REPORT OF

GREEN AUDIT

Marian College Kuttikkanam (Autonomous)

Kuttikkanam P.O,
Peermade, Idukki District,
Kerala, India

Based on International Standards
ISO 14001: 2015, ISO 50001: 2018,
ISO 46001: 2019, ISO 14046: 2014,
ISO 14067: 2018, ISO 45001:2018

TIES

MARIAN COLLEGE KUTTIKKANAM (AUTONOMOUS)
Affiliated to Mahatma Gandhi University, Kottayam

REPORT OF GREEN AUDIT

Based on International Standards

ISO 14001: 2015, 50001: 2018, 46001: 2019, 14046: 2014, 14067: 2018, ISO 45001:2018

Auditee

Marian College Kuttikkanam (Autonomous)

Kuttikkanam P.O, Peermade, Idukki District, Kerala, India

Affiliated to Mahatma Gandhi University

Auditor

Tropical Institute of Ecological Sciences

ISO 9001:2015 Certified organization

Ecological Research Campus, K.K. Road, Velloor P.O., Kottayam, Kerala - 686501

Affiliated Research Centre of Mahatma Gandhi University, Kottayam

Tel: - 9497290339, 9633723305, 0481- 2957050

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January, 2026

Disclaimer

This report is meticulously crafted by the Environment Management Committee of Marian College Kuttikkanam (Autonomous), Idukki, Kerala 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. College hostels and centenary block are not included in the study. Furthermore, the Report and Manual of Documented Information have undergone rigorous. Scrutiny by external auditors from TIES, ensuring alignment with ISO standards.

Published on 28th January 2026

Marian College Kuttikkanam (Autonomous), Idukki

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Preface

We are pleased and excited to present the Green Audit Report of Marian College Kuttikkanam (Autonomous), Idukki, Kerala. This report represents the result of extensive research, careful analysis, and committed efforts to thoroughly assess the Environmental Management System (EMS) of our institution. As a college dedicated to educational excellence, Marian College Kuttikkanam (Autonomous), understands the vital role of environmental stewardship and sustainability. In alignment with these values, we conducted a comprehensive review of our environmental practices, identifying strengths and areas for improvement in various aspects of our operations.

The report provides a detailed overview of our environmental performance, including an Energy Audit, Water Efficiency Management Audit, Waste Management Audit, Biodiversity Audit, Occupational Health & Safety and Carbon Footprint Data. Each section offers valuable insights into our resource use, conservation initiatives, and environmental impact, demonstrating our commitment to creating a greener and more sustainable campus.

The findings in this report not only highlight our dedication to environmental responsibility but also set the foundation for strategic initiatives to further enhance our sustainability efforts. By implementing the recommendations outlined here, we aim to continuously improve our environmental performance, reduce our ecological footprint, and inspire positive change both within our campus community and beyond.

We sincerely thank all those who contributed to this report, including management, Principal, IQAC, faculty, staff, students, and external stakeholders. Your collective efforts have been crucial in advancing our environmental objectives and reinforcing our commitment to sustainability. As we continue on this journey, we remain dedicated to the principles of sustainability, innovation, and excellence, working together toward a greener and more resilient future for everyone.

Environment Management System Committee
Marian College Kuttikkanam (Autonomous), Idukki Dist.
28.01.2026

In every walk with nature,
one receives far more than he seeks

- John Muir -

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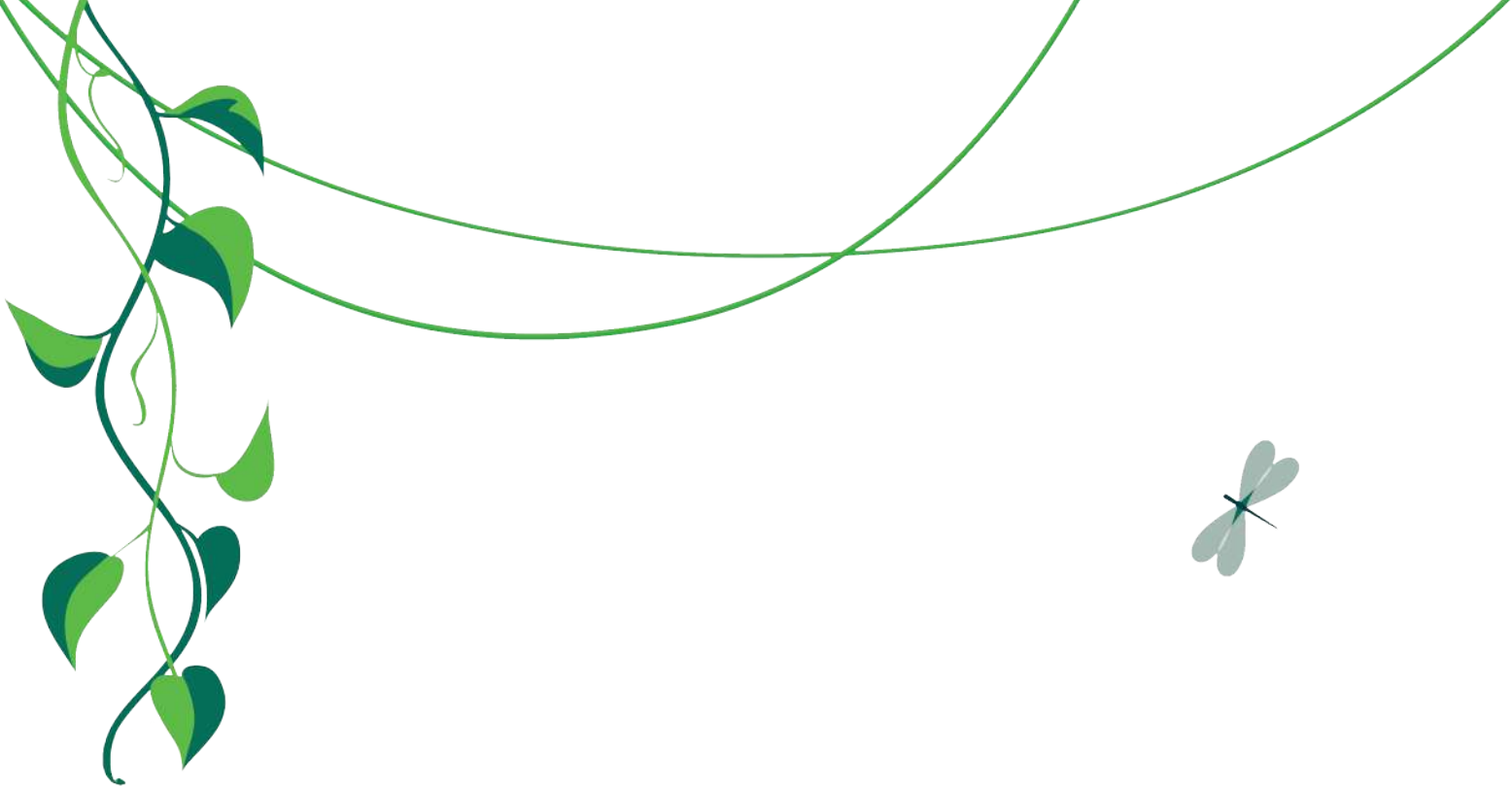
Chapter I

GREEN AUDIT AT ISO STANDARDS FOR COLLEGES & UNIVERSITIES

An Introduction

TIES



The Earth does not belong to us.
We belong to the Earth

- Marlee Matlin -

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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 MARIAN COLLEGE KUTTIKKANAM (AUTONOMOUS), IDUKKI

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 customized 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. Marian College Kuttikkanam (Autonomous)

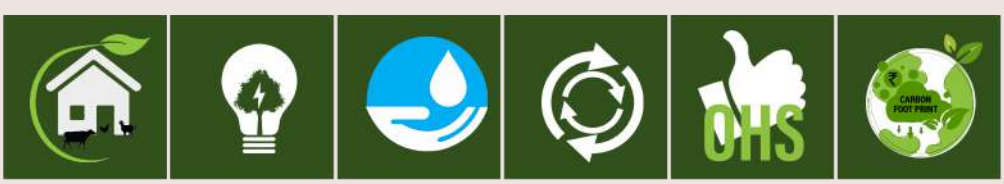
The IQAC coordinator and the Principal of the college requested Tropical Institute of Ecological Sciences (TIES) to conduct a green audit at the college on 18.02.2025. TIES initiated the formal proceedings of the audit by requesting the prerequisite data for green audit from the college, on 20.02.2025. The college has submitted required information on 22.02.2025. Subsequently, the MoU for green audit was signed between the Principal of the college and Secretary, TIES on 04.03.2025 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 04.03.2025. All participants who passed the evaluation process were given certificate as Internal auditor.

Internal auditors aggregated to various committees like Environment Management System Committee (EMS), Energy Management System Committee (EnMS), Water Efficiency Management System (WEMS), Waste Management System(WMS), Biodiversity Management Committee (BMC) and Occupational Health and Safety Management Committee (OHSM). The internal audit process have been implemented and carbon foot print of the college was estimated by EMS of 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 19.09.2025.
The first surveillance audit is scheduled for October 2026.

GREEN AUDIT
Based on ISO Standards

Environment Management System

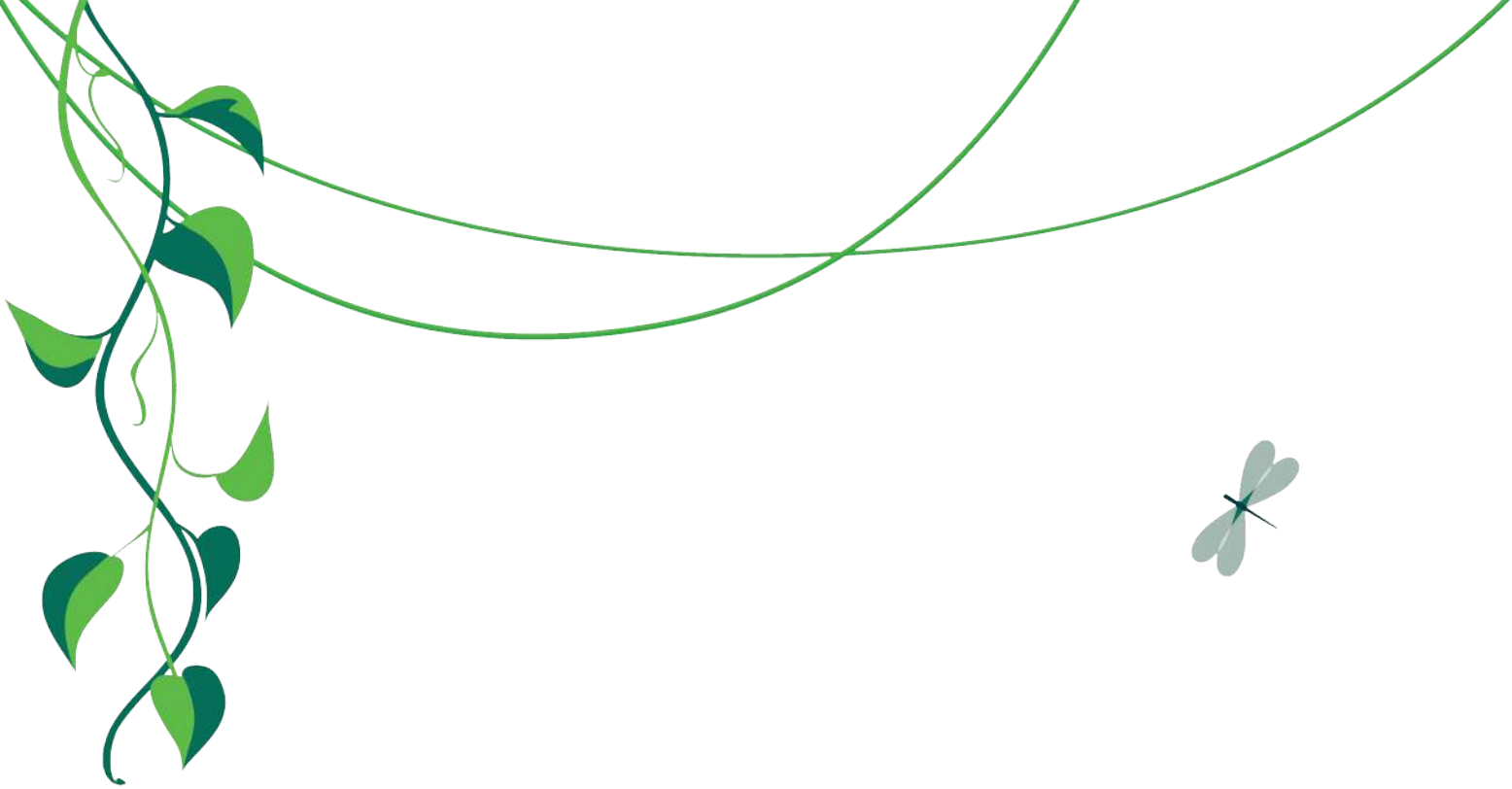


Biodiversity Management System | Energy Management System | Water Efficiency Management System | Waste Management System | Occupational Health & Safety | Carbon Foot print

TIES 2025

Chapter II

COLLEGE PROFILE
MARIAN COLLEGE
KUTTIKKANAM
(AUTONOMOUS)



Sustainable development begins
with Education

- UNESCO -

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College Profile
Marian College Kuttikkanam (Autonomous)

2.1 HISTORY OF THE COLLEGE

Marian College Kuttikkanam Autonomous, affiliated to Mahatma Gandhi University Kottayam, Kerala, was founded in 1995 and is managed by the Catholic Diocese of Kanjirapally through the Peermade Development Society (PDS). The institution is the realisation of the management's vision to provide quality higher education opportunities in the backward hill district of Idukki, which has a tribal, migrant, and minority population. Situated on a sprawling 26.5-acre campus in a serene rural location, the college holds Autonomous status with Minority Status and offers both Grant-in-Aid and Self-Financing programs. Since achieving autonomous status in 2016, Marian College has expanded its academic offerings to include thirteen departments, six undergraduate programs, seven postgraduate programs, and one PhD program. The institution is recognized under the University Grants Commission (UGC) under Sections 2(f) and 12(B), further enhancing its commitment to excellence in education and research.

The College is nestled in the green highlands of the Western Ghats, where biodiversity is garbed in the mantle of a cool, misty, and salubrious ambience ideal for academic pursuits. With her focus on job-oriented study programs that incorporate an outcome-based, technology-integrated learning approach, Marian is committed to enhancing the district's educational standing and preparing students to meet the challenges of the competitive job market and life situations. Banking on the divine direction of Christ Jesus and the benefaction of Mother Mary, the College champions her commitment to the 'full flowering of life in abundance.

The educational vision of the Management has given a sense of direction to the development of the College over the years. Marian performed consistently in the NAAC accreditations, securing high scores. The College was first accredited in 2003 with a B++ (83%) and again reaccredited with an 'A' grade (CGPA of 3.45) in 2009. During the third cycle of accreditation, held in 2014, Marian scored a high 'A' grade (CGPA 3.52/4). The College was conferred with the prestigious CPE status by UGC in 2009, and it was extended in 2014, making Marian eligible for phase II financial assistance. In 2016, the institution was elevated to the status of an Autonomous College by the UGC and was ranked 84th in NIRF 2018. Marian has mentored three colleges to get successful accreditation under the PARAMARSH scheme, including a college from North East India. In 2023, the college received a reputed CGPA score of 3.71 with an A++ grade in its fourth cycle of NAAC re-accreditation.

Marian has a glorious tradition of academic excellence proven through University ranks and high placements.

The College has academic tie-ups with several renowned international Universities like Hong Kong Baptist University, Chinese University of Hong Kong, Lincoln University College Malaysia, etc. Marian imparts information with the intention of the right character formation for the students, eventually achieving their holistic transformation. As a premier centre of knowledge generation and empowerment, Marian has always been at the forefront of taking up new academic and co-academic initiatives.

2.2 VISION

To be a transformational leader in education, facilitating and celebrating the "full flowering of life in abundance"

2.3 MISSION

- Facilitate an enriching scholastic experience focused on higher-order thinking and competencies.
- Create avenues for developing artistic, literary, and sports talents, life skills, personal health, and well-being.
- Nurture a collaborative learning community, open to the free exchange of ideas in which research, creative ideation, innovation, and entrepreneurship flourish.
- Influence the educational sector by strengthening and innovating outcome-based learning and assessments, fostering multidisciplinary engagements, and integrating technologies.
- Bring in a transformative impact on society – regional, national, and global- by attracting diverse talents and engaging with institutional partners.

2.4 MOTTO

Inform: To gain knowledge: Syllabus and beyond

Form: To assimilate the knowledge from different branches of information

Transform: To realise one's potential

2.5 CORE VALUE

- Respect: Respect moves us to understand the gifts and unique nature and contributions of every person in the Marian learning community and to value diverse perspectives.
- Excellence: Excellence commits us to challenge ourselves to utilize our God-given gifts – intellectual, social, physical, spiritual, and ethical.
- Compassion: Compassion compels us to stand with and embrace others in their sufferings so that, together, we may experience God's liberating, healing, and life-giving presence.
- Service: Service calls us to use our gifts, talents, and abilities to advance the genuine well-being of our community and those we encounter.
- Hospitality: Hospitality draws us to do our daily work with a spirit of graciousness that welcomes new ideas and people of all backgrounds and beliefs.
- Integrity: Integrity gives us the ability to realise the greater good in our actions and programs and challenges us to look at our work and ourselves holistically and as one that is united with nature and others across the globe.
- Diversity: Diversity builds a community that fosters an environment that is open and welcoming to diverse people, ideas, and perspectives; that promotes constructive discourses on the nature of diversity; and that engages faculty, staff, and students in activities that promote the core values of Marian's.
- Learning for life: Learning for life, in the liberal arts tradition, encourages us to pursue knowledge and truth throughout our lives in ways that improve our communities and ourselves and that strengthen our understanding of each other.

2.6 BOARD OF MANAGEMENT (BoM)

Name	Designation
H E Mar Jose Pulickal	Patron & Chairman of BoM
H E Mar Mathew Arackal	
V Rev Fr Joseph Vellamattam	
V Rev Fr Boby Alex Mannamplackal	Manager & Chairman of GB
V Rev Fr Kurian Thamarassery	
V Rev Fr Thomas Abraham Njalliyil	Administrator
V Rev Fr Philip Thadathil	
Prof Dr Ajimon George	Principal
V Rev Sr Mary Philip SH	
V Rev Fr Roy Abraham P	
V Rev Fr Dr Sabu John Panachickal	
Rev Fr James Kozhimala	
Dr Jose James	
Mr Joseph M Kallivayalil	
Mr George J Mathew	
Dr Mendus Jacob	
Adv V C Sebastian	
Mr K C Dominic	
Dr Jose Kallarackal	
Mr Jose Manuel Vattakkatt	
Prof Sheela Kuncheria C	
Rev Fr Dr Shaiju K S	Vice Principal & Secretary of BoM

Table 2.1 Board of Management

2.7 STATUTORY BODIES OF THE COLLEGE

A. Governing Board

Name	Constituency
Very Rev Fr Boby Alex Mannamplackal	Chairman
Prof Dr Baiju K R	University nominee
Mr T K Jose IAS	Management Nominee
Dr Jose James	Management Nominee
Dr Jose Kallarackal	Management Nominee
Rev Fr Thomas Abraham Njalliyil	Management Nominee
Dr James Jacob	Management Nominee
Prof K C Sunny	Management Nominee- Educationalist
Mr C M Ajayamohan	special Secretary Higher Education
Adv Biju P Mani	Representative of the Teachers
Dr Joshy John	Representative of the Teachers
Prof Dr Ajimon George	Secretary & Principal

Tabel 2.2 Statutory bodies - Governing board

B. Examination Cell

Designation	Name	Academic Qualification
Controller of Examinations	Dr Soosy Joseph	MA, M Phil, PhD
Additional Controller of Examinations	Mr Win Mathew John	MCA, PhD (pursuing)
Chief Superintendent of Examinations	Fr Dr Akhil P Joseph	MSW, PhD

Tabel 2.3 Statutory bodies - Examination cell

C. Finance Committee

Designation	Name	Academic Qualification
Chairman	Prof Dr Ajimon George (Principal)	M Com, M Phil, MBA, PhD
Nominee of the Governing Board	Fr Dr Sibichan Joseph (Assistant Professor)	MA, MBA, PhD
Member Secretary	Fr Thomas Abraham Njalliyil (Administrator)	B Th
Senior faculty of the college	Dr Joshy John	MBA, M Com, M Phil, PhD

Tabel 2.4 Statutory bodies - Finance committee

A. Academic Council

Category of Selection	Name	Academic Qualifications
Chairman (Principal)	Prof Dr Ajimon George	M Com, MBA, M Phil, PhD
Member Secretary	Dr Benymol Jose	MSc, M Phil, PhD
Head, School of Commerce and Professional Studies	Dr Rupa R	M Com, PhD
Head, Department of Business Administration	Dr Joshy John	MBA, M Com, M Phil, PhD
Head, UG Department of Computer Applications	Dr Rajimol A	MCA, PhD
Head, School of Social Work	Dr Justin P J	MSW, PhD
Director, PG Department of Computer Applications	Dr Mendus Jacob	MSc, M Phil, PhD, MioD
Head, Department of English	Mr Allen George Podipara	MA
Head, Department of Economics	Ms Suzanna Oommen	MA, MBA, HSM, PhD (pursuing)
Head, Department of Mathematics	Mr Kiran V Nath	MSc
Head, Department of Hospitality and Tourism Management	Mr Sajan N Thomas	M Com, PhD (pursuing)
Director, Marian Institute of Management	Dr Muralivallabhan T V	MA, PhD
Director, Department of Communication and Media Studies	Prof M Vijayakumar	MCJ
Head, Department of Physics	Dr Sunny Mathew	MSc, PhD
Head, Department of Health and Wellness	Dr Martin Babu Panackal	M P Ed, PhD
Controller of Examinations	Dr Soosy Joseph	MA, M Phil, PhD
Member based on seniority	Ms Amruth K John	MSc, M Phil, PhD (pursuing)
Member based on seniority	Dr Lumy Joseph	MCA, M Phil, PhD
Teacher elected by Regular Teachers of the College from among themselves	Mr Biju P Mani	LLM, PhD (pursuing)
Teacher elected by Regular Teachers of the College from among themselves	Dr Binu Thomas	MCA, PhD
Experts from outside (Administration & Law)	Mr Augustine Peter IES	MA, MSc, LLB
Experts from outside (Industry)	Mr Anumod Alex Thomas	MCA
Experts from outside (Industry)	Mr Jeevan Sasidharan	MBA, ACCA, CS
Experts from outside (Education)	Prof Dr Gireeshkumar G	M Com, M Phil, MBA, PhD

Nominee of University	Prof Dr Beena Mathew	MSc, PhD
Nominee of University	Prof Dr P S Sukumaran	MA, M Ed, PhD
Nominee of University	Prof Dr Johney Johnson	M Phil, PhD
Special Invitees	Dr Jose James	PhD, DSc
Special Invitees	Fr Dr Shaiju K S	MA, PhD
Special Invitees	Dr Joby Cyriac	MA, B Ed, PhD
Special Invitees	Mr Sreejayan P P	MBA

Tabel 2.5 Academic council of the college

2.8 EXECUTIVE COUNCIL

Name	Designation
Rev Fr Thomas Abraham Njalliyil	Administrator
Prof Dr Ajimon George	Chairman
Dr Lumy Joseph	Vice-Principal (Academics)
Rev Fr Dr Shaiju K S	Vice-Principal (Students Affairs)
Dr Joby Cyriac	Vice Principal (Administration) and Coordinator- IQAC
Dr Soosy Joseph	Controller of Examinations
Mr Sajan N Thomas	Coordinator- PM-USHA

Tabel 2.6 Executive council of the college

2.9 COLLEGE COUNCIL

Name	Academic Qualifications	Category
Prof Dr Ajimon George	M Com, M Phil, MBA, PhD	Principal
Dr Soosy Joseph	MA, M Phil, PhD	CoE
Dr Lumy Joseph	MCA, M Phil, PhD	Vice Principal (Academics)
Dr Joby Cyriac	MA, B Ed, PhD	Vice Principal (Administration)
Rev Fr Dr Shaiju K S	MA, PhD	Vice Principal (Student Affairs)
Dr Rajimol A	MCA, PhD	HoD, UG Department of Computer Applications
Dr Rupa R	M Com, PhD	HoD, SCAPS
Dr Joshy John	MBA, M Com, M Phil, PhD	HoD, UG Department of Business Administration
Dr Justin P J	MSW, PhD	HoD, UG Department of Social Work
Mr Allen George Podipara	MA	HoD, Department of English
Ms Suzanna Oommen	MA, MBA, PhD (pursuing)	HoD, Department of Economics
Mr Kiran V Nath	MSc	HoD, Department of Mathematics
Dr Sunny Mathew	MSc, PhD	HoD, Department of Physics
Dr Martin Babu Panackal	M P Ed, PhD	HoD, Department of Health & Wellness

Mr Sajan N Thomas	M Com, PhD (pursuing)	HoD, Department of Hospitality and Tourism Management
Dr Muralivallabhan T V	MA, PhD	HoD, PG Department of Business Administration
Dr Mendus Jacob	MSc, M Phil, PhD, MioD	HoD, PG Department of Computer Applications
Mr Ajesh P Joseph	MSW	HoD, PG Department of Social Work
Fr Sobi Thomas Kannalil	MSc, MBA, M Phil	HoD, Department of Media Studies
Dr Benymol Jose	M Phil, PhD	Secretary- Academic Council
Adv Biju P Mani	LLM, PhD (pursuing)	Coordinator -NEP Implementation Cell
Mr Siju P T	MA	Secretary
Mr Jobin Jose	M LISc	Librarian
Mr Pappachan K V	B Com	Office Superintendent In-charge

Tabel 2.7 Council college representatives

2.10 MARIAN IQAC

IQAC Composition 2024-2025	
Prof Dr Ajimon George	Chairperson
Core Team Members	
Dr Joby Cyriac	Co-ordinator
Dr Juby George	Joint Co-ordinator
Dr Benymol Jose	Criterion I
Ms Melby Joseph	Criterion II
Fr Dr Sibichan Joseph	Criterion III
Dr Jacob Bose	Criterion IV
Mr Ajesh P Joseph	Criterion V
Fr Dr Shaiju K S	Criterion VI
Ms Amruth K John	Criterion VII
Dr Lumy Joseph	Vice Principal – Academics
Mr Biju P Mani	Nodal Officer – FYUGP/NEP
Dr Soosy Joseph	Controller of Examinations
Mr Radhakrishna Pillai B	
Ms Jeena Joseph	
Mr Jerome Varghese	
Ms Reny Jose	
Dr Jobi Babu	
Mr. Sebastian Manuel	
Mr. Harishankar	
Mr Albin Kurian	

Management Representative	
Fr Thomas Abraham Njalliyil	Administrator
Administrative/Technical staff	
Mr Pappachan K V	Head Accountant
Mr Joby Jose	Clerk
Mr John Joseph	Technical Staff
Mr Jobin Jose	Librarian
One Nominee Each from Local Society, Students and Alumni	
Mr Vazhoor Soman	Local body member
Ms Anju Benny	Student
Mr Binoy Mathew	Alumni
One nominee each from Employers /Industrialists/Stakeholders	
Mr Joseph M Kallivayalil	Employer
Mr Amel Mathai	Industrialist
Dr Jose James	Stakeholder
Criteria Members	
All the Teaching Staff and Non-Teaching Staff	

Tabel 2.8 Marian IQAC representatives

2.11 NOTABLE ACHIEVEMENTS

Year	Title
Jan 2022	Outcome-Based Education Book released by Shri M Venkaiah Naidu, Honorable Vice-President of India on 3rd January 2022
	Transform Learning – A guide to implement Outcome -based Education written by Dr Cherian P Kurien, Fr Dr Roy Abraham P, and Fr Dr Regi M Cherian was published by Honorable Kerala Governor, Dr Arif Muhammed Khan on 11th January 2022
Oct 2022	Winner conferred on Marian College Kuttikkanam Autonomous for the category "Inclusive and Experiential Learning -Higher Education" by India Didactics Association (IDA).
	Excellence in distinctive accomplishments in main training a Sustainable Environment Award by Deepika in 2022
	Outlook i-care Ranking 2022 BBA-All India Rank : 80 Kerala Rank : 3 MCMS-All India Rank : 28 Kerala Rank : 3 BCA-All India Rank: 68 Kerala Rank :1 Arts college Category- All India Rank : 33
Dec 2022	1 Star Rating for Institution Innovation Council (IIC)
Mar 2023	Sustainable Institutions of India, within the Gold Band (A Grade), in The Green Rankings 2023
Apr 2023	Awarded the prestigious A++ Grade with a 3.71 CGPA on a 4 Point Scale CGPA on a 4-point Scale in the 4th Cycle by National Assessment and Accreditation Council (NAAC).

May 2023	Shortlisted by Higher Education Review Magazine as: Top 10 Most Promising BBA Colleges from India 2023
Jun 2023	OBE Ranking 2023 -ranked in the Gold Band
Oct 2023	MHW Rankings 2023 -ranked in Gold band
Nov 2023	Conferred "Torchbearer "award from India Didactics Association (IDA) 2023
	2 Star Rating for Institution Innovation Council (IIC)
Jan 2024	Autonomy status extension for a period of 10 years from the academic year 2022-2023 to 2031-2032
	Recognized as AICPA & CIMA academic partner
Mar 2024	Sustainable Institutions of India, within the Silver Band, in The Green Rankings 2024

Tabel 2.9 College reorganisation and awards

2.12 COLLEGE ORGANOGRAM

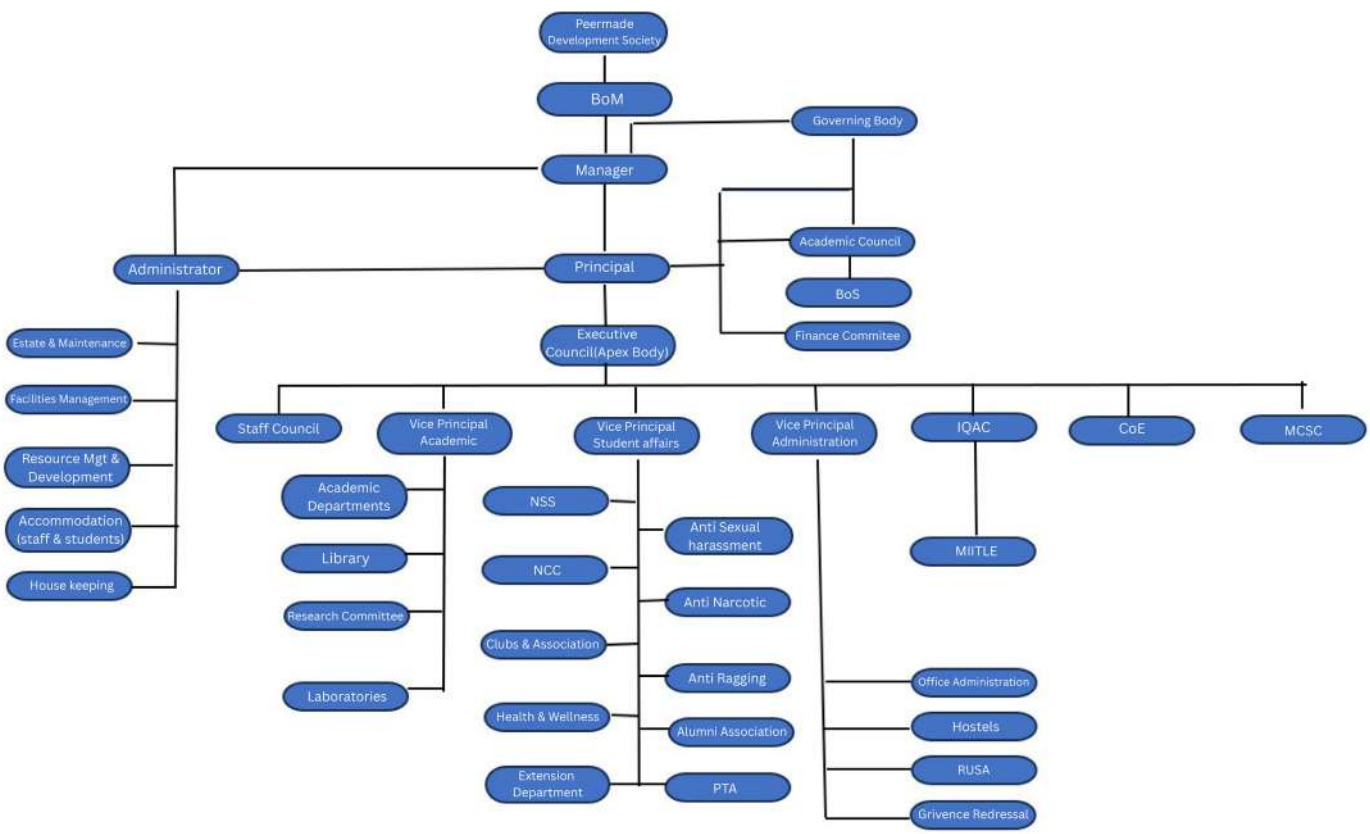


Fig 2.1 Organogram of the college

2.13 STRENGTH OF THE COLLEGE

2.13.1 Student

Strength of the college					
Sl No	Department	Program	Boys	Girls	Total
1	Physics	Integrated MSc Programme in Basic Sciences - Physics	24	32	56
2	Communication and Media Studies	M A in Communication and Media Studies (MCMS)	16	28	44
3	Hospitality and Tourism Management	MA (Hospitality and Tourism Management)	32	12	44
4	PG Department of Business Administration	Master of Business Administration	177	158	335
5	School of Commerce and Professional Studies	Master of Commerce Aided	10	20	30
6	School of Commerce and Professional Studies	Master of Commerce SF	19	32	51
7	PG Department of Computer Applications	Master of Computer Applications	77	39	116
8	School of Social Work	Master of Social Work	26	32	58
9	Mathematics	B Sc Mathematics	23	35	58
10	Economics	BA Applied Economics	44	36	80
11	Languages	BA English Literature, Communication & Journalism	27	53	80
12	UG Department of Business Administration	Bachelor of Business Administration	101	75	176
13	UG Department of Business Administration	Bachelor of Business Administration B	114	53	167
14	School of Commerce and Professional Studies	Bachelor of Commerce	82	113	195
15	School of Commerce and Professional Studies	Bachelor of Commerce (B Com) B	213	178	391
16	UG Department of Computer Applications	Bachelor of Computer Applications	86	99	185
17	UG Department of Computer Applications	Bachelor of Computer Applications B	114	63	177
18	School of Social Work	Bachelor of Social Work (BSW)	31	52	83
19	School of Social Work	Bachelor of Social Work (BSW) B	85	90	175
		Total	1301	1200	2501

Tabel 2.10 College students' strength

2.13.2 Teaching staffs

Strength of the Faculty							
Sl No	Department	Program	Men	Women	Contract	Permanent	Total
1	Physics	Integrated MSc Programme in Basic Sciences - Physics	4	4	0	8	8
2	Communication and Media Studies	M A in Communication and Media Studies (MCMS)	4	2	0	6	6
3	Hospitality and Tourism Management	MA (Hospitality and Tourism Management)	7	0	2	5	7
4	PG Department of Business Administration	Master of Business Administration	13	6	0	19	19
5	PG Department of Computer Applications	Master of Computer Applications	5	3	0	8	8
6	School of Social Work	Master of Social Work	3	2	0	5	5
7	Mathematics	B Sc Mathematics	1	5	0	6	6
8	Economics	BA Applied Economics	2	2	0	4	4
9	Languages	BA English Literature, Communication & Journalism	14	7	10	11	21
10	UG Department of Business Administration	Bachelor of Business Administration	2	1	0	3	3
11	UG Department of Business Administration	Bachelor of Business Administration B	1	3	0	4	4
12	School of Commerce and Professional Studies	Bachelor of Commerce and Master of Commerce	8	17	0	25	25
13	UG Department of Computer Applications	Bachelor of Computer Applications	2	5	0	7	7
14	UG Department of Computer Applications	Bachelor of Computer Applications B	1	7	0	7	8
15	School of Social Work	Bachelor of Social Work (BSW)	5	4	0	9	9
16	Health and Wellness		2	1	0	0	3
17	Law		1	1	0	0	2
			75	70	12	127	145

Tabel 2.10 College teaching staff strength

2.13.3 Non -teaching staff

Strength of the Non-Teaching Staff				
Sl No	Category	Permanent	Contract	Total
1	Academic Councillors	1	0	1
2	Library Staff Group A	2	0	2
3	Library Staff Group B	2	0	2
4	Library Staff Group C	2	0	2
5	NTS Group A	10	0	10
6	NTS Group B	2	0	2
7	NTS Group C	22	0	22
8	NTS Group D	2	0	2
		43	0	43

Tabel 2.11 College non- teaching staff strength

2.13.4 Total Strength

Total strength of the college community		
Sl No	Inmates category	Total no
1	Teaching Staff	145
2	Non Teaching Staff	43
3	Students	2501
4	House Keeping, Security & Other Staffs	89
Total		2778

Tabel 2.12 Strength of the college

2.13.5 Detailed program of the college

2.13.5.1 Aided program

Aided stream		
Sl No	Department	Program
1	School of Commerce and Professional Studies	Bachelor of Commerce
2	UG Department of Computer Applications	Bachelor of Computer Applications
3	UG Department of Business Administration	Bachelor of Business Administration
4	School of Social Work	Bachelor of Social Work (BSW)
5	School of Commerce and Professional Studies	Master of Commerce Aided
6	Hospitality and Tourism Management	MA (Hospitality and Tourism Management)
7	Physics	Integrated MSc Programme in Basic Sciences - Physics

Table 2.13 Aided programs of the college

2.13.5.2 Self-financing program

Self- financing program		
Sl No	Department	Program
1	School of Commerce and Professional Studies	Bachelor of Commerce (B Com) B
2	UG Department of Computer Applications	Bachelor of Computer Applications B
3	UG Department of Business Administration	Bachelor of Business Administration B
4	School of Social Work	Bachelor of Social Work (BSW) B
5	Mathematics	B Sc Mathematics
6	Economics	BA Applied Economics
7	Languages	BA English Literature, Communication & Journalism
8	School of Commerce and Professional Studies	Master of Commerce SF
9	PG Department of Computer Applications	Master of Computer Applications
10	PG Department of Business Administration	Master of Business Administration
11	School of Social Work	Master of Social Work
12	Communication and Media Studies	M A in Communication and Media Studies (MCMS)

Table 2.14 Unaided programs of the college

2.13.5.3 Research Department

Doctoral program		
Sl No	Department	Program
1	Commerce	PhD Commerce
2	Social Work	PhD Social Work

Table 2.15 PhD programs

Sl No	Program	Male	Female	Total
1	LUCMRC	14	32	46
2	Social Work	2	3	5
3	Commerce	5	8	13
Total		21	43	64

Table 2.16 Strength of PhD student

Sl No	Program	Staff
1	LUCMRC	6
2	Social Work	2
3	BCA	1
4	Commerce	4
Total		13

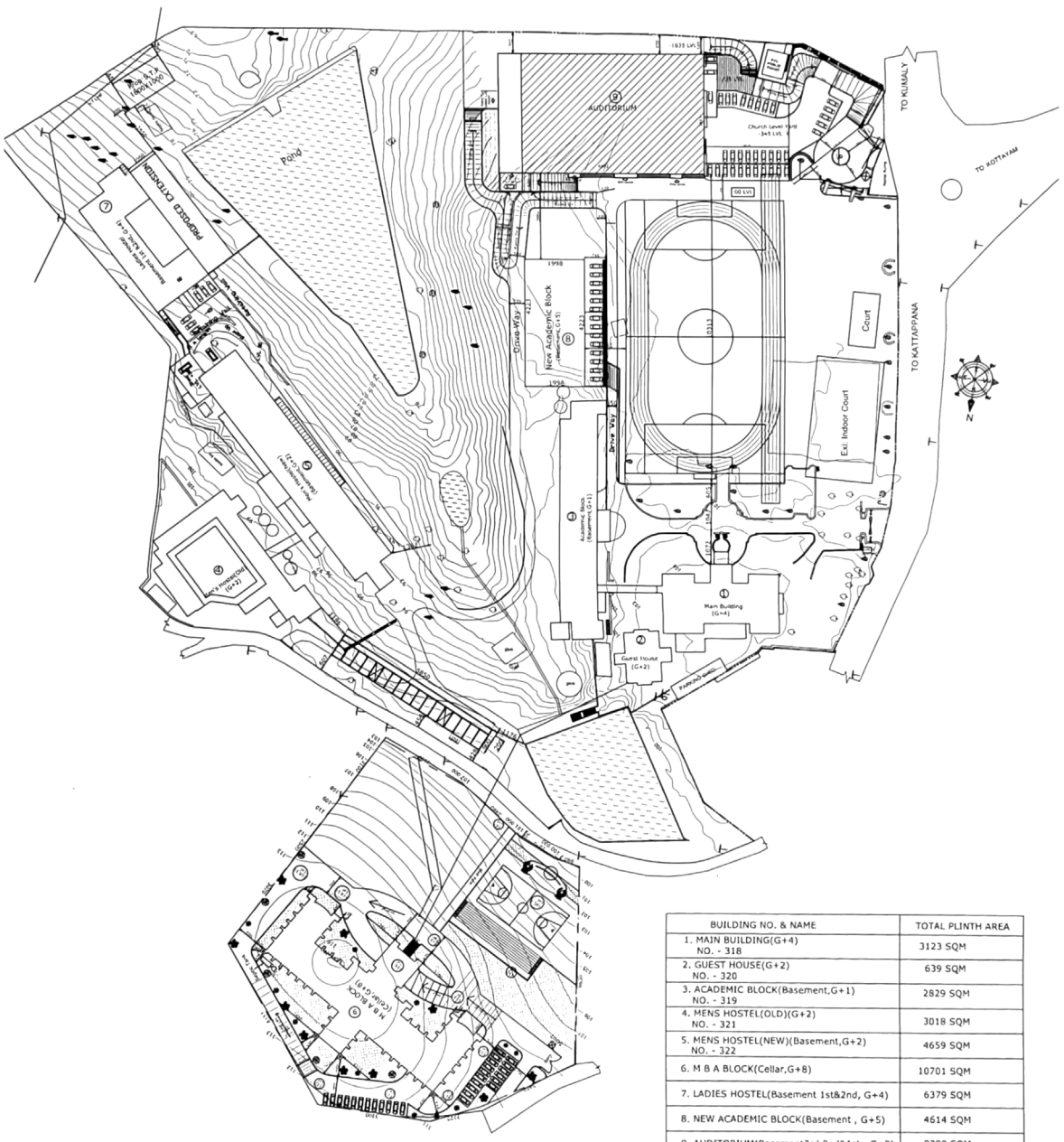
Table 2.17 PhD supervising teachers

Sl No	Name	Title	Design No:	Status
1	Dr Vincent	AI-Based English Learning Robot	437512-001	Published
2	Binu Thomas	Web Accessibility Enabled Ai-Usb Device	444851-001	Published
3	Akhil P Joseph and Anithamol Babu	Social work training ai device	441286-001	Published
4	Kochumol Abraham	Soil monitoring device	423043-001	Published
5	Akhil P Joseph and Anithamol Babu	Device for alcohol use disorder monitoring	441866-001	Published
6	Sr. Italia Joseph Maria	Leukemia diagnosing portable machine	448799-001	Published
7	Binny Jose	AI Assisted psychotherapy device	451276-001	Published
8	Dr Martin Babu Panackal	Portable sports field line marker machine	452815-001	Published
9	Gilbert A. R and Sobi Thomas	Portable teleprompter display	451275-001	Published
10	Anithamol Babu and Akhil P Joseph	Psychosocial assessment device	452536-001	Published
11	Dr Soosy Joseph	Mathematics learning assessment device	453285-001	Published
12	Kochumol Abraham and Sr. Italia Joseph Maria	Cardamom quality identify device	453288-001	Published
13	Akhil P Joseph and Anithamol Babu	Therapeutic chamber for trauma recovery	452260-001	Published
14	Dr Soosy Joseph	Clinical smart bed	453283-001	Published
15	Dr Soosy Joseph	Disability monitoring wearable neurocognitive device	453284-001	Published
16	Jeena Joseph	Neuro-responsive tactical helmet	459270-001	Published
17	Dr. Jobi Babu	Portable rural education smart pod	459273-001	Published
18	Sr. Italia Joseph Maria	Mountain hazard detecting driving assistance device	457581-001	Published
19	Dr. Justin P. J	Neuro sensory mapping stimulation device	463991-001	Published
20	Robins A Kattoor	Swarm-based hazard detection device	458617-001	Published
21	Dr. Jobi Babu	Curriculum scheduling device	463989-001	Published
22	Dr. Justin P. J	Portable mdma detection biosensor	463994-001	Published
23	Jeena Joseph	Cardiogram diagnostic ai device	462842-001	Published
24	Dr Juby George	Hybrid deep learning architecture device	465548-001	Published
25	Dr Juby George	Automatic cardamom irrigation machine	466099-001	Published
26	Melby Joseph	AI-Powered business finance planning device	463953-001	Published

27	Sobi Thomas	Newsroom assistant ai console	462197-001	Published
28	Sobi Thomas	Wearable speech to sign translator device	462616-001	Published
29	Dr Ajimon George	Portable Document Scanner	472737-001	Published
30	Sr Soumya	Emotion Mapping Device	467753-001	Published
31	Gilbert A R	News reading and Reporting Device	467780-001	Published
32	Gilbert A R	Educational device for Classrooms	469662-001	Published
33	Simi John	Eco identifying seal	472651-001	Published
34	Win Mathew John	Portable interactive stylus device	471532-001	Published
35	Simi John	Office waste segregation device	472653-001	Published
36	Jobin Jose	Library noise monitoring device	470093-001	Published
37	Jobin Jose	AI-Powered smart book tracking device	475255-001	Published

Table 2.18 Patent titles the college had received

2.13.6 Campus layout



BUILDING NO. & NAME	TOTAL PLINTH AREA
1. MAIN BUILDING(G+4) NO. - 318	3123 SQM
2. GUEST HOUSE(G+2) NO. - 320	639 SQM
3. ACADEMIC BLOCK(Basement,G+1) NO. - 319	2829 SQM
4. MENS HOSTEL(OLD)(G+2) NO. - 321	3018 SQM
5. MENS HOSTEL(NEW)(Basement,G+2) NO. - 322	4659 SQM
6. M B A BLOCK(Cellar,G+8)	10701 SQM
7. LADIES HOSTEL(Basement 1st&2nd, G+4)	6379 SQM
8. NEW ACADEMIC BLOCK(Basement , G+5)	4614 SQM
9. AUDITORIUM(Basement3rd,2nd&1st , G+2)	9299 SQM
TOTAL	45261 SQM

ARCHITECT JOHN.J.KOCHERRY M.G.ROAD CHANGANACHERRY	MARIAN COLLEGE AT KUTTIKKANAM	SITE PLAN
		DATE - 8th DEC. 2025

Fig 2.2 Campus Layout of the college (Second photo shared in WhatsApp)

2.13.7 Campus Location

Fig 2.3 Campus Location of the college

2.13.8 Facilities of the college

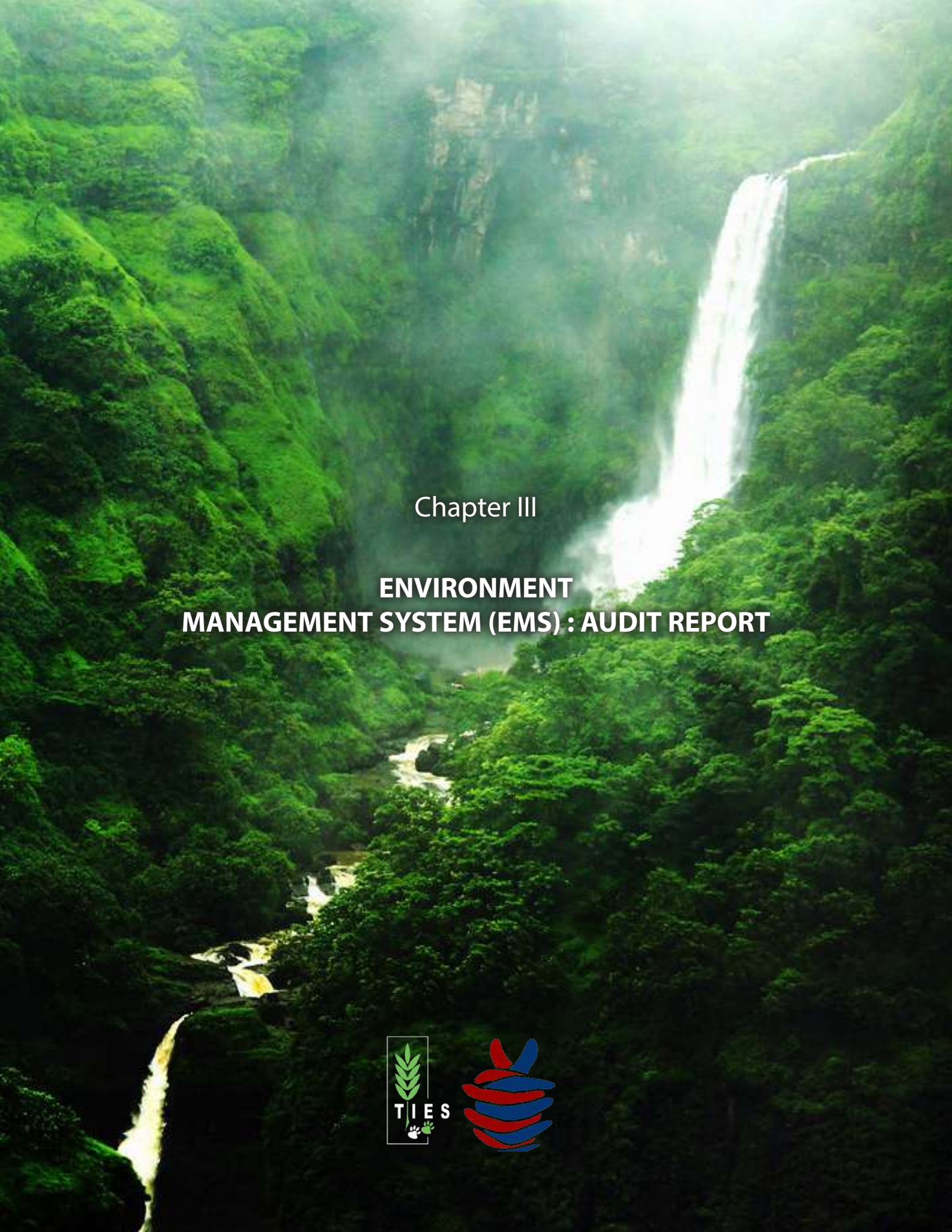
Facilities of the College		
Sl No	Facilities	Count
1	Playground	5
2	Auditorium	2
3	Library	2
4	Laboratory	4
5	Conference Hall	8
6	Indoor Stadium	1
7	Gym	2
8	Common Rooms	14
9	Computer Centre	5
10	Cafeteria	2
11	Guest House	1
12	Classrooms and Seminar Halls	72
13	Toilets	104
14	Studio	1
15	Dams	2
16	Health Centre	2

Table 2.19 Facilities of the college

2.13.9 Hostel Strength

Total Strength of Hostel					
Sl No	Hostel	Inmates category			Remarks
		Students	Staff	Total no	
1	Paul Iby	224	5	229	
2	Maryknoll	402	4	406	
3	Madonna	368	23	391	
4	SH	327	0	327	Outside college limits
5	Amala	100	0	100	Outside college limits
6	Carlo	234	12	246	Outside college limits
7	John Bosco Pratheeksha	154	2	156	Outside college limits
	Total resident capacity of the campus hostel			1026	

Table 2.20 Hostel strength of the college



Chapter III

ENVIRONMENT MANAGEMENT SYSTEM (EMS) : AUDIT REPORT

ENVIRONMENTAL MANAGEMENT COMMITTEE (EMS 2025-26)

Rev. Fr. Boby Mannamplakal
Manager
Rev. Fr. Thomas Abraham Njaliyil
Administrator
Fr. Ajo Pezhumkattil
Asst. Administrator
Prof. Dr Ajimon George
Principal
Dr. Joby Cyriac
IQAC coordinator & Vice-Principal
Dr. Fr. Shaju, Dr. Lumy Joseph
Vice Principals
Dr. Joshy Josh, Dr. Sunny Mathew, Dr. Mendus Jacob, Dr. R. Rupa, Dr. Martin Babu, Mr. Kiran V Nath, Mr. Allen George Podippara, Mr. Sajan N Thomas
Directors / HoDs
Dr. Muralivallabhan & Dr. Suzanna Oommen
Green audit coordinators
Dr. Juby George
IQAC Joint coordinator
Dr. Sheeja V. N., Ms. Amruth K John, Ms. Sheela S, Dr. Justin P. J., Fr. Binny Kaiyaniyil
Group coordinators
Giridhar Girish
Student Coordinator
Mr. Shibu Varghese, Mr Sijo Thomas, Mr. John Joseph
Non-teaching staff

3 Environment Management System

3.1. INTRODUCTION

An environmental management system (EMS) offers organizations a systematic framework for the identification, management, monitoring, and resolution of their environmental challenges in a thorough manner. ISO 14001, recognized as a premier international standard for EMS, is designed to be compatible with other ISO standards such as ISO 9001 for quality management and ISO 45001 for occupational health and safety, all of which follow a High-Level Structure. This alignment facilitates the seamless integration of ISO 14001 into pre-existing management systems. Applicable to organizations of various types and sizes, including private, governmental, and non-profit entities, ISO 14001 promotes the consideration of all environmental factors pertinent to operations. These factors encompass air quality, water and sewage management, waste minimization, soil contamination, climate change mitigation and adaptation, as well as the efficient use of resources. By complying with this standard, organizations can effectively diminish their ecological impact, fulfil legal obligations, and attain their environmental objectives.

The framework emphasizes the importance of resource efficiency, effective waste management, environmental monitoring, and active stakeholder participation in sustainability efforts. In a time marked by increased environmental consciousness and urgent global issues like climate change, biodiversity decline, and resource scarcity, higher education and various sectors play a crucial role in promoting sustainable practices. ISO 14001 provides organizations with a means to tackle these significant challenges by committing to regulatory compliance and ongoing environmental enhancement. Implementing ISO 14001 can yield substantial advantages, including waste reduction, energy conservation, cost savings, and improved organizational reputation. It highlights the organization's duty to sustainable development and encourages the cultivation of environmentally conscious citizens. As a symbol of environmental responsibility, ISO 14001 demonstrates a commitment to building a sustainable future while enhancing organizational resilience and success.

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 regularises 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 MANAGEMENT SYSTEM POLICY

3.2.1 Statement of Commitment

Marian College Kuttikkanam (Autonomous) is committed to fostering a sustainable, healthy, and resilient campus through the integration of environmental stewardship, energy efficiency, water conservation, biodiversity protection, waste management, and occupational health and safety, in alignment with the Sustainable Development Goals.

Situated in the peaceful hill station of Kuttikkanam, Peermade region, Idukki district, Kerala at an elevation of approximately 3,500 feet (1,100 meters) within the southern Western Ghats, a UNESCO World Heritage Site and global biodiversity hotspot the College enjoys a unique salubrious climate characterized by cool temperatures, frequent mists, lush greenery, and heavy monsoon rainfall that sustains expansive tea, coffee, and cardamom plantations, as well as man-made pine forests rich in avian diversity.

However, the region's steep terrain, combined with intense rainfall and growing tourism as a popular destination, poses significant challenges, including risks of soil erosion, landslides, habitat disturbance, and indirect impacts on local biodiversity and climate resilience.

The College recognises its responsibility to minimize environmental impact, conserve natural resources, and promote the well-being of students, staff, and the broader community. By embedding sustainability into governance, academics, operations, and community engagement, Marian seeks to create a model campus that harmonises education with ecological responsibility,

while addressing these location-specific vulnerabilities.

3.2.2 Goals

The Marian College Environmental Sustainability Policy aims to establish a unified framework for responsible campus stewardship by protecting biodiversity, promoting energy efficiency and renewable solutions, achieving a water-positive campus, minimising waste through circular economy practices, and ensuring a safe, healthy, and inclusive environment. As a learning centre located in the ecologically delicate and diverse area of Kuttikkanam in the Western Ghats, the College embraces its vital role in making meaningful contributions to the conservation of the unique natural beauty, fragile ecosystems, and rich biodiversity of the surrounding hill station and its environment. The policy integrates sustainability principles across academics, operations, and community engagement activities, while actively fostering awareness and cultivating a deep culture of environmental responsibility among students, staff, and visitors.

3.2.3 Objectives

- To conserve native and endemic species, restore degraded habitats, and promote awareness of ecosystem services.
- To reduce energy consumption, increase energy efficiency, and adopt renewable energy technologies wherever feasible.
- To achieve water positivity, reduce wastage, implement rainwater harvesting, and promote greywater reuse.
- To segregate, recycle, and responsibly dispose of waste; reduce single-use materials and promote circular economy principles.
- To protect the physical and mental well-being of all campus members through proactive risk management, safety protocols, and continuous improvement.
- To incorporate environmental literacy, sustainability practices, and responsible resource use into teaching, research, and co-curricular activities.
- To collaborate with local bodies, NGOs, and the community to promote sustainability and biodiversity initiatives beyond the campus.

3.2.4 Resource Management

Marian College adopts a holistic approach to resource management, ensuring sustainable use, conservation, and efficiency across all campus operations. The College actively manages and monitors key environmental resources through dedicated systems:

3.2.4.1 Biodiversity Management

In alignment with Sustainable Development Goal 15 (Life on Land), the college is committed to protecting and conserving native and endemic plant and animal species on campus. Efforts will focus on restoring and maintaining degraded habitats through targeted afforestation, tree-planting programs, and ecological restoration initiatives. The college also operates a dedicated weather forecasting service to support local farmers, enabling timely predictions of climatic conditions and early detection of potential changes. To further enhance ecological diversity, the institution will establish and maintain specialised botanical, herbal, butterfly, and pollinator gardens. Sustainable landscaping practices will be promoted, prioritising the use of native, drought-tolerant, and climate-resilient species. In addition, biodiversity awareness will be integrated into the curriculum, field projects, and community outreach programs. As part of our broader objective to protect, restore, and promote terrestrial ecosystems, regular biodiversity audits will be conducted, and comprehensive inventories of campus flora and fauna will be maintained to identify and address any deficiencies effectively.

3.2.4.2 Energy Management:

Consistent with the objectives of Sustainable Development Goal 7, which aims to ensure access to affordable, reliable, sustainable, and modern energy, upgrade to energy-efficient lighting, HVAC systems, appliances, and laboratory equipment. prioritise the installation of renewable energy solutions, such as solar panels and solar water heating systems, wherever feasible. Smart energy management systems will be implemented to optimise energy usage in hostels, laboratories, and administrative buildings. Energy conservation will be promoted through targeted awareness campaigns, student-led initiatives, and behavioural change programs. The unique climate of Kuttikanam naturally limits the need for fans and air conditioners, thereby reducing overall energy demand. To address potential power interruptions common in hilly areas, the campus is equipped with high-capacity

generators (two 125 kVA units and one 65 kVA unit) to ensure an uninterrupted supply. The institution will further explore innovations in sustainable energy through research collaborations and pilot projects. Additionally, regular energy audits will be conducted, and consumption patterns across the campus will be monitored with expert assistance to assess performance and identify opportunities for continuous improvement.

3.2.4.3 Water Efficiency Management:

Pursuant to Sustainable Development Goal 6, which focuses on clean water and sanitation, transform our campus into a model of water conservation practices. This will be achieved through the implementation of rainwater harvesting and recharge systems, as well as greywater recycling. Low-flow taps, dual-flush toilets, and sensor-operated fixtures will be installed to significantly reduce water consumption. Additionally, the college is equipped with a Sewage Treatment Plant (STP) of 27,000 L capacity for treating greywater. Harvested rainwater, stored in the check dam, serves as the primary water source for the campus. Water scarcity remains a critical challenge during the summer months, and stored water from the main source is utilised to address such situations. To optimise water usage in landscaping, smart irrigation systems, drip irrigation, and mulching techniques will be adopted. To foster a culture of conservation, behavioural change campaigns will be launched targeting students, faculty, and staff to encourage mindful water use in daily activities. Furthermore, water management principles will be integrated into academic programs, research initiatives, and community outreach efforts. Regular water usage audits will be conducted, along with proactive leakage detection and maintenance of plumbing systems, to ensure efficient and sustainable water management across the campus.

3.2.4.4 Waste Management:

In support of United Nations Sustainable Development Goal 12, which emphasises responsible consumption, implement a comprehensive waste management strategy that includes reducing, segregating, reusing, and recycling all waste generated on campus. promote circular economy practices by incorporating composting, biogas production, and the conversion of food waste into animal feed. Efforts will be made to minimise the use of single-use plastics by adopting eco-friendly, biodegradable, and reusable alternatives. ensure the proper disposal of hazardous, electronic, and chemical waste in accordance with applicable regulations. To foster a culture of sustainability, conduct awareness campaigns, community clean-up initiatives to foster connections among residents and workshops aimed at promoting responsible waste management practices among students and staff. Moreover, monitor waste generation trends and continuously enhance our recycling and composting programs. Regular audits of waste generation and management practices will be conducted to assess our progress and identify areas for improvement.

3.2.4.5 Occupational Health & Safety (OHS)

In furtherance of Sustainable Development Goal 3, which focuses on good health and well-being, committed to maintaining a safe and supportive environment for all students, faculty, staff, contractors, and visitors. conduct comprehensive risk assessments, regular safety audits, and emergency preparedness drills to ensure the safety and well-being of our community. The given regions are favourable for vulnerable terrain / landslide-prone slopes. The college will prioritise addressing these potential risks to prevent any structural damage. Our health and wellness programs will encompass first-aid training, mental health support, and preventive care initiatives to promote overall well-being. To enhance safety in high-risk areas, we will mandate the use of appropriate personal protective equipment in laboratories, workshops, and worksites. Clear safety signage will be prominently displayed, accessible pathways will be maintained, and we will comply with local, national, and international safety regulations. To foster a culture of safety, we will implement training sessions, awareness campaigns, and encourage active participation from both students and staff in safety committees. This integrated resource management framework will ensure that Marian College operates sustainably while bolstering our environmental, social, and institutional resilience.

3.2.5 Curriculum Integration

Environmental sustainability is integrated throughout various disciplines by offering courses, conducting field projects such as start-up facilities, and facilitating the publication of faculty research and patents. Initiatives include biodiversity mapping through the nature club, eco-restoration programs, and waste management

exercises, as well as conducting energy and water audits. Students engage in experiential learning projects and sustainability challenges to connect theoretical concepts with practical, real-world applications.

3.2.5 Green Initiatives

3.2.5.1 Biodiversity-Friendly Landscapes and Sustainable Gardens:
Maintenance of botanical, herbal, butterfly, and pollinator gardens; promotion of native, drought-tolerant, and climate-adaptive plants; ecological restoration of degraded areas; and integration of biodiversity-friendly practices across campus landscaping.

3.2.5.2 Smart Energy Management and Renewable Energy Adoption:
Implementation of energy-efficient lighting, appliances, and HVAC systems; installation of solar panels and other renewable energy solutions; energy audits; and behavioural programs to reduce energy consumption and carbon footprint.

3.2.5.3 Water Efficiency and Management:
Rainwater harvesting, groundwater recharge systems, greywater treatment and reuse; smart irrigation and drip systems for landscaping; periodic leak detection and plumbing upgrades; and campus-wide campaigns to encourage water-positive practices.

3.2.5.4 Waste Reduction and Circular Economy Practices:
Segregation of solid waste at the source, recycling and upcycling initiatives, composting of organic waste, conversion of food waste into animal feed, and minimising the use of single-use plastics; promoting awareness and participation across departments and residences.

3.2.5.5 Awareness, Training, and Student-Led Programs:
Workshops, campaigns, and seminars on sustainability and environmental responsibility; student-led green ambassador initiatives; participation in World Environment Day, Biodiversity Day, and other eco-events; and fostering a culture of environmental stewardship across the campus community.

3.2.6 Research and Innovation

The EMC, coupled with the Marian Centre for Sustainable Development and the Research Committee, fosters a strong culture of research and innovation by encouraging faculty and students to explore and design evidence-based solutions for biodiversity conservation, efficient water and energy management, waste minimisation, and enhanced OHS practices. The campus functions as a real-time sustainability laboratory where innovative ideas are piloted, tested, and refined, often in collaboration with local communities and partner institutions. Research initiatives also emphasise the integration of traditional ecological knowledge with modern sustainability technologies, enabling the development of context-specific, nature-aligned, and future-ready environmental strategies.

3.2.7 Community Engagement

3.2.7.1 Collaborate with the NGO Mental Health Action Trust to empower local communities through social, economic, educational, and psychological support initiatives. Conduct outreach programs in partnership with local panchayats, including Peelimedu, Peruvanthanam, Kanchiyar, Elappara, and Vandiperiyar. Additionally, implement an outreach program named "TENDILLS" that integrates tribal communities, rural villages, NGOs, schools, and community groups to deliver awareness campaigns and training on biodiversity conservation, energy efficiency, responsible water use, and sustainable waste management.

3.2.7.2 Engage community elders, farmers, traditional practitioners, and local knowledge holders to integrate indigenous ecological knowledge, traditional cultivation practices, and culturally rooted sustainability methods into campus learning and initiatives. Additionally, the college operates a weather forecasting program to support local farmers in villages through the early detection of weather changes.

3.2.7.3 Work closely with the Haritha Karma Sena for responsible scrap collection, plastic waste management, and community-linked recycling processes, ensuring efficient waste handling beyond the campus.

3.2.7.4 Disseminate sustainability knowledge and provide technical guidance through workshops, exhibitions, open programmes, and demonstration projects, helping neighbouring communities adopt eco-friendly practices.

3.2.7.5 Participate in government-led and community-driven environmental campaigns to strengthen the collective impact of Marian College's sustainability initiatives and promote long-term ecological stewardship.

3.2.8 Purchasing and Procurement

The management, students and staff of Marian College are committed to responsible purchasing practices that minimise environmental impact and support long-term sustainability. The purchase department prioritises eco-friendly, energy-efficient, and water-saving products in all procurement decisions to reduce resource consumption and operational footprints. Engagement with responsible vendors is a key focus, ensuring that suppliers follow ethical sourcing, sustainable manufacturing, and proper waste management practices. Additionally, all infrastructure development, construction, and renovation projects are guided by clearly defined sustainability standards, ensuring that materials, technology, and design choices align with environmental responsibility and the College's broader green campus goals.

3.2.9 Monitoring and Reporting

The IQAC, coupled with the administrative office, ensures effective implementation of its Environmental Management Policy through a structured and transparent monitoring system. All key environmental metrics, including energy use, water consumption, biodiversity health, waste generation, and OHS compliance, are continuously tracked by designated coordinators under the supervision of the Environmental Management Committee with the assistance of the audit committee of each component. Periodic internal audits, safety inspections, and environmental reviews are conducted to assess policy effectiveness and identify gaps that require corrective action. The findings from these evaluations are consolidated into an annual report, which documents major initiatives, performance outcomes, challenges, and improvement measures. This systematic monitoring and reporting mechanism ensures accountability, informed decision-making, and sustained progress toward the College's long-term environmental goals.

3.2.10 Compliance and Review

Marian College is committed to upholding the highest standards of environmental stewardship by ensuring full compliance with all relevant national, state, and local regulations governing environmental protection, water and energy management, waste handling, and occupational health and safety. To maintain the policy's effectiveness and alignment with emerging needs, the College undertakes a comprehensive review every three years or earlier, if required due to legislative changes, technological advancements, or institutional priorities. Designated committees are entrusted with monitoring compliance, addressing concerns, and implementing corrective measures, ensuring continuous improvement and responsible governance across all sustainability domains.

3.2.11 Leadership and Accountability

Leadership at Marian College plays a central role in advancing the institution's environmental sustainability commitments. The Environmental Management Committee (EMC), operating under the IQAC and supported by the Administrator, oversees the implementation of this policy, ensuring that sustainability initiatives are effectively integrated into campus operations. Department Heads, facility supervisors, and other key stakeholders are responsible for maintaining compliance and strengthening environmental practices within their respective areas of responsibility. Students, faculty, and staff contribute actively by adopting conservation habits, supporting efficiency measures, and upholding campus safety standards. Through regular reviews, audits, and awareness programmes, the College fosters a culture of continuous improvement, shared responsibility, and collective environmental stewardship.

3.2.12 Conclusion

This Environmental Sustainability Policy affirms Marian College's commitment to creating a campus that is ecologically responsible, resource-efficient, and socially conscious. By integrating biodiversity protection, energy and water stewardship, waste minimisation, and strong OHS practices into every level of campus functioning, the College ensures a holistic and future-ready approach to environmental management. Through coordinated leadership, community participation, continuous monitoring, and a culture of learning and accountability, Marian College positions itself as a model green campus dedicated to long-term sustainability and collective well-being.

3.3 ENVIRONMENTAL MANAGEMENT PLAN

Marian College Kuttikkanam (Autonomous) will commit to fostering a sustainable, healthy, and resilient campus by fully integrating environmental stewardship into its governance, academics, operations, and community engagements. The College will work to minimise its

environmental impact, conserve natural resources, and enhance the well-being of students, staff, and the wider community. Through this plan, Marian will move systematically toward becoming a model green campus that harmonises education with ecological responsibility and integrating sustainable development goals.

3.3.1 Establish an Adept Environmental Management Team

The College will establish a strengthened Environmental Management Committee (EMC) under the IQAC, supported by the Administrator and the Marian Centre for Sustainable Development. This team will coordinate campus-wide sustainability actions, assign responsibilities, and ensure effective implementation of biodiversity, water, energy, waste, and OHS initiatives. Department Heads, facility managers, and administrative units will be oriented to support and enforce policy decisions.

3.3.2 Formulate a Comprehensive Strategy for Sustainable Environmental Management

Marian College is committed to developing a comprehensive implementation strategy that effectively translates its sustainability policy commitments into actionable and measurable plans. This strategy will establish clear, quantifiable targets across key areas, including biodiversity conservation to protect native flora and fauna; energy efficiency and renewable energy adoption, with a focus on expanding solar power capacity and resolving existing production challenges; and enhancement of greywater treatment capacity to meet the water scarcity during the summer season. Reduction of water consumption through targeted behavioural change initiatives; promotion of circular economy principles and the Clean Drive initiative; and integration of innovative practices leveraging the institution's academic strengths. Additionally, the College will introduce and strengthen occupational health and safety (OHS) systems, ensuring efficient communication of emergency procedures and providing particular emphasis on climate-related risks. The overall plan will be fully aligned with institutional priorities, relevant national regulations, and internationally recognised global sustainability benchmarks.

3.3.3 Implement Effective Methods to Attain Set Objectives

The College will roll out structured programmes, infrastructure upgrades, behavioural campaigns, and capacity-building activities to achieve the policy objectives. Key measures will include:

3.3.3.1 Biodiversity Conservation

- Native species conservation and restoration of degraded habitats will be prioritised.
- Botanical, herbal, butterfly, and pollinator gardens will be maintained and expanded.
- Annual biodiversity audits and field-based learning will be strengthened.

3.3.3.2 Energy Management

- The College will conduct periodic energy audits and upgrade to energy-efficient systems.
- Solar panels and other renewable solutions will be installed wherever feasible.
- Smart energy monitoring systems will be implemented across academic blocks, hostels, and labs.

3.3.3.3.Water Efficiency

- Marian will work toward becoming a water-positive campus through rainwater harvesting, groundwater recharge, and greywater recycling.
- Smart irrigation, low-flow fixtures, and plumbing upgrades will be adopted.
- Regular water audits and leak detection mechanisms will be institutionalised.

3.3.3.4 Waste Management

- The campus will ensure strict segregation, composting, recycling, biogas production, and responsible disposal.
- Single-use plastics will be phased out.
- The College will continue engaging the Haritha Karma Sena for scrap and plastic waste collection, ensuring responsible community-linked recycling.

