnanamangai, B.M., Murugananth, G. and Rajalakshmi, S. 2020. *A Manual on Environment Management Audits to Educational Institutions and Industrial Sectors*. Laser Park Publishing House, Coimbatore, Tamil Nadu, India, p. 127.

Gowri, S. and Harikrishnan, V. 2014. Green computing: Analyzing power consumption using local cooling. *International Journal of Engineering Trends*

and Technology **15** (3): 105-107.

Goyal, E. and Gupta, M. 2014. Moving toward socially and environmentally responsible management education-Case study of Mumbai. *Journal Applied Environmental Education & Communication* **13**: 146-161.

Henry, A.N., Chitra, V. and Balakrishnan, N.P. 1989. Flora of Tamil Nadu. Vol. 3. Botanical Survey of India, Coimbatore, Tamil Nadu, India.

IGBC, 2020. Indian Green Building Council. https://igbc.in/igbc/

ISO, 2020. International Organization for Standardization. https://www. iso.org / home. html**.**

Jayson, E.A. and D.N. Mathew, 2000. Diversity and species-abundance distribution of birds in the tropical forests of Silent Valley, Kerala. *Journal of the Bombay Natural History Society* **97** (3): 390–399.

Lauder, A., Sari, R.F., Suwartha, N. and Tjahjono, G. 2015. Critical review of a global campus sustainability ranking: Green Metric. *Journal of Cleaner Production* **108**: 852–863.

Leal Filho, W., Muthu, N., Edwin, G. and Sima, M. 2015. Implementing campus greening initiatives: approaches, methods and perspectives. Springer, London, UK.

León-Fernández, Y. and Domínguez-Vilches, E. 2015. Environmental management and sustainability in higher education: The case of Spanish Universities. *International Journal of Sustainability in Higher Education* **16**: 440-455.

Marrone, P., Orsini, F., Asdrubali, F. and Guattari, C. 2018. Environmental performance of universities: Proposal for implementing campus urban morphology as an evaluation parameter in Green Metric. *Sustainable Cities and Society* **42**: 226-239.

Matthew, K.M. 1983. The flora of Tamilnadu Carnatic. The Repinat Herbarium, Tiruchirapalli, Tamil Nadu, India.

Nair, N.C. and Henry, A.N. 1983. Flora of Tamil Nadu, India. Ser. 1: Analysis. Vol. 1. Botanical Survey of India, Coimbatore, Tamil Nadu, India.

NCP, 2016. *National Environmental Policy-2006*, Government of India, Ministry of Environment and Forest, New Delhi.

Nunes, B.T., Pollard, S.J.T., Burgess, B.J., Ellis, G., de los Rios, I.C. and Charnley, F. 2018. University contributions to the circular economy: Professing the hidden curriculum: Professing the hidden curriculum. *Sustainability* **10** (8): 112-119.

Orange, A., James, P.W. and White, F.J. 2001. Microchemical methods for the identification of lichens. British Lichen Society, London, UK, 375p.

Ounsaneha, W., Chotklang, N., Laosee, O. and Rattanapan, C. 2017. Predictors of behavior intention to develop a green university: A case of an undergraduate university in Thailand. *International Journal of GEOMATE*. **15** (49): 162-216.

Pradip, J.S. and Patil, P.D. 2014. Green Audit - A tool for attaining sustainable development and achieving competitive advantage. *IBMRD's Journal of Management & Research,* **3** (1): 85-93.

Rajalakshmi, S., Kavitha, G. and Vinoth kumar, D. 2020. Energy and Environment Management Audits. AkiNik Publishing, New Delhi. 217p.

Report of Green Audit, 2018. *Report of Green Audit Nitte Meenakshi Institute of Technology, Chennai, Tamil Nadu, India.* https://www.google.com /search?q =Green+Audit+ Report+Nitte+Meenakshi+Institute+Of+Technology&sxsrf

Ribeiro, J.M.P., Barbosa, S.B., Casagrande, J.L., Sehnem, S., Berchin, I.I., da Silva, C.G., da Silveira, A.C.M., Zimmer, G.A.A., Faraco, R.A. and de Andrade Guerra, J.B.S. 2017. Promotion of sustainable development at universities: The adoption of green campus strategies at the University of Southern Santa Catarina, Brazil. Springer Nature, Handbook of Theory and Practice of Sustainable Development in Higher Education. pp. 471-486.

