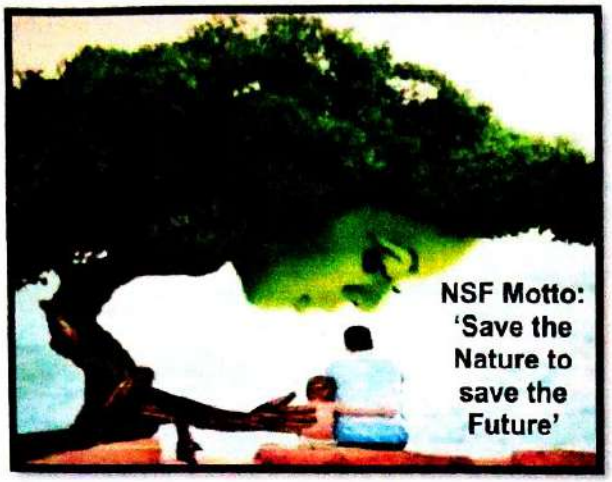
TECHNICAL REPORT OF GREEN CAMPUS AUDIT



Submitted to

ROHINI COLLEGE OF ENGINEERING AND TECHNOLOGY, KANYAKUMARI – 629 401, TAMIL NADU

Date of Audit: 02.12.2021

Submitted by

NATURE SCIENCE FOUNDATION

(A Unique Research and Development Centre for Society Improvement)
[ISO QMS (9001:2015), EMS (14001:2015), OHSMS (45001:2018) & EnMS (50001:2018) Certified and Ministry of MSME Registered Organization]

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1. Introduction

Green campus is an area of the Organisation or the Organisation as a whole itself contributing to have an infrastructure or development that is structured/planned to incur less energy, less water, less or no CO_2 emission and less or pollution free environment (Aparajita, 1995). Green Campus Audit is a tool to evaluate environment management system which is systematically executed to protect and preserve the environment. Green campus audit constitutes the environmental friendly practices and education combined to promote sustenance of green environment adopting user-friendly technology within the campus. It creates awareness on environmental ethics, resolves environmental issues and offers solutions to various social and economic needs (APHA, 2017). It strengthen the concept of "Green building" and "Oxygenated building" which in turn provides a healthy atmosphere to the stakeholders.

Green Campus Audit ensures the Organization's campus should be greenish with large diversity of trees, herbs, shrubs, climbers and lawns to reduce the environmental pollution and soil erosion; it is also useful in relation to biodiversity conservation, landscape management, irrigation/economic water utilisation and maintenance of natural topography and vegetation (Gowri and Harikrishnan, 2014, Aruninta *et al.*, 2017). The maintenance of an eco-friendly campus ensures a neat and clean environment. For the benefit of stakeholders, solid waste management, recycling of water, disposal of sewage and waste materials (electronic and biomedical wastes), 'zero' use of plastics, etc. should be followed consistently in the organization campus.

Green Campus Audit procedures includes the definition of green audit, methodology on how to conduct Green audit at Educational Institutions and Industrial sectors as per the checklist of Environment Management Systems and International Standards on ISO 14001:2015, Indian Green Building Council, Swachh Bharath Scheme under Clean India Mission to understand the principles and importance of various audits in the context of the organization and risk assessment at 360° views. Green campus audit helps the educational institutions/ industries to maintain eco-friendly environment, assures personal hygiene to various stakeholders and supports the nation; on the whole for the noble cause of environmental protection and nature conservation which in turn enhances the quality of life of all living beings (Arora, 2017).

2. Role of Educational Institutions in India

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

environment to tribal, rural and urban people across the country, besides the regular and conventional activities carried out by NSS, NCC/Student Force, Nature club, Eco club, Science club, Fine Arts club, Flora and Fauna club, Youth Red cross unit, etc. Seminar, Conference, Workshop, training and awareness programmes on Biodiversity conservation education, environmental awareness programmes, etc. may be conducted periodically by the Management and Administrative people of an Organization to the stakeholders.

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

3. Green Campus and Environment Policy

Green campus and environment policy aims to provide an education and awareness in a clean and green environment to the stakeholders with regard to environmental compliance. Scope of the policy applies to all employees and students of the Institution/organisation to provide an ecofriendly atmosphere. Green Campus Policy dealt with cleanliness of the campus maintained through proper disposal of wastes and steps to be followed to recycle the biodegradable wastes and utilization of eco-friendly supplies to maintain the campus free from hazardous wastes/pollutants. The concept of eco-friendly culture is disseminated among the students as well as rural community through various awareness programmes. Attempts are made to minimise the energy usage and substitute the non-renewable energy sources with renewable energy sources. Head of the Organization, Departmental Heads and Senior Managers/ Management Representatives are responsible for monitoring the "Go Green" initiatives of the College/University and maintain a clean/green campus while each and every individuals of the organisation should adhere to the policy.

4. Environment Friendly Campus

As stated earlier, Organization is liable to provide an eco-friendly atmosphere along with good drinking water facility to all the stakeholders (students and staff members). Manuring the cultivated plants/grown within the campus may applied with organic manure, cow dung, farmyard manure and vermicompost instead of using chemical fertilizers. All non-compostable and single-use disposable plastic items, plastic utensils, plastic straws and stirrers should be avoided. Demonstration/awareness programme on establishing plastic-free environment and utility of oganic alternatives for all incoming and current students, staff and faculty

should be organised. Reduction of use of papers alternated with e-services, e-circulars, etc. and proper disposal of wastes, recycling and suitable waste management system should be considered to establish environment friendly campus.

5. Aims and Objectives of Green Campus Audit

- To recognise the initiatives taken towards establishing the green campus in terms of gardening.
- To grow a large number of oxygen releasing and carbon dioxide assimilating plants in the campus to give a pure atmosphere to the stakeholders.
- To identify and provide baseline information to assess threat and risk to the ecosystem due to Organization development.
- To recognise and resolve different environmental threats of the Organization.
- To ensure proper utilization of resources available in the surrounding areas towards future prosperity of the humanity.
- To fix a couple of norms for disposal of all varieties of wastes and use green cover as a carbon sink for pollution free air.
- To assess the greenish nature of an Organization campus in terms of trees, herbs, shrubs, climbers, twins, lianas, lawns and reflected in reducing the environmental pollution soil erosion, biodiversity conservation, landscape management, natural topography and vegetation.

6. Importance of Green Auditing

The Management of the Organization (Auditee) should be exposed their inherent commitment towards making ecofriendly atmosphere through the green auditing and ready to encourage/follow all types of green activities. They should promote all kinds of green activities such as conduct of environment awareness programmes, in-campus farming, planting trees and maintenance of greening, irrigation, use of biofertilizers and avoidance of chemical fertilizers and agrochemicals, etc., prior to and after the green campus auditing (Suwartha and Sari, 2013). The administrative authorities should formulate 'Green and Environment Policies' based on technical report of green ampus auditing. A clean and healthy environment will enhance an effective teaching/learning process and creates a favorable learning green environment to the scholars. They should create the awareness on the importance of greenish initiatives through environmental education among the student members and research scholars. Green Audit is the most effective, ecological approach to manage environmental complications.

Green campus audit may be beneficial to the campus in improving the greenery activities which in turn useful to save the planet for future generation. Green campus audit is a kind of professional care and a simple indigenized system about the environment monitoring in terms of planting a huge number of trees which is a duty of each and every individual who are the part of economical, financial, social, and environmental factors. It is necessary to conduct green audit frequently at least once in three years in campus because students and staff members should aware of the green audit and its beneficial effects in order to save planet by means of 'Go green concept' which in turn support the institution to set environmental models ('icon') for the community. Green audit is a professional and useful measure for an Organization to determine how and where they are retaining the campus eco-friendly manner. It can also be used to implement the alleviation measures at win-win situation for the

stakeholders and the planet. It provides an opportunity to the stakeholders for the development of ownership, personal and social responsibility.

7. Benefits of the Green Auditing

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

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

- recommendation in use of biofertilizers, organic and green manures, cow dung manures and farmyard manures for the cultivation of plants to protect the environmental health
- Conduct of outreach programmes for dissemination of Green Campus motto and Green pledge initiatives to rural, tribal and urban people through Eco club, Nature club, Science club, Fine Arts club, Youth Red Cross unit, NCC/Student Force and NSS bodies.
- Academic credentials like major and minor Projects, Dissertations and Thesis work on green campus, environment protection and nature conservation by the students and staff members.
- The plants available in the campus must be tagged with their common name and Botanical name for the stakeholders to impart the knowledge on medicinal and ornamental, economic and food values of plant varieties.
- MoU may be signed with Government and non-Governmental Organizations (NGOs) to utilize the resources for nature conservation and environmental protection.
- Implementation of Government schemes (Swatch Bharath Abhiyan under Clean India Mission) to give pure and safe water to rural people and teach the importance of cleanliness of toilets and restrooms.
- Conduction of awareness programmes and cultural activities on global warming, environmental changes and ecosystem maintenance to the stakeholders.
- Steps taken for organic, inorganic, toxic, e-waste, biomedical, food, sewage waste management, segregation of wastes and reuse methods.
- Public transport, low-emitting vehicles and control of car smokes and exhaust towards carbon accumulation in the campus by carbon footprint studies.
- Implementation of advanced methods for watering plantations (Drip irrigation, Sprinkler irrigation, etc.) and use of metering for water utility, IoT based watering, automation, water device, remote water lines, etc.
- Percentage of Organization's budget for environment sustainability efforts and green campus initiatives planning and efforts.
- Campus facilities for disabled, special needs and/or maternity care including security, safety and health infrastructure facilities for stakeholder's wellbeing.
- High degree of resource management offers the basis for improved sustainable and creation of plastic free campus to evolve health consciousness among the stakeholders.
- Impart of knowledge on environment through systematic management approach and improving environmentally friendly standards by creating a benchmark for environmental protection initiatives
- Best practices followed on green campus initiatives in the Organization listed and disseminated among the stakeholders.
- Recommendations for improving the green initiatives, planning and efforts in the campus after audit report to improve further.

8. About the Organization

8.1. Rohini College of Engineering and Technology

Rohini college of Engineering and Technology (RCET) was started in the year 2012 by Shri.K.Neela Marthandan, a great Industrialist and philanthropist and now managing by his son Dr.N.NeelaVishnu. It is located at Palkulam near Anjugramam junction & Kanyakumari, the southernmost town in India. RCET is about 5 kms from the Kanyakumari railway station and 14 kms from Nagercoil junction. RCET is approved by All India Council for Technical Education (AICTE), New Delhi & affiliated to ANNA University, Chennai since 2012. The main feature of the college comprises world class infrastructure with experienced and talented faculties, excellent pass percentage, good placement records and society-oriented products/projects developed by the students.

Vision

- To be an academic institute of continuous excellence towards education and research in rural regime and provide service to nation in terms of nurturing potentially higher social, ethical and engineering companion graduands.

Mission

- To foster and promote technically competent graduands by imparting the state of Art engineering education in rural regime.

- To enunciate research assisted scientific learning by dissemination of knowledge towards science, agriculture, industry and national security.

8.2. About Nature Science Foundation (NSF)

NSF is an ISO QMS (9001:2015), EMS (14001:2015), OHSMS (45001:2018) & EnMS (50001:2018) Certified and registered with Ministry of Micro, Small and Medium Enterprise (MSME), Government of India Organization functioning energytically 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 12AA, 80G and Form 10AC certificates for income tax exemption and implanting various Government schemes. 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' in a big way. NSF family is wide spread across India with over 115 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

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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 across the world, 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'. These award and honours will be given to the deserved meritorious candidates during the 'Annual Meet and Award Distribution Ceremony' which will be conducted every year during the first week of January.

NSF has introduced various types of Audits such as 'Eco Audit', 'Green Audit', 'Energy Audit', 'Hygienic Audit' Water & Soil Audit, Plastic Waste Management Audit, Biomedical Waste Audit, Solid Waste Management Audit, E-Waste Management Audit, Academic & Administrative Audits including ISO certification process to Academic Institutions, R&D Organizations and Industries towards the accreditation process as well as maintaining a hygienic eco-friendly environment to the stakeholders in their campus. All audits will be conducted as per the Checklist prepared by the NSF ISO 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, Energy Policy, MoU, International Eco Club student Chapter.

Audit processes are being conducted through the certified Auditors as per the following by the NSF

Audit	Certified Auditors	Certified Auditors
Green Audit	• IGBC - Indian Green Building Council • GBCRS - Green Building Code and Green Rating	➢ Dr. S. Rajalakshmi ➢ Dr. R. Mary Josephine ➢ Dr. B. Mythili Gnanamangai ➢ Er. N. Shanmugapriyan

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	Systems • GRIHA – Green Rating for Integrated Habitat Assessment	
Energy Audit	• BEE - Bureau of Energy Efficiency • LEED - Leadership in Energy and Environmental Design • CII-GreenCo – GreenCo Rating System Felicitator	➢ Er. D. Dinesh kumar ➢ Er. N. Shanmugapriyan ➢ Dr. N. Balasubramaniam ➢ Dr. P. Thirumoorthi ➢ Dr. G. Murugananth
Environment Audit	• IGBC -Indian Green Building Council • ASSOCHAM - Associated Chambers of Commerce and Industry of India • FSRS – Fire Safety & Rescue Services	➢ Dr. S. Rajalakshmi ➢ Dr. A. Geetha Karthi ➢ Dr. R. Mary Josephine ➢ Dr. B. Mythili Gnanamangai ➢ Er. N. Shanmugapriyan
Hygiene Audit	• FSMS – Food Safety Management System & • Occupational Safety & Health (ISO 22000:2018) • SBICM - Swatch Bharath under India Clean Mission	➢ Mrs. Gaanaappriya Mohan ➢ Dr. R, Sudhakaran ➢ Dr. N. Saranya
Waste Management Audits	• Water & Soil Audit, Plastic Waste Management Audit, Biomedical Waste Audit, Solid Waste Management Audit, E-Waste Management Audit as per the Checklist of NSF	➢ Mrs. Gaanaappriya Mohan ➢ Dr. R, Sudhakaran ➢ Er. N. Shanmugapriyan
ISO Certification	QMS (9001:2015), EMS (14001:2015), OHS (45001: 2018), ISMS (27001:2018), FSMS (22000:2018), QMSMD (13485:2016), EnMS (50001: 2018)	➢ Er. Ashutosh Kumar Srivastava ➢ Dr. S. Rajalakshmi ➢ Dr. A. Geetha Karthi ➢ Mrs. Gaanaappriya Mohan ➢ Dr. R. Mary Josephine

Table 1. The RCET Campus facility details

S.No.	Details of Area	Total area
1.	Total Campus area	10.7 acres
2.	Total Built up area	20112 Sq. m

3.	Covered Car parking area	250 Sq.m
4.	Air-conditioned area	2253 Sq.m
5.	Non-Airconditioned area	NA
6.	Gross Floor area	NA
7.	Public area	NA
8.	Service area	NA
9.	Forest vegetation	37%
10.	Planted vegetation	42%

9. Audit Details

Date / Day of Audit : **02.12.2021**

Venue of Audit : **Rohini College of Engineering and Technology,**
Kanyakumari – 629401, Tamil Nadu, India.

