REPORT OF
GREEN AUDIT

Based on International Standards
ISO 14001: 2015, 50001: 2018,
46001: 2019, 14046: 2014, 14067: 2018

Kuriakose Gregorios College, Pampady

Kottayam, Kerala, India.

TIES

KURIAKOSE GREGORIOS COLLEGE PAMPADY
DUTY ACCOMPANIES RIGHT

REPORT OF GREEN AUDIT

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Auditee

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February, 2024

This report is meticulously crafted by the Environment Management Committee of Kuriakose Gregorios College, Pampady, Kottayam, with invaluable guidance and support from the ISO Green Audit Consultancy division of the Tropical Institute of Ecological Sciences (TIES: www.ties.org.in), located in Kottayam, Kerala.

As an integral component of the Green Audit initiative conducted within the college premises, the data presented herein has been diligently collected by a team of certified internal auditors. Furthermore, the Report and Manual of Documented Information have undergone rigorous scrutiny by external auditors from TIES, ensuring alignment with ISO standards.

Published on 15th February 2024
Kuriakose Gregorios college, Pampady

Preface

It is with great pleasure and enthusiasm that we present the Green Audit Report of Kuriakose Gregorios College, Pampady, Kottayam, Kerala. This report embodies the culmination of extensive research, meticulous analysis, and dedicated efforts aimed at comprehensively evaluating the Environmental Management System (EMS) of our esteemed institution.

As an institution committed to excellence in education, Kuriakose Gregorios College recognizes the critical importance of environmental stewardship and sustainability. In line with this ethos, we embarked on a thorough examination of our environmental practices, seeking to identify areas of strength and opportunities for improvement across various facets of our operations.

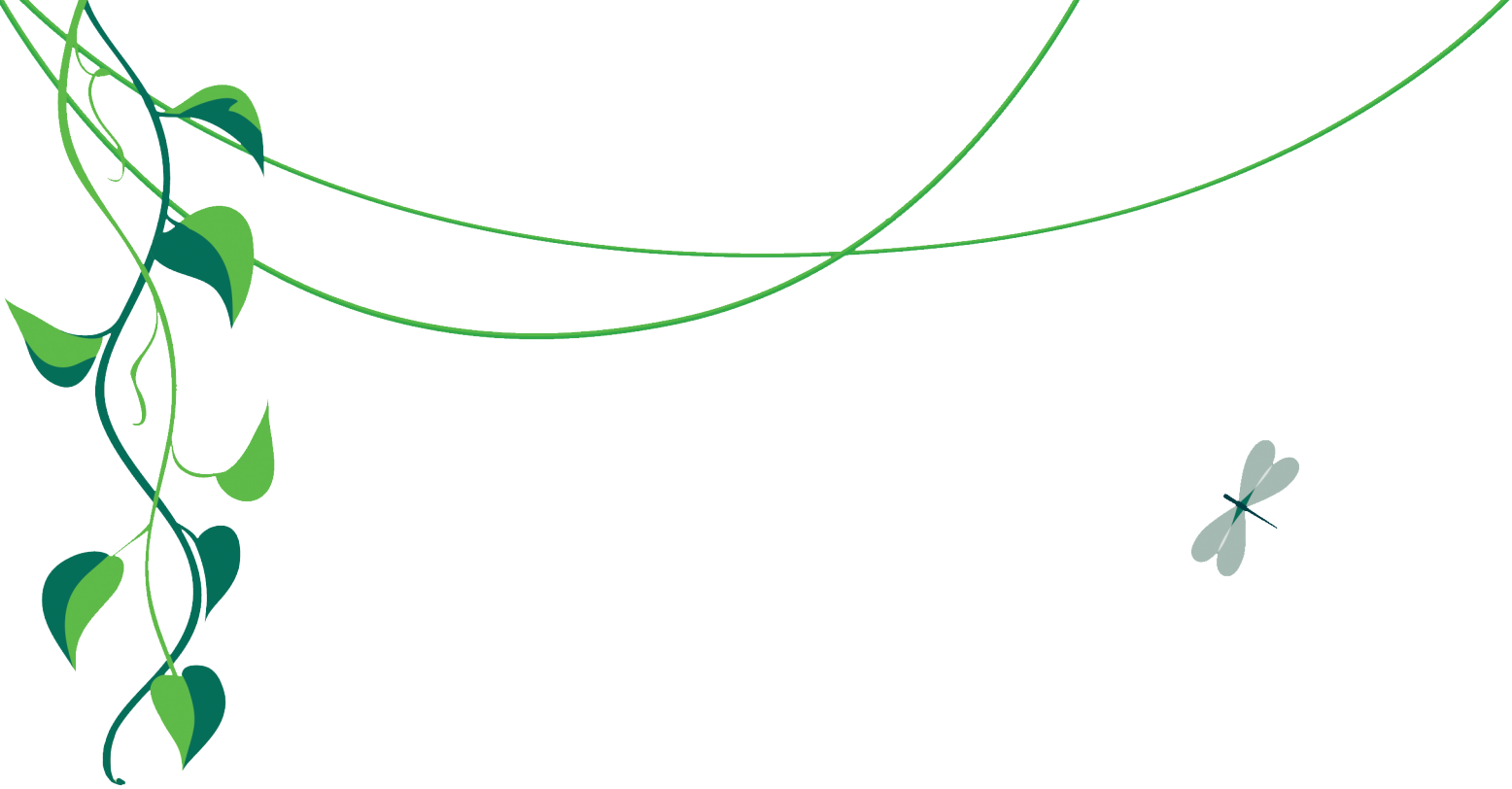
This report provides a holistic overview of our environmental performance, encompassing a detailed Energy Audit, Water Efficiency Management Audit, Waste Management Audit, Biodiversity Audit, and Carbon Footprint Data. Each section offers valuable insights into our resource utilization, conservation efforts, and environmental impact, reflecting our dedication to fostering a greener, more sustainable campus environment.

The findings presented herein not only serve as a testament to our ongoing commitment to environmental responsibility but also lay the groundwork for strategic initiatives aimed at further enhancing our sustainability practices. Through the implementation of targeted recommendations derived from this report, we aspire to continually elevate our environmental performance, reduce our ecological footprint, and inspire positive change within our campus community and beyond.

We extend our heartfelt gratitude to all those who contributed to the development and realization of this report, including faculty members, administrative staff, students, and external stakeholders. Your collective support and dedication have been instrumental in shaping our environmental journey and reinforcing our commitment to sustainability.

As we embark on the next phase of our environmental stewardship journey, we remain steadfast in our resolve to uphold the principles of sustainability, innovation, and excellence. Together, let us strive to create a greener, more resilient future for generations to come.

Environment Management System Committee
K.G.College, Pampady



Look deep into nature,
and then you will understand
everything better.

- Albert Einstein

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GREEN AUDIT AT ISO STANDARDS FOR COLLEGES & UNIVERSITIES

An Introduction

TIES

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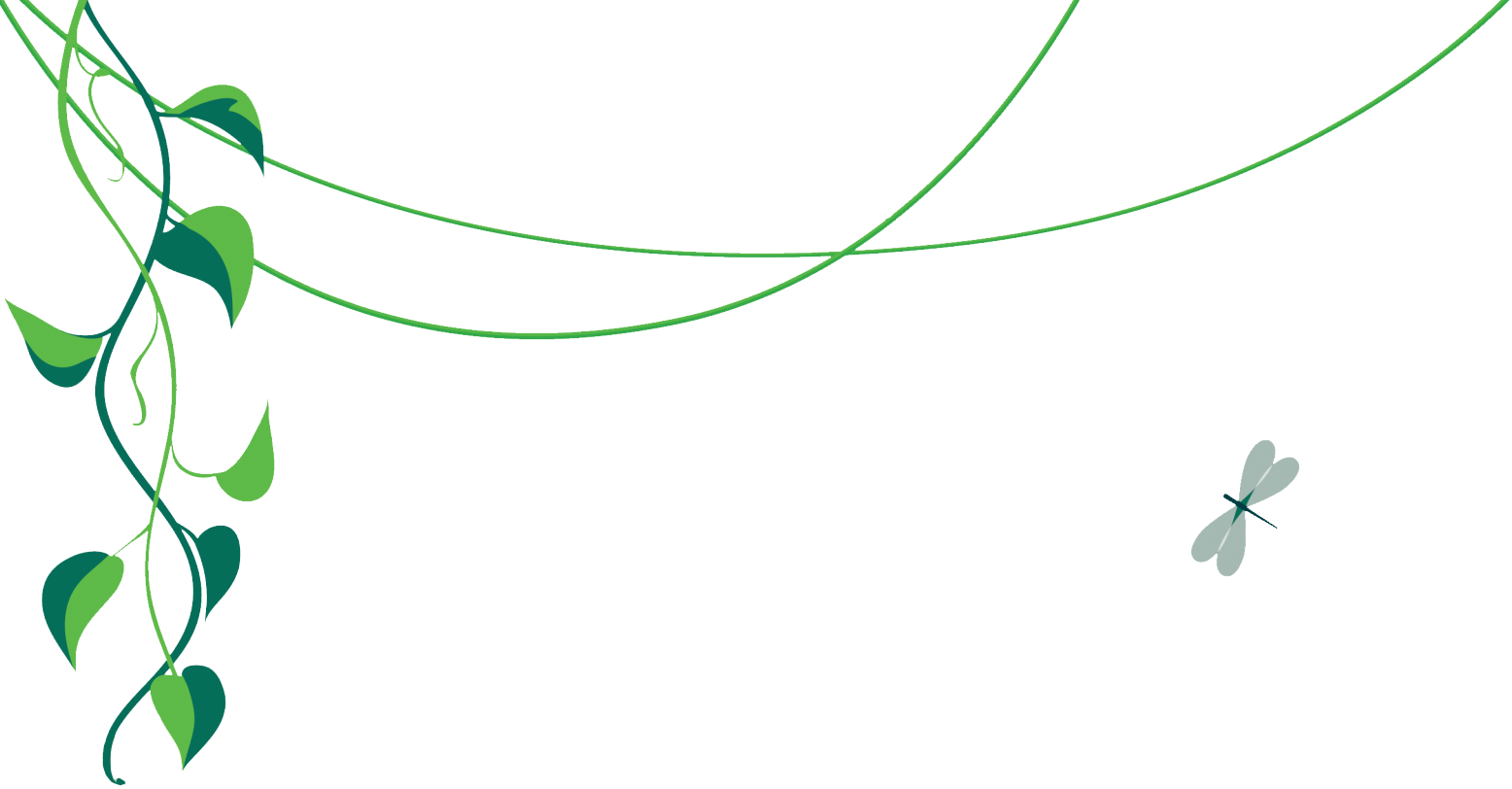


The geatest threat to our planet
is the belief that someone else
will save it.

- Robert Swan

1

Green audit at ISO Standards

1.1. INTRODUCTION

Green audit in colleges, also known as an environmental audit or sustainability audit, is a systematic examination of an educational institution's operations, practices, and facilities to assess their environmental impact and identify opportunities for improvement in sustainability efforts.

During a green audit, various aspects of the college's operations are typically evaluated, including energy consumption, waste management, water usage, transportation, procurement practices, and overall environmental policies. The audit may involve gathering data, conducting interviews with key stakeholders, and assessing compliance with environmental regulations and standards.

The goal of a green audit in colleges is to promote environmental responsibility, reduce the institution's ecological footprint, and foster a culture of sustainability among students, faculty, and staff. By identifying areas for improvement and implementing targeted strategies, colleges can enhance their environmental performance and contribute to broader efforts toward sustainability and climate action.

1.2. HIGHER EDUCATION AND SUSTAINABLE DEVELOPMENT

The 2030 Agenda, powered by the UN Sustainable Development Goals (SDGs), goals encompass a broad view of development, spanning environmental, social, and economic sustainability.
The SDGs serve as a compass for nations, institutions, and civil society to navigate their journey towards lasting peace and prosperity for both people and the planet. In this monumental task, every individual and organization have a role to play. Among them, higher education institutions (HEIs) occupy a unique and pivotal position.

Firstly, HEIs have a primary mission to educate and train the future leaders, equipping them with the skills and knowledge necessary to contribute to sustainable societies.
Secondly, HEIs undertake a significant and innovative role in research, generating cutting-edge knowledge and technology that can drive societal progress.
Thirdly, HEIs directly benefit communities by sharing their knowledge and technology and forging alliances with other stakeholders in the Quadruple Helix, which includes governments, industry, and societal groups.

Moreover, the management and administration of HEIs offer an opportunity to lead by example, promoting ethical and sustainable governance, strategies, and operations.

This distinctive position empowers HEIs not only to participate in but to lead the charge toward sustainable economic, social, and environmental development. However, this potential comes hand in hand with a significant responsibility to do everything possible to advance sustainable development. While many HEIs already contribute to the SDGs in various ways and to varying degrees, these efforts are often scattered and lack a comprehensive institutional-level sustainability approach or strategy.

In this era of unprecedented global challenges, it's time for HEIs to unite their efforts, align their strategies, and take a leadership role in driving sustainable development forward. Together, they can be the change-makers, guiding us towards a brighter, more sustainable future for all.

[Adapted from "General guidelines for the implementation of sustainability in Higher Education Institutions", 2023. UNESCO & UN Academic Impact].

1.3. UN SD GOALS AND ISO STANDARDS

The UN-SD goals, an ambitious action plan to enhance peace and prosperity, eradicate poverty and protect the planet is recognized globally as essential for the future sustainability of our world. To be successful, the process requires consensus, collaboration and innovation. ISO has published more than ¬¬ 22000 International Standards and related documents that represent globally recognized guidelines and frameworks based on international collaboration. Built around consensus, they provide a solid base on which innovation can thrive and are essential tools to help governments, industry and consumers contribute to the achievement of every one of the SDGs.

ISO standards support the three pillars of sustainable development :
Economic - ISO standards promote economic sustainability by facilitating international trade, improving a country's national quality infrastructure and supporting sustainable business practices. They cover everything from efficient farming methods to anti-bribery management systems.
Social - ISO Standards promote social sustainability by helping countries and communities to improve the health and well-being of their citizens. They cover all aspects of social welfare, from healthcare systems and related products to social inclusion and accessibility.

Environmental - ISO International Standards promote environmental sustainability by helping businesses and countries manage their environmental impact. They cover such aspects as implementing an environmental management system, measuring and reducing greenhouse gas emissions and energy consumption, and encouraging responsible consumption.

1.4. GREEN AUDIT AT ISO STANDARDS- WHY?

Green Audits are not merely an obligation for NAAC accreditation; they are in alignment with the broader canvas of Sustainable Development Goals. This dynamic form of environmental scrutiny reveals compliance gaps and pinpoints areas for bolstering management systems, all while proposing viable corrective actions.
Green audit helps to reduce negative impacts on environment and enhancing conservation in college and university campuses. Its main objectives are:

- A systematic examination to assess an institution's environmental responsibility
- Aims to identify environmental compliance, gaps or lapses in implementation of conservation activities
- Checking whether they meet stated institutional objectives and complied with including environmental management laws and ISO standards
- Suggesting corrective measures for improvement

It is highly significant for every academic institutions in the present scenario:

- Mandatory as per the NAAC advisory
- Essential for complying with SD Goals

- It can help to improve the quality of academic and research processes, by complying environmental quality standards which are at par with international standards.
  Help to identify areas where improvement could be possible.
- It can exhibit your university/college as an institution of international standards.
- It will help to bring more accreditations and awards easily.
- ISO certification will help to save money by streamlining your processes and making them more efficient.

1.5. GREEN AUDIT CERTIFICATION BODY

The present audit report is evaluated and external audit is conducted by Tropical Institute of Ecological Sciences (TIES- www.ties.org.in), following relevant ISO standards. TIES, a trailblazing and professionally managed environmental research organization, holding the prestigious ISO 9001:2015 accreditation and a certification body with ISO 17020, the singular accredited agency in South India dedicated to conducting Green Audits in academic and research institutions. With an illustrious track record encompassing 25 colleges, spanning arts, science, and professional institutions, as well as two prestigious
universities in South India, TIES brings a wealth of experience to every audit it undertakes.

TIES have developed a unique Green Audit protocol based on relevant ISO standards. The Green audit certification for academic and research institutions by TIES is based on the following international standards:
1.5. Steps of green audit as per ISO standards

No.	Phase	Major activities
1	Pre Audit Period	Questionnaire survey Pre audit visit to assess the facilities/infrastructure available Identify the key persons/system personals- organize for the audit
2	Audit activities at the site	Collection and collation of information (review of records) Conducting audit, Monitoring and verification
3	Post audit period	Draft report, Final report

Table 1.1. Stages of Green Audit

1.6. GREEN AUDIT AS PER ISO STANDARDS AT KURIAKOSE GREGORIOS COLLEGE, PAMPADY.

1.6.1. Process of green audit as per ISO standards

The Green audit programme as per ISO standards and developed by TIES is a ccustomized package for universities and colleges in India, considering prevailing specific academic and social environment. It is relatively simple and easy to implement and practice.
A PLAN-DO-CHECK-ACT System is implemented.

Fig.1.1. PDCA cycle of Green Audit

1.6.2. Green Audit at K G College

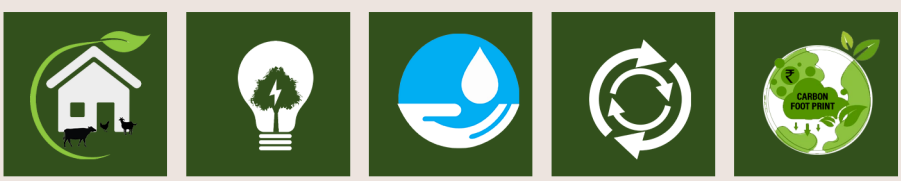
The IQAC chairman and the Principal of the college requested Tropical Institute of Ecological Sciences (TIES) to conduct a green audit at the college on 19.10.2023. TIES initiated the formal proceedings of the audit by requesting the prerequisite data for green audit from the college, on 20.10.2023. The college has submitted required information on 25.10.2023. subsequently, the MoU for green audit was signed between the Principal of the college and Secretary, TIES on 06.11.2023 for a period of three months for the completion of the audit process and valid for three years. Experts from TIES ISO Green Audit Consultancy division had given a full day training for internal auditors on 17.11.2023. All participants who passed the evaluation process were given with certificate as Internal auditor.

Internal auditors aggregated to various committees like Environment Management System Committee, Energy Management System Committee etc. and they have implemented EMS in the college. They collected data on various audit components and documented, analyzed and prepared the report.

The final external audit by assessee from TIES was conducted on 16.02.2024.
The first surveillance audit is scheduled for June 2024.

GREEN AUDIT
Based on ISO Standards

Environment Management System

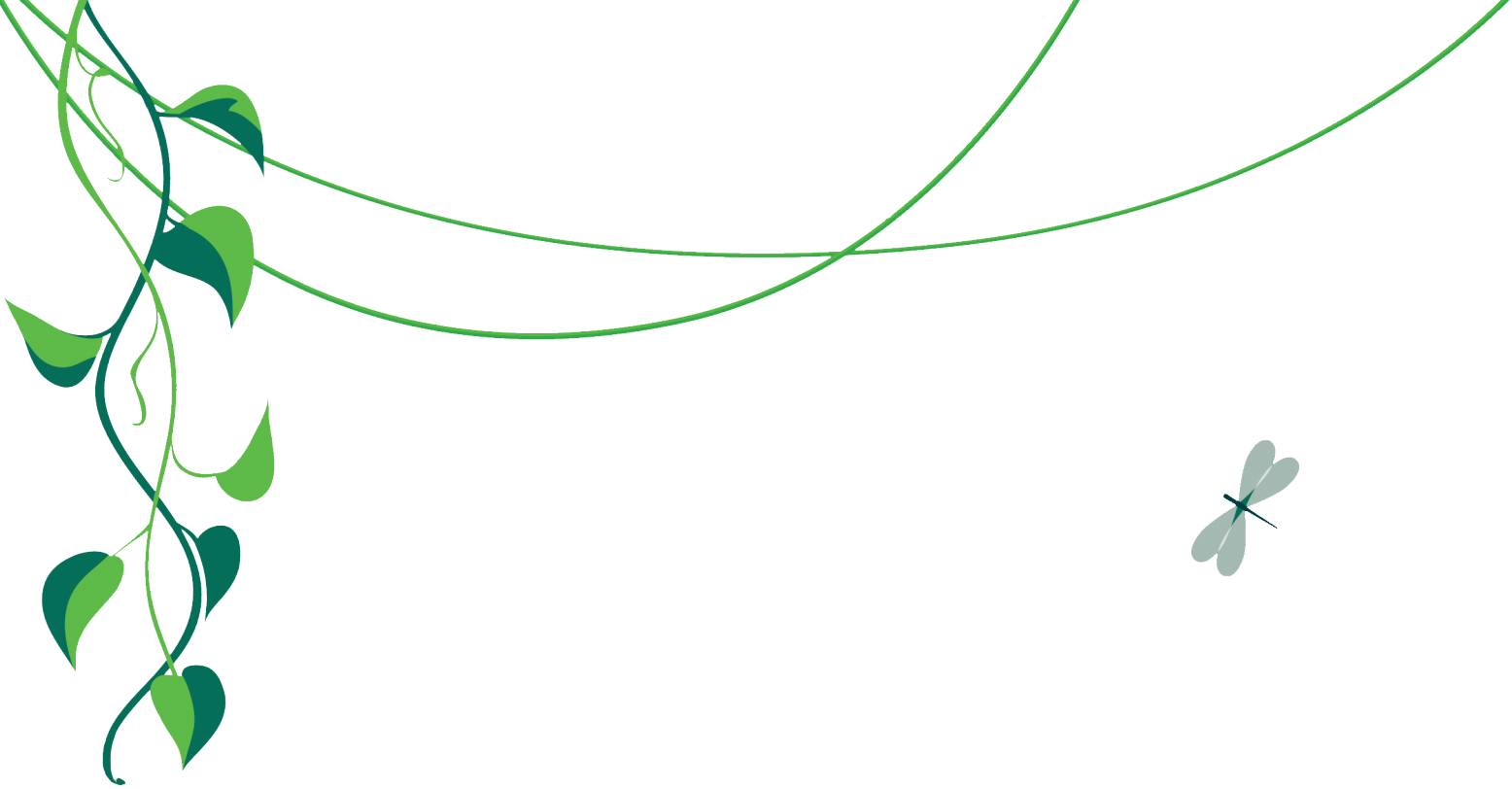


Biodiversity Management System | Energy Management System | Water Efficiency Management System | Waste Management System | Carbon Foot print

TIES 2024

Chapter II

COLLEGE PROFILE
KURIAKOSE GREGORIOS COLLEGE, PAMPADY



Sustainable development begins
with Education

- UNESCO

2

College Profile

Kuriakose Gregorios College, Pampady

2.1.HISTORY OF THE COLLEGE

Kuriakose Gregorios College, located on the verdant Kilimala Kunnu (9033'24"N76038'30"E), just a kilometer southwest of Alampally Junction, Pampady, Kottayam, Kerala, stands as a distinguished center of higher learning. It venerates the memory of Kuriakose Mar Gregorios, the saintly Metropolitan of the Malankara Church, embodying his grace's benevolence and empathy, perpetuating the spread of education and enlightenment to the underprivileged. An institution dedicated to excellence with unwavering zeal, K.G. College had its inception in 1981 within the ITC buildings at Pothenpuram, near the revered tomb of Pampady Thirumeni, in whose honor the college was established. On September 14, 1981, the cornerstone of the new college building was laid, and within a year, the college transitioned to its current location. The ensuing four decades marked a saga of success for the college. Affiliated with Mahatma Gandhi University, Kottayam, and managed by the cooperative administration of MOC colleges, Devalokam, Kottayam and educational agencies is the Catholic and Malankara Methrapolitha.

2.2.AIM AND OBJECTIVES

- The primary aim of the college, at the time of its inception was to perpetuate the sacred memory of Kuriakose Mar Gregorios (Pampady Thirumeni), the saintly Metropolitan of the Kottayam Diocese of the Malankara Orthodox Church. The College bears the name of the Patron saint and tries to do justice to his vision and mission.
- In keeping with the vision of the late lamented Metropolitan, whose life was a glowing beacon of charity and compassion, the college specially caters to the weaker sections of society

2.3.VISION

To become a centre of academic excellence by imparting quality education

2.4.MISSION

To develop the physical, spiritual, intellectual, moral and aesthetic power of the student so that they may

transform themselves into intellectually trained morally upright, socially committed and spiritually inspired men and women

2.5.COLLEGE ADMINISTRATION

The organogram of the college is given as Fig 3.1.College is managed by cooperate management of M.O.C College Kottayam through its central governing body and an additional local governing body. H. H. Catholics is the manager and resident manager look after the day- to day affairs. Principal is the head of the institution and college council is responsible for curricular and core-curricular activities of the college

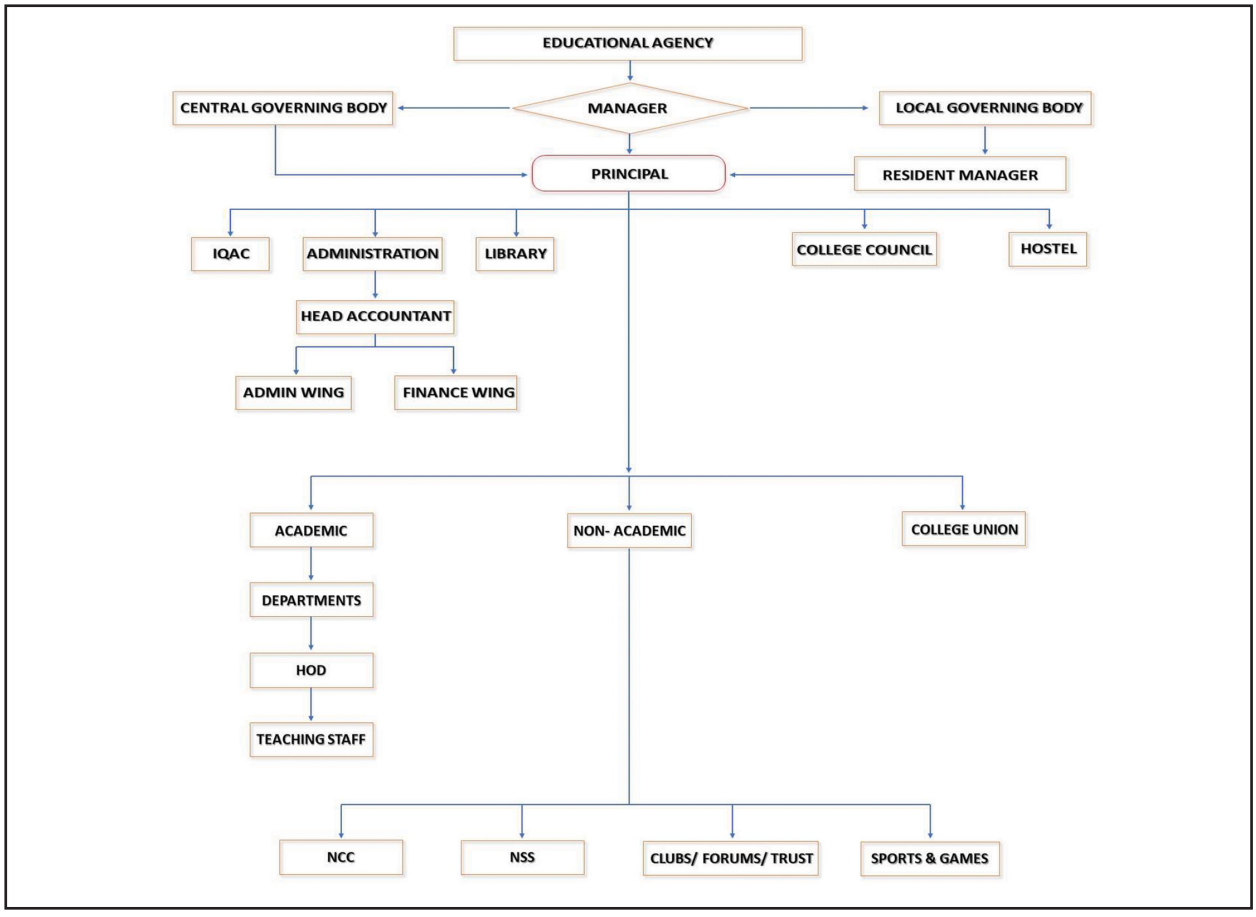


Fig. 2.1. Organogram of the college

2.6.STUDENT STRENGTH OF THE COLLEGE (2023-24)

Sl.No.	Department	Boys	Girls	Total
1	Commerce	78	76*	154
2	Physics	13	8	21
3	Economics	49	34	83
4	Chemistry	6	14	20
5	Zoology	8	32	40
6	Food Science & quality Control	26	32	58
7	Management Sciences -BBA (SF)	66	19	85
8	English (SF)	3	7	10
Grand Total		**249**	**222**	**471**

* Including one Ph.D student

2.7.STAFF STRENGTH OF THE COLLEGE (2023-24)

2.7.1. Faculty

Sl.No.	Subject	Permanent faculty	Guest/visiting faculty	Total
1	Commerce	7	0	7
2	Physics	3	0	3
3	Economics	2	1	3
4	Chemistry	2	2	4
5	Zoology	4	2	6
6	Food Science & quality Control	0	3	3
7	English	2	2	4
8	Hindi & Malayalam	1	1	2
9	Physical education	1	0	1
10	Political Sciences	1	0	1
11	History	1	0	1
12	Mathematics	1	1	2
13	Botany	0	1	1
14	Electronics	0	1	1
11	Management Sciences (SF)	0	4	4
Total				**43**

2.7.2. Non-teaching staff

Sl.No.	Category	Permanent	Management/contract	Total
1	DTP centre	0	1	1
2	Security	0	1	1
3	Cafeteria & canteen	0	2	2
4	Lab/lib. assistants	1	0	1
5	Librarian	1	0	1
6	College office	9	7	16
Total				**22**

2.7.3. Strength of Women's hostel

Sl.No.	Inmate category	Total no.
1	Students	44
2	Staff	2
Total		**46**

2.7.4. Total strength of college community

Sl.No.	Inmate category	Total no.
1	Students	471
2	Teaching Staff	42
3	Non teaching staff	22
4	Hostel	1
Total		**536**

2.8. DETAILS OF PROGRAMMES OF THE COLLEGE

2.8.1. Aided stream

Sl No	COURSE	DEPARTMENT
1	Fundamental of Economics	Economics
2	Chemistry in Everyday Life	Chemistry
3	Fundamental of Accounting	Commerce
4	Physics in Daily Life	Physics
5	Physical Health and Life Skill Edn	Physical Education
6	Right and Human Right in India	Political Science
7	Introducing Environmental History	History
8	Public Health & Nutrition	Zoology

2.8.2. CBCSS - Open Courses for UG Programmes (Aided)

Sl No	COURSE	DEPARTMENT
1	Fundamental of Economics	Economics
2	Chemistry in Everyday Life	Chemistry
3	Fundamental of Accounting	Commerce
4	Physics in Daily Life	Physics
5	Physical Health and Life Skill Edn	Physical Education
6	Right and Human Right in India	Political Science
7	Introducing Environmental History	History
8	Public Health & Nutrition	Zoology

2.8.3. Self - Financing Programmes

Sl No	COURSE	DEPARTMENT
1	BBA	Management Science
2	BA English Literature	English

2.8.4. Certificate / Add-on / Value added course

Department	Courses
Commerce	1 GST Practitioner Course
Language	2 Bivariate and multivariate statistical tools and its applications using SPSS
Physics	Introduction to Python
Economics	Fundamental of Research Methodology
Zoology	1 Aquarium Construction and management
	2 Edible Mushroom Farming and Value Addition
Chemistry	Certificate Course in Capacity Building
BBA	Portfolio & Investment Management
English(SF)	English for Career Development

2.9. COLLEGE CAMPUS AND LOCATION

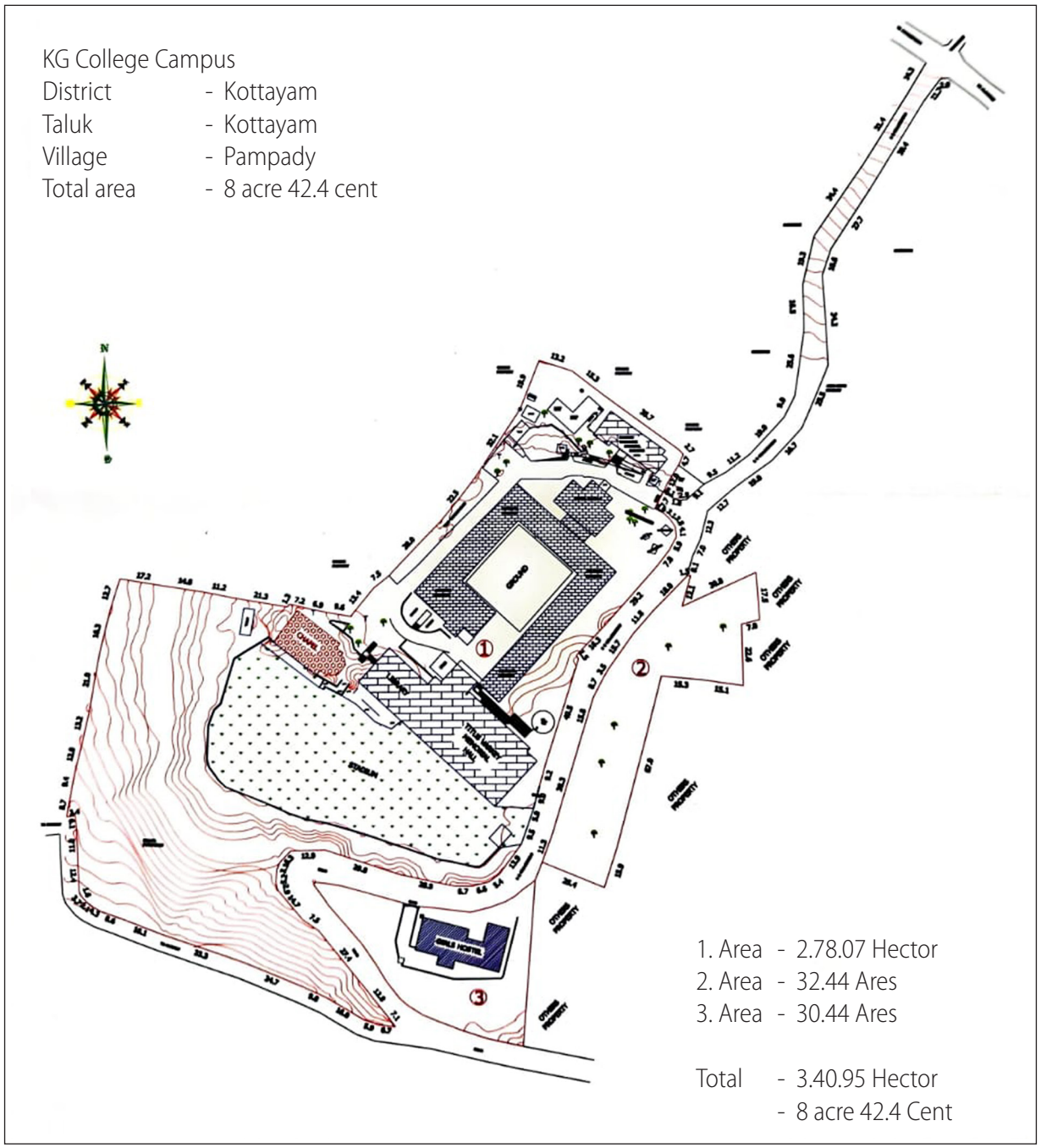


Fig. 2.2. Map of the College property

2.10. CAMPUS LAYOUT

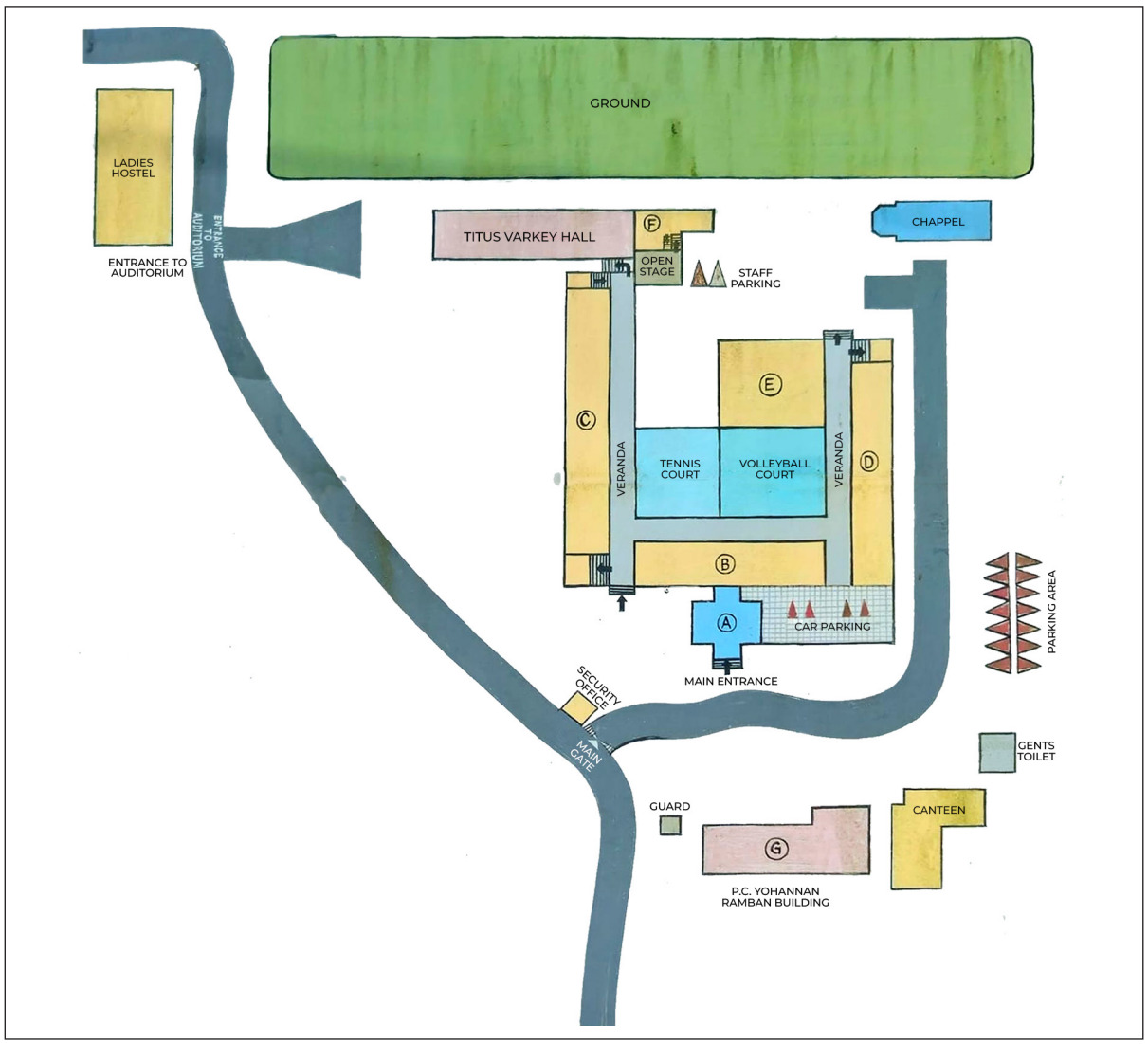
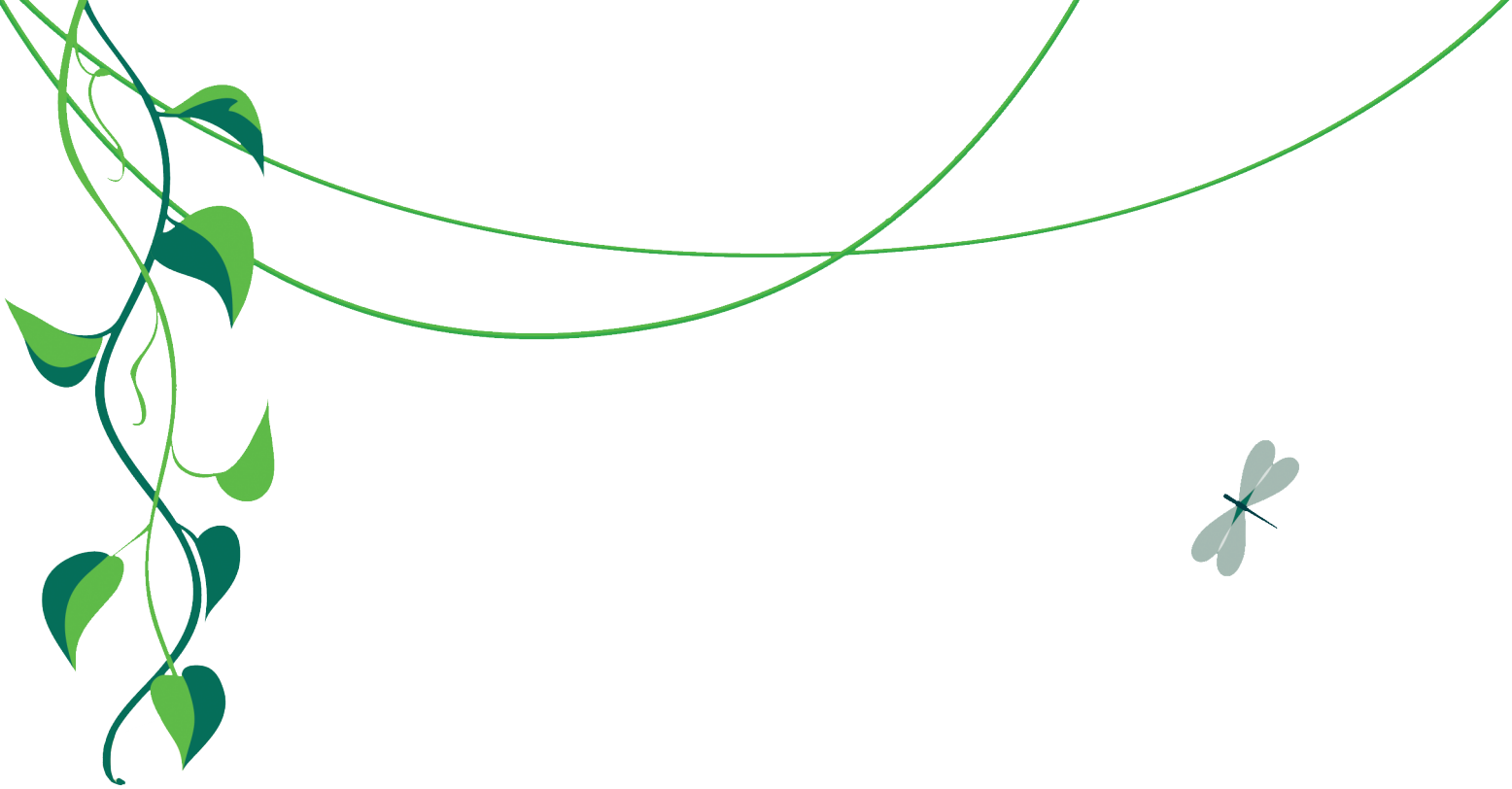


Fig. 2.3. Campus Layout

2.10.1. Facilities of the college			
1	College Hostel	9	NCC Room
2	Auditorium	10	Boomithra Sena Club Office
3	Conference Hall	11	Swachhta Ambassadors
4	Exam Hall	12	Physical Education
5	Library	13	Sports Room
6	Lab	14	Play Ground
7	Computer Lab	15	Women Cell
8	NSS Room	16	Beauty Therapy Hall



The Environment is where we all meet;
where all have mutual interest;
it is the one thing all of us share.

- Lady Bird Johnson

Chapter III

ENVIRONMENT MANAGEMENT SYSTEM (EMS) OF K.G. COLLEGE, PAMPADY

ENVIRONMENT MANAGEMENT COMMITTEE (EMS 2023-24)

Mrs. Archana Kartha
Assistant professor

Ms. Jyothi V
Assistant professor

Harikrishnan K S
Rithin Iype Mathew
Nandhana Nair
Avany P R
Diya Shibu
Shibin Mathukutty
Christy Sebastian
S Devanarayanan
Rubin Jacob Mathew
Devi Krishna N M

3 Environment Management System

3.1. INTRODUCTION

An Environmental Management System (EMS) is a voluntary management tool that provides an organization with a framework to proactively manage potential and actual environmental risks and opportunities in a college campus. EMS identify, document, monitor, evaluate and communicate the level of environmental protection in the institution. EMS is part of the college and overall management system. EMS provides institution, processes and procedures, assigns responsibilities, allocates resources and evaluates ongoing planning activities, organizational structure and practices.

ISO 14001 is the best known and most successful international standard that formulates requirements for the environmental system. Its purpose is to provide an administrative framework to raise the level of corporate and environmental protection and to do so according to socio-economic requirements. An essential element of sustainable development is environmental management. Preserving the habitat for the current and upcoming generations has turned into an international endeavour. Many businesses have included this promise in their corporate policies. Thus, limiting environmental consequences and adhering to legal requirements are not the only aspects of environmental preservation. ISO 14001, on the other hand, is more concerned with a company's ongoing environmental performance improvement.

The objectives, needs, and importance of an Environmental Management System (EMS) in a college campus are as follows:

3.1.1. Objectives

- To systematically identify, evaluate, and manage environmental aspects and impacts associated with college operations and activities.
- To comply with relevant environmental regulations, laws, and standards.
- To continuously improve environmental performance through the establishment of objectives and targets.
- To raise awareness and promote environmental responsibility among students, faculty, staff, and other stakeholders.
- To integrate environmental considerations into decision-making processes across all levels of the institution.

3.1.2. Need

Increasing environmental concerns:
With growing awareness of environmental issues such as climate change, pollution, and resource depletion, there is a need for colleges to address their environmental impacts and contribute to sustainability efforts.

Legal and regulatory requirements: Compliance with environmental regulations is mandatory for colleges to avoid legal penalties and maintain their reputation as responsible institutions.

Stakeholder expectations: Students, parents, faculty, staff, and the broader community increasingly expect colleges to demonstrate a commitment to environmental stewardship and sustainability.

Resource efficiency and cost savings:
Implementing environmental management practices can lead to efficiencies in resource use, waste reduction, and cost savings for the college.

3.1.3. Importance

Environmental stewardship: An EMS helps colleges fulfil their role as environmental stewards by managing their operations in a manner that minimizes adverse environmental impacts.

Reputation and credibility: A well-implemented EMS demonstrates the college's commitment to environmental responsibility, enhancing its reputation and credibility among stakeholders.

Risk management: By proactively identifying and mitigating environmental risks, colleges can reduce the likelihood of incidents, fines, and reputational damage.

Educational opportunities: An EMS provides valuable learning opportunities for students, allowing them to engage with real-world environmental challenges and solutions.

Innovation and competitiveness: Colleges with strong environmental management practices can attract environmentally-conscious students, faculty, and staff, enhancing their competitiveness in a socially responsible marketplace.

EMS management plan regularise the practice of environment management through introducing sustainable practice. By integrating the principle of sustainability into their own operations and campus management, serving as living laboratories for students to observe, learn and participate in sustainable practice which gradually disseminate in regular lifestyle.

3.2. ENVIRONMENT POLICY OF K.G.COLLEGE, PAMPADY

3.2.1. Introduction

Nestled amidst the lush expanse of Kilimalakunnu, Kuriakose Gregorios College stands as a beacon of dedication to environmental preservation. The college has woven a stringent green policy into its very fabric, aligning seamlessly with the National Environment Policy and nurturing an eco-conscious haven on its campus. At the heart of its mission lies the deep desire to instill a deep-rooted sense of environmental responsibility in the young minds it nurtures.

