GREEN AND ENVIRONEMNTAL AUDITS

REPORT

CENTRAL UNIVERSITY OF KERALA

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We also express our gratitude to following officials & staff for showing their keen interest and co-operation, during the course of study. We also convey thanks to maintenance staff who were directly or indirectly involved for collecting the data and field measurements.

Prof. (Dr.) M.S. John, Department of International Relations and Politics	- Chairman
Prof. (Dr.) K.J. Thomas, Department of Physics	- Member
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Prof. (Dr.) Muthukumar Muthuchamy, Department of Environmental Science	- Convener

And, two student namely Mr. Arun Gorati and Mr. Harshit Mishra of Department of Environmental Science.

We hope that the recommendations and assessment given in the Report will help the management to better utilise in environment systems.

It is well worthy to mention that the efforts being taken and the enthusiasm shown by all the personnel towards clean environment, waste reuse and recycling, water and energy conservation are really admirable.

For URS Verification Pvt. Ltd

Ashok Kumar AGM – Energy & Sustainability

CERTIFICATE

We certify the following

- The data collection has been carried out diligently and truthfully.
- All data measuring devices used by the auditor are in good working condition, have been calibrated and have valid certificate from the authorized approved agencies and tampering of such devices has not occurred.
- All reasonable professional skill, care and diligence had been taken in preparing the Green Audit report and the contents thereof are a true representation of the facts.

URS Verification Pvt. Ltd

Ashok Kumar AGM – Energy & Sustainability

ABBREVATIONS

A	Ampere
CUK	Central University of Kerala
DO	Dissolved oxygen
ETP	Effluent Treatment Plant
HP	Horse Power
hr	Hours
INR	Indian Rupee
KL	Kilo Liter
KV	Kilo Volt
KVA	Kilo Volt Ampere
kW	Kilo Watts
Lit	Litres
LPCD	Litre Per Capita per Day
LPM	Litres Per Minute
M or m	Meter
Max.	Maximum
MBBR	Moving Bed Biofilm Reactor
Min.	Minimum
mm	Milli Meter
MT	Metric Ton
No.	Number
NOC	No Objection Certificate
PF	Power Factor
RO	Reverse Osmosis
RWH	Rain Water Harvesting
STP	Sewage Treatment Plant
TDS	Total dissolved oxygen
V	Voltage
WTP	Water Treatment Plant

HIGHLIGHTS OF GREEN AND ENVIRONMENT AUDIT

Sr. No	Area	Observations	Recommendations
1.	Green campus	• CUK has carried out tree plantation activity. Several types of trees have been planted by students and staff. Also, it is surrounded by indigenous trees of the Kasaragod region.	Assign Scientific name and Common name to the plants present in the campus.
2.	Waste Management	• The Central University of Kerala has 3 Incinerators for the disposal of Municipal Solid Waste (MSW) including biodegradable and non-biodegradable waste. During the audit, it was observed that all 3 incinerators are not in use by the university, and waste is burned openly in the campus. The university is also having one biogas plant having a capacity of 2 m3/Day which was not working during an audit. • The kitchen waste generated at all hostels is collected on a daily basis by a nearby pig farm. • The paper waste was given to Kabadiwala for recycling. It may be used for making briquettes for energy generation. • Dustbins are provided at only a few places on the campus to collect the waste at the source. • The sewerage generated from the main building, teaching department, hostels, guest house,	• Good initiative taken by university towards use of Waste Management but audit team recommend to dispose MSW in an adequate manner and can also get energy from waste by proper segregation and disposal of waste i.e. suitable operation of already installed biogas plant and incinerator plants. • University have Waste Management policy. However, same is not implemented. • Dustbins should be provided at all prominent locations with color code. • It is recommended to use the facility present in the campus on full load basis

		cafeteria, etc. is sent to the treatment plant (STP). • The hazardous or chemical waste generated from the science laboratory is directly sent to ETP for treatment. • But, during an audit, it was observed that ETP and STP are not working on full load/total wastewater generated from a different source.	
3.	Energy Management	• Central University of Kerala has followed all guidelines in the direction of energy conservation and energy-efficient systems. • The four-star system (fans, ACs, and other equipment) has been utilized all over the campus. • Inverter-based air conditioning system has been installed at every place. • LED has been installed at every point on the university campus • Power factor of the university is also 0.99. • Lifts are installed with VFDs at different places.	Good initiative taken by university towards energy management. Whereas, renewable energy options are present in university which can be utilized in future for meeting energy demand.
4.	Carbon free campus	• Six E-vehicles are given to different daily workers of the university like (Electrician, plumbers, drivers, guest house etc.) • Two electrical buggies (car) is provided in the campus for student or teachers movement. • To reduce the pollution in campus for student movements to city, hostels and various location in	Although a good initiative has been taken in form of E-vehicles, shuttle bus service. But, bicycles, few more E-vehicles, cars and buses could be used for students and staffs movement within the campus.

		university shuttle bus service is run which reduces vehicles movement in the campus.	
5.	Water management	• The university is comprises of water treatment plant (WTP) • Sewage treatment plant (STP) was built of 200 KLD for different sewage water treatment. • 8 Reverse Osmosis (RO) with 1000 L water tank is installed at different academic blocks. • Whereas, several 20 L capacity RO is installed in guest house, girls and boys hostel. • The total water consumption of university was around 600 KLD.	Although, after following different measures for water and wastewater treatment on the day of audit some of the plants are not working efficiently. Girls and boys hostel RO are also not working properly. And, the total water consumption of university is also very high.
6.	Rain Water Harvesting	• CUK adopt RWHs system in the campus having 2 submerged tank of 5000 L one in boy's hostel and other in in girl's hostel which is utilized for washroom flushes and in no monsoon condition open well is utilized. Whereas, at several other points RWHs is done ground water recharging.	Good initiative taken by university towards use of Water conservation but a lot more can be done in this area in CUK

EXECUTIVE SUMMARY

The growth of a country begins at its educational institutions, where the environment is considered a key component in development. A clean and healthy environment promotes effective learning and is favorable to learning. Educational institutions are becoming more environmentally conscious, and new innovations are being implemented to make them more environmentally friendly. Several educational institutes use various views to tackle their environmental challenges on campus, such as promoting energy conservation, garbage recycling, water reduction, and water harvesting, among other things.

University activities can potentially have a range of negative environmental consequences. Environmental auditing is the practice of comparing an organization's environmental performance against its policies and objectives. A green audit is an official study of a university's environmental impact at a broader level. Internal environmental audits (Green Audits) are undertaken as part of this practice to assess the current situation on campus.

Green and environmental audits can be a beneficial tool for a university to assess how and where they consume the most energy, water, or resources, and then evaluate how to make improvements and save money. It can also be used to determine the type and volume of garbage, which can be helpful in planning a recycling project or improving a waste minimization strategy. Green auditing and mitigation actions are a win-win situation for the college, the students, and the environment. It can also encourage health awareness and environmental awareness, as well as values and ethics. It gives staff and students a greater knowledge of the campus's environmental impact. Green auditing encourages financial savings via reducing resource consumption. It allows children and teachers to build a sense of ownership, personal accountability, and social responsibility. If self-exploration is a natural and necessary part of a good education, then institutional self-exploration is also a natural and necessary part of a good educational institution. As a result, it is critical that the college assess its own contributions to the long-term future. The function of higher educational institutions in connection to environmental

sustainability is growing more widespread as environmental sustainability becomes an increasingly crucial issue for the nation.

The audit procedure at the Central University of Kerala, Kasaragod included initial interviews with management to define policies, activities, and records, as well as staff and student cooperation in the execution of mitigation measures. This was followed by interviews with staff and students, data collecting via a questionnaire, record review, practice observation, and observable outcomes. Furthermore, the methodology ensured that management and employees are active participants in the university green auditing process.

The baseline data generated for the Central University of Kerala, Kasaragod will be a useful tool for campus greening, resource management, project planning, and execution of the university's sustainable development strategy. The university will be able to compare its programs and operations to those of peer institutions, identify areas for improvement, and prioritize the implementation of future initiatives based on the data available. We anticipate management's commitment to putting the green audit recommendations into action. We are pleased to present the Central University of Kerala, Kasaragod authorities with this green and environment audit report.

This audit report is a result of a study/assessment conducted by the URS team at the Central University of Kerala, Kasaragod, Kerala to assess the actual status of Green and Clean Campus, Waste Management, Energy Resources and Management, Water Resources, and Management, Waste Management, etc. This study is also an assessment of the university preparedness in line with criteria 7 of NAAC, The URS Audit team has conducted Green Audit, Energy Audit, Water Audit, and Waste Audit and reviewed the status of green campus and environmental promotion activities carried out by the university so far. This report has been prepared based on the physical verification, on-site measurement, and document review conducted from 16th June 2022 to 18th June 2022.

Project Title:		**URS Project Report Number:**
Green and Environmental Audits in Central University of Kerala, Kasaragod, Kerala		
Client: Central University of Kerala, Kasaragod, Kerala		
Contact Person: Prof. (Dr.) Muthukumar Muthuchamy, (HOD), Department of Environmental Science		
Date of Audit : 16/06/2022-18-06/2022		
Date of this Report:		**Date of Approval:**
20/08/2022		29/08/2022
Work carried out by: (Team Composition)	Mr. Atin Kumar Pathak – Assessor (Ph. D. Energy Management, M. Tech- Energy and Environment and M. Sc.- Environmental Science) Mr. Dinbandhu Sharma (B. Tech. – Electrical and Electronics)	No Distribution without permission from the client or responsible organization unit
Final Report Verified: (AGM-Energy & Sustainability)	 Name: Ashok Kumar	Unrestricted Distribution

CHAPTER 1

INTRODUCTION

1.1. General

Clean and Environment Audit can be defined as the systematic identification, quantification, recording, reporting, and analysis of components of environmental diversity. The 'Clean and Environment Audit' aims to analyze environmental practices within and outside the university campus, which will have an impact on the eco-friendly ambiance. It was initiated with the motive of inspecting the work conducted within the organizations whose exercises can cause risk to the health of inhabitants and the environment. Through Clean and Environment Audit, one gets a direction as to how to improve the condition of the environment and there are various factors that have determined the growth of carrying out Clean and Environment Audit.

The National Assessment and Accreditation Council, New Delhi (NAAC) has made it mandatory from the academic year 2016–17 onwards that all Higher Educational Institutions should submit an annual Green Audit Report. Moreover, it is part of the Corporate Social Responsibility of the Higher Educational Institutions to ensure that they contribute to the reduction of global warming through Carbon Footprint reduction measures. A green audit is assigned to criteria 7 of NAAC, National Assessment and Accreditation Council which is a self-governing organization of India that declares the institutions as Grade A, B, or C according to the scores assigned during the accreditation.

Clean and Environment Audit focuses on the Green Campus, Waste Management, Water Management, Air Pollution, Energy Management & Carbon Footprint, etc. being implemented by the University Management.

1.2. Overview of University

The Central University of Kerala, Kasaragod, came into being in 2009 under the Central Universities Act 2009 (Parliament Act No. 25 of 2009). The University is founded on the noble vision of a 'Caring Wisdom' and is guided by the lofty ideals of academic and social commitment, moral steadfastness and intellectual and spiritual enlightenment, as reflected in the vision statement. The University opened its academic portals in October 2009 with 17 students enrolled in two PG programmes and operated from a rented building at Nayanmarmoola (Vidyanagar) in Kasaragod town. From this humble beginning the University has grown into an institution offering twenty eight postgraduate and twenty two research programmes with a total enrolment of around 2500 students. The campus of the University known as Thejaswini Hills is located at Periye, Kasaragod on the 310 acres of land allotted by the Govt. of Kerala in 2012. The permanent campus has a built-up area of 6,58,400 Sq Ft. In addition to headquarters located at Periya the University has Law department located at Thiruvalla in Pathanamthitta and BA programme in International Relations is offered at Trivandrum Centre.

With modernization, the use of resources and chemicals has increased which has negatively impacted the environment creating an imbalance in nature. This is now a great matter of concern. Green and Environmental audit is a way to ensure that such negative impacts on the campus environment, due to the development and other activities, are kept at a minimum. Realizing the importance of Green and Environmental audits, the Internal Quality Assurance Cell (IQAC) of the University has constituted a team to work toward such environment-related assessments on Campus.

An Eco-Friendly University agenda for the Central University of Kerala is its road map for building and operating a healthy and self-renewing vibrant Campus community. With the idea to create an environment where youth can be educated to live a sustainable life in harmony with nature, the University has formulated an eco-friendly policy with the following objectives:-

Objectives

- To disseminate and advance knowledge by providing instructional and research facilities in such branches of learning as it may deem fit;
- To make special provisions for integrated courses in humanities, social sciences, science and technology in its educational programmes;
- To take appropriate measures for promoting innovations in teaching-learning process and inter-disciplinary studies and research;
- To educate and train manpower for the development of the country;
- To establish linkages with industries for the promotion of science and technology;
- To pay special attention to the improvement of the social and economic conditions and welfare of the people, their intellectual, academic and cultural development.

Keeping the objectives as enumerated in the Act in mind, the Central University of Kerala is committed to provide instructional and research facilities in all suitable and relevant branches of learning. Special provisions shall be made for integrated courses in Humanities, Social Sciences, Science & Technology in our academic programmes. Interdiscipliniarity will be promoted in the academic courses and research. Innovations in modern teaching-learning process will be implemented, avoiding rigidity and exclusion in extending the borders of learning and research resources. We shall educate and train the manpower for the development of the country; establish linkages with industries for promoting science and technology. The activities of the University will be planned in order to contribute to the improvement of the social and economic conditions of the people by developing their intellectual, academic and cultural resources.

1.2.1. Vision

Driven by the sense of knowledge, wisdom and values, we passionately strive to drawing out the human potential for building a responsible society by mentoring.

1.2.2. Mission

- To extend the frontiers of knowledge facilitating innovation and creativity
- To motivate, encourage and support students to think analytically, critically, socially and culturally.
- To enhance student strengths to help sustainable growth of the nation and the world.
- To prepare students to understand and analyze the real life situations.

