

TECHNICAL REPORT OF ENVIRONMENT AUDIT



Submitted to
**M.A.M SCHOOL OF ENGINEERING,
SIRUGANUR
TIRUCHIRAPPALLI – 621 105, TAMIL NADU.**

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Submitted by



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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, an 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 for the environment. In this context, to conserve the 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, 2021).

Environmental audit plays a vital role in keeping track of 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 voluntarily 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 an 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 the environment (recycling of solid wastes and wastewaters, plastic free zone, napkin disposal, water consumption, rainwater harvesting and storage mechanisms, etc.) through Environmental Education. Implementation of Unnath Bharath Abhiyan Scheme by the Indian Government through Educational institutions imparted a 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 aim 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 deals 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 of 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 maintaining 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 over use 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 the safe use of air, land and water resources. The management of any organization should attempt to continuously 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 a clean and environment friendly work culture.



Main purpose of the EMP is to determine the environmental protection measures to be followed during day-to-day activities of the organization and to confirm that minimal environmental effects are met. Environmental protection is an imperative component of overall preparation and execution of an eco-friendly and green campus of an organization. It addresses the issues starting 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, birds, moths, houseflies, reptiles, amphibians, termites) and soil and air microbial biodiversity	Continuous	Conservation of macro and micro plant, animals (mammals, birds, moths, houseflies, reptiles, amphibians, termites) and soil 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 elements, soil composition	Half yearly	Legal obligation and structure protection, 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

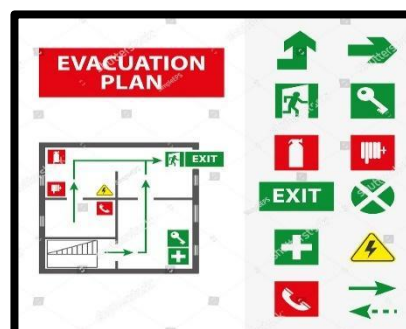
6. Environmental health and safety management system

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.*, 2021). 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

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); 

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

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 2021) have formulated a series of standards in the field of environmental auditing. These standards are basically intended to guide organizations and auditors on the general principles common to the execution of environmental audits. 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 includes 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 fire fighting 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, 2021; WGBC, 2021). Environmental audit was carried out as per the procedures mentioned of the Manual of Gnanamangai *et al.* (2021). 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 CO₂ Analyzer (Nondispersive infra-red gas analyser). In addition, CO₂ meter is also displayed the readings of atmospheric temperature, relative humidity and dew point in the places, where the level CO₂ is measured. The Carbon footprint per year is calculated (www.carbonfootprint.com) based on electricity usage per year in which CO₂ emission from electricity and the sum of transportation per year in terms of number of the shuttle buses service operated by the Organization and number of cars, motorcycles and trucks entering in the Organization campus. These factors are multiplied with total number of trips/day and approximate distance covered by the vehicle / day (in km) with a coefficient (0.01) to calculate the emission of CO₂ 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 MAMSE 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.*, 2021).

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 Mount Zion College of Engineering and Technology.

M.A.M. School of Engineering was founded in the year 2010 and was Affiliated to the Anna University, Chennai and approved by the All-India Council of Technical Education (AICTE) in the same year. The college secured its ISO 9001 certification in the year 2003, and continues to hold the same, till date, with the award of ISO 9001:2010.

M.A.M. School of Engineering, founded by the lofty mission and vision of its founder, Janab M. Abdul Majedu under the guidance of a noted engineer, academician and an administrator, Dr. S. Sathikh, the former Vice Chancellor of the University of Madras, is led by Mr. M.A. Peer Mohamed, its Correspondent. Dr P Ranjith Kumar assumes office as Principal and led the organization to get NAAC accreditation by the year 2017. The administration is backed up by the well experienced person Prof C. Rajagopalan, who is also an accomplished academician and an administrator, with a number of laurels and achievements to his credit.

M.A.M. School of Engineering which began to admit students in the academic year, 2009-2010 is currently in the 9th year of its relentless service to the cause of the muslim minority, the economically weaker, socially marginalized and the underprivileged sections of the nation. Since the time of its humble student strength, the college has grown enormously to have about three thousand students across the UG and the PG departments, all of which are proudly accredited by the National Assessment and Accreditation Council NAAC, New Delhi.