3.3.3.5 Occupational Health & Safety

- Regular safety audits, risk assessments, and emergency drills will be conducted.
- Safety gear will be mandated in all laboratories, workshops, and high-risk zones.
- Wellness, first-aid, and mental-health programmes will be strengthened.

3.3.4 Establish Robust Communication Channels and a Governing Body

The College with the support of EMS create strong communication platforms circulars, dashboards, awareness campaigns, stakeholder meetings to ensure transparency and community participation. The EMC will function as the governing body responsible for coordination, while student green ambassadors and departmental representatives will support ground-level communication and action.

3.3.5 Set Long-Term and Short-Term Goals

3.3.5.1 Long-Term:

- The College will strive to become a carbon-conscious, water-positive, biodiversity-rich green campus.
- Renewable energy share will progressively increase.
- A circular waste economy will be achieved through full segregation, recycling, and composting.
- A culture of environmental responsibility will be ingrained among all stakeholders.
- Install labelled, colour-coded waste segregation station in areas with high waste generation and demand

3.3.5.2 Short-Term:

- Conduct baseline assessments for energy, water, biodiversity, waste, and OHS.
- Install essential infrastructure (solar units, low-flow fixtures, segregation systems, safety equipment).
- Implement initial training and awareness programmes for students and staff.
- Raise the capacity of the sewage treatment plant
- Strengthen collaborations with panchayats, NGOs, and Haritha Karma Sena.

3.3.6 Continuously Monitor and Enhance the System

Designated coordinators under the EMC will continuously monitor environmental parameters, including resource use, waste trends, biodiversity health, and safety compliance. Internal audit and inspections will be conducted periodically to evaluate progress and identify areas for improvement. An annual Sustainability Report will be prepared to review performance, document achievements, and propose corrective measures to the respective team and management

3.3.7 Conclude and Conduct Follow-Ups on the System

At the end of each year, the EMC will evaluate the implementation outcomes and propose strengthened strategies for the following cycle. Follow-up actions will be scheduled to address pending tasks, emerging environmental issues, and new institutional priorities. The sustainability plan will be reviewed every three years, or more frequently if necessary, to incorporate new technologies, regulatory changes, and updated institutional objectives.

3.3.8 Conclusion

This Environmental Management Plan outlines Marian College's future pathway toward a fully sustainable and environmentally responsible campus. By adopting a structured implementation strategy, strengthening leadership and accountability, engaging all stakeholders, and continuously monitoring progress, the College will work toward becoming a model institution for ecological stewardship and long-term environmental well-being.

Chapter IV

ENERGY MANAGEMENT SYSTEM (En MS): AUDIT REPORT

ENERGY MANAGEMENT SYSTEM COMMITTEE (EnMS 2025-26)

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4

Energy Management System: Audit Report

4.1. INTRODUCTION

Energy is crucial to our daily lives, fulfilling a fundamental human need. It underpins almost every aspect of our routines, and our planet provides a variety of energy sources, each with its own characteristics. However, all energy sources have environmental implications, with ecological impacts arising from different factors. This article examines energy sources and their environmental consequences. The connection between energy and environmental issues is deeply intertwined, as the production, transport, and consumption of energy inevitably lead to significant environmental repercussions. The immediate consequences of energy use include air pollution, climate change, water contamination, thermal pollution, and the generation of solid waste. In particular, fossil fuel combustion is a major contributor to urban air pollution and a leading source of greenhouse gas emissions. Additionally, energy-related activities often create problems related to water pollution.

Electrical systems are complex networks of wiring and safety features that provide power to various applications, including heating, ventilation, and air conditioning (HVAC) systems, fans, pumps, computers, lighting, blowers, compressors, and heavy machinery. Nevertheless, their efficiency can decline due to factors such as ageing parts, dust accumulation, humidity, and outdated technology. These issues lead to energy losses, as electricity can be converted into heat, reducing efficiency and increasing power demand. Implementing energy auditing techniques can alleviate these inefficiencies by assessing the overall performance of the electrical system.

ISO 50001 enables organisations to systematically improve energy performance across all processes by identifying strategies to effectively manage energy consumption while communicating their energy management practices to a more environmentally aware public. Energy auditing, conducted in accordance with ISO standards and aligned with sustainable development goals, involves a thorough evaluation of energy usage in a specific area or building, focusing on identifying inefficiencies and enhancing energy performance. The insights gained from the audit inform the creation of effective energy management strategies, with the primary objective of reducing energy use while ensuring operational efficiency, comfort, and performance. Throughout the auditing process, factors such as occupant behaviour, building age, and climatic conditions are carefully examined to achieve precise and actionable results.

4.1.1 What is an energy Audit?

Energy auditing serves as a crucial instrument for pinpointing opportunities and strategies to improve energy efficiency. It plays a key role in uncovering potential efficiency measures and evaluating their economic feasibility at various operational levels. The process begins with an initial assessment that involves site inspections and general energy evaluations, aimed at discovering low-cost savings options. As the audits progress to more in-depth phases, they delve deeper into energy costs, consumption patterns, and system features, employing on-site measurements to identify significant efficiency upgrades that fit customised financial plans for the location. The requirements for carrying out an energy audit include:

- A comprehensive assessment of the energy infrastructure at the college or university is essential.
- An in-depth analysis of the energy consumption patterns across various utility points, highlighting areas of energy loss or inefficiency.
- To identify potential energy-saving opportunities, which may involve behavioural changes, upgrades to energy-efficient infrastructure and equipment, as well as the integration of alternative energy sources.

Conducting such thorough energy audits not only lays the groundwork for establishing an Energy Management System (EnMS) within educational institutions but also enhances the overall management of energy demand.

4.1.2. Needs for Energy Audit

With the increasing emphasis on sustainability in our everyday activities, there is a heightened and ongoing interest in professional energy management systems. This trend is fuelled by the understanding that conserving energy and minimising CO_2 emissions can significantly benefit our climate and environment. Recently, there has been a marked change in energy consumption patterns. In addition to the desire to lower electricity costs, many organisations are now utilising advanced machinery and equipment that are engineered for reduced energy use. The necessity for an efficient infrastructure has become increasingly apparent.The functions of the energy audit are:

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

Customising energy audits to align with effective energy management systems can significantly reduce energy expenses, enhancing your financial flexibility. As a result, you gain a more comprehensive understanding of operational processes and consumption trends, which facilitates the rapid and sustainable implementation of enhancement strategies.

4.1.3 Benefits Of Adopting Energy Management System

An energy management system, based on ISO 50001, can provide

Organisations have several benefits. These include:

- Aiding in the systematic reduction of energy consumption and carbon emissions.
- Establishing a detailed understanding of current energy usage to inform the setting of new goals and objectives.
- Assessing and prioritising the integration of new energy-efficient technologies and strategies.
- Offering a structure to enhance energy efficiency across the entire supply chain.
- Providing recommendations on how to benchmark, measure, document, and report on effective energy utilisation.
- Improving the utilisation of energy-consuming assets to discover opportunities for lowering maintenance expenses or increasing capacity.

4.2. ENVIRONMENT MANAGEMENT POLICY

4.2.1 Statement of Commitment

Marian College Kuttikkanam (Autonomous) is dedicated to integrating responsible energy management into its sustainability mission. The College commits to

continuously enhancing its energy performance by promoting efficient energy practices in alignment with Sustainable Development Goal 7, which seeks to provide affordable, reliable, sustainable, and modern energy for all. This commitment includes investing in standardised electrical systems that comply with national standards, upgrading infrastructure, and fostering a culture of energy conservation among all stakeholders.

4.2.2 Goals

Marian College aims to enhance energy efficiency and sustainability by reducing campus energy use by 5–10% annually, cutting carbon emissions through low-carbon practices, fully transitioning to LED lighting within a set timeframe, and requiring all departments to implement and review energy management plans aligned with ISO 50001:2018 EnMS standards.

4.2.3 Objectives

- To implement energy-saving programmes and ensure the use of energy-efficient appliances and electrical systems in alignment with Bureau of Energy Efficiency (BEE) standards.
- To integrate energy management and sustainability themes into academic curricula, projects, and practical learning experiences across departments.
- To promote interdisciplinary academic collaborations that link economics, environmental science, and technology for sustainable resource management.
- To optimize institutional resource planning and utilization based on periodic energy audits and data-driven decision-making.
- To create a campus culture that values mindful resource use through consistent communication, training, and recognition of exemplary energy stewardship.

4.2.4 Resource management

4.2.4.1 Energy-Efficient Infrastructure Upgrades: The institution prioritizes the phased upgrade of infrastructure to enhance energy efficiency. Lighting systems are being fully converted to LED. Automated pumping facilities have been introduced to eliminate frequent motor operation and optimize water flow. Complete transition to advanced electronic controls will proceed in stages. Future development plans will incorporate detailed assessments in consultation with EnMS members to align with internal standards and ensure long-term investment in high-quality infrastructure, including safer wiring, enhanced electrical security, and clearly visible signage. Given the unique climate of the area, the use of ceiling fans is infrequent; however, the institution will advocate for the installation of energy-efficient BLDC fans. Additionally, low-energy HVAC solutions, including naturally ventilated buildings designed for optimal daylighting and cross-ventilation, will be implemented.

4.2.4.2 Sustainable Power Generation: The college currently has an 80 kW solar generation capacity. Plans are underway to strengthen and expand solar energy production.

4.2.4.3 Energy-Saving Initiatives: Vehicle-sharing practices are actively promoted, with approximately 44% of the college community currently participating. Prominent signage is displayed across campus to encourage users to switch off electronic devices when not in use, fostering behavioural change toward energy conservation.

4.2.5 Curriculum Integration

Marian College integrates the principles of environmental stewardship and sustainable development into academic and co-curricular activities through the following initiatives:

4.2.5.1 Curriculum Integration: Embedding concepts of energy efficiency, renewable energy, and sustainability across relevant courses through exhibitions, add-on/ certificate programmes, crash courses, and internship opportunities.

4.2.5.2 Interdisciplinary Engagement: Promoting interdisciplinary projects, case studies, and club activities that focus on sustainable campus operations and green innovations aimed at developing energy-efficient processes, equipment, and practices.

4.2.5.3 Capacity Building and Awareness: Organising seminars, workshops, and expert lectures on sustainability issues for students and faculty under the

guidance of the IQAC and the Marian Research Centre for Sustainable Development, in collaboration with external agencies.

4.2.6 Green Initiatives

To promote a culture of sustainability across the campus, the College undertakes:

4.2.6.1 Eco-friendly Transportation: Promoting sustainable commuting by encouraging carpooling, adopted by nearly 40% of staff and students, fostering shared rides that reduce emissions; advocating cycling with dedicated campus paths and bike racks; and operating at least one electric vehicle for official institutional needs to minimise carbon footprints.

4.2.6.2 Energy-Conservation Campaigns: Launching engaging "Switch Off" and "Save Energy" drives to promote thoughtful energy-saving mindsets among all stakeholders, reinforced through vibrant informational signage across facilities and targeted behavioural nudges that inspire lasting conservation practices.

4.2.7 Purchasing and Procurement

4.2.7.1 Sustainable Procurement Guidelines: The EnMS will prioritize energy-efficient, eco-labelled, and recyclable products through a structured Priority Purchase policy presented to the management team; procurement decisions will incorporate life-cycle cost analysis and environmental impact assessments to ensure long-term efficiency and minimal ecological footprint.

4.2.7.2 Ethical Sourcing and Compliance Oversight: EnMS will promote local, ethical, and environmentally responsible suppliers while playing a key role in evaluating and reporting on energy-efficient infrastructure prior to building construction; all new equipment purchases will adhere to Minimum Energy Performance Standards (MEPS), undergoing mandatory review and approval by the Energy Management Committee (EnM Committee) as mandated by management.

4.2.8 Research and Innovation

4.2.8.1 Financial and Institutional Support for Research: Marian fosters advanced research in sustainable energy solutions by offering strong financial support, sanctioned by the college's research committee, to faculty and students investigating renewable energy sources, green technologies, and efficient carbon management strategies, thus facilitating innovative advancements that align with environmental objectives.

4.2.8.2 Strategic Collaborations and Global Engagement: The institution fosters a collaborative ecosystem for green innovation through formal Memoranda of Understanding (MoUs) with leading institutions, industries, and government agencies, enabling joint sustainable initiatives; additionally, it promotes active participation in prestigious national and international research projects on sustainability, carefully selected by the Internal Quality Assurance Cell (IQAC) and the Marian Centre for Sustainable Development.

4.2.8.3 Interdisciplinary Innovation and Intellectual Property Incentives: Marian encourages cross-disciplinary research and experimentation in sustainable energy by offering management-backed incentives for patenting novel ideas and technologies, inspiring faculty and students to blend diverse expertise into practical, impactful solutions that advance eco-friendly practices.

4.2.9 Community Engagement

4.2.9.1 Community Partnerships for Awareness: Marian College actively collaborates with the Peruvanthanam and Ellapara Grama Panchayats, local NGOs, and community groups through its dedicated Extension Department to organise impactful awareness campaigns and hands-on training programmes focused on energy conservation, empowering residents with practical knowledge to reduce consumption and adopt eco-friendly habits.

4.2.9.2 Outreach Programmes on Renewable Energy: The college conducts targeted outreach initiatives, including interactive workshops and seminars on renewable energy technologies and sustainable living practices, specifically tailored for students and staff of nearby schools as well as households in surrounding areas, fostering widespread adoption of green solutions.

4.2.9.3 Knowledge Sharing for Regional Impact: By disseminating best practices, innovative research

findings, and proven sustainability models developed on campus, Marian College supports broader local and regional efforts, contributing to policy advocacy, community projects, and collective environmental stewardship beyond institutional boundaries.

4.2.10 Monitoring and Reporting

4.2.10.1 Comprehensive Data Oversight and Management: The Energy Management Committee will oversee thorough data gathering and detailed analysis of energy usage trends throughout the institution, guaranteeing precise tracking and well-informed decision-making. At the same time, the EnMS will keep thorough inventories of all electrical equipment, along with careful records of maintenance schedules and usage logs to enhance accountability and minimise inefficiencies.

4.2.10.2 Annual Reporting and Performance Evaluation: An Annual Marian Energy Impact Report will be published to encapsulate key consumption trends, highlight audit findings, and measure progress against predefined energy targets, providing a clear benchmark for success and areas needing attention.

4.2.10.3 Audits, Transparency, and Continuous Improvement: Internal audits coupled with periodic external reviews will rigorously validate EnMS compliance, uncover opportunities for enhancement, and drive systemic improvements; all results, progress indicators, and actionable insights will be shared transparently with stakeholders via the IQAC and dedicated Sustainability Reports to foster trust and collective commitment.

4.2.11 Compliance and Review

4.2.11.1 Regulatory Compliance: The Administrator, in close consultation with the Energy Management Committee (EnMC) and Internal Quality Assurance Cell (IQAC), shall ensure full adherence to all applicable national and state-level environmental and energy regulations, maintaining updated documentation and conducting periodic audits to uphold legal and sustainability standards.

4.2.11.2 Annual Review and Goal Alignment: All energy management activities will undergo a comprehensive annual review process to evaluate implementation effectiveness, measure progress against predefined key performance indicators, and confirm alignment with the institution's broader environmental and operational objectives.

4.2.11.3 Stakeholder Feedback and Continuous Improvement: The Administrator will actively incorporate input from students, faculty, staff, and other stakeholders through surveys, forums, and feedback mechanisms, using these insights to drive continuous improvement, refine policies, and enhance the overall efficacy of energy management initiatives.

4.2.12 Leadership and Accountability

4.2.12.1 Leadership and Strategic Oversight by the Energy Management Committee: Chaired by the Administrator, the EnMS spearheads the planning, coordination, and evaluation of all energy-related initiatives across the campus; it ensures alignment with institutional sustainability goals through regular internal communication via periodic committee meetings, with detailed minutes precisely captured and promptly shared with the Internal Quality Assurance Cell (IQAC) and all relevant stakeholders for seamless transparency.

4.2.12.2 Departmental Accountability through Heads of Departments (HoDs): Each HoD is entrusted with enforcing energy management protocols within their respective departments, seamlessly integrating energy-efficient practices into daily operations; they proactively communicate responsibilities and guidelines to faculty, staff, and students via structured staff meetings, official circulars, and targeted training sessions to build awareness and compliance at the grassroots level.

4.2.12.3 Active Participation and Responsibility of Faculty, Staff, and Students: All members of the college community are mandated to strictly follow prescribed energy conservation practices, promptly report any observed inefficiencies or malfunctions, and actively engage in awareness campaigns, workshops, and conservation drives to cultivate a collective ethos of mindful resource usage and environmental stewardship.

4.2.12.4 Transparency and Continuous Improvement via IQAC Coordination: Working in close synergy with the EnMC, the IQAC upholds accountability by systematically maintaining comprehensive records of energy audits, performance reports, and corrective actions; it conducts thorough annual reviews and progress assessments to identify gaps, celebrate achievements, and drive ongoing enhancements in the energy management framework.

4.2.12.5 Holistic Framework for Sustainable Administration and Cultural Transformation: This integrated structure guarantees solid institutional coordination, real-time monitoring, and iterative improvement of the Energy Management System (EnMS), nurturing a pervasive culture of shared responsibility, proactive sustainability, and institutional excellence in energy conservation at Marian College.

4.2.13 Conclusion

Marian College Kuttikkanam (Autonomous) ensures effective implementation of this policy through coordinated efforts of the Administrator, IQAC, and Energy Management Committee (EnMC), supported by Heads of Departments and all campus stakeholders. Regular meetings, documented reviews, and internal audits will maintain transparency and accountability, while energy data analysis and annual reporting will guide continuous improvement. The college remains committed to integrating energy-efficient practices into all operations and progressively adopting smart monitoring and renewable energy systems to achieve sustainability outcomes.

4.3. METHODOLOGY

The energy audit systematically analysed the institution's energy usage according to a structured program. The 13 member internal audit team, comprising 11 students and 2 faculty, collected data under faculty supervision.

4.3.1 Internal audit training

Green audit training fosters institutional ownership and engagement through comprehensive, participatory approaches. To prepare the college for this, the established Energy Management System (EnMS) selects students and faculty for internal audit training. This one-day program certifies them as internal auditors, qualifying them to conduct an energy audit. The internal energy audit process includes key stages: assessment, risk analysis, data collection, policy generation, and documenting registers and programs for water conservation and resource management.

4.3.2. Power quality analysis

This assessment will evaluate the integrity of the facility's electrical system. A power quality analyser will be used to measure the power supplied by KSEB, focusing on voltage variations, power levels, and harmonic distortion. Concurrently, a thermal imaging of single phase and three phase performed to check for thermal anomalies and verify load balancing across each phase, serving as a basis for preventive maintenance. The evaluation will conclude with an assessment of the equipment's accessibility for service and the clear identification of the emergency shutdown controls within the specified area

4.3.3. Registers and documents

The team initiated the energy audit by consolidating seven registers and five documents, including the energy audit training attendance sheet, auditor list, meeting records, and the institution's energy conservation plan and policy. Students received the task of mapping the campus and marking electrical appliances. To monitor usage, the team maintained various registers tracking energy meter readings, monthly utility bills, solar production, motor pump operations, and appliance logs. They also kept a maintenance register to assess appliance performance (effective/ineffective) and log daily/weekly operating hours. The process specifically focused on collecting weekend data and separate meter readings for each block.

4.3.4. Energy infrastructure documentation

Detailed documentation of the college's energy infrastructure (covering lighting, audio-visual equipment, lab instruments, computers, and appliances) was prepared. Subsequently, the total annual energy consumption was calculated in KWH using the power specifications of these items and their average yearly usage duration.

4.3.5. Usage pattern assessment through energy meter sampling data

Power consumption for each block was calculated by consolidating data collected centrally over three weeks, ensuring accuracy through daily and weekly cross-checks. This process involved multiple methods: energy meter readings taken three times daily during a nine-day period (covering weekends and a weekday), observational visits by team members to detail equipment, lighting, appliances, power capacities, and usage patterns, and interviews with the system manager and relevant faculty for operational context.

4.3.6 Analysis of KSEB meter reading

Power consumption data from the Kerala State Electricity Board (KSEB) were obtained from regular meter bills for the specified periods (2022-2023, and 2023-2024).

4.3.7 Identification of energy saving options and scope of alternate energy resources

The team identified and documented potential alternative energy sources and proposed a corresponding action plan. To assess the college's carbon footprint, they analysed the campus's energy resources including KSEB supply and alternatives along with their annual usage patterns across various locations like laboratories, offices, and kitchens.

4.3.8 External Audit

External auditors visit the college to evaluate conformity with energy management audit requirements and identify any non-conformities. If only minor non-conformities are found, the external auditor may then approve the institution for certification against relevant ISO standards.

4.3.9. Assumption

An effective Energy Management System (EnMS), when aligned with an organization's business strategy, provides crucial visibility into energy usage and highlights areas for performance improvement. It achieves this by establishing structured policies, processes, procedures, and action plans specifically designed to identify and implement energy-saving opportunities, fostering a culture of continuous improvement in energy management.

The primary benefit of an EnMS is tangible cost reduction. Energy savings identified through the system directly translate into lower energy bills, significantly reducing overhead. Many organizations implementing ISO 50001 report first-year savings that meet or exceed the initial investment, demonstrating a strong link between reduced energy consumption and improved financial performance. Furthermore, an EnMS deepens the understanding of where, when, and how energy is consumed, enabling ongoing identification of efficiency improvements.

ISO 50001:2018, utilizing the Annex SL high-level structure, facilitates integration with other management systems like ISO 9001 (Quality) and ISO 14001 (Environmental). This allows for streamlined processes like document control, internal audits, and corrective actions, avoiding duplicated effort. A cornerstone of ISO 50001 is the comprehensive energy review, which forms the basis for determining Significant Energy Uses (SEUs) and identifying key efficiency opportunities.

Successful implementation hinges on management involvement. The standard requires setting clear energy objectives and measurable targets, considering SEUs and improvement opportunities. These must be monitored using tools like Energy Performance Indicators (EnPIs) compared against an Energy Baseline (EnB), then communicated and updated. Prescriptive data collection requirements ensure relevant information is gathered. Critically, ISO 50001 extends to the design and procurement of new or renovated energy-using installations, equipment, systems, or processes, embedding energy performance improvement throughout their lifecycle. Any significant deviations from expected energy performance must be investigated.

4.3.10. Stages of Energy audit

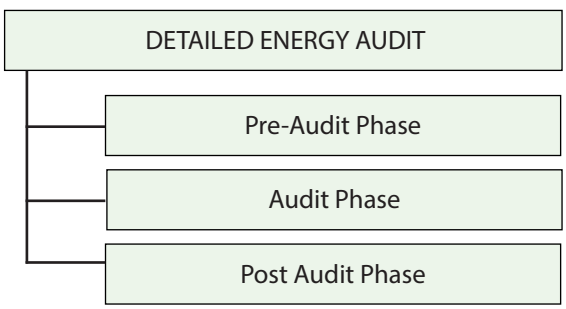


Fig. No. 4.1 An energy audit has three phases: pre-audit, audit, and post-audit.

1. Pre-Audit phase

- Formation of audit team; scheduling audit programmes
- Setting up of scope and objectives (in tune with the 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

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 the last 24 months)
- Collect the load sector data (power ratings of equipment, 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, 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).

3. Post audit phase

- The plan of action for the post-audit phase is implementation and follow-up. The result is to assist in implementing ENCON recommendation measures and monitor the performance.
- The 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.

4.3.11.Steps of Energy Audit

1. Site assessment

Collection of contour maps and campus diagrams

Preparing an inventory of the 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
- Equipment, appliances, instruments, etc. – watts, utility pattern, average consumption (monthly or yearly)
- Discussion with the responsible persons of each infrastructure (on utility pattern, working condition, operation and maintenance procedures, etc.)
- Date entry in prescribed forms (Energy spreadsheets)

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

3. Final audit by the external audit team

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

4.3.12 Work plan and schedule of Energy Audit

Date to date	Weekly Work Plan
20/08/2025 to 30/08/2025	A meeting was held to evaluate the policies and finalise the action plan. All team members have been tasked with reviewing the manual and developing checklists to implement the action plan. The campus map of the college has been compiled. Locations for meter readings have been identified. The internal audit team has been divided into … groups. The campus has been divided into three sections, with each group assigned to a specific section for conducting the survey.
01/09/2025	Each group is responsible for finding the meters in their assigned area. A map has been supplied to each group, marking the specific locations for gathering meter reading information. Each group must identify and illustrate the electrical devices and instruments in their section using basic diagrams and line drawings. Data sheets have been handed out, and data collection will begin for each group next week.
15/09/2025	Each group will be responsible for strategically positioning registers in their assigned areas to ensure efficient data collection. Each team will evaluate the functionality of the appliances and instruments they inspect. Devices will be classified as either efficient or inefficient based on their performance metrics. A meeting will be scheduled to assess the progress of the energy audit and discuss the findings.
20/09/2025 to 20/10/2025	Preparing and uploading registers and documents, which will involve documenting programs and activities, as well as recording meeting minutes.
	Each group will be tasked with meticulously tracking the operational hours of each appliance individually, capturing daily and weekly usage data, including information for weekends.
	The power meter readings for each block must be recorded simultaneously.
20/11/2025	This week is designated for calculating and documenting the power meter readings for each block, which must be recorded simultaneously, using data gathered in the fourth week.
21/11/2025	All blocks must have their power consumption data collected and cross-verified with the power meter readings to detect any discrepancies.

Table no 4.1 Schedule of the energy management

Data Collection Process

Energy Meter reading (for every meter in the college)	9 days; 3 times a day	Three Holidays (26/10/2025, 02/11/2025, 09/11/2025); Three semi holidays (25/10/2025, 01/11/2025, 08/11,2025) Three working days (24/10/2025, 31/10/2025,10/11/2025)	Entry in the given format
Usage pattern of instruments, equipment, 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, equipment, appliance, instrument, instruments etc.	Entry in the given formats
Alternate energy resources	Documents the details of the present alternative energy resources on the campus	Identify possible alternative energy sources	Entry in the given format Include in the action plan
List & details of energy resources in the campus	I. Electrical energy 1. KSEB supply per month 2. Alternative 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 No. 4.2 Work plan for the audit of the energy management

4.4 RESULT AND DISCUSSION

4. 4.1 Mandatory Energy Audit Assessment

4. 4.1.1 Energy Performance

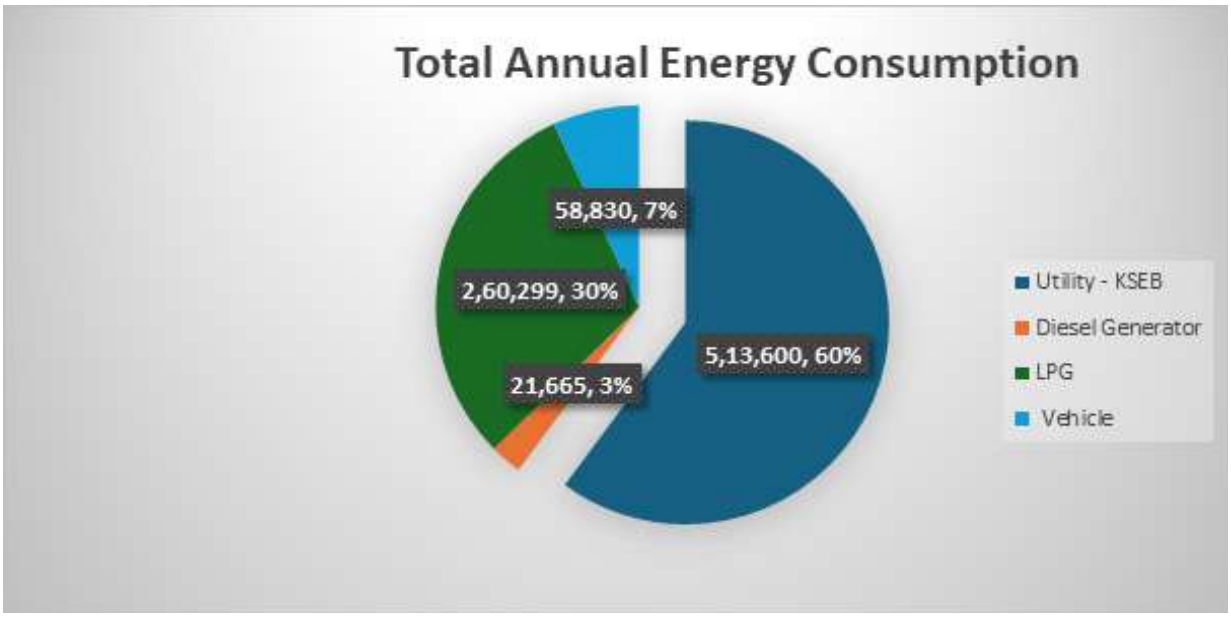


Fig 4.2 The total energy usage

4. 4.1.2 Utility Details – KSEB Limited

Utility	Kerala State Electricity Board Limited
Consumer Number	1356120031901
LCN No	25/7020
Tariff	HT II B General
Contract Demand, kVA	140
Connected Load, kW	353.756
Electrical Section	Peermede
Electrical Circle	Thodupuzha
Average Recorded MD, KVA	130
Average Consumption, kWh	40,437
Average PF	0.99

Table 4.3The Utility details

The facility receives 11kV supply from the utility Kerala State Electricity Board.

The details of the Transformers are as follows:

315 kVA Transformer	
Transformer Rating, kVA	315kVA
Voltage HV / LV	11kV /433V
Current HV/LV	16.53A/420A
SL No	loph.1 3458
Mfg Date	2014
Make	Unipower transformers (Pvt)

Table 4.4 315 kVA Transformer details

4. 4.1.3 Backup Power – Diesel Generator

Rating	125 KVA
Make	CUMMINS
Model No	C1125D5P/F89
Capacity	125 KVA
Rated Voltage	415 V
Rated Current	173.9 A
Mfg Date	11/01/24

Table 4.5 backup power – diesel generator details

4. 4.1.4 Historic Energy Analysis

The energy analysis based on the utility electrical bill for the period starting from August 2024 to July 2025 is provided below.

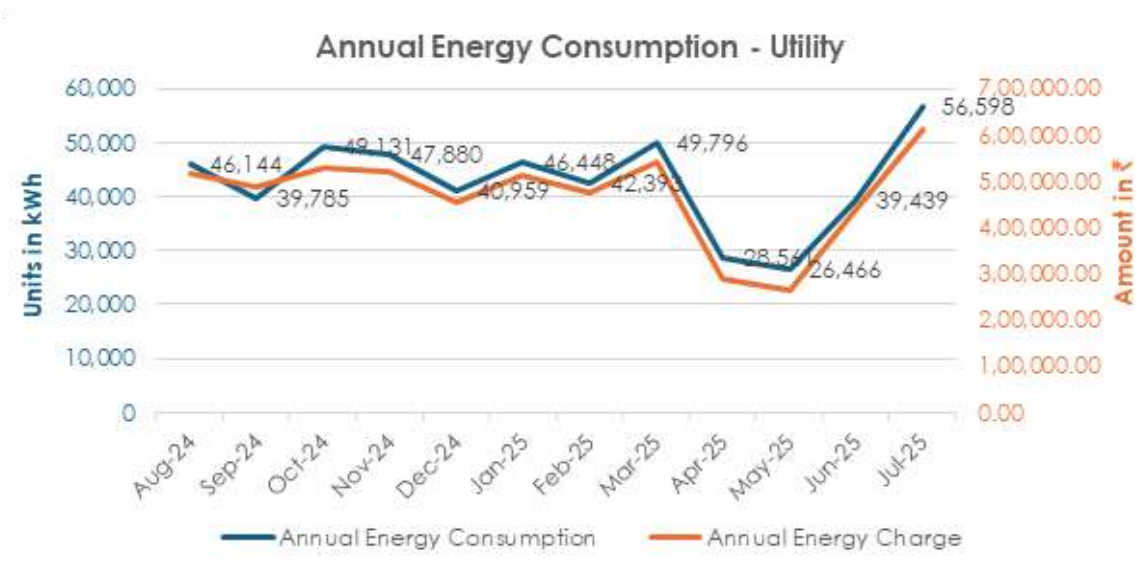


Fig 4.3 Annual energy consumption and utility

There are two charges in the energy bills, that is fixed charges and energy charges. The fixed charge is based on the demand, and the energy charge is based on the energy consumption of the facility.

The energy charges are based on the energy consumption of the facility. 24 Hours are divided into three time zones, and for each time zone, the energy charges are different. The details are provided in the tables.

Zone	Time
Normal	6AM to 6PM
Peak	6PM to 10 PM
Off Peak	10 PM – 6AM

Table 4.6 Energy charge of different zones

Zone	Energy Charge, ₹ / kWh
Normal	7.85
Peak	11.7750
Off Peak	5.88750

Table 4.7 Energy Charges for each zone

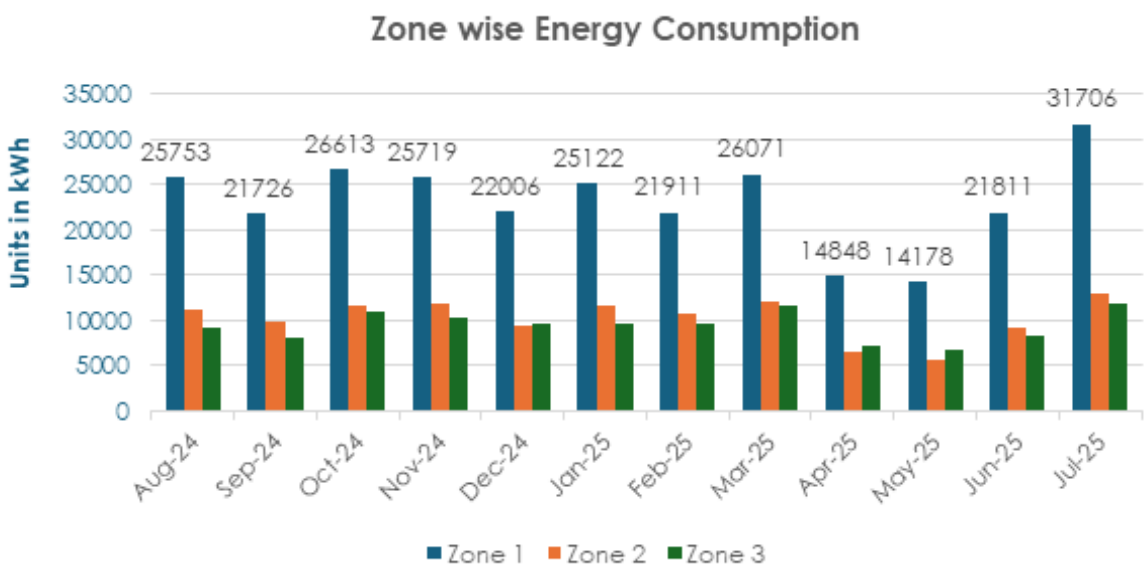


Fig 4.4 Zone-wise energy consumption

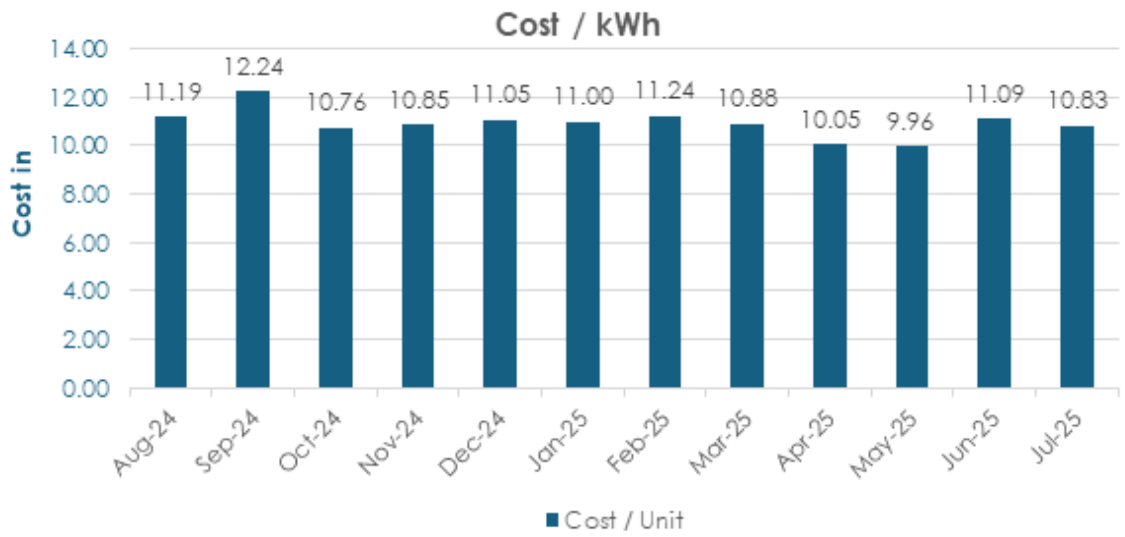


Fig 4.5 The cost per kWh, including the fixed and energy charge
The average cost per kWh is ₹ 10.97

4. 4.1.5 Historic Demand

As mentioned above, the fixed charge is based on the demand of the facility. An agreement is executed between the utility and the facility for fixing the demand required and is mentioned as the Contract Demand.

Contract Demand (CD), KVA	140
75% of Contract Demand, kVA	105
130% of Contract Demand, kVA	182

Table 4.8 Demand of facility

Based on the contract demand, the fixed charges are levied and the facility is levied the maximum demand recorded in any of the time zones or 75% of the contract demand, whichever is higher (called Billing Demand) as the fixed charges. If the facility exceeds the contract demand, for the excess demand, there is a penalty for the excess demand charges.

Fixed Charge / KVA,	535
Excess Demand Charge / kVA, ₹	267.50

Table 4.9 Fixed charge for the facility

The historic trend in demand is shown below:

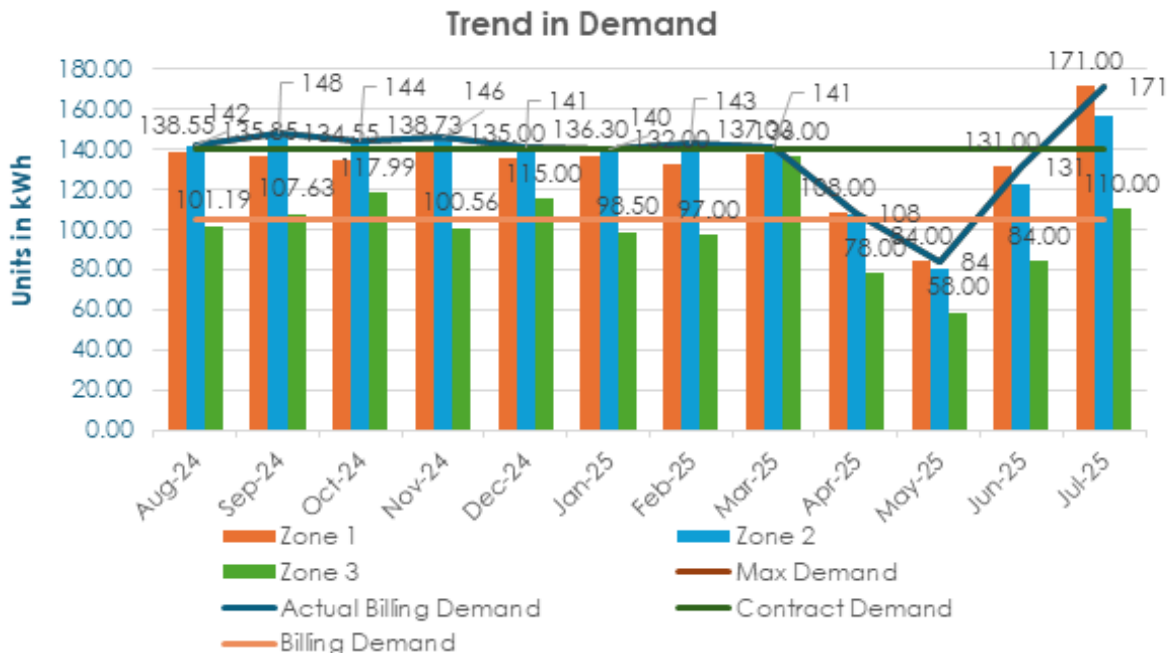


Fig 4.6 Consumption trend and demand

The facility is crossing the contract demand of 140kVA and attracting excess demand charges. Recommend revising the demand to 200kVA to avoid the penalty.

4. 4.1.6 Historic Power Factor

1. As per the rule, the facility must maintain an average Power Factor of 0.95 Lagging. The utility calculates the Average Power Factor based on the kWH and kVAH readings.
2. Average Power Factor, PF = kWH / kVAH.
3. Also, the Reactive Energy, kVARH should be lagging.
4. There is an incentive for maintaining the Power Factor and a penalty if not maintained.
5. For a power factor between 0.95 to 1.00, the incentive is @ 0.50% of energy charges for every increase of 0.01 from 0.95.
6. The disincentive is @ 0.50% of energy charges for each 0.01 fall from 0.95 up to 0.90 and at 1% of energy charges for every drop of 0.01 from 0.90.
7. There is no PF Incentive or penalty for consumers with leading power factor.

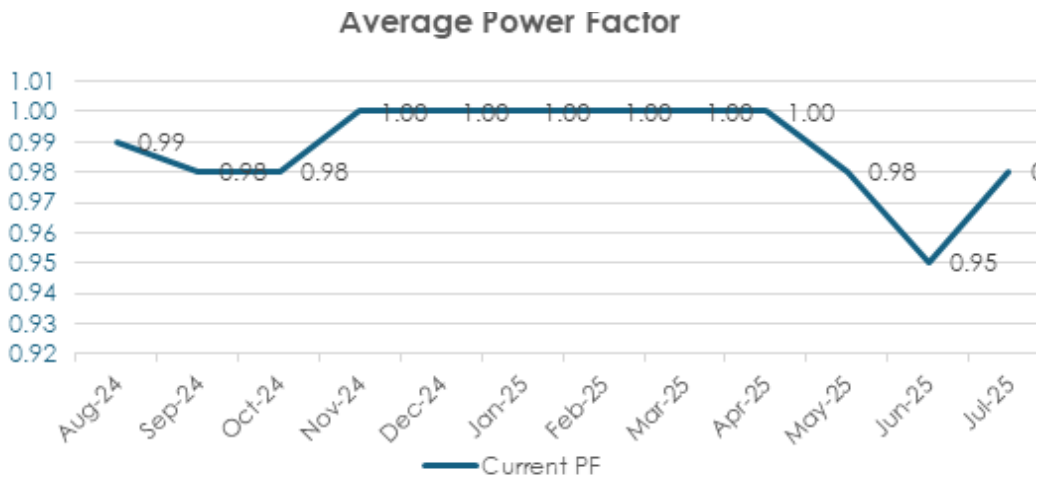


Fig 4.7 Average power factor

The average Power Factor of the facility is good, and there is scope for improvement.

Please find the calculation as below:

Power Factor Incentive					
Month	Current PF	Penalty/ Incentive	Target PF	Energy Charge	Incentive Lost
Aug-24	0.99	7,993.75	1.00	3,99,687.60	1,998.44
Sep-24	0.98	4,996.92	1.00	3,33,128.00	3,331.28
Oct-24	0.98	6,102.39	1.00	4,06,826.00	4,068.26
Nov-24	1.00	9,989.75	1.00	3,99,590.00	0.00
Dec-24	1.00	8,471.28	1.00	3,38,851.00	0.00
Jan-25	1.00	9,780.60	1.00	3,91,224.00	0.00
Feb-25	1.00	8,903.60	1.00	3,56,144.00	0.00
Mar-25	1.00	10,393.98	1.00	4,15,759.00	0.00
Apr-25	1.00	5,139.33	1.00	2,05,573.00	0.00
May-25	0.98	2,832.59	1.00	1,88,839.00	1,888.39
Jun-25	0.95	0.00	1.00	3,29,478.00	8,236.95
Jul-25	0.98	7,008.71	1.00	4,67,247.00	4,672.47
TOTAL		81,613			24,195

There is a loss of 24,200/- annually.

Table 4.10 Power factor incentive

Making an annual maintenance contract will help the facility to maintain a unity power factor and help for additional incentive.

Annual Savings, ₹	24,000
Total Investment for AMC and Capacitor, ₹	20,000
Return of Investment in Months	11

Table 4.11 Cost of annual maintenance

4.4.2 Specific Energy Performance Index

The Energy Performance Index (EPI) is a metric that measures how much energy a building uses per square meter of its built-up area. It is calculated by dividing a building's annual energy consumption by its total built-up area.

SPECIFIC ENERGY CONSUMPTION DURING THE YEAR 2024-25					
No	Description of Fuel / Production	Unit	Consumption	Conversion Factor	Total (kWh)
A	Electricity	kWh	5,13,600	1	5,13,600
B	High Speed Diesel	Ltr	6190	3.5	21665
C	High Speed Diesel - Vehicle	Ltr	5883	10	58830
D	Liquified Petroleum Gas – Propane	Kg	20,023	13	2,60,299
	Total				8,54,394
E	Average Number of Students/Year			Nos	2778
E	Specific Energy Consumption (kWh /Students/Yr)				307.56

Table 4.12 Energy consumption during the year 2024-25

ENERGY PERFORMANCE INDEX DURING THE YEAR 2024-25					
No	Description of Fuel / Production	Unit	Consumption	Conversion Factor	Total (kWh)
A	Electricity	kWh	5,13,600	1	5,13,600
B	High Speed Diesel	Ltr	6190	3.5	21665
C	High Speed Diesel - Vehicle	Ltr	5883	10	58830
D	Liquified Petroleum Gas – Propane	Kg	20,023	13	2,60,299
	Total				8,54,394
E	Approximate Built-up Area	m^2			1,07,242
F	Energy Performance Index (kWh /m^2/Yr)				7.97

Table 4.13 Energy performance during the year 2024-25

4.4.3 Measured Electrical Parameters

4.4.3.1 Power Quality Analysis –Transformer (9.00 to 13.00 Hrs)

Parameter	Minimum	Average	Maximum
Voltage Line to Neutral	Volts, V		
V1	243.97 - 254.53	245.57 - 254.71	246 - 254.94
V2	242.12 - 251.86	243.21 - 252.11	243.5 - 252.35
V3	242.99 - 253.99	245.22 - 254.16	245.67 - 254.41
V N – G	0.2 - 0.34	0.22 - 0.39	0.26 - 0.47
Voltage Line to Line	Volts, V		
U12	420.43 - 437.77	422.91 - 438.43	423.5 - 438.73
U23	419.28 - 437.08	422.36 - 437.46	422.87 - 437.91
U31	423.52 - 441.84	426.29 - 442.2	427.11 - 442.7
Current	Ampers, A		
A1	57 - 166	65 - 186	75 - 210
A2	40 - 142	58 - 156	70 - 193
A3	65 - 153	69 - 163	73 - 189
AN	41 - 83	46 - 93	53 - 103
Power Factor			
PF1	0.85 - 0.98	0.92 - 0.98	0.94 - 0.99
PF2	0.84 - 0.98	0.94 - 0.99	0.96 - 0.99
PF3	0.83 - 0.98	0.91 - 0.98	0.93 - 0.99
PFT	0.81 - 0.97	0.92 - 0.98	0.94 - 0.98
Active Power	Kilowatts, kW		
P1	12.9 - 40.2	15 - 45	17.7 - 50.8
P2	9.2 - 34	13.7 - 37.4	16.7 - 46.2
P3	14.9 - 36.9	16.2 - 39.3	16.9 - 44.3
PT	39.9 - 110.7	47.4 - 115.8	53.4 - 129.3
Apparent Power	Kilovolt-Ampere, kVA		
S1	14.1 - 40.9	16 - 45.7	18.6 - 51.5
S2	9.7 - 34.6	14.1 - 38	17.1 - 47.6
S3	15.9 - 37.7	17.1 - 40.1	18 - 47.1
ST	42.9 - 113.4	50.1 - 118.2	56.1 - 143.7
Reactive Power	Kilovolt-Ampere Reactive, kVAR		
Q1	-5.4 - 2.3	-4.7 - 2.9	-3.8 - 13.2
Q2	-3.7 - 4.4	-3.1 - 5	-2.6 - 15.3
Q3	-5.4 - 2.5	-4.5 - 6.5	-3.9 - 15.8
QT	-13.8 - 7.5	-12.3 - 9.3	-9.6 - 41.4

Harmonics	Percentage %		
THD V1	1.67 - 2.37	1.87 - 2.46	1.95 - 2.56
THD V2	1.59 - 2.33	1.79 - 2.44	1.88 - 2.55
THD V3	1.77 - 2.32	1.97 - 2.42	2.06 - 2.69
THD A1	11.43 - 30.69	14.18 - 34.86	16.06 - 40.45
THD A2	8.21 - 26.27	11.16 - 29.28	13.55 - 33.29
THD A3	13.39 - 30.36	16.4 - 35.04	17.65 - 42.4
Frequency, Hz	49.782 - 50.078	49.791 - 50.093	49.808 - 50.106

Table 4.14 Transformer power quality analysis

System Voltage

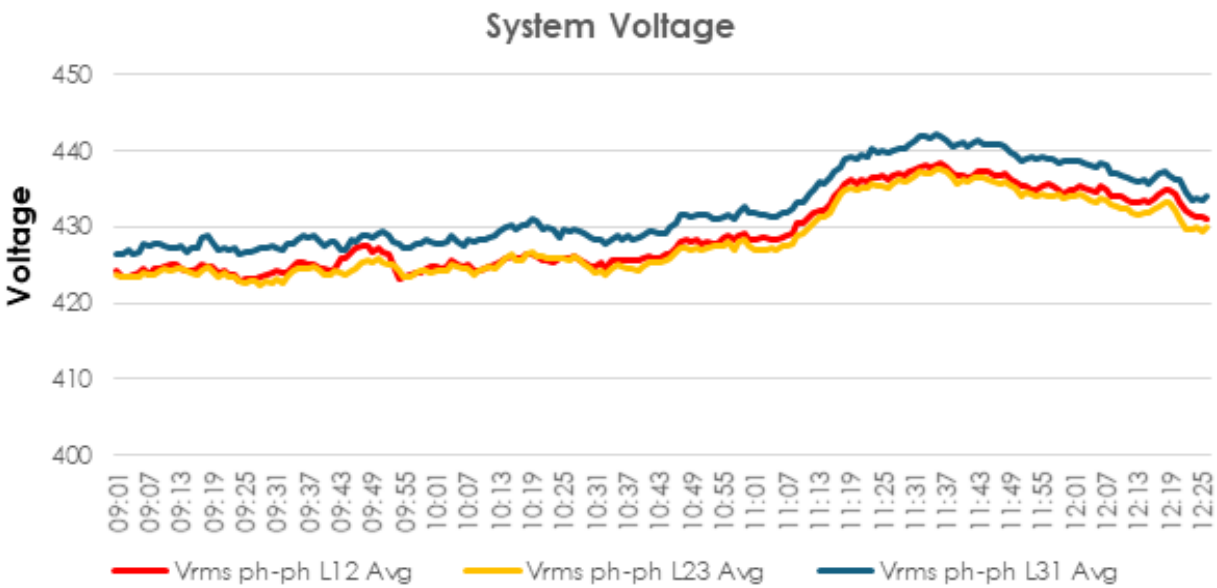


Fig 4.8 System Voltage

Voltage Profile

- Line-to-neutral voltages (V1, V2, V3) mostly lie in the 243–255 V range, implying the system is operating slightly above the nominal 230 V. This mild overvoltage is still typically in utility tolerance bands (often ±10%), but it can increase losses and stress on lighting and electronic equipment over long periods.
- Line-to-line voltages (U12, U23, U31) in the 419–442 V band confirm a similar slight overvoltage on the 400 V side, with phase-to-phase levels tightly clustered, indicating no severe phase voltage deviation. For most 400 V equipment, this remains acceptable, but combined with continuous operation, it can marginally increase kW and kVA demand and reduce equipment life.

Neutral–earth voltage and power quality

- V N–G remains very low (roughly 0.2–0.47 V across min–max), showing that the neutral is well-bonded and the earthing system is effective, with no significant stray neutral voltage. This is favourable for single-phase loads, IT equipment, and sensitive electronics, as it reduces nuisance tripping and malfunction risk.

Voltage unbalance

- Voltage unbalance indices (Unbalance Vn and Vz) are very low: Vn around 0.48–0.65% and Vz around 0.05–0.15%, well within typical recommended limits (generally aim <2% for good motor performance). This means the supply from the transformer/utility is quite symmetrical.

Key insights

- The supply quality from the upstream system is generally good,
- Slight overvoltage, when combined with underloaded or lightly loaded conditions, tends to increase no-load and iron losses in transformers and some equipment, raising base kWh consumption without proportional benefit in service.
- From an energy audit perspective, the marginal overvoltage present opportunities for improving system efficiency, reducing losses, and enhancing reliability of motors, air conditioners, and other three-phase loads.

Summary of Findings

- The voltage quality and neutral–earth condition are good, while current unbalance is the main PQ concern impacting energy performance and equipment health.

4.4.3.2 Load Current

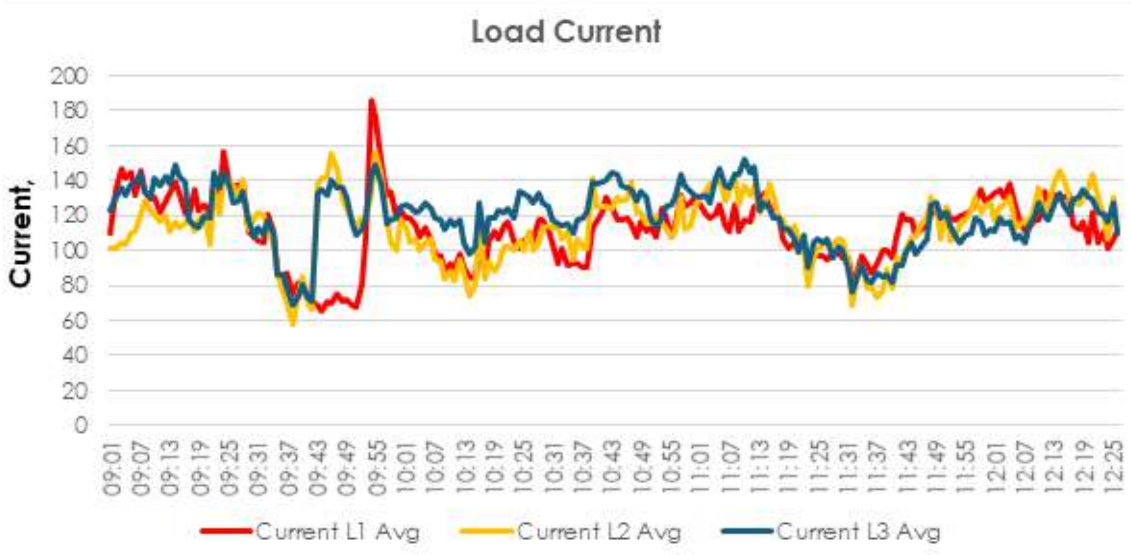


Fig 4.9 Load current

The current readings show moderately high load levels with clear phase imbalance and a significantly loaded neutral, pointing to uneven single-phase loading and substantial non-linear or unbalanced single-phase loads. These conditions increase losses, heating, and potential power quality stress and should be systematically addressed through phase balancing and load management.

Load Current

- Phase currents vary roughly in these bands:
  - A1: 57–210 A, A2: 40–193 A, A3: 65–189 A across min–max. A2 is clearly the lightest on the lower side, while A1 tends to be the heaviest, indicating phase loading is not symmetrical.
- The neutral current AN ranges from about 41–103 A, which is quite high compared to phase currents,

showing that singlephase loads are not evenly distributed and/or there is a significant presence of non-linear singlephase loads (PCs, SMPS, LED drivers, etc.) creating triplen harmonics summing in the neutral.

Key insights

- Phase imbalance
  - The spread between phases (e.g., A1 vs A2 at minimum and maximum) is large enough to confirm the earlier unbalance index values of 3–11%: some feeders/phases are carrying substantially more current than others. This increases copper losses (I^2R) in the more heavily loaded phase conductors and in the transformer windings.

- High neutral current
  - Neutral current values approaching or exceeding half of the highest phase current indicate that the neutral conductor and terminals experience significant thermal stress. In systems with many electronic loads, this can be aggravated by third-harmonic and other triplen harmonic currents, which do not cancel but add in the neutral.

- Current Unbalance
  - Current unbalance indices (Unbalance An and Az) are significantly higher, in the range of about 3–11%, indicating that the connected loads are not evenly distributed across the three phases. Such current unbalance can cause additional I^2R losses, transformer and cable heating, negative-sequence currents in motors, and a reduction in motor life and efficiency even when voltage unbalance is small.

- Impact on reliability and efficiency
  - Sustained current unbalance and high neutral current can cause hot spots at terminals, busbars, and neutral links, accelerate insulation aging, and potentially lead to nuisance tripping at MCCBs/ELCBs. From an energy-efficiency standpoint, additional I^2R losses occur in cables and transformer, adding to kWh consumption without useful output.

- Summary of findings:
  - The current profile shows good overall supply capacity but significant phase and neutral current imbalance, leading to higher distribution losses and thermal stress.

4.4.3.3 Power Factor

The total Power Factor of the facility is provided below:

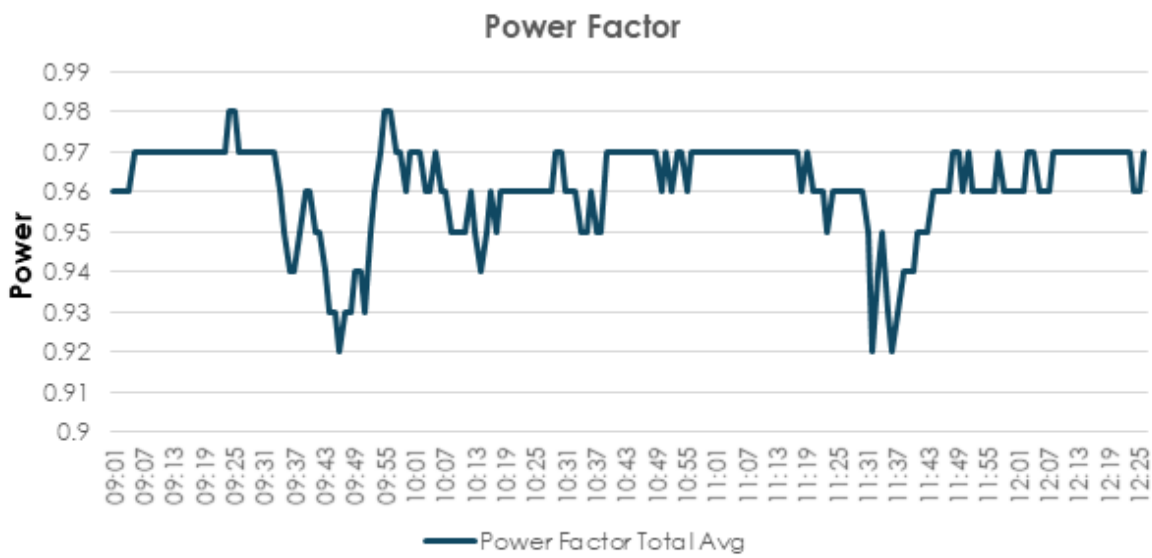


Fig 4.10 Annual power factor

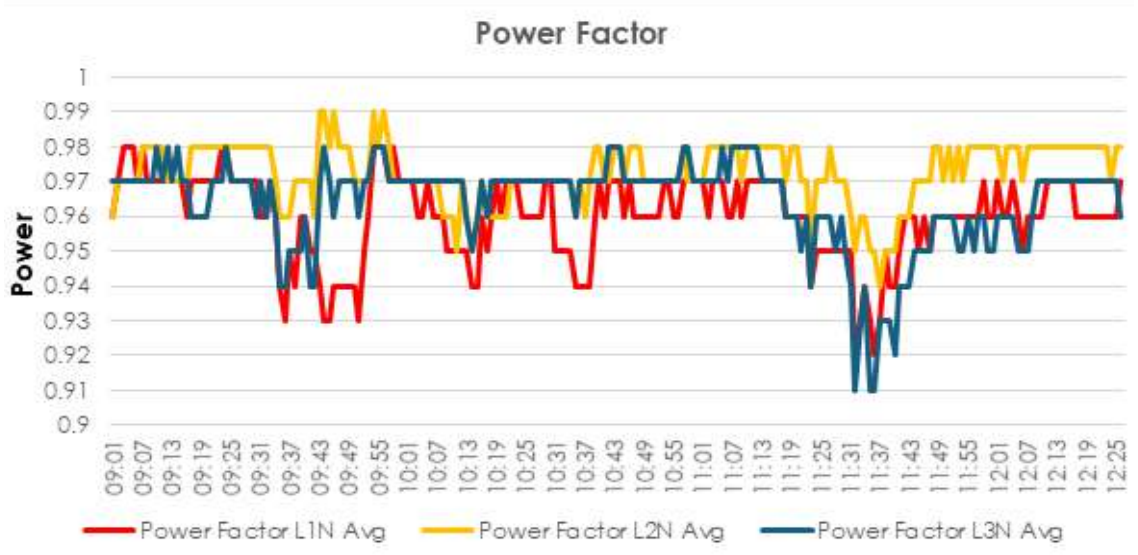


Fig 4.11 The individual phase-wise power factor

The transformer is generally operating with a good power factor and moderate kvar swings, but there are indications of occasional over- and undercompensation; fine-tuning the APFC Panel and phase balancing will improve reliability and fetch additional incentives.

Power factor observations

- Phase-wise PF (PF1–PF3) stays mostly between 0.85–0.99, and total PF (PFT) between 0.81–0.98, which is acceptable.
- Minimum PFT going down to about 0.81 suggests short intervals of low PF (lagging), likely when some inductive loads run without adequate capacitor support.

Reactive power behaviour

- Reactive power on individual phases (Q1–Q3) ranges from roughly −5.4 kvar (leading) to around 15–16 kvar (lagging), while total QT varies from −13.8 kvar to +41.4 kvar, showing both overcompensation (leading) and undercompensation (lagging) at different times.
- The presence of negative kvar (leading PF) plus PF values as high as 0.99 indicates fixed capacitors or oversized banks that remain in circuit even when the active load is low, making the transformer operate with leading PF at light load.

Technical interpretation

- For a 315 kVA transformer in a college campus (mixed lighting, HVAC, computers, labs, hostels), this PF band (0.9–0.98 most of the time) is consistent with reasonably designed PF correction, but the spread of kvar indicates the capacitor steps are not optimally matched to the actual load curve.
- Occasional PFT near 0.81 with QT up to 41 kvar lagging implies that at some peak inductive periods (pumps, motors) the installed kvar may be insufficient or not switching in fast enough, briefly increasing kVA demand and possible billing demand.

Practical insights

- When PF is 0.92–0.98 on average, the kVA loading of the 315 kVA transformer is efficient, reducing copper losses and voltage drop.
- However, swings into leading kvar can cause slightly higher voltage at the LT bus and potential resonance issues with harmonics if significant nonlinear loads (IT, LED drivers, VFDs) exist; this risk grows when the active kW is low, but the capacitor kvar is fixed.

Recommendations

- Retune the automatic PF correction (APFC) panel with smaller kvar steps, using kVAR-based or cosφ-based control so that PF is held

in a narrow band (for example, 0.97 lagging to 0.99 lagging) and leading PF (negative kvar) is avoided during low load.

- Review phase loading and redistribute single-phase loads to reduce phase-to-phase kvar and PF imbalance (PF1–PF3), then re-size capacitor steps per phase; verify that no fixed capacitors are left on feeders that experience long lightload durations.
- Coordinate PF correction with any solar PV export (ongrid inverters) so that in lowload/ highgeneration periods, the combined effect of inverter kvar support and LT capacitors does not push the system into leading PF beyond a small margin.

4.4.3.4 Demand

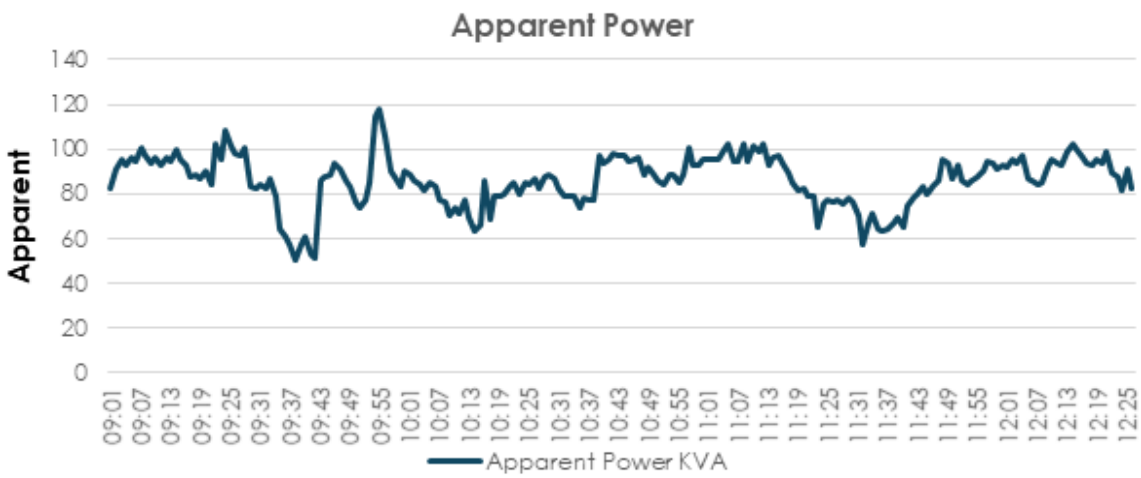


Fig 4.12 Maximum apparent power

The transformer handles a light to moderate load profile typical for a college campus, with maximum total apparent power (ST) reaching 143.7 kVA or about 46% of its 315 kVA rating, indicating no overload risk but room for efficiency gains. Phase imbalances persist, contributing to higher apparent power than necessary; targeted load balancing and PF optimisation can reduce billed demand under KSEB's 75% contract demand clause.

Active power analysis

Total active power (PT) varies from 39.9–129.3 kW, averaging 47.4–115.8 kW, reflecting typical campus usage. Phase loads show P2 consistently lowest (9.2–46.2 kW) versus P1/P3 (up to 50.8 kW), creating ~10–20% imbalance that raises neutral current and losses. This pattern suggests uneven distribution of single-phase loads like lighting or IT across phases.

Apparent power patterns

Apparent power ST ranges 42.9–143.7 kVA (max ~46% of transformer capacity), with phase S2 lowest and S1 highest, mirroring active power imbalance. The S/PT ratio (implied PF) aligns with (0.81–0.99), where max ST/PT ~1.11 at low PF moments, inflating billed kVA demand under KSEB tariffs that charge based on recorded max demand or 75% of contract.

Load insights

For Marian College's profile (hostels, labs, ~199 kW daily need offset by 80 kW solar), these levels indicate partial solar export during lows (PT ~40 kW) and grid import peaks at ~129 kW active / 144 kVA. Imbalance increases total losses by 5–10% and risks higher voltage drop on unbalanced phases; transformer operates well below thermal limits but not optimally.

Recommendations

- Balance phases by redistributing single-phase loads (fans, lighting, sockets) using clamp meter surveys, aiming for <10% deviation to cut ST by 5–8% and lower demand charges.
- Revise contract demand with KSEB (recommend 200kVA given max 144 kVA); monitor max demand meter monthly to stay under 75% clause.