By imparting knowledge on sustainable development, waste management, and the balance of both renewable and finite resources, the college endeavors to sow the seeds for a brighter, greener future. The college, through its teachings and actions, seeks to illuminate the path towards a harmonious coexistence, where humans and nature thrive hand in hand.

3.2.2. Goal

The primary aim of the environmental policy at Kuriakose Gregorios College is to cultivate a mindset of sustainability and responsible environmental care among the college community and this tunes with Sustainable Development Goals (SDG). It involves advocating for methods that lessen environmental harm, like adopting energy-saving initiatives, cutting down on waste production, preserving natural resources, improving native biodiversity, and educating students, faculty, and staff on environmental matters and ethical behaviors. Ultimately, the policy strives to establish a campus setting that not only reduces its impact on the environment but also sets a learning center for sustainable practices in the wider community.

3.2.3. Objective

To reduce the college's ecological footprint by 20% within the next five years through the implementation of targeted sustainability initiatives, including the installation of energy-efficient systems, waste reduction programs, conservation practices, and comprehensive (formal and informal) educational campaigns and research programmes. By fostering a culture of environmental stewardship, the objective aims to inspire active participation from students, faculty, and staff while establishing Kuriakose Gregorios College as a regional leader in sustainable campus practices.

- Integrate environmental and sustainability themes into curriculum by various approaches like case studies, practical projects, and interdisciplinary discussions. Encouraging hands-on experiences and collaborative learning cultivates a deeper understanding and commitment to these crucial global issues among students and faculty
- To promote sustainable life style in the campus by encouraging student involvement in maintaining green spaces to foster a sense of ownership and connection to nature, advocating for eco-friendly transportation options, such as bike-sharing programs or incentives for carpooling, electric vehicle charging stations, encouraging the use of public transport. Sustainability practices shall be integrated into college policies, procurement processes, and decision-making frameworks to ensure a long-term commitment to eco-friendly practices.
- Inspire and support initiatives, projects, and campaigns initiated by students to instigate transformation and impact from within the student community.
- Implementation of rigorous policies prioritizing eco-friendly purchases and sustainable procurement practices, collaborating closely with ethical local suppliers.
- Active support for research initiatives addressing environmental challenges, sustainability practices, and the development of innovative green technologies. Support may be extended to fostering interdisciplinary collaborations and providing resources to drive impactful research that addresses pressing environmental issues.
- Teaming up with neighbourhood communities and environmental groups, taking part in nearby sustainability efforts, and exchanging resources and insights to extend environmental awareness beyond the campus.
- Setting up protocols to monitor progress regarding environmental goals, conducting regular audits to assess the institution's environmental performance, and ensuring transparent reporting of results to stakeholders to maintain accountability and transparency.
- Ensure strict adherence to existing environmental laws and regulations.
- Define specific roles and responsibilities for individuals or teams tasked with implementing the policy by designating leaders, coordinators, and operational staff responsible for different aspects of environmental initiatives.

3.2.4. Resource management

The institution's community is urged to choose alternative energy sources and practice conservation of energy to protect the environment for present and upcoming generations. The policy strongly advocates for the utilization of alternative energy sources to uphold environmental sustainability. All stakeholders must make every effort to employ alternative energy sources and preserve energy in order to safeguard the environment for both current and future generations. The institution has clear cut policy in identifying and utilizing alternative sources of energy.

3.2.4.1. Solar Power

Solar roof top PV systems must be used to capture solar energy, ensuring that the maximum amount of electricity is produced while adhering to the standards established by the Commission of Alternate Sources of Energy (CASE), a division of the Ministry of New and Renewable Energy (MNRE), Government of India.

3.2.4.2. Promoting usage of LED Lights

LED lighting will be installed in place of the conventional lighting systems currently used in classrooms, laboratories, auditoriums, halls and hallways.

3.2.4.3. Utilizing Energy -

Efficient Equipment with star rating - refrigerators, air conditioners, microwaves, deep freezers, etc.— alone shall be purchased. LED monitors will be used in the staff areas, offices, and computer labs. Additionally, the current TFT monitors will eventually be phased out.

3.2.4.4. Conservation of water

We target conservation of water through enhancement of quality and quantity of available water with maximum possible energy input. The institution strives to conserve water by employing a systematic and well-planned approach to preserve water in all its states. This includes adopting techniques like rainwater collection and harvesting. For the collection of rain water, the following standards will be put into place:

- sizable portion of the campus's water demand must be satisfied by rainwater.
- The annual rainwater should be gathered as much as possible. A water conservation facility with a capacity of 3 Lakh Liters is installed in the campus.

3.2.3.5. Recharging open well

- The institution is having storage tanks or bunds to hold extra water that can be redirected during intense downpours.
- Institution is responsible for the appropriate maintenance and protection of the open well in the campus as well as the installation of a suitable distribution system for the use of the water that has been stored.

3.2.5. Waste management

Efficient management of waste is a primary focus within the green policy. By segregating, reducing, reusing, recycling, and composting waste, the institution aims to adhere to waste management regulations. Through orientation, circulars, announcements, and signs in conspicuous locations, all individuals involved with the institution will be informed about the importance of maintaining a clean and environmentally friendly campus. The institution's management will employ composting methods for biodegradable waste, utilizing the resultant compost as a natural fertilizer to nurture the campus's plant life. To mitigate environmental pollution, the institution needs an efficient system for diminishing, recycling, and repurposing non-biodegradable waste

3.2.5.1. Solid waste

The institution's solid waste management protocols need to align with the guidelines established by the International Institute of Waste Management. Implementing the following standards will ensure the establishment of a systematic, structured, and multi-tiered process for solid waste management:

- Bins that are color-coded and labelled must be placed in classrooms, auditoriums, cafeterias, labs, corridors, washrooms, open area set in order to separate and collect waste at every level of the organization.
- Personnel shall be appointed and entrusted specifically to assist with garbage collection, Segregation, treatment or disposal.
- The collected paper trash can be delivered to an authorized recycling facility.
- Segregated plastic garbage can be handed over to the Panchayat Haritha Karma Sena.
- A biogas plant is used to treat wet waste at St. Eulithee women's hostel of the college.
- Vermicomposting can be used to treat the garden waste and the finished product will be used as bio fertilizers.
- Sanitary napkins are burned in incinerators after use.

3.2.5.2. Liquid waste

There are two types of liquid waste generated in the college.

- Drainage water: discharged from wash basins to farm fields on campus.
- Drainage water (from laboratories) is diluted with fresh water and piped underground. No radioactive waste or medical waste is generated in the campus.

3.2.5.3. E-Waste

A well-organized strategy for handling electronic waste is devised right at the outset of the procurement process. The following standards will be used to manage e-waste.

- An agreement in the form of an LoU is made with an authorized e-vendor to ensure swift collection and recycling of electronic waste.
- The maintenance division is responsible for organizing the annual collection and destruction of the e-waste.
- Outdated technology is utilized to study the hardware component.

3.2.5.4. Recycling System for Solid Waste

The recycling of solid waste will be governed by the following standards:

- The primary sources of paper waste generation is located, collected, and delivered to the designated paper recycling unit.
- The main sources of plastic waste generation is located, gathered and transferred to accredited plastic recycling facilities.
- Metal scrap is handed over to scrap dealer

3.2.6. Green initiatives

The college has implemented numerous green initiatives across its campus. Landscaping efforts have been undertaken extensively, transforming available spaces. Indoor corridors are adorned with carefully placed plants, creating refreshing greenery. Moreover, within classrooms, students take charge of nurturing dedicated green corners.

One of the standout features is the butterfly garden meticulously maintained by the college. With a variety of host plants catering to numerous butterfly species, it draws a steady stream of these beautiful creatures daily. Additionally, the Zoology and Botany Department tends to a medicinal plant garden, enriching the campus with its valuable diversity.

Furthering its commitment to sustainability, the college actively advocates for a green lifestyle. Providing a convenient bus service on all working days for students and staff from town to campus significantly reduces individual carbon footprints. Additionally, the installation of charging points for electric vehicles, powered by rooftop solar panels, represents a forward-thinking approach toward eco-friendly transportation solutions.
Moreover, the college plays a proactive role in spreading awareness. Through internal campaigns and invited lectures, it educates the community about biodiversity conservation, water preservation, and energy efficiency. Additionally, the college maintains a comprehensive biodiversity register, documenting the diverse flora and fauna thriving within its campus.

3.2.7. Purchasing and procurement

The college prioritizes environmentally friendly office stationery and energy-efficient equipment in its procurement practices. The stationery used in offices is eco-friendly, and when purchasing equipment, the energy-efficient models are opted.
Moreover, the college has taken a conscious step by refraining from purchasing disposable plates and glasses. Instead, they invest in reusable steel or glass utensils for use in the cafeteria and college canteen. This commitment to sustainable choices not only reduces waste but also promotes the use of long-lasting and environmentally responsible alternatives.

3.2.8. Research and innovation

The college is dedicated to fostering research endeavors centered on environmental concerns and sustainability, particularly emphasizing innovation in green technologies. Both postgraduate and undergraduate students in life science disciplines are actively encouraged to undertake academic projects focusing on biodiversity estimation and exploring the impact of non-eco-friendly practices on various life forms.
In a significant move towards sustainability, the college has introduced an innovative solution for managing organic and food wastes generated on campus. By installing 'Valakkoodu' or vegetable towers at strategic locations, these wastes are efficiently converted. The produce harvested from these vegetable towers is made available for sale within the college, creating a sustainable loop for waste reduction and local produce consumption. This initiative not only tackles waste management but also promotes a culture of self-sufficiency and environmental consciousness within the college community.

3.2.9. Community engagement

The college has been actively engaged in fostering community involvement and participation in various green initiatives aimed at promoting sustainability and environmental consciousness. Through collaborative efforts, the college has successfully implemented numerous programs and initiatives, fostering a strong bond between the college and the local community. As part of its community engagement efforts, the NSS (National Service Scheme) of the college organizes regular cleaning drives in the surrounding neighbourhood. These initiatives aim to enhance the cleanliness and hygiene of the local area, involving students in active participation towards a cleaner environment beyond the college campus.

Furthermore, extending its green initiatives beyond campus borders, the college has established a butterfly garden in the premises of the Kottayam Collectorate. This collaborative effort not only beautifies the area but also serves as a sustainable green space promoting biodiversity conservation in the wider community.

3.2.10. Monitoring and reporting

Stakeholders associated with Kuriakose Gregorios College – from the management and employees to the students and all others using the facilities – is expected to abide by the green policy and code. A green protocol and swachatha committee function in the campus which will be in charge of organising, carrying out and overseeing the institution's environmental efforts. With these, Kuriakose Gregorios College explicitly declares its steadfast commitment to environmental sustainability, acknowledging its duty to minimize its environmental footprint.

3.2.11. Compliance and review

Additionally, periodic reviews and updates are conducted to ensure that the green policy remains adaptive to evolving challenges, embraces new technological advancements, and seizes emerging opportunities in the environmental landscape. This commitment to regular policy evaluation allows the institution to stay updated about changing environmental framework and readily adopt innovative approaches as they emerge, ensuring a proactive and responsive stance towards caring for the environment. As part of environment policy an environment management system is implemented (EMS) in our campus and periodic internal audit and external audit are practiced.

3.2.12. Towards a green campus

The college is dedicated to fostering a culture of environmental awareness and sustainability among its community members. With a firm commitment to creating an environmentally friendly campus, the institution is actively implementing necessary precautions and practices. It envisions a future where sustainability is ingrained in every aspect of campus life.

Embracing a long-term vision, the college is steadfast in its dedication to continually improving the campus environment. It seeks to achieve green certifications and national environmental benchmarks, setting a standard for sustainable practices within the educational landscape.

The college eagerly anticipates the journey ahead, working hand in hand with its community to instil a profound commitment to a greener, more eco-conscious campus. Through collective efforts and a shared vision, the institution is poised to create a lasting impact and lead by example in environmental stewardship.

3.3. ENVIRONMENT MANAGEMENT PLAN

The Environment Management Plan of Kuriakose Gregorios College delineates the strategies and actions essential for executing and maintaining the institution's dedication to environmental sustainability as stated in its Environment Policy. This plan aims to steer the college community in realizing the specified environmental objectives, cultivating a culture of stewardship, and fostering ongoing enhancement towards a more sustainable campus.

3.3.1. Establishment of an Environmental Management Team

Form a dedicated team comprising representatives

from different departments and stakeholders (faculty, students, administration) to oversee the implementation of the plan and ensure accountability.

3.3.2. Assessment and Environmental Audit

Conduct a thorough assessment of the institution's current environmental impact, including energy consumption, waste generation, water usage, transportation, and land use. This audit will serve as a baseline against which progress can be measured.

3.3.3. Set SMART Goals

Define Specific, Measurable, Achievable, Relevant, and Time-bound (SMART) goals aligned with the institution's mission and values. Examples include reducing energy consumption by a certain percentage, increasing recycling rates, and promoting sustainable transportation options.

3.3.4. Advancing Curriculum Integration and Educational Initiatives

Foster collaboration with academic departments to seamlessly integrate environmental and sustainability themes into the curriculum, leveraging case studies, practical projects, and interdisciplinary discussions. Promote experiential learning and foster collaborative opportunities to enhance students' and faculty members' grasp and dedication to environmental issues

3.3.5. Promoting Sustainable Lifestyles

Encourage students to actively preserve green spaces, nurturing a deeper sense of responsibility and affinity with nature.

Champion eco-conscious transportation alternatives, including bike-sharing initiatives, incentives for carpooling, and the installation of electric vehicle charging stations. Embed sustainability principles within college policies, procurement procedures, and decision-making structures.

3.3.6. Facilitating the development of frameworks

Encourage and support student-led initiatives, projects, and campaigns aimed at fostering environmental transformation and impact within the college community.

3.3.7. Enhance sustainable procurement practice

Enforcing stringent policies that prioritize environmentally friendly purchases and sustainable procurement practices.Forge strong partnerships with ethical local suppliers, ensuring strict compliance with environmental
standards.

3.3.8. Research Support

Drive research initiatives addressing environmental challenges, sustainability practices, and innovative green technologies.
Cultivate interdisciplinary collaborations and allocate resources to advance impactful research addressing urgent environmental issues.

3.3.9. Community Engagement

Partner with local communities and environmental organizations to contribute to nearby sustainability endeavours.
Share resources and knowledge to broaden environmental awareness beyond the campus.

3.3.10. Monitoring and Reporting

- Establishing protocols to monitor progress toward environmental goals.
- Conducting regular audits to assess the institution's environmental performance.
- Ensuring transparent reporting of results to stakeholders to maintain accountability and transparency.

3.3.11. Compliance and Review

- Ensuring strict adherence to existing environmental laws and regulations.
- Conducting periodic reviews and updates of the Environment Management Plan to adapt to evolving challenges and opportunities.

3.3.12. Resource Management

- Encouraging the utilization of alternative energy sources and the conservation of energy to protect the environment for present and future generations.
- Implementing solar rooftop PV systems, LED lighting, and energy-efficient equipment.

- Promoting water conservation techniques such as rainwater harvesting and open well recharge.

3.3.13. Waste Management

- Implementing efficient waste management practices including segregation, reduction, reuse, recycling, and composting.
- Establishing solid waste management protocols aligned with international guidelines.
- Managing liquid waste through appropriate drainage systems and treatment methods.

3.3.14. Green Initiatives

- Implementing landscaping efforts to transform available spaces and create green corridors.
- Maintaining butterfly gardens and medicinal plant gardens to enrich campus biodiversity.
- Advocating for a green lifestyle through eco-friendly transportation solutions and internal awareness campaigns.
- Purchasing and Procurement
- Prioritizing environmentally friendly office stationery and energy-efficient equipment in procurement practices.
- Avoiding the purchase of disposable plates and glasses, opting for reusable alternatives to reduce waste.

The Environment Management Plan detailed above is in harmony with Kuriakose Gregorios College's environmental policy, underscoring the institution's dedication to sustainability, prudent resource utilization, and community involvement. By executing this plan, the college endeavours to cultivate a greener, environmentally conscious campus while assuming a pivotal role as a regional pioneer in sustainable initiatives within the educational sphere.

Chapter IV

ENERGY MANAGEMENT SYSTEM (En MS) AUDIT REPORT

ENERGY MANAGEMENT SYSTEM
(EnMS 2023-24)

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Energy Audit Report

4.1. INTRODUCTION

Energy audit is a systematic process of evaluating the energy consumption patterns and identifying opportunities for energy improvement. Energy conservation is an integrated approach to save energy consumption. Energy conservation is a critical element in the UN's Sustainable Development Goals (SDGs), particularly linked to SDG 7: Affordable and Clean Energy, SDG 12: Responsible Consumption and Production and SDG 13: Climate Action. However, its impact spans across multiple other goals.

Affordable clean energy aims to ensure access to affordable, reliable, sustainable, and modern energy for all. Energy conservation plays an indispensable role in this goal. By encouraging the efficient use of energy and reducing overall demand, we can stretch our existing energy resources further.

Energy conservation practice in academic institutions develops the importance of energy conservation among students and gradually developed it as the behaviour practice along with which they can contribute their expertness and competence to executive innovating methods particularly, infrastructure arrangement, and technological equipment and so on. Energy conservation measures, such as the use of energy-efficient appliances and lighting, can make the existing energy supplies more accessible and affordable to all.

4.1.1. What is an energy audit?

An energy audit helps us to understand how the energy is used in the college/university and helps in identifying areas where the waste of energy can occur and where the scope for improvement exists. The audit should provide a clear picture of energy consumption and energy opportunities for improvements. The requirements that must be fulfilled for an energy audit are:

- Detailed inventory of energy infrastructure of the college/university
- A detailed review of the energy consumption profile (pattern of consumption of energy through each utility point- including ways of energy loss or wastage)
- Identification of energy saving opportunities (habitual modifications, change to energy saving infrastructure and equipments, and use of alternate energy resources).

The international standards ISO 50002:2014 specifies the process required for carrying out an energy audit. It specifies the principles, common process, and deliverables for an energy audit. ISO 50001:2014 specifies the standards of energy Management System.

4.1.2. Need for energy audit

The energy demand is increasing day-by-day and to fulfill this demand, we need to use more fossil fuels. Fossil fuel generates energy as well as pollution, which is harmful to mankind. An energy audit will reduce the environmental effect directly or indirectly. The functions of the energy audit are:

- an energy audit can reduce energy consumption
- an energy audit can reduce the energy bill and save the money
- an energy audit can improve the comfort level
- an energy audit can reduce the carbon footprints
- an energy audit can reduce unnecessary waste and pollution

The energy audit is the great and most valuable step to save energy consumption and save money. It may seem that an organization's energy audit provides a point of reference for managing the consumption of energy and also it provides a better plan for the essential use of energy in a university or a college.

4.2.ENERGY MANAGEMENT POLICY

The ethos of our institution is deeply rooted in environmental stewardship, advocating for a concerted effort towards the adoption of alternative energy sources and the conscientious conservation of energy. With a firm commitment to safeguarding the environment for the benefit of present and future generations, our community is strongly encouraged to embrace sustainable practices. Central to our policy framework is the unequivocal endorsement of alternative energy sources, underscoring their pivotal role in advancing environmental sustainability. It is incumbent upon all stakeholders to diligently pursue the integration of alternative energy sources into our daily operations and to prioritize energy preservation as a collective imperative. Guided by a clear and unwavering mandate, our institution is steadfast in its pursuit of identifying and harnessing alternative sources of energy, exemplifying our unwavering dedication to environmental responsibility and resilience

This Energy Management Policy has been formulated to guide Kuriakose Gregorios located in Kerala, towards efficient and sustainable energy usage. Recognizing the importance of energy conservation and environmental responsibility, this policy outlines our commitment to reducing energy consumption, promoting renewable energy sources, and integrating energy efficiency practices into our operations.

4.2.1.Objectives:

4.2.1.1. **Reduce Energy Consumption:** Implement measures to minimize energy consumption across all facilities and operations of the institution.

4.2.1.2. **Promote Renewable Energy:** Increase the utilization of renewable energy sources such as solar, wind, and biomass to reduce dependence on non-renewable energy.

4.2.1.3. **Energy Efficiency**: Upgrade infrastructure and adopt energy-efficient technologies to optimize energy use and reduce wastage.

4.2.1.4. **Raise Awareness:** Educate students, faculty, and staff about the importance of energy conservation and encourage their active participation in energy-saving initiatives.

4.2.1.5. **Monitor and Evaluate:** Establish mechanisms to monitor energy usage regularly, set targets for reduction, and evaluate the effectiveness of energy management initiatives.

4.2.2.Policy Measures:

4.2.2.1. Energy Conservation:

- All members of the institution are responsible for conserving energy by switching off lights, computers, and other electrical devices when not in use.
- HVAC systems will be operated efficiently, and temperature settings will be optimized to minimize energy consumption while ensuring occupant comfort.
- Regular maintenance and servicing of equipment will be conducted to ensure optimal performance and energy efficiency.

4.2.2.2. Renewable Energy Integration

- Install solar panels on rooftops and open spaces to generate clean energy for powering lighting, water heating, and other electrical needs.
- Explore opportunities for harnessing wind energy through the installation of small-scale wind turbines on campus.
- Utilize biomass or biogas for cooking and heating purposes where feasible, utilizing organic waste generated on campus.

4.2.2.3. Energy-Efficient infrastructure

- Retrofit existing buildings with energy-efficient lighting, insulation, and windows to reduce energy losses and enhance thermal comfort.
- Incorporate energy-efficient appliances and equipment in new construction projects and major renovations.
- Implement smart building technologies and energy management systems to monitor and control energy usage in real-time.

4.2.2.4. Awareness and Training

- Conduct awareness campaigns, workshops, and training sessions to educate the campus community about energy conservation practices and their role in achieving energy efficiency goals.
- Encourage students to undertake research projects related to energy management and sustainability, fostering innovation and knowledge dissemination.

4.2.2.5. Monitoring and Evaluation

- Establish a dedicated Energy Management Committee responsible for monitoring energy usage, analyzing trends, and identifying opportunities for improvement.
- Set annual targets for energy reduction and track progress towards achieving these targets through regular audits and performance assessments.
- Review and update the Energy Management Policy periodically to reflect advancements in technology and best practices in energy conservation.

Kuriakose Gregorios is committed to becoming a leader in energy management and sustainability within the educational sector. By adhering to this Energy Management Policy and fostering a culture of energy conservation and innovation, we aim to reduce our environmental footprint, enhance operational efficiency, and inspire future generations to embrace sustainable practices

4.3. METHODOLOGY

Energy audit is conducted by analysing a comprehensive area of energy functioning. Initially prepared a program schedule for systematic working. Total team members in energy audit consist of fifteen students and two faculty total seventeen members each member subdivided into four members in five groups for data collection under the direction of faculties who were in charge of the audit. Team members consolidate seven registers and five documents, which includes a register of attendance sheet of energy audit training, list of auditors, regular documentation of meetings, and energy conservation policy. Students were assigned to plot a map of the block and mark the electrical appliances/ instruments in the block. Register are recorded by students for energy metre reading, monthly utility bill, solar system energy production, motor pump register, appliance stroke register. At the same time maintenance register is recorded for monitoring the working conditions of each appliance and sorted them into effective and non- effective devise and also recorded the working hours of each appliances for both daily using devise and weekly using device at the same time reported separate data for weekends, simultaneously noted the metre reading of each block. Team members consolidated the power consumption in each block by calculating the data of the fourth week, daily and weekly, accordingly cross-checked the power reading for verifying the possibilities of mismatch.

Group members followed a centralised method for data collection, taking energy metre reading (for every metre in the college) during nine days, each day three times like, three Sundays and Saturday(holidays) and three working days.(Wednesday,). Record the details and usage pattern of instrument, equipment, lights through observation visits in the assigned area and collect data on power capacity, its usage time of every light, fan, equipment, appliance, instruments there after conducting an interview with system manager and

respective faculties for further information. Team members identified and documented the possible alternate energy source by specifying an action plan and list the details of energy resources in the campus including, electrical energy, KSEB supply per month, alternative energy resources meanwhile recorded the annual usage with respective purpose use and location of nine lab, office and kitchen.

4.3.1. Assumption

- An effective EnMS, aligned with the organization's business strategy, will visualize how energy is used and where performance can be improved. It provides structured policies, processes, procedures and action plans to implement energy savings opportunities. Continuous improvement in energy management is thus achieved.
- Any energy savings identified through an EnMS will result in measurable savings on your energy bills, which will significantly reduce your business's overhead costs, and in some cases, significantly. There are numerous examples of an organization that implements ISO 50001 achieving first year energy savings that are equal to or greater than their initial costs of implementation of the Standard.
- Reducing costs (as defined in b) and reducing energy consumption (as defined in c) go hand-in-hand. By setting up, implementing, maintaining and continuously improving an ENMS, an organization will not only be able to address initial energy saving opportunities or low-hanging fruit, but it will also be able to identify and manage where energy is being consumed, when and how it is being consumed, and identify energy efficiency improvements and reductions.
- The cost reduction identified in b) above and energy reduction go hand in hand. By establishing, implementing, maintaining and continuously improving EnMS, an organization will not only be able to manage initial energy savings opportunities or "low-hanging fruit", but also identify and where, when and how to manage energy.
  Consumption and identify improvements and reductions in energy efficiency.
- Good use of Annex SL and an example of an integrated management system (IMS) is a standard that simultaneously manages the requirements of ISO , ISO 14001 and ISO 50001. In general, the processes required within each standard for document control, internal audits, handling of nonconformities case, corrective action or management review are shared, to meet the requirements of each standard without duplicating efforts with, i.e. by having three processes - one for ISO , ISO 14001 and ISO 50001.
- A new concept of ISO 50001: 2018 is introduced as part of the reformatting of ISO on ISO management using Annex SL, ISO 50001 has always called for undertaking a comprehensive review of energy within an organization, but the context "enhances" this to provide a common understanding of energy use/consumption/requirements of an organization before developing the energy SEU or details efficiency
- The overall success and energy efficiency achieved by the will depend on the extent to which senior management is involved in most aspects of the facility, the implementation of the and the continuous improvement of the EnMS system.
- The standard states that an organization must "establish objectives at relevant functions and levels and establish energy targets". The framework shall documented by including following documents energy policy, measurable (if practicable), take into account applicable requirements, Consider SEUs, take into account opportunities to improve energy performance, monitored, communicated and updated as appropriately.
- Prescriptive standards in describing the data to be collected (or obtained by measurement, if any) and the documentation to be maintained, including: relevant variables for SEUs, Energy consumption related to SEUs and to the organization, Operational criteria related to SEUs, Static factors, if applicable and Data specified in action plans.
- Accounts for energy performance throughout the operating life cycle that does not require life cycle analysis or life cycle management ISO 50001 applies to the design of installations, equipment, systems or processes that consume energy within the scope and limits of EnMS. An organization must consider

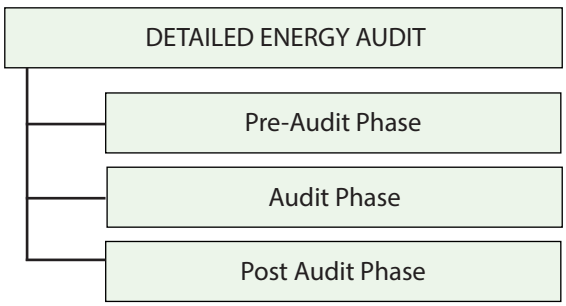
opportunities to improve energy performance and implement operational controls in the design of new or renovated SEUs and integrate the results into the specifications, design and procurement activities.

For new installations, improved technology and engineering, alternative energy such as renewable energy or less polluting types of energy options

- Improved energy efficiency can be demonstrated by an improvement in EnPI value of more than times compared to the corresponding EnB. There are possible situations in which energy efficiency improvements are achieved from an activity that is not linked to an SEU or key characteristic. In these cases, EnPI and EnB can be established to demonstrate improvements in energy performance. Where there are significant deviations in energy performance, the standard indicates that they should be investigate.

4.3.2. Stages of Energy audit

Energy audit has three phases: Pre audit, audit and post audit.



4.3.2.1. Pre audit phase

- Formation of audit team ; scheduling audit programmes- On 21st November 2023, the audit team is formed and work initiated at K.G.College, Pampady (see Manual of Documents)
- Setting up of scope and objectives (in tune with energy policy of the institution)
- Discusses with the responsible persons of each location (staff, teachers, lab assistants, sweepers, watchmen, students etc.) about the usage pattern and habits related to energy consumption.
- Preparation of inventory of energy infrastructure- site diagrams, electrical diagrams, checklists etc.
- Analysis of consumption pattern; identification of energy loss or wastage

4.3.2.2. Audit phase

Auditors collect all data collected to ensure that nothing is overlooked completely in the audit. The following information has been collected during the audit phase:

- Collect the information about the source of the energy supply
- Collect the energy bills to find out the tariff data and electrical energy cost (monthly bills of last 24 months)
- Collect the load sector data (power ratings of equipments, instruments, utilities etc.)
- Review of present energy management procedure-losses, wastage, options for improvement for energy conservation.

The outcomes of the collected data are:

- Preparing process flow diagram and energy, and material balance.
- Identification of Energy Conservation (ENCON) opportunities.
- Energy conservation & saving options and recommendations.
- Technical and feasibility report.
- Implementation plan for energy-saving measures and projects for the third phase (post-audit phase).

4.3.2.3. Post audit phase

- The plan of action for the post-audit phase is implementation and follow-up. The result is to assist and implement ENCON recommendation measures ad monitor the performance.
- EMS committee will ensure that the Energy Management System is in place and the college is participating, by making the entire college/university community well informed through regular communications; monitoring through periodical evaluation programmes etc.

4.3.3. Steps of Energy Audit

4.3.3.1. Site assessment

Collection of contour map and campus diagram

- Preparing inventory of energy infrastructure of each building:
- Construction details of the building envelope (e.g. walls, roof, windows, doors and related insulation

values)

- Manual, time clock or automated control and measuring methods (energy meters, main switches; MCB, ELCB etc.)- control section; capacity; location etc.
- Interior and exterior lighting systems and related controls
- Equipments, appliances, instruments etc. – watts, utility pattern, average consumption (monthly or yearly)
- Discussion with responsible persons of each infrastructure (on utility pattern, working condition, operation and maintenance procedures etc.)
- Date entry in prescribed forms (Energy spread sheets)

4.3.3.2. Data analysis

- Analysis of current and past performance (energy bill comparison, previous audit data etc.)
- Regression analysis involves the comparison of energy consumption on the Y axis versus the potential energy driver on the X axis (weather, working days/ holidays etc.).
- Preparation of checklists and verification
- Carbon credit calculation

4.3.3.3. Final audit by external audit team

- Checklists verification- identifying non conformities
- Action plan –long tern and short term
- Final report & certification as per ISO standards.

ENERGY AUDIT – PROGRAMME SCHEDULE		
Week	Week Days	Weekly Work Plan
First Week	20.11.2023 to 26.11.2023	The college campus is divided into four to six blocks for audit survey. The whole internal audit members divided into 4-6 groups. Each group is assigned a block for survey. A group for noting down the power meter reading is also formed.
Second week	27.11.2023 03.12.2023	Each group plotted a map of the block assigned to them and then marked the electrical appliances/ instruments in the block. (line sketches and simple diagrams)
Third Week	04.12.2023 10.12.2023	The working conditions of each appliances/ Instruments were inspected by the groups. The efficient and non efficient devices were sorted.
Fourth week	11.12.2023 17.12.2023	The working hours of each appliance were noted. This was noted for daily using devices and weekly using devices. A separate data for weekends were also collected. The power meter reading for each blocks were noted in parallel.
Fifth Week	14.01.2024 21.01.2024	Based on the data collected in the fourth week, daily and weekly power consumption in each block were calculated and noted.
Sixth Week	22.01.2024 28.01.2024	Power consumption from the 4-6 blocks were collected and cross checked the power meter reading and verified for any mismatch.

Table 4.1 Energy audit- suggested schedule for colleges

Activity	Frequency	Dates	Mode of data Collection
Energy Meter reading (for every meter in the college)	9 days; 3 times a day	Three Sundays as holidays (03.12.23; 10.12.23; 07.01.24) Three semi holidays (02.12.23; 06.12.23; 06.01.24) Three working days (29.11.23; 07.12.23; 12.12.23) (completed by three weeks)	Data entered in the given format (see Manual of documents)
Usage pattern of instruments, equipments, lights etc. Documentation of current ECM practices	Walk through audit and interviews with system managers (controlling or responsible staff or teachers)	One visit is enough in the assigned area. Collect data on power capacity and usage time of every light, fan, equipments, appliances, instruments etc.	Data entered in the given format (see Manual of documents)
Alternate energy resources	Documents details of present alternate energy resources in the campus	Identify possible alternate energy sources	Data entered in the given format (see Manual of documents)
List & details of energy resources in the campus	I. Electrical energy 1. KSEB supply per month 2. Alternate energy resources	Record the monthly/ annual usage quantity.	Keep registers. Data shall be entered in the given format
	II. Fossil fuels 1. LPG, 2. Petrol/diesel 3. Kerosene etc.	Record annual usage with respective purpose uses and location 9lab, office, kitchen etc.)	Enter in the given format

Table 4.2. Data collection process

4.4. RESULTS & OBSERVATIONS

4.4.1. Energy infrastructure of K.G. College Campus (Lights and fittings)

The infrastructure for main energy source, i.e., electricity is minimal in the college in relation to the population size. Lighting is 90% of LED bulbs and tube lights. It is recommended to change the existing CFL, incandescent bulb (4 each) and fluorescent tube lights (168) to LED lights. Significant energy savings can be achieved through this measure.

Location in the campus		List of Infrastructure (Lighting, fan, communications, computer etc.)																	
No.		Fan	Tube ligt	LED lamp	Bulb	CFL	Com-puter	Projec-tor	Mic Am-plifi-er	Wa-ter puri-fier	Ex-haust fan	Bell	CCTV	Print-er	Ex-haust fan	Speak-er	Light hold-er	Wifi In-ter-net	LED Tube	Spot Light
1	English dept.	4	10	1	0	2	1	0	0	1	0	1	1	1	0	0	0	0	0	0
2	BBA dept	14	24	0	0	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0
3	BBA (store room)	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	Men's toilet	0	1	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
5	Commerce Varanda	0	0	0	0	1	0	0	0	0	0	1	2	0	0	0	2	2	0	0
6	Commerce Research	11	8	0	0	0	0	1	1	0	0	0	0	0	0	1	0	0	0	0
7	Commerce Department	32	10	9	0	0	0	4	1	0	0	0	0	1	0	5	0	0	14	0
8	Chemistry Dept. (indoor)	11	4	3	0	1	0	1	0	0	0	0	0	0	0	2	0	0	2	0
9	Chemistry Varanda	0	0	0	1	0	0	0	0	1	0	0	2	0	0	0	1	2	4	0
10	Chem-com- stairs	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
11	Zoology Dept. (comp.lab)	2	4	0	0	0	12	0	0	0	0	0	0	0	0	0	0	0	0	0
12	Zoology class rooms	10	7	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
13	Zoology wetlab & store	4	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	Zool. Mushroom & library	5	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	Dept. of Physical edn.	4	6	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
16	Food Science & QC	2	5	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
17	Physics dept.	7	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	Physics Staff room	3	3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
19	Physical & Chemical lab	4	19	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	Titus Varkey Hall	40	12	0	0	0	0	0	0	0	0	0	4	0	0	4	0	0	0	12
21	Women's Hostel	35	40	40	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0
	TOTAL	**188**	**168**	**55**	**4**	**4**	**17**	**9**	**2**	**4**	**0**	**2**	**10**	**2**	**1**	**13**	**4**	**4**	**20**	**12**

Table 4.3.A. Energy infrastructure of the campus

4.4.2. Energy infrastructure of K.G. College Campus (Equipments and instruments)

		List of Infrastructure (Equipment, instrument, appliances etc.)																
No.		Refrigerator	Grinder	Mixie	Laptop	Incubator	Dig. Microscope	centrifuge	Calorimeter	Weighing Balance	Hot plate	Kettle	DW instrument	Water bath	Hot air oven	Rotator	Inverter	Muffle furnace
1	Women's Hostel	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	Chemistry Dept. (indoor)	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
3	M1 Zoology	0	0	0	0	1	3	1	1	1	1	0	0	0	0	0	0	0
4	Zoology wetlab & store	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	Physical education	1	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0
6	Physics dept. staff room	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
7	Physical & Chemical lab	1	0	0	0	0	0	1	0	1	0	0	1	2	11	1	1	1
	TOTAL	5	1	1	2	1	3	2	1	3	2	2	1	2	11	1	1	1

Table 4.3. Energy infrastructure of the campus

The power rating and average usage time of each item is not documented this time. This will be a non conformity and it is rectified before the first surveillance audit. The following inferences can be made based on the available data:

The electrical infrastructure of the college includes lighting, fan, lab equipment, instrument, appliances, computers, communication and audio visual provisions. There are no major machines or highly sensitive equipment in the college. Being an arts science college, with few science departments, lab equipment, i nstruments or appliances that presently available are limited to the curriculum of UG and PG courses. 95% of equipment, instrument and appliances are of old models and not having energy star rating. This means that such gadgets might consume heavy volume of energy. Hence it is recommended to make it compulsory of purchasing energy star rated items only in future.

The lack of usage register for almost all equipment was a serious non conformity. This is rectified and confirmed that all equipment have respective usage registers are maintained. The usage register will enable to find out equipment with highest time of usage and of caried use. This information can be used for implementing suitable energy saving practices.

4.4.3. Analysis of Energy Meter Reading (KSEB) of KG College, Pampady

Sl No	Consumer No	Consumer ID	C load	OMF	GPS location	Area cover	Location name
1	1156352003529	9087243	720	1.00	9.557098590, 76.64293360	Boys toilet	Gas plant
2	1156353003203	9085449	4230	1.00	9.5516570, 76.63947640	Water pump	Pump house
3	1156351003205	9085460	4230	15	9.5516570, 63947640	Main building	Main building
4	1156355014592	9137062	3260	1.00	9.55652160, 76.64186110	Titus varkey hall, library Block, chapel	chapel
5	1156355003528	9087235	1320	1.00	9.55710090, 76.64202830	Canteen, BBA block (Now it is powered from solar)	canteen
6	1156352016533	9141787	11360	1.00	9.55711380, 76.64210980	Women's hostel	Women's hostel
7	1156352020429	9152500	7460	1.00	9.55608390, 76.63945020	New water pump	New water pump

Table 4.4. Energy meters at KG college campus

There are total seven electricity connection of KSEB are for KG college Pampady and details are given in Table 3.4. The given electric connection of a Consumer number cover the respective building and associated area. The maximum connected load is women's hostel (11360 kW) and the lowest is in gas plant (720 kW).
The energy meter reading for last two years (24 months) of these seven consumer numbers are analysed and the results are given below:

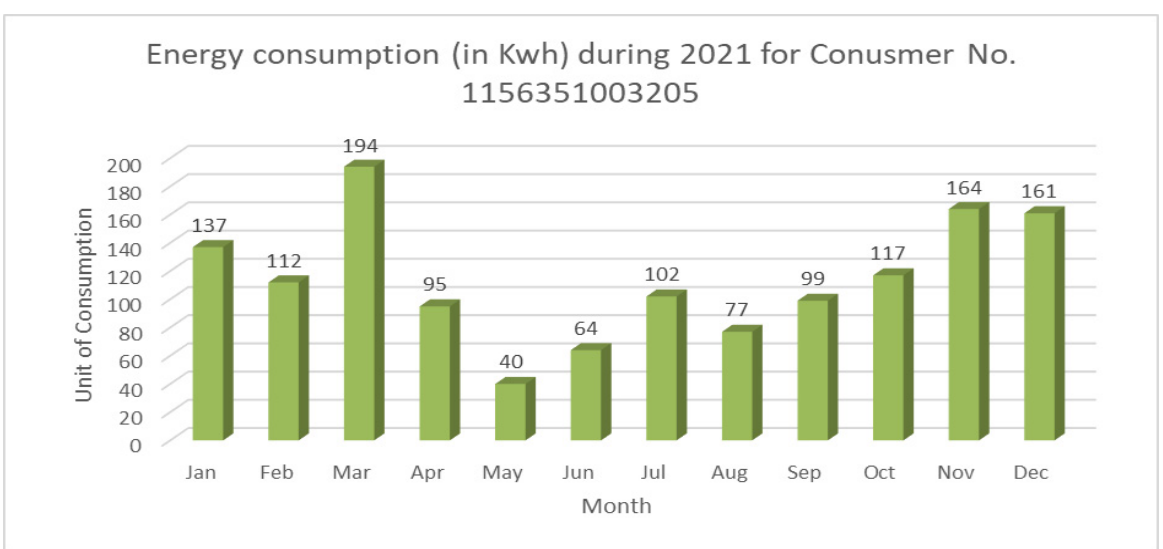


Fig..4.1. Energy consumption pattern with consumer No. 3205, during the year 2021

During the year 2021, highest amount of energy consumption was recorded in the month of March followed by November and December (Fig.4.1). Supply from this energy meter goes to the main building where the office and main activity areas are situated. The high energy consumption was because during those months main building has possibilities of academic activities, exam so on. Lowest level of energy consumption reported at the month of May because of summer vacation.

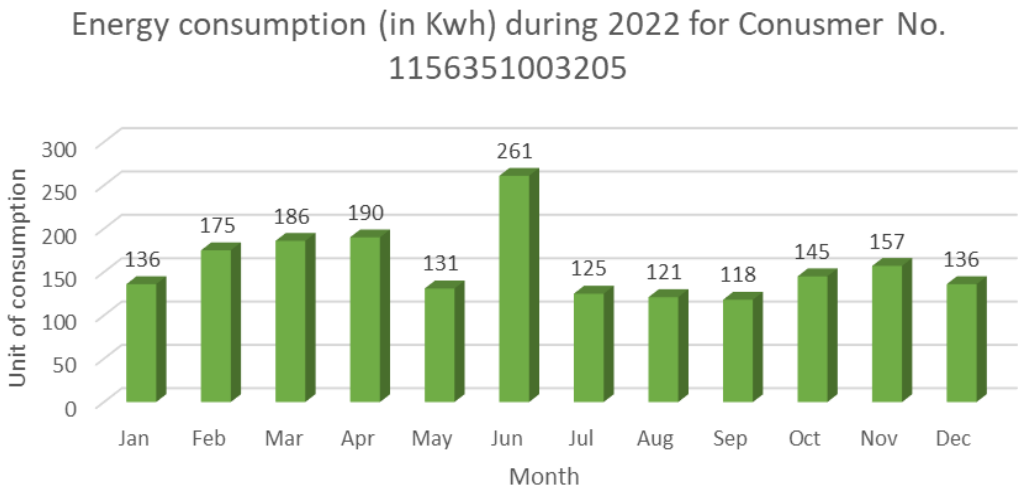


Fig.4.2 Energy consumption for the meter no.3205 for the year 2022

In 2022, the highest amount of energy consumption was recorded in the month of June followed by November, and December for the consumer No. 3205 (Fig.4.2). During March, November and December, energy consumption is reported at the highest level because during those months, main building utilize high amount of energy due to the possibilities of academic activities, exam so on. Lowest level of energy consumption reported at the month of May because of summer vacation.

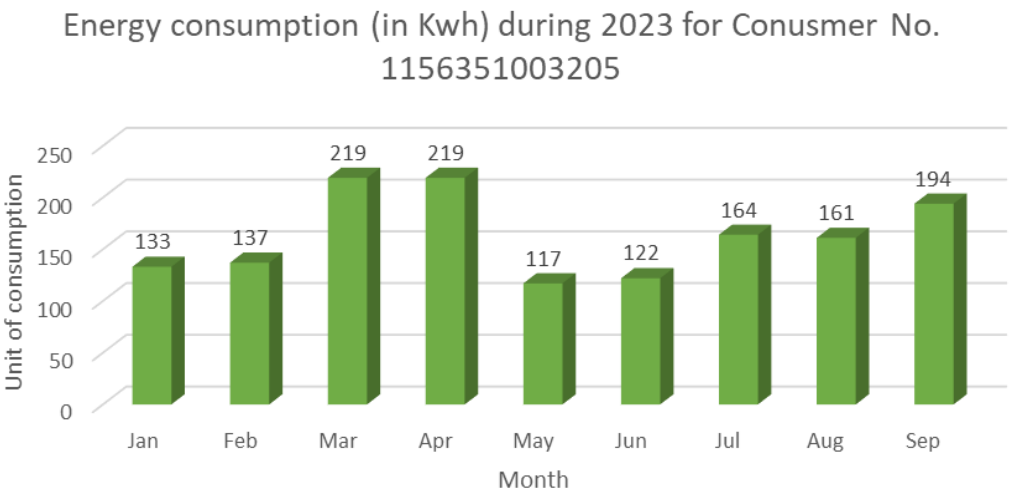


Fig.4.3 Energy consumption for the meter no.3205 for the year 2023

In 2023 (data only up to the month of September) the highest amount of energy consumption was recorded in March and April followed by July and June (Fig.4.3). During March and April months energy consumption is reported at the highest level because during those month main building utilize high amount of energy consumption due to the possibilities of academic activities, exam so on. Lowest level of energy consumption reported at the month of May because of summer vacation. Higher amount consumption during March and April because those day construction of building were take place and majority worker were stayed at college and utilize college toilets, rooms etc.

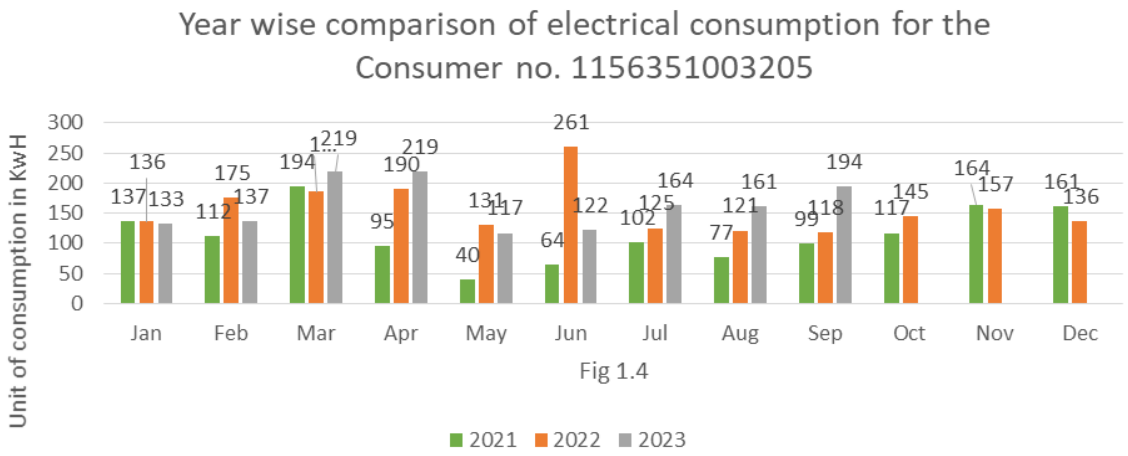


Fig.4.4 Year-wise comparison of energy consumption for the meter no.3205 (2021, 2022 & 2023)

The year wise comparison of energy consumption of 2021, 2022 and 2023 (Fig. 4.4) showed that the varied trend in energy consumption in each year. During 2021, highest consumption was in March, in 2022 during June and in 2023 (part data) it was in March and April. Covid restrictions were existed in 2021 hence the offline classes were almost absent. However, in 2023, the academic year begun in June itself and hence the maximum consumption was reported. The lowest consumption was recorded in the month May during the all years, as those period is fully summer holidays even without examinations.