The able faculty members of the M.A.M. School of Engineering are most proficient with the many teaching methodologies, as applicable in engineering education and are nobly devoted to their profession. These faculty members of the college, upon whom the pride and the pillars of the college rest, are most consistent at their efforts in educating their students and helping them with the achievement of the dreams of themselves and those of their parents.

The facilities at the M.A.M. School of Engineering are fast expanding and are continuously updated to reflect the change and trends in the engineering sector. The Labs, Libraries, and the wi-fi internet facilities are all part of the expanding infrastructure of the college, that aim at helping the students to secure hands on experience along with the knowing and understanding of the advanced concepts and techniques in the realms of their pursuits.

M.A.M. School of Engineering offers Undergraduate B.E., degree programmes in Aeronautical Engineering, Computer Science and Engineering, Electrical & Electronics

Engineering, Electronics & Communication Engineering, Mechatronics Engineering, Mechanical Engineering. In addition, the M.A.M. School of Engineering also offers Post Graduate programmes leading to an M.E in Power Electronics and Drives.

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	<ul style="list-style-type: none"> ● IGBC - Indian Green Building Council ● GBCRS - Green Building Code and Green Ratings Systems ● GRIHA – Green Rating for Integrated Habitat Assessment 	<ul style="list-style-type: none"> ➤ Mrs. S. Rajalakshmi ➤ Dr. R. Mary Josephine ➤ Dr. B. Mythili Gnanamangai ➤ Er. Ashutosh Kumar Srivastava ➤ Er. N. Shanmugapriyan
Energy Audit	<ul style="list-style-type: none"> ● BEE - Bureau of Energy Efficiency ● LEED - Leadership in Energy and Environmental Design ● CII-GreenCo – GreenCo Rating System Felicitator 	<ul style="list-style-type: none"> ➤ Er. D. Dinesh kumar ➤ Er. N. Shanmugapriyan ➤ Dr. N. Balasubramaniam ➤ Dr. P. Thirumoorthi ➤ Dr. G. Muruganath
Environment Audit	<ul style="list-style-type: none"> ● IGBC - Indian Green Building Council ● ASSOCHAM - Associated Chambers of Commerce and Industry of India ● FSRS – Fire Safety & Rescue Services 	<ul style="list-style-type: none"> ➤ Mrs. S. Rajalakshmi ➤ Dr. A. Geetha Karthi ➤ Dr. R. Mary Josephine ➤ Dr. B. Mythili Gnanamangai ➤ Er. Ashutosh Kumar Srivastava ➤ Er. N. Shanmugapriyan
Hygiene Audit	<ul style="list-style-type: none"> ● FSMS – Food Safety Management System & ● Occupational Safety & Health (ISO 22000:2018) ● SBICM - Swachh Bharath under India Clean Mission 	<ul style="list-style-type: none"> ➤ Mrs. Gaanaappriya Mohan ➤ Er. Ashutosh Kumar Srivastava ➤ Dr. R. Sudhakaran ➤ Dr. N. Saranya

Waste Management Audits	<ul style="list-style-type: none"> ● Water Audit, Soil Audit, Biomedical Waste Audit, Solid Waste Management Audit as per the IGBC, GRIHA and BEE 	<ul style="list-style-type: none"> ➤ Mrs. Gaanaappriya Mohan ➤ Er. Ashutosh Kumar Srivastava ➤ Dr. R, Sudhakaran ➤ Er. N. Shanmugapriyan
Academic & Administrative Audits	<ul style="list-style-type: none"> ● Academic & Administrative Audits as per the NAAC Criteria 	<ul style="list-style-type: none"> ➤ 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	46417 sq.m
2.	Total Built up area	23,810sq.m
3.	Covered Car parking area	10,000sq.ft
4.	Air-conditioned area	25,000sq.ft
5.	Non Air-conditioned area	1,25,000sq.ft
6.	Gross Floor Area	10,000sq.ft
7.	Public area	5,000sq.ft
8.	Service area	5,000sq.ft
9.	Forest vegetation	-
10.	Planted vegetation	20,000sq.ft
9.	Total number of Girl students	148
10.	Total number of Boy students	475
11.	Total number of Teaching Staff	103
12.	Total number of Non-teaching staff	34
13.	Total number of College Vehicles	18



MAMSE campus Infrastructure.