4.4.4 System Harmonic Analysis

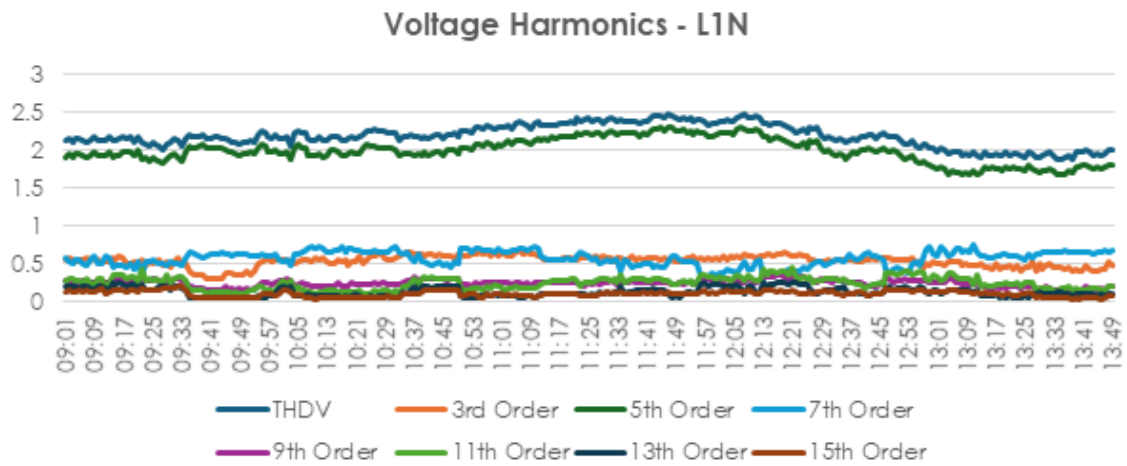


Fig 4.13 Voltage harmonic(L1N)

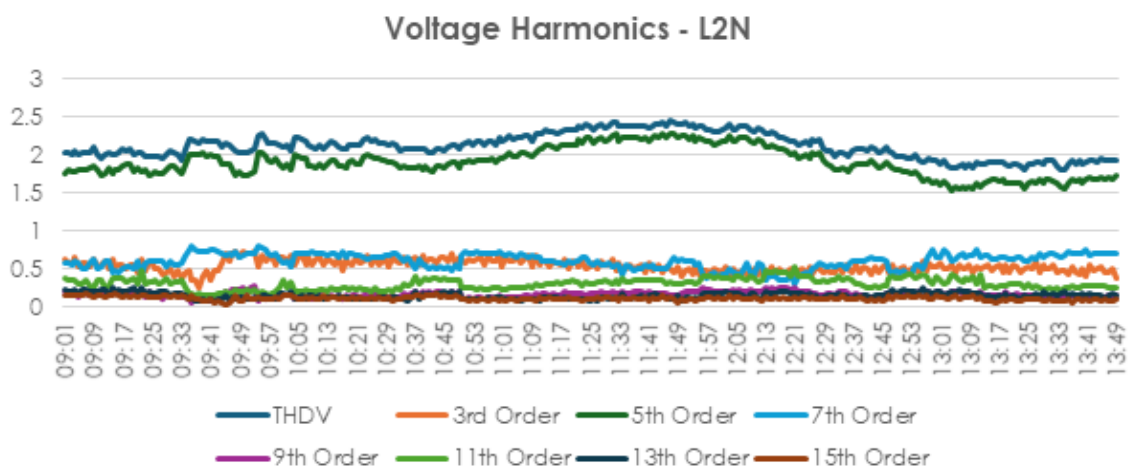


Fig 4.14 Voltage harmonic(L2N)

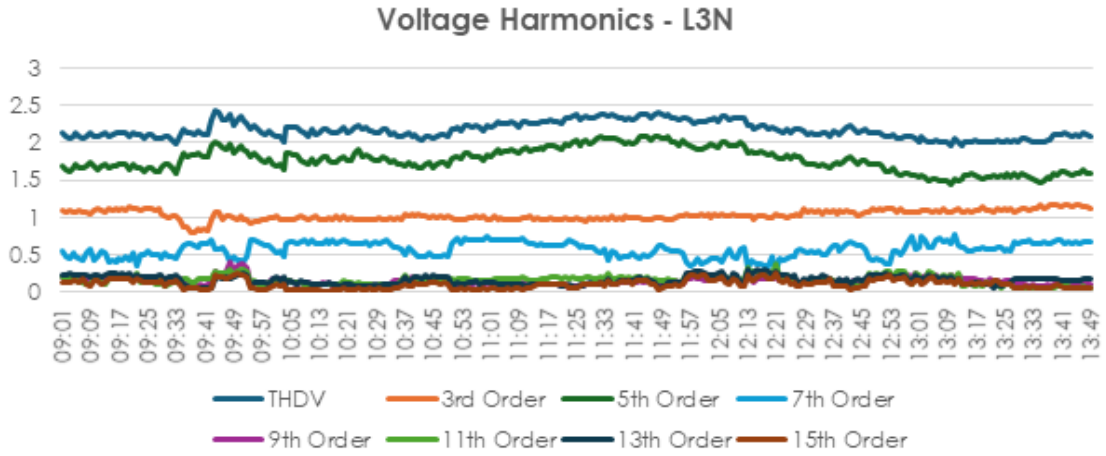


Fig 4.15 Voltage harmonic(L3 N)

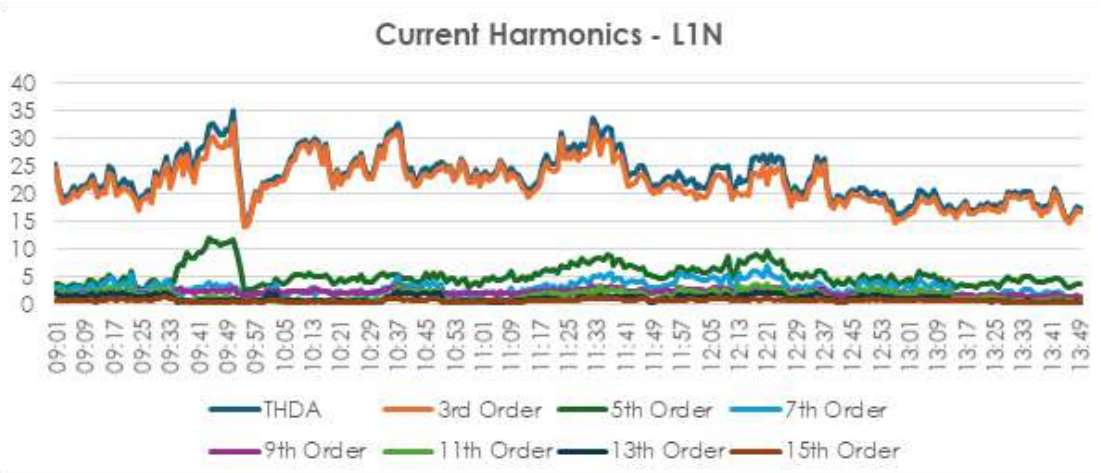


Fig 4.16 Current harmonics (L1 N)

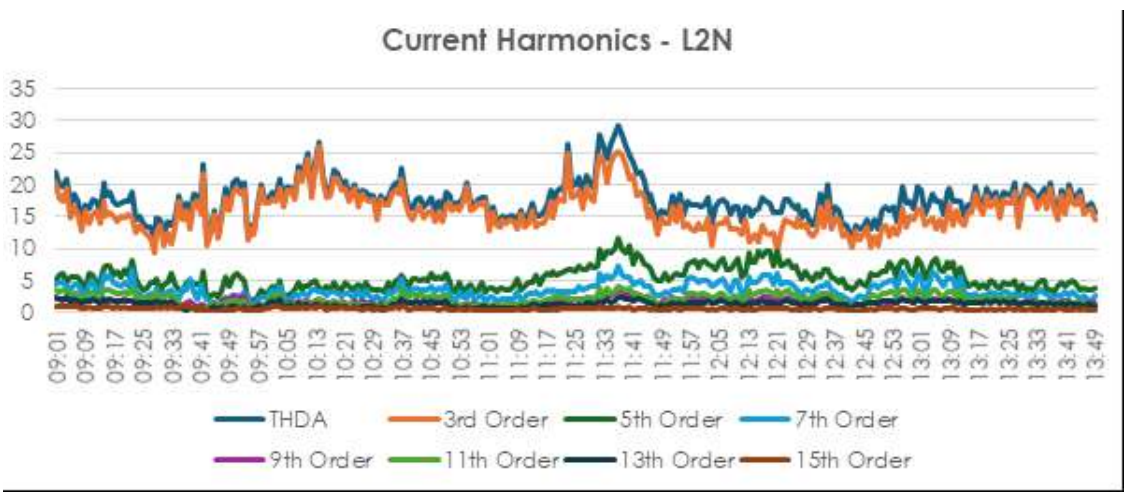


Fig 4.17 Current harmonics (L2 N)

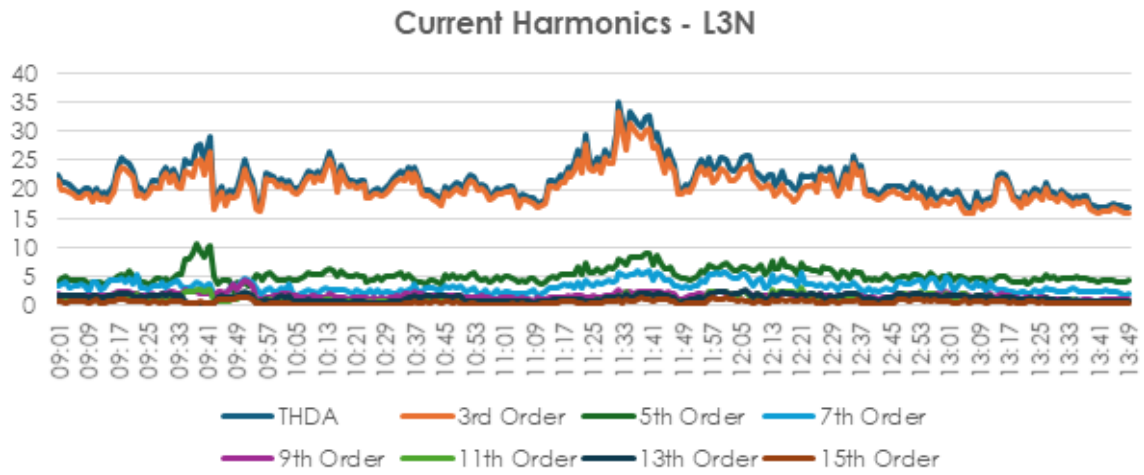


Fig 4.18 Current harmonics (L3 N)

Harmonics	THD	3rd	5th	7th	9th	11th	13th
V1	2.18	0.53	1.98	0.56	0.24	0.24	0.12
V2	2.11	0.53	1.89	0.6	0.16	0.30	0.14
V3	2.16	1.03	1.77	0.57	0.15	0.16	0.16
A1	23.02	21.86	5.28	3	2.22	1.58	1.06
A2	17.64	15.83	5.44	3.5	1.75	2.15	1.37
A3	21.65	20.45	5.29	3.38	1.76	1.23	1.34

Table 4.15 Harmonics analysis

Harmonic Limit

The latest CEA regulations on harmonics are defined under the Central Electricity Authority (Technical Standards for Connectivity to the Grid) (Amendment) Regulations, 2023 and reaffirmed through enforcement circulars issued in 2024–2025. These updates emphasize strict compliance with IEEE 519 2014 harmonic limits for all renewable, hybrid, and large industrial consumers, with mandatory harmonic filter deployment across India.

- Harmonics are governed by Regulation 23 (Voltage and Current Harmonics) of the CEA (Technical Standards for Connectivity to the Grid) Regulations, originally issued in 2013 and amended through 2018 and 2023 notifications.
- The 2023 amendment, fully enforceable from March 2025, aligns Indian grid codes directly with IEEE 519 2014 standards. There is no much variation in the new amended IEEE 519:2022 from 2014 standard.

Limits of Harmonics as per IEEE 519 :2022,

According to IEEE Std 519 2022 — "Recommended Practice and Requirements for Harmonic Control in Electrical Power Systems", the acceptable levels of voltage and current harmonic distortion are defined at the Point of Common Coupling (PCC), where the utility supply meets the user's system.

4.4.4 .1 Voltage Harmonic Distortion Limits

Bus voltage V at PCC	Individual harmonic (%)	Total harmonic distortion THD (%)
V≤1.0 kV≥	5.0	8.0
1 kV<V≤66 kV	3.0	5.0
69 kV<V≤161 kV	1.5	2.5
161 kV<V	1.0	1.5a

Table 4.16 Voltage Harmonics distortion limit analysis

4.4.4.2 Current Harmonic Distortion Limits (for 120 V – 69 kV

For the ratio ISC/IL (short circuit current at PCC / maximum demand load current):**Systems)**

Maximum harmonic current distortion in percent I_L Individual harmonic order (odd harmonics) ①②						
I_{SC}/I_L	3≤h≤11	11≤h≤17	17≤h≤23	23≤h≤35	35≤h≤50	TDD
<20 ③	4.0	2.0	1.5	0.6	0.3	5.0
20<50	7.0	3.5	2.5	1.0	0.5	8.0
50<100	10.0	4.5	4.0	1.5	0.7	12.0
100<1000	12.0	5.5	5.0	2.0	1.0	15.0
>1000	15.0	7.0	6.0	2.5	1.4	20.0

Table 4.17 Current Harmonics distortion limit analysis

Measured Parameters

1. For the 315kVA Transformer with 4.5% Impedance and average maximum current of 186A noted in L1, the $I_{SC}/I_L = 52$.
2. THD (V) % is within limit (Permissible limits < 5% as per CEA Technical standards for connectivity to the grid-2007 & IEEE Std 519 – 2022 for Bus Voltage below 69kV),
3. indicating the RMS voltage waveform is not severely distorted.
4. Individual Voltage Harmonics within limit (Permissible limits < 3% as per CEA Technical standards for connectivity to the grid-2007 & IEEE Std 519 – 2022 for Bus Voltage below 69kV)
5. THD (I) % is above the limits (Permissible limits < 12%as per CEA Technical standards for connectivity to the grid-2007 & IEEE Std 519 – 2022 for I_{SC}/I_L - 50 < 100)
6. Odd Harmonic level exceeds the limit (3rd) (Permissible limits < 10%as per CEA Technical standards for connectivity to the grid-2007 & IEEE Std 519 – 2022 for I_{SC}/I_L - 50 <100).

Harmonic levels show acceptable voltage quality (THDv ~2.1–2.2%, individual <2%) but elevated current distortion (THDi 17.6–23%, dominated by triplens ~16–22%), typical for a campus with solar inverters, IT loads, and APFC switching.

Harmonic levels

Voltage THD across phases V1–V3 remains low at 2.11–2.18%, with dominant 5th (1.77–1.98%) and minor 3rd/7th (~0.5–1%), well under IEC 61000-2-4 limits of 5–8% for LV general environments. Current THD is high at 17.64–23.02% (A1–A3), driven by 3rd harmonics (15.83–21.86%), followed by 5th (~5.3%), with 7th–13th <3.5%; this exceeds IEEE 519 limits (~12–20% THDi at Isc/IL=52) for high triplen content.

Interpretation and causes

Dominant odd triplen harmonics (3rd,9th) in current point to single-phase nonlinear loads like computers, LED drivers, and UPS in hostels/labs, which zero-sequence flow into the neutral and amplify at the transformer. Solar PV inverters (80 kWp grid-tied) contribute low-order odds (5th/7th) during export, while APFC switching injects transients; voltage remains clean due to transformer impedance damping.

Key inferences

High current THDi risks neutral overheating (triplens ~140–160 pu relative to fundamental), capacitor detuning in APFC (3rd/5th resonance), and 2–5% extra I^2R losses in the 315 kVA transformer at average loads. No immediate voltage issues, but cumulative effects could shorten equipment life if unmitigated, especially with solar variability.

Recommendations

- Install detuned harmonic filters (7% or 14% reactor) on the APFC panel to block 3rd/5th resonance and handle ~20–30 kvar reactive while attenuating THDi to <10%.
- Add active harmonic filters (AHF, 30–50A rating) at the main LT bus for dynamic triplen cancellation from IT/solar loads, targeting <8% THDi.

Survey and upgrade single-phase loads (derate neutral to 200% or use zig-zag transformer); monitor per IS 15959/ IEEE 519 quarterly, especially during solar peaks.

4.4.5 Thermographic Assessment

Thermal images are an easy way to identify apparent temperature differences in industrial three-phase electrical circuits, compared to their normal operating conditions. By inspecting the thermal gradients of all three phases side-by-side, can quickly spot performance anomalies on individual legs due to unbalance or overloading.

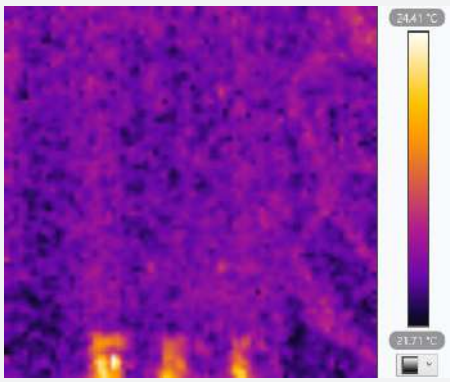
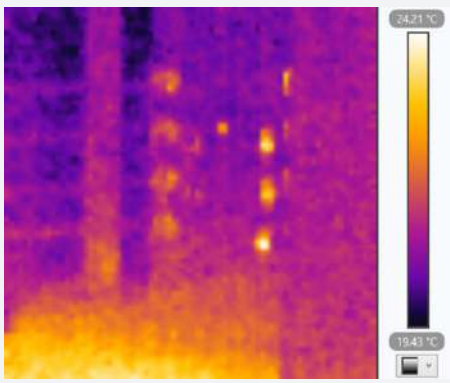
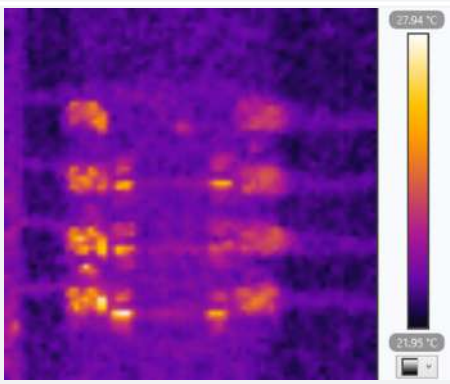
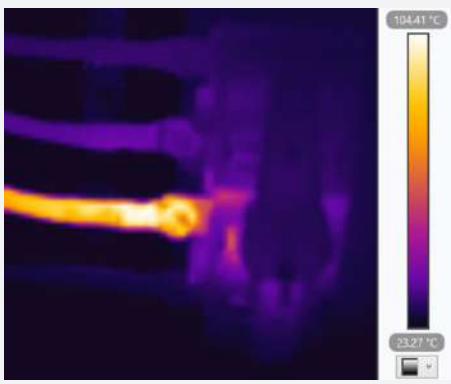
Equal load should equate to equal temperatures. In an unbalanced load situation, the more heavily loaded phase(s) will appear warmer than others due to the heat generated by resistance. However, an unbalanced load, an overload, a bad connection, and a harmonic imbalance can all create a similar pattern. Measuring the electrical load is required to diagnose the problem.

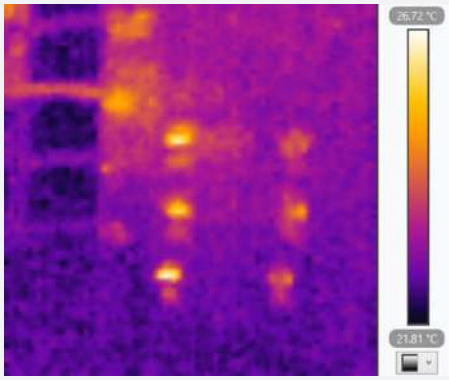
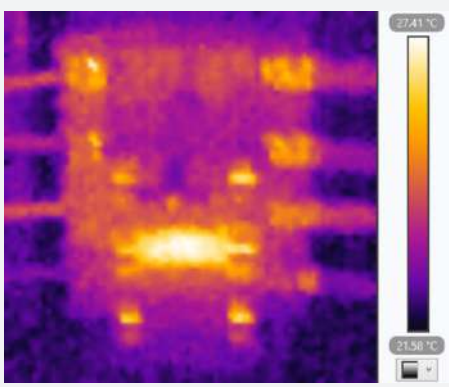
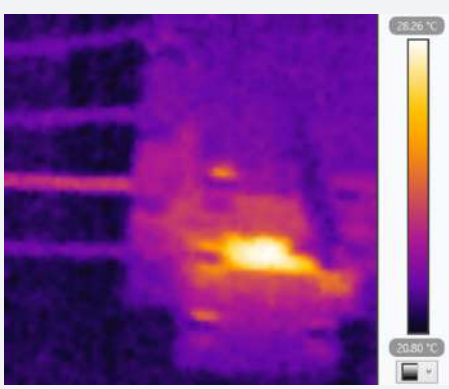
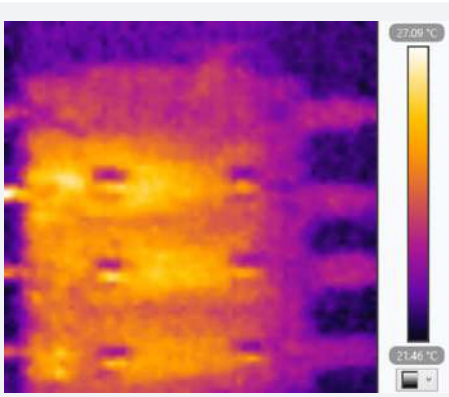
The measured temperature with respect to the ambient temperature is compared to detect the abnormal heating of components.

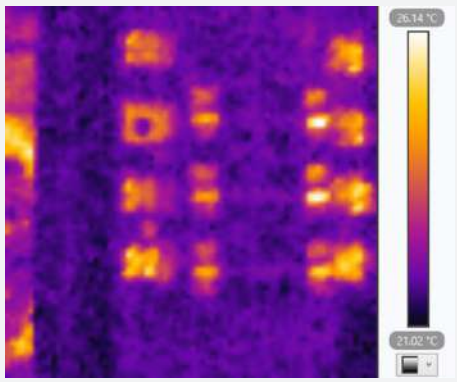
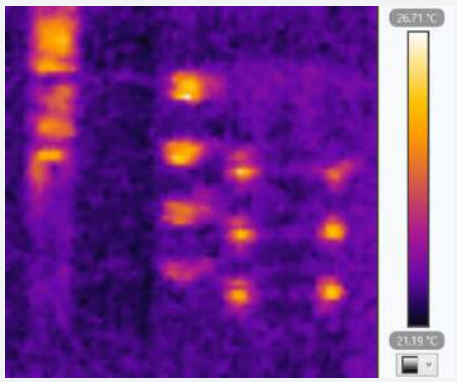
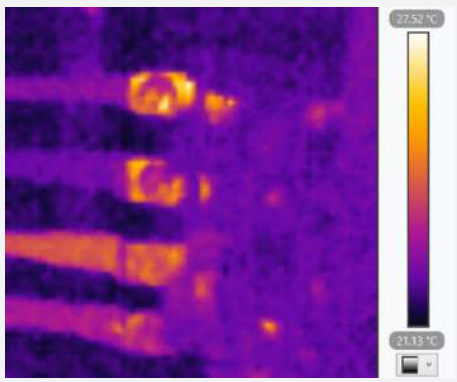
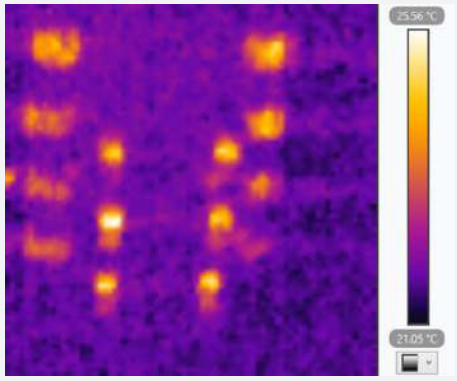
Temperature Rise above Ambient	Severity	Recommended Action
1°C to 10°C	Normal	No Action Required
11°C to 20°C	Minor	Monitor, analyse load condition, schedule for repairs.
21°C to 40°C	High	Repair in one or two days, reduce load until repairs are complete.
Over 40°C	Critical	Repair immediately, reduce or control load till repairs are complete.

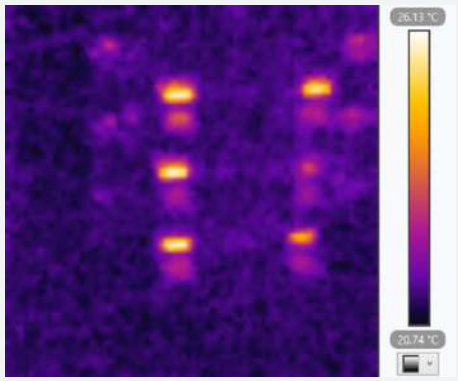
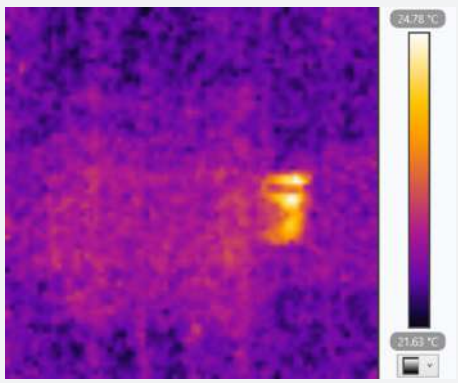
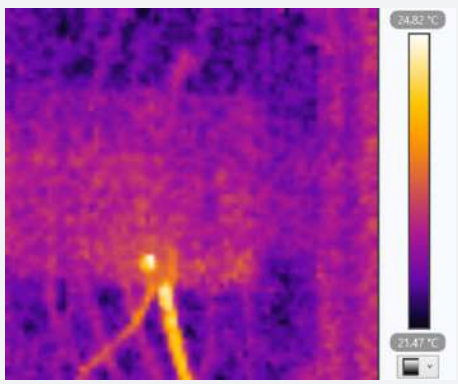
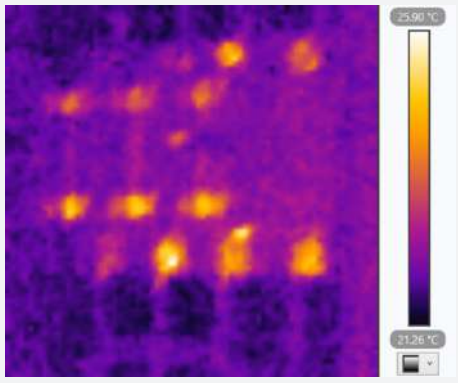
Table 4.18 Thermographic assessment

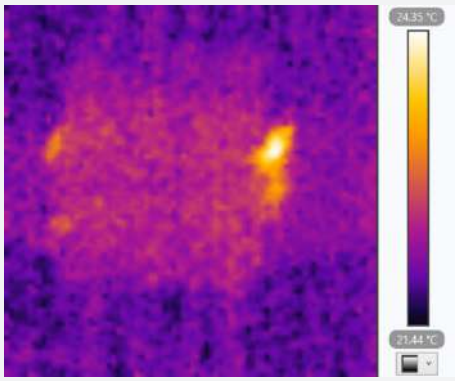
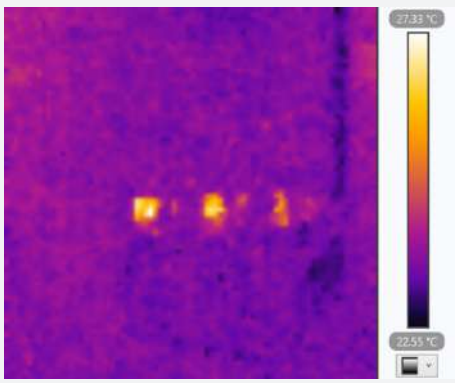
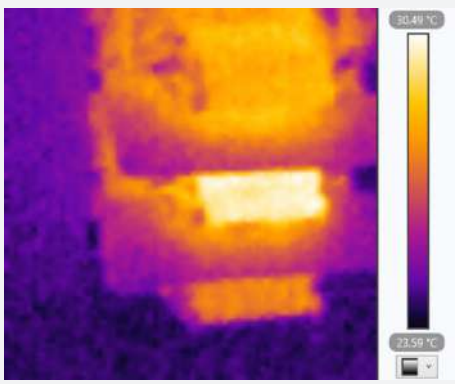
4.4.5 .1 Thermal Images

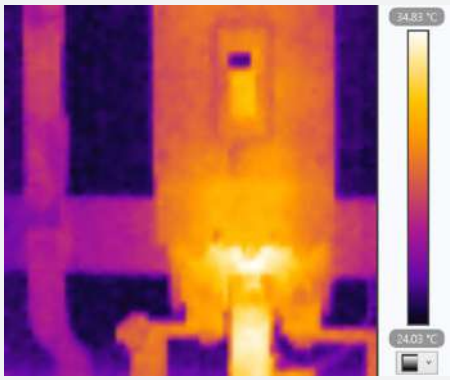
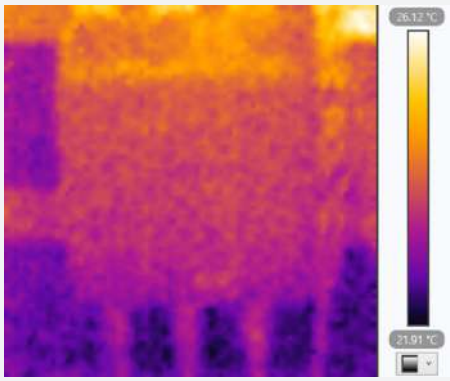
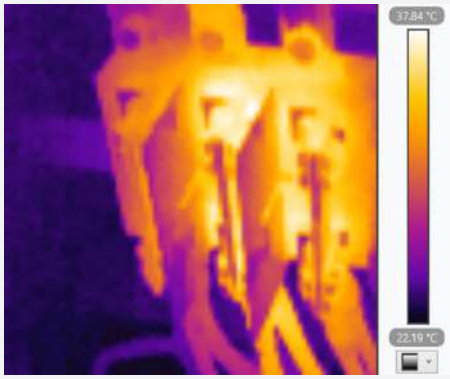
No	DESCRIPTION	Thermal Image	Temperature, ^{0}C
		SB3	
1	spare		24.41
2	D B8		24.21
3	SB5		27.94
4	SB5 Income		104.41

5	DB7		26.72
6	DB6		27.41
7	DB5		28.26
8	DB 12		27.09

9	DB14		26.14
10	spare		26.71
11	Incomer		27.52
12	DB9		25.56

13	UPS-2		26.13
		SB5	
14	Incomer		24.78
15	DB17		24.82
16	DB16		25.90

17	DB15		24.35
		MSBA Admin	
18	SB3		IR-120003
19	SB4		27.33
20	spare		IR-120149
21	MSB UGH		30.49
22	SB2		Not Taken
23	SB1		Not Taken

24	Incomer 20 0A MCCB		34.83
25	200A 4P Is olator Hostel Income		26.12
26	200A 4P Isolator		37.84

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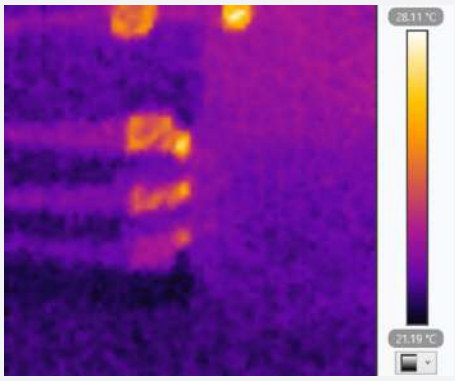
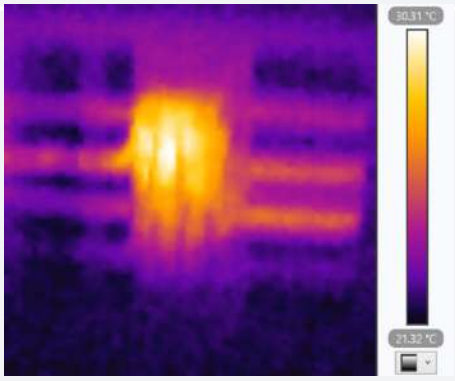
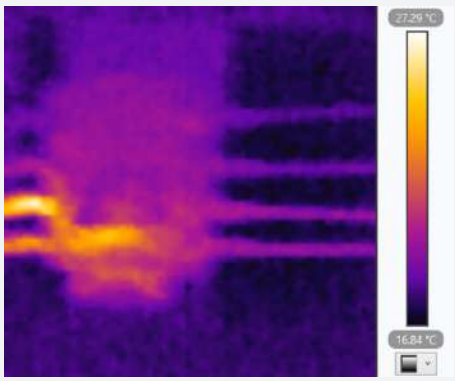
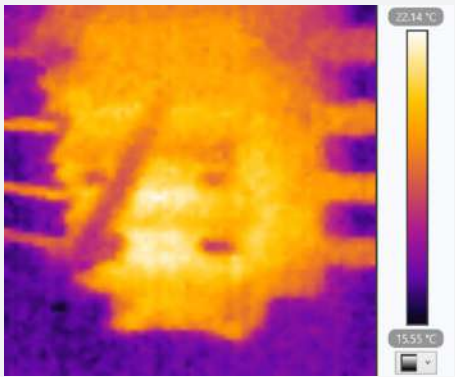
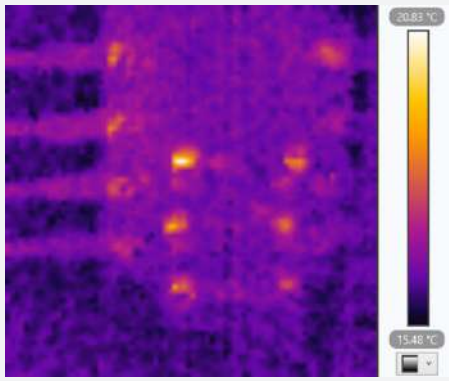
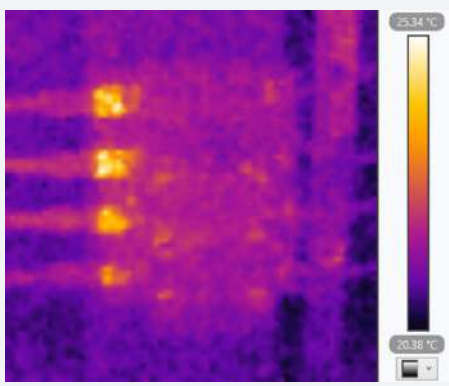
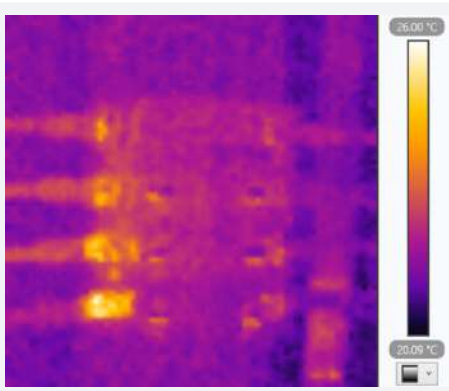
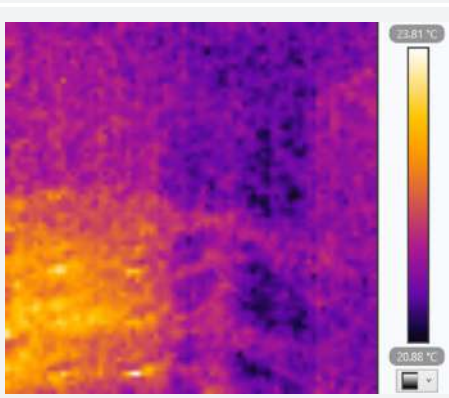
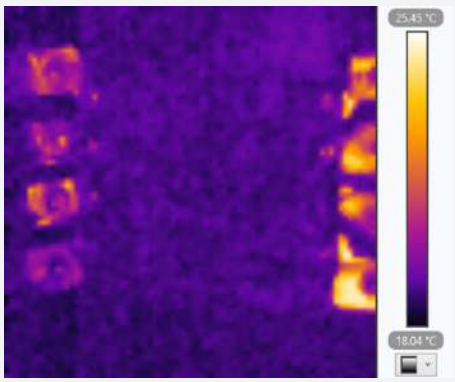
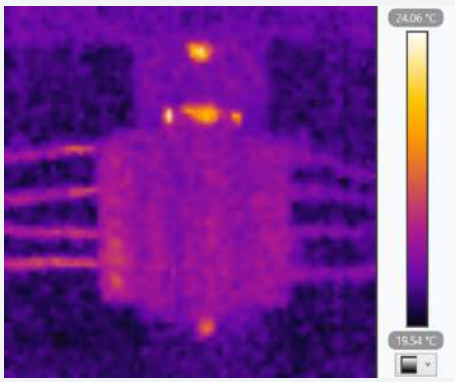
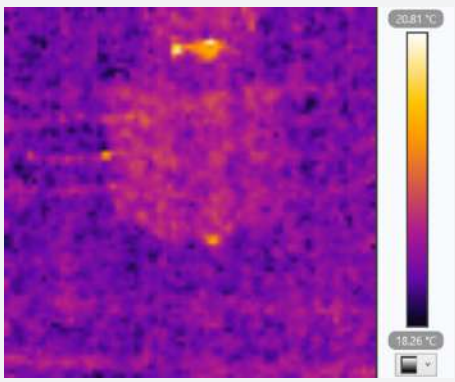
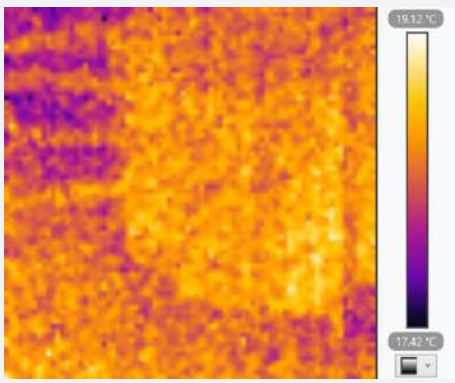
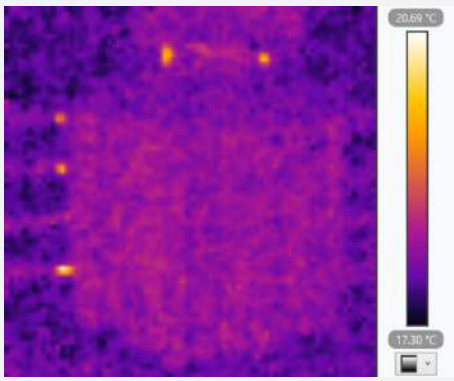
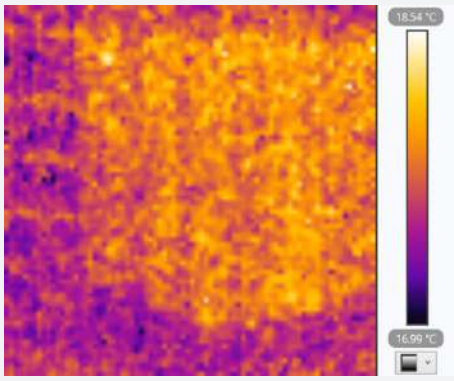
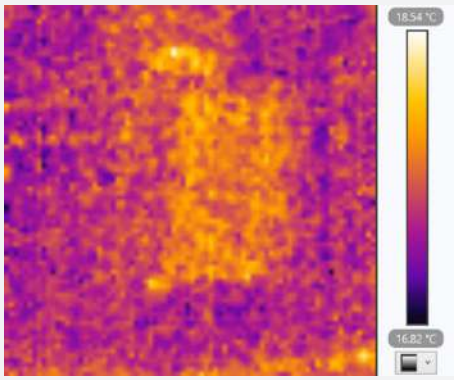
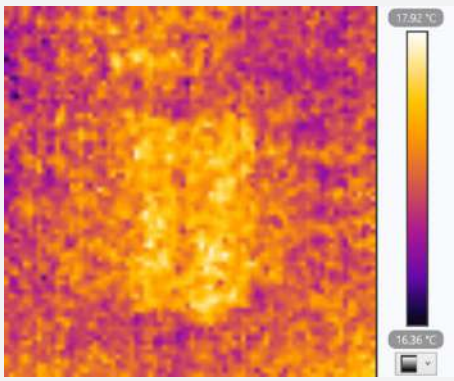
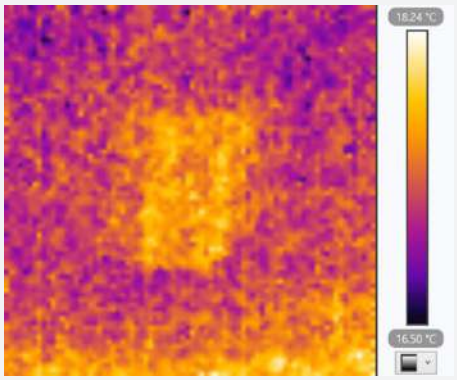
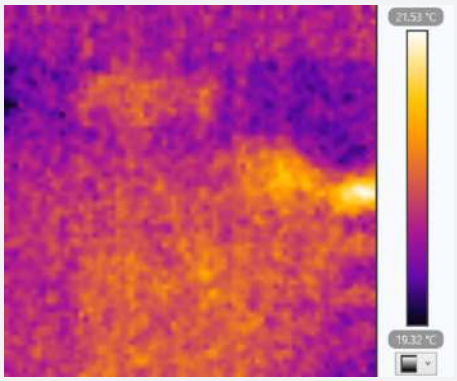
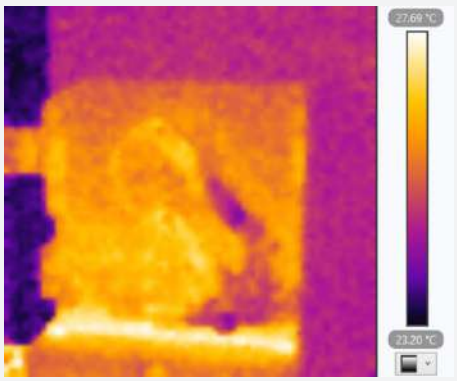
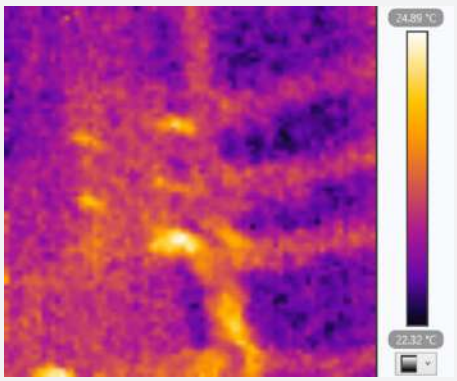
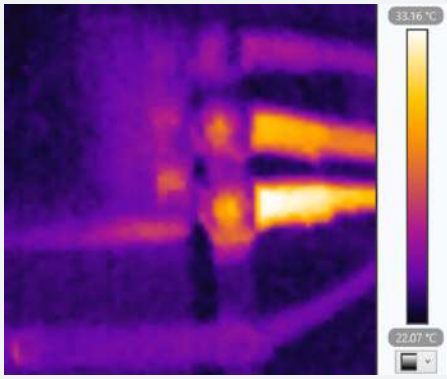
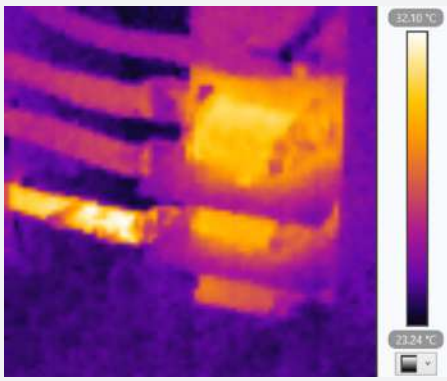
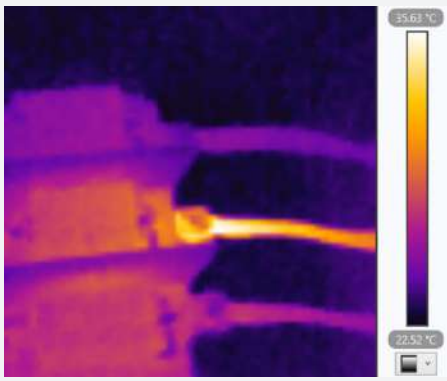
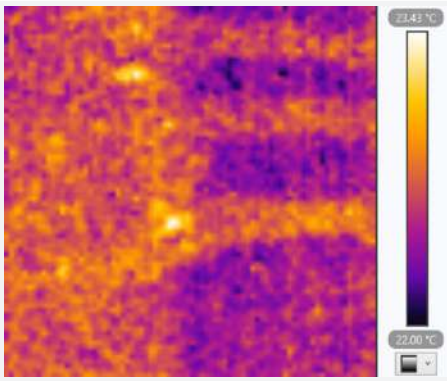
27	1st		28.11
28	2nd		Not Taken
		SB 8 2	
29	100A TPN Incomer		30.31
30	Old AC Block		27.29
31	To Pump		22.14

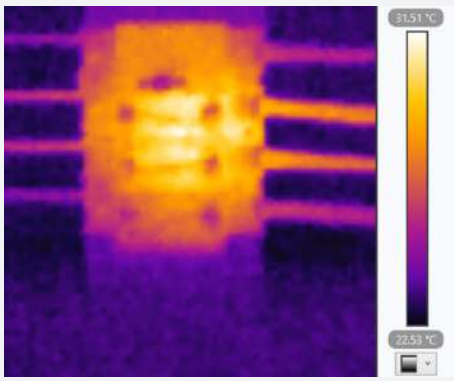
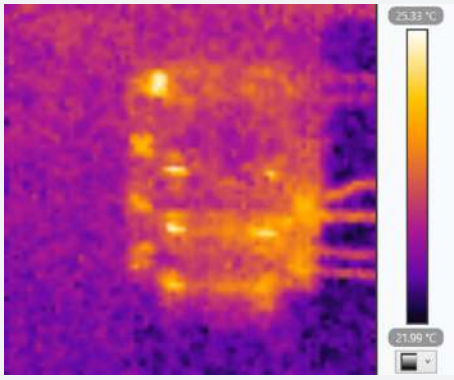
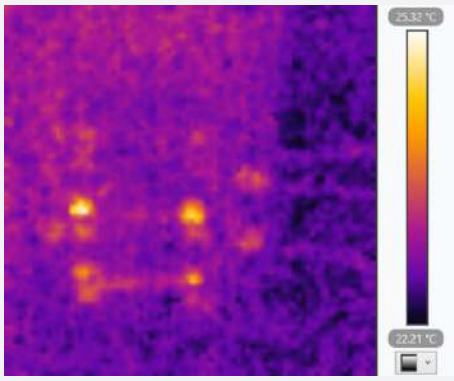
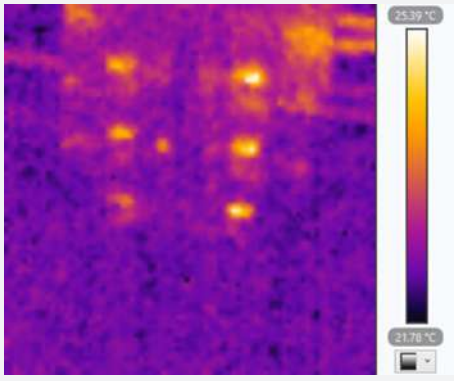
32	DB1		20.83
33	DB2		25.34
34	DB3		26.00
35	DB4		23.81
		New Acedemic Block-MSB	

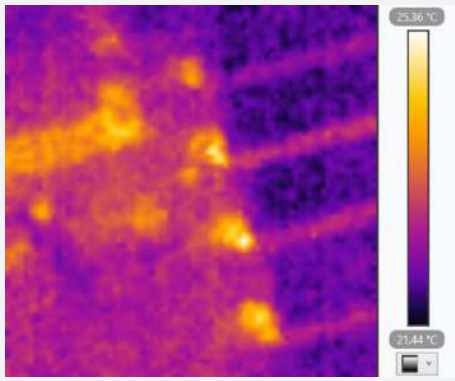
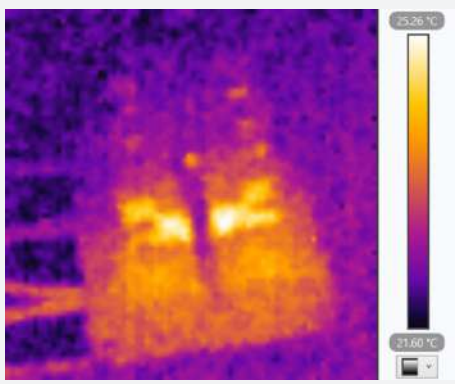
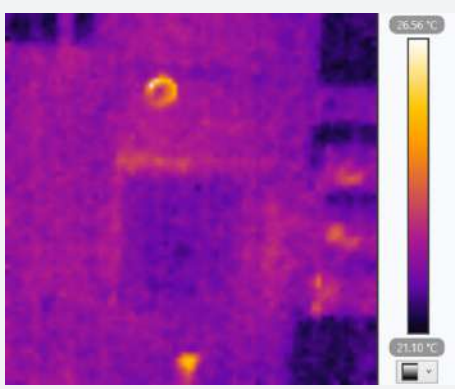
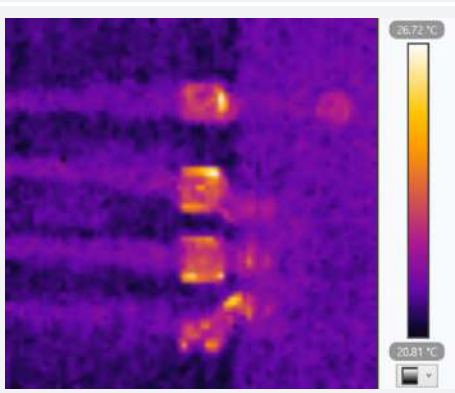
36	Incomer		25.45
37	GF		24.06
38	B1		20.81
39	FF		19.12

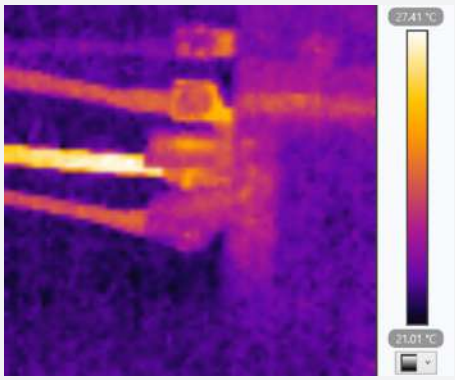
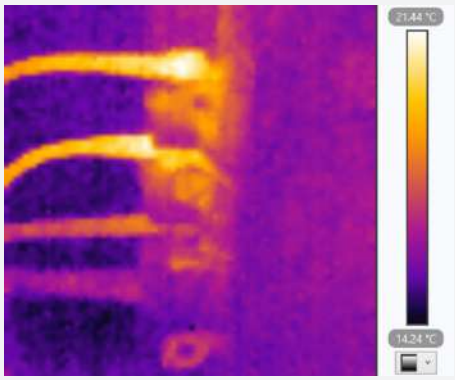
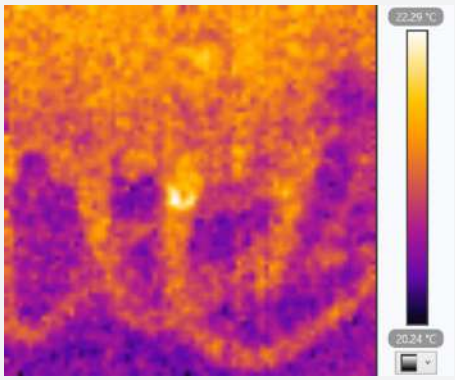
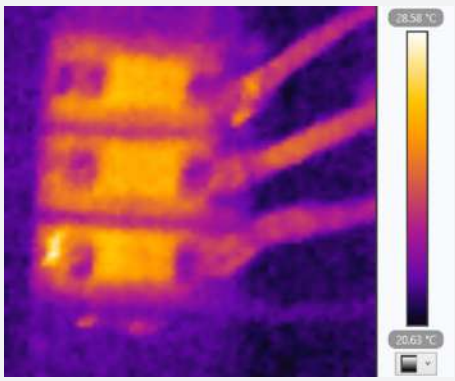
40	SP		20.69
41	TF		18.54
42	UPS		18.54
43	B2		17.92

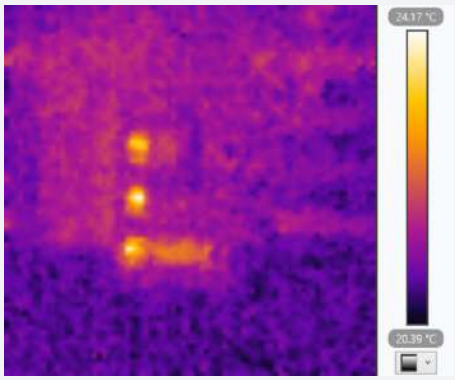
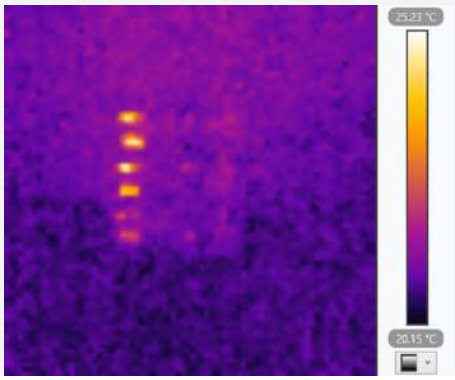
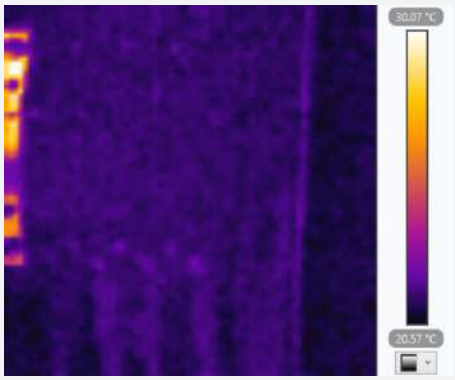
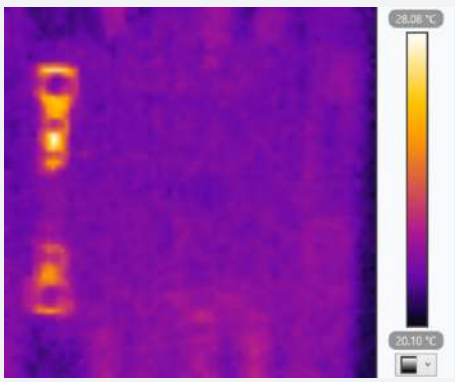
44	Class Room		18.24
45	Lift		21.53
		Gents Hostel	
46	Incomer		27.69
47	College		IR-not taken
48	Boys Hostel		24.89

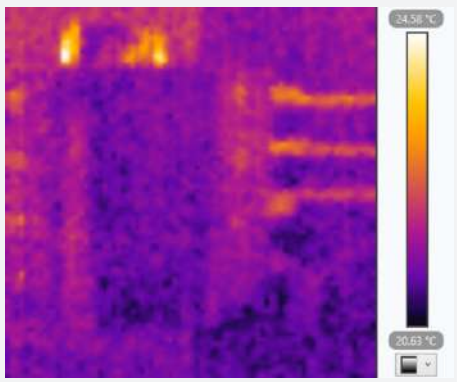
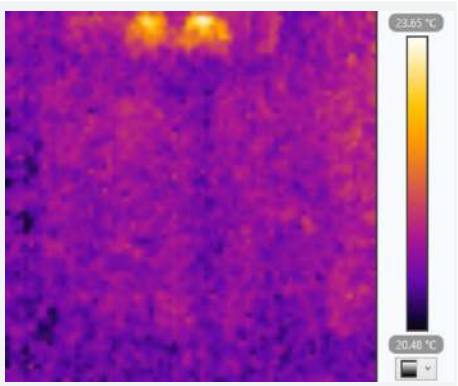
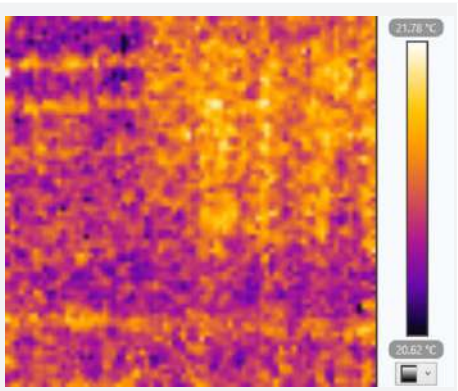
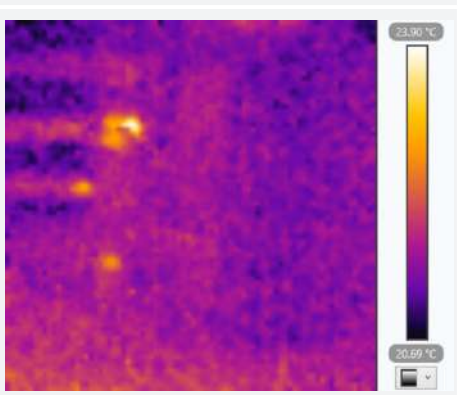
49	Ladies Hostel		33.16
		SB4	
50	Incomer		32.10
51	DB8 Kitchen		35.63
52	GF		23.43

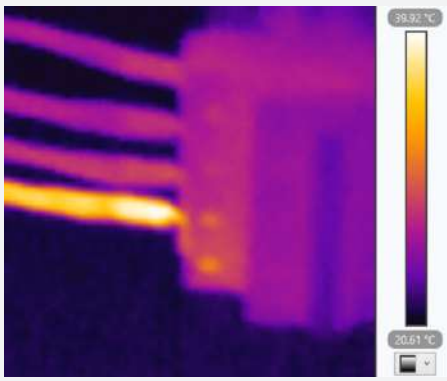
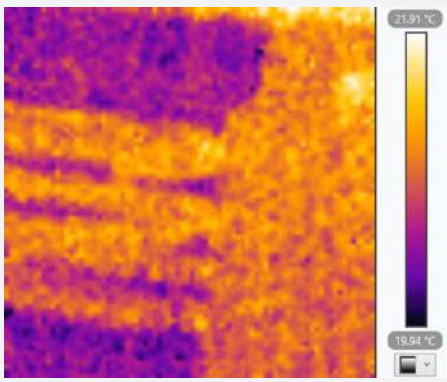
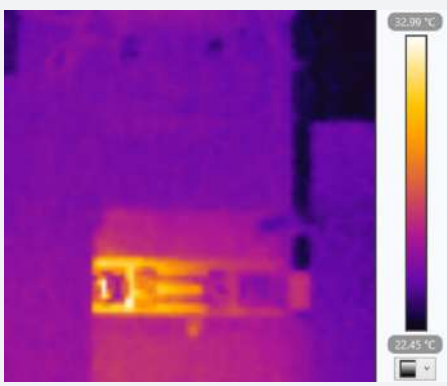
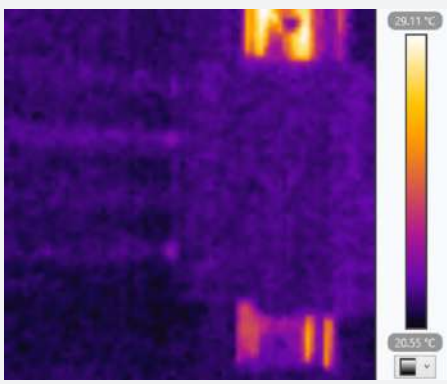
53	DB5		31.51
54	DB6		25.33
55	DB7		25.32
56	DB2		25.39

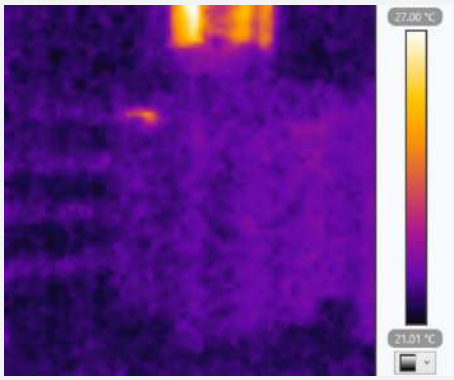
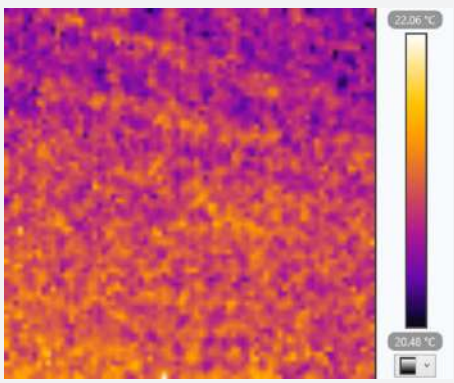
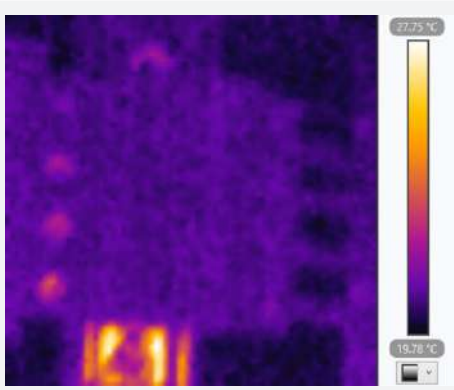
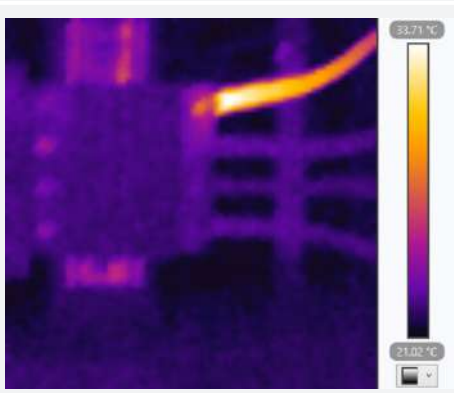
57	DB3		25.36
58	DB4 UPS		25.26
		LADIES HOSTEL	
59	Incomer		26.56
60	Basement		26.72

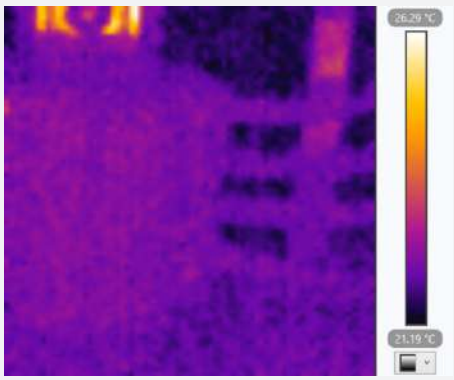
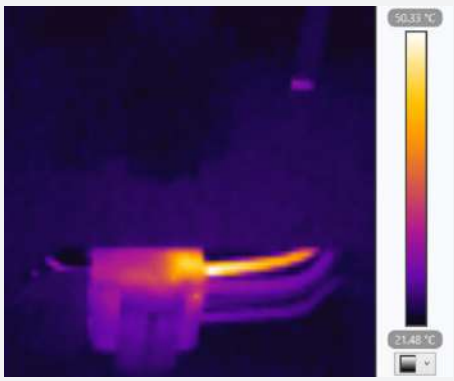
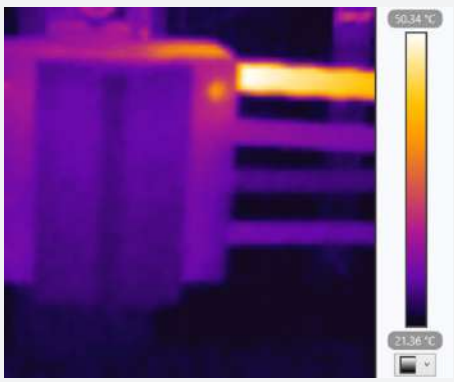
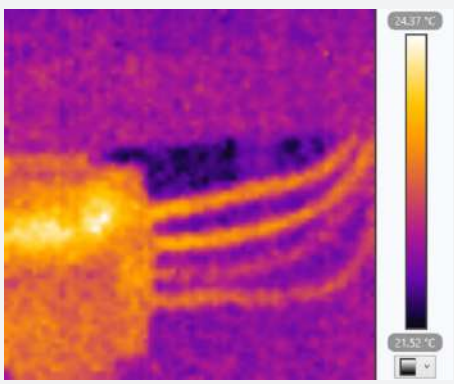
61	STP		27.41
		SB10	
62	Incomer		21.44
63	MSB UGH		22.29
64	DB1		28.58

65	DB2		24.17
66	DB4		25.23
		MBH MB	
67	UPS IN		30.07
68	UPS OUT		28.08

69	UPS		24.58
70	LIFT		23.65
71	DB 2nd F		21.78
72	DB GF + 1st		23.90

73	DB3rd		39.92
74	DB5		21.91
75	Incomer		32.99
76	7th F		IR-132017
77	6th F		29.11

78	5th F		27.00
79	PC (1-7) LIFT		22.06
		SSB PANEL	
80	VDB(3)		27.75
81	VDB(1)		33.71

82	VDB(2)		26.29
83	MOTOR		50.33
84	EXAM HALL		50.34
85	FEED-1		Not Taken
86	TPN DB-1		Not Taken
87	TPN DB-2		24.37

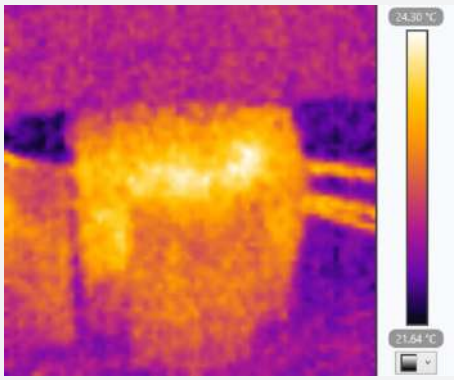
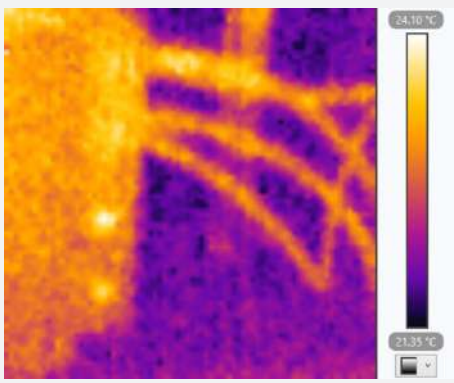
88	TPN DB-3		24.30
89	UPS IN		24.10

Table 4.19 Thermal assessment conducted panel-wise

4.4.5 .2 Summary of Thermography

No	DESCRIPTION	Temperature, ^{0}C	Criticality
	SB3		
1	spare	24.41	Normal
2	D B8	24.21	Normal
3	SB5	27.94	Minor
4	SB5 Income	104.41	Critical
5	DB7	26.72	Normal
6	DB6	27.41	Minor
7	DB5	28.26	Minor
	SB1		Normal
8	DB12	27.09	Minor
9	DB14	26.14	Normal
10	spare	26.71	Normal
11	Incomer	27.52	Minor
12	DB9	25.56	Normal
13	UPS-2	26.13	Normal
	SB5		Normal

14	Incomer	24.78	Normal
15	DB17	24.82	Normal
16	DB16	25.9	Normal
17	DB15	24.35	Normal
	MSBA Admin		Normal
18	SB3	IR-120003	
19	SB4	27.33	Minor
20	spare	IR-120149	
21	MSB UGH	30.49	Minor
22	SB2	Not Taken	
23	SB1	Not Taken	
24	Incomer 20 0A MCCB	34.83	Minor
25	200A 4P Is olator Hostel Income	26.12	Normal
26	200A 4P Isolator	37.84	High
	SUB-PANEL&MAJIS AUDIT		Normal
27	1st	28.11	Minor
28	2nd	Not Taken	
	SB 8 2		Normal
29	100A TPN Incomer	30.31	Minor Normal
30	Old AC Block	27.29	Minor
31	To Pump	22.14	Normal
32	DB1	20.83	Normal
33	DB2	25.34	Normal
34	DB3	26	Normal
35	DB4	23.81	Normal

	New Acedemic Block-MSB		Normal
36	Incomer	25.45	Normal
37	GF	24.06	Normal
38	B1	20.81	Normal
39	FF	19.12	Normal
40	SP	20.69	Normal
41	TF	18.54	Normal
42	UPS	18.54	Normal
43	B2	17.92	Normal
44	Class Room	18.24	Normal
45	Lift	21.53	Normal
	Gents Hostel		Normal
46	Incomer	27.69	Minor
47	College	IR-not taken	

48	Boys Hostel	24.89	Normal
49	Ladies Hostel	33.16	Minor
	SB4		Normal
50	Incomer	32.1	Minor
51	DB8 Kitchen	35.63	Minor
52	GF	23.43	Normal
53	DB5	31.51	Minor
54	DB6	25.33	Normal
55	DB7	25.32	Normal
56	DB2	25.39	Normal
57	DB3	25.36	Normal
58	DB4 UPS	25.26	Normal
	LADIES HOSTEL		Normal
59	Incomer	26.56	Normal
60	Basement	26.72	Normal
61	STP	27.41	Minor
	SB10		Normal
62	Incomer	21.44	Normal
63	MSB UGH	22.29	Normal
64	DB1	28.58	Minor
65	DB2	24.17	Normal
66	DB4	25.23	Normal
	MBH MB		Normal
67	UPS IN	30.07	Minor
68	UPS OUT	28.08	Minor
69	UPS	24.58	Normal
70	LIFT	23.65	Normal
71	DB 2nd F	21.78	Normal
72	DB GF + 1st	23.9	Normal
73	DB3rd	39.92	High
74	DB5	21.91	Normal
75	Incomer	32.99	Minor
76	7th F	IR-132017	
77	6th F	29.11	Minor
78	5th F	27	Minor
79	PC (1-7) LIFT	22.06	Normal
	SSB PANEL		Normal
80	VDB(3)	27.75	Minor
81	VDB(1)	33.71	Minor
82	VDB(2)	26.29	Normal
83	MOTOR	50.33	High

84	EXAM HALL	50.34	High
85	FEED-1	Not Taken	
86	TPN DB-1	Not Taken	
87	TPN DB-2	24.37	Normal
88	TPN DB-3	24.3	Normal
89	UPS IN	24.1	Normal

Table 4.20 Summary analysis of thermography

4.4.6 Infrastructure Assessment And Overview

SL.NO	EQUIPMENT	COUNT	WATTAGE	DURATION IN H	KILOWATT	KWH PER YEAR
1	LED Bulb	417	10	9	0.01	18
2	Cutting light	11	12	9	0.012	21.6
3	Mirror light	1	80	9	0.08	144
4	Firing light	26		9	0	0
5	Fridge	3	1000	24	1	4800
6	Smart board	10	190	2	0.19	76
7	AC	3	1000	2	1	400
8	Modem	11	11	24	0.011	52.8
9	Fan	62	42	1	0.042	8.4
10	CCTV	53	13	24	0.013	62.4
11	Speaker	50	25	2	0.025	10
12	Bulb	294	60	9	0.06	108
13	Tube	19	37	9	0.037	66.6
14	TV	1	40	2	0.04	16
15	Smart TV	1	40	2	0.04	16
16	Tread mill	3	800	5	0.8	800
17	Stair Treadmill	1	1200	5	1.2	1200
18	Steam Bath Machine	1	6000	1	6	1200
19	Kettle	1	1500	0.3	1.5	90
20	Exhaust Fan	2	35	24	0.035	168
21	Steamer	1	120	2	0.12	48
22	Printer	2	250	2	0.25	100
23	Weighing Machine	1	9	2	0.009	3.6
24	Big Fan	1	70		0.07	0
25	Freezer	1	100	24	0.1	480
						395.58

Table 4.21 MAGIS (cafeteria and auditorium) infrastructure

SL.NO	EQUIPMENT	COUNT	WATTAGE	DURATION IN H	KILOWATT	KWH PER YEAR
1	PC(lab)	258	400	6	0.4	480
2	CCTV	75	13	24	0.013	62.4
3	LED tube	148	37	5	0.037	37
4	Speaker	50	25	0.2	0.025	1
5	printer	23	250	9	0.25	450
6	Tv	1	40	5	0.04	40
7	Fan	17	42	2	0.042	16.8
8	AC	3	1000		1	0
9	LED Bulb	97	10	5	0.01	10
10	Filter	6	450	9	0.45	810
11	Modem	14	11	24	0.011	52.8
12	Coffee machine	4	1500	5	1.5	1500
13	Bulb	66	60	6	0.06	72
14	Tube light	166	37	6	0.037	44.4
15	Smart TV	2	40	5	0.04	40
16	Smart board	3	190	5	0.19	190
17	Projector	2	100	2	0.1	40
18	vending Machine	4	50	9	0.05	90
						218.69

Table 4.22 Administrative block infrastructure

SL.NO	EQUIPMENT	COUNT	WATTAGE	DURATION IN H	KILOWATT	KWH PER YEAR
1	LED Tubes	36	37	7	0.037	51.8
2	LED Bulb	8	60	7	0.06	84
3	Modem	1	11	24	0.011	52.8
4	Fan	12	42	1	0.042	8.4
5	Fridge	1(5 star)	1000	24	1	4800
6	Dishwasher	1	1200	2	1.2	480
7	washing machine	1	900	1	0.9	180
8	Heater	13	1000	1	1	200
9	Water filter	1	450	24	0.45	2160
10	Mirror light	13	80	1	0.08	16
						803.30

Table 4.23 Guest House infrastructure

Fig 4.19 Electrical infrastructure mapping

SL.NO	EQUIPMENT	COUNT	WATTAGE	DURATION IN H	KILOWATT	KWH PER YEAR
1	Speaker	21	25	0.2	0.025	1
2	LED Tube	256	37	12	0.037	88.8
3	Printer	6	250	3	0.25	150
4	CCTV	48	14	24	0.014	67.2
5	Computer	139	400	6	0.4	480
6	LED Bulb	4	10	6	0.01	12
7	Filter	16	450	24	0.45	2160
8	Modem	4	11	24	0.011	52.8
9	Electric bill	6	5	0.2	0.005	0.2
10	Lift	1	3000	10	3	6000
11	Smart TV	1	40	12	0.04	96
12	Speaker	18	25	0.2	0.025	1
13	Fan	4	42	1	0.042	8.4
14	Smart board	12	190	12	0.19	456
15	Projector	8	100	12	0.1	240
						654.23

Table 4.24 MIM infrastructure

SL.NO	EQUIPMENT	COUNT	WATTAGE	DURATION IN H	KILOWATT	KWH PER YEAR
1	CCTV	50	13	24	0.013	62.4
2	LED Tube	98	37	6	0.037	44.4
3	LED Bulb	36	10	6	0.01	12
4	Speaker	28	25	0.2	0.025	1
5	Filter	6	450	9	0.45	810
6	Bulb	5	60	6	0.06	72
7	Fan	5	42	1	0.042	8.4
8	Computer	19	400	5	0.4	400
9	Smart board	17	190	3	0.19	114
10	Printer	6	250	3	0.25	150
						167.42

Table 4.25 Academic block infrastructure

Fig 4.20 Computer Lab facilities of the college

SL.NO	EQUIPMENT	COUNT	WATTAGE	DURATION IN H	KILOWATT	KWH PER YEAR
1	CCTV	94	13	24	0.013	62.4
2	LED Tube	166	37	6	0.037	44.4
3	LED bulb	117	10	6	0.01	12
4	Speaker	20	25	0.2	0.025	1
5	Filter	8	450	9	0.45	810
6	Router	4	10	24	0.01	48
7	Modem	6	11	24	0.011	52.8
8	Bulb	6	60	6	0.06	72
9	Smart TV	9	40	6	0.04	48
10	Smart Board	11	190	6	0.19	228
11	Printer	9	250	3	0.25	150
12	Fan	1	42	1	0.042	8.4
13	Lift	1	3000	10	3	6000
14	Projector	2	100	2	0.1	40
						541.21

Table 4.26 Vattakuzhi infrastructure

Fig 4.21 Electrical infrastructure of Auditorium -Magis Block

Marian College Kuttikkanam comprises several distinct blocks, each exhibiting a unique profile of electrical appliance usage. The Magis block is notable for its high energy consumption, primarily due to its auditorium, training workshop room, and cafeteria, all of which demand extensive lighting and house high-wattage equipment such as steam bath machines, kettles, and treadmills. This block notably features 294 non-LED bulbs, significantly impacting its overall energy usage, particularly in comparison to more energy-efficient LED alternatives.