1.2.3. *Schools, Departments and Courses*

SCHOOLS AND DEPARTMENTS

School of Biological Sciences

- Department of Biochemistry and Molecular Biology
- Department of Genomic Science
- Department of Plant Science
- Department of Zoology

School of Economics

- Department of Economics

School of Legal Studies

- Department of Law

School of Social Sciences

- Department of Public Administration and Policy Studies
- Department of Social Work

School of Business Studies

- Department of Commerce & International Business
- Department of Management Studies
- Department of Tourism Studies

School of Education

- Department of Education

School of Medicine and Public Health

- Department of Public Health and Community Medicine
- Department of Yoga

School of Cultural Studies

- Mahathma Ayyankali Centre for Kerala Studies

School of Global Studies

- Department of International Relations, Capital Centre
- Department of International Relations and Politics

School of Physical Sciences

- Department of Chemistry
- Department of Computer Science

- Department of Mathematics
- Department of Physics

School of Earth Science Systems

- Department of Environmental Science
- Department of Geology

School of Languages and Comparative Literatures

- Department of English and Comparative Literature
- Department of Hindi
- Department of Kannada
- Department of Linguistics
- Department of Malayalam

Centres in different Schools

- E Sreedharan Centre for Life Skills Education
- Center for Language Skills

1.2.4. Courses Offered

Each department offer M.A./M. Sc. and Ph. D. degree.

1.3. Others

Strategic Plans

Teaching

Continuously strive for enhancements in Teaching – Learning process, through continuous innovations in pedagogy, experimentations. This is done through:

- Developing NEP courses
- Developing Skill component courses
- Employability focused curriculum
- Continuous feedback from stakeholders
- Addressing diverse background of the students by mentoring
- Developing library resources
- Regular contact with eminent academicians across the nation and globe.
- Developing value added courses
- Honorary Professors to bring in expertise
- Continuous Evaluation system

Research

Encouraging, motivating, supporting and Facilitating Faculty and Research scholars to undertake research, Research projects from Governmental and other than governmental institutions,

undertake micro and macro research for developing policy inputs and to encourage publication of research output. This is done through,

- Central Instrumentation facility
- Recognizing and Rewarding faculty for best research
- Continuously improving the lab and research conditions
- Developing an effective research ecosystem and research culture in the University through constant mentoring

Outreach

To interact with the nearby society in understanding the socio-economic, health and cultural issues, to provide a framework to the policy makers for a better understanding. A scheme is in place to integrate Social Work, NSS, Public Health and Medical Departments to undertake a village survey and to organize health and education awareness program and to organize community development programs. This helps students to understand an overall integration with the society.

1.4. Total area of university and constructed/unconstructed

The University is spread in a huge area of 310 Acre with 10 academic buildings, 1 guest house, 5 hostel (boys and girls), sports ground, faculty quarters etc. The various constructed and under construction area with other are presented through tabular form:-

Table 1: Total area of university and constructed/unconstructed

S. No.	Particulars	Area (SqM)
1.	Constructed floor area	31977.27
2.	Constructed area with all floor	63823.3
3.	Under Construction floor area	9951.56
4.	Under Constructed area with all floor	39446.92
5.	Others	125721.13
6.	Greenery	1086866.04
Total Area (1+3+5+6)		1254516.00

1.5. Various facilities in University

Various facilities present in the campus comprises of sports ground, water treatment plant, sewage treatment plant, guest house, hostels, open theatre etc.

1.6. *University Map*

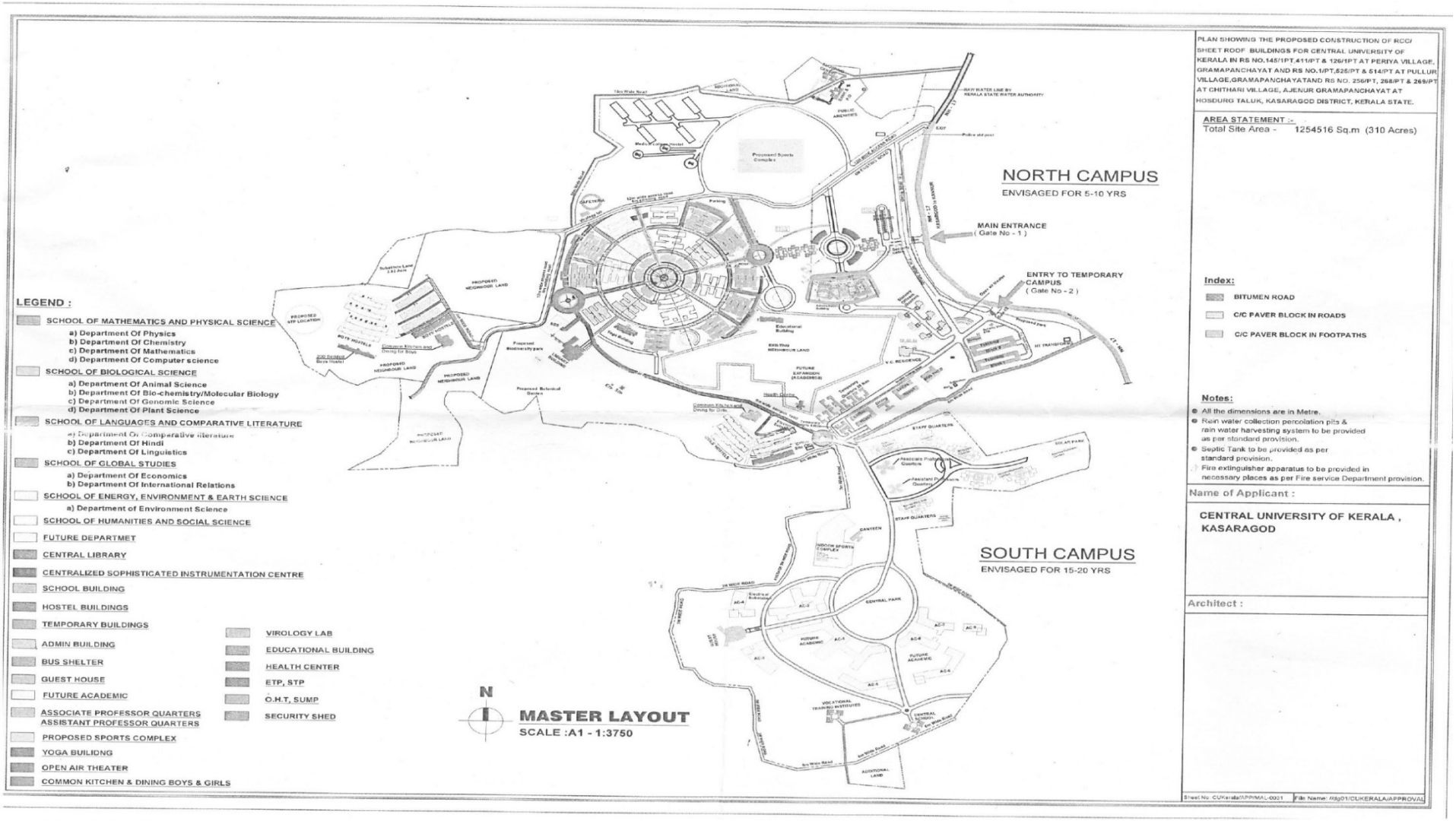


Figure 1: *Map of Central University of Kerala*

(a)

(b)

(c)

(d)

Figure 2: *(a) & (b) Campus main gate; (c) & (d) Arial view of university main campus*

1.7. About URS group

URS is an independent assessment and certification body offering services in the field of Management System Assessments, Training, Climate Change, Social Compliances, Sustainability Reporting Assurance and Energy Audits. URS is a third party audit agency offers services in the field of Green Audit, Water Audit, Environmental Audits, Energy Audits, Electrical Safety Audits, Comprehensive Safety Audits, Verification of GHG inventories under ISO 14064 standard, Sustainability Reporting as per GRI framework and Assurance to Sustainability Reports in line with AA1000AS and Water Footprint as per ISO 14046 standard etc. URS is a Member to Alliance of Water Stewardship (AWS) and Regular Partner to Water Footprint Network (WFN) for conducting water audit and water footprint assessment. URS is also a technical partner to PHD Chamber of Commerce India (PHDCCI) for Water Audit. URS is a regular faculty at Indian Aviation Academy (IAA) for Water Audit Training. URS is also an Energy Saving Company (ESCOs) and Accredited Energy Audit Agency by Bureau of Energy Efficiency (BEE). URS is empanelled and authorized agency with Energy Efficiency Services Limited (EESL), National Productivity Council (NPC for Industry 4.0 Program), Petroleum Conservation Research Association (PCRA), Punjab Energy Development Agency (PEDA) and Maharashtra Energy Development Agency (MEDA). URS is an authorized agency by Delhi Metro Rail Corporation (DMRC) and UP Metro Rail Corporation Limited (UPMRCL) for conducting Environmental Audits and External Safety Audit. For More details visit www.ursindia.com

2. Pre audit stage

The scope and objectives of the audit were reinforced during a pre-audit meeting, and topics related to the audit's practicalities were also covered. As the first opportunity to meet the auditee and address any issues, this encounter is a crucial prerequisite for the clean and environmental audit. The meeting was held in online mode on May 11, 2022. The meeting provided an opportunity to collect data that the audit team could review before visiting the location. At this meeting, the audit protocol and audit plan were distributed and discussed in advance of the audit itself. Before the start of the audit processes, the pre-audit meeting with Central University of Kerala was successfully performed, and the essential papers were obtained via E. Mail from the university. In the pre-audit meeting, the actual planning of the audit processes was discussed. In this meeting, the audit team was also chosen with the assistance of the staff and the college administration. At this meeting, the audit protocol and audit plan were distributed and discussed in advance of the audit itself. To guarantee completion within the audit's scope and short, the audit team collaborated under the direction of the lead auditor.

2.1. Benefits of Green and Environmental Audits

Green audit forms part of a resource management process. Although they are individual events, the real value of green audits is the fact that they are carried out, at defined intervals, and their results can illustrate improvement or change over time. Eco-campus concept mainly focuses on the efficient use of energy and water; minimize waste generation or pollution and also economic efficiency. All these indicators are assessed in process of "Green Auditing of educational institute". Eco-campus focuses on the reduction of contribution to emissions, procure a cost effective and secure supply of energy, encourage and enhance energy use conservation, promotes personal action, reduce the institute's energy and water consumption, reduce wastes to landfill, and integrate environmental considerations into all contracts and services considered to have significant environmental impacts. Target areas included in this green auditing are water, energy, waste, green campus and carbon footprint.

An audit is important as it provides credibility to a set of financial statements and gives the shareholders confidence that the accounts are true and fair. It can also help to improve an organization internal controls and systems.

An environment that is clean and healthy promotes learning and is favorable to learning. To solve concerns with environmental education, there are numerous initiatives worldwide. The most effective and sustainable method of handling environmental issues is through a green audit. Each person who is a part of an economic, financial, social, or environmental aspect is responsible for this form of professional care. Conducting a green and environmental audit on a university campus is essential because it makes students more environmentally conscious and helps them grow into responsible citizens. As a result, green auditing is required in higher education.

To track Central University of Kerala, Kerala environmental performance, a very straightforward indigenous system has been developed. It includes a list of inquiries that must be returned often. This creative programme is simple to use and entirely optional. The purpose of this is to assist the university in educating the younger students and serving as an environmental role model for the neighborhood.

- To provide basis for improved sustainability
- To create a green campus
- More efficient resource management
- To create plastic free campus and evolve health consciousness among the stakeholders
- To enable waste management through reduction of waste generation, solid- waste and water recycling

- Point out the prevailing and forthcoming complications
- Authenticate conformity with the implemented laws
- Recognize the cost saving methods through waste minimizing and managing
- Developing an environmental ethic and value systems in youngsters
- Green auditing should become a valuable tool in the management and monitoring of environmental and sustainable development programs of the university
- Empower the organizations to frame a better environmental performance
- Enhance the alertness for environmental guidelines and duties
- Impart environmental education through systematic environmental management approach and Improving environmental standards
- Benchmarking for environmental protection initiatives
- Financial savings through a reduction in resource use
- Development of ownership, personal and social responsibility for the University and its environment
- Enhancement of university profile

2.2. University Commitment

During the pre-audit meeting, the university management demonstrated their dedication to clean and environmental auditing. They were prepared to support any green activity. After the green audits, it was agreed to support all environmentally friendly initiatives, including environmental awareness campaigns, campus farming, increasing the number of trees on campus, etc. The university administration was open to developing policy based on the results of the green audit.

2.3. Scope of work

The Scope of services primarily includes auditing the green cover and biodiversity of the main campus, energy source and efficiency of the built environment of all campuses, environmental quality of the main campus viz., water & soil quality, and the waste management practices.
The Scope of Services to be provided by shall include the following sub-audits which are indicative and mandatory but not exhaustive:

1. Green Audit

a. Land use/ Land cover mapping of the campus
b. Floral and faunal diversity
c. Built environment - eco-friendly campus

2. Waste Audit

1. Policy & Practice
2. Waste Generation Per Capita
3. Solid Waste
4. Biomedical Waste
5. E-Waste
6. Hazardous Waste
7. Effluent Treatment Plant

3. Energy Audit

1. Policy & Practice
2. Energy Resources & Supply
3. Energy Demand Per Capita
4. Energy Efficiency & Renewable Energy

4. Water & Soil audit

1. Water Resources & Management
2. Water & Soil Quality Analysis
3. Water Treatment Plant
4. Sewage Treatment Plant

The scope of services shall also include the following:

1. Execution Plan of the above Sub-Audits
2. Co-ordination with CUK sections/ Departments, and with Audit Committee Coordinators for data
3. Pre-audit and post-audit meetings before report finalization

3. Objective of the study

The main objective of the Green and Environmental Audit is to promote the Energy, Water, Waste, Environment Management and Conservation in the College Campus. The purpose of the audit is to identify, quantify, describe and prioritize framework of Environment Sustainability in compliance with the applicable regulations, policies and standards.