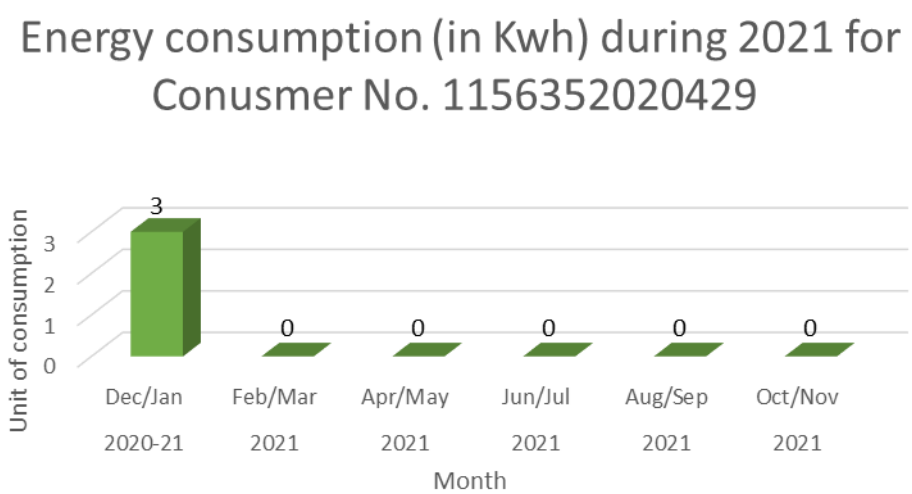


Fig 4.5 Energy consumption for the meter no.0429 for the year 2021

In 2021 highest amount of energy consumption was recorded in December and January.(Fig.4.5). During those month reported highest level of energy consumption because of the possibilities of regular classes. Zero level of energy consumption reported in the month of February-November. Closure of college due to covid, natural calamities, study leave and exam might be the reason.

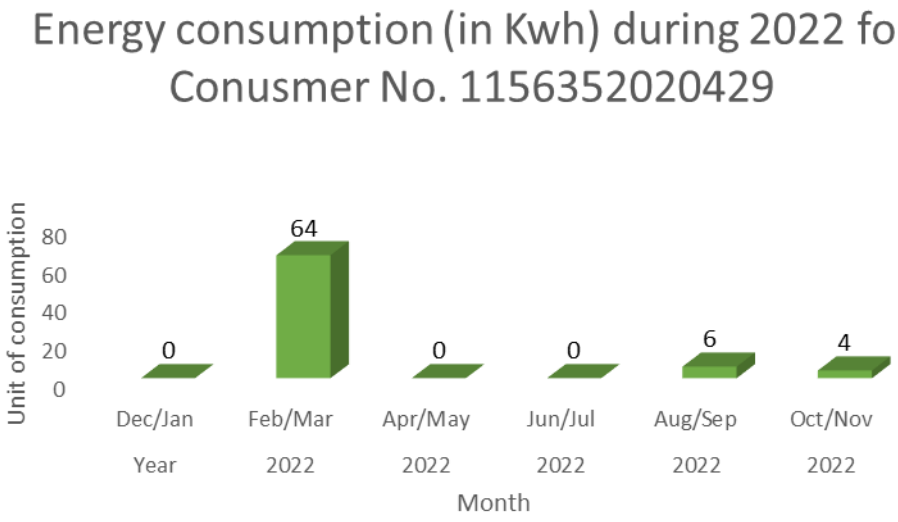


Fig 4.6. Energy consumption for the meter no.0429 for the year 2022

In 2022 the highest amount of energy consumption was recorded in February-March (Fig 4.6). During those month energy consumption reported high because of the possibilities of regular functioning of the college. During August-September, October-November observe the decline in energy consumption, possibilities for Onam holidays, study leave for semester exam. December-July reported zero level of energy consumption. During those day working of college is declined due to Christmas vacation, study leave, summer vacation and semester exams

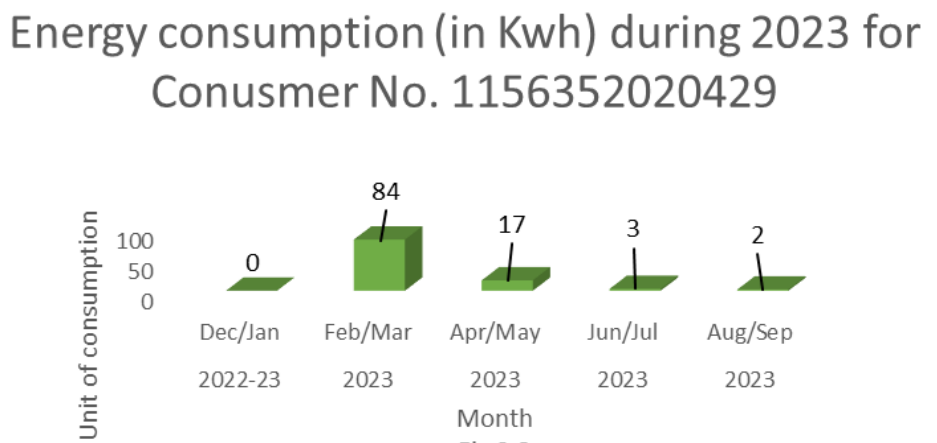


Fig 4.7 Energy consumption for the meter no.0429 for the year 2023

In 2023 highest amount of energy consumption was recorded in February-March followed by, April-May (Fig.4.7). During those month energy consumption reported high because of the possibilities of regular functioning of the college, delayed semester exam were conducted or might be due to additional classes. All the above might be the reason for student to spend regular days in hostel.

During this year in ladies hostel, December-January reported zero level of energy consumption. Lowest level of energy consumption reported at the month of December-January because closure of college for Christmas and New Year holidays.

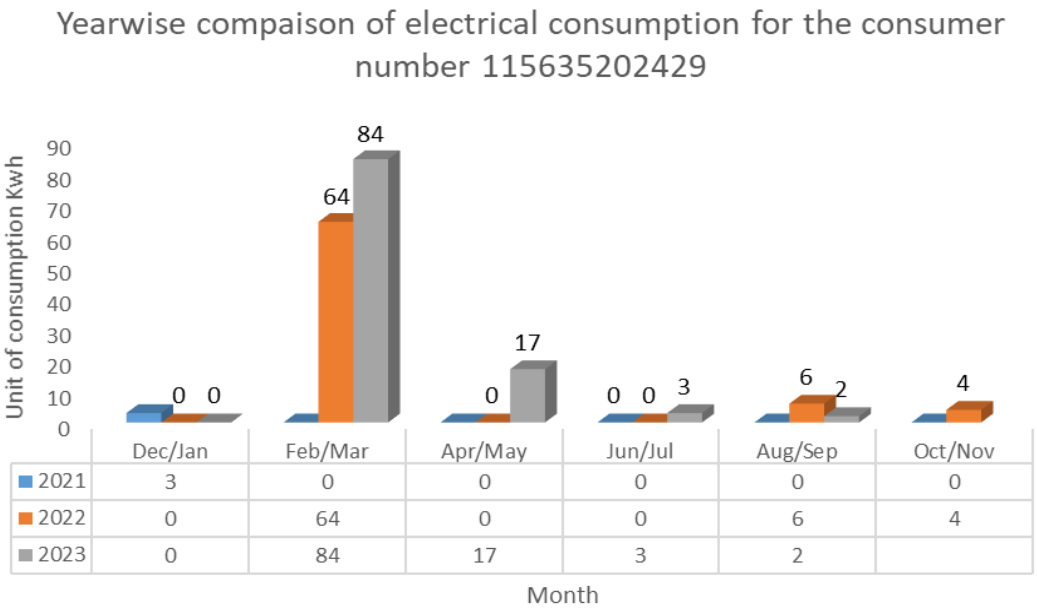


Fig.4.8. Year-wise comparison of energy consumption for the meter no.0429 (2021, 2022 & 2023)

The year wise comparison of energy consumption of 2021, 2022 and 2023 (Fig.4.8) showed that the varied trend in energy consumption in each year. During 2021, highest energy consumption was in December-January, in 2022 and 2023 (Part data) it was in February-March. Covid restrictions were existed in 2021 hence the offline classes were almost absent. Eventually by 2021december-January raised due to semester exam and offline classes.

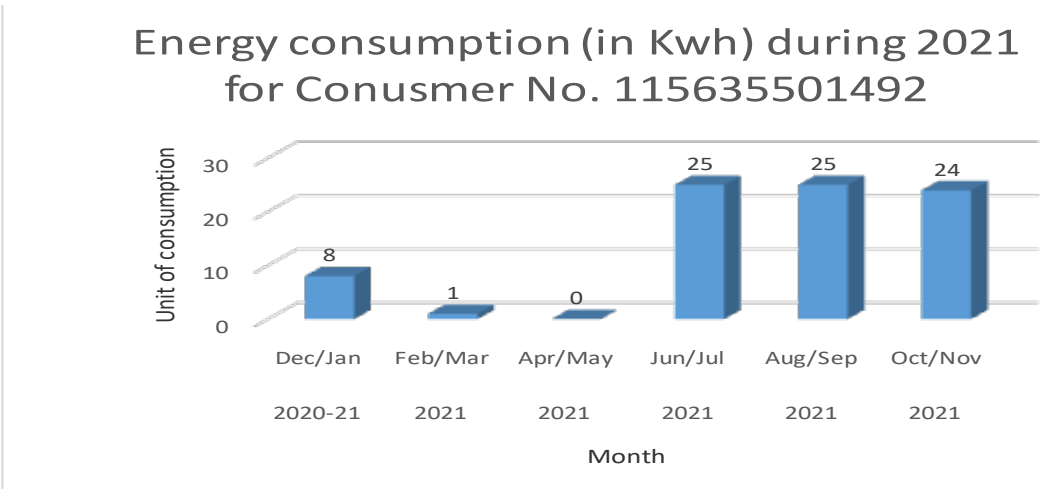


Fig 4.9 Energy consumption for the meter no.1492 for the year 2021

In 2021 highest amount of energy consumption was recorded in June-July 2021 followed by, August-September, (Fig. 4.9) High rate of energy consumption observed in those months because of the beginning of academic year, possibilities for regular classes.

Lowest level of energy consumption reported at the month of April-May closure of college for summer vacation.

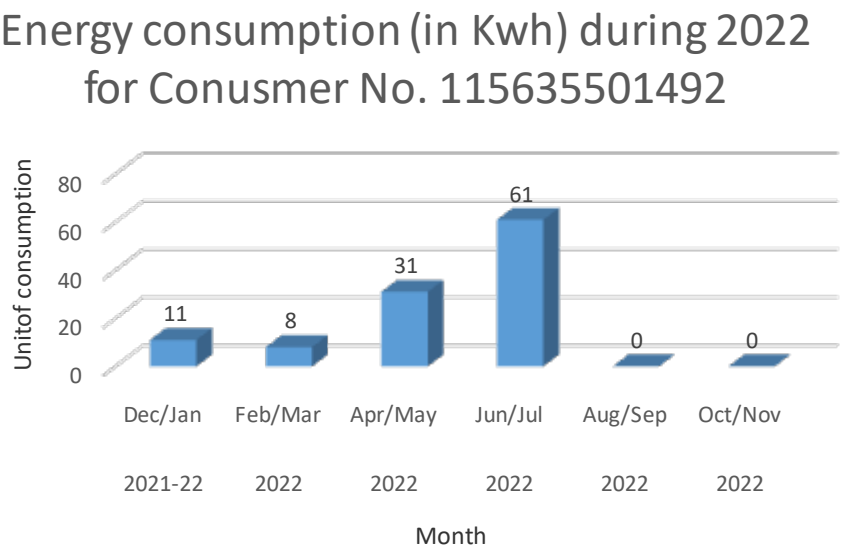


Fig 4.10 Energy consumption for the meter no.1492 for the year 2022

In 2022 highest amount of energy consumption was recorded in June-July 2022 followed by, April-May (Fig.4.10). Those month reported highest level of energy consumption because of the beginning of new academic year possibilities for scheduling orientation and retreat. Lowest level of energy consumption reported at the month of August-September and October-November due to the closure of college for Onam vacation, Puja holiday and study leave for semester exam.

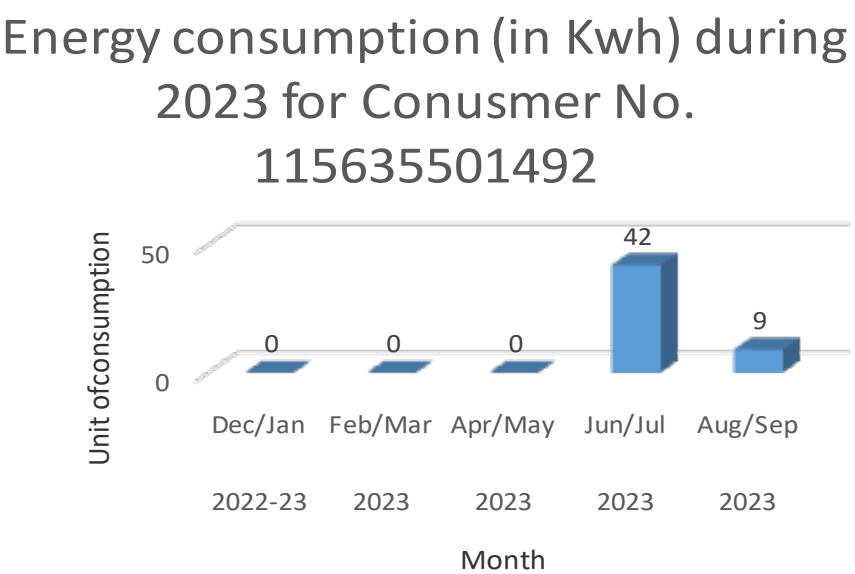


Fig 4.11 Energy consumption for the meter no.1492 for the year 2023

In 2023 highest amount of energy consumption was recorded in June-July 2022. (Fig 4.11) Jun-July reported highest because of the beginning of new academic year possibilities for scheduling orientation and retreat. Lowest level of energy consumption reported at the month of August-September due to closure of college for Christmas and New Year vacation and study leave for semester exam. The lowest consumption was recorded in December to May as during those day working of college is partial due to the Christmas vacation, study leave, summer vacation and semester exams.

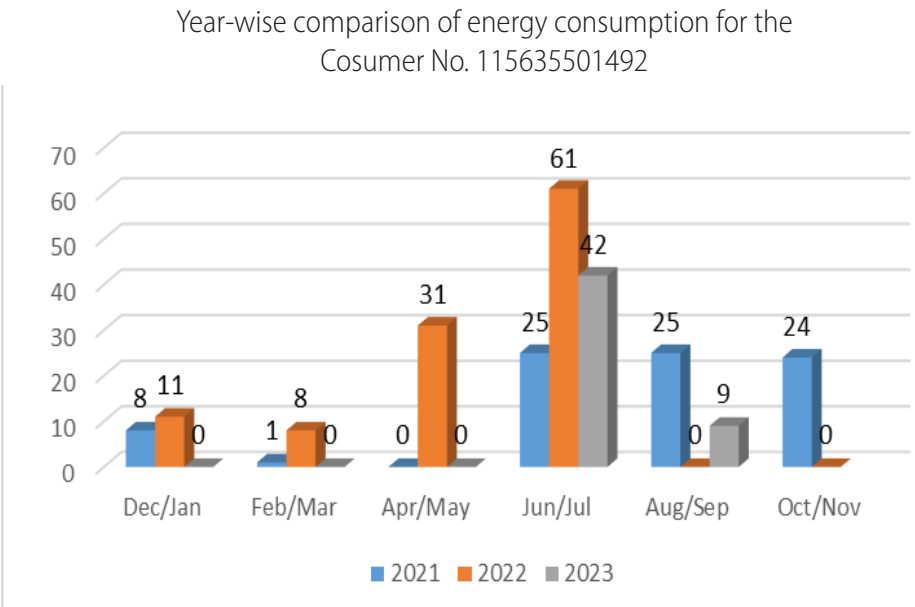


Fig.4.12 Year-wise comparison of energy consumption for the meter no.1492 (2021, 2022 & 2023)

The year wise comparison of energy consumption of 2021, 2022 and 2023 (Fig.4.12) showed that in all the three year reported high level unit of consumption in June/July. Those month were the beginning of new academic year.
Lower level of energy consumption was recorded in 2021 due to Covid restrictions were existed in 2021 hence the offline classes were almost absent. Energy consumption raised by 2022 due to the shift in offline class after covid followed by semester exams.

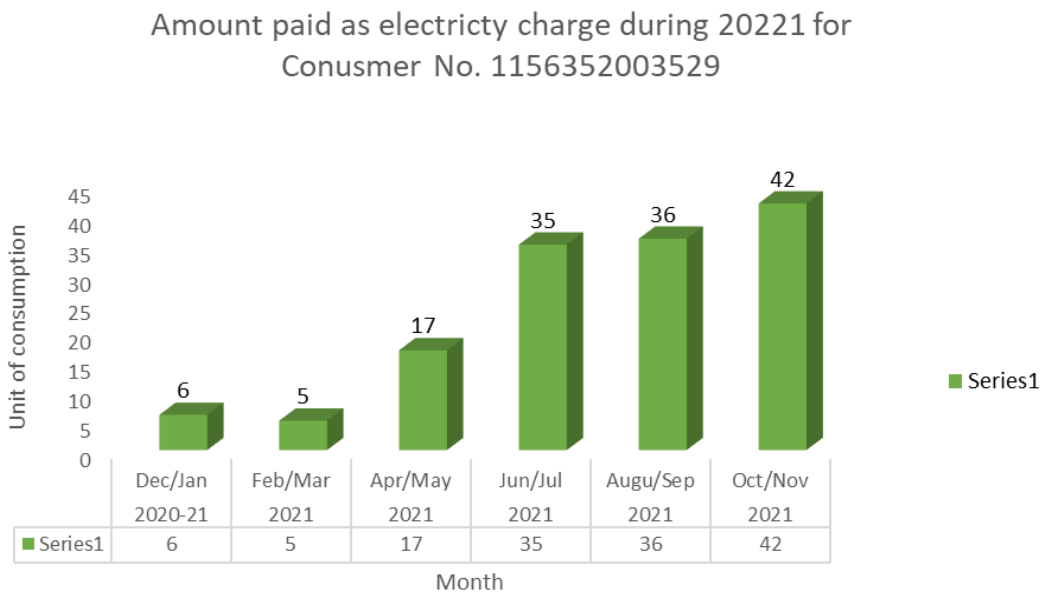


Fig 4.13. Energy consumption for the meter no.3529 for the year 2021

In 2021 highest amount of energy consumption was recorded in October-November 2021 followed by, August- September, June-July. During those month energy consumption reported high because of the possibilities of semester exam, beginning of academic year.
Lowest level of energy consumption reported at the month of December-January and February-March closure of college for Christmas and New Year vacation and study leave for semester exam.

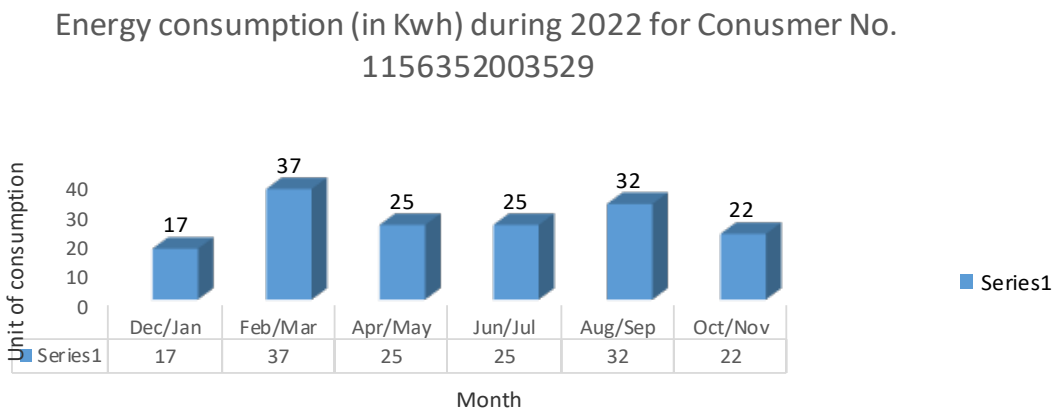


Fig.4.14. Energy consumption for the meter no.3529 for the year 2022

The highest amount of energy consumption was recorded in February-March 20221 followed by, August-September, June-July. (Fig. 4.14). During those month higher level of energy consumption reported because of regular function of the college and beginning of academic year.

Lowest level of energy consumption reported at the month of December-January, closure of college for Christmas and New Year vacation.

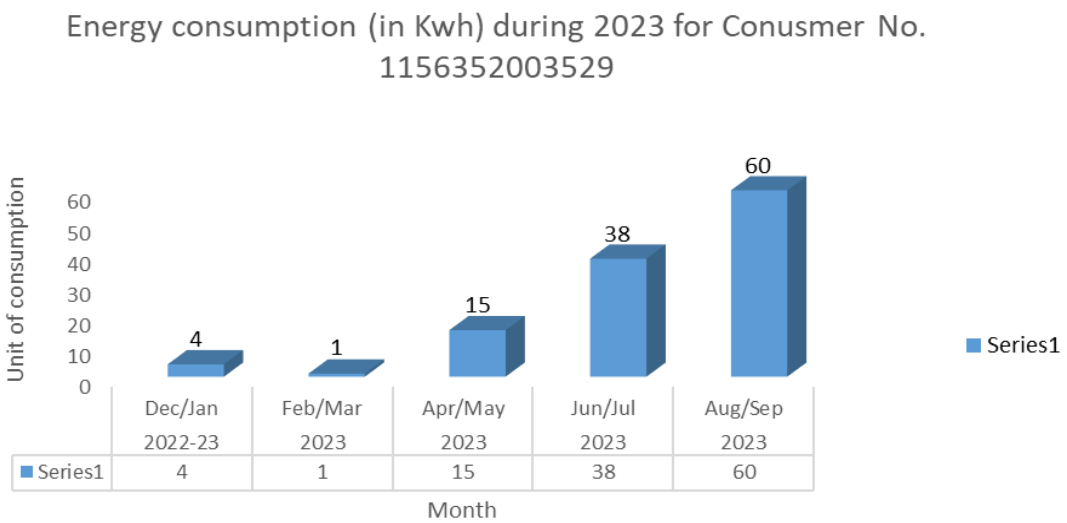


Fig. 4.15. Energy consumption for the meter no.3529 for the year 2023

In 2023 highest amount of energy consumption was recorded in August-September 2021 followed by, June-July (Fig.4.15) (data only up to the month of September). During those month higher amount of energy consumption because of the possibilities of regular class, semester exam.

Lowest level of energy consumption reported during the month of February-March December-January, possibilities of study leave for semester exam, closure of college for Christmas and New Year vacation.

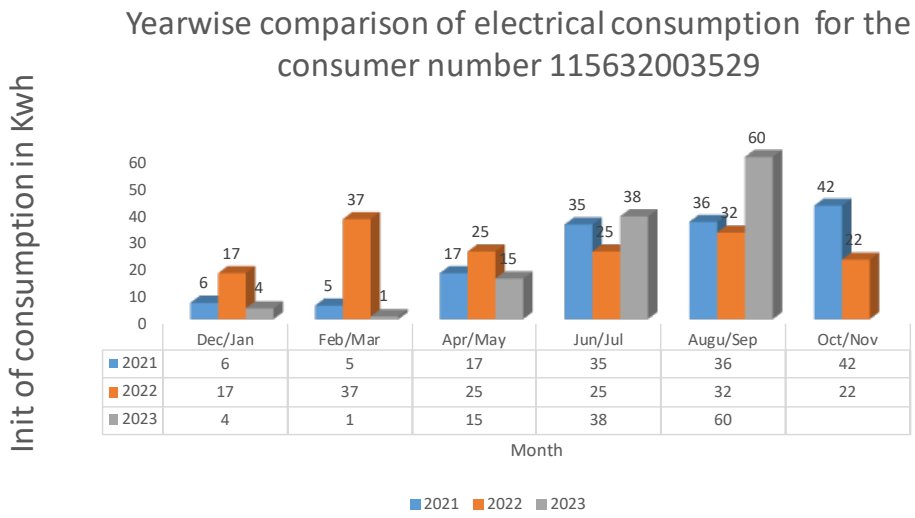


Fig.4.16. Year-wise comparison of energy consumption for the meter no.3529 (2021, 2022 & 2023)

The year wise comparison of energy consumption of 2021, 2022 and 2023 (Fig.4.16) showed that the varied trend in energy consumption in each year.

During 2021, highest consumption was in October-November, in 2022 during February-March and in 2023 (part data) it was in August September. Covid restrictions were existed in 2021 hence the offline classes were almost absent. However, in 2023, the regular classes, classes were resumed after summer vacation and hence the maximum consumption was reported. The lowest consumption was recorded in the month December-January and February-March during the all years, as those period closure of college for summer vacation and study leave for semester exam.

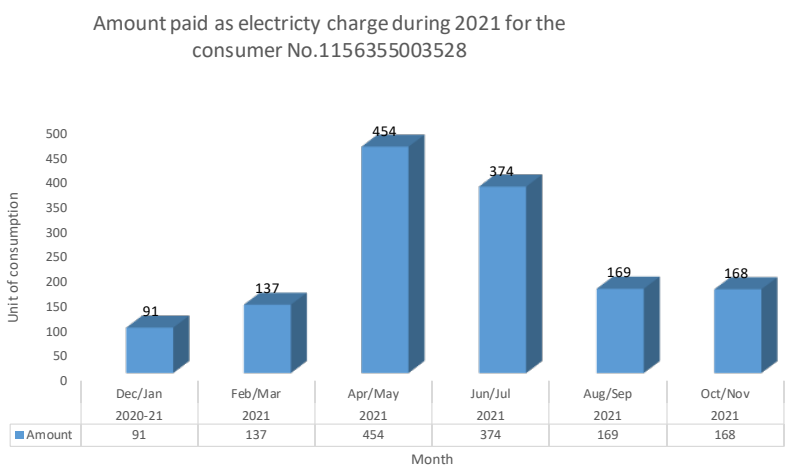


Fig. 4.17. Energy consumption for the meter no.3528 for the year 2021

In 2023 highest amount of energy consumption was recorded in April-May followed by June-July.(Fig. 4.17) During those month energy consumption is high because of the working of college and official administrative actives due to beginning of academic period. Lowest level of energy consumption reported at the month of December-January, closure of college for Christmas and New Year vacation.

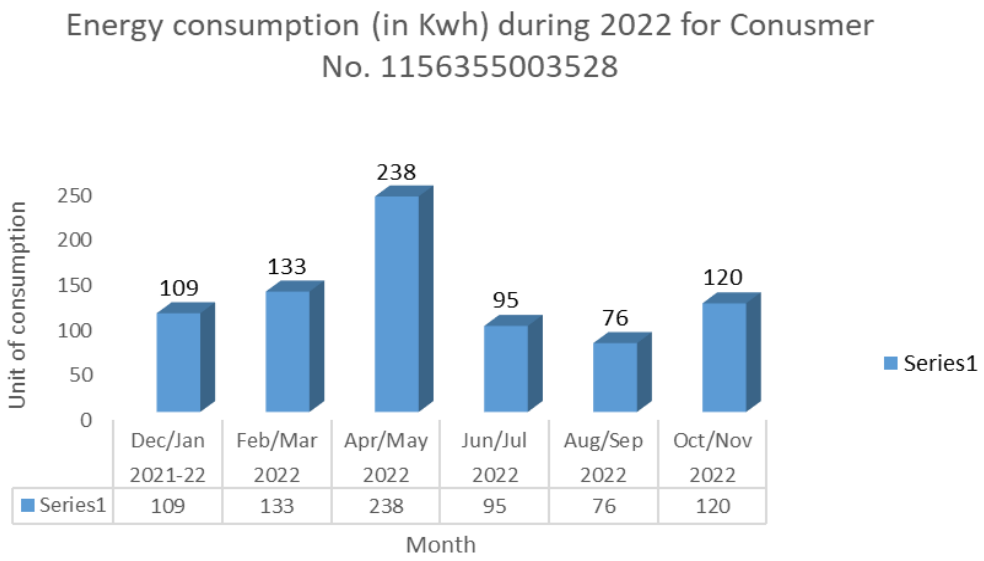


Fig 4.18 Energy consumption for the consumer no.3528 for the year 2022

In 2022 highest amount of energy consumption was recorded in April-May followed by February-March and October-November (Fig. 4.18). During those month amount of energy consumption is high because of the working of college, official administrative actives and postponed semester resumed after covid break.
Lowest level of energy consumption reported in August-September. Low level of energy consumption due the closure of college for Onam vacation

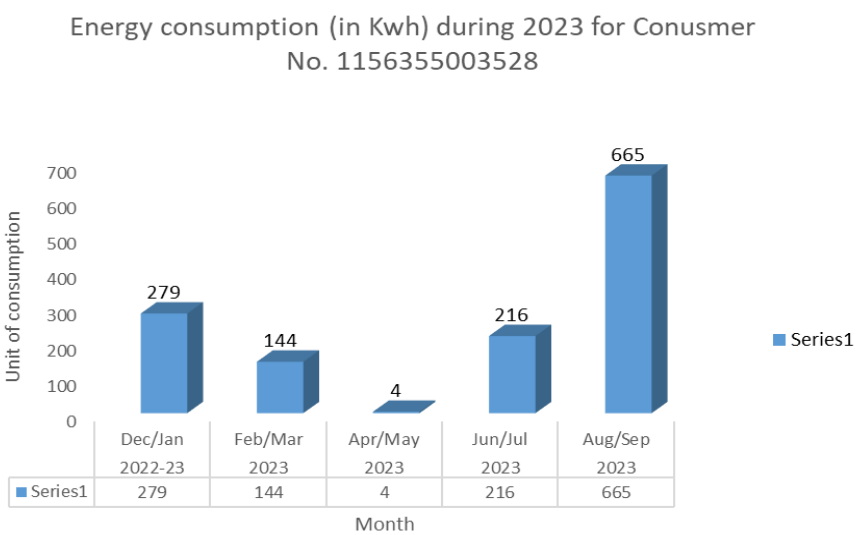


Fig 4.19 Energy consumption for the meter no.3528 for the year 2023

2023 highest amount of energy consumption was recorded in August-September followed by December-January, June-July.(Fig.4.19) (data only up to the month of September). During those month energy consumption is high because of the working of college, official administrative activities and reopening of college after summer vacation. April-May reported low level of energy consumption possibilities for closure of college for summer vacation.

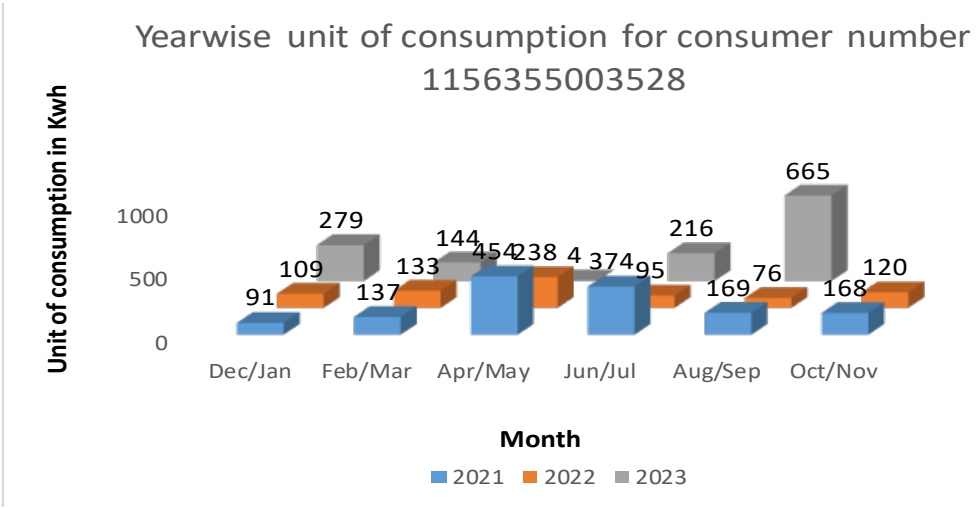


Fig.4.20. Year-wise comparison of energy consumption for the meter no.3528 (2021, 2022 & 2023)

The year wise comparison of energy consumption of 2021, 2022 and 2023 (Fig.4.20) showed that the varied trend in energy consumption in each year. During 2021and 2022 highest energy consumption was in April-May. During 2023 (Part data) it was in August-September. Covid restrictions were existed in 2021 hence the offline classes were almost absent. However, by the binging of 2021 April-May and 2022 April-May energy consumption increased because, college were resumed after covid restriction followed by postponed semester exams.

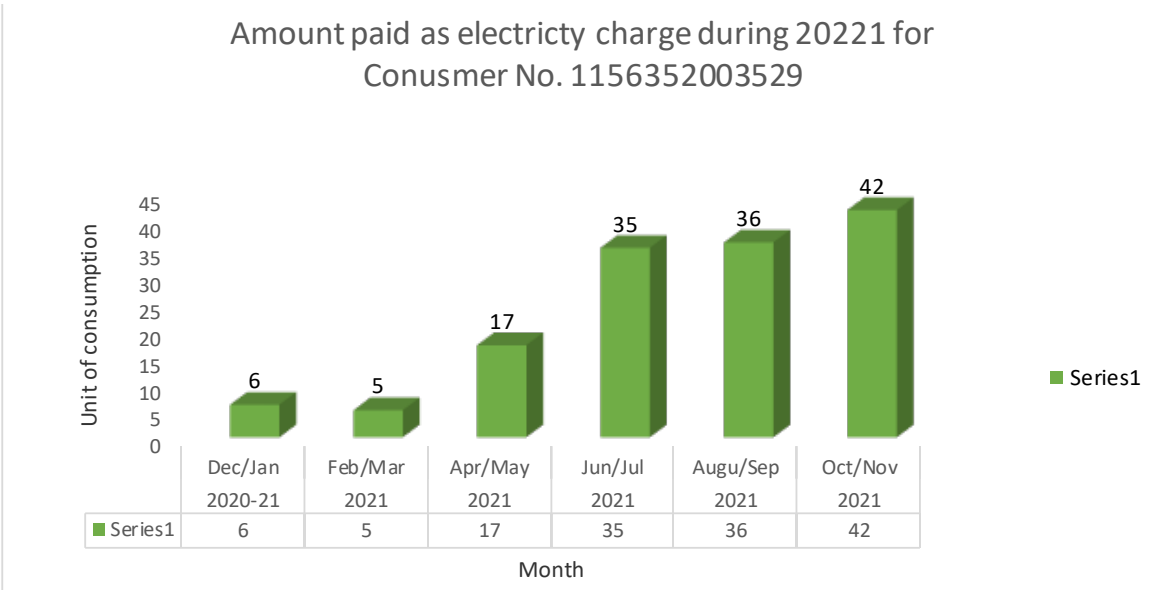
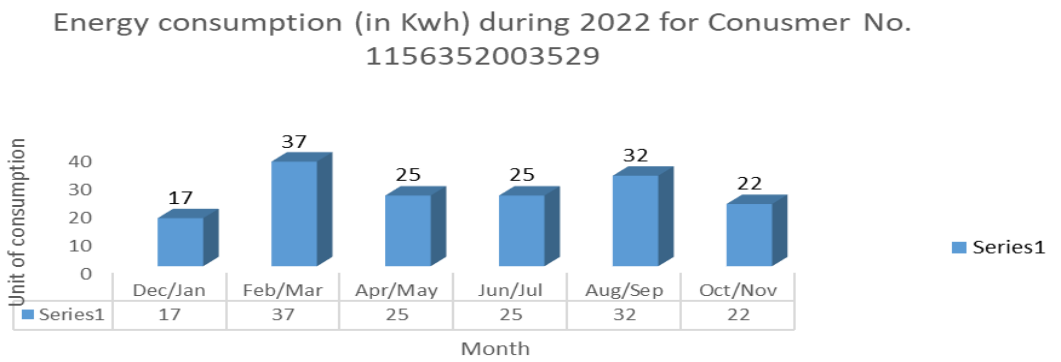


Fig.4.21. Energy consumption for the meter no.3529 for the year 2021

In 2021 highest amount of energy consumption was recorded in October-November followed by December-January (Fig.4.21). During those month energy consumption increased because of the regular functioning of college. Lowest level of energy consumption reported at April-May because of closure of college for summer vacation.



vFig.4.22. Energy consumption for the meter no.3529 for the year 2022

In 2021 highest amount of energy consumption was recorded in February-March followed by August-September. (Fig.4.22) During those month amount of energy consumption increased because of regular classes and administrative function of the college. Lowest level of energy consumption of recorded in December-January due to the possibilities for the closure of college for Christmas vacation.

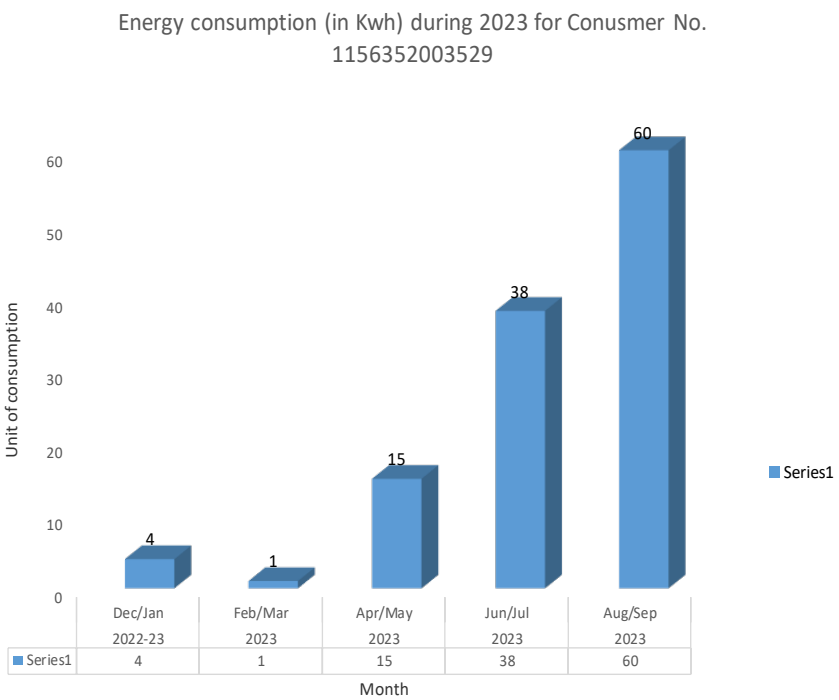


Fig 4.23 Energy consumption for the meter no.3529 for the year 2023

In 2023 highest amount of energy consumption was recorded in August-September followed by June-July. (Fig. 4.23). During those month energy consumption increased because of regular classes and administrative function of the college. Lowest level of energy consumption is reported in February-March due to the possibilities of study leave for semester exams.

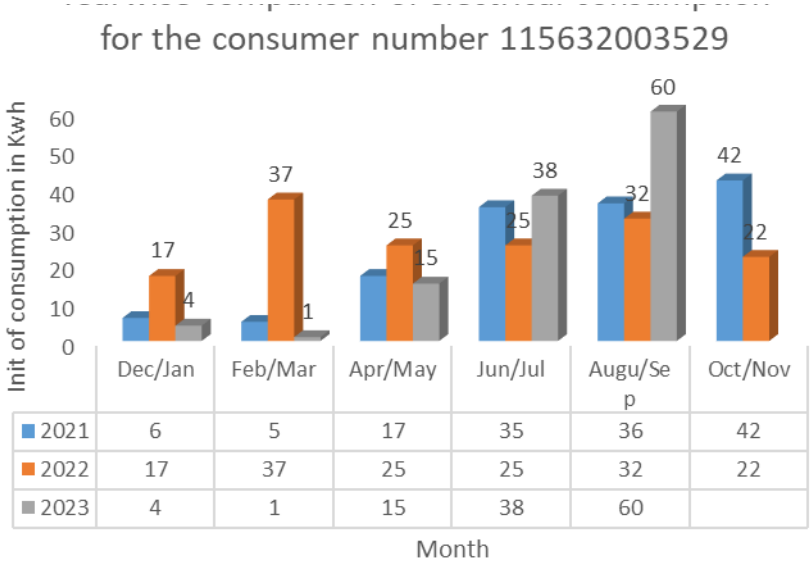


Fig.4.24. Year-wise comparison of energy consumption for the meter no.3529 (2021, 2022 & 2023)

The year wise comparison of energy consumption of 2021, 2022 and 2023 (Fig. 4.24) showed that the varied trend in energy consumption in each year. During 2021, highest consumption was in October-November in 2022 during February-March and in 2023 (part data) it was in August-September. Covid restrictions were existed in 2021 hence the offline classes were almost absent. The lowest consumption was recorded in the month April-May during the year 2021, as those periods is fully summer holidays even without examinations. Lowest consumption was recorded in December-January during year 2022 because of the possibilities for the closure of college for Christmas vacation. Lowest consumption was recorded in February-March during the year 2023 because of the possibilities of study leave for semester exams.

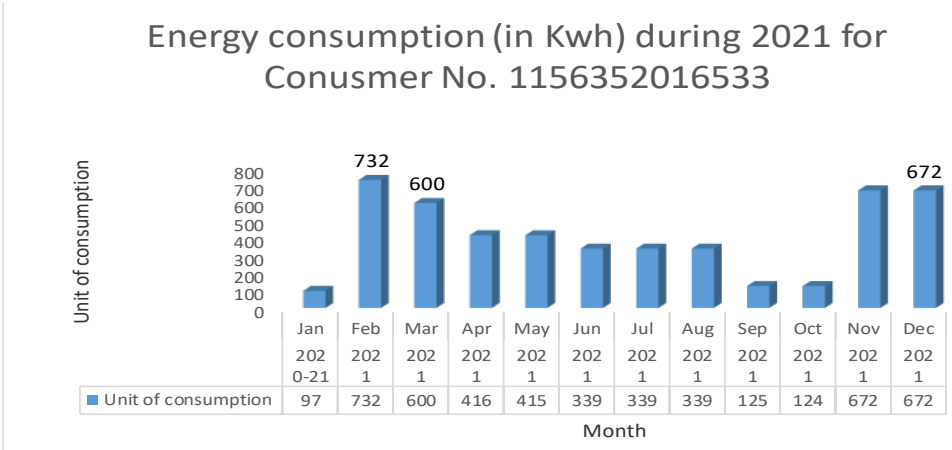


Fig.4.25. Energy consumption for the meter no.6533 for the year 2021

In 2021 highest amount of energy consumption was recorded in February followed by December and November. (Fig.4.25). During those month highest energy consumption because of the regular class and college administrative activities after the reduction of covid restriction and shift from virtual classes to online classes.

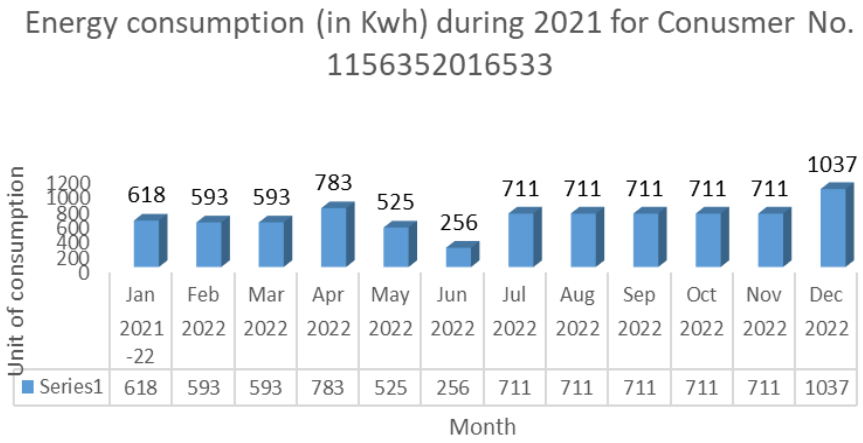


Fig.4.26. Energy consumption for the meter no.6533 for the year 2022

In 2022 highest energy consumption was recorded for consumer number 1156352016533 during, December followed by April, November (Fig.4.26). During those months highest energy consumption was reported, because of the regular class and college administrative activities after the reduction of covid restriction and shift from virtual classes to online classes. Lowest energy consumption was reported in June may be due to the closure of college during the period of natural calamities.

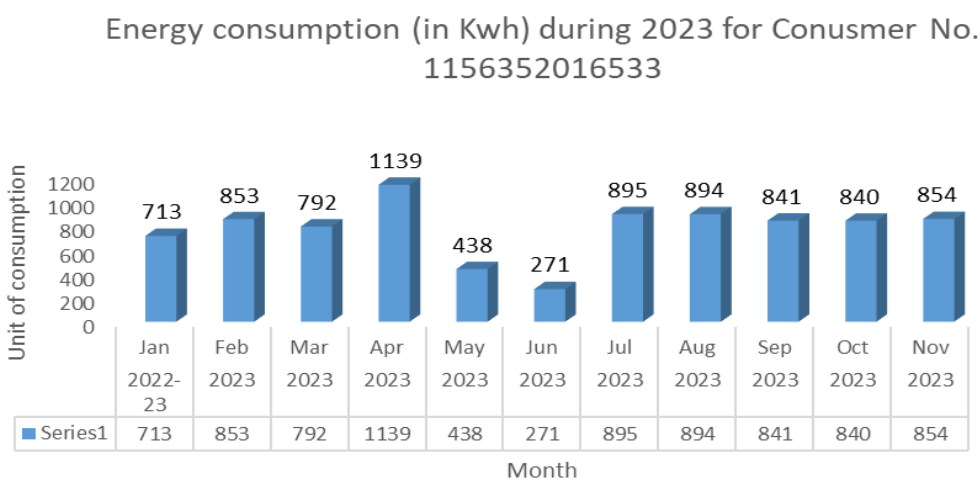


Fig.4.27. Energy consumption for the meter no.6533 for the year 2023

In 2023 highest energy consumption was recorded in April followed by, July, and August. (Fig. 4.27). During those months energy consumption is high because semester exam and additional classes. Lowest energy consumption was reported in June possibilities for the closure of college due to natural calamities.

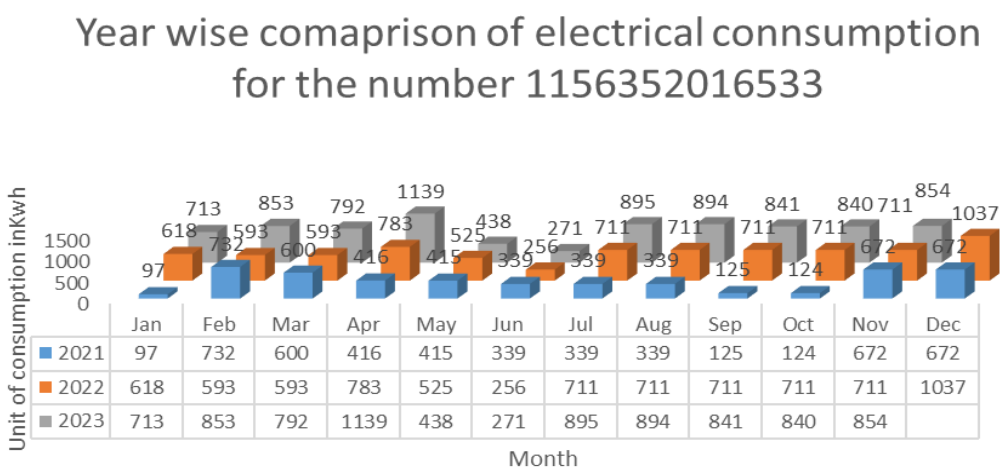


Fig.4.28. Year-wise comparison of energy consumption for the meter no.6533 (2021, 2022 & 2023)

The year wise comparison of energy consumption of 2021, 2022 and 2023 (Fig.4.28) showed that the varied trend in energy consumption in each year. During 2021, highest consumption was in February, in 2022 during December and in 2023 (part data) it was in April. Covid restrictions were existed in 2021 hence the offline classes were almost absent. Gradually observed increase in 2022 and 23 because classes were resumed after the decline in covid restriction
The lowest consumption was recorded in the month June during the years 2022 and 23, as those period college were closed due to natural calamities.