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

Audit type : **Green Campus Audit**

Name of Auditing Chairman : **Dr. S. Rajalakshmi Jayaseelan,**
Chairman of NSF & ISO QMS, EMS, OHSMS, EnMS Auditor.

Name of IGBC AP Auditor : **Dr. B. Mythili Gnanamangai,**
Vice Chairman of NSF & Indian Green Building Council Accredited Professional.

Name of Lead Green Auditor : **Dr. R. Mary Josephine,**
Plant Taxonomist & Principal, St Joseph College for Women, Kamalapuram, TN.

Name of Subject Expert-I : **Dr. D. Vinoth Kumar**
Joint Director of NSF & ISO EnMS Auditor.

Name of Subject Expert-II : **Mr. B.S.C. Naveen Kumar,**
Senior Faculty, Mahatma Gandhi National Council of Rural Education, Ministry of Higher Education, Hyderabad.

Name of Subject Expert-III : **Er. D. Dinesh Kumar,**
Certified Lead Auditor, IGBC, ASSOCHEM, GRIHA & LEED

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Name of the Energy Auditor : **Dr. N. Balasubramanian,**
Certified Bureau of Energy Efficiency Auditor of NSF.

Name of Eco & Green Officer : **Ms. R.S. Thulaja,**
Environment, Energy & Green Council Programme Officer, NSF.

10. Procedures followed in Green Campus Audit

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

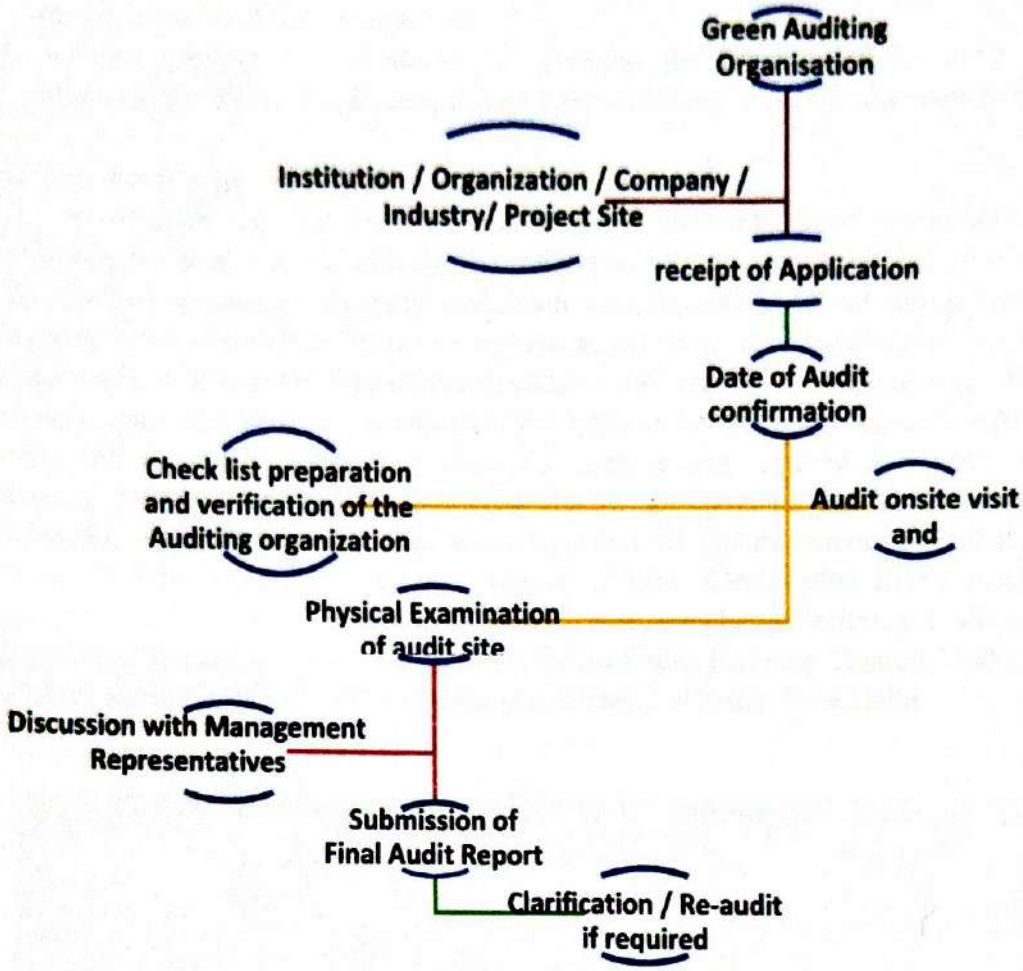
Green campus is not intended for the self-sustainability of the building alone, it also involves in propagation of the green campus initiatives so as to be adopted by any individuals and organization at a minimum cost. Green campus audit has been conducted as per the checklist of Nature Science Foundation,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

During the audit, the nature of plants and animals / birds species thriving within the campus were recorded. Establishment of lawns, trees, herbs, shrubs and climbers and establishment of terrace / kitchen / herbal / zodiac / ornamental / medicinal garden / aquarium and aquatic (hydrophytes) plants in the campus were recorded. Labelling of common names and Botanical names of plants were observed. The operation of the water irrigation system, trip and sprinkler irrigation methods and use of recycled water for irrigation purpose or any other purpose in the campus area were noted.

Attempts made for water scarcity during summer season towards the maintenance of plants and frequency of watering for plantations in the campus were noted. Biodiversity conservation education, projects, awareness programmes, etc., through Indian Biodiversity Act and Ministry of Environment, Forests and Climate Change, Government of India and the conduct of outreach programmes for

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

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



Flow-chart of Green Campus Audit Procedures

10.1. Onsite Green Campus Audit activities

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

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

10.2. Pre-Audit stage activities

A pre-audit meeting (opening meeting) is conducted with Management and Administrative people along with staff coordinators of Energy and Environment audit process, wherein, audit protocol and audit plan were discussed in brief. The purpose of this meeting is to provide a chance to emphasize the scope and objectives of the audit and discussions held on the feasibilities associated with the audit (Marrone *et al.*, 2018). Pre-audit stage activities are an essential prerequisite for the green audit to meet the auditee and to gather information about the campus and required documents were collected directly from the Organization before the start of the audit processes (Fachrudin *et al.*, 2019). Audit team was selected by the Nature Science Foundation as per the checklist comprised of Lead Auditor of ISO (EMS 14001:2015), Botanist, Agriculture and Horticulture Scientists from Conventional and Technical Universities across India, Accredited Professionals from Indian Green Building Council, Hyderabad and Associated Chambers of Commerce and Industry of India, New Delhi.

Opening meeting with the Principal, IQAC Coordinator and Management Representatives of the RCET and Audit Team of Nature Science Foundation

Green, Environment and Energy Audit Activity at Rohini college of Engineering and Technology by the NSF Audit Team

10.3. Target Areas of Green Auditing

Green campus audit is nothing but a professional tool to assess the greenery activities in the educational institutions and give a value addition to the campus and considered as a resource management process. Eco-campus concept mainly concentrate on the efficient use of energy and water; Minimize waste generation or pollution and also improve the economic efficiency. Green campus audit process may be undertaken at frequent intervals and their results can demonstrate improvement or change over time. Eco-campus focuses on the reduction of carbon emissions, water consumption, wastes to landfill and enhance energy use conservation to integrate environmental considerations into all contracts and services considered to have significant environmental impacts (Choy and Karudan, 2016).

There are several target listed in the Green audit process in which a few are taken into consideration as per the Indian scenario is concerned. They are water use efficiency, energy use efficiency, solid, e-waste biomedical, food, sewage waste management and reuse methods, planting of oxygen releasing and carbon dioxide assimilating plants, landscape management, topology, vegetation, soil erosion control, carbon footprint due to use of vehicles, electricity and fossil fuels (León-Fernández and Domínguez-Vilches, 2015). drinking water quality supply, Biogas plant, rain harvesting system, water reservoirs, percolation pond, establishment of various herbal, terrace and ornamental, gardens, campus and flora fauna, water irrigation, implementation of

Government schemes, conduction of awareness programmes management, public transport, low-emitting vehicles and control of car smokes and exhaust, Organization's budget for greenery activities, campus facilities for disabled, persons needs special attention and or maternity care, security, safety and health infrastructure facilities for stakeholder's wellbeing (Nunes *et al.*, 2018).

10.4. Flora and Fauna diversity of study area

The RCET is situated in Kanyakumari, Tamil Nadu, India. It is located about (5.8 km via Anjugramam Rd. At present, the campus is quite clean, green and with much less pollution when compared to the rest of the city. Study/documentation of biodiversity provides a useful measure of the quality of the environment and the ecological studies are important aspects of environment, in view of the consideration of environmental quality and natural flora and fauna conservation.

10.4.1. Topography

The RCET consists of an environment of Red Loamy type, located at an altitude of 411 m above mean sea level, 77.5385° E of longitude and 8.0883° Nlatitude.

10.4.2. Geology and Soil condition

Kanyakumari district is bordered by Western Ghats (Ridge and valley complex) in the West. Western Ghats form an elevation of 200 m amsl from these foothills in the west. The areas gently slope to southeast towards the Gulf of Mannar attaining an elevation of 25 to 30 m amsl. The eastern and central tracts are quite barren, but there are a few isolated knife edged hillocks. The coastal tracts are occupied by the marshy swamps and number of sand dunes (Teri sands). The RCET Campus is classified into two regions based on geology, sandy areas and loamy areas.

10.4.3. Climatic conditions

The Kanyakumari district received the rain under the influence of both southwest and northwest monsoons. The southwest monsoon chiefly contributes to the rainfall in the district. Most of the precipitation occurs in the form of cyclonic storms caused due to the depressions in Bay of Bengal. The normal annual rainfall over the district varies from about 826 to 1456 mm. It is the minimum around Kanyakumari in the southeastern

part of the district. It gradually increases towards west, north and northwest and attains a maximum around Thackalay.

The highest humidity is generally recorded in May with the value of 95 percent whereas the minimum of 45 percent is recorded during February. The maximum wind speed of 17.74 km/hr is recorded during August and the minimum wind speed of 5.53 km/hr is recorded during December. Wind velocity is low from October to December. The Sun Shine Hours is March-April forms the average bright sunshine hours. The maximum of 12.74 hrs/day has been recorded during April and the minimum of 5.74 hrs/day is recorded during November. The temperature data indicate higher and lower temperatures prevailed during monsoon period. The average maximum temperature during May is 35.93o C. The average minimum temperature recorded is 23.85o C during January. The annual mean minimum and maximum temperatures are 23.78 and 33.95o C respectively.

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

S.No	Details of Parameters	Data collected
Soil edaphic parameters		
1.	Soil pH	8.02
2.	Soil types	Black soil with clay, sandy soil
3.	Total organic carbon	6.22
4.	Electrical conductivity	0.86
5.	Water holding capacity	34.04%
6.	Total Nitrogen	2542 ppm
7.	Available Phosphorous	11.04 ppm
8.	Exchangeable Potassium	11.45 ppm
Environmental parameters		
1.	Minimum Temperature	11-21.2°C
2.	Maximum Tempearture	27-30.8°C
3.	Minimum Relative humidity	24.5-63.9%
4.	Maximum Relative humidity	25.4-98.3%
5.	Annual Average Rainfall	668-701mm
6.	Annual Average Sunshine	3-6 hrs/day
7.	Wind speed	18.4-21.2 km/h

11. Identification of Plant Species

11.1. Identification of Flowering Plant Species

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

11.2. Identification of Non-Flowering Plant Species

11.2.1. Lichen Identification

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

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

11.2.3. Identification of Algae Genera

Algae are the members of a group of predominantly aquatic photosynthetic organisms of the kingdom *Protista* followed by terrestrial algae found in freshwater and slump areas. Algae are non-flowering and lower group of plants which are green in colour because of presence of chlorophyll pigments in the body called thallus. Algae adopt diverse life cycles, and by size, they range from microscopic *Micromonas* to giant kelps that reach 60 metres (200 feet) in length. Their photosynthetic pigments highly varied when compared to that of higher plants; their cells have features not found among plants and animals. In addition to their ecological roles as oxygen producers, they serve as food base for almost all aquatic life; algae are economically important as a source of crude oil and as sources of food and a number of pharmaceutical and industrial products for humans. Algae are defined as eukaryotic (nucleus-bearing) organisms that photosynthesize. They lack specialized multicellular reproductive structures of plants, but they always contain fertile gamete-generating cells surrounded by sterile cells. Algae also lack true roots, stems, and leaves features they share with the avascular lower plants (e.g., mosses, liverworts, and hornworts). Algae identification key consists of couplets of characteristics using algal description of the specimen based on morphological characterization from 58 Genera to species level identification as per the comprehensive key.

12. Identification of Mammals, Birds, Reptiles, Amphibians and Termites

Birds were observed by visual sightings and by calls also the avifaunal data were observed through the Nikon 8 x 40 binoculars and photographs were taken by Canon 600 D camera (55 – 250 mm). The recorded data was noted in the field work note. Later, the birds were identified with the help of field guide- "Birds of Indian subcontinent" by Richard Grimmett, and the IUCN category of the birds were also noted with the same. The point count and transect line methods were used to record the number of bird species in the study area in which regular visits and personal visits were carried out (Ferenc *et al.*, 2014). The surveys were conducted to understand the distribution of bird species in relation to habitats and nesting behaviour of birds in the study area. Based on survey richness and abundance of bird species were calculated using Shannon-weaver diversity index. Based on available data and species were selected for nest site selection study. Selected species of birds was analyses for its nest site characteristics between the habitats and also plant species preference was enumerated and assessed. The number of breeding bird species and nests found in different habitats as depend variables such as biotic and biotic factors as the independent variable (Jayson and Mathew, 2000).

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

13. Green Campus Audit Observations

It covers both qualitative and quantitative measurements including physical observation of greeneries in terms of growing of terrestrial and aquatic plants, animals and microflora in natural and planted vegetation and their maintenance. Topography, landscape management design and soil erosion control are playing important role in environment sustainable development in the campus. An account of a large number of Oxygen releasing and Carbon dioxide assimilating plants planted in the Campus are taken into consideration to give pure atmosphere to the stakeholders. Establishment of different types of gardens in the campus, rainwater harvesting system, operation of water irrigation, drip and sprinkler irrigation methods may be adopted to improve the green campus. Similarly, biodiversity conservation strategies are very essential to conserve a variety of plant and animal species in the campus ecosystem. Biofertilizers, organic and green manures, cow dung manures and farmyard manures may be used for

the cultivation of plants which may be protected the environmental health that will not cause any air, water and soil pollution. The various Clubs, Forums, Cells, Associations and Student / Staff Chapters such as Eco club, Nature club, Science club, Fine Arts club, Flora and Fauna club, Youth Red Cross, NCC/Student Force and NSS bodies may be involved in green campus initiatives, planning and efforts among stakeholders. Outreach programmes may be conducted for dissemination of Green Campus motto and Green pledge initiatives to rural, tribal and urban people. Academic credentials like taking up major and minor Projects, Dissertations and Thesis work by the students and staff members may be taken into account towards green campus initiatives, planning and efforts. Best practices followed on green campus initiatives in the Organization and recommendations for greening are illustrated in the audit report as well.