The main objectives of carrying out Green and Environmental Audit are:

- To examine real concerns of environment and its Sustainability.
- To suggest sustainable energy usage and water conservation practices.
- To find out various sources of organic and solid waste generation and mitigation

possibilities.

- To secure the environment and cut down the threats posed to human health by analyzing the pattern and extent of resource use of the campus.
- To establish a baseline data to assess future sustainability by avoiding the interruptions in environment that are more difficult to handle and their corrections requiring high cost.
- To bring out a status report on environmental compliance.

4. Methodology of Green and Environmental Audit

A detailed Green and Environmental Audit was conducted at Central University of Kerala, Kasaragod, Kerala from 16th June 2022 to 18th June 2022. The audit team comprised of Environmental Expert, Renewable Energy Expert and Electrical Expert. During the field visit, a range of portable energy audit instruments were used to take various measurements at different sections of the premises. In addition, design and operational data were collected from logbooks and equipment manuals. Discussions were held with various technical personnel at the premises to understand its operations and energy requirements completely. The Green and Environmental audit focused on the study of all major energy consuming equipment and the evaluation of operational efficiency/performance of such equipment from the energy conservation point of view. Also, the study involved assessment various load handling equipment and to assess their utilization. In order to perform green audit, the methodology included different tools such as preparation of questionnaire, physical inspection of the campus, observation and review of the documentation, interviewing key persons and data analysis, measurements and recommendations. The study covered the following areas to summarize the present status of environment management in the campus:

- Water management
- Waste management
- Energy management
- Environmental Awareness
- Green Area management

CHAPTER 2

GREEN AUDIT

2.1. Introduction

Green Audit can be defined as systematic identification, quantification, recording, reporting and analysis of components of environmental diversity. This includes the plants, greenery and sustainability of the campus to ensure that the buildings conform to green standards. This also helps in ensuring that the Environmental Policy is enacted, enforced and reviewed using various environmental awareness programmes.

2.2. Green Management

Unfortunately, biodiversity is facing serious threats from habitat loss, pollution, over consumption and invasive species. Species are disappearing at an alarming rate and each loss affects nature's delicate balance and our quality of life. Without this variability in the living world, ecological systems and functions would break down, with detrimental consequences for all forms of life, including human beings. Newly planted and existing trees decrease the amount of carbon dioxide in the atmosphere. Trees play an important ecological role within the urban environment, as well as support improved public health and provide aesthetic benefits to cities. In one year, a single mature tree will absorb up to 48 pounds of carbon dioxide from the atmosphere, and release it as oxygen. The amount of oxygen that a single tree produces is enough to provide one day's supply of oxygen for people. So while you are busy studying and working on earning those good grades, all the trees on campus are also working hard to make the air cleaner for us. Trees on our campus impact our mental health as well; studies have shown that trees greatly reduce stress, which a huge deal is considering many students are under some amount of stress.

2.3. Land use/land cover mapping of the university campus

The total use/allotted land of the campus is 1254516.00 Sqm and total constructed area of the campus is 114118.3 Sqm, the total under construction area of the campus is 11549.05 Sqm, university garden is spread over 93077.7 Sqm at different location, botanical garden is spread over 40468.6 Sqm and ground in 10926.5 Sqm and rest is covered by dense forest and other (shaded area etc.).

Table 2: Central University of Kerala area wise and building wise details

S. No.	Description	Floor	Built up area in Sqm
Total Area of Campus			
1.	**Total Area**	NA	1254516.00
Constructed Buildings			
1.	Teaching block No. 1 and Two hostel Blocks (Semi-Permanent Building)	G	4206.00

S. No.	Description	Floor	Built up area in Sqm
2.	Kitchen and Dining Block including internal water supply, sanitary installations, drainage and internal electrification, etc. (Semi-Permanent Building)	G	378.00
3.	Teaching block No. 1 (Semi-Permanent Building)	G	2200.00
4.	24 Nos. of Semi-Permanent Transit Quarters	G	2016.00
5.	Construction of utility building	G	432.00
6.	Providing Bulk Electrical Services including HT switch gear, HT cabing, Transformers and DG set (Substation Building Area only)	G	166.93
7.	Open Air Stage	G	174.98
8.	Site office (CPWD)	G	108.00
9.	PG Hostel for Boys at Periya	G + 4	5093.00
10.	PG Hostel for Girls at Periya	G + 4	5093.00
11.	Four Weeler shed, women's room, drivers room and security shed and additional works	G	1156.00
12.	Office Facility for the Engineering Wing of the University	G	160.59
13.	Gangotri Building	G + 1	2739.00
14.	Brahmaputra Building	G + 1	2739.00
15.	Sindhu Building	G + 1	2739.00
16.	Kaveri Building	G + 1	2739.00
17.	Krishna Building	G + 2	4506.00
18.	Godavari Building	G + 2	4506.00
19.	Narmada Building	G + 2	4507.00
20.	Sabarmati Building	G + 2	4968.94
21.	Neyyar Boys Hostel	G + 4	1586.82
22.	Pamba Girls Hostel	G + 4	2850.35
23.	Reading hall facility at Kabani Hostel	G	280.00
24.	Sewage Treatment Plant	G	117.15

S. No.	Description	Floor	Built up area in Sqm
25.	Yoga Building	G + 1	1413.00
26.	Saraswathi Building	G + 1	1920.00
27.	Nilagiri Guest House	G + 1	2374.00
28.	Police Aid Post	G	19.44
29.	Common Dining and Kitchen- Girls	G	1154.00
30.	Common Dining and Kitchen- Boys	G	1154.00
31.	Health Centre	G	325.90
Under Construction Buildings			
1.	Central Library Building	G + 1	3402.00
2.	Administration Building	G + 2	6339.00
3.	Girls Hostel	G + 4	4548.00
4.	Boys Hostel	G + 4	4548.00
5.	Staff Quarters for Associate Professor (20 Nos.)	G + 4	3613.60
6.	Staff Quarters for Assistant Professor (20 Nos.)	G + 4	3480.00
7.	2nd 100 seater OBC Girls hostel	G + 3	1495.00
8.	2nd 100 seater OBC Boys hostel	G + 3	1196.00
9.	200 seater Girls (PMJVK) Ministry of Minority	G + 4	4771.30
10.	200 seater Boys (PMJVK) Ministry of Minority	G + 3	4771.3
11.	100 seater SC Boys (BJRCY) Ministry of Social Justice	G + 3	1236.52
12.	200 PMJVK + 100 SC Boys connecting corridor	G + 4	46.2
Constructed road area			
1.	Road	NA	83792.3
Other Areas			
1.	Gardens	NA	93077.7
2.	Botanical garden	NA	40468.6
3.	Ground	NA	10926.5
4.	Forest and other	NA	210437.00

2.4. *Floral diversity observation*

Central University of Kerala is surrounded by flourishing green belt and forest. Although Kerala itself is very green and forest dense area and campus is located in the vicinity of many trees (species) to maintain the bio-diversity. The total green area of campus was 210437 Sqm. Various tree plantation programs are being organized at university campus. This program helps in encouraging eco-friendly environment which provides pure oxygen within the university and awareness among students. The plantation program includes various type of indigenous species of ornamental and medicinal wild plant species. The university is also home of many fauna species and birds; whereas various other birds are also seen during different seasons of the year. The university is expanded in 1254516.00 Sqm area and is surrounded by green forest at one side and buildings on the other side of the campus. Although university is build up with many gardens and tress are planted all over the campus.

As university is in its initial phase and it been three years in new campus, therefore the trees planted around road side, gardens and other areas are new and there height and canopy is less. In coming years the campus will definitely covered with the larger tress and road will be covered with tress canopy. It has also observed that the trees planted are not flowering/fruits so we recommended to plant more tress which produces fruits in different season this will help the student to be familiar with the fruits tress. Also, the plantation should be more comprises of tress of *Ficus* family, *Alstonia Scholaris* which help in reduction of sound pollution and has the highest carbon dioxide reduction potential as well.

The horticulture department of the university also grows different fruits and sale to the faculty, students and staff which is one of the great initiative by botanical and horticulture department and the amount collected is utilized for purchase of different fertilizers etc. There are around 114 indigenous species found in university and many other species of plants of fruits, medicinal is grown by botany department in separate land and spread all over the campus. Some of the flora species found in campus is tabulated in Table 3 and few important plant species present in the campus is shown through Table 4.

Table 3: Flora Details of Central University of Kerala

S. No.	Scientific name	Common name
1.	*Ayapana triplinervis*	Water hemp
2.	*Amaranthus spinosus*	Spiny amaranth
3.	*Aloe vera*	Aloevera
4.	*Bacopa monnieri*	Water hyssop
5.	*Adhatoda vasica*	Malabar nut

S. No.	Scientific name	Common name
6.	*Annona muricata*	Soursop
7.	*Alpinia galanga*	Siamese ginger
8.	*Capsicum frutescens*	Bird eye chilli
9.	*Annona squamosa*	Sugar apple
10.	*Areca catechu*	Arecanut
11.	*Argyreia nervosa*	Elephant creeper
12.	*Biancacea sappan*	Sappan wood
13.	*Bryophhyllum pinnata*	Miracle leaf
14.	*Biophytum sensitivum*	Little tree plant
15.	*Bauhinia sp.*	Orchid-tree
16.	*Carica papaya*	Pappaya
17.	*Hemidesmus indicus*	Sarsaparilla
18.	*Baliospermum montanum*	Redphysic nut
19.	*Acacia catechu*	Black cutch
20.	*Calophyllum inophyllum*	Tamanu
21.	*Cinnamomum verum*	Cinnamon
22.	*Citrus limon*	Lemon
23.	*Cassia fistula*	Golden shower tree
24.	*Chamaecostus cuspidatus*	Fiery costus
25.	*Crescentia cujete*	Calabash tree
26.	*Clinacanthus nutans*	Snake plant
27.	*Cnidoscolus aconitifolius*	Tree spinach
28.	*Coleus barbatus*	lndian borage
29.	*Eryngium foetidum*	Wild coriander
30.	*Curcuma longa*	Turmeric
31.	*Desmodium gangeticum*	Salparni
32.	*Elephantopus scaber*	Elephants foot
33.	*Centella asiatica*	Indian penny wort
34.	*Emblica officinalis*	Indian goose berry
35.	*Hiptage benghalensis*	Hiptage
36.	*Homalocladium platycladum*	Centipede Plant
37.	*Garcinia cambogia*	Malabar Tamarind
38.	*Geophila repens*	Rubiaceae
39.	*Gmelina arborea*	Beechwood

S. No.	Scientific name	Common name
40.	*Hemigraphis colorata*	Red ivy
41.	*Justicia beddomei*	Tamil Nadu Vasa
42.	*Inula recemosa*	Oriss root
43.	*Justicia adhatoda*	Malabar nut, adulsa
44.	*Leucas aspera*	Common leucas
45.	*Lawsonia inermis*	Henna
46.	*Loeseneriella arnottiana*	Arnott's Hippocratea
47.	*Justicia gendarussa*	Willow-leaved justicia
48.	*Lagerstroemia speciosa*	Queen's crepe-myrtle
49.	*Leea indica*	Bandicoot berry
50.	*Limonia acidissima*	Wood apple
51.	*Aquilaria malaccensis*	Agar wood tree
52.	*Nyctanthes arbor-tristis*	Night flowering jasmine
53.	*Mangifera indica*	Mango Tree
54.	*Mansoa alliacea*	Garlic vine
55.	*Ocimum basilicum*	Sweet basil
56.	*Curcuma aromatica*	Wild turmeric
57.	*Phyllanthus amarus*	Phyllanthus
58.	*Ocimum sanctum*	Holy basil
59.	*Orthosiphon aristatus*	Java Tea
60.	*Morinda citrifolia*	Indian mulberry
61.	*Mimusops elengi*	Spanish cherry
62.	*Chrysopogon zizanioides*	Vetiver
63.	*Monoon longifolium*	Asoka
64.	*Artemisia nilagarica*	Flea bane
65.	*Passiflora edulis*	Passion fruit
66.	*Scaevola taccada*	Beach Cabbage
67.	*Psidum guajava*	Guava
68.	*Piper nigrum*	Black pepper
69.	*Piper betle*	Betel leaf
70.	*Pogostemon cablin*	Indian patchouli
71.	*Phyllanthus niruri*	Gale of the wind
72.	*Talinum fruticosum*	Waterleaf
73.	*Simarouba glauca*	Paradise-tree

S. No.	Scientific name	Common name
74.	*Ricinus communis*	Castor
75.	*Scaevola taccada*	Sea lettuce
76.	*Premna serratifolia*	Buas-Buas
77.	*Murraya koenigii*	Curry leaf
78.	*Tinospora cordifolia*	Heart-leaved moonseed
79.	*Streblus asper*	Siamese rough bush
80.	*Sida rhombifolia*	Arrow leaf sida
81.	*Strobilanthus ciliata*	Lesser kurinji
82.	*Tamarindus indica*	Tamarind
83.	*Eclipta prostrata*	Trailing Eclipta Plant
84.	*Xanthostemon chrysanthus*	Common penda
85.	*Terminalia catappa*	Indian Almond
86.	*Terminalia arjuna*	Arjun tree
87.	*Psoralea corylifolia*	Babchi
88.	*Santalum album*	Sandalwood
89.	*Moringa oleifera*	Drumstick tree
90.	*Musa paradisiaca Linn.*	Banana

Table 4: *Photograhs of some Flora present in Central University of Kerala*

Some medicinal present in medicnal garden of Central University of Kerala maintained by Depratment of Botany	
Scientific Name:- *Chrysopogon zizanioides* **Common Name:-** Vetiver	**Scientific Name:-** *Rauvolfia serpentina* **Common Name:-** Indian snakeroot

Scientific Name:- *Coleus zeylanicus* **Common Name:-** Hribera	**Scientific Name:-** *Pogostemon cablin* **Common Name:-** Indian pachouli
Scientific Name:- *Cissus quadrangularis* **Common Name:-** Devil's backbone	**Scientific Name:-** *Inula recemosa* **Common Name:-** Oriss root

Scientific Name:- *Ricinus communis* **Common Name:-** Castor	**Scientific Name:-** *Bahospermum montanam* **Common Name:-** Redphysic nut
Some plants present in botincal garden of Central University of Kerala maintained by Depratment of Botany	
	
Scientific Name:- *Amaranthus spinosus* **Common Name:-** Spiny amaranth	**Scientific Name:-** *Terminalia arjuna* **Common Name:-** Arjun tree

	
Scientific Name:- *Piper nigrum* **Common Name:-** Black pepper	**Scientific Name:-** *Tamarindus indica* **Common Name:-** Tamarind
Some common plants present in Central University of Kerala in and around the campus	
	
Scientific Name:- *Mangifera indica* **Common Name:-** Mango	**Scientific Name:-** *Cocos nucifera (L.)* **Common Name:-** Coconut

	
Scientific Name: - *Musa paradisiaca Linn.* **Common Name:-** Banana	**Scientific Name:-** *Psidum guajava* **Common Name:-** Guava

2.5. Fauna

The national bird "peacock" (*Pavo cristatus*) is one of the most beautiful faunal diversity found in university campus and enhance the university beautifulness. There are many other fauna species found in the campus like birds, amphibians, reptiles, bugs, butterflies etc. The list of the same is provided in Table 5 and photographs of the fauna taken during audit and by students is given through Table 6.