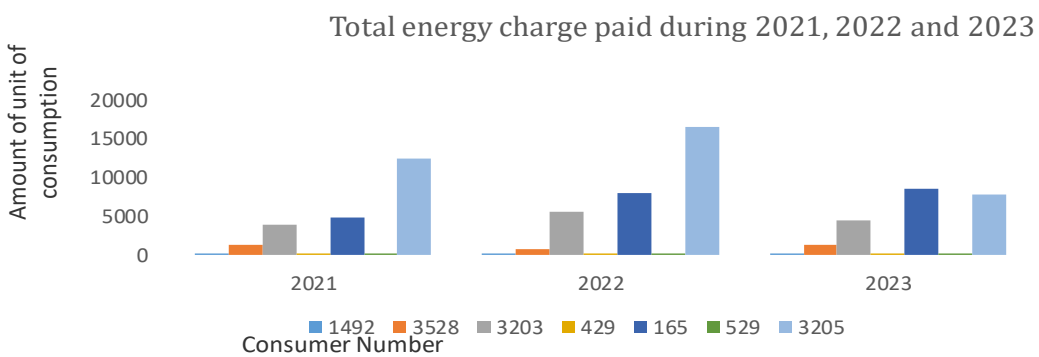


Fig.4.29. Toatal amount of unit of consumption during the period 2021-23.

Higher amount (in rupees) electricity charge was incurred for the main buliding during all three year followed by women's hostel due regular functioning. Lowest amount is (rupees) was reported in chapel (Fig.4.29).

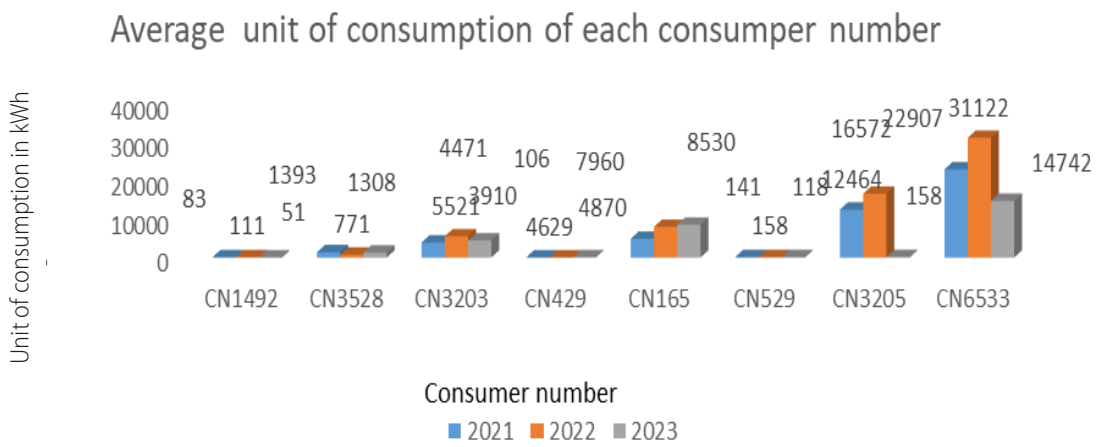


Fig 4.30. Average of unit of consumption

Total amount for unit consumption (kWh)				
Consumer Number	Location	2021	2022	2023
1156355014592	Chapel	83	111	51
1156355003528	Canteen	1393	771	1308
1156353003203	Pump house	3910	5521	4471
1156352020429	New water pump	46	29	106
1156352016533	Women's hostel	4870	7960	8530
1156352003529	Gas plant	141	158	118
1156351003205	Main Building	12464	16572	14584
Total		**22907**	**31122**	**29168**
Average		**27732**		

Table 4.4. Summary data on unit consumption of KSEB energy meters

Highest consumption is reported in the year 2022. During 2021, while the Covid was retrieving, regular functioning of the college was disrupted, hence consumption was low. The women's hostel consistently recorded a higher energy consumption in 2022 and 2023 compared to the main building. This trend is noticeable when evaluating the overall energy usage in the college hostel throughout the week, including weekends. While inmates typically reside in the college during weekends, it is noteworthy that the college often observes holidays on Saturdays and Sundays, potentially contributing to the observed fluctuations in energy consumption. In 2022, there was a decline in energy consumption within the hostel, while the main building experienced heightened usage, coinciding with the period of online classes due to varying COVID-19 case numbers. As the number of hostel residents decreased over time due to the pandemic, energy consumption decreased accordingly. The lowest energy consumption was recorded in the chapel and water pump areas, possibly due to lower usage compared to other sections. This gradual decline in energy consumption can be attributed to changes in inmate numbers and usage patterns.

4.4.4. Energy meter data collection analysis

The energy meter reading of six meters of the college was recorded in the morning (FN), noon (MD) and after noon (AN) by the internal auditors for three replication each of three representative days like working day, semi holiday and holiday. The data is given in Table 4.4 to 4.10.

Meter reading recorded (kWh)					Mean consumption/day
		Working day			
FN	MD	AN	MD-FN	MD-AN	AN-FN (kWh)
188.17	188.81	190.88	0.64	2.71	2.71
202.3	202.31	202.31	0.01	0	0.01
235.29	235.34	235.4	0.05	0.11	0.11
StD.Value					0.94
No. of working days/year					200
Average consumption per year					240
		Working day			
FN	MD	AN	MD-FN	MD-AN	AN-FN (kWh)
200.66	200.8	202.3	0.14	1.5	1.64
214.28	214.28	214.28	0	0	0
232.31	233.66	235.28	1.35	1.62	2.97
StD.Value					1.54
No. of semiholidays/year					95
Average consumption per year					146.3
		Working day			
FN	MD	AN	MD-FN	MD-AN	AN-FN (kWh)
202.3	202.31	202.31	0.01	0	0.01
215.43	215.43	215.43	0	0	0
188.81	188.93	188.93	0.12	0	0.12
StD.Value					0.043
No. of Holidays/year					70
Average consumption per year					3.03
Average consumption through the energy meter/year					**389.33**

Table 4.4. Energy consumption per year for the consumer No 1156351003205 (Main building)

Higher energy consumption was recorded in working day followed by Semi holidays. Due to the regular function of the college. Semi holidays has energy consumption because those days are working day for college of functioning. Holiday has lowest level of energy consumption(Table 4.4).

Meter reading recorded (kWh)					Mean consumption/day
		Working day			
FN	MD	AN	FN-MD	MD-AN	AN-FN (kWh)
9110	9112	9116	2	4	6
9024	9027	9029	3	2	5
5737	5739	5743	2	4	6
StD value					5.67
No. of working days/year					200
Average consumption per year					1133.34
		Working day			
FN	MD	AN	FN-MD	MD-AN	AN-FN (kWh)
23836	23839	23845	3	6	9
9020	9025	9029	5	4	9
5755	5758	5763	3	5	8
StD value					8.67
No. of semi holidays/year					95
Average consumption per year					823.33
		Working day			
FN	MD	AN	FN-MD	MD-AN	AN-FN (kWh)
5676	5680	5690	4	10	14
9030	9036	9040	6	4	10
5823	5826	5831	3	5	8
StD value					10.66666667
No. of holidays/year					70
Average consumption per year					746.67
Average consumption through the energy meter/year					**2703.34**

Table 4.5. Energy consumption per year for the consumer No 115635201653 (Women's Hostel)

Higher energy consumption was recorded in Semi Holiday followed by holidays. When compare to workings day inmate spend entire day in hostel during holidays. In some circumstance inmates leave hostel on Saturday and return back Monday gradually which resulted variations in Saturday and Sunday (Table 4.5).

Meter reading recorded (kWh)					Mean consumption/day
Working day					
FN-MD	MD-AN	AN-FN (kWh)	FN-MD	MD-AN	AN-FN (kWh)
2	4	6	2	4	6
2	2	4	3	2	5
3	3	6	2	4	6
StD value					5.33
No. of working days/year					200
Average consumption per year					1066.67
Working day					
FN	MD	AN	FN-MD	MD-AN	AN-FN (kWh)
7471	7472	7473	1	2	2
7490	7493	7496	3	6	6
7501	7502	7505	1	4	4
StD value					4
No. of Semi holidays/year					95
Average consumption per year					380
Working day					
FN	MD	AN	FN-MD	MD-AN	AN-FN (kWh)
7474	7474	7474	0	0	0
7484	7484	7484	0	0	0
7506	7507	7509	1	2	3
StD value					1
No. of Semi holidays/year					70
Average consumption per year					70
Average consumption through the energy meter/year					**1516.67**

Table 4.6. Energy consumption per year for the consumer No 1156355003528 (canteen; BBA block section)

Canteen is used up to 30% of students and staff, on an average. However, heavy consumption is reported due to the possibilities of grinders, mixie, refrigerator etc. in the canteen (Table 4.6).

Meter reading recorded (kWh)					Mean consumption/day
Working day					
FN-MD	MD-AN	AN-FN (kWh)	FN-MD	MD-AN	AN-FN (kWh)
1	0	1	2	4	6
1	2	3	3	2	5
2	1	3	2	4	6
StD. value					2.33
No. of working days/year					200
Average consumption per year					466.67
Working day					
FN	MD	AN	FN-MD	MD-AN	AN-FN (kWh)
507	507	508	0	1	1
520	520	520	0	0	0
529	530	530	1	0	1
SD value					0.67
No. of semiholidays/year					95
Average consumption per year					63.33
Working day					
FN	MD	AN	FN-MD	MD-AN	AN-FN (kWh)
514	514	514	0	0	0
514	514	514	0	0	0
521	522	524	1	2	3
SD value					1
No. of holidays/year					70
Average consumption per year					70
Average consumption through the energy meter/year					**600**

Table 4.7. Energy consumption per year for the consumer No 1156352003529 (Gas plant/BBA toilet)

The relatively higher energy consumption is because of the higher number of fans (14) and fluorescent tube lights (24) in BBA block. It is recommended to replace required number of fans with energy saving models and fluorescent tube lights with LED tube lights (Table 4.7).

Meter reading recorded (kWh)					Mean consumption/day
Working day					
FN	MD	AN	MD-FN	MD-AN	AN-FN (kWh)
251	251	251	0	0	0
251	251	251	0	0	0
251	251	251	0	0	0
StD value					0
No. of working days/year					200
Average consumption per year					0
Semiholiday					
FN	MD	AN	MD-FN	MD-AN	AN-FN (kWh)
251	251	251	0	0	0
251	251	251	0	0	0
251	251	251	0	0	0
StD value					0
No. of semiholidays/year					95
Average consumption per year					0
Holiday					
FN	MD	AN	MD-FN	MD-AN	AN-FN (kWh)
251	251	251	0	0	0
251	251	251	0	0	0
251	251	251	0	0	0
StD value					0
No. of holidays/year					70
Average consumption per year					0
Average consumption per year					**0**

Table 4.8. Energy consumption per year for the consumer No 1156355014592 (Chapel, Titus Varkey Hall)

Zero level on energy consumption was recorded in chapel 115635501492 consumer number also cover Titus Varkey hall, library Block. In chapel prayer take place occasionally and Titus working hall also open occasionally for exam or programmes (Table 4.8).

Consumer No. (Energy Meter)	Location	Average consumption through the energy meter/year (kWh)	Average consumption through the energy meter/day (kWh)	Per capita daily consumption of energy (kWh)
1156351003205	Main building	389.33	1.066	0.002
1156352016533	Women's hostel	2703.33	7.406	0.161
1156355003528	Canteen	1516.66	4.155	0.077
1156352003529	Gas Plant/ BBA toilet	600	1.643	0.003
1156355014592	Chapel, Titus varkey hall	0	0	0
TOTAL		5209.32	14.27	

Table 4.9. Summary data on energy meter reading by internal auditors

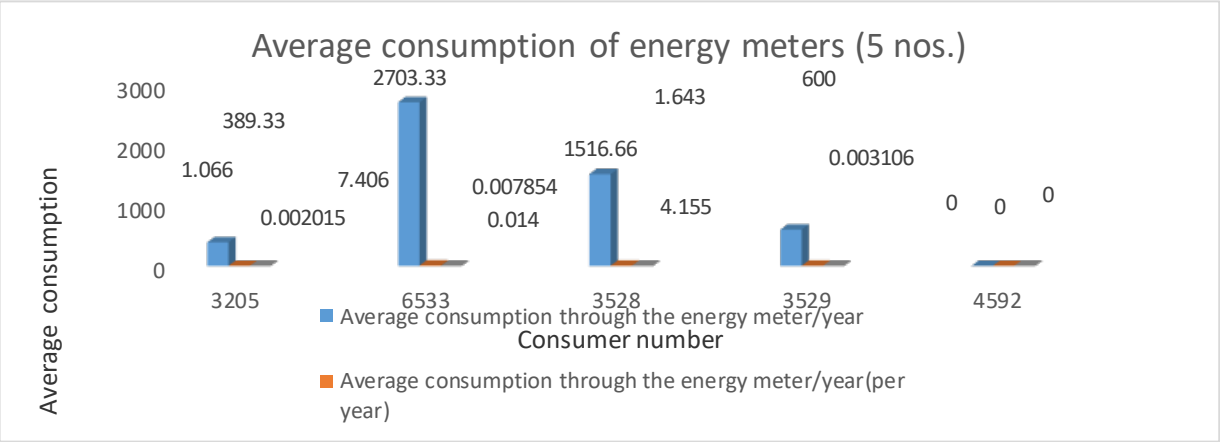


Fig.4.31. Average consumption per year based on energy meter reading data collected by internal auditors

4.4.5. Solar energy production in the college

College has a solar power plant at the top of the main building with an installed capacity of 10 kVhA (Kilo volt ampere hour). It is an on grid system and a portion of the electricity generated is using at the college and rest of the amount supplied to the KSEB. This grid system is attached to the Consumer No. 1156351003205. There are two meters one for import (production- main meter) and the other is a dual meter, through which the export to KSEB and supply to the main building and Self financing block.

The system became operational since 11th September 2023. The data regarding solar production is given in Table 4.10.

No.	Period	Days	Production of Electricity (kWh)	Quantity given to KSEB grid (kWh)
1	11.09.23 to 04.10.23	23	1699	1410
2	05.10.23 to 01.11.23	27	2098	1575
3	02.11.23 to 05.12.23	33	2023	960
4	06.12.23 to 01.01.24	26	2500	990
5	01.01.24 to 01.02.24	31	2238	690

Table 4.10. Data on electricity generation by solar power system

The data on solar electricity generation shows that on an average a monthly production of 1100 units is generated. Out of this, around 50% of electricity is using in the college and the rest is exported to KSEB grid.
The present generation of electricity through the solar plant is used to meet a minor portion of the actual requirement. Hence the production shall be maximised with the upgradation of installation capacity.

4.4.6. LPG usage in the college

There are 26 allotted LPG cylinders for the college. A total of 704 cylinders are used per year. The LPG consumption in the college hostel is notably high, with a total of fourteen cylinders. To sustain their usage pattern, they require one cylinder (19.7 kg) for eight days, it translates to a monthly requirement of 45 cylinders and an annual need of 638 cylinder, in the women's hostel alone. Despite having a biogas plant, it's evident that LPG consumption remains excessively high. However, the increased LPG usage post-biogas installation suggests either the biogas system is not functioning optimally or the generated energy from the biogas plant is not being effectively utilized. Hence it is recommended to consider more energy saving practices in the hostel mess.

Total Number of cylinders used in the college					
Sl No	Department/Location	Total no. of cylinders (by connection)	14.7Kg. size	19 Kg size	Average no. of cylinders used /year
1	Chemistry	6	4	2	12
2	Zoology	2	2	0	2
3	Canteen/Cafeteria	4	2	2	52
4	Women's Hostel	14	0	14	638
TOTAL		**26**	**8**	**18**	**704**

Table 4.11. Use of LPG cylinders in the college

4.5. CONCLUSIONS

- The college's electricity consumption is disproportionately low compared to its population size. Currently, 90% of the lighting comprises led bulbs and tube lights. Switching the remaining CFL incandescent bulbs (4 each), and fluorescent tube lights (168) to led variants is strongly advised. This transition promises substantial energy savings.
- The power rating and average usage time of each item are inappropriately documented.
- The college predominantly focuses on arts and sciences, with a limited presence of major machines or highly sensitive equipment. The available lab equipment, instruments, and appliances are restricted to the curriculum of undergraduate (UG) and postgraduate (PG) courses within the science departments.
- Approximately 95% of the equipment, instruments, and appliances currently in use are outdated models lacking an Energy Star rating. Consequently, these devices may contribute to a substantial energy consumption. Therefore, it is strongly advised to mandate the procurement of only Energy Star-rated items in the future
- The absence of usage registers for nearly all equipment constituted a significant non-conformity. This has been rectified, and it is now confirmed that usage registers are maintained for all equipment. These registers facilitate the identification of equipment with the highest usage time and frequency of use. Such information can be utilized to implement effective energy-saving practices.
- Despite having the infrastructure for a biogas plant, it's evident that LPG consumption remains excessively high. However. It's imperative to implement more effective measures to reduce LPG consumption.

4.6. RECOMMENDATION

- Student can also take initiatives to bring innovative technologies and mechanism with low coast as model and at the same to save energy
- Students can also take initiatives to introduce innovative technologies and mechanisms at a low cost as a model, while simultaneously aiming to conserve energy.
- Colleges can organize techno fests by collaborating with other institutions, providing students with opportunities to exchange ideas and engage with diverse knowledge. This collaborative effort represents a significant advancement for both students and faculty, fostering teamwork and the adoption of innovative plans.
- Students, with faculty guidance, have the opportunity to proactively undertake initiatives, introducing innovative technologies and mechanisms at a low cost as a model, all while concurrently striving to conserve energy.
- Establish a proficient power management team to regularly monitor the energy function's progress, engage in discussions, formulate plans, document findings, and assess the ongoing developments for implementing modifications in sustainable energy management.
- It would be preferable to devise an alternative plan aimed at reducing energy consumption through different methods, particularly focusing on reducing LPG usage. For example, implementing a biogas plant could be a viable solution
- Strongly recommend to place efficient power management team members to systematically monitoring and documenting the energy management progress.

4.7. ENVIRONMENT MANAGEMENT PLAN

In our endeavour to foster sustainable practices and reduce energy consumption, a comprehensive set of measures will be implemented across our institution. Under the umbrella of Energy Saving Measures, a primary focus will be on the widespread adoption of LED lighting technology. This initiative entails the systematic replacement of conventional lighting systems in key areas such as classrooms, laboratories, auditoriums, halls, and hallways with energy-efficient LED fixtures. Furthermore, to further curb energy usage, a stringent purchasing policy will be enforced, prioritizing the acquisition of energy-efficient equipment bearing star

ratings. This includes appliances like refrigerators, air conditioners, microwaves, and deep freezers. Transitioning from traditional TFT monitors to LED monitors in staff areas, offices, and computer labs will also be facilitated, ensuring a gradual phase-out of outdated technology.

Additionally, to cultivate a culture of energy consciousness and promote sustainable practices within the college community, a robust Information, Education, and Communication (IEC) program will be instituted. This initiative will encompass regular awareness programs, informative display boards, and engaging social media communications. Through these channels, students, faculty, and staff will be sensitized to the importance of energy conservation and encouraged to adopt eco-friendly behaviours in their daily lives. By fostering a collective commitment to energy efficiency, we aspire to create a greener and more sustainable campus environment for generations to come

4.7.1. Establish an Energy Management Team

- Form a dedicated team comprising staff members from various departments, including facilities management, administration, finance, and sustainability.
- .manager to oversee the implementation process.

4.7. 2. Set Clear Goals and Targets:

- Define specific, measurable, and time-bound goals for energy reduction and sustainability.
- Establish targets for incorporating renewable energy sources and improving energy efficiency in buildings and operations.

4.7. 3. Conduct Energy Audit and Assessment:

- Hire an external energy consultant or engage internal resources to conduct a comprehensive energy audit of all facilities and operations.
- Analyse energy consumption patterns, identify areas of inefficiency, and prioritize opportunities for improvement.
- Assess the potential for integrating renewable energy sources such as solar, wind, and biomass into the institution's energy portfolio.

4.7. 4. Develop an Energy Management Plan and Policy

- Based on the findings of the energy audit, develop a detailed energy management plan outlining specific goals, targets, and strategies for reducing energy consumption and promoting sustainability.
- Set measurable objectives for energy conservation, renewable energy integration, and efficiency improvements, taking into account the institution's budgetary constraints and timelines.

4.7. 5. Implement Energy Efficiency Measures:

- Implement low-cost and no-cost energy-saving measures such as:
- Installing energy-efficient lighting, including LED bulbs and sensors for automatic lighting control.
- Implementing power management settings on computers and other electronic devices to reduce standby power consumption.
- Conducting regular maintenance and tuning of HVAC systems to optimize performance and energy efficiency.
- Invest in energy-efficient appliances and equipment for use in classrooms, laboratories, offices, and other facilities.

4.7. 6. Regular Maintenance and Equipment Upgrades:

- Develop a preventive maintenance schedule for all equipment to ensure optimal performance and energy efficiency.
- Replace outdated and inefficient appliances and systems with energy-efficient models.

4.7.7. Integrate Renewable Energy Systems:

- Install solar panels on rooftops and open spaces to generate electricity for powering lighting, heating, and other electrical loads.
- Explore opportunities for installing small-scale wind turbines or biomass systems to supplement the institution's energy needs.
- Investigate the feasibility of establishing

partnerships with local renewable energy providers or government agencies to access incentives and financing options for renewable energy projects.

4.7. 8. Promote Energy Awareness and Engagement:

- Launch a campus-wide energy conservation awareness campaign to educate students, faculty, and staff about the importance of energy management and sustainability.
- Organize workshops, seminars, and training sessions to provide practical tips and strategies for reducing energy consumption in daily activities.
- Encourage active participation and engagement from the campus community by soliciting feedback, ideas, and suggestions for energy-saving initiatives.

4.7. 9. Engage Students in Energy Projects:

- Encourage students to take part in energy-related projects and research initiatives.
- Create student-led groups or clubs focused on sustainability and energy

4.7. 10 Monitor, Measure, and Evaluate Performance:

- Implement energy monitoring and metering systems to track energy usage in real-time and identify areas of excessive consumption or waste.
- Establish key performance indicators (KPIs) to measure progress towards achieving energy management goals and targets.
- Conduct regular performance reviews and evaluations to assess the effectiveness of energy management measures and identify opportunities for further improvement.

4.7. 11. Establish Continual Improvement Process:

- Establish a process for continual improvement by regularly reviewing and updating the energy management plan based on evolving priorities, technologies, and best practices.
- Foster a culture of innovation and collaboration by encouraging feedback, sharing successes, and celebrating achievements in energy management and sustainability.
- Engage stakeholders from across the institution in ongoing dialogue and decision-making processes to ensure alignment with broader strategic objectives and priorities.

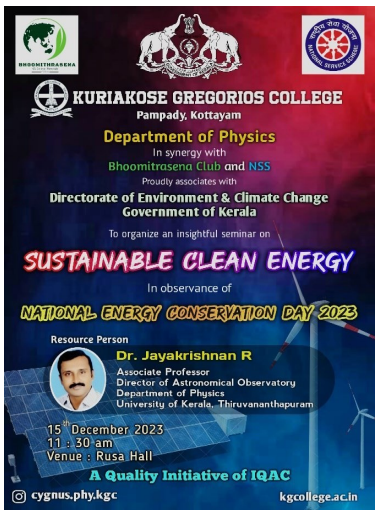
4.7. 12 Continuous Improvement:

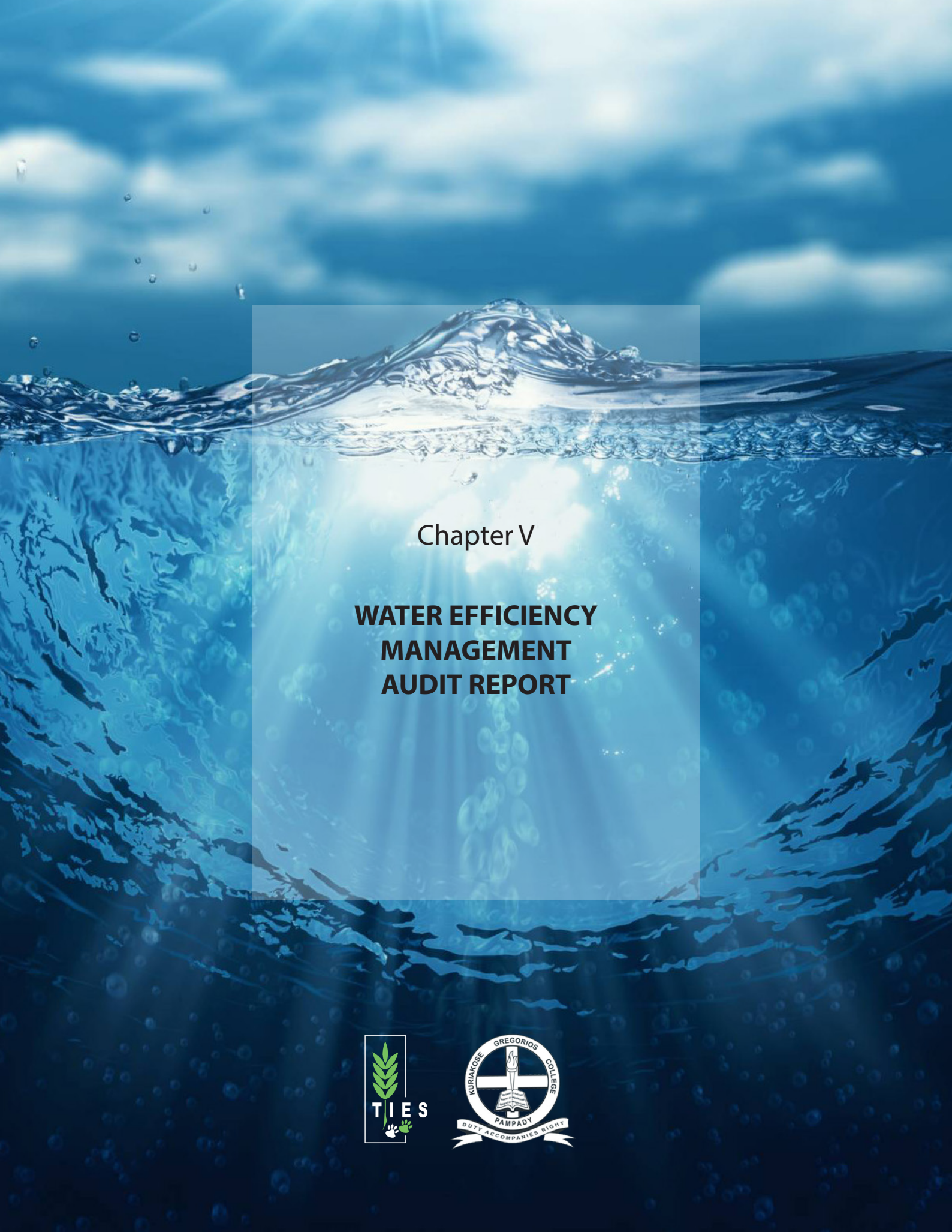
- Foster a culture of continuous improvement by regularly reviewing and updating the energy management plan to align with evolving technologies and best practices.

4.8. ACTIVITIES CONDUCTED
by Energy Audit Team

On December 15, 2023, a seminar in connection with National Energy Conservation Day was conducted, following the celebration of the day on December 14, 2023. The seminar focused on the crucial theme of sustainable clean energy, with specific emphasis on the necessity of lead-free solar panels. The esteemed speaker for the event was Dr. Jayakrishnan, an Associate Professor in the Department of Physics at the University of Kerala. The seminar proved to be an enlightening and thought-provoking event, providing participants with valuable insights into the imperative need for sustainable clean energy, specifically emphasizing the transition to lead-free solar panels.

The visit to Mithradham Renewable Energy Plant on December 19, 2023, was an enriching experience, aligning with the objectives of National Energy Conservation Day. It served as a practical and educational initiative, showcasing advancements in photovoltaic technology and promoting awareness of the benefits of renewable energy. The diverse range of solar panel configurations and the integration of storage solutions underscored the plant's commitment to sustainability. This visit left participants inspired and better informed, contributing to the collective effort towards a greener and more energy-efficient future.





Chapter V

WATER EFFICIENCY MANAGEMENT AUDIT REPORT

TIES

KURIAKOSE GREGORIOS COLLEGE
PAMPADY
DUTY ACCOMPANIES RIGHT

WATER EFFECIENCY MANAGEMENT SYSTEM (WEMS 2023-24)

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5

Water Efficiency Management Audit

5.1. INTRODUCTION

Water is a transparent, tasteless, odourless, and colourless chemical substance composed of hydrogen and oxygen molecules (H2O). It is essential for the survival of all known forms of life on Earth. Water exists in three states: solid (ice), liquid (water), and gas (water vapour), and it is the only common substance found naturally in all three states. Water plays crucial roles in various biological, chemical, and physical processes. It serves as a solvent, facilitating chemical reactions and transporting nutrients and waste products within living organisms. Water also regulates temperature through its high specific heat capacity, helping to stabilize Earth's climate and maintaining suitable conditions for life. In addition to its biological importance, water is essential for human activities such as agriculture, industry, and household use. It is used for drinking, irrigation, sanitation, hygiene, manufacturing processes, and generating electricity through hydropower. A water audit serves as a powerful management instrument, reducing losses, optimizing diverse applications, and facilitating substantial water conservation. It involves accounting for all water within a system, providing a quantified insight into its integrity and operation. This audit is the initial stride towards crafting an economically viable strategy to combat water losses and promote sustainable conservation practices.

The international standard ISO 14046 specifies the processes required for conducting water footprint assessments, outlining the principles, common processes, and water deliverables for a water audit. Meanwhile, ISO 46001 stands as the standard for efficient water management systems. The natural water resources are facing threats from pollution, deforestation, and climate change, leading to widespread water shortages and declining water quality. Despite these challenges, water wastage persists across all communities and contexts. Conducting a water audit can pave the way for implementing water conservation measures, ultimately fostering sustainability. The primary objectives of a water audit include reducing water loss, enhancing financial performance, improving the reliability of supply systems, and optimizing the performance of distribution networks.

One of the paramount challenges confronting the world today is water scarcity, a crisis anticipated to exacerbate over the next decade. To mitigate water demand in the non-domestic sector and advocate for water conservation, organizations must implement a sustainable water management strategy. Freshwater scarcity persists in numerous regions globally, with only a fraction available for agriculture and distribution, rendering areas with access to freshwater susceptible to drought. Contributing factors include human consumption patterns, the adoption of intensive agricultural and industrial water practices, and the impacts of climate change. The escalating demands are inversely proportional to water availability. While it's impossible to manufacture additional water, prudent utilization of existing resources can be achieved through effective water resource management.

A meticulously executed framework and directives for enhancing water efficiency, coupled with tools for consumption assessment and a systematic approach to implementing water-saving measures, result in substantial water and energy conservation and a diminished environmental footprint. The successful implementation of a water management plan, guided by ISO 46001 principles, yields the following outcomes:

Identifying water resources becomes integral to organizational and financial planning. Assisting organizations in optimizing water demand and enhancing water usage management. Understanding the potential ripple effects of altering water usage on communities. Ensuring greater accountability in water consumption. Establishing a protocol for regularly evaluating areas for improvement and seizing opportunities for water efficiency enhancements. Realizing operational savings through the use of water conservation devices, sustainable design practices, and effective monitoring.

5.1.1. What is water efficiency audit?

Water audit or water efficiency audit compound, designed according to ISO standards 46001 and 14046, serves as a comprehensive framework for evaluating and managing water resources sustainably. ISO 46001 outlines the requirements for establishing, implementing, maintaining, and improving a water management system, ensuring organizations effectively address water-related challenges. Meanwhile, ISO 14046 provides guidelines for conducting a water footprint assessment, enabling businesses to quantify and understand their water usage and impacts throughout the supply chain. By integrating these standards, a water audit compound facilitates meticulous monitoring, analysis, and optimization of water usage, promoting conservation efforts and minimizing environmental footprints. This holistic approach not only enhances operational efficiency but also fosters responsible stewardship of precious water resources for present and future generations.

Alternatives resources, encompass a range of methods, including rainwater harvesting, grey water recycling and wastewater treatment. Rainwater harvesting involves collecting and storing rainwater for various uses, such as irrigation and toilet flushing, reducing dependence on mains water. Grey water recycling systems treat wastewater from sinks, showers, and Pipes to a quality suitable for non-potable purposes. Additionally, advanced wastewater treatment technologies enable the purification of sewage for reuse in agriculture, institution and even potable applications with appropriate treatment. Embracing these alternate water resources fosters resilience against water scarcity while promoting sustainable water management practices globally.

5.1.2. Need for water audit

The natural water resources are under threat due to several reasons ranging from pollution, deforestation to climate change. Hence, water shortage or lack of good quality water is becoming a burgeoning issue everywhere. Even then, wastage of water is taking place in all communities and situations. A water audit will lead to water conservation measures and thereby a sustainable solution may emerge. The functions of the water audit are:

- reduced water losses
- improved financial performance

- improved reliability of supply system (quality water)
- enhanced performance of the distribution system
- better safeguard to public health and property
- an effective educational and public relations tool for the water
- system reduced legal liability, and
- reduced disruption, thereby improving level of service to the entire college/university community
- Creating awareness among water users (students, staff, guests)

5.2. WATER EFFICIENCY MANAGEMENT POLICY

K.G. College, Pampady, is dedicated to championing water conservation, emphasizing the critical importance of water quality and ensuring an ample supply for present and future generations. The college employ a comprehensive approach that enhances both the quality and quantity of available water while maximizing efficiency and minimizing waste. This commitment extends to optimizing energy inputs to ensure responsible and sustainable water use. Our efforts are guided by a systematic strategy aimed at preserving water in all its forms and states, incorporating innovative techniques and best practices to mitigate water loss and promote water security. Central to this strategy is the adoption of advanced methodologies such as rainwater collection and harvesting, which offer decentralized and environmentally sound solutions for augmenting water supplies. By harnessing the natural process of rainfall, we can effectively capture and utilize precipitation, reducing reliance on traditional water sources and alleviating pressure on strained ecosystems. Rainwater harvesting systems enable us to capture runoff from impermeable surfaces, preventing erosion, minimizing flooding risks, and replenishing groundwater reserves. We are committed to upholding the highest standards of quality and integrity in rainwater collection practices, establishing rigorous guidelines and protocols for design, installation, and maintenance to ensure purity and safety. By adhering to these standards, we aim to optimize the efficiency and effectiveness of our rainwater harvesting systems, mitigating the impacts of drought and water scarcity. Through ongoing monitoring and evaluation, we continuously refine our approach, embracing innovative solutions to safeguard water resources for the benefit of current and future generations, ensuring a more sustainable and resilient water future for all.

5.2.1. Assessment and Audit

conduct a comprehensive assessment of water usage periodically. This includes evaluating current consumption patterns, identifying areas of high usage, and assessing existing infrastructure for water management

5.2.2. Conservation Measure

Implement measures to reduce water consumption. This could involve installing water-efficient fixtures, promoting water-saving practices such as rainwater harvesting, and encouraging the use of recycled water for non-potable purposes.

5.2.3. Education and awareness

Develop educational programs to raise awareness about water conservation among students, faculty, and staff. This could include workshops, seminars, and campaigns highlighting the importance of water conservation and practical tips for reducing water usage

5.2.4. Policy integration

Integrate water management goals into the curriculum of relevant disciplines such as environmental science, engineering, and agriculture. Encourage research and innovation in water conservation technologies and practices

5.2.5. Infrastructure Updates

Invest in infrastructure upgrades to improve water management systems in higher education institutions. This may include retrofitting existing buildings with water-saving technologies, upgrading plumbing systems, and implementing smart irrigation systems for landscaping

5.2.6. Monitoring and Reporting

establish a system for monitoring water usage and reporting on conservation efforts. This could involve installing water meters, setting consumption targets, and regularly assessing progress towards meeting those targets.

5.2.7. Regulatory and Compliance

Ensure compliance with relevant water regulations and standards. Develop guidelines and protocols for water management in higher education institutions, and provide support for compliance efforts.

5.2.8. Emergency Preparedness

Develop contingency plans for dealing with water shortages or other water-related emergencies. This may involve establishing emergency water storage facilities, implementing water rationing measures, and coordinating with local authorities.

5.2.9. Long-term Sustainability

Emphasize the long-term sustainability of water resources in higher education institutions. Encourage the adoption of holistic approaches to water management that take into account environmental, social, and economic factors.

5.3 WATER AUDIT - METHODOLOGY

Water efficiency audit is the vital compound for sustainable development which is conducted through analysing the overall usage and their maintenance. Water audit is conducted to analyse overall water usage and maintenance for sustainable development. Documents and registers are systematically recorded to reduce water wastage and effectively utilize resources. The water audit team consists of thirteen members, including eleven students and two faculty. Initially, a water audit program schedule is prepared, and audit members are grouped. Each group is assigned to document events, meetings, and check taps and faucets in each block. The audit team holds eight registers and five documents. Before recording, team members conduct surveys to count the number and type of taps and faucets and assess their working condition in each block of the college. They also map each block to identify water sources, noting if they are outside the campus. Water flow meter readings and water pumping registers are recorded three times in nine days by team members assigned to each point, specifying date, time, quantity, and period to determine water flow rates. The audit members register water storage systems, specifying types, capacity, year of installation, and location to check the functionality of taps, faucets, and pumping lines.

Additionally, water quality analysis, water risk management, water infrastructure maintenance, and water footprint registers are recorded by team members to identify usage patterns, water quality, current practices, grey water usage, water losses, and to prepare a detailed inventory of current water resources. The team members regularly document meetings and programs associated with water conservation and sustainability.

5.3.1. Assumption

Water scarcity stands out as one of the paramount challenges facing the world today, a crisis that is expected to worsen in the coming decade. To address this pressing issue and promote water conservation in the non-domestic sector, organizations need to implement sustainable water management strategies. Freshwater scarcity is a persistent concern in various regions globally, with only a fraction of it available for agriculture and distribution. This renders areas with access to freshwater vulnerable to drought. Contributing factors include human consumption patterns, intensive agricultural and industrial water practices, and the impacts of climate change. The escalating demands for water are inversely proportional to its availability.

Although it is impossible to manufacture additional water, prudent utilization of existing resources is achievable through effective water resource management. A meticulously executed framework, accompanied by directives for enhancing water efficiency, consumption assessment tools, and a systematic approach to implementing water-saving measures, can result in substantial water and energy conservation, ultimately reducing environmental footprints.

The successful implementation of a water management plan, guided by ISO 46001 principles, yields several significant outcomes. It integrates the identification of water resources into organizational and financial planning, assists in optimizing water demand, and enhances water usage management. Understanding the potential ripple effects of altering water usage on communities becomes a key aspect, ensuring greater accountability in water consumption. Moreover, the plan establishes a protocol for regularly evaluating areas for improvement and seizing opportunities for water efficiency enhancements, leading to operational savings through the use of water conservation devices, sustainable design practices, and effective monitoring.

5.3.2. Method of Internal Audit

Water audit has the following three phases:

5.3.2.1. Pre audit phase

- Formation of audit team ; scheduling audit programmes
- Setting up of scope and objectives (in tune with water conservation policy of the institution)
- Discusses with the responsible persons of each location (staff, teachers, lab assistants, sweepers, watchmen, students etc.) about the usage pattern and habits related to water consumption.

This phase includes following specific activities:

5.3.2.1.1 .System audit (inventory of infrastructure)

- The current water usages and systems for water use under various sectors such as canteen, toilets, departments, common facilities, wash areas, and others need to be studied to check their operational efficiency and level of maintenance.
- The scope for any modification or up-gradation will depend on the status of existing systems.

5.3.2.1.2.Water Supply and Usage audit (Usage pattern of the campus)

- Water audit comprises of preparation of layout of water sources, distribution network, service/delivery points to water users (lab, mess, canteen, toilets, office, public etc.) and return flow of waste or excess water.
- The layout should include locations and capacities of flow measurement devices installed at key points, dimensions of pipes and fittings in the water supply system, locations and particulars of flow control devices and history sheets of all measuring and control devices including pipes and fittings.

5.3.2.2. Audit phase

Auditors collect all data collected to ensure that nothing is overlooked completely in the audit. The following information regarding process has been collected during the audit phase:

- Flow measurement devices may be installed at all

strategic points so that water losses from various components such as raw water source, conveyance system from raw water source to treatment plant, from treatment plant to treated water storage system, treated water storage system to distribution networks, individual users, etc. could be assessed at regular intervals (WEMS).

- Such audit will also prove useful for future extension, renovation and modernization of the system.
- Water quality of the distribution system needs to be monitored regularly at strategic points to find out the level and nature of contaminants present in the supplied water. Depending on the types of application and degree of purity needed, the treatment system can be designed and developed.
- The water distribution system, leakage assessment etc. will form an integral part of this study.

5.3.2.3. Post audit phase

- The plan of action for the post-audit phase is implementation and follow-up. The result is to assist and implement or enhance existing WEMS with sustainability solutions and monitor the performance.
- WEMS committee will ensure that the WEMS is in place and the college is participating, by making the entire college/university community well informed through regular communications; monitoring through periodical evaluation programmes etc.

Two major activities are included in this phase:

5.3.2.3.1. Source sustainability audit

- A study of the availability of water from the current sources and past consumption patterns for various sectors of the college/university is necessary to understand the present water utilization and projecting future requirement.
- Data on development of sustainable source of water through rainwater harvesting and waste water (grey water) recycling should also be taken into consideration.
- Water conservation measures shall be identified and included in the action plan.

5.3.2.3.2. Discharge audit

- The quantity of grey water from all points of water usage shall be calculated. Based on such statistics recycling or waste water treatment options shall be implemented.

5.3.3. Steps of water audit

The standard water balance or methodology is the framework for categorizing and quantifying all water uses in the water audit. It is called a 'balance' because when it is completed, all uses of water in the system equal the amount of water input by the sources.

5.3.3.1. Site assessment

Collection of contour map and campus diagram

- Preparing inventory of water infrastructure of each building:
- Water meter data (from various points of use)
- Data on quantity of water pumped every day (pump wise/location wise)
- Data on leaking infrastructure and quantity of lost water
- List of water conservation measures (WCM) and sustainability measures (SM) implemented
- Discussion with responsible persons of each infrastructure (on utility method, working condition, operation and maintenance procedures etc.)
- Date entry in prescribed forms (water spread sheets)

5.3.3.2. Data analysis

- Analysis of current and past performance (water usage data and water loss data, before and after the implementation of WCM, SM etc.)
- Regression analysis involves the comparison of water consumption on the Y axis versus the potential water driver on the X axis (weather, working days/ holidays etc.).
- Preparation of checklists and verification
- Water footprint calculation

5.3.3.3. Final audit by external audit team

- Checklists verification- identifying non conformities
- Action plan –long tern and short term
- Final report & certification as per ISO standards.

Water Audit – programme schedule			
Week	Week Days	Weekly Work Plan	Activity
First Week	29/11/2023	To conduct a survey for counting the number and type of taps and faucets and it's working condition in each block of the College Campus.	1. Audit members were grouped 2. Each group assigned to check taps and faucets of each block.
Second Week	2/12/2023	Mapping of each block (campus) to identify the water sources. If the source is outside campus that also shall be recorded	Internal audit team plot map based on the survey
Third Week	6/12/2023,	To check the working condition of the taps, faucets and plumbing lines (pipes; fittings) and grading – Good, Poor or Moderate	Each group records the data in the prescribed format Graphically represent through sketches or diagrams depicting location of taps, faucets etc.
Fourth week	10/12/2023	To measure the water flow rate of each user points	Flow meter is the best alternative rather manual measuring
Fifth Week	13/12/2023	Identifying water losses through walk through audit	Data recorded in the given format
Sixth Week	17/12/2023	Identifying inception of water conservation and sustainability programs	Preparation of action plan Final report preparation

Table 5.1. Data collection schedule for water audit at K.G.College

5.3.4. Data collection process

The team of internal auditors conducted the field survey in order to document available water infrastructure of the college, its working condition, maintenance status, and basic details like capacity or power of fixtures etc.
They collected the data of water usage through the meters and pumping registers for analysing the daily water usage pattern of the college.
Instead of conventional data collection method for delivery points, water usage to various sections of the campus were evaluated through mechanical water flow meters fitted near to control valves of respective points. Currently, there are three water flow meters are in the college: one at top of the main building, second one at the back side of chemistry department and the third at the water line of auditorium.

Activity	Frequency	Dates of study	Mode of data collection
Water meter reading (for every meter in the college) OR manual one time evaluation	9 days; 3 times a day	Three Sundays; 3/12/2023, 10/12/2023, 17/12/2023. Three holidays Saturday; 2/12/2023, 9/12/2023, 16/12/2023 Three working days; 29/11/2023, 6/12/2023, 13/12/2023 (complete by three weeks)	Entry in the given format
Usage pattern and quantity of water. Documentation of current WEMS practices. Grey water quantity from each section	Walk through audit and interviews with system managers (controlling or responsible staff or teachers)	Collect data on water usage from each section of every divisions of the college (for eg., in canteen, how much water is used for hand wash, cooking and its preparation, cleaning utensils, floor, table etc.	Entry in the given formats
Details of present water sources Water tank details	Type (open well, pond, tube well etc.), external sources (water supply)	Prepare a detailed inventory on each and every current water resources (capacity, sustainability etc.)	Entry in the given format
Alternate water resources (e g., Rain water harvesting systems)	Documents details of present alternate water resources in the campus	Identify possible alternate water sources	Entry in the given format

Table 5.2. Details of data collection process of water audit at K.G.College

5.4. RESULTS & DISCUSSION

5.4.1. Water infrastructure of the college

Sl. No.	Department /Floor	Fixture Type			Status	
		Tap	Flush tanks	Water Filter	Leakage	Damage
1	Commerce Department	4	1	1	0	1 tap
2	Language Department	4	0	0	0	0
3	Physics Department	2	0	1	0	1 tap
4	Chemistry Department	3	1	1	0	1 tap
5	Economics	2	0	0	0	0
6	Chapel	2	0	0	0	0
7	MSc Zoology 1st	2	0	1	0	0
8	MSc. Zoology 2nd	2	0	0	0	1 tap
9	Toilet	14	0	0	0	0
10	Washing Area ground	5	0	0	0	0
11	PG Zoology	1	0	0	0	0
12	Chemistry Lab	23	0	0	0	0
13	Zoology Mushroom lab	3	0	0	0	0
14	Library	2	0	0	0	0
15	MEK	6	0	0	0	0
16	Food Science Department	4	0	0	0	0
17	Room	3	0	0	0	0
18	Office	2	0	1	0	1 tap
19	Canteen	6	0	0	0	0
20	BBA Boys Toilet	4	0	0	0	0
21	Common Boys Toilet	31	0	0	0	0
22	BBA Department	24	0	2	0	1 tap
23	Ground	15	0	0	0	0
24	Ground Floor	4	4	0	0	0
25	Upper Floor	4	3	0	0	0
26	MSc Block	9	0	0	0	0
27	Library	3	1	0	0	0
28	Chemistry Lab	4	0	0	6 tap	0
29	Language Department	2	1	0	0	0
30	Auditorium	6	3	0	0	0
31	Department of Economics	2	1	0	0	0
32	Cafeteria	1	0	0	0	0
33	Manager Room	4	1	0	0	0
34	Self-Financing Block	4	3	0	0	0
35	Food Science Lab	4	0	0	0	0
36	Food Science Department	3	1	0	0	0
37	Zoology Department	4	1	0	0	0
38	BBA Department	4	1	0	0	0
39	Parking Ground	5	0	0	0	0
40	Hostel	21	10	3	0	0
Total		**248**	**32**	**10**	**6**	**6**

Table 5.3. Water delivery infrastructure of K.G.College, Pampady

Sl. No.	Item	Quantity
1	Water meter	3
2	Ball valve 1 ¼"	1
3	Ball valve 1 ½"	1
4	Ball valve 2"	1
5	Ball valve ¾"	3
6	Tee pipe 1 ½"	2
7	Tee pipe 1 ¼"	2
8	Italy lab ball valve (brass)	1
9	Reducer bush ¾"	4
10	Reducer bush 1 ½"	2
11	Reducer tee ¾"	6
12	Elbow pipe ¾"	6
13	Tee ¾"	3

Table 5.4. Water flow controlling/measuring infrastructure

K.G. College boasts a good and quality water infrastructure. As per the current documented information, there are 248 water delivery taps, 32 flush units and 10 water filters in the college. There are only 6 taps are in leaking condition and another 6 are damaged. Majority of such taps are in chemistry lab. This is due to the corrosive actions of chemicals used in the laboratory. It is recommended to replace the taps with corrosive free, chemical resistant laboratory type taps and fixtures in all laboratories. College is planning to implement a regular maintenance system for water infrastructure of the college.