20. Audit Details

Date / Day of Audit	: 22.04.2020 (Wednesday)
Type of Audit Undertaken	: Environmental Audit
Venue of Audit	: M.A.M School Of Engineering, Tiruchirappalli - 621 105. Tamilnadu, India.
Audited by	: Nature Science Foundation, Coimbatore, Tamil Nadu, India.
Name of ISO EMS Auditor	: Mrs. S. Rajalakshmi, Chairman & ISO EMS Auditor, NSF
Name of Subject Expert-I	: Dr. D.VinothKumar Joint Director, NSF
Name of Subject Expert-II	: Mrs. Nagadeepa Certified Lead Auditor
.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. Pirathiba Programme Officer, NSF
Name of the Eco Auditor	: Ms. V.Sri Santhya Assistant Director, NSF



Auditing Team of the Nature Science Foundation, Coimbatore, Tamil Nadu at the MAMSE, Tiruchirappalli.

21. Qualitative and quantitative measurements of the 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	√		
	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.)	√		
	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	3000 L		
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	4
2.	Number of Borewell water and Open well water facility	40
3.	Number of Percolation Pond and Check Dam facility	1
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)	6
7.	Number of Rain harvesting system and water reservoirs	2
8.	The ratio of Environment sustainability courses (Environmental Science, Engineering, Technology, Management, Monitoring, Climate change, Global warming) to total courses / subjects	12:410
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	2

11.	Implementation of Government schemes (Swachh Bharath Abhiyan under Clean India Mission) programmes conducted	--
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	3000 lit/day
14.	Carbon footprint in the campus due to Electrical energy usage	184.11 m/t
15.	Carbon footprint in the campus due to Vehicles usage	1082 m/t
16.	Carbon footprint in the campus due to Petroleum gas usage	10 m/t
17.	Carbon footprint in the campus due to Human population load	6 m/t
18.	Carbon footprint in the campus due to use of Petrol and Diesel for operating Generators for power generation	7 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 degrade, 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.

MAMSE 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 MAMSE

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.

MAMSE 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.



Solid waste management facilities in MAMSE, Tiruchirappalli, Tamilnadu.

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 MAMSE, 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 MAMSE viz. Students Hostels and Staff rooms, Students Service Centre, Sports Complex and Guest rooms. A Contractor in Tiruchirappalli 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 MAMSE

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.



E- waste management facilities in MAMSE, Tiruchirappalli, Tamilnadu.

In compliance to the E-Waste Management Rules, 2016, Government of India, e-waste materials were collected from the MAMSE 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 Hazardous 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.

MAMSE 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 : M.A.M School of Engineering.

Address of the Organization : Siruganur
Tiruchirappalli,
622 - 507, Tamilnadu.

Date of Waste Disposal : From April 2018 to March 2021

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)	12	Off site	--
8.	Biomedical Waste	Not Applicable	--	--
9.	Car exhaust	Not Applicable	--	--
10.	Charcoal	Not Applicable	--	--
11.	Clinical Waste	Data available with college Hospital	Off-site	Tiruchirappalli 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.)	5Kg	Off-site	Tiruchirappalli Municipality
21.	Electronic Waste (Computer, Laptop, CD, Pen drive, Keyboards, Mouse, Printers, UPS)	5Kg	Off-site	-do-
22.	Fertilizer Waste	Not Applicable	--	--
23.	Filters	Not Applicable	--	--
24.	Fluorescent Light Tubes	50	Off-site	Tiruchirappalli Municipality
25.	Food Waste	500Kg	On-site	Biogas
26.	Furniture Items	20Kg	Off-site	Tiruchirappalli Municipality
27.	Garbage and Cardboards	Garbage :20Kg	On -site	Biogas
28.	Glass Bottles	10Kg	Off-site	Tiruchirappalli 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	25Kg	On-site	--
34.	Inert Waste	Not Applicable	--	--
35.	Laboratory Wastes	10Kg	On-site	--
36.	Lights and Bulbs	50Kg	Off-site	Tiruchirappalli Municipality
37.	Kitchen Waste	Data available with the Hostel Office	On-site	--
38.	Metal Waste	10Kg	--	--
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	Tiruchirappalli Municipality
44.	Paper Waste	50Kg	Off-site	--

45.	Pathological Wastes	Not Applicable	--	--
46.	Pigging Wastes	Not Applicable	--	--
47.	Plant Wastewater	300 L	On-site	Wastewater treatment
48.	Plastic Waste	50Kg	Off-site	Tiruchirappalli Municipality
49.	Plasticware items Waste	100 L	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	Tiruchirappalli 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 its 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 include 1) 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 MAMSE, Tiruchirappalli, Tamilnadu.