13.1. Table 3. Qualitative Measurements of Green Auditing

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

	f. Rain harvesting system, water reservoirs, etc.	✓		
	g. Aquarium and aquatic (hydrophytes) plants		✓	
	h. Establishment of terrace garden, herbal garden, kitchen, zodiac, ornamental gardens, etc.	✓		
	i. Natural Topography or Forest, Planted vegetation	✓		
	j. Water well, Bore well, lake, water reservoir facility	✓		
	k. Water consumption towards plant cultivation, canteen, hostel, machinery cleaning, transport, toilet use			✓
	l. Treated water consumption towards plant cultivation, machinery cleaning, transport, toilet use and etc.		✓	
	m. Per capita water consumption per day calculated (45L/P/C/D)	✓		
7.	Whether plants are tagged properly with their common name and Botanical name for stakeholders?	✓		
8.	Signing of MoU with Govt. and NGOs to disseminate Green campus motto and pledge	✓		
9.	Biodiversity conservation of plants, animals and wildlife, genetic resources (Endangered and endemic species) at each appropriate function and level?	✓		
10.	Are any biofertilizers, organic manures, farmyard manures, vermicompost, green manures and chemical fertilizers used for maintaining plants?	✓		
11.	Establishment of herbal garden, zodiac garden, medicinal garden, kitchen garden, terrace garden and ornamental plants garden in the campus		✓	
12.	Implementation of Government schemes (Swatch Bharath Abhiyan under Clean India Mission)	✓		
13.	Functioning of Nature club, Eco club, Cell, Forum, Association, NCC/Student Force, NSS bodies and Social Service League for students and staff members on biodiversity conservation, green campus development, etc.	✓		
14.	Conduction of awareness programmes and cultural activities on global warming, environmental changes and ecosystem maintenance to the stakeholders	✓		

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15.	Conduction of outreach programmes for dissemination of green campus initiatives, natural resources, environmental pollution and biodiversity conservation to rural, tribal and urban people	✓		
16.	Implementation of composting pits, vermicompost unit, recycling of kitchen wastes collected from Hostels, Canteens, Cafeteria, Food court and other places	✓		
17.	Maintenance of plantations in the campus and steps taken for water scarcity during summer season to maintain plants	✓		
18.	Steps taken for organic, inorganic, toxic, e-waste, biomedical, food, sewage waste management, segregation of wastes and reuse methods	✓		
19.	Public transport, low-emitting vehicles and control of car smokes and exhaust towards environment monitoring	✓		
20.	Observation on the site preservation, soil erosion control and landscape management	✓		
21.	Projects and Dissertation works and Scholarly publications on environmental science and management carried out by students and staff members	✓		
22.	Implementation of advanced methods for watering plantations (Drip irrigation, Sprinkler irrigation, etc.)	✓		
23.	Use of metering for water utility, IoT based watering, automation, water device, remote water lines, etc.			NA
24.	Percentage of Organization's budget for environment sustainability efforts	✓		
25.	Campus facilities for disabled, special needs and or maternity care including security, safety and health infrastructure facilities for stakeholder's wellbeing	✓		

13.2. Table 4. Quantitative Measurements of Green Auditing

S.No.	Details of Plant and animal species	Numbers / Percentage
1.	Total number of Flowering plant species inside the Campus	60 species belonging to 47 Genera under 50 families
2.	Total number of Non-Flowering plant species inside the Campus	10 species belonging to Lichens, Pteridophytes, Bryophytes and Mycoflora
3.	Total number of living Mammals inside the Campus	5 such as Cats, Mice and Dog
4.	Total number of visiting Mammals inside the Campus	5 Species belonging Rabbit, Squirrel and Monkey

5.	Total number of living Birds inside the Campus	10 species belonging Common Myna, House Sparrow, King- crow, House Crow, Jungle Babbler, , Honey bird
6.	Total number of visiting Birds inside the Campus	20 species belonging Mangrove heron, Common Wood shrike, Peacock.
7.	Total number of Aquarium	-
8.	Total number of Aquatic (hydrophytes) plant species	-
9.	Total number of Grasshopper and Termites	Grasshopper: 3 species Termites: 2 species
10.	Total number of Amphibians and Reptiles	Amphibians: 3 species Reptiles: 3 species
11.	Total number of Butterflies and Mosquitos	Butterflies : 20 species Mosquitos: 03 species
12.	Percentage of Forest Vegetation	37%
13.	Percentage of Planted Vegetation	42%
14.	Percentage of Water consumption to total human population	NA
15.	Percentage of Water consumption to total flora and fauna	NA
16.	Per capita water consumption per day	NA

13.3 Flora and Fauna diversity in the RCET Campus

13.3.1. Flora diversity in the RCET Campus

13.3.1.1. Flowering plants diversity in the RCET Campus

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

The observations indicated that the RCET Campus has more than 30-50% of wild, 50-60% native plant species and the other 20-25% plant species are ornamental in nature coming under the planted vegetation. Native plant traits promote the indigenous fauna at the site area. Hence, the accountancy of 35% of the wild traits are

leveraged for the native animals and birds. The most probable natural vegetation of RCET Campus is the dry deciduous type. The remnants of this past vegetation are found in the campus.

The most plants RCET recorded are, *Cassia fistula*, Dypsis lutescens, *Azadiracta indica* L., *Cocus nucifera* L., which are dominant trees species characteristic to the vegetation within the campus.Some of the shrub species like *Ixora finlaysoniana, Cycas revoluta Thunb.*, are also rather common in the campus.

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

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

This campus is rich in grass species like *Andropogon pumilis*, *Apluda mutica*, *Cenchrus ciliaris*, *Asparagus racemosus* Wild., and *Commelina benghalensis* L.

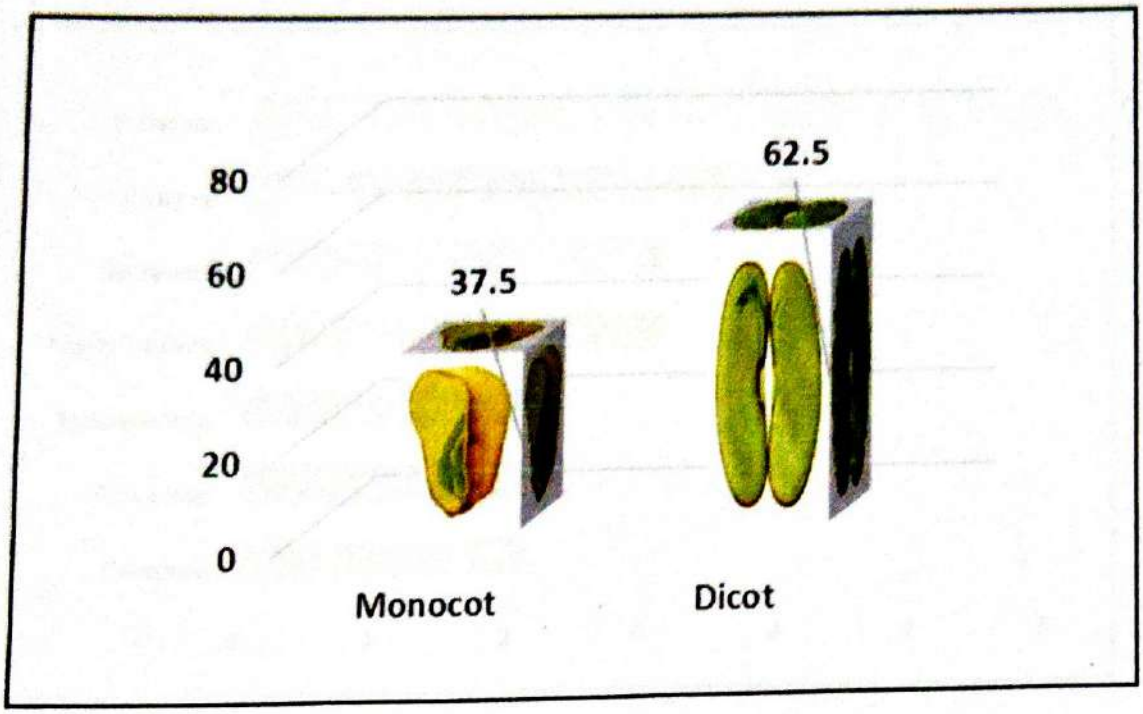
Most of the species found are common in the campus, some of the species *Cucumis dipsaceus* Ehrenb, *Hybanthus, Bothriochloa compressa* (Hook.F.), and *Caralluma bicolor* Ramach., is the rare species. Some endemic grass species like *Andropogon pumilus* Roxb., *Panicum psilopodium* Trin., and *Perotis indica* (L.) Kuntze are also occurring in the campus. Number of above species decreased in number and a few face the danger of going extinct due to anthropogenic activities (regular clearing and construction activities). Hence in terms of conserving the available floral biodiversity, it is pertinent to set up a botanical garden within the campus and cultivate them while protect the ones that grow naturally on the grounds upon the vegetation maintenance.

Invasive species

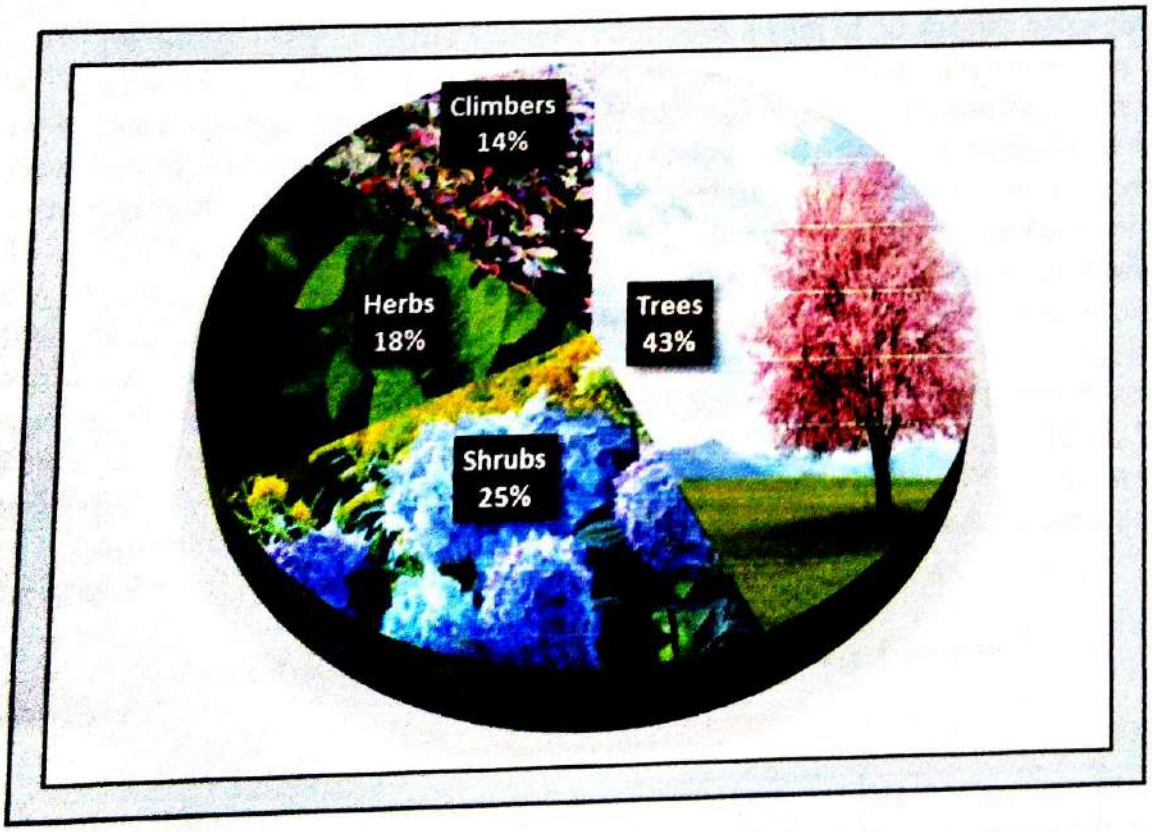
The campus has invasive species such as Wild tamarind *Leucaena leucocephala* L. This is clearly indicated disturbances to the natural setting in the vegetated areas.

The alien / exotic species *viz.*, *Plumeria,* and *Tecoma stans* (L.) Kunth are occur in the campus.

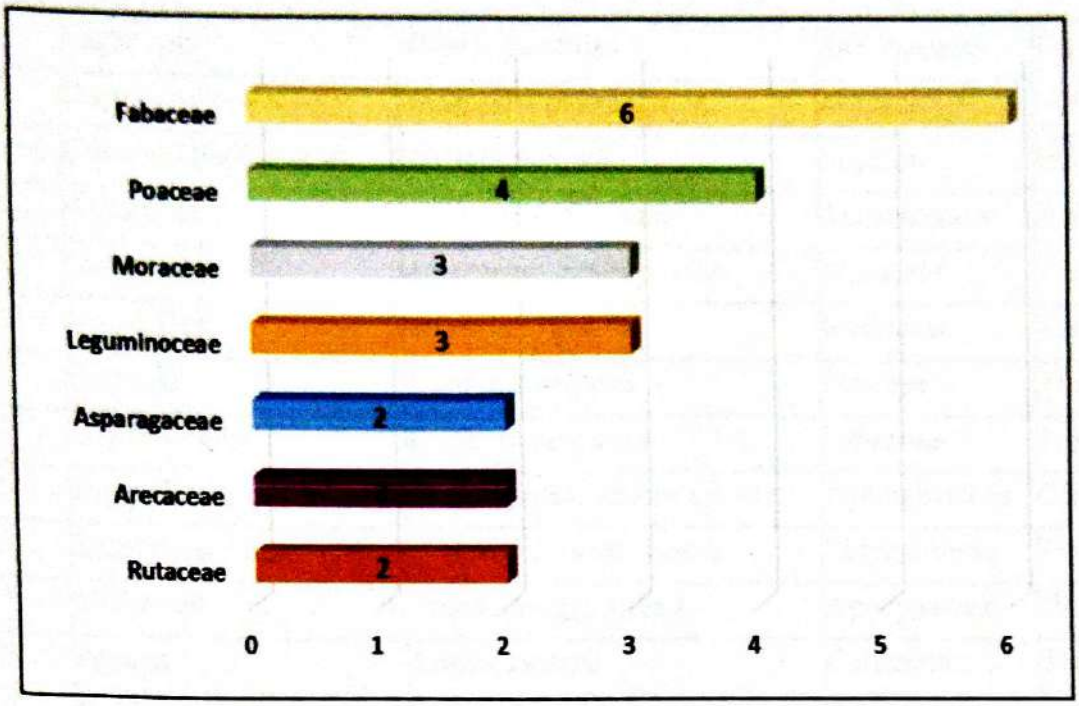
Some of the species are utilized as fruit yielding like *Mangifera indica* L. (Maa), *Psidium guajava* L., (Koyya), *Moringa pterygosperma* Gaertn. (Murungai), Phyllanthus emblica L. (Nelli), *Morinda citrifolia* L., *Phyllanthus acidus* (Amla) and Species such as *Bougainvillea glabra*, *Ixora coccinea* are exploited for their attractive flowers.