The water consumption monitoring is still not perfect. There are only three water flow meters. For, every storage tank one water flow meter shall be fitted. College has 10 water filters now. This is good considering the water quality of the college. However, a centralised filtration unit can save much amount of energy and water. Also can be ensure that every drop of water delivered to the campus is pure. College is planning to install such a system in future.

As part of water conservation measures installation of sensor taps in all toilets, disc type types in all laboratories, sensor taps in wash areas etc. are recommended.

No.	Type	Capcity	Year of installation	Location	Water source	Area/building to which delivery	Purpose of water	Type of tank	How many time daily filled
1	Main Tank	18000	2013	Roof top of main building	Well	To the whole college + Ashakiran	Drinking, washing , cleaning, gardening and all kinds of usages	concrete	Twice daily
SUB WATER STORAGES (fed by the water from the main tank)									
2	Water Tank (White)	1000	2013	Roof top of main building	Main tank	Main building	Drinking, washing , cleaning, gardening	plastic	automatic filling
3	Water Tank (White)	2000	2013	Roof top of main building	Main tank	Main building	Drinking, washing , cleaning,	concrete	automatic filling
4	Water Tank (Black)	2000	2013	Roof top of main building	Main tank	Main building+ cafeteria	Drinking, washing , cleaning,	plastic	automatic filling
5	Water Tank (White)	1500	2013	Roof top of main building	Main tank	Main building	Drinking, washing , cleaning,	plastic	automatic filling
6	Water Tank (Black)	500	2013	Roof top of main building	Main tank	Main building	Drinking, washing , cleaning,	plastic	automatic filling
7	Purifying Tank (Black)	500	2013	Roof top of main building	Main tank	Main building	Drinking, washing , cleaning,	plastic	automatic filling
8	Purifying Tank (Black)	500	2013	Roof top of main building	Main tank	Main building	Drinking, washing , cleaning,	plastic	automatic filling
9	Water Tank (Black)	1000	2013	3rd floor near MEK hall	Main tank	Self finance block+ canteen+ boys toilet	Drinking, washing , cleaning, cooking	plastic	automatic filling
10	Water Tank (Black)	12000	2013	Roof top of main building	Main tank	Library + economics dept+ ladies toilet (9) + Titus varkey hall +Gym + chapel	Drinking, washing , cleaning,	concrete	automatic filling
11	Water Tank (Black)	2000	2013	Roof top of hostel	Main tank	Hostel	Drinking, washing , cleaning, bathing, gardening. cooking	plastic	automatic filling
12	Water Tank (Black)	2000	2013	Roof top of hostel	Main tank	Hostel	Drinking, washing , cleaning, bathing, cooking	plastic	automatic filling
13	Water Tank (Black)	2000	2013	Roof top of hostel	Main tank	Hostel	Drinking, washing , cleaning, bathing, cooking	plastic	automatic filling
Rain water harvesting tank									
14	Rain water harvesting tank	3,00,000	2017	Infront of the Titus Varkey Hall (semi sub surface)	Roof top of the main building		Gardening	Ferro cement tank	During rains water get stored

Table 5.5. Water storage infrastructure of K.G.College, Pampady

College has a main storage tank of 18000 L capacity. The water pumped to this tank is distributed to 12 other sub tanks. Each sub tank has valve type regulator mechanism, hence an area of distribution can be controlled. The college has a total of twelve tanks with a combined capacity of 45,000 L. The main tank, with a capacity of 18,000 L, serves as the primary storage facility. Additionally, there is one tank with a capacity of 1,500 units, one with 1,200 units, five with 2,000 L, two with 1,000 L, and three with 500 L. The main tank, with its 18,000-L capacity, is where water is initially stored, while water is automatically transferred to the smaller tanks as needed, to ensuring a continuous water supply.
College has a Rain water Harvesting Tank of 3,00,000 lakh L. capcity. But the water is neither used nor is the tank maintained properly. The WEMS committee has taken a decision to maintain the tank properly and ensure optimum utilisation with next rainy season.

5.4.2. Analysis of water flow meter reading data

Holiday		
FN reading	AN reading	Quantity of Consumption (L)
1,27,432	1,33,388	5,956
3,56,712	3,62,312	5,600
4,21,363	4,26,491	5,128
Std. Value (average)		5,561
Total Holidays /year		70
Total consumption/year		**389293.33**
Semiholiday		
FN reading	AN reading	Quantity of Consumption (L)
2,77,652	2,77,652	0
4,34,216	4,40,134	5,918
2,19,765	2,24,633	4,868
Std. Value (average)		3,595
Total Semi holiday /year		95
Total consumption/year		**341556.66**
Working day		
FN reading	AN reading	Quantity of Consumption (L)
4,77,227	4,82,283	5,056
2,97,363	3,03,313	5,950
2,19,765	2,24,633	4,868
Std. Value (average)		5,291
Total Workingday/Year		200
Total consumption/year		**1058266.66**

Table 5.6 Amount of water consumption through the water flow meter at Aashakiran

The working day saw a higher quantity of water c onsumption compared to both holidays and semi-holidays. This increased water usage is primarily attributed to the elevated utilization of water at Ashakiran, a free homeopathic clinic centre. Consequently, it is plausible that regular usage contributes to the heightened water consumption levels.

Holiday		
FN reading	AN reading	Quantity of Consumption (L)
75,632	82,007	6,375
76,687	81,105	4,418
7,24,231	7,32,727	8,496
Std. value (average)		6,430
Total Holidays /year		70
Total consumption/year		**450076.66**
Semiholiday		
FN reading	AN reading	Quantity of Consumption (L)
75,632	82,007	6,375
76,687	81,105	4,418
7,24,231	7,32,727	8,496
Std. value (average)		6,430
Total Semiholiday /year		95
Total consumption/year		**610818.33**
Working day		
FN reading	AN reading	Quantity of Consumption (L)
1,81,421	1,96,057	14,636
1,66,874	1,82,122	15,248
1,48,237	1,63,069	14,832
Std. value (average)		14,905
Total Working day/Year		70
Total consumption/year		**1043373.33**

Table 5.7 Amount of water consumption through the water flow meter at College Hostel

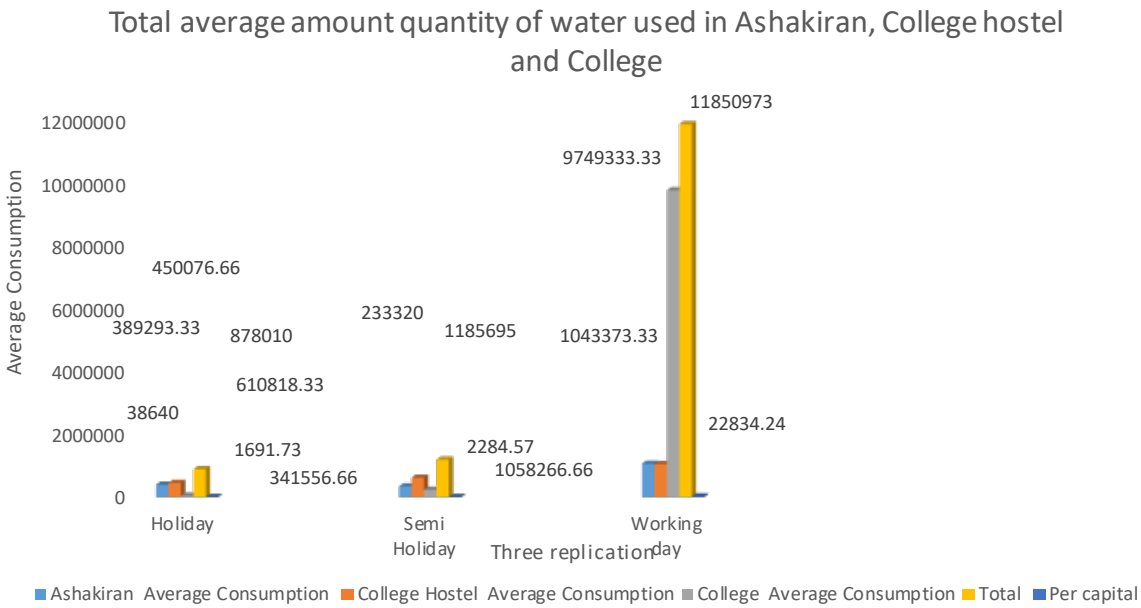
Holiday		
FN reading	AN reading	Quantity of Consumption (L)
2,12,112	2,12,648	536
78,603	79,115	512
42,276	42,884	608
Std. value (average)		552
Total Holidays /year		70
Total consumption/year		**38640**
Semiholiday		
FN reading	AN reading	Quantity of Consumption (L)
4,32,176	4,35,608	3,432
748660	7,49,128	468
1,64,738	1,68,206	3,468
Std. value (average)		2,456
Total Semi holiday/year		95
Total consumption/year		**233320**
Working day		
FN reading	AN reading	Quantity of Consumption (L)
2,42,437	3,57,005	1,14,568
1,45,401	1,60,639	15,238
4,37,643	4,54,077	16,434
Std. value (average)		48,747
Total Working day/Year		200
Total consumption/year		**9749333.33**

Table 5.8. Amount of water consumption through the water flow meter at College buildings

The working day saw increased water usage, followed by semi-holidays and holidays, likely due to the regular operations of the college. Saturdays also experienced notable water consumption, possibly due to special classes, remedial sessions, or other programs.

Type of the day	Average Consumption (L)/year			Total Per capita (L)/year	
	Ashakiran	College Hostel	College		
Holiday	389293.33	450076.66	38640.00	878010.00	1691.73
Semi Holiday	341556.66	610818.33	233320.00	1185695.00	2284.57
Working day	1058266.66	1043373.33	9749333.33	11850973.00	22834.24
TOTAL	1789116.65	2104268.32	10021293.33	13914678.3	26810.56

Fig 5.9. Annual total and per capita consumption of water at the college



In working day average quantity and per person usage of water consumption was recorded high in the college, hostel and Ashakiran. This is primarily due to the larger population strength in the college, resulting in proportionally higher water usage. However, both Hostel and Ashakiran maintain minimal water usage that is proportionate to their overall capacity of the respective storage tanks.

On semi-working days, the overall average water consumption and per person usage is slightly lower compared to regular working days. Hostel exhibits the highest water usage, followed by Ashakiran and the college. Typically, the college observes a holiday on Saturdays, leading to the potential for lower water usage, while the hostel experiences higher consumption due to the presence of residents, especially students from long distances. Similarly, Ashakiran operates consistently during these periods.

During holidays, the average water consumption and per person usage is lower compared to semi-holidays and working days. Holidays are non-working days, unlike others. Despite the hostel showing the highest water usage, followed by Ashakiran and the college, the college typically observes a holiday on Sunday, potentially resulting in decreased water usage, while the hostel sees higher consumption due to resident presence, especially students from distant areas. Similarly, Ashakiran maintains consistent operations during these periods.

5.4.3. Analysis of pumping data

The data on the time taken for filling the main tank (capacity 18000 L) is given in Table 5.10. This shows that on an average 60-75 minutes is required for filling the main storage tank. The pump is of 10 HP power rating and this means that 7.5 kWh to 10 kWh (unit) (1 HP= 735.5 W). The head of the pump is significantly high hence the time.

Currently college has only one water source. This is highly risky in the present ecological scenario. During summer season hydrological drought is already experiencing in the college. Hence, an additional perennial source has to be identified. Promotion of rain water harvesting through artificial means and enabling nature is the most sustainable solution. It is a serious lapse, that the present rain water harvesting tank (capacity 3 lakh L) is not been used.

Week 1					
Sl.no	Frequency	Duration	Date		Time (min)
			From	To	
1	29-11-2023	1	5:00 AM	6:15 AM	75
		2	6:30 AM	7:30 AM	60
2	30-11-2023	1	5:00 AM	6:15 AM	75
		2	6:30 AM	7:30 AM	60
3	01-12-2023	1	5:15 AM	6:00 AM	75
		2	6:00 AM	6:45 AM	60
4	02-12-2023	1	5:00 AM	6:15 AM	75
		2	6:30 AM	7:30 AM	60
5	03-12-2023	1	5:00 AM	6:15 AM	75
		2	6:30 AM	7:30 AM	60
6	04-12-2023	1	5:15 AM	6:15 AM	60
		2	6:00 AM	7:00 AM	60
7	05-12-2023	1	5:00 AM	6:15 AM	75
		2	6:30 AM	7:30 AM	60
8	06-12-2023	1	5:00 AM	6:15 AM	75
		2	6:30 AM	7:30 AM	60
Week 2					
1	07-12-2023	1	5:00 AM	6:15 AM	75
		2	6:30 AM	7:30 AM	60
2	08-12-2023	1	5:00 AM	6:15 AM	75
		2	6:30 AM	7:30 AM	60
3	09-12-2023	1	5:15 AM	6:00 AM	75
		2	6:00 AM	6:30 AM	30
4	10-12-2023	1	5:00 AM	6:15 AM	75
		2	6:30 AM	7:30 AM	60
5	11-12-2023	1	5:00 AM	6:15 AM	75
		2	6:30 AM	7:30 AM	60
6	12-12-2023	1	5:15 AM	6:15 AM	60
		2	6:20 AM	7:15 AM	55
7	13-12-2023	1	5:00 AM	6:15 AM	75
		2	6:30 AM	7:30 AM	60
Week 3					
1	14-12-2023	1	5:00 AM	6:15 AM	75
		2	6:30 AM	7:30 AM	60
2	15-12-2023	1	5:00 AM	6:15 AM	75
				7:30 AM	60
3	16-12-2023	1	5:00 AM	5:45 AM	45
				6:30 AM	30
4	17-12-2023	1	5:00 AM	6:15 AM	75
				7:00 AM	45
5	18-12-2023	1	5:00 AM	6:15 AM	45
		2	6:30 AM	7:30 AM	30
6	19-12-2023	1	5:00 AM	6:15 AM	75
				7:30 AM	60
7	20-12-2023	1	4:45 AM	5:45 AM	60
					60

Table 5.10. Data on pumping time for the main source (Tank capacity – 18000 L)

5.4.4. Water Foot Print of K.G.College

The water footprint is an indicator of freshwater use that looks not only at direct water use of a consumer or producer, but also at the indirect water use. . It is a multidimensional indicator, showing water consumption volumes by source and polluted volumes by type of pollution; all components of a total water footprint are specified geographically and temporally. An extremely simplified methodology for assessing balance of used water and conserved water is developed and applied in the present audit process. The water matrix for calculating the water foot print of a college is given as Table 5.11.

Fresh water consumption	Fresh water conservation
Consumption of water in day to day life- For a college: amount of water used for washing, cleaning, drinking, cooking etc. will be considered.	Rain water harvesting
Wastage of water (including used water) • Grey water or sewage • Wasted water while using • Pollution of water bodies	Recycled or reused water
	Water saved through conservation measures
DATA USED (2022-23 schedule)	
Water consumption per year (in KL)	RWH is not being used. But single time capacity is considered (i e., 3 lakh L) No data regarding the quantity of wwater saved through recycle or reuse of grey water & through water conservation measures.

Table 5.11. Matrix of water footprint of a college ***(only direct footprints considered; water footprint of the products consumed (virtual water content) by the members of the college are not included this time)***

Fresh water consumption	Fresh water conservation
Total water consumption of the college per year: 13,9,14,678.3 L	Rain water harvesting – capacity of the tank: 3,00,000 L.
Water balance (quantity used less quantity conserved)	13,614,678.3 L
Per capita consumption of water/year :	26232.53 L

Table 5.12. Matrix of water footprint of KG College

Analysis of available data on water foot print shows that per capita per year water foot print of K.G. College is 26232.53 L. This is based on the use of fresh water alone. It means that daily per capita consumption is 71.86L. As per WHO standards and Indian Standard recommendations, per capita optimum use is 70 L/day, at households. Considering these standards the per capita use of the college is significantly high. Ninety percent of the college communities are day scholars and a 50% reduction in the present use shall be expected. The high level of current use of water mainly owes to the lack of water conservation measures in the campus. Implementation of a customized action plan coupled with awareness campaigns will fetch good results.

5.4.5. Water quality analysis of drinking water in the campus

Ten samples of drinking water including one from the main source and the remaining from the utility points were collected and tested for 14 parameters (as per ISO: 10500-2012) including physical, chemical and biological parameters. The summary results are given in Table 5.13.

Sl.No.	Parameter	Sample code										Limits
		F 4344	F4345	F4346	F4347	F4348	F4349	F4350	F4351	F4352	F4353	6.5-8.5
1	pH	5.95	6.24	5.77	5.49	6.05	6.62	6.38	6.37	5.38	5.64	6.5-8.5
2	Conductivity	42.5	42	42.5	42.6	40.5	44.8	41.5	43.2	42.3	95.5	1476 µS
3	TDS	27.6	27.2	27.5	27.7	26.3	29.1	27	28.1	27.6	61.9	500mg/L
4	Salinity	0.031	0.031	0.031	0.032	0.03	0.03	0.031	0.032	0.031	0.071	3 ppt.
5	Acidity	9.99	16.6	9.99	23.3	6.66	6.66	3.33	6.66	6.66	36.6	200 mg/L as CaCO3
6	Alkanity	6.66	6.66	6.66	9.99	9.99	9.99	6.66	9.99	9.99	29.9	200 mg/L as CaCO3
7	Chlorinity	2.36	4.732	4.73	4.73	4.73	4.73	4.73	4.73	4.73	4.73	250 mg/L as CaCO3
8	Total Hardness	3.33	0	0	3.33	0	9.99	0	3.33	0	29.9	300 mg/L as CaCO3
9	Ca+ions	3.33	0	0	3.33	0	9.99	0	3.33	0	26.6	75 mg/L as Ca+
10	Mg+ions	0	0	0	0	0	0	0	0	0	3.35	80 mg/L as Mg+
11	Total iron	0	0.04	0.039	0.02	0.035	0.01	0.039	0.001	0.05	0.035	0.3 mg/L as Fe+
12	MPN count	2400	2400	2400	210	2400	0	2400	460	2400	120	0/100 ml
13	FC count	1100	240	1100	93	460	0	1100	93	2400	43	0/100 ml
14	E.coli	Present	Present	Present	Present	Present	0	Present	Present	Present	Present	0/1 ml

Table 5.13. Report on water quality analysis of drinking water in KG college campus

Legend:

F 4344- Main storage tank; F 4345-Tank-1:outlet; F4347-Tank-2: outlet; F4348- Tank: Library; F 4349-Tank 3:outlet; F 4350- Tank-4: Ashakiran; F 4351-Tank-4: outlet; F4352- Tank 5; F 4353- Tank 5: outlet.

It was alarming that high level of coliforms were observed in all the tested samples. This may be due to the lack of periodic cleaning of sources and tanks. Cleaning the source and repetitive chlorination of the water resource and storage tanks fetched good results. Currently the water is pure and safe.

There is no purification or filtration system as of now, hence a centralised filter unit with UV filters is recommended. This shall be implemented before the next surveillance audit. Periodic cleaning and maintenance is done. According to system personal cleaning of tanks is twice a year. Quality analysis of the water shall be made once in six month period.

There is no quality related issues are reported in the college so far. However, more strictness should be given n the imposition of maintenance protocol.

5.5. CONCLUSIONS

- College has good and quality water infrastructure. However, regulatory and monitoring mechanism is poor. Besides, there are no infrastructural provisions for water conservation.
- College has a single source of water- an open well. The water from the well is pumped to a main storage tank of capacity of 18000L. There are 12 sub tanks.
- College has a rain water harvesting tank of 3,00,000 L capacity. But its optimum use is not yet begun.
- The analysis of water flow meter data shows that a total of 13,9,14,678.3 L, is used in the college in an year.
- The water foot print for the college is calculated as 71.86 per capita.
- The current water quality test revealed that all samples are contaminated with coliforms. It has been rectified by proper cleaning and disinfection.
- Currently college has no major water conservation programmes. IEC campaign is also weak.

5.6. RECOMMENDATIONS

- Regular monitoring and control over water consumption in all sectors should be implemented. More water flow meters, regular data collection, sensitization on college community on water conservation etc. are essential.
- A centralised water filter shall be fitted. This will enable to tackle water quality issues. A person must be entrusted with the duty of pumping and maintenance of water filter.
- Rain water harvesting tank must be purified and get in optimum use. More such structures should be implemented.
- The proposed water conservation plan should be implemented in a fixed time line. The water conservation practices shall be habituated among the college community through these steps.

5.7. WATER EFFICIENCY MANAGEMENT PLAN

The college's Water Efficiency Management Plan encompasses various strategies to promote sustainable water use campus-wide. This includes installing water-efficient fixtures like low-flow faucets and toilets in all buildings and implementing a comprehensive irrigation schedule utilizing smart technologies and drought-resistant landscaping to minimize outdoor water consumption. Additionally, rainwater harvesting systems will be introduced to collect and reuse rainwater for non-potable purposes such as landscape irrigation. Regular water audits will be conducted to evaluate consumption patterns and identify areas for improvement. Awareness campaigns will also be launched to educate the college community about water conservation practices and promote responsible water usage. Collaboration with local water authorities and communities will be emphasized to foster collective efforts in promoting water sustainability. Overall, this plan reflects the college's dedication to environmental stewardship by aiming to reduce water consumption, lower operational costs, and create a resilient, water-efficient campus.

5.7.1. Policy and Approval

- Form a task force comprising representatives from higher education institutions, government agencies, experts in water management, and stakeholders.
- Draft the water management policy considering

inputs from all stakeholders, local water regulations, and best practices.
- Seek approval from relevant authorities and governing bodies.

5.7.2. Baseline Assessment and Planning
- Conduct a comprehensive assessment of water usage in all higher education institutions, including consumption patterns, sources of water, infrastructure, and current conservation efforts.
- Identify key areas for improvement and set specific targets for water conservation.

5.7.3. Infrastructure update and retrofits
- Allocate funds for upgrading infrastructure to improve water efficiency, such as installing water-saving fixtures, repairing leaks, and implementing rainwater harvesting systems.
- Prioritize infrastructure upgrades based on the assessment findings and available resources.

5.7.4. Education and Awareness
- Develop educational materials and conduct awareness campaigns to promote water conservation among students, faculty, and staff.
- Organize workshops, seminars, and training sessions on water-saving practices and the importance of conservation.
- Incorporate water management topics into the curriculum of relevant disciplines.

5.7.5. Conservation Measure
- Implement measures to reduce water consumption, involve installing water-efficient fixtures, promoting water-saving practices such as rainwater harvesting, and encouraging the use of recycled water for non-potable purposes.

5.7.6. Monitoring and Reporting Mechanism
- Establish a system for monitoring water usage in higher education institutions, including installing water meters and collecting data on consumption.
- Set up a reporting mechanism to track progress towards conservation goals and identify areas needing improvement.

5.7.7. Capacity Building
- Provide training and capacity-building programs for maintenance staff, facility managers, and other personnel responsible for water management.
- Equip staff with the knowledge and skills necessary to operate and maintain water-efficient systems and technologies effectively.

5.7.8. Research and Innovation
- Encourage research and innovation in water management technologies and practices through grants, scholarships, and collaborative projects.
- Support interdisciplinary research initiatives focused on addressing water-related challenges

5.7.9. Regulatory Compliance
- Ensure compliance with local water regulations and standards by developing guidelines and protocols for water management in higher education institutions.
- Provide training and support to ensure that institutions understand and adhere to regulatory requirements.

5.7.10. Emergency Preparedness
- Develop contingency plans for dealing with water shortages, droughts, and other water-related emergencies.
- Establish protocols for water rationing, emergency water storage, and coordination with local authorities during crises.

5.7.11. Long-term Sustainability
- Emphasize the long-term sustainability of water resources
- Encourage the adoption of holistic approaches to water management that take into account environmental, social, and economic factors.

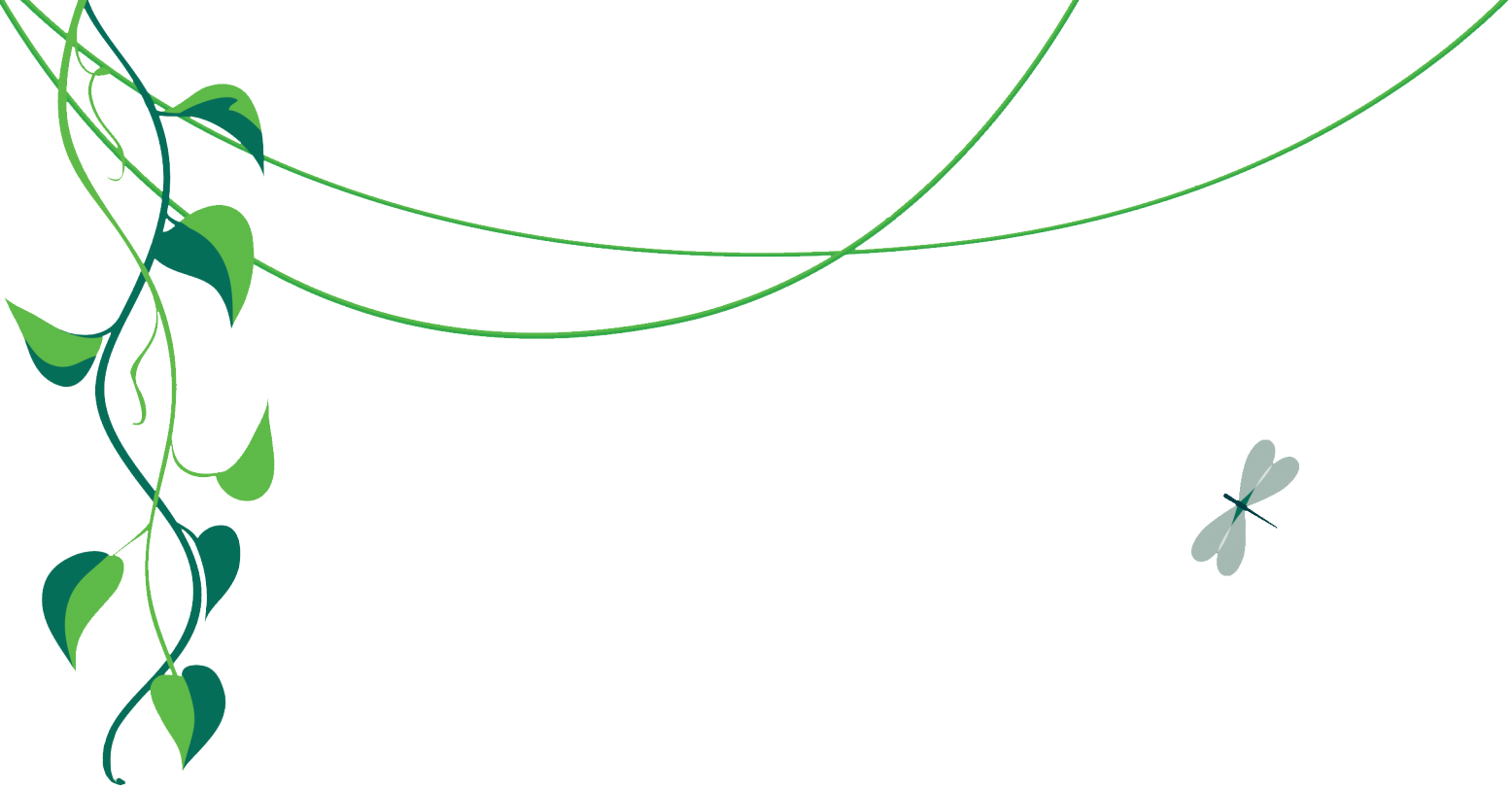
5.7.12. Evaluation and continuous improvement
- Regularly evaluate the effectiveness of the water management policy and implementation strategies.
- Solicit feedback from stakeholders and adjust the policy as needed to improve outcomes.
- •Celebrate successes and recognize institutions that demonstrate exemplary water conservation efforts.

5.8. ACTIVITIES CONDUCTED

By Water Management Committee

5.8.1. Awareness class on water conservation

The K G College Pampady Green Audit, Water Audit Team arranged an insightful awareness event to raise awareness about sustainable practices and water conservation. The program's goal was to raise awareness among college students of the value of water conservation for their long-term health. The awareness program was held in the D3 Chemistry class on January 29, 2024. Attendees at the event included staff, educators, and students who were passionate about the importance of water conservation. At 2:00 pm, the event began with an introductory ceremony that featured a welcome speech by the head of the Water Audit Team. The importance of water conservation and practices of using water efficiently to reduce unnecessary water usage was emphasized. A faculty member of our college Mr. Anoop K R delivered an insightful lecture on the significance of water conservation. The talk covered various aspects, including need and various methods of water conservation and management. Feedback collected from participants indicated a positive response to the program. Attendees expressed a heightened awareness of the importance of water conservation for human well- being. The program succeeded in fostering a sense of responsibility towards water conservation and sustainable living.



Thousands have lived without love,
not one without water.

- H Auden

Chapter VI

CAMPUS BIODIVERSITY REGISTER (CBR)

BIODIVERSITY MANAGEMENT COMMITTEE
(BMC 2023-24)

Ms. Libi Thampi
Govt. Guest Lecturer

Ms. Remina M Shajahan
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Meenu Manoj
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6

Biodiversity Audit Report

6.1. INTRODUCTION

The conservation and maintenance of biodiversity is a vital aspect of sustainable development. Emerging importance of biodiversity in educational institution are essential for the integration of academic learning with sustainable development goals (SDG). It provides valuable learning opportunities by allowing students to observe and study diverse ecosystems, fostering a deeper understanding of the natural world.

Biodiversity also supports educational research, helping students to explore ecological relationships and contribute to scientific knowledge, which will result in the germination of innovative practices. Moreover, it instilled a sense of environmental responsibility, emphasising the importance of preserving diverse species and ecosystems for the well-being of the planet. Overall, integrating biodiversity into educational settings enhances ecological awareness and promotes sustainable habits. Encouraging students to make knowledgeable decisions and take responsible activities for sustainable development is the goal of Education for sustainable development, or ESD. The sustainable development goals' cognitive, socio-emotional, and behavioural learning areas and competences include biodiversity. Therefore, biodiversity ought to play a major role in ESD. These days, biodiversity is incorporated, for example, into the science or biology curricula in schools; nevertheless, further study is needed to determine the efficacy and best practices of biodiversity education (BE), particularly as it relates to ESD.

Other issues with BE have also been highlighted by earlier research, which indicate that there is a disconnect between humans and the natural world, that the notion of biodiversity may be hard to understand, and that BE does not reach a wide range of individuals.

Biodiversity is a growing concern within the international community—the loss of different species of animals, plants, and micro-organisms is accelerating. Life on Earth depends on nature. Humans need the diversity of nature for important

services, such as food and water resources. Nature is also a source of economic opportunities. Protecting biodiversity is in everybody's interest because its loss could eventually lead to the: extinction of species; loss of genetic diversity; the global spread of common plants and animals, and major changes in the way the ecosystems—which are essential to humans (for example, pharmaceutical products, food, timber and purification of air and water)—function.

According to the international Convention on Biological Diversity (1992), biodiversity (or biological diversity) is the variability among living organisms from all sources including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species and of ecosystems.

Human activities are the main cause of biodiversity loss. As stated in the Millennium Ecosystem Assessment (MA) released in 2005 "Human activity is putting such strain on the natural functions of Earth that the ability of the planet's ecosystems to sustain future generations can no longer be taken for granted." Habitat fragmentation caused by urbanization and agriculture and the overexploitation of resources lead to depletion of species. Urbanised consumerist lifestyle, that led to the pollution of environment, overexploitation of biodiversity, loss of traditional sustainable agriculture, emergence of zoonotic diseases etc., is the major threat for biodiversity in Kerala.

As per the provisions of Biodiversity Act (2002), biodiversity can be perceived people centric, and preparation of Peoples Biodiversity Register (PBR) is suggested, including documentation of traditional knowledge of the community with regard to the local biodiversity. Besides, it records agro biodiversity (crops, landscapes, pests, weeds etc.), domesticated diversity (plants, animals, pets etc.), etc.

The present approach for preparation of Campus Biodiversity Register (CBR) is based on quantified data which recorded through field audit of the campus, by trained internal auditors.

6.1.1. What is Biodiversity Audit?

Because biodiversity is a broad and diverse subject area, selecting audits of biodiversity to conduct can be challenging for auditors. Once the topic has been selected, it can be difficult to know where to start, because there are many possible, scopes (for example, genetics, species, and ecosystems); threats (for example, habitat loss, pollution, and urbanization); and government responses (for example, international conventions, national parks, national laws of protection and environmental impact assessments). The scope of the biodiversity audit for a college/university campus is confined as follows:

- Preparation of campus biodiversity register including plants (trees, herbs, shrubs, grasses, crops, fruit trees etc.) and animals (butterflies, dragonflies & damselflies, birds etc.) and calculation of biodiversity indices (microbial diversity is excluded).
- Identification of threats and challenges of biodiversity conservation in the campus and analysis of current biodiversity conservation activities.
- Assessment of Biodiversity Indices for the campus and formulating biodiversity conservation plan (tree planting drives, introduction thematic gardens such as medicinal plants; bamboos; butterfly garden; seminars, workshops; visits etc.).
- ISO standards for Biodiversity audit are not yet finalised. However, directives for the same are available and it is incorporated in this schedule.

6.1.2. Why measuring Biodiversity?

- Degradation of habitats at alarming rate- urgent to estimate the current status before extinction
- Measures of biodiversity regarded as indicators of the well being of ecological systems
- Currently biodiversity is the central theme of ecology and development

- Varied tools and techniques are essential for measuring biodiversity in diverse habitats
- Mandatory- as a signatory of Convention on Biological Diversity (1992)

6.1.3. Need for biodiversity audit

The biodiversity audit looks at how well the college/ university campus provide habitat for wildlife (any animal or plant which are not nurtured by man). It also helps to aware and sensitise the college community on the importance and services provided by the biodiversity. The functions of the biodiversity audit are:

- college community is aware and sensitised on the campus biodiversity
- improved greenery and liveliness
- improved aesthetic beaty of the campus
- enhanced informal and formal education provisions in the campus (name tag on a tree is an example)
- better safeguard to public health and environment (good air, water, food etc.)
- an effective educational and public relations tool (e.g., exhibition of thematic gardens)
- community education and community feedback (e.g., traditional knowledge regarding plants or animals

6.2. BIODIVERSITY CONSERVATION POLICY

The Biodiversity Conservation Policy of Kuriakose Gregorios College, Pampady, underscores our dedication to preserving and enriching the ecological diversity of our campus in Kerala. Focused on conserving native species, restoring habitats, and promoting sustainable land management, the policy strives to cultivate a campus atmosphere that nurtures biodiversity awareness and conscientious stewardship. Through curriculum integration and awareness campaigns, it aims to educate and involve the campus community in conservation endeavours. Waste reduction, water conservation, and the establishment of green infrastructure are central elements, emphasizing a comprehensive approach. Collaboration with local stakeholders, regular biodiversity assessments, and support for research initiatives highlight our commitment to staying informed and improving our practices. By adhering to principles of environmental sustainability and responsible campus growth, Kuriakose Gregorios College, Pampady, endeavours to make a significant contribution to regional and national biodiversity conservation efforts.

6.2.1. Introduction

At Kuriakose Gregorios, we recognize the importance of preserving and promoting biodiversity within our campus environment. This Biodiversity Audit Management Policy serves as a framework to guide our efforts in assessing, conserving, and enhancing the rich array of flora and fauna present on our premises.

6.2.2. Objectives

- To conduct regular audits to assess the biodiversity within the campus.
- To identify and protect endangered or threatened species.
- To promote environmental awareness and education among the campus community through academic projects and programmes
- To enhance green spaces and habitats for wildlife.
- To integrate biodiversity conservation into research, campus planning and development.

6.2.3. Responsibilities

- The Biodiversity Committee: Responsible for overseeing the implementation of biodiversity audits, developing conservation strategies, and coordinating educational initiatives.
- Facilities Management: Ensure compliance with biodiversity conservation measures during campus construction and maintenance activities.
- Academic Departments: Integrate biodiversity conservation into relevant curricula and research activities.
- Students and Staff: Actively participate in biodiversity conservation efforts and support educational initiatives.

6.2.4. Biodiversity Audit Process

- Conduct regular biodiversity audits to assess the abundance and distribution of flora and fauna across campus.
- Document species diversity and population trends using standardized methods.
- Identify and prioritize areas for conservation and habitat restoration based on audit findings.

6.2.5. Conservation Measures

- Implement habitat restoration projects to enhance biodiversity hotspots.
- Establish protected areas and wildlife corridors to safeguard critical habitats.
- Monitor and manage invasive species to minimize their impact on native biodiversity.
- Promote sustainable landscaping practices to support native flora and fauna.

6.2.6. Education and Outreach

- Organize workshops, seminars, and educational campaigns to raise awareness about biodiversity conservation.
- Engage students and staff in citizen science initiatives, such as species monitoring and habitat restoration.
- Foster partnerships with local communities and conservation organizations to expand conservation efforts beyond campus boundaries.

6.2.7. Research and conservation

- Conducting minor and major research projects on campus biodiversity, its changing pattern, threats and challenges.
- Assisting local community and local bodies in order to prepare PBRs.
- Conducting filed surveys in local and neighbouring locations and preparation of checklist of flora and fauna.
- To document traditional knowledge related to biodiversity among the local community.

6.2.8. Reporting and Evaluation

- Prepare annual reports on biodiversity audit findings, conservation activities, and educational initiatives.
- Regularly evaluate the effectiveness of biodiversity conservation measures and update the policy accordingly.
- Solicit feedback from stakeholders to improve biodiversity management practices.

6.2.9. Compliance and Review

- Ensure compliance with relevant environmental regulations and guidelines.
- Conduct periodic reviews of the Biodiversity Audit Management Policy to incorporate new scientific findings and best practices.

6.2.10. Conclusion

At Kuriakose Gregorios, we are committed to preserving and enhancing the biodiversity of our campus environment. Through collaborative efforts and proactive conservation measures, we strive to create a sustainable ecosystem that benefits present and future generations.

6.3.METHODOLOGY

Biodiversity conservation stands as a crucial measure in safeguarding the environment. The college has set forth sustainable goals aimed at steadfastly preserving biodiversity. These objectives are cantered on instilling a culture of sustainability within the campus, gradually disseminating the concept of nature conservation from students to their families and throughout society. To fulfil this mission, the college has established a biodiversity audit group comprising twelve members, including ten students and two faculty members, tasked with coordinating internal auditing efforts. The group has taken the initiative to organize various programs focused on green initiatives and raising awareness among students. They execute these programs and assess progress through periodic meetings, which are consistently monitored and documented by assigned students and faculty members.

- To conduct an assessment of campus biodiversity, team members have recorded the taxonomical data on herbs, plants, trees, butterflies, insects, and other common organisms. The following data documented:
- Checklist of selected major flora and fauna through repetitive field survey (random sampling- spot survey; transect walk survey).
- Biodiversity indices (Simpson index) for major floral and faunal species through quadrat sampling (e. g., butterflies, grasses etc.) and transects (e.g. : birds, trees etc.)
- Identifying the threats, challenges and developing solutions or management plan for the biodiversity of the college- utilising the data collected and secondary sources.

Simpson's Diversity Index is a measure of diversity which takes into account the number of species present, as well as the relative abundance of each species. As species richness and evenness increase, so diversity increases.

$$D = \frac{N(N-1)}{\sum n(n-1)}$$

n - the total number of organisms of a particular species

N - the total number of organisms of all species

The value of D ranges between 0 and 1. With this index, 1 represents infinite diversity and 0, no diversity.

6.3.1. Assumption of Biodiversity audit ISO standards

Biodiversity is currently undergoing an unprecedented decline, a trend that directly impacts ecosystems, the natural world, and human lives. This loss of biodiversity, encompassing animals, plants, and microorganisms, is exacerbated by the escalating demand for biological resources driven by population growth and increased consumption. It is imperative that people worldwide recognize the significance of ecosystems and the invaluable benefits provided by biodiversity.

Life on Earth relies heavily on the diversity found in nature, which is essential for vital services such as food and water sources. Moreover, nature serves as a significant source of economic opportunity. Protecting biodiversity is a shared responsibility, as humans derive numerous essential goods and services from ecosystems, ranging from seafood and game to medicines and wood. Ecosystem services, including air and water purification, nutrient cycling, and pollination, are indispensable for sustaining life on Earth and maintaining a healthy environment.

Recognizing the critical need to address biodiversity loss, the Biodiversity Areas Standard was developed to establish clear, measurable, and realistic environmental sustainability criteria for integrating biodiversity conservation into human-made landscapes. This standard promotes best practices that result in the creation of healthy, cost-effective environments and self-sustaining ecosystem services. By implementing this standard, significant reductions in land use can be achieved, thereby mitigating the impact on ecosystems. Additionally, the program aligns with global conservation goals by addressing the catastrophic decline in biodiversity caused by habitat destruction and carbon emissions.

Given the vital role that cities and surrounding areas play in biodiversity conservation, it is imperative to prioritize the protection and regeneration of ecological capital. Integrating biomes, the fundamental components of planetary self-sufficiency, into every aspect of land use is essential for fostering a green and sustainable planet. Through concerted efforts and a commitment to biodiversity conservation, societies can contribute to the preservation and restoration of ecosystems, ensuring a harmonious coexistence between human activities and the natural environment.

6.3.2. Stages of biodiversity audit

Biodiversity audit has the following three phases:

6.3.2.1. Pre audit phase

- Formation of audit team; scheduling audit programmes
- Setting up of scope and objectives (in tune with biodiversity conservation policy of the institution)
- Assigning each and every area of the campus (excluding interior of buildings) for specific groups of auditors

This phase includes following specific activities:

- Preliminary observations will be made by each group in their assigned area for visible organisms including plants and animals (selected fauna and flora only- see scope/objectives)
- Scheduling the sampling dates for quadrat/transect study.
- Preparing data entry sheets and field equipment, devices or instruments (e g., binoculars; GPS device, identification field guides etc.)

6.3.2.2. Audit phase

The following data will be recorded. Photographs of the audit process and the observations also will be taken as much as possible in order to include in the report.

- Quadrat study for grasses, herbs, shrubs etc. All the trees will be identified and counted.
- Quadrat sampling: Sampling plots with identical measurements are laid in the study area in a random or systematic manner. The target species is searched on foot or from any vehicle within these plots. Quadrats can be of various shapes. Most common are square or rectangular. Circular quadrats are also useful since they have minimum bias related to the 'edge effect' i.e., whether a specimen is inside or outside a quadrat. The optimum number of quadrats necessary to sample a population is decided based on the rarefaction curve, which reaches a plateau if enough samplings are done. Quadrat sampling is widely used to sample vegetation.
- Transect study for butterflies, birds, dragonflies and damselflies of the campus.

Line transect: In this method the observer searches for the focal organisms along straight lines or transect lines either selected randomly or laid in a systematic manner for repeated surveys. For the observations which are not on the transect line, the perpendicular distance is measured. Line transect method is useful in calculating population density when it follows the assumptions that a) No specimen on the transect line is missed, b) specimens do not move before they are sighted; in case of movement, the first detection is considered; utmost care is taken to avoid replicative observation, c) the sighting angle and the exact distance of any sighting away from the transect line, is calculated, d) each sighting is independent. For birds, mammals etc. this is a good method.

- Sign count: In case of animals, which are hard to detect, signs like fecal matter, movement tracks, scratch marks are considered. Other signs include nests or burrows.
- Point count method for birds/butterflies/dragoflies: In this method the observer stands at a specific point and counts the specimens within the circle of a certain radius. Usually the radius is determined based on the maximum distance, which can be sampled by the observer. While conducting many point count samplings in an area, the radius 64 for all should be the same to compare the data. Point count is widely used to sample bird populations. The numbers of birds seen or heard within a circle are recorded in this method.

6.3.2.3. Post audit phase

- Analysis of data: species list of fauna and flora in the campus; calculation of Simpson index for the biodiversity of the campus
- Biodiversity conservation action plan preparation (awareness and sensitisation programmes; display boards; tree naming project; planting drives; promotion of native wild and medicinal plants etc.)

6.3.3. Principles of Biodiversity Field estimation techniques

Biodiversity estimation in the field is measuring, on the basis of three parameters:

- Species richness- No. of species: A systematic inventory of the number of species found in an area/ sample. Richness tends to increase over area. It is a measure used to find out rapid impact on the biodiversity.
- Abundance: Total number of individuals of each species in a sample/area. Represents numerical strength of each species in a community. Described as the number of individuals per sample unit (quadrate/ transect). It can be represented as biomass or percent ground cover (for terrestrial plants). Relative species abundance- represents how common or rare species is relative to other species in a given location.
- Species evenness: Defined as the relative abundance with which each species is represented in an area. When all species are equally abundant, such an ecosystem has high evenness. If some species are

more abundant in an ecosystem, it has less evenness. Primarily depicts the distribution of a species in an area. Represents the relative contribution of each species to the total biomass or functioning of the ecosystems.

- Biodiversity indices: A mathematical measure of species diversity in a community- a composite value. They account species richness, abundance and evenness in varied degrees. It also provides information about the rarity and commonness of species in a community. An important tool to understand community structure.
- Simpson Index D: This is an intuitively simple, appealing biodiversity index. It is the probability that two consecutive samples drawn from the same population will be different species. It involves sampling individuals from a population one at a time.