MAMSE 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 MAMSE

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. MAMSE was in the initial development process for setting up biogas plant in the campus.



Biogas Plant Facility at MAMSE, Tiruchirappalli, Tamilnadu.

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. MAMSE is at the initial level of this practice.



Composting unit at MAMSE, Tiruchirappalli, Tamilnadu.

22.5. Recycling of Wastewaters at the MAMSE

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 MAMSE



Eco-friendly MAMSE 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



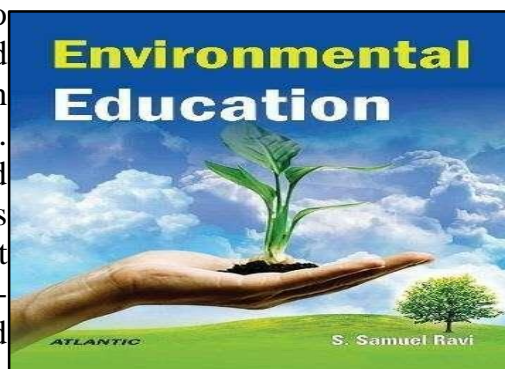
exposes others inside the vicinity to decaying material and must be averted. Some of the unsafe practices of napkins include throwing them unwrapped into fields and rooftops, wrapping them in paper/ plastic bags and throwing them outdoors or in dustbins, burying them for de-composting, throwing them 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. Incinerator's facility and disposal structures 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.

MAMSE operates some vehicles to pick up the students and staff members around Tiruchirappalli 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 a 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 MAMSE, Tiruchirappalli, 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 stale 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 MAMSE has a large number of ventilators for effective air circulation.



Ventilation and Exhaust system Facilities in MAMSE 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

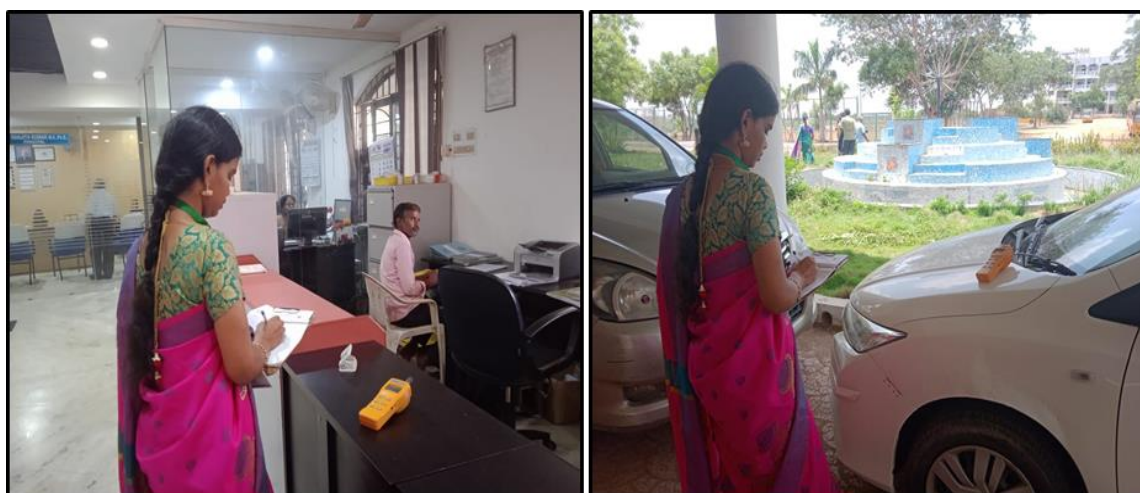
role to act as a global indicator for checking the purity of the atmosphere. In general, a portable CO₂ Analyzer is used to measure the level of carbon dioxide in the atmosphere at different places across the campus. The observation showed that the concentration of CO₂ in the atmosphere is found to be low which did not exceed the critical limit of CO₂. It is further revealed that all the selected locations are having pure air without any air contaminants with good air exchange/circulation in the campus. Some of the places like 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 CO₂ concentration in the MAMSE

S.No.	Different locations of the Organization's Campus	Carbon dioxide level (ppm)	Remarks
1.	Geo technical lab	482	CO ₂ level is low
2.	Environmental lab	546	CO ₂ level is low
3.	Canteen	451	CO ₂ level is low
4.	Classroom	422	CO ₂ level is low
5.	Auditorium	468	CO ₂ level is low
6.	Parking	392	CO ₂ level is low
7.	Open place	331	CO ₂ level is low

Reference of Set values of CO₂ 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 CO₂ level at MAMSE, Tiruchirappalli, 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 O₂ level at MAMSE, Tiruchirappalli, Tamilnadu.