Systematic groups of the plants in the RCET Campus



Analysis of Habit-wise distribution of plant species in the RCET Campus



Plant families with higher number of Species in the RCET Campus area

The biodiversity of RCET Campus comprises a sum of 60 species belonging to 47 genera under 50 families besides the lichens, mycoflora, pteridophytes and bryophytes. Among the documented higher plants, Dicots are dominating with 62.5 families followed by monocots (37.5 families). Over all analysis revealed that trees were dominating flora (43%) followed by herbs, shrubs and climbers which accounts 18%, 25% and 14%, respectively. Among the documented dicots, Polypetalae formed a major proposion with 18 families, 15 genera and 23 species; Gamopetalae with 9 families, 11 genera and 15 species while Monochlamydeae with 10 families, 9 genera and 12 species. In monocots 13 families are spreading over 14 genera belonging to 10 species. Poaceae is first dominant family and followed, fabaceae, Euphorbiaceae, Rubiaceae, Acanthaceae, Apocynaceae and Amaranthaceae with 19, 16, 10, 8, 7, 6, and 5 species respectively. At the time of green campus audit at RCET Campus, a total of 1 invasive floral species were recorded. This clearly specified the disturbances to the natural setting in the vegetated sector.

Table 5. List of Flowering plants in the RCET Campus

S.No	Common Name	Scientific Name	Family	Habitat
1.	Monkey Bush	*Abutilon indicum*	Malvaceae	Herb
2.	Garden sisal	*Agave vivipara*	Asparagaceae	shrub
3.	Spiny amaranth	*Amaranthus spinosus*	Amaranthaceae	Herb
4.	Cashew nut	*Anacardium occidentale*	Anacardiaceae	Tree
5.	King of Bitters	*Andrographis paniculata*	Acanthaceae	Herb
6.	Custard apple	*Annona reticulata*	Annonaceae	Tree

7.	Sugar apple	*Anona squamosa*	Annonaceae	Tree
8.	Flamingo Flower	*Anthurium andraeanum*	Araceae	Herb
9.	Common needle grass	*Aristida pinnata*	Poaceae	Herb
10.	Asparagus	*Asparagus officinalis*	Asparagaceae	Herb
11.	Jack fruit	*Atrocarpus heterophyllus*	Moraceae	Tree
12.	Neem Tree	*Azadiracta indica*	Meliaceae	Tree
13.	Bamboo	*Bambusa vulgaris*	Poaceae	Tree
14.	Butterfly Tree	*Bauhinia purpurea*	Fabaceae	Tree
15.	Paper flower	*Bougainvillea glabra Choisy*	Nyctaginaceae	Climber
16.	Surinamese stick	*Calliandra surinamensis*	Leguminosae	Tree
17.	Milkweed	*Calotropis gigantea* L.	Apocynaceae	Herb
18.	Papaya	*Carica papaya*	Caricaceae	Tree
19.	Golden shower	*Cassia fistula* L.	Fabaceae	Tree
20.	Bright eyes	*Catharanthus roseus* L.	Apocynaceae	Herb
21.	Lemon	*Citrus limon* (L.) Osbeck	Rutaceae	Shrub
22.	Blue pea	*Clitoria ternatea* L.	fabaceae	Herb
23.	Cocunut	*Cocos nucifera* L.	Areaceae	Tree
24.	Variegated Croton	*Codiaeum variegatum*	Euphorbiaceae	Shrub
25.	King sago	*Cycas revoluta*	Cycadaceae	Tree
26.	Indian rosewood	*Dalbergia sissoo*	Leguminosae	Tree
27.	Male bamboo	*Dendrocalamus strictus*	Poaceae	Tree
28.	Dragon tree	*Dracaena reflexa Lam.*	Asparagaceae	Tree
29.	Golden dewdrops	*Duranta erecta* L.	*Verbenaceae*	Shrubs
30.	Areca palm	*Dypsis lutescenes*	Arecaceae	Tree
31.	Fasle Daisy	*Eclipta prostrata*	Asteraceae	Herb
32.	Money Plant	*Epipremnum aureum*	Araceae	Climber
33.	Asthma weed	*Euphorbia hirta* L.	Euphorbiaceae	Herb
34.	umbrella bamboo	*Fargesia murielae*	Poaceae	Shrub
35.	Weeping fig	*Ficus benjamina*	Moraceae	Tree
36.	Bodhi tree	*Ficus religiosa*	Moraceae	Tree
37.	Flame Lily	*Gloriosa superba*	Lilliaceae	Herb
38.	Hibiscus	*Hibiscus rosa-sinensis*	Malvaceae	Shrub
39.	Scarlet jungle flame	*Ixora Coccinea*	Rubiaceae	Shrub
40.	Common Jasmine	*Jasminum officinale*	Oleaceae	Climbers

41.	Mango Tree	*Mangifera indica* L.	Anacardiaceae	Tree
42.	Shame plant	*Mimosa pudica*	Fabaceae	Creeper
43.	Spanish cherry	*Mimusops elunji*	Sapotaceae	Tree
44.	Indian mulberry	*Morinda citrifolia L.*	Rubiaceae	Tree
45.	Curry Leaf Tree	*Murraya koenigii*	Rutaceae	Tree
46.	Dwarf banana	*Musa acuminata*	Musaceae	Tree
47.	Common Basil	*Ocimum basilicum*	Lamiaceae	Herb
48.	Yellow Flame Tree	*Pelthophorum pterocarpum*	Fabaceae	Tree
49.	Canary Island date palm	*Phoenix canariensis*	Arecaceae	Tree
50.	Stone Breaker	*Phyllanthus niruri*	Phyllanthaceae	Tree
51.	Pagoda-tree	*Plumeria alba*	Apocynaceae	Tree
52.	Pomegranate	*Punica granatum*	Lythraceae	Shrub
53.	Sandal Wood	*Santalum album*	Santalaceae	Tree
54.	Asoka tree	*Saraca asoca*	Fabaceae	Tree
55.	Queen palm	*Syagrus romanzoffiana*	Arecaceae	Tree
56.	Tamarind	*Tamarindus indica* L.	Fabaceae	Tree
57.	Yellow Balls	*Tecoma stans* L.	Bignonaceae	Shrub
58.	Teak	*Tectona grandis*	Lamiaceae	Tree
59.	Almond Tree	*Terminalia catappa* L.	Combretaceae	Tree
60.	Tridax Daisy	*Tridax procumbens* L.	Asteraceae	Herb

Melaleuca alternifolia

Ixora coccinea L.

Allamanda cathartica L.

Calotropis gigantea **(L.) Dryand.**

Cocus nucifera L.

Azadiracta indica L.

Araucaria columnaris

Rauvolfia caffra

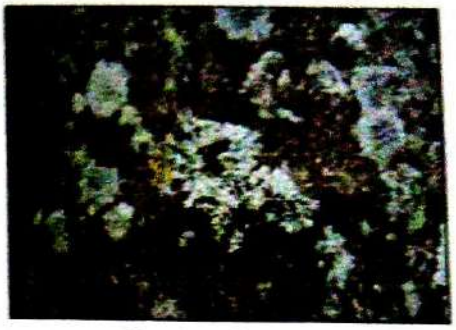
Ficus retusa L.

Termnalia cattappa

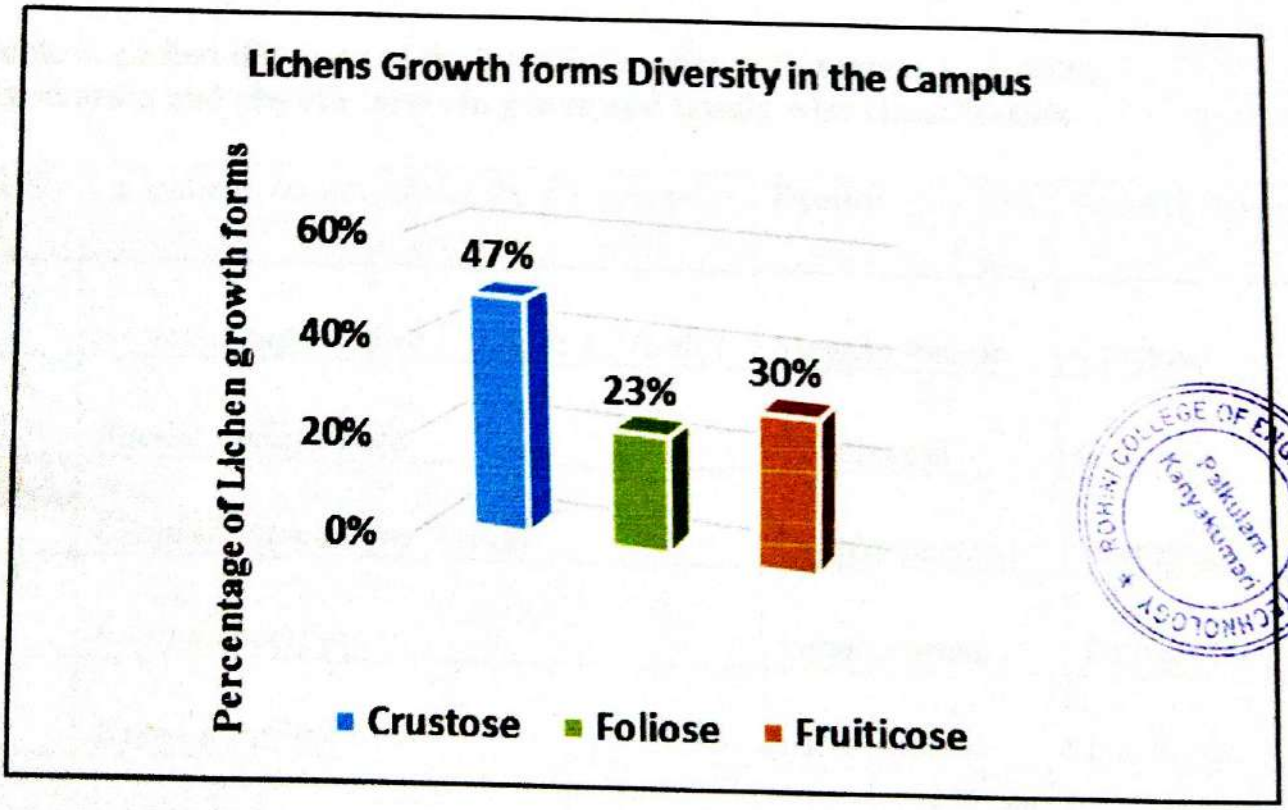
Bambusa vulgaris

Duranta erecta L.

13.3.1.2. Lichen diversity in the RCET Campus



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



Lichen diversity reorded in the RCET Campus showed a total of 5 different lichens species representing 2 genera and 2 families. Three species accounted for 5% of total available lichen diversity and identified up to species level while 52 were RCETrecognized to genus level. The observation on lichen diversity revealed that two types of lichens growth forms belonging to the genus, *Parmotrema and Lecanora* were accounted 5% diversity coming under crustose lichens and three types of foliose lichens belonging too the genus, *Dimeralla*, *Graphis* and *Pertusaria* were accounted. About 2% lichens were found to be one single species in each genus of fruticose lichens.

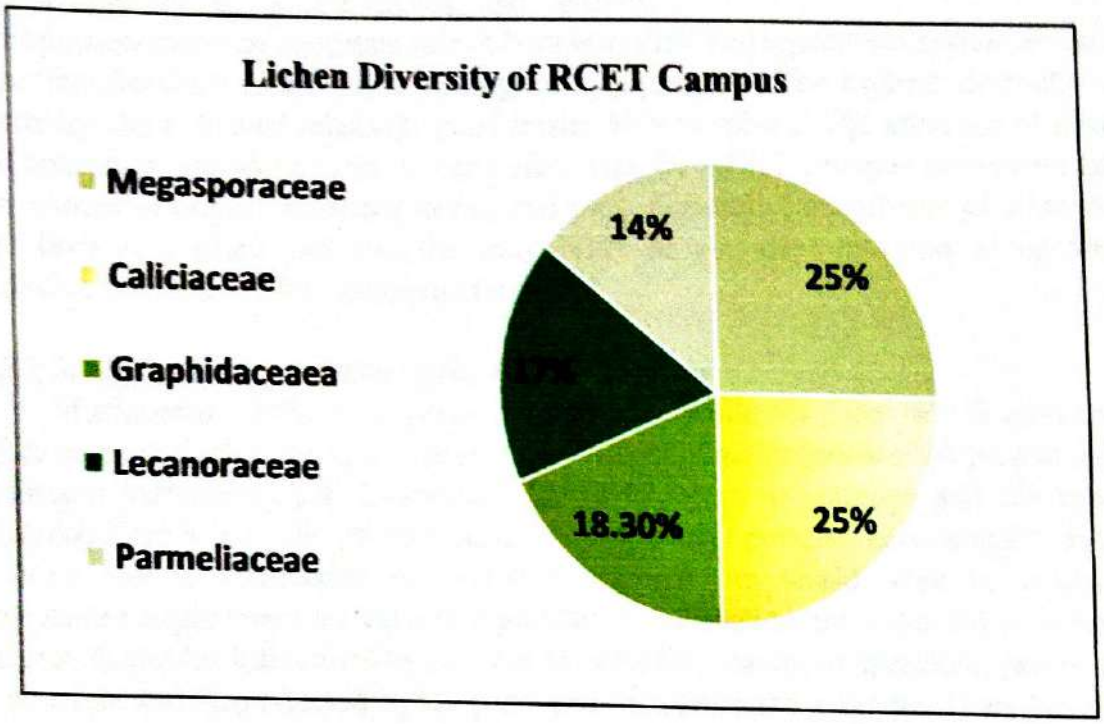


Table 6. Lichen diversity of the RCET Campus with respect to family, substratum and growth forms in genus and family wise classification

S.No	Lichen diversity of the RCET campus	Family	Growth forms
1.	*Aspicilia cuprea* Owe-Larss. & A.Nordin	Megasporaceae	Crustose
2.	*Buellia pullata* Tuck	Caliciaceae	Crustose
3.	*Graphis glauconigra* Vainio	Graphidaceaea	Furticose
4.	*Lecanora perplexa*	Lecanoraceae	Foliose
5.	*Usnea coralline* Mot	Parmeliaceae	Furticose

13.3.3. Algal diversity in the RCET Campus

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

13.3.1.3. Mushrooms diversity in the RCET Campus

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

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

13.3.2. Fauna Diversity in the RCET Campus

13.3.2.1. Birds Diversity in the RCET Campus

The observations on fauna diversity indicated that the RCET Campus has a large number of living as well as visiting animals, birds, reptiles and insects including termites. A total number of 30 birds belonging to the 2 species were recorded from different habitats during winter and summer, of them one of which were endemic to the deccan plateau like purple rumped sunbird. Totally 11 species of birds representing 2 families and 2 orders were observed during this study, passeiformes constituted the

predominated group representing 15. Total number of 6 bird species, out of them 2 species were migrant, 2 species were local migrant during winter and summer season because of unfavourable environment and low availability of food resources. Migratory bird species like Mangrove heron, Common Wood shrike, Black-rumped flameback and Peacock.