6.3.4. Final audit by external audit team

- Field verification of Biodiversity register
- Action plan –long tern and short term (biodiversity enhancement programmes; awareness campaigns etc.)
- Final report & certification

WEEK	WEEK DAYS	GROUP AND SAMPLING METHOD	ZONE
Schedule 12.11.2023 to 13.12.2023	12/11/2023	Group 1 – Quadrant	Zone - 1
		Group 2 – Quadrant	Zone – 3
		Group 3 – Quadrant	Zone – 5
		Group 4 – Quadrant	Zone – 7
		Group 5 – Quadrant	Zone – 9
		Group 6 – Quadrant	Zone – 11
		Group 7 – Quadrant	Zone - 13
		Group 8 – Quadrant	Zone - 15
	12/11/2023	Group 1 – Transect	Zone - 1
		Group 2 – Transect	Zone – 3
		Group 3 – Transect	Zone – 5
		Group 4 – Transect	Zone – 7
		Group 5 – Transect	Zone – 9
		Group 6 – Transect	Zone – 11
		Group 7 – Transect	Zone - 13
		Group 8 – Transect	Zone - 15
	14/11/2023	Group 1 – Quadrant	Zone – 2
		Group 2 – Quadrant	Zone – 4
		Group 3 – Quadrant	Zone – 6
		Group 4 – Quadrant	Zone – 8
		Group 5 – Quadrant	Zone – 10
		Group 6 – Quadrant	Zone – 12
		Group 7 – Quadrant	Zone – 14
		Group 8 – Quadrant	Zone - 16
	12/12/2023	Group 1 – Transect	Zone – 2
		Group 2 – Transect	Zone – 4
		Group 3 – Transect	Zone – 6
		Group 4 – Transect	Zone – 8
		Group 5 – Transect	Zone – 10
		Group 6 – Transect	Zone – 12
		Group 7 – Transect	Zone - 13
		Group 8 – Transect	Zone - 15
	13/12/2023	Calculation of the Sampling by using Simpson's Biodiversity Index	

Table 6.1. Schedule of the biodiversity audit

6.4. CHECK LIST OF SELECTED FAUNA AND FLORA

6.4.1. Checklist of Birds of K.G.College campus

No.	ENGLISH NAME	SCIENTIFIC NAME	MALAYALAM NAME	DENSITY OBSERVED
1	BLACK DRONGO	*Dicrurus macrocercus*	ആനറാഞ്ചി പക്ഷി	8
2	BLACK RUMPED FLAMEBACK	*Dinopium benghalense*	നാട്ടുമരംകൊത്തി	2
3	BLUE TAILED BEE EATER	*Merops philippinus*	വേലിത്തത്ത	21
4	BRAHMINY KITE	*Haliastur indus*	കൃഷ്ണപ്പരുന്ത്	3
5	CATTLE EGRET	*Bubulcus ibis*	കാലിമുണ്ടി	4
6	COMMON MYNA	*Acridotheres tristis*	നാട്ടുമൈന	134
7	COMMON TAILER BIRD	*Orthotomus sutorius*	തുന്നാരൻ	2
8	BLACK HOODED ORIOLE	*Oriolus xanthornus*	മഞ്ഞക്കിളി	2
9	GREATER COUCAL	*Centropus sinensis*	ചെമ്പോത്ത്	2
10	HOUSE CROW	*Corvus splendens*	പേനകാക്ക	617
11	JUNGLE BABBLER	*Turdoides striata*	കരിയിലക്കിളി	60
12	LARGE BILLED CROW	*Corvus macrorhynchos*	ബലികാക്ക	17
13	ASIAN KOEL	*eudynamys scolopaceus*	കുയിൽ	15
14	LOTENS SUNBIRD	*Cinnyris lotenius*	കൊക്കൻ തേൻകിളി	3
15	MAGPIE ROBIN	*Copsychus saularis*	മണ്ണാത്തിപ്പുള്ള്	29
16	REDWISCKERD BULBUL	*Pycnonotus jocosus*	ഇരട്ടത്തലച്ചി	2
17	ROCK PIGEON	*Columba livia*	മാടപ്രാവ്	101
18	ROSE RINGED PARAKEET	*Psittacula krameri*	മോതിരത്തത്ത	1
19	WHITE CHEEKED BARBET	*Psilopogon viridis*	ചിന്നകുട്ടുറുവൻ	41
20	WHITE THROTED KINGFISHER	*Halcyon smyrnesis*	മീൻകൊത്തിച്ചാത്തൻ	1
21	ROUFUS TREE PIE	*Dendrocitta vagabunda*	ഓലേഞ്ഞാലി	8
22	GREATER RACKET TAILED DRONGO	*Dicrurus paradiseus*	ഇരട്ടവാലൻ	9
23	PALE BILLED FLOWER PECKER	*Dicaeum erythrorynchos*	ഇത്തിക്കണ്ണികുരുവി	2
24	COMMON HAWK CUCKOO	*Hierococcyx varius*	പേക്കുയിൽ	1
25	JUNGLE OWLET	*Glaucidium radiatum*	ചെമ്പൻ നത്ത്	1
26	SHIKRA	*Accipiter badius*	പുള്ള്	1
27	RED WATTLED LAPWING	*Vanellus indicus*	ചെങ്കണ്ണി തിത്തിരി	1

Table 6.2. Checklist of Birds of K.G.College campus

Jungle babbler

Lotens sunbird

Magpie robin

Indian Pond Heron

Red Vented Bulbul

Rock Pigeon

White-cheeked barbet

Red Wattled lapwing

Greater coucal

White- throated kingfisher

Rose-ringed parakeet

Black drongo

Asian Koel

Brahmin Kite

White breasted Waterhen

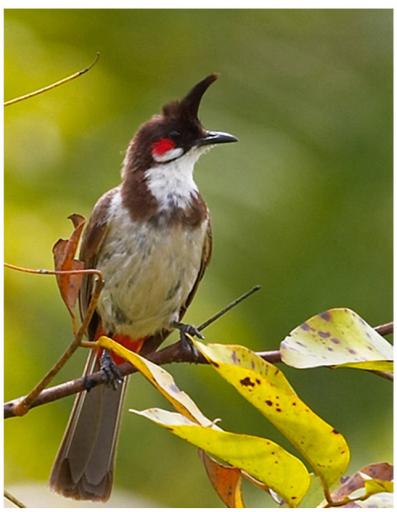
Cattle Egret

Myna

Tailor bird

Black Rumped Flameback

Blackhooded oriole



Red whiskered bulbul

6.4.2. Checklist of Odonates of K.G.College campus

No.	COMMON NAME	SCIENTIFIC NAME	MALAYALAM NAME	DENSITY
1	TRUMPET TAIL	*Acisoma panorpoides*	മകുടി വാലൻ	2
2	SCARLET MARSH HAWK	*Aethriamanta brevipennis*	ചോപ്പൻ കുറുവാലൻ	4
3	GRANITE GHOST	*Bradinopyga geminata*	മതിൽത്തുമ്പി	1
4	GROUND SKIMMER	*Diplacodes trivialis*	നാട്ടുനിലത്തൻ	1
5	PIED PADDY SKIMMER	*Neurothemis tullia*	സ്വാമിത്തുമ്പി	4
6	BROWN-BACKED RED MARSH	*Orthetrum chrysis*	ചെന്തവിടൻ വ്യാളി	1
7	GREEN MARSH HAWK	*Orthetrum sabina*	പച്ച വ്യാളി	1
8	WANDERING GLIDER	*Pantala flavescens*	തുലാത്തുമ്പി	8
9	COMMON PICTUREWING	*Rhyothemis variegata*	ഓണത്തുമ്പി	3
10	PYGMY DARTLET	*Agriocnemis pygmaea*	നാട്ടുപുൽ ചിന്നൻ	1
11	ORANGE-TAILED MARSH DART	*Ceriagrion cerinorubellum*	കനൽവാലൻ ചതുപ്പൻ	1
12	COROMANDEL MARSH DART	*Ceriagrion coromandelianum*	നാട്ടുചതുപ്പൻ	1
13	BLUE GRASS DART	*Pseudagrion microcephalum*	നാട്ടുപൂത്താലി	2

Table 6.3. Checklist of dragon flies and damselflies of K.G.college campus

Ceriagrion cerinorubellum

Acisoma panorpoides

Diplocodes trivialis

Neurothemis tullia male

Orthetrum sabina

Neurothemis tullia

Aethriamanta brevipennis

Rhyothemis varigata

Copera vittata

Pseudagrion microcephalum

Ceriagrion coromandelianum

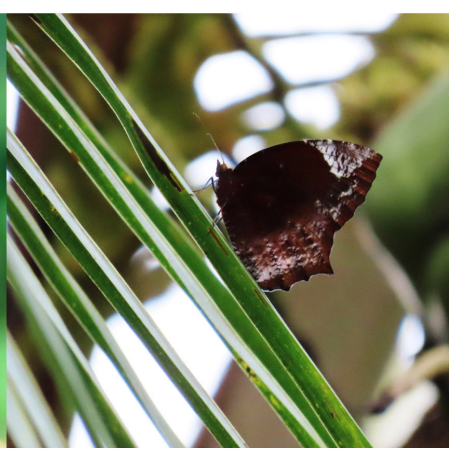
6.4.3. Checklist of Butterflies of K.G.College campus

No	ENGLISH NAME	SCIENTIFIC NAME	MALAYALAM NAME	DENSITY
1	BLUE MORMON	*Papilio polymnestor*	കൃഷ്ണശലഭം	2
2	BLUE TIGER	*Tirumala limniace*	നീലക്കടുവ	84
3	CHOCOLATE PANSY	*Junonia iphita*	കരിയില ശലഭം	3
4	COMMON BLUE BOTTLE	*Graphium teredon*	നീലകുടുക്ക	1
5	COMMON BUSHBROWN	*Mycalesis perseus*	തവിടൻ	3
6	COMMON CASTOR	*Ariadne merione*	ആവണചോഷൻ	1
7	COMMON CROW	*Euploea core*	അരളി ശലഭം	21
8	COMMON EMIGRENT	*Catopsilia pomona*	മഞ്ഞതകരമുത്തി	6
9	COMMON FOUR-RING	*Ypthima huebneri*	നാല്ക്കണ്ണി	8
10	COMMON GRASS YELLOW	*Eurema hecabe*	മഞ്ഞപാപ്പത്തി	8
11	COMMON JEZEBEL	*Delias eucharis*	വിലാസിനി	1
12	COMMON MIME	*Papilio clytia*	വഴനപൂമ്പാറ്റ	2
13	COMMON MORMON	*Papilio polytes*	നരകക്കാളി	3
14	COMMON ROSE	*Pachliopta aristolochiae*	നാട്ടു റോസ്	7
15	CRIMSON ROSE	*Pachliopta hector*	ചക്കരശലഭം	1
16	GREAT EGG FLY	*Hypolimnas bolina*	വൻചോട്ടശലഭം	1
17	GREY PANSY	*Junonia atlites*	വയൽക്കോത	6
18	MOTTLED EMIGRANT	*Catopsilia pyranthe*	തകരമുത്തി	12
19	PLAIN TIGER	*Danaus chrysippus*	എരുക്കുത്തപി	2
20	PSYCHE	*Leptosia nina*	പൊട്ടുവെള്ളാട്ടി	12
21	SOUTHERN BIRDWING	*Troides minos*	ഗരുഡ ശലഭം	1
22	STRIPED TIGER	*Danaus genutia*	വരയൻ കടുവ	6
23	TAWNY COASTER	*Acraea terpsicore*	തീച്ചിറക്കൻ	2
24	COMMON CERULEAN	*Jamides celeno*	പൊട്ടുവാലാട്ടി	4
25	RED PIERROT	*Talicada nyseus*	ചെങ്കോമാളി	2
26	COMMON PALMFLY	*Elymnias hypermnestra*	ഓലകൺൻ	1

Table 6.4. Checklist of butterflies of K.G.college campus

Psyche

Red pierrot



Palm fly

Blue tiger

Common bushbrown

Common cerulean

Great eggfly

Tawny coster

Striped tiger

6.4.4. Checklist of other common fauna of K.G.College campus

A random survey was conducted to find out the other common fauna of the campus. Accidental sightings also included.

SI. NO.	SCIENTIFIC NAME	COMMON NAME	NUMBER
1	*Lasius niger*	BLACK GARDEN ANT	32
2	*Gesonia obeditalis*	OWL MOTH	1
3	*Gomophocerippus rufus*	RUFUS GRASSHOPER	5
4	*Megalocaria dilatata*	LADY BUG	1
5	*Oecophylla smaragdina*	ASIAN WEAVER ANT	15
6	*Componotus irritans*	GAINT HONEY ANT	28
7	*Anoplodesmus anthracinus*	ANOPLODESMUS	1
8	*Argiope pulchella*	GARDEN CROSS SPIDER	1
9	*Cyrtophora cicatrosa*	DOME SPIDER	1
10	*Oxyopes hindostanicus*	LYNX SPIDER	1
11	*Spinotarsus colosseus*	MILLIPEDE	1
12	*Chrysso angula*	COBWEB SPIDER	1
13	*Coenocephalous melaenus*	BLACK KNEED CONEHEAD	1
14	*Leptocorisa acuta*	RICE SEED BUG	1
15	*Odontomantis planiceps*	ASIAN ANT MANTIS	1
16	*Hersilia savignyi*	TWO TAILED SPIDER	2
17	*Oxyopes birmanicus*	BURMESE LYNX SPIDER	2
18	*Heteropoda venatoria*	GAINT CRAB SPIDER	1
19	*Argiope aemula*	SIGNATURE SPIDER	1
20	*Musca domestica*	HOUSE FLY	30
21	*Diacamma assamense*	GREATER STRIATED BISPINOUS ANT	2
22	*Anoplolepis gracilipes*	YELLLOW CRAZY ANT	40
23	*Apis cerana indica*	HONEYBEE	12
24	*Myrmicaria brunnea*	COMMON HUNCHBACK	50
25	*Vespa orientalis*	ORIENTAL HORNET	1
26	*Funambulus palmarum*	INDIAN PALM SQUIRREL	4
27	*Pteropusgiganteus*	INDIAN FLYING FOX	4
28	*Urva edwardsii*	INDIAN GREY MANGOOSE	1
29	*Varanus bengalensis*	BENGAL MONITOR	1
30	*Ptyas mucosa*	INDIAN RAT SNAKE	1
34	*Lycodon aulicus*	COMMON WOLF SNAKE	1
35	*Hemidactylus frenatus*	COMMON HOUSE LIZARD	4
36	*Calotes versicolor*	ORIENTAL GARDEN LIZARD	2

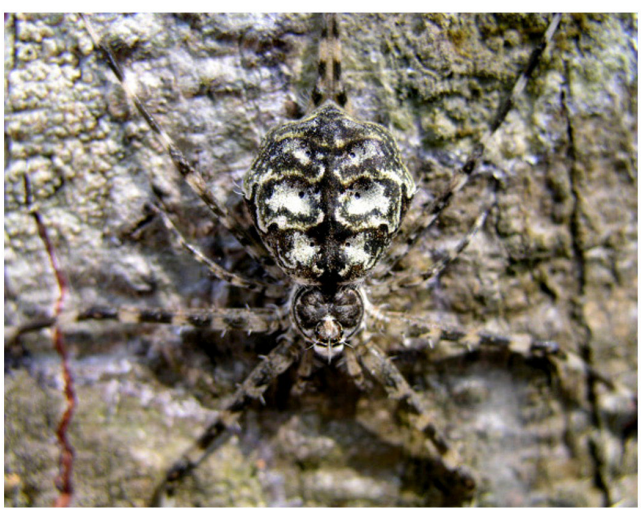
Table 6.5. Checklist of insects (other than odonates, butterflies etc.) of K.G.college campus

Heteropoda venatoria

Argiope pulchella

Cyrtophora cicatrossa

Oxyopes birmanicus



Hersilia savignyi

Oecophylla smaragdina

6.4.5. Checklist of trees of K.G.College campus

SI. NO.	SCIENTIFIC NAME	MALAYTALAM NAME	COMMON NAME	NUMBER
1	*Acacia auriculiformis*	അക്കേഷ്യ	EARPOD WATTLE	1
2	*Annona squamosa*	ആത്ത	SUGER APPLE	1
3	*Annona reticulata*	ആത്തച്ചക്ക	CUSTARD APPLE	2
4	*Araucaria heterophylla*	ക്രിസ്തുമസ് ട്രീ	ARAUCARIA	4
5	*Artocarpus heterophyllus*	പ്ലാവ്	JACK FRUIT TREE	5
6	*Artocarpus hirsutus*	ആഞ്ഞിലി	WILD JACK FRUIT TREE	5
7	*Averrhoa bilimbi*	ഇരുമ്പൻപുളി	BILIMBI	1
8	*Azadirachta indica*	ആര്യവേപ്പ്	NEEM	2
9	*Bambusa ventricosa*	ബുദ്ധമുള	BUDHA BELLY BAMBOO	1
10	*Bridelia retusa*	മുള്ളുവേങ്ങ	SPINOUS KINO TREE	1
11	*Cananga odorata*	കനകമരം	CANANGA	1
12	*Caryota urens*	ചൂൺപ്പന	FISHTAIL PALM	1
13	*Casuarina equisetifolia*	ചൂളമരം	COAST SHE OAK	4
14	*Cocos nucifera*	തെങ്ങ്	COCONUT TREE	7
15	*Cyrtostachys renda*	അലങ്കാര പന	RED PALM	1
16	*Delonix regia*	പൂമരം	GULMOHAR	1
17	*Ficus auriculata*	വലിയ അത്തി	ELEPHANT EAR FIG TREE	1
18	*Ficus benjamina*	വെള്ളാൽ	WEEPING FIG	2
19	*Flacourtia inermis*	ലൂവി	LUVI	1
20	*Leucaena leucocephala*	സുബാബോൾ	SUBABOL	3
21	*Mangifera indica*	മാവ്	MANGO TREE	28
22	*Manilkara zapota*	സപ്പോട്ട	SAPOTTA	1
23	*Moringa citrifolia*	നോനി	INDIAN MULBERRY	1
24	*Nephelium lappaceum*	മുള്ളൻ പഴം	RAMBUTAN	2
25	*Peltophorum pterocarpum*	മഞ്ഞവാക	COPPER-POD	2
26	*Phyllanthus emblica*	നെല്ലി	INDIAN GOOSEBERRY	1
27	*Pongamia pinnata*	ഉങ്ങ്	INDIAN BEECH	2
28	*Psidium guajava*	പേര	GUAVA	4
29	*Pterocarpus santalinus*	രക്തചന്ദനം	RED SANDAL	1
30	*Simarouba glauca*	ലക്ഷ്മി തരു	PARADISE TREE	1
31	*Strychnos nux-vomica*	കാഞ്ഞിരം	POISON NUT	1
32	*Swietenia mahagoni*	മഹാഗണി	MAHOGANY	9
33	*Syzygium cumini*	ഞാവൽ	BLACK PLUM	5
34	*Syzygium samarangense*	വലിയ ചാമ്പ	JAVA APPLE	1
35	*Tamarindus indica*	വാളൻ പുളി	TAMARIND	2
36	*Terminalia arjuna*	നീർമരുത്	ARJUN TREE	5
37	*Terminalia catappa*	ഇന്ത്യൻ ബദാം	TROPICAL ALMOND	6

38	*Litchi chinensis*	ലിച്ചി	LITCHI	
39	*Areca montana*	അലങ്കാരപ്പന	ORNAMENTAL PALM	1
40	*Bambusa guangxiensis*	അലങ്കാര മുള	ORNAMENTAL BAMBOO	2
41	*Carica papaya*	പപ്പായ	PAPPAYA	2
42	*Cycas revoluta*	ഈന്ത്	CYCAS	1
43	*Thuja occidentalis*	തുജ	THUJA	1
44	*Vitex negundo*	കരിനൊച്ചി	CHINESE CAST TREE	1

Table 6.6. Checklist of trees of K.G.college campus

Cananga odorata

Peltophorum pterocarpum

6.4.6. Checklist of herbs of K.G.College campus

SI. NO.	SCIENTIFIC NAME	MALAYALAM NAME	COMMON NAME	DENSITY
1	*Acalypha indica*	കുപ്പമണി	INDIAN ACALYPHA	4
2	*Andrographis paniculata*	കിരിയാത്ത്	BITTER WEED	1
3	*Axonopus compressus*	കാർപെറ്റ് ഗ്രാസ്സ്	TROPICAL CARPET GRASS	195
4	*Biophytum sensitivum*	മുക്കുറ്റി	LITTLE TREE PLANT	158
5	*Commelina virginica*	കോമലീന	VIRGINIA DAYFLOWER	2
6	*Centrosema virginianum*	പൂമ്പാറ്റ പയർ	BUTTERFLY PEA	3
7	*Cyanthilium cinerum*	പൂവാംകുറന്തൽ	LITTLE IRONWEED	34
8	*Cynodon dactylon*	കറുക	BERMUDA GRASS	142
9	*Dentella repens*	ചെറു മണ്ണെലി	CREEPING DENTELLA	4
10	*Desmodium gangeticum*	ഓരില	DESMODIUM	1
11	*Desmodium triflorum*	നിലംപരൺ	TREEFLOWER TICKTREFOIL	63
12	*Digitaria sanguinalis*	ക്രാബ് ഗ്രാസ്സ്	HAIRY CRABGRASS	115
13	*Emilia sonchifolia*	മുയൽചെവിയൻ	EMILIA	9
14	*Eragrostis cilianensis*	സ്റ്റിങ്ക് ഗ്രാസ്സ്	STINKGRASS	13
15	*Euphorbia heterophylla*	ചിത്തിര പാല	WILDPOINSETTIA	2
16	*Euphorbia hirta*	നിലപ്പാല	ASTHMA WEED	37
17	*Lindernia crustacea*	ചെറുകാക്കപ്പൂ	MALAYSIAN FALSE PIMERNEL	22
18	*Microstachys chamaelea*	കൊടിയവണ്ണക്ക്	CREEPING SEBASTIANA	3
19	*Mitracarpus hirtus*	താവൽ	TROPICAL GIRDLEPOD	10
20	*Oldenlandia corymbosa*	പർപ്പടകപ്പുല്ല്	DIAMOND FLOWER	16
21	*Oxalis corniculata*	പുളിയാറില	INDIAN SORREL	2
22	*Peperomia pellucida*	മഷിത്തണ്ട്	SHINY BUSH	17
23	*Phyllanthus amarus*	കീഴാർനെല്ലി	HURRICANE WEED	163
24	*Pilea microphylla*	മതിൽ പച്ച	ARTILLERY PLANT	48
25	*Ruellia prostrata*	ഉപ്പുതാളി	BELL WEED	1
26	*Rungia pectinata*	റുംഗിയ	COMP RUNGIA	4
27	*Rungia repens*	റുംഗിയ	CREEPING RUNGIA	9
28	*Scoparia dulcis*	കല്ലുരുക്കി	SWEET BROOM	40
29	*Selaginella kraussiana*	സലാജിനല്ല	SELAGINELLA	5
30	*Spermacoce exilis*	കുടൽച്ചുരുക്കി	PACIFIC BUTTONWEED	243
31	*Stemodia verticillata*	സ്ട്രെമോഡിയം	WHORLED TWINTIP	1
32	*Synedrella nodiflora*	മുടിയൻ പച്ച	CINDRELLA WEED	269
33	*Tridax procumbens*	മൂക്കുത്തി പൂ	MEXICAN DAISY	5
34	*Urochloa mosambicensis*	ദേശപുല്ല്	SIGNAL GRASS	44
35	*Zornia latifolia*	സൊർണിയ	MACONHA BRAVA	2

Table 6.7. Checklist of herbs of K.G.college campus

Mangifera indica

Manilkara zapota

Litchi chinensis

6.4.7. Checklist of Shrubs of K.G.College campus

SI. NO.	SCIENTIFIC NAME	MALAYALAM NAME	COMMON NAME	DENSITY
1	*Heliconia psittacorum*	ഹെലിക്കോണിയ	PARAKEET FLOWER	20
2	*Crotalaria pallida*	കിലുകിലുക്കി	SMOOTH RATTLEPOD	75
3	*Hibiscus rosa-sinensis*	ചെമ്പരത്തി	HIBISCUS	6
4	*Bauhinia acuminata*	വെളുത്ത മന്ദാരം	DWARF ORCHID TREE	1
5	*Lantana camara*	കൊങ്ങിണി	LANTANA	1
6	*Stachytarpheta jamaicensis*	നരിവാലൻ	JAMICAN BLUSPIKE	2
7	*Ixora coccinea*	ചെത്തി	IXORA	9
8	*Coleus scutellarioides*	തിരുഹൃദയചെടി	COLEUS	2
9	*Clerodendrum paniculatum*	കൃഷ്ണകിരീടം	PAGODA FLOWER	2
10	*Rosa var.*	റോസ്	ROSE	8
11	*Hydrangea macrophylla*	ഹൈഡ്രാഞ്ചിയ	HYDRANGEA	2
12	*Lantana montevidensis*	വള്ളി കൊങ്ങിണി	LANTANA CLIMBER	1
13	*Rondeletia odorata*	റോഡലേഷ്യ	FRAGRANT PANAMA ROSE	2
14	*Pseuderanthemum reticulatum*	ചുക്ക് മല്ലി	YELLOW VEINED ERANTHEMUM	3
15	*Dracaena sanderiana*	ലക്കി ബാംബൂ	LUCKY BAMBOO	3
16	*Ayapana triplinervis*	അയ്യപ്പാന	AYAPANA	3
17	*Myxopyrum serratulum*	ചതുര്മുല്ല	MYXOPYRUM	1
18	*Jasminum sambac*	മുല്ല	JASMIN	1
19	*Codiaeum variegatum*	കോഴിവാലൻ	CROTON	31
20	*Graptophyllum pictum*	അഞ്ചുനിറപ്പച്ച	CARICATURE PLANT	1
21	*Heptaplerum arboricola*	കുടമരം	SCHEFFLERA VINE	2
22	*Allamanda cathartica*	കോളാമ്പി	ALLAMANDA	19
23	*Tabernaemontana divaricata*	നന്ത്യാർവട്ടം	PINWHEEL FLOWER	30
24	*Ocimum sanctum*	കൃഷ്ണതുളസി	HOLY BASIL	16
25	*Pleroma semidecandrum*	കദളി	MELASTOMA	1
26	*Capsicum frutescens*	കാന്താരി	CHILLY	2
27	*Euphorbia milii*	യൂഫോർബിയ	EUPHORBIA	5
28	*Tagetes erecta*	ചെണ്ടുമല്ലി	MARIGOLD	2
29	*Cosmos sulphureus*	ആകാശമല്ലി	SULFUR COSMOS	31
30	*Solanum lycopersicon*	തക്കാളി	TOMATO	1
31	*Chromolaena odorata*	കമ്മ്യൂണിസ്റ്റ് പച്ച	CHROMOLAENA	4
32	*Excoecaria cochinchinensis*	കടപ്പാല	CHINESE CROTON	1
33	*Cordyline fruticosa*	കോർഡിലൈൻ	CABBAGE PALM	1
34	*Dracaena trifasciata*	മാരൽ	SNAKE PLANT	2
35	*Euodia ridleyi*	യൂയോഡിയ	EUODIA	1
36	*Dracaena reflexa*	മഞ്ഞകാന്ത	SONG OF INDIA	7
37	*Nerium oleander*	അരളി	OLEANDER	9
38	*Polyscias fruticosa*	ഇല ചെടി	MING ARALIA	1

39	*Xanthostemon chrysanthus*	ഗോൾഡൻ പെൺ	GOLDEN PENDA	2
40	*Philodendron xanadu*	ഫിലോഡെൻഡ്രോൺ	PHILODENDRON	2
41	*Loropetalum chinense*	ലോറോപെറ്റാലം	CHINESE FRINGE FLOWER	2

Table 6.8. Checklist of shrubs of K.G.college campus

6.5.BIODIVERSITY INDEX FOR K.G.COLLEGE CAMPUS

Simpson Index is employed for assessing the biodiversity strength of the K.G.college campus. Calculations are based on selected taxa only (herb, shrub, trees, and small insects and animals).

6.5.1. Biodiversity index for birds (transect analysis)

DATE OF SAM-PLING	Sl.No	NAME OF THE ORGANISM	NUMBER OBSERVED AT EACH POSITION (in m) Time : 7-7.30 am			NUMBER OBSERVED AT EACH POSITION (in m) Time: 4.30- 5 pm			TOTAL
			T1	T2	T3	T1	T2	T3	
12-12-2023	1	*Corvus splendens*	4	10	5	45	15	30	109
	2	*Acridotheres tristis*	4	2	2	4	2	6	20
	3	*Corvus macrorhynchos*	3	0	2	0	0	0	5
	4	*Dendrocitta vagabunda*	1	0	0	0	0	0	1
	5	*Dicrurus paradiseus*	3	0	0	0	0	0	3
	6	*Columba livia*	6	0	10	0	2	5	23
	7	*Psilopogon viridis*	1	0	0	1	0	5	7
	8	*Argya striata*	5	0	6	0	0	0	11
	9	*Copsychus saularis*	0	0	0	2	0	0	2
	10	*Centropus sinensis*	0	0	2	0	0	0	2
	11	*Eudynamys scolopaceus*	0	0	1	0	1	0	2
13/12/2023	1	*Corvus splendens*	12	15	10	30	10	15	92
	2	*Acridotheres tristis*	4	3	2	10	4	4	27
	3	*Corvus macrorhynchos*	1	0	2	0	0	1	4
	4	*Dendrocitta vagabunda*	1	0	0	0	0	0	1
	5	*Dicrurus paradiseus*	2	0	0	0	0	0	2
	6	*Columba livia*	1	4	0	0	0	0	5
	7	*Psilopogon viridis*	2	1	2	0	2	1	8
	8	*Argya striata*	2	0	0	4	5	0	11
	9	*Copsychus saularis*	3	0	0	2	2	0	7
	10	*Eudynamys scolopaceus*	0	0	1	0	1	0	2
14/12/2023	1	*Corvus splendens*	10	12	6	10	15	40	93
	2	*Acridotheres tristis*	2	2	8	5	2	0	19
	3	*Copsychus saularis*	5	2	0	2	0	3	12
	4	*Columba livia*	10	0	0	5	0	0	15
	5	*Psilopogon viridis*	1	0	0	3	1	1	6

	6	*Dendrocitta vagabunda*	2	0	2	0	0	0	4
	7	*Dicrurus paradiseus*	0	0	1	0	0	5	6
	8	*Corvus macrorhynchos*	0	0	0	0	2	0	2
	9	*Argya striata*	0	0	0	10	0	0	10
	10	*Eudynamys scolopaceus*	0	0	1	0	1		0
15/12/2023	1	*Corvus splendens*	12	20	6	30	28	13	109
	2	*Columba livia*	10	0	0	8	0	0	18
	3	*Copsychus saularis*	2	0	0	2	0	3	7
	4	*Psilopogon viridis*	1	0	3	0	0	1	5
	5	*Acridotheres tristis*	4	2	0	5	2	0	13
	6	*Corvus macrorhynchos*	0	1	0	0	1	0	2
	7	*Dendrocitta vagabunda*	0	1	0	0	0	0	1
	8	*Argya striata*	0	0	0	8	0	0	8
	9	*Eudynamys scolopaceus*	0	0	1	0	0	1	2
18/12/2023	1	*Corvus splendens*	8	25	10	15	10	40	108
	2	*Acridotheres tristis*	2	2	0	5	0	4	13
	3	*Columba livia*	1	6	0	10	0	0	17
	4	*Psilopogon viridis*	1	1	2	0	2	1	7
	5	*Copsychus saularis*	1	0	0	0	0	0	1
	6	*Argya striata*	0	0	0	0	9	0	9
	7	*Eudynamys scolopaceus*	0	1	0	0	0	1	2
19-12-2023	1	*Corvus splendens*	10	10	5	36	15	30	106
	2	*Acridotheres tristis*	8	10	2	4	8	10	42
	3	*Corvus macrorhynchos*	2	0	2	0	0	0	4
	4	*Dendrocitta vagabunda*	1	0	0	0	0	0	1
	5	*Dicrurus paradiseus*	1	0	0	0	0	0	1
	6	*Columba livia*	0	0	16	0	2	5	23
	7	*Psilopogon viridis*	0	2	0	1	0	5	8
	8	*Argya striata*	0	5	6	0	0	0	11
	9	*Copsychus saularis*	0	0	3	0	0	0	3
	10	*Eudynamys scolopaceus*	0	0	1	0	0	1	2
		Total density							1034
		SIMPSON INDEX	0.93						

Table 6.9. Biodiversity index for bird fauna of K.G.College campus

6.5.2. Biodiversity index for butterflies (transect analysis)

DATE OF SAMPLING	Sl.No	NAME OF THE ORGANISM	NUMBER OBSERVED AT EACH POSITION (in m)			Total(n)
			T1	T2	T3	
12-11-2023	1	*Tirumala limniace*	2	17	10	29
	2	*Catopsilia pyranthe*	1	4	1	6
	3	*Catopsilia pomona*	0	12	3	15
	4	*Mycalesis mineus*	0	3	0	3
	5	*Euploea core*	0	0	2	2
12-12-2023	1	*Tirumala limniace*	1	15	9	25
	2	*Catopsilia pyranthe*	1	5	0	6
	3	*Catopsilia pomona*	0	6	0	6
	4	*Euploea core*	0	5	7	12
	5	*Troides minos*	0	1	0	1
	6	*Pachliopta hector*	0	0	1	1
	7	*Hypolimnas bolina*	0	1	0	1
13/12/2023	1	*Tirumala limniace*	2	20	8	30
	2	*Euploea core*	0	4	3	7
	3	*Catopsilia pomona*	0	1	0	1
		Total density				145
	SIMPSON INDEX	0.86				

Table 6.10. Biodiversity index for butterflies of K.G.College campus

6.5.3. Biodiversity index for small animals (quadrate analysis)

SPECIES CODE	NAME OF THE ORGANISM	NUMBER OF INDIVIDUALS OF EACH SPECIES						TOTAL(n)
		Q1	Q2	Q3	Q4	Q5	Q6	
1	*Grasshopper*	5	1	3	0	2	1	12
2	*Lasius niger*	12	7	13	0	0	0	32
3	*Gesonia obeditalis*	1	0	0	0	0	0	1
4	*Gomophoceripus rufus*	2	2	0	0	0	1	5
5	*Small black ant*	8	5	0	0	0	0	13
6	*Ant spp*	10	5	15	5	30	20	85
7	*Megalocaria dilatata*	1	0	0	0	0	0	1
8	*Oecophylla smaragdina*	0	10	0	0	0	5	15
9	*Spider*	0	0	1	0	0	0	1
10	*Grass hopper*	0	0	1	0	0	0	1
11	*Ladybug*	0	0	0	4	0	0	4
12	*Termites*	0	0	0	16	0	0	16
13	*Componotus irritans*	0	10	0	18	0	0	28
14	*Anoplodesmus anthracinus*	0	0	0	1	0	0	1
15	*Argiope pulchella*	0	0	0	0	1	0	1
16	*Cyrtophora cicatrosa*	0	0	0	0	1	0	1
17	*Oxyopus hindostanicus*	0	0	0	0	0	1	1
18	*Spinotarsus colosseus*	0	0	0	0	0	1	1
19	*Chrysso angula*	0	0	0	0	0	1	1
20	*Coenocephalous melaenus*	0	0	0	0	0	1	1
21	*Leptocorisa acuta*	0	0	0	0	0	1	1
22	*Odontomantis planiceps*	0	0	0	0	0	1	1
								223
	SIMPSON INDEX	0.80						

Table 6.11. Biodiversity index for small animals of K.G.College campus

6.5.4. Biodiversity index for trees (total count)

Sl.No	NAME OF PLANTS	NO. OF PLANTS
1	*Acacia auriculiformis*	1
2	*Annona reticulata*	2
3	*Annona glabra*	1
4	*Araucaria heterophylla*	4
5	*Areca montana*	1
6	*Artocarpous heterophyllus*	5
7	*Artocarpous hirsutus*	5
8	*Averrhoa bilimbi*	1
9	*Azadirachta indica*	2
10	*Bambusa guangxiensis*	2
11	*Bambusa ventricosa*	1
12	*Bridelia retusa*	1
13	*Cananga odorata*	1
14	*Carica papaya*	2
15	*Caryota urens*	1
16	*Casuarina equisetifolia*	4
17	*Cocos nucifera*	7
18	*Cycas revoluta*	1
19	*Cyrstostachys renda*	1
20	*Delonix regia*	1
21	*Ficus auriculata*	1
22	*Ficus benjamina*	2
23	*Flacourtia jangomas*	1
24	*Garcinia mangostana*	1
25	*Leucaena leucocephala*	3
26	*Litchi chinensis*	1
27	*Mangifera indica*	28

28	*Manilkara sapota*	1
29	*Morinda citrifolia*	1
30	*Nephelium lappaceum*	2
31	*Peltophorum pterocarpum*	2
32	*Pongamia pinnata*	2
33	*Phyllanthus emblica*	1
34	*Psidium guajava*	4
35	*Pterocarpous santalinus*	1
36	*Simarouba glauca*	1
37	*Strychnos nux vomica*	1
38	*Swietenia macrophylla*	9
39	*Syzygiun cumini*	5
40	*Syzygium samarangense*	1
41	*Tamarindus indica*	2
42	*Tecoma stans*	2
43	*Tectona grandis*	5
44	*Terminalia catappa*	6
45	*Thuja occidentalis*	1
46	*Vitex negundo*	1
	Total density	129
	SIMPSON INDEX	0.93

Table 6.12. Biodiversity index trees of K.G.College campus

6.5.5. Biodiversity index for shrubs (Quadrate analysis)

SPECIES CODE	NAME OF THE ORGANISM	NUMBER OF INDIVIDUALS OF EACH SPECIES						TOTAL (n)
		Q1	Q2	Q3	Q4	Q5	Q6	
1	*Heliconia psittacorum*	20	0	0	0	0	0	20
2	*Crotalaria pallida*	12	26	14	22	1	0	75
3	*Hibiscus rosa-sinensis*	3	1	0	0	2	0	6
4	*Bauhinia acuminata*	1	0	0	0	0	0	1
5	*Lantana camara*	1	0	0	0	0	0	1
6	*Stachytarpheta jamaicensis*	2	0	0	0	0	0	2
7	*Ixora coccinea*	4	0	0	0	5	0	9
8	*Coleus scutellarioides*	2	0	0	0	0	0	2
9	*Clerodendrum paniculatum*	2	0	0	0	0	0	2
10	*Rosa species*	2	0	0	0	0	6	8
11	*Hydrangea macrophylla*	1	0	1	0	0	0	2
12	*Lantana montevidensis*	1	0	0	0	0	0	1
13	*Rondeletia odorata*	2	0	0	0	0	0	2
14	*Pseuderanthemum reticulatum*	3	0	0	0	0	0	3
15	*Dracaena sanderina*	3	0	0	0	0	0	3
16	*Ayapana tripilinervis*	3	0	0	0	0	0	3
17	*Myxopyrum serratulum*	1	0	0	0	0	0	1
18	*Jasminum sambac*	1	0	0	0	0	0	1
19	*Codiaeum variegatum*	0	15	1	13	2	0	31
20	*Graptophyllum pictum*	0	1	0	0	0	0	1
21	*Heptaplerum arboricola*	0	2	0	0	0	0	2
22	*Allamanda cathartica*	0	5	0	2	12	0	19
27	*Tabernaemontana divaricata*	0	2	1	0	0	27	30
23	*Ocimum sanctum*	0	6	0	10	0	0	16
24	*Pleroma semidecandrum*	0	0	1	0	0	0	1

25	*Capsicum frutescens*	0	0	1	1	0	0	2
26	*Euphorbia milli*	0	0	4	0	1	0	5
28	*Tagetes erecta*	0	0	0	2	0	0	2
28	*Cosmus sulphureus*	0	0	0	31	0	0	31
29	*Rosa species*	0	0	0	5	0	0	5
30	*Solanum lycoperiscum*	0	0	0	1	0	0	1
31	*Chromolaena odorata*	0	0	0	4	0	0	4
32	*Excoecaria cochinchinensis*	0	0	0	1	0	0	1
33	*Cordyline cointreau*	0	0	0	0	1	0	1
34	*Dracaena trifasciata*	0	0	0	0	2	0	2
35	*Euodia ridleyi*	0	0	0	0	1	0	1
36	*Dracaena reflexa*	0	0	0	0	7	0	7
37	*Ixora chinensis*	0	0	0	0	2	0	2
38	*Nerium oleander*	0	0	0	0	9	0	9
39	*Polyscias fruticosa*	0	0	0	0	0	1	1
40	*Xanthostemon chrysanthus*	0	0	0	0	0	2	2
41	*Philodendron xanadu*	0	0	0	0	0	2	2
42	*Loropetalum chinense*	0	0	0	0	0	2	2
								322
	SIMPSON INDEX	0.91						

Table 6.13. Biodiversity index shrubs of K.G.College campus

SPECIES CODE	Name of the organ+D12:D42ism+DD12:D21	NUMBER OF INDIVIDUALS OF EACH SPECIES										TOTAL
		1	2	3	4	5	6	7	8	9	10	
1	*Cynodon dactylon*	142	0	0	0	0	0	0	0	0	0	142
2	*Euphorbia hirta*	18	0	0	2	0	9	8	0	0	0	37
3	*Biophytum sensitivum*	5	0	36	8	66	1	42	0	0	0	158
4	*Phyllanthus niruri*	21	1	24	6	1	105	0	4	1	0	163
5	*Emilia sonchifolia*	5	0	3	0	0	0	0	0	1	0	9
6	*Oxalis corniculata*	2	0	0	0	0	0	0	0	0	0	2
7	*Cyanthillium cinerum*	11	3	6	0	5	0	0	9	0	0	34
8	*Cammelina virginica*	2	0	0	0	0	0	0	0	0	0	2
9	*Scoparia dulcis*	1	0	0	0	0	1	1	17	20	0	40
10	*Spermacoce exilis*	52	33	84	9	0	8	0	39	9	9	243
11	*Stemodia verticillata*	1	0	0	0	0	0	0	0	0	0	1
12	*Oldenlandia corymbosa*	4	2	0	0	0	3	3	4	0	0	16
13	*Synedrella nodiflora*	2	220	29	0	0	2	8	0	1	7	269
14	*Desmodium trifolium*	2	1	5	0	0	8	0	2	43	2	63
15	*Digitaria sanguinalis*	0	12	0	0	10	28	17	48	0	0	115
16	*Acalypha indica*	0	4	0	0	0	0	0	0	0	0	4
17	*Grass 1*	0	3	0	0	0	0	0	0	2	0	5
18	*Grass 2*	0	5	0	0	0	0	0	0	0	0	5
19	*Lindernia crustacea*	0	0	1	0	0	0	7	2	10	2	22
20	*Mitracarpus hirtus*	0	0	4	0	0	0	0	0	4	2	10
21	*Grass 3*	0	0	4	0	0	0	0	0	0	0	4
22	*Rungia (white flower)*	0	0	3	3	0	2	1	0	0	0	9
23	*Peperomia pellucida*	0	0	0	1	15	1	0	0	0	0	17
24	*Tridax procumbens*	0	0	0	5	0	0	0	0	0	0	5
25	*Euphorbia heterophylla*	0	0	0	2	0	0	0	0	0	0	2
26	*Centrosema virginianum*	0	0	0	2	1	0	0	0	0	0	3
27	*Ruellia prostrata*	0	0	0	1	0	0	0	0	0	0	1
28	*Rungia (violet flower)*	0	0	0	4	0	0	0	0	0	0	4

29	*Selaginella kraussiana*	0	0	0	0	0	1	2	2	0	0	5
30	*Pilea microphylla*	0	0	0	0	0	48	0	0	0	0	48
31	*Dentella repens*	0	0	0	0	0	4	0	0	0	0	4
32	*Urochloa mosambicensis*	0	0	0	0	0	0	26	18	0	0	44
33	*Desmodium gangeticum*	0	0	0	0	0	0	0	1	0	0	1
34	*Zornia latifolia*	0	0	0	0	0	0	0	0	2	0	2
35	*Eragrostis cilianesis*	0	0	0	0	0	0	0	0	13	0	13
36	*Microstachys chamaelea*	0	0	0	0	0	0	0	0	3	0	3
37	*Axonopus compressus*	0	0	0	0	0	0	0	0	15	180	195
38	Andrographis paniculata	0	0	0	0	0	0	0	0	0	1	1
	Total density											1701
	SIMPSON INDEX	0.91										

Table 6.14. Biodiversity index herbs of K.G.College campus

6.5.6. Biodiversity index – summary

No.	TAXA	SIMPSON INDEX	REMARKS
1	Birds	0.93	Very high
2	Butterflies	0.86	High
3	Small animals	0.80	High
4	Trees	0.93	Very high
5	Shrubs	0.91	Very high
6	Herbs	0.91	Very high

Table 6.15. Biodiversity index for K.G.College campus

6.6. CONCLUSION

- The diverse array of plant species observed in various campus gardens and green spaces illustrates the richness of biodiversity.
- Regular sightings of different bird species indicate a healthy ecosystem supporting avian life.
- Insect diversity, as evidenced by the presence of various species in different habitats across campus, demonstrates a thriving ecological community.
- The presence of multiple tree species, each with its own unique characteristics and ecological roles, further emphasizes the high biodiversity on campus.
- Ongoing research projects documenting the variety of flora and fauna on campus provide quantitative evidence of its biodiversity richness.
- The coexistence of various wildlife species, such as squirrels, rabbits, and small mammals, highlights the balanced ecosystem supporting diverse habitats within the campus environment.
- Engaging educational initiatives cantered around biodiversity awareness and conservation efforts underscore the importance of preserving the campus's rich ecological heritage.

6.7. RECOMMENDATION

- Encourage the use of native plant species in landscaping and gardening projects to support local ecosystems and attract native wildlife.
- Develop strategies for managing invasive plant species that may threaten native biodiversity. Implement regular monitoring and removal programs to control their spread.
- Establish pollinator gardens or habitats with a variety of flowering plants to support pollinator species such as bees, butterflies, and hummingbirds.
- Develop a tree management plan that includes preserving existing mature trees while also planting a diverse range of tree species to enhance habitat diversity and ecosystem resilience.
- Engage students, faculty, and staff in citizen science initiatives to monitor biodiversity on campus. This could involve organized bird watching events, insect surveys, or plant identification projects.
- Bird Nesting Boxes and Feeders: Install nesting boxes and bird feeders strategically across campus to provide additional resources for bird species, especially during nesting seasons and harsh weather conditions.
- Foster a sense of stewardship and community involvement in biodiversity conservation through outreach programs, volunteer opportunities, and educational workshops.

6.8. BIODIVERSITY MANAGEMENT PLAN

The Biodiversity Management Plan for Kuriakose Gregorios College, Pampady, aims to develop a comprehensive strategy for preserving and enriching campus biodiversity. This plan entails various initiatives, such as identifying and safeguarding native flora and fauna, with a specific focus on endemic species. Additionally, habitat restoration projects will be executed to establish green corridors that facilitate wildlife movement. Sustainable land use practices will be embraced to reduce the ecological impact of campus expansion. Educational programs and awareness campaigns will engage the campus community in biodiversity conservation efforts. Waste management and water conservation measures will be integrated to promote responsible resource utilization. Regular biodiversity monitoring, conducted in collaboration with local environmental agencies, will ensure continuous evaluation and adjustment of conservation endeavors. Furthermore, the plan emphasizes forging partnerships with local organizations to promote collaborative conservation initiatives. By adhering to this Biodiversity Management Plan, Kuriakose Gregorios College,

6.8.1. Assessment of Current Biodiversity:

Conduct a thorough assessment of the biodiversity present on campus. This includes flora, fauna, and ecosys-

tems. Engage students, faculty, and local experts in this process to ensure a comprehensive understanding.

6.8.2. Identification of Threats:

Identify potential threats to biodiversity on campus, such as habitat destruction, pollution, invasive species, and climate change. Understanding these threats is crucial for effective management.

6.8.3. Goal Setting:

Establish clear and measurable goals for biodiversity conservation and enhancement on campus. These goals should be aligned with broader conservation objectives and may include increasing species diversity, restoring habitats, and reducing ecological footprint.

6.8.4. Stakeholder Engagement:

Engage all relevant stakeholders, including students, faculty, administrators, local communities, and environmental organizations. Encourage participation in decision-making processes and foster a sense of ownership and responsibility for biodiversity conservation.