The administrative block ranks second in appliance density, although its energy consumption is comparatively moderate. The only high-wattage device present is a coffee machine, while the remaining appliances operate below 500 watts. Most lighting in this block is LED, though a considerable number of non-LED bulbs still contribute to its energy footprint.

In the MIM block, the primary energy consumers are 16 water filters strategically distributed throughout the building. These filters operate continuously, 24 hours a day, making them significant contributors to the block's energy consumption. Additionally, this block features a lift and accommodates the second-largest number of computers on campus, following the administrative block, further increasing its electricity demand.

The Vattakkuzhi block demonstrates moderate energy usage. It houses eight water filters that operate for approximately nine hours daily and exclusively utilises LED lighting, aiding in energy conservation. The principal high-energy device in this block is a 3000-watt lift, which serves as the primary source of elevated energy consumption.

The academic block is characterised by minimal electrical appliance usage, including basic equipment such as lights, water filters, speakers, computers, and smart boards. Notably, this block boasts the highest number of smart boards on campus, utilised for interactive teaching. The only device operational around the clock is the CCTV system, which ensures campus security.

Finally, the guest house contains the fewest appliances among all blocks, though many are high-wattage, including a dishwasher, heater, refrigerator, and washing machine. Despite their power ratings, most of these appliances are utilised sparingly, generally for just one to two hours per day. The exception is the refrigerator, which operates continuously and serves as the primary contributor to the guest house's energy consumption.

The distribution and usage patterns of electrical appliances across the campus reflect the functional requirements of each block, with energy consumption closely aligned to the nature of activities conducted within them.

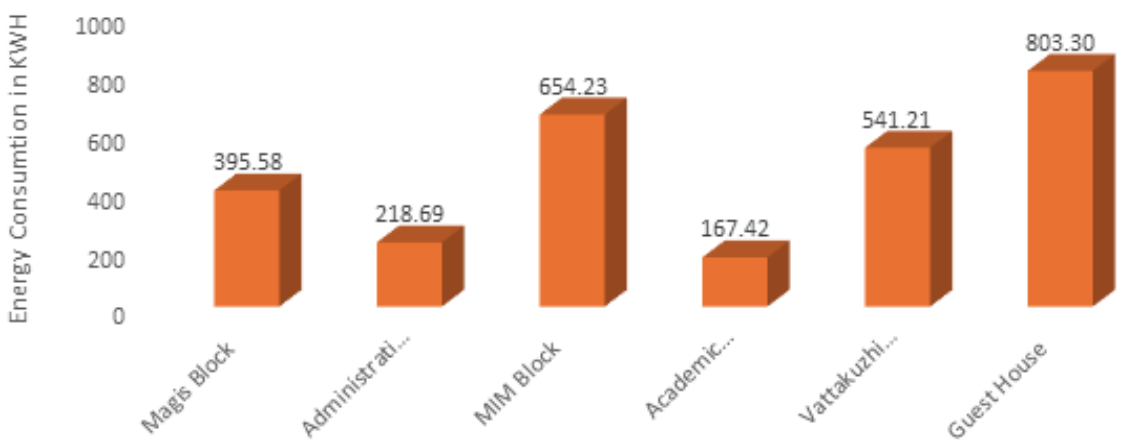


Fig 4.22 Energy consumption based on infrastructure assessment

The guest house exhibits the highest average energy consumption among all the blocks, primarily due to the extensive use of high-wattage electrical appliances. Key contributors include washing machines, dishwashers, and refrigerators, which operate frequently and require substantial power. This heightened usage pattern significantly drives up the overall energy demand in the guest house. Following the guest house, the MIM block ranks next in energy consumption. This is largely attributed to the presence of a lift, which consumes considerable energy during operation, and a higher number of water filters that run continuously to maintain water quality. Fig 4.18 Energy consumption based on infrastructure assessment These appliances, though essential, contribute heavily to the block's energy footprint. The Vattakuzhi and Magis blocks also show notable energy usage, primarily due to the prolonged operational hours of various electrical devices. Unlike other blocks, appliances here tend to run for extended periods throughout the day, leading to increased cumulative energy consumption. The Administrative block and the Academic block report comparatively lower energy usage. This can be linked to fewer high-power appliances and more regulated usage patterns, resulting in a more modest energy profile.

Fig 4.23 Parts of a professional audio mixer

4.4.7 Electricity Bill Assessment Analysis

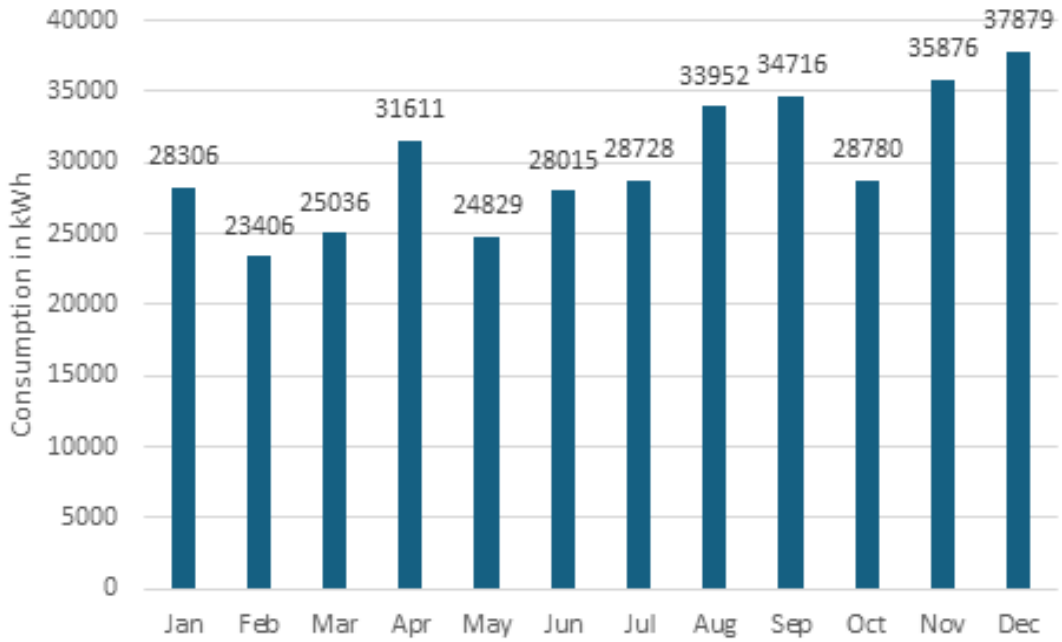


Fig 4.24 Energy consumption based on bill assessment (2022)

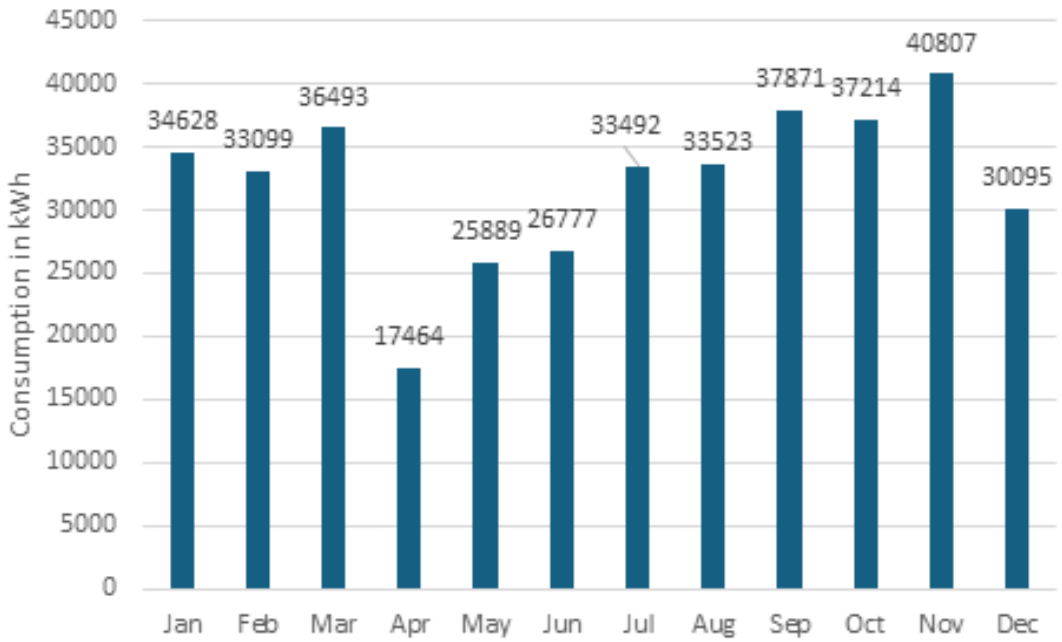


Fig 4.25 Energy consumption based on bill assessment (2023)

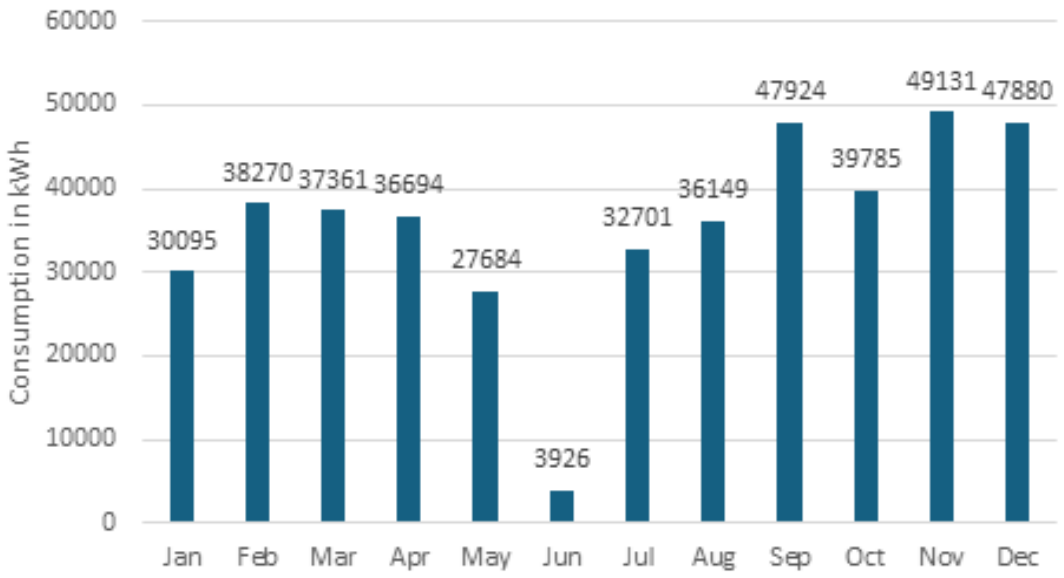


Fig 4.26 Energy consumption based on bill assessment (2

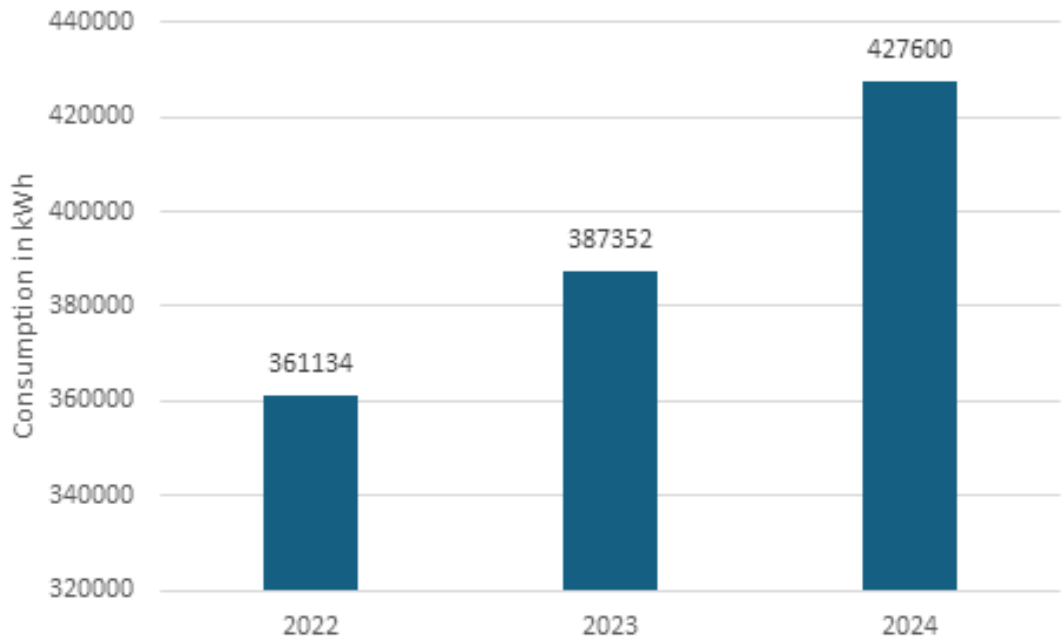


Fig 4.27 Annual energy consumption each year

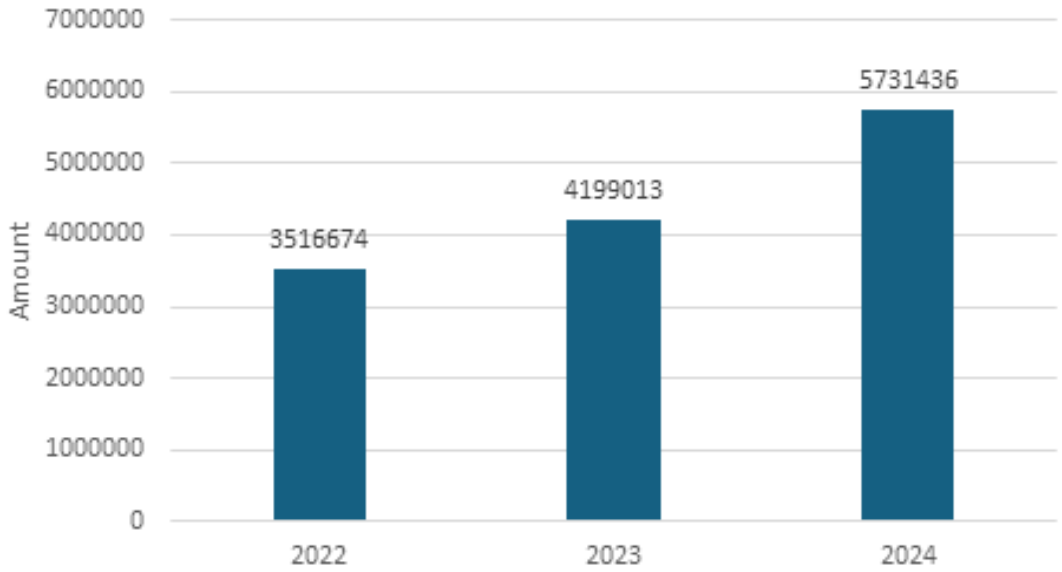


Fig 4.28 Annual KSEB bill amount

The college's average annual energy consumption stands at **392,028.7 kWh**. This figure reflects a noticeable upward trend in recent years, driven by the institution's evolving operational and infrastructural demands. In 2024, energy usage increased significantly compared to previous years. This rise can be attributed to several key factors, including:

- Enhanced overall facility utilization

- Improved and expanded infrastructure

- A growing student and staff population

Notably, the commissioning and full operationalization of the new Magis building, along with the introduction of additional batches in programs such as BBA, BCA, and BCom, contributed substantially to this increase. These developments expanded the number of programs, facilities, and members within the college community, all of which heightened energy requirements.

Variations in both the energy bill and consumption can be attributed to several key factors:

Actual Usage Decline: Energy consumption may be less than anticipated due to the adoption of energy-efficient appliances, intentional reductions in usage, or the implementation of new energy-saving practices.

Meter Alteration: Evidence of tampering with the meter could indicate that the recorded readings are artificially inflated.

Enhanced Appliance Usage: Rising consumption levels may result from the introduction of new electrical devices, prolonged usage of existing appliances, or the use of less energy-efficient models.

Tariff Changes: Fluctuations in electricity pricing can lead to increased total bills, even when energy consumption remains unchanged.

Defective Appliances: Malfunctioning appliances may consume significantly more energy than their standard operational capacity.

Inefficient Building Structure: Poor insulation, inadequate ventilation, and significant air leaks can result in higher energy consumption to maintain comfortable heating and cooling temperatures. These factors collectively highlight the complexities surrounding energy consumption and billing at the college.

Fig 4.29 Spatial distribution of solar photovoltaic panels and STP treatment plan across the college campus

The institution has an 80 kW on-grid solar photovoltaic system installed. Regrettably, the plant is presently non-functional / yielding negligible generation. Comprehensive production data could not be retrieved during the study period; the few available readings indicate an average output of merely 16,176 kWh. Immediate corrective action is required to resolve the technical faults and enable productive use of the solar power facility

4.4.8 KSEB Meter Reading Analysis

Sampling days	Unit of consumption (kWh)
Working day	1101.33
Semi holiday	375.57
Holiday	233.33
Annual energy consumption	1,710.23 kWh

Table 4.27 Meter reading of cons:1356120031901

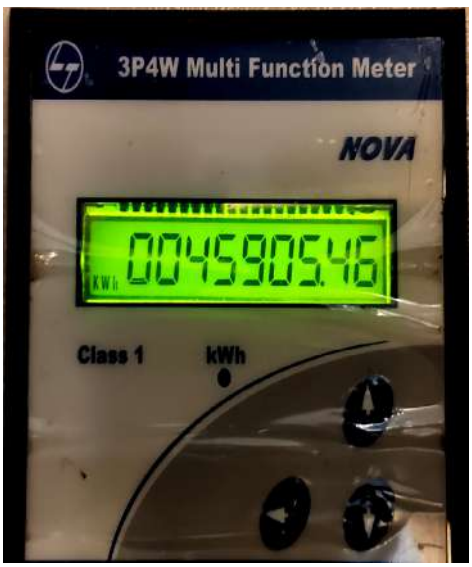


Fig 4.30 Three-phase electric meter of cons:1356120031901

Analysis of KSEB meter readings reveals that energy consumption on weekdays is consistently higher than on semi-holidays and public holidays. This increase aligns with the operational requirements of classrooms, offices, and administrative functions. The estimated annual energy consumption, based on meter reading analysis, is 1,710.23 kWh

Fig 4.31 Recording three phase electric meter reading

4.4.9 Total energy consumption of Marian College

Sl.no	Assessment Mode	Total energy Consumption/year (kWh)
1	Infrastructure assessment	463.405
2	Mandatory Audit	40,437
3	KSEB Bill analysis	392028.7
4	Energy Meter Reading Sample Study	1,710.23
5	Annual solar Production	16,176

Table 4.28 Findings from the energy assessment of each method.

4.4.10 Lpg Uasge

Sl.no	Location	Quantity kg	count per year
1	Cafeteria Magis	10.48	224
2	Cafeteria Magis	16.32	144
3	MIM cafeteria	10.48	60
4	Girls and boys hostel Kitchen	14.2	724
5	Chemistry lab	14.2	1
6	Laundry	14.2	310
		79.88	1463

Table 4.29 Annual LPG usage

A total of 1,463 cylinders have been acquired, with an annual LPG consumption of approximately 20023.4 kg The implementation of biomass energy solutions presents a significant opportunity for the college to reduce LPG purchases and enable carbon footprint credit acquisition. However, the institution's climate conditions may influence the operational efficiency of the biogas plant. As an alternative, the college could utilise solar energy to power the canteen and cafeteria, as well as consider biofuels such as bio-propane, which can act as direct replacements for LPG in existing cylinders and stoves while producing lower emissions. Additionally, these options could serve as a reliable backup in case of variability in biogas output.

Fig 4.32 LPG Cylinder Supply and Distribution Pattern for College Mess and Canteen

4.4.11 Fossil Fuel

Purpose	2024	2023	2022
Generator(Deisel)	6190.50	4040.00	1951.62
Bus (Diesel)	2151.13	3271.80	3578.40
Car (Diesel)	781.41	857.31	783.42
Car (Diesel)	2358.28	2297.20	1856.07
Car (Diesel)	29.74	38.34	34.74
Car (Petrol)	564.34	0.00	0.00
	12075.39	10504.65	8204.25

Table 4.30 Annual fuel consumption

Fuel consumption continues to rise annually, with a total of 12,075.39 liters purchased in 2024, including 11,511.05 liters of diesel and petrol for institutional use across all college-owned vehicles. The college prioritises car-sharing practices, and while this initiative is already in place, there remains an opportunity to enhance participation and transition to electric vehicles (EVs).

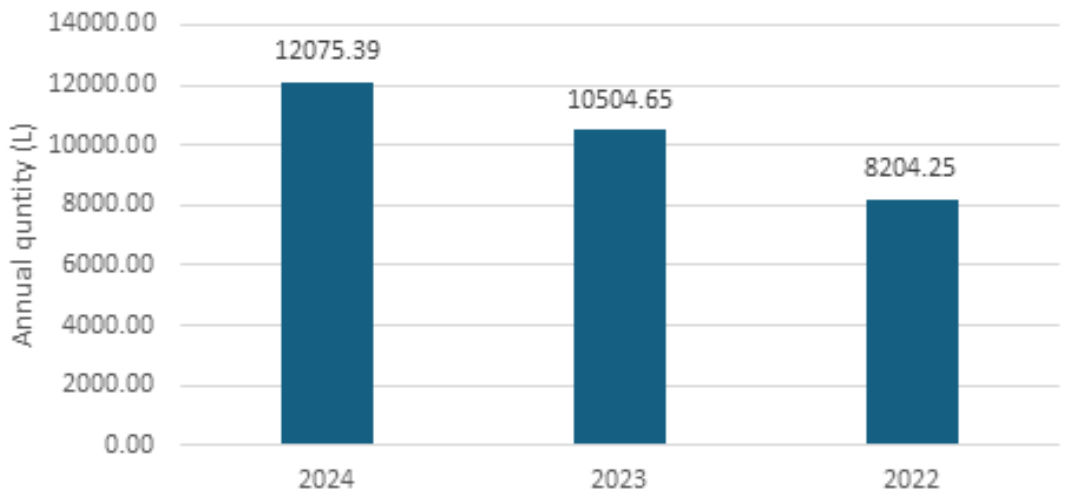


Fig 4.33 Annual fuel purchase

Fig 4.34 On campus auto service

Fig 4.35 Common transporation service

4.4.12 Vehicle Sahring Status

Sl.No	Two-wheeler count	Four-wheeler count	Distance travelled (from-to and to-from) Km	Status of sharing
1	1	1	8	0
2	1	0	100	0
3	0	1	70	4
4	1	1	75	0
5	1	1	80	4
6	1	1	24	0
7	1	0	60	0
8	1	0	45	0
9	0	1	38	0
10	0	1	215	0
11	1	0	160	0
12	1	1	65	0
13	1	1	30	4
14	0	1	40	4
15	0	1	30	1
16	1	1	10	0
17	1	1	68	4

18	1	0	16	1
19	1	0	34	0
20	1	1	40	0
21	0	1	52	3
22	0	1	80	4
23	1	1	30	0
24	0	1	40	4
25	1	0	70	1
26	1	1	20	2
27	0	1	80	0
28	0	1	9	3
29	0	1	9	2
30	0	1	9	1
31	0	1	9	1
32	0	1	10	1
33	0	1	124	5
34	0	1	44	5
35	0	1	140	4
36	0	1	54	3
37	0	1	72	4
38	0	1	2	1
39	0	1	2	1
40	0	1	80	4
41	0	1	62	4
42	0	1	60	0
43	0	1	50	3
44	1	0	70	0
45	1	0	6	0
46	0	1	16	0
47	1	0	24	0
48	1	0	20	0
49	0	1	40	0
50	0	1	112	4
51	0	1	2	0
52	0	1	2	1
53	0	1	2	1
54	0	1	80	1
55	0	1	220	0

56	0	1	100	0
57	0	1	70	0
58	0	1	9	0
59	1	0	5	0
60	0	1	120	1
61	0	1	70	0
62	1	0	30	0
63	0	1	16	1
64	0	1	16	0

Table 4.31 Vehicle sharing status of the college

Sl.no	four-wheeler count	Distance travelled (from-to and to-from) Km	Status of sharing
1	1	70	4
2	1	80	4
3	1	30	3
4	1	40	4
5	1	30	1
6	1	68	4
7	1	52	3
8	1	80	4
9	1	40	4
10	1	20	2
11	1	9	3
12	1	9	2
13	1	9	1
14	1	9	1
15	1	10	1
16	1	124	5
17	1	44	5
18	1	140	4
19	1	54	3
20	1	72	4
21	1	2	1
22	1	2	1
23	1	80	4
24	1	62	4
25	1	50	3
26	1	112	4

27	1	2	1
28	1	2	1
29	1	80	1
30	1	120	1
31	1	16	1

Table 4.32 Four-wheeler sharing status of the college

Sl.no	two-wheeler count	Distance travelled (from-to and to-from) Km	Status of sharing
1	1	80	2
2	1	30	2
3	1	68	2
4	1	16	2
5	1	70	2
6	1	20	2
	6	284	12

Table 4.33 Two-wheeler sharing status of the college

A total of 51 four-wheelers, including 31 shared vehicles, have resulted in a fuel savings of 1679920 liters. Additionally, there are 24 two-wheelers, of which 6 are shared, leading to an annual fuel saving of 12496 liters

4.5 CONCLUSION

- Based on the infrastructure assessment, energy consumption varies across each block, influenced by construction patterns, the availability of infrastructure, usage habits, outdated facilities, and electricity utilisation. This variability has contributed to a significantly high consumption rate. Notably, the Guesthouse exhibits elevated energy use, which can be attributed to its comparatively lower infrastructure capabilities and the operation of appliances such as the fridge, dishwasher, washing machine, heater, and water filter, many of which are not Energy Star rated and thus are prone to higher consumption. Given the campus's size and the frequent occupancy of the Guesthouse by external visitors, as noted by college authorities, there is a pressing need for energy efficiency improvements. The college can effectively reduce energy consumption by upgrading to Energy Star-rated appliances and promoting energy conservation practices among users.
- The electricity bill has been increasing annually, despite the college having an 80 KVA solar capacity. An audit has revealed that over the past three years, solar energy has not been exported nor reflected in the electricity charges. This situation has become a significant concern regarding the ineffective utilisation of alternative energy sources.
- Marian College Kuttikkanam exhibits commendable energy performance, with a notably low EPI, high average power factor, good supply quality, and alignment with its sustainability commitments as an energy-positive, green campus. The identified issues, primarily related to harmonic distortion, phase/neutral imbalance, occasional PF/demand excursions, and specific thermal anomalies, are typical for mixed-load educational campuses with significant IT, hostel, and lab usage, and do not indicate systemic inefficiency.
- Prompt implementation of the recommended low-investment measures (APFC repair/tuning, phase rebalancing, thermographic corrections, and demand revision) will deliver quick returns through

reduced penalties, maximised PF incentives, lower technical losses, enhanced equipment reliability, and avoided downtime. These steps will further strengthen the institution's position as a model for sustainable higher education in Kerala, supporting reduced CO_2 emissions, cost optimisation, and long-term environmental stewardship. Regular follow-up audits and integration of PQ monitoring into maintenance routines are advised to sustain and build on these gains.

4.6 RECOMMENDATION

- Upgrade to LED Lighting and Smart Controls: Replace traditional fluorescent or incandescent bulbs with energy-efficient LEDs, which can cut lighting energy use by up to 80%. Install occupancy sensors, motion detectors, and timers in classrooms, hallways, dorms, and common areas to ensure lights are only on when needed. Moreover, upgrade to an automatic motor system to track the water pumping time and its duration.
- Voltage level management. If the transformer has on-load or off-load tap-changer provision, consider adjusting taps to bring the average voltage closer to nominal (e.g., 230/400 V), provided utility side conditions permit.
- Coordinate with the utility (if tap change is not under campus control) to check if feeder voltage can be slightly optimised, especially if similar overvoltage is observed consistently at different times.
- Motor and HVAC protection and efficiency to ensure that the major three-phase motors (pumps, fans, AHUs, compressors) are protected with relays or protection functions that monitor negative-sequence/unbalance and thermal overload, given the measured current unbalance. Use VFDs on large motor loads with proper parameter settings; they can help mitigate thermal stress and improve efficiency under variable loading, especially when the supply is slightly overvoltage.
- Integrate periodic PQ logging (voltage, current, unbalance, THD) into the college's maintenance plan, at least once each semester, and after any major load additions or redistribution. Document trends and correlate with events such as new equipment installation, semester opening, or hostel occupancy changes to maintain phase balance and keep unbalance indices within recommended limits over time.
- Optimise HVAC Systems: Invest in high-efficiency heating, ventilation, and air conditioning (HVAC) units, programmable thermostats, and regular maintenance to prevent energy waste from defective or overworked equipment.
- Conduct a circuit-level survey from the main LT panel down to major DBs to map which singlephase circuits (classroom lighting, plug loads, office loads, hostel floors, IT labs) are connected to each phase.
- Re-distribute these circuits so that the average currents on A1, A2, and A3 are as closely matched as practical during key operating periods (class hours, evening hostel peak), aiming to bring current unbalance below about 3–4%.
- Inspect and thermographically scan neutral busbars, links, and terminations at the transformer LT panel, main LT panel, and heavily loaded DBs to identify overheating or loose connections periodically.
- Ensure the neutral conductor size and rating are adequate for the measured AN values; if undersized, plan reinforcement or parallel neutral paths for critical feeders.
- Harmonic and non-linear load management. There are large concentrations of IT/ICT loads (computer labs, offices), consider grouping these on specific feeders and, if measurements confirm high THD, use suitable harmonic mitigation (K-rated transformers, passive filters, or active harmonic filters, depending on scale).
- Prefer higher powerfactor LED drivers and Star-rated

IT/office equipment; these tend to produce lower harmonic currents and reduce neutral loading over time.

- Review settings of protective devices (MCCBs, ELCBs, relays) on heavily loaded phases and neutrals to ensure they are coordinated with actual current levels and derating due to harmonics/unbalance.

- Institutionalise periodic PQ measurements (phase currents, neutral current, THD, unbalance) at least annually or after major load changes, so that deviations in A1–A3–AN can be quickly detected and corrected.

- Promote Behavioural Changes and Awareness: Launch energy awareness campaigns, competitions (e.g., dorm energy challenges), and educational programs to encourage turning off lights, unplugging devices, and reducing phantom loads. Simple habits like closing doors and using natural light can add up to 10-20% savings. Posters and infographics reinforce these messages effectively.
- Integration of Renewable Energy Sources: The institution maintains and has reinstalled an 80 kVA rooftop solar system, which is capable of generating approximately 320–480 kWh of electricity per day, depending on solar irradiance and system performance. As the college operates as an on-grid facility, it has the potential to export surplus energy to the grid; however, no such export occurred during the audit period.

- Conduct Energy Audits: Conduct an external energy audit with an expert agency to evaluate the electrical performance, track consumption, identify inefficiencies, and prioritise improvements. Regular audits and "energy treasure hunts" involving staff and students can uncover quick wins, such as eliminating standby power or optimising appliance usage.

Additional Measures

- Replace old appliances with ENERGY STAR-rated models.
- Implement demand response programs to reduce peak usage.
- Explore green revolving funds or incentives for funding projects.

By starting with low-cost behavioural and lighting upgrades while planning for larger investments like renewables and HVAC modernisations, the college can reverse rising consumption trends, lower bills, and demonstrate leadership in sustainability. Consulting resources from ENERGY STAR or local utilities can provide tailored guidance and potential rebates.

4.7 ENVIRONMENT MANAGEMENT PLAN

4.7.1 Establish an Adept Energy Management Team

Marian College is dedicated to bolstering its commitment to sustainable energy management by establishing an enhanced Energy Management Committee (EnMC), under the leadership of the Administrator and with the support of the Internal Quality Assurance Cell (IQAC). This initiative aligns with Sustainable Development Goal 7, as the College aims to improve energy efficiency, reduce carbon emissions, and advocate for modern, sustainable energy systems throughout the campus. The College will invest in upgrading its electrical infrastructure, ensuring adherence to national energy standards, and fostering a culture of mindful energy consumption through targeted training, awareness initiatives, and community engagement. The EnMC will comprise faculty with technical expertise, facility managers, electricians, student representatives, and administrative staff. This Committee will be responsible for planning, coordinating, and overseeing all energy-related activities. Its duties will include conducting energy audits, monitoring energy consumption, maintaining accurate documentation, and guiding the implementation of systems aligned with ISO 50001:2018. The Committee will convene regularly to analyse data trends, identify areas for improvement, and develop actionable plans for enhancing energy management across the College.

4.7.2 Formulate a Comprehensive Strategy for Sustainable Energy Management

The College will formulate and begin executing a comprehensive strategy focused on energy conservation, renewable energy expansion, and behavioural transformation. This strategy will:

- Implement a comprehensive transformation of the institution's infrastructure by transitioning to 100% LED lighting and upgrading electrical installations to comply with Bureau of Energy Efficiency (BEE) and Minimum Energy Performance Standards (MEPS). Additionally, install smart meters to facilitate real-time energy monitoring and incorporate energy-efficient design principles in all new construction and renovation projects.
- Establish an internal auditing process led by trained auditors. This will include regular assessments and reporting, as well as the implementation of necessary changes following external audits conducted by an independent agency. This framework will ensure that all departments adhere to standardised operating procedures for energy use, maintenance, procurement, and reporting.
- Embed themes of energy sustainability into the curriculum, research initiatives, and community engagement projects. This approach aims to enhance students' educational opportunities while sensitising them towards sustainability practices, positioning the institution as a leading reference model in energy stewardship within the educational sector.

4.7.3 Implement Effective Methods to Attain Set Objectives

- Introduce energy-efficient appliances and low-energy HVAC systems.
- Carry out preventive and scheduled maintenance of electrical installations.
- Apply operational controls to reduce energy-intensive usage in laboratories, computer rooms, and pumping systems.
- Strengthen behavioural campaigns such as "Switch Off" and "Save Energy."
- Expand sustainable commuting practices such as carpooling, e-mobility, walking, and cycling.
- Enforce sustainable procurement prioritising energy-efficient and recyclable products.
- Implement recommendations arising from periodic energy audits.

4.7.4 Establish Robust Communication Channels and a Governing Body

- The College will implement robust communication strategies that include circulars, email notifications, staff meetings, student forums, and IQAC platforms. The Energy Management Committee will serve as the primary governing body, collaborating with Heads of Departments to ensure adherence to compliance standards.
- A dedicated communication channel will be established to facilitate interactions among administrators, staff, students, and technical teams, managed by the energy auditor. Energy data, reports, and audit findings will be systematically recorded in registers for evaluation and future reference, while maintaining transparent documentation that includes meeting minutes and monitoring records.

4.7.5 Long-term and Short-term goals

4.7.5.1 Long-Term:

- Aim for an annual energy consumption reduction of 5–10%.
- Transition 80% of our infrastructure to LED and energy-efficient technologies.
- Gradually increase solar capacity from 80 kW to 150 kW.
- Promote the use of electric vehicles (EVs) for campus transportation needs and encourage bicycle usage.
- Facilitate a 50% increase in long-term research,

innovation, and collaboration in sustainable energy initiatives.

4.7.5.2 Short-Term:

- Appoint a permanent electrician and install signage to restrict access to the electrical room.
- Install smart meters and replace outdated or inefficient equipment.
- Upgrade under-star-rated equipment** to star-rated alternatives.
- Display signage that encourages energy conservation and wise usage.
- Replace tube lights with energy-efficient LED lighting.

4.7.6 Continuously Monitor and Enhance the System

Marian College will continuously monitor energy consumption through smart metering, consumption logs, and an internal tracking system.

- The energy management team will conduct internal monthly reviews and periodic external audits to ensure comprehensive documentation of equipment performance and maintenance.
- An Annual Energy Impact Report will be published, summarising progress and identifying gaps, which will be presented to the EMS administrative body after verifying its necessity. This will enable informed management decisions and appropriate actions when necessary.
- Regular review meetings will be held with internal auditors to promote transparency and accountability among participants. These meetings will provide a platform to address concerns and suggestions from team members, facilitating the revision of strategies and the integration of new technologies. This continuous monitoring will drive steady improvements in energy performance.

4.7.7 Conclude and Conduct Follow-ups on the System

- At the end of each review cycle, the Energy Management Committee will prepare follow-up action plans addressing audit findings, gaps, and system inefficiencies. Departments will receive specific tasks with timelines, and subsequent reviews will track progress. Stakeholder feedback will be gathered through surveys and interactive sessions to guide refinements and ensure ongoing alignment with institutional priorities.

4.7.8 Conclusion

Marian College Kuttikkanam (Autonomous) will implement this Energy Management Plan through the coordinated efforts of the Administrator, IQAC, the Energy Management Committee, and all departments. The plan will evolve through regular meetings, audits, and data-driven reviews, ensuring transparency and accountability. By progressively adopting smart monitoring systems, energy-efficient technologies, and sustainable behavioural practices, the College will move toward long-term institutional excellence in energy conservation and sustainability.

4.8 ACTIVITIES CONDUCTED

Activities of promoting Sustainability on the campus

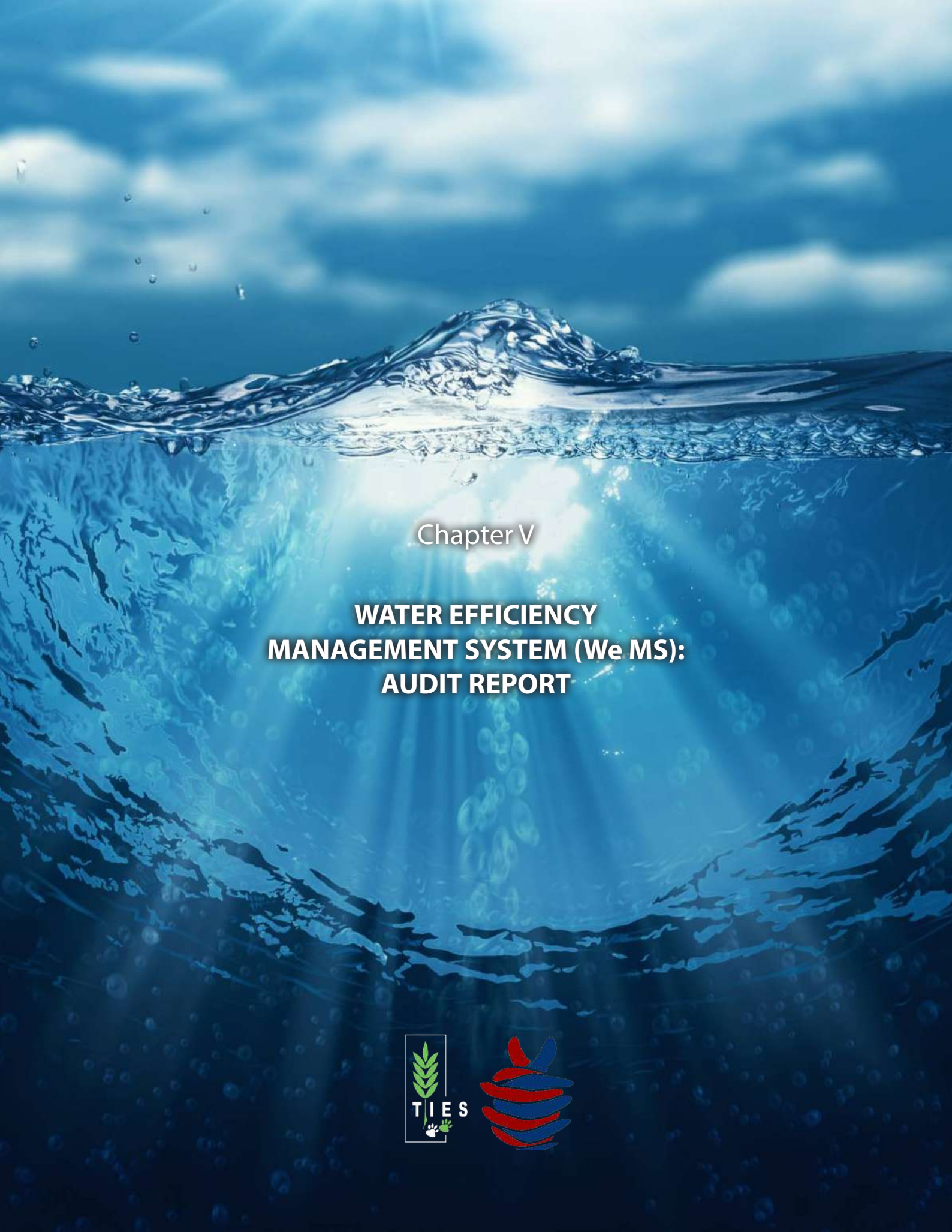
A hands-on workshop titled "LED: Assembly, Repair, and Applications" was conducted on 05 February 2025 as part of the Albertian Knowledge Summit (AKS-2025), an international multidisciplinary conference organised by St. Albert's College (Autonomous), Ernakulam. The programme was organised by the Department of Renewable Energy and facilitated by the Department of Physics, Marian College Kuttikanam, with Dr. Roshan Jose and Mr. Sadasivan M. J. serving as resource persons.

The workshop focused on imparting practical knowledge of LED technology, covering fundamentals, assembly techniques, troubleshooting and repair, and applications in energy-efficient and renewable energy systems. Through demonstrations and hands-on sessions, participants gained exposure to LED components, circuit integration, repair methods, and safety practices. The programme also highlighted the role of LEDs in sustainable and solar-powered lighting solutions.

The workshop saw active participation from students,

faculty, and researchers across disciplines. Key outcomes included enhanced technical skills in LED assembly and repair, improved understanding of energy-efficient lighting technologies, increased sustainability awareness, and opportunities for interdisciplinary collaboration in renewable energy research.

To celebrate Environment Day and raise awareness about environmental conservation, a reel-making competition was conducted. The event aimed to engage participants creatively while highlighting critical environmental issues and promoting sustainable practices.



Chapter V

WATER EFFICIENCY MANAGEMENT SYSTEM (We MS): AUDIT REPORT

WATER EFFICIENCY MANAGEMENT SYSTEM (WEMS 2025-26)

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5 Water Efficiency Management System Audit Report

5.1 INTRODUCTION

Water is a vital natural resource necessary for the survival of all living organisms. Both animals and plants depend on water for life, as it is integral to their metabolic processes. For plants, water is essential for photosynthesis, enabling them to produce food and foster growth. Water resources include all natural water bodies on Earth, whether in vapor, liquid, or solid form, that can be utilised by humans. The most accessible sources are oceans, rivers, and lakes, while additional reserves include groundwater, deep subsurface water, glaciers, and permanent snowfields. On average, individuals consume approximately 600 to 700 liters of water each day. While humans can endure several days without food, the absence of water is inconceivable; likewise, plants will wilt and shed their leaves in its absence.

India experiences an average annual precipitation of 4,000 billion cubic meters (BCM), distributed unevenly across different regions and times. About 75% of this rainfall occurs during the four-month monsoon season, with nearly half falling within just 15 days and less than 100 hours. Kerala, noted for its substantial annual rainfall of around 3,000 mm, receives approximately 60% of this precipitation during the two monsoon periods, while the remaining 40% arises from summer rain. However, recent changes in weather patterns have disrupted this regular cycle, leading to intensified rainfall and flooding, which pose significant challenges for the state.

ISO standards provide a unified framework for technology and terminology, promoting effective collaboration among nations that share water resources. These standards deliver practical solutions and best practices for sustainable water management, focusing on the measurement and optimisation of water use, treatment and reuse of wastewater, and the management of water services and irrigation in sectors such as agriculture, manufacturing, and construction. Additionally, they serve as a foundation for public policies addressing climate change impacts, sanitation, and commitments to water management.

ISO's environmental management guidelines, including water footprint assessments, help organisations evaluate the implications of their water usage and identify strategies to enhance efficiency and minimise consumption. These standards also specify approaches

for managing and treating sludge and by-products generated from urban wastewater systems, stormwater, and water treatment facilities, thereby promoting sustainable practices in water and wastewater management.

5.1.1 What is a Water Audit?

A water audit provides a thorough evaluation of an entity's water usage, encompassing everything from the intake source to the discharge point, while systematically analysing all aspects of consumption. This evaluation quantifies the volume of water used, detects potential leaks or waste, and identifies opportunities for usage reduction. It also assesses current treatment systems and methodologies, offering recommendations for improvements to enhance efficiency and lower overall consumption. Based on the findings, the audit delivers actionable recommendations to minimise waste, optimise treatment practices, and perform cost-benefit analyses. Furthermore, it recommends the establishment of a system for monitoring water intake, distribution, and usage. The essential requirements for conducting a water audit include:

Documentation of the overall volume of water used by the college.

- Identification of water losses along with recommended strategies for mitigation, including the rectification of leaks, management of overflow, and the reduction of unmonitored losses due to improper usage.
- A comprehensive water conservation strategy that incorporates behavioural changes, advocates for water reuse, supports wastewater recycling initiatives, and investigates alternative water sources.

The water audit involves a systematic approach to creating a water balance by evaluating the flow of water from its source or treatment facility, through the distribution system, to various points of use, and finally to its discharge. This process includes calculating the water balance, analysing water usage, and identifying potential opportunities for conservation.

5.1.2 Need for Water Audit

Water audits serve as a valuable tool for identifying areas of significant water consumption, assessing the impact of pollutants in wastewater, and developing mitigation strategies grounded in the 3R principles: Reduce, Reuse, and Recycle. Our water audit services have empowered industries to implement effective measures that lower water usage, minimize wastewater production, and enhance resource recovery. These audits provide holistic solutions for improving water efficiency, resulting in cost savings and ensuring compliance with internal policies and regulatory requirements, while also demonstrating a commitment to sustainability.

The objectives of the water audit are to:

- Reduce water losses
- Improve financial performance
- Enhance the reliability of the supply system (providing quality water)
- Optimise the performance of the distribution system
- Strengthen protection for public health and property
- Serve as an effective educational and public relations tool for water
- Minimise legal liabilities, and
- Decrease disruptions, thus improving service levels for the entire college/university community.

The water audits employ a comprehensive, multi-phased approach to raise awareness among users, including students, staff, and visitors, while providing both immediate and long-term sustainable water management solutions. During this process, multidisciplinary teams of analysts, designers, and engineers work together to analyse the audit results and develop improved strategies for water management and sustainability. Implementing a water efficiency management plan can lead to significant water and energy savings, thereby mitigating the environmental impacts associated with water discharge and the long-distance transportation of water.

- The creation and proper implementation of a water efficiency management system are designed to improve water efficiency and can lead to the following outcomes:
- Viewing water as a valuable resource can be incorporated into organisational and financial planning.
- Assisting an organisation in effectively managing its water usage and enhancing water demand efficiency.
- Recognising the possible effects on others that may

result from alterations in water consumption.
- Promoting increased accountability for water usage.
- Providing a structure for continuous assessment to pinpoint areas for enhancing water efficiency.
- Achieving cost reductions by decreasing water consumption through sustainable design practices, the implementation of water-saving devices, and efficient monitoring.

5.2 WATER EFFICIENCY MANAGEMENT POLICY

5.2.1 Statement of Commitment

Marian College is committed to sustainable water management, Sustainable Development Goals (SDGs), particularly Goal 6, which advocates for ensuring the availability and sustainable management of water and sanitation for all through efficient use, conservation, reuse, and protection of water resources across the campus. The institution recognises water as a vital natural resource and strives to minimise wastage, enhance reuse, and ensure responsible stewardship through systematic planning, monitoring, and innovation.

5.2.2 Goals

The Marian Water Efficiency Management Policy seeks to establish a sustainable framework for water stewardship within the campus. It aims to ensure that water resources are used responsibly, conserved effectively, and replenished through proactive measures that align with the institution's broader sustainability vision.

5.2.3 Objectives

- To Ensure Reliable and Safe Water Supply
- To Reduce Water Consumption and Wastage
- To Promote Reuse, Recycling, and Rainwater Harvesting
- To maintain high water hygiene standards, prevent contamination, and ensure potable and non-potable water resources are safe and sustainable.
- To Integrate Water Management Across Campus Operations
- To raise awareness among students, staff, and the local community about water conservation through workshops, campaigns, and active participation in water-positive initiatives.
- To comply with local, state, and national water and environmental regulations, align campus practices with legal standards and sustainability frameworks.

5.2.4 Resource Management

Marian College adopts a holistic approach to water resource management, ensuring the sustainable use, conservation, and replenishment of water across the campus. The institution integrates modern technologies with practical conservation practices to reduce water consumption, enhance reuse, and maintain ecological balance within campus grounds.

5.2.4.1 Replenishment and Reuse Systems: The College has established rainwater harvesting and water recharge facilities to replenish water resources. Greywater treatment and reuse systems ensure that water from hostels and wash areas will be recycled for non-potable uses such as irrigation, toilet flushing, and landscaping, reducing dependence on external water sources.

5.2.4.2 Water-Saving Techniques: All departments and facilities will implement water-efficient practices, such as installing low-flow faucets, dual-flush toilets, sensor-operated fixtures, and establishing leak detection protocols.

5.2.4.3 Awareness and Behavioural Programs: Awareness campaigns and behavioural programs encourage students, staff, and faculty to actively conserve water in their daily activities.

5.2.4.4 Upgraded Infrastructure and Smart Landscaping: The campus plumbing systems are continuously upgraded to prevent leakage and optimise water delivery. Smart irrigation systems, drip irrigation, and eco-sensitive landscaping using native, drought-tolerant, and climate-resilient plant species ensure that gardens and green patches thrive with minimal water input.

5.2.4.5 Holistic Campus Approach: Water management is integrated across academic, administrative, residential, and recreational operations. From laboratory practices to hostel management, and from sports fields to green spaces, the College ensures a coordinated and sustainable approach that balances resource efficiency with campus biodiversity and environmental responsibility.

5.2.5 Curriculum Integration

Marian College integrates sustainable water management concepts within its academic and co-curricular framework. Topics related to water efficiency, conservation, and sustainable resource use are incorporated into general courses and value-added courses such as Environmental Studies and Sustainability and Ethics. Faculty members are encouraged to include case studies, campus-based audits, and simple water conservation projects within courses and seminars. The Department of Physics may engage students in primary water quality testing, rainwater measurement, or efficiency assessments of campus systems. Students across disciplines participate in awareness campaigns, community outreach, and innovation challenges that promote practical and locally relevant approaches to water sustainability.

5.2.6 Green Initiatives

The Water Efficiency Management Committee (WEMC), in collaboration with the Facility Management Team, IQAC and student Green Ambassadors, will implement and monitor these initiatives to ensure effective water conservation and sustainable management across the campus. Key measures include:

5.2.6.1 Rainwater Harvesting and Groundwater Recharge: The college has successfully constructed two check dams as part of its rainwater collection systems, along with percolation pits designed to capture runoff and replenish groundwater levels, thereby ensuring long-term water security for the campus.

5.2.6.2 Sewage treatment plant: The college currently operates a sewage treatment plant (STP) with a capacity of 27,000 litres; however, the treated water is primarily utilised for grinding and exterior washing. To enhance our sustainability efforts, we plan to introduce a new plant with a larger capacity aimed at recycling wastewater from hostels and academic blocks for secondary uses, including garden irrigation, cleaning, and toilet flushing.

5.2.6.3 Water-Efficient Infrastructure: Replacement of conventional taps and plumbing fixtures with low-flow aerators, dual-flush toilets, and automatic shut-off systems, alongside a periodic inspection and leak detection programme to prevent wastage.

5.2.6.4 Sustainable Landscaping: Adoption of eco-sensitive landscaping practices that prioritise native, drought-tolerant plant species, use of mulching, and drip irrigation systems to minimise water use in green spaces.

5.2.6.5 Awareness and Behavioural Change Campaigns: Regular student-led drives, green ambassador programmes, and visual campaigns (signage, posters, and social media initiatives) to build a culture of water conservation within the campus community.

5.2.7 Purchasing and Procurement

The Water Efficiency Management Committee (WEMC), in coordination with the Purchase Committee and the Infrastructure Department, shall ensure that all water-related procurement and development activities align with Marian College's sustainability and water efficiency goals. The purchasing and procurement committee will:

5.2.7.1 Prioritises Water-Efficient Products: Procures plumbing fixtures, taps, and appliances with verified water-saving features such as low-flow aerators, dual-flush systems, and automatic shut-off valves.

5.2.7.2 Ensures Responsible Supply Chains: Engages vendors and contractors who adhere to environmentally responsible manufacturing, delivery, and wastewater management practices.

5.2.7.3 Selects Durable and Low-Maintenance Materials: Chooses materials and fittings that minimise leakage, corrosion, and replacement needs, thereby reducing long-term water and maintenance costs.

5.2.7.4 Integrates Sustainability into Infrastructure Projects: Mandates the inclusion of water-saving technologies such as rainwater collection points or greywater reuse lines in all new construction and renovation plans.

5.2.8 Research and Innovation

Marian College's Research Committee promotes and supports research and innovation in water efficiency, with the Water Efficiency Management Committee (WEMC) overseeing implementation in collaboration with faculty members and student researchers. The institution encourages:

5.2.8.1 Innovative Reuse and Wastewater Treatment Methods: Development facilities for testing of greywater treatment systems, rainwater capture techniques, and cost-effective water recycling solutions will be conducted in collaboration with a consulting expert agency. This initiative will actively involve students in service and maintenance processes, with support from non-teaching faculty responsible for campus building maintenance. Through this hands-on training, students will gain practical experience and have the opportunity to contribute to further advancements in these systems.

5.2.8.2 Community-Based Water Management Practices: Conduct studies and pilot projects designed for the needs of the local community by engaging residents, schools, and NGOs. This collaborative approach will introduce a participatory program aimed at addressing critical issues such as water scarcity, water contamination, and the exploration of alternative water sources, thereby promoting effective water stewardship.

5.2.8.3 Integration of Traditional and Modern Systems: Colleges provide extensive research facilities and library resources that facilitate discussions on various methods of water conservation. In addition, training sessions led by experts from diverse fields, along with student field observations and interactions with local communities, including indigenous groups, will foster an understanding of both traditional and modern approaches to introducing innovative initiatives. Furthermore, departments may undertake comparative research on indigenous water conservation methods alongside modern technologies to identify optimal, context-specific solutions.

5.2.9 Community Engagement

Marian College extends its water stewardship initiatives beyond the campus, coordinated by the Extension Department with support from faculty coordinators and student Green Ambassadors. Key activities include:

5.2.9.1 Collaborative Partnerships: Working with local panchayats, schools, and NGOs to conduct awareness programs, training sessions, and capacity-building workshops on water conservation practices.

5.2.9.2 Knowledge Sharing and Technical Support: Providing guidance and demonstrations on rainwater harvesting, greywater reuse, and other sustainable water management techniques for community projects.

5.2.9.3 Workshops and Campaigns: Organising interactive workshops, seminars, and outreach campaigns to foster responsible water use behaviours among students, staff, and residents.

5.2.9.4 Participation in Local and Government Initiatives: Supporting state and district-level programs for efficient water use, water literacy drives, and sustainability projects to amplify community impact.

5.2.10 Monitoring and Reporting

To ensure accountability and progress:

- The Water Efficiency Management Committee (WEMC) systematically monitors usage trends and performance indicators by maintaining comprehensive records of infrastructure purchases, maintenance activities, and subsequent meter readings and water quality assessments.
- Periodic internal and external audits are performed to assess risks, and detailed reports are prepared for submission to the Internal Quality Assurance Cell (IQAC) to facilitate prompt action in addressing identified issues.
- An Annual Water Efficiency Report is compiled and submitted to the administration, which transparently documents progress, challenges, and improvements. This report provides stakeholders with an overview of campus water management and serves as a reference for future infrastructure projects to ensure optimal utilisation and high-quality standards.

5.2.11 Compliance and Review

The College adheres to all relevant national, state, and local water and environmental laws.
The Water Efficiency Management Policy is reviewed every three years (or earlier if required) to align with emerging technologies, institutional needs, and legislative changes.

5.2.12 Leadership and Accountability

The Water Efficiency Management Committee (WEMC), in collaboration with the Administrator, is assigned to

implement and oversight of this policy. Department Heads and Facility Managers are responsible for ensuring compliance within their respective units.

To foster transparency and inclusivity, the committee will hold regular meetings to encourage the sharing of diverse perspectives among its members. Ongoing reviews, audits, and awareness initiatives will promote a culture of continuous improvement in water conservation efforts.

5.2.13 Conclusion

Marian College is committed to a water-positive campus through efficient use, conservation, reuse, and replenishment of water resources. By combining infrastructure upgrades, smart irrigation, rainwater harvesting, awareness programs, and community engagement, the College fosters a culture of water responsibility. Continuous monitoring, compliance, and participation from students, faculty, and staff ensure sustainable water stewardship aligned with Marian's broader environmental sustainability goals.

5.3 METHODOLOGY

A comprehensive water efficiency assessment, essential for sustainable progress, evaluated water consumption and maintenance practices throughout the college. The methodology for the audit included a ground-level survey carried out by a team of ten members (seven students and three faculty) following a predetermined schedule. The team was divided into specialised groups to carry out tasks such as documenting activities, inspecting plumbing fixtures, and performing site evaluations on a block-by-block basis. The organised audit relied on eight different registers and five main guiding documents.

5.3.1 Internal Audit Training

Green audit training executes detailed, participatory methods to cultivate a sense of ownership and involvement within the institution. To prepare the college for this initiative, the implemented Environmental Management System (EMS) identifies students and faculty for training as internal auditors. This one-day course certifies participants as internal auditors, enabling them to perform a water audit. The internal water audit procedure consists of several essential phases: evaluation, risk assessment, data gathering, policy development, and the creation of records and programs for water conservation and resource management.

5.3.2 Water Infrastructure Survey

The internal audit team conducted a comprehensive survey of the water infrastructure. This process included cataloguing taps and faucets according to their type and quantity, evaluating their condition, and specifically noting the locations and counts of any leaks. The team created a map of all water sources for each block, including external sources, and recorded the details of water storage systems, such as type, capacity, year of installation, and placement. This information enabled an evaluation of the functionality of the infrastructure (taps, faucets, pumping lines). The audit also included an analysis of water quality, an assessment of water risk management strategies, and a review of maintenance practices.

5.3.3 Sampling Data Collection of Five Water Meters

To oversee water distribution, flow meters were installed at five sites where main lines emerge from their designated sources or tanks. Meter readings were collected over three weeks during planned sampling days. Simultaneously or independently, based on the actual procedures, pump operating times and related water volumes were recorded in triplicate throughout a nine-day observation period. The data gathered, which included date, time, volume, and duration measures, enabled calculations of flow rates.

5.3.4 Registers for the Monitoring and Analysis

The audit subsumes an evaluation of water footprint records, examination of consumption trends, grey water recycling systems, strategies for reducing water loss, and thorough management of water resources. Additionally, organised documentation of meetings and initiatives centred on water conservation and sustainability created a solid baseline of the college's existing water resources and practices.

5.3.5 External Auditing

Following the completion of the internal audit, an external auditor arrives at the college to assess compliance and identify any non-conformities related

to the water management audit standards. In cases where only minor non-conformities are identified, the external auditor can grant the institution certification in alignment with the applicable ISO standards.

5.3.6 Assumption

The global challenge of water scarcity is critical and increasingly urgent, necessitating proactive solutions. To address this concern and promote water conservation in non-domestic sectors, organisations should adopt sustainable water management practices. The ongoing shortage of freshwater, made worse by consumption habits, high agricultural and industrial demands, and climate change, calls for improved resource management. Although freshwater supplies cannot be expanded, their management can be refined through a structured approach that includes enhancing water efficiency, utilising consumption analysis tools, and implementing systematic conservation efforts. This approach not only yields significant savings in water and energy but also lessens environmental impacts.

By aligning water management strategies with established standards, such as those specified in ISO 46001, organisations can reap considerable benefits. This alignment involves incorporating water resource identification into organisational planning and financial decisions, optimising water demand, enhancing management of usage, and promoting accountability by emphasising potential societal impacts. Regular evaluation procedures uncover chances for efficiency improvements, resulting in operational savings through conservation technologies, sustainable design, and careful monitoring. Thorough audits of critical infrastructure elements—from source and treatment facilities to distribution systems and end-users—are vital for detecting water losses, supporting system enhancements, and ensuring water quality via systematic monitoring, which guides the development of suitable treatment systems. Assessing leaks is a fundamental component of this evaluation process.

5.3.7 Water Footprint Verification

The critical role of water usage within national sustainability initiatives highlights the necessity for reliable and comparable data to enable effective regulation. ISO 14046 meets this need by providing a standardised approach for assessing and reporting water footprints, emphasising precision through independent verification protocols. There is a growing interest among stakeholders, consumers, and international organisations in the water performance of corporations, focusing on the overall water footprint, which encompasses both direct and indirect water usage along with associated environmental effects. As a result, the ISO 14046 standard was created to offer a solid framework for these evaluations. It aids in determining the water footprints for entities, processes, and products, assessing not only the volumes of water consumed but also the potential environmental impacts. ISO 14046 assessments can be executed independently, focusing specifically on water-related effects, or integrated into a broader life cycle assessment (LCA). With increasing pressures in the 21st century, such as climate change leading to diminished water resources, businesses need to implement effective water management strategies. Leveraging ISO 14046 and its verification process, often supported by training programs (e.g., SGS), allows organisations to credibly showcase their commitment to responsible water management.

5.3.8 Stages of Water Audit

Water audit has the following three phases:

5.3.8.1 Pre audit phase

- Formation of audit team; scheduling audit programmes
- Setting up of scope and objectives (in tune with the water conservation policy of the institution)
- Discuss 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 the following specific activities:

5.3.8.1.1.System audit (inventory of infrastructure)

- The current water usage 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.

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

- Water audit comprises the preparation of a layout of water sources, distribution network, and 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.

5.3.8.2 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 an 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.

5.3.8.3 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:

5.3.8.3.1.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 project future requirements.
- Data on the development of a sustainable source of water through rainwater harvesting and wastewater (grey water) recycling should also be taken into consideration.
- Water conservation measures shall be identified and included in the action plan.

5.3.8.3.2.Discharge audit

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

5.3.9 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.

5.3.9.1 . Site assessment

Collection of contour maps and campus diagrams

- Preparing an inventory of the water infrastructure of each building:

- Water meter data (from various points of use)
- Data on the quantity of water pumped every day (pump-wise/location-wise)
- Data on leaking infrastructure and the 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)

5.3.9.2 . 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

5.3.9.3 . Final audit by external audit team

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

5.3.10. Work Plan Schedule of Water Audit

Date to date	Weekly Work Plan
07/06/2025	Conducting a comprehensive survey to evaluate the quantity and types of taps and faucets, along with their operational status across various sections of the College Campus.
15/07/2025	Mapping the entire campus to identify water sources, including those located beyond the campus perimeter, if relevant.
30/07/2025	Assessing the functionality of taps, faucets, and plumbing systems (including pipes and fittings) and categorising their condition as Good, Poor, or Moderate.
16/08/2025	Measuring the water flow rate at each usage point and identifying instances of water loss through an on-site audit.
18/08/2025	Implementing initiatives aimed at promoting water conservation and sustainability.
15/09/2025 to 30/10/2025	Conducting a comprehensive survey to evaluate the quantity and types of taps and faucets, along with their operational status across various sections of the College Campus.

Table No.5.1 Schedule of the water efficiency management

Activities	Frequency	Dates of study	Mode of data collection
Usage pattern and quantity of water. Documentation of current WEMS practices. Grey water quantity from each section Flow meter reading data	Walk-through audit and interviews with system managers (controlling or responsible staff or teachers) Three replication	Collect data on water usage from each section of every division of the college (for eg, in the canteen, how much water is used for hand wash, cooking and its preparation, cleaning utensils, floor, table etc. Three holiday (11/08/2025, 17/08/2025, 25/08/2025); Three semi holiday (10/08/2025, 16/08/2025, 24/08/2025); three working days(09/08/2025, 15/08/2025, 23/08/2025)	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 every current water resource (capacity, sustainability etc.)	Entry in the given format
Alternate water resources (eg., Rain water harvesting systems)	Documents details of present alternate water resources in the campus	Identify possible alternate water sources	Entry in the given format Include in the action plan

Table 5.2 Work plan for the audit of the water efficiency management

5.4 RESULT AND DICUSSION

5.4.1 Water Sources Of The Institution: An Overview

Sl No	Water source	Location	Capacity (L)
1	Reservoir	Near to Magis block	1, 71000
2	Reservoir	Near the MIM block	71000

Table 5.3 Water source of the college

Fig 5.1 Main water source used by the college

The check dams serve as the primary water source for the college, where rainwater is collected to fulfil demand as well during the summer months. The institution does not utilise bore wells, relying instead on the two reservoirs as its main water supply.

5.4.2 Water Storage & Infrastructure

Sl.no	Type(eg:manual/ automatic)	No. of Tanks	capacity (L)	water source	building to which delivered	purpose of use	no.of times filled per day
1	Automatic	5	2000	Reservoir	Vattakkuzhy	fire, water	1
2	Automatic	2	25000	Reservoir	MIM	grey water + cafeteria + fire + water	1
3	Automatic	1	10000	Reservoir	Madonna Hostel	fire	1
4	Automatic	3	5000	Reservoir	Madonna Hostel	drinking + grey water	1
5	Automatic	1	5000	Reservoir	Academic	drinking + fire	1
6	Automatic	2	10000	Reservoir	Old Academic Block	drinking + fire	1
7	Manual	2	5000	Reservoir	Administrative	Drinking + fire	1
8	Automatic	6	5000	Reservoir	Maryknoll	drinking + fire + laundry + grey water	1
9	Automatic	3	5000	Reservoir	Paul Iby	drinking + fire + grey water	1
10	Manual	1	5000	Reservoir	Guest House	drinking + fire	1
11	Automatic	1	25000	Reservoir	Magis	drinking + grey water	1

Table 5.4 Water storage facilities of the college

Fig 5.2 Water storage tank installed on campus

Location	Tap	Flush	Faucet	Shower	Sprinkler	Filter
Cafeteria	6	0	0	0	0	2
Teachers' Café	2	0	0	0	0	0
Cafeteria Bathroom Girls	11	11	12	0	0	0
Cafeteria Bathroom Boys	11	12	12	0	0	0
VIP Space Bathroom	2	2	2	0	0	0
Staff Bathroom	2	2	2	0	0	0
GYM	11	10	11	3	0	0
Total	45	37	39	3	0	2

Table 5.5 Magis water infrastructure

Location	Tap	Flush	Faucet	Shower	Sprinkler	Filter
B2 Floor Girl's Washroom	8	4	4	0	0	0
B1 Floor	9	4	4	0	0	1
Parlor	3	1	1	0	0	0
Gr Floor Girl's Washroom	7	4	4	0	0	0
1st Floor	0	0	0	0	0	1
1st Floor Boy's Washroom	10	4	4	0	0	1
1st Floor Staff Washroom	2	1	1	0	0	0
2nd Floor	0	0	0	0	0	1
2nd Floor Girl's Washroom	7	4	4	0	0	0
3rd Floor Boy's Washroom	2	1	1	0	0	0
3rd Floor Staff Gents Washroom	2	1	1	0	0	0
3rd Floor Staff Ladies Washroom	2	1	1	0	0	0
4th Floor	0	0	0	0	0	1
4th Floor Staff Ladies Washroom	4	2	2	0	0	0
4th Floor Balcony	2	0	0	0	0	0
Total	58	27	27	0	0	5

Table 5.6 Vattakkuzhy water infrastructure

Location	Tap	Flush	Faucet	Shower	Sprinkler	Filter
Madona	211	82	82	41	0	7
Maryknoll	90	40	40	0	0	4
Pauliby	58	28	28	0	0	3
Total	359	150	150	41	0	14

Table 5.7 Hostel water infrastructure

Fig 5.3 Water fixature installed in campus building

Location	Tap	Flush	Faucet	Shower	Sprinkler	FILTER	Heater
MBA	51	26	26	0	1	1	0
SSW & BBA	28	20	20	0	0	2	0
TOP FLOOR	80	45	45	18	0	4	7
Total	159	91	91	18	1	7	7

Table 5.8 MIM water infrastructure

Location	Tap	Flush	Faucet	Shower	Sprinkler	FILTER
Washrooms	39	24	24	0	0	0
Corridor	0	0	0	0	0	3
Total	39	24	24	0	0	3

Table 5.9 Academic water infrastructure

Location	Tap	Flush	Faucet	Shower	Sprinkler	FILTER
Garden	2	0	0	0	3	0
Corridor	0	0	0	0	0	4
Washrooms	28	10	10	0	0	0
Total	30	10	10	0	0	4

Table 5.10 Administrative water infrastructure

Location	Tap	Flush	Faucet	Shower	Sprinkler	WATER PURIFIER
Guest House	26	12	12	10	0	1
Total	26	12	12	10	0	1

Table 5.11 Guest House water infrastructure

Fig 5.4 Distribution of water fixature across campus

The institution is equipped with eleven water tanks, with capacities ranging from 2,000 litres to 25,000 litres. Among these, two tank operates manually, while the remaining ten are automatic. The hostel facilities comprise four separate hostels, accommodating a total of approximately 704 fixtures. These facilities include 309 taps, 150 flush toilets, 150 faucets, 14 showers, and 14 water filters, all utilising water from the 20,000-litre capacity tank. In addition, the MIM Block supports around 374 facilities, which include 159 taps, 91 flush toilets, 91 faucets, one sprinkler, seven water filters, and one heater, drawing water from the 25,000-litre capacity tank. The Maggis Block, comprising about 126 facilities, features 45 taps, 37 flush toilets, 39 faucets, and two water filters, utilising water from the 20,000-litre tank.

The Vattakkuzhy Block caters to 117 facilities, equipped with 117 taps, five water filters, and 27 faucets and flush toilets, relying on the 2,000-litre tank for its water supply. The Academic Block includes approximately 90 facilities and features 39 taps, three water filters, and 24 flush toilets and faucets, drawing water from the 20,000-litre tank. The Guest House accommodates around 61 guests, providing 26 taps, 10 showers, one water filter, and 12 flush toilets and faucets, with water sourced from the 5,000-litre tank. Finally, the Administrative Block consists of 54 facilities, equipped with three taps, four water filters, and 13 flush toilets and faucets, utilising water from another 5,000-litre tank. This comprehensive water supply system ensures that all areas of the institution have adequate access to clean water.