Table 7. Birds Diversity in the RCET Campus

S.no	Scientific name	Common name
1.	*Accipiter*	shikra
2.	*Acridotheres tristis*	common myna
3.	*Athenebrama*	spotted owlet
4.	*Bubulcus ibis*	Cattle egret
5.	*Centropusparroti*	barn owl-tylo alba
6.	*Corvus splendens*	House crow
7.	*Egrettagarzetta*	Little egret
8.	*Elanusaxillaris*	black-shouldered kite
9.	*Leptocoma zeylonica*	Purple-rumped sunbird
10.	*Merops orientalis*	Green bee-eater
11.	*Milvusmigrans*	shikra-accipiter babius
12.	*Motacilla*	Indian robin

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

S.No	Common Name	Scientific Name
1.	Koel	*Eudynamys scolopaceus*
2.	Rose-ringed	*Psittacula krameri*
3.	Mangrove heron	*Butorides striata*
4.	Wood shrike	*Tephrodornis Pondicerianus*

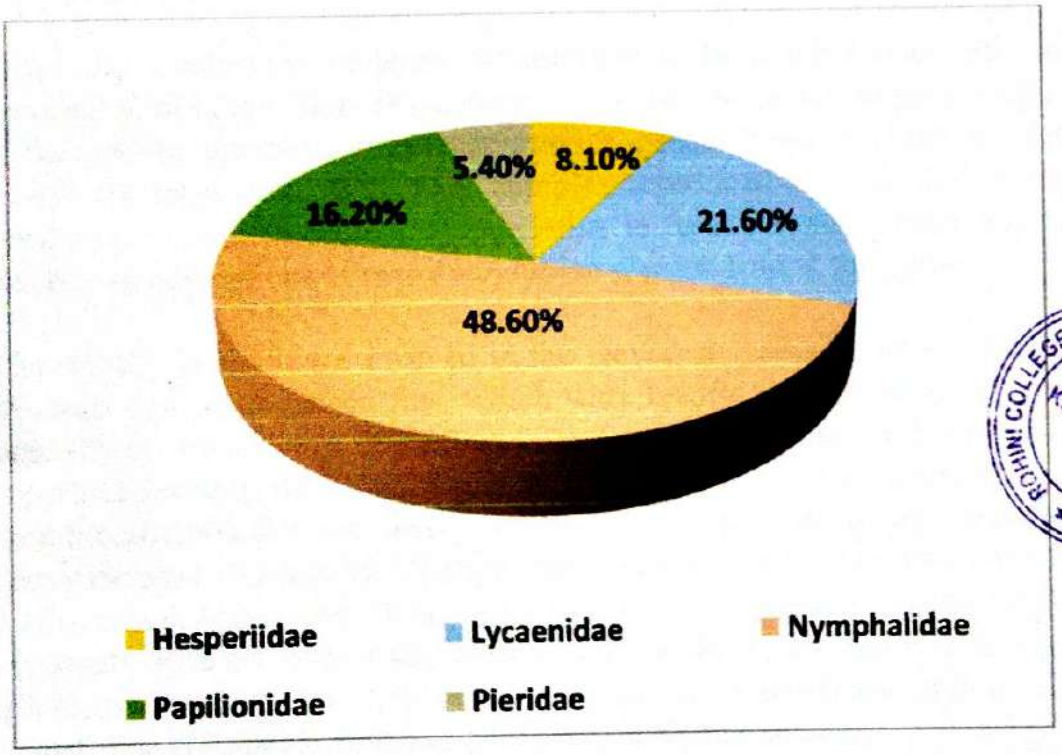
13.3.2.2. Butterflies diversity in the RCET Campus

The RCET Campus has five family level diversities such as Papilionidae, Pieridae, Nymphalidae, Lycaenidae and Hesperiidae in which Common butterflies species such as Mormon, Rose, Birdwing, Emigrant, Grass yellow, Gull Wanderer, Emigrant, Small Orange Tip, Plain Orange Tip, White Orange Tip, Yellow Orange Tip, Pioneer Chocolate, Pansy, Baron, Palmfly, Bush, Brown, Eggfly, Leopard, Sailer, Evening, Brown, Eggfly, Pansy, Grey and Pansy are commonly found.

Table 9. List of Butterflies recorded in the RCET Campus

S.No.	Common Name	Scientific Name	Family
1.	Common hedge	Actolepis puspa	Lycaenidae
2.	Common Hedge Blue	Acytolepis puspa	Lycaenidae
3.	Pioneer	Belenois aurota	Pieridae
4.	Tamil yeoman	Cirrochroa thais	Nymphalidae
5.	Rustic	Cupha erymanthis	Nymphalidae
6.	Plain tiger	Danaus chrysippus	Lycaenidae
7.	Common crow butterfly	Euploea core	Papilionidae
8.	African Marbled Skipper	Gomalia elma	Hesperiidae
9.	Tailed jay	Graphium agamemnon	Papilionidae
10	Yellow Orange Tip	Ixias pyrene	Pieridae
11	Common cerulean	Jamides celeno	Lycaenidae
12	Lemon pansy	Junonia lemonias	Papilionidae
13	Red Pierrot	Talicada nyseus	Lycaenidae
14	Common Grass Dart	Taractrocera maevius	Hesperiidae
15	Blue tiger	Tirumala limniace	Nymphalidae
16	Southern birdwin	Triodes minos	Papilionidae
17	White hedgeqe	Udara akasa	Lycaenidae
18	Painted lady	Vanessa cardui	Nymphalidae

Butterfly Diversity in the RCET Campus



13.3.2.3. Mammals diversity in the RCET Campus

Mammals, a group of vertebrate animals (class: Mammalia), characterized by the presence of mammary glands (where females produce milk for feeding/nursing their young), a neocortex (a region of brain), fur or hair and three middle ear bones. These characteristic features differentiate them from reptiles and birds. Observation on diversity of mammals in the RCET Campus indicated that around 5 Mammal species are commonly distributed. The commonly found mammals are Black-naped Hare, Three-striped Palm Squirrel, Common or Grey Mangoose, Indian Flying Fox, Short-nosed Fruit Bat, House Rat and Indian Mole-rat.

Table10. List of Mammals diversity in the RCET Campus

S.No.	Common Name	Scientific Name	Common Name
1.	Black-naped Hare	*Lepus nigricollis*	Muyal
2.	Three-striped Palm Squirrel	*Funambulus palmarum*	Anil
3.	Indian Flying Fox	*Pteropus giganteus*	Periya Vowaal
4.	House Rat	*Rattus rattus*	Sundeli
5.	Indian Mole-rat	*Bandicota bengalensis*	Peruchali

13.3.2.4. Amphibians diversity in the RCET Campus

Amphibians (class: Amphibia) are ectothermic, tetrapod vertebrates. All living amphibians represent the group Lissamphibia and they inhabit a wide variety of habitats. Most of them living within terrestrial, fossorial, arboreal or freshwater aquatic ecosystems. Amphibians naturally start out as larvae living in water, but some species bypass this by developed behavioural adaptations. Observation made on diversity of Amphibians in the RCET indicated that around 6 species are Amphibians are commonly distributed.

Generally amphibians undergo metamorphosis from larva with gills to air-breathing adult with lungs. Skin of the Amphibians served as a secondary respiratory organ while very few terrestrial salamanders and frogs lack lungs and they rely entirely on their skin for respiration. With their complex reproductive needs and permeable skins, amphibians are often ecological indicators. In recent decades, there has been a drastic decline in populations of many amphibian species around the globe.

Historically, amphibians evolved in the Devonian period from sarcopterygian fish with lungs and bony-limbed fins, which were helpful them to adapt to dry land conditions. Their spread was higher and predominant during Carboniferous and Permian periods and they were later displaced by reptiles and other vertebrates. Over a period, amphibians shrank in size and their diversity decreased drastically, leaving only the modern subclass Lissamphibia. Modern amphibian orders include Anura (the frogs), Urodela (the salamanders) and Apoda (the caecilians). Number of known amphibian species is nearly 50% are frogs. Observation made in the RCET Campus on diversity of Amphibians revealed that around 3 species of Amphibians are commonly disseminated. The commonly found amphibians are listed hereuner.

13.3.2.5. Grasshopper diversity in the RCET Campus

Grasshoppers, a group of insects belonging to the suborder Caelifera and they are probably most ancient living group of chewing herbivorous insects. They are typically ground-dwelling insects with powerful hind legs which allow them to escape from threats by leaping dynamically. As a hemimetabolous insects, they do not undergo complete cycle of metamorphosis. In other word, they hatch from an egg into a nymph or "hopper" which undergoes five moults, to become identical to that of an adult. Grasshoppers hear through the tympanal organ which can be found in the first segment of the abdomen attached to the thorax; its sense of vision is compound eyes. Under certain environmental conditions, some grasshopper species at high population densities can change colour and behaviour besides form swarms. Grasshoppers are plant-eaters; few species at times become as a serious pests of cereals, vegetables and pasture, especially when they swarm to destroy the crops over huge contiguous areas. Surveillance audit at RCET on diversity of Grasshoppers demonstrated that 4 species are Amphibians are commonly distributed which includes *Eyprepocnemis alacris, Crucinotacris decisa and Aulacobothrus luteipes.*

13.3.2.6. Termites Diversity in the RCET Campus

Termites are most successful groups of insects on earth, colonising most landmasses. Their colonies range in size from a few hundred individuals to enormous societies with several million individuals. Eusocial insects, commonly Termites, are taxonomically ranking as infraorder. Isoptera, or alternatively as epifamily Termitoidae, within the order Blattodea (along with cockroaches). Although Termites are habitually known as "white ants", they are not ants and they are not closely related with them. Earlier, Termites were classified as a separate order from cockroaches. Recent phylogenetic studies revealed that they evolved from cockroaches, as they are deeply nested within the group and the sister group found to wood eating cockroaches of the genus *Cryptocercus*. More recent estimates suggest that they have originated during the Late Jurassic period evidenced with the first fossil records in the Early Cretaceous. Termites mostly nourish on cellulose based dead plant material (wood, leaf litter), soil and animal dung. Two species of Termites (*Odontotermes anamallensis, Trivitermes fletcheri)* recorded during on-site Green Campus audit at RCET and they are belonging to the Genera *Odontotermes* and *Nasutitermes*.

13.4. An account of more Oxygen releasing and Carbon dioxide assimilating plants in the RCET Campus

There are some plants which are being considered highly efficient in oxygen releasing and carbon dioxide assimilating (Carbon sinks) which in turn reflected the quality of the green campus. If more oxygen is made available in the campus naturally, the stakeholders may be free from various cardiovascular and pulmonary problems and breathing troubles. *Sansevieria zeylanica* (commonly known as snake plant or the mother-in-law's tongue plant) is unique for oxygen release during night time and it is able to purify the atmospheric air in terms of removal of toxic gases. Although options are available to enhance the level of oxygen by reducing CO_2 with the aid of oxygenators and air purifiers, there are certain alternatives to improve the air quality which is beneficial for both body and mind. Green campus audit at RCET campus revealed that the capus is well distributed with more oxygen releasing and CO_2 assimilating plants such as *Money plant, Neem tree, Tamarind tree, arali,* and *Pongam*

trees. There are 6 plant species which are able create an eco-friendly atmosphere in terms of reducing erosion, moderating the climate, improving air quality and supporting wildlife besides they are economically important and valued for different medicinal aspects.

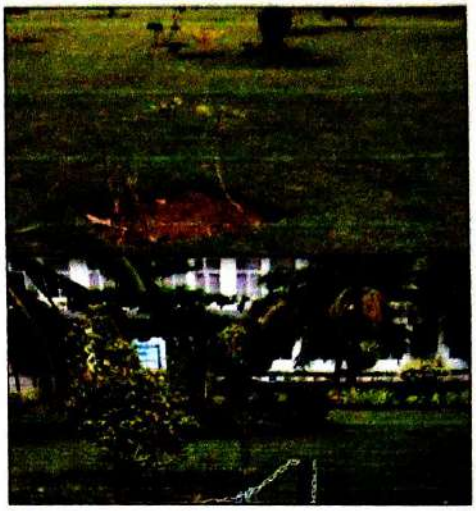
The ornamental plants such as Java Plum / Jamun (*Syzygium cumini*), Yellow Trumpetbush / Yellow Bells (*Tecoma stans*) are made available. In addition, medicinal plant such as *Tinospora cordifolia and Medicinal garden is also* available in the campus.

Oxygen releasing and Carbon dioxide assimilating plants in the RCET Campus

Table 11. List of Oxygen releasing and Carbon dioxide assimilating, Ornamental / Medicinal plants in the RCET Campus

S.No	Plant Name (Tamil Name)	Plant Name (English)	Scientific Name	Grouping / Nature	Characteristic Features of the plant
1.	Kuppaimeni	Copper leaf	*Acalypha wilkesiabna*	Dicots	O_2 releasing Plant
2.	Kattralai	Aloe Vera	*Aloe barbadensis miller*	Dicots	O2 releasing Plant
3.	Vembu	Neem	*Azadirachta indica*	Dicots	O_2 releasing Plant
4.	Munkil	Bamboo	*Bambusa vulgaris*	Monocots	O2 releasing Plant
5.	Kaatu panai	Areca Palm	*Dypsis lutescens*	Monocots	O2 releasing Plant
6.	Arasu	Peepal, Bot-tree	*Ficus religiosa*	Dicots	O2 releasing Plant
7.	Vetchi	Chinese ixora	*Ixora chinensis*	Monocots	O2 releasing Plant
8.	Sinduram	Sxarlet jungle flame	*Ixora coccinea*	Monocots	O2 releasing Plant
9.	Thulasi	Tulsi	*Ocimum tenuiflorum*	Dicots	O2 releasing Plant
10.	Puli	Tamarind	*Tamarindus indica*	Dicots	O2 releasing Plant
11.	Money Plant	Money Plant	*Epipremnum aureum*	Monocots	O2 releasing Plant

13.5. Lawns, Trees, Herbs, Shrubs, Climbers and Lianas in the RCET Campus



Lawns are gazing features of unutilized land made to cover the soil with green grass for the ambience of the place to have a greenish look. Lawn provides a hollow space among the building structures. The shaded trees in between the grass lawn, pathways and garden benches are meaningful lineaments to the green campus. The advantage of lawn is that it prevents the unintended weeds growth in the unutilized landscape areas. Trees that are native to land with medicinal value, ethnicity and environmental value add an advantage to green building. Purpose of trees is to provide shade, atmospheric CO_2 sequestration and supply of oxygen that serves the purpose of a green campus. Herbs are small plants with medicinal values and shrubs are small plants with thick stems and can hold soil to some extent than the herbs and serve the purpose of soil erosion. Climbers can grow with the support of wall structures and the climbers can enhance the wall value with greeneries.

