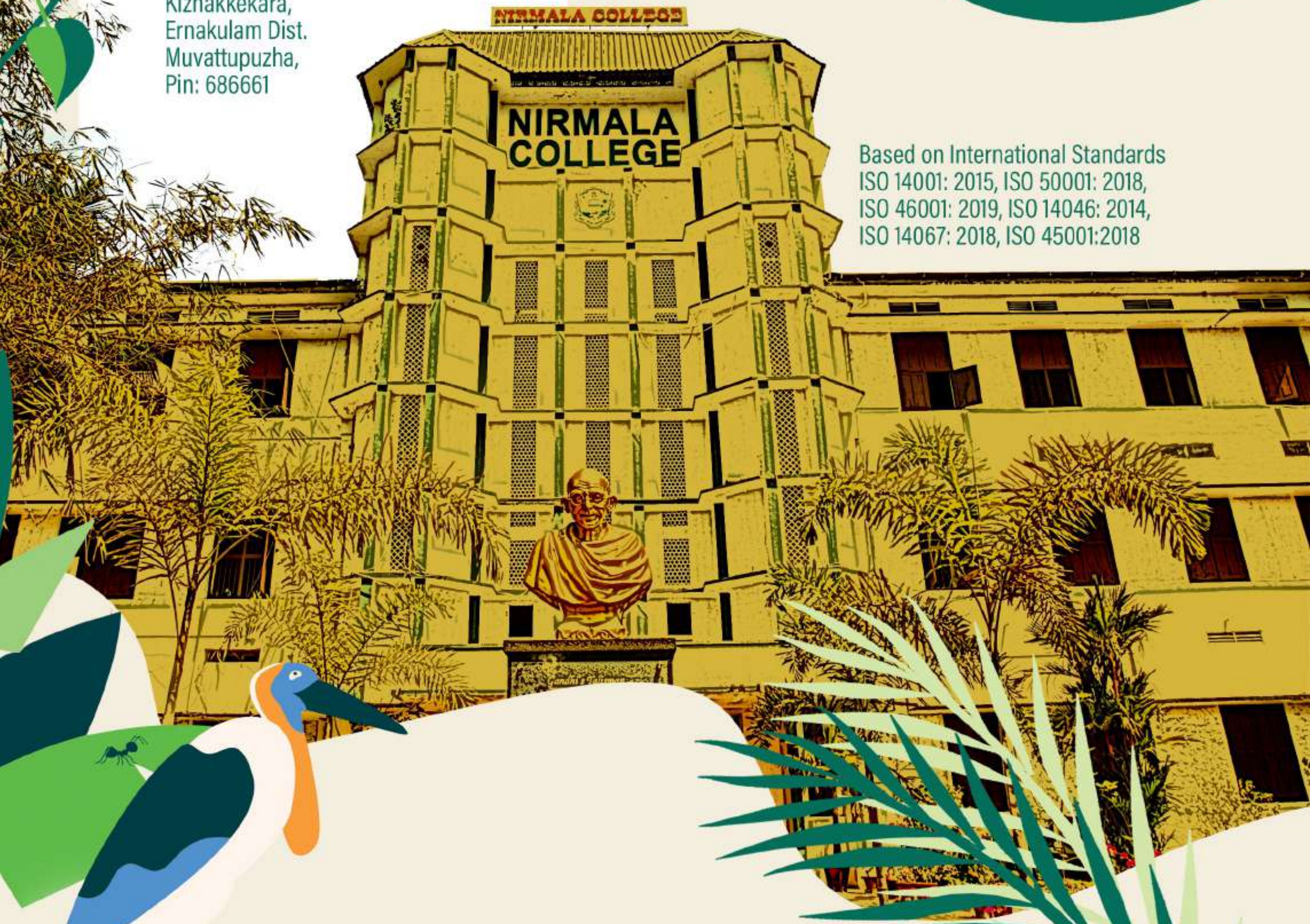
REPORT OF GREEN AUDIT

Nirmala College Muvattupuzha (Autonomous)

Kizhakkekara,
Ernakulam Dist.
Muvattupuzha,
Pin: 686661



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

TIES

NIRMALA COLLEGE
MUVATTUPUZHA AUTONOMOUS

REPORT OF GREEN AUDIT

Based on International Standards

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

Auditee

Nirmala College Muvattupuzha (Autonomous)

Kizhakkekara, Ernakulam Dt. Muvattupuzha, Pin: 686661

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Affiliated to Mahatma Gandhi University

Auditor

Tropical Institute of Ecological Sciences

ISO 9001:2015 Certified organization; ISO 17020:2012 Certification body

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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July, 2025

Disclaimer

This report is meticulously crafted by the Environment Management Committee of Nirmala College Muvattupuzha (Autonomous), Ernakulam Dist. 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. Furthermore, the Report and Manual of Documented Information have undergone rigorous

Scrutiny by external auditors from TIES, ensuring alignment with ISO standards.

Published on 31st July 2025

Nirmala College, Muvattupuzha, Ernakulam Dist.

TIES wish to acknowledge respective contributor's photographs and graphics are given in the pages 01, 25, 37, 213, 271, 314, 405, 407, 423, 425, 431 & 443

Preface

We are pleased and excited to present the Green Audit Report of Nirmala College Muvattupuzha (Autonomous), Ernakulam Dist., 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, Nirmala College, 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 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
Nirmala College, Muvattupuzha, Ernakulam Dist.
31.07.2025

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

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

- Marlee Matlin -

1

Green audit at ISO Standards

1.1. INTRODUCTION

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

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

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

1.2. HIGHER EDUCATION AND SUSTAINABLE DEVELOPMENT

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

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

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

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

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

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

1.3. UN SD GOALS AND ISO STANDARDS

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

ISO standards support the three pillars of sustainable development :

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

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

1.4. GREEN AUDIT AT ISO STANDARDS- WHY?

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

- A systematic examination to assess an institution's environmental responsibility
- Aims to identify environmental compliance, gaps or lapses in implementation of conservation activities
- Checking whether they meet stated institutional objectives and complied with including environmental management laws and ISO standards
- Suggesting corrective measures for improvement
  It is highly significant for every academic institutions in the present scenario:
- Mandatory as per the NAAC advisory
- Essential for complying with SD Goals

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

1.5. GREEN AUDIT CERTIFICATION BODY

The present audit report is evaluated and external audit is conducted by Tropical Institute of Ecological Sciences (TIES- www.ties.org.in), following relevant ISO standards.

TIES, a trailblazing and professionally managed environmental research organization, holding the prestigious ISO 9001:2015 accreditation and a certification body with ISO 17020, the singular accredited agency in South India dedicated to conducting Green Audits in academic and research institutions. With an illustrious track record encompassing 25 colleges, spanning arts, science, and professional institutions, as well as two prestigious
universities in South India, TIES brings a wealth of experience to every audit it undertakes.

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

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

Table 1.1. Stages of Green Audit

1.6. GREEN AUDIT AS PER ISO STANDARDS AT NIRMALA COLLEGE MUVATTUPUZHA (AUTONOMOUS)

1.6.1. Process of green audit as per ISO standards

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

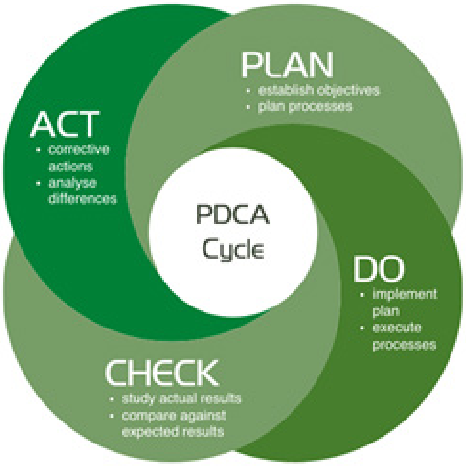


Fig.1.1. PDCA cycle of Green Audit

1.6.2. Green Audit at Nirmala College, Muvattupuzha

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 20.11.2024. TIES initiated the formal proceedings of the audit by requesting the prerequisite data for green audit from the college, on 11.12.2024. The college has submitted required information on 12.10.2024. Subsequently, the MoU for green audit was signed between the Principal of the college and Secretary, TIES on 13.12.2024 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 13.12.2024. All participants who passed the evaluation process were given with certificate as Internal auditor.

Internal auditors aggregated to various committees like Environment Management System Committee (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 23.05.2025
The first surveillance audit is scheduled for May 2026.

GREEN AUDIT
Based on ISO Standards

Chapter II

COLLEGE PROFILE
NIRMALA COLLEGE (AUTONOMOUS) MUVATTUPUZHA

Sustainable development begins
with Education

- UNESCO -

2

College Profile
Nirmala College (Autonomous), Muvattupuzha

2.1 HISTORY OF THE COLLEGE

Nirmala College, Muvattupuzha (Autonomous) affiliated to Mahatma Gandhi University, Kottayam is a first-grade college which has completed 71 years of glorious service to the cause of higher education. The college is managed by the catholic diocese of Kothamangalam and treads on to conquer new heights in the path of academic excellence. Towering aloft on the peak of a high hill, surrounded by luxuriant vegetation, intermingled with shady trees and distant from the clamour and confusion of the city, stands Nirmala College; the beacon light of learning and scholarship. Renowned for its picturesque landscape and tranquil serenity, the college provides a congenial atmosphere for study and research. The college is situated in Avoly Panchayat of Muvattupuzha taluk in the district of Ernakulam. It was founded in 1953 by His Grace Most Rev. Dr. Augustine Kandathil, Archbishop of Ernakulam to meet the educational needs of the eastern districts of north Travancore, especially of the Catholic community, at a time when higher education was the wildest dream of the ordinary people living in the villages and the suburbs. In 1955, the college was raised to First Grade by starting B.A., B.Sc. and B.Com courses. Post graduate courses were introduced in 1965 and research facilities are now available in seven departments. Thus over the years, the college has grown in size and stature. The divine legacy left behind by the founders of this college and the rich heritage built up by their successors have placed us on a high pedestal in the field of education and research.

The college is accorded the star college status in 2017 by the Dept. of Bio-Technology, Govt. of India, in recognition of the advancements made by the science departments of the college in scientific research. The college was ranked at 91st positioning NIRF rankings 2017. The college is nationally reaccredited by NAAC with A++ grade with CGPA 3.73 in 2021, which is the highest-grade point among affiliated college in India, in the fourth cycle of accreditation. The College is ranked at 100-150 position in NIRF ranking 2023. The college become autonomous in the year 2024

Now Nirmala is one of the foremost colleges in Kerala with over 3000 students and over 142 faculty members spread over 17 UG programmes, 13 PG programmes, 2 integrated Programmes and 7 research programmes.

2.2 VISION

Academic Excellence with Integrity of Character – To shape learners into empowered individuals through holistic and value-based education, fostering academic excellence, cultivating competencies, and upholding integrity of character for a world of dignity, prosperity and sustainability.

2.3 MISSION

To provide an enriching educational environment that fosters academic excellence, holistic development, and the acquisition of 21st-century skills, while instilling ethical values that transcend traditional academic boundaries.

To cultivate socially responsible citizens who actively contribute towards the achievement of Sustainable Development Goals (SDGs) and lead purpose-driven lives, making meaningful impacts in their communities and beyond.

To foster a culture of innovation and entrepreneurship by aligning educational practices with the National Start-Up and Innovation Policy, nurturing students' creativity, and providing support for ideation, incubation, and real-world application of ideas.

To nurture creativity and encourage exploration of student's creative potential, fostering an ecosystem that supports ideation, incubation, and the practical application of innovative ideas across disciplines.

To continuously adapt academic programs and co-curricular activities to meet the evolving demands of the 21st-century job market, ensuring students are equipped with the skills and knowledge necessary for success in their chosen fields.

To promote a vibrant research culture across disciplines, fostering an environment that encourages curiosity, critical thinking, and knowledge creation, thus contributing to the integral development of both students and faculty.

2.4 CORE VALUE

- Trust in God
- Integrity of Character
- Social Commitment
- Pursuit of Excellence
- Altruism
- Inclusivity

2.5 COLLEGE MILESTONES

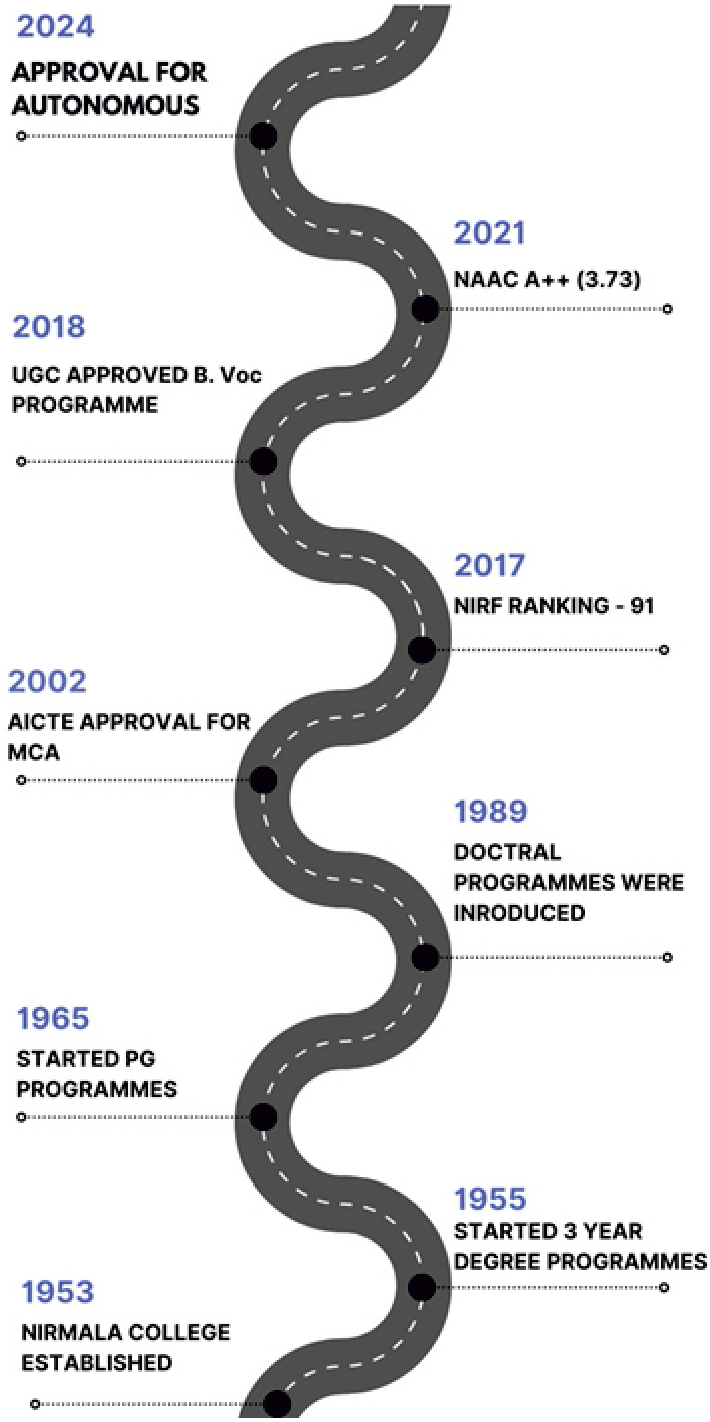


Fig 2.1 Milestones of the college

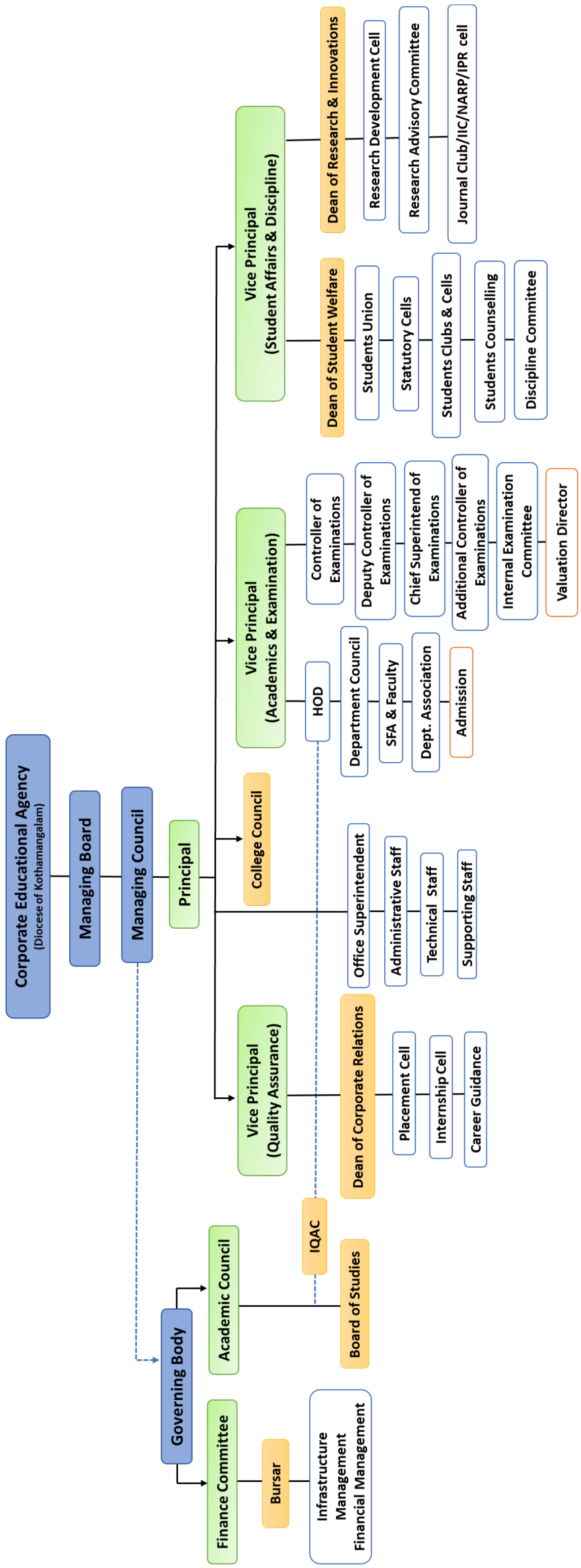


Fig 2.2 Organogram of the college

2.6 COLLEGE ADMINISTRATION

Mar George Madathikandathil (Patron)
Rev. Msgr. Dr. Pius Malekandathil (Manager)
Rev. Msgr. Dr. Vincent Nedungatt (Syncellus)
Rev. Msgr. Dr. Cherian Kanjirakompil
Rev.Dr. Paul Parathazham (Secretary, Higher Education)
Rev. Fr. Mathew Mundackalss (Secretary, Corporate Education)
Rev. Fr. Jose Kulathoor (Chancellor, Bishop's House)
Rev. Jose Pulparampil (Procurator, Bishop's House)
Rev. Fr. Joseph Kallarackal (Director, Vijnanabhavan, Bishop's House)
Rev. Dr. George Thanathuparambil
Rev. Fr. Paul Nedumpurath
Rev. Dr. Thomas Pothanamuzhi
Rev. Dr. Manuel Pichalakatt
Rev. Fr. George Vadakkel
Rev. Fr. Thomas Kallarackal
Rev. Fr. Kuriakose Kodakallil
Rev. Dr. Jestin K Kuriakose
Rev. Fr. Abraham Niravathinal
Rev. Dr. Stanislaus KunnelERNANCE
Rev. Fr. Jose Pulloppillil
Rev. Fr. Johnson Oroplackal
Rev.Fr. Paul Kalathoor
Rev. Sr. Christie S.H.
Dr. Thomas K.V.
Dr. Bijimol Thomas
Dr. Gigi K. Joseph
Prof. Emmanuel A. J.
Dr. Saju Abraham
Prof. Biju Peter
Dr. T.M. Joseph
Dr. Badmanaban R.
Prof. Jose Karikunnel
Dr. Aloysius Sabu N.
Dr. Sony Kuriakose
Dr. Jenni K. Alex
Ms. Alice John
Sr. Jayamol Thomas
Ms. Shija Paul P.
Mr. P.J. Joseph (MLA)
Adv. Dean Kuriakose (MP)
Mr. Antony John (MLA)
Adv. Francis George (Ex.MP)