Fig 5.5 College water tank automatic filling and pumping mechanism

5.4.3 Overview Of Manual Water Consumption Trends And Usage Patterns.

Water usage estimates are based on sample measurements of discharge rates at various fixtures over a fixed duration, from which annual consumption was extrapolated. Due to daily variations in individual usage, fluctuating demand, and the specific climatic characteristics of the region, actual consumption may differ from these figures. This analysis offers only a rough estimate of the college's annual and daily water requirements

MAGIS

Sl.no	Location name	fixtures	rate of discharge in L	Water Consumption (L)
1	Magis Cafeteria Taps	6	5.494	32.964
2	Teachers' Café	2	4.411	8.822
3	Cafeteria Bathroom Tap Girls	11	5	55
4	Cafeteria Bathroom Faucet Girls	12	5	60
5	Cafeteria Bathroom Tap Boys	11	5	55
6	Cafeteria Bathroom Faucet Boys	12	5	60
7	VIP Space Bathroom Tap	2	4.411	8.822
8	VIP Space Faucet	2	5	10
9	Staff Bathroom Tap (inside teachers' cafe)	1	5	5
10	Staff Bathroom Faucet (inside teachers' cafe)	1	5	5
11	Gym Tap	11	5	55
		71		355.61

Table 5.12 Magis manual water discharge

Fig 5.6 Manual water discharge sampling

Sl.No	Location name	fixtures	rate of discharge in L	Water Consumption (L)
1	Vattakkuzhy B2 Floor Girl's Washroom Washbasin Taps	4	5.3	21.2
2	Vattakkuzhy B2 Floor Girl's Washroom Faucet	4	12	48
3	Vattakkuzhy B2 Floor Girl's Washroom Cubicle Taps	4	7.5	30
4	Vattakkuzhy B1 Drinking Filter	1	2.38	2.38
5	Vattakkuzhy B1 Floor Staff Washroom Washbasin Taps	1	6	6
6	Vattakkuzhy B1 Floor Staff Washroom Faucet	1	7	7
7	Vattakkuzhy Gr Floor Girl's Washroom Washbasin Taps	3	4.5	13.5
8	Vattakkuzhy Gr Floor Girl's Washroom Cubicle Taps	4	10	40
9	Vattakkuzhy Gr Floor Girl's Washroom Faucet	4	8.23	32.92
10	Vattakkuzhy 1st Floor Drinking Filter	1	2.37	2.37
11	Vattakkuzhy 1st Floor Boy's Washroom Washbasin Taps	3	9.9	29.7
12	Vattakkuzhy 1st Floor Boy's Washroom Cubicle Taps	7	9.9	69.3
13	Vattakkuzhy 1st Floor Boy's Washroom Faucet	4	10	40
14	Vattakkuzhy 1st Floor Staff Washroom Washbasin Taps	1	9.69	9.69
15	Vattakkuzhy 1st Floor Staff Washroom Cubicle Taps	1	7	7
16	Vattakkuzhy 1st Floor Staff Washroom Faucet	1	2.37	2.37
17	Vattakkuzhy 2nd Floor Drinking Filter	1	2.41	2.41
18	Vattakkuzhy 2nd Floor Girl's Washroom Washbasin Taps	3	9.9	29.7
19	Vattakkuzhy 2nd Floor Girl's Washroom Cubicle Taps	4	9.9	39.6
20	Vattakkuzhy 2nd Floor Girl's Washroom Faucet	4	10	40
21	Vattakkuzhy 3rd Floor Boy's Washroom Washbasin Taps	1	3.09	3.09
22	Vattakkuzhy 3rd Floor Boy's Washroom Cubicle Taps	1	9.9	9.9
23	Vattakkuzhy 3rd Floor Boy's Washroom Faucet	1	5.92	5.92
24	Vattakkuzhy 3rd Floor Staff Gents Washroom Washbasin Taps	1	8	8
25	Vattakkuzhy 3rd Floor Staff Gents Washroom Cubicle Taps	1	7	7
26	Vattakkuzhy 3rd Floor Staff Gents Washroom Faucet	1	4.35	4.35
27	Vattakkuzhy 3rd Floor Staff Ladies Washroom Washbasin Taps	1	7.2	7.2
28	Vattakkuzhy 3rd Floor Staff Ladies Washroom Cubicle Taps	1	9.5	9.5
29	Vattakkuzhy 3rd Floor Staff Ladies Washroom Faucet	1	5.5	5.5
30	Vattakkuzhy 4th Floor Drinking Filter	1	2.34	2.34
31	Vattakkuzhy 4th Floor Staff Ladies Washroom Washbasin Taps	2	8.22	16.44
32	Vattakkuzhy 4th Floor Staff Ladies Washroom Cubicle Taps	2	10.95	21.9
33	Vattakkuzhy 4th Floor Staff Ladies Washroom Faucet	2	5.93	11.86
34	Vattakkuzhy 4th Floor Balcony Washbasin Tap	2	6.59	13.18
		74		599.32

Table 5.13 Vattakkuzhy manual water discharge

Sl.no	Location name	fixtures	rate of discharge in L	Water Consumption (L)
	Ground floor Girls' Tap	8	5.8	46.4
	Ground floor Girls' Washbasin Tap	8	3.06	24.48
	Teacher's washroom washbasin Tap	7	3.33	23.31
	Teacher's washroom Tap	8	8.5	68
	Basement Boys washroom washbasin Tap	8	5.8	46.4
				208.59

Table 5.14 Academic manual water discharge

Fig 5.7 College well not in use for water demand

Sl.no	Location name	fixtures	rate of discharge in L	Water Consumption (L)
1	Garden Front	1	15.67	15.67
2	Conference hall filter	1	2.73	2.73
3	Parlour	4	5.88	23.52
4	Boys' washroom	2	20.27	40.54
5	Faucet	3	6.22	18.66
6	Girls	2	20.33	40.66
7	Faucet	4	4.5	18
8	Finance dept	1	13.33	13.33
9	Staff washbasin	2	9.23	18.46
10	Faucet	3	4.5	13.5
11	MCA Filter	1	2.24	2.24
12	Wasbasin	2	3.19	6.38
13	Boys toilet	1	16	16
14	Washbasin	2	3.07	6.14
15	Staff room washbasin	2	4.81	9.62

16	Tap	1	3.06	3.06
17		1	5.79	5.79
18	Girls' washbasin	1	5.2	5.2
19		1	12.24	12.24
20	Library	1	7.54	7.54
21		1	5.9	5.9
22	Girl's	1	10	10
23		1	12.12	12.12
24	Filters	1	1.58	1.58
25	Lab	1	19.8	19.8
26	Garden near the guest house	1	52.17	52.17
				380.85

Table 5.15 Administrative manual water discharge

Sl.no	Location name	fixtures	rate of discharge in L	Water Consumption (L)
1	Sink tap	5	6	30
2	Tap	7	12	84
3	Sink tap	55	6	330
4	Tap	80	15	1200
5	Tap	12	7.18	86.16
				1730.16

Table 5.16 MIM manual water discharge

Fig 5.8 Rainwater collecting drainage system

Sl.no	Location name	fixtures	rate of discharge in L	Water Consumption (L)
1	Gest house	61	5.7	347.7
		12	10.29	123.48
		12	6.94	83.28
		10	3.58	35.8
				590.26

Table 5.17 Guest House manual water discharge

Location name	fixtures	rate of discharge in L	Water Consumption (L)
Madona			
Washbasin Tap	136	6.48	881.28
Washroom Tap	75	13.64	1023
Maryknoll			
Mess small tap	10	24.49	244.9
Big tap	5	39	195
Staff mess			
Washbasin tap	30	9.23	276.9
Washroom Tap	30	5.7	171
Top floor	5	3.03	15.15
Food lab	10	5.7	57
Paullby			
Washbasin Tap	24	6	144
Tap	34	6.36	216.24
			3224.47

Table 5.18 Hostels manual water discharge

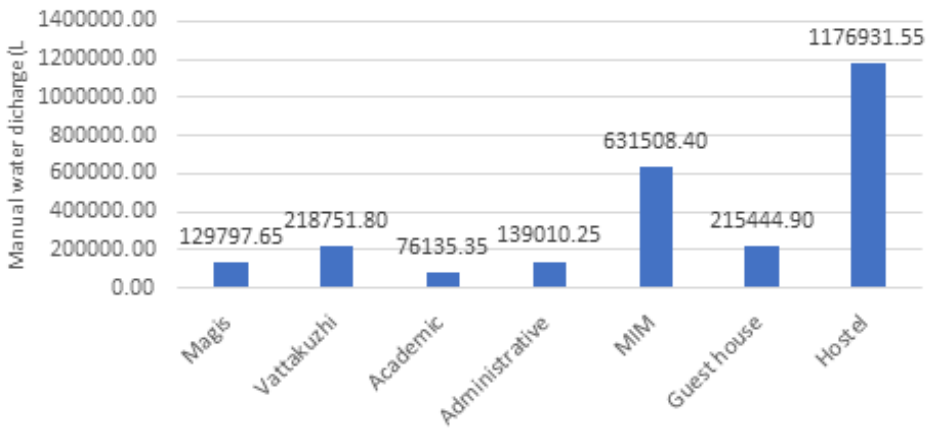


Fig 5.9 Manual water discharge of the campus fixture

The highest recorded water usage is observed in the hostel, amounting to approximately 2587579.90 litres per year. This facility accommodates three adjacent hostels that share a common kitchen and water supply. With a total occupancy of 500 residents and a multitude of water fixtures, several factors contribute to the increased water consumption in the college hostels. Primarily, the large resident population creates a significant demand for water for essential activities, such as bathing, cooking, and cleaning. Additionally, communal activities, including laundry and group cooking, further heighten water usage among students. Moreover, a lack of awareness or ineffective management of water conservation practices among residents can exacerbate this issue, leading to wasteful habits such as prolonged showers, unnecessary dishwashing, and inefficient laundry practices. Certain hostels may also have infrastructure that is not designed for water efficiency, resulting in leaks or inferior fixtures that do not support conservation efforts.

Collectively, these challenges lead to a considerable increase in water usage in college hostels 1176931.55L. Furthermore, water consumption in the MIM building is notably high, 631508.40 L, reflecting the increased demand placed on its infrastructure. This building is vital for maintaining hygiene across restroom facilities, handwashing stations, and other wash areas, and is equipped with eighteen showers and seven frequently used water filters, contributing to the overall increase in water usage. Additionally, the Vattakuzhi, 218751.80 L, Guest house 215444.90 L, Administrative 139010.25 L, and Magis blocks 73322 L show the third-highest levels of water consumption, with slight variations among them; the Magis block features more water fixtures than both the Vattakuzhi and Administrative blocks. This increase may be attributed to the consumption patterns within the college community, while the efficient infrastructure of these blocks helps mitigate excessive usage in areas with high fixture counts.

Fig 5.10 Second water source used by the college

5.4.4 Annual Consumption Summary For Flow Water Meter Readings

Monitoring days	Average use of water per day (L)	Total average per consumption per year (L)
Holiday	68.67	4806.67
Semi holiday	93.67	8898.33
Working day	93.67	18733.33
		32438.33

Table 5.19 Flow meter reading

Currently, there is only one flow meter installed on campus at the common delivery point, which distributes water to various connections. This arrangement limits the ability to assess water usage accurately, as it only provides the total water consumption for the entire campus, which is 32438.33 L, with a per capita consumption of 88.87 L/day Consequently, unable to identify the specific water usage for each block. To conduct a more detailed assessment, it is necessary to install additional flow meters at the delivery points of each block. In the absence of this data, it depends on inferring higher water usage from manual discharge observations. The water consumption is applicable and appropriate in an educational institution. The hostel is not covered in the flow meter water analysis study.

5.4.5 Annual Grey Water Released

Sl No	Department/section	Rate Grey water released (L)
1	Magis Cafeteria Taps	8900.28
2	Teachers' Café	1587.60
3	Lab	2.00
4	Hostel	60018
	Average grey water released	17626.97

Table 5.20 Grey water released

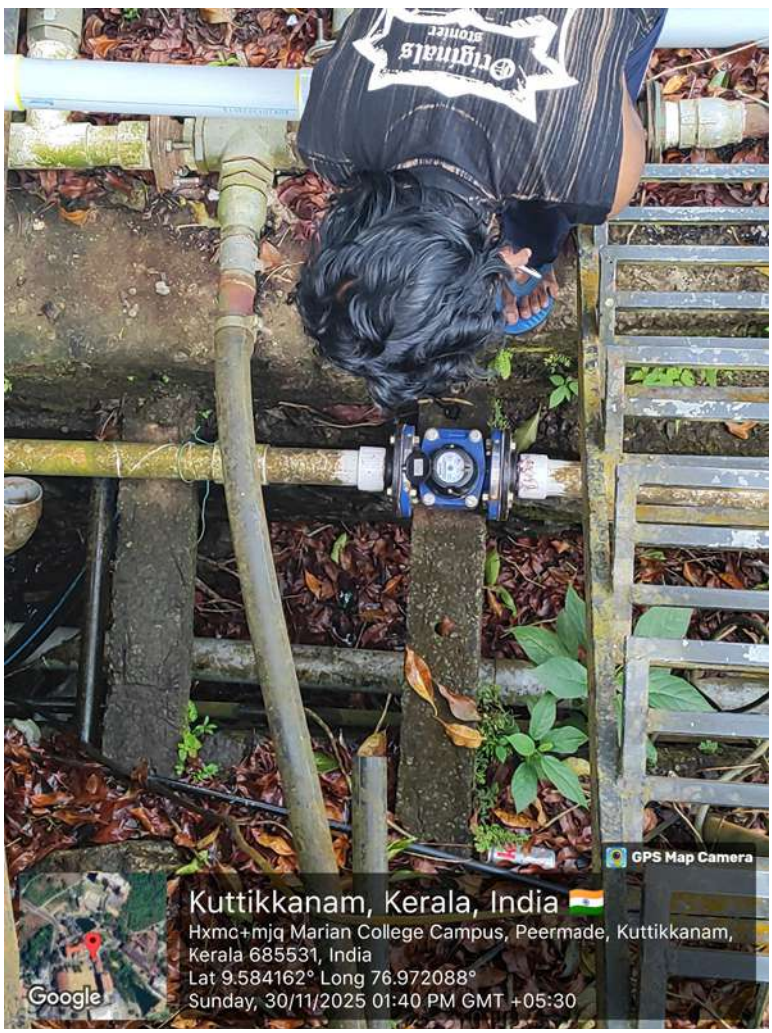


Fig 5.11Flow water meter reading data collection process

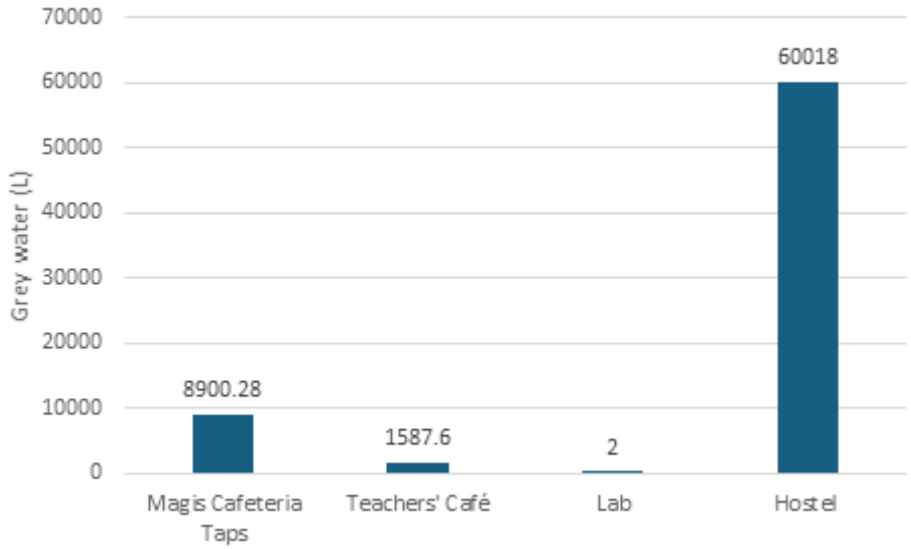


Fig 5.12 Annual grey water released

The hostel produces a substantial amount of grey water, primarily due to elevated water consumption associated with daily activities and meal preparation. Its kitchen serves as the primary cooking facility for both the residents and the common kitchens of four additional hostels, supplying meals for the cafeteria and canteen. This extensive usage has resulted in the generation of approximately 60018 litres of grey water, which is collected through a piping system and directed into a sink pit.

Currently, the college releases 10489.88 litres of grey water while operating a 7,500-litre capacity sewage treatment plant (STP) that treats water for gardening purposes. The institution is also planning to establish a new treatment plant to enhance water quality, thereby extending its applications beyond gardening. Additionally, plans are underway to implement a treatment system for grey water to make it suitable for non-potable uses.

5.4.6 Water Quality Assessment Report

Sl No	Characteristic	Unit	Test method	Acceptable limits as per 10500:2012	Limit of detection	Result
1	Colour	HU	APHA -24 th Edition (202J) 2120 B - Visual comparison method	5	1	1
2	Odour		IS 3025 (Part 5) 2018 (Reaffirmed 2022)	Agreeable	Agreeable	Agreeable
3	Taste		IS 3025 (Part 8) :2023	Agreeable	Agreeable	Agreeable
4	Turbiditv	NTU	S 3025 (Partl0):2023 Nephlometric N'lethod	1	0.5	BLD
5	PH at 25 oC		IS 3025 (Part 1l) - 2022 Potentiometric Method	6.5- 8.5	2	7.3

6	Total Alkalinity (as CaCOr)	mg/l	lS 3025 (Part 23) t2023 Indicator Method	200	5	26.0
7	Total dissolved solids (TDS)at r80. c	mg/l	IS 3025 (Part l6 :2023 Gravimetric Method	500	5	72.6
8	Total hardness (as CaCOr)	mg/l	lS 3025 (Part2l) - 2009 (Reaffirmed 2023) - trDTA Method	200	5	16
9	Calcium (as Ca)	mg/l	IS 3025 (Part 40) ;2024 EDTA Titrimetric Method	75	5	BLD
10	Magnesium (as Mg)	mg/l	APHA -24 th Edition (2023) 3500 -Mg B Calculation Method	30	5	BLD
11	Chloride (as Cl)	mg/l	lS 3025 (Part32) -1988 (R€.ffirmcd 2019) Arscntometric method	250	5	19
12	Electrical Conductivity at 25 °C	pS/cm	lS 3025 (Partl,l) -2013 (Reaffirmed 2019)		l0 trs/cm	11 1.8
13	Acidity	mg/l	IS 3025 (Part22) :202.1 Indicator)method		5	14
	Sulphate (as SOa)	mg/l	lS 3025 (Pari24 / Secl) 2022 Turbidity Method	200	1	1.77
	Fluoride (as F)	mg/l	APHA 24th Edition 45OO _F. D SPADNS Method	1	0.1	BDL
	Iron (as Fe)	mg/l	IS 3025 (l'art 53) : 202,1 Phenanthroline I method	1	0.1	0.14
	Nitrate(as N03)	mg/l	APHA 24th Edition Edition.1500-NO3 - B Ultraviolet Spectrophotometric Screenings method	45	1	6.51

Table 5.21 Water quality report source one

Sl No	Characteristic	Unit	Test method	Acceptable limits as per 10500:2012	Limit of detection	Result
	Residual Chlorine	mg/l	Kit Mcthod	0.2		NIL
	Dissolved Oxygen	mg/l	IS 3025 (Part 38) 1989 (Reaffirmed 2019) Winkler Method			NT
	Chemical Oxygen demandmg/l	mg/l	IS 3025(part 58)2006(Reafiirmed 2023)-open Reflux method			NT
	Biological Oxygen demand	mg/l	IS 3025(part 44):2023-oxygen Depletion method			NT
	Total Suspended Solids @ro3oc-ros.c (TSS)	mg/l	IS 3025(part l7) 2022Gravimetric Method			NT
	Oil & Crease	mg/l	IS 3025 (Part 39) 2021 - _Liquid Partition Gravimetric method			NT

Table 5.22 Water quality report source two

Sl No	Parameters	Acceptable limits as per IS 10500-2012	Test Method	Result
1	Coliforms	Shall not be detected/l00ml	IS l5185 ;2016	Absent
2	E-coli	Shall not be detected/l00ml	IS l5185 ;2016	Absent

Table 5.23 Water quality report findings

Fig 5.13 Water filtration unit of the campus

The water sample meets all safety parameters and is considered safe for drinking. Furthermore, periodic water quality analyses will be conducted every six months. If necessary, chlorination will be performed, and expert consultation from a certified laboratory will be sought to determine any additional procedures required. Measures will also be taken to ensure the cleaning of the water tank and pumping connections to prevent contamination.

5.5 CONCLUSION

- The college possesses a 195,000-litre water tank and an effective water infrastructure, including an automatic pumping system, which facilitates easy access to water for a community of 2,778 people. The average water consumption is 32,438.33 litres per year, equating to a per capita consumption of 88.87 litres, which is below the recommended standard of 135 litres per person per day as per the National Building Code of India and Bureau of Indian Standards. Furthermore, the assessment indicates that there are no issues of leakage, overflow, or waste in the current water usage.
- Despite the efficient water management, the college faces significant water scarcity during peak periods. Currently, the existing sewage treatment plant (STP) is only utilised for gardening purposes. It is essential to extend the STP's capabilities to address the increased water demands during these peak times.
- The assessment currently falls short of identifying the water consumption of each college block using flow meters capable of detecting overconsumption. Consequently, it is unable to pinpoint areas with high water demand or analyse the reasons behind varying levels of consumption. Manual water release data provides only an approximate representation of water consumption patterns, and its accuracy may not be fully reliable for the results. Once these areas are identified, immediate actions can be taken to conserve water during peak usage periods, reduce the overall water footprint, and improve the institution's water efficiency management practices. Therefore, the water efficiency plan recommends extending the installation of flow meters at the distribution points of each block to accurately monitor and quantify water consumption therein.

5.6 RECOMMENDATION

- College campuses typically utilise substantial amounts of water to support their diverse community needs, including landscaping, dormitories, laboratories, dining, and recreational facilities. By implementing effective water conservation strategies, institutions can achieve reductions in consumption by 20-50%, lower utility costs, and mitigate the risks associated with water scarcity, particularly during peak seasons when access to water becomes critical. The rainwater harvested and stored in check dams serves as a key resource in supporting both daily operations and sustainability objectives. Currently, the college is implementing a STEP plan with a capacity of 2,500 litres and is transitioning to a new facility equipped with advanced purification systems to enhance water usage efficiency and promote recycling practices.
- Install Low-Flow Fixtures: Replace standard faucets, showerheads, and toilets with low-flow or Water Sense-labelled models in dorms, bathrooms, and kitchens. These can reduce water use by 30-60% without compromising performance. Dual-flush toilets and aerated faucets are installed in newly constructed buildings, and plan to install such infrastructure to replace the odd one particularly in high-traffic areas.
- Adopt Drought-Resistant Landscaping (Xeriscaping): Shift to native, drought-tolerant plants and reduce turf grass areas. Use mulch to retain soil moisture and group plants by water needs. This approach can cut outdoor water use often 50% of campus totals by up to 70%.
- Implement Efficient Irrigation Systems: Use drip irrigation, smart controllers with weather-based adjustments, and soil moisture sensors for campus lawns and gardens. Schedule watering during early morning or evening to minimise evaporation.
- Harvest Rainwater and Recycle Greywater: Collect rooftop runoff in cisterns for irrigation or non-potable uses. Explore greywater systems to reuse water from sinks and showers for flushing toilets or landscaping (where regulations permit).
- Promote Reusable Bottles and Hydration Stations: Install filtered water bottle filling stations across campus to discourage single-use plastic bottles.

Many campuses report millions of bottles avoided annually through this measure.

- Launch Education and Behavioural Campaigns: Raise awareness through posters, workshops, dorm challenges, and pledge programs encouraging shorter showers, reporting leaks, and turning off taps. Behavioural changes alone can yield 10-20% savings.
- Conduct Water Audits and Monitoring: Perform regular audits to detect leaks, benchmark usage, and prioritise fixes. Sub-metering in buildings helps identify high-use areas. Tools like EPA's Water Sense resources can guide assessments.
- Additional Measures
  - Fix leaks promptly (a single dripping faucet can waste thousands of gallons yearly).
  - Use water-efficient appliances in labs and laundry facilities.
  - Partner with local utilities for rebates and incentives.
- Starting with low-cost fixes like fixture upgrades and education, while planning larger projects like rainwater systems, campuses can achieve substantial reductions. Resources from EPA Water Sense, Alliance for Water Efficiency, or campus sustainability networks provide further guidance and funding opportunities.

5.7 MARIAN WATER EFFICIENCY MANAGEMENT PLAN

Marian College Kuttikkanam (Autonomous) will remain committed to sustainable and responsible water stewardship by ensuring efficient use, conservation, reuse, and replenishment of water resources across the campus. This Water Efficiency Management Plan will guide the institution in implementing systematic, technology-enabled, and community-driven initiatives to move towards a water-efficient campus.

5.7.1 Establish an Adept Water Efficiency Management Team

The College will establish a dedicated Water Efficiency Management Committee (WEMC) under the umbrella body of EMS and the Internal Quality Assurance Cell (IQAC). This committee will comprise representatives from administration, faculty, students, facility management, and the Green Ambassadors. Its primary responsibilities will include overseeing the implementation of water conservation initiatives, coordinating with government agencies, NGOs, and technical experts for audits, training, and system upgrades, as well as reviewing progress and recommending enhancements for all water-related operations.

5.7.2 Formulate a Comprehensive Strategy for Sustainable Water Efficiency Management

The WEMC will formulate a comprehensive institution-wide strategy aimed at establishing campus systems for conservation, reuse, rainwater harvesting, and replenishment, while effectively addressing the needs of academic, residential, administrative, and landscaping sectors. This strategy will align with national water guidelines and the Sustainable Development Goals (SDGs) about environmental sustainability, thereby promoting a framework for advancing water management and safety initiatives. Furthermore, it will enhance academic integration and foster innovative research practices, while also engaging and educating the community. To achieve optimal administration, the strategy will delineate clear responsibilities for departments and campus units in pursuing established efficiency targets.

5.7.3 Implement Effective Methods to Attain Set Objectives

To achieve optimal water conservation and reuse, the College will:

- install low-flow taps, aerators, sensor-based fixtures, and dual-flush toilets in all facilities;
- undertake leak detection drives and immediate repair protocols;
- expand rainwater harvesting structures, percolation pits, and groundwater recharge points;
- operate and improve the greywater treatment plant to supply water for irrigation, flushing, and cleaning;
- introduce smart irrigation systems, drip lines, and eco-sensitive landscaping;
- integrate water conservation routines in hostels, labs, kitchens, sports facilities, and green patches.

5.7.4 Establish Robust Communication Channels

To ensure effective coordination of implementation, the College will designate a Water Efficiency Supervisor within

the WEMC. This role will involve disseminating official updates, water-saving instructions, and emergency notifications through Principal-approved communication channels, including the departmental WhatsApp group and official emails from the principal's office. Additionally, the supervisor will establish grievance and reporting mechanisms for issues such as leaks, water wastage, operational challenges, or water quality concerns, and will be responsible for compiling a review report based on data assessments to address these requirements. Furthermore, the internal auditors will organise campus-wide awareness sessions to promote responsible water use behaviour.

5.7.5 Objectives

5.7.5.1 Long-Term:

The College will:

- Install seven water flow meters at the main distribution points of each building to accurately monitor and measure water consumption per building.
- Install a Sewage Treatment Plant (STP) with a capacity of 100,000 liters per day (1 lakh liters) to treat wastewater effectively.
- Construct two additional check dams to enhance rainwater storage, thereby ensuring sufficient water availability during summer months.
- Upgrade 50% of the existing infrastructure to a sensor-based tap system (automatic/sensor-activated faucets) to promote water conservation and reduce wastage.

5.7.5.2 Short-Term:

The College will:

- Complete water audits in at least 50% of departments and all hostels using internal auditors to establish baseline consumption data, identify leaks/high-use areas, and prioritize quick-fix opportunities.
- Upgrade the existing automatic motor pumping systems to a smart, software-based mobile monitoring and control system; concurrently, launch targeted behavioral change campaigns to promote mindful and responsible water usage among students, staff, and residents.
- Implement a standardized water quality testing program with monthly sampling in key storage points and conduct full cleaning/maintenance of all water tanks at least twice within the period, while maintaining detailed records for compliance and trend monitoring.
- Install educational and reminder signage in all high-usage areas (e.g., restrooms, kitchens, laundry zones, and common wash areas) to encourage conservation habits, with signage designed for visibility and including simple tips like "Turn off taps" or "Short showers save water.

5.7.6 Continuously Monitor and Enhance the System

The Water and Environmental Management Committee (WEMC) will perform comprehensive internal audits focusing on consumption, leakage, reuse, and quality. These audits will track key performance indicators (KPIs), including litres saved, greywater reused, and recharge levels achieved. Additionally, the WEMC will gather feedback from residents, staff, and students to evaluate system performance. Operational challenges will be addressed through maintenance upgrades and refined protocols. The committee will also update the strategy annually based on audit findings and advancements in technology.

5.7.7 Conclude and Conduct Follow-ups on the System

At the end of each academic year, the College will compile an Annual Water Efficiency Report, which will be authored by the internal auditor and approved by the IQAC. This report will outline initiatives, consumption trends, achievements, and areas of concern. Following the report's submission, review meetings will be held with the Administrator, IQAC, and the faculty team to evaluate its findings. Subsequently, improvement plans for the forthcoming year will be formulated, and mandatory follow-up actions will be established. These may include the installation of additional fixtures, necessary repairs, and the enhancement of reuse systems

5.7.8 Conclusion

This Water Efficiency Management Plan will lead Marian College toward becoming a water-positive and environmentally responsible campus. By implementing strategic conservation measures, enhancing infrastructure, promoting behavioural change, and engaging with the wider community, the College

will ensure long-term water sustainability. Through continuous monitoring, strong leadership, and collective participation, Marian College will uphold its commitment to preserving water as a vital natural resource.

5.8 ACTIVITIES CONDUCTED

Marian College Kuttikkanam (Autonomous) follows a sustainable and integrated approach to water efficiency management, considering its hill-station location, seasonal variability in rainfall, and campus requirements. The institution emphasizes conservation, reuse, source diversification, and responsible consumption as core principles of water management.

1. Multiple and Sustainable Water Sources

The college depends on three major water sources, ensuring water security and reducing reliance on a single source:

- One semi-manmade check dam, serving as the primary water source
- One semi-manmade open well for regular domestic needs
- One borewell used as a supplementary source during scarcity

This diversified sourcing enhances resilience, particularly during summer months when water availability declines.

2. Water Storage and Capacity Management

The check dam has a storage capacity of 71,00,000 litres, with an average daily usage of 2,00,000 litres.

The open well has a capacity of 1,71,000 litres, supplying approximately 50,000 litres per day.

The borewell provides about 5,000 litres per day, mainly as a backup source.

During summer, water availability reduces to around 1 lakh litres per day, necessitating careful monitoring and prioritisation.

3. Water Treatment and Filtration

Water drawn from the check dam and open well is routed through a filtering unit before distribution across the campus. This practice ensures:

- Improved water quality
- Removal of sediments and impurities
- Safe and efficient usage for institutional purposes

The filtration system is periodically maintained to ensure optimal performance.

4. Wastewater Recycling and Reuse

The campus operates a Sewage Treatment Plant (STP) with a capacity of 50,000 litres per day.

- Treated wastewater is used exclusively for gardening and landscaping
- This significantly reduces dependence on freshwater for non-potable purposes
- It supports sustainable green cover management across the campus

5. Water Use Prioritisation and Seasonal Management

In view of reduced water availability during summer:

- Priority is given to drinking water, sanitation, and academic needs
- Non-essential water usage is curtailed

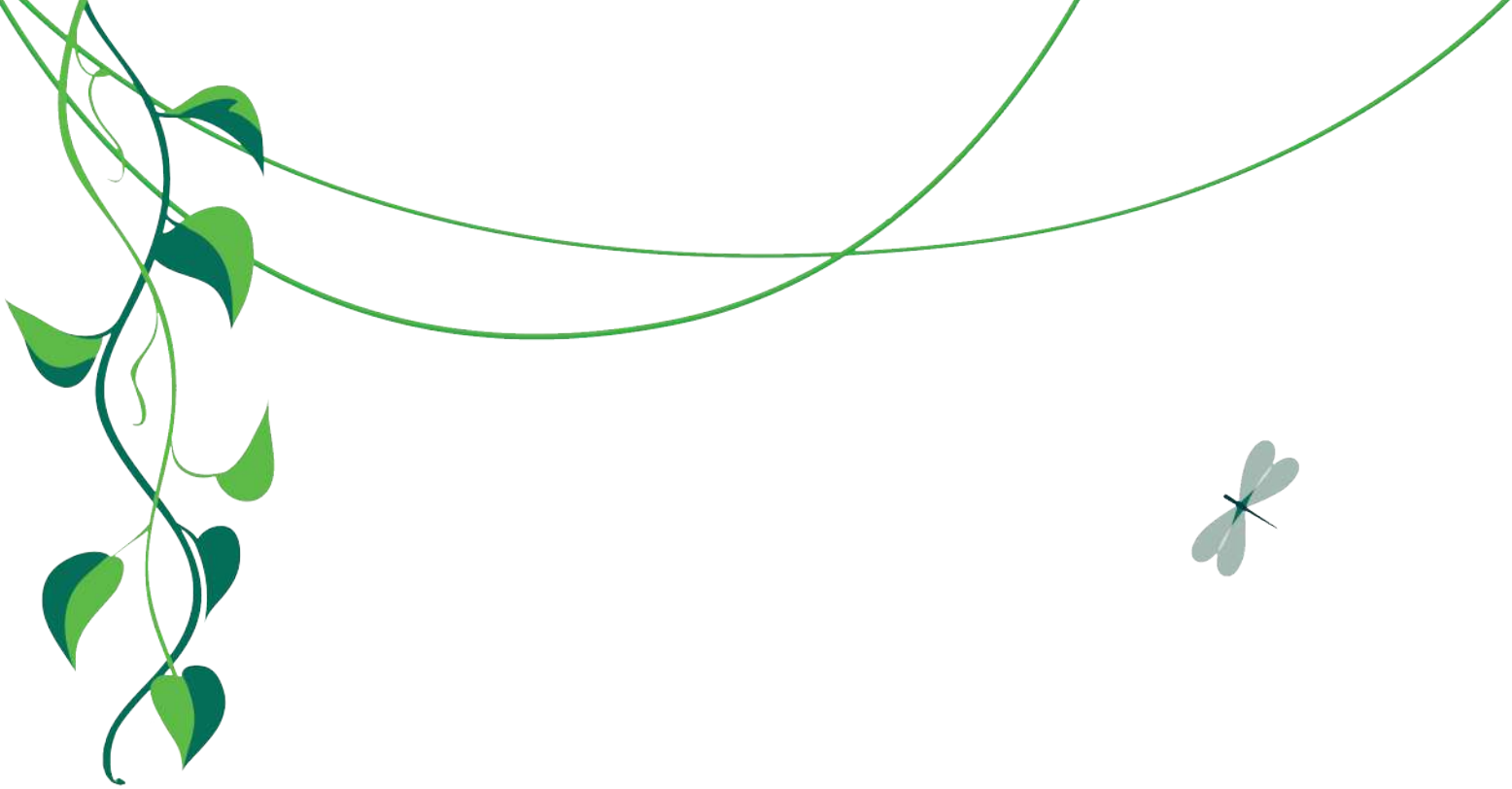
This adaptive approach ensures optimal utilisation of limited water resources.

6. Conservation-Oriented Campus Practices

The institution promotes water conservation through:

- Regular monitoring of water consumption
- Prompt repair of leakages and prevention of wastage
- Automatic cut-off switches have been installed in overhead tanks to prevent overflow and water loss
- Water flow meter is installed to measure and monitor water usage, enabling data-based assessment and corrective action.
- Encouragement of responsible water use as part of campus sustainability initiatives

These measures align water management practices with the institution's broader environmental sustainability goals, contributing to responsible resource use and long-term water security.



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 VI

CAMPUS BIODIVERSITY (CBR): AUDIT REPORT

BIODIVERSITY MANAGEMENT COMMITTEE
(BMC 2025-26)

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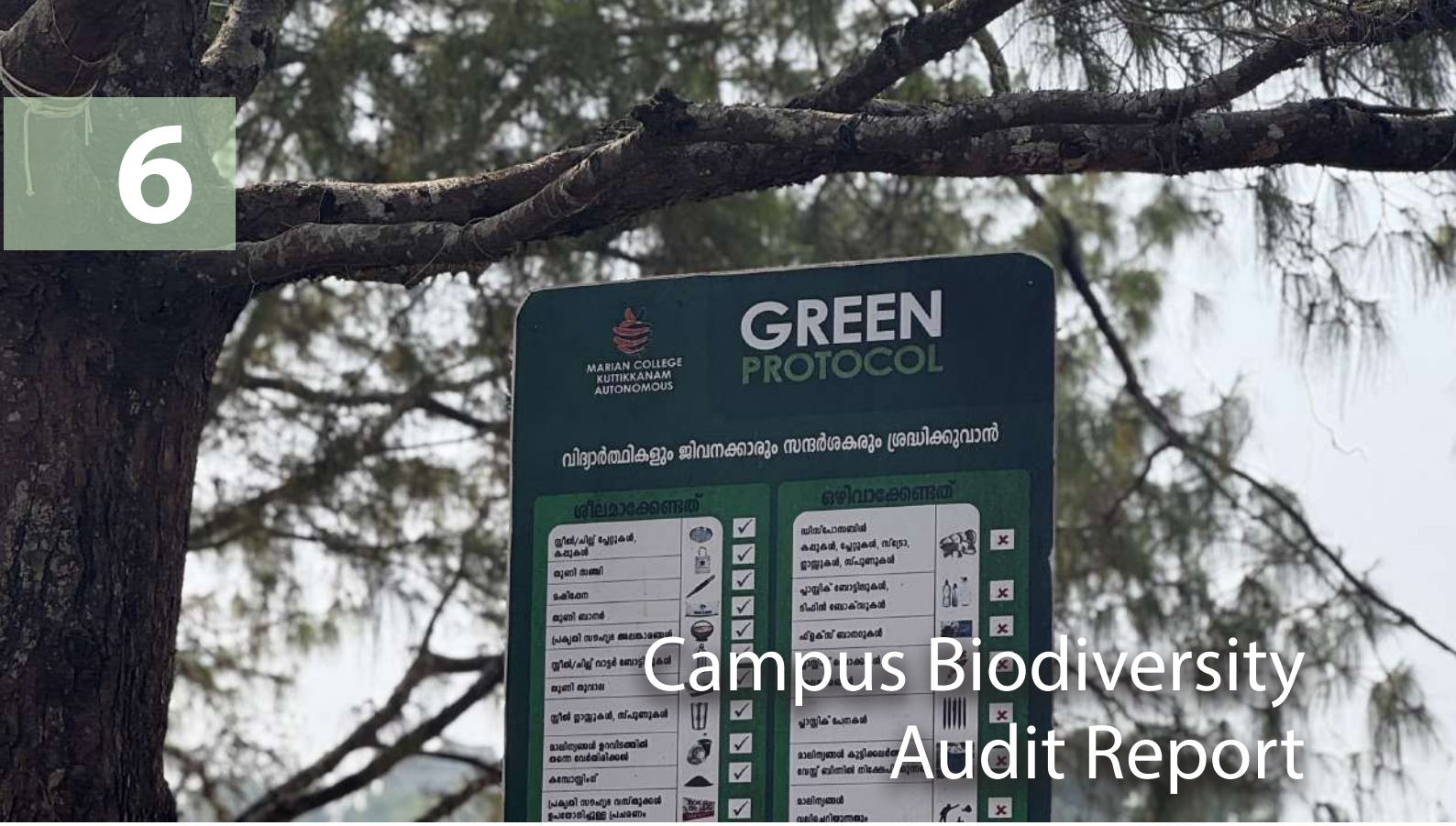


6

Campus Biodiversity Audit Report

6.1 INTRODUCTION

Biodiversity is essential for sustaining life, providing critical ecosystem services such as food production, water purification, regulation of floods and droughts, nutrient cycling, and climate stabilisation. These services are fundamentally important for human health and economic prosperity. Biodiversity serves as a comprehensive reflection of the biosphere, intricately connected with Earth's physical components, including soil, rocks, water, and air, all energised by solar power. Over 2 to 3 billion years, a highly complex and stable cyclical system has developed, facilitating the exchange of energy, materials, and information among living organisms and their physical surroundings. Despite its immense ecological, economic, and cultural importance, biodiversity is rapidly declining worldwide, driven by factors such as pollution, habitat destruction, urbanisation, industrial activities, population growth, and unsustainable exploitation of species. A significant contributor to this decline is habitat destruction, primarily due to developmental projects, coupled with the overharvesting of specific species for economic or recreational purposes. The loss of biodiversity disrupts ecosystems, leading to species extinction or decline and adversely affecting ecosystem functionality and food webs. This has far-reaching consequences, including reduced agricultural productivity and diminished resilience to natural disasters such as floods and droughts. Therefore, it is imperative to safeguard biodiversity, as its decline poses serious threats, including reduction in genetic diversity and uniformity in plant and animal life.

The disruption of vital ecosystem functions critical for human survival, including food, medicine, timber production, and the purification of air and water, poses a significant concern. Ecosystem services provide a wide array of advantages, which can be classified into four categories: provisioning services (such as food, water, timber, and genetic resources), regulating services (including climate regulation, flood management, disease control, and water purification), cultural services (covering recreational, aesthetic, and spiritual values), and supporting services (such as soil formation, pollination, and nutrient cycling). However, the demand for these services from human populations is escalating rapidly. According to the Millennium Ecosystem Assessment, around 60% of the assessed ecosystem services—comprising 70% of regulating and cultural services are currently experiencing degradation or unsustainable use, jeopardising their availability for future generations. Therefore, implementing standardised biodiversity

management systems is essential to establish principles, frameworks, requirements, guidance, and tools through a comprehensive and global approach for organisations, thereby enhancing their contributions to sustainable development.

6.1.2 What is a Biodiversity Audit?

The Biodiversity Audit involves a thorough assessment of the importance of biodiversity within the campus environment. The purpose of implementing a Biodiversity Audit Strategy is to lay a solid foundation for upcoming initiatives. Evaluating the ability of the campus's green spaces to sustain essential and protected species and habitats is critical. Furthermore, the audit provides customised recommendations for improving and optimising biodiversity. This evaluation will identify the current habitats present, generate habitat maps for each designated area, and assess the condition of each habitat type. Additionally, we will analyse existing management practices and suggest modifications where necessary to enhance current conditions. Our primary objective is to measure progress in biodiversity, thereby facilitating future developments in this area.

6.1.3 Why measure Biodiversity?

- The rapid decline of habitats is alarming, necessitating an assessment of their current status to prevent possible extinction.
- Biodiversity metrics are recognized as essential indicators of the health of ecological systems.
- Currently, biodiversity is the primary focus within both ecology and development fields.
- A variety of methods and tools are essential for evaluating biodiversity across different habitats.
- Adhering to the Convention on Biological Diversity (1992) mandates these assessments.

6.1.4 Need for Biodiversity Audit

The biodiversity audit assesses how well the college/ university campus supports wildlife habitats, which include any plant or animal species not cultivated by humans. It also aims to enhance awareness and educate the campus community about the importance and advantages of biodiversity. The key objectives of the biodiversity audit are as follows:

- Increasing awareness among the college community about the biodiversity found on campus
- Promoting greenery and vibrancy
- Enhancing the aesthetic appeal of the campus
- Expanding both informal and formal educational opportunities (such as labelling trees with their names)
- Improving public health and environmental protection (like ensuring clean air, water, and food)
- Acting as a valuable resource for education and public relations (for example, through themed garden exhibits)
- Supporting community education and gathering feedback (including sharing traditional knowledge related to plants and animals)

6.2 CAMPUS BIODIVERSITY MANAGEMENT SYSTEM POLICY

6.2.1 Statement of Commitment

Marian College Kuttikkanam (Autonomous) is committed to the preservation and enhancement of biodiversity, viewing it as a crucial component of its environmental sustainability mission. The institution acknowledges its duty to align with sustainable development principles by protecting native flora and fauna, sustaining ecological balance, and fostering a living campus that embodies harmony with nature. Through a combination of academic, operational, and community-driven initiatives, the College aims to empower every member of the Marian community to actively participate in the conservation and sustainable utilisation of natural resources. Marian College is situated at an elevation of approximately 1000 meters above mean sea level, offering a distinctive high-altitude climate that supports unique flora and fauna. The College is committed to enhancing and conserving the biodiversity of the campus in harmony with this ecological setting.

6.2.3 Goals

The goal of Marian College's Biodiversity Management Policy is to conserve, enhance, and sustainably manage the rich natural resources of its

campus, ensuring the protection of native flora and fauna and the maintenance of ecological balance. By fostering habitat restoration, promoting awareness of biodiversity values, integrating conservation into academic and community activities, and encouraging sustainable practices, the College aims to create a living campus that exemplifies harmony with nature and inspires all members of the Marian community to act as responsible stewards of the environment.

6.2.4 Objectives

- To protect the native and endemic species that inhabit its campus and surrounding areas. This includes safeguarding plant and animal species, preserving natural habitats, and preventing the introduction or spread of invasive species.
- To maintain a healthy and resilient ecosystem through sustainable land use, environmentally responsible landscaping, and effective waste management practices.
- To monitor enables informed decision-making, early detection of potential threats, and effective conservation planning.
- Promote educational programs, workshops, and awareness campaigns to foster a sense of stewardship and active participation in conservation initiatives.

6.2.5 Resource Management

Marian College is committed to preserving its native ecosystems, recognising their essential role in maintaining ecological balance. The maintenance of campus biodiversity will be managed responsibly by the gardening and housing staff under the guidance and oversight of internal auditors.

6.2.5.1 Protecting Native Ecosystems: Natural habitats are generally preserved and carefully managed to ensure that local flora and fauna thrive. The College also undertakes initiatives to prevent the introduction of invasive species and to restore areas that have been degraded, thereby maintaining the integrity of its ecosystems.

6.2.5.2 Conserving Water Resources for Biodiversity: Water is a critical resource for sustaining biodiversity, and Marian College implements practices to conserve it across the campus. Rainwater harvesting, efficient irrigation systems, and the reuse of treated wastewater for gardening ensure that water is utilized responsibly. These measures not only support plant and animal life but also contribute to the broader goal of environmental sustainability.

6.2.5.3 Soil Health and Microbial Conservation: To maintain fertile and biologically active soils, Marian College avoids the use of chemical fertilisers and promotes natural soil enrichment techniques. This approach protects the microbial diversity essential for ecosystem functioning and supports sustainable landscaping and gardening practices. Healthy soils enable the growth of native and climate-adapted plant species, reinforcing the campus's ecological resilience.

6.2.5.4 Prioritising Native and Climate-Adaptive Flora: The College emphasises the cultivation of native and climate-resilient plant species in all landscaping and green spaces. This practice ensures that vegetation can withstand local environmental conditions while providing food, shelter, and habitat for native fauna. Prioritising such species also reduces maintenance requirements and enhances the ecological sustainability of the campus.

6.2.5.5 Wastewater Reuse and Gardening: College promotes circular resource management by converting treated wastewater into a resource for campus gardening and landscaping. This approach reduces dependence on freshwater sources, supports green cover maintenance, and demonstrates the practical integration of sustainable practices into daily campus operations.

6.2.5.6 Conserving Green Growth Patches: The College actively protects and maintains green growth patches across the campus as vital areas for biodiversity conservation. These zones serve as microhabitats for flora and fauna, act as natural buffers against environmental stressors, and enhance the overall aesthetic and ecological value of the campus. Preservation of these areas reflects Marian College's commitment to creating a living, sustainable environment.

6.2.5.7 Classroom Integration: Integrates

environmental awareness and biodiversity conservation into the teaching-learning process across all relevant disciplines. Topics related to Environmental Studies and allied themes, such as sustainable development strategies, are incorporated across all branches of study. This approach ensures that every student gains a solid theoretical foundation in sustainability and conservation principles.

6.2.5.8 Field-Based Learning: Students are encouraged to apply classroom knowledge through hands-on experiences. Activities such as field projects, biodiversity inventories, ecological mapping, and eco-restoration initiatives enable students to directly engage with natural ecosystems and observe conservation practices in action. These experiences strengthen practical understanding and skill development.

6.2.5.9 Social impact Engagement: Collaborative projects with local communities, NGOs, and government agencies provide students with opportunities to connect with real-world environmental challenges. Through outreach programs, awareness campaigns, and community-based conservation initiatives, students learn to implement sustainable solutions while contributing positively to society.

6.2.5.10 Interdisciplinary Learning and Critical Thinking: The curriculum encourages interdisciplinary approaches, enabling students to analyse environmental issues from multiple perspectives. By reflecting on the impact of human activities on ecosystems and exploring sustainable alternatives, students develop critical thinking skills and a sense of responsibility towards biodiversity preservation and sustainable development.

6.2.6 Green Initiatives

6.2.6.1 Botanical and Herbal Gardens: Marian College maintains botanical and herbal gardens featuring native, endemic, and medicinal plants. These gardens serve as living laboratories for students, providing opportunities for research, ecological study, and hands-on learning, while also creating habitats for local wildlife.

6.2.6.2 Butterfly and Pollinator Gardens: The College has established butterfly and pollinator gardens to enhance ecological diversity and support natural pollination networks. These gardens promote biodiversity conservation and provide students with practical insights into ecosystem functioning.

6.2.6.3 Waste Segregation and Composting: The Waste Management Committee, in partnership with the Biodiversity Committee, has initiated a collaborative effort to segregate biodegradable and non-biodegradable waste and to compost organic materials. This compost not only enhances soil quality and supports sustainable landscaping but also reduces campus pollution, thereby promoting a circular approach to resource use.

6.2.6.4 Food Waste Conversion: Food waste generated on campus is efficiently converted into animal feed, demonstrating circular economy principles. This practice not only minimises waste but also supports local livestock initiatives and encourages responsible resource utilisation.

6.2.6.5 Water Conservation and Management: The College preserves natural water bodies and implements the use of treated wastewater for irrigation and gardening. These measures ensure sustainable water use, protect aquatic ecosystems, and contribute to the overall health of campus biodiversity.

6.2.6.6 Environmental Awareness and Observances: Marian College actively promotes environmental consciousness through events such as World Environment Day, Ozone Day, and Biodiversity Day. These observances involve students, staff, and the local community in awareness campaigns, workshops, and practical conservation activities, fostering a culture of sustainability on campus.

6.2.7 Purchasing and Procurement

Marian College actively promotes sustainable and responsible procurement practices to minimise environmental impact and support local economies.

6.2.7.1 Eco-Friendly Materials: The College prioritises purchasing eco-friendly and biodegradable materials, ensuring that products have minimal environmental footprint.

6.2.7.2 Reducing Non-Recyclable Waste: Single-use plastics and non-recyclable products are avoided wherever possible, promoting waste reduction and encouraging the use of reusable, sustainable alternatives across campus operations.

6.2.7.3 Sustainable Vendor Engagement: Vendors and suppliers are encouraged to adopt sustainable production, packaging, and delivery practices, such as reducing excessive packaging, using recyclable materials, and minimizing carbon footprint during transportation.

6.2.7.4 Supporting Local Economy: The College actively supports local vendors, farmers, and small-scale suppliers, fostering a regional green economy while promoting traditional crafts and environmentally responsible products.

6.2.8 Research and Innovation

6.2.8.1 Multidisciplinary Research Engagement: Marian College, with its multidisciplinary academic environment, actively encourages faculty and students from all departments to engage in research focused on biodiversity conservation, sustainable agriculture, ecosystem restoration, and climate resilience. This approach ensures diverse perspectives and expertise contribute to holistic solutions.

6.2.8.2 Collaborative Projects: Faculty and students are promoted to collaborate on projects that address both local and global environmental challenges. Interdepartmental cooperation strengthens research quality and fosters a culture of shared responsibility towards sustainability.

6.2.8.3 Role of Marian Centre for Sustainable Development: The Marian Centre for Sustainable Development serves as a central hub for research initiatives. It supports innovative projects that integrate indigenous ecological knowledge, environmental ethics, and cultural aesthetics, linking traditional wisdom with modern sustainability practices.

6.2.8.4 Practical and Scalable Solutions: Through research and innovation, the College aims to develop practical, scalable, and community-relevant solutions. These initiatives enhance biodiversity management, climate-resilient plant promotion, promote environmental stewardship, and translate academic learning into real-world impact.

6.2.9 Community Engagement

6.2.9.1 Institutional Partnerships: Marian College is committed to fostering partnerships with local panchayats, Haritha Karma Sena, the Forest Department, and environmental NGOs. The college has recently signed a Memorandum of Understanding (MoU) with an environmental research institution to create opportunities for faculty and students to engage in sustainable and environmental conservation programs aimed at enhancing biodiversity protection and conservation efforts. These collaborations ensure that our campus initiatives are aligned with regional environmental priorities.

6.2.9.2 Student Participation in Outreach: Students are encouraged to take part in hands-on outreach activities such as tree planting drives, waste management campaigns, and conservation awareness programs. These initiatives provide experiential learning opportunities and foster a sense of environmental responsibility.

6.2.9.3 Disseminating knowledge and resources to the community: Marian College actively promotes the sharing of knowledge and resources on biodiversity and sustainability with the broader community. The institution organizes open programs, exhibitions, competitions, and awareness campaigns to engage students, staff, and local residents. These initiatives aim to foster ecological literacy, highlight the importance of conservation, and encourage practical participation in sustainable practices.

6.2.10 Monitoring and Reporting

Regular monitoring and evaluation mechanisms are established to track biodiversity health and sustainability progress. Biodiversity audits, tree inventories, and environmental performance indicators are periodically reviewed. Annual reports document progress, identify gaps, and outline corrective measures to ensure transparency and accountability.

6.2.11 Compliance and Review

6.2.11.1 Legal and Regulatory Adherence: Marian College ensures full compliance with all relevant environmental laws, regulations, and other local authorities.

6.2.11.2 Periodic Policy Review: The Biodiversity Management Policy will be reviewed regularly to incorporate new scientific insights, emerging conservation practices, and evolving regulatory

requirements.

6.2.11.3 Continuous Improvement: The College integrates feedback from audits, monitoring, and stakeholder inputs to refine strategies, enhance sustainability measures, and ensure ongoing improvement in biodiversity conservation and management.

6.2.12 Leadership and Accountability

6.2.12.1 Policy Leadership and Coordination: The implementation of the Biodiversity Management Policy is guided by the Biodiversity Management Committee, which operates under the overarching framework of the Environment Management System, chaired by the principal. This initiative involves active participation from college administrators. Supported by the Marian Centre for Sustainable Development, the committee coordinates the execution of the policy, supports departmental programs, and facilitates research, awareness campaigns, and community engagement activities, thereby ensuring effective oversight and seamless execution of all biodiversity initiatives.

6.2.12.2 Departmental Responsibility: All academic and administrative departments share the responsibility for maintaining biodiversity-friendly practices, including green landscaping, waste management, and resource conservation, ensuring that sustainability is embedded across all campus operations.

6.2.12.3 Student and Staff Stewardship: Students and staff are encouraged to take up initiatives and act as biodiversity stewards, actively participating in conservation programs, awareness drives, and eco-restoration projects. This fosters a campus culture deeply rooted in respect for nature, environmental ethics, and sustainability.

6.2.13 Conclusion

Marian College Kuttikkanam (Autonomous) remains firmly committed to protecting and enhancing campus biodiversity as a core part of its sustainability mission. Through responsible resource management, academic integration, community collaboration, and active participation from students and staff, the College strives to maintain a resilient and ecologically balanced campus. This policy provides a clear framework for ongoing conservation efforts and continuous improvement. Moving forward, the College will strengthen its initiatives, adopt emerging best practices, and ensure that every member of the Marian community contributes to preserving our natural heritage

6.3 METHODOLOGY

Integrating biodiversity conservation into its core sustainability strategy, the college has established a comprehensive plan for its preservation and enhancement. This initiative is guided by a Biodiversity Audit Team, consisting of fifteen members (including eleven students and four faculty members), who are responsible for conducting thorough biodiversity assessments and overseeing internal review processes related to conservation efforts.

6.3.1 Internal Audit Training

Green audit training employs comprehensive and engaging methodologies to cultivate a sense of ownership and active participation within the institution. To prepare the college for this initiative, the Environmental Management System (EMS) selects students and faculty members for internal audit training. This one-day course certifies participants as internal auditors, equipping them to conduct biodiversity audits effectively. The internal biodiversity audit process encompasses several critical phases: evaluation, risk assessment, data collection, policy development, and the documentation of water conservation registers and initiatives.

6.3.2 Data sampling by categorising the area into different zones

Pivotal responsibilities focused on acquiring comprehensive taxonomic information through systematic and repeated field surveys. Plant data for herbs, shrubs, and trees were gathered employing random sampling techniques, spot surveys, and transect walks. Fauna data collection involved the use of transects for birds and quadrat studies for butterflies and insects.

6.3.3 Calculating the campus diversity

Quadrat sampling and transect methodologies are employed to collect data on plant and animal life, which is subsequently utilized to calculate biodiversity indices, including Simpson's Diversity Index. These measurements provide critical insights into species diversity and abundance, serving as essential indicators of the overall

health of the biological community.

6.3.4 Preparing the checklist & threat and challenges to the biodiversity of the college campus

The audit team systematically identifies risks to campus biodiversity and formulates management strategies grounded in both primary data collection and a thorough analysis of secondary sources. Ongoing assessments are performed during regular meetings aimed at evaluating sustainability programs and awareness initiatives. Designated students and faculty members are responsible for documenting these activities, promoting a coordinated effort to foster a culture of sustainability on campus and to encourage its adoption within the surrounding community.

6.3.5 External Audit

An external auditor conducts an assessment to evaluate compliance with biodiversity management audit criteria and identify any discrepancies. If only minor discrepancies are found, the auditor may proceed to grant certification to the institution in accordance with the relevant ISO standards.

6.3.6 Assumption of Biodiversity audit ISO standards

The decline in global biodiversity is occurring at an unprecedented rate, significantly impacting ecosystem stability, environmental health, and human well-being. This rapid loss of species is largely driven by the rising demand for biological resources, fueled by population growth and consumption patterns.

Human societies fundamentally depend on biodiversity for critical ecosystem services. These services encompass provisioning elements such as food, freshwater, timber, and medicinal resources, as well as regulatory functions like climate moderation, air and water purification, pollination, and flood management. Furthermore, vibrant ecosystems provide vital support functions such as soil formation and nutrient cycling, along with essential cultural and aesthetic benefits. Consequently, the conservation of biodiversity is imperative for human survival and well-being.

The Biodiversity Areas Standard offers a structured approach to addressing this challenge by establishing clear, measurable criteria for the integration of biodiversity into land-use planning and management. It promotes best practices that foster resilient, self-sustaining ecosystems, enhance environmental cost-effectiveness, and mitigate the negative impacts of human development.

In alignment with global conservation goals aimed at mitigating habitat loss and land transformation, this standard highlights the significance of urban and surrounding areas. By incorporating ecological principles into all land-use decisions, we can protect and restore vital natural resources, thereby supporting a sustainable future.

6.3.7. 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. It 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.

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.

$D = \sum (n / N)^2$	$D = \frac{\sum n(n-1)}{N(N-1)}$

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.

6.3.8 Stages of biodiversity audit

Biodiversity audit has the following three phases:

6.3.8.1 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.)

6.3.8.2 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/dragonflies: 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.

6.3.8.3 Post audit phase

- Analysis of data: species list of fauna and flora in the campus; calculation of the 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.)

6.3.9 Work plan and schedule of Biodiversity Audit

Date to date	Weekly Work Plan
24/01/2025 to 30/01/2025	Obtain registers to document the campus's flora and fauna. Designate specific areas to individuals or groups for targeted activities. Allocate the responsibility of documenting plant life. Initiate a sample survey of the designated areas.
06/07/2025	Finalise the work schedule and proceed with data sampling based on the reference document, Campus Flora. Ensure to document findings with geotagged photos.
07/08/2025	Evaluate the flora and fauna recorded by students. Complete the BMS policy and plan.
10/10/2025	Ensure the completion of the fauna survey. Compile a thorough checklist of fauna by documenting herbs, shrubs, trees, butterflies, odonates, birds, amphibians, insects, and mammals in an Excel spreadsheet, capturing their scientific, English, Malayalam, and common names. Keep a uniform set of registers for recording meeting minutes, checklists, activities, and action plans.
10/11/2025	Finalisation of documentation Review of the checklist and student-recorded data
15/11/2025	Data entry Uploading photos to the drive
20/11/2025	Final upload of documents.

Table 6.1 Schedule of the biodiversity audit

Activities	Frequency	Dates of study	Mode of data collection
Quadrat sampling & transect sampling	Working days; three times a day	04/08/2025 - 13/08/2025 10/09/2025 - 19/09/2025 17/10/2025 - 22/10/2025	Entry in the given format

Table 6.2 Workplan of biodiversity audit

6.4 RESULT AND DISCUSSION

6.4.1 Checklist of flora and fauna

6.4.1.1 Checklist of birds

Sl No	ENGLISH NAME	SCIENTIFIC NAME	MALAYALAM NAME	DENSITY
1	SHIKRA	*Accipiter badius*	പുള്ള്	1
2	COMMON MYNA	*Acridotheres tristis*	നാട്ടു മൈന	5
3	GREATER COUCAL	*Centropus sinensis*	ചെമ്പോത്ത്	1
4	ROCK PIGEON	*Columba livia*	അമ്പലപ്രാവ്	15
5	LARGE BILLED CROW	*Corvus macrorhynchos*	ബലികാക്ക	2
6	ROUFUS TREEPIE	*Dendrocitta vagabunda*	ഓലഞ്ഞാലി	1
7	BLACK DRONGO	*Dicrurus macrocerus*	ആനറാഞ്ചിപക്ഷി	2
8	GREATER RACKET TAILED DRONGO	*Dicrurus paradiseus*	ഇരട്ടവാലൻപക്ഷി	1
9	BLACK RUMPED FLAMEBACK	*Dinopium benghalense*	നാട്ടുമരംകൊത്തി	2
10	JUNGLE OWLET	*Glaucidium radiatum*	ചെമ്പൻനത്ത്	1
11	WHITE CHEEKED BARBET	*Psilopogon viridis*	ചിന്നകുട്ടുറുവൻ	4
12	ROSE RINGED PARAKEET	*Psittacula krameri*	മോതിരത്തത്ത	1
13	JUNGLE BABBLER	*Turdoides striata*	കരിയിലകിളി	7
14	RED VENTED BULBUL	*Pycnonotus cafer*	നാട്ടുബുൾബുൾ	2
15	INDIAN POND HERON	*Ardeola grayii*	കുളക്കൊക്ക്	1
16	BRAHMINY KITE	*Haliastur indus*	കൃഷ്ണപരുന്ത്	1
17	COMMON KINGFISHER	*Alcedo atthis*	ചെറിയ മീൻകൊത്തി	1
18	BLOSSOM HEADED PARAKEET	*Psittacula roseata*	പൂന്തത്ത	1
19	HILL MYNA	*Gracula religiosa*	കാട്ടുമൈന	1
20	HOUSE SWIFT	*Apus nipalensis*	അമ്പലം ചുറ്റി	1
21	ORIENTAL MAGPIE ROBIN	*Copsychus saularis*	മണ്ണാത്തിപ്പുള്ള്	1
22	RED WHISCKERED BULBUL	*Pycnonotus jocosus*	ഇരട്ടത്തലച്ചി	2
23	VERNAL HANGING PARROT	*Loriculus vernalis*	തത്തച്ചിന്നൻ	1
24	HOUSE CROW	*Corvus splendens*	പേനക്കാക്ക	2
25	PURPLE SUNBIRD	*Cinnyris asiaticus*	കറുപ്പൻ തേൻകിളി	1
26	LOTEN'S SUNBIRD	*Cinnyris lotenius*	കൊക്കൻ തേൻകിളി	1
27	COMMON TAILOR BIRD	*Orthotomus sutorius*	തുന്നാരൻ	1
28	PALE BILLED FLOWER PECKER	*Dicaeum erythrorhynchos*	ചെങ്കൊക്കാൻ ഇത്തിക്കണ്ണികുരുവി	1
29	GREENISH WARBLER	*Phylloscopus trochiloides*	കടുംപച്ച പൊടികുരുവി	1
30	BLACK HOODED ORIOLE	*Oriolus xanthornus*	കരിന്തലയൻ മഞ്ഞക്കിളി	2
31	WHITE BROWED WAGTAIL	*Motacilla maderaspatensis*	വലിയ വാലുകുലുക്കി	2
Simpson's index				0.07

Table 6.3 Diversity of birds

Oriental magpie robin

White Cheeked Barbet

Rock pigeon

Greater coucal

Rose-ringed parakeet

Black drongo

Brahminy kite

Red vented bulbul

Common myna

Black rumped flameback

Red whiskered bulbul

Purple rumbed sunbird

6.4.1.2 Checklist of Dragonflies

Sl.No.	COMMON NAME	SCIENTIFIC NAME	MALAYALAM NAME	No.
1	SPLENDID DARTLET	*Agriocnemis splendidissima*	കാട്ടുപുൽചിന്നൻ	1
2	WAYANAD BAMBOOTAIL	*Caconeura risi*	വയനാടൻ മുളവാലൻ	1
3	COMMON CLUBTAIL	*Ictinogomphus rapax*	നാട്ടുകടുവ	1

Table 6.4 Diversity of Dragonflies

Agriocnemis splendidissima

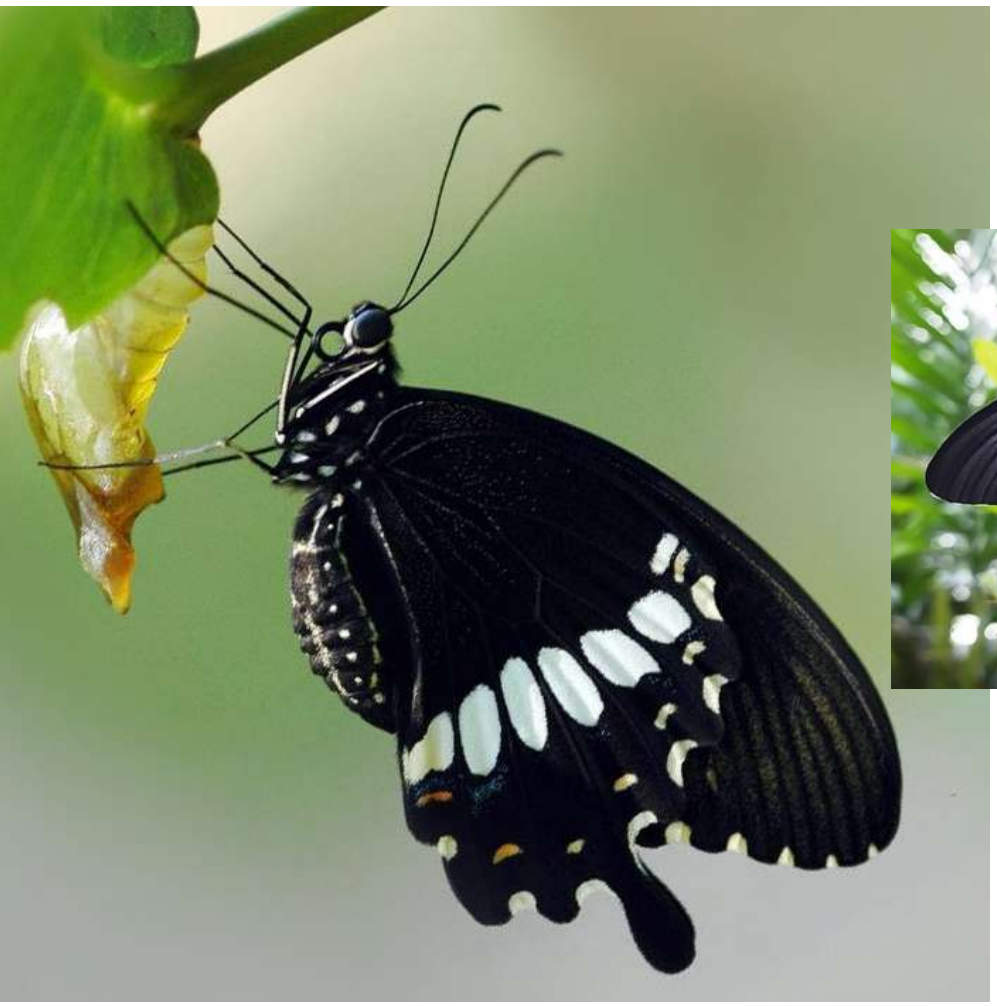
Caconeura risi

Ictinogomphus rapax

6.4.1.3 Checklist of Butterfly

Sl No	ENGLISH NAME	SCIENTIFIC NAME	MALAYALAM NAME	DENSITY
1	Common Pirate	*Castalius rosimon*	നാട്ടുകോമാളി	3
2	Blue Mormon	*Papilio polymnestor*	കൃഷ്ണശലഭം	2
3	Snow Flat	*Tagiades japetus*	നാട്ടുപരപ്പൻ	1
4	Common Mormon	***Papilio polytes***	നരകകാളി	1
5	Evening Brown	***Melanitis leda***	കരിയില ശലഭം	3
6	Angled Pierrot	***Caleta caleta***	വരയൻ കോമാളി	1
7	Common Five-ring	***Ypthima baldus***	പഞ്ചനേത്രി	2
Simsons index				0.10

Table 6.5 Diversity of Butterfly



Common mormon

Blue mormon

6.4.1.4 Checklist of Reptiles

Sl No	ENGLISH NAME	SCIENTIFIC NAME	MALAYALAM NAME	DENSITY
1	ORIENTAL RAT SNAKE	*Ptyas mucosa*	ചേര	1
2	COMMON KRAIT	*Bungarus caeruleus*	ശംഘുവരയൻ	1
3	ORIENTAL GARDEN LIZARD	*Calotes versicolor*	ഓന്ത്	2
Simsons index				0.17

Table 6.6 Diversity of Reptiles

Ptyas mucosa

Calotes versicolor

6.4.1.5 Checklist of Trees

Sl No	SCIENTIFIC NAME	MALAYTALAM NAME	COMMON NAME	DENSITY
1	*Alstonia scholaris*	ഏഴിലം പാല	DEVIL TREE	1
2	*Araucaria heterophylla*	ക്രിസ്തുമസ് ട്രീ	ARAUCARIA	1
3	*Artocarpus heterophyllus*	പ്ലാവ്	JACK FRUIT TREE	4
4	*Bambusa bambos*	ഇല്ലി	THORNY BAMBOO	2
5	*Calophyllum inophyllum*	പുന്ന	OIL NUT	2
6	*Camellia sinensis*	തേയില	TEA	120
7	*Citrus sinensis*	ഓറഞ്ച്	ORANGE	3
8	*Cocos nucifera*	തെങ്ങ്	COCONUT TREE	1
9	*Coffea arabica*	കാപ്പി ചെടി	ARABICA COFFEE	10
10	*Coffea canephora*	കാപ്പി ചെടി	ROBUSTA COFFEE	5
11	*Erythrina variegata*	മുരിക്ക്	INDIAN CORAL TREE	2
12	*Eucalyptus spp.*	യൂക്കാലിപ്റ്റസ്	EUCALYPTUS	2
13	*Ficus benghalensis*	പേരാൽ	BANYAN TREE	1
14	*Ficus racemosa*	അത്തി	INDIAN FIGTREE	1
15	*Ficus religiosa*	അരയാൽ	PEEPALTREE	1
16	*Garcinia mangostana*	മാംഗോസ്റ്റീൻ	MANGOSTEEN	1
17	*Garcinia morella*	പുളിഞ്ഞി	INDIAN GAMBOGE	1
18	*Gmelina arborea*	കുമിഴ്	WHITE TEAK	1
19	*Hibiscus mutabilis*	ചീനപരുത്തി	COTTON ROSE	1
20	*Madhuca longifolia*	ഇലിപ്പ	MAHUA	1
21	*Mangifera indica*	മാവ്	MANGO TREE	2
22	*Manilkara hexandra*	കിർണി പഴം	CEYLON WOOD	1
23	*Manilkara zapota*	സപ്പോട്ട	SAPOTTA	3
24	*Mimusops elengi*	ഇലഞ്ഞി	SPANISH CHERRY	2
25	*Muntingia calabura*	പഞ്ചസാര പഴം	BIRD CHERRY	1
26	*Myristica fragrans*	ജാതി	NUTMEG	1
27	*Persea americana*	അവകാഡോ	AVOCADO	3
28	*Pinus spp.*	പൈൻ	PINE	100
29	*Pongamia pinnata*	ഉങ്ങ്	INDIAN BEECH	1
30	*Psidium guajava*	പേര	GUAVA	13
31	*Santalum album*	ചന്ദനം	SANDAL WOOD	2
32	*Senna siamea (or other Cassia spp.)*	മഞ്ഞക്കൊന്ന	SIAMESE SENNA	8
33	*Sesbania grandiflora*	അഗസ്ത്യ ചീര	VEGETABLE HUMMINGBIRD TREE	1

34	*Spathodea campanulata*	ആഫ്രിക്കൻ പൂമരം	AFRICAN TULIP TREE	2
35	*Syzygium cumini*	ഞാവൽ	BLACK PLUM	13
36	*Syzygium jambos*	പനിനീർ ചാമ്പ	ROSE APPLE	14
37	*Tamarindus indica*	വാളൻപുളി	TAMARIND	1
38	*Wrightia tinctoria*	ദന്തപ്പാല	PALA INDIGO PLANT	1
39	*Sterculia guttata*	കാവളം	SPOTTED STERCULIA	2
40	*Symplocos cochinchinensis*	പാച്ചോറ്റി	LAUREL SAPPHIRE BERRY	80
41	*Terminalia paniculata*	പുല്ലമരുത്	KINDAL TREE	2
42	*Macaranga peltata*	വട്ട	SHIELD LEAF TREE	16
43	*Toona ciliata*	ചന്ദനവേമ്പ്	TOON TREE	2
44	*Cinnamomum malabatrum*	വയന	WILD CINNAMON	10
45	*Barringtonia acutangula*	ആറ്റുപേഴ്	INDIAN OAK	3
46	*Tetrapilus dioicus*	കരിവെട്ടി	ROSE SANDAL WOOD	1
47	*Dalbergia latifolia*	ഈട്ടി	ROSE WOOD	56
48	*Syzygium caryophyllatum*	ഞാറ	SOUTH INDIAN PLUM	31
49	*Careya arborea*	പേഴ്	WILD GUAVA	12
50	*Terminalia catappa*	ബദാം	INDIAN ALMOND	10
Simsons index				0.12

Table 6.7 Diversity of Trees

6.4.1.5 Checklist of Herbs

Sl. No.	Scientific Name	Malayalam Name	COMMON NAME	No.
1	*Alpinia galanga*	ചിറ്റരത്ത	GREATER GALANGAL	1
2	*Alternanthera sessilis*	പൊന്നാങ്കണ്ണി ചീര	SESSILE JOYWEED	1
3	*Celosia argentea*	കോഴിപ്പൂ	COCKSCOMP	1
4	*Curcuma longa*	മഞ്ഞൾ	TURMERIC	1
5	*Diplazium esculentum*	പന്നൽ	VEGETABLE FERN	1
6	*Ipomoea purpurea*	മോർണിംഗ് ഗ്ലോറി	COMMON MORNING GLORY	1
7	*Justicia adhatoda*	ആടലോടകം	MALABAR NUT	1
8	*Mimosa diplotricha*	ആനത്തൊട്ടാവാടി	GIANT SENSITIVE PLANT	1
9	*Mimosa pudica*	തൊട്ടാവാടി	TOUCH ME NOT PLANT	1
10	*Musa spp.*	വാഴ	BANANA	100
11	*Ocimum tenuiflorum*	തുളസി	HOLY BASIL	1
12	*Phyllanthus niruri*	കീഴാർനെല്ലി	STONE BREAKER	1
13	*Piper nigrum*	കുരുമുളക്	PEPPER	25
Simsons index				0.57

Table 6.8 Diversity of Herb

6.4.1.6 Checklist of Shrub

Sl. No.	SCIENTIFIC NAME	MALAYALAM NAME	COMMON NAME	DENSITY
1	*Abutilon indicum*	വെള്ളുരം	INDIAN MALLOW	1
2	*Alysicarpus monilifer*	നില ഓരില	NECKLACE - POD	1
3	*Caesalpinia bonduc*	കഴഞ്ഞി	FEVER NUT	1
4	*Caesalpinia pulcherrima*	രാജമല്ലി	PEACOCK FLOWER	6
5	*Impatiens balsamina*	ബാൾസം	CHINESE BALSAM	100
6	*Clerodendrum infortunatum*	പെരിങ്ങലം	HILL GLORYBOWER	1
7	*Clidemia hirta*	പൊട്ടൻ കദളി	SOAPBUSH	1
8	*Clitoria ternatea*	ശംഖുപുഷ്പം	BUTTERFLY PEA	1
9	*Coccinia grandis*	കോവൽ	IVY GOURD	1
10	*Hamelia patens*	വിടരാമുല്ല	FIREBUSH	1
11	*Hypoestes phyllostachya*	പോൾക ഡോട്ട്	POLKA DOT	2
12	*Ipomoea spp.*	ഗ്ലോറി	GLORY	1
13	*Jatropha curcas*	കടലാവണക്ക്	JATROPHA	1
14	*Melastoma malabathricum*	കദളി	MELASTOMA	1
15	*Rosa indica var.*	റോസ്	ROSE	75
16	*Solanum nigram*	ചുണ്ട	BLACK NIGHT SHADE	1
17	*Solanum villosum*	മണി തക്കാളി	HAIRY NIGHT SHADE	1
18	*Strongylodon macrobotrys*	ജേഡ് വൈൻ	GREEN JADE VINE	1
19	*Wedelia trilobata*	കമ്മൽ പൂവ്	SINGAPORE DAISY	1
Simsons index				0.40

Table 6.9 Diversity of Shrub

6.4.1.7 Checklist of Mammals

Sl No	Common Name	Scientific Name	Malayalam Name	No
1	PALM SQUIRREL	*Funambulus tristriatus*	അണ്ണാൻ	1
2	INDIAN GIANT SQUIRREL	*Ratufa indica*	മലയണ്ണാൻ	1
3	INDIAN GREY MANGOOSE	*Herpestes edwardsii*	കീരി	1
4	SAMBAR DEER	*Rusa unicolor*	മ്ലാവ്	1

Table 6.10 Diversity of Mammals

6.4.1.8 Checklist of Other

Sl No	COMMON NAME	SCIENTIFIC NAME	NO	n-1	n(n-1)
1	LADYBUG	*Coccinellidae spp.*	3	2	6
2	GRASSHOPPER	*Grasshopper spp.*	2	1	2
3	INDIAN BLACK ANT	*Black Carpenter ants*	8	7	56
4	CICADAS	*Cicada spp.*	4	3	12
5	LEECH	*Haemadipsa zeylanica*	10	9	90
6	HAMMERHEAD WORM	*Biphalium spp.*	2	1	2
7	TADPOLE	*Frog spp.*	1	0	0
8	WATER STRIDER	*Gerridae spp.*	6	5	30
9	CLUSTER FLY	*Pollenia SPP.*	2	1	2
10	INDIAN TREE FROG	*Polypedates maculatus*	1	0	0
11	WASP	*Vespidae spp.*	1	0	0
12	MALABAR GIANT WOOD SPIDER	*Nephila pilipes*	1	0	0
Simpson's index					0.12

Table 6.11 Diversity of Others

Sl No	Table No	Funa/Flora	Abundance	Density
1	6.4	Dragonflies	3	Not applicable
2	6.3	Birds	31	0.07
3	6.5	Butterfly	7	0.10
4	6.6	Reptiles	3	0.17
5	6.7	Trees	50	0.12
6	6.8	Herbs	13	0.57
7	6.7	Shrub	19	0.40
8	6.10	Mammals	4	Not applicable
9	6.11	Others	12	0.12

Table 6.12 Abundance and density of campus flora and fauna

The college campus exhibits moderate to low biodiversity, particularly when compared to other campuses in neighbouring districts. Kuttikkanam, a hill station in Idukki district, Kerala, India, is situated at an elevation of approximately 1,100 meters (3,500 feet) above sea level. The mid-to-high ranges of the southern Western Ghats are characterised by a cool, misty climate with high rainfall, which supports a diverse mix of vegetation typical of montane and sub-montane zones. The surrounding landscape features extensive tea and cardamom plantations, natural grasslands, and patches of forest, including an artificial pine forest that serves as a buffer zone and hosts around 30 bird species, some of which are rare or endangered. Although the region is renowned for its rich flora and fauna, the campus itself displays limited biodiversity richness. This is primarily due to intensive campus development, landscaping practices, extensive monoculture lawns, the prevalence of exotic ornamental plants, and habitat fragmentation. The campus supports approximately 50 tree species, with a relatively low tree density of 0.12 trees per unit area commendable achievement for an educational institution. These trees likely include a combination of native, ornamental, and exotic species. However, faunal diversity remains comparatively low overall. While birds represent the primary component of the campus's animal life, both species richness and abundance of fauna are limited.