The RCET Campus has a huge number of trees, herbal plants, bushes, climbers, lianas, twiners and lawns. It is further observed that all the plants are growing profusely and showing healthier free from pests and diseases attack. The commonly available native as well as wild shrub species in the RCET Campus are *Bougainvillea spectabilis*, *Cycas revolute*, *Hibiscus rosa-sinensis*, Koranan (*Ixora coccinea*) and erra ganneru *(Nerium oleander)*.

Similar to that of shrubs, there are 3 kinds of herbs available in the RCET Campus. The predominant species of herbs available in the RCET campus are, (Croton) *Tradescantia spathaceae* and (Bright eyes) *Vinca rosea.*

The existence of climber, creepers, twiners and lianas species available which accounted more than seven species in the RCET Campus is Amirtaval (*Tinospora cordifolia*). The major grasses are Arugam Pillu (*Cynodon dactylon*), Korai Pollu (*Cyperus rotundus*) and Crowfoot grass (*Dactyloctenium aegyptium*). Weak stemmed creeper plants grow alongside the ground, depends another plant support, or climb up a wall by means of extending stems or branches. Climbers, include herbs or shrubs, whose stems are weak, which needs support to grow, where it climb up trees and walls and grow vigorously without any pest and disease attach which are observed in the RCET campus.

13.6. Establishment of different Gardens in the RCET Campus

Growing many types of herbal plants having medicinal importance in the campus becomes more attractive and useful if concept gardens are maintained. Medicinal plant gardens can contain the locally available medicinal plants, RET (Rare Endangered Threatened) listed plants and those plants are most useful in terms of economic importance. The tree garden / arborea can be planted based on the zodiac signs which

would attract the public and students, faculties, staff members, employees and educate them based on their uses. In the tree gardens, trees as linings all over the campus can act as oxygen corridors. Native trees along with trees like *Azadirachta*, *Pongamia* and *Ficus* species can be cultivated at the maximum as these plants are used to remove the dust particles and carbon lead from the air and purifies the air considerably. Similarly, the ornamental plants with beautiful flowers can be maintained in the frontage gardens of campus for attraction and good ambience. This will give an overall aesthetic look and also provide fresh air for healthy respiration to the stakeholders.

In RCET, they are planted ornamental plants for the display of appealing characteristic features including: varying types of leaves and their texture, flowers and their fragrance, fruit, stem and bark. In some places, plants unusual features also planted to be of interest, such as the prominent thorns of cactus and snake cactus. There are many varieties of ornamentals plants we are maintaining surrounding of our college campus. In front of principal's room, cafeteria, college grounds and many places planted ornamentals plants. Nearly 100 plants in different places. These plants are making the college campus pleasantly and decoratively. Every year they try to plant new varieties with help of Environmental department. Once in three months the unwanted barks of the plants are cut it down, to make the beautification of their campus. No plant is cut unless it becomes dead. Not only can visitors enjoy seeing the ornamentals plants and also humming birds, butterflies shelter in that. This environment makes campus greenish and pleasant.

13.7. Natural Topography and Vegetation

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

13.8. Rainwater Harvesting System and Percolation Pond

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

rainwater harvesting or any new methods that has the benefit of conserving the water resource as well. A small square shaped pit containing gravels and sands constructed near the building for rainwater harvesting and connected with pipes from the roof of the building to pit. During the audit, there having well developed rain harvesting systems were observed with the RCET Campus. Rainwater harvesting structures have been commissioned in the campus at different locations.

13.9. Landscape design and Soil Erosion control

Landscape management is the maintenance of land to make sure that backgrounds can fulfil the needs and objectives in an effective and sustainable manner for current and future members. It is an action that forms a perception of viable expansion, to ensure the preservation of a panorama, in order to help and harmonize alterations which are supplemented through social, monetary and environmental methods. Landscape design is an important feature for any disasters to control especially with respect to the soil erosion. In general, soil erosion occurs if the design of the land is not altered so as to prevent the slope features by strong vegetation and use of a plant buffer zone as safe for escape of nutrients or fertilizers entering the streams. When the slope features are altered, adequate vegetation can alone be enough to prevent soil erosion. The observation revealed that the RCET Campus has very good landscape design without disturbing the natural vegetation. Contour ploughing is being done at right angles to the slope wherever possible and ridges and furrows are properly maintained to break the flow of water down to the empty land. These activities are widely adopted to control soil erosion in the campus.

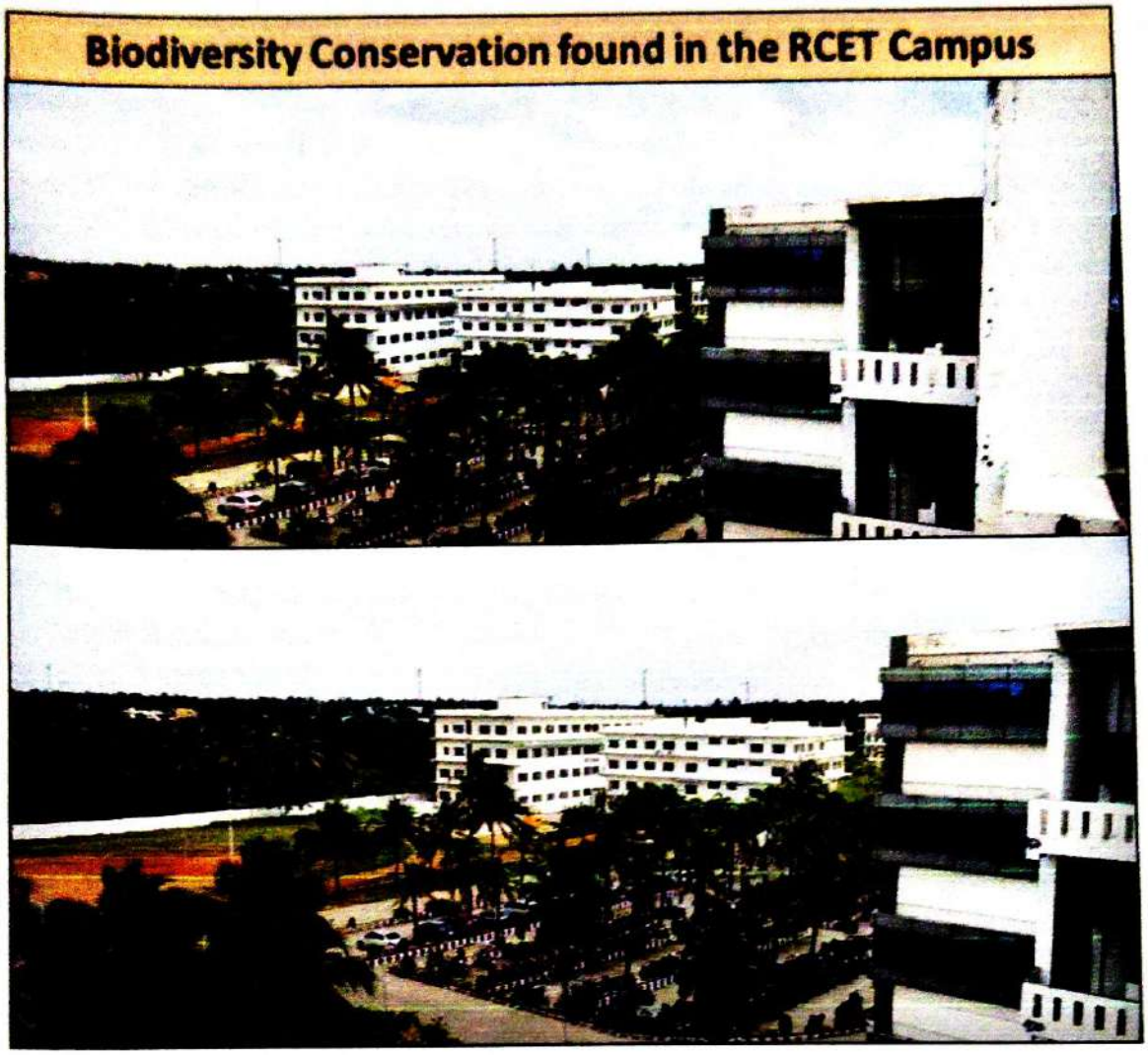
13.10. Operation of Water irrigation, Drip and Sprinkler Irrigation methods

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

13.11. Importance of Biodiversity Conservation

The campus should be a mini biodiversity conservation area, wherein, more greenery due to native plant species, medicinal plant garden, concept gardens, flowering plants that attract bees, birds, beetles and other animals like squirrels should be monitored as ecosystems. Shade giving trees in the paths, flowering trees in the avenues and fruit trees at the back yards also would attract birds, bees, butterflies and squirrels. The RCET Campus is free of exotic plants that cause threat to the natural vegetation. It is like a mini bio-reserve rich in native species and endemic plants. A complete data on the soil type, water holding capacity and soil nutrition in the campus is being thoroughly studied internally or with the Government agriculture departments. It is useful for

cultivation of various native and wild plant species and also helps in choosing the proper irrigation system.



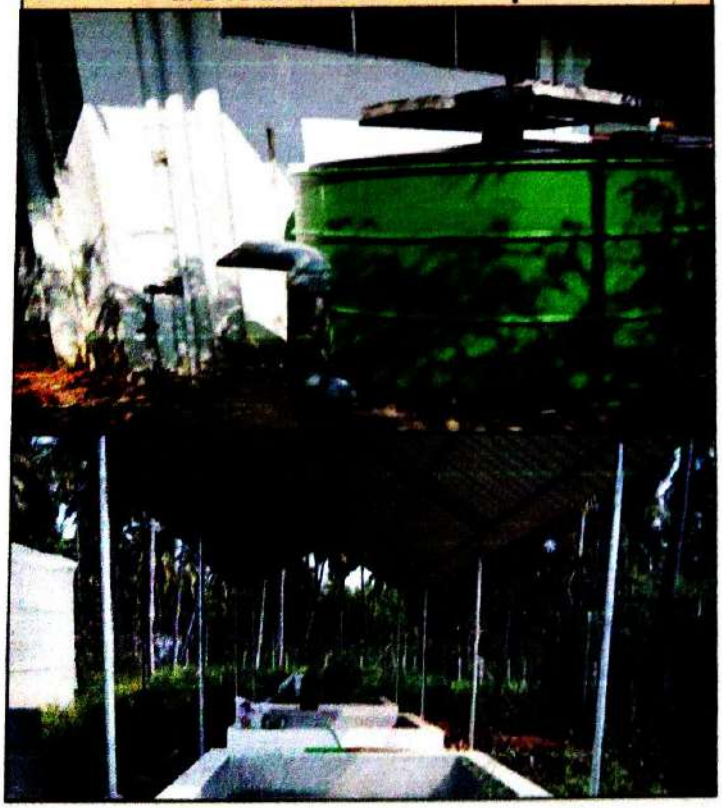
13.12. Pedestrian Path facility at the RCET Campus

The concept of pedestrian path is to give safe space to walk freely by the pedestrian. It is very important in the green campus in terms of freely walk pedestrians or people going on foot without any obstacles. The pedestrian path is otherwise called as zebra crossing by the combination of black and white stripes remained to characterize the zebra. This path is specially designed space to the stakeholders to walk freely without any disturbance. It is useful for cross walk and easy to recognize to walk by means of wide black and white colour combination of lines and authorize to walk while crossing and walking on the foot. In addition, pedestrian path are created in the green campus along with road side which meant for walking only using special cement bricks and stones. The pedestrian path aims to end circulation not only cars, buses, vans, trucks and other vehicles but also giving safe space to the pedestrians, where cross and pass through blocks and also forcing vehicles to comply with it. The RCET Campus is having very good facility in creating pedestrian path for stakeholders.

13.13. Use of Biofertilizers, Organic and Green manures

Natural or eco-friendly methods should be used to grow plants vigorously in the campus which could reduce the environmental pollution. Use of biofertilizers, organic manures (cow dung, vermicompost and plant wastes and litters) and green manures to grow healthy plants in the medicinal plant garden, kitchen garden and terrace garden should be ensured to keep the campus organic. The plant waste such as fallen leaves, stems, fruits, nuts, seeds and other plant parts should be used to make green manures. A concrete or ground level green manure production unit and vermicomposting units will help to convert all the plant and animal based wastes into green/organic manures. This will be a healthy way of solid litter waste management in the campus. Minimal use of chemical fertilizers as part of integrated nutrient management system is acceptable but nil use of chemical fertilizers is highly appreciable and also helps to keep the campus more of an organic ecosystem. The soil, air, water and sunlight are the four major natural resources any campus gets. Proper use and conservation of these resources are mandatory in green campus audit sites. The available resources and their utilization should be accounted for from time to time. Management of the right way of utilization of these resources with the vision of sustainability should be carried out by framing a committee led by the Head of the Institution concerned. Biofertilizers such as Nitrogen fixing bacteria, Potassium and Phosphorus solubilizing bacteria, Potassium mobilizing fungi (VAM), farm yard manure, dried cow dung manure, vermicompost manures and biofungicides and biopesticides are extensively used in the RCET to cultivate plants. Agrochemicals, chemical fertilizers (urea, murate of potash, sulphate of potash, rock phosphate, etc.), pesticides and fungicides are not used. These practices are very well appreciated because air, water and soil pollution due to use of agrochemicals is eradicated which in turn to improve the soil health significantly.