2.6.1 B - Managing Council

Mar George Madathikandathil (Bishop &Patron)
Rev. Msgr. Dr. Pius Malekandathil (Manager)
Rev. Fr. Paul Parathazham (Secretary, Higher Education)
Adv. Reji Zachariah (M.G. University Nominee)

Govt. Nominee

Rev. Msgr. Dr. Vincent Nedungatt (Syncellus)
Rev. Fr. Mathew Mundackal (Secretary, Corporate Educational Agency)
Rev. Fr. Joseph Kulathoor (Chancellor, Bishop's House)
Rev. Fr. Jose Pulparampil (Procurator, Bishop's House)
Dr. Bijimol Thomas (Former Principal, Newman College, Thodupuzha)
Prof. Dr. K.V. Thomas (Former Principal, Nirmala College, Muvattupuzha (Autonomous)
Rev. Dr. George Thanathuparambil
Rev. Dr. Jestin K. Kuriakose
Rev. Fr. Benson N. Antony
Rev. Fr. Paul Kalathoor
Rev. Sr. Christie S. H.
Dr. T.M. Joseph
Prof. Jose Karikunnel
Dr. Jenny K. Alex (Teacher's Representative)
Dr. Radhu S. (Teacher's Representative)
Smt. Alice John (Non-Teaching Staff Representative)

2.6.2 C - Governing Body

Msgr. Rev. Dr. Pius Malekandathil - Manager, Corporate Education Agency,
Diocese of Kothamangalam
Rev. Dr. Paul Parathazham - Secretary, Higher Education, Corporate
Education Agency, Diocese of Kothamangalam
T. K. Jose IAS (Rtd) - Chairman, Kerala Electricity Regulatory

Commission

Prof. Dr. Thomas K. V.- Higher Education Liaison Officer, Corporate
Educational Agency, Diocese of Kothamangalam
Prof. Jose Karikunnel
Prof. Emmanuel A. J. - Associate Professor, Nirmala College, Muvattupuzha (Autonomous)
Dr. T. M. Jacob - Associate Professor, Nirmala College, Muvattupuzha (Autonomous)

Smt. Alice John - Office Superintendent, Nirmala College, Muvattupuzha (Autonomous)
Sri. Joy Alukkas - Industrialist
Sri. Anil Kumar V. S.- Additional Secretary, Higher Education

Department

Dr. Cyriac Joseph- School of Pure & Applied Physics, Mahatma Gandhi University
Rev. Dr. Jestin K. Kuriakose - Principal, Nirmala College, Muvattupuzha (Autonomous)

2.6.3 D - Finance Committee

1. Rev. Dr. Jestin K. Kuriakose - Chairman
2. Prof. Jose Karikunnel - Nominated by Governing Body
3. Prof. Emmanual A. J. - Member
4. Smt. Alice John – Member

2.6.4 E - Academic Council

1. Rev. Dr. Jestin K. Kuriakose -Principal/Chairman
2. Rev. Dr. Paul Parathazham Expert-Administration-Governing Body Nominee
3. CA Roy Varghese Expert-Industry and Commerce-Governing Body Nominee
4. Dr. K K Rajan Expert- Engineering - Governing Body Nominee
5. Dr. T M Joseph Expert – Education - Governing Body Nominee
6. Prof. Dr. Beena Mathew - University Nominee
7. Prof. Dr. M. H. Ilias - University Nominee
8. Prof. Dr. P. S. Radhakrishnan - University Nominee
9. Sri. Emmanual A. J. - Controller of Examinations
10. Dr. Sony Kuriakose Teacher Representative - Commerce
11. Dr. Meera R. Teacher Representative - Social Sciences
12. Dr. P B Sanish Teacher Representative - Humanities
13. Ms. Sindhu Rachel Joy Teacher Representative - Science
14. Dr. Manu C. Scaria - HoD, English
15. Dr. Juliya Emmanuel - HoD, Hindi
16. Ms. Seema Joseph - HoD, Malayalam
17. Sri. Pratheesh Mathew - HoD, Mathematics
18. Dr. T. M. Jacob - HoD, Statistics
19. Sri. Titu Thomas - HoD, Physics
20. Dr. Jyothish Kuthanappillil - HoD, Chemistry
21. Dr. Geena George - HoD, Botany
22. Ms. Ambili Elizabeth George - HoD, Zoology
23. Dr. Liji George HoD, - Economics
24. Dr. Anu Jossy Joy HoD, - Commerce
25. Ms. Sherry O Panikkar - HoD, Computer Science Department (SF)
26. Ms. Dinna Johnson - HoD, Management Studies
27. Ms. Lissy Paul - HoD, Department of Commerce (SF)
28. Ms. Soumya T K - HoD, Department of Logistics Management (SF)
29. Mr. Augustine Benny- HoD, Department of Communicative English (SF)
30. Ms. Vidhula Thomas - HoD, Department of Computer Science
31. Ms. Preethy George - HoD, BCA (SF)
32. Sri. Sankar P D - HoD, Department of Tourism
33. Dr. Gigi K Joseph - Member Secretary

2.6.5 F - College Council

1. Rev. Dr. Jestin K. Kuriakose - Principal
2. Mr. Emmanual A.J. - Vice Principal
3. Dr. Gigi K. Joseph - Vice Principal
4. Dr. Sony Kuriakose - Vice Principal & IQAC Coordinator
5. Dr. T.M. Jacob - HoD, Department of Statistics
6. Dr. Manu C Skaria - HoD, Department of English
7. Mr. Titu Thomas - HoD, Department of Physics
8. Dr. Jyothish Kuthanapillil - HoD, Department of Chemistry
9. Dr. Anu Jossy Joy - HoD, Department of Commerce
10. Dr. Liji George - HoD, Department of Economics
11. Ms. Seema Joseph - HoD, Department of Malayalam
12. Dr. Geena George - HoD, Department of Botany
13. Ms. Ambily Elizabeth George - HoD, Department of Zoology
14. Dr. Juliya Emmanuel - HoD, Department of Hindi
15. Dr. Santhosh J. - HoD, Department of Physical Education
16. Mr. Augustine Benny - Coordinator, BA Communicative English
17. Ms. Lissy Paul - HoD, Department of Commerce, Self-Financing\
18. Ms. Sherry O. Panicker - HoD, Department of Computer Science (MCA)
19. Ms. Preethy George - HoD, Department of Computer Science (BCA)
20. Mr. Sankar P.D. - HoD, Department of Tourism Studies
21. Ms. Dinna Johnson - HoD, Department of MA HRM
22. Ms Vidhula Thomas - Coordinator, MSc. Computer Science (Data Sci.)
23. Ms. Soumya T. K. - Coordinator B.Voc. Logistics Management
24. Dr. Nibu Thomson - Elected Teacher Representative
25. Ms. Sindhu Rachel Joy - Elected Teacher Representative

26. Smt. Alice John - Senior Administrative Officer
27. Mr. Jomy Jose – Librarian

2.6.6 G - Internal Quality Assurance Cell (IQAC)

2.6.7 A. Chairperson

Rev. Dr. Jestin K Kuriakose, Principal

2.6.8 B. Senior Administrative Officer

Smt. Alice John, Office Superintendent

2.6.9 C. Teaching Faculty Representatives

Ms. Liz George, Assistant Professor, Department of Chemistry
Dr. Jasmine Jose, Assistant Professor, Department of English
Dr. Shibin Mohanan, Assistant Professor, Department of Botany
Dr. Boni Samuel, Assistant Professor, Department of Physics
Dr. Jijo V. J., Assistant Professor, Department of Chemistry
Ms. Ambily Elizabeth George, Assistant Professor, Department of Zoology
Dr. Sreeja G.R., Assistant Professor, Department of Hindi
Dr. Sr. Armila Antony, Assistant Professor, Department of English
Dr. Meera R, Assistant Professor, Department of Economics
Dr. Dinu Alexander, Assistant Professor, Department of Physics
Mr. Amal Sebastian, Assistant Professor, Department of Communicative English
Ms. Priya K. Dev, Assistant Professor, Department of Commerce
Mr. Sherin Mathew G, Assistant Professor, Department of Computer Science

2.6.10 D. Member from the Management

Rev. Dr. Paul Parathazham, Higher Education Secretary

2.6.11 E. Member from the Local Society

Ms. Joice Mary Antony, Municipal Councillor

2.6.12 F. Nominee from the Student Community

Mr. Gem K. Jose, II BA Economics

2.6.13 Nominees from the Industry/ Employers/ Stakeholders/Alumni/PTA

Mr. Joe Varkey, Senior General Manager, Malayala Manorama
Mr. Anil Kumar Gopalan Nair, Head HR & Admin, Apollo Tyres Ltd
Dr. Ignatious Abraham, Assistant Professor, Department of Chemistry, SH College Thevara
Dr. Gigi K. Joseph, PTA Representative

2.6.14 H. Co-ordinator of IQAC

Dr. Sony Kuriakose, Assistant Professor, Department of Commerce
Dr. Lincy Tom, Assistant Professor, Department of Chemistry (Additional IQAC Coordinator)

2.21 H - NCM-UGP Academic Committee

Rev. Dr. Jestin K Kuriakose - Principal & Chairman
Mr. Mathews K Manayani - Nodal Officer & Convener
Mr. Emmanual A J - Associate Professor
Dr. Meera R Assistant - Professor
Dr. Anitha J Mattam - Assistant Professor
Ms. Jaya S - Assistant Professor
Dr. Manu C Skaria - Assistant Professor
Dr. Juliya Emmanuel - Assistant Professor
Ms. Seema Joseph - Assistant Professor
Mr. Pratheesh Mathew - Assistant Professor
Dr. T M Jacob - Associate Professor
Mr. Titu Thomas - Assistant Professor
Dr. Jyothish Kuthanapillil - Assistant Professor
Dr. Geena George - Assistant Professor
Ms. Ambily Elizabeth George - Assistant Professor
Dr. Liji George - Assistant Professor
Dr. Anu Jossy Joy - Assistant Professor
Ms. Lissy Paul - Assistant Professor
Ms. Soumya T K - Assistant Professor
Mr. Augustine Benny -Assistant Professor
Ms. Vidhula Thomas - Assistant Professor
Ms. Sherry O Panicker - Assistant Professor
Ms. Dinna Johnson - Assistant Professor
Mr. Sankar P D - Assistant Professor
Dr. Santhosh J - Assistant Professor
Ginto Pottackal - Principal Biostatistician, PPD Banguluru, Karnataka
Mr. Jismon Issac - Executive Director, Metcon Industries
James V George - Associate Professor, SH College,Thevara
Dr. Shaju Thomas - Former Associate Professor, Department of Zoology

2.7 STRENGTH OF THE COLLEGE

2.7.1 Students

Strength of the college					
Sl No	Department	Program	Boys	Girls	Total
1	Logistics Management	B voc Logistics	161	12	173
2	Economics	BA Economics	77	106	183
3		MA Economics	12	17	29
4	Chemistry	BSc Chemistry	21	61	82
5		MSc Chemistry	2	22	24
		PhD	0	2	2
6	English	BA English Literature and Communicative Studies	16	35	51
7		MA English	6	24	30
		PhD	2	15	17
8	Hindi	BA Hindi	29	50	79
9		MA Hindi	0	35	35
		PhD	0	10	10
10	Malayalam	BA Malayalam	39	43	82
11		MA Malayalam	3	27	30
		PhD	1	6	7
12	Physics	BSc Physics Mod I	42	33	75
13		BSc Physics Mod II	28	14	42
14	Mathematics	BSc Mathematics	32	65	97
15	Botany	BSc Botany	18	46	64
16	Zoology	BSc Zoology	15	63	78
17		MSc Zoology	4	24	28
		PhD	12	3	15
18	Commerce (Regular)	B. Com Mod I Finance & Taxation	82	100	182
19		M. Com	8	29	37
		PhD	3	14	17
20	Commerce (Self)	B. com Mod III Computer Applications	109	46	155
21		B. com Mod III OMSP	109	45	154
22		B.com Mod III Taxation	84	84	168
23		M. Com	11	23	34
24	Tourism	BTTM	102	23	125
25		MTTM	12	11	23
26	Computer Science	BCA	111	85	196
27	MCA	MCA	132	108	240
		Integrated MCA	12	8	20
28	Management Studies	MAHRM	9	39	48
29	Data Science	Integrated MSc	29	34	63
30	Statistics	MSc Statistics	9	29	38
		PhD	0	3	3
	Total				2736

Table 2.1 Number of students studying in the college during the academic year 2024- 25

2.7.2 Faculty

Strength of the Faculty					
Sl No	Department	Program	Men	Women	Total
1	Logistics	B.Voc Logistics	1	3	4
2	Economics	BA Economics	1	6	7
		MA Economics			
3	Chemistry	BSc Chemistry	5	4	9
		MSc Chemistry			
4	English	BA English Literature and Communicative Studies	2	4	6
		MA English	2	5	7
5	Hindi	BA Hindi	0	8	8
		MA Hindi			
6	Malayalam	BA Malayalam	3	8	11
		MA Malayalam			
7	Physics	BSc Physics Mod I	4	5	9
		BSc Physics Mod II			
8	Mathematics	BSc Mathematics	1	3	4
9	Botany	BSc Botany	1	3	4
10	Zoology	BSc	2	5	7
		MSc			
11	Commerce (Regular)	B. Com Mod I Finance & Taxation	3	4	7
		M. Com			
12	Commerce (Self)	B.com Mod III Computer Applications	2	15	17
		B.com Mod III OMSP			
		B.com Mod III Taxation			
		M.Com			
13	Tourism	BTTM	5	6	11
		MTTM			
	Computer Science	BCA	0	5	5
14		MCA	3	9	12
		Integrated MCA			
15	Management Studies	MAHRM	1	4	5
16	Data Science	Integrated MSc	0	6	6
17	Statistics	MSc Statistics	2	3	5
18	Physical Education		1		1
	Total				145

Table 2.2 Strength of the faculty of the college during the academic year 2024-25

2.7.3 Non-teaching staff

Strength of the Non-Teaching Staff				
Sl No	Category	Permanent	Contract	Total
1	Library Staff	2	1	3
2	Lab Assistants	6	1	7
3	Office Administration	7	0	7
4	Office Attendants	5	1	6
5	Senior Clerks	4	0	4
6	Clerk	3	0	3
7	Store Keeper	1	0	1
8	Computer Assistant	1	0	1
9	NTS MCA	0	7	7
10	Computation Division	0	9	9
11	System Administrator	0	2	2
12	LGS	0	8	8
13	Civil Service Academy	0	2	2
14	Security Staff	0	3	3
15	Canteen & Cafeteria	0	7	7
16	Total			70

Table 2.3 Strength of the non-teaching staff of the college during the 2024-25

2.7.4 Total strength of college community

Total strength of college community		
Sl No	Inmates category	Total no
1	Students	2736
2	Teaching Staff	145
3	Non-Teaching Staff	70
4	Hostel Staff	44
	Total	2995

Table2.4 Total strength of the college during the academic year 2024-25

2.7.5.Details of program of the college

2.7.5.1 Aided Programs

Aided stream		
Sl No	Department	Program
1	Economics	BA Economics
2		MA Economics
3	Chemistry	BSc Chemistry
4		MSc Chemistry
5	English	MA English
6	Hindi	BA Hindi
7		MA Hindi
8	Malayalam	BA Malayalam
9		MA Malayalam
10	Physics	BSc Physics Mod I
11		BSc Physics Mod II
12	Mathematics	BSc Mathematics
13	Botany	BSc Botany
14	Zoology	BSc Zoology
15		MSc Zoology
16	Commerce (Regular)	B. Com Mod I Finance and Taxation
17		M. Com
18	Data Science	Integrated MSc
19	Statistics	MSc Statistics

Table 2.5 Aided programs of the college

2.7.5.2 Self- Financing program

Self- financing program		
Sl No	Department	Program
1	Commerce (Self)	B. com Mod III Computer Applications
2		B. com Mod III OMSP
3		B. com Mod III Taxation
4		M. Com
5	Tourism	BTTM
6		MTTM
7	Computer Science	BCA
8	MCA	MCA
9		Integrated MCA
10	Management Studies	MAHRM
11	Logistics	B Voc Logistics Management
12	English	BA English Literature and Comm. Studies

Table 2.6 Self- financing program of the college

2.7.5.3 Ph.D Programs

Doctoral program		
Sl No	Department	Program
1	Chemistry	PhD in Chemistry
2	Malayalam	PhD in Malayalam
3	Hindi	PhD in Hindi
4	English	PhD in English
5	Zoology	PhD in Zoology
6	Statistics	PhD in Statistics

Table 2.7 Doctoral Program of the college

2.8 COLLEGE CAMPUS AND LOCATION

Fig 2.3 Location map of the college (Google Map)

The college is situated in the Avoly Panchayat of Muvattupuzha Taluk, within the Ernakulam District. Its location on the Punalur-Muvattupuzha State Highway (SH-08) offers easy accessibility, being approximately 2 km from Muvattupuzha town.