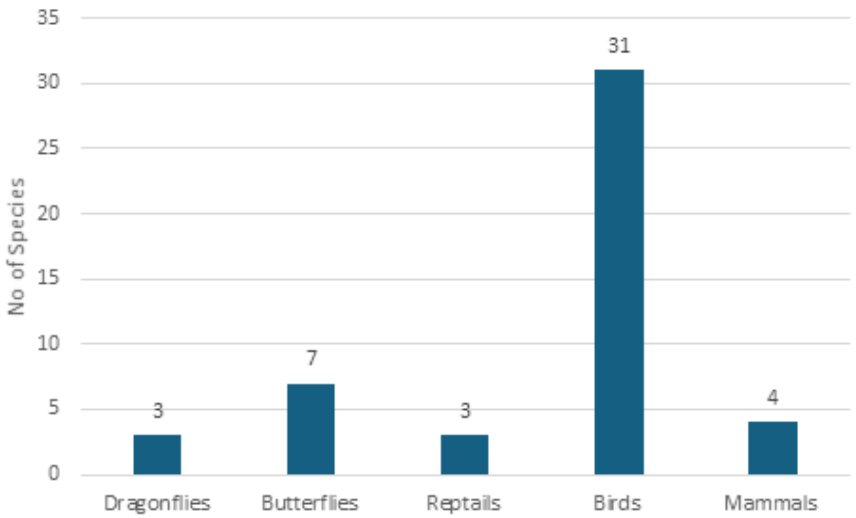


Fig. 6 .2 Fauna diversity of the campus

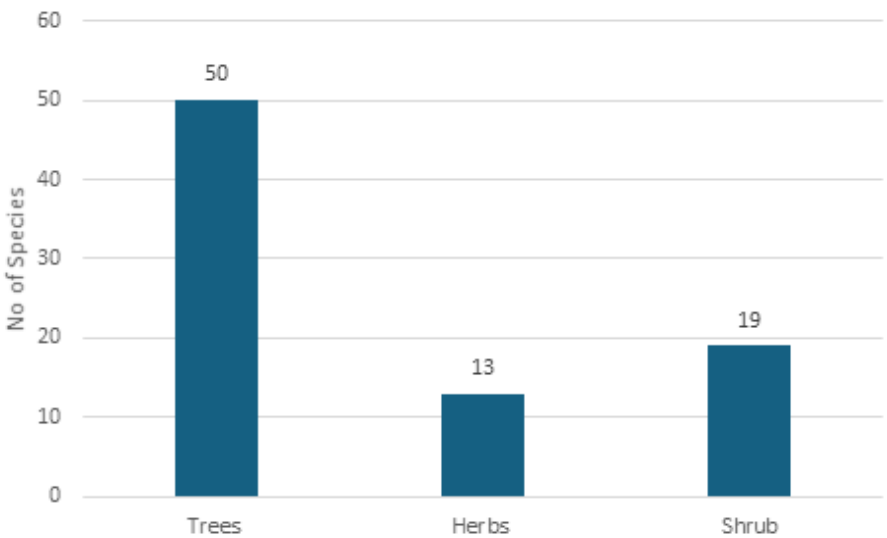


Fig 6.3 flora diversity of the campus

6.5 CONCLUSION

- Despite the area being known for observing rich biodiversity of flora and fauna, very low biodiversity is found in nearby locations, which are also featured by tree plantation and cash crop fragmentation. Contiguous habitats are divided into smaller, isolated patches, which is a primary driver of biodiversity loss and significantly reduces both flora and fauna populations. It acts as one of the most severe, long-term threats to ecosystems by restricting species movement and reducing genetic diversity. Campus building 24*7 presence of humans.
- The college campus exhibits a visible increase in the number of birds and trees when compared to other species diversity ·
- Low biodiversity can signal habitat degradation, monoculture practices, or environmental stressors, and therefore, efforts should focus on enhancing plant diversity and protecting faunal habitats. Regular biodiversity assessments can help track changes and guide restoration strategies.

6.6 RECOMMENDATION

- Establish mixed plantings of indigenous trees, shrubs, and grasses adapted to local ecological conditions (e.g., Western Ghats climate and soil in Kerala). Techniques such as the Miyawaki method involve dense, multi-layered planting of numerous native species at close spacing (typically 2–3 per square meter), accelerating forest succession, enhancing structural complexity, and rapidly increasing biodiversity.
- Prioritise diverse native compositions over monocultures to support long-term ecosystem health. Begin with fast-growing native pioneer species to provide initial cover and soil stabilisation, then incorporate a broader range of climax species to promote carbon sequestration, habitat complexity, and attraction of wildlife, including birds, pollinators, and other fauna.
- Establish wildlife corridors or green linkages to reconnect fragmented habitat patches, facilitating species movement, gene flow, and ecological resilience. Supplement these with habitat-enhancing features such as nest boxes, perches, deadwood piles, rock piles, or small ponds to create nesting, shelter, roosting, and breeding opportunities for birds, insects, mammals, and amphibians.
- Emphasise the integration of insect- and bird-friendly native plants, particularly those rich in nectar, pollen, fruits, or seeds (e.g., flowering and fruiting species endemic to Kerala's biodiversity hotspots). These support pollinators, food webs, and trophic interactions, thereby strengthening overall faunal diversity and ecosystem services.

6.7 BIODIVERSITY MANAGEMENT PLAN

6.7.1 Introduction

Marian College Kuttikkanam (Autonomous) will strengthen its commitment to protecting, enhancing, and sustainably managing the biodiversity of its ecologically rich campus. Aligned with its Biodiversity Management Policy and the broader sustainability vision, the College will work to conserve native flora and fauna, maintain ecological balance, and safeguard natural resources for future generations. Through academic integration, campus operations, and community engagement, Marian will evolve into a living learning ecosystem where biodiversity is studied, nurtured, and restored.

6.7.2 Establish an Adept Biodiversity Management Team

Marian College has established an enhanced Biodiversity Management Committee (BMC), which will be led by the Principal and Administrator, with the invaluable support of the Marian Centre for Sustainable Development. This Committee will comprise faculty members with ecological expertise, student representatives, gardening staff, and administrative personnel. The BMC will be responsible for overseeing all biodiversity conservation and restoration initiatives, conducting regular biodiversity audits, performing campus ecological mapping, and compiling species inventories. The Committee will manage green spaces, including botanical gardens, herbal gardens, and pollinator zones, while also identifying degraded areas in need of restoration. Collaboration with external agencies, such as the Forest Department and Haritha Karma Sena, will be essential for the BMC's activities. The Committee will convene periodically to

review progress, address emerging issues, and strategise future interventions.

6.7.3 Formulate a Comprehensive Strategy for Sustainable Biodiversity Management

The College will develop a comprehensive, science-based biodiversity strategy to guide ecological planning and restoration efforts across the campus. This strategy will emphasise the conservation of native and endemic species, developed in consultation with ecological experts. Key components of the strategy include the protection and enhancement of green spaces, water bodies, and natural habitats. The College will promote climate-resilient and native landscaping that is tailored to the area's unique topography and climate. Furthermore, measures will be implemented to prevent the introduction and spread of invasive species. Soil health will be prioritised through organic practices, thereby reducing the reliance on chemical fertilisers. The integration of biodiversity themes into teaching, research, and student projects is essential for fostering innovation and growth in research and academic disciplines. Sustainable land use planning will be a cornerstone of this strategy, incorporating contour maintenance, water conservation, and ecological buffers. Ultimately, this strategy will serve as a comprehensive framework for all departmental and institutional biodiversity initiatives, providing reference and support for community involvement and action.

6.7.4 Implement Effective Methods to Attain Set Objectives

To meet its biodiversity goals, the College will undertake the following measures:

- Restore degraded zones through native plantings and enrichment programs.
- Maintain botanical, herbal, butterfly, and pollinator gardens to support ecological diversity.
- Use treated wastewater for irrigation and ensure responsible water management for ecosystem health.
- Promote waste segregation, composting, and circular resource use to support soil and plant health.
- Implement sustainable gardening practices, including mulching, contour maintenance, and rainwater harvesting.
- Organise biodiversity awareness programmes, nature walks, and observation-based learning activities.
- Integrate biodiversity monitoring into student coursework and field projects.

These actions will collectively strengthen ecological resilience across the campus.

6.7.5 Establish Robust Communication Channels

Marian College will implement strong communication strategies through the Biodiversity Management Committee (BMC) to ensure transparency, effective coordination, and seamless execution of biodiversity initiatives. The Committee will collaborate with various departments to organise biodiversity-related academic programs and field activities. Regular circulars and reports will be disseminated to keep the campus community informed about ongoing biodiversity efforts. Additionally, a dedicated WhatsApp group will be established to facilitate communication across the college community, enabling auditors to maintain comprehensive biodiversity records, inventory databases, and audit documentation. The Committee will also engage with external stakeholders, including the Forest Department, NGOs, panchayats, and Haritha Karma Sena, to foster collaboration and support. These communication mechanisms will promote the structured implementation of initiatives and encourage widespread participation across the campus.

6.7.6 Objectives

6.7.6.1 Long-Term:

- To preserve and enhance native flora and fauna across the campus by 2028
- To allocate at least 50% of the college's green initiative budget to protect and maintain ecosystem health through sustainable resource management.
- To strengthen long-term research and community-based conservation initiatives by 2030.
- College is planning to planting of flora typical to 1000 MSL in the Western Ghats.

- To establish sustained partnerships with government bodies (e.g., Kerala State Biodiversity Board), NGOs, and local communities for collaborative biodiversity enhancement.

6.7.6.2 Short-Term:

- Strengthen and expand botanical, herbal, butterfly, and pollinator gardens across the college campus.
- Document flora, fauna, insects, and key microhabitats, and update the campus biodiversity inventory/checklist annually.
- Conduct regular awareness programmes and celebrate key biodiversity observances in collaboration with the campus nature group members.
- Promote and increase the proportion of native flora species in campus landscaping and restoration efforts.
- Expand community outreach activities, including tree-planting drives, conservation initiatives, and school-level awareness programmes to cover at least 10 nearby panchayats.

6.7.7 Continuously Monitor and Enhance the System

The College will implement a systematic approach to monitor biodiversity health through tools such as ecological surveys, species checklists, GIS-based mapping, and photographic documentation. To enhance capabilities, either provide training for students or collaborate with experts to employ advanced methodologies for conducting internal biodiversity audits annually, along with periodic external reviews. Monitoring will include assessing the condition of green spaces, soil health, water availability, and pollinator activity. Publish an Annual Marian Biodiversity Report that summarises progress, identifies challenges, and outlines future actions. Additionally, biodiversity strategies will be revised in response to monitoring outcomes, scientific insights, and stakeholder feedback. This ongoing monitoring process will facilitate adaptive and effective management of biodiversity.

6.7.8 Conclude and Conduct Follow-ups on the System

At the end of each monitoring cycle, the Biodiversity Management Committee (BMC) will formulate targeted follow-up action plans to address any identified gaps. Departments will be assigned specific tasks along with corresponding timelines that are informed by the audit findings. To ensure steady progress towards our biodiversity objectives and the timely implementation of improvements, regular follow-up meetings, stakeholder consultations, and review sessions will be conducted.

6.7.9 Conclusion

Marian College Kuttikkanam (Autonomous) will implement this Biodiversity Management Plan through coordinated efforts by the BMC, Marian Centre for Sustainable Development, administrators, faculty, staff, students, and community partners.
The plan will evolve through periodic audits, scientific monitoring, and continued stakeholder participation. By strengthening its natural ecosystems, promoting ecological awareness, and integrating conservation into academic and operational systems, Marian College will develop into a model eco-friendly campus rooted in harmony with nature and long-term sustainability.

6.8 ACTIVITIES CONDUCTED

On 14th February 2025, the third-year students of the Department of Physics, Marian College Kuttikkanam, conducted a presentation on plant propagation. The workshop was highly informative and interactive, covering key artificial propagation techniques such as grafting, layering, cutting, and tissue culture. Dr. Akhil M elaborated on the scientific principles behind these methods and their practical applications in modern agriculture. The session provided valuable experience and deepened our understanding of plant propagation methods. After the workshop, we visited PDS Organic Spices, a unit of Peermade Development Society (PDS). PDS is a social service organization under the Catholic Diocese of Kanjirappally, dedicated to promoting the cultivation, processing, and marketing of high-quality organic spices. The organization plays a crucial role in supporting small, marginal, and tribal farmers across the Western Ghats region of Idukki, Kerala.


MARIAN COLLEGE
KUTTIKKANAM
AUTONOMOUS
MAKING COMPLETE
IN ASSOCIATION WITH
DEPARTMENT OF PHYSICS
THE
HEALING
GARDEN
"A journey through
Nature's Pharmacy"
MEDICINAL PLANT EXHIBITION
PART OF VAC (SUSTAINABLE AGRICULTURAL AND ORGANIC FARMING)
2024-28 BATCH
11TH AUGUST
ACADEMIC BLOCK
1:45 PM

Chapter VII

WASTE MANAGEMENT SYSTEM (WMS): AUDIT REPORT

WASTE MANAGEMENT COMMITTEE
(WMC 2025-26)

Dr. Justin P J
Dr. Shalom Ann Mathews
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Kaveri
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Sreya
Sweety
Students

7

Waste Management System Audit Report

7.1 INTRODUCTION

Solid waste management (SWM) is a significant challenge for governments and local authorities, particularly in developing countries, where poor management systems exacerbate social, environmental, and health problems. Globally, approximately 2.01 billion tons of waste are generated each year, with the East Asia and Pacific region accounting for 468 million tons equivalent to the weight of 46,337 Eiffel Towers or 4.5 million blue whales. The rising volume and complexity of waste, driven by modern consumption patterns and economic growth, pose serious threats to ecosystems and public health. About 5% of global greenhouse gas emissions result from the decomposition of organic waste. In India, one of the fastest-growing economies, annual waste production amounts to 62 million tons; however, only 70% of this is collected, and just 12 million tons are processed. As a result, 31 million tons end up in landfills, causing significant air, water, and soil pollution. Estimates suggest that municipal solid waste (MSW) generation in India could reach 165 million tons by 2030 due to evolving consumption trends and rapid urbanisation. Major challenges include inefficient collection systems, open and unsanitary landfills, and inadequate treatment facilities. Additionally, the situation with e-waste, which contains hazardous materials, is critical and is expected to worsen in both developed and developing nations.

In India, the informal sector plays a crucial role in recovering waste value. Nevertheless, inefficiencies in the collection, sorting, and recycling processes lead to a substantial amount of recyclable materials being sent to landfills. Urban areas, with a population of 377 million, produce significant waste but only manage to collect 43 million tons annually, leaving much untreated. The lack of infrastructure is apparent, with just 21 million waste collectors compared to China's 700 million, and only 30% of waste is sorted correctly.

The Union Ministry of Environment, Forests, and Climate Change is responsible for solid waste management in India, following principles of "sustainable development," "precaution," and "polluter pays." The Environmental Protection Act of 1986 provides the legal structure for waste management regulations, emphasising the responsibility of cities and businesses to lessen environmental harm and implement sustainable practices. On educational campuses, Municipal Solid Waste (MSW) includes items like stationery, organic waste, food scraps, metals, packaging, hazardous material containers, and electronic waste. Sustainability initiatives at these institutions aim to enhance MSW management

and liquid waste management through waste audits. Higher Education Institutions (HEIs) play an essential role in promoting sustainability by combining knowledge with community engagement and advancing societal improvement through research and innovation.

The ISO 14001 standard serves as a global guideline for environmental management systems, offering a framework for developing and maintaining effective waste management practices. This framework aids institutions in reducing waste, minimizing environmental impacts, and enhancing overall efficiency. It assesses the performance of waste management systems, encourages responsible resource use, and identifies areas for improvement to ensure ongoing progress in waste reduction and sustainability efforts.

7.1.1 What is Waste Management Audit?

A waste audit entails a comprehensive analysis of all waste generated by an organisation. It offers valuable information regarding the types of items being discarded, their amounts, and the typical contaminants produced by individuals. This process evaluates the efficiency of the current waste management system and identifies potential areas for implementing new strategies. A detailed inventory of the different types of waste produced on the college campus from various sources, including canteens, dormitories, classrooms, offices, and laboratories.

- A comprehensive evaluation of current waste management methods at each source, focusing on their environmental impact and effects on stakeholder well-being.
- The creation of a robust scientific waste management system on campus designed to improve waste management practices while promoting environmental sustainability, which includes encouraging behavioural changes and establishing facilities like a biogas plant, composting units, and materials recovery centres.

7.1.2 Need for Waste Management Audit

The goals of the waste management and environmental policy are to educate and inform stakeholders about the significance of adhering to environmental standards in order to maintain a clean environment. This policy is relevant for all faculty and students at colleges and universities, promoting an eco-friendly culture. The Waste Management Policy underscores the necessity of keeping the campus clean through appropriate waste disposal methods and recycling guidelines for biodegradable materials, alongside the use of environmentally safe products to prevent hazardous waste and pollution (Cardenas and Halman, 2016). Awareness-raising initiatives contribute to developing an environmentally conscious mindset among students and the surrounding rural community. Leadership, such as Department Heads and Senior Managers/Management Representatives, is responsible for overseeing the institution's waste management practices and ensuring a tidy campus, while all organizational members are required to follow the policy. Efficient waste management plays a vital role in supporting the institution's green initiatives, helping to preserve the planet for future generations. Furthermore, conducting a Waste Management audit every three years is essential, as it deepens the understanding of students and staff regarding the importance of waste management and its positive impact on advancing the 'Go Green' initiative, positioning the institution as an environmental leader in the community. Implementing effective waste management is a crucial approach for organizations to assess their ability to maintain an eco-friendly campus (Kaseva and Gupta, 1996).

7.1.3. Waste Management in a College in alignment with SDGs

Efficient waste management in educational institutions involves reducing, reusing, and recycling campus-generated waste through education, appropriate sorting, and sustainable practices. This contributes to the attainment of Sustainable Development Goals (SDGs) such as:

• SDG 11: Sustainable Cities and Communities

• SDG 12: Responsible Consumption and Production

• SDG 13: Climate Action

Establishing environmentally friendly waste management systems contributes to a cleaner campus and fosters a sense of environmental responsibility among students.

7.2 WASTE MANAGEMENT POLICY

7.2.1 Statement of Commitment

Marian College Kuttikkanam (Autonomous) is dedicated to responsible waste management practices that prevent pollution, conserve resources, minimise environmental impact, and promote environmental health, in full alignment with the Sustainable Development Goals and relevant international and national legal frameworks. The College endeavours to foster a clean, safe, and sustainable campus environment through structured initiatives focused on waste reduction, segregation, reuse, and recycling. By means of this policy, Marian College reaffirms its commitment to establishing efficient waste management systems that adhere to all applicable environmental regulations while nurturing an environmentally aware academic community. However, the region's cooler climate, with temperatures often ranging between 10°C and 25°C, poses challenges to the optimal operation of the campus biogas plant. Food waste constitutes a significant portion of the biodegradable waste stream, yet the lower ambient temperatures hinder efficient biogas production, leading to reduced functionality and occasional operational issues, including potential damage to the system.

7.2.3 Goals

The goal of Marian College's Waste Management Policy is to create a clean, sustainable, and responsible campus environment by minimising waste generation, promoting segregation and safe disposal, and integrating waste management into every level of institutional functioning. The College aims to foster a culture of environmental responsibility among all stakeholders through awareness and behavioural change and maintain transparency through proper documentation to build a waste-free ecosystem, ensuring continual improvement through regular monitoring and innovation.

7.2.4 Objectives

- To minimise waste generation through reduction, reuse, and recycling.
- To promote segregation at source and ensure safe disposal of all waste types — solid, liquid, hazardous, and e-waste.
- To integrate waste management into institutional planning, operations, and decision-making.
- To foster awareness and behavioural change among students, faculty, staff, and visitors to encourage responsible waste practices.
- To maintain proper documentation and transparent reporting of waste management practices.
- To collaborate with local authorities and community partners to build a waste-free ecosystem.
- To promote continual improvement through monitoring, evaluation, and innovation.

7.2.5 Curriculum Integration

7.2.5.1 Curriculum Integration Across Disciplines: Embed waste management and environmental sustainability topics within the core curriculum of all academic programs, ensuring at least one dedicated course per program. This aligns with the institution's statutory requirements for curriculum development, fostering interdisciplinary awareness and compliance.

7.2.5.2 Campus as a Living Laboratory: Transform the campus into a practical "Living Lab" by enabling students to analyse and enhance existing waste management infrastructure, such as segregation points, composting units, and recycling initiatives, through hands-on projects and research.

7.2.5.3 Community and External Collaborations: Marian has partnered with local panchayats, the Haritha Karma Sena, and NGOs as part of its extension activities to facilitate field-based student research, data collection, and practical interventions. The Haritha Karma Sena collects segregated waste from the campus on a weekly basis. At present, food waste is supplied to a pig farm in the nearby village of Amalagiri. Students also undertake extension projects through various departments—for instance, a survey and awareness program on waste management in the Kuttikkanam Ward was conducted, and the report was submitted to the Sub-Collector, Idukki District.

7.2.5.4 Incentives for Research and Dissemination: Encourage students and faculty to contribute to knowledge dissemination by incentivising publications

in college journals, presentations at sustainability conferences, or participation in exhibitions focused on environmental themes.

7.2.6 Green Initiatives

7.2.6.1 Installation of Segregation Bins: Labelled or colour-coded bins shall be installed in all classrooms, office rooms, staff rooms, hostels, the cafeteria, and high-traffic areas to facilitate waste segregation at the source.

7.2.6.2 Management of Biodegradable Waste: Biodegradable waste shall be collected separately and disposed of through eco-friendly methods, such as composting or redirecting food waste to local pig farms. The Estate Officer, in collaboration with the housekeeping team, shall oversee daily collection, transportation, and maintain detailed records of disposal.

7.2.6.3 Handling of Recyclable Waste: All recyclable plastic and paper waste shall be transferred to authorised local collection agencies, such as the Haritha Karma Sena. The Green Protocol Committee shall supervise the process and ensure comprehensive documentation of each collection in the Waste Quantity Register.

7.2.6.4 Designated Waste Segregation Room: A well-equipped waste segregation room shall be maintained for sorting and temporary storage of categorised waste prior to final disposal. The Facility Supervisor shall be accountable for the room's maintenance, ensuring waste removal occurs twice weekly. Clear instructions and signage shall be prominently displayed to guide users on segregation standards.

7.2.6.5 Awareness and Community Engagement Initiatives: The Marian Centre for Sustainable Development (MCSD) and the Department of Applied Economics shall jointly organise green events, "Zero Waste" campus campaigns, and competitions to enhance awareness and foster community participation.

7.2.7 Purchasing and Procurement

7.2.7.1 Adoption of Eco-Friendly Procurement Practices: Implement sustainable procurement practices by prioritizing the use of eco-friendly, reusable, and recyclable materials across all campus operations and events. Minimize the acquisition of single-use plastics and non-biodegradable packaging. Mandate that all vendors and contractors adhere to Marian's established waste management protocols.

7.2.7.2 Prioritisation of Green-Certified and Local Suppliers: Ensure preference to suppliers providing green-certified products or locally sourced goods to reduce environmental impact and support regional economies.

7.2.7.3 Monitoring, Auditing, and Accountability Mechanisms: The Purchase Committee and Maintenance Department shall oversee compliance with sustainable procurement guidelines. The Waste Management Committee, in collaboration with the Purchase Committee and Maintenance Department, will conduct periodic audits and maintenance reviews. Reports detailing findings, areas for improvement, and accountability measures shall be submitted to the Internal Quality Assurance Cell (IQAC) to ensure ongoing adherence and continuous enhancement.

7.2.8 Research and Innovation

7.2.8.1 Promotion of Small-Scale Research and Innovation Projects: Faculty and students from diverse departments, including Economics, Commerce, Physics, Computer Applications, and Social Work, will be actively encouraged to initiate small-scale research and innovation projects focused on waste management, recycling technologies, and sustainable consumption practices. These initiatives will prioritise relevance to the campus environment and the surrounding local community, fostering practical and impactful outcomes.

7.2.8.2 Encouragement of Interdisciplinary Research Initiatives: Faculty and students across all departments will be supported in pursuing small-scale research and innovation projects addressing waste management, recycling technologies, and sustainable consumption. Emphasis will be placed on applicability to the campus and local community to enhance real-world sustainability efforts.

7.2.8.3 Fostering Interdepartmental Collaboration and Annual Initiatives: Interdepartmental collaboration will be advanced through integrated projects and coursework centered on circular economy models, low-waste campus operations, and comprehensive sustainability audits. To promote creative engagement

and knowledge exchange, new annual initiatives—such as "Zero Waste Campaigns," "Recycling Drives," and "Sustainable Design Challenges"—will be strategically planned and implemented.

7.2.9 Community Engagement

7.2.9.1 Participation in Government-Led Campaigns: Actively engage in regional and state-level waste management initiatives, including Haritha Karma Sena drives, Suchitwa Mission programs, and other governmental efforts to promote zero-waste campuses.

7.2.9.2 Educational Workshops and Awareness Programs: Organise and conduct community workshops and awareness sessions focused on waste segregation, composting, e-waste management, and sustainable consumption practices.

7.2.9.3 Strategic Partnerships for Waste Management: Collaborate with authorised entities, such as the Haritha Karma Sena, for the collection and recycling of non-biodegradable waste; partner with local farmers or pig farms for effective organic waste processing.

7.2.9.4 Inter-Club Collaboration via MCSD and WEMS: The Marian Centre for Sustainable Development (MCSD) and Waste and Environmental Management Society (WEMS) coordinate with affiliated clubs, including the Nature Club, Sustainability Advocacy Club, NSS, NCC, and UNAI Aspire Marian Chapter to execute joint community initiatives, encompassing waste management drives, campus and community clean-up activities, awareness campaigns, and sustainability advocacy efforts.

7.2.10 Monitoring and Reporting

7.2.10.1 Policy Implementation and Monitoring: The Waste Management Committee (WMC) shall oversee the implementation and continuous monitoring of this policy through periodic inspections, maintenance of Waste Registers, and solicitation of feedback from custodial staff.

7.2.10.2 Waste Register Maintenance: Cleaning staff shall maintain a comprehensive Waste Register to systematically record waste generation, segregation, and disposal activities.

7.2.10.3 Audit Mechanisms: Internal and external audits shall be conducted to evaluate overall performance and identify opportunities for enhancement.

7.2.10.4 Audit Schedule and Scope: Internal audits shall be performed by the WMC once per semester, while external audits shall be carried out annually in collaboration with authorised agencies. These audits will assess segregation practices, recycling efficiency, and disposal methods.

7.2.10.5 Annual Reporting: The WMC shall prepare an Annual Marian Waste Impact Report, detailing achievements in waste reduction, audit outcomes, best practices, and recommendations for improvement. This report will be submitted to the Principal and the Marian Centre for Sustainable Development (MCSD) for review and subsequent strategic actions.

7.2.11 Compliance and Review

7.2.11.1 Regulatory Compliance: The College shall enforce rigorous compliance with all applicable local, state, and national waste management laws, including the Solid Waste Management Rules (2016), Plastic Waste Management Rules (2018), and E-Waste (Management) Rules (2022).

7.2.11.2 Alignment with National Frameworks: This policy shall maintain full consistency with the University Grants Commission (UGC) Green Campus Guidelines and the Institutional Development Plan, thereby ensuring seamless integration with broader national sustainability objectives.

7.2.11.3 Monitoring and Corrective Mechanisms: Compliance obligations shall be fulfilled through ongoing surveillance, meticulous upkeep of a Waste Register and Audit Reports, and regular assessments conducted by the Waste Management Committee (WMC). Any instances of non-compliance or operational deficiencies shall be promptly rectified via targeted corrective actions, staff training programs, and enhanced procedural protocols.

7.2.11.4 Policy Review and Revision: This policy shall undergo a comprehensive review every three year, or sooner in response to amendments in legislation,

advancements in technology, or shifts in institutional priorities. The review shall be spearheaded by the WMC, in close collaboration with the Marian Centre for Sustainable Development (MCSD) and the College administration.

7.2.12 Leadership and Accountability

7.2.12.1 Oversight and Implementation: The Waste Management Committee (WMC), under the guidance of the Principal and the Management Committee for Sustainable Development (MCSD), shall oversee the administration and implementation of the Waste Management Policy. Heads of departments and designated Green Coordinators shall ensure compliance within their respective units.

7.2.12.2 Record Custodianship: The supervisor responsible for waste management staff shall serve as the custodian of operational waste records, including Waste Registers. The WMC shall maintain custody of Audit Checklists and Meeting Minutes to document activities and performance against established targets. These records shall provide evidence of compliance and demonstrate continuous improvement.

7.2.12.3 Communication Coordination: The WMC shall coordinate all internal and external communications related to policy implementation, performance reporting, and sustainability initiatives. This shall be achieved through periodic meetings, official circulars, and regular updates on the college website and notice boards.

7.2.12.4 Transparency and Accountability: Transparency and accountability shall be maintained through regular WMC meetings, with documented minutes and follow-up actions. Minutes of each meeting shall include review outcomes, assigned responsibilities, and progress reports.

7.2.12.5 Stakeholder Communication: Responsibilities and procedures outlined in this policy shall be disseminated to all stakeholders, including faculty, students, administrative staff, and service providers, through induction sessions, training workshops, and official circulars.

7.2.12.6 Compliance Verification: Compliance shall be verified through half-yearly inspections and audits conducted by the WMC. Findings and recommendations shall be reported to the Principal, the Internal Quality Assurance Cell (IQAC), and the college management for appropriate administrative action.

7.2.13 Conclusion

Marian College Kuttikkanam (Autonomous) upholds its commitment to sustainability through a comprehensive, action-oriented waste management framework that integrates education, innovation, and community partnership. The policy ensures systematic waste reduction, segregation, and responsible disposal while fostering a culture of environmental accountability among all stakeholders. Through continuous monitoring, collaboration with local agencies, and alignment with national and global sustainability goals, the College strives to maintain a zero-waste, eco-conscious campus that serves as a model for higher education institutions.

7.3 METHODOLOGY

Proper waste management is essential for upholding tidy surroundings, diminishing pollution, preserving resources, and safeguarding public health. An established Waste Management Group, consisting of 12 members (including 9 student representatives and 3 faculty members), oversees these initiatives according to a detailed policy. This policy delineates specific goals, action plans, and strategies, which are consistently evaluated and improved during group meetings to guarantee maximum effectiveness.

7.3.1 Data sampling and categorisation of waste

The annual waste management audit evaluates the generation of different types of waste, including food waste, plastics, litter, and electronic waste. Individual records are kept for each waste category, noting the amounts produced in key locations like the canteen and throughout the campus. Collected waste is sorted and organized into five separate streams: (1) Plastic and Paper, (2) Bio-waste, (3) E-waste, (4) Chemical Waste (Chemical samples, stain, dye, cultured media contaminated substance) and (5) Other Waste (Mat, glass wares cutleries, desk chair, bench instruments) which includes items such as broken glass, construction debris, textiles, packaging, and office supplies. Analysing the gathered data offers important insights into the annual waste

generation trends on campus, differentiating between times such as regular working days, holidays, and semi-holidays.

7.3.2 Registers and Documents to monitor the process

Detailed records of waste disposal are kept, monitoring the amounts sent to recycling centres, composting sites, and other disposal methods. Student representatives are responsible for overseeing the documentation linked to recycling centres and waste processing facilities.

7.3.3 Internal Audit Training

Green audit training promotes a sense of ownership and involvement within the institution by utilizing thorough, participatory methods. To prepare the college for this endeavor, the existing Environmental Management System (EMS) chooses students and faculty to participate in internal audit training. This one-day course certifies participants as internal auditors, enabling them to carry out a waste audit. The internal waste audit process consists of several crucial phases: evaluation, risk assessment, data gathering, policy development, and the creation of registers and initiatives for water conservation and resource management.

7.3.4 External Audit

External auditors come to the college to assess compliance with waste management audit standards and pinpoint any discrepancies. Should only minor discrepancies be identified, the external auditor may grant the institution certification in line with applicable ISO standards.

7.3.5 Assumption

The generation of waste presents an increasing challenge at global, regional, and local levels. Traditional waste management techniques, such as incineration and landfilling, often lead to negative environmental effects through emissions and contaminations of soil, air, and water, which contribute to pollution and damage to ecosystems. These issues are exacerbated by unsustainable production and consumption models alongside rapid global urbanization. The significant financial resources required for effective and environmentally friendly waste management may be seen as a barrier, encouraging inadequate disposal methods that threaten both human health and environmental integrity. On a worldwide scale, waste management practices vary greatly: developed nations, particularly those in the OECD, usually maintain strong management systems, while non-OECD countries often struggle with dependence on unregulated landfills and insufficient waste sorting systems. In many countries, waste management policies still tend to support incineration or landfilling, a trend often reinforced by industrial growth. Conversely, the last few decades have seen the emergence of 'Integrated Waste Management.' This approach, guided by the principles of the Waste Hierarchy and in alignment with standards like ISO 14001, emphasizes prevention, reuse, recycling, and recovery over disposal, thus creating a more sustainable and environmentally responsible method for handling waste.

7.3.6 Stages of Waste Management Audit

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

7.3.6.1. 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.); bio-wastes (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

7.3.6.2. 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

7.3.6.3. Post audit phase

- The plan of action for the post-audit phase 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.

7.3.7 Steps of Waste Management Audit

7.3.7.1. 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

7.3.7.2. 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

7.3.7. 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.

7.3.8. Work plan and Schedule of Waste Management Audit

Date to date	Weekly Work Plan
22/01/2025	A meeting was held to define the team's goals and formulate a strategy for collecting information on waste management practices. Team members were asked to examine the manual to help in developing the action plan. The college campus map was collected, showing various blocks, with each group designated to a specific block for the survey. The internal audit team has been divided into three groups, and each group will reach out to the housekeeping staff in their assigned blocks to understand existing practices. Data sheets were provided, and each group is anticipated to commence data collection the following week.
24/012025	Identify major waste sources (cafeteria, classrooms, hostels, offices) Each group is asked to understand the current waste handling procedure in their assigned area
25/01/2025	Oversee the categorisation of waste into groups, including organic, recyclable, and hazardous materials. Each team will establish registers in high-waste areas such as the canteen and hostel to facilitate data collection. Teams should also identify the different waste management systems present in their assigned locations, such as biogas plants, incinerators, and landfills. Document any inoperative equipment. Lastly, teams are tasked with collecting information regarding the disposal of materials, such as paper and plastic, that are sent to outside organisations.
29/01/2025	Become acquainted with the current waste management practices and the challenges they face. Keep track of the frequency of waste disposal and pinpoint any areas where regulations may not be adhered to. Ensure that all documents and records are accurately completed.

Table 7.1. Schedule of the audit of the waste management at Marian College

Activities	Frequency	Dates of study	Mode of data collection
Recording waste generation and collection food waste, plastic, litter, and e-waste) OR manual one time evaluation	Three-week, one time a day of sampling	Three working day ; 29/01/2025, 13/02/2025, 24/02/2025 holidays (Sunday; 2/02/25, 16/02/2025, 23/02/2025 Three semi holiday Saturday ; 01/02/2025, 15/02/2025,23/02/2025	Entry in the given format

Table 7.2. Work plan for the audit of the waste management

7.4 RESULT AND DISCUSSION

7.4.1 Analysis Of Waste Generation And Quantities

Mar Mathew Vatakuzhy block

Plastic	
Samplings days	Average waste generation (Kg) /year
Working day	292.07 ± 62.76
Semi holiday	309.70 ± 40.22
Holiday	99.87± 5.83

Table 7.3 Plastic waste quantity at Mar Mathew Vattakuzhy block

Paper	
Samplings days	Average waste generation (Kg) /year
Working day	1200.00± 111.36
Semi holiday	348.33 ± 145.11
Holiday	0.00

Table 7.4 Paper waste quantity at Mar Mathew Vattakuzhy block

Paper waste is Plentiful- on weekdays than on weekends. This increased waste on working days can be attributed to several factors. During weekdays, students and faculty engage in regular academic activities such as lectures, assignments, and laboratory work, which necessitate the use of paper for notes, handouts, and experiments. The continuous influx of students leads to a higher consumption of resources, resulting in more paper waste. Additionally, administrative work in staff rooms and the chemistry lab's requirements for worksheets and reports also contribute to this daily cycle of paper usage. In contrast, the weekend significantly reduces human activity within the college, leading to less paper generation as there are fewer classes, assignments, and academic interactions during this time, alongside minimal administrative activities. The combined effect of regular weekday operations highlights the efficiency pressures and educational demands in academic environments.

Fig 7.1 Waste segregation point -source separation

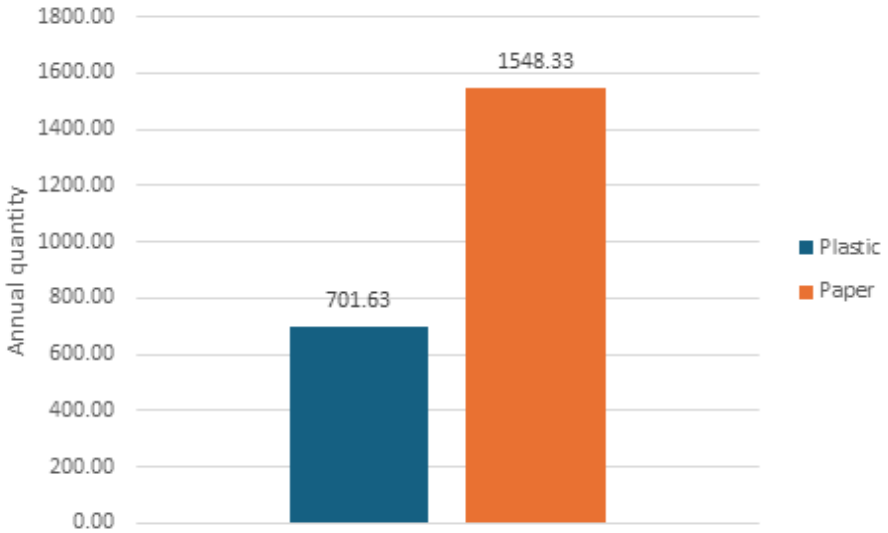

Fig 7.2 Annual waste quantity at Vattakuzhi Block

The Mar Mathew Vatakuzhy block generates a higher volume of paper waste compared to plastic, primarily due to the frequent usage of classrooms, the chemistry lab, the exam office, and the staff room for academic activities. The assessment study indicates an annual generation of 10 kg of electronic waste, along with an additional 10 kg of other waste, which includes textiles, mats, glassware, and metals. Limited amounts of chemical waste have been reported, as the chemistry lab primarily involves the use of solvents and chemicals in controlled quantities, including bottles and prepared solutions.

Fig 7.3 Proper waste segregration at collection point

Plastic	
Samplings days	Average waste generation /year
Working day	453.33 ± 110.15
Semi holiday	153.58 ± 31.63
Holiday	89.37 ±17.80

Table 7.5 Plastic waste quantity at the Academic block

Plastic waste is dominant in college academic blocks on weekdays due to activities in classrooms and staff rooms. During these days, a higher number of students and faculty members utilise the facilities, resulting in increased consumption of disposable items, including plastic water bottles, coffee cups, and food containers. The fast-paced nature of academic life encourages convenience, prompting individuals to choose readily available single-use plastic products for meals and snacks. Vending machines and cafés, primarily operate on weekdays, contributing further to the prevalence of plastic waste. With limited recycling facilities available in these areas, a significant portion of this waste ends up in trash bins.

Paper waste	
Samplings days	Average waste generation /year
Working day	1293.33 ±167.73
Semi holiday	161.50±59.33
Holiday	28.00 ±48.50

Table 7.6 Paper waste quantity at the Academic block

Paper waste in college academic blocks occurs during working days due to the higher volume of educational activities occurring within classrooms and staff rooms. Students and faculty members engage in various tasks that involve the use of paper, such as taking notes, printing assignments, preparing handouts, and completing projects. The frequency of classes leads to an increase in printed materials and physical worksheets, which are often discarded after use. Staff rooms frequently see the disposal of administrative documents, memos, and reports. The academic environment prioritizes tangible resources for learning and communication, contributing to an accumulation of paper waste. The combination of daily academic routines and the necessity for physical learning materials generate paper waste in these spaces.

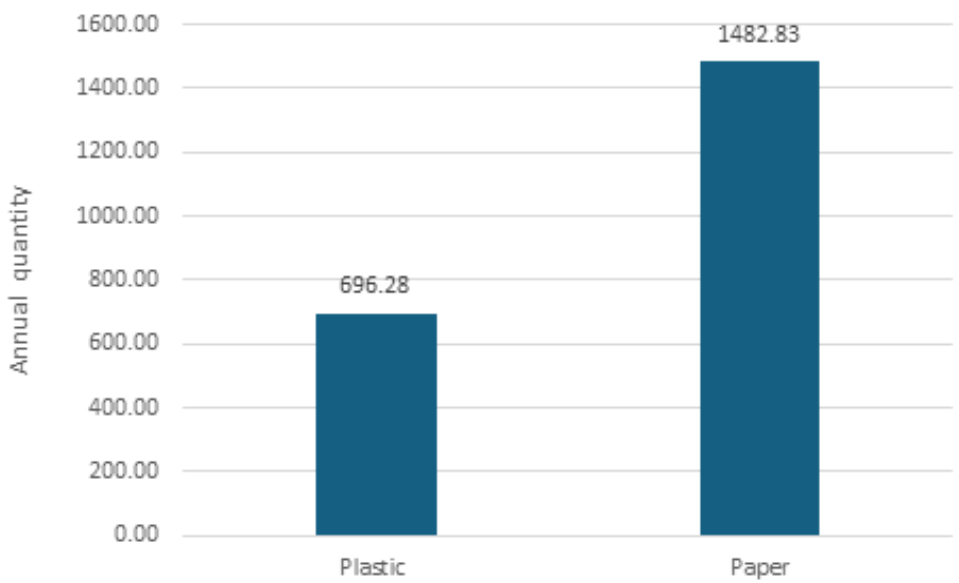

Fig 7.4 Annual waste quantity at the Academic block

The academic block consists of rooms that generate a greater number of papers than plastic because of classroom and staffroom peak usage corresponding with the academic purpose, stationery, assignment reports, exam paper activity report and other academic activities. The annual other waste reported in the assessment study is 15 kg other waste, including cloth, mat, and glassware wares

Fig 7.5 Breakdown of waste quantities by waste type

Plastic	
Samplings days	Average waste generation /year
Working day	410.00 ± 166.43
Semi holiday	96.58 ± 43.10
Holiday	0.00

Table 7.7 Plastic waste quantity at the Administrative block

Plastic waste is particularly predominant in the administrative block of a college during working days due to several factors related to daily operations and activities. The main computer lab and library, which serve as key resources for students and faculty, often see a high usage of single-use plastic items, such as water bottles, food wrappers, and packaging from supplies like printer cartridges and electronic devices. Students and staff frequently rely on convenience, leading to the consumption of snacks and beverages in plastic packaging, further contributing to the waste. Administrative offices often utilise various plastic supplies, including binders, folders, and stationery, which adds to the overall plastic footprint. The use of disposable items for convenience and the infrastructural reliance on plastic products in administrative processes result in a significant accumulation of plastic waste in these areas during workdays.

Paper		
Samplings days	Average waste generation /year	SDV
Working day	1253.33	250.07
Semi holiday	307.17	110.92
Holiday	0.00	0.00

Table 7.8 Paper waste quantity at the Administrative block

Paper waste in the administrative block of a college on working days is due to the intensive use of paper for various academic and administrative functions. The Main Computer Lab and Main Library are often busy with students printing assignments, resources, and study materials, leading to significant paper consumption. Classrooms and staff rooms contribute further as teachers print lesson plans and other educational materials for their classes or meetings. The Main Office, which handles a variety of administrative tasks, frequently utilises paper for memos, reports, budget proposals, and correspondence. The combination of educational activities, administrative requirements, and the reliance on printed materials for communication creates a high demand for paper, resulting in substantial paper waste accumulating in these areas throughout the working week.

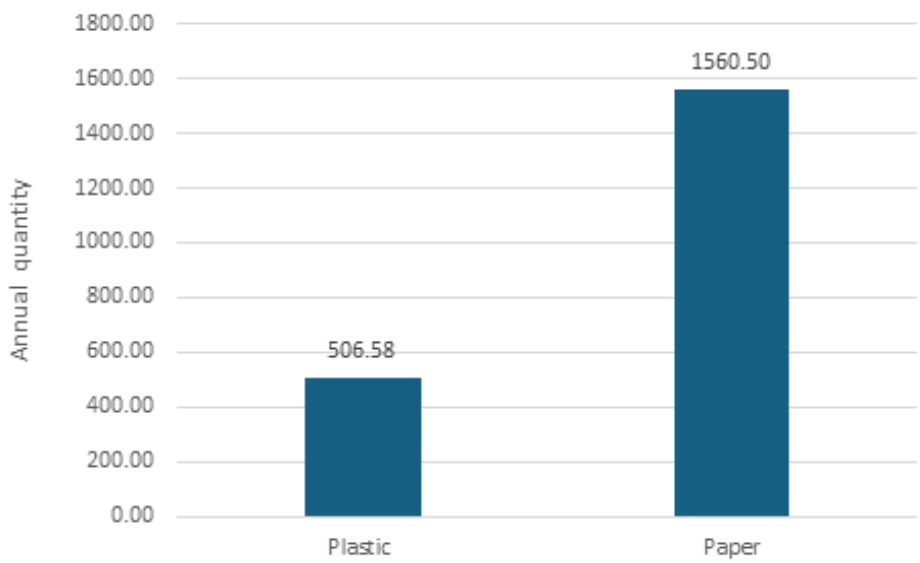

Fig 7.6 Annual waste quantity at the Administrative block

The administrative block produces a significantly higher volume of paper waste compared to plastic waste. This considerable amount of paper waste predominantly stems from activities conducted in the main computer lab, library, administrative office, classrooms, and staff operations, where reliance on paper remains more pronounced than on digital communication. Furthermore, approximately 360 kg of electronic waste is generated each year as a result of the replacement of equipment in the office, computer lab, and library.

Fig 7.7 Total waste quantity and composition analysis

MIM (Marian Institute of Management)

Paper	
Samplings days	Average waste generation /year
Working day	500.00 ± 100.00
Semi holiday	503.50 ± 66.50
Holiday	158.67 ±78.68

Table 7.9 Paper waste quantity at MIM block

Paper waste occurs during working days due to the high volume of interactions and activities that require printed materials. Classrooms generate waste from lesson plans, assignments and printed materials for students, contributing to a significant amount of paper usage. Staff rooms also see excessive paper consumption as faculty prepare teaching materials, reports, and document the academic affairs. The cafeteria, while primarily focused on food service, may contribute to waste through the use of printed menus and promotional materials. Restrooms may have fixtures like paper towels and toilet paper. The extensions of the main library and computer lab, as the students regularly print study materials, research papers, and project drafts, create a cycle of consumption that leads to considerable paper waste. This combination of educational demands, administrative needs, and communal facilities creates a perfect storm for paper waste accumulation in these areas.

Food	
Samplings days	Average waste generation /year
Working day	20666.67 ±1154.70
Semi holiday	5383.33 ± 548.48
Holiday	3500.00 ± 0.00

Table 7.10 Food waste quantity at MIM block

Food waste during working days is due to several factors. The cafeteria, as the primary dining area, generates significant waste from uneaten meals, leftover food items, and discarded packaging, reflecting rushed meal times and varying student preferences. Classrooms and staff rooms contribute to this waste as faculty and students often bring in snacks or packed lunches, which may go uneaten due to time constraints or lack of storage for leftovers. Toilets, while not directly related to food, often see waste from food packaging littering the area.

Paper	
Samplings days	Average waste generation /year
Working day	636.67±47.26
Semi holiday	129.83±14.51
Holiday	77.00± 12.12

Table 7.11 Paper waste quantity at MIM block

Classrooms are hotspots for paper waste, as students frequently use paper for assignments and notebooks, resulting in discarded papers from lectures and notes. In the cafeteria, disposable plates and take-out packaging significantly contribute to waste. The staff rooms also generate paper waste through printed materials, reports, and memos. In toilets, discarded hygiene products and paper towels. In the library and computer lab extensions, the high demand for printing, photocopying, exam hall tickets and study materials leads to further accumulation of paper waste. This combination of educational activities, reliance on disposable materials, and administrative processes creates a significant environmental footprint in terms of paper waste on campus.

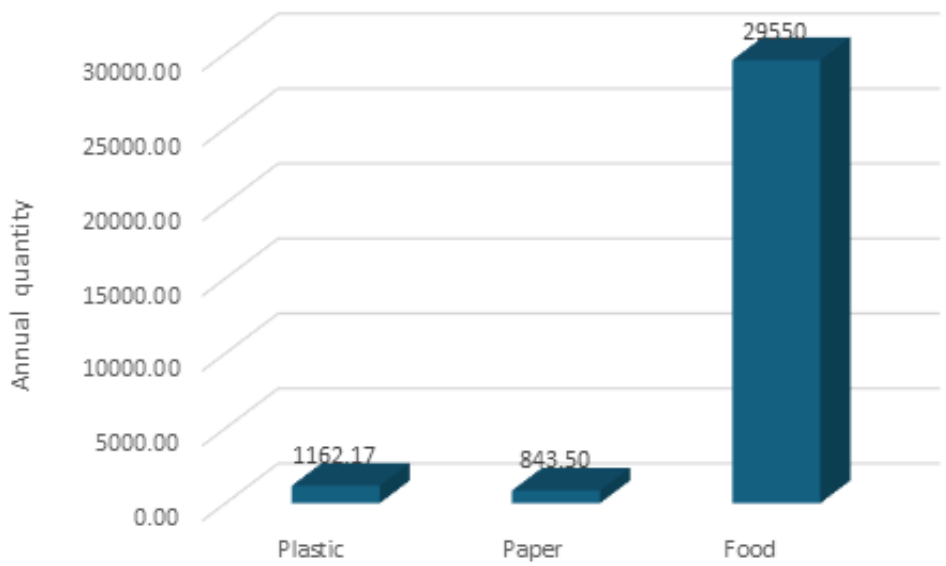

Fig 7.8 Annual waste quantity at the MIM block

Food waste in this block, which comprises a classroom, staffroom, and cafeteria, is notably high. This can largely be attributed to the usage patterns of the college community as well as the volume of food prepared in the cafeteria. Additionally, paper waste is another significant contributor, originating from classroom activities, staffroom functions, and the packaging used in the cafeteria. Furthermore, paper materials generated from the library and computer lab also contribute to the overall paper waste.

Fig 7.9 Open waste disposal point

Hostel

Plastic	
Samplings days	Average waste generation /year
Working day	666.67±305.51
Semi holiday	300.83±72.56
Holiday	170.33 ±81.13

Table 7.12 Plastic waste quantity at Hostel

Plastic waste is particularly dominant in college hostels during weekdays due to the convenience and accessibility of single-use plastics. Students often rely on packaged foods, bottled beverages, and take-out meals for their busy lifestyles, leading to an increase in plastic packaging waste. Additionally, many students prioritise quick meals between classes or study sessions, opting for ready-to-eat items that come with excessive plastic wrapping. The fast-paced environment of college life, coupled with limited recycling facilities and awareness about waste separation, makes it easier for plastic waste to accumulate. Furthermore, the culture of disposability within a busy campus setting encourages the use of items like plastic cutlery, plates, and cups, which are frequently disposed of after a single use, exacerbating the plastic waste problem in hostels on working days.

Food	
Samplings days	Average waste generation /year
Working day	56666.67±5773.50
Semi holiday	17416.67±2742.41
Holiday	8166.67±2020.73

Table 7.13 Food waste quantity at Hostel

Food waste in college hostels during weekdays can primarily be attributed to students' busy schedules, which often lead to irregular eating habits and time constraints. Many students attend classes, study sessions, and extracurricular activities, leaving little time for meal preparation and consumption. This results in food being prepared in advance but not eaten, and portion sizes may be misjudged when students cook in bulk, leading to leftovers that are sometimes discarded rather than consumed later. The lack of awareness about food waste management contributes significantly to the prevalence of food waste in college hostels on working days.

Paper	
Samplings days	Average waste generation /year
Working day	33.07±60.18
Semi holiday	47.50±23.75
Holiday	0.00

Table 7.14 Paper waste quantity at Hostel

Paper waste tends to be more dominant in college hostels during the weekends compared to weekdays for several reasons. On weekends, students often engage in leisure activities, which may include organising events, parties, or study groups, leading to an increase in printed materials such as flyers, posters, and handouts for activities or gatherings. Additionally, students may take the opportunity to catch up on coursework, resulting in more printed notes, drafts, and study materials being generated than on regular school days, when many students are focused on digital resources and attending classes. Students sometimes choose convenience over sustainability, leading to a rise in the disposal of paper items. Consequently, the combination of increased social activity and academic catch-up contributes to higher paper waste levels during weekends in college hostels.

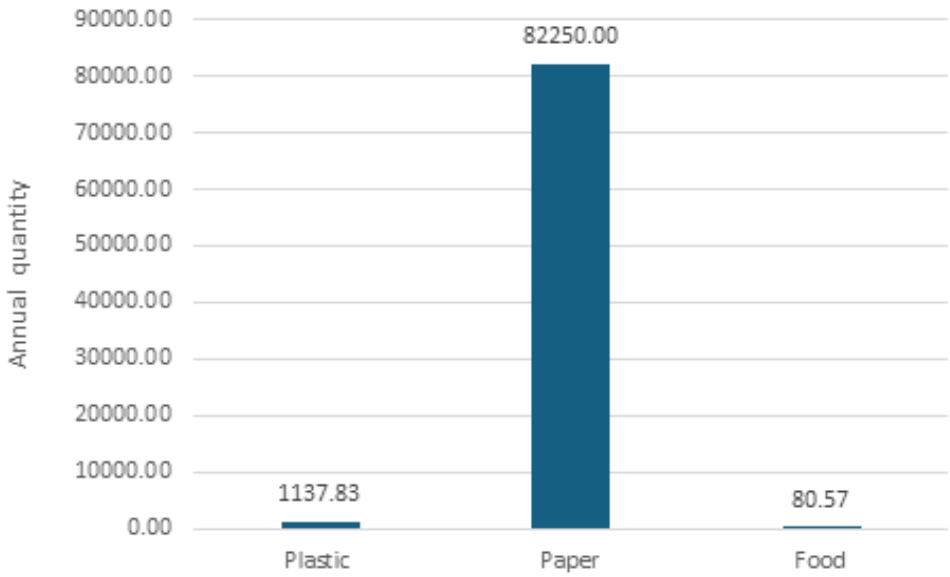

Fig 7.10 Annual waste quantity at Hostel

Paper waste is more significant than plastic and food waste, as more printed notes, drafts, and study materials are generated compared to regular school days. During these times, many students rely on digital resources and classroom attendance, which reduces their need for physical materials. However, the increased dependence on packaged items has led to a rise in the use of paper, plastic, stationery, and personal products.

Fig 7.11 Signages supporting green campus practices

Magis

Food waste	
Samplings days	Average waste generation
Working day	4800.00±200.00
Semi holiday	886.67±109.70
Holiday	0

Table 7.15 Food waste quantity at Magis

During weekdays at locations such as the Main Cafeteria, training halls, Main Auditorium, and even restrooms. The high volume of students dining at the cafeteria often leads to over-preparation of food, contributing to leftovers that go uneaten. Additionally, time constraints force students to grab quick meals, resulting in unconsumed portions if they are unable to finish due to busy schedules. In training halls and auditoriums, snacks provided during events may not always be fully consumed, leading to further waste. Moreover, the lack of awareness or infrastructure for food donation programs or composting exacerbates the problem, as excess food is frequently discarded rather than repurposed. The combination of these factors creates a significant amount of food waste across various campus locations during the busy workweek.

Paper waste SDV	
Samplings days	Average waste generation
Working day	636.67± 47.26
Semi holiday	129.83±14.51
Holiday	77±12.12

Table 7.16 Paper waste quantity at Magis

Paper waste is particularly prevalent in college settings during weekdays in areas such as the Main Cafeteria, training halls, Main Auditorium, and even restrooms due to several interlinked factors. One primary reason is the high volume of printing materials, such as handouts, flyers, and menus, generated for classes, events, and dining options, which often leads to excessive paper use. In the cafeteria, single-use paper products, like napkins and takeout containers, contribute significantly to waste as students eat on the go. Training sessions and events in auditoriums frequently utilise printed resources for presentations and promotional materials, further elevating paper waste. Furthermore, students' transient lifestyles may lead to the neglect of recycling practices, as the urgency of busy schedules can result in improperly discarding paper products. Collectively, these factors highlight the substantial presence of paper waste across campus facilities during the workweek.

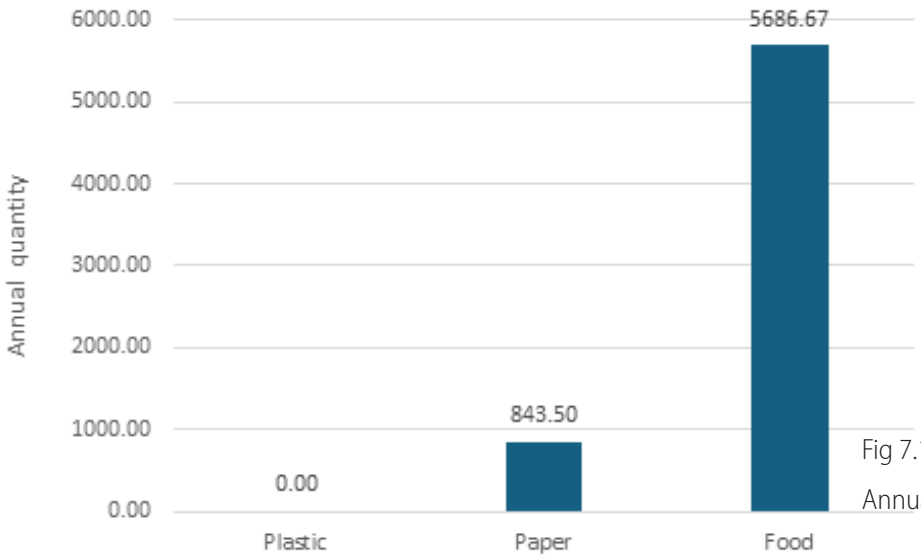

Fig 7.12
Annual waste quantity at Magis

Food waste is substantial, primarily due to the operations of the Main Cafeteria and the distribution of food and beverages during events held in the training halls and Main Auditorium. When programs are conducted, surplus food often results in waste. Additionally, paper waste is generated from worksheets and modules used for training sessions and functions in the auditorium.

Fig 7.13 Singages for responsible waste management

7.4.2 Current Waste Management Practices

Type of waste	Factors Contributing to Waste Growth	Method of treating	Waste Reduction Strategies: Current Practices and Future Implementation Plans
Paper waste	Exam office answer-sheets and other papers	Giving to scrap dealers through quotations Around 3,480 kg of paper waste is sold annually, resulting in an income of about ₹64,750.	Encourage minimising paper usage and maximising the use of virtual platforms for academic and administrative functions.
Plastic Waste	Packages from the cafeteria	Handing over to Haritha Karma Sena	Implement a sustainability protocol aimed at reducing plastic usage by transitioning from plastic utensils and dinnerware to stainless steel and ceramic alternatives.
Paper/ Sanitary pad	Negligible amount only	Incinerator Capacity of 200 per day	Preparing to enhance the incinerator's capacity to accommodate the needs of women students & staff.
Food waste	Waste from the mess halls and the cafeteria	Sent to the pig farm The document required to obtain details regarding the quantity transported to the pig farm is currently unavailable.	The practice involves appointing a designated housekeeping staff member to accurately record the quantity collected for the pig farm.
Other waste (steel, mat, infrastructure and construction waste	Construction, modification	Sold for scrap The document required to obtain details on the quantity taken by scrap dealers is not currently available.	The practice involves appointing a designated office staff member to accurately document the quantities collected from scrap dealers.
E-waste	Upgradation of systems	Given as scrap from the computer lab Sold as scrap. The details regarding the quantities acquired by scrap dealers are currently unavailable	Appointing a designated office staff member to accurately record the quantities collected from scrap dealers.
Chemical waste	Chemistry lab	Sink pit. The functioning is not evident	

Table 7.17 Waste management practices of the college

Fig 7.14 Signages for the practice of green protocol inside the campus

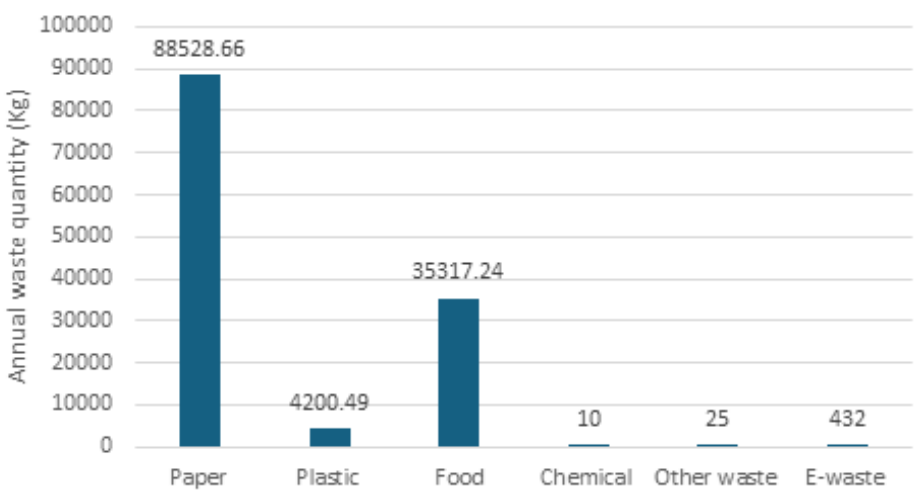

Fig 7.15 classification of waste produced each year

Paper waste constitutes the predominant type of waste generated at the college, 88528.66 Kg closely tied to both academic and administrative functions. Although the institution utilises digital platforms for examinations and various academic requirements, there remains a significant reliance on paper for exam sheets, answer scripts, evaluation forms, and question papers.

Food waste constitutes the second largest waste category at the college, totalling 35,317.24 kg with a per capita generation of 12.71 kg. This aligns with the household average of 55 kg per person per year, as reported by UNEP (2024). While this figure is both realistic and applicable for an educational institution, the college has the opportunity to harness this food waste to generate biomass energy. This alternative could effectively meet the LPG demands of the main kitchen in the hostel mess, as well as the canteen and cafeteria, rather than diverting it to a pig farm

In line with its commitment to environmental sustainability, the college strictly adheres to green protocols aimed at single-use plastics in internal events; exceptions if the numbers are less than 200 at a time. This policy has been reinforced through circulars and notices prohibiting such items. Multiple clubs and departmental programmes, including the Sustainability Advocacy Club, actively promote these initiatives. Campus decorations avoid the use of flex banners or plastic materials, and bottled water is not provided for any college-hosted events.

Regular activities refrain from using disposable items such as cups and plates. Disposables are employed only during large-scale events with external attendees or on special occasions. In such cases, paper and plastic waste are segregated at source and stored appropriately.

Scrap paper from the examination office is auctioned annually to local scrap dealers, with the contract awarded to the highest bidder following the collection of quotations. Approximately 3,480 kg of paper waste is sold each year, generating revenue of around ₹64,750.

A dedicated waste collection room facilitates the sorting of all paper and plastic waste, which is subsequently handed over to the Haritha Karma Sena for recycling. An incinerator is used to dispose of non-recyclable wet paper waste and sanitary napkins. Food waste is transported directly to a nearby pig farm.

Other waste streams, including construction debris and electronic waste (e-waste), are recorded based on information provided by college authorities, though actual quantities have not been independently verified. E-waste from across the campus is collected and handed over for recycling once a year.

Chemical waste generation is observed in limited quantities, approximately 10 kg per year. This is primarily attributable to the presence of only one complementary chemistry paper in the science stream, supported by a single chemistry laboratory. Laboratory activities are predominantly conducted during the even semester, with restricted student access for practical sessions and research. As reported by laboratory attendants and the faculty in charge, green chemistry principles are strictly adhered to, including the use of water as a green solvent, micro-scale experiments to minimise reagent quantities, and meticulous record-keeping in a dedicated register. Grey water from washing is directed to a soak pit, while used glassware is collected by authorised scrap dealers for appropriate disposal or recycling.