Table 7. The Oxygen concentration in the MAMSE

S.No	Location	Oxygen Level (%)	Remarks
1.	Canteen	21	O ₂ level is good
2.	Board Room	25	O ₂ level is good
3.	Class Room	24	O ₂ level is good
4.	Principal Room	19	O ₂ level is good
5.	Reception	18.0	O ₂ level is good
6.	Open Place	17.2	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 help 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 are 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 184.11 metric tons. It is calculated based on CO₂ emission from electricity per year in kWh/1000 units. The carbon footprint due to transportation (Shuttle services) per year at campus showed 9.198 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 1022 metric tons. The Carbon footprint due to Motorcycles usage per year is 51.1 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 MAMSE

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

$$\begin{aligned} &\text{The CO}_2 \text{ emission from electricity} \\ &= (\text{electricity usage per year in kWh}/1000) \times 0.84 \\ &= (219665\text{kWh}/1000) \times 0.84 \\ &= 184.11 \text{ metric tons} \end{aligned}$$

Notes:

Electricity usage per year= 209665 kWh
0.84 is the coefficient to convert kWh to metric tons.

b. Transportation per year (Shuttle)

$$\begin{aligned} &= (\text{Number of the shuttle bus in the campus} \times \text{total trips for shuttle bus service each day} \\ &\times \text{approximate travel distance of a vehicle each day inside campus only (in kilometers)} \\ &\times 365/100) \times 0.01 \\ &= [(18 \times 2 \times 7 \times 365)/100] \times 0.01 \\ &= 9.198 \text{ metric tons} \end{aligned}$$

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

= [(1000 x 2 x 7 x 365)/100] x 0.02

= 1022 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

= [(100 x 2 x 7 x 365)/100] x 0.01

= 51.1 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

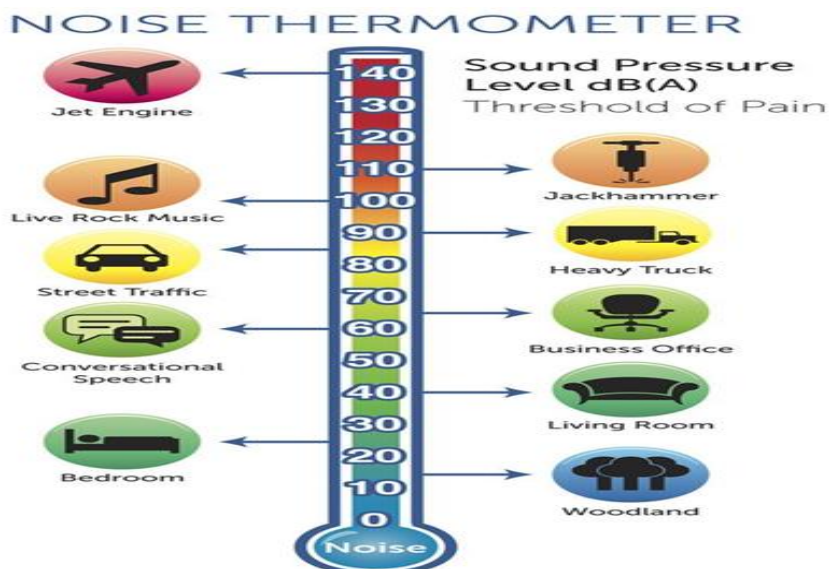
= total emission from electricity usage + transportation (bus, car, motorcycle)

= x+ (33+ 3679.2 +183.96) / 0.81 (Constant Factor)