Fig 2.4 Campus map of the college

2.9 CAMPUS LAYOUT

Campus Layout		
Sl No	Main building	Open spaces
1	Main Block	Hand Ball Ground
2	Administrative block	Football Ground
3	Silver Jubilee Block	Basketball Ground
4	Golden Jubilee Block	Cricket Net
5	Diamond Jubilee Block (DJ)	Volleyball Ground
6	MCA Block	Parking Ground
7	Parking	Open Stage
8	Jeevajyothi Men's Hostel	Pineapple Plantation
9	Little Flower Ladies Hostel (LF)	Botanical Garden
10	St. Joseph Ladies Hostel	Herbal/Spices Garden
11	Nirmala Ladies Hostel	Butterfly garden
12	Sports Hostel	Natural Rainwater Harvesting Area
13		Oxygen Park-Arboretum

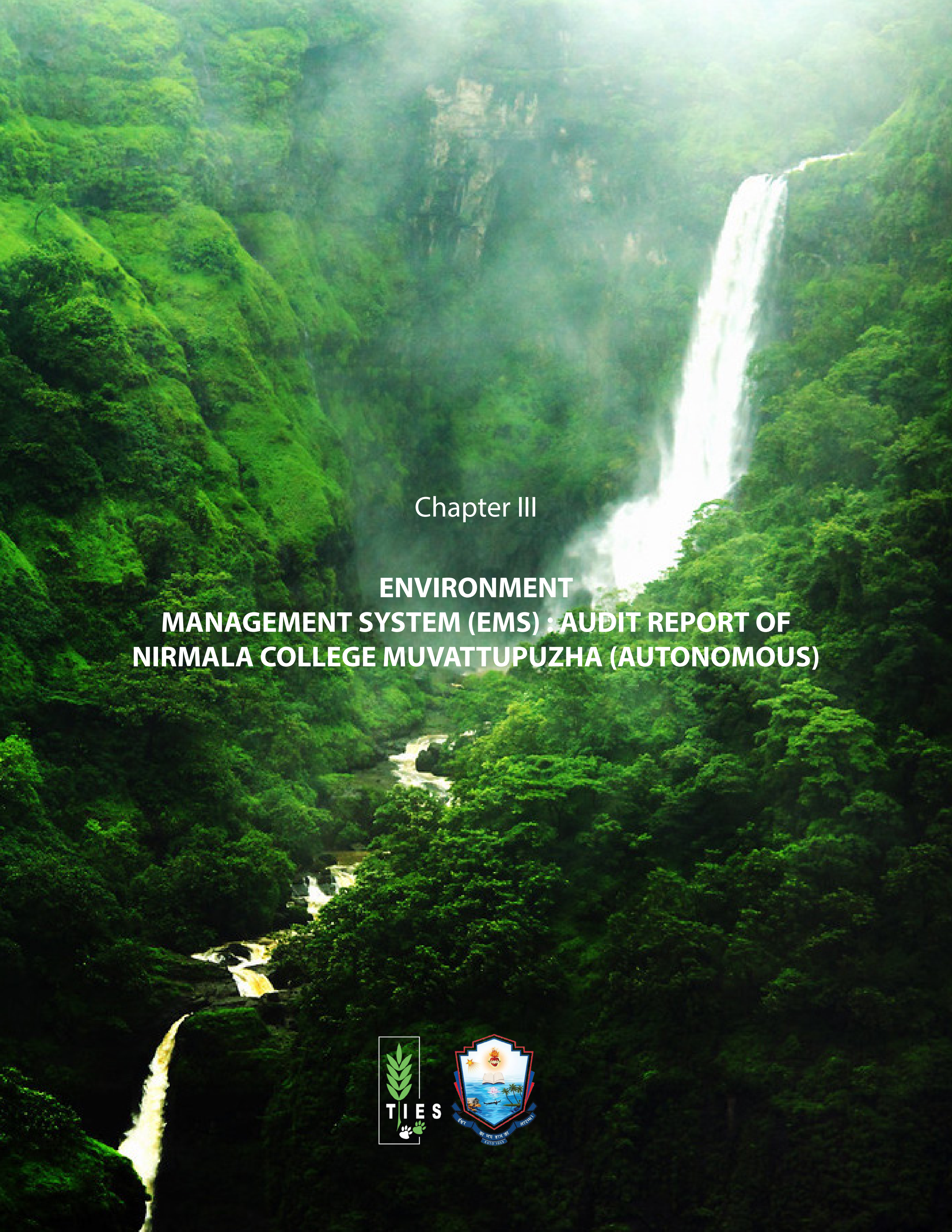
Table 2.8 Facilities of the college

Facilities of the College		
Sl No	**Facilities**	**Count**
1	College Buildings	6
2	Classrooms (Big)	36
3	Classrooms (Standard)	24
4	Classrooms (Normal)	26
5	Laboratory	9
6	Research Lab	3
7	Computer Lab	8
8	Digital Library	1
9	Auditorium	4
10	Open Air Auditorium	1
11	Seminar Halls	7
12	Examination Hall	3
13	Conference Hall	2
14	Smart rooms	2
15	Digital Theatre	1
16	Meditation/Yoga Hall	1
17	IQAC Hall/Board/Discussion room	3
18	Alumni Hall	1
19	Parlour/Faculty Colloquium Hall	2
20	Incubation Centre Hall	2
21	Controller of Examination	1
22	Examination Room for PWDs	1
23	Media Lab	1
24	Health & Fitness/Yoga Centre	2
25	Hostel facility	4
26	IGNOU Study Centre	1
27	Civil Service Academy/Institute of Competitive Studies	1
28	Canteen/Cafeteria/Retail outlets	3
29	Medical Aid/Sick Room	1
30	Ladies Rest Room	2
31	Mushroom Cultivation/Vermicompost centre	1
32	Bank/ATM	3
33	NSS/NCC rooms	2
34	Generator	7
35	Solar Panel	4

Table 2.9 Facilities of the college

Sustainable development is the development that meets the needs of the present without compromising the ability of future generations to meet their own needs

- Gro Harlem Brundtland -



Chapter III

ENVIRONMENT MANAGEMENT SYSTEM (EMS) : AUDIT REPORT OF NIRMALA COLLEGE MUVATTUPUZHA (AUTONOMOUS)

ENVIRONMENT MANAGEMENT COMMITTEE (EMS 2024-25)

Rev. Dr. Jestin K Kuriakose
Principal
Prof. Emmanual A J
Vice- principal
Dr. Gigi K Joseph
Vice- principal
Dr. Sony Kuriakose
Vice- principal/IQAC Coordinator
Fr. Paul Kalathoor
Bursar
Dr. Lincy Tom
Assistant Professor

Pranav M S
Student representative

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

3.2. ENVIRONMENT MANAGEMENT SYSTEM POLICY

Environment Policy of Nirmala College

3.2.1 Statement of Commitment

Nirmala College Muvattupuzha (Autonomous), driven by its vision and mission, provides value-based, life-oriented education. We foster authentic individuals within a culture of responsibility and sustainability. A comprehensive policy underpins our commitment, addressing energy, water, biodiversity, occupational health and safety, carbon footprint reduction, and waste management. Our green initiatives actively cultivate a conscious mindset in future generations. We transform learning principles into action, empowering youth to be catalysts for change in their families and society. Committed to Sustainable Development Goals, the college champions the balance of renewable and finite resources, paving the way for a brighter, greener future. Through our teachings and actions, we strive to illuminate a path where humanity and nature flourish in harmony.

3.2.2 Goal

To champion environmental stewardship and holistic wellbeing by proactively minimizing our ecological impact through substantial reductions in waste, water, and energy consumption; cultivating rich campus biodiversity; and embedding a culture of safety, health, and sustainability throughout the college community, supported by ongoing awareness, education, and innovative solutions

3.2.3 Objectives

- To champion resource efficiency and conservation across all institutional operations, significantly reducing waste, water, and energy consumption, and minimizing environmental impact.
- To cultivate a pervasive culture of environmental stewardship, safety consciousness, and well-being among all students, faculty, and staff through education, engagement, and awareness initiatives.
- To provide and maintain a safe, healthy, and secure campus environment by proactively identifying risks, adhering to regulations, promoting preventative practices, and offering supportive services.
- To develop, implement, and continuously improve sustainable systems, practices, and infrastructure, including waste management, water recycling, biodiversity enhancement, and renewable energy solutions.
- To integrate principles of sustainability, environmental responsibility, and occupational health and safety into the core academic, research, and community engagement activities of the institution.

3.2.4 Resource Management

3.2.4.1 Energy Management:

The College is dedicated to comprehensive energy resource management, prioritizing energy-efficient infrastructure by transitioning to LED lighting and higher star-rated appliances, with 85% of current infrastructure already well-maintained and featuring such measures. Solar energy integration is actively pursued, with existing panels at the MCA block, DJ block, and Pharmacy hostel contributing to savings, and plans for further expansion to reduce reliance on non-renewable sources. Annual internal energy audits are conducted to assess consumption, identify inefficiencies in systems and gadgets, and guide improvements. Future construction and renovations will incorporate energy-efficient building designs, informed by these audits, to continuously enhance energy savings and reduce overall consumption and waste.

3.2.4.2 Water Management:

Effective water resource management mandates a periodic water usage assessment to analyse consumption rates and patterns, identify high-usage areas, and evaluate existing infrastructure for improvement opportunities. Key strategies stemming from this assessment involve implementing replenishment systems and comprehensive water conservation measures, such as installing water-efficient taps, promoting rainwater harvesting, establishing water recharge facilities to encourage recycling, and using recycled water for non-potable purposes. Alongside these, infrastructure updates are vital, including retrofitting buildings with water-saving technologies, upgrading plumbing, and deploying smart irrigation. Finally, robust emergency preparedness plans, encompassing emergency storage, rationing protocols, and coordination with authorities, must be established to address potential shortages, all underpinned by a holistic approach that considers environmental, social, and economic factors.

3.2.4.3 Occupational health and safety Management:

College Management is responsible for ensuring a safe and healthy campus environment by establishing, implementing, regularly reviewing, and updating comprehensive health and safety policies, structured protocols, and drills. This includes ensuring compliance with specific policies like the Noise Pollution Policy—through monitoring, designated zones, and awareness—and maintaining accessibility for individuals with disabilities via ramps, handrails, and clear signage. They are tasked with providing adequate resources for safety training, including fire drills and first aid sessions, under the supervision of internal audit, and supporting initiatives by groups like the Yoga Club and Women's Cell, as well as staff tours and student trips, to promote mental well-being and a healthy campus environment. The Principal is central to communicating common announcements and safety-related updates through official channels and serves as the escalation point for any safety issues not resolved at lower levels.

3.2.4.4 Biodiversity Management:

Nirmala College recognizes the critical role of sustainable natural resource management in supporting and enhancing biodiversity on campus, prioritizing the efficient and responsible use of land, water, soil, and biological resources. This commitment is actualized through sustainable land use practices designed to protect native vegetation, prevent soil erosion, and enhance natural habitats, emphasizing the use of native and endemic plant species in landscaping to create self-sustaining ecosystems for pollinators and local wildlife. Water conservation is advanced via rainwater harvesting, xeriscaping, and wetland preservation to support aquatic biodiversity and reduce consumption. Soil health is actively promoted by minimizing synthetic fertilizers and pesticides in favor of organic alternatives and by transforming organic waste into valuable compost, thereby enhancing soil fertility and minimizing habitat degradation. Furthermore, the college undertakes comprehensive strategies to restore degraded campus ecosystems through targeted reforestation, invasive species removal, and the creation of diverse microhabitats to maximize biodiversity recovery.

3.2.4.5 Waste Management:

The college's waste resource management is implemented through a structured approach, beginning with the classification of waste into Non-Biodegradable (paper, plastic, glass, metal), Biodegradable (organic), Hazardous, and Electronic categories. This systematic process aims to facilitate a circular economy by maximizing opportunities for reducing, reusing, recycling, respecting, and rethinking, while promoting responsible consumption. To achieve this, the college will install color-coded bins for effective segregation across eight designated campus locations, complemented by a central waste collection centre, clear signage, and CCTV surveillance for compliance. The categorized waste will be managed through donations, biomass utilization, and collaboration with Haritha Karma Sena for responsible disposal and recycling, further enhanced by smart strategies like e-waste recycling kiosks that may offer incentives for disposing of electronics.

3.2.4.6 Carbon Footprint:

These strategies will significantly reduce the campus's carbon footprint through sustainable practices. Key initiatives include prioritizing water conservation with efficient systems, enhancing biodiversity by cultivating native plant species for a balanced ecosystem, and emphasizing responsible waste management to minimize environmental impact

3.2.5 Curriculum Integration

The institution's policy mandates a comprehensive curriculum integration of energy, water, biodiversity, and waste management. This involves embedding environmental and sustainability themes across disciplines, notably through interdisciplinary courses on biodiversity, ecology, and environmental conservation, supplemented by a mandatory intensive program to deepen student understanding. Water management objectives are integrated via specialized courses on topics like rainwater harvesting and water quality assessment. Similarly, waste management concepts including decomposition processes, recycling techniques, economic implications, and relevant civic policies are incorporated into academic studies, with encouragement for additional courses on commercial and technological advancements. While not formal coursework for all, energy conservation is systematically promoted through educational awareness campaigns and tailored departmental sessions focused on practical saving strategies, thereby fostering a campus-wide culture of sustainability. Faculty development initiatives will underpin the effective delivery of these integrated environmental themes.

3.2.6 Green Initiative

The college is committed to fostering a sustainable campus environment through a comprehensive green initiative. This will involve enhancing energy efficiency through greener infrastructure, promoting eco-friendly transportation, and integrating energy conservation into research and educational programs via workshops and awareness campaigns. Water conservation efforts will be advanced by expanding existing practices like drip irrigation and mulching, implementing xeriscaping, and developing greywater treatment and recycling systems. Biodiversity will be enriched through the cultivation and meticulous maintenance of diverse green spaces, including native plant and butterfly gardens, regular tree planting drives, comprehensive biodiversity audits, and leveraging technology for ecological education. Furthermore, a robust waste management strategy will be implemented, featuring a campus-wide composting program, a significant shift towards paperless operations and digital documentation, extensive recycling and creative reuse of materials, and fostering responsible waste behaviours through educational outreach, awareness campaigns, and dedicated student-led clubs.

3.2.7 Research and Innovation

The institution's policy strongly emphasizes fostering research and innovation across key environmental domains. It will prioritize research focused on energy conservation and the development of innovative waste-to-energy solutions. In water management, the focus is on advancing water conservation strategies, researching technologies for greywater reuse, and conducting periodic analysis of local water body contaminants. For biodiversity, the college will support research projects and dissertations addressing campus biodiversity, conservation, and sustainable practices. Regarding waste, initiatives will encourage research into waste management technologies and sustainable practices, again highlighting innovative waste-to-energy solutions. These diverse research endeavours will be underpinned by robust institutional support, including research grants, scholarships, optimized research infrastructure with workshops and field visits, the cultivation of interdisciplinary and external collaborative networks, and active promotion of disseminating findings through peer-reviewed publications and conference participation.

3.2.8 Curriculum Integration

The institution will foster a culture of research and innovation across key environmental areas. For energy, this involves student-led innovation in energy-saving projects and the development of an 'urja' group module to improve energy utilization efficiency. In water management, the focus is on fostering research and innovation in conservation technologies and practices, alongside designing educational initiatives and specialized courses on topics like rainwater harvesting and water quality assessment. For biodiversity and broader sustainability, the institution will encourage research projects focused on campus biodiversity, support the publication of student thesis work, and develop interdisciplinary courses; experiential learning through internships will further enable students to conduct case studies and contribute to ongoing projects. While direct research and innovation for waste are not explicitly detailed, the overarching emphasis on sustainability research and project-based learning provides a framework for its future inclusion.

3.2.9 Purchasing and Procurement

Energy-Efficient Equipment: All new electrical equipment, appliances, and systems purchased by the college will prioritize energy-efficient options, focusing on models that help to conserve energy. Whenever new equipment is procured, the energy management team will provide expert advice to ensure that energy-efficient options are selected, helping to further reduce the college's energy consumption and environmental impact. Green Procurement: The College will prioritize purchasing from environmentally conscious suppliers who provide eco-friendly products, including those made with sustainable materials and energy-efficient technologies.

3.2.9.1 Prioritizing Environmentally Preferable Products:

The college will prioritize the purchase of environmentally preferable products that support sustainable construction, enhance campus greenery, and promote responsible landscaping practices.

3.2.9.2 Establishing Sustainable Procurement Guidelines:

Develop and implement comprehensive sustainable procurement guidelines, submitted to the college council for approval, to prioritize purchasing decisions based on a thorough assessment of the environmental and social impacts of products and services.

3.2.9.3 Supporting Local and Ethical Suppliers:

The college is committed to supporting local and ethical suppliers who demonstrate a commitment to quality and long-term sustainability, thereby contributing to their market viability and promoting responsible business practices that integrate commercial benefits with social responsibility.

3.2.9.4 Integrating Lifecycle Assessment into Procurement Decisions:

Incorporate lifecycle assessment principles into purchasing decisions, considering the environmental impacts of products from raw material extraction to end-of-life disposal, while integrating suggestions from EnMS, WEMS, WMS, OHS, and other relevant committee members.

3.2.10 Community Engagement

The institution will actively engage with local communities and organizations across multiple sustainability fronts. For energy, this includes promoting conservation through shared knowledge, LED lamp assembly training, community classes, and student-led awareness initiatives. In water management, the college will collaborate with local bodies on rainwater harvesting training and offer well water quality testing with remedial recommendations for residents. Biodiversity efforts will involve partnerships for community-based conservation, empowering communities through environmental education like workshops and guided nature walks, disseminating knowledge via open programs and exhibitions, and enhancing local ecosystems through initiatives like butterfly gardens in adopted villages. Waste management will be improved through partnerships with municipal authorities and private agencies, alongside community clean-up drives. Broader collaborations will see the institution working with local bodies and industries on sustainable practices such as organic farming, adopting villages to create model communities with beautification projects, and providing students with real-world experience in applying technology for social and environmental benefit.

3.2.11 Purchasing and Procurement

The College's Purchase and Procurement Policy mandates a holistic approach to sustainability, integrating considerations for energy, water, waste, occupational and health and biodiversity into all purchasing decisions. This includes prioritizing energy-efficient equipment and systems, guided by expert advice from the energy management team to reduce overall consumption. For water conservation, the policy mandates the installation of low-flow taps, dual-flush systems, procurement of drought-resistant native plants, and materials facilitating rainwater harvesting and greywater recycling, supported by periodic audits. Waste reduction is addressed through pre-procurement optimization reports from the Waste Management Committee, emphasizing minimization of plastics and hazardous materials, promoting reusable alternatives like steel utensils and cloth bags, implementing a Green Protocol for events, and ensuring responsible disposal including incinerators for sanitary waste, while enhancing campus biodiversity through responsible landscaping with native species. This comprehensive strategy is underpinned by sustainable procurement guidelines, prioritizing environmentally preferable products from ethical and local suppliers, and incorporating lifecycle assessment principles with input from EnMS, WEMS, WMS, OHS, and other relevant committees to ensure a minimal environmental footprint and foster responsible consumption across campus.

3.2.12 Monitoring and Reporting

The institution will implement a comprehensive system for monitoring and reporting on environmental performance across energy, water, biodiversity, and waste, guided by measurable Key Performance Indicators (KPIs) aligned with policy goals and auditor recommendations. Energy consumption will be tracked through internal audits of meter readings, bills, and departmental stock registers, with findings compiled into reports by internal auditors and an annual energy performance report published by the energy audit team. Similarly, water usage will be monitored via appointed representatives, flow meters, and infrastructure assessments, with progress towards consumption reduction targets periodically evaluated. Waste management will involve monthly audits by the Waste Management Committee, regular monitoring by housekeeping staff and internal auditors (including CCTV surveillance), and an annual report summarizing initiatives and achievements. Biodiversity metrics will also be systematically tracked. The effectiveness of these environmental management practices will be rigorously evaluated through regular internal environmental assessments and routine audits. Annually, a comprehensive environmental report will be publicly published in college publications, documenting KPIs, energy and water consumption data, waste generation statistics, and biodiversity metrics, ensuring transparency and engaging stakeholders—including students, faculty, and staff through feedback mechanisms like annual surveys—to drive continuous improvement.