6.8.5. Education and Awareness:

Develop educational programs and awareness campaigns to inform the campus community about the importance of biodiversity and the role they can play in its conservation. This can include workshops, seminars, guided nature walks, and informational materials. Green

6.8.6. Campus Initiatives:

Develop and implement sustainable landscaping practices, including native plant species and green roofs and reduce the use of pesticides and fertilizers; adopt organic gardening methods by Installing birdhouses, beekeeping stations, and bat boxes to promote wildlife habitat.

6.8.7. Habitat Restoration and Conservation:

Implement measures to restore and conserve natural habitats on campus. This may involve reforestation, wetland restoration, creation of wildlife corridors, and removal of invasive species. Work with experts to ensure that restoration efforts are ecologically sound.

6.8.8. Sustainable Land Management:

Adopt sustainable land management practices to minimize negative impacts on biodiversity. This includes reducing pesticide and herbicide use, practicing organic landscaping, and implementing water conservation measures.

6.8.9. Biodiversity Monitoring:

Establish a system for monitoring biodiversity on campus to track changes over time and evaluate the effectiveness of conservation efforts. Encourage student involvement in data collection and analysis.

6.8.10. Collaboration and Partnerships:

Collaborate with other institutions, government agencies, non-profit organizations, and local communities to leverage resources and expertise. Partnering with external organizations can enhance the impact of biodiversity conservation initiatives.

6.8.11. Policy Development and Integration:

Develop institutional policies that support biodiversity conservation and integrate them into existing campus sustainability initiatives. This may involve incorporating biodiversity considerations into campus master plans, purchasing policies, and construction projects.

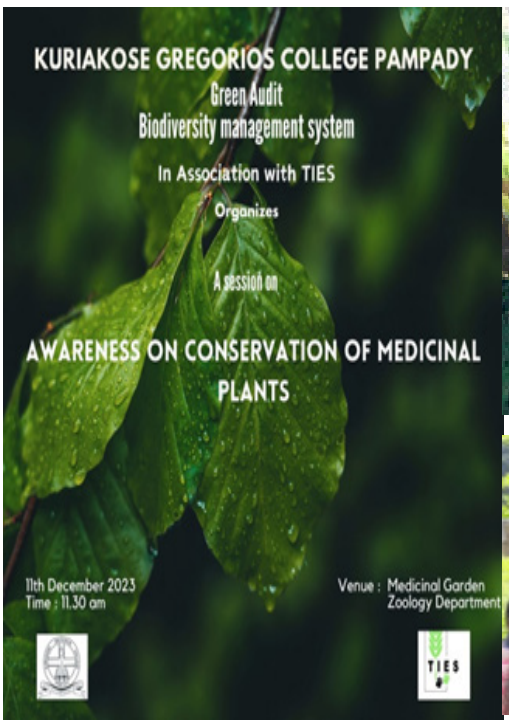
6.8.12. Long-term Planning and Adaptation:

Develop long-term strategies for biodiversity management that take into account future challenges such as climate change and urbanization. Continuously review and update the management plan to adapt to changing conditions and new information.

6.9. ACTIVITIES CONDUCTED AWARENESS ON CONSERVATION OF MEDICINAL PLANTS

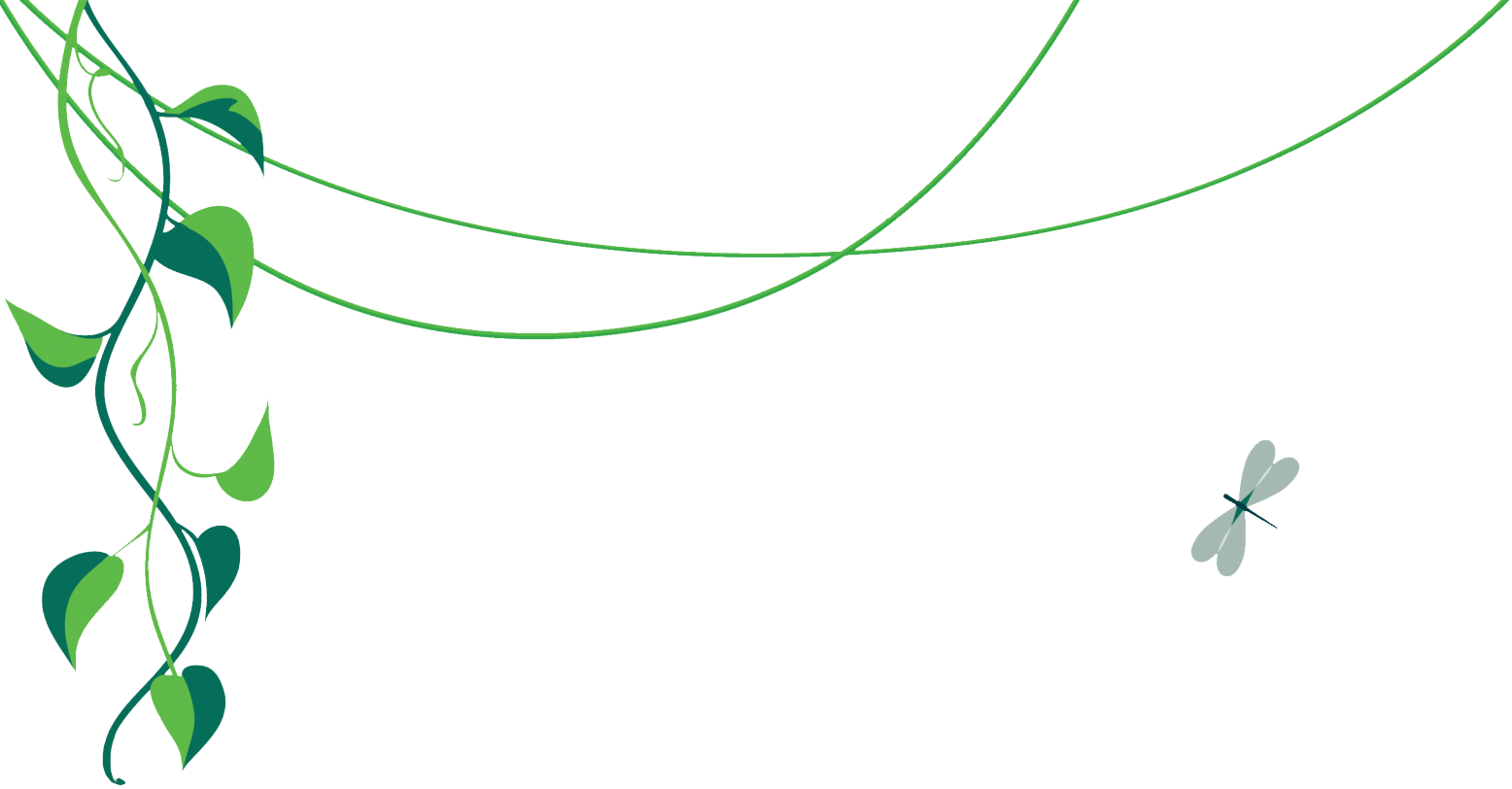
The Green Audit, Biodiversity audit team, of K G College Pampady , hosted an awareness session on

medicinal plant conservation. The purpose of this programme was to identify the several medicinal plants on campus and to discuss the importance of their conservation. Ms. Jeena Antony, Auditor, Biodiversity management system, welcomed the meeting. The session was run by the teachers in charge of Biodiversity Management system, Ms. Libi Thampi and Ms. Remina M Shajahan. We began in the Zoology Department's medicinal garden and then had a leisurely stroll around the campus to become acquainted with the medicinally significant plants there. Additionally, we familiarized ourselves with the Dashapushpam, the sacred flowers of Kerala, on our campus. The programme took place on December 11, 2023, at 11.30 a.m. Vote of thanks was delivered by Ms. Meenu Manoj, Auditor, Biodiversity management system. A total of 20 students from various departments took part in the event. There were no operational expenditures because the programme solely used the college's facilities and was held there in its entirety. The programme was well received, according to participant feedback. Those in attendance demonstrated a greater understanding of the benefits of medicinal plants for health, and many expressed a desire to adopt a more herbal lifestyle. The programme was successful in spreading awareness of the need to protect the environment and lead a sustainable lifestyle.



6.9.1. Field trip to Iringole Kavu

In collaboration with our Bhoomitrasena Club, NSS & Green Audit committee, on December 19th, members of the club together with students from the Zoology and Physics departments visited Iringole Kavu in the Ernakulam district. The Teachers, Dr. Nishitha P. Mathew, Dr. Ratheesh R, and Ms. Libi Thampi headed the group. Studying and comprehending Kerala's protected regions biodiversity was the main goal of our journey. Iringole Kavu, a sacred grove in Ernakulam district Kerala stand as a haven for biodiversity conservation. Earlier study documented a total of 142 plant species, showcasing the grove's significance in nurturing diverse flora. Notably, the grove houses three vulnerable species and 18 endemic species, highlighting its importance in the conservation of rare and indigenous plants. When we got there about 3.20 pm, we had a leisurely stroll through the grove. In the midst of the sacred grove, we encountered majestic millipedes alongside their adorable offspring. Rauwolfia serpentina and the Gnetum species caught our attention. As our eyes widened with wonder, we found ourselves enchanted by the mystical symphony of the grove's vibrant sounds. Embarking on that fascinating journey proved to be an enthralling adventure and reluctantly, we bid farewell as the clock struck 4:30 pm, carrying the magic of the grove with us.



I can't imagine anything more important than air, water, soil, energy and biodiversity. These are the things that keep us alive

- David Suzuki

Chapter VII

REPORT ON WASTE MANAGEMENT SYSTEM (WMS) AUDIT

WASTE MANAGEMENT COMMITTEE (WMC 2023-24)

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7

Waste Management System Audit

7.1. INTRODUCTION

Waste management refers to the systematic handling, control, and disposal of various types of waste materials generated by human activities in order to minimize environmental impact, promote public health, and conserve resources. It encompasses processes such as collection, transportation, treatment, recycling, and disposal of waste materials, aiming to reduce pollution, prevent environmental contamination, and optimize resource utilization. Waste management involves both regulatory measures and practical strategies to manage waste in a sustainable and efficient manner, taking into account factors such as waste composition, volume, and potential hazards.

7.1.1. What is waste?

Waste is a product or substance which is no longer suited for its intended use. Whereas in natural ecosystems waste (i.e. oxygen, carbon dioxide and dead organic matter) is used as food or a reactant, waste materials resulting from human activities are often highly resilient and take a long time to decompose.

For legislators and governments, defining and classifying waste based on risks related to the environment and human health are therefore important in order to provide appropriate and effective waste management. For the producer or holder, assessing whether a material is waste or not is important in identifying whether waste rules should be followed. Definitions are also relevant in the collection and analysis of waste data as well as in domestic and international reporting obligations.

Waste has been defined in most countries and is generally tied to the concept of disposal. Article 5 of the Basel Convention defined: " 'Wastes' are substances or objects which are disposed of or are intended to be disposed of or are required to be disposed of by the provisions of national law". Waste Framework Directive of the European Union, Article 3 defined: "'Waste' means any substance or object which the holder discards or intends or is required to discard."
Wastes are classified on the basis of their source as industrial waste (from industries), domestic waste (from home), municipal solid waste (from public spaces), commercial waste (schools, colleges, shops, and offices) etc.

Wastes are classified based on their natural disintegration ability as biodegradable and non-biodegradable. The simplest classification of wastes is based on their chemical phase such as solid, liquid and gas. The present audit considers solid and liquid wastes alone for the college campus.

7.1.2. What is waste management system?

A waste management system is a streamlined process that organizations use to dispose of, reduce, reuse, and prevent waste. Also known as waste disposal, it is an approach where companies implement comprehensive strategies to efficiently manage wastes from their origin until their final disposal. Possible waste disposal methods are recycling, composting, incineration, landfills, bioremediation, waste to energy, and waste minimization.

7.1.3. What is waste management audit?

The waste management audit involves evaluating the efficiency of the current Waste Management system in Campus. Additionally, the waste management audit aimed to assess the extent to which various types of waste were addressed by regulatory frameworks for safe disposal, and whether appropriate agencies were tasked with responsibility and accountability for waste management. ISO 14001, an international standard governing Environmental Management Systems (EMS), delineates the fundamental principles, standard procedures, and expected outcomes for conducting a Waste Management Audit.

The requirements that must be fulfilled for a waste management audit are:

- Detailed inventory of quantity of wastes generated in the college/university campus at various sources (Canteen, Hostel, Class rooms, Office, laboratories etc.)
- A detailed review of the existing waste management system at each source points (evaluation of existing practices) and their impacts on environment and health of stakeholders.
- Implementation of proper scientific waste management system in the campus in order to enhance waste management processes and contribute nature conservation (habitual modifications, installation of Biogas Plant, composting unit; MCF etc.).

7.1.4. Need for waste management audit

The Waste Management and Environmental Policy aims to foster education and awareness within a clean environment for stakeholders regarding environmental compliance. This policy applies to all employees and students of the college/university, ensuring an eco-friendly atmosphere. It addresses campus cleanliness through proper waste disposal, recycling of biodegradable waste, and the use of eco-friendly supplies to prevent hazardous waste/pollution (Cardenas and Halman, 2016). The ethos of an eco-friendly culture is promoted among students and rural communities through various awareness programs. The Head of the Organization, Departmental Heads, and Senior Managers/Management Representatives are accountable for monitoring waste management initiatives and maintaining a clean campus, while all individuals within the organization must adhere to the policy. Waste Management not only enhances campus greenery but also contributes to safeguarding the planet for future generations. Frequent Waste Management audits, at least once every three years, are essential for ensuring that students and staff are aware of its benefits and can actively participate in the 'Go Green' concept, thereby setting environmental standards for the community. Waste Management serves as a professional and practical measure for organizations to maintain an eco-friendly campus (Kaseva and Gupta, 1996)."

Waste management and sustainable educational practices are crucial aspects of creating a more environmentally responsible and socially conscious society integrating sustainable practices into education, institutions can promote awareness, responsibility, and long-term positive environmental impacts. Curriculum integration of effective waste management practice timulates awareness and possibility for novel approaches. Thereby, Students can learn about the life cycle of products, waste management processes, and the importance of resource conservation.

7.2 WASTE MANAGEMENT POLICY

Efficient management of waste stands as a paramount pillar within our overarching green policy, a core principle guiding our institution's commitment to sustainability and environmental stewardship. Through a multifaceted approach encompassing segregation, reduction, reuse, recycling, and composting of waste materials, we endeavour to uphold stringent waste management regulations while fostering a culture of ecological responsibility. This concerted effort extends beyond mere compliance, aiming to install a profound understanding and appreciation for the intrinsic value of maintaining a clean, healthy, and environmentally friendly campus environment among all members of our community. For achieve this goal, we employ a variety of communication channels, including orientation sessions, circulars, announcements, and strategically placed signage, ensuring that every individual associated with our institution is well-informed about the significance of their role in waste management practices. By raising awareness and promoting active participation, we seek to cultivate a collective ethos of sustainability, where each action contributes to the greater preservation of our natural resources and the mitigation of our ecological footprint.

Our commitment to sustainable waste management extends to the implementation of composting methods for biodegradable waste streams. Through the utilization of composting infrastructure, we harness the organic potential of these materials, transforming them into nutrient-rich compost that serves as a natural fertilizer to nourish the diverse plant life across our campus. This closed-loop system not only diverts organic waste from landfills but also promotes soil health and biodiversity, exemplifying our dedication to holistic environmental stewardship.

However, we recognize that addressing environmental challenges requires a comprehensive approach that encompasses both organic and non-biodegradable waste streams. As such, we are actively developing and implementing efficient systems for the reduction, recycling, and repurposing of non-biodegradable waste materials. By embracing innovative technologies and strategic partnerships, we aim to minimize our environmental impact while maximizing resource efficiency, paving the way for a more sustainable life for future generations, which is possible through following practice

7.2.1. Waste Assessment and Segregation:

- Conduct a waste audit to understand the types and quantities of waste generated on campus.
- Categorize waste into organic, recyclable, non-recyclable, and hazardous waste.
- Provide separate bins for each waste category across the campus.

7.2.2. Awareness and Education:

- Launch awareness campaigns to educate students, faculty, and staff about the importance of waste management and segregation.
- Organize workshops, seminars, and training sessions on waste reduction, recycling, and composting techniques.
- Distribute informational materials such as brochures and posters across the campus.

7.2.3. Waste Collection:

- Establish a regular waste collection schedule for each type of waste.
- Designate specific collection points across the campus.
- Train waste collection staff on proper handling and transportation of different types of waste.

7.2.4. Recycling Initiatives:

- Collaborate with local recycling facilities or vendors to collect recyclable materials such as paper, plastic, glass, and metal.
- Install recycling bins in prominent locations and ensure regular collection and transportation to recycling centers.
- Encourage the use of recycled products and materials within campus facilities.

7.2.5. Composting Program:

- Set up composting facilities on campus to process organic waste from the cafeteria, food courts, and landscaping.
- Educate the campus community on composting methods and encourage participation.
- Utilize compost generated for landscaping, gardening, or agricultural purposes on campus.

7.2.6. Hazardous Waste Management:

- Implement strict protocols for the handling, storage, and disposal of hazardous waste such as chemicals, batteries, and electronic waste.
- Provide specialized containers for hazardous waste and ensure proper labeling and segregation.
- Partner with authorized agencies for the safe disposal of hazardous materials.

7.2.7. Waste Reduction Strategies:

- Promote the use of reusable items such as water bottles, mugs, and containers within campus facilities.
- Minimize paper usage by encouraging electronic communication, digital submissions, and double-sided printing.
- Implement policies to reduce food waste in dining areas through portion control, tray-less dining, and donation programs.

7.2.8. Monitoring and Evaluation:

- Regularly monitor waste generation, segregation, and disposal practices on campus.
- Collect feedback from the campus community to identify areas for improvement.
- Conduct periodic audits to assess the effectiveness of waste management initiatives and adjust policies accordingly.

7.2.9. Partnerships and Collaboration:

- Collaborate with local municipalities, NGOs, and community organizations working in waste management for knowledge sharing and resource mobilization.
- Engage students, faculty, and staff in research projects or community outreach programs related to waste management.

7.2.10. Policy Enforcement and Compliance:

- Establish clear guidelines and regulations for waste management on campus.
- Implement penalties or incentives to ensure compliance with waste management policies.
- Provide adequate resources and support for the enforcement of policies, including training for staff and designated personnel responsible for waste management.

7.3. WASTE MANAGEMENT AUDIT-METHODOLOGY

Effective waste management is paramount for preserving clean and healthy environments, mitigating pollution, conserving natural resources, and safeguarding public health, all of which are achieved through a systematic approach. A dedicated waste management group, comprising twelve members—ten student representatives and two faculty members—has been organized to oversee all waste management activities. This team operates in accordance with the principles outlined in their waste management policy, which delineates their objectives, action plans, and strategies for ensuring an efficient waste management process. To ensure the team's effectiveness, regular meetings are conducted to assess progress. Waste Management audit has been place through three phases: Pre audit, audit and post audit. To streamline operations, waste is categorized into food, plastic, litters, and e-waste, with separate records maintained for the quantity of waste in each category sourced from various sectors including the canteen, hostel, and campus. Additionally, comprehensive records are kept for waste disposal, detailing the quantity sent to recycling facilities, composting units, and other disposal methods. Students are entrusted with maintaining these records for recycling facilities and waste processing units. They also carry out their assigned tasks periodically. Specifically, team members are designated to collect plastic waste, which is then handed over to the Haritha Karam Sena on a monthly basis. Recycling waste is sold to scrap dealers. Organic and food waste management is handled by the compost pit team, who convert biodegradable waste into fertilizer. The resulting fertilizer is utilized in the vegetable garden, yielding better crops, which are subsequently sold in the nearby market.

7.3.1. Assumption

Waste poses an escalating predicament across the globe, permeating through various scales from the global to the regional and local levels. The management of waste, predominantly encompassing methods such as incineration or landfilling, frequently leads to detrimental releases into the soil, air, and water, thereby serving as a significant source of both global and local pollution. This

predicament is further compounded by prevailing trends in production and consumption patterns, coupled with the relentless march of global urbanization. The financial implications associated with implementing proper waste management practices often render it seemingly cost-prohibitive, incentivizing the neglect of waste treatment and fostering a disposition towards hazardous disposal methods detrimental to both human health and the environment.

At a global scale, waste management manifests as a complex dichotomy. Generally, countries within the Organisation for Economic Co-operation and Development (OECD) boast relatively robust solid waste management infrastructures. Conversely, non-OECD countries grapple with an extensive network of approximately 4,444 landfills, exacerbated by the absence of a standardized waste classification system. Against the backdrop of escalating industrialization, the predominant waste policies in many nations lean towards either incineration or landfill disposal. Nonetheless, a discernible shift towards the adoption of an integrated waste management approach has gradually gained momentum, particularly within developed nations over the course of the past few decades.

This evolving paradigm champions a comprehensive framework encapsulated by the Waste Hierarchy, delineating a sequence of priorities: Respect, Rethink, Reduce, Reuse, and Recycle. Embracing these principles entails a departure from conventional linear waste management practices towards a more circular and sustainable model, emphasizing the imperative to minimize waste generation, maximize resource utilization, and promote environmental stewardship. Through concerted efforts to instil these principles into waste management strategies, there exists a tangible opportunity to mitigate the adverse impacts of waste proliferation, fostering a more resilient and environmentally-conscious global community.

7.3.2. Method of Internal Audit

Waste Management audit has three phases: Pre audit, audit and post audit.

7.3.2.1. Pre audit phase

- Formation of audit team; scheduling audit programmes
- Setting up of scope and objectives (in tune with waste management policy of the institution)
- Discusses with the responsible persons of each location (staff, teachers, lab assistants, sweepers, watchmen, students etc.) about the waste generation pattern, and provisions of their management.
- Preparation of inventory for quantity of various types of solid waste generation (location wise): MSW (general- litter, paper, stationary waste etc.); biowastes (food, plant litter etc.); plastic waste; hazardous waste (chemical residue from labs; discarded e wastes etc.); construction and demolition wastes; biomedical waste (e.g., from life science laboratories); e wastes (computers, CDs, pen drives, mobile phones etc.).
- Documentation of all existing practices and provisions of solid waste management in the campus

7.3.2.2. Audit phase

Auditors collect all data collected to ensure that nothing is overlooked completely in the audit. The following information has been collected during the audit phase:

- Assessment of collected data in relation with environmental policy and waste management policy of the college/university
- Review of present waste management systems and enhancement suggestions

7.3.2.3. Post audit phase

- The plan of action for the post-audit phase is implementation and follow-up. All possible suggestions for the improvement of WMS of the institution is implemented.
- WMS committee will ensure that the Waste Management System is functional at expected level and the college is participating, by making the entire college/university community well informed through regular communications; monitoring through periodical evaluation programmes etc.

7.3.3. Steps of Waste Management Audit

7.3.3.1. Site assessment

Collection of contour map and campus diagram; mark the waste generation points and storage points in the diagram.

- Walk through survey; quantification process of each kind of waste at each location;
- Survey on existing waste management practices in the campus. Data on quantity and type of processing of each kind of waste is recorded

7.3.3.2. Data analysis

- Analysis of current and past performance (pre audit and post audit performances, previous audit data etc.)
- Regression analysis involves the comparison of waste production on the Y axis versus the potential waste management driver on the X axis (weather, working days/holidays etc.).
- Carbon credit calculation

7.3.3.3. Final audit by external audit team

- Data verification- identifying non conformities
- Action plan –long tern and short term
- Final report & certification as per ISO standards.

The waste Management committee of the college has implemented the internal audit process. The internal auditors have been given training on 21st November 2023. The registers and documents to be maintained also listed and implemented. The data collection was done by the students and entered in the prescribed formats.

Week	Week Days	Weekly Work Plan	Activity Implementation
First week	24.11.2023 to 26.11.2023	Computing the quantity of each type of waste generated Assessment of Waste Management system	• Identification of waste generation units/points/ sector in the college/university campus • Ass1igning different audit team for each identi-fied sector of the campus • First sampling of waste quantity • Documentation of existing waste management practices
Second Week	02.12.2023 to 03.12.2023	Computing the quantity of each type of waste generated Assessment of Waste Management system	• Second sampling of waste quantity • Documentation of existing waste management practices
Third Week	06.12.2023 to 12.12.2023	Computing the quantity of each type of waste generated Assessment of waste Management system	• Third sampling of waste quantity • Documentation of existing waste management practices
Fourth week	20.12.2023 to 27.12. 2023	Computing the quantity of each type of waste generated Assessment of Waste Management system	• Fourth sampling of waste quantity • Documentation of existing waste management practices
Fifth Week	08.01.2024 to 12.01.2024	Data analysis Suggestions for improving WMS of the college	• Calculation of various kind of waste generated at each point • Analysis of existing waste management practices • New WMS Pla
Sixth week	22.01.2024 to 25.01.2024	Report submission on Waste audit	Report preparation and presentation

Table 7.1.Schedule of the waste management audit

Table 7.1. Data collection schedule of waste management audit

Activity	Frequency	Dates of activity	
Water collection records of food waste, plastic, litter and e-waste) OR manual one time evaluation	9 days; 3 times a day	Three Sundays;26/11/2023,3/12/2023, 10/12/2023Three holidays (Saturday;25/12/2023 2/12/2023 6/12/2023Three working days; 24/11/ 2023,29/12/2023,6/12/2023,12/12/2023 (completed by three weeks)	Entry in the given format

Table 7.2. Data collection process of waste management audit done at K.G.College

7.4. RESULTS & DISCUSSION

7.4.1. Analysis of data on quantity of solid waste

7.4.1.1. Litter (sweepings)

Particulars	Total Litter in Kg
Working day	
24-11-2023	7
29-11-2023	5.9
06-12-2023	5
11-12-2023	10.1
Std. Value (average)	7
Total working day/year	200
Litter waste in working day/year	1400
Semi holiday	
25-11-2023	5
02-12-2023	7
09-12-2023	6
Std. Value (average)	6
Total Semi holiday/year	95
Litter waste in semi holiday/year	570
Holiday	
26-11-2023	0
03-12-2023	0
10-12-2023	0
Std. Value (average)	0
Total Holiday/year	70
Litter waste in holiday/year	0
Total	**1970**

Table 7.3. Data on litter in the college

The college generates an average of 1970Kg litter per year. On a typical workday, a higher volume of waste is observed, surpassing that of Saturdays. Workdays follow the college's regular schedule, while Saturdays may involve the potential for holding classes to compensate for holidays, conducting remedial classes, or hosting various programs (Table 7.3)

7.4.1.2. Food waste in the college campus

Particulars	Total food waste in Kg
Working day	
24-11-2023	6
29-11-2023	5.9
06-12-2023	10
11-12-2023	10
Std. Value (average)	7.975
Total working day	200
Food waste in college/year	1595
Semi holiday	
25-11-2023	0
02-12-2023	0
09-12-2023	0
Std. Value (average)	0
Total semi holiday/year	95
Average food waste in college/year	0
Holiday	
26-11-2023	6
03-12-2023	7
10-12-2023	6.5
Std. Value (average)	6.5
Total Holiday/year	70
Food waste in hostel/year	455
Total	**3399**

Table 7.5. Data on food waste in the women's hostel

The college hostel accumulates an total food waste of 3399 kg. Higher waste generation is reported on working days, followed by holidays and semi-holidays. Working days exhibit increased waste due to the regular functioning of the hostel, where inmates consume meals throughout the day, leading to a higher quantity of food waste. On semi-holidays, waste generation is lower than on working days, as some inmates leave the hostel on Fridays or students go out for activities, resulting in minimal food usage. However, on Sundays, waste generation is slightly higher compared to semi-holidays, as inmates residing in the hostel or may return from their homes, increasing the possibility of food waste. The food waste is utilizing with biogas plant attached to the Hostel premises.

7.4.1.4. Plastic waste in the college campus

Particulars	Total amount of plastic in Kg (college)
Working day	
24-11-2023	6
29-11-2023	2
06-12-2023	5.3
11-12-2023	7.6
Std. Value (average)	5.225
Average working days/year	200
Amount of plastic waste in college campus/year	1045
Semi Holiday	
25-11-2023	0.5
02-12-2023	4
09-12-2023	6.45
Std. Value (average)	3.65
Total semi holiday	60
Amount of plastic waste in college campus/year	219
Holiday	
25-11-2023	0.5
03-12-2023	4
10-12-2023	6.45
Std. Value (average)	3.65
Total holiday	40
Average amount of plastic waste in college campus/year	146
Total	**1410**

Table 7.6. Data on plastic waste in the college campus

The annual production of plastic waste amounts to 1410 kg. Working days exhibit a significant increase in plastic waste, compare to semi-holidays. The heightened plastic waste during working days can be attributed to the routine activities of the college. Semi-holidays also present opportunities for increased plastic usage, as the college operates on Saturdays for additional classes to compensate for holidays or to host various programs. (Table 7.6)

7.4.1.5. Plastic waste in the cafeteria & canteen

Particulars	Total amount of plastic in Kg (cafeteria)
Working day	
24-11-2023	1.4
29-11-2023	2
06-12-2023	9
11-12-2023	12.8
Std. Value (average)	6.3
Total working day	200
Average amount of plastic waste in cafeteria	1260
Semi Holiday	
25-11-2023	1.4
02-12-2023	5
09-12-2023	11
Std. Value (average)	5.8
Total semi holiday	60
Average amount of plastic waste in cafeteria	348
Holiday	
25-11-2023	1.4
03-12-2023	5
10-12-2023	11
Std. Value (average)	5.8
Total holiday	40
Average amount of plastic waste in cafeteria	232
Total	**1840**

Table 7.7. Data on plastic waste in the cafeteria/canteen

The yearly production of plastic waste amounts to 1840 units. Plastic consumption tends to be higher in cafeterias and canteens compared to the rest of the college, primarily due to the higher prevalence of one-time disposal plastics in these dining areas.

Plastic usage peaks on working days, reflecting the regular operational activities of the college. However, semi-holidays also contribute to plastic consumption, as they may involve classes, administrative tasks, or events, leading to a slight uptick in plastic waste generation (Table 7.7)

7.4.1.6. e-Waste & Scrap of the college

Sl.No.	Type of waste	Source	Quantity /year (Kg)
1	e-Waste	College campus	624.50
2	Plastic, Metal & Paper	College campus	1139.90

Table 7.8. Other wastes in the college (scrap etc.)

e-wastes and scrap materials are collected at the store rooms on a monthly basis and sold to scrap dealers once in a while. The amount shown here are the quantity that sold to the scrap dealers.

7.4.1.7. Total quantity of solid wastes generated in the college

Sl.No.	Type of waste	Source	Total Quantity /year (Kg)	Perc capita quantity (Kg)
1	Litter (sweepings)	College campus	1970	3.67
2	Food waste	College campus	1595	2.97
3	Food waste	Women's Hostel	3399	73.89
4	Plastic waste (disposables)	College campus	1410	2.63
5	Plastic waste (disposables)	Cafeteria/canteen	1810	3.37
6	e-Waste	College campus	624.50	1.16
7	Plastic, metal & paper	College campus	1139.90	2.12
TOTAL			10922.40	

Table 7.9. Total waste generation and per capita waste quantity of K.G. College

The per capita waste generation for various types of wastes are given in Table 7.9. Average per capita waste generation of plastic, litter and scrap, ranges between 2.12 to 3.67 per year. This is minimal comparing to the urban campuses. The disposal is also carried out systematically. Food wastes are used as compost or biogas. Scrap and plastics are sold to vendors for recycling. Non recyclable disposable plastics are given to Harithakarma sena (women assigned to collect wastes from sources regularly levying a user fee) of the Pampady Grama panchayath.

The per capita food waste of hostlers is extremely high. i.e., 73.89 Kg of food is wasting each of them every year. This should be regulated and reduced through continuous sensitization programmes.

7.4.2. Analysis of data on quantity of liquid waste

SECTION/DEPARTMENT	MEASUREMENT OF WATER USED (PER DAY) RATE OF DISTARGE (L/ MONTH)
CHEMISTRY	600
ZOOLOGY	100
AQUARIUM TANK	3000
FOOD SCIENCE AND QUALITY CONTROL	250
BOTANY	10

Table 7.10. Average grey water production in various laboratories of the college (per month)

The liquid waste produced in the college is not estimated in this audit. Data from the laboratories only collected and is given in Table 7.10. Major quantity of grey water is from kitchens, mess hall, wash area, and toilets. These volume will be estimated before the first surveillance audit and respective registers will be maintained.

7.5. CONCLUSIONS

- Being a college situated in a semi rural location, the average production of waste is below or at par with the state and national averages.
- Litter, plastic waste, e waste and scraps are regularly collected, segregated and processed.
- Organic wastes are also managed in an ideal manner, either by biogas plant or with a unique composting pillar, the Vegetable Tower. Scraps and e-wastes are sending for recycling. Disposables are given to Public Waste collection system, by paying user fee.
- Liquid waste is a neglected area at present. Plans are on the anvil to manage liquid wastes before the surveillance audit.

7.6. RECOMMENDATIONS

- Sensitization campaign among the college community, especially hostlers for minimizing the wastage of precious food.
- A plastic shredder machine can be installed at the college for handling bottles and sheet plastic wastes.
- Grey water flow meters shall be fixed in every such points and an estimate shall be made periodically.
- Heap or wind row composting technique shall be employed for managing litter and sweepings.
- Awareness seminars, workshops etc, shall be conducted more to extend the message of these good practices to their homes.

7.7. WASTE MANAGEMENT PLAN

The waste management action plan for a K.G. college campus prioritizes sustainable practices aligned with the state's commitment to environmental conservation. The plan includes implementing a robust waste segregation system with clearly labelled bins for paper, plastic, glass, organic waste, and non-recyclables, alongside conducting awareness campaigns to educate the campus community on proper waste disposal. Additionally, the plan involves establishing on-site composting facilities for organic waste, promoting compost production for campus gardens, and encouraging participation in composting initiatives to reduce landfill burden. Regular e-waste collection drives are organized to responsibly dispose of electronic devices, collaborating with authorized e-waste recycling centers for proper handling and recycling. Moreover, reusable alternatives such as water bottles, containers, and bags are promoted, with water refill stations installed across the campus to minimize single-use plastic consumption. Eco-friendly events and competitions are hosted to engage the campus community, incorporating waste reduction challenges, tree-planting drives, and environmental awareness campaigns. Partnerships with local waste management authorities, local bodies, and recycling facilities are established to streamline waste collection and disposal processes, participating in community-wide initiatives to address broader environmental concerns. Periodic waste audits are conducted to evaluate the effectiveness of the waste management system, utilizing findings to make informed adjustments and improvements. Sustainability and waste management education are integrated into the curriculum, offering workshops, seminars, and courses emphasizing environmental stewardship. A monitoring and reporting system is implemented to track progress and share achievements with the campus community, regularly updating stakeholders on waste diversion rates, recycling efforts, and overall environmental impact. By implementing this comprehensive waste management action plan, the college campus in Kerala can significantly contribute to the state's environmental goals while fostering a culture of sustainability among students, faculty, and staff. Effective waste management can administrate through following methods.

7.7.1. Assessment and Analysis:

- Conduct a thorough assessment of current waste generation sources, types, and quantities.
- Analyse the existing waste management practices and their effectiveness.
- Identify any legal requirements or regulations governing waste management in your area.

7.7.2. Set Objectives and Targets:

- Define clear objectives for waste reduction, recycling, and disposal.
- Set measurable targets to track progress, such as reducing waste sent to landfills by a certain percentage or increasing recycling rates.

7.7.3. Create a Waste Management Team:

- Form a dedicated team responsible for overseeing the implementation of the waste management plan.
- Ensure representation from various departments or stakeholders to facilitate collaboration and buy-in.

7.7.4. Develop Policies and Procedures:

- Draft comprehensive waste management policies outlining responsibilities, procedures, and guidelines.
- Establish procedures for waste segregation, collection, storage, and disposal.

7.7.5. Educate and Train Staff:

- Provide training sessions and workshops to educate staff on proper waste management practices.
- Emphasize the importance of waste reduction, recycling, and proper disposal methods.

7.7.6. Implement Segregation Systems:

- Introduce segregation bins or containers for different types of waste (e.g., recyclables, organic waste, hazardous waste).
- Ensure clear labelling and instructions for proper segregation.

7.7.7. Promote Recycling and Reuse:

- Encourage recycling by providing recycling bins and promoting awareness campaigns.
- Explore opportunities for reusing materials within the organization or donating items to local charities or community organizations.

7.7.8. Establish Partnerships:

- Collaborate with waste management companies, recycling facilities, and other organizations to enhance waste management capabilities.
- Explore partnerships with vendors or suppliers to reduce packaging waste or facilitate the return of packaging materials.

7.7.9. Monitor and Evaluate Performance:

- Implement a monitoring system to track waste generation, recycling rates, and compliance with waste management policies.
- Regularly evaluate progress against objectives and targets, and adjust strategies as needed.

7.7.10. Continuous Improvement:

- Foster a culture of continuous improvement by soliciting feedback from staff and stakeholders.
- Identify areas for optimization and implement changes to enhance waste management practices.

7.7.11. Document and Reporting:

- Ensure compliance with relevant regulations and reporting requirements.
- Prepare regular reports on waste management performance to stakeholders and regulatory agencies (internal audit).

7.7.12. Celebrate Successes and Encourage Participation:

- Recognize and celebrate achievements in waste reduction and recycling.
- Encourage staff participation through incentives, recognition programs, or rewards.

7.8. ACTIVITIES CONDUCTED

This report highlights the best practices implemented by our college in the areas of waste management, food fest organization, and vegetable harvesting for sale in the market. These initiatives not only contribute to the sustainability goals of our institution but also foster a culture of environmental responsibility and community engagement.

7.8.1 Awarness program

The aim of organizing a waste management awareness program in college is multifaceted and crucial. Primarily, it seeks to educate students and faculty about the importance of responsible waste disposal and recycling practices, fostering a culture of environmental

consciousness and sustainability within the campus community. By raising awareness about the detrimental effects of improper waste management on ecosystems, public health, and future generations, the program aims to inspire behavioural change and empower individuals to make informed choices in their daily lives. Furthermore, such initiatives often provide practical guidance on reducing waste generation, implementing recycling programs, and promoting the reuse of resources, contributing to the overall efforts towards a greener and more sustainable future.

By actively engaging in initiatives like reducing waste, promoting recycling, conserving energy, and adopting sustainable practices, students and faculty members demonstrate their dedication to minimizing their ecological footprint. This pledge fosters a sense of responsibility and stewardship, empowering individuals to make conscious choices that contribute to a healthier environment locally and globally. Moreover, it cultivates a culture of environmental awareness and inspires positive change, fostering a campus community that values sustainability and works towards a greener, more sustainable future.

Fig 7.8.2 Circular of announcement

Circulars and announcements are executed in a timely manner inside the campus by the Principal. The aim of ensuring timely announcements regarding waste management within the college campus is to foster a culture of accountability and awareness among students, faculty, and staff. By promptly disseminating information, the college aims to educate and engage the campus community in sustainable practices, thereby promoting effective waste management strategies and encouraging active participation in environmental conservation efforts. 5th June 2023 on World Environment Day: The college community made a pledge to environmental conservation under the direction of Principal Dr. Mini Joseph. The principal gave an overview of how waste is managed on campus.

Taking a pledge to environmental conservation in a college campus signifies a collective commitment towards preserving our planet for future generations.

7.8.3 Food fest

On 9th November 2023, during the biriyani fest sponsored by the College MGOCSM unit, Principal Dr. Renny P. Varghese addressed the College Community through the public announcement system with the aim of raising awareness about the various waste management methods employed by the College, particularly highlighting the responsible disposal of food waste.

7.8.4 Food waste management methods inroduced

Establishing a vegetable garden on campus utilizing biogas waste presents an innovative approach to sustainability, integrating eco-friendly practices into everyday campus life. By repurposing biogas waste as fertilizer, the garden not only reduces waste but also enriches soil health, fostering optimal conditions for vegetable cultivation. Furthermore, selling the produce to the community not only promotes local, sustainable food options but also generates revenue that can be reinvested into further environmental initiatives on campus. This initiative serves as a tangible example of how sustainable habits can be seamlessly integrated into daily routines, inspiring students to adopt similar practices in their own lives and encouraging broader community engagement in environmental conservation efforts.

7.8.4 Installation of collection point

Placing collection boxes for used pens on campus serves as a simple yet effective method of waste management with numerous benefits. These designated boxes provide a convenient and visible location for students, faculty, and staff to discard their used pens instead of disposing of them in regular trash bins. By segregating pens for recycling or proper disposal, it promotes the diversion of waste from landfills, contributing to overall waste reduction efforts. Additionally, collecting used pens in a centralized location facilitates easier organization and transportation for recycling or appropriate disposal processes. This initiative not only promotes environmental conservation but also raises awareness about the importance of responsible waste management practices within the campus community.

Implementing a biogas system in our college for cooking purposes not only serves to reduce waste but also plays a crucial role in educating students about responsible citizenship. By utilizing biogas, derived from organic waste, as a renewable energy source, we not only mitigate the environmental impact of waste disposal but also demonstrate the importance of sustainable practices in daily life. This initiative fosters a culture of environmental consciousness among students, empowering them to make informed choices and become stewards of the planet.

Donating plastic waste to Haritha Karma Sena serves as an effective method of waste management with numerous benefits. By channelling plastic waste to this organization, individuals contribute to the reduction of environmental pollution and the promotion of recycling efforts. Haritha Karma Sena typically employs strategies such as segregating, recycling, or up cycling plastic waste, thereby diverting it from landfills and reducing its harmful impact on ecosystems. Additionally, this initiative supports the employment of individuals involved in waste management, thereby promoting economic empowerment within communities. Overall, by collaborating with Haritha Karma Sena in managing plastic waste, individuals actively participate in sustainable practices that foster environmental conservation and social responsibility.

Installation of biogas plant at girls hostel and biogas is utilized for cooking purpose.

While giving e-waste and non-degradable waste to scrapers might seem like a convenient method of waste management, it's important to consider the potential drawbacks and implications. While this approach can help in diverting waste from landfills and promoting recycling, it may also pose risks to both human health and the environment if not handled properly. Scrapers often use rudimentary methods to extract valuable materials from electronic and non-degradable waste, which can lead to harmful emissions and contamination of soil and water bodies.

Moreover, there's a risk of informal or illegal recycling practices, where hazardous substances are mishandled, leading to health hazards for workers and nearby communities. To ensure responsible waste management, it's crucial to promote proper recycling infrastructure and regulations, encouraging the use of certified recycling facilities that adhere to environmental and safety standards. Additionally, raising awareness about the importance of proper e-waste disposal and supporting initiatives for safe recycling can help mitigate the negative impacts associated with informal scrap recycling practices.

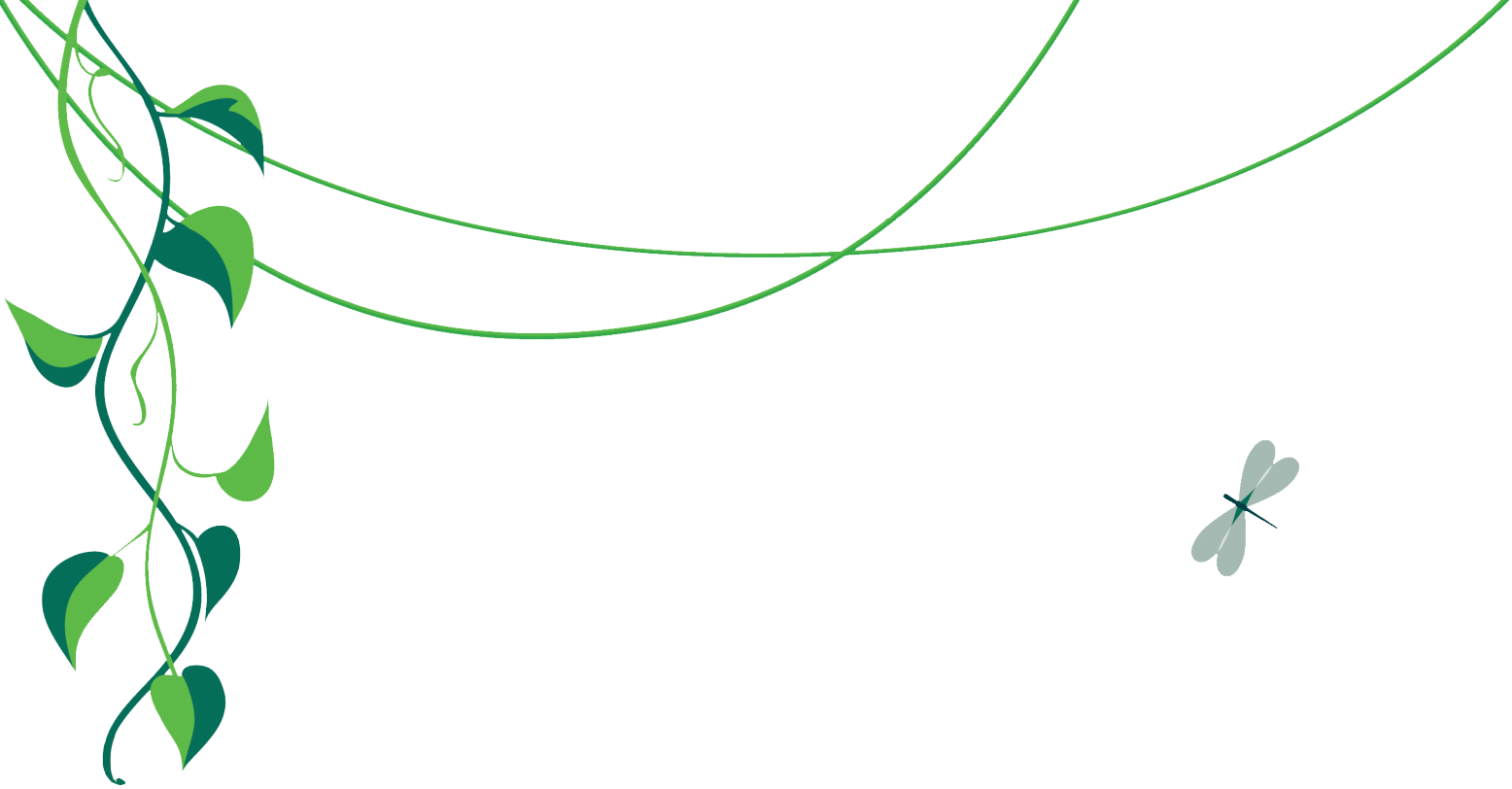
In the year 2023, through the sale of scrap (paper, metal, e-waste) the waste management committee earned a sum of Rs. 34356.50 for the College through its various sales.

Our college has adopted a comprehensive waste management system that focuses on reducing, reusing, and recycling. Separate bins for different types of waste are placed across the campus, accompanied by informative signage to encourage proper disposal. Additionally, we have established partnerships with local recycling facilities to ensure that recyclable materials are properly processed. Regular awareness campaigns and workshops are conducted to educate students and staff about the importance of waste reduction and responsible disposal practices.
The best practices implemented by our college in waste management, food fest organization, and vegetable harvesting demonstrate our commitment to sustainability, environmental stewardship, and community engagement. These initiatives serve as examples of how educational institutions can play a significant role in promoting sustainable development and fostering a culture of responsibility towards the environment and society. We remain dedicated to continually improving and expanding upon these efforts to create a more sustainable future for our college and beyond.