= 1377.9 metric tons

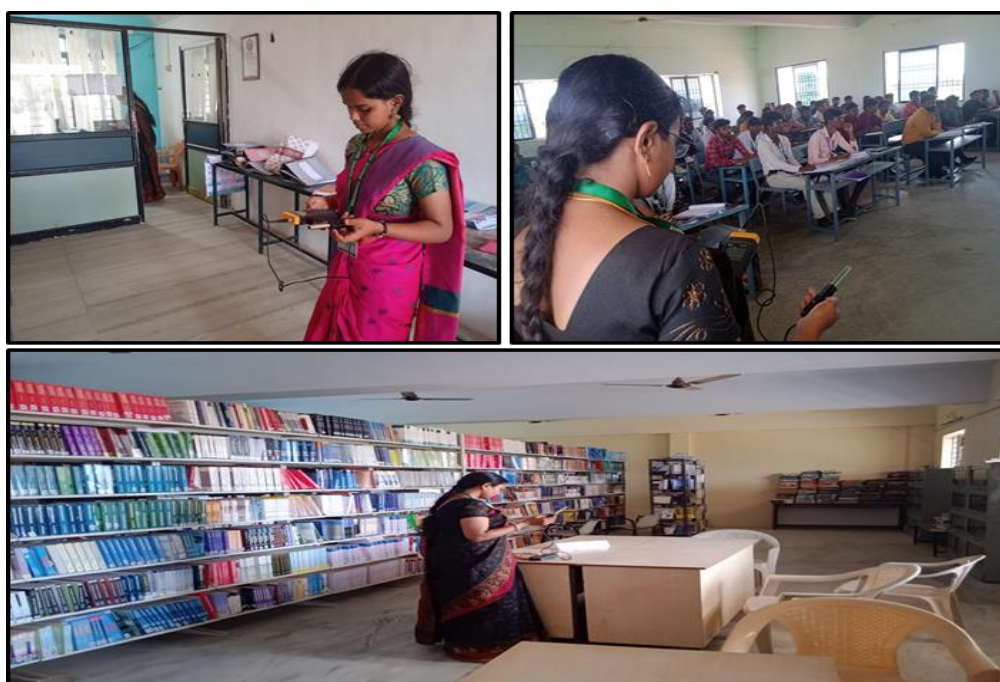
22.14. Noise level Measurements, Analysis, and Interpretation

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 μ Pa.



Measurement of Noise level at various places in MAMSE, Tiruchirapalli.

Table 8. Noise level at the MAMSE

S.No	Locations	Measurements (dB)	Major Noise Sources	Remarks
1.	Common Room	58	Celling and exhaust fans	No Noise Pollution
2.	Reception Room	61	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.	Class Rooms	60	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 MAMSE

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 MAMSE, Tiruchirappalli, TN

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 units in MAMSE, Tiruchirappalli, Tamilnadu.

Rainwater harvesting programme concerned with a) installation of rain gauge rain recording system (equipment), 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.

$$\text{Quantity} = \text{Per capita demand} \times \text{Human population}$$

22.15.5. Water Consumption Rate

Since several variables influence 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 MAMSE

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	$Q \text{ (L/min)} = 4637 \sqrt{P} (1 - 0.01 \sqrt{P})$	41760
2.	Kuchling's Formula: per capita fire demand	$Q \text{ (L/min)} = 3182 \sqrt{P}$	31800
3.	Freeman's Formula: per capita fire demand	$Q \text{ (L/min)} = 1136.5(P/5 + 10)$	35050
4.	Ministry of Urban Development Manual Formula	$Q \text{ (kilo liters/d)} = 100 \sqrt{P}$ 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

$$\begin{aligned}
 &= 1.5 \times \text{average hourly demand} \\
 &= 1.5 \times \text{Maximum daily demand}/24 \\
 &= 1.5 \times (1.8 \times \text{average daily demand})/24 \\
 &= 2.7 \times \text{average daily demand}/24 \\
 &= 2.7 \times \text{annual average hourly demand}
 \end{aligned}$$

22.16. Auditing for Waste Management

Waste management reduces the effect of waste in the environment and improves the ecological conditions, and so on. Auditing for waste management can help 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 audits for waste management 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, the auditor diagnoses the prevailing waste 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 37°C with a daily record of 37°C. Mean minimum temperature ranges between 22 and 27°C. The Tiruchirappalli district experienced the annual rainfall 5.5 inches/avg for the last two decades. Since the district is located on the dry pass, it experiences southwest monsoon from June to August. Southwest monsoon is irregular as the masses of clouds are intercepted with 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 MAMSE