Satean, G. 2017. The need to go beyond "Green University" ideas to involve the community at Naresuan University, Thailand. Springer Nature, Sustainability Through Innovation in Product Life Cycle Design. pp. 841-857.

SCSR, 2018. Sustainability Curriculum in UK University Sustainability Reports by Katerina Kosta, Springer, Implementing Sustainability in the Curriculum of Universities. World Sustainability Series, pp. 79-97.

Staniskis, J.K. and Katiliute, E. 2016. Principles, implementation and results of the new assessment and accreditation system "Engineering education for sustainable industries". Springer Nature, New Developments in Engineering Education for Sustainable Development. pp. 283-294.

Suwartha, N. and Sari, R.F. 2013. Evaluating UI Green Metric as a tool to support green universities development: Assessment of the year 2011 Ranking. *Journal of Cleaner Production* **61**: 46–53.

Verma, S., Ahmad, M. and Parwal, R. 2012. Green audit - A Boom to human civilization. *International Journal of Trends in Economics Management & Technology*, **1** (6): 82-86.

Venkataraman, K. 2009. India's Biodiversity Act 2002 and its role in conservation. *Tropical Ecology* **50** (1): 23-30.

Vinothkumar, D., Sreenivasan, P.V., Rajalakshmi, S., Vanitha, S. and Gnanamangai, B.M. 2020. Environment and Green Campus Audits. AkiNik Publishing, New Delhi. In Press.

WGBC, 2020. World Green Building Council. https://www.worldgbc.org.

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 distict 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 disck…….....… Cleomaceae
b. Stamens inserted of the gynophore …….……Capparaceae
11a. Trees, Petals more or like the sepals; carpels free …….. Mangnoliaceae
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 apocarpus……..... Menispermaceae
b. Flowers bisexual, gynoecium Syncarpous……...……14
14a. Petals 4, Stamens 6 ……....……Brassicaceae
b. Petals 5, Stamens ∞…….…….....15
15a. Ovary1, loculated ……..…….....16
b. Ovary 2-more loculated…… 17
16a. Flowers actinomorphic, placentas free- central …….....Caryophyllaceae
b. Flowers zygomorphic, placentas parietal …….....…….……..Viloaceae
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 …….....…… Zygophyllaceae
20a. Leaves pellucid-gland dotted …….....…… Rutaceae
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 ….....……Stericuliaceae
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 sycarpous; 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 carplelled……..Sapotaceae
b. Ovary 2-carpelled……..45
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 inseperratable; 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

66a. Terrestrial or epiphytic……..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……...Araceae
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.

Key to identify the Lichen Genera

Key to Genera

1 a. Photobiont cyanobacteri urn .....*Leptogium cyanascens.*
1 b. Photobiont green alga 2
2. Thallus leprose, crustose……..Group I
3. Thallus foliose…….Group II
4. Thallus fruticose……..……...Group III

Group I

1 a. Thallus leprose,…….*Chrysothrix chlorina*
1 b. Thallus crustose..……*Graphis* sp

Group II

1 a. Lower side of thallus pseudocyphellae, photobiont Nostoc .....*Pseudocyphellaria*
1 b. Thallus lacking pseudocyphellae 2
2 a. Upper cortex thick walled longitudinally oriented, conglutinate hyphae…….3
2 b. Upper cortex otheriwse…….....4
3 a. Thallus lower side canaliculated zeorin, norstictic and salazinic acids, and unknown pigments and triterpenoids present……...*Heterodermia leucomelos*
3 b. Thallus lower side no canaliculated only in medulla……*Heterodermia diademata*
4 a. Cilia bulbate at the base, thallus grey to grey brown .....*Bulbothrix*
4 b. Cilia present or absent, not bulbate.....5
5 a. Rhizines dichotomously branched present throughout the margins...*Hypotrachyna*
5 b. Rhizines restricted to center of lower surface, margin bare, smooth shining……6
6 a. Lobes narrow, long, dichotomously branched, canaliculate.....*Everniastrum*
6 b. Lobes otherwise.....7