Biogas Production unit and Composting pits are found in RCET Campus



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

Professional implementation of all the Eco plans in the campus should be done through the Eco clubs, Nature clubs, Science clubs, Youth Red cross units, Fine Arts clubs, Women cell, Associations, Forums, SSL, NCC (National Cadet Corps) and NSS (National Service Scheme). All the students, members of staff and employers should be mandatory members of the club and should do tree planting and maintenance of greenery in the campus periodically. Conducting frequent seminars, conferences, workshops, awareness rallies, etc. on topics relevant to the environment is necessary to educate and create awareness among the students and staff members. In addition, student's associations, cells, clubs and forums should be the first hand receivers of all the new plans proposed by the Government such as Swachh Bharath Abhiyan and Jal Shakti Abhiyan under Clean India Mission and implement the same in the campus. The RCET has well developed NCC/Student Force, NSS, Swatch Bharath Abhiyan under Clean India Mission. These bodies are actively involved in tree planting programmes and cleaning the surrounding areas of tribal, rural and urban people across Mannar of Kanyakumari. The RCET is conducting a large number of activities to conserve the nature and to teach about the importance of environment to rural, tribal and urban people.

Free Medical camp organized by the NSS team of RCET

Awareness programmes on the green campus initiatives and dissemination of green motto and pledges are accounted in a sustainable manner. Its benefits and self-

sustainability are being projected for wider centric on earth and Ecology conservation. Innovative practices that add up credentials in implementing the green campus which needs to be promoted in the awareness programme to the students and staff members including public domain. Technology driven solutions initiated by the green campus organization are periodically disseminated and documented successively for propagating the attitude of the green campus in wider masses. The RCET has taken sufficient attempts to disseminate the green campus motto and green pledge such as 'Don't cut trees', 'Don't use plastic bags', 'Don't waste waters', 'Plastic Free Zones' and 'Preserve the Natural Resources' and etc. among the students and staff members in the campus.

Road Safety Awareness Programs given by the students of RCET, Kanyakumari

Tree Plantation Activities found at the RCET

5001 Palm seed sowing and Tree Plantation activities at Palkulam Village by the Students of RCET, Kanyakumari

Tree Plantation Activities found in Rohini College of Engineering and Technology, Kanyakumari

The RCET is implemented the Government schemes (Swatch Bharath Abhiyan under Clean India Mission) to give pure and safe water to rural people and teach the importance of cleanliness of toilets and restrooms to people living in Kanyakumari city. These activities are very important in view of the instantaneous vicinity to undertake progressive programmes and conducted Participatory rural appraisal programmes. It is involving the socioeconomic position of the inhabitants, natural resources, traditional knowledge systems, cropping patterns, etc. of the rural and tribal people. The RCETis also focusing on the development of women, youth, children and dalits and to identify the extension and training needs of the target group through the Department of Women Studies and Career Guidance. It provides the vocational training to marginal farmers to overcome the problem of seasonal employment. Some of areas identified are goat farming, mushroom cultivation, vermicomposting, bee keeping, ornamental fisheries, organic farming and medicinal plant cultivation.

Swacch bharath Activities done by the Students of RCET, Kanyakumari

Plastic Waste Collecting from Palkulam Village and Kanyakumari beach

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

13.15. Establishment of Aquarium and Aquatic plant

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

13.16. Academic credentials: Projects, Dissertations and Thesis work

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

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

1. It is observed that the RCET is maintaining more than 60% of the green cover area after building construction as per the guidelines of World Green Building Council and Indian Green Building Council to provide a healthy environment and ecofriendly atmosphere to the stakeholders. It is calculated that the natural vegetation was 37% and planted vegetation was 42%.

2. The RCET Campus is established in India, belonging to Kanyakumari which provide pure atmosphere to the stakeholders under natural environment, topology, landscape and soil erosion. The campus is established without disturbing the natural vegetation along with the artificially created topography like pathways and parking areas.

3. In view of floral biodiversity in the RCET campus, a sum 80 species belonging to 65 Genera under 60 families covering trees, herbs, shrubs, climbers, lianas, twiners and lawns and 12 species belonging to Lichens, Pteridophytes, Bryophytes and Mycoflora like Mushrooms were recorded. It is observed that all the plants are growing profusely and showing healthier free from pests and diseases.

4. In view of faunal biodiversity in the RCET Campus, a total of 5 living Mammals representing two Genera under two families, visiting Mammal species (5), 25 species of birds, 3 species of Grasshopper, 2 species of Termites, 3 species of Amphibians, 3 species of Reptiles, 33 species of Butterflies and Three species Mosquitos were recorded and documented.

5. The RCET has established rainwater harvesting models, percolation pond to recharge the borewells by collecting rainwaters from the building roofs, open areas and playgrounds including unexplored areas which are channelized to flow of rainwaters to increase the ground water level.

6. The campus has a maximum number of more oxygen releasing and carbon dioxide assimilating plants such as Cocunut tree and Neem tree including some of the shrub and herbal plants.

7. Nature Conservation is well maintained.

15. Recommendations for Greening

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

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

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

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

- *RCET Management has to take smart initiatives towards creating a Green Campus in the areas of green computing and waste management. The desktop infrastructure is virtualized through VMW virtualization technology.*

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

- *Proper treatments for waste were also suggested.*

- *Rain water harvesting systems, solar power generation, environmental education programs have to be strengthened.*

- The RCET has to create 'Medicinal garden' for establishing a massive reforestation / afforestation planting programme in which a large number of trees and shrubs species were planted together with a minimum distance covering fruits, nuts and timber yielding plants are planted. It will be established by following the method of 'Miyawaki Concept' that helps build dense, native forests and to restore the natural potential vegetation, landscape management and control soil erosion.

- Exotic grassland can be replaced by growing native grasses which yield revenue.

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

16. Conclusion

After the establishment of Rohini College Engineering and Technology, Kanyakumari, Tamil Nadu, it has made significant progressive contributions with respect to teaching learning, research and consultancy, innovation and transfer of technology, community service and value education, *in toto*. The RCET is a well-established Private Institution in Kanyakumari which imparts quality education to rural, tribal and urban people across the Nation. This Organization is excellent in terms of academic activities and providing an eco-friendly atmosphere to the stakeholders. The Organization has taken enormous efforts to maintain green campus to the students, research scholars, staff members and parents in a sustainable manner which reflects the importance of the environment and stakeholders. It is conducting a large number of activities for the benefit of rural and tribal community people without disturbing the natural environment, topology, landscape management and vegetation. The RCET Campus is maintaining more than 60% of the green cover area after building construction along with 37% of natural vegetation and 42% planted vegetation.

The natural topography and very good landscape design without disturbing the natural vegetation are being maintained by the RCET. A maximum number of more oxygen releasing and carbon dioxide assimilating plants are being maintained to provide pure atmosphere to the stakeholders. The installation of a rainwater harvesting system, percolation ponds and drip irrigation system to conserve rainwater and ground

water are noteworthy in the campus. The Organization has created medicinal, herbal and ornamental gardens at small scale level for establishing a massive reforestation / afforestation planting programme in which a large number of trees and shrubs species were planted together for providing an eco-friendly atmosphere to the stakeholders in a sustainable manner.

17. Acknowledgement

Nature Science Foundation, Coimbatore, Tamil Nadu, India is grateful to the Principal and IQAC coordinator of the Rohini College of Engineering and Technology, Kanyakumari, Tamil Nadu for providing necessary facilities and co-operation extends during the Green Campus Audit. This helped us in making the audit a magnificent success. Further, we hope Concept of establishing and maintenance of Green Campus proposed by the RCET Management will create Clean and Green Environment and this will be taken care of by up coming generation and propagate further.

Annexure - I

Methodology for Flora and Fauna Identification

I. Identification of Flowering Plant Species

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

Key to Plant Families Identification

1a. Seeds enclosed in fruit wall, Perianth Present.....2
b. Seeds not enclosed in fruit wall, perianth absent.....Gymnosperm
2a. Leaves usually net veined seeds-2.....3
b. Leaves parallel veined, seeds-1.....66
3a. Petals free.....4
b. petals connate 41
4a. Corolla and calyx present.....5
b. Corolla and calyx absent.....24
5a. calyx of united sepals; ovary inferior 31
b. Calyx of distict or unit sepals; ovary syncarpous.....6
6a. Sepals imbricate in bud 7
b. Sepals valvate in bud.....24
7a. Sepals more or less united at the base.....19
b. Sepals free 8
8a. Stamens more than 12 9
b. Stamens 10 or fewer 13
9a. Sepals 2-3.....11
b. Sepals 4 or more.....10
10a. Stamens inserted on the disck..... Cleomaceae
b. Stamens inserted of the gynophore .....Capparaceae

11a. Trees, Petals more or like the sepals; carpels free ..... Mangnoliaceae
b. Herbs, petals coloured unlike the sepals; carpels united.....12
12a. Plants with yellow sap, Flowers pedicelled .....Papaveraceae
B. Plants with watery sap, Flowers sessile.....Portulacaceae
13a. Flowers unisexual, gynoecium apocarpus..... Menispermaceae
b. Flowers bisexual, gynoecium Syncarpous.....14
14a. Petals 4, Stamens 6 .....Brassicaceae
b. Petals 5, Stamens ∞.....15
15a. Ovary1, loculated 16
b. Ovary 2-more loculated..... 17
16a. Flowers actinomorphic, placentas free- central .....Caryophyllaceae
b. Flowers zygomorphic, placentas parietal .....Viloaceae
17a. Filaments of anthers more or less united .....Polygalaceae
b. Filaments of anthers more or less united 18
18a. Leaves stipulate; stamens 5 or 10 19
b. Leaves exstipulate; stamens usually 8 .....Sapindaceae
19a. Style 5; stamen 5 ..... Oxalidaceae
b. Style many; stamens 10 ..... Zygophyllaceae
20a. Leaves pellucid-gland dotted ..... Rutaceae
b. Leaves not gland dotted 21
21a. Placentas parietal; Fruit elongated .....Moringaceae
b. Placentas axile; Fruits not elongated 22
22a. Ovules and seeds pendulous; sometimes horizontal.....Meliaceae
b. Ovules and seeds erect or ascending 23
23a. Stamens alternate with the petals..... Anacardiaceae
b. Stamens opposite the petals .....Vitaceae
24a. Leaves simple; Flowers 3-merous.....Annonaceae
b. Leaves compound; Flowers 4-6 merous 25
25a. Filaments of anther united into a columnar toothed cup.....26
b. Filaments of anther free; rarely connate at the base in ring 28
26a. Stamens 15; anther united .....Stericuliaceae
b. Stamens 2; anther free.....27
27a. Anther unilocular; pollen muricate .....Malvaceae
b. Anther bilocular; pollen smooth .....Bombacaceae
28a. Stamens 4-5; usually embraced and adnate to the base of the petal.....29
b. Stamen many; atleast twice as many as and free from the petals 30
29a. Shrub .....Lythraceae
b. Straggler .....Rhamnaceae
30a. Anther dehisce by slits; fruits capsule .....Tiliaceae
b. Anther dehisce by spores; fruits drupe .....Elaeocarpaceae
31a. Ovary sycarpous; placentas 3-5, parietal.....32
b. Ovary 1 or more free, placentas basal.....33
32a. Climbing herbs tendril.....Passifloraceae
b. Erect shrubs or trees with tendril.....Turneraceae
33a. Ovules arising from the inner angles or from base of the carpels or loculi.....34
b. Ovules pendulous form the apex of the carpels or locules.....Combretaceae
34a. Carpels solitary; fruits legume.....35

b. Carpels more than 1; fruits otherwise.....37
35a. Flowers zygomorphic; petals imbricate.....36
b. Flowers actinomorphic; petals valvate.....Mimosaceae
36a. Upper petals outermost stamens monodelphous or diadelphous.....Fabaceae
b. Upper petals innermost stamens always free .....Caesalpiniaceae
37a. Flowers unisexual.....Cucurbitaceae
b. Flowers bisexual.....38
38a. Ovary 1-celled.....Cactaceae
b. Ovary more than 1 celled.....39
39a. Carpels free if ultimately united the styles distinct.....40
b. Carpels and styles united throughout.....Myrtaceae
40a. Flowers in dichasial – polychasial cyme.....Molluginaceae
b. Flowers in clustered, cymes or solitary.....Aizoaceae
41a. Ovary inferior, stamens as many as the corolla lobes.....42
b. Ovary superior, stamens numerous.....43
42a. Anther free; ovary 2-loculed; stipulate.....Rubiaceae
b. Anther syngenesious; ovary 1-loculed, exstipulate.....Asteraceae
43a. Ovary 1-loculed; placentation free central.....Plumbaginaceae
b. Ovary 2-many loculed; placentation axile or parietal.....44
44a. Ovary 3 or more carplelled.....Sapotaceae
b. Ovary 2-carpelled.....45
45a. Corolla actinomorphic.....46
b. Corolla zygomorphic.....50
46a. Plants leafless; parasitic.....Cuscutaceae
b. Plants leafy ; not parasitic 47
47a. Leaves opposite; stamens 2.....--48
b. Leaves alternate; stamens 4 or more 49
48a. Leaves not scabrid, corolla tube white: fruits berry .....Oleaceae
b. Leaves scabrid; corolla tube orange; fruits capsules .....Nyctanthaceae
49.a. Anther inseperratable; corona present .....Asclepidiaceae
b. Anther seperatable; corona absent .....Apocyanaceae
50a. Corolla lobes imbricate ;fruit drupe .....Boraginaceae
b. Corolla lobes plicate; fruit capsule .....Convolvulaceae
51.a Ovary cells many ovulated .....Solanaceae
b. Ovary cells 1-4 ovuled.....52
52.a Carpels 2 or more ovulated ; fruits dehiscent 53
b. Carpels 1 –ovulated ; fruits indehiscent 57
53.a Fruits dehiscent; seeds supported on reticulae.....Acanthaceae
b. Fruits indehiscent; seeds not supported on reticulae.....54
54.a. Leaves compound; fruits elongated; seeds winged .....Bignoniaceae
b. Leaves simple;fruits not elongated, seeds not winged.....55
55.a. Ovules many on swollen placentas; seeds albuminous.....Scropulariaceae
b. Ovules 2 lobed placenta ; seeds not albuminous.....56
56.a Flowers solitary; axile placentation .....Pedaliaceae
b. Flowers raceme; axile placentation.....Marytiniaceae
57.a Ovary entire, style terminal .....Verbinaceae
b. Ovary 4 –lobed, style gynobasic.....Lamiaceae