3.2.13 Compliance and Review

The College is committed to full regulatory compliance, upholding all applicable national, local, state, and international environmental laws, regulations, and mandates, with specific attention to energy efficiency and sustainability, water management, waste management (including hazardous waste disposal), biodiversity considerations, and health and safety. Institutional policies governing these areas will undergo periodic and comprehensive review at least every three years, or more frequently as necessary to integrate technological advancements, regulatory changes, emerging best practices, performance data from internal audits, and the College's strategic vision. This review process will actively involve students, faculty, staff, and community members, ensuring a collaborative approach to environmental governance. Internal audits and designated committees will monitor adherence to standards and regulations, identify any shortcomings, and facilitate the implementation of necessary improvements and corrective actions. Compliance will be further supported by the development and dissemination of clear guidelines, protocols, informative signage, awareness initiatives, and appropriate measures for non-adherence, particularly concerning waste segregation and disposal protocols.

3.2.14 Leadership and Accountability

The Environmental Management Committee, comprised of students, faculty, staff, and administrators, responsible for governing policy implementation and ongoing oversight. This committee's efforts will be supported by a highly qualified Sustainability Coordinator, reporting to senior institutional leadership (e.g., Upper Body EMS), who will coordinate all environmental initiatives, meticulously monitor progress towards established goals, and provide expert technical guidance. For specific resource areas, dedicated teams—such as an Energy Management Team, a Waste Management Team (both including faculty, staff, and students), and a team designated by the head of the institution for water efficiency will manage the implementation and continuous monitoring of their respective policies. Clear roles, responsibilities, and specific departmental accountabilities will be defined for all environmental practices, including audits, reporting, and campus-wide awareness initiatives. Ultimately, institutional leadership will hold all departments and individuals accountable for meeting targets in energy saving, water efficiency, biodiversity protection, and waste minimization, with regular performance reviews and progress evaluations ensuring that these environmental management goals are achieved.

3.2.15 Conclusion

Nirmala college is dedicated to cultivating a culture of sustainability and environmental responsibility within community. Through the implementation of this environmental management policy, strive to reduce ecological impact, raise environmental awareness, and encourage responsible behaviors among students, faculty, and staff. By working together and continually improving, we reaffirm commitment to environmental sustainability, emphasizing community engagement and education.

The institution goal is to create a healthier, more sustainable future for generations to come and contribute to a global shift towards environmental consciousness and responsibility

3.3. ENVIRONMENT MANAGEMENT SYSTEM PLAN

3.3.1 Formulate a Robust Environment Statement of Commitment

Nirmala College, Muvattupuzha (Autonomous), grounded in its vision and mission, is committed to providing value-based, life-oriented education that fosters responsible individuals and environmental sustainability. The college's environmental commitment is articulated through a comprehensive Environmental Management Policy focused on energy, water, biodiversity, occupational health and safety (OHS), carbon footprint reduction, and waste management. The college envisions empowering future generations to become changemakers aligned with the UN Sustainable Development Goals (SDGs), transforming learning principles into real-world action that nurtures harmony between humanity and nature.

3.3.2 Define clear Objectives for optimizing the management

3.3.2.1 Resource Efficiency: Minimize consumption of energy, water, and material resources while maximizing conservation and efficiency.

3.3.2.2 Culture of Sustainability: Promote widespread awareness, participation, and responsibility among students, faculty, and staff.

3.3.2.3 Safe and Healthy Campus: Establish proactive occupational health and safety measures and well-being programs.

3.3.2.4 Sustainable Infrastructure: Continuously upgrade systems for waste, water, energy, and biodiversity management.

3.3.2.5 Integrated Sustainability Education: Infuse environmental responsibility and OHS principles across teaching, research, and community engagement.

3.3.3 Implement Strategic to accomplish the objectives

3.3.3.1 Resource Management

- **Energy:** Transition to LEDs, expand solar panel infrastructure, conduct annual internal audits, and integrate efficient building designs in future construction.

- **Water:** Implement rainwater harvesting, greywater recycling, smart irrigation, and emergency water management plans.
- **Occupational Health & Safety:** Enforce safety protocols, accessibility standards, fire drills, and mental health programs. Maintain communication and escalation frameworks.
- **Biodiversity:** Promote native plant use, organic composting, reforestation, xeriscaping, and micro-habitat creation.
- **Waste:** Classify waste, install color-coded bins, monitor via CCTV, and collaborate with Haritha Karma Sena and others for sustainable disposal.

3.3.3.2 Carbon Footprint Reduction

Sustainable practices in water conservation, waste management, biodiversity restoration, and clean energy usage will collectively reduce the campus's carbon footprint.

3.3.3.3 Curriculum Integration

Environmental themes will be integrated into curricula through interdisciplinary courses, awareness campaigns, hands-on projects, faculty development, and specialized modules.

3.3.3.4 Green Initiatives

Enhance green infrastructure, promote sustainable transportation, organize tree-planting drives, biodiversity audits, eco-awareness clubs, and campus composting.

3.3.3.5 Research and Innovation

Support student and faculty-led environmental research, foster innovation in waste-to-energy systems, water quality analysis, and biodiversity conservation, and publish results in scholarly forums.

3.3.3.6 Purchasing and Procurement

Prioritize green procurement: energy-efficient appliances, locally sourced ethical products, sustainable landscaping materials, and lifecycle-based product assessments.

3.3.3.7 Community Engagement

Partner with local communities for:

LED training,

- Water quality workshops,
- Butterfly garden creation,
- Waste cleanup drives,
- Village beautification and organic farming initiatives.

3.3.4 Establish Effective Communication Channels and Oversight Authority

The process includes conducting monthly EMC meetings, issuing campus-wide notices, managing grievance redressal, and preparing for monthly Subcommittee meetings with subsequent reporting. All official communications are conveyed via email or the designated official WhatsApp group

3.3.5 Set Both Long- Tern And Short-Term Targets For Occupational Health And Safety Management

3.3.5.1 Short-term Goals (1–2 years):

- Conduct semester-based environmental awareness programs and safety workshops.
- Launch student eco-clubs and green ambassador programs.
- Integrate safety and sustainability modules into orientation programs.
- Implement an annual "Sustainability Week" with student-led activities and campaigns.

3.3.5.2 Long-term Goals (3–5+ years):

- Institutionalize environmental literacy across all programs.
- Achieve full student participation in annual green initiatives and safety drills.
- Establish an environmental leadership certificate program.
- Create a "Green Alumni Network" for extended community influence.

3.3.6 Ongoing Implement Monitoring and refinement mechanism

- KPI's (Key Performance Indicator) will track energy use, water savings, waste diversion rates, biodiversity indices, and safety incident reports.
- Annual environmental performance reports will be published.
- Continuous internal audits and surveys will refine

strategies and engage stakeholders.

3.3.7 Conclude with a comprehensive evaluation and follow up procedure

- The policy ensures adherence to national and international environmental and sustainability regulations.
- Policy reviews will occur every 3 years or as needed, incorporating feedback from audits and stakeholders, regulatory changes, and evolving technologies.
- Penalties and remedial measures will be outlined for non-compliance.

3.3.8 Conclusion

Nirmala College is steadfast in fostering a culture of environmental consciousness, safety, and sustainability. By uniting policy, education, community, and innovation, we aim to build a campus that not only teaches sustainability but lives it—ensuring a greener, safer, and more equitable future for all.

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 IV

ENERGY MANAGEMENT SYSTEM (En MS): AUDIT REPORT

ENERGY MANAGEMENT SYSTEM
(EnMS 2024-25)

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4.1. INTRODUCTION

Energy is essential to our everyday existence, addressing a core human requirement. We rely on it for nearly all facets of our daily activities, and the planet offers a variety of energy resources, each possessing unique attributes. Nonetheless, every energy source has an environmental impact, with ecological effects stemming from various origins. This article explores energy resources and their environmental ramifications. The relationship between energy and environmental issues is profoundly intertwined. The processes of producing, transporting, and utilizing energy inevitably result in considerable environmental consequences. Immediate effects of energy consumption include air pollution, climate change, water pollution, thermal pollution, and solid waste disposal. Notably, the burning of fossil fuels significantly contributes to urban air pollution and is the primary source of greenhouse gas emissions. Furthermore, energy-related operations frequently lead to challenges associated with water pollution.

Electrical systems consist of intricate networks of wiring and safety mechanisms that supply power to diverse loads, including heating, ventilation, and air conditioning (HVAC) systems, fans, pumps, computers, lighting, blowers, compressors, and various heavy machinery. Nevertheless, their effectiveness and efficiency may decline due to several factors, such as aging components, dust build up, humidity, and obsolete technology. These challenges lead to energy losses, as electricity is transformed into heat, which diminishes efficiency and raises power consumption. Employing energy auditing techniques can help mitigate these inefficiencies by evaluating the overall performance of the electrical system.

ISO 50001 empowers organizations to systematically enhance energy performance across all processes by identifying measures to manage energy consumption effectively while communicating energy management efforts to an increasingly environmentally conscious public. Energy auditing, in accordance with ISO standards and aligned with sustainable development goals, involves a comprehensive assessment of energy use in a specific area or building, aimed at identifying inefficiencies and improving energy performance. Insights from the audit are utilized to develop effective energy management strategies, with the primary goal of reducing energy consumption while maintaining operational efficiency, comfort, and performance. Factors such as occupant behaviour, building age, and climate conditions are carefully considered throughout the auditing process to ensure accurate and actionable outcomes.

4.1.1 What is an energy audit?

Energy auditing is an essential tool for identifying opportunities and strategies to enhance energy efficiency. It is instrumental in revealing potential measures for efficiency and assessing their economic viability across different operational levels. The process starts with a preliminary evaluation that includes site inspections and general energy assessments, which help identify low-cost savings options. As the audits advance to more detailed stages, they explore energy expenses, consumption trends, and system characteristics more thoroughly, utilizing on-site measurements to identify capital-intensive efficiency improvements that align with tailored financial strategies for the site. The prerequisites for conducting 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 behavioral 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 energy management systems (EnMS) within educational institutions but also enhances the overall management of energy demand.

4.1.2 Needs for energy audit

The increasing emphasis on sustainability in our everyday activities, there is a heightened and ongoing interest in professional energy management systems. This trend is fueled by the understanding that conserving energy and minimizing 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 organizations are now utilizing 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 footprints
- An energy audit can reduce unnecessary waste and pollution

Customizing energy audits to align with effective energy management systems can significantly reduce energy expenses, enhancing your financial flexibility. As a result, you acquire a more comprehensive insight into operational processes and consumption trends, which aids in the rapid and sustainable execution of enhancement strategies.

4.1.3 Benefits of adopting energy management system

Energy management system, ISO 50001 can provide Organisations with a number of benefits. These include:

- Helping to achieve energy use reduction and carbon emissions in a systematic way
- Creating a clear picture of current energy use status, based on which new goals and targets
- Evaluating and prioritizing the implementation of new energy-efficient technologies and measures
- Providing a framework to promote energy efficiency throughout supply chain;
- Providing guidance on how to benchmark, measure, document and report effective energy use
- Making better use of energy consuming assets, thus identifying potentials to reduce
- Maintenance costs or expand capacity

4.2 ENERGY MANAGEMENT POLICY

4.2.1 Statement of Commitment

Nirmala College (Autonomous), Muvattupuzha, is committed to the responsible and sustainable use of energy resource. Recognizing its environmental responsibility, the College actively works to reduce its carbon footprint through efficient energy management practices aligned with the Sustainable Development Goals. It strives to ensure access to affordable, reliable, sustainable, and modern energy. The institution is dedicated to fostering a learning environment that promotes awareness of energy conservation while leading by example in minimizing overall energy consumption on campus

4.2.2 Goals

- Energy Reduction: To reduce overall electrical energy consumption across the campus by 5-10% annually.
- Sustainability and Carbon Footprint: To decrease the college's carbon emissions by adopting energy-efficient practices.
- Energy Monitoring: To implement a comprehensive energy monitoring system to identify opportunities for further reduction of energy consumption across the campus.

4.2.3 Objectives

4.2.3.1 Energy-Efficient Practices and Equipment Upgrades: To implement energy-efficient practices across campus, upgrade existing equipment with energy-saving technologies, and encourage behavior changes among students and staff.

4.2.3.2 Renewable Energy Integration: To continue utilizing solar energy as a primary renewable energy source and explore additional opportunities for integrating renewable technologies, enhancing the campus's overall energy efficiency.

4.2.4 Resource Management

4.2.4.1 Energy-Efficient Infrastructure: The College will prioritize installing and maintaining energy-efficient lighting systems and electrical appliances, focusing on transitioning to LED lighting and energy-efficient appliances with higher star ratings.

4.2.4.2 Currently, College has implemented several energy-efficient measures, including the installation of LED lights in classrooms, halls, and other areas, as well as the use of energy-efficient appliances. Approximately 85 % of the infrastructure is well-maintained, with ongoing efforts to ensure that wiring and electrical systems are properly set up and functioning efficiently. Moving forward, the College plans to further enhance its energy efficiency by upgrading to appliances with higher energy star ratings. This initiative will ensure even greater energy savings and contribute to reducing the College's overall energy consumption. Additionally, the College is committed to continuously monitoring energy use, maintaining infrastructure, and prioritizing energy-efficient lighting systems and electrical appliances in future infrastructure developments to further reduce energy waste.

4.2.4.3 Solar Energy Integration: College utilizes solar energy to meet part of its electrical needs. Currently, solar panels are installed at the MCA block, DJ block, and Pharmacy hostel, contributing to energy savings. The College will continue to expand and optimize its solar power systems to further reduce reliance on non-renewable energy sources. In the future, the College aims to enhance the use of solar energy, further increasing its sustainability and reducing overall energy consumption.

4.2.4.4 Energy Audits: Energy audits will be conducted to assess energy consumption patterns, identify inefficiencies, and develop improvement plans. Currently, the college has an internal audit team that conducts annual energy audits. This team reviews electricity bills, maintains energy consumption registers, and ensures that meter readings are accurate. Monitor the functioning of all electrical gadgets, using a checklist to track performance. The auditors examine these records and systems to identify any inefficiencies or issues. If any rectifications or improvements are needed, they report their findings and recommendations for corrective action.

4.2.4.5 Building Design: Future construction and renovation projects will incorporate energy-efficient building designs, including insulation, passive cooling, and energy-efficient windows. These developments will be based on the findings of previous energy audits and reports, ensuring that energy-saving measures are integrated into the design and construction processes.

4.2.5 Green Initiatives

4.2.5.1 Campus-wide Energy Awareness Campaigns: Periodic Energy Awareness Campaigns will be conducted to raise awareness about energy conservation and promote energy-saving habits among students, faculty, and staff.

4.2.5.2 Department-wise Campaigns: Internal auditors will organize tailored sessions for each department, focusing on their specific energy usage. These sessions will educate participants on practical energy-saving strategies to reduce consumption. The goal is to foster a culture of sustainability and encourage everyone on campus to adopt energy-efficient behaviours.

4.2.6 Research and Innovation

The college will engage in initiatives aimed at making the campus greener, such as creating energy-efficient green spaces, promoting eco-friendly transportation options (e.g., bicycles, and electric vehicles), and hosting sustainability-related events and competitions. These efforts will be aligned with the college's focus on research with a particular emphasis on energy conservation. To support this, a series of seminars and workshops will be conducted to educate students and staff about sustainable practices and encourage participation in energy-saving projects.

4.2.7 Curriculum integration:

Establish student-led energy conservation programs and clubs to encourage active participation and innovation in energy-saving projects. Students, who have already been trained in LED lamp assembly, will provide training to other students, staff, and members of the community. Form a group called 'urja' and develop a module focused on improving energy utilization efficiency. This module will outline key precautions and measures to be taken to maximize energy savings and promote sustainable practices.

4.2.8 Purchasing and Procurement

4.2.8.1 Energy-Efficient Equipment: All new electrical equipment, appliances, and systems purchased by the college will prioritize energy-efficient options, focusing on models that help to conserve energy. Whenever new equipment is procured, the energy management team will provide expert advice to ensure that energy-efficient options are selected, helping to further reduce the college's energy consumption and environmental impact.

4.2.8.2 Green Procurement: The College will prioritize purchasing from environmentally conscious suppliers who provide eco-friendly products, including those made with sustainable materials and energy-efficient technologies.

4.2.9 Community Engagement

4.2.9.1 Local Collaboration: The College will collaborate with local communities and environmental organizations to promote energy conservation and share knowledge on sustainable energy practices. As part of this initiative, the college will offer LED lamp assembly training for the community, conduct classes on energy conservation, and encourage student-led initiatives to raise awareness and foster community engagement in sustainability and energy-saving practices.

4.2.9.2 Educational Outreach: The College will organize seminars, workshops, and awareness programs to engage students and staff in sustainability efforts, with a focus on electrical energy conservation and the benefits of renewable energy. These classes will be conducted by experts in the field.

4.2.10 Monitoring and Reporting

4.2.10.1 Energy Consumption Tracking: The College will monitor energy consumption patterns across different buildings and departments. Internal auditors will check meter readings, review bills, examine checklists, and verify department-wise stock registers to track energy usage. Based on this data, they will generate a report. If any modifications or improvements are needed, the energy management team will inform the concerned departments to take necessary action.

4.2.10.2 Annual Reports: A comprehensive energy performance report will be published annually, detailing energy consumption data, progress towards goals, and strategies for future improvements. This report will be prepared by the energy audit team. Based on the energy audit report, the energy management team will recommend measures to increase energy efficiency, helping students and staff implement practical steps for energy conservation.

4.2.10.3 Transparency and Stakeholder Engagement: Regular updates will be shared with relevant stakeholders within the college community, including students, faculty, and staff.

4.2.11 Compliance and Review

4.2.11.1 Regulatory Compliance: The College will comply with all national and local laws regarding energy efficiency and sustainability, including energy conservation regulations and renewable energy standards.

4.2.11.2 Periodic Review: The policy will be reviewed periodically to incorporate technological advances, regulatory changes, and new opportunities for energy conservation. Feedback from stakeholders will be solicited for continuous improvement. This review will help identify any shortcomings, and once identified, the internal auditors will take the necessary steps to address them and implement improvements.

4.2.12 Leadership and Accountability

4.2.12.1 Energy Management Team: A dedicated energy management team, including faculty, staff, and students, will be responsible for the implementation and ongoing monitoring of the energy management resource policy.

4.2.12.2 Designated Roles: Clear roles and responsibilities will be established for energy management activities, including energy audits, reporting, and campus-wide awareness initiatives.

4.2.12.3 Accountability: Leadership at the college will hold all departments and individuals accountable for meeting energy-saving targets. Regular performance reviews will ensure that energy management goals are achieved.

4.2.13 Conclusion

The energy management system policy of Nirmala College (Autonomous) Muvattupuzha is a commitment to creating a sustainable and energy-efficient campus. Through strategic planning and widespread engagement, the college aims to reduce its environmental impact, foster a culture of sustainability, and actively promote energy efficiency in both academic and operational practices.

4.3 METHODOLOGY

The energy audit systematically analysed the institution's energy usage according to a structured program. The 11-member of internal audit team, comprising 8 students and 3 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 a waste 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. Manadatory Audit as per EnMS Standards

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 KESB, 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 Energy audit as per EMC standards

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.