To further reduce its environmental footprint, the college has initiated measures to minimise paper usage through paperless communication and enhanced digital education systems. Additionally, it is exploring the feasibility of installing a biogas plant or compost pit to replace the current practice of transporting organic waste to the pig farm, thereby converting plant and garden waste into biogas fuel and organic manure.

Paper Waste Management: The college generates approximately 88,528.66 kg of paper waste annually, making it the most significant waste stream. Although the institution prioritises digital communication, examinations, assignments, and certain academic requirements necessitate substantial paper usage. Currently, only documented waste is disposed of through a formal tender process, awarded to the agency offering the highest bid. However, other paper waste, such

as question papers, answer sheets, and assignments, is either taken by students or left on campus. The remaining waste is managed independently by individual departments without centralised records or traceability regarding its final disposal. This fragmented approach highlights the urgent need for a structured, college-wide system to effectively manage and track paper waste disposal.

Food Waste Management: Food waste constitutes the second-largest waste category at the college, totalling 35,317.24 kg annually. As a large institution specialising in management studies and serving a substantial community, the college maintains a standardised menu to offer diverse meal options. All meals are freshly prepared in the on-campus canteen and served directly (primarily as live, buffet-style or plated food rather than pre-packed portions) before being distributed across college facilities. The extended operating hours of MBA classes running from morning to noon, with other shifts extending into the evening and night, necessitate multiple meal services provided entirely on campus. These factors, combined with observed instances of significant plate leftovers when students depart, contribute substantially to the generation of food waste.

Other Waste Management: The assessment was unable to accurately determine the quantity of other waste generated, as the amount of other waste transferred to scrap dealers is not formally documented, making it difficult to reliably estimate annual generation rates.

E-Waste Management: The assessment encountered significant challenges in accurately determining the total quantity of e-waste (and associated "other waste") generated annually. This difficulty stems primarily from the absence of formal documentation for the majority of e-waste transferred to scrap dealers and informal channels, a common issue in many e-waste management systems where undocumented flows predominate. 258 kg of e-waste was sold to a nearby school (name of one school specified in the records, St Mary's School, Marykulam); however, the institution's subsequent handling, reuse, refurbishment, or disposal practices for these gadgets remain unknown, and 174 kg of e-waste was handed over to MSH e-waste collection services. Due to the reliance on informal and undocumented pathways for the bulk of e-waste disposal, a comprehensive and reliable estimation of annual generation rates could not be established. This highlights the broader need for improved formal tracking, documentation, and integration of informal sectors to enable more accurate monitoring and effective management of e-waste streams.

Chemical waste: According to the feedback from faculty members and the lab in charge, only a minimal amount of chemical waste is generated. This is primarily because the laboratory facilities are utilised solely for complementary courses, which are conducted exclusively during the even semesters.

7.5 CONCLUSION

- The results clearly indicate that the generation of paper waste is significantly high. It is essential to take measures to reduce paper usage, as food waste is the second-largest contributor. Rather than supplying this waste to a pig farm, it would be more beneficial to utilise a biogas plant for energy generation and to create organic manure for use in vegetation or gardening.
- The college has a dedicated segregation room for collecting paper waste from the examination cell. Only records that are accurately documented regarding the quantity and monetary value received from the sale of the paper waste collected from the examination cell. Implementing proper record-keeping for annual waste in categorised segments will enhance sustainability and improve effective management. This approach will allow for the identification of trends in waste generation, enabling the development of strategies to mitigate the increasing volume of waste.

7.6 RECOMMENDATION

- Go Digital to Reduce Paper Waste: Shift to paperless systems for communication, assignments, exams, and records. Use digital platforms for submissions, newsletters, and announcements, which can bring a steady decline in paper waste
- To enhance waste segregation and supporting infrastructure, the institution should install clearly labeled, color-coded bins designated for

recyclables, compostables, and non-recyclable landfill waste in high-traffic areas, such as dining halls, classrooms, and common quads. Standardised signage, educational prompts, and strategically convenient placement of bins should be prioritized to minimize contamination and encourage proper sorting behavior. Additionally, for large-scale events including sports games, move-in/move-out periods, and similar gatherings temporary multi-stream sorting stations and dedicated donation points for reusable items should be established to maximize resource recovery. These infrastructure investments may be funded either through direct procurement by institutional management or by leveraging Corporate Social Responsibility (CSR) initiatives from external partners and agencies.

- Create reuse initiatives: Thrift stores, surplus property exchanges, or move-out donation. Handle e-waste and hazardous materials through annual collections and certified recyclers.
- Implement a systematic tracking system to meticulously document the types and quantities of waste generated, including plastic, paper, food waste (such as that collected by pig farms), electronic waste, and greywater. Assign responsibility for maintaining these records to designated management staff, supported by housekeeping personnel, ensuring all disposals to external agencies are accurately logged. Additionally, explore and adopt enhanced treatment methods for greywater, such as advanced soak pit facilities or equivalent sustainable solutions, to optimize environmental impact. Where applicable, record any monetary benefits derived from selling recyclable materials, enabling the analysis of annual trends in waste generation, identification of root causes, and formulation of targeted reduction strategies to promote long-term sustainability and resource efficiency.
- Foster Education, Engagement, and Culture: Form student-led "green teams" or clubs (e.g., Sustainability Advocacy Clubs) to run campaigns, audits, and events. Integrate waste education into curricula and host workshops, competitions (e.g., Campus Race to Zero Waste), or rewards for participation. Communicate successes via social media, dashboards, or reports to build pride and participation.
- Explore Innovative and Circular Approaches: Adopt a "zero-waste" mindset in collaboration with the energy management and physics department to prioritise reduce/reuse over recycling. Use technology like bin sensors or apps for efficient collection routes. Pursue certifications (e.g., LEED) or join networks for shared best practices.

7.7 WASTE MANAGEMENT PLAN

7.7.1 Introduction

Marian College Kuttikkanam (Autonomous) will strengthen its commitment to responsible waste management by adopting systematic, sustainable, and transparent practices that minimise pollution, conserve resources, and protect environmental health. In alignment with the Marian Waste Management Policy, national regulations, and global sustainability frameworks, the College will work towards creating a clean, safe, and zero-waste campus. Through planned actions involving reduction, segregation, recycling, innovation, and community partnership, Marian will develop a culture of waste consciousness and environmental responsibility.

7.7.2 Establish an Adept Waste Management Team

The College established the Waste Management Committee (WMC) as the primary governing body tasked with the planning, implementation, and evaluation of all waste management activities on campus. The WMC will comprise administrators, faculty coordinators, student representatives, facility supervisors, and housekeeping staff. Its responsibilities will include overseeing waste segregation, collection, transportation, documentation, and disposal processes. The committee will also conduct regular waste audits and maintain the Waste Register and Audit Checklists. Additionally, it will collaborate with authorised external agencies, including Haritha Karma Sena, local panchayats, and waste contractors. The WMC will convene regularly to assess progress, address

challenges, and propose enhancements.

7.7.3 Formulate a Comprehensive Strategy for Sustainable Waste Management

The Waste Management Committee (WMC) will formulate a comprehensive strategy to enhance waste management practices across the campus. This strategy will emphasise the principles of reduction, reuse, and recycling. It will ensure effective segregation at the source within academic, administrative, residential, and food service areas while promoting eco-friendly consumption patterns to reduce waste generation. Implement sustainable disposal systems for various waste streams, including biodegradable, recyclable, hazardous, and electronic waste. Infrastructure improvements will include the installation of colour-coded bins, composting units, dedicated segregation rooms, and clear signage. Moreover, we will establish thorough documentation processes for all waste management activities and conduct regular audits to monitor the quantity of waste generated and the mechanisms used for waste treatment. All operations will be aligned with the Solid Waste Management Rules (2016), the Plastic Waste Management Rules (2018), and the E-Waste Rules (2022). To further enhance our initiatives, we will integrate academic research into our strategy and foster collaborations with external agencies to strengthen engagement in waste management efforts.

7.7.4 Implement Effective Methods to Attain Set Objectives

To achieve its policy objectives, Marian College will implement a structured set of operational measures:

7.7.4 .1 Waste Reduction & Resource Efficiency

- Minimise single-use items and promote reusable and recyclable materials.
- Prioritise eco-friendly procurement across all departments and events.

7.7.4.2 Segregation & Infrastructure Management

- Install colour-coded segregation bins in classrooms, hostels, office rooms, staff rooms, canteen, and high-traffic areas.
- Maintain a dedicated waste segregation room with instructions, ventilation, and safety guidelines.
- Ensure that waste is moved out of the segregation room twice weekly or as required.

7.7.4 .3 Biodegradable Waste Management

- Collect all food and organic waste separately.
- Use campus composting and redirect food waste to the pig farm in Amalagiri.
- Maintain daily records of biodegradable waste handled.

7.7.4 .4 Recyclable & Non-Biodegradable Waste Management

- Hand over segregated plastic, paper, and recyclable materials weekly to the Haritha Karma Sena, ensuring full documentation in the Waste Quantity Register.

7.7.4 .5 Hazardous & E-Waste Management

- Safely collect and store hazardous waste (chemicals, lab waste) following safety norms.
- Maintain e-waste temporarily and transfer it to authorised recyclers annually.

7.7.4 .6 Awareness & Engagement

- Conduct "Zero Waste" campaigns, student-led clean-up drives, and departmental competitions.
- Display signage promoting responsible waste practices campus-wide.
- Include training for faculty, students, housekeeping, and vendors.

7.7.5 Establish Robust Communication Channels and a Governing Body

The Waste Management Committee (WMC) will establish communication mechanisms to facilitate the effective implementation of the waste management plan. This will include the distribution of circulars and guidelines on waste segregation, disposal methods, and updates on policies via notice mail and digital signage. Coordination with various departments will be conducted through appointed Green Coordinators to ensure consistent

communication. The WMC will also engage in regular interactions with external partners such as Haritha Karma Sena, Suchitwa Mission, and local panchayats. Updates regarding the waste management initiatives will be consistently shared on the college website, notice boards, and during official meetings to promote transparency. Additionally, we will implement a system for custodial staff, students, and faculty to report issues, enabling prompt corrective action.

7.7.6 Objectives

7.7.6.1 Long-Term

- To transform the campus into a zero-waste, resource-efficient institution.
- To institutionalise segregation, recycling, and compliant disposal practices.
- To foster strong environmental ethics and behavioural change among all stakeholders.
- To strengthen community collaborations for sustainable waste systems.
- To align campus operations with national sustainability frameworks and global SDGs.
- To develop continuous innovation and research-based solutions in waste management.

7.7.6.2 Short-Term

- To streamline segregation and improve the functioning of the waste segregation room.
- To implement effective collection and transfer mechanisms through the housekeeping and maintenance teams.
- To strengthen partnerships with the Haritha Karma Sena for regular and responsible waste offloading.
- To conduct campus-wide awareness programmes and student-led clean-up activities.
- To ensure accurate and updated maintenance of Waste Registers and disposal records.
- To implement regular internal audits and prepare for an annual external audit.

7.7.7 Continuously Monitor and Enhance the System

The Waste Management Committee (WMC) will implement a comprehensive monitoring system to oversee the waste management process. This will include conducting internal audits each semester to assess waste generation, segregation efficiency, and adherence to compliance standards. To ensure performance validation and alignment with regulatory requirements, the WMC will also coordinate annual external audits with authorised agencies. The committee will maintain meticulous records, including waste registers, stock inventories, audit checklists, and disposal documentation. It will systematically track the quantities of biodegradable, recyclable, hazardous, and electronic waste. Additionally, the WMC will publish an Annual Marian Waste Impact Report that encapsulates achievements, challenges, and strategies for improvement. This report will be presented to the Internal Quality Assurance Cell (IQAC) and will facilitate discussions among IQAC members and management to assess progress and identify necessary adjustments. Processes will be updated based on the findings from audits, stakeholder feedback, and emerging sustainability trends.

7.7.8 Conclude and Conduct Follow-ups on the System

At the end of each audit cycle, the Waste Management Committee (WMC) will formulate actionable follow-up plans to address any identified gaps. Departments and units will receive targeted instructions along with specific timelines for improvement. Review meetings will be held to monitor implementation progress, involving internal auditors to evaluate performance and ensure transparent decision-making among committee members. Moreover, training sessions will be organised for both staff and students to address recurring issues effectively. Processes will be revisited and revised as necessary to enhance sustainability and improve operational efficiency.

Conclusion

Marian College Kuttikkanam (Autonomous) will

implement this Waste Management Plan with a strong focus on environmental responsibility, operational efficiency, and community partnership. By integrating waste reduction into institutional processes, promoting behavioural change, fostering research and innovation, and maintaining transparent documentation, the College will work towards becoming a model of sustainable waste management. With the support of the WMC, MCSD, Haritha Karma Sena, students, faculty, and local community partners, Marian will evolve into a zero-waste, environmentally conscious campus committed to continual improvement and sustainability excellence.

7.8 ACTIVITIES CONDUCTED

Paper Recycling training: The second-year Integrated MSc Physics students at Marian College Kuttikkanam, (Autonomous) organized a session on paper recycling for the first-year Integrated MSc Physics, students. The session included a comprehensive demonstration of the paper recycling process and a discussion on its environmental benefits. Emphasis was placed on how recycling helps reduce waste, conserve natural resources, and mitigate pollution. The primary objective of the session was to instil a sense of environmental responsibility among students and promote awareness about sustainable practices. The focus was on the importance of recycling waste paper and its far-reaching impacts on the environment, economy, and society. By engaging the students, the session aimed to encourage a

A waste bin planting initiative was organized on 09 September 2024 at Kuttikkanam Town as part of the Eco Semester Activity by III B.Com A, in collaboration with the Peermade Panchayath. The programme aimed to reduce land littering in public spaces, create awareness about sustainability, promote proper waste disposal and segregation practices, involve the local community in cleanliness drives, and strengthen collaboration between students, local authorities, and residents.

The programme was inaugurated by Shri K. Dinesan, President of Peermade Panchayath, who addressed the gathering and emphasised the importance of sustainable waste management and collective responsibility in maintaining a clean environment. Student coordinators actively led the initiative and facilitated community participation.

The initiative resulted in visibly cleaner public spaces in Kuttikkanam Town and encouraged active involvement from shopkeepers, college students, and local residents in maintaining the waste bins. It also enhanced public awareness of sustainable waste management practices and demonstrated the effectiveness of student–community collaboration. Overall, the programme contributed meaningfully to environmental conservation while fostering a sense of civic responsibility among students and the local community.


GPS Map Camera
Kuttikkanam, Kerala, India
HXMC+274, Peermade, Kuttikkanam, Kerala 685531, India
Lat 9.58249°
Long 76.870774°
09/09/24 09:35 AM GMT +05:30


GPS Map Camera
Kuttikkanam, Kerala, India
HXMC+274, Peermade, Kuttikkanam, Kerala 685531, India
Lat 9.58249°
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09/09/24 09:35 AM GMT +05:30


GPS Map Camera
Kuttikkanam, Kerala, India


MINERVA
TEA & SPICES
GPS Map Camera
Kuttikkanam, Kerala, India

Chapter VIII

OCCUPATIONAL HEALTH & SAFETY MANAGEMENT SYSTEM (OHS) : AUDIT REPORT

OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT SYSTEM COMMITTEE (2025)

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8

Occupational Health & Safety Management System Audit Report

8.1 INTRODUCTION

A comprehensive assessment of Occupational Health and Safety (OHS) practices was conducted at Marian College in Kuttikkanam to evaluate the institution's compliance with established safety standards and identify potential hazards within the campus environment. This audit, carried out in accordance with ISO 45001 guidelines, focused on reviewing infrastructure, emergency preparedness, chemical management, waste disposal, and the overall safety awareness among staff and students. The findings, observations, and recommendations presented in this report are aimed at enhancing the safety and health of all individuals on campus.

ISO 45001 serves as the international standard for Occupational Health and Safety (OH&S) management systems, emphasizing risk prevention, promoting innovation, and fostering continuous improvement. It provides organizations with a framework to enhance resilience and operational efficiency. Attaining this global standard not only improves an organization's capability to manage OH&S effectively but also fosters higher levels of engagement among students, faculty, and staff by visibly committing to sustainable practices that ensure a safe and healthy environment.

Additionally, health and safety audits enable institutions to evaluate the effectiveness of their internal safety protocols, offering a comprehensive understanding of internal controls. These audits facilitate early risk detection, allowing organizations to implement corrective measures swiftly to mitigate hazards, thereby reducing the likelihood of accidents and unexpected incidents. This proactive strategy diminishes potential disruptions, enhances stakeholder motivation, and bolsters the institution's reputation, while safeguarding it against negative publicity that could affect its operations or partnerships.

Aligning an organization's occupational health and safety management systems with strategic objectives through ISO 45001 improves overall performance in this area and demonstrates a strong commitment to employee welfare for customers, investors, and stakeholders alike. The standard's relevance is further underscored by its connection to the United Nations Sustainable Development Goals (SDGs). By implementing ISO 45001,

organisations can showcase their leadership in sustainable development and their steadfast dedication to protecting and valuing their workforce.

8.1.1 What is a Health and Safety Audit?

A health and safety audit entails evaluating an organisation's systems, procedures, and policies concerning the health and safety of both students and staff to ensure compliance with applicable regulations. The audit aims to identify potential health and safety hazards, assess the effectiveness of internal risk management controls, and verify conformity with regulatory standards.

8.1.2 Need for an Occupational Health and Safety Audit

Identifying deficiencies and weaknesses in an organization's safety protocols, evaluating compliance with regulatory requirements, and recommending improvements to safeguard employee health and safety. Additionally, ensuring that machinery, equipment, and facilities meet safety standards through thorough inspections.

8.2 OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT SYSTEM POLICY

Statement of Commitment

Marian College Kuttikkanam (Autonomous) is committed to providing a safe, healthy, and supportive environment for all students, faculty, staff, contractors, and visitors. The College recognizes that promoting occupational health and safety (OHS) is an essential part of sustainable campus management and institutional excellence. This policy outlines Marian's dedication to ensuring physical safety, mental well-being, and overall health through proactive risk management, preventive care, and continuous improvement in safety standards and practices.

Goals

The goal of the Marian Occupational Health & Safety Policy is to cultivate a safe, healthy, and resilient campus environment where all members of the Marian community can learn, work, and engage without risk. Through proactive risk prevention, strong institutional governance, and continuous improvement, the College aims to integrate health, safety, and well-being into every aspect of campus life—ensuring that physical safety, mental wellness, and environmental responsibility remain central to its academic and operational culture.

Objectives

1. Provide a safe and healthy environment for all stakeholders, minimizing risks associated with college activities.
2. Prevent injury, illness, and hazards arising from college operations.
3. Ensure compliance with all applicable occupational health, safety, and environmental legislation and standards.
4. Promote awareness, training, and capacity building to foster a safety-first culture.
5. Integrate health and safety considerations into decision-making, infrastructure design, and academic planning.
6. Continuously monitor, review, and improve health and safety performance.

Responsibility

College Management

The institution places the highest priority on the health, safety, and well-being of all members of the Marian community. To uphold this commitment, the College Management shall:

Ensure Resource Allocation and Capacity Building: Provide adequate resources for Occupational Health and Safety (OHS) initiatives, including structured training programmes such as CPR, fire safety, hygiene, and sanitation facilities, as well as first aid for students, faculty, and staff. Periodic drills and demonstrations shall be conducted in accordance with established protocols. Official safety announcements will be issued by the principal through authorised channels, including WhatsApp groups and departmental communication systems, and relayed to all concerned teachers and class groups.

Maintain Institutional Compliance: Ensure full adherence to all relevant health and safety laws, standards, and internal audit recommendations. Under audit supervision,

the College will support ongoing safety training, fire drills, and first-aid sessions. In addition, wellness initiatives such as meditation and yoga sessions led by the Yoga Club, staff tours, and student field trips will be organised to promote mental health and overall well-being. The Women's Cell will organize awareness programs and interactive activities aimed at promoting a healthy campus culture by addressing critical issues such as anti-ragging, substance abuse, harassment, and sexual violence. Accessibility for individuals with disabilities shall be ensured through well-maintained ramps, handrails, and clear signage. Measures to comply with pollution-related regulations, including noise pollution control, will be implemented through monitoring systems, designated silent zones, restrictions, and awareness campaigns.

Review and Continuous Improvement: Regularly review, update, and refine safety policies and procedures to align with evolving standards and campus needs. Significant updates will be communicated promptly through designated communication groups. Issues that cannot be resolved at the initial level will be escalated to the Principal for immediate action.

Safe Infrastructure and Mobility: Ensure that the campus remains accessible, inclusive, and free from hazards. Clearly marked pedestrian pathways, designated vehicle zones, and visible safety signage shall be maintained to facilitate safe movement across campus.

Employees (Staff and Faculty)

All staff and faculty members share collective responsibility in fostering a safe, healthy, and supportive campus environment. In alignment with Marian College's OHS framework, employees shall:

Adhere to Established Safety Protocols: Follow all institutional safety guidelines, standard operating procedures, and emergency protocols. Actively participate in mandatory training programmes including fire safety, first aid, evacuation drills, and mental health awareness sessions to maintain readiness and ensure personal and collective safety.

Identify and Report Hazards Promptly: Remain vigilant in recognizing potential hazards, unsafe conditions, equipment malfunctions, or behavioural risks within classrooms, laboratories, offices, and common spaces. All such concerns must be reported immediately to the Safety Officer, Department Head, or designated authority to ensure timely corrective action. Faculty and staff must also cooperate during investigations of safety-related incidents.

Promote a Safe and Supportive Learning Environment: Model responsible behaviour by consistently following safety procedures and encouraging students to do the same. Ensure that classrooms, laboratories, and workspaces remain orderly, hazard-free, and accessible to all learners, including persons with disabilities. Faculty shall integrate safety awareness where relevant into teaching practices, and staff shall support a culture of preparedness, respect, and well-being across campus.

Support Compliance and Continuous Improvement: Contribute to the regular review of safety practices by providing feedback, sharing observations, and recommending improvements. Staff and faculty must participate in periodic safety audits, drills, and awareness programmes organised by committees such as the Internal Quality Assurance Cell (IQAC), Women's Cell, and Yoga Club.

Students

Students are key stakeholders in maintaining a safe, healthy, and inclusive learning environment at Marian College. They are expected to take responsibility for their own safety as well as the well-being of their peers by adhering to the following:

Adherence to Safety Rules: Follow all safety instructions and guidelines issued by faculty, staff, and the institution, especially during classes, laboratory sessions, field visits, sports activities, and other campus events. Students must use safety equipment properly, respect restricted areas, and maintain discipline in all academic and co-curricular settings.

Active Participation in Drills and Training: Attend and participate sincerely in all safety drills, demonstrations, and awareness programmes—including fire drills, first aid training, mental health awareness sessions, and evacuation exercises. Such participation is essential for building preparedness and fostering a culture of safety on campus.

Prompt Reporting of Hazards or Incidents: Immediately report any hazards, unsafe practices, damaged equipment, harassment, or suspicious activities to the concerned

faculty member, Safety Officer, department representative, or college authorities. Students should not ignore or attempt to manage unsafe situations on their own and must cooperate during any safety-related inquiries or corrective measures.

Respect for Campus Infrastructure and Community Well-Being: Use campus facilities responsibly, avoid activities that may cause injury or property damage, and support peers in creating a clean, inclusive, and hazard-free environment. Students are encouraged to uphold campus values such as mutual respect, environmental consciousness, and responsible behaviour.

Visitors and Contractors

Visitors, vendors, and external contractors are expected to respect and follow the safety standards of Marian College while accessing any part of the campus. Their cooperation is essential to maintaining a secure and hazard-free environment for the entire Marian community.

Compliance with Institutional Safety Requirements: All visitors and contractors must follow the college's safety rules, including wearing appropriate identification badges, adhering to entry and exit protocols, and following instructions issued by security personnel or the designated staff in charge. Contractors must also ensure that their work practices comply with safety norms related to equipment use, material handling, and waste disposal.

Prompt Reporting of Hazards or Safety Concerns: Any potential hazards, unsafe conditions, damaged infrastructure, or incidents observed on campus must be immediately reported to the Security Office, Administrative Office, or any designated safety officer. Contractors must also alert college authorities before beginning any task that may pose risks to students, staff, or property.

Responsible Behaviour and Respect for Campus Norms: Visitors and contractors are expected to conduct themselves responsibly, avoid restricted areas unless authorised, and ensure that their actions do not disrupt academic activities or compromise safety. Contractors must ensure that noise, dust, or other disturbances are minimised and follow all instructions given by supervisors or college officials.

Parents

Code of conduct: Parents are expected to support the college's safety measures by encouraging their wards to follow all health and safety rules. They should promptly report any health, safety, or well-being concerns to the appropriate authorities and cooperate with the institution's initiatives that promote a safe and supportive campus environment.

Risk Management

Safety Inspections and Risk Assessment: A dedicated Risk Assessment Team is formed to evaluate these risks and recommend corrective measures. They conduct regular inspections of laboratories, kitchens, workshops, and other high-risk areas to identify potential hazards. The college office maintains an updated risk register documenting identified hazards and actions taken to mitigate them. This structured approach ensures proactive management of safety concerns across the campus.

Indoor Environment and Workspace Safety: The College ensures that all classrooms, offices, laboratories, and workspaces maintain adequate lighting, ventilation, cleanliness, and ergonomic standards. Floors, corridors, and common areas are monitored to prevent slips, particularly during the rainy season. Noise reduction and sound-proofing measures are implemented in designated zones to promote a safe and conducive learning environment. Seasonal maintenance of buildings and infrastructure is carried out to address weather-related risks.:

Personal Protective Equipment (PPE) and First Aid: Wherever required, the use of PPE is strictly enforced, particularly in laboratories, workshops, and technical zones. All departments are equipped with first-aid facilities and trained personnel to provide immediate assistance during emergencies. Safety signage and instructions are displayed prominently to guide students, staff, and visitors in using protective equipment correctly and accessing medical support when needed.

Building and Structural Safety: Regular checks are conducted on doors, glass panels, staircases, balconies, and other structural elements to ensure physical safety. Measures such as fall prevention systems, handrails, and clearly marked safety signboards are implemented throughout the campus to minimize the risk of accidents.

Emergency Preparedness and Response: The College carries out periodic, unannounced fire and emergency evacuation drills to ensure readiness for real-life incidents. Functional emergency communication systems are maintained to provide timely alerts during crises. Clear emergency evacuation procedures and assembly points are displayed across campus buildings to facilitate safe and organized evacuations.

Awareness and Education

Health and Safety Training

1. Provide orientation and training on OHS protocols to all staff and students.
2. Organize workshops on stress management, mindfulness, self-defence, and first aid.
3. Conduct CPR and fire safety training annually.

Disaster Management Programs

1. Educate the campus community on disaster response and emergency resilience.
2. Conduct mock drills for earthquake, fire, and medical emergencies.

Emergency Procedures

The College maintains an updated Emergency Response Plan covering potential scenarios such as fire, medical emergencies, earthquakes, floods, or other disasters. All staff, students, and visitors are trained to follow clear evacuation protocols, with assembly points and exit routes prominently marked throughout campus buildings. Regular mock drills will be conducted to ensure preparedness, including unannounced exercises to test real-time responsiveness. Emergency equipment such as fire extinguishers, alarms, first-aid kits, and communication systems are strategically placed and maintained to facilitate immediate action during crises.

Accident and Incident Reporting

Marian College promotes a culture of safety through the prompt reporting and documentation of all accidents, near-misses, and unsafe conditions. All incidents, regardless of severity, must be reported immediately to the designated Security Officer, department head, or administrative authority. Detailed incident reports will be maintained, including the nature of the event, affected individuals, root causes, and corrective actions taken. The College analyses these reports to identify patterns, prevent recurrence, and implement preventive measures. Follow-up actions may include training, infrastructure modifications, policy updates, or disciplinary measures, ensuring continuous improvement in campus safety and risk management.

Health and Well-being

Marian College is committed to the holistic health and well-being of its campus community through a comprehensive Health and Wellness Program that integrates physical fitness, medical support, mental health services, and recreational activities.

1. First-Aid Preparedness: All departments are equipped with first-aid kits and trained personnel to provide immediate medical assistance in case of emergencies.
2. Preventive Health Measures: The College conducts periodic health check-ups, vaccination drives, and medical camps, organized by the NSS and various academic departments, to promote preventive care.
3. Counselling and Psychological Support: Licensed psychiatrists and counsellors provide mental health services, including individual sessions and wellness guidance for students, faculty, and staff.
4. Physical Fitness and Recreation: Mental and physical wellness is encouraged through gym facilities, yoga and meditation programs, sports activities, and other recreational initiatives.
5. Stress-Relief Initiatives: The College organizes staff tours and wellness activities to reduce stress, foster relaxation, and enhance overall well-being.

Monitoring and Review

The College conducts annual audits and safety inspections across all departments and facilities to assess the effectiveness of OHS policies, protocols, and preventive measures. Feedback is actively collected from students, faculty, staff, and other stakeholders to identify areas for improvement and inform decision-making.

An annual OHS report will be prepared to summarize key initiatives, incidents, training programs, and performance metrics, ensuring transparency and accountability. The

College undertakes a comprehensive policy review every three years, or sooner if mandated by new legislation, emerging risks, or institutional requirements, to ensure that the OHS framework remains aligned with best practices, legal standards, and the evolving needs of the Marian community.

Communication

Ensure effective communication of the Occupational Health and Safety (OHS) policy, updates, risk alerts, and notifications regarding construction or maintenance areas. This can be accomplished through the use of notice boards, induction materials, the college website, and workshops.

Foster an open dialogue among staff, students, and administration to address safety concerns effectively. This can be achieved through regular meetings and presentations of risk assessment evaluation reports.

Compliance and Review

Marian College shall ensure full compliance with all local, state, and national occupational health and safety laws, including standards prescribed by the International Labour Organisation (ILO) and other relevant authorities. The OHS policy will be periodically reviewed to incorporate changes in legislation, emerging technologies, and evolving institutional requirements. A designated Safety Committee or appropriate authority shall be responsible for monitoring compliance, addressing safety concerns, and guiding the implementation of corrective measures.

Conclusion

Marian College remains steadfast in its commitment to providing a safe, healthy, and supportive environment for all members of its community. Through proactive risk management, comprehensive health and wellness initiatives, continuous monitoring, and adherence to legal and institutional standards, the College seeks to foster a culture of safety, well-being, and preparedness. By integrating occupational health and safety into every aspect of campus life from infrastructure and training to emergency preparedness and stakeholder engagement Marian College ensures that physical safety, mental wellness, and environmental responsibility remain central to its mission of academic and institutional excellence.

8.3 METHODOLOGY

The OHS Management Committee acts as the internal audit team and is made up of forty three members, including three faculty members and forty student representatives. A thorough register and documentation system has been implemented to enable regular assessment and monitoring of safety practices for staff, students, and visitors to the campus. This system comprises two registers and four key documents. It functions by the institution's OHS policy, which outlines specific goals, action plans, and strategies for safety management. The committee convenes regularly to review progress and verify the effectiveness of these safety initiatives.

8.3.1 Internal Audit Training

Green audit training fosters institutional commitment and involvement through extensive, collaborative methods. In preparation for this, the college's Environmental Management System (EMS) identifies students and faculty members to participate in a one-day internal audit program. This program certifies them as internal auditors capable of performing an Occupational Health and Safety audit, which includes evaluating, analysing risks, collecting data, developing policies, and documenting water conservation initiatives and records.

8.3.2 List of register and document to monitor OHS

A review was conducted to evaluate the organisation's Occupational Health and Safety (OHS) framework, covering policies, procedures, and records of compliance. This evaluation involved examining: (1) safety protocols, (2) methods of communication, (3) plans for emergency response, and (4) reports of incidents. Various potential hazards were pinpointed across different campus locations, specifically: practices for storing chemicals in laboratories, physical dangers in workshops/laboratories and general activity spaces; issues related to food safety, sanitation, and hygiene; management of vehicle traffic and pedestrian movement on and around the campus; and ergonomic issues in campus settings.

8.3.3 Respondent's comments and observation

The Internal Audit team performed thorough examinations of campus facilities to evaluate safety practices, maintenance status, and adherence to safety

regulations. At the same time, the team interacted with staff, faculty, and students to collect their insights on health and safety experiences and perceptions. The audit also involved an in-depth analysis of current risk control measures, assessing their effectiveness in addressing identified hazards, as well as an evaluation of the documentation concerning health and safety training procedures for both staff and students.

8.3.4 Campus Noise & Tree Mitigation Study

The assessment measures fluctuations in noise levels across the college campus employing a systematic sampling approach. Sound levels were recorded at ten chosen sites, which included noisy zones near roadways and spaces next to prominent trees, utilizing a portable digital sound level meter. The data is captured in Decibels (dB). Noise levels will be recorded in sets of three (covering minimum and maximum readings) during the morning, midday, and evening. The main goal is to pinpoint areas with high noise levels on campus and analyse the findings to determine the effectiveness of trees in reducing noise.

8.3.5 External Audit

An external auditor assesses compliance with Occupational Health and Safety management standards. If only minor discrepancies are identified, the organization may receive approval for ISO certification.

8.3.6 Assumption

Implementing robust occupational health and safety (OHS) protocols is essential for the enduring success and reputation of educational institutions. The physical and mental well-being of both staff and students is intricately linked to the institution's performance, both presently and in the long term. Adopting a structured OHS management system, particularly one certified to the ISO 45001 standard, provides a framework for fostering safe, engaging, and efficient environments.

Such systems are designed to mitigate risks, aiming to prevent injuries and health complications among all personnel and students. This commitment yields numerous advantages: a clearly defined safe learning environment, assurance of compliance with local and national regulations as well as sector-specific standards, reduced institutional liability and legal risks, enhanced operational efficiency, and an improved public image as a responsible and sustainable organisation.

Conducting comprehensive OHS audits allows for the systematic identification and rectification of critical areas needing improvement—such as laboratory and classroom safety, ergonomic hazards, management of chemical and biological risks, fire safety, emergency preparedness, and prevention of slips and falls. This approach promotes a pervasive safety culture that positively impacts employee morale, job satisfaction, and attendance rates. Measurable outcomes often include a reduction in compensation claims from staff and students, increased community trust, improved talent retention, and heightened productivity.

Achieving these results requires the active involvement of all stakeholders: the administration leads the development and enforcement of policies; faculty and staff ensure adherence to safety procedures and report potential hazards; and students follow established safety protocols. Continuous improvement is driven by assessing OHS performance, conducting regular risk assessments, identifying various hazards, implementing controls (including equipment and training), providing initial OHS orientations, offering ongoing education (with specialised training as needed), and maintaining well-practised emergency response plans. Ultimately, prioritising OHS is vital for safeguarding individuals, fulfilling regulatory requirements, and fostering a successful, reputable educational institution.

8.3.7 Stages of Occupational Health and Safety Management Audit

An occupational health and safety management audit has three phases: Pre-audit, audit, and post-audit.

8.3.7.1. Pre-audit phase

- Formation of audit team; scheduling audit programmes
- Setting up of scope and objectives (in tune with the occupational health and safety management policy of the institution)
- Discussed with the responsible personnel of each location (staff, teachers, lab assistants, sweepers,

watchmen, students, etc.) about the waste generation pattern and provisions of their management.

- Documentation of all existing materials and provisions for health and safety measures inside the campus.

8.3.7.2. Audit phase

Auditors collect all data 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 to the environmental policy and OHS management policy of the college/university
- Review of present emergency health and safety management systems and enhancement suggestions

8.3.7.3. Post audit phase

- The plan of action for the post-audit phase implementation and follow-up. All possible suggestions for the improvement of OHS in the respective institution.
- OHS committee will ensure that the Occupational Health and Safety Management System is functional at the 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.

8.3.8 Steps of Occupational Health & Management Audit

8.3.8.1. Site assessment

Collection of contour maps and campus diagrams, For ensuring safety infrastructure and alternative methods applied during the renovation of the campus.

Walk-through survey; Identification of risks and their nature, category, etc., recording existing practices and provisions regarding the OH & S system in the college.

8.3.8.2. Data analysis

- Analysis of current and past performance (pre audit and post audit performances, previous audit data, etc.)

8.3.8.3. Final audit by external audit team

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

8.3.9 Work plan and schedule of Occupational Health and Safety Audit

Date to Date	Weekly Work Plan
08/06/2025 to 15/06/2025	All team members are encouraged to consult the manual to aid in developing the action plan. A map of the college campus has been obtained. The campus is divided into four sections, with each group tasked with surveying one particular section. The internal audit team is organised into three groups. Each group will collaborate with the housekeeping staff from their designated sections to gather information on existing waste management practices. Data sheets have been handed out, and each group is set to begin data collection next week.
16/06/2025 to 25/06/2025	Determine the main sources of waste, such as the cafeteria, classrooms, hostels, and offices. Each group is responsible for understanding the existing waste management practices in their assigned areas. Develop a policy and action plan, and hold internal audit meetings with minutes to report on the discussions.
26/06/2025 to 25/07/2025	Prepare the policy and plan for the occupational Health and Safety of the college
30/07/2025 to 30/08/2025	Recognize the primary sources of waste (such as the cafeteria, classrooms, hostels, and offices). Each group is requested to familiarize themselves with the existing waste management procedures in their designated area and identify any risks and hazardous conditions The verification of the report issued by the external auditor

Table 8.1 Schedule of the occupational health and safety management

Activities	Frequency	Dates of study	Mode of data collection
Sound recording data	9 days; three times a day	Working day 01/08/2025, 08/08/2025, 15/08/2025	Entry in the given format

Table 8.2 Work plan for the audit of the occupational Health and safety management

8.4 RESULT AND DISCUSSION

Ensuring campus safety is an essential legal obligation for academic institutions, governed by Occupational Health and Safety (OHS) regulations. Non-compliance can result in severe repercussions, including lawsuits and damage to reputation. Conversely, adherence to OHS guidelines not only provides legal protection but also fosters essential trust within the community. This commitment is paramount in protecting students, particularly minors, from potential harm by ensuring well-maintained facilities and a secure workplace for all staff, which in turn enhances morale and productivity. Ultimately, promoting a robust safety culture is both legally and ethically imperative; it also reassures parents, strengthens community relationships, and improves the institution's reputation and enrolment prospects.

8.4.1.OHS System of the College

To promote a safe and productive environment for its community, the college implements an Occupational Health and Safety (OHS) management system that complies with ISO 45001 standards. This comprehensive framework facilitates systematic efforts to monitor health hazards, ensure the operational safety and reliability of resources such as laboratory equipment, canteen provisions, and first-aid supplies, and effectively manage visitor access to enhance security.

Well-defined emergency protocols are established to ensure safety and fortify the institution's credibility. In alignment with international guidelines (EU-OSHA, HSE, OSHA), the college actively integrates OHS principles into the educational experience through a "whole-institute" model. This approach includes embedding risk awareness, health promotion, and respect initiatives into the curriculum and campus culture, thereby fostering a comprehensive understanding of safety that transcends isolated discussions. Collaboration with relevant authorities further supports this integrated strategy.

8.4.2. Risk Areas of The College and Existing OHS Facilities:

Sl.No.	Risk Area	Type of risk	Hazards	Existing OHS system
1	Chemistry/Physics laboratory	Chemical, physical, biological	Toxins Burning chemicals Pathogenic organisms	Protocols exist for handling chemicals, biological waste and emergency response
2	Physics, computer and language laboratories	Electrical	Shock	(uploaded in separate files) Protocols are maintained.
3	Roads and campus safety	Vehicle accidents	Health issues including fatality	0 incidents reported. Presence of speed control humps, signage and pedestrian paths.

4	Canteen, Hostel mess and other food serving areas	Sanitation, hygiene and food safety issues; drinking water quality	Food poisoning; health issues	1 incident Reported incidents of food issues by students. Proper waste management system.
5	General issues Water quality related issues	Water borne or water related diseases	Infections; water borne diseases	0 incidents reported. Clear and safe filtered water.
	Electrical distribution system related	Improper earthing Unbalanced and lack of harmonious	Shocks; damages to equipment	0 incidents reported. Proper earthing is maintained.
	Ragging Sexual harassment Violence	Mental well being	Conflict between the college students	1 incident of violence 0 incidents are reported. Safety protocols, surveillance, counselling and grievance redressal mechanism.
	Frequent health issues	Physical well being	Infections Diseases Accidents Mental stress	Few Climate related health issues are reported such as viral fever.. Protocols are maintained during such climates.
6	Women safety	Psychological well being	Safety Health Social support	0 incidents reported. Formal safety protocols, surveillance, counselling, or grievance redressal mechanism.
7	Emergency response system	Safety protocol	Diseases Disaster Medical emergency	0 incidents reported. Emergency exits are available. Drills infrequent or absent.
8	First Aid Frailties	Emergency medical support	Injuries Diseases Accident	First aid kits available in some areas but not regularly checked. Trained nurses are there in campus.

9	Infrastructure facilities	Outdoor and indoor facilities Hostel	Safety Emergency exit Recreation Networking	Facilities exist with safety audits, signage etc.
10	Register and documents	Safety Health Emergency	safety and security framework procedures for incident management, the implementation and practice of emergency protocols through regular drills, and the enforcement of campus access control measures.	Records are maintained in most of the cases. Regular drills are not conducted.

Table 8.3 Identified risk areas within the college and current OHS facilities

Fig 8.1 Hazards identification and risk assessment - cafeteria

Fig 8.2 Campus cafeteria risk and hazard assessment

8.4.2.1. Health

- The college provides first aid facilities and services through the infirmary, which is staffed by two designated nurses responsible for delivering medical assistance. These nurses also ensure the availability of first aid supplies. Information regarding the infirmary and its services is communicated to students during their orientation call and to newly joined staff during the orientation meeting on their first day. If a student requires assistance, they are directed to the infirmary by their department head or class teacher. A first aid register is diligently maintained and regularly monitored to ensure that any expired supplies are promptly replaced by the nurse in charge. For further health care needs, referrals are made to MMT Hospital as necessary.
- The college operates a single laboratory dedicated to the complementary paper, which is available for use during one even semester. This facility is occasionally utilised by students for their research activities. All students are expected to comply with established laboratory protocols, which include the mandatory requirement to wear white lab coats during practical sessions involving chemical materials. Adhering to these guidelines is essential for ensuring personal safety and preventing contamination. Safety instructions are provided to students prior to each practical session. Additionally, a usage register is maintained in the laboratory to document the quantities of materials used. Lab attendants and faculty members are assigned to oversee and facilitate these sessions.

Fig 8.3 Laboratories safety gears

- The campus canteen and hostel mess operate in accordance with valid and up-to-date health certificates and health cards for staff, as well as the necessary FSSAI certification and licenses, thereby adhering to stringent food safety standards. Expiry dates for packed food items are meticulously documented, and all raw materials are sourced exclusively from certified vendors. A recent risk assessment of occupational health and safety (OHS) reveals that while hair caps and appropriate cooking attire are worn, gloves are not currently utilised; instead, cutlery is employed for food service. To promote a hygienic dining experience, cashless payment methods are encouraged.

Fig 8.4 Workflow of daily mess service in canteen

- An annual water quality analysis is performed to evaluate the physical, chemical, and bacteriological parameters of the water supply. The most recent assessment confirms that the water is safe for drinking purposes. All water sources undergo purification before being distributed to each storage tank from the main supply. Additionally, water tank cleaning and chlorination of the surrounding areas occur biannually, with oversight and coordination provided by the college caretaker, who directs the staff in the cleaning processes.

8.4.2.2. Emergency Management System

- The Occupational Health and Safety (OHS) auditors are responsible for maintaining comprehensive records and registers about medical incidents, particularly health hazards such as accidents and chronic health issues that occur on campus. This includes documenting the specifics of laboratory equipment and chemicals utilised, such as purchase dates, expiration dates, and calibration records. Additionally, they maintain registers for emergency rescue measures, an inventory of first aid supplies along with their expiry dates, and the list of food items in the canteen and cafeteria, including their expiration dates. All reported events and actions taken, both internal and external, are also recorded to ensure accountability and transparency. These records are periodically reviewed to enhance the effectiveness of the safety and health management system.

Fig 8.5 Emergency medical service station

- The campus is equipped with 87 portable fire extinguishers, each with a 4 kg capacity, strategically placed across nine designated locations (refer to Table 8.5). The distribution of extinguishers is determined based on the specific fire risk and capacity requirements of individual rooms and areas. Maintenance and refilling of these extinguishers are currently handled manually by the college caretaker, with periodic inspections to ensure operational readiness. In addition, all college buildings are fitted with automatic fire sprinkler systems. These systems provide critical life safety and property protection in educational environments, particularly where large numbers of students reside in dormitories or gather in classrooms, laboratories, and lecture halls. Fire sprinklers activate automatically only in the area affected by heat from a fire, rapidly suppressing flames and containing the incident to the room of origin in the vast majority of cases. This quick response creates essential evacuation time especially vital in sleeping quarters or crowded spaces while significantly reducing the risk of fatalities, limiting fire spread, and minimising smoke and water damage to adjacent areas. By controlling fires effectively, sprinkler systems help protect valuable assets such as research equipment, library collections, and historical structures. They also play a key role in preventing major disruptions to academic activities, avoiding prolonged building closures or student relocations, ensuring regulatory compliance, and often enabling favourable insurance terms. These systems represent a proven, high-return investment in comprehensive campus fire protection. The sprinkler installations were carried out by an external specialised team, which also holds the maintenance contract. The team conducts regular, thorough inspections and addresses any non-functioning components promptly. Emergency procedures, including step-by-step response protocols and contact details for relevant authorities, are clearly displayed on information boards throughout the campus for immediate reference by all occupants.

Fig 8.6 Emergency exist and fire station access

- Emergency exits are strategically located throughout the campus, providing accessible pathways from multiple directions in the event of an emergency. Emergency communications, including notifications regarding college closures due to critical issues, disease outbreaks, or other significant threats, will be disseminated through general announcements and circulated within departments via email or WhatsApp. It is essential to designate a responsible individual to oversee and ensure these messages are delivered promptly to all departmental and non-teaching staff members. The MSW department, active NSS and NCC are strong supports in handling emergencies in college. Relief campus, supply of essential products is handled for the college community and the local community.
- The emergency evacuation route plan for the lower ground floor of the newly constructed Magis building outlines designated exit routes, locations of safety equipment, and essential emergency contact information for various services and personnel. Primary exit routes are highlighted in yellow on the accompanying map. Occupants are advised to utilize stairwells and emergency doors for evacuation, as elevators are not to be used during emergencies. Additionally, key emergency contact numbers for the fire station, police, ambulance, and local hospitals are provided. Contact information for the emergency response team and fire wardens is also included for effective coordination during an emergency.

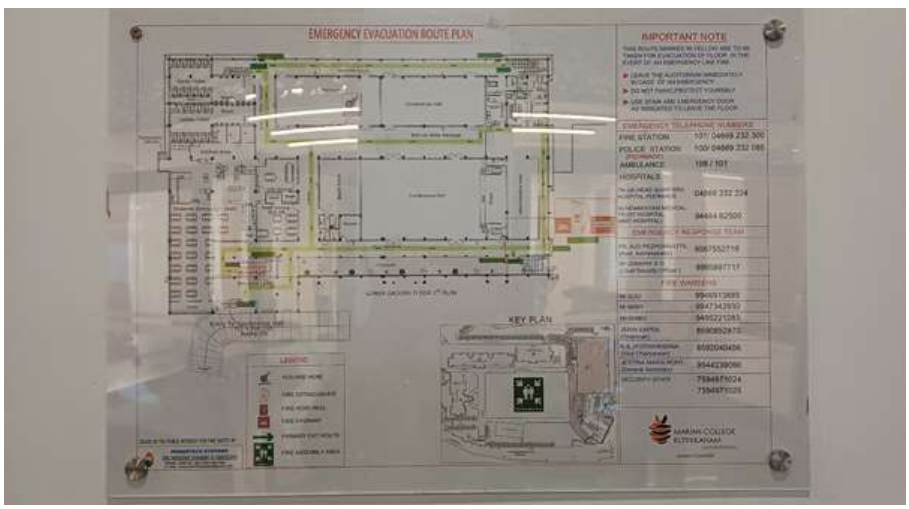


Fig 8.7 Emergency evacuation route plan signages displayed in campus

- To enhance emergency medical support, the college has established a Memorandum of Understanding (MoU) with MMT Hospital in Mundakkayam and Caritas Hospital in Kottayam. This partnership is designed to promote the professional development, mental support, and the overall social and physical well-being of students, staff, and their family members. The college, in collaboration with MMT Hospital, will assist in conducting health status assessments during student admissions. These assessments will encompass comprehensive primary evaluations, including vital signs, vision, glycosylated hemoglobin (GRBS), body posture, back pain evaluation, body mass index (BMI), and hearing tests. Normal ranges for all mentioned parameters will be established during this process. If any assessments yield results outside of the normal range, MMT Hospital will carry out a detailed evaluation, with Caritas Hospital providing support for assessments as necessary. In instances requiring detailed assessments or inpatient care, the Second Party (MMT Hospital) will transfer the relevant individual to the Third Party (Caritas Hospital), based on the clinical recommendations from the attending physician and after confirming bed availability and necessary medical services. A nurse will be provided by the Second Party to accompany the patient, if needed. Prior to the transfer, the Second Party will ensure that a referral letter and pertinent medical records, including investigation and scan reports, are handed over to the patient or their escort. The Third Party will confirm bed availability upon receiving the transfer request from the Second Party. The Second Party must notify the Third Party in advance regarding the anticipated number of patients to be transferred and must inform them immediately of any cancellations to transfer requests. Invoices for medical services provided at Caritas Hospital will be issued directly by the Third Party and collected from patients at the time of discharge. The Second Party is responsible for ensuring that patients have settled all dues associated with their treatment at MMT Hospital. Furthermore, the Second Party holds full liability for all services and treatments rendered to patients at their facility. In the case of medico-legal incidents, the Second Party is obliged to report such cases to the appropriate police authorities prior to transferring the patient to the Third Party's hospital.

8.4.2.3. Environmental Health

- The Women's Cell of the college is committed to fostering the holistic development of female students by prioritising their mental and physical well-being, financial independence, rights awareness, and legal security. To this end, the college has established a dedicated Women's Cell that collaborates with experts to organise sessions on health, hygiene, lifestyle, and fitness training, as well as workshops promoting healthy eating habits. In addition, the Cell arranges exhibitions for women entrepreneurs and conducts sessions with industry experts to introduce emerging technologies and effective marketing strategies. Furthermore, through partnerships with legal professionals, the college empowers women with knowledge of their rights and access to justice, while providing essential resources and support for addressing instances of violence.
- The laboratory is equipped with fire extinguishers to enable an immediate response to any accidental fires that may occur due to the use of flammable chemicals or equipment. Safety devices, including circuit breakers, are installed to prevent electrical shocks and damage to equipment during practical sessions. Clear signages have to be prominently displayed to emphasise the mandatory use of personal protective equipment (PPE), and a register is maintained to record compliance and attendance.
- The college ensures meticulous maintenance of electrical safety, including the prevention of exposed wiring, regular campus cleaning, and timely repairs as required. It is responsible for supervising and directing the assigned staff to carry out these tasks effectively.

Fig 8.8 Hygienic and fully equipped campus infrastructure

- A total of 89 housekeeping staff, including security and others, are dedicated to cleaning duties, with a standard frequency of twice daily or more, depending on specific requirements. The caretaker maintains an attendance register for the cleaning staff to monitor their presence, health, and safety. Safety gear is provided every month, and replacements are issued promptly when items are no longer reusable. Eco-friendly cleaning materials are sourced from Bellaris Cleansers Company, a reputed organisation in the cleaning and sanitation industry. The company also provides comprehensive training to housekeeping employees, covering essential topics such as the proper use and handling of cleaning equipment and materials, worker safety and protection measures during tasks, best practices for maintaining hygiene and cleanliness standards, and efficient cleaning techniques for various surfaces and environments.

8.4.2.4. Facilities

- The hostel mess and canteen maintain high standards of hygiene. Kitchen staff are required to wear appropriate attire, including caps and gloves when necessary, and the serving areas are cleaned regularly. The kitchen team adheres to strict hygiene protocols, which include the use of hairnets and aprons. Staff receive specialised training on maintaining cleanliness and sanitation standards. Seating arrangements are organised separately for staff and students to minimize congestion, and a

QR code system is available for convenient food selection. The canteen utilises steel and ceramic utensils, and our cleaning staff diligently segregate waste for effective disposal.

- Filtered drinking water systems are installed throughout the campus, regularly tested, and stored in clean, covered containers. Waste disposal is systematically managed to prevent contamination and ensure sanitary conditions.
- The institution provides comprehensive sports facilities for both indoor and outdoor activities, allowing all students and staff to engage after regular class hours. Unisex gym facilities are also available, supported by a certified trainer to assist participants

Fig 8.9 Well equipped gym facilities with trainer

Fig 8.10 Indoor sports court equipped with flooring and maintained under hygienic standards

8.4.2.5. Training And Awareness Programme

- The college places a strong emphasis on fostering a safe, respectful, and supportive campus environment. Regular awareness programs and sensitisation workshops are conducted to promote respectful interactions and prevent harassment. A robust grievance redressal system is in place, enabling confidential reporting and prompt intervention. Faculty members and mentors are assigned to interact regularly with students, addressing concerns proactively to prevent escalation.
- To support psychosocial well-being, the college provides comprehensive counselling services through a dedicated Counselling Centre. The team comprises three full-time counsellors Fr. Binny Jose (M.Sc. in Counselling and Psychotherapy), Ms Anna Marie Nainan (M.Sc. in Psychology), and Sr. Soumya CMC (Diploma in Counselling) and one part-time counsellor, Ms. Elizabath Thomas (M.Sc. in Psychology). Full-time counsellors are available on campus during working hours on all academic days, while the part-time counsellor offers services on designated days each week. The team collaborates to deliver individual and group counselling, psychological assessments, and wellness promotion activities for the college community. Each counsellor is assigned as the custodian for specific student groups, programmes, and batches, ensuring personalised and continuous access to mental health support. These services are accessible to all students of the institution. As part of the student well-being initiative, counsellors personally meet all first-year students (totalling 710) for an introductory session and initial assessment. In the previous academic year, approximately 100 students availed themselves of individual counselling sessions to address personal, academic, and emotional concerns. The college remains committed to enhancing its counselling services, thereby promoting a healthy, inclusive, and supportive campus environment.
- Prioritising the safety, health, and well-being of students, staff, and visitors, the college organises regular training programs, including expert-led yoga and physical exercise sessions supported by a dedicated room and mat facilities. Partnerships with external agencies, such as the Kerala State Fire Force, facilitate periodic professional training on fire extinguisher usage. A Memorandum of Understanding (MoU) with MMT and Caritas Hospital enables the provision of CPR training for students and staff. Additionally, detailed safety protocols for laboratories covering the safe handling of chemicals and glassware, emergency procedures, and facility guidelines are formally communicated to Department Heads, who ensure dissemination within their respective departments.
- Orientation training in basic first aid is provided separately to first-year students, teaching staff, and non-teaching staff, equipping them to manage minor injuries and health issues effectively. These initiatives, combined with clear communication of institutional services and individual responsibilities, contribute to a safer and more responsive campus environment.
- The institution prioritises the provision of safe and convenient transportation facilities, including dedicated pedestrian walkways, vehicle parking areas for staff and students, designated cycling spaces, and zebra crossings. Speed limit signs and humps are clearly marked throughout the campus. Additionally, pedestrian walking spaces are distinctly demarcated, stand-alone signboards are installed in high-risk areas, and regular surveillance is maintained to ensure safety and compliance.

Fig 8.11 Well-design road safety facilities on college campus roads

- The library is equipped with student-centric facilities designed for comfort and productivity. These include ergonomic easy chairs and a variety of study spaces, such as quiet individual study areas, bookable group study rooms equipped with whiteboards and screens, collaborative zones, and relaxed "living room"-style social spaces. Extended operating hours are provided, along with amenities such as coffee machines. The library features dedicated computer labs, high-speed Wi-Fi, printing and scanning stations, and loanable laptops or devices. It houses extensive physical collections with open-stack access for free browsing, complemented by millions of digital resources, including e-books, academic journals, databases, and streaming media accessible 24/7. Professional librarians offer personalised consultations, conduct workshops on information literacy, and provide support with citation tools.

Fig 8.12 Area for rest and recreation

Fig 8.13 Wall-falling and pedestrian safety facilities

Fig 8.14 Main library facilities and service

8.4.2.6. Infrastructure Assessment

- All electrical installations are inspected and monitored through a dedicated energy management team. To prevent faults and reduce the risk of electric shock in Physics and Computer laboratories, and Circuit breakers are in place to manage electrical load safely. Emergency shut-off switches are installed for quick power disconnection during incidents.
- The existing OHS system for roads and campus safety includes security personnel monitoring vehicle movement within the campus to prevent accidents. Entry and exit points are controlled to minimise traffic flow conflicts outside the campus. Appointed security staff to control the entry of outsiders

Fig 8.15 Relaxed and comfortable reading arrangement

- Surveillance cameras are strategically installed in various areas of the campus to provide continuous monitoring of campus activities, even in the absence of on-site security personnel. This ensures constant oversight and helps maintain adherence to the established norms of the college community, while enabling a prompt response to any emergencies that may occur.

Fig 8.16 Distribution of CCTV across the campus

- Adequate washroom facilities, featuring clear signage to ensure accessibility for all users, including those with disabilities. The facilities include pad vending machines and disposal units, accompanied by cautionary messages to discourage the flushing of inappropriate materials. The institution provides separate and adequate washroom facilities for both women and men. In the women's washrooms, designated disposal units for sanitary products and napkin vending machines are available. These facilities are regularly maintained by housekeeping staff to uphold hygiene standards and minimise odours. Information about these amenities is effectively communicated by non-teaching faculty and housekeeping personnel, and directional signage is strategically placed throughout the premises to guide users accordingly.

Fig 8.17 Accessibility of walking path and mobility

8.4.2.7. Empowering Inclusive Systems And Community Engagement Initiative In College

- To foster an inclusive and barrier-free environment, the campus has implemented a range of infrastructure and support services designed to accommodate individuals with disabilities and ensure equitable access to facilities and academic resources including, Rails, toilets and Talking library. Ramps are installed at the key locations, including Central Block and Centenary Block, to support accessible movement.
- Braille books, magazines, and resources, Talking books/audiobooks and audio resource centres, Computers equipped with screen reading software (e.g., JAWS, NVDA), magnifiers, low-vision aids, scanners, and text-to-speech technology, Dedicated resource centres (e.g., Resource Centre for the Differently Abled) for independent study. Were provided for visually impaired students

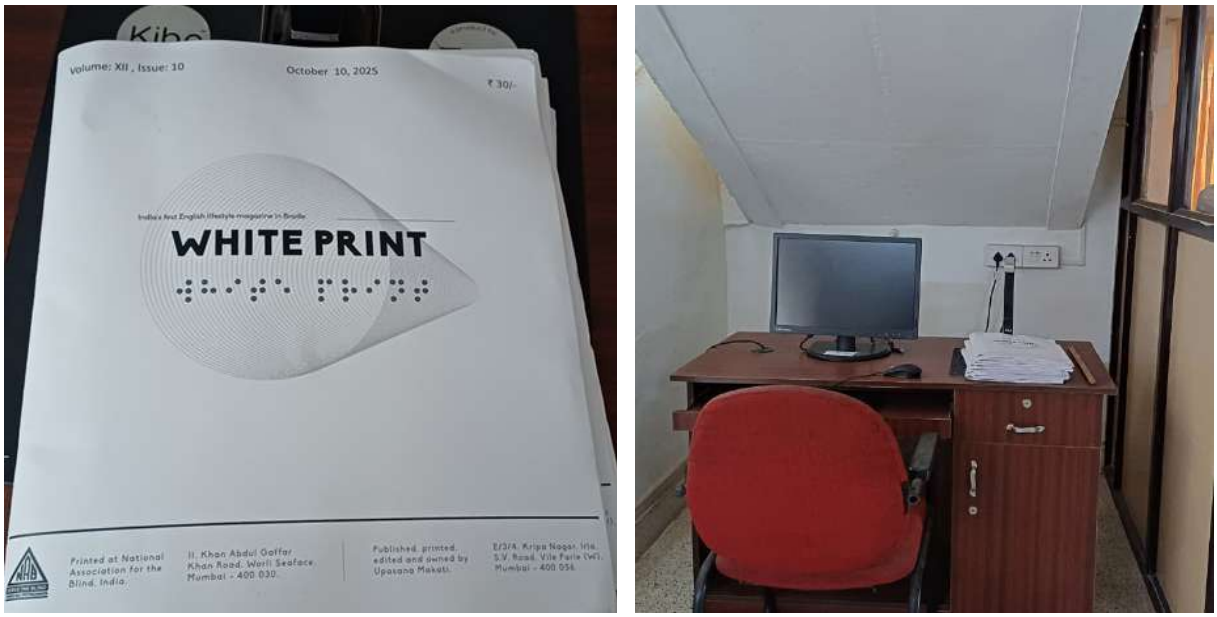


Fig 8.18 Accessible reading materials for the visually impaired

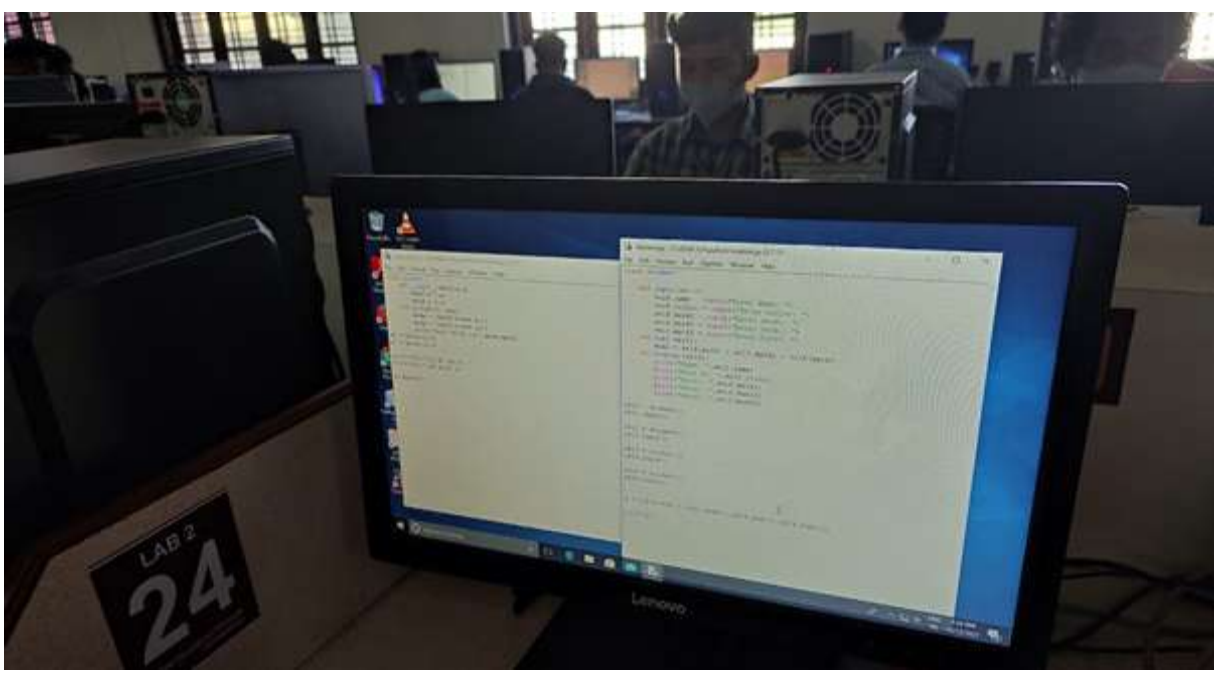


Fig 8.19 Digital library facilities

- Before the announcement of the semester exams, the Examination Control Office disseminates a notice via WhatsApp to the heads of departments (HODs), who then share it with all student groups. Students can access the service by clicking on the registration form included in the notice, which must be submitted along with the necessary supporting documents related to their individual circumstances (such as for persons with disabilities or students requiring accommodations). After verification, the exam cell allocates a scribe based on the specific needs of the students. For those who require additional time, an approved letter will be shared with the relevant individuals. These services will be

available during the exam period, and the exams will be conducted in spaces arranged by the exam cell. The college has established a robust scribe pool to effectively meet these requirements.

- The Lifelong Learning and Extension (LL&E) initiative of Marian College Kuttikkanam (Autonomous) has signed a Memorandum of Understanding (MoU) with the Mental Health Action Trust (MHAT). The primary objective of this MoU is to implement community mental health interventions through continued services in community clinics, commencing initially in the Peermade Grama Panchayat and subsequently expanding to Peruvanthanam, Elappara, Kanchiyar, and Vandiperiyar in Idukki District. This initiative aims to socially, economically, and educationally empower the surrounding communities, enabling them to integrate into mainstream society and make significant contributions to the state's development process. LL&E formulates, promotes, and implements projects designed to enhance community living standards while providing valuable engagement opportunities for college students. MHAT, in collaboration with partners, non-governmental organisations, and government health institutions (such as primary health centres, palliative care units, and other third-sector organisations), delivers free bio-psychosocial mental health care to the most vulnerable and economically disadvantaged individuals suffering from mental illness. The project focuses on establishing and extending community wellness clinics starting in Peermade Grama Panchayat and progressively in the aforementioned villages to address the psychiatric and counselling needs of economically backward residents, which represents a critical community requirement. Under the MoU, MHAT undertakes to execute the community mental health intervention by establishing Community Wellness Clinics; providing psychiatric treatment, de-addiction services, counselling, and therapy sessions; conducting school mental health programs; and initiating social development activities for the recovery and rehabilitation of clients and their families, with support from LL&E. MHAT's responsibilities include appointing full-time staff for project activities; forming teams of volunteers to assist fieldwork; assessing the mental health status of the target population; establishing clinic operations based on assessments; screening and identifying eligible individuals and families for treatment; providing domiciliary care as needed; maintaining tele-psychiatry services for round-the-clock access; training volunteers in community mental health services; and planning and implementing social development activities for clients and caregivers. LL&E's roles and responsibilities encompass identifying target villages and mobilising volunteers; releasing ₹10,000 monthly per clinic to support operations; ensuring stakeholder support from entities such as the District Administration, Grama Panchayats, and other government agencies; providing space for outpatient services in selected villages and tribal hamlets; arranging vehicles for home visits; and supplying medicines for those requiring medication.

8.4.3.8. Facilities Offered in the College

Sl No	Facilities offer	Location
1	Rails and Ramps	Academic block, administrative block, vattakuzhy block, MIIM
2	Lift	Vattakuzhy block & MIIM
3	Accessible room	Rooms in all locations are barrier free
4	Emergency exit	In all blocks, including hostels.
5	Transportation	Yes
6	Accessible signages	Parking area
7	Scribe and examinations	A pool of scribes is available and provided for needy students
8	Reserved seat	2 seats
9	Human assistance	Campus entry points and hostels, if requested.
10	Electric Examination Table	Not clearly mentioned.
11	Wheelchair facilities	Not clearly mentioned.
12	Fire Exit	Multiple exit points in most of the buildings.

Table 8.4 Facilities of the college

Fig 8.20 Yoga training room of the campus

Fig 8.21 Main kitchen of the campus

8.4.2.9. Installation of Fire Extinguishers in Various Locations

Sl No	Count	Capacity	Location
1	17	4Kg (ABC Category)	Magis
2	13	4Kg (ABC Category	Vattakuzhy
3	6	4Kg (ABC Category	Academic
4	7	4Kg (ABC Category	Administrative
5	3	4Kg (ABC Category	Guest house
6	17	4Kg (ABC Category	MIM
7	10	4Kg (ABC Category	Madona Hostel
8	10	4Kg (ABC Category	Maryknoll Hostel
9	4	4Kg (ABC Category	Paul Iby Hostel

Table 8.5 Fire extinguisher at various locations

8.4.3 Sound Recording of The College

Sl No	Location	Sound (in dB)	
1		Min	Max
2	MIM	179.97± 15.12	124.70 ±8.32
3	ACADEMIC BLOCK	202.63± 5.28	149.40± 4.12
4	PARKING AREA	202.93±18.67	152.17±0.49
5	MAGIS	205.47±12.28	149.87±6.63
	HOSTEL	203.23±6.08	155.80± 3.62

Table 8.6 Zone ways Sound Analysis

Maximum, 155.80± 3.62dB, minimum and vehicle movements. In contrast, the parking area exhibits comparatively lower sound levels, likely due to the presence of nearby trees that help buffer and reduce noise in that region. According to the WHO Classroom/Academic Standards, the recommended average sound level is 35 dB; however, measurements indicate levels exceeding this limit. To address this issue, recommend implementing a silent zone and planting smaller trees with narrower canopies to further mitigate sound levels.

Fig 8.22 Recording sound level in each zone of the campus

8.5 CONCLUSION

- The institution demonstrates a comprehensive and proactive approach to health, safety, and environmental well-being, ensuring a secure and supportive campus environment for students, staff, and visitors.
- The institution maintains efficient health services through a well-equipped infirmary, MoUs with MMT and Caritas Hospitals for advanced care, and regular first aid and emergency training programs.
- Stringent safety measures, including fire suppression systems, laboratory protocols, hygiene standards in food services, and biannual water quality checks, reflect a strong commitment to risk prevention and compliance.
- Environmental health and inclusivity are prioritised via eco-friendly practices, dedicated support for differently abled individuals, mental health counselling, and community outreach initiatives.
- Ongoing training, awareness programs, infrastructure maintenance, and surveillance further strengthen emergency preparedness and foster a culture of safety, hygiene, and holistic development across the campus.

8.6 RECOMMENDATION

- Establish mixed plantings of indigenous trees, shrubs, and grasses that are well-adapted to local ecological conditions, such as the climate and soil typical of the Western Ghats in Kerala. These plantings should incorporate thematic gardens featuring native species, including butterfly-attracting gardens, fruit tree orchards, and dense, multi-layered forests created using the Miyawaki method. The Miyawaki approach involves planting a diverse selection of native species at high density, typically 3–5 saplings per square meter, to mimic natural forest succession. This technique accelerates growth, enhances structural complexity through multi-layered canopies (emergent, canopy, sub-canopy, shrub, and understory layers), promotes rapid biodiversity gains, and fosters self-sustaining ecosystems in a significantly shorter timeframe compared to conventional planting methods.Pedestrian Walking Facilities: Currently, there are no designated pedestrian walking facilities or restrictions on vehicular traffic within the campus. Due to spatial constraints, formal construction of such facilities is not feasible; therefore, we recommend marking the existing floor area with standard signage to effectively communicate this message.

- Targeted Improvements: Some areas of the college remain under construction. The authorities need to coordinate with the contractor to communicate the necessary rules and regulations for visitors. Furthermore, caution signs should be strategically placed in high-risk areas near pedestrian pathways to enhance safety.

- Occupational Health and Safety System: The recent audit emphasised the critical need for a comprehensive Occupational Health and Safety (OHS) management system. In response, the institution has established and implemented a foundational framework that systematically addresses emergency preparedness, response, and crisis management, encompassing physical, chemical, biological, and psychological hazards. The institution remains dedicated to the continuous improvement of this system, proactively adapting to emerging requirements to ensure the ongoing safety and inclusivity of the campus community.

8.7 ENVIRONMENT MANAGEMENT PLAN

Marian College Kuttikkanam (Autonomous) will remain committed to establishing a safe, healthy, and supportive campus environment for students, faculty, staff, contractors, and visitors. This OHS Plan will guide the College in implementing systematic safety practices, strengthening preparedness, and cultivating a culture of well-being and risk prevention across all academic and administrative operations.

8.7.1 Establish an Adept OHSManagement Team

The College will establish a dedicated Occupational Health & Safety Management Team, comprised of

members from the Health and Wellness Department, operating under the Emergency Management Services and Internal Quality Assurance Cell (IQAC). This team will include representatives from administration, faculty, staff, and student bodies to implement a comprehensive system to ensure the safety and security of the college community. The team will also focus on raising awareness and disseminating information while collaborating with external agencies for training, audits, and compliance. Furthermore, it will facilitate regular communication of safety updates to all stakeholders by clearly defining responsibilities and duties for management, faculty, students, parents, and external partners.