58.a Flower bisexual 59
b. Flower unisexual 62
59.a. Ovary inferior 60
b. Ovary superior 61
60.a Ovary 4-6 loculated; ovules many .....Aristolochiaceae
b. Ovary 1-loculated; ovules 1-4 .....Santalaceae
61.a Perianth not tubular .....Amarathaceae
b. Perianth trubular .....Nyctaginaceae
62a. Leafless trees; brachlets ribbed and joined at the nodes.....Casuarinaceae
b. Leaves well developed ; brachlets not ribbed and not joined at the nodes.....63
63 a. Ovary 1- loculed; ovules 1-2 in each loule.....64
b. Ovary 2 or more loculed;ovules 1 or 2 in each locule.....65
64a. Leaves glandular.....Euphorbiaceae
b. Leaves eglandular.....Urticaceae
65a. Filaments inflexed in bud with reversed anther.....Moraceae
b. Filaments not inflexed in bud, not with reversed anther.....Ulmaceae
66a. Terrestrial or epiphytic.....67
b. Aquatic, marsh or riparian.....Cyperaceae
67a. Arbrorescent woody; leaf blade many nerved articulate with sheath...Bambusaceae
b. Herbs with herbaceous culms; leaf blade sessile not articulate with sheath.....68
68a. Perianth 0 or reduced to scale.....Araceae
b. Perianth present.....69
70a. Plant armed.....71
b. Plant unarmed.....72
71a. Plants Xerophytic; leaves fibrous.....Agavaceae
b. Plants not xerophytic; leaves nor fibrous.....Lilliaceae
72 a. Perianth segments connate.....Amaryllidaceae
b. Perianth segments free.....73
73a. Outer perianth calycine; inner coroline.....Commelinaceae
b. Outer and inner perianth.....74

II. Identification of Non-Flowering Plant Species

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

Key to identify the Lichen Genera

Key to Genera

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

Group I

1 a. Thallus leprose,.....*Chrysothrix chlorina*

1 b. Thallus crustose.....*Graphis* sp

Group II

1 a. Lower side of thallus pseudocyphellae, photobiont Nostoc .....*Pseudocyphellaria*
1 b. Thallus lacking pseudocyphellae 2
2 a. Upper cortex thick walled longitudinally oriented, conglutinate hyphae.....3
2 b. Upper cortex otheriwse.....4
3 a. Thallus lower side canaliculated zeorin, norstictic and salazinic acids, and unknown pigments and triterpenoids present.....*Heterodermia leucomelos*
3 b. Thallus lower side no canaliculated only in medulla.....*Heterodermia diademata*
4 a. Cilia bulbate at the base, thallus grey to grey brown .....*Bulbothrix*
4 b. Cilia present or absent, not bulbate.....5
5 a. Rhizines dichotomously branched present throughout the margins....*Hypotrachyna*
5 b. Rhizines restricted to center of lower surface, margin bare, smooth shining.....6
6 a. Lobes narrow, long, dichotomously branched, canaliculate.....*Everniastrum*
6 b. Lobes otherwise.....7
7 a. Lobe margins ciliate.....8
7 b. Lobe margins eciliate.....9
8 a. Salazinic acid present K+ Red cortex.....10
8 b. Salazinic acid absent 11
9 a. Thallus with isidia.....*Parmotrema tinctorum*
9b Thallus with soredia.....12
10 a. thallus emaculate.....*P.stuppeum*
10 b. thallus maculate.....*P.reticulatum*
11 a. Protolichesternic acid in medulla .....*P.grayanam*
11 b. Alectoronic acid in medulla.....*P. nilgherrense*
12 a. Thallus large lobed, loosely attached, mainly corticolous .....*P. austrosinense*
12 b. Thallus smaller, closely to strongly attached, saxicolous.....*P.defectum*

Group III

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

III. Identificayion of Algae Genera

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

Key to identify the Algae species

1A. Plant pigments contained in chromatophores or chloroplasts ----------10
IB. Plant pigments not contained, but diffused through protoplast ----------2

2A. Plants filamentous; cells arranged in trichomes ---------- 4
2B. Plants colonial, not filamentous ---------- 3
3A. Cells in regular rows, in multiples of four; ----------*Agmenellum*
3B. Cells somewhat evenly arranged toward periphery of spherical colony; barely visible gelatinous strands radiate from center of colony to cells ----- *Gomphosphaeria*
3C. Colony asymmetrical; cells very dense and unevenly distributed ---------*Anacystis*
4A. Filaments straight or slightly flexed ---------- 6
4B. Filaments curved, twisted, or spiralled ----------5
5A. Heterocysts and akinetes present ----------*Anabaena*
5B. Heterocysts absent ----------*Raphidiopsis*
6A. Heterocysts present ----------9
6B. Heterocysts absent ----------7
7A. Filaments without a sheath; cells discoid ----------*Oscillatoria*
7B. Filaments with distinct sheath ----------8
8A. Trichomes tangled; sheaths confluent ----------*Phormidiwn*
8B. Trichomes separate; sheaths not confluent ----------*Lyngbya*
9A. Heterocysts terminal ----------*Cylindrospermum*
9B. Heterocysts intercalary ----------*Ahphanizomenon*
10A. Cell walls without punctae or striae ----------31
10B. Cell walls rigid, ornamented with punctae or striae ---------- 11
11A. Frustules adiametric, two or more times longer than wide, elongate ----------15
11B. Frustules isodiametric, generally shorter in length than in diameter, round or elliptical or ovoid or nearly so ---------- 12
12A. Frustules elliptical or ovoid or nearly so ----------14
12B. Frustules discoid or nearly so ----------13
13A. Valves radially punctate ----------*Stephanodiscus*
13B. Valves with two concentric regions, the inner being smooth ----------*Cydotella*
14A. Frustules with marginal keel containing a raphe ----------*Surirella*
14B. Frustules with a pseudoraphe or with a raphe not in a marginal keel ---*Cocconeis*
15A. Frustules cylindrical arranged end to end into filament ----------*Melosira*
15B. Frustules not arranged into filaments ----------16
16A. Frustules with a raphe in at least one valve ----------21
16B. Frustules without a raphe in either valve, pseudoraphe evident ----------17
17A. Frustules united in zigzag chains ----------*Tabellaria*
17B. Frustules not in zigzag chains ----------*Pseudoraphe*
18A. Frustules united laterally ----------*Fragilaria*
18B. Frustules not united laterally ----------19
19A. Frustules united apically forming spokelike colony ----------*Asterionella*
19B. Frustules not forming spokelike colony ----------20
20A. Frustules needle shaped without costae ----------*Synedra*
20B. Frustules with prominant costae ----------*Diatom*
21A. Frustules sigmoid or "S" shaped ----------*Gyrosigma*
2IB. Frustules not sigmoid ---------- 22
22A. Frustules longitudinally symmetrical, other than lunate in valve view --------- 25
22B. Frustules with raphe in both valves, longitudinally asymmetrical, lunate ------ 23
23A. Valves with transverse costae ----------*Epithemia*
23B. Valves without transverse costae ----------24

24A. Raphe a smooth curve with well defined central and polar nodules -----*Cymbella*
24B. Raphe not a smooth curve, gibbose with marginal central nodule -------*Amphora*
25A. Frustules with raphe in both valves ----------27
25B. Frustules with pseudoraphe in one valve and raphe in other valve ----------26
26A. Frustules wedge-shaped in girdle view and cuneate in valve ------*Rhoicosphenia*
26B. Frustules shaped otherwise ----------*Achnanthes*
27A. Raphe extended length of valve; polar nodules; central nodules lacking -*Eunotia*
27B. Raphe restricted to polar regions ----------28
28A. Raphe located in a canal ----------*Nitzschia*
28B. Raphe not located in a canal ----------29
29A. Frustules with symmetrical valves ----------30
29B. Frustules with valves symmetrical but asymmetrical ----------*Gomphonema*
30A. Valves with transverse costae ----------*Pinnularia*
30B. Valves with transverse punctae ----------*Navicula*
31A. Cells solitary ----------45
31B. Cells colonial or grouped ----------32
32A. Cells enclosed in conical to cylindrical lorica; joined lorica have treelike appearance ----------*Dinobryon*
32B. Cells and lorica without treelike appearance ----------33
33A. Colony discoid, one cell in thickness; cells in concentric rings --------*Pediastrum*
33B. Colony not discoid ----------34
34A. Colonies spherical or globose ----------40
34B. Colonies not spherical ----------35
35A. Colony with elongate cells radiating from common center ----------*Actinastrum*
35B. Colony with cells not radiating from common center ----------36
36A. Colony with four to eight cells positioned in linear series ----------*Scenedesmus*
36B. Colony with cells not in linear series ----------37
37A. Colony with arcuate to lunate cells with apices acutely----------*Selenastrum*
37B. Colony with spherical to broadly ellipsoidal cells ----------38
38A. Cells without spines or setae ----------*Crucigenia*
38B. Cells with spines or setae ----------39
39A. Cells quadrate, closely apposed; free face of each cell with spines ----*Tetrastrum*
39B. Cells quadrate and united; free face cell with long delicate setae ---*Micractinium*
40A. Colony with biflagellated cells ----------*Pandorina*
40B. Colony with nonflagellated cells ----------41
41A. Cells lunate to sickle shaped ----------*Kirchneriella*
41B. Cells spherical or nearly so ----------42
42A. Cells borne terminally on dichotomously branched threads -----*Dictyosphaerium*
42B. Cells not on dichotomously branched threads ----------43
43A. Colony a hollow sphere ----------*Coelastrum*
43B. Colony not a hollow sphere ----------44
44A. Colony surrounded by gelatinized and expanded parent cell wall --------*Oocystis*
44B. Colony with cells equidistant and toward periphery ----------*Sphaerocystis*
45A. Cells with median constriction dividing cell into two distinct halves -*Cosmarium*
45B. Cells without pronounced median constriction ----------46
46A. Cells nonflagellated ----------53
46B. Cells flagellated ----------47

47A. Cell walls without polygonal plates ----------49
47B. Cell walls with polygonal plates ----------48
48A. Cells walls of thick plates with distinct sutures ----------*Peridinium*
48B. Cells walls with faintly distinct plates and sutures ----------*Glenodinium*
49A. Cells uniflagellate ----------50
49B. Cells biflagellate ----------*Chlamydomonas*
50A. Cells with two flagella of equal length ----------51
50B. Cells with two flagella of unequal length ----------*Chroomonas*
51A. Cells with single chromatophore ----------*Cryptomonas*
51B. Cells with 2 large chromatophores ----------*Trachelomonas*
52A. Cells surrounded by distinct lorica ----------*Euglena*
52B. Cells without lorica; fusiform to acicular shaped; posterior end ----------*Schroederia*
53A. Cells acicular to fusiform with ends tapering into long spines --------54
53B. Cells without ends tapering into long spines ----------56
54A. Cells without setae ----------55
54B. Cells with setae ----------*Chodatella*
55A Cells with subpolar or both subpolar and equatorial long setae --------*Golenkinia*
55B Cells with multiple peripheral long delicate setae ----------*Ankistrodesmus*
56A Cells long, slender, and tapered at both ends ----------*Tetraedron*
56B Cells flattened or isodiametric, triangular, quadrangular ----------

IV. Identification of Major Groups of Mushrooms

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

Key to identify the Mushrooms species

1. Mushroom growing on other mushrooms or the decayed remains -------- *Mycotrophs*
2. Growing shelflike on wood (or, if not, then gills *concentric* rather than radial); mushroom *very* tough and leathery, corky, or woody (try tearing it in half); gills tough and hard, sometimes maze-like; cap frequently (but not always) with concentric zones of colour ----------*Polypores*
3. Gills running down the stem, not platelike and thus not easily separable from the cap and stem (try removing an entire "gill" with your fingers or a sharp object); mushroom usually *not* growing on wood ----------*Chanterelles and Trumpets*
4. Gills not as above; mushroom growing on wood or elsewhere ----*Gilled Mushrooms*
5. Stem absent--or, if present, lateral, Flesh in stem tough---------- *Polypores*
6. Raphe a smooth curve with well defined central and polar nodules ---------*Cymbella*
7. Raphe not a smooth curve, gibbose with marginal central nodule ----------*Amphora*
8. Frustules with raphe in both valves ----------27
9. Frustules with pseudoraphe in one valve and raphe in other valve ----------26
10. Colony with cells not radiating from common center ----------36
11. Colony with four to eight cells positioned in linear series ----------*Scenedesmus*
12. Colony with cells not in linear series ----------37
13. Colony with arcuate to lunate cells with apices acutely----------*Selenastrum*
14. Cells acicular to fusiform with ends tapering into long spines ----------*Schroederia*
15. Cells without ends tapering into long spines ----------54

16. Cells without setae ----------56
17. Cells with setae ----------55
18 Cells with subpolar or both subpolar and equatorial long setae ----------*Chodatella*
19. Raphe extended length of valve; polar nodules; central nodules lacking ----*Eunotia*
20. Raphe restricted to polar regions ----------28
21. Raphe located in a canal ----------*Nitzschia*
22. Filaments with distinct sheath ----------8
23. Trichomes tangled; sheaths confluent ----------*Phormidiwn*
24. Trichomes separate; sheaths not confluent ----------*Lyngbya*
25. Heterocysts terminal ----------*Cylindrospermum*
26. Heterocysts intercalary ----------*Ahphanizomenon*
27. Cell walls without punctae or striae ----------31
28. Cell walls rigid, ornamented with punctae or striae ---------- 11
29. Frustules adiametric, two or more times longer than wide, elongate ----------15
30. Frustules isodiametric, generally shorter than round or elliptical or ovoid ------- 12
31. Frustules elliptical or ovoid or nearly so ----------14
32. Frustules discoid or nearly so ----------13
33. Valves radially punctate ----------*Stephanodiscus*
34. Valves with two concentric regions, the inner being smooth ----------*Cydotella*
35. Frustules with marginal keel containing a raphe ----------*Surirella*
36. Frustules with a pseudoraphe or with a raphe not in a marginal keel -----*Cocconeis*
37. Cap round in outline; pore surface not running down the stem, or only slightly running down the stem; spore print not white ----------*Boletes*
38. Mushroom with spines or "teeth"--either on the underside of a cap, or hanging from a branched structure, or clumped in an indistinct mass ----------*Toothed Mushrooms*
398. Mushroom covered in some part with a foul-smelling slime; arising from a soft underground "egg"; variously shaped (like a club or stick, like crab claws, like a lantern, like a Wiffle ball, etc.); frequently found in woods---------- *Stinkhorns*
40. Mushroom more or less shaped like a ball, or like a ball raised up on a stem, or like a ball set on a starfish---------- *Puffballs*
41. Cap shape convex to centrally depressed or vase-shaped; undersurface, smooth, wrinkled, or gill-like; fruiting embedded ----------*Chanterelles*
42. Cap shape oval, pointed, lobed, saddle-shaped, irregular, or thimble-like (never vase-shaped or convex); undersurface absent, or hard to see or define; many (but definitely not all) species fruiting---------- *Trumpets*
43. Stem completely hollow, or hollow with cottony fibers inside; cap with pits and ridges, or longitudinally wrinkled, or fairly smooth (never lobed or convoluted); without reddish or reddish brown shades; found in spring---------- *Morels & Verpas*
44. Found in summer and fall (or spring in warm coastal areas); cap lobed, saddle-shaped, or irregular and whitish, greyish, brownish, or black; stem surface ribbed or "pocketed" in some species ----------*Saddles*
45. Found in summer and fall (or spring in warm coastal areas); cap lobed, saddle-shaped, or irregular and whitish, greyish, brownish, or black --------*Oddballs & Misfits*

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