Table 5: *Fauna Details of Central University of Kerala*

S. No.	Scientific name	Common name
BIRDS		
1.	*Pavo cristatus*	Peacock
2.	*Pycnonotus jocosus*	Red wisked Bulbul
3.	*Pycnonotus cafer*	Red Vented Bulbul
4.	*Columbidae*	Pigeon
5.	*Loriculus vernalis*	Vernal hanging parrot
6.	*Turdoides affinis*	Yellow billed babblers
7.	*Turdoides striata*	Jungle Babblers
8.	*Turdoides subrufa*	Rufous babbler
9.	*Dicrurus macrocercus*	Black drongo
10.	*Meropidae*	Bee eater
11.	*Lonchura punctulata*	Scaly breasted munia (nesting)

S. No.	Scientific name	Common name
12.	*Corvus brachyrhynchos*	Common crow
13.	*Corvus macrorhynchos*	Jungle crow
14.	*Lonchura Malacca*	Tricolored munia
15.	*Dicaeum erythrorhynchos*	Pale billed flower pecker
16.	*Dicaeum concolor*	Nilgiri flower pecker
17.	*Coturnix coturnix*	Quail
18.	*Lanius cristatus*	Brown shrike
19.	*Jynx torquilla*	Wryneck (First report in Kasaragod)
REPTILES		
20.	*Pythonidae*	Python
21.	*Calotes versicolor*	Garden lizard
22.	*Naja*	Cobra
23.	*Viperidae*	Viper
AMPHIBIANS		
24.	*Pterophyllum*	Angel Fish
25.	*Etroplus suratensis*	Green chromide
26.	*Pomoxis*	Crap
27.	*Carassius auratus*	Gold fish
28.	*Osphronemidae*	Gourami
29.	*Carassius auratus*	Black moor
30.	*Poecilia reticulate*	Guppy
31.	*Brachyura*	Crab
32.	*Paguroidea*	Hermit crab
33.	*Caridea*	Prawns/shrimp
34.	*Astronotus ocellatus*	Oscar fish
35.	*Danio rerio*	Zebra fish
BUGS/BUTTERFLIES		
36.	*Apis dorsata*	Giant honey bee
37.	*Acraea terpsicore*	Tawny coster
38.	*Acherontia*	Death's head Hawk moth
39.	*Atrophaneura hector*	Crimson rose
40.	*Cassidinae*	Tortoise beetle
41.	*Troides minos*	Southern birdwing
42.	*Psychidae*	Bag worm

S. No.	Scientific name	Common name
43.	*Amata phegea*	Nine spotted moth
44.	*Eurema hecabe*	Common grass yellow
45.	*Castalius rosimon*	Common pierrot
46.	*Coccinellidae*	Lady bug
47.	*Common emigrant*	Common emigrant
MAMMALS		
48.	*Canis lupus familiaris*	Dog

Table 6: Photographs of some Fauna present in Central University of Kerala

	
Scientific Name:- *Lonchura punctulata* **Common Name:-** Scaly breasted munia	**Scientific Name:-** *Turdoides subrufa* **Common Name:-** Rufous babbler
	
Scientific Name:- *Dicrurus macrocercus* **Common Name:-** Black drongo	**Scientific Name:-** *Lonchura malacca* **Common Name:-** Tricolored munia
	
Scientific Name:- *Lanius cristatus* **Common Name:-** Brown shrike	**Scientific Name:-** *Pavo cristatus* **Common Name:-** Peacock

	
Scientific Name:- *Viperidae* **Common Name:-** Viper	**Scientific Name:-** *Calotes versicolor* **Common Name:-** Garden Lizard
	
Scientific Name:- *Apis dorsata* **Common Name:-** Giant honey bee	**Scientific Name:-** *Troides minos* **Common Name:-** Southern birdwing
	
Scientific Name:- *Coccinellidae* **Common Name:-** Lady bug	**Scientific Name:-** *Canis lupus familiaris* **Common Name:-** Dog
	
Scientific Name:- *Pterophyllum* **Common Name:-** Angel Fish	**Scientific Name:-** *Brachyura* **Common Name:-** Crab

2.6. Eco-friendly campus initiative

The Green campus drive is an initiative of the university to protect the environment. The college has been declared as a 'No Plastic' zone. The campus protects age old trees in addition to several new trees and plants planted. The campus is lush green with gardens, lawns, flowers and plants wherever there is open space. Rain water is harvested and collected in the well in front of the college. There is a big pond at the far end of the college ground to harvest water. Bio-degradable waste is collected and made into compost. Non-degradable and electronic waste and toxic materials are regularly disposed of. The Nature club of the college has named all the flora of the campus. Important days like World Environment Day, Ozone Day, Hiroshima Day etc are observed and several programmes including processions with placards, competitions and street plays are conducted by various departments and the Nature Club to create awareness in environment protection and conservation. The Department of Environmental Science and Department of Botany regularly conducts drives on nature and fauna. The mini forest was inaugurated at university, with medicinal garden and adopt a tree program in last year as an green initiative.

Figure 3: *Mini forest inauguration at university in the auspicious presence of different officials*

Figure 4: *An initiative of university on adopt a tree inaugurated by Vice chancellor of University*

Figure 5: *Inauguration of medicinal garden at university campus an initiative by Department of Botany*

2.7. Observations

- The Central University of Kerala is a new campus with greenish environment around.
- The university is found with many native flora and fauna species.
- The newly planted species are of 1-3 years, 3-5 years of age. Whereas, the floral species present in forest area is of age 10-15 years and above.
- The university is covered with 38% greener (including forest, gardens etc.) of total area of campus.
- Different birds are seen during the audit which includes peacock, babbler, munia etc.
- University is also found with various native medicinal plants species. And, also a separate medicinal garden is also found in development stage by Department of Botany.
- Celebrate every year 5th June as 'World Environment Day' and plant trees on this day to make the campus more Green.

2.8. Recommendations

- Review periodically the list of trees planted in the garden, allot numbers to the trees and keep records. Assign scientific and common names to the trees.
- Fruits plant and large canopy plants are advice to plant alongside the roads.
- Create awareness of environmental sustainability and take actions to ensure environmental sustainability.
- A separate park or conservative area should be identified in the campus for faunal species to conserve and make it one of the attraction point.

CHAPTER 3

WASTE AUDIT

3.1. Introduction

Waste generation is a continually growing problem at global, regional and local levels. Solid wastes are those organic and inorganic waste materials produced by various activities of the society, which have lost their value to the first user. Improper disposal of wastes pollutes all the vital components of the living environment (*i.e.*, air, land and water) at local and global levels.

3.2. Waste Management

Pollution from garbage causes a lot of litter in our neighborhoods, which can have a negative impact on our health and is unsightly. Birds and other animals can be seriously injured by plastic bags, abandoned ropes, and strings. This indicator covers trash generation and disposal, recycling, and wastes of plastic, paper, and food. General garbage and hazardous waste are the two categories into which solid waste can be separated. Garbage, paper, cans, and glass bottles are examples of general wastes. These items are typically thrown away in households and schools. Waste that poses a risk to human health or the environment, such as gasoline and cleaning products, is referred to as hazardous waste. Unscientific landfills may contain dangerous chemicals that seep into the ground and water systems and contribute to the global greenhouse effect and climate change.

Additionally, solid trash frequently contains unused materials that may be recycled, repaired, or reused to provide better services. Therefore, a sustainable university/institute must reduce its solid waste output. The auditor diagnoses the current waste disposal practices and makes recommendations for the most effective solutions to the issues. The organization must consequently collect its garbage's from various place and dispose it off in a proper manner.

3.3. Policy and practices examination

The scope of waste management audit is to checking compliance of the university with respect to policies/laws/rules/regulations framed by the Parliament/state legislature. With respect to waste, compliance audit would check whether the audited entity is complying with the policies/laws/rules/regulations relating to waste (like, Municipal Solid waste management and Handling Rules, Hazardous Waste management rules, E-Waste, Battery Waste and Plastic Waste *etc.*,) framed by the Ministry of Environment and Forests at the central level and Department of Environment at the state level. In this waste management audit, URS has done assessment on different like solid, municipal, kitchen, bio-medical waste etc. at generation, storage, collection, transfer and transport, processing, and disposal stages in an environmentally sound manner in accordance with the best principles of public health, economics, engineering,

conservation, aesthetics and environmental considerations. Audit team has found that university is following all the compliances and policies for waste management with few recommendations which is discussed in separate section.

Figure 6: *Signs boards are installed at different places to follow different practices*

3.4. Sources of waste generation

The waste in university takes place from laboratory, offices, canteen, washrooms, hostels, garden, medical etc. The waste generated at different places is collected in different colours bins installed inside every buildings and medical facility.

Figure 7: *Different colour bins installed at different places for waste collection*

3.5. Types of waste generated

Different types of waste is generated in the university campus from various places. The waste generated is verified on the dates of audit generating from various places. The various waste generated are biodegradable, non-biodegradable, bio-medical, E-waste, Chemical/Hazardous waste etc. The campus generates at least no/ very less plastic waste as university management has already adopted the policy of plastic free campus.

Total Stakeholders – 2987

Quantity of waste generated:-

- ❖ Biodegradable – 3 kg/day (office)
- ❖ Non-biodegradable – 2½ kg/day (office)
- ❖ Biodegradable – 4 kg/day (labs)
- ❖ Non-biodegradable – ¼ kg/day (including glass bottles)
- ❖ Hazardous waste –¼ kg/day

Canteen waste

- ❖ Biodegradable college canteen – 20 kg/day
- ❖ Non-biodegradable – 2½ kg/day

Hostel waste/Guest house

- ❖ Biodegradable/kitchen waste – 90 kg/day

3.6. Techniques/Initiative for waste dispose

- ❖ **E-wastes-** computers, Xerox machine, printers, electrical and electronic parts – Central University of Kerala is a new university not that much of E-waste was generated till date in the university campus.
- ❖ **Plastic waste-** The plastic waste generated in the campus is very less as it is a plastic free campus. Although plastic waste generated thus is burned in incinerator.
- ❖ **Solid wastes–** Damaged furniture, paper waste, paper plates, food wastes – to incinerator plants.
- ❖ **Chemical wastes**– Laboratory waste – Effluent treatment plant
- ❖ **Biodegradable waste–** Kitchen waste – Collected by local pig farm on daily basis
- ❖ **Wastewater–** washing, urinals, and bathrooms etc. – Sewage treatment plant
- ❖ **Napkin incinerators–** Installed in all girls hostel

3.7. Waste generation per capita

On site visit to the university campus audit team find that the waste generation per capita in the university is less as compared to any other institute or organizations. The student and staffs are very much keen in waste generation reduction. The kitchen waste producing is lesser in the university campus as compared to other. The total waste generation from all the sources per capita is 0.04 kg.

3.8. Effluent treatment plant

The university is equipped with well-developed ETP of 40 KLD capacity developed by Sainath Envirotech based on latest technologies viz. Membrane Bio Reactor (MBR). The University generates various chemical/hazardous waste from different laboratories i.e. Biochemistry Laboratory, Molecular Biology Laboratory, Microbiology Laboratory, Environmental Science Laboratory, Chemistry Laboratory, Nanotechnology Laboratory etc. The total wastewater from all the laboratories is around 32.5 KLD which is directly collected in raw sewage chamber through different drainage pipe. The ETP is designed of 40 KLD capacity for future demands. The treated water from ETP against goes in the STP for treatment. Although during the visit the audit team found that no laboratory waste is reaching the ETP tank for treatment. The authorities were informed and the problem was rectified as there is some leakage in the drainage pipe. The audit team member suggested the authority to check and clean the drainage pipe on regular basis so that the proper utilization of ETP could be taken. And, there will be no open flow of chemical/hazardous waste in surrounding took place without treatment. The inlet and outlet wastewater parameters in ETP was shown through Figure which was earlier performed by Sainath Envirotech.