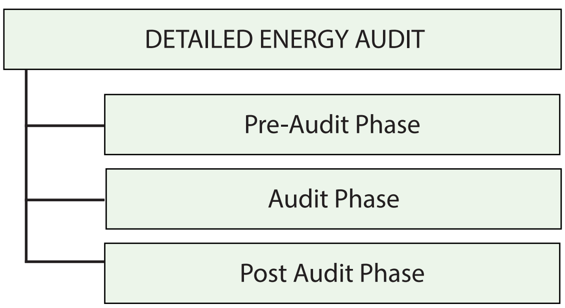
ISO 50001:2018, utilizing the Annex SL high-level structure, facilitates integration with other management systems like ISO 9001 (Quality) and ISO 14001 (Environmental). This allows for streamlined processes like document control, internal audits, and corrective actions, avoiding duplicated effort. A 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

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



4.3.10.1 Pre-Audit phase

- Formation of audit team; scheduling audit programmes
- Setting up of scope and objectives (in tune with energy policy of the institution)
- Discussion with the responsible persons of each location (staff, teachers, lab assistants, sweepers, watchmen, students etc.) about the usage pattern and habits related to energy consumption.
- Preparation of inventory of energy infrastructure- site diagrams, electrical diagrams, checklists etc.
- Analysis of consumption pattern; identification of energy loss or wastage

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

The outcomes of the collected data are:

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

4.3.10.3. Post audit phase

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

4.3.10.4 Schedule of Energy Audit

Week	Week Days	Weekly Work Plan
First Week		• A meeting was held to discuss about the policies and to finalize the action plan • Every team member is asked to go through the manual and asked to prepare the checklists for carrying out the action plan • Collected the map of the college campus • Identification of meter locations to take the meter readings • The internal audit team is divided into ……. groups • The college campus is divided into ……. blocks and each group is assigned a block for the survey
Second Week		• Each group is asked to identify the meter locations in their assigned area • A map is given to each group and assigned locations for meter reading data collection • Each group is asked to mark the electrical appliances/ instruments in the block. (line sketches and simple diagrams) • Handed over the data sheets and each group will start the data collection from the next Wednesday onwards
Third Week		• Each group is assigned to place registers on required areas for efficient data collection • Each team is asked to identify the working conditions of each appliance / Instruments were inspected by the groups. • The efficient and non-efficient devices will be sorted. • A meeting will be held to analyse the progress of the energy audit and to analyse the results
Fourth Week		• Preparing and uploading registers and documents, which includes documenting programs and activities as well as recording meeting minutes
Fifth Week		• Each group will be assigned to record the operational hours of each appliance separately for daily and weekly usage. Weekend data should also be collected. • The power meter readings for each block have to be recorded simultaneously

Sixth Week		• This week is assigned for computation and documentation of the daily and weekly power consumption for each block, utilizing data from the fourth week
Seventh Week		• Collection of power consumption data from all the blocks and should cross-checked it with the power meter readings to verify for any discrepancies.
Eighth Week		• Submit the document to external team and make suitable correction based on the requirements

Table 4.1 Schedule of energy audit

4.3. 11 Steps of Energy Audit

4.3.11.1. Site assessment

Collection of contour map and campus diagram

- Preparing inventory of energy infrastructure of each building:
    - Construction details of the building envelope (e.g. walls, roof, windows, doors and related insulation values)
    - Manual, time clock or automated control and measuring methods (energy meters, main switches; MCB, ELCB etc.)- control section; capacity; location etc.
    - Interior and exterior lighting systems and related controls
    - Equipment, appliances, instruments etc. – watts, utility pattern, average consumption (monthly or yearly)
    - Discussion with responsible persons of each infrastructure (on utility pattern, working condition, operation and maintenance procedures etc.)
    - Date entry in prescribed forms (Energy spread sheets)

4.3.11.2. Data analysis

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

4.3.11.3. Final audit by external audit team

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

Fig 4.1 External energy audit discussion

4.3.11.4 Work Plan of Energy Audit

Activities	Frequency	Dates of study	Mode of collection
Energy Meter reading (for every meter in the college)	9 days; three times a day	Three Sundays; Three holidays as 16/02/2025, 23/02/2025, 02/03/2025 (Saturday)as 15/02/2025, 22/02/2025, 01/03/2025 Three working days 14/02/2025, 21/02/2025, 28/02/2025 (completed by three weeks)	Entry in the given format
Energy infrastructure assessment: 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, appliances, instruments etc.	Entry in the given formats
Power quality assessment and Thermal imaging assessment	Two Full working day by external energy auditor	Working days (23/04/2025, 24/04/2025)	Detailed assessment report
Alternate energy resources	Documents details of present alternate energy resources in the campus	Identify possible alternate 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. Alternate energy resources	Record the monthly/ annual usage quantity.	Keep registers. Data shall be entered in the given format
	II. Fossil fuels 1. LPG 2. Petrol/diesel 3. Kerosene etc.	Record annual usage with respective purpose uses and location (lab, office, kitchen etc.)	Enter in the given format

Table 4.2 Workplan of energy audit

Fig 4.2 External energy audit

4.4 RESULT AND DISCUSSION

4.4.1 Assessment of energy consumption as per EMC standards

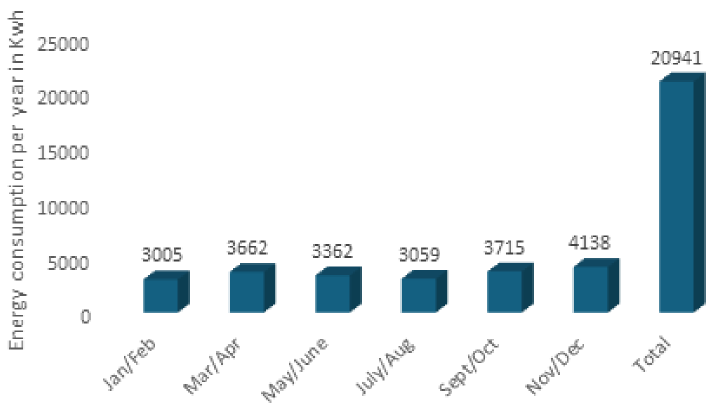


Fig. 4.3 Energy consumption of con - 115591240751

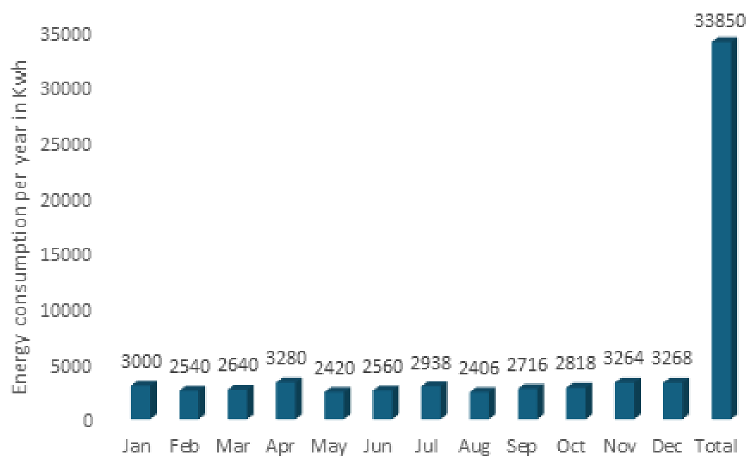


Fig. 4.4 Energy consumption of con - 115591000209

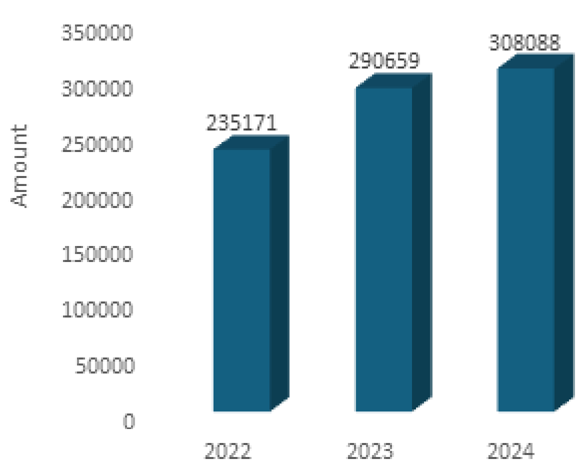


Fig. 4.5 Energy consumption of con - 1155910000232

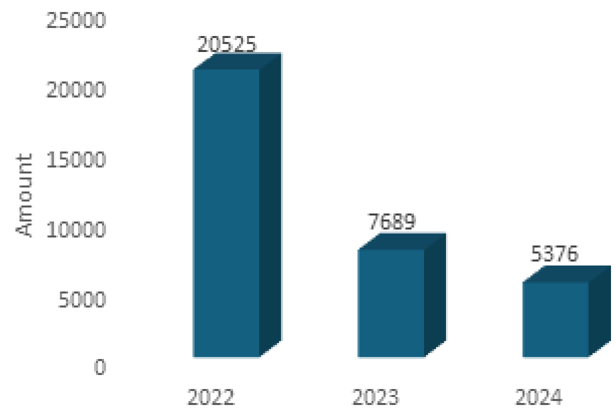


Fig. 4.6 Energy consumption of con - 115591401805

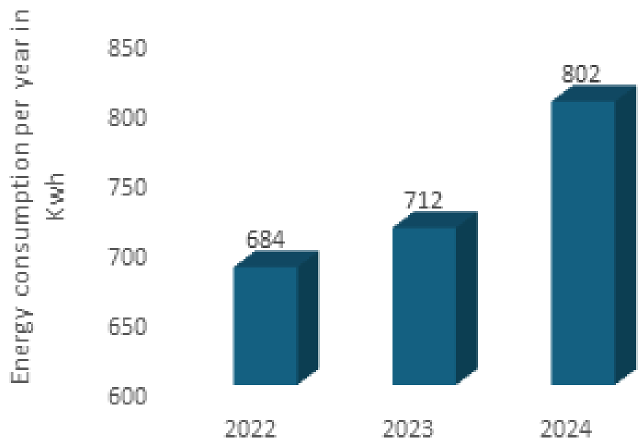


Fig. 4.7 Energy consumption of con - 11559100006281

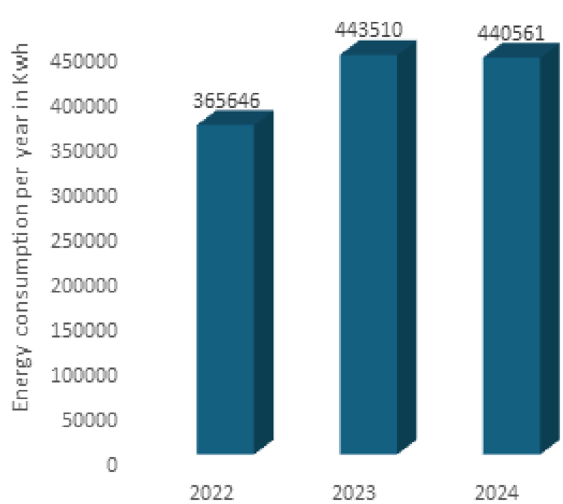


Fig. 4.8 Energy consumption of con - 1155911000336

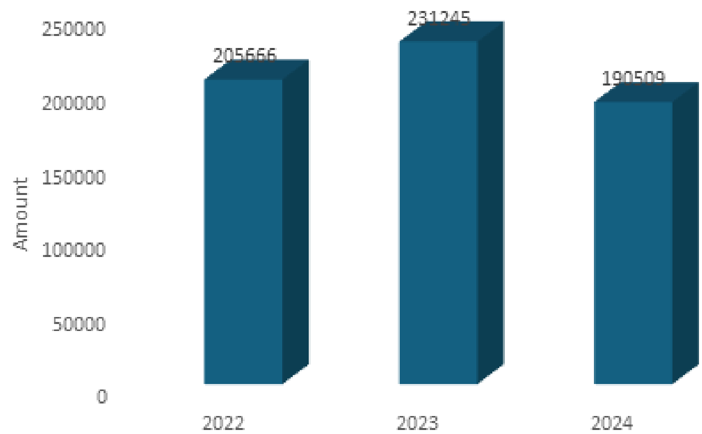


Fig. 4.9 Energy consumption of con - 115591000857

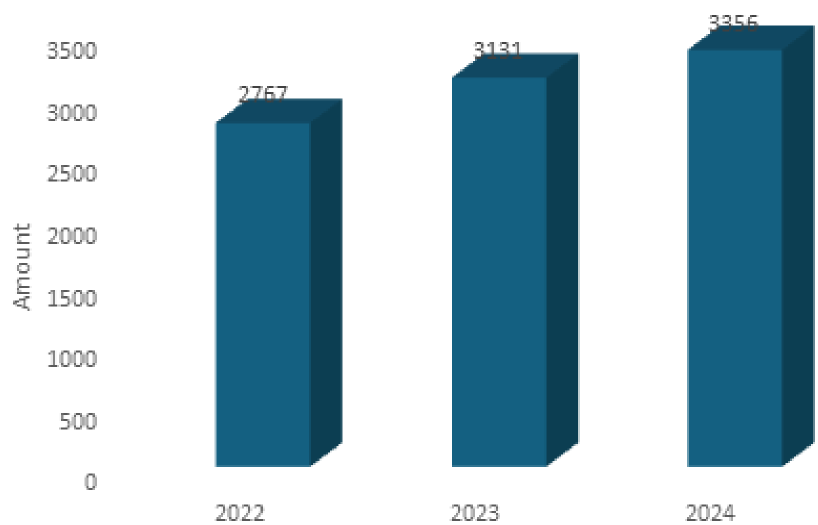


Fig. 4.10 Energy consumption of con - 1155911005418

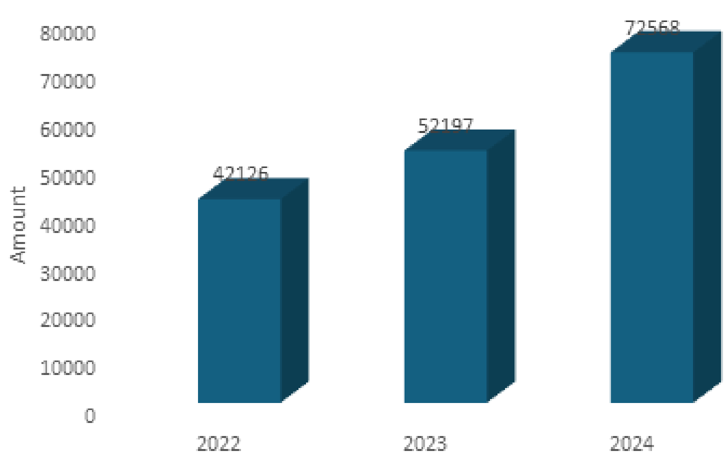


Fig. 4.11 Energy consumption of con - 1155912008235

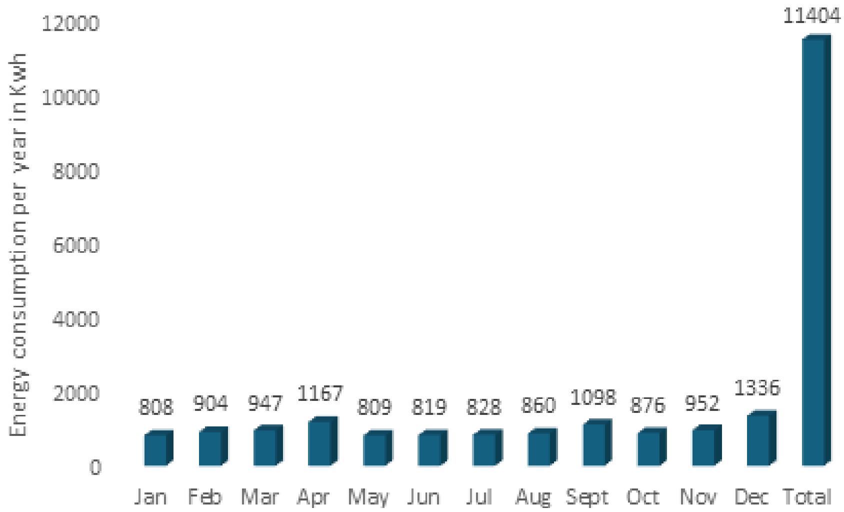


Fig. 4.12 Energy consumption of con - 1155915022207

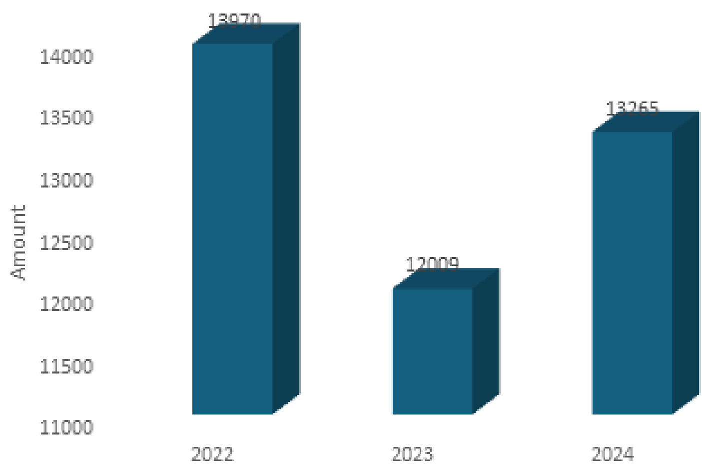


Fig. 4.13 Energy consumption of con - 1155918000157

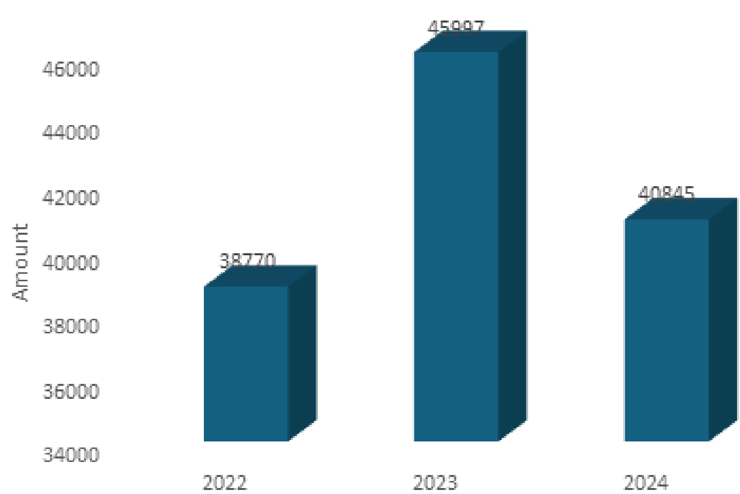


Fig. 4.14 Energy consumption of con - 1155918003650

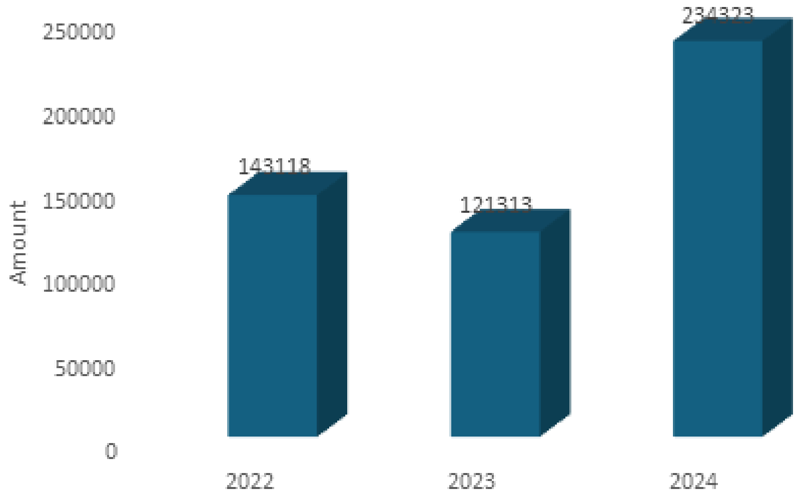


Fig. 4.15 Energy consumption of con - 1155919021412

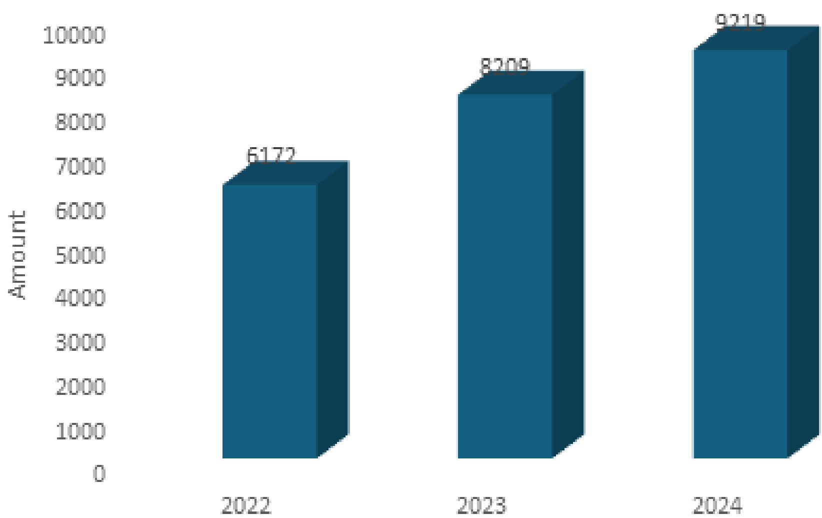


Fig. 4.16 Energy consumption of con - 11559190282926

4.4.2 Performance Evaluation

Parameter	Minimum	Average	Maximum
Voltage Line to Neutral		Volts,V	
V1	233.35-246.45	234.40-246.90	234.80-247.10
V2	233.25-245.50	234.15-245.95	234.75-246.25
V3	232.90-245.05	233.70-245.40	234.10-245.70
VN-E	0.05-0.25	0.05-0.30	0.05-0.35
Voltage Line to Line	Volts,V		
U12	405.00-426.65	406.65-427.3	407.7-427.75
U23	403.35-424.25	404.90-424.95	405.70-425.50
U31	403.10-425.65	404.8-426.3	405.50-426.70