7 a. Lobe margins ciliate……...……8
7 b. Lobe margins eciliate……..…..…9
8 a. Salazinic acid present K+ Red cortex…….……10
8 b. Salazinic acid absent ……...…..11
9 a. Thallus with isidia……...……..*Parmotrema tinctorum*
9 b Thallus with soredia……..……..12
10 a. thallus emaculate……..……*P.stuppeum*
10 b. thallus maculate…….*P.reticulatum*
11 a. Protolichesternic acid in medulla ……*P.grayanam*
11 b. Alectoronic acid in medulla……*P. nilgherrense*
12 a. Thallus large lobed, loosely attached, mainly corticolous .....*P. austrosinense*
12 b. Thallus smaller, closely to strongly attached, saxicolous……..*P.defectum*

Group III
1 a. Squamules in thallus……*Cladonia* sp
1 b. Squamules absent in thallus …….2
2 a. Thallus flat, strap shaped or palmately lobed.....*Ramalina*
2 b. Thallus round to angular in section 3
3 a. Thallus bright yellow to orange, K+ purple... .....*Teloschistes*
3 b. Thallus greenish grey or yellowish grey pendent or erect…….4
4 a. Medulla K+ red Stictic acid present ….……*Usnea stigmatoides*
4 b. Medulla K- norstictic psoromic acid present……*Usnea dasaea*

III. Identificayion of Algae Genera

Algae identification key consists of couplets of characteristics using algal description of the specimen based on morphological characterization from 58 Genera to species level identification as per the comprehensive key.

Key to identify the Algae species
1A. Plant pigments contained in chromatophores or chloroplasts ----------10
IB. Plant pigments not contained, but diffused through protoplast ----------2
2A. Plants filamentous; cells arranged in trichomes ---------- 4
2B. Plants colonial, not filamentous ---------- 3
3A. Cells in regular rows, in multiples of four; ----------*Agmenellum*
3B. Cells somewhat evenly arranged toward periphery of spherical colony; barely visible gelatinous strands radiate from center of colony to cells ----- *Gomphosphaeria*
3C. Colony asymmetrical; cells very dense and unevenly distributed ---------*Anacystis*
4A. Filaments straight or slightly flexed ---------- 6
4B. Filaments curved, twisted, or spiralled ----------5
5A. Heterocysts and akinetes present ----------*Anabaena*
5B. Heterocysts absent ----------*Raphidiopsis*
6A. Heterocysts present ----------9
6B. Heterocysts absent ----------7
7A. Filaments without a sheath; cells discoid ----------*Oscillatoria*
7B. Filaments with distinct sheath ----------8
8A. Trichomes tangled; sheaths confluent ----------*Phormidiwn*
8B. Trichomes separate; sheaths not confluent ----------*Lyngbya*