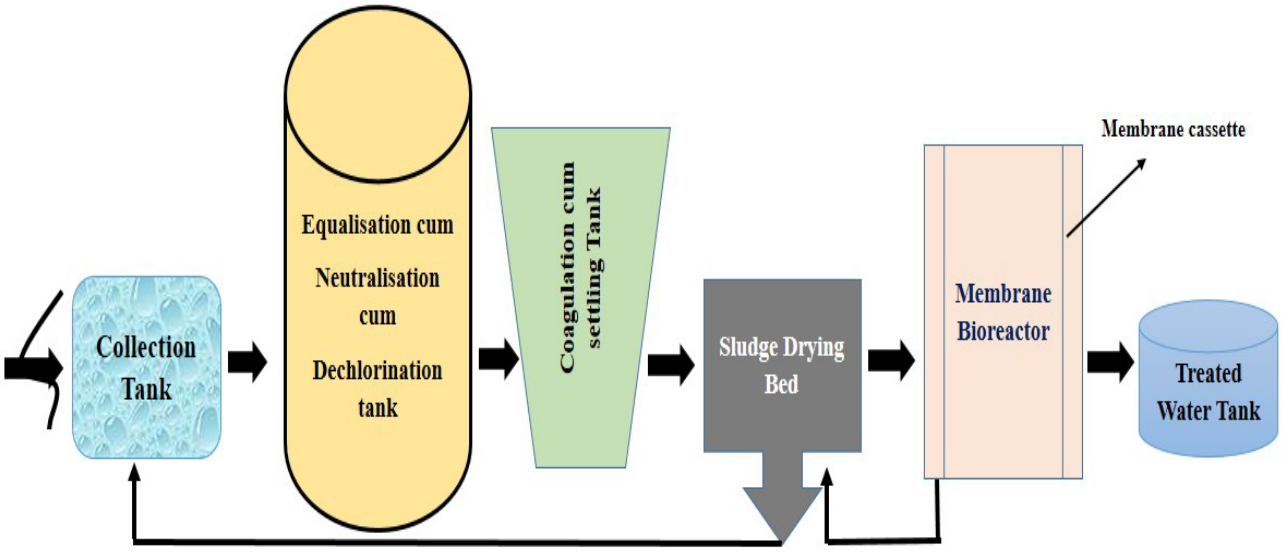


Figure 8: *Schematic Diagram of Effluent Treatment Plant (ETP)*

2.1 Raw Effluent & Treated Effluent Parameters

The initial characteristic of waste water generated and the parameters of treated effluent to be achieved are as tabled below:

S.No	Description	Raw Sewage Parameter	PCB Discharge Norms	Treated Water Parameters
1	pH	6-7	5.5 -9 .0	7-8
2	Total suspended solids	150 ppm	< 100 ppm	< 10 ppm
3	B.O.D	100 ppm	< 30 ppm	< 10 ppm
4	C.O.D	300 ppm	< 250 ppm	< 50 ppm
5	Oil and Grease	5 ppm	< 10 ppm	---
6	Residual Chlorine	20 ppm	< 2 ppm	< 2 ppm

2.2 Selection of Treatment Processes

Table 3 – 1 Sewage Parameters to Be Treated and Treatment Scheme Required

S.No	Description	Raw Effluent Parameters	Treatment Scheme Required as per Tender Conditions
1	pH	6-7	1. Primary Treatment a. Collection b. Equalisation , Neutralisation & Dechlorination i. Screening ii. pH Correction Chamber iii. Dechlorination iv. Coagulation v. Primary settling tank
2	BOD	100 ppm	
3	COD	300 ppm	
4	TSS	150 ppm	
5	Oil and Grease	5 ppm	
6	Residual Chlorine	20 ppm	

Figure 9: *Inlet and outlet parameter of ETP conducted by outsource*

3.9. Observations

CUK have different waste treatment and collection facility with in the campus. The onsite observation reading waste generation and treatment capacity is bulleted in the below given points:

- Campus was declared as "No Plastic Zones". It is informed to audit team that the E-Waste and Battery waste generated in the campus will be sold to the state pollution control board to approved vendor in coming future.
- The waste generated from tree droppings and lawn management is disposed in nearby open area.
- Single sided used papers reused for writing and printing in all departments and recently both side printing is carried out as per requirements.
- The waste generated by newspapers 250 kg/year, magazine 170 kg/year and of cartons is 15 kg/year.
- The sewage generated from the main building, teaching department, hostels and cafeteria is discharging in to the Municipal drain as the quantity of sewage is very less and not feasible to install STP for its treatment is discussed in next section.
- The chemical waste generated from different waste was treated through ETP before sent to STP for treatment to remove all hazardous chemicals etc.
- Three incinerator plant one of 60 kg/hour capacity and the other two of small size of 20 kg/hr to dispose of waste.
- Regular training was provided to the students regarding waste management and cleanliness program under Swacch Bharat Mission.
- Dustbins are provided at all prominent places in the campus to collect the waste at source. However, it is noticed that separate bins for bio-degradable and non- biodegradable is not provided.
- The solid waste generated in different buildings and canteen is found burning in open air while audit team visit to different sites.
- CUK have their own Waste Management Policy.

3.10. Recommendations

- It is recommended to provide separate bins for bio-degradable and non-biodegradable waste in the campus with proper color coding to promote clean and green energy at different locations.
- The medical facility bins should be removed with color coded closed bins.
- It was suggested that designated pit inside the campus should be built and a good quality compost is made from plant waste which is further used as a manure in the campus plantation.

- The paper waste should be sold to Kabbadiwala and which should be further sent to paper mills for making paper from waste paper.
- The incinerator plant should be run on a regular basis and all relevant waste (solid, garden, plastic etc.) should be collected and sent to the plant.
- The ETP plant should also be run on regular basis and all laboratory waste should directly sent to the ETP plant.
- The university comprises of well and advanced equipment but there is no proper utilization was observed during on-site visit.
- Open burning of waste should totally be avoided as at some places open burning of waste was observed during the audit team visit at different places.

(a) **(b)**

Figure 10: (a) *Solid waste generated in hostels kitchen and (b) some of the unlawful open solid waste dumping practices*

CHAPTER 4

ENERGY AUDIT

4.1. Introduction

Energy audit can be defined as systematic identification, quantification, recording, reporting and analysis of components of, energy usage.

The 'Energy audit' aims it is a technique used to establish the pattern of energy use, and identifies the areas where energy can be saved or where energy can be used judiciously. An energy audit consists of a detailed examination of how a facility uses energy, what the facility pays for that energy, and finally, a recommended program for changes in operating practices or energy consuming equipment that will effectively save on energy bills. Green audit & Energy audit is assigned to the criteria 7 of NAAC, National Assessment and Accreditation Council which is a self-governing organization of India which declares the institutions as Grade A, B or C according to the scores assigned during the accreditation.

4.2. Energy Management

Although energy cannot be seen, we know it exists because its effects, such as heat, light, and power, are readily apparent. Energy use, energy sources, energy monitoring, lighting, appliances, and automobiles are all included by this indication. Energy use is undoubtedly a crucial component of campus sustainability, thus its inclusion in the assessment doesn't call for any justification. While an energy-efficient light emitting diode (LED) requires less than 10 W, an old-fashioned incandescent bulb uses roughly 60 to 100 W. Energy auditing focuses on ways to conserve energy and cut back on use that could lead to environmental damage. Any organization that cares about the environment must consequently review its methods for using energy.

4.3. Policies and Practices Examination

Energy Policy

Central University Kerala is committed to policy of energy efficiency, energy conservation, and the reduction of our environmental impact, particularly during this time of increased environmental awareness, rising utility costs, tighter budgets, and new construction on campus. The goal of the policy is to create a realistic and comprehensive document that identifies energy and water conservation and efficiency as significant issues for the entire campus community as well as developing better ways to operate to reduce our environmental impact.

Energy Practice

Best Practices followed in the Organization.

- Transformer, Generators and UPS are protected properly with shading fencing and kept.
- Awareness boards on Dangers and Warnings.
- Most of places, sign board of 'Switch ON' and 'Switch OFF' are kept towards saving energy measures to the stakeholders.
- Electrical wires, switch boxes and stabilizers are properly covered without any damage which will cause any problems to the staff and student members.
- Installed roof top solar power plant 10 kW at Yamuna Block.
- Solar Water heaters are installed and they are functioning well.
- LED lights and LED street lights are utilized.
- Power factor is maintained near to unity with APFC.
- VFDs based Lift, Inverter AC are utilized.
- Availability of e-vehicle inside the campus.
- Use of few star rated equipment.
- Solar Heater is also installed.

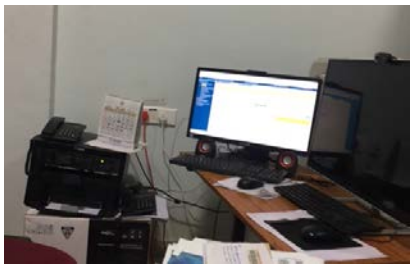
Transformer

DG Set

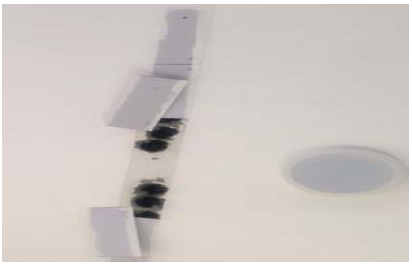
LT Panel Room

Solar Heater

UPS



Desktop Computer



LED Light

FAN

Inverter ACS

LED Tube Light

LED Street Light

Figure 11: *Walk-through Audit conducted in various locations at Central University Kerala the energy equipment's were inspected.*

Systems Studied during the Energy Audit

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

4.4. Energy Resource Analysis

There are two sources of energy supply Kerala State Electricity Board and Diesel Generator to operate at Central University of Kerala. CUK has Overall building level energy meter to track the energy usage of the building. CUK has 11 Nos. of Diesel Generators and 8 Nos. of Transformers to meet its electricity requirement.

8 Nos. of Step down Transformer has been installed in campus for distribution of power to different units.

Transformer Details

Table 7: *Transformer details*

Sr. No.	Location	Capacity	Number
1.	Teaching Block	500 KVA	2 Nos
2.	Main Campus	630 KVA	2 Nos
3.	Nila Hostel	400 KVA	2 Nos
4.	Nilgiri Guest House	500 KVA	2 Nos
TOTAL			**8 Nos**

In case of power cut university supply power to fulfil demands with help of generator which runs on diesel as Fuel and UPS Supply available in Premises.

DG Set Details

Table 8: *Diesel Generators details*

Sr. No.	Location	Capacity in KVA	Number
1.	Academic Complex	500 KVA	2 Nos
2.	Academic Guest House	125 KVA	3 Nos
3.	Hostels	62.5 KVA	4 Nos
4.	Hostels	40 KVA	1 Nos
5.	Health Center	10 KVA	1 Nos
Total		**737.5 KVA**	**11 Nos**

UPS and Battery Details

Table 9: *UPS and Battery Details*

Sr. No.	Location	Capacity
1.	Gangotri	20 KVA
2.	Brahmaputra	20 KVA
3.	Sindhu	20 KVA
4.	Kauveri	20 KVA
5.	Yamuna	10 KVA

Sr. No.	Location	Capacity
6.	Krishna	80 KVA
7.	Godavari	80 KVA
8.	Narmada	80 KVA
9.	Sabarmathi	80 KVA
10.	Saraswathi	15 KVA
11.	Teaching Block-1	20 KVA
12.	Teaching Block-2	20 KVA
TOTAL		465 KVA

PUMP Efficiency

Table 10: *Pump efficiency installed in Central University of Kerala*

		Rated Parameter					Measured Parameter									
S. No.	**Type of Structure/Location**	**Power**	**Motor Eff.**	**Motor Input Power (KW)**	**Flow (m^3/hr)**	**Head (Mtr)**	**Volt**	**Current**	**PF**	**Power**	**Shaft Power**	**Flow**	**Head**	**Hydraulic Power**	**System Efficiency**	**Pump Efficiency**
	Unit	**kW**					**V**	**A**		**kW**		**m^3/hr**	**m**	**kW**	**%**	**%**
1.	**Raw Water**	45	93.00%	48	97.2	103	401.00	51.00	0.90	31.88	29.65	**102.00**	65.00	18.07	56.67%	**60.94%**
2.	**Sump to Overhea**	30	92.30%	33	201	35	405.00	42.30	0.78	23.14	21.36	**190.00**	26.00	13.46	58.16%	**63.02%**

Solar Energy

There are Roof top Solar plant available in at Yamuna Block.
Make- Power –One
Capacity– 10 KW
Battery– 15 Nos

Figure 12: *10 KW Roof top solar panel*

Supply from utility

Electricity is supplied by Kerala State Electricity Board Limited. The unit has one HT energy meter provided by the distribution company within its premises.

Details of the supply are as follows:
Supply Voltage- 11 KV HT
Supply Voltage- 440 V LT
Connected Load- 1000 KW
Contract Demand- 500 KVA
Maximum Demand- 290 KVA

4.5. Energy bills analysis

The month wise variation in electricity consumption is shown graphically in the figure below:

Table 11: *Electricity Bills for Academic Year 2021-22*

Sr. No.	Month	Year	(KWH)	Amount (Rs.)	KVA	Amount (Rs.)	Electricity Duty Surcharge & Other Charges Amount (Rs.)	Total Amount (Rs.)
1.	April	2021	124488	712883	387	143190	75725	931798
2.	May	2021	114180	652999	375	138750	71416	863165
3.	Jun	2021	72558	409558	375	138750	49819	598127
4.	July	2021	70530	397950	375	138750	45852	582552
5.	August	2021	73824	416656	375	138750	45415	600821
6.	September	2021	79794	450954	375	138750	47089	636793
7.	October	2021	86910	492559	375	138750	67884	699193
8.	November	2021	98664	560960	375	138750	56619	756329
9.	December	2021	107916	615291	375	138750	65470	819511
10.	January	2022	120000	684146	375	138750	73567	896463
11.	February	2022	101670	577063	375	138750	61424	777237
12.	March	2022	98748	559314	375	138750	58399	756463
Total Power Consumption in Yearly							1149282 KWH	
Average Power Consumption in Monthly							95773.5 KWH	
Average traiff Charge							INR 5.72/unit	