Current	Ampers,A		
A1	35-79	35-80	35-94
A2	38-77	39-79	40-94
A3	51-75	52-78	52-109
AN	05-25	05-28	06-41
PowerFactor			
PF1	0.86-0.98	0.94-0.98	0.94-0.98
PF2	0.84-0.98	0.85-0.99	0.86-0.99
PF3	0.84-0.99	0.96-0.99	0.96-0.99
PFT	0.86-0.98	0.92-0.98	0.92-0.98
ActivePower	Kilowatts,kW		
P1	7.9- 18.5	08.00-18.60	08.1- 21.2
P2	8.2- 17.4	08.40- 17.70	08.5- 20.5
P3	12-17.6	12.10-18.50	12.3-23.5
PT	28.7-48.7	29.20-49.80	29.5-53.3
ApparentPower	Kilovolt-Ampere, kVA		
S1	08.30- 18.80	08.40- 18.90	08.50- 22.30
S2	09.20- 18.20	09.40- 18.60	09.50- 22.10
S3	12.30-18.10	12.50-18.80	12.60-25.40
ST	31.00-50.60	31.50-51.90	31.90-58.80
ReactivePower	Kilovolt-Ampere Reactive,kVAR		
Q1	1.1- 3.6	01.20- 3.60	01.20- 07.50
Q2	1.4- 6.7	01.50- 06.90	01.60- 08.50
Q3	1.4- 3.9	01.50- 04.00	01.50- 09.40
QT	4.1- 12.9	04.20- 13.20	04.30- 17.90
Harmonics	%%		
THDV1	1.13-2.04	01.16-02.14	01.18-02.41
THDV2	1.06-1.85	01.10- 01.98	01.15-02.20
THDV3	1.08-2.21	01.13-02.33	01.19-02.63
THDA1	11.52-29.74	12.05-30.18	12.22-31.12
THDA2	5.88-22.5	09.50- 22.90	09.62-23.72
THDA3	6.27-20.76	06.54-20.97	06.86-21.97
Frequency,Hz	49.861-50.168	49.864-50.17	49.867-50.173

Table 4.3 Measured Parameters

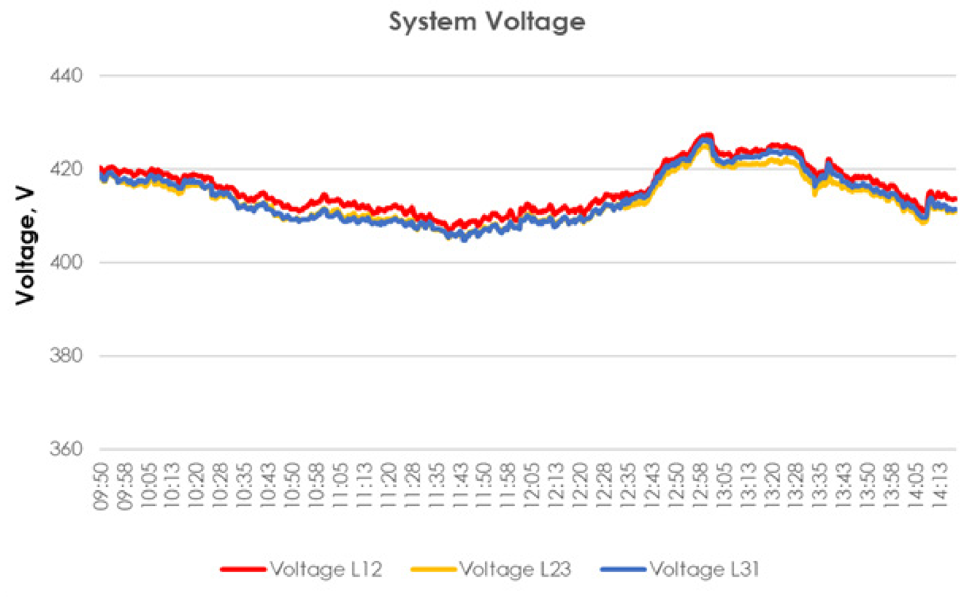


Fig. 4.17 System voltage

- The average System Voltage is plotted in the above graph.
- The minimum voltage recorded is 404V and the maximum recorded is 427V.
- The System Voltage is in safe limits.
- The load current is plotted in the above graph.

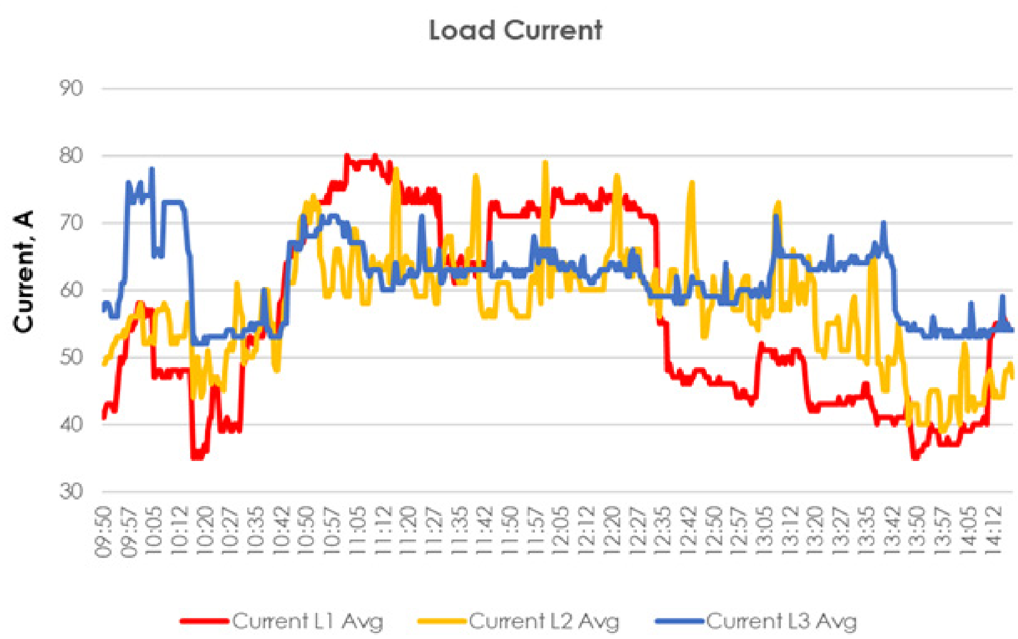


Fig. 4.18 Load current

- The Load is not balanced and need to balance the load.
- L1 and L2 Phases are loaded almost equal but the L3 Phase is loaded the most.

4.4.3 Critical Areas Observerd

4.4.3.1 Mens Hostel :

One of the main critical issue is related to the men’s hostel. There we find huge loss of energy due to the old wiring, all safety equipment like RCCBs are bypassed or not present in the DBs. Erathing was not not proper in the site. Due to this unstandard wirings and lack in protection the energy bills may rise and operator will work under unsafe conditions. Rewiring of the hostel is recommended and poper maintenance and observations may arranged for this particulat building.

4.4.3.2 MCA Block:

Battery water is spilled out, one of the panel is burnt due to some short circuit. Also RCCBs are not working properly in this building.

4.4.3.3 General comments:

There is no responsible and qualified person for operating the electrica sysytem is not present in the campus. There is no relevant documents or drawings regarding the electrical system are not present in the campus. There is no preventive maintenance registers or records are present. It is recommended that a person with qualification to operate in electrical system may appointed to the campus. It may also recommended that the management may appoint a consultancy for preapring the electrical schematic of the entire campus(As-built), preparing preventive maintrenace records, preparing electrical load registers and identifying the defects and rework on it.

Fig. 4.19 Oil filling equipment are kept inside the DG

Fig. 4.20 Energy meter are absent in DG GCP

Fig. 4.21 Oil spillage is present inside the DG set

Fig. 4.22 Waste materials present on BUS of DG set

Fig. 4.23 Diesel can kept at the door of DG which will blocke the access to DG set and cause fire

Fig. 4.24 Cable leg of MCCB is burned at GECP

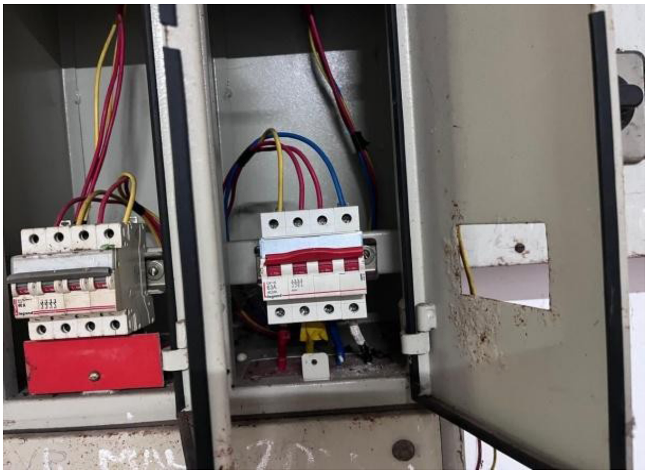


Fig. 4.25 Multiple connections are wired from same switches

Fig. 4.26 Temperory extension from panel without switch

Fig. 4.27 Inflammable materials kept at electric room

Fig. 4.28 Battery water are spilled out from battery unit

Fig. 4.29 Cables are burned and damages found in KSEBL

Fig. 4.30 Panel board is burned and running without any protection

Fig. 4.31Panels are running without fuse links

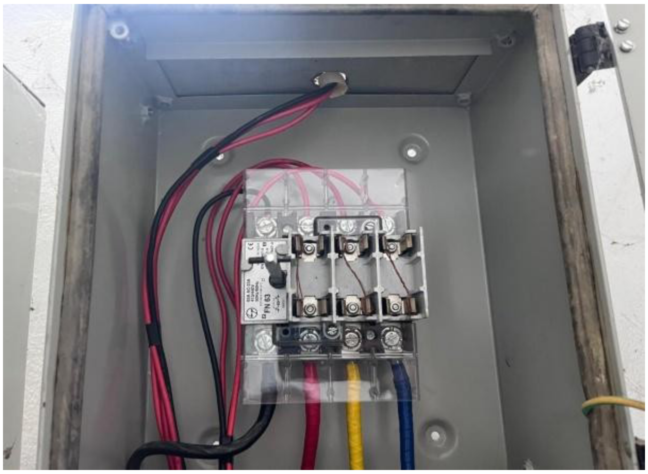


Fig. 4.32 SFUs are working without proper rated fuse links

Fig. 4.33 Blowed fuses are wired without non-standard bare coper

Fig. 4.34 Water Motor pump

4.4.4 Phase Currents and Nutral earth Voltage

SlNo.	Location	Currentin(A)			NeutralEarth Voltage(V)
		Red	Yellow	Blue	
MAIN BLOCK					
1	NewBlock	15.7A	11.08A	10.06A	4.9 V
2	Auditorium	18.3A	13.9A	11.3A	4.8 V
3	NewBlock	19.06A	26.4A	10.12A	5 V
4	Ex Hall	3.15A	3.18A	3.4 A	4 V
5	ToMSB1	48.29A	21.36A	25.17A	2.32V
6	MainBlock	46.19A	21.45A	25.9A	4.12V
7	Dg62.5kVA	52 A	32.5A	35.9A	0.45V
8	DG62.5kVA	46 A	30.3A	35 A	0.35V
MCA BLOCK					
9	LDB2	3.43A	3.23A	8.07A	7.9 V
PG BLOCK					
10	125Aisolator	8.15A	16.33A	5.19A	7 V
11	100ASFU	0.17A	2.8 A	0.5 A	0.59V
12	40 Aout1	2.48A	2.45A	3.32A	0.24V
LF HOSTEL					
13	63 ADGset	4.25A	7.6 A	5.27A	0.4 V
NIRMALA HOSTEL					
14	Out 4	3.238A	14.9A	16.38A	4.04V
15	Out 3	5.3 A	5.89A	4.6 A	4.7 V
16	Out 2	3.17A	3.18A	3.13A	5.4 V
ATMUNIT					
17	ATM	3.16A	3.04A	6.16A	0.43V

Table 4.4 Phase current and nutral earth voltage

4.4.5 Observations and comments

- The phase voltages are differs some time in each phase
- The load current is unbalanced.
- Frequency is in safe limit
- DG loaded at a safe line also DGs are with a high load margin
- The Specific Energy Generation Ratio is low and recommends to do the service of the Diesel Generator for correcting the AVR Control and improving the SEGR. Also give AMC for the Diesel Generator which will help monitor and maintain the efficiency of the Diesel Generator.
- It is required to make a distribution schematic for the entire campus.

4.4.6 Thermography

4.4.6.1 Thermographic Assessment

Fig. 4.35 Taking thermal imaging data

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.

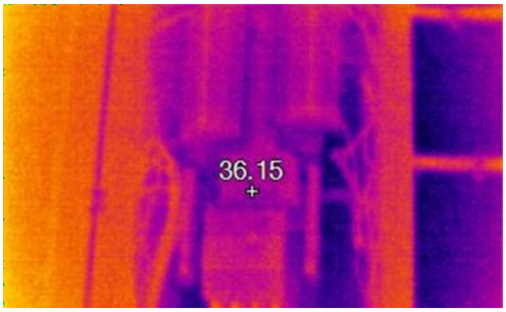
Temperature Rise above Ambient	Severity	Recommended Action
1^0C to 10^0C	**Normal**	**No Action Required**
11^0C to 35^0C	**Minor**	**Monitor, analyse load condition, schedule for repairs.**
36^0C to 75^0C	**High**	**Repair in one or two days, reduce load until repairs are complete.**
Over 76^0C	**Critical**	**Repair immediately, reduce or control load till repairs are complete.**

Table 4.5 Measuring temperature

Fig. 4.36 Solar panelof the college

4.4.6.2 The thermal assessment conducted panel wise is detailed in the following section.

Vertical DB Hostel



Name	IR000442.IS2
Emissivity	0.95
Background Temperature	20.00 ℃
Calibration Range	-10.00 ℃ to 600.00 ℃
Image Range	35.59 ℃ to 37.53 ℃
IR Sensor Size	320X240
Camera Serial Number	Ti32-13080298 (9Hz)
DSP Version	1.2.19
Image Time	01/05/2012 11:48:14 AM

Table 4.6 Vertical DB - Hostel Image Info

Marker Info

Marker Name	Maximum	Minimum	Average	Emissivity	BG Temp	Std.Dev	Delta-T
Centerpoint	36.2 ℃	36.2 ℃	36.2 ℃	0.95	20.0 ℃	0.00	

Fig. 4.37 Thermal imaging at various electrical points

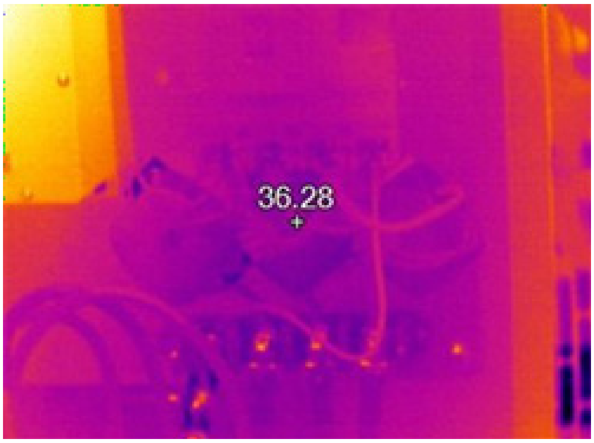
Name	IR000441.IS2
Emissivity	0.95
Background Temperature	20.00 ℃
Calibration Range	-10.00 ℃ to 600.00 ℃
Image Range	34.85 ℃ to 39.84 ℃
IR Sensor Size	320X240
Camera Serial Number	Ti32-13080298 (9Hz)
DSP Version	1.2.19
Image Time	01/05/2012 11:23:03 AM

Table 4.7 DG 45kVA - Image Info

Marker Info

Marker Name	Maximum	Minimum	Average	Emissivity	BG Temp	Std.Dev	Delta-T
Centerpoint	36.3 ℃	36.3 ℃	36.3 ℃	0.95	20.0 ℃	0.00	

Fig. 4.38 Thermal imaging at various electrical points



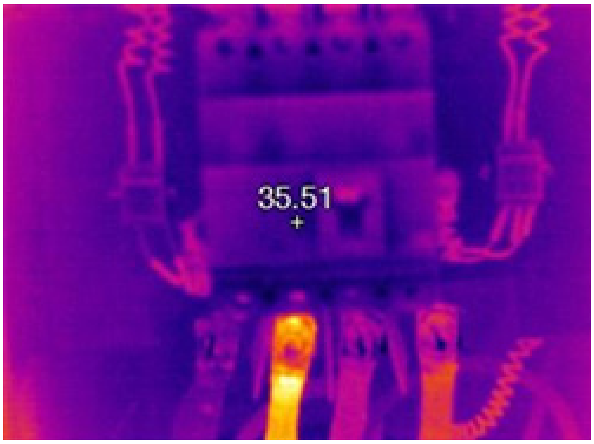
Name	IR000440.IS2
Emissivity	0.95
Background Temperature	20.00 ℃
Calibration Range	-10.00 ℃ to 600.00 ℃
Image Range	37.44 ℃ to 49.63 ℃
IR Sensor Size	320X240
Camera Serial Number	Ti32-13080298 (9Hz)
DSP Version	1.2.19
Image Time	01/05/2012 11:18:18 AM