9A. Heterocysts terminal ----------*Cylindrospermum*
9B. Heterocysts intercalary ----------*Ahphanizomenon*
10A. Cell walls without punctae or striae ----------31
10B. Cell walls rigid, ornamented with punctae or striae ---------- 11
11A. Frustules adiametric, two or more times longer than wide, elongate ----------15
11B. Frustules isodiametric, generally shorter in length than in diameter, round or elliptical or ovoid or nearly so ---------- 12
12A. Frustules elliptical or ovoid or nearly so ----------14
12B. Frustules discoid or nearly so ----------13
13A. Valves radially punctate ----------*Stephanodiscus*
13B. Valves with two concentric regions, the inner being smooth ----------*Cydotella*
14A. Frustules with marginal keel containing a raphe ----------*Surirella*
14B. Frustules with a pseudoraphe or with a raphe not in a marginal keel ---*Cocconeis*
15A. Frustules cylindrical arranged end to end into filament ----------*Melosira*
15B. Frustules not arranged into filaments ----------16
16A. Frustules with a raphe in at least one valve ----------21
16B. Frustules without a raphe in either valve, pseudoraphe evident ----------17
17A. Frustules united in zigzag chains ----------*Tabellaria*
17B. Frustules not in zigzag chains ----------*Pseudoraphe*
18A. Frustules united laterally ----------*Fragilaria*
18B. Frustules not united laterally ----------19
19A. Frustules united apically forming spokelike colony ----------*Asterionella*
19B. Frustules not forming spokelike colony ----------20
20A. Frustules needle shaped without costae ----------*Synedra*
20B. Frustules with prominant costae ----------*Diatom*
21A. Frustules sigmoid or "S" shaped ----------*Gyrosigma*
2IB. Frustules not sigmoid ---------- 22
22A. Frustules longitudinally symmetrical, other than lunate in valve view --------- 25
22B. Frustules with raphe in both valves, longitudinally asymmetrical, lunate ------ 23
23A. Valves with transverse costae ----------*Epithemia*
23B. Valves without transverse costae ----------24
24A. Raphe a smooth curve with well defined central and polar nodules -----*Cymbella*
24B. Raphe not a smooth curve, gibbose with marginal central nodule -------*Amphora*
25A. Frustules with raphe in both valves ----------27
25B. Frustules with pseudoraphe in one valve and raphe in other valve ----------26
26A. Frustules wedge-shaped in girdle view and cuneate in valve ------*Rhoicosphenia*
26B. Frustules shaped otherwise ----------*Achnanthes*
27A. Raphe extended length of valve; polar nodules; central nodules lacking -*Eunotia*
27B. Raphe restricted to polar regions ----------28
28A. Raphe located in a canal ----------*Nitzschia*
28B. Raphe not located in a canal ----------29
29A. Frustules with symmetrical valves ----------30
29B. Frustules with valves symmetrical but asymmetrical ----------*Gomphonema*
30A. Valves with transverse costae ----------*Pinnularia*
30B. Valves with transverse punctae ----------*Navicula*
31A. Cells solitary ----------45
31B. Cells colonial or grouped ----------32

32A. Cells enclosed in conical to cylindrical lorica; joined lorica have treelike appearance ----------*Dinobryon*
32B. Cells and lorica without treelike appearance ----------33
33A. Colony discoid, one cell in thickness; cells in concentric rings --------*Pediastrum*
33B. Colony not discoid ----------34
34A. Colonies spherical or globose ----------40
34B. Colonies not spherical ----------35
35A. Colony with elongate cells radiating from common center ----------*Actinastrum*
35B. Colony with cells not radiating from common center ----------36
36A. Colony with four to eight cells positioned in linear series ----------*Scenedesmus*
36B. Colony with cells not in linear series ----------37
37A. Colony with arcuate to lunate cells with apices acutely----------*Selenastrum*
37B. Colony with spherical to broadly ellipsoidal cells ----------38
38A. Cells without spines or setae ----------*Crucigenia*
38B. Cells with spines or setae ----------39
39A. Cells quadrate, closely apposed; free face of each cell with spines ----*Tetrastrum*
39B. Cells quadrate and united; free face cell with long delicate setae ---*Micractinium*
40A. Colony with biflagellated cells ----------*Pandorina*
40B. Colony with nonflagellated cells ----------41
41A. Cells lunate to sickle shaped ----------*Kirchneriella*
41B. Cells spherical or nearly so ----------42
42A. Cells borne terminally on dichotomously branched threads -----*Dictyosphaerium*
42B. Cells not on dichotomously branched threads ----------43
43A. Colony a hollow sphere ----------*Coelastrum*
43B. Colony not a hollow sphere ----------44
44A. Colony surrounded by gelatinized and expanded parent cell wall --------*Oocystis*
44B. Colony with cells equidistant and toward periphery –----------*Sphaerocystis*
45A. Cells with median constriction dividing cell into two distinct halves -*Cosmarium*
45B. Cells without pronounced median constriction ----------46
46A. Cells nonflagellated ----------53
46B. Cells flagellated ----------47
47A. Cell walls without polygonal plates ----------49
47B. Cell walls with polygonal plates ----------48
48A. Cells walls of thick plates with distinct sutures ----------*Peridinium*
48B. Cells walls with faintly distinct plates and sutures ----------*Glenodinium*
49A. Cells uniflagellate ----------52
49B. Cells biflagellate ----------50
50A. Cells with two flagella of equal length ----------*Chlamydomonas*
50B. Cells with two flagella of unequal length ----------51
51A. Cells with single chromatophore ----------*Chroomonas*
51B. Cells with 2 large chromatophores ----------*Cryptomonas*
52A. Cells surrounded by distinct lorica ----------*Trachelomonas*
52B. Cells without lorica; fusiform to acicular shaped; posterior end ----------*Euglena*
53A. Cells acicular to fusiform with ends tapering into long spines --------*Schroederia*
53B. Cells without ends tapering into long spines ----------54
54A. Cells without setae ----------56
54B. Cells with setae ----------55