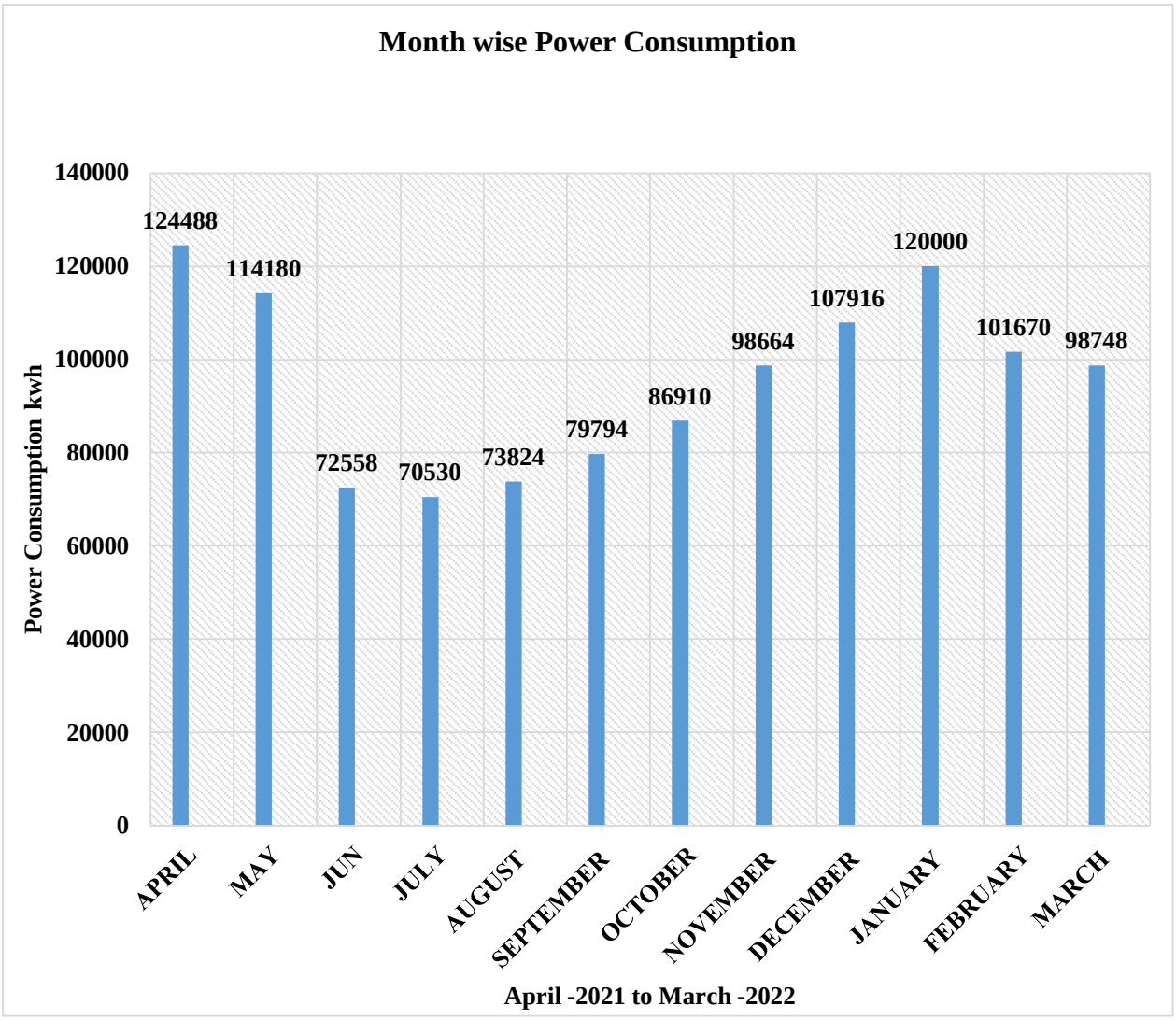


Figure 13: *Month wise variation in electricity consumption from different sources*

4.6. Major Equipment related to Electrical Utilization

The university has many laboratories, class rooms, faculty rooms, administrative officer's rooms, engineering rooms, quarters, canteens, hostels, medical center etc. Different electrical equipment's are installed at various locations in all buildings, whereas, the major inventory details is provided by university authority and physically verified by the audit team and found in line with the inventory provided by university. Whereas, other electrical instruments are present in various laboratories which consumes maximum energy. Whereas, the details of the instruments has not been listed in Table 11.

Table 12: *Electrical Inventory Details of Central University of Kerala*

Sr. No.	Building Name	20 Watt LED Tube Light	2*18 Watts Recessed Light	Energy Efficient BLDC Ceiling	Four Star Ceiling Fans 50 Watt	Inverter AC	Dekstop 175 Watt	Printers 400 Watt	Photocopiers500 Watt	Projector & Speakers	Corridor Speakers 20 Watt	Passenger Lift 7500 watt	Borewell Pumps
1.	Gangotri	76	104	0	54	21	115	58	12	4	18	1	1
2.	Brahmaputra	72	120	0	52	14	137	14	3	6	12	0	1
3.	Sindhu	68	94	0	52	13	61	18	3	7	16	0	0
4.	Kauveri	68	83	0	51	14	25	7	3	7	14	0	1
5.	Yamuna	61	82	48	0	5	23	5	2	1	0	1	0
6.	Krishna	193	128	0	128	33	66	20	2	8	21	1	1
7.	Godavari	179	132	0	129	42	41	7	2	10	21	1	1
8.	Narmada	171	128	0	132	38	100	13	2	13	21	1	1
9.	Sabarmathi	165	120	0	149	29	96	10	2	12	21	1	0
10.	Saraswathi	84	69	43	0	7	60	11	1	4	0	0	0
11.	Teaching Block-1	62	98	0	138	12	115	0	3	6	0	0	1
12.	Teaching Block-2	71	98	0	122	17	66	5	5	5	0	0	1

Sr. No.	Building Name	20 Watt LED Tube Light	2*18 Watts Recessed Light	Energy Efficient BLDC Ceiling	Four Star Ceiling Fans 50 Watt	Inverter AC	Dekstop 175 Watt	Printers 400 Watt	Photocopiers500 Watt	Projector & Speakers	Corridor Speakers 20 Watt	Passenger Lift 7500 watt	Borewell Pumps
13.	Kabani Hostel	133	99	0	198	0	0	1	0	0	0	0	1
14.	Nila Hostel	208	29	0	282	0	0	0	0	0	0	1	1
15.	Pamba Hostel	234	34	272	0	0	0	0	0	0	0	1	0
16.	Periyaar Hostel	252	29	0	303	0	0	0	0	0	0	1	0
17.	Neyyar Hostel	243	37	272	0	0	0	0	0	0	0	1	1
18.	Nilgiri Guest House	132	56	78	0	38	2	0	0	1	0	1	1
19.	Health Center	46	17	21	0	4	0	0	0	0	0	0	0
	TOTAL	**2518**	**1557**	**734**	**1790**	**287**	**907**	**169**	**40**	**84**	**144**	**11**	**12**
	Wattage	**50360**	**56052**	**20552**	**89500**	**588350**	**158725**	**67600**	**20000**	**10080**	**2880**	**82500**	**27000**
	TOTAL KW	**1173.599**											

4.7. Per capita energy demand

- It is the annual average amount of daily energy required by one person and includes the energy required for domestic use, industrial and commercial use, Public use, Wastes thefts.
- It depends on various factors like Standard of living, number and type of commercial places in a town etc.
- It is expressed in (Energy per capita per day) which means energy required daily by one person.
- Central University of Kerala energy consumption was 1.05 kWh/person/day.

4.8. Energy efficiency initiative examination

University is using star rated Electrical & Electronics equipment which saves energy. LED Bulbs/ Tube-light, 4-5 star Rated Air Conditioners. University has always been effortful in making use of renewable energy resources. The average electricity consumption of the University per month is approximately 188940.38 units. For the purpose, University has already installed an off gird solar power plant of 10 kW. This is the step forward for energy conservation and will definitely reduce the electricity consumption of the university and save the money for university.

4.9. Renewable energy initiative analysis

Energy efficiency and renewable energy are the twin pillars of a sustainable energy Policy. Both strategies must be developed concurrently in order to stabilize and reduce Carbon dioxide emission. Efficient energy use is essential to slowing the energy demand growth so that rising clean Energy supplies can make deep cuts in fossil fuel use. If energy use grows too rapidly. Renewable energy development will chase a receding target. Likewise, unless clean energy Supplies come online rapidly, slowing demand growth will only begin to reduce total Carbon emissions; a reduction in the carbon content of energy sources is also needed. A Sustainable energy economy thus requires major commitments to both efficiency and Renewable. Estimates of the world energy use indicate that the demand for energy, by the middle of the 21st Century, may significantly exceed the energy supplied by conventional sources.

Renewable energy is energy which comes from natural resource such as sunlight, winds, Plants growth, rain, tides and geothermal heat which are naturally replenished. The first law of thermodynamic says that the total amount of energy on our planet remains Constant. The second law states that as forms of energy are expended they become less easily available.

Energy efficiency means improvement in practice and products that reduce the energy necessary to provide services like lightning, cooling, heating, manufacturing, cooking, transport, entertainment etc. Energy efficiency products essentially help to do more work with less energy. Thus, the efficiency of an appliance or technology is determined by the amount of energy needed to provide the energy service. For instance, to light a room with an incandescent light bulb of 60

W for one hour requires 60 W/h. A compact florescent light bulb would provide the same or better lighting at 11 W and only use 11 W/h. This means that 49w (82% of energy) is saved for each hour the light is turned on.

4.10. Observations

- The University has already adopted Energy Efficient practices.
- Usage of Energy Efficient LED Fittings.
- Usage of Energy Efficient BEE STAR Rated equipment.
- Maintenance of good power factor.

4.11. Recommendations

The energy audit included suggestions for energy cost reduction, preventive maintenance and quality control activities, all of which are critical for utility operation in the audit sites. Some of the recommendations find after observation and analysis are given below:-

- Procurement of equipment with energy efficiency (4-5 star rated equipment) during replacement may be considered.
- Sub meters in all the buildings for energy monitoring is recommended so that energy load required and energy consumption in each building may be noted.
- Optimal water usage and temperature settings may be used which comes under automatic process towards energy savings.
- Continuous monitoring and analysis of energy consumption by dedicated team maybe planned within the campus.
- Turn off electrical equipment when not in use,
- Maintain appliances and replace old appliances in all laboratories.
- Use computers and electronic equipment in power saving mode.
- Installation of Biogas plant for hostel kitchen, hostel and canteen waste for energy generation.
- Automatic switches with occupancy sensors in common areas
- Regular monitoring of equipment in all laboratories and immediate rectification of any problems.
- Solar lights panel should be installed in campus.
- Gardens should be watered by using drip/sprinkler irrigation system to minimize water use.
- It is preferable to purchase electricity from a company that invests in new sources of renewable and Carbon-neutral electricity.
- Installation of LED lamps instead of CFL and replacing the old tube lights with the new LED tubes.
- Cleaning of tube-lights/bulbs to be done periodically, to remove dust over it.
- Installed automatic switches with sensors.

CHAPTER 5

WATER AUDIT

5.1. Introduction

Water auditing is a method of quantifying water flows and quality in simple or complex systems, with a view to reducing water usage and often saving money on otherwise unnecessary water use. There is an increasing awareness around the globe of the centrality of water to our lives.
Water is one of the most important substances on earth. All plants and animals must have water to survive. If there was no water there would be no life on earth. Therefore, it is a prime responsibility of Central University of Kerala management to meet basic water requirement of college staff, students and visitors in the college campus. In current Water Audit assessment at CUK, URS team has done assessment of available Water sources, Water storage facility, and Water consumption pattern in the college and how wastewater (Sewerage) is dispose-off/treated in the university.

5.2. Sources of water examination

The audit team observed that the river water is the main sources of meeting all water demand in the university. It has been informed by the university that Kerala Water Board has recently provided the river water pipeline to university to fulfil their water demand prior to this water demand is fulfilled through groundwater through 12 submersible pump. The water is used mainly for drinking, domestic (toilets and cleaning) and gardening etc. The CUK is having 2 water substation one near river installed with two pump of 45 HP one is kept on standby. The water is sent to university substation through 7 km long pipeline. The water reaching university is first treated through water treatment plant and the treated water is sent to underground submerged tank of 400 KLD and from there it is pumped to overhead tank (OHT) of capacity 1000 KLD through 30 HP pump. There are two 30 HP pump installed at university water substation in which one is kept on standby. The OHT is utilized to fulfil all domestic needs, drinking and other requirements. Whereas, submersible pump each having capacity of 3 HP is not utilized these days but has kept on standby for any emergency. The gardening water was fulfilled through OHT presently but in coming future the treated water from STP and other outlet water such as water from WTP will be sent to small OHT of 100 KLD constructed for fulfilling gardening activity in the university campus. Beside this there are three open well present in the university premises which can also be utilized in emergency to fulfil the university water demand. And, at some places university has installed with rain water harvesting (RWH) system. There are two underground submerged water tank of 5000 L on at each boys and girls hostel. The water from RWH tank is pumped for flushing activities in both the hostel. Whereas, the other RWH is used to recharge underground water table. Table provides details of tanks installed at different locations to fulfil the water requirements.

Table 13: Details of water tank installed at various location in Central University of Kerala to meet different water requirement

S. No.	Building/Tank name	Material of tank	Capacity of tank	Number of tank
1.	Overhead tank	Cemented	1000 KLD	1 No.
2.	Overhead tank (treated water from STP)	Cemented	100 KLD	1 No.
3.	Krishna	PVC	3000 L	3 Nos.
		PVC (Fire)	5000 L	2 Nos.
4.	Godavari	PVC	3000 L	3 Nos.
		PVC (Fire)	5000 L	2 Nos.
5.		Submerged water tank	10000 L	1 No.
6.	Narmada	PVC	3000 L	3 Nos.
		PVC (Fire)	5000 L	2 Nos.
7.		Submerged water tank	10000 L	1 No.
8.	Sabarmathi	PVC	3000 L	3 Nos.
		PVC (Fire)	5000 L	2 Nos.
9.		Submerged water tank	10000 L	1 No.
10.	Gangothri	PVC	2000 L	2 Nos.
11.		Submerged water tank	10000 L	1 No.
12.	Sindhu	PVC	2000 L	3 Nos.
13.	Kaveri	PVC	2000 L	3 Nos.
14.	Yamuna	PVC	10000 L	1 No.
15.	Saraswathi	PVC	10000 L	1 No.
16.	Periyar Boys Hostel	PVC	5000 L	2 Nos
		PVC (Fire)	10000 L	2 Nos.
		Submerged water tank	50000 L	1 Nos.
17.		Submerged water tank for water harvesting	50000 L	1 Nos.
18.	Neyyar Boys Hostel	PVC	10000 L	2 Nos.
19.	Nila Girls Hostel	PVC	5000 L	2 Nos.
20.		PVC (Fire)	10000 L	2 Nos.
21.		Submerged water tank	50000 L	1 Nos.