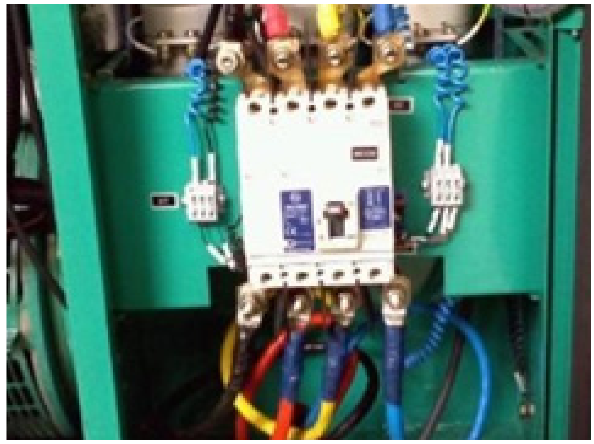
Table 4.8 DG 45 kVA - Image Info

Marker Info

Marker Name	Maximum	Minimum	Average	Emissivity	BG Temp	Std.Dev	Delta-T
Centerpoint	40.2 ℃	40.2 ℃	40.2 ℃	0.95	20.0 ℃	0.00	

Fig. 4.39 Thermal imaging at various electrical points





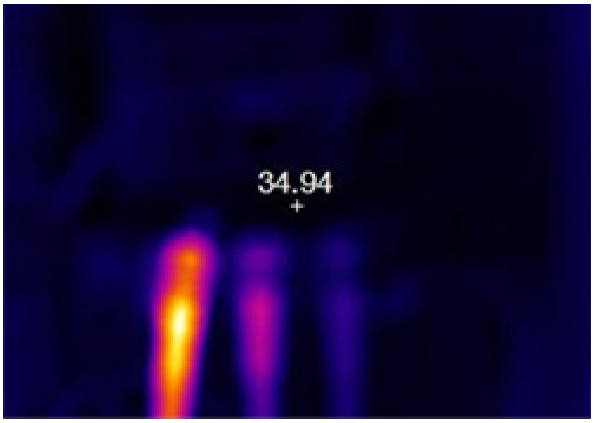
Name	IR000439.IS2
Emissivity	0.95
Background Temperature	20.00 °C
Calibration Range	-10.00 °C to 600.00 °C
Image Range	34.85 °C to 39.64 °C
IR Sensor Size	320X240
Camera Serial Number	Ti32-13080298 (9Hz)
DSP Version	1.2.19
Image Time	01/05/2012 10:34:04 AM

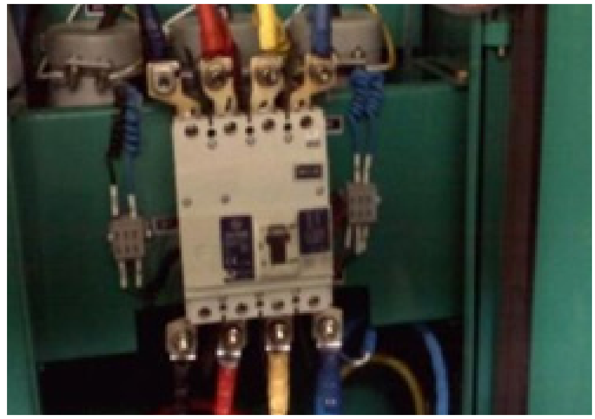
Table 4.9 DG GCB - Image Info

Marker Info

Marker Name	Maximum	Minimum	Average	Emissivity	BG Temp	Std.Dev	Delta-T
Centerpoint	35.5 °C	35.5 °C	35.5 °C	0.95	20.0 °C	0.00	

Fig. 4.40 Thermal imaging at various electrical points





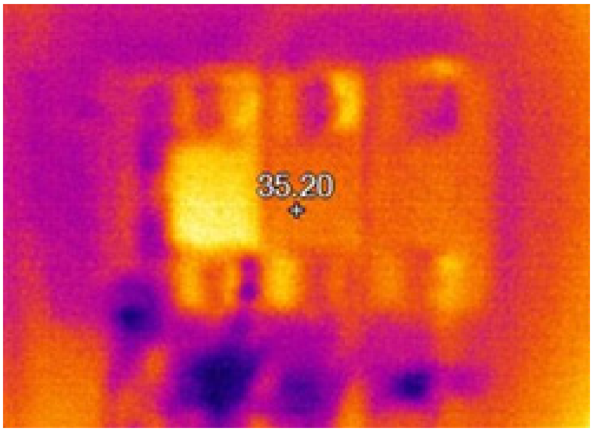
Name	IR000438.IS2
Emissivity	0.95
Background Temperature	20.0 ℃
Calibration Range	-10.0 ℃ to 600.0 ℃
Image Range	34.7 ℃ to 53.1 ℃
IR Sensor Size	320X240
Camera Serial Number	Ti32-13080298 (9Hz)
DSP Version	1.2.19
Image Time	01/05/2012 10:24:19 AM

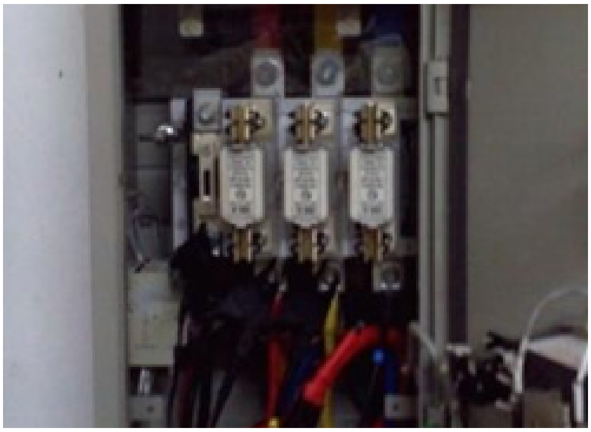
Table 4.10 DG incomer - Image Info

Marker Info

Marker Name	Maximum	Minimum	Average	Emissivity	BG Temp	Std.Dev	Delta-T
Centerpoint	34.9 ℃	34.9 ℃	34.9 ℃	0.95	20.0 ℃	0.00	

Fig. 4.41 Thermal imaging at various electrical points





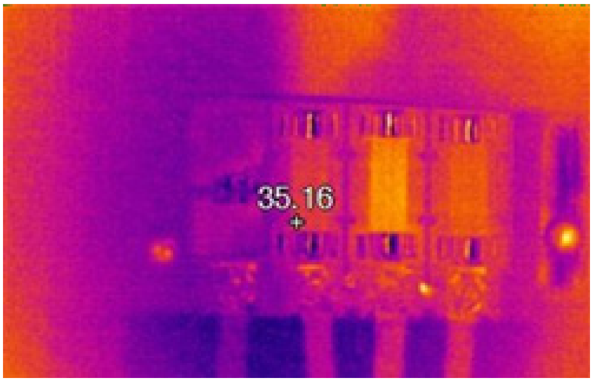
Name	IR000437.IS2
Emissivity	0.95
Background Temperature	20.00 ℃
Calibration Range	-10.00 ℃ to 600.00 ℃
Image Range	34.07 ℃ to 35.90 ℃
IR Sensor Size	320X240
Camera Serial Number	Ti32-13080298 (9Hz)
DSP Version	1.2.19
Image Time	01/05/2012 10:05:36 AM

Table 4.11 Nirmala Hostel Incomer - Image Info

Marker Info

Marker Name	Maximum	Minimum	Average	Emissivity	BG Temp	Std.Dev	Delta-T
Centerpoint	35.2 ℃	35.2 ℃	35.2 ℃	0.95	20.0 ℃	0.00	

Fig. 4.42 Thermal imaging at various electrical points



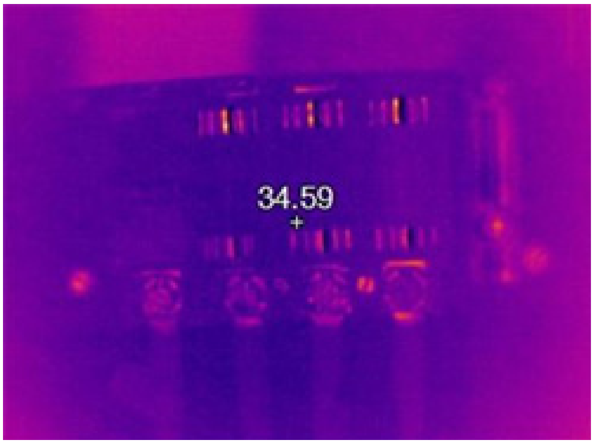
Name	IR000436.IS2
Emissivity	0.95
Background Temperature	20.00 ℃
Calibration Range	-10.00 ℃ to 600.00 ℃
Image Range	34.24 ℃ to 36.28 ℃
IR Sensor Size	320X240
Camera Serial Number	Ti32-13080298 (9Hz)
DSP Version	1.2.19
Image Time	01/05/2012 10:05:26 AM

Table 4.12 Nirmal Hostel Out 1 - Image Info

Marker Info

Marker Name	Maximum	Minimum	Average	Emissivity	BG Temp	Std.Dev	Delta-T
Centerpoint	35.2 ℃	35.2 ℃	35.2 ℃	0.95	20.0 ℃	0.00	

Fig. 4.43 Thermal imaging at various electrical points



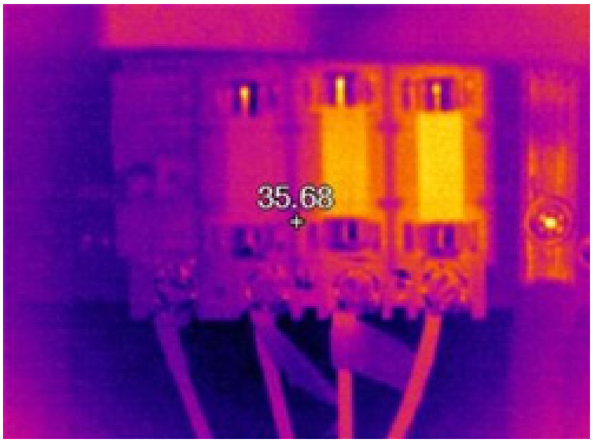
Name	IR000435.IS2
Emissivity	0.95
Background Temperature	20.00 ℃
Calibration Range	-10.00 ℃ to 600.00 ℃
Image Range	33.85 ℃ to 38.42 ℃
IR Sensor Size	320X240
Camera Serial Number	Ti32-13080298 (9Hz)
DSP Version	1.2.19
Image Time	01/05/2012 10:05:18 AM

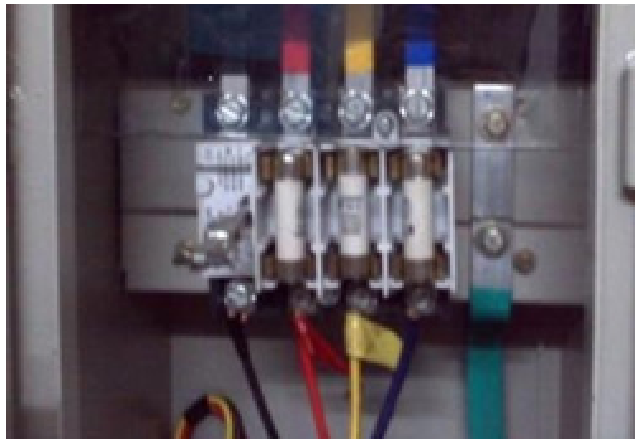
Table 4.13 Nirmala Hostel Out 2 - Image Info

Marker Info

Marker Name	Maximum	Minimum	Average	Emissivity	BG Temp	Std.Dev	Delta-T
Centerpoint	34.6 ℃	34.6 ℃	34.6 ℃	0.95	20.0 ℃	0.00	

Fig. 4.44 Thermal imaging at various electrical points





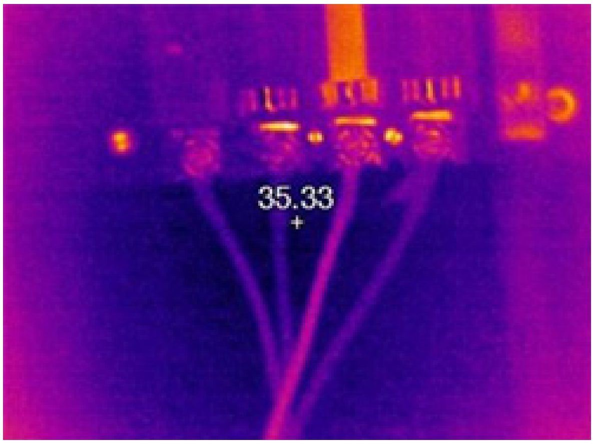
Name	IR000434.IS2
Emissivity	0.95
Background Temperature	20.00 ℃
Calibration Range	-10.00 ℃ to 600.00 ℃
Image Range	34.72 ℃ to 37.35 ℃
IR Sensor Size	320X240
Camera Serial Number	Ti32-13080298 (9Hz)
DSP Version	1.2.19
Image Time	01/05/2012 10:05:04 AM

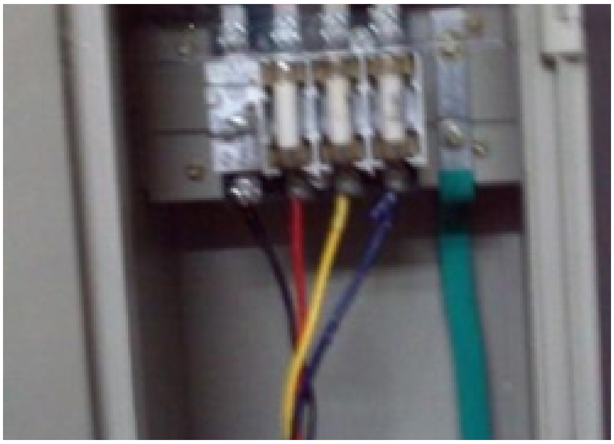
Table 4.14 Niramal Hostel out 3 - Image Info

Marker Info

Marker Name	Maximum	Minimum	Average	Emissivity	BG Temp	Std.Dev	Delta-T
Centerpoint	35.7 ℃	35.7 ℃	35.7 ℃	0.95	20.0 ℃	0.00	

Fig. 4.45 Thermal imaging at various electrical points





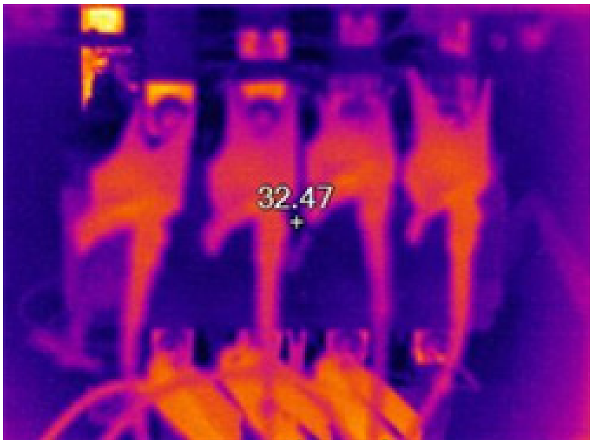
Name	IR000433.IS2
Emissivity	0.95
Background Temperature	20.00 °C
Calibration Range	-10.00 °C to 600.00 °C
Image Range	35.16 °C to 37.35 °C
IR Sensor Size	320X240
Camera Serial Number	Ti32-13080298 (9Hz)
DSP Version	1.2.19
Image Time	01/05/2012 10:04:32 AM

Table 4.15 Nirmala Hostel DG Incomer - Image Info

Marker Info

Marker Name	Maximum	Minimum	Average	Emissivity	BG Temp	Std.Dev	Delta-T
Centerpoint	35.3 °C	35.3 °C	35.3 °C	0.95	20.0 °C	0.00	

Fig. 4.46 Thermal imaging at various electrical points



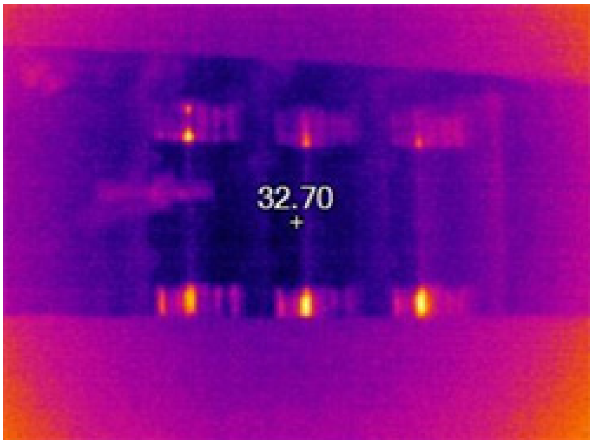
Name	IR000432.IS2
Emissivity	0.95
Background Temperature	20.00 °C
Calibration Range	-10.00 °C to 600.00 °C
Image Range	31.98 °C to 35.64 °C
IR Sensor Size	320X240
Camera Serial Number	Ti32-13080298 (9Hz)
DSP Version	1.2.19
Image Time	01/05/2012 08:58:26 AM

Table 4.16 LF Hostel PDB - Image Info

Marker Info

Marker Name	Maximum	Minimum	Average	Emissivity	BG Temp	Std.Dev	Delta-T
Centerpoint	32.5 °C	32.5 °C	32.5 °C	0.95	20.0 °C	0.00	

Fig. 4.47 Thermal imaging at various electrical points



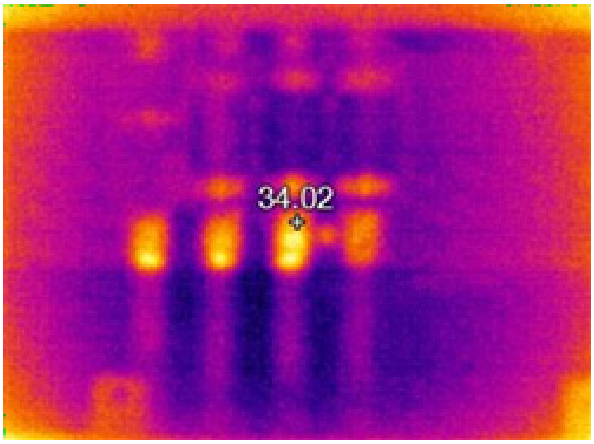
Name	IR000431.IS2
Emissivity	0.95
Background Temperature	20.00 ℃
Calibration Range	-10.00 ℃ to 600.00 ℃
Image Range	32.56 ℃ to 34.94 ℃
IR Sensor Size	320X240
Camera Serial Number	Ti32-13080298 (9Hz)
DSP Version	1.2.19
Image Time	01/05/2012 08:58:10 AM