55A Cells with subpolar or both subpolar and equatorial long setae --------*Chodatella*
55B Cells with multiple peripheral long delicate setae ----------*Golenkinia*
56A Cells long, slender, and tapered at both ends ----------*Ankistrodesmus*
56B Cells flattened or isodiametric, triangular, quadrangular ----------*Tetraedron*

IV. Identification of Major Groups of Mushrooms

Mushrooms are belonging to fungal kingdom which are edible and non-edible in nature. 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

Key to identify the Mushrooms species

1. Mushroom growing on other mushrooms or the decayed remains --------*Mycotrophs*
2. Growing shelflike on wood (or, if not, then gills *concentric* rather than radial); mushroom *very* tough and leathery, corky, or woody (try tearing it in half); gills tough and hard, sometimes maze-like; cap frequently (but not always) with concentric zones of colour ----------*Polypores*
3. Gills running down the stem, not platelike and thus not easily separable from the cap and stem (try removing an entire "gill" with your fingers or a sharp object); mushroom usually *not* growing on wood ----------*Chanterelles and Trumpets*
4. Gills not as above; mushroom growing on wood or elsewhere ----*Gilled Mushrooms*
5. Stem absent--or, if present, lateral, Flesh in stem tough----------*Polypores*
6. Raphe a smooth curve with well defined central and polar nodules ---------*Cymbella*
7. Raphe not a smooth curve, gibbose with marginal central nodule ----------*Amphora*
8. Frustules with raphe in both valves ----------27
9. Frustules with pseudoraphe in one valve and raphe in other valve ----------26
10. Colony with cells not radiating from common center ----------36
11. Colony with four to eight cells positioned in linear series ----------*Scenedesmus*
12. Colony with cells not in linear series ----------37
13. Colony with arcuate to lunate cells with apices acutely----------*Selenastrum*
14. Cells acicular to fusiform with ends tapering into long spines ----------*Schroederia*
15. Cells without ends tapering into long spines ----------54
16. Cells without setae ----------56
17. Cells with setae ----------55
18 Cells with subpolar or both subpolar and equatorial long setae ----------*Chodatella*
19. Raphe extended length of valve; polar nodules; central nodules lacking ----*Eunotia*
20. Raphe restricted to polar regions ----------28
21. Raphe located in a canal ----------*Nitzschia*
22. Filaments with distinct sheath ----------8
23. Trichomes tangled; sheaths confluent ----------*Phormidiwn*
24. Trichomes separate; sheaths not confluent ----------*Lyngbya*
25. Heterocysts terminal ----------*Cylindrospermum*
26. Heterocysts intercalary ----------*Ahphanizomenon*