S. No.	Building/Tank name	Material of tank	Capacity of tank	Number of tank
22.		Submerged water tank for water harvesting	50000 L	1 Nos.
23.	Pumba Girls Hostel	PVC	10000 L	2 Nos.
24.	Kabani Girls Hostel	PVC	5000 L	5 Nos.
25.		Submerged water tank	10000 L	1 Nos.
26.		Submerged water tank for water harvesting	50000 L	1 Nos.
27.	Teaching Block- 1	PVC	5000 L	4 Nos.
28.	Teaching Block- 2	PVC	2000 L	1 No.
29.	Medical Centre	PVC	3000 L	1 No.
30.	Quarters	PVC	5000 L	4 Nos.
31.		Submerged water tank	10000 L	1 No.

The total water consumption of Central University of Kerala on per month basis is presented through Figure. It was observed and verified that total pumping of the water to overhead tank on 16/06/2022 is 600 KLD. As data provided by the competent authority that water was pumped for 3 hours to the OHT from university substation and water flow was verified by Ultrasonic flow meter and find that 202 m^3/hr was pumped to the OHT.

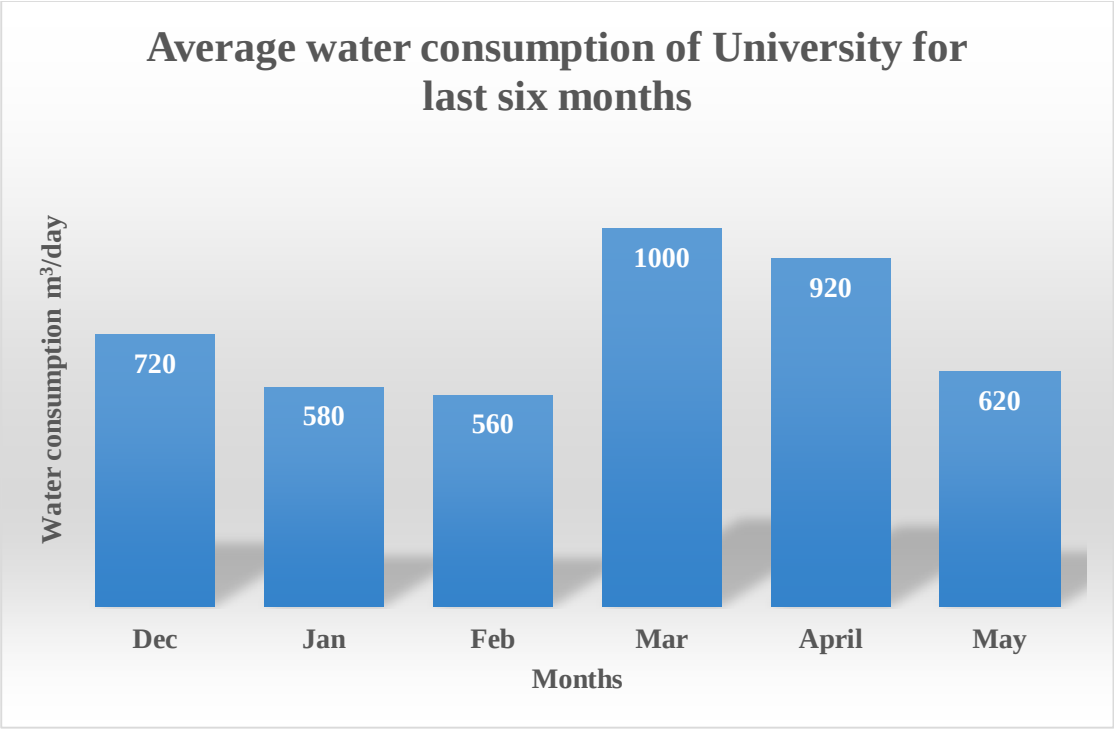


Figure 14: Average water consumption of CUK for six months (Dec, 21 to May, 22)

Figure shows that maximum water consumption was observed in months of March and April due to summer season. The increment in water requirement during this period is high due to fulfilment of gardening practices, hostel, drinking water and other activities.

5.3. Water bill analysis

Central university of Kerala water requirement is fulfilled by Kerala water board form nearby river. The board don't charge any tariff till date to university for water supply. Therefore, university didn't pay any water bills to the water authority.

5.4. Water management practices analysis

Recycling of water, reuse of treated wastewater and rainwater harvesting are the important measures of reducing/saving groundwater and conservation on the premises. Central University of Kerala has commissioned state-of-the-art technology in its facilities to use water efficiently and all the units are equipped with recycling and reuse arrangements. Central University of Kerala has one water treatment plant (WTP) at initial water collection point for treatment of river water before supply to different sources, one sewage treatment plant (STP) for treatment of domestic waste generated from different sources from campus, effluent treatment plant (ETP) for treatment of chemical waste generated from different science based laboratories, and reverse osmosis (RO) plant at different location for supply of safe and healthy drinking water. University is equipped with 8 nos. of large RO plant fitted with 1000 L water tank for proper supply of drinking water to different academics and administrative buildings, whereas, hostels, guest house and teaching blocs is installed with 20 liter capacity RO plant. The rejected RO water is utilized in gardening and other activities. The university has built STP and ETP for water recovery and the treated water from the plant is again utilized for plantation, gardening and construction works. The Central University of Kerala can be kept in category of very advance and environmental friendly campus in terms of water management besides WTP, ETP, STP, and RO University has many rain water recharging/harvesting points. The boys and girls hostel has 50 KL rain water harvesting tank the water thus collected in the tank is utilized for sanitation practices. Whereas, there are several water recharge pits has built as an initiative for ground water recharge. The university practices are very appreciable in terms of water management. But, the vary problem which was noted during physical audit by audit team was that the reject of RO was greater at some places, RO is not cleaned/working in girls and boys hostel and STP is not working on its full load due some leakages in pipe line. Thus, the team recommend to check and clear the pipe lines on a regular basis so that the built system can be utilized at its fullest and the advantage of the same could benefits the university and environment at large. The sensors based water taps are installed at different locations in academic blocks for reduction of water wastage.

5.5. *Water treatment plant*

Central University of Kerala have one water treatment facility to treat raw water received from river. The raw water once treated is supplied to overhead tank situated in campus near water treatment plant. The water pumped from river is first treated on the basis of series of water treatment steps that include coagulation, flocculation, sedimentation, filtration, and disinfection. The water once treated is collected in submerged tank and from there it is transferred to overhead tank. Alum is utilized as flocculation in the WTP and the rejected water is again collected and transferred to smaller overhead tank for utilization in gardening process. Around 2 ppm chlorine is mixed for disinfection process. The water is transferred to different locations from overhead tank through two different pipelines. The water distribution system is presented through figure 15.

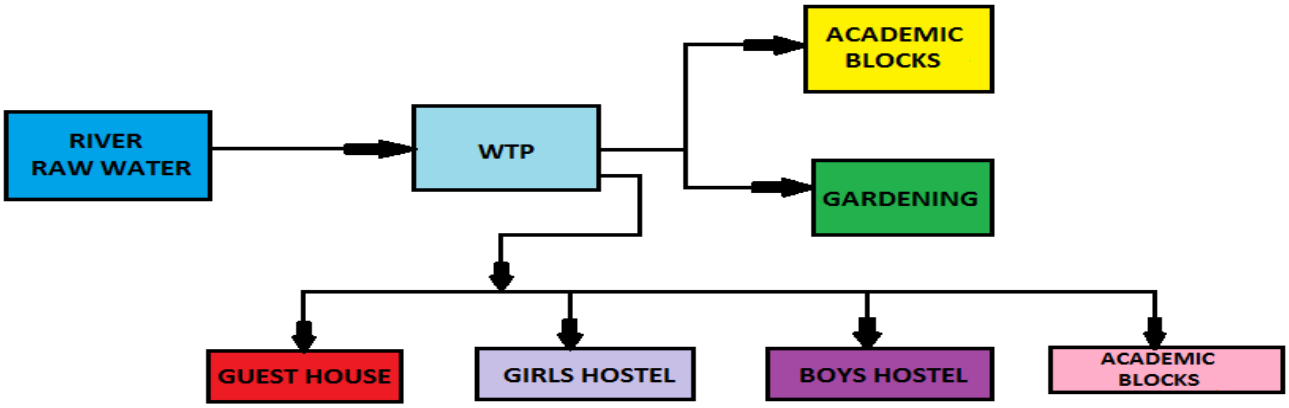


Figure 15: *Water flow chart of Central University of Kerala*

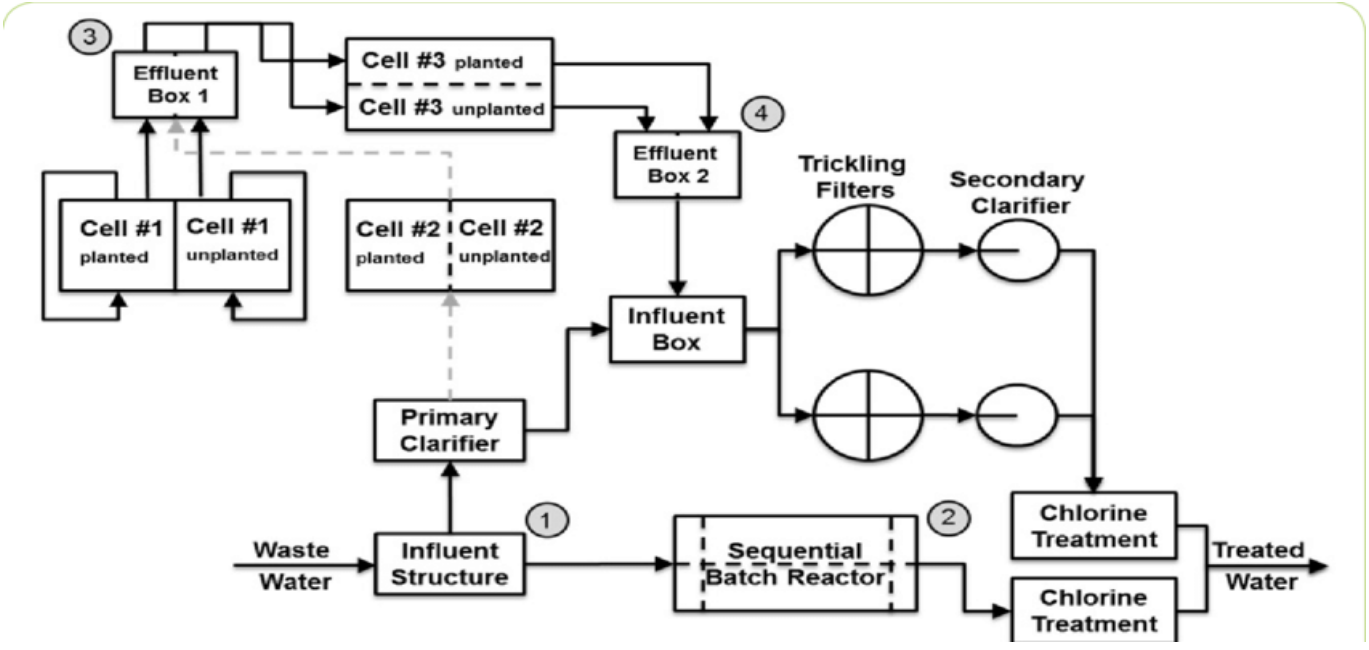


Figure 16: *Schematic diagram of Water treatment Plant*

Figure 17: *Photographic view of different components of water treatment plant (a) Overhead tank (b) Pipeline for water supply (c) Flocculent mixing chamber (d) Flocculation chamber (e) Aeration chamber (f) settling chamber (g) metering point (h) chlorination cylinder (i) chlorinator meter*

5.6. Sewage treatment plant

The Water Treatment Practices in Central University of Kerala, Kasaragod, Kerala has commissioned state-of-the-art technology in its facilities to use water efficiently and all the units are equipped with recycling and reuse arrangements for wastewater treatment from the university buildings. The wastewater generated at different locations except laboratories are send to STP for further treatment. The STP is constructed by Sainath Envirotech Pvt. Ltd. the STP is based on advanced technology *i.e.* MBBR (moving bed biofilm reactor). The total capacity of the STP is 200 KLD is utilized for all sewage wastewater as well as treated water from ETP. There are no flaws found in the system in the present system is found. The Blower, exhaust and other tanks equipment's are in good condition. The treated water thus produces from STP is pumped back to 100 KLD overhead tank for use in gardening, and other unhuman activities. The layout of the present STP is presented through Figure 18.