S.No	Details of Parameters	Data collected
Soil Edaphic parameters		
1.	Soil pH	6.4 – 7.9
2.	Soil type	Red soil
3.	Total Organic carbon	0.3%
4.	Electrical conductivity	0.03 ds/m
5.	Water holding capacity	70.23%
6.	Total Nitrogen	3 - 110 Kg/ac
7.	Available Phosphorous	0.3 - 100 Kg/ac
8.	Exchangeable Potassium	0.2 – 300 Kg/ac
9.	Available Mg and Mn contents	2, 5ppm

10.	Available Zn and Fe contents	0.4, 6.0 ppm
Environmental parameters		
1.	Minimum Temperature	22- 27°C
2.	Maximum Temperature	29-37°C
3.	Minimum Relative humidity	44 - 93%
4.	Maximum Relative humidity	7-100%
5.	Annual Average Rainfall	5.5 inches /avg.year
6.	Annual Average Sunshine	11 hrs/avg.day
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 staff towards the safety measures. MAMSE has very good safety measures as per the Green building conservation code such as fire extinguishers in all the places. In addition, in all the places, 'Exit', 'Entry' and other sign boards were kept across the places to give cent percent safety to the stakeholders.



Safety measures at MAMSE, Tiruchirappalli, Tamilnadu.

22.20. Implementing Swachh Bharath Abhiyan Scheme under Clean India Mission

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 MAMSE 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 clubs 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 ‘ International Drug Abuse Rally’ ‘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 Empowerment cell, Associations, Forums, etc. 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 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 Unnath Bharath Abhiyan under MHRD and implement the same in the campus. MAMSE has well developed Students’ExNoRa, Unnath Bharath Abhiyan , YRC, RRC, Rotract , etc. These bodies are actively involved in tree planting programmes and cleaning the surrounding areas of tribal, rural and urban people across Tiruchirappalli. The Campus is conducting a large number of activities to conserve nature and to teach about the importance of the environment to rural, tribal and urban people.

Awareness programmes on the green campus initiatives and dissemination of green motto and pledges are accounted for 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

MAMSE implemented the Government schemes (Unnath Bharath Abhiyan under MHRD) 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 and to identify the extension and training needs of the target group through the Department of Science and Humanities.

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

MAMSE under National service scheme conducted programmes like Awareness on using fire extinguisher & protecting environment, yoga, Womens day, Covid & No Fear for Vaccination, FIRST Aid and Training, ONE LAKH PALM TREE PLANTATION.



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

1. 'YRC Club', 'RRC Club' and 'Rotract' Club along with Students'ExNoRa 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 has 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 eco-friendly 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 are two Reverse Osmosis (RO) water units to produce RO water which is periodically tested for the physico-chemical properties and all water parameters with a water quality analysis meter designed by MAMSE.
5. The College is providing bicycles for campus students to maintain an 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 systems to recharge ground water status by collecting rainwaters from the campus coinciding with the contour of the terrain and natural drains.
8. Unnath Bharath Abhiyan and National service schemes are implemented effectively towards sanitation, solid waste management and refining drinking water quality to promote cleanliness to rural and tribal people across the Tiruchirappalli 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 CO₂ in the atmosphere is found to be low which did not exceed the critical limit of CO₂ coinciding with pure air circulation without any contaminants in the campus.
11. Youth Red Cross, Students' ExNoRa & Red Ribbon Club activities at MAMSE conducted Medical Camp, Drug Abuse Campaign, Blood Donation camp, Eye checkup Camp, Women Empowerment programme, Yoga Day Event, Swatch Bharat campaign, Road Safety Programme, 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 sensitizing the students to minimize the use of plastics, non-biodegradable materials and exploitation of natural resources which pose 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 purposes.
- 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 extent 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 the biogas plant may be diverted to the STP for storage and utilized for irrigation purposes.
- 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 eco friendly campus to the stakeholders.

25. Conclusion

M.A.M School Of Engineering, Tiruchirappalli, 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. MAMSE 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 supports a rich biodiversity of flora and fauna which is making a sustainable environment and eco-friendly campus. Students' ExNoRa is implemented effectively by the campus to promote sanitation and cleanliness to the rural/tribal people across the Tiruchirappalli District, Tamilnadu. Environmental audit is carried out to provide an indication to company management about how the environmental Organization system and equipments 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 MAMSE 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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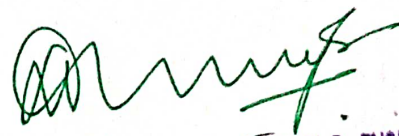
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