27. Cell walls without punctae or striae ----------31
28. Cell walls rigid, ornamented with punctae or striae ---------- 11
29. Frustules adiametric, two or more times longer than wide, elongate ----------15
30. Frustules isodiametric, generally shorter than round or elliptical or ovoid ------- 12
31. Frustules elliptical or ovoid or nearly so ----------14
32. Frustules discoid or nearly so ----------13
33. Valves radially punctate ----------*Stephanodiscus*
34. Valves with two concentric regions, the inner being smooth ----------*Cydotella*
35. Frustules with marginal keel containing a raphe ----------*Surirella*
36. Frustules with a pseudoraphe or with a raphe not in a marginal keel -----*Cocconeis*
37. Cap round in outline; pore surface not running down the stem, or only slightly running down the stem; spore print not white ----------*Boletes*
38. Mushroom with spines or "teeth"--either on the underside of a cap, or hanging from a branched structure, or clumped in an indistinct mass ----------*Toothed Mushrooms*
398. Mushroom covered in some part with a foul-smelling slime; arising from a soft underground "egg"; variously shaped (like a club or stick, like crab claws, like a lantern, like a Wiffle ball, etc.); frequently found in woods---------- *Stinkhorns*
40. Mushroom more or less shaped like a ball, or like a ball raised up on a stem, or like a ball set on a starfish---------- *Puffballs*
41. Cap shape convex to centrally depressed or vase-shaped; undersurface, smooth, wrinkled, or gill-like; fruiting embedded ---------- *Chanterelles*
42. Cap shape oval, pointed, lobed, saddle-shaped, irregular, or thimble-like (never vase-shaped or convex); undersurface absent, or hard to see or define; many (but definitely not all) species fruiting---------- *Trumpets*
43. Stem completely hollow, or hollow with cottony fibers inside; cap with pits and ridges, or longitudinally wrinkled, or fairly smooth (never lobed or convoluted); without reddish or reddish brown shades; found in spring---------- *Morels & Verpas*
44. Found in summer and fall (or spring in warm coastal areas); cap lobed, saddle-shaped, or irregular and whitish, greyish, brownish, or black; stem surface ribbed or "pocketed" in some species ----------*Saddles*
45. Found in summer and fall (or spring in warm coastal areas); cap lobed, saddle-shaped, or irregular and whitish, greyish, brownish, or black --------*Oddballs & Misfits*

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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)

S.No.	Name of Unit(s)
1	Green Campus, Energy and Environment Management Audits

OFFICAL ADDRESS OF ENTERPRISE

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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:	chairmannsf@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)

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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

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 M/o 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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Welcome, Nature Science Foundation

Your Unique Id: TN/2018/0187711

PROCEEDINGS OF THE COMMISSIONER OF INCOMETAX (EXEMPTIONS),
III FLOOR, ANNEXE BLDG, NO.121, MAHATMA GANDHI SALAI, CHENNAI-34

Present : G.M.DOSS, I.R.S
Commissioner of Income Tax (Exemptions)

** URNo. AACTN7857J/05/18-19/T-1105 Dated:03/09/2018

Sub: Registration u/s. 12AA of the Income tax Act 1961 - in the case of

"Nature Science Foundation"
LIG-II, 2669, Gandhimaa Nagar, Peelamedu, Coimbatore – 641 004.

Ref : Application in form 10 A filed on 28/03/2018

ORDER UNDER SECTION 12AA OF THE INCOME TAX ACT 1961.

1. The above **Trust/~~Society/Association/ Company/ others/~~**, bearing **PAN AACTN7857J** was constituted by **Trust Deed / ~~Memorandum of Association~~** dated **29/11/2017** registered with **Sub-Registrar's Office/ ~~Registrar of Societies/Registrar of Companies/others~~** on **29/11/2017.**

2. ~~The Trust Deed / Memorandum of Association has subsequently been amended / modified / altered by a Codicil / Supplementary Deed / Amendment Deed / Alteration to Memorandum of Association/others dated XX/XX duly registered on XX/XX.~~

3. The above **TRUST** filed an application seeking Registration u/s 12 AA of the Income tax Act, 1961.

4. On going through the objects of the **TRUST** and its proposed activities as enumerated in the **Trust Deed / ~~Memorandum of Association,~~** I am satisfied about the genuineness of the **TRUST** as on date.