8.7.2 Formulate a Comprehensive Strategy for Sustainable OHS Management

The OHS Team is tasked with developing a comprehensive strategy to define safety protocols and standard operating procedures throughout the campus. This service will be communicated via the college diary, notice boards, signage, and the information desk, integrating physical safety, mental well-being, and environmental responsibility into our institutional planning. The strategy will also ensure that campus practices align with statutory standards and international OHS guidelines while establishing clear accountability mechanisms for departments, committees, and individuals.

8.7.3 Implement Effective Methods to Attain Set Objectives

The College will adopt structured methods to meet its OHS goals, including:

- scheduled training programmes on CPR, first aid, fire safety, evacuation, mental health, and stress management;
- periodic facility inspections, risk assessments, and safety audits;
- improved infrastructure safety measures such as signage, fall-prevention systems, ergonomic upgrades, and accessible pathways;
- enforcement of PPE use in laboratories, workshops, and technical areas;
- systematic documentation of hazards, incidents, and corrective actions.

8.7.4 Establish Robust Communication Channels

- To ensure transparent and effective safety governance, the College shall designate a dedicated Safety Officer and establish a Safety Committee, operating with the support and guidance of the Occupational Health and Safety Committee, to oversee the implementation, monitoring, and continuous improvement of all fire safety and emergency preparedness measures.
- Emergency communication and official safety notifications, including new risk assessments, service updates, policy changes, and emergency alerts, shall be disseminated promptly through Principal-approved channels. These include college WhatsApp groups, physical notice boards, circulars, and updates on the official college website to reach the entire college community promptly.
- Provide contact details for reporting hazards, incidents, near-misses, or safety concerns shall be prominently displayed in the college diary, on the website, and via dedicated WhatsApp channels. The Safety Officer shall serve as the primary point of contact for such communications. Minor issues shall be addressed and rectified immediately, while major or complex concerns shall be escalated to the management for consultation and approval before proceeding with remedial actions.

Clear contact details for reporting hazards, incidents, near-misses, or safety concerns shall be prominently displayed in the college diary, on the website, and via dedicated WhatsApp channels. The Safety Officer shall serve as the primary point of contact for such communications. Minor issues shall be addressed and rectified immediately, while major or complex concerns shall be escalated to the management for consultation and approval before proceeding with remedial actions.

8.7.5 Long-term and Short-term goals

8.7.5.1 Long-Term:

The College will:

- An automatic fire protection system, consisting of pipes, a water supply, and heat-activated sprinkler heads, has been implemented in the new block. This system must also be installed in the remaining three blocks.
- Enhance mental health and wellness programs for students and staff, aiming to achieve an 80% increase in participation through the support of an external agency.
- Increase the availability of facilities and recreational options that are accessible to differently-abled individuals by 2029

8.7.5.2 Short-Term:

The College will:

- Continue the training for housekeeping staff on cleaning procedures and health and safety measures and develop a monthly schedule to outline the frequency of cleaning.
- Standardise the signage for internal road traffic and clearly mark a line on the roadway to delineate pedestrian pathways.
- Display the contact information for the nurse responsible for medical support in the college diary and/or website, and ensure that details of a designated point of contact are provided for when the nurse is on leave.
- Designate a responsible individual to communicate emergency issues and updates to the college community

8.7.6 Continuously Monitor and Enhance the System

The OHS Management Team will undertake annual and mid-year audits and analyse incident reports, near misses, and hazard logs to identify trends. This will involve maintaining a comprehensive register and preparing detailed assessment reports. Additionally, the team will gather feedback from students, faculty, staff, and contractors to inform safety practices. Procedures will be revised in response to emerging risks, changes in legislation, and findings from audits. Moreover, any unresolved issues will be escalated immediately to the principal to ensure prompt resolution.

8.7.7 Conclude and Conduct Follow-ups on the System

At the end of each academic year, the College will prepare an Annual Occupational Health and Safety (OHS) Report. This report will detail initiatives, incidents, training sessions, audit results, and the actions taken, which will be submitted to the Internal Quality Assurance Cell (IQAC). Subsequently, the management will engage in discussions to conduct end-of-cycle reviews, assessing the effectiveness of the OHS Plan.

Plans will be ensured for follow-up training, infrastructure improvements, and necessary policy updates for the upcoming year. To ensure transparency and accountability, periodic meetings will be held to incorporate suggestions and feedback from all members. Additionally, measures will be taken to ensure that corrective actions are completed within specified timelines.

8.7.8 Conclusion

This Occupational Health & Safety Plan will guide Marian College in shaping a safe and thriving learning environment. Through preventive measures, capacity building, structured governance, and continuous improvement, the College will work towards embedding safety and well-being into every aspect of campus life. By implementing this plan, Marian College will uphold its commitment to academic excellence, responsible campus management, and the holistic health of its community.

8.8 ACTIVITIES CONDUCTED

1. The outreach programme is a one-day extension activity undertaken by all classes every year. It aims to help, uplift, and support those who are deprived of certain services and rights. It involves giving learning, social planning, health support, and other projects for their welfare

2. Need analysis in tribal areas by social work students

കെയറിംഗ് ഹാൻഡ്സ് പരിപാടി സംഘടിപ്പിച്ചു

ഉപ്പുതറ: കുട്ടിക്കാനം മരിയൻ കോളജ് ബികോം ഒന്നാം വിദ്യാർഥികളും പരപ്പ് ചാവറഗിരി സിഎംഐ സ്പെഷൽ സ്കൂളും ചേർന്ന് കെയറിംഗ് ഹാൻഡ്സ് എന്ന പരിപാടി സംഘടിപ്പിച്ചു. പരപ്പ് ചാവറ സ്പെഷൽ സ്കൂളിൽ സംഘടിപ്പിച്ച പരിപാടി ഉപ്പുതറ ഗ്രാമപഞ്ചായത്ത് പ്രസിഡന്റ് കെ.ജെ. ജയിംസ് ഉദ്ഘാടനം ചെയ്തു.

ഫാ. പ്രിൻസ് ജോയി, അധ്യാപിക റോസ്മേരി, പ്രഫ. ഡേവിസ് ജോസഫ് എന്നിവർ നേതൃത്വം നൽകി. വിദ്യാർഥികളുടെ വിവിധ കലാപരിപാടികളും അരങ്ങേറി.

On 22 November 2024, a group of social work trainees from the III BSW A batch, accompanied by Ms. Jesline Elizabeth (Project Staff, ICSSR), undertook a field visit to the Malapandaram tribal community. The visit was organized in collaboration with the Forest Department as part of "Jan Jatiya Gaurav Diwas", with the objective of understanding the community's lifestyle, socio-economic conditions, challenges, and aspirations.

Upon arrival, the trainees interacted with community members with the support of Mr. Sunil from the Forest Department. The team visited several households and conducted a survey to collect information on living conditions, livelihood patterns, and key social issues. The interaction revealed that the community faces multiple challenges, including limited access to education, healthcare, electricity, and clean drinking water. The primary sources of livelihood are the collection of spearmint and honey. However, water scarcity and lack of stable employment opportunities compel some community members to migrate seasonally to nearby forest areas. The trainees also observed that housing conditions remain underdeveloped due to the community's semi-nomadic lifestyle. Inadequate transportation facilities further restrict children's access to schooling.

Based on their observations, the trainees concluded that the Malapandaram tribal community is confronted with several interrelated challenges that require immediate and focused intervention.

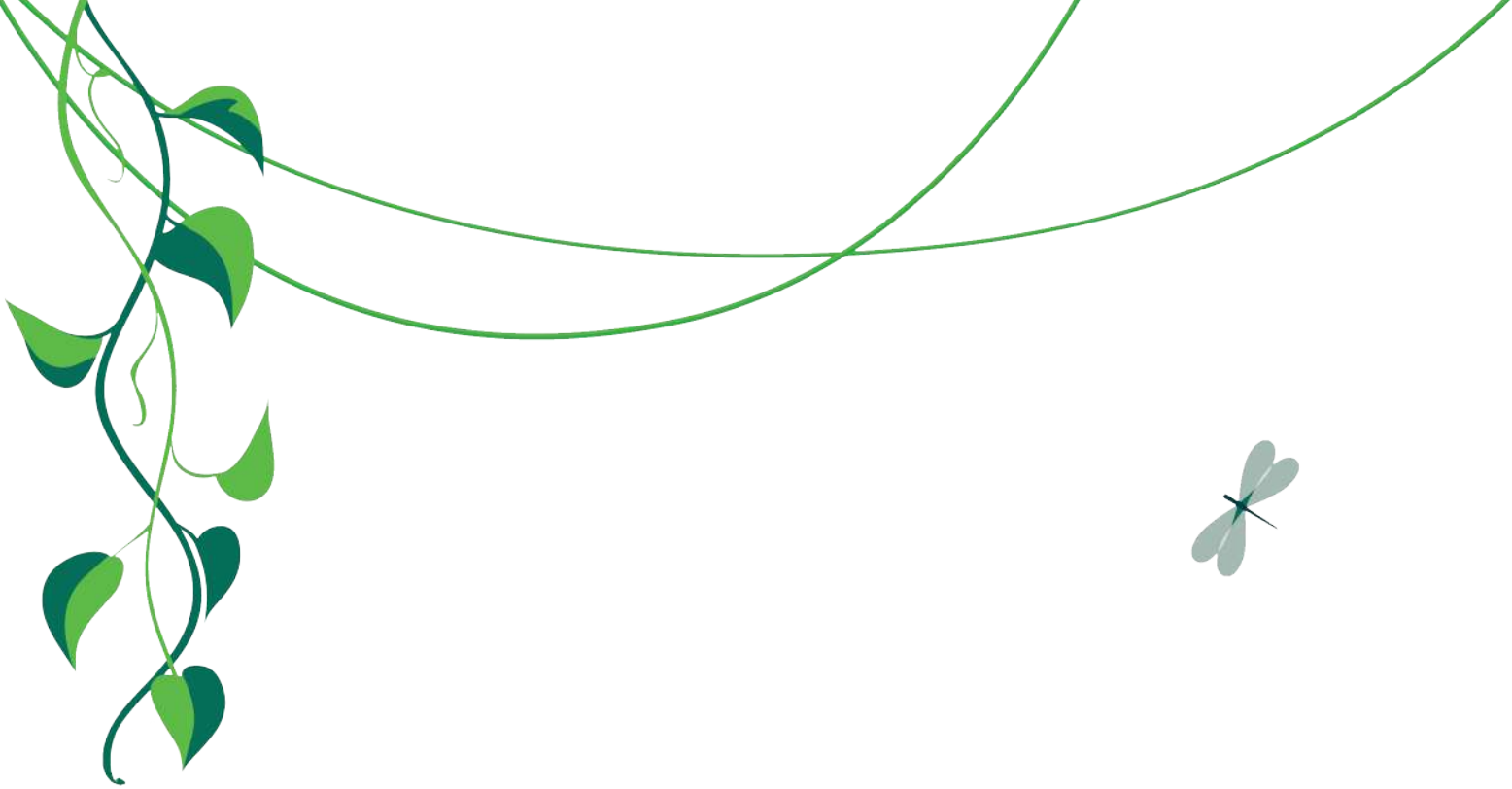
Need and Suggested Interventions

The community continues to face persistent issues such as lack of electricity, inadequate housing, and limited educational access. Although applications have been submitted to the local panchayat to address these concerns, approvals have not yet been granted. To expedite the process, support from ASHA workers or ST promoters may be sought to assist in documentation and coordination with authorities.

To improve educational access for children, the implementation of the Gothra Sarathi scheme, which provides transportation facilities, is recommended. This intervention could help overcome distance and accessibility barriers and ensure regular school attendance. Addressing these critical needs through coordinated institutional support can significantly enhance the overall quality of life of the Malapandaram tribal community.

Chapter IX

CARBON FOOTPRINT : AUDIT REPORT



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
stewardship, and strengthen governance

- Ban Ki - Moon

9

Carbon Footprint

9.1. INTRODUCTION

Carbon footprint analysis is a critical component of the Green Audit, serving as a quantitative measure of the institution's impact on global climate change. It represents the total amount of greenhouse gases (GHGs) produced to directly and indirectly support the college's activities, expressed in equivalent tons of Carbon Dioxide (tCO_2e).

This report assesses Marian College's carbon footprint for the audit period, identifies major emission hotspots, and evaluates the mitigation potential of existing green initiatives.

9.2. METHODOLOGY & SCOPE

The assessment boundaries include the physical campus of Marian College and the operational activities involving its 2,778 community members.

- Scope 1 (Direct Emissions): Emissions from sources owned or controlled by the college (LPG for cooking/labs, Diesel/Petrol for college vehicles and generators).
- Scope 2 (Indirect Emissions): Emissions from the generation of purchased electricity consumed by the college.
- Scope 3 (Other Indirect Emissions): Emissions that occur as a consequence of the operations of the college, specifically focusing on waste generation and water consumption.

Methodology Note:

- Protocol: The calculations follow the WRI/WBCSD Greenhouse Gas (GHG) Protocol Corporate Standard, categorizing emissions into Scope 1 (Direct), Scope 2 (Indirect Energy), and Scope 3 (Other Indirect).
- Emission Factors: Standard emission factors relevant to the Indian context (e.g., Central Electricity Authority for grid power) were used to convert activity data into Carbon Dioxide Equivalent (CO_2e).
- Population: The calculation uses the specific total population provided: 2,778 (Staff + Students).

9.3. DATA INVENTORY

The following data, collected from institutional records, form the basis of this calculation:

Category	Item	Annual Consumption / Quantity
Population	Total Community Strength	2,778 individuals
Energy (Scope 2)	Grid Electricity (KSEB)	3,92,028.7 kWh
Fuels (Scope 1)	Liquid Fuel (Diesel/Petrol)	12,075.39 Litres
	LPG	20,023.40 kg
Water (Scope 3)	Total Water Usage	2,587,580 Litres (approx)
Waste (Scope 3)	Paper Waste	88,528.66 kg
	Plastic Waste	4,200.49 kg
	Food Waste	35,317.24 kg
	Other (E-waste/Metal/Construction)	467 kg
Sequestration	Trees (Richness)	555 Trees (Total Density)

9.4. CARBON EMISSION CALCULATIONS

9.4.1 Scope 1: Direct Emissions (Fossil Fuels)

This scope covers fuel burned on-site. The college utilises diesel for generators and transportation, and LPG for the canteen and laboratories.

- **LPG Emissions:**
  - Consumption : 20,023.4 kg
  - Emission Factor: 2.983 kg CO_2e/kg
  - Calculation : 20,023.4 x 2.983 = 59,729.80 kg CO_2e
- **Liquid Fuel (Diesel/Petrol):**
  - Consumption : 12,075.39 Litres
  - Emission Factor : 2.68 kg CO_2e/Litre (Average for Diesel)
  - Calculation : 12,075.39 x 2.68 = 32,362.05 kg CO_2e

Total Scope 1 Emissions: 92.09 Tons CO_2e

9.4.2 Scope 2: Indirect Emissions (Electricity)

This is often the largest contributor to an educational institution's footprint.

- **Grid Electricity (KSEB):**
  - Consumption : 3,92,028.7 kWh
  - Emission Factor : 0.718 kg CO_2e kWh (Grid Average)
  - Calculation : 3,92,028.7 x 0.718 = 281,476.61 kg CO_2e

Total Scope 2 Emissions: 281.48 Tons CO_2e

9.4.3 Scope 3: Other Indirect Emissions (Waste & Water)

Waste decomposition contributes to methane emissions, while water consumption implies indirect energy usage for pumping and treatment.

- **Waste Generation:**
  - Paper : 88,528.66 kg x 0.233 = 20,627.18 kg CO_2e
  - Plastic : 4,200.49 kg x 0.033 = 138.62 kg CO_2e (Assuming largely recyclable/inert)

- Food Waste : 35,317.24 kg x 0.529 = 18,682.82 kg CO_2e (Standard factor for mixed organic waste)
- Other/E-waste: Negligible impact in this specific model due to low volume/recycling.
- Total Waste Emissions: 39,448.62 kg CO_2e

- **Water Consumption:**
  - Total Annual Volume : 2,587,579.9 Litres (2,587.58 m^3)
  - Emission Factor : 0.3 kg CO_2e/m^3 (Estimated energy intensity for pumping/ supply)
  - Calculation: 2,587.58 x 0.3 = 776.27 kg CO_2e
  - Total Scope 3 Emissions : 40.22 Tons CO_2e

9.5 CARBON SEQUESTRATION & OFFSETS

9.5.1 Carbon Sequestration by Flora

The biodiversity audit recorded 555 trees on campus. Trees act as carbon sinks, absorbing CO_2 from the atmosphere.

- Calculation: 555 trees x 22 kg CO_2/tree/year (Average for mature tropical trees).
- Total Sequestration: 12,210 kg (12.21 Tons CO_2e)

9.5.2 Avoided Emissions (Solar Energy)

The college has an installed solar capacity of 80kW, producing 16,176 kWh annually.

- Calculation : 16,176 kWh x 0.718 kg CO_2e/kWh.
- Avoided Emissions: 11,614 kg (11.61 Tons CO_2e)

Note: Avoided emissions demonstrate what the college saved the environment from, but strict accounting subtracts only Sequestration (Trees) from the Gross footprint to find the Net footprint.

9.6 RESULTS & DISCUSSION

9.6.1 Total Annual Carbon Footprint|

Emission Scope	Source	Emissions (kgCO2e)	Emissions (Tons CO2e)	Share (%)
Scope 1	Fossil Fuels (LPG, Diesel)	92,091.85	92.09	22.25%
Scope 2	Electricity (Grid)	281,476.61	281.48	68.03%
Scope 3	Waste & Water	40,224.89	40.22	9.72%
GROSS TOTAL		413,793.35	413.79	100%
Less Sequestration	Trees	-12,210.00	-12.21	
NET TOTAL		401,583.35	401.58	

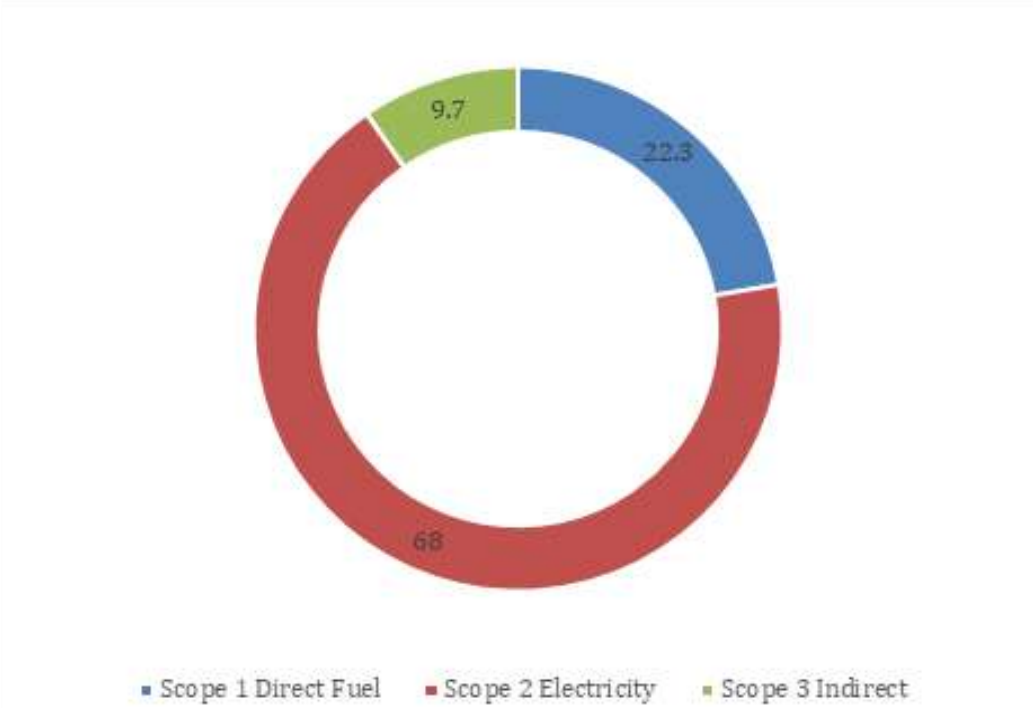


Fig.9.1. Annual Carbon Emission Distribution (%) by Scope. Scope 2 (Electricity) accounts for 68% of the total footprint.

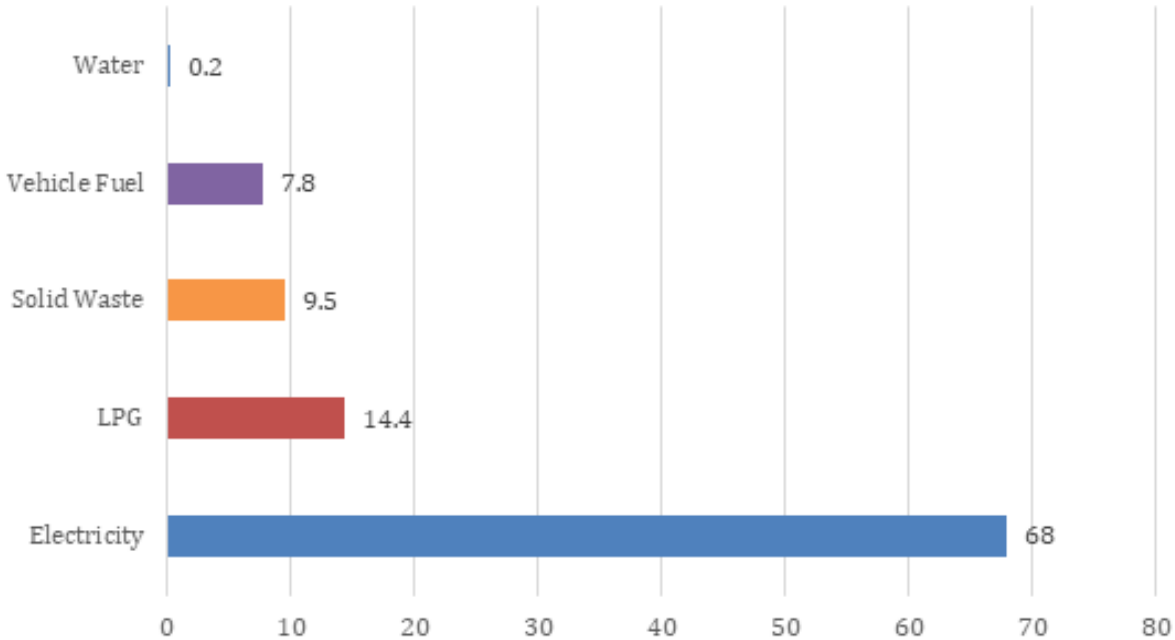


Fig.9.2. Major Contributors to Carbon Footprint (in %). Electricity and LPG are the most significant hotspots.

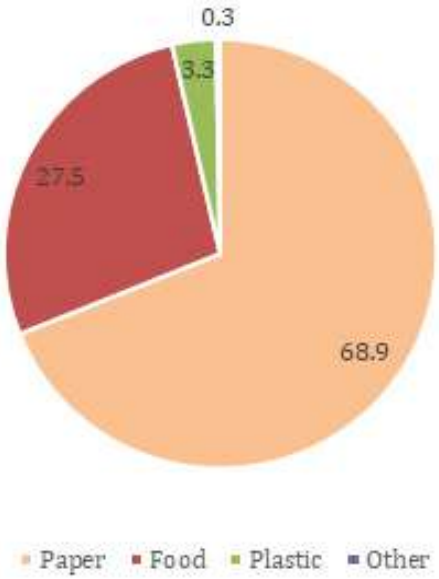


Fig.9.3. Composition of Campus Waste (in %). The high volume of paper waste represents a significant opportunity for reduction.

9.6.2 Per Capita Footprint

- Total Population : 2,778
- Net Carbon Footprint per Capita : 401,583.35 / 2778
- Result : 144.56 kg CO_2e / person / year (or 0.14 Tons)

9.6.3 Interpretation

1. **Low Per Capita Emission:** The per capita footprint of 0.14 Tons is exceptionally low compared to the Indian national average (approx. 1.8 Tons). This indicates highly efficient resource management and low energy intensity per student.
2. **Energy Dominance:** Electricity (Scope 2) accounts for 68% of the total footprint. This suggests that energy conservation measures in the MIM, Hostel, and Academic blocks will yield the highest reduction in carbon emissions.
3. **Fuel Efficiency:** Despite having 51 four-wheelers, the reported fuel consumption is relatively managed. The college's initiative of vehicle sharing (31 shared four-wheelers and 6 shared twowheelers) has reportedly avoided the consumption of significant fuel volumes, preventing massive potential emissions.
4. **Waste Impact:** Paper waste is significant (88.5 tons). Digitisation of academic records and doublesided printing policies could reduce Scope 3 emissions.

9.7 CONCLUSION

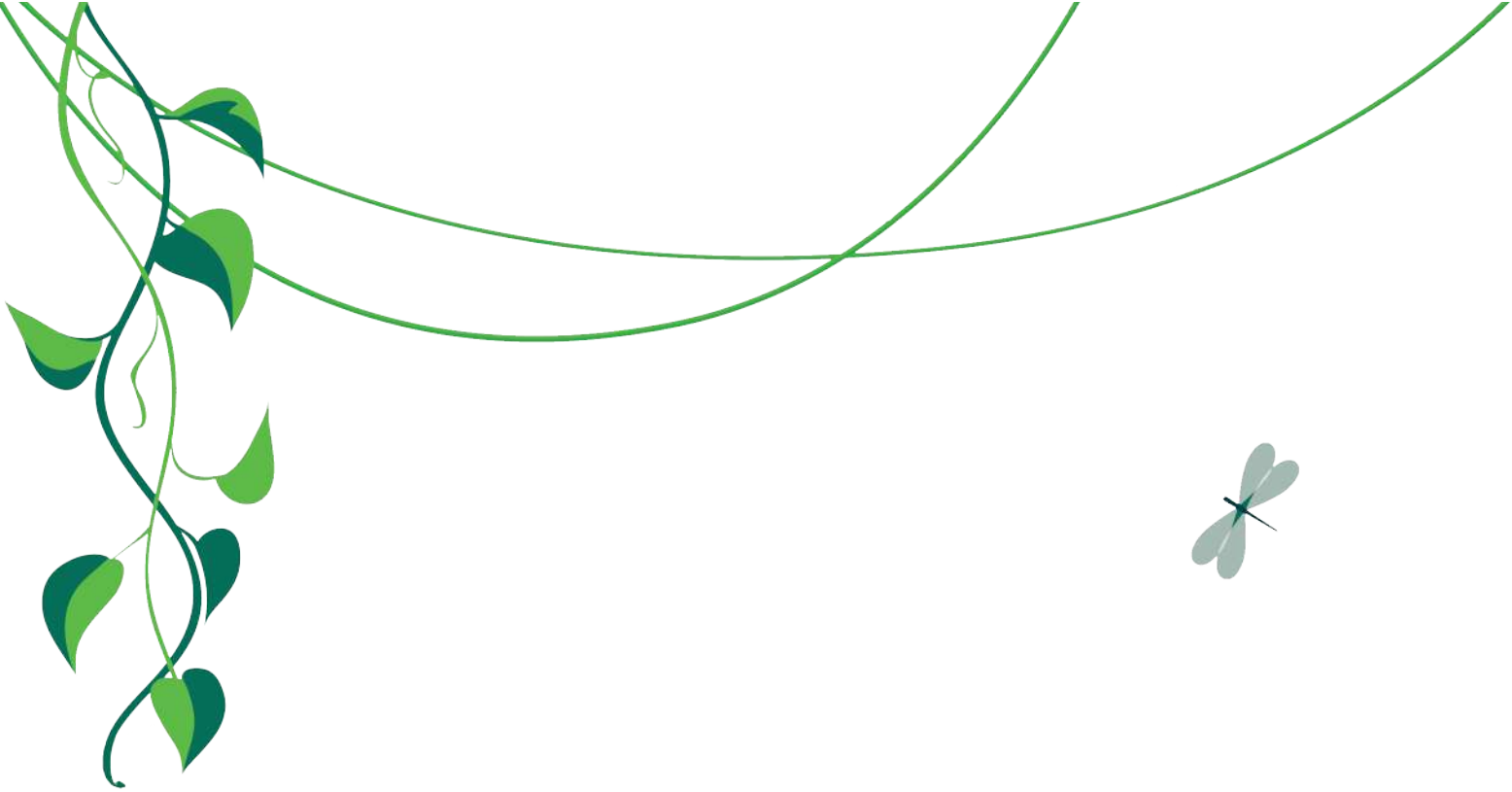
Marian College, Kuttikkanam, demonstrates a sustainable operational model with a Net Carbon Footprint of 401.58 Tons CO_2e. The presence of substantial biodiversity (555 trees) and active vehicle-pooling strategies contributes positively to this low baseline. Future sustainability efforts should focus on transitioning from grid electricity to on-site solar generation.

9.8 RECOMMENDATIONS

- Solar Expansion: Currently, solar energy offsets only ~4% of grid consumption (16,176 vs 392,028 kWh). Increasing solar capacity to utilise the available roof space could drastically lower the Scope 2 footprint.
- Biogas Implementation: With 35,317 kg of food waste generated, the college has high potential for a larger biogas plant. This would simultaneously reduce Scope 3 emissions (waste) and Scope 1 emissions (by replacing purchased LPG).
- Water Auditing in Hostels: The Hostel block consumes the vast majority of water (1.17 million litres). Leak detection and flow restrictors in hostels would reduce the indirect carbon cost of water pumping.

Chapter X

GENERAL CONCLUSION OF GREEN AUDIT & RECOMMENDATIONS



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

- Margaret Mead

10 General Conclusions & Recommendations

10.1 GENERAL CONCLUSION

10.1.1 SDG 3 Good Health and Well-being

The Occupational Health and Safety (OHS) Management System is aligned with ISO 45001 international standards, which provides a structured, risk-based framework to safeguard the well-being of the entire college community, including students, faculty, staff, and visitors. Central to this system is the maintenance of an up-to-date and accurate register of available support services and facilities, encompassing physical and mental health promotion, hygiene and sanitation practices, medical emergency response and first-aid provisions, as well as social welfare initiatives and legal protections. These services are systematically documented, delivered, and monitored to effectively address the evolving needs of the community. Furthermore, the college actively communicates the availability and access protocols of these services through multiple channels to ensure widespread awareness and utilisation. Implementation focuses on proactive emergency risk management, comprehensive health and environmental protection measures, and the continuous enhancement of infrastructure facilities to support a safe and resilient campus environment. Embracing an inclusive, participatory approach, the system integrates psychosocial support mechanisms, prioritises mental and emotional well-being, and promotes socioeconomic progress for all members of the community, fostering a culture of safety, equity, and holistic development in line with global best practices.10.2

10.1.2 SDG 6 Clean Water and Sanitation

The college boasts a robust and well-maintained water infrastructure, including efficient storage facilities, an extensive plumbing network, and a comprehensive distribution system tailored to fulfil the daily water requirements of its students, faculty, and staff.
The primary sources of water are two strategically constructed check dams that capture and store rainwater, serving as vital reservoirs to ensure a reliable supply throughout much of the year. While the campus occasionally experiences water shortages during peak summer months, these issues are mitigated by the seasonal closure of the institution for summer vacation, which significantly reduces consumption and allows stored rainwater to suffice without excessive drawdown. The college's water management policy and action plan is to further strengthen the existing Sewage Treatment Plant (STP) and enhance the quality of the treated effluent released from it. Recent water quality test reports confirm that the processed and filtered water meets potable standards, making it safe and suitable for drinking purposes, and it is responsibly distributed across the campus for various uses. The institution is actively developing plans to weave water conservation principles into the academic curriculum, while also

extending support to the surrounding community through regular water quality assessments and awareness programs. These forward-thinking initiatives are designed to instill practical skills in sustainable freshwater management, deepen students' understanding of conservation techniques, and cultivate a broader culture of responsibility toward preserving precious freshwater resources among the entire college community.

10.1.3 SDG 7 Affordable and Clean Energy

The college's Energy Management System (EMS) policy and comprehensive plan establish a robust, structured framework designed to advance sustainability goals while maintaining full compliance with **ISO 50001** standards for energy management systems. Regular energy audits rigorously assess the institution's current energy management practices, pinpointing actionable opportunities for enhancement in close collaboration with certified energy auditors. These evaluations also address critical concerns related to electrical infrastructure, system reliability, and adherence to safety protocols in line with Indian electrical safety regulations. In energy efficiency, the college maintains active partnerships with the Bureau of Energy Efficiency (BEE) and relevant electrical safety authorities. Ongoing initiatives include modernising energy conservation infrastructure, seamlessly incorporating renewable energy principles into academic curricula to foster student awareness and innovation, prioritising the adoption of energy-efficient star-rated appliances across campus facilities, and forging strategic collaborations with external experts and agencies to leverage specialised knowledge while creating valuable experiential learning opportunities for students. Although targeted solar energy production has yet to deliver immediate substantial outputs, necessitating infrastructure revamping and upgrades, proactive efforts are underway to identify and pursue promising investment avenues in diverse alternative and renewable energy sources. These endeavours align with the college's long-term vision of establishing a carbon-neutral campus, thereby contributing to broader environmental stewardship and sustainable development objectives.

10.1.4 SDG 12 Responsible Consumption and Production

The college is steadfastly committed to a holistic waste management system, driven by the collective participation of students, faculty, staff, and the wider campus community. This system strictly adheres to a rigorous green protocol, bolstered by dedicated volunteer-led initiatives that promote environmental stewardship and collective responsibility. The program prioritises waste reduction at the source, efficient recycling of materials, and meticulous systematic documentation of waste generation patterns to enable data-driven improvements and continuous monitoring. In recent years, the college has significantly expanded its efforts by incorporating innovative strategies such as enhanced on-campus composting, awareness campaigns for behaviour change, and participatory projects that integrate sustainability into academic curricula and extracurricular activities. These advancements not only strengthen academic development through real-world experiential learning but also deepen community engagement by encouraging active involvement from all stakeholders.

To further amplify impact, the institution is actively increasing the number of source segregation points across the campus, ensuring clear categorisation of waste streams (e.g., biodegradable, recyclable, and non-recyclable) right from the point of disposal. Complementing this, a structured documentation system tracks the quantity and types of waste generated, with segregated recyclables and other recoverable materials handed over to authorised external agencies. This approach not only diverts substantial waste from landfills but also generates monetary benefits through the sale of recyclables, creating a self-sustaining financial incentive that supports ongoing green initiatives and reinforces the college's dedication to circular economy principles and long-term environmental sustainability.

10.1.5 SDG 15 Life on Land

Biodiversity stands as a paramount priority for our college, perched at an elevation exceeding 1000 meters above sea level in the ecologically sensitive Western Ghats region of Kerala. This high-altitude setting naturally harbours the potential for rich species diversity, yet ongoing campus construction, extensive landscaping, increasing human activity, and habitat fragmentation have contributed to noticeable declines in biodiversity, particularly evident in reduced bird populations and tree abundance. To effectively counteract these pressures and build long-term ecological resilience amid escalating climate challenges, the institution must substantially ramp up investments in campus biodiversity enhancement while embedding climate-

adaptive practices into its core operations. A targeted tree-planting and shrub campaign could prioritise native species with narrow canopies, which facilitate better light penetration to understory plants, support diverse bird foraging and nesting opportunities, and contribute efficiently to carbon sequestration through rapid growth and root systems. Complementing this, rigorous preservation and scientific maintenance of existing mature trees would safeguard established carbon sinks and provide continuity for wildlife corridors. Creating dedicated native plant gardens and restoring patches with endemic flora would nurture local ecosystems, boost pollinator and insect populations, optimise water efficiency through drought-resistant species suited to montane conditions, and minimise long-term maintenance demands compared to conventional exotic landscaping. Furthermore, installing thoughtfully designed habitats such as birdhouses and nesting boxes tailored to regional avian species, vibrant pollinator gardens rich in nectar-producing natives, and small constructed wetlands or rain gardens would actively promote species diversity, enhance ecological connectivity, and strengthen overall campus ecosystem health. Introducing sustainable agriculture initiatives on suitable campus plots could simultaneously advance food security for students and staff, slash the institution's carbon footprint by reducing food transport emissions, and introduce additional biodiversity hotspots through organic, polyculture farming that supports beneficial insects and soil microbes.

To deepen institutional commitment, the college should actively pursue research collaborations focused on inventorying local flora and fauna, monitoring endangered or endemic species characteristic of high-elevation Western Ghats habitats, and evaluating climate change impacts, such as shifting rainfall patterns or temperature regimes on campus ecosystems. Partnerships with local environmental NGOs, biodiversity boards, or research bodies would amplify these efforts, enabling joint species monitoring programs, habitat restoration projects, and community outreach to extend conservation benefits beyond campus boundaries. By strategically implementing and integrating these multifaceted initiatives, the college can transform its grounds into a thriving biodiversity refuge, significantly elevate ecological resilience, and exemplify sustainable stewardship in one of India's most precious ecological hotspots.

10.1.6 SDG 13 Climate Action

The institution's carbon footprint assessment reveals total Scope 1 emissions from fossil fuels at 92.09 tCO_2e, Scope 2 emissions from electricity consumption at 281.48 tCO_2e, Scope 3 emissions from waste at 0.45 tCO_2e, and Scope 4 emissions associated with water usage at 40.22 tCO_2e. This results in a net annual institutional carbon footprint of 401.58 tCO_2e, equivalent to approximately 0.145 tCO_2e per capita (or 144.56 kg CO_2e per person per year) across a student and staff population of 2,778. On-campus tree cover, comprising 555 documented trees, currently sequesters an estimated 12.21 tCO_2e annually, partially offsetting emissions. To advance climate resilience and biodiversity, the college should prioritise the establishment of native plant gardens, creation of wildlife habitats (such as pollinator gardens, birdhouses, promotion of community and sustainable agriculture initiatives, and active participation in ecosystem research and monitoring. Strengthening partnerships with local environmental organisations for habitat restoration, species conservation, and climate impact studies will further enhance ecological health. By systematically implementing these measures alongside continued optimisation of renewable energy adoption and shared mobility practices, the institution can meaningfully reduce its carbon footprint, bolster biodiversity, and demonstrate strong leadership in addressing climate challenges.

10.2 GENERAL RECOMMENDATION

- Energy Management System (EnMS), aligned with ISO 50001 guidelines where feasible, should prioritise a structured approach to energy performance improvement. This includes conducting an initial energy review to establish a baseline, identifying significant energy uses (e.g., lighting, HVAC, appliances), and setting measurable targets for reduction. Key measures involve adopting energy conservation practices, replacing outdated equipment with energy-efficient alternatives (such as LED lighting, 5-star rated appliances, and variable frequency drives), promoting renewable energy sources like rooftop solar PV systems, and upgrading infrastructure (e.g., insulation, smart metering, and energy-efficient building designs). Annual activities should include thorough inspection and maintenance of earth pits for grounding safety, evaluation of alternative/renewable energy

installations (e.g., solar panels, wind, if applicable), and verification of electrical room safety in line with relevant standards such as those from the Bureau of Energy Efficiency (BEE) in India. Comprehensive annual risk assessments for energy-related hazards and opportunities must be performed, with findings integrated into the EnMS documentation, action plans, and continual improvement cycles. Progress should be tracked through phased rollouts (e.g., pilot in high-consumption buildings first), supported by regular internal audits and periodic external audits/certification to ensure compliance, identify deviations, and drive ongoing enhancements.

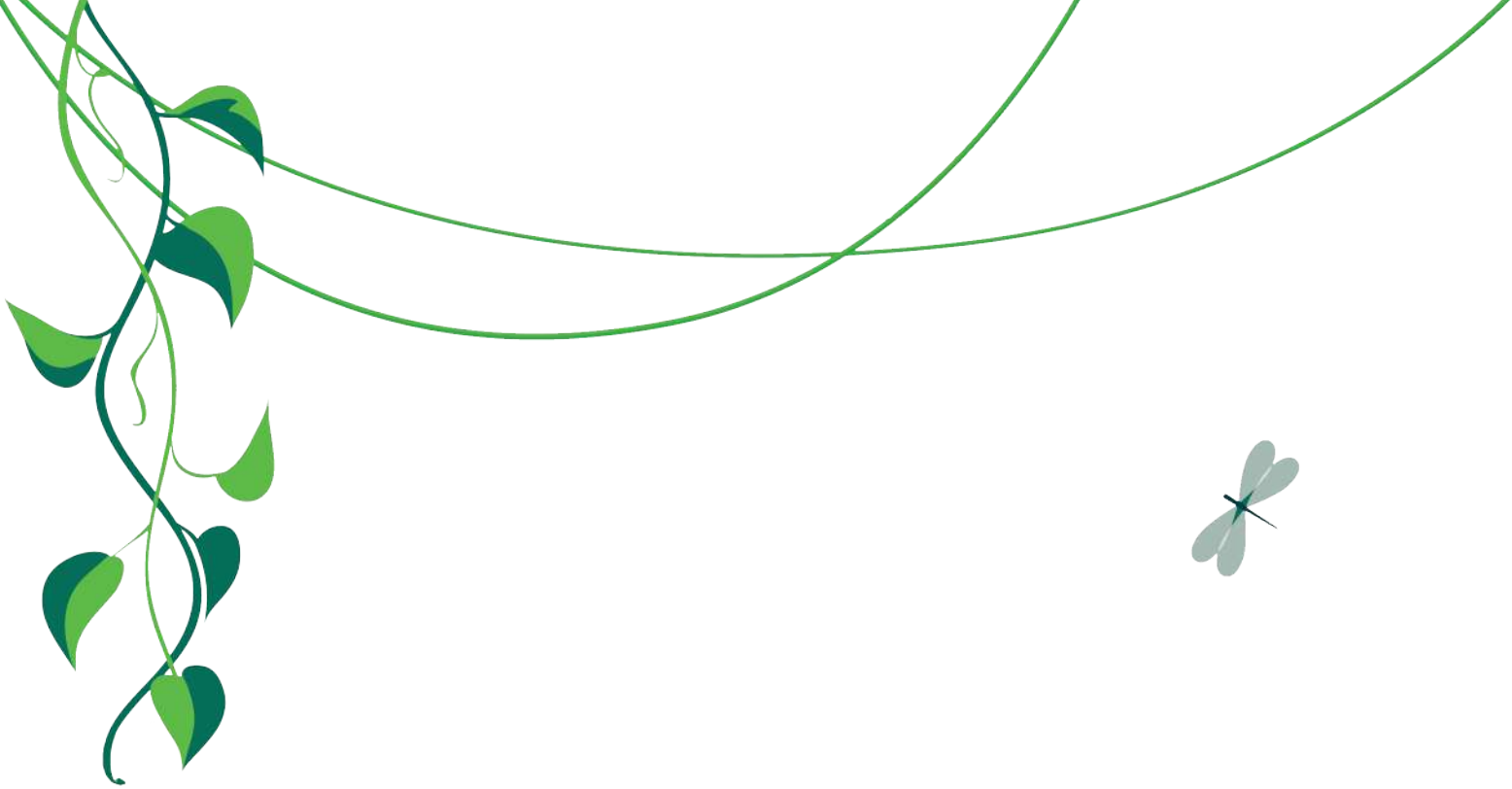
- Enhance Information, Education, and Communication (IEC) programs by engaging a broad range of stakeholders, including students, faculty, staff, parents, alumni, and the local community in awareness campaigns, workshops, and hands-on activities focused on resource conservation and sustainable behaviours. Empower students to lead initiatives by incorporating innovative, low-cost energy-saving technologies into academic projects, internships, research, or extracurricular efforts (e.g., developing IoT-based energy monitors or solar-powered devices). Foster collaboration through inter-institutional partnerships to host techno-fests, hackathons, sustainability challenges, and idea-exchange forums that promote interdisciplinary teamwork, innovation, and knowledge sharing. Under faculty mentorship, students should be encouraged to propose and prototype scalable, cost-effective solutions emphasising energy efficiency, with opportunities for pilot testing on campus and documentation of outcomes for broader dissemination.

- Implement water conservation strategies, starting with detailed water audits and budgeting to identify high-usage areas (e.g., hostels, landscaping) and set reduction targets. Launch targeted awareness campaigns, signage, and behavioural nudges to minimise wastage. Expand rainwater harvesting infrastructure—such as rooftop collection systems, recharge pits, and storage tanks—to capture and store sufficient volumes for non-potable needs, including irrigation, flushing, and integration with Sewage Treatment Plants (STPs) for treated water reuse. Actively pursue research and pilot projects on grey water quality assessment, advanced treatment technologies (e.g., constructed wetlands, slow sand filters, or membrane systems), and reuse applications (e.g., for gardening or cooling towers). Develop an integrated water resource management model that combines harvesting, recycling, efficient fixtures (low-flow taps, sensor-based systems), leak detection, and monitoring to achieve measurable reductions in freshwater consumption and wastewater generation.
- To promote biodiversity on campus, install QR code labels on trees and shrubs linking to detailed species information, and place educational boards with photographs, scientific names, and ecological roles of common flora and fauna at strategic locations. Encourage participatory science projects among students, faculty, and staff, such as regular birdwatching drives, insect surveys, butterfly monitoring, plant phenology tracking, and biodiversity inventories using apps or citizen science platforms. Install and maintain nesting boxes, bird feeders, insect hotels, and pollinator gardens to support local wildlife, especially during breeding seasons and adverse weather. Strengthen community engagement through outreach programs, volunteer tree-planting drives, biodiversity workshops, school partnerships, and public events. Launch an on-campus initiative, rose garden, produce varieties of rose products, and serve as an educational tool for sustainable agriculture and entrepreneurship.

- Sustain and evolve responsible waste management practices through a dynamic, adaptive, comprehensive plan that incorporates emerging technologies, regulatory updates, and campus-specific challenges. Conduct regular system reviews (e.g., quarterly or biannually) involving stakeholder feedback for continuous improvement and alignment with circular economy principles. Mandate monthly segregation and collection of e-waste, with accurate record-keeping of volumes, sources, and disposal/recycling through authorised channels to comply with E-Waste Management Rules and prevent informal handling risks. Integrate composting for organic waste, upcycling for recyclables, and awareness drives to achieve higher diversion rates from landfills, while exploring waste-to-energy synergies for campus use.

Chapter XI

BEST PRACTICES OF ENVIRONMENT MANAGEMENT SYSTEM (EMS)



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

- Stewart Udall

11

Best practices of Environment Management System (EMS)

Weather Updates for farmers by Dr. Jacob Bose (faculty member): There is a community-based weather forecasting initiative led by Dr. Jacob Bose, a faculty member, that started in 2016 to support farmers. Using forecasts based on the ECMWF model with Copernicus and NOAA data, the initiative began as a personal hobby using a Personal Weather Station. It gained wide recognition after accurately anticipating the trajectory, rainfall, and wind patterns of Cyclone Ochi in 2016. What started as informal updates in WhatsApp groups has now evolved into a WhatsApp community with around 6,000 users. The platform provides periodic forecasts, region-specific weekly updates, and widely shared content, enabling farmers to reduce input costs, improve disease and plantation management, enhance crop quality, and make better financial planning decisions by anticipating weather-related risks.

Tendrils

1. A significant collaborative initiative between the Union Rural Self Employment Training Institute (RSETI), Idukki and Marian College Kuttikkanam (Autonomous) was the establishment of the Souhrudam Tailoring and Dress Designing Unit. This programme successfully imparted essential skills and practical knowledge in tailoring and dress designing, while also promoting skill development, entrepreneurship, and financial literacy.

The initiative marked a major milestone in women empowerment, as participants emerged confident, motivated, and equipped to pursue economic independence and self-reliance in the tailoring sector. The programme strongly reinforced the belief that "learning with ambition can create transformative change", opening pathways to new opportunities and a brighter future for the beneficiaries.

Subsequently, the trained women were extended institutional support to establish their own entrepreneurial venture on campus, named "Tendrils." The unit now undertakes bulk tailoring orders, including the stitching of convocation gowns for graduating students of Marian College, as well as for students from neighbouring colleges. This transition from skill training to a sustainable enterprise highlights the long-term impact and success of the initiative.

2. MHAT (Mental Health Action Trust)

A community-focused initiative dedicated to promoting

mental health awareness and providing accessible mental health care services. It works to reduce stigma associated with mental illness through education, early intervention, and community engagement.

In collaboration with institutions and local health systems, MHAT offers clinical support, counselling services, and outreach programmes, especially at the grassroots level. Through its partnership with Marian College, Kuttikkanam (Autonomous), MHAT has initiated the establishment of a Community Wellness Centre, providing regular clinical services and strengthening mental health support within the community.

MHAT emphasizes a collaborative and preventive approach, involving local health workers and institutions to ensure sustainable mental health care and improved community well-being.

3. **The Sustainability Ambassador Programme (SAP)** is an initiative of the Marian Centre for Sustainable Development, aimed at fostering environmental awareness and responsible citizenship among students and the wider community. The programme is led by Dr. T. V. Muralivallabhan, Director of the Centre, along with a team of like-minded faculty members and students who act as Sustainability Ambassadors.

SAP is designed to create basic yet critical awareness about the environment in which we live, with the belief that informed awareness can lead to self-designed action programmes at the individual, family, and institutional levels. In the context of a rapidly expanding consumerist lifestyle, the programme encourages participants to rethink their mindset, values, and everyday practices in relation to sustainability.

The programme typically begins with a detailed and descriptive PowerPoint presentation, delivered at the host institution, explaining the "why", "how", and "what" of ecology and environmental concerns. The content is grounded in authoritative research and publications and presents a holistic understanding of environmental challenges. The presentation also highlights both preventive and curative measures to address these challenges.

Following the presentation, participants engage in a sharing session, where they reflect on their own experiences and perspectives. This interactive exchange enriches the discussion and deepens collective understanding. The programme then moves into a clarification and dialogue session, during which presenters and participants jointly deliberate on practical ways forward and work towards framing context-specific action programmes.

To date, more than 20 SAP sessions have been successfully conducted across Marian College as well as in other institutions, including schools and colleges, contributing to the creation of a growing network of environmentally conscious individuals and institutions.

4. **Research:** Paper publications, Book and book chapters; final year UG and PG projects, PhD titles etc are focused on promoting sustainability. List of Scopus indexed publications are attached: (Sustainability related topics are highlighted

Sustainability-related topics are highlighted:

Title of the Paper
Examining the Sustainable Integration of Artificial Intelligence in Human Resource Digitalization in the Context of Industry 4.0; Examinando la integración sostenible de la inteligencia artificial en la digitalización de los recursos humanos en el contexto de la Industria 4.0
Lasso and Ridge regression: a comprehensive review of applications and developments in machine learning
The universal tongue: Charting the rise of english as a Lingua Franca through bibliometrics
Structural, spectral, dielectric, and nonlinear optical properties of 2,4,6-Trinitrophenol with optical limiting behavior
Bridging quantum and computation: A bibliometric analysis of machine learning in quantum chemistry
ResBiA-FusionNET: A Robust Deep Learning Framework with Harmonic-Contrast Mel Spectrogram for Audio Sound Classification
Planning sustainable futures: critical drivers of success in the global context
The persistence of originality: will AI blur or brighten the line between inspiration and imitation?
Reflections on Green Purchase Behaviour in the Era of COVID-19: A Conceptual Framework
A Gauss Hypergeometric-Type Model for Heavy-Tailed Survival Times in Biomedical Research
Rethinking assessment: how AI is changing the way we measure student success?
Extended Slash Modified Lindley Distribution to Model Economic Variables Showing Asymmetry
Beyond degrees: redefining higher education institutions as ethical AI hubs
EXPLORING THE IMPACT OF HYBRIDIZATION ON BIODIVERSITY: A BIBLIOMETRIC ANALYSIS AND VISUALIZATION OF RESEARCH TRENDS
A novel discrete slash family of distributions with application to epidemiology informatics data
Design and Analysis of Reliability Sampling Plans Based on the Topp–Leone Generated Weibull Distribution
Probing the effects of pH and sintering temperature on the structure and magnetic properties of La0.833Ag0.167MnO3
Bibliometric Mapping of Social Media Banking: Analyzing Research Trends and Developments
Development and Validation of a Scale to Measure Glass Ceiling Among Women Employees in the Banking Sector
Revisiting the Push–Pull Tourist Motivation Model: A Theoretical and Empirical Justification for a Reflective–Formative Structure

Deep Learning Driven Anomaly Detection in Social Graphs by Using Anti-Corona Political Optimization
Crop Leaf Disease Prediction Using Graph Diffusion TCN with Fibroblast Optimization
Machine Fault Diagnosis Using Random Forest with Recursive Feature Elimination and Cross Validation
Wavelet Aided Multi Task Transformer for Sugarcane Leaf Disease Prediction
A scientometric analysis of bibliotherapy: mapping the research landscape
AI unleashed: will it empower us and promote social independence, or enslave us?
Predicting crime or perpetuating bias? The AI dilemma
Mapping knowledge landscapes in influencer marketing and social media: A scientometric perspective
Analyzing the academic discourse on RPA in banking: A bibliometric approach
The unseen dilemma of AI in mental healthcare
The illusion of understanding: AI's role in cognitive psychology research
Biases within AI: challenging the illusion of neutrality
Deep Learning Architectures for OCT Images Retinal Disease Classification
Validation and testing of a measurement model for the assessment of agripreneurial competencies
A Hybrid CNN-Transformer Deep Learning Framework with Convolutional Block Attention Module for Enhanced Gastrointestinal Endoscopy Analysis
Electrifying the Road: A Comprehensive Analysis of Factors Influencing Consumer Adoption of Electric Vehicles
Exploring the Intersection of Brands and Linguistics: A Comprehensive Bibliometric Study
The Rise of Open Banking: A Comprehensive Analysis of Research Trends and Collaborative Networks
Integrating Artificial Intelligence with NHEQF Descriptors for Pedagogical Excellence
New discrete trigonometric distributions: estimation with application to count data
Outsourcing cognition: the psychological costs of AI-era convenience
Inclusive pedagogies in multilingual classrooms: teachers' perspectives on supporting students with learning disabilities
Cognitive offloading or cognitive overload? How AI alters the mental architecture of coping
The compassion illusion: Can artificial empathy ever be emotionally authentic?
Impact of RISE Model on Scholastic and Holistic Development of Undergraduate Social Work Students: A SoTL Study
A Self-Supervised Contrastive Learning Approach for Detecting Deepfakes in Medical CT Scans
Whose bias gets coded? Psychology's role in decolonizing AI
FEDERATED LEARNING-DRIVEN AI MODEL FOR DECENTRALISED ANALYSIS OF OXIDATIVE STRESS INDICATORS IN GENOMIC DATA

The brush is dead, long live the prompt: how AI is rescripting creativity
Repositioning intellectual disability in the ethics of digital mental health technologies
Swipe, click, regret: an opinion on persuasive e-commerce and consumer autonomy
Between access and anxiety: the paradox of digital mental health literacy
The Algorithmic Alibi: why we trust machines to absolve our moral failures
Framing emotions: using cinema as a tool for emotional intelligence in education
A New Versatile Discrete Distribution for Censored Data: Frequentist and Bayesian Methods With Real-Life Applications
Chasing the digital high: should hedonic consumption be viewed through the lens of behavioral addiction?
Digital decay: when AI eats its own homework
Exploring the role of social media in artrepreneurship: initial empirical insights
Digital silence: the psychological impact of being shadow banned on mental health and self-perception
Impact of social media influencer marketing on customer purchase intention in the fashion industry: a systematic literature review
Mitigating distraction: interactivity and atmospherics in social commerce
The generative illusion: how ChatGPT-like AI tools could reinforce misinformation and mistrust in public health communication
The silence curriculum: emotional neglect in schools as a hidden psychiatric risk
Emotional AI and the rise of pseudo-intimacy: are we trading authenticity for algorithmic affection?
From tools to co-learners: entangled humanism and the co-evolution of intelligence in AI education
Mindfulness, rebranded: the silicon sedation of dissent
Your algorithm has my accent, but not my permission
A comparative study of bayesian and classical methods for the weighted Lindley distribution under unified hybrid censoring with survival data applications
Digital anthropomorphism and the psychology of trust in generative AI tutors: an opinion-based thematic synthesis
MODEL AGNOSTIC META LEARNING – LONG SHORTTERM MEMORY FOR LEARNING STYLE CLASSIFICATION
Curiosity zones: resisting epistemic automation
Cognitive alignment in cardiovascular AI: designing predictive models that think with, not just for, clinicians
Neuroimmunological impact of media-induced stress: rethinking inflammation and brain-immune crosstalk
Designing for dignity: ethics of AI surveillance in older adult care
Reimagining digital mental health literacy from the Global South: a call for epistemic justice and innovation equity
Epistemic authority and generative AI in learning spaces: rethinking knowledge in the algorithmic age

Social Media as a Catalyst for Digital Entrepreneurship: A Scientometric Review and Visualization Using Citespace, VOSviewer and Biblioshiny; Las redes sociales como catalizador del emprendimiento digital: una revisión y visualización cienciométrica utilizando Citespace, VOSviewer y Biblioshiny
Digital silence: how algorithmic censorship undermines academic freedom in the Global South
Beyond personalization: autonomy and agency in intelligent systems education
Redefining communication in mental healthcare: generative AI for neurodivergent equity and non-verbal autistic inclusion
A Comprehensive Bibliometric Analysis of Voice Commerce Research: Trends, Contributions, and Collaborations
Effect of tantalum doping on dielectric, ferroelectric and piezoelectric properties of lead-free strontium bismuth titanate ceramics
The gaze that doesn't blink: how AI reconstructs desire in digital culture
A decade of subnational gender budgeting and its effects in India: A difference-in-differences analysis
The syntax of power: how large language models recode social hierarchies
Mapping the Scientific Landscape of Social Media's Role in Digital Health: A Bibliometric and Network Analysis Using Biblioshiny, VOSviewer and Citespace; Mapeo del panorama científico del papel de las redes sociales en la salud digital: un análisis bibliométrico y de redes utilizando Biblioshiny, VOSviewer y Citespace
Sign language is not a dataset: Rethinking AI's approach to deaf communication
Algorithmic bias in public health AI: a silent threat to equity in low-resource settings
FROM MEDICINAL PLANTS, ANIMALS AND MICROORGANISMS TO MODERN MEDICINE: A BIBLIOMETRIC ANALYSIS OF PHARMACOGNOSY RESEARCH, TRENDS AND COLLABORATIONS
Optimized Task Scheduling and VM Allocation in Cloud Computing Using PPMMcNE and RSMBO Algorithms
The Hashtag Health Revolution: A Bibliometric Study of Social Media in Health Literacy
The algorithmic self: how AI is reshaping human identity, introspection, and agency
AI-powered creative stimulus: the ascent of virtual virtuoso entrepreneurship
Digital storytelling and the pedagogy of belonging: reimagining inclusion in higher education
Mapping Research on mHealth and Wearable Technologies in Sports and Gaming: A Bibliometric and Visualization Approach (2005–2025)
When machines decide: the quiet death of judgment at work
Emotional literacy as curriculum: a new paradigm for resilient classrooms
Antifeminism as moral governance in India: caste, religion, and the political erasure of queer and Dalit lifeworlds
Rebranding empire in the age of generative AI
Alcohol and social drinking norms as a catalyst between tourist motivation and tourist satisfaction

Visualizing the Full Spectrum Optimization of K-Nearest Neighbors From Data Preprocessing to Hyperparameter Tuning and K-Fold Validation for Cardiovascular Disease Prediction
Unseen suffering: the urgent need for gender-affirming pain and mental health management for transgender individuals in India
Integrating virtual reality into ADHD therapy: advancing clinical evidence and implementation strategies
The cognitive paradox of AI in education: between enhancement and erosion
From Tweets to Trends: Bibliometric Insights on Social Media and Knowledge Management
Digital wellness or digital dependency? a critical examination of mental health apps and their implications
Placing spiritual capital in sustainable development frameworks
Daily PM10 Prediction of Thiruvananthapuram City and Interpretability Analysis of Influencing factors
Geopolitical shockwaves: the Russia-Ukraine war's impact on BRICS financial markets
The power duo: unleashing cognitive potential through human-AI synergy in STEM and non-STEM education

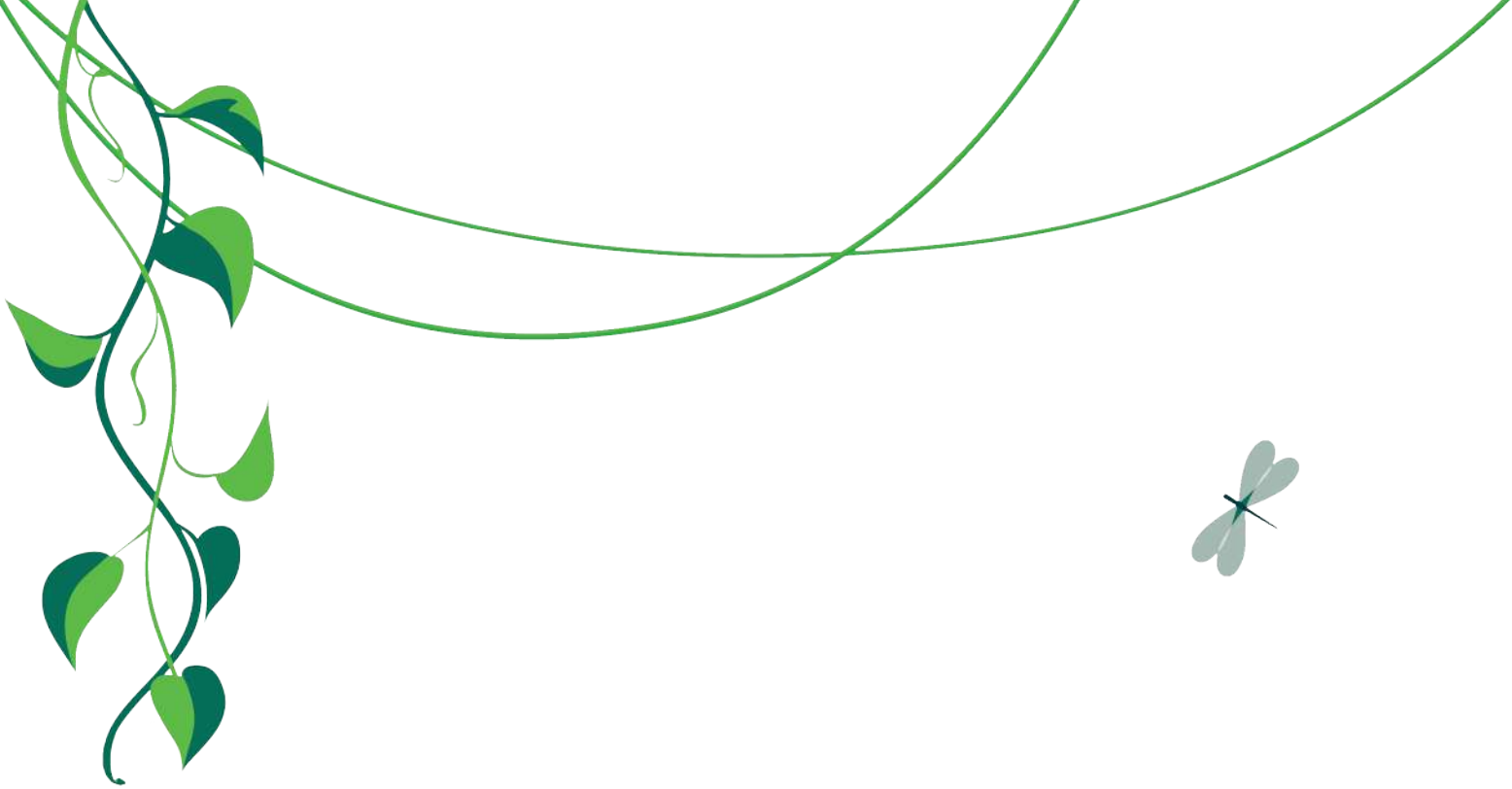
Title of the Book / Chapter published
How a Flexible Mindset Unlocks Work-Life Balance and Mindfulness: Insights from Kerala's Bank Managers

Nanomaterials and Composite/Hybrids in Energy Storage Systems
Quantum Computing in Digital Marketing: The Next Revolution
Rationality in Changing Online Purchase Decisions: The Impact of Robotic Process Automation Among Youngsters
A Comprehensive Exploration of Water Purification Using Nanomaterials
Bayesian Methods in Marketing: A Bibliometric Examination of Trends and Patterns
Customer satisfaction in indigenous telecommunication companies in nigeria: Role of service quality
Mapping the Evolution of Social Accounting: A Comprehensive Bibliometric Analysis
Pyramid Supply Chain Model for Cardamom and Black Pepper in Idukki Dist Kerala, India: Review
The Mediating Role of Brand Preference on the Sustainable Buying Behaviour of Branded Organic Food

The Role of Women Empowerment in Promoting Gender Equality and Economic Advancement
The Last Tribal Kingdom: Governance and Sustainability Lessons from the Mannan Tribes of Idukki District in Kerala
Towards Sustainable Development: Unveiling the Synergies of Industry 4.0, Quality Management, and Supply Chain Management Through SCQM 4.0
Revolutionizing Circular Business Practices with Waste Reduction and Resource Optimization
Impact of Financial Development on Economic Growth in Developing Countries
LuxSense: Leveraging Machine Learning to Classify Streetlight Illumination Levels Using Geospatial and Infrastructure Data in Urban Streetlight Networks
Decryption of Cybernetic Veil Using Fernet64: A Semantic Cryptographic Method
Deep Learning-Driven Facial Emotion Recognition with GANs for Optimizing Student Learning
Residual-Based Hybrid Deep Learning Model for Anomaly Detection in Wireless Sensor Networks
A Comprehensive Exploration of Water Purification Using Nanomaterials
Hybrid CNN-LSTM Model for Predictive Career Guidance and Entrepreneurial Development in Higher Education
From Waste to Wellness: Circular Economy Strategies for the Indian Healthcare Industry
Blind De-Blurring Scale-Aware Quaternion Core Components and Binary Spiking Network based Keratinocytic Skin Cancer Detection on Facial Images
Sleep EEG Signal Analysis using Graph Embedding Simplicial Convolutional Recurrent Attention Network with Duck Swarm Algorithm
Enhancing Performance and Interpretability on Small Imbalanced Datasets: A Case Study Using SMOTE and SHAP
Sustainable Polymer Composites: Classification and Its Applications
Weaving a Sustainable Future: Social Determinants, Digital Literacy and Tribal Well-Being
Optimizing Pricing Strategies: A Comprehensive Framework Using Bayesian Inference and Game Theory
Leveraging Deep Learning for Spice Identification: A Comparative Study of AlexNet, VGGNet, and YOLO

Chapter XII

EXECUTIVE SUMMARY

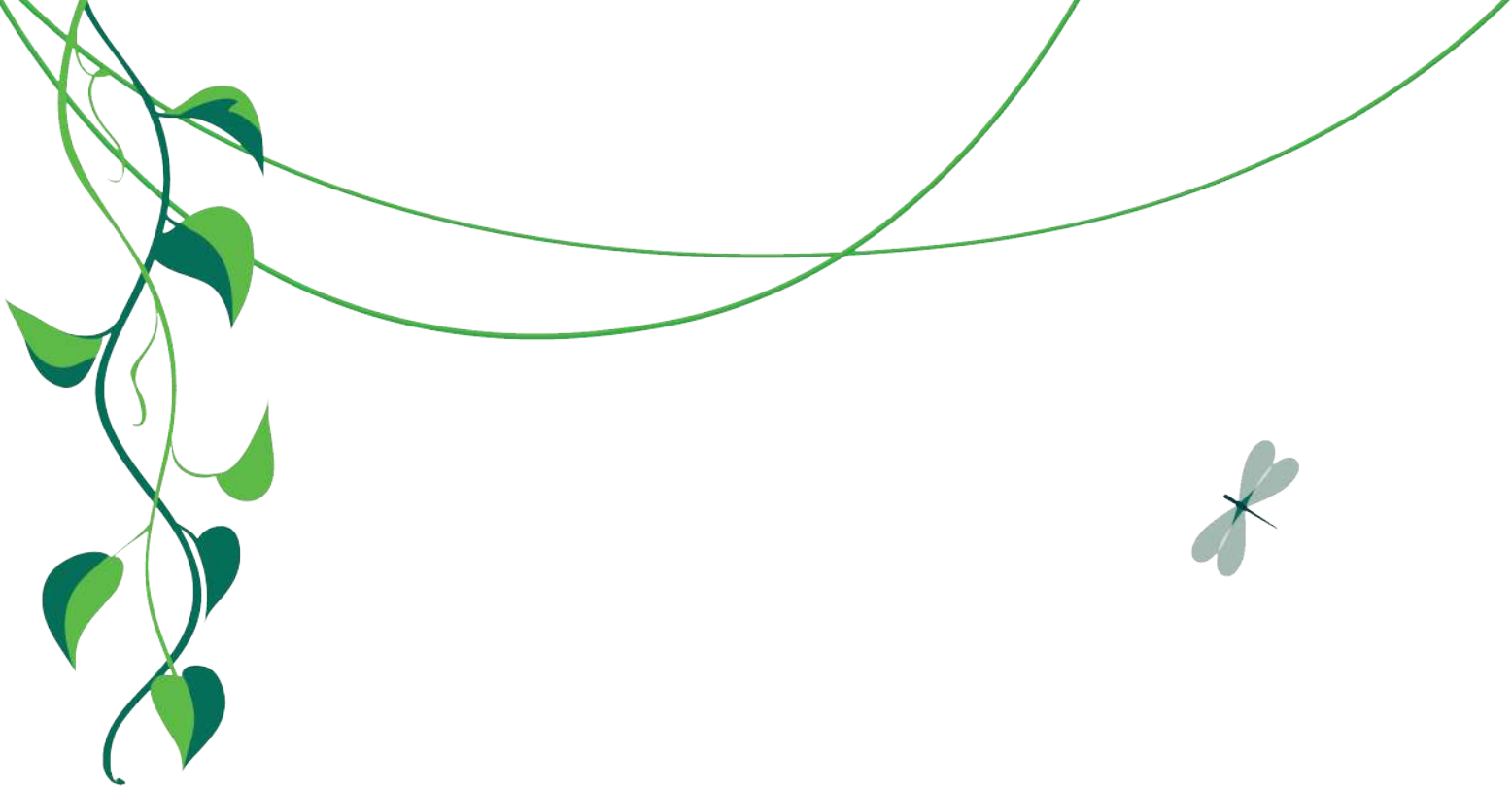


There is no such thing as away.
When we throw anything away
it must go somewhere

- Annie Leonard -

EXECUTIVE SUMMARY

Marian College Kuttikkanam demonstrates a strong sustainability-oriented institution, including a notably low Energy Performance Index (EPI), high power factor, good supply quality and efficient water management, with per capita water consumption of 88.87 litres per day, well below national standards, and no significant leakage or wastage. However, opportunities for improvement remain, as electricity consumption is high and rising due to outdated appliances (particularly in the Guesthouse) and underutilisation of the 80 kVA solar installation, which has not exported power or reduced bills over the past three years. Minor power quality issues, including harmonic distortion and phase imbalance, can be quickly addressed through low-cost measures such as APFC tuning, rebalancing, and thermographic corrections. Waste management shows high paper waste generation (88,529 kg annually) and substantial food waste (35,317 kg), with potential for improved segregation, record-keeping, and diversion of food waste to biogas production rather than external disposal. Water efficiency could be enhanced by installing block-level flow meters and expanding the sewage treatment plant's reuse capacity to mitigate peak-season scarcity. Biodiversity, despite the campus's location in the ecologically sensitive Western Ghats, remains low due to habitat fragmentation, construction, and human activity, though 555 trees currently sequester 12.21 tCO_2e annually. The institution's net carbon footprint stands at 401.58 tCO_2e (0.145 tCO_2e per capita). Prioritising energy-efficient upgrades, effective solar utilisation, native planting, wildlife habitat creation, waste reduction strategies, and partnerships with local environmental organisations will further strengthen the college's commitment to climate action, biodiversity conservation, and sustainable campus operations.



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

- David Suzuki

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