Sale of scrap

Sales Report of Waste Management Team						
No.	Category	MCF	Date	Vendor	Total Weight in Kgs	Total Amount (in Rs)
1	Plastic, Metal & Paper	I	11/11/2022	Sudhi's Scrap Unit, Pampady	119.50	941.00
2	Plastic, Metal & Paper	I	05/18/2023	Sudhi's Scrap Unit, Pampady	99.50	1035.50
3	Organic Farming	III	08/17/2023	Auction at College	5.00	1340.00
4	E-waste	V	09/08/2023	Microage Networks and Solutions, Ernakulam	420.00	9240.00
5	Organic Farming	III	09/07/2023	College Canteen	2.50	100.00
6	Plastic, Metal & Paper	I	12/07/2023	Sudhi's Scrap Unit, Pampady	920.90	21700.00
TOTAL					**1567.40**	**34356.50**

Table 7.11. e-waste and scrap sales details



There is no such things as away.
When we throw anything away
it must go somewhere

- Annie Leonardv

Chapter VIII

REPORT ON CARBON FOOT PRINT (CF)

CARBON FOOT PRINT COMMITTEE
(CFC 2023-24)

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8.1. INTRODUCTION

Carbon dioxide (CO2) stands as the predominant greenhouse gas (GHG) stemming from human activities. Institutions of higher learning are urged to embrace goals aimed at achieving carbon neutrality in the foreseeable future, setting a standard for others to emulate. Increasing greenhouse gas emissions is one of the primary causes of global warming. The primary sources of GHG's are transportation, electricity production, industry, commercial and residential, agriculture and land use and forestry. The four major GHG's are CO2, methane (CH4), Nitrous Oxide (N2O) and Chlorofluorocarbons (CFCs). In addition to this water vapor (H2O) also contributes to Greenhouse effect. An essential element of the atmosphere, carbon dioxide (CO2) is emitted through natural processes, such as volcanic eruptions, as well as human activities, including the combustion of fossil fuels and deforestation.

There is substantial evidence demonstrating that the primary cause of this warming is largely attributed to the emission of GHGs resulting from human activities. Consequently, measures must be implemented to mitigate these GHG emissions. A crucial initial step in emission reduction and comprehending disaster risk involves quantifying GHG emissions from various human activities. Likewise, Carbon foot printing has emerged as a tool to direct pertinent emission reduction efforts and verifications, thereby aiding in the understanding of the risks associated with global warming from its outset.

8.1.1. What is Carbon Footprint?

CO2 is emitted into the atmosphere across the entire span of human existence. Through the utilization of electricity sourced from fossil fuel power plants, the combustion of gas for heating, or the operation of petrol or diesel vehicles, each individual bears responsibility for CO2 emissions. Moreover, every product or service consumed indirectly contributes to CO2 emissions, as energy is requisite for their production, transportation, and disposal. The total set of greenhouse gas emissions caused directly and indirectly by an individual, organization, event or product is commonly called their carbon footprint (CF). A carbon footprint is defined as the total amount of greenhouse gases, specifically carbon

dioxide (CO2) and other equivalents like methane (CH4) and nitrous oxide (N2O), that are emitted directly or indirectly by human activities. The United Nations Climate Change Conference (COP 28, 2023) ended with an agreement that signals the "beginning of the end" of the fossil fuel era by laying the ground for a swift, just and equitable transition, underpinned by deep emissions cuts and scaled-up finance. Carbon footprint is an inevitable thing to attain the climate action, the 13th SDG.

An organizational carbon footprint assesses the greenhouse gas (GHG) emissions stemming from all activities within the organization, encompassing energy consumption in buildings, industrial processes, and company vehicles. Beyond simply quantifying the organization's overall GHG impact, conducting a Carbon Footprint (CF) analysis furnishes the organization with a thorough GHG inventory, enabling the identification and targeting of reductions in major emissions sources. Research has indicated that various types of organizations make significant contributions to global GHG emissions.

8.1.2. Carbon Footprint for Universities and colleges

Universities or colleges, as organizations engaged in education, research and community services, play an important role in generating knowledge, integrating sustainability in education and research projects, and promoting environmental issues in society, as well as in preparing responsible graduates capable of maintaining sustainable development. In addition, universities or colleges typically consist of a mix of buildings used for classrooms, laboratories, offices, canteens, residences, etc. that generate significant GHG emissions. Furthermore, the Carbon Footprint (CF) serves as a valuable decision-making instrument, empowering organizations such as universities to enhance their oversight of environmentally impactful activities. It furnishes a quantifiable metric, enabling comparisons of environmental footprints across academic institutions. Additionally, it establishes a foundational benchmark for assessing the efficacy of future mitigation endeavors on campus. The carbon footprint serves as a crucial instrument not only for pinpointing major emitters but also for fostering awareness among faculty and students regarding the diverse impacts of everyday actions on campus. This encompasses all facets, spanning from research and education to administrative matters. Given these factors, it is imperative for universities, as pioneers in science and technology, to take on a leadership role in computing, monitoring, disclosing, minimizing, or even offsetting their carbon emissions. By doing so, they exemplify sustainable organizations and champion the transition towards a carbon-neutral society. The carbon footprint as a form of greenhouse gas emission inventory provides the possibility to define a baseline for institutions of higher education aiming for carbon neutrality.

8.2. METHODOLOGY

In the context of KG College, various aspects of resource consumption and environmental impact are being evaluated (See the Matrix given in Table 8.1). This assessment encompasses several key areas, including energy consumption (encompassing both electricity and fuel usage), water consumption on a monthly basis, waste generation, and the digital footprint of the institution. But, full data is not available for any such parameters used to calculate carbon foot print, from the current audit at K.G.College, Pampady, Kottaym.

When examining waste generation specifically, the focus primarily lies on biowaste, indicating organic waste materials such as food scraps, garden waste, or other biodegradable items. This emphasis on biowaste suggests a recognition of its significance in terms of both environmental impact and potential for sustainable management practices. Here the daily waste generated was accounted.

Overall, this comprehensive approach to assessing resource usage and environmental impact reflects a commitment to understanding and potentially

mitigating the college's ecological footprint, with specific attention paid to areas such as energy efficiency, water conservation, waste management, and digital sustainability.

8.2.1. Assumptions

- Emissions of greenhouse gases, especially carbon dioxide from burning fossil fuels for energy, are causing climate change. Climate change is a significant threat to life on Earth, so humankind needs to first reduce and then ultimately eliminate emissions of carbon dioxide (CO2).
- There is clear evidence that increases in atmospheric green house gas concentrations–including CO2 from burning fossil fuels for energy and transportation –are changing Earth's climate. Other important greenhouse gases are methane (CH4), often produced during the decomposition of organic waste such as waste water, nitrous oxide (N2O) and halogenated compounds.
- According to the Intergovernmental Panel on Climate Change (IPCC), we must limit the increase in average global temperature to below15°C by 2030.This means we must use More efficient energy, replacing fossil energy sources. Energy using carbon-free renewable energy sources to transition to a carbon-free sustainable economy.

8.2.1.1. ISO 14064

- The standard specifies how an organization develops verifiable GHG inventories, where the inventory is defined as "the sum of the organization's GHG sources and sinks". ISO has designed the standard for any organization that needs tools and guidance for assessing and reporting greenhouse gas emissions. There are two types of institutional boundaries are applied:
  (1) the organizational boundaries refer to any facilities for which the organization has practical and financial responsibilities
  (2) The operational boundaries refer to the organization's activities, such as burning fossil fuels for heating and industrial processes.
- ISO14064-2 describes processes for quantifying, monitoring and reporting emission reductions or greenhouse gas removal improvements at the project level. In this regard, a project is defined as a distinct activity or endeavour; Some examples include:
- An anaerobic digestion plant in a waste water treatment plant is designed to capture methane and then use the methane to generate energy in a gas engine
- A carbon capture and storage facility, in which underground well would provide a reservoir for the captured CO2.
- ISO 14064 -2 applies a life cycle approach to assess greenhouse gas emission and eliminate from project. This standard describes how users quantify baseline emissions from sources, and then explains the requirements for quantifying the amount of greenhouse gases that will reservoirs remove from the atmosphere.

8.2.1.2. ISO 14067

- Coverage for a single type of impact: a product's impact on climate change, where carbon foot print (CFP) is defined as the total amount of greenhouse gas emissions and removals in a product system, expressed as CO2 equivalent. ISO 14067 applies the proven and widely used international standards for lifecycle assessment (LCA), ISO14040 and ISO14044. The elimination of greenhouse gases is relevant because a product can reduce impacts of climate change; for example, CO2 removal techniques, such as carbon capture and storage, or methane capture and utilization from anaerobic digestion.
- ISO 14067 describes procedures for determining direct and in direct CO2 emissions from products. Coverage applies to a single type of impact–a product's impact on climate change, where carbon foot print (CFP) is defined as the total amount of green house gas emissions and removals over a period of time system of products, expressed in CO2 equivalents. ISO 14067 applies the widely used and proven international standards for life cycle assessment

(LCA), ISO14040 and ISO14044.

- Green house gas absorption is relevant as a product can reduce the impact of climate change; for example, CO2 removal techniques, such as carbon capture and storage, or methane capture and utilization from an aerobic digestion.
- Applying the principles of LCA, the ISO standard describes processes for determining green house gas emissions and removals from the purchase of raw materials through the end of the product's lifecycle ,i.e. analysis from start to finish. Standard also describes how users can define partial CFP, end-to-end analysis, or CFP throughout the lifecycle of the product in use.

Carbon emission	Carbon sequestration
Direct emissions (from own or controlled sources) -campus facilities, vehicles and equipment's	Biomass (biodiversity of the campus)
Indirect emissions (from activities) (including purchased energy) • electricity, water or fossil fuels (LPG etc.) • commuting, waste generation and procurement	Alternate energy resources – solar energy
DATA USED (2022-23 schedule)	
Electricity consumption in the college per year (in KWH) Water consumption per year (in KL)	Biomass estimation based on trees and grasses Solar energy generation (in KWH) per year

Table 8.1. Simplified carbon footprint matrix for academic institutions.

Calculating the carbon footprint of a college campus involves considering various factors such as energy consumption, water usage, waste generation, and biodiversity impact, as given in the above matrix. However, many of these data are deficient in the present audit. Since limited data only available, a simplified methodology is developed by TIES for estimating the Carbon foot Print of the college. Keep in mind that this approach provides a rough estimate, and for a more accurate calculation, additional data may be needed.

8.2.3. TIES' simplified calculator for the estimation of carbon Foot print of colleges/ universities

Carbon Foot print of the college is estimated through calculating component foot prints of based on available data:

8.2.3.1. Electricity Carbon Footprint:

Calculate the total electricity consumption in kilowatt-hours (kWh) per year. Use the carbon intensity factor for the region to convert electricity consumption to CO2 emissions. As per Our World Data (2022), carbon intensity factor of electricity or grams of CO2 equivalents per Kilowatt hour is 633g of CO2, in India. (https://www.google.com/search?q=carbon+intensity+factor+of+electricity&oq=carbon+intensity+factor+of+electricity&aqs=chrome..69i57j33i160.9020j0j15&sourceid=chrome&ie=UTF-8)

Electricity Carbon Footprint (kg CO2) = Electricity Consumption (kWh) × Carbon Intensity Factor (kg CO2/kWh)

8.2.3.2. Water Carbon Footprint:

Calculate the total water consumption in cubic meters (m^3) per year. The water consumption carbon footprint factor, which is the average carbon footprint associated with water use, in India for potable water is estimated as 0.137 Kg. CO2/m3. (https://wint.ai/blog/the-carbon-footprint-of-water/#:~:text=In%20fact%2C%2013%25%20of%20 electricity,10.6Kg)%20of%20carbon%20emissions).

Water Carbon Footprint (kg CO2) = Water Consumption (m^3) × Water Carbon Footprint Factor (Kg CO2/m^3)

8.2.3.2. Waste Carbon Footprint:

Estimate the annual waste generation in kilograms. Use the waste generation carbon footprint factor, representing the average carbon emissions associated with waste disposal in the region.

In India, the CO2 equivalent of organic or food waste is estimated as 0.165g CO2 per one Kg of organic waste (Ramachandra et al., 2015; https://www.researchgate.net/publication/275017534_Carbon_Footprint_of_the_Solid_Waste_Sector_in_Greater_Bangalore_India#read).

Disposable and packing plastic wastes are found to generate 3.50 Kg. of CO2 per one KG. of such wastes. (TERRA. https://www.teorra.info/blog/what-is-the-carbon-footprint-of-packaging#: ~:text=Plastic%3A%203.50kg%20carbon%20emissions%20per%201kg%20of%20packaging).

E Wastes or electronic wastes generally responsible for emission of 1.44 Kg. CO2 per one Kg of waste. (World Loop- https://worldloop.org/e-waste/bo2w-impact-on-co2-emissions/#:~:text=The%20results%20were%20astounding%3A%20For,CO2%20emissions%20have%20been%20avoided).

Waste Carbon Footprint (kg CO2) = Waste Generation (kg) × Waste Carbon Footprint Factor (kg CO2/kg)

8.2.3.2. Total Carbon Footprint:

Sum up the carbon footprints from electricity, water, and waste, impact to get the total carbon footprint.

Total Carbon Footprint (kg CO2) =
Electricity Carbon Footprint +
Water Carbon Footprint +
Waste Carbon Footprint

Special Note: This simplified formula provides a basic estimation of the carbon footprint. For more accurate results, it's recommended to obtain specific data, collaborate with environmental agencies, or hire a professional to conduct a comprehensive assessment.

8.2.4. Using Carbon footprint calculator App (Chandigarh Administration, India)

A Microsoft cloud based app developed by Chandigarh (Punjab) administration represents a simplified tool for calculating the Carbon Footprint based on fundamental information. It operates by aggregating greenhouse gas (GHG) emissions and converting them into equivalent CO2 units. This conversion is crucial for standardizing results into a universally accepted measurement of GHG potential. The app provides users with an estimated approximation of their carbon footprint, offering a general overview. However, it's important to note that the figure provided is not precise due to the complexity involved in obtaining absolute accuracy. Calculating an exact number would necessitate accounting for numerous independent variables, which could significantly impede the app's performance, making the user experience cumbersome and slow.

8.3. RESULTS AND DISCUSSION

8.3.1. Manual calculation

The Carbon foot print calculated for K. G. College, as per the methodology suggested in section 8.2.3 is as follows:

No.	Component	Total quantity /year	Equivalent to CO2	Respective foot print (Kg of CO2)
1	Electricity (kWh)	27732	0.633 Kg/kWh	17554.36
2	Water (m3)	13914.67	0.137 Kg/m3	1906.31
3	Organic waste (Kg)	8964	0.000165 Kg/Kg	1.48
4	Plastic waste (Kg)	3220	3.50 Kg/Kg	11270
5	E waste & scraps (Kg)	1764.40	1.44 Kg/Kg	2540.74
			Total Carbon Foot print (kg. of CO2)	**33,272.89**
			TOTAL	**33.28 tCO2eqv**

Table 8.2. Carbon foot print of K.G.College –manual calculation using simplified formula

As per the data given in Table 8.2, the carbon foot print of K.G. College is 33.28 tons however, calculation by cloud based app. has a higher estimate. This is because it considered use of LPG but in manual calculation it is not included.

8.3.2. Using Microsoft cloud app

Sl. No.	Area of consumption	Quantity	Avr. Emission
1.	Avg. units of fresh water consumed (per month)	1.16 kL	0.07 %
2.	Avg. units of energy consumed (per month)	2773 kWh	98.44%
3.	LPG cylinder (per year)	704 nos.	
4.	Avg daily waste generation (biowaste per day)	44.82 kg	1.43 %
	Digital footprint / week	150 hrs	0.07 %
		TOTAL	**57.16 tCO2eqv**

Table 8.3. Carbon foot print of K. G. College calculated using App

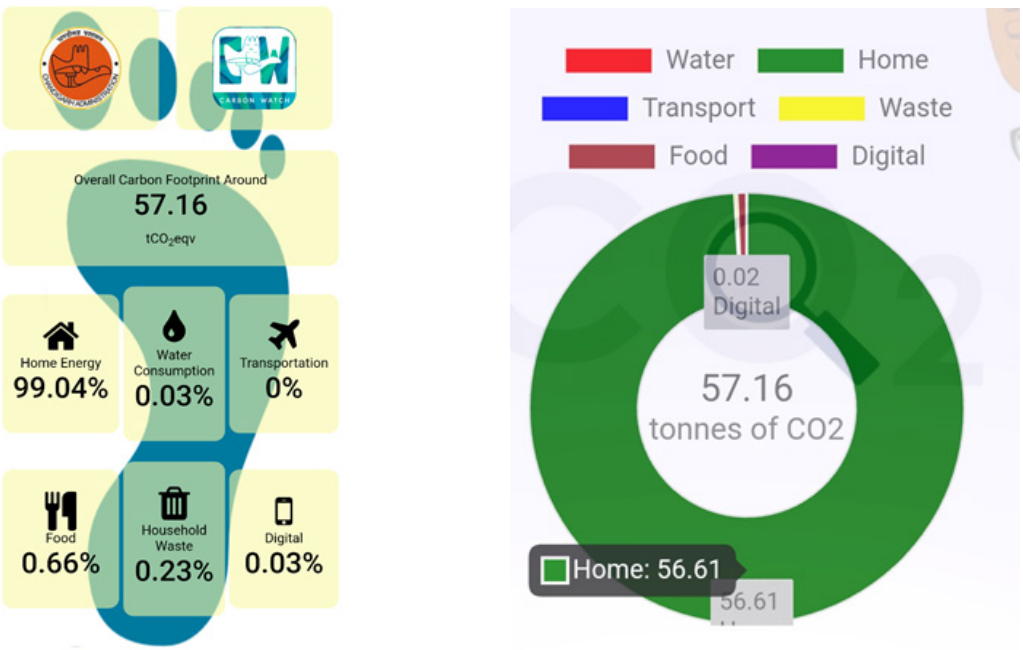


Fig. 8.1. Carbon foot print of K.G. college calculated through mobile app.

8.4. CONCLUSIONS

As these calculations are mere rough estimates no valid conclusions can be made. However, it gives an indicator to the carbon emission scenario of the campus. In future, detailed studies shall be made making data perfect.

8.5. CARBON NEUTRAL PLAN FOR THE COLLEGE

Creating a carbon-neutral action plan for K.G. college involves implementing a combination of strategies that reduce greenhouse gas emissions, increase energy efficiency, and promote sustainable practices. Here's a detailed plan:

8.5.1. Baseline Assessment:

Conduct a comprehensive carbon footprint assessment to understand the current emission sources. Identify energy consumption patterns, transportation emissions, waste generation, and other relevant factors contributing to the carbon footprint.

8.5.2. Renewable Energy Integration:

Invest in renewable energy sources such as solar panels and wind turbines to generate clean energy on campus. Explore partnerships with local renewable energy providers or government initiatives for subsidies and incentives.

8.5.3. Energy Efficiency Measures:

Upgrade existing buildings with energy-efficient technologies, including LED lighting, energy-efficient HVAC systems, and smart building management systems. Establish and enforce energy conservation practices among students, faculty, and staff.

8.5.4. Green Transportation:

Promote sustainable transportation options such as cycling, walking, and public transit. Encourage the use of electric vehicles (EVs) and provide charging infrastructure on campus. Implement a carpooling program and incentivize eco-friendly commuting habits.

8.5.5. Waste Management:

Implement a comprehensive waste reduction and recycling program on campus. Educate the campus community about proper waste disposal and recycling practices. Consider composting organic waste to further reduce the
environmental impact.

8.5.6. Sustainable Procurement:

Source products and materials with low environmental impact and prioritize suppliers with sustainable practices. Consider the lifecycle environmental impact of products before purchasing, and promote circular economy principles.

8.5.7. Afforestation and Green Spaces:

Plant native trees and create green spaces on campus to absorb carbon dioxide and enhance biodiversity. Establish a campus-wide tree-planting initiative involving students, faculty, and staff.

8.5.8. Curriculum Integration:

Integrate sustainability and climate change topics into the academic curriculum across disciplines. Encourage research and projects focused on sustainable solutions and technologies.

8.5.9. Water Conservation:

Implement water-saving measures, such as rainwater harvesting and efficient irrigation systems. Educate the campus community on water conservation practices.

8.5.10. Behavioral Change Campaigns:

Conduct awareness campaigns to promote sustainable behavior among students, faculty, and staff. Organize events, workshops, and seminars on environmental conservation and climate change.

8.5.10. Monitoring and Reporting:

Establish a monitoring system to regularly track and report progress toward carbon neutrality goals. Share information transparently with the campus community to foster accountability and engagement.

8.5.11. Partnerships and Collaboration:

Collaborate with local government bodies, NGOs, and industry partners to enhance the impact of sustainability initiatives. Join national and international sustainability

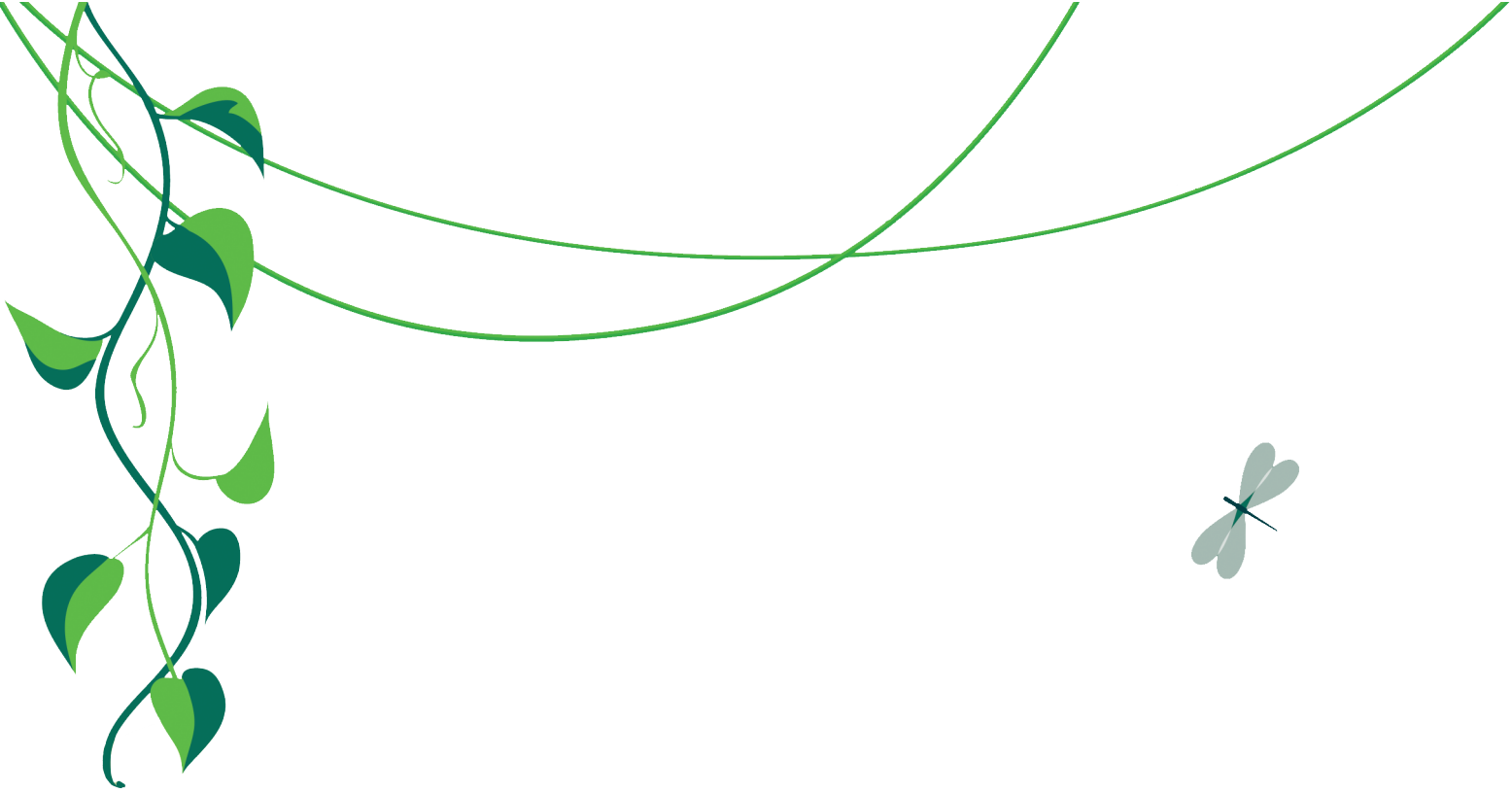
networks for knowledge sharing and best practices. By combining these measures, K.G.College can implement a holistic carbon-neutral action plan that addresses various aspects of its operations and fosters a culture of sustainability on campus. Regularly reassess and update the plan to incorporate new technologies and practices that emerge over time.

Chapter IX

GENERAL CONCLUSIONS OF GREEN AUDIT & RECOMMENDATIONS FOR SUSTAINABILITY

TIES

KURIAKOSE GREGORIOS COLLEGE
PAMPADY
DUTY ACCOMPANIES RIGHT



Never doubt that a small group of thoughtful,
committed citizens can change the world;
indeed, it is the only thing that ever has.

- Margret Mead

9

General Conclusions & Recommendations

1.1.GENERAL CONCLUSIONS

9.1.1. Energy audit conclusions

- The college's electricity consumption is notably lower compared to its population size.
  Currently, 90% of the lighting comprises LED bulbs and tube lights. To further enhance energy efficiency, it is strongly advised to switch the remaining CFL incandescent bulbs (4 each) and fluorescent tube lights (168) to LED variants. This transition promises significant energy savings.
- The power rating and average usage time of each item are inaccurately documented, necessitating a thorough review and update of documentation practices to ensure accuracy and in energy usage tracking.
- The college predominantly focuses on arts and sciences, with minimal presence of major machinery or highly sensitive equipment. The available lab equipment, instruments, and appliances are not tailored to the curriculum of undergraduate (UG) and postgraduate (PG) courses within the science departments.
- Approximately 95% of the equipment, instruments, and appliances currently in use are outdated models lacking an Energy Star rating. As a result, these devices may contribute to considerable energy consumption. Hence, it is strongly recommended to enforce the procurement of only Energy Star-rated items in the future.
- Previously, the absence of usage registers for nearly all equipment constituted a significant non-conformity. This issue has been addressed, and it is now confirmed that usage registers are maintained for all equipment. These registers facilitate the identification of equipment with the highest usage time and frequency of use, enabling the implementation of effective energy-saving practices.
- It is strongly recommended to assign dedicated members to an efficient power management team tasked with systematically monitoring and documenting energy management progress, ensuring accountability and continuous improvement in energy efficiency efforts.
- Despite having the infrastructure for a biogas plant, it's evident that LPG consumption remains

excessively high. Therefore, it is imperative to implement more effective measures to reduce LPG consumption and explore further opportunities for utilizing biogas as a sustainable alternative.

9.1.2. Conclusions of water efficiency audit

- Although the college boasts good and quality water infrastructure, its regulatory and monitoring mechanisms are lacking, and there are no provisions for water conservation.
- The college relies solely on an open well as its water source, which pumps water into a main storage tank with a capacity of 18,000 liters, distributed across 12 sub-tanks.
- Despite having a rainwater harvesting tank with a capacity of 300,000 liters, its full potential remains untapped.
- Analysis of water flow meter data reveals a yearly consumption of 13,914,678.3 liters within the college premises.
- The water footprint per capita is calculated at 71.86, indicating significant water usage.
- Recent water quality tests indicate contamination with coliforms, which has been addressed through proper cleaning and disinfection measures.
- The college currently lacks substantial water conservation programs and has a weak Information, Education, and Communication (IEC) campaign in place.

9.1.3. Conclusions of biodiversity audit

- The rich tapestry of plant species thriving in our campus gardens and green spaces serves as a testament to the wealth of biodiversity present.
- The regular presence of a diverse range of bird species indicates a robust ecosystem that nurtures avian life.
- Across campus, the abundance of insect species in their respective habitats is a clear indicator of a flourishing ecological community.
- The multitude of tree species, each playing a unique role in the ecosystem, further highlights the exceptional biodiversity on campus.
- Ongoing research endeavours dedicated to cataloguing the myriad flora and fauna species provide concrete evidence of the campus's biodiversity richness.
- The harmonious cohabitation of various wildlife species, from squirrels to rabbits and small mammals, underscores the equilibrium of habitats within the campus environment.
- Educational initiatives cantered around biodiversity awareness and conservation efforts reinforce the significance of safeguarding our campus's diverse ecological legacy.

9.1.4. Conclusions of audit on waste management

- Situated in a semi-rural setting, our college consistently maintains waste production levels that either match or fall below both state and national averages.
- Regular collection, segregation, and processing of litter, plastic waste, e-waste, and scraps are integral practices within our institution.
- Our organic waste management practices are exemplary, employing innovative solutions such as our biogas plant and the unique Vegetable Tower composting system. Scraps and e-wastes are diligently sent for recycling, while disposables are directed to the Public Waste collection system, with associated user fees.
- Although our waste management efforts excel in many areas, liquid waste remains a current area of neglect. Plans are underway to address liquid waste management before the upcoming surveillance audit.

9.1.5. Conclusions on carbon foot print data

- A preliminary approximation is documented based on generated data, providing a general overview of the carbon footprint; although not an authentic result, it offers a broad understanding of the carbon footprint produced.
- Inaccuracies in tabulating the carbon footprint resulted from insufficient data, highlighting the need for increased attention to data quality in future assessments.

9.2. GENERAL RECOMMENDATIONS

9.2.1. Recommendations based on findings of energy audit

- Students can proactively initiate the development of innovative technologies and mechanisms at a low cost, serving as models while also emphasizing energy conservation efforts.
- Colleges can foster collaboration with other institutions to host techno fests, providing platforms for students to exchange ideas and engage with diverse knowledge, thereby promoting teamwork and the adoption of innovative strategies.
- With guidance from faculty, students can spearhead initiatives to introduce innovative technologies and mechanisms at a low cost, while also prioritizing energy conservation efforts.
- Establishing a proficient power management team to oversee the progress of energy functions, engage in discussions, formulate plans, document findings, and evaluate ongoing developments for implementing sustainable energy management strategies.
- Exploring alternative plans to reduce energy consumption, such as focusing on decreasing LPG usage through methods like implementing biogas plants, could be a viable solution.

9.2.2. Recommendations based on findings of water audit

- Implement regular monitoring and control measures for water consumption across all sectors. This includes installing additional water flow meters, conducting routine data collection, and raising awareness among the college community about water conservation.
- Install a centralized water filtration system to address water quality concerns. Assign a designated individual responsibility for the operation and maintenance of the filtration system.
- Optimize the purification and utilization of rainwater harvesting tanks. Expand the installation of such structures throughout the college campus.
- Enforce a specific timeline for the implementation of the proposed water conservation plan. Foster a culture of water conservation among the college community through these initiatives.

9.2.3. Recommendations based on findings of biodiversity audit

- Promote the use of native plant species in landscaping and gardening endeavors to bolster local ecosystems and attract indigenous wildlife.
- Formulate tactics for managing invasive plant species that pose a threat to native biodiversity. Enact routine surveillance and removal initiatives to curb their proliferation.
- Establish pollinator gardens or sanctuaries featuring a diverse array of flowering plants to nurture pollinator species like bees, butterflies, and hummingbirds.
- Craft a comprehensive tree management blueprint encompassing the preservation of existing mature trees alongside the introduction of a wide spectrum of tree species to enrich habitat diversity and fortify ecosystem resilience.
- Involve students, faculty, and staff in citizen science endeavours aimed at monitoring biodiversity on campus. This may entail coordinated bird watching excursions, insect surveys, or projects focused on plant identification.
- Deploy strategically positioned bird nesting boxes and feeders across campus to furnish supplementary resources for avian species, particularly during nesting periods and inclement weather.
- Cultivate a culture of stewardship and communal engagement in biodiversity conservation through outreach programs, volunteer opportunities, and educational workshops.

9.2.4. Recommendations based on findings of waste management audit

- Install a plastic shredder machine on campus to manage plastic bottle and sheet waste effectively.
- Conduct sensitization campaigns within the college

community, with a special focus on dormitory residents, to reduce food wastage.
- Install grey water flow meters at key points and regularly estimate water usage.
- Implement heap or windrow composting techniques to manage litter and sweeping waste.
- Organize awareness seminars, workshops, and similar events to promote these sustainable practices and encourage their adoption at home.

9.2.5. Recommendations regarding carbon foot print

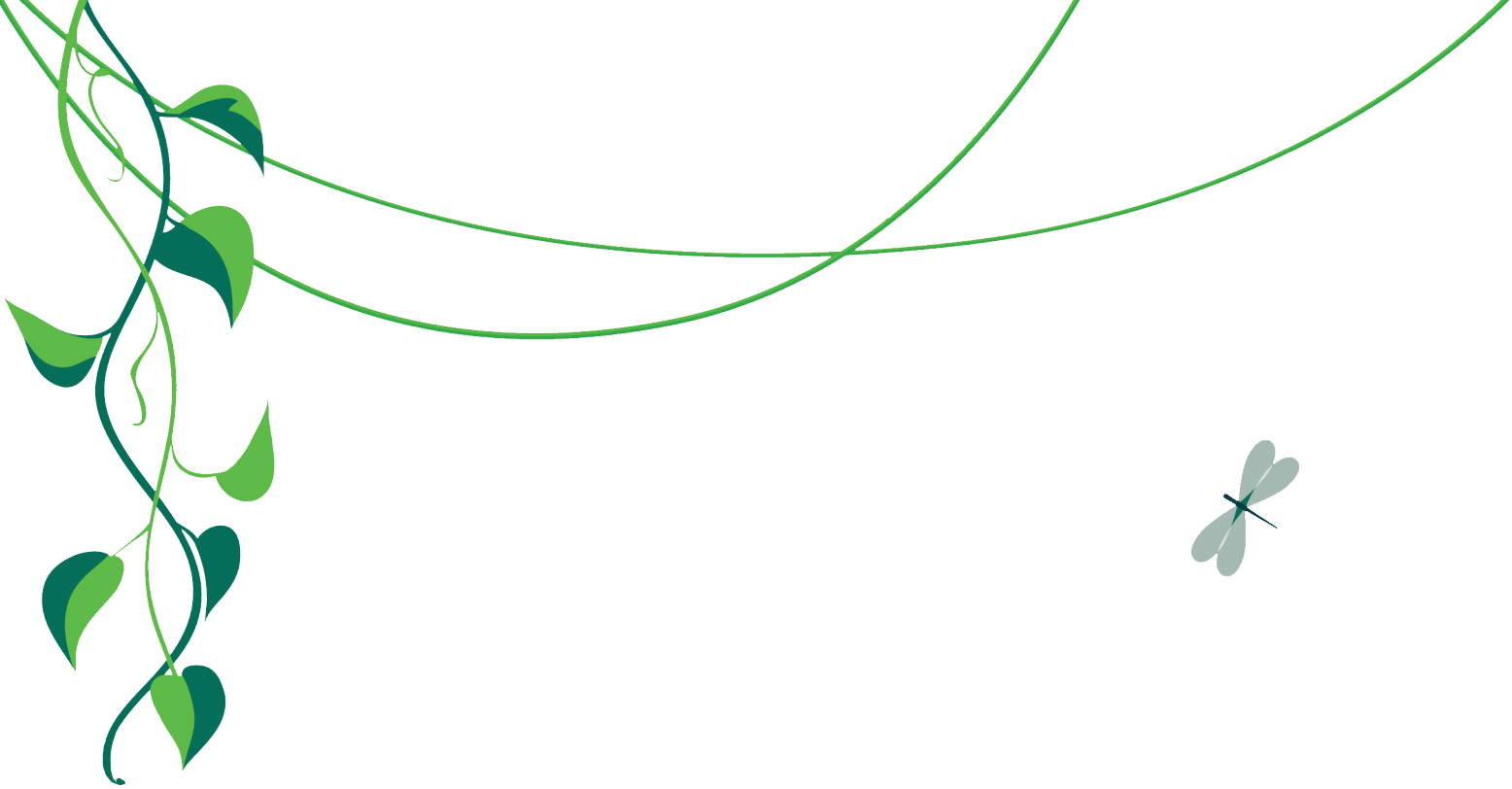
- The is serious non-conformity of data efficiency shall be ratified through improved system of documentation and data management

Chapter X

BEST PRACTICES OF ENVIRONMENT MANAGEMENT SYSTEM (EMS)
OF K.G.COLLEGE, PAMPADY

TIES

KURIAKOSE GREGORIOS COLLEGE
PAMPADY
DUTY ACCOMPANIES RIGHT



Plans to protect air and water,
wilderness and wildlife
are infact plans to protect man

- Stewart Udall

10

Best practices
of Environment Management System

10.1. INTRODUCTION

The College has a strong environment management system. In today's rapidly evolving world, the integration of sustainable development into college curricula has become increasingly imperative. As institutions of higher learning, colleges bear a crucial responsibility in equipping students with the knowledge and skills necessary to navigate the complexities of a sustainable future. By embracing best practices that foster academic integration in sustainable development, colleges not only empower students with practical insights but also ignite a ripple effect that extends beyond the classroom, reaching into their families and communities. This introduction sets the stage for an exploration of how colleges can serve as catalysts for meaningful change, nurturing a generation of individuals poised to make impactful contributions to society's collective well-being.

10.2. ALTERNATIVE ENERGY SOURCE- SOLAR PLANT

Implemented as part of Energy Management System

Energy is a highly utilized resource, and its conservation poses a significant global challenge. To address this, the implementation of alternate energy resources becomes imperative. In line with this objective, our educational institution has embarked on a path towards adopting alternative sources, notably through the installation of solar energy. Presently, the college boasts a 10 kVAh solar production capacity, empowering the campus to harness solar energy for the main building and self-financing department functions. The surplus energy is redirected to the Kerala State Electricity Board (KSEB). This approach not only aids in reducing the institution's carbon footprint effectively but also aligns with a commitment to environmental sustainability. The solar installation is associated with meter number 1156351003205, featuring a dual meter (net meter) production system. During the five month period ie., 11.09.2023 to 01.02.2024, a total of 5595 unit of electricity has been generated with a monthly average production of 1120 kWh. Students actively participate in monitoring the readings and documenting the progress, providing them with valuable insights into the significance of alternate energy resources and their potential impact.

10.3. VEHICLE SHARING PRACTICE

Implemented as part of Energy Management System

Faculty and few staff members practice the habit of sharing vehicles to reduce the number vehicle thereby reduce the burning of fossil fuels and reduce carbon emissions. Here faculty and staff act as model for practicing such method of energy conservation.

10.4. VEGETABLE TOWER

Implemented as part of Waste Management System

College has a vegetable tower which is well managed by student under guidance of faculty, the implementation of waste management and sustainability practices is a crucial objective. Food waste of the campus is regularly collect and put in tower like structures made out of wire mesh. Vegetable seeds are sown to the compost formed inside the tower. This sustainable process not only yields 2 to 3 kg of quality produce but also allows students to market the vegetables to nearby shopkeepers. This initiative not only imparts practical knowledge about organic farming but also integrates vocational training seamlessly into higher education, emphasizing the significance of responsible and sustainable practices.

10.5. GARDEN FOR MEDICINAL PLANTS

Implemented as part of Biodiversity Management System

The college actively preserves its greenery, emphasizing the establishment and upkeep of a medicinal garden by students under faculty guidance. This initiative serves the overarching objective of cultivating a cultural awareness among students regarding traditional medicinal practices employed by ancestors. By fostering an understanding of herbs and shrubs, the college aims to impart additional knowledge and instill a sense of responsibility for sustaining the ecosystem.

10.6. BUTTERFLY GARDEN

Implemented as part of Biodiversity Management System

The college actively preserves its greenery, with a primary focus on implementing environmental conservation and sustainability in educational institutions. This involves the establishment and upkeep of a butterfly garden, aiming to plant more host and nectarine plants to attract butterflies and contribute to the conservation of their habitat. It is an amazing visual treat that the aggregation of butterflies (Blue tiger [Tirumala limniace]; plain tiger [Danaus chrysippus]; common crow [Euploea core]; striped tiger [Danus genutia] etc.) on the inflorescence of host plants like Crotalaria retusa, which are planted at several locations, in the campus.

10.7. WATER USAGE MONITORING SYSTEM THROUGH WATER FLOW METERING

Implemented as part of Water Efficiency Management System

Water resource is a critical aspect of environmental conservation and sustainability in educational institutions, it is crucial to recognize water as a finite resource. The scarcity of fresh water necessitates proactive measures to conserve existing resources, achieved through systematic monitoring and efficient utilization. In pursuit of water conservation, our college has installed three water flow meters for accurate readings. Under the guidance of faculty, students (internal audit team) systematically monitor and record the progress, contributing to the effective maintenance of water conservation initiatives.

10.8. PARTICIPATORY AUDIT FOR SUSTAINABILITY

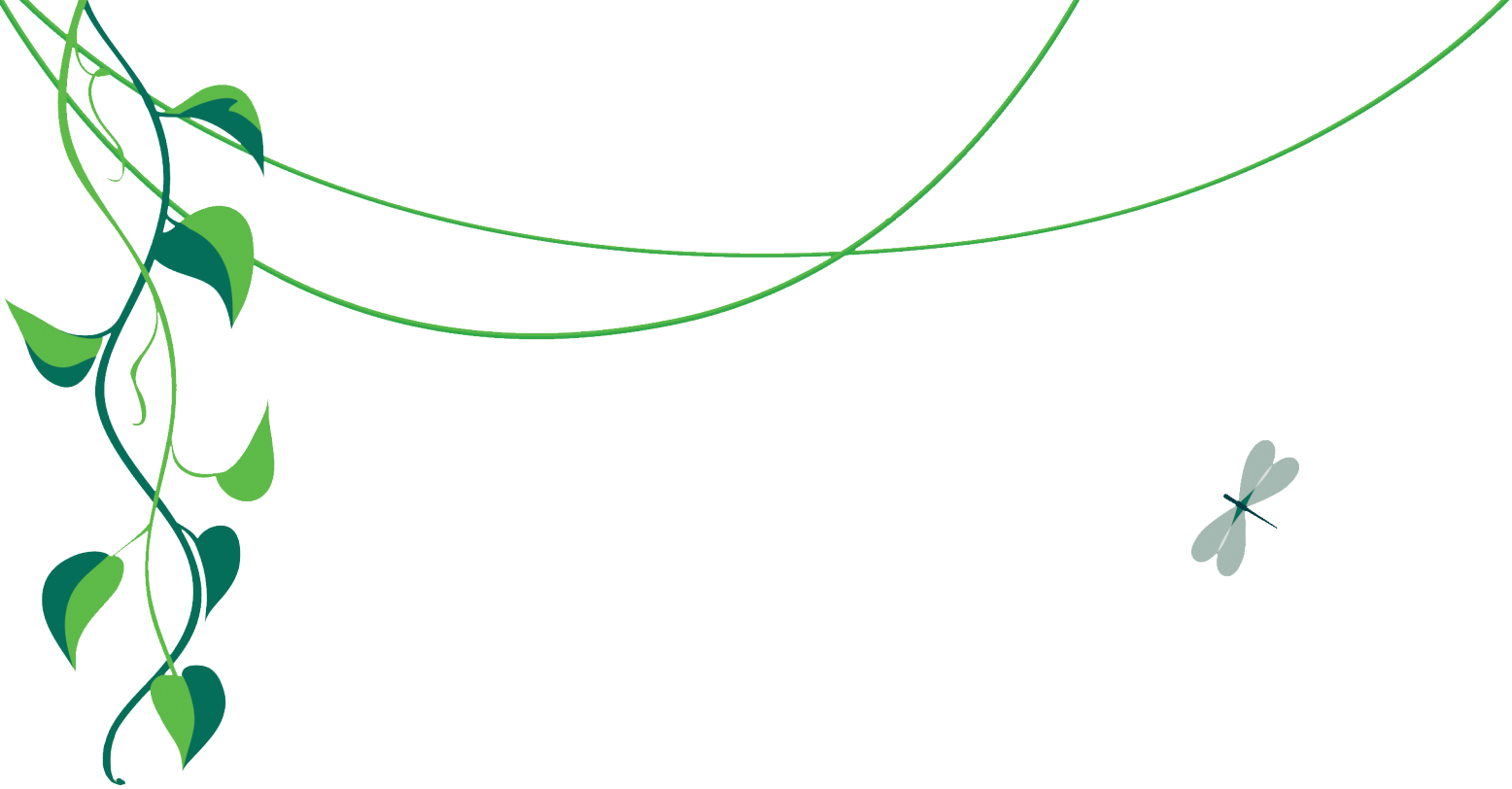
Implemented as part of Environment Management System

The college community actively participate in the green audit process, which ensure the sustainability of environment management in the educational institution. College has a team of 76 certified internal

auditors for monitoring and rectifying non conformities. Here college aims to ensure sustainable lifestyle among the college community. This involves integrating environmentally friendly practices, resource management, and conservation efforts into various aspects of campus life, curriculum, and operations to ensure long-term sustainability and environmental responsibility.

10.9. CONCLUSION

In conclusion, the implementation of an Environment Management System (EMS) incorporating solar power generation, vehicle sharing initiatives, establishment of medicinal plant and butterfly gardens, utilization of compost in vegetable tower gardens, deployment of water flow monitoring systems, and the integration of participatory audit processes presents a comprehensive framework for sustainable practices within a college environment. By embracing these best practices, the college not only reduces its environmental footprint but also fosters a culture of conservation, innovation, and community engagement. This holistic approach not only benefits the institution but also serves as a model for others striving towards environmental stewardship and sustainability.



Sustainable Development is the pathway
to the future we want for all it offers
a framework to generate economic growth
achieve social justice, exercise, environmental
stewartship, and strengthen governance

- Ban Ki - Moon

Chapter XI

EXECUTIVE SUMMARY

Executive summary

The green audit, conducted in accordance with ISO Standards 14001, 50001, 46001, 14046, and 14067/14064, is currently underway at KG College. This comprehensive assessment entails the scrutiny of various systems vital to environmental sustainability: the Environment Management System (EMS), Energy Management System (EnMS), Water Efficiency Management System (WEMS), Campus Biodiversity Register (CBR), Waste Management System (WMS), and Carbon Footprint (CF).

Upon analyzing the campus's energy consumption patterns, it was revealed that a total of 5209 kWh of electricity is utilized annually. Notably, the hostel demonstrates a higher annual energy consumption of 2703.33 kWh compared to the college, with an average monthly energy per capita consumption of 7.406 units. The college boasts a solar plant with an installed capacity of 10 kVha, generating an average of 1120 units of electricity per month. Furthermore, proactive measures such as awareness programs are implemented to promote energy conservation.

In terms of water efficiency management, an annual usage of 2104268.32 liters was observed across the college campus, with the main functionary area exhibiting the highest consumption at 13914678.3 liters per year. Despite experiencing hydrological droughts during summer, the college effectively monitors water usage through flow meters, contributing to conservation efforts. Additionally, the presence of a 3 lakh liter capacity rainwater harvesting tank reinforces the commitment to sustainable water management.
The Campus Biodiversity Register (CBR) encompasses a diverse array of species, including 27 species of birds, 13 species of butterflies, 26 species of other fauna, 44 trees, 35 herbs, and 41 shrubs. Calculations based on the Simpson Index indicate a relatively high level of biodiversity within the campus, a commendable feat considering its modest size of 8 acres and 42.4 cents.

KG College excels in Waste Management System (WMS) practices, with waste segregation at the source and proper management protocols in place. A total of 10992.40 kg of waste is generated annually, predominantly consisting of food waste (31%) and litter (18%). The innovative "vegetable tower" system efficiently utilizes food waste through organic farming-composting integration. Additionally, the hostel's biogas plant contributes to waste management efforts, though the management of greywater remains an unaddressed concern.

Despite challenges in data sufficiency, efforts to estimate the Carbon Footprint (CF) yielded approximate figures, with manual calculations indicating 33.28t CO2 and a cloud-based app suggesting 57.16 t CO2. The audit acknowledges the college's commendable Environment Management System quality, albeit with some non-conformities. Recommendations include infrastructure enhancements and improved internal communication mechanisms, alongside regular program implementations to further enhance sustainability initiatives.

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