5. The application has been entered at **Sl.No.1105** maintained in this office. The above **Trust** is accordingly registered as a **PUBLIC CHARITABLE TRUST** u/s 12 AA of the Income Tax Act, 1961 with effect from **29/11/2017**

6. It is hereby clarified that the Registration so given to the **Trust/~~Institution~~** is not absolute. Subsequently, if it is found that the activities of the **Trust/~~Institution~~** are not genuine or are not being carried out in accordance with the objects and clauses of the **Trust Deed / ~~Memorandum of Association~~** submitted at the time of registration or modified with the approval of the **Commissioner of Income-tax (Exemptions), Chennai** or there is a violation of the provisions of Section – 13, **the** Registration so granted shall be cancelled as provided u/s 12 AA (3) or 12AA(4) of the Income Tax Act. Further, this approval is also subject to the **Trust/~~Society/Association/Company/ Others~~/** complying to the provisions of the proviso to sec 2(15) of the Income Tax Act 1961.

7. **Granting of Registration u/s 12AA** does not confer any automatic exemption of income from taxation. The **Trust/~~Institution~~** should conform to the parameters laid down in Sections 11, 12, 13 and 115 BBC of the I.T. Act, 1961, to claim exemption of its income on year to year basis before the Assessing Officer.

** This Unique Registration No. URNo. **AACTN7857J/05/18-19/T-1105** Should be mentioned in all your future correspondence.

Sd/-
(G.M.DOSS, I.R.S)
Commissioner of Income-tax(Exemptions), Chennai.

Copy to:
1. The Assessee.
2. The ACIT(Exemptions), Coimbatore Circle.
3. Office Copy.

//CERTIFIED TRUE COPY//

(N SRINIVASA RAO)
Asst. Commissioner of Income-tax (H.Qrs)(Exemptions),
Chennai.

F.2984

GOVERNMENT OF INDIA
INCOMETAX DEPARTMENT
OFFICE OF THE COMMISSIONER OF INCOME TAX (EXEMPTIONS)
Aayakar Bhawan, Annexe III Floor, 121 M.G. Road, Chennai 600 034

URNo. AACTN7857J/05/18-19/T-1105/80G — Date: 10.04.2019

Name of the Trust ~~/Society /Company/Institution~~	:	NATURE SCIENCE FOUNDATION
Address	:	LIG II 2669, GANDHIMAA NAGAR, PEELAMEDU, COIMBATORE - 641 004
PAN	:	AACTN7857J
Date of Application	:	12.11.2018

Received 17/07/19
Rajes. 17/07/2019

APPROVAL UNDER SECTION 80G(5)(vi) OF THE INCOME TAX ACT, 1961

The aforesaid Trust~~/Society/Company/Institution~~ has been registered u/s.12AA of the Income Tax Act with effect from **29.11.2017** vide **AACTN7857J/05/18-19/T-1105** dated **03.09.2018.** It is certified that donation made to **NATURE SCIENCE FOUNDATION** at **LIG II 2669, GANDHIMAA NAGAR, PEELAMEDU,COIMBATORE - 641 004** shall qualify for deduction u/s 80G(5)(vi) of the Income Tax Act, 1961, subject to the fulfillment of conditions laid down in clauses [i] to [v] of sub-section (5) of section 80G of the I.T Act, 1961.

2. This approval shall be valid in perpetuity with effect from **A.Y. 2019-20** unless specifically withdrawn. **The details and validity of the certificate is available @ office.incometaxindia.gov.in**

3. The Return of Income along with the Income & Expenditure Account, Receipts and Payments Account and Balance Sheet should be submitted annually **to** the Assessing Officer having jurisdiction over the case.

4. No change in the Trust Deed/~~Memorandum of Association~~ shall be effected without the prior approval of the undersigned i.e. **Commissioner of Income Tax (Exemptions), Chennai**.

5. Every receipt issued to a donor shall bear the **Unique Registration Number** i.e. **URNo. AACTN7857J/05/18-19/T-1105/80G** and date of this order i.e. **10.04.2019.**

6. Under the provisions of section 80G(5)(i)(a), the institution/fund registered u/s.12A, u/s.12AA(1)(b) or approved u/s.10(23C), 10(23C)(vi)(via), etc., shall have to maintain separate books of accounts in respect of any business activity carried on and shall intimate this office within one month about commencement of such activity.