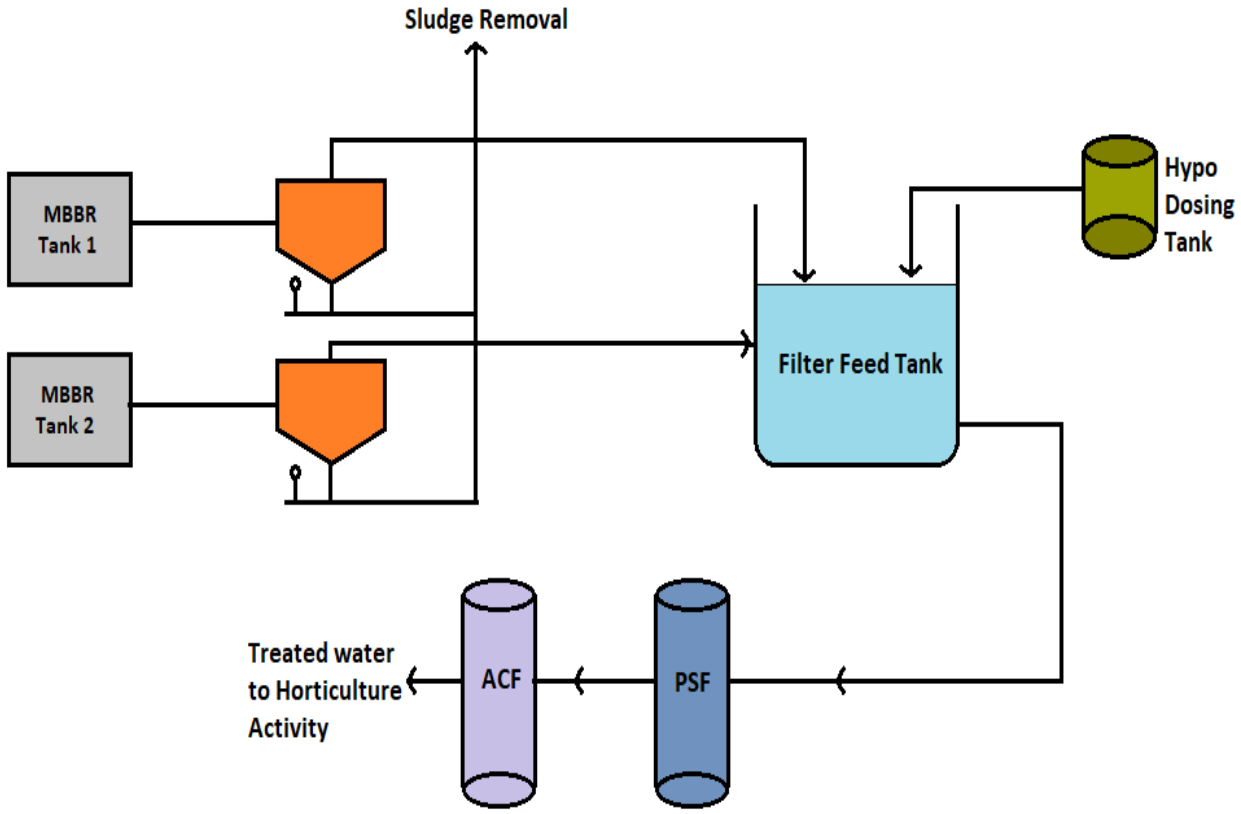
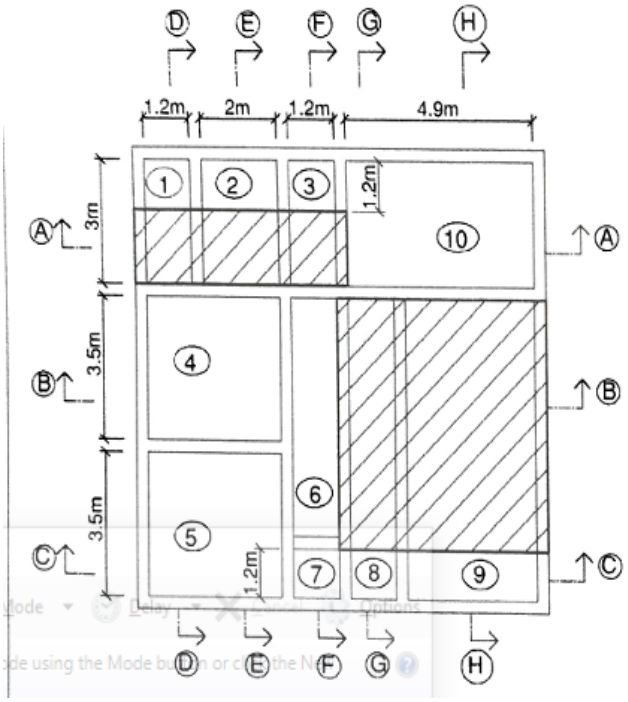


Figure 18: Process Flow Diagram of STP



No.	Unit	Dimensions in Meters
①	pH CORRECTION CHAMBER	3 x 1.2 x 4
②	OIL&GREASE REMOVAL CHAMBER	3 x 2 x 4
③	DISTRIBUTION CHAMBER	3 x 1.2 x 4
④	MBBR 1	3.5 x 3.5 x 5
⑤	MBBR 2	3.5 x 3.5 x 5
⑥	TUBE SETTLER	5.8 x 1.2 x 4.5
⑦	SLUDGE HOLDING TANK	1.2 x 1.2 x 4
⑧	CHLORINE CONTACT TANK	7.2 x 1.2 x 4
⑨	TREATED WATER TANK	7.2 x 3.5 x 4
⑩	CONTROL ROOM	4.9 x 3 x 3 (app)
	COVER SLAB CUM PLATFORM	

Figure 19: *Process Diagram along with layout of Sewage Treatment Plant*

5.7. Observation

- The audit team observed that the River Water is the main sources of water in the university from last eight months before this ground water is the main source of university. The water is used mainly for drinking, domestic (toilets and cleaning), construction and gardening etc. The Central University of Kerala is having 2 Substation for one at source point and the other at university for collection of water. The capacity of pump installed at source point is of 45 HP whereas, the pump installed at university for supply of water to overhead tank is of 30 HP capacity. There are two number of pump at each location in which one is always kept on standby. The water is pumped to overhead tank is supplied for Drinking and Domestic Purpose whereas the water from another submersible is used for gardening purpose. There are also eight submersible pump of 3 HP present at different location which is kept on standby for emergency situation.
- The water collected from source river is primarily treated through water treatment plant installed at university campus after which water is supplied to different locations.
- The meter installed in the water treatment plant is not found working during visit onsite physical verification.
- The water supplied from overhead tank is stored in PVC Water Tanks located at rooftop of different buildings for further utilization. The Water stored in PVC tanks is supplied to Main Building, Teaching Department, Hostels, Guest House and other buildings through gravity.
- The institute is having 8 RO Plant of 250 LPH for drinking water in academic blocks. The RO reject (wastewater from the RO) is used for gardening purpose. Whereas, 20 liter capacity RO plant is installed at teaching blocks, 01 nos. at guest house, 01 nos. at canteen, 11 nos. at girls hostel, 8 nos. in boys hostel.
- During the Audit in girls and boys hostel few RO plant is not found in working condition.
- During the Audit few water loss is observed, due to few leakages, but no water loss was observed by over flow of water from overhead tanks.
- The water utilized during construction process was pumped from submersible pump installed by constructor at different locations.
- The total water consumption in college campus is provided below:

Particulars	**Total number of stakeholders**	**Water Requirement as per BIS (L)**	**Total Water Required (L)**
Administration and Academic blocks	4000	45	1,80,000

Particulars	Total number of stakeholders	Water Requirement as per BIS (L)	Total Water Required (L)
Hostel, Guest house, University Residence	1428	130	1,85,640
Gardening		---	39,200
Total			**4,04,840**

As estimated in above table that the total water consumption of the college in the range of 4, 04,840 Litre/Day.

- The sewerage generated from main building, teaching department, hostels and cafeteria is discharging in to the sewage treatment plant installed at university campus for onsite treatment.
- The university is having 5 Rain Water Harvesting (RWH) Structures in the university campus to collect the rain water and recharge the ground water table.
- The university Celebrates World Water Day every year on 22nd March for creating awareness on water conservation among students and teaching staff.

5.8. Recommendations

- It is recommended that the drip irrigation system/Sprinkler System can be used in garden or in plantation to reduce water consumption as these system are having more efficiency compare to flooding irrigation system.
- Regular clean of the RO plant at different locations should be done and the date of cleaning and due date should also be mentioned at the source point.
- The RO plant installed different academic building is rejecting more water and chemicals are not present in the chemical chambers which needs to be monitored at regular interval of time.
- The chlorine mixing in the supply water is 1.5 ppm which is supposed to be higher and can be reduced upto 0.2-0.4 ppm as the distance between source and end point is less.
- The STP is not find working on full load during Audit team visit which is supposed to check regularly and if not much water is produced the wastewater should be stored and on full

load the plant needs to be run for energy saving.

- It is recommended that supportive evidences of World Water Day Celebration need to be managed every year as it is not managing in present situation.
- It is recommend to use the treated water from STP for water in garden and plantation to reduce the consumption of ground water. Presently this practice is not followed while the separate tank and lines are present to pump the treated water in treated water overhead tank.
- The telemetric meter should be installed at pipe lines for water consumptions examination.
- It is recommended to regularly maintain the log register at both the water station to log the number of running hour of motors.

CHAPTER 6

RECOMMENDATIONS

1. The audit team recommended to install university maps at entry gates and near academic blocks with proper fire exit locations as per GoI guidelines.
2. Audit team strongly recommend to check, change, and refill the fire extinguishers at all locations.
3. Indoor plantation to inculcate interest in students, Bonsai can planted in corridor to bond a relation with nature.
4. Review periodically the list of trees planted in the garden, allot numbers to the trees and keep records. Assign scientific names to the trees.
5. Create awareness of environmental sustainability and take actions to ensure environmental sustainability.
6. It is recommended that the drip irrigation system/Sprinkler System can be used in garden or in plantation to reduce water consumption as these system are having more efficiency compare to flooding irrigation system.
7. It is recommended to regularly check the number of fauna species present in campus and some reserved area should be allocated for their reproduction and conservation.
8. Review periodically the number of running hours of the pumps and check the efficiency of the pumps.
9. Monitoring is the most important prerequisite for efficient water management. Thus, in the water supply network, it is necessary to have a robust system of monitoring as per GoI guidelines.
10. The regular cleaning and change of RO filters are requested for healthy water supply, as during audit some of the RO are find unfit for drinking.
11. It is recommended to run the STP and ETP on full load and municipal water generated at different locations should be sent to STP and ETP for further processing.
12. It is recommended to utilize the treated water and rejected water from RO for gardening practices which will reduce the freshwater use.
13. The audit team recommend to dispose MSW in an adequate manner and can also get energy from waste by proper adequate segregation and disposal of waste i.e. suitable operation of already installed biogas plant and can install the briquetting plant for paper waste.
14. Audit team strongly recommend to install dustbins with proper color coding at all prominent locations and particular distance on roads.
15. The regular collection of solid waste, paper waste and other waste should be done from academic blocks, hostels, canteen, guesthouse, hospitals etc. should be done and treated/disposed through incinerator.
16. It is also recommended that the proper utilization of laboratory facility available at water treatment plant should be done for water examinations. And, it is also recommend to show the environmental science students for onsite visit, training and water examination at WTP, ETP and STP as it will help them to study and get training on the physical plant.

CHAPTER 7

ANNEXURE

POLUCHEM LABORATORIES (P) LTD.

CHEMICAL, ENVIRONMENTAL AND MICROBIOLOGY LABORATORY

PALLATH BUILDING, N. KALAMASSERY P. O., ERNAKULAM - 683104

Phone: 0484-2544050, 8281982022, 9747400685, 9747400689, www.poluchem.com, poluchem@gmail.com

TEST REPORT

Ref.No. PL/RT/SW/157/2022
(ULR NO:TC658922000000000157F)

Date of Issue: 04/02/2022

Name & address of customer : M/s. Central University of Kerala,
Tejaswini Hills
Periyar, Kerala, 671316

Sample Collected by : The Customer
Sample code : A/157/2022
Sample description : STP Water
Date of receipt of sample : 31/01/2022
Date of analysis started : 31/01/2022
Date of completion of analysis : 04/01/2022

Parameters	Test method	Results
pH	IS 3025 (P) 11 -1983RA2017	6.83
Total Suspended Solids	IS 3025 (P) 15 – 1984 RA 2017	4 mg/l
B.O.D (3 days at 27° C)	IS 3025 (P) 44 -1993RA2014	2.9 mg/l
C O D	IS 3025 (P) 58 -2006RA2017	22 mg/l
Total Nitrogen	IS 3025 (P) 34 -1998RA2014	5.2 mg/l
Ammonical Nitrogen	IS 3025 (P) 34 -1998RA2014	3.96 mg/l
Oil & Grease	IS 3025 (P) 39 – 1991 RA2014	BDL(MDL-1 mg/l)
FecalColiforms(MPN/100ml)	IS 1622: 1981 RA 2009	Absent

BDL- Below Detection Level,MDL-Minium Detection Level

For Poluchem Laboratories (P) Ltd.

Authorized Signatory.

SREEJA RAMESH
QUALITY MANAGER
POLUCHEM LABORATORIES (P) LTD

End of the report

POLUCHEM LABORATORIES (P) LTD.

CHEMICAL, ENVIRONMENTAL AND MICROBIOLOGY LABORATORY

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TEST REPORT

Ref.No. PL/RT/DW/191/2022
(ULR NO:TC658922000000191F)

Date of Issue: 10/02/2022

Name & address of customer	: M/s. Central University of Kerala, Tejaswini Hills Periyar, Kerala, 671316
Sample Collected by	: The Customer
Sample code	: B/191/2022
Sample description	: RO Out
Date of receipt of sample	: 07/02/2022
Date of analysis started	: 07/02/2022
Date of completion of analysis	: 09/02/2022

Parameters tested	Test method	Results	Acceptable Limit As per IS – 10500 – 2012
pH	IS 3025 (P) 11 –1983RA2017	6.59	6.5 – 8.5
Color	IS 3025 (P) 04 –1983RA2017	1 Hazen Unit	5 Hazen Unit
Odour	IS 3025 (P) 05 –1983RA2017	Agreeable	Agreeable
Turbidity	IS 3025 (P) 10 – 1984RA2017	BDL(MDL-0.1NTU)	1 NTU
Total Dissolved Solids	IS 3025 (P) 16 – 1984RA2017	78 mg/l	500 mg/l
Total Hardness as $CaCO_3$	IS 3025 (P) 21 – 1983RA2014	23.8 mg/l	200 mg/l
Calcium as Ca	IS 3025 (P) 40 – 1991RA2014	3.9 mg/l	75 mg/l
Magnesium as Mg	IS 3025 (P) 46 – 1994RA2014	3.4 mg/l	30 mg/l
Total Alkalinity as $CaCO_3$	IS 3025 (P) 23 – 1986RA2014	46 mg/l	200 mg/l
Chloride as Cl	IS 3025 (P) 32 – 1988RA2014	17.6 mg/l	250 mg/l
Sulphate as SO_4	IS 3025 (P) 24 – 1986RA2014	5.8 mg/l	200 mg/l
Iron as Fe	IS 3025 (P) 53 – 2003RA2014	BDL(MDL-0.05mg/l)	1 mg/l

BDL- Below Detection Level
MDL- Minimum Detection Level

For Poluchem Laboratories (P) Ltd.

Authorized signatory