Sd/-
(G.M.DOSS, I.R.S)
Commissioner of Income Tax (Exemptions)
Chennai.

Copy to:
1. The applicant
2. Guard File
3. The DCIT(Exemptions) Coimbatore Circle.

//Certified True Copy//

(N. SRINIVASA RAO)
Assistant Commissioner of Income-tax (H.qrs)
(Exemptions), Chennai.

Certificates of Green Campus Auditors

1. ISO Environment Management System (14001:2015 TUV NORD) of Dr. A. Geethakarthi, NSF Environment Auditor.
2. Indian Green Building Council (IGBC AP) Accredited Professional of Dr. B. Mythili Gnanamangai, Vice-Chairman of NSF.
3. Associated Chambers of Commerce and Industry of India (ASSOCHAM), of Dr. B. Mythili Gnanamangai, Vice-Chairman of NSF.
4. Associated Chambers of Commerce and Industry of India (ASSOCHAM), of Er. Ashutosh Kumar Srivastava, Board of Directors (North Zone) of NSF.
5. Botanist and Subject Expert of Plant Taxonomy of Dr. D. Vinoth kumar, Joint Director of NSF.
6. Bureau of Energy Efficiency (BEE) and National Productivity Council of Er. N. Dineshkumar and Dr. N. Balasubramanian, Energy Auditors of NSF.

TÜV NORD

PR315: ISO 14001:2015 Lead Auditor (Environmental Management Systems) Training course

Certificate of Achievement

Geethakarthi Alagarsamy

has successfully completed the above mentioned course and examination.

23rd - 27th March 2019

COIMBATORE, INDIA

Certificate No. 35242817 02

Delegate No. 171136

for TÜV NORD CERT GmbH

Essen, 2019-04-26

The course is certified by CQI and IRCA (Certification No. 18125). The learner meets the training requirements for those seeking certification under the IRCA EMS Auditor certification scheme.

TÜV NORD CERT GmbH Langemarckstraße 20 45141 Essen www.tuev-nord-cert.com

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CERTIFIED COURSE

GRIHA

GREEN RATING FOR INTEGRATED HABITAT ASSESSMENT

GRIHA CERTIFIED PROFESSIONAL CERTIFICATE

This is to certify that

Dinesh Kumar Dhanasekaran

has qualified as a **GRIHA** Certified Professional For V. 2015

Date of issue: 19th June 2020

Note : This certification is valid only for GRIHA version 2015.

Chief Executive Officer
GRIHA Council

Medicinal Plants Farmes 1999-2000

Kuppayee Thottam, Vadugampalayam Privu,

Gobi.

ATTENDANCE CERTIFICATE

FOR INSITUTIONAL TRAINING

This is to Certify that Mr D. VINOTHKUMAR

of B.Sc., BOTANY FINAL YEAR of

Chikkaiah Naicker College, Erode-4. Has undergone institutional training in Plantation,Cultivation and Collection of medicinal plants for 14 days from 18.12.99 to 31.12.99 at Gobi.

M.M.R. SARAVANAN, SCIENTIST GOBI-638476 HERBAL

Station : GOBI

Date : 31.12.99

SIGNATURE OF THE CONCERNED AUTHORITY
M. R. SARVANAN, GOBI

Regn. No. EA-7391

Certificate No. 5093

National Productivity Council

(National Certifying Agency)

PROVISIONAL CERTIFICATE

This is to certify that Mr. / Ms. N.Balasubramaniam

son / daughter of Mr. M.Nanjukuttigounder

has passed the National Certification Examination for Energy Auditors held in December - 2009, conducted on behalf of the Bureau of Energy Efficiency, Ministry of Power, Government of India.

He / She is qualified as Certified Energy Manager as well as Certified Energy Auditor.

He / She shall be entitled to practice as Energy Auditor under the Energy Conservation Act 2001, subject to the fulfillment of qualifications for the Accredited Energy Auditor and issue of certificate of Accreditation by the Bureau of Energy Efficiency under the said Act.

This certificate is valid till the issuance of an official certificate by the Bureau of Energy Efficiency.

Place : Chennai, India

Date : 11th February 2010

Controller of Examination