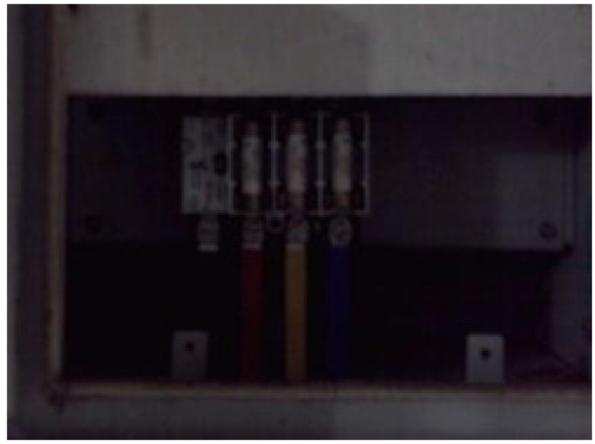
Table 4.17 LF Hostel LDB 3 - Image Info

Marker Info

Marker Name	Maximum	Minimum	Average	Emissivity	BG Temp	Std.Dev	Delta-T
Centerpoint	32.7 ℃	32.7 ℃	32.7 ℃	0.95	20.0 ℃	0.00	

Fig. 4.48 Thermal imaging at various electrical points





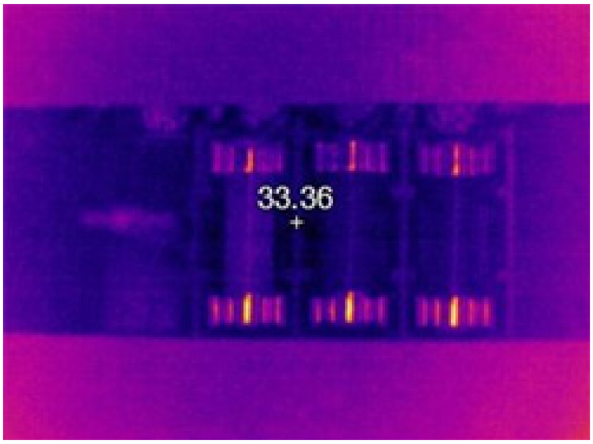
Name	IR000430.IS2
Emissivity	0.95
Background Temperature	20.00 ℃
Calibration Range	-10.00 ℃ to 600.00 ℃
Image Range	32.79 ℃ to 34.46 ℃
IR Sensor Size	320X240
Camera Serial Number	Ti32-13080298 (9Hz)
DSP Version	1.2.19
Image Time	01/05/2012 08:57:58 AM

Table 4.18 LF Hostel LDB 2 - Image Info

Marker Info

Marker Name	Maximum	Minimum	Average	Emissivity	BG Temp	Std.Dev	Delta-T
Centerpoint	34.0 ℃	34.0 ℃	34.0 ℃	0.95	20.0 ℃	0.00	

Fig. 4.49 Thermal imaging at various electrical points



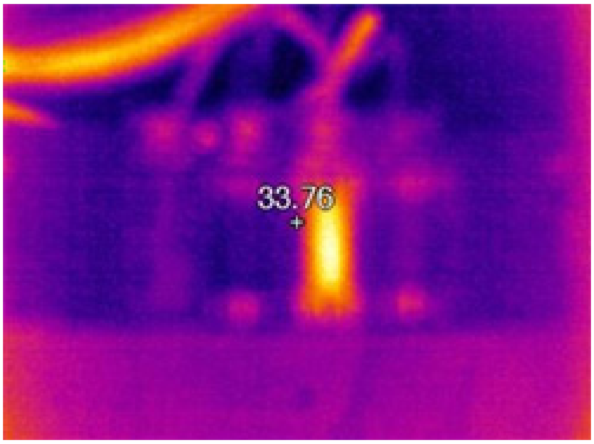
Name	IR000429.IS2
Emissivity	0.95
Background Temperature	20.00 ℃
Calibration Range	-10.00 ℃ to 600.00 ℃
Image Range	33.01 ℃ to 36.20 ℃
IR Sensor Size	320X240
Camera Serial Number	Ti32-13080298 (9Hz)
DSP Version	1.2.19
Image Time	01/05/2012 08:57:49 AM

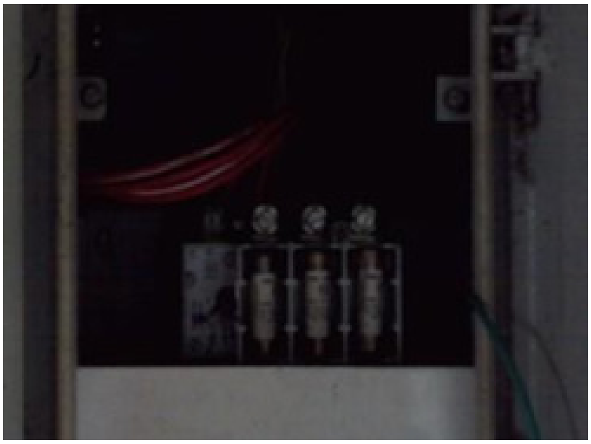
Table 4.19 LF Hostel LDB 1- Image Info

Marker Info

Marker Name	Maximum	Minimum	Average	Emissivity	BG Temp	Std.Dev	Delta-T
Centerpoint	33.4 ℃	33.4 ℃	33.4 ℃	0.95	20.0 ℃	0.00	

Fig. 4.50 Thermal imaging at various electrical points





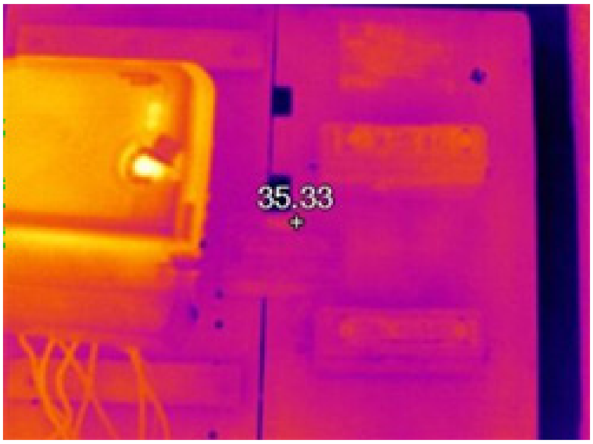
Name	IR000428.IS2
Emissivity	0.95
Background Temperature	20.00 ℃
Calibration Range	-10.00 ℃ to 600.00 ℃
Image Range	33.05 ℃ to 35.81 ℃
IR Sensor Size	320X240
Camera Serial Number	Ti32-13080298 (9Hz)
DSP Version	1.2.19
Image Time	01/05/2012 08:57:36 AM

Table 4.20 Meter Board Jeeva Jyothi Hostel - Image Info

Marker Info

Marker Name	Maximum	Minimum	Average	Emissivity	BG Temp	Std.Dev	Delta-T
Centerpoint	33.8 ℃	33.8 ℃	33.8 ℃	0.95	20.0 ℃	0.00	

Fig. 4.51 Thermal imaging at various electrical points



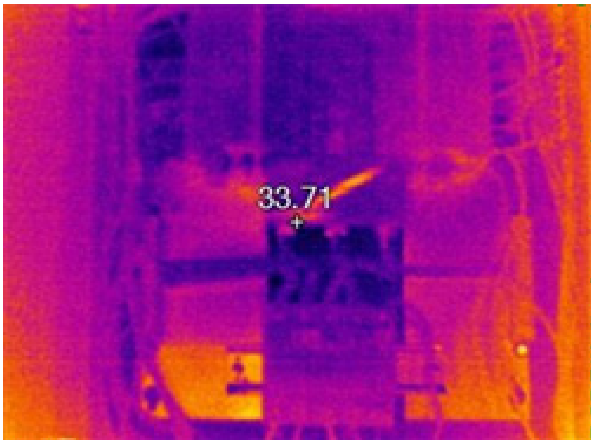
Name	IR000427.IS2
Emissivity	0.95
Background Temperature	20.00 ℃
Calibration Range	-10.00 ℃ to 600.00 ℃
Image Range	32.25 ℃ to 39.38 ℃
IR Sensor Size	320X240
Camera Serial Number	Ti32-13080298 (9Hz)
DSP Version	1.2.19
Image Time	01/05/2012 07:43:22 AM

Table 4.21 Meter Boards Jeeva Jyothi Hostel - Image Info

Marker Info

Marker Name	Maximum	Minimum	Average	Emissivity	BG Temp	Std.Dev	Delta-T
Centerpoint	35.3 ℃	35.3 ℃	35.3 ℃	0.95	20.0 ℃	0.00	

Fig. 4.52 Thermal imaging at various electrical points



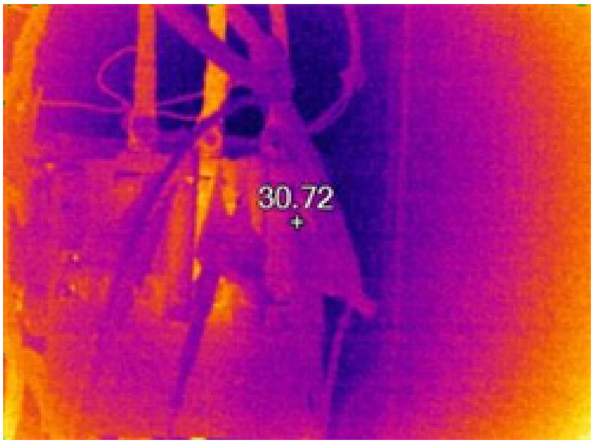
Name	IR000426.IS2
Emissivity	0.95
Background Temperature	20.00 °C
Calibration Range	-10.00 °C to 600.00 °C
Image Range	33.14 °C to 34.90 °C
IR Sensor Size	320X240
Camera Serial Number	Ti32-13080298 (9Hz)
DSP Version	1.2.19
Image Time	01/05/2012 07:42:01 AM

Table 4.22 DB Jeeva Jyothi Hostel - Image Info

Marker Info

Marker Name	Maximum	Minimum	Average	Emissivity	BG Temp	Std.Dev	Delta-T
Centerpoint	33.7 °C	33.7 °C	33.7 °C	0.95	20.0 °C	0.00	

Fig. 4.53 Thermal imaging at various electrical points



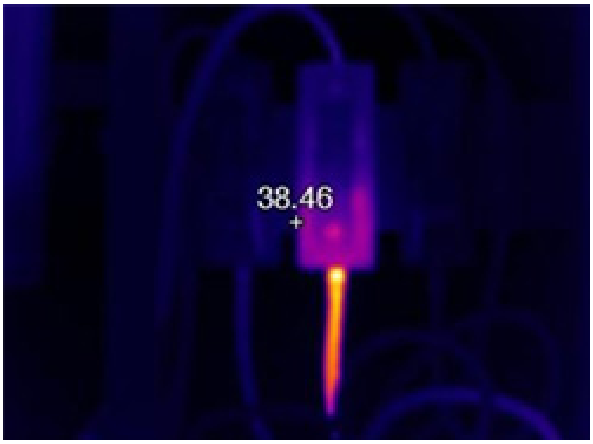
Name	IR000425.IS2
Emissivity	0.95
Background Temperature	20.00 ℃
Calibration Range	-10.00 ℃ to 600.00 ℃
Image Range	30.22 ℃ to 31.89 ℃
IR Sensor Size	320X240
Camera Serial Number	Ti32-13080298 (9Hz)
DSP Version	1.2.19
Image Time	01/05/2012 07:18:30 AM

Table 4.23 Panel Jeevajyothi Hostel - Image Info

Marker Info

Marker Name	Maximum	Minimum	Average	Emissivity	BG Temp	Std.Dev	Delta-T
Centerpoint	30.7 ℃	30.7 ℃	30.7 ℃	0.95	20.0 ℃	0.00	

Fig. 4.54 Thermal imaging at various electrical points



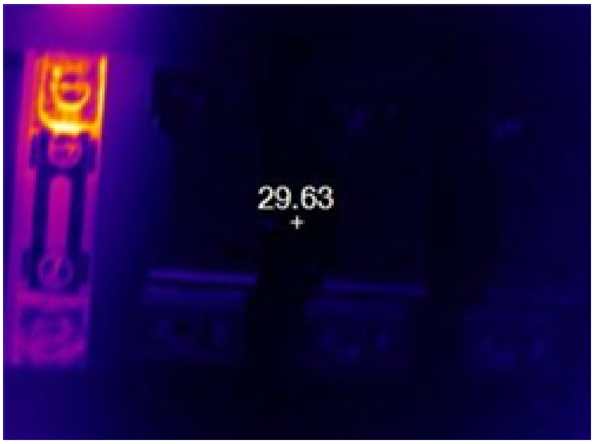
Name	IR000424.IS2
Emissivity	0.95
Background Temperature	20.00 ℃
Calibration Range	-10.00 ℃ to 600.00 ℃
Image Range	32.96 ℃ to 74.86 ℃
IR Sensor Size	320X240
Camera Serial Number	Ti32-13080298 (9Hz)
DSP Version	1.2.19
Image Time	01/05/2012 07:16:31 AM

Table 4.24 Meter Board Jubilee - Image Info

Marker Info

Marker Name	Maximum	Minimum	Average	Emissivity	BG Temp	Std.Dev	Delta-T
Centerpoint	38.5 ℃	38.5 ℃	38.5 ℃	0.95	20.0 ℃	0.00	

Fig. 4.55 Thermal imaging at various electrical points



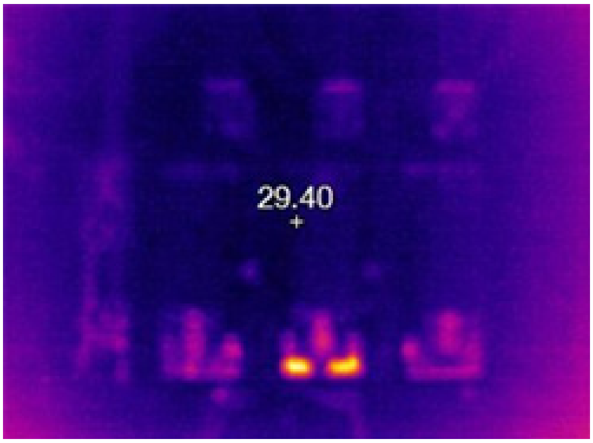
Name	IR000423.IS2
Emissivity	0.95
Background Temperature	20.00 °C
Calibration Range	-10.00 °C to 600.00 °C
Image Range	29.50 °C to 43.30 °C
IR Sensor Size	320X240
Camera Serial Number	Ti32-13080298 (9Hz)
DSP Version	1.2.19
Image Time	01/05/2012 06:49:16 AM

Table 4.25 125 A Isolator PG Block - Image Info

Marker Info

Marker Name	Maximum	Minimum	Average	Emissivity	BG Temp	Std.Dev	Delta-T
Centerpoint	29.6 °C	29.6 °C	29.6 °C	0.95	20.0 °C	0.00	

Fig. 4.56 Thermal imaging at various electrical points



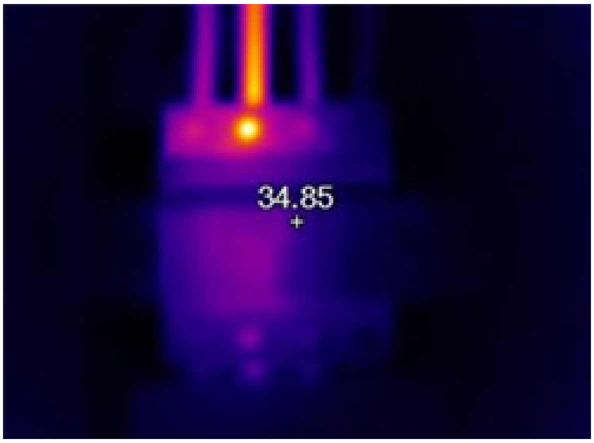
Name	IR000422.IS2
Emissivity	0.95
Background Temperature	20.00 ℃
Calibration Range	-10.00 ℃ to 600.00 ℃
Image Range	29.17 ℃ to 32.74 ℃
IR Sensor Size	320X240
Camera Serial Number	Ti32-13080298 (9Hz)
DSP Version	1.2.19
Image Time	01/05/2012 06:48:59 AM

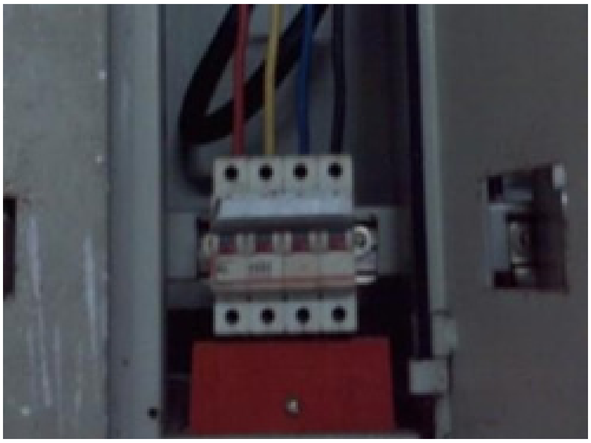
Table 4.26 100 A SFU PG Block - Image Info

Marker Info

Marker Name	Maximum	Minimum	Average	Emissivity	BG Temp	Std.Dev	Delta-T
Centerpoint	29.4 ℃	29.4 ℃	29.4 ℃	0.95	20.0 ℃	0.00	

Fig. 4.57 Thermal imaging at various electrical points





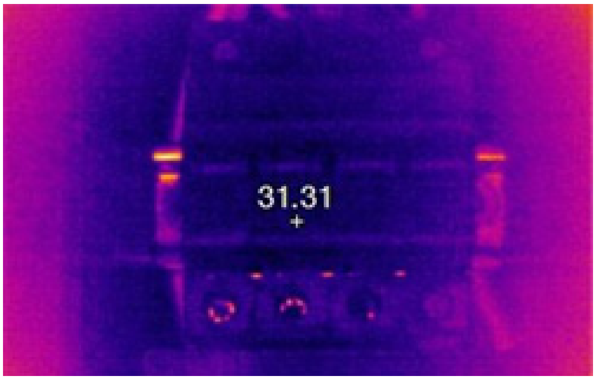
Name	IR000421.IS2
Emissivity	0.95
Background Temperature	20.00 °C
Calibration Range	-10.00 °C to 600.00 °C
Image Range	31.18 °C to 54.82 °C
IR Sensor Size	320X240
Camera Serial Number	Ti32-13080298 (9Hz)
DSP Version	1.2.19
Image Time	01/05/2012 06:43:59 AM

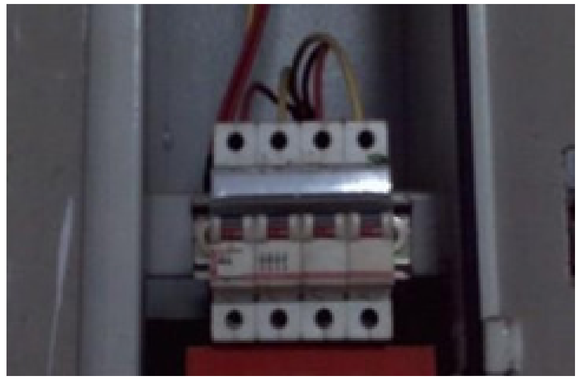
Table 4.27 40 A out 2 SJ Block - Image Info

Marker Info

Marker Name	Maximum	Minimum	Average	Emissivity	BG Temp	Std.Dev	Delta-T
Centerpoint	34.9 °C	34.9 °C	34.9 °C	0.95	20.0 °C	0.00	

Fig. 4.58 Thermal imaging at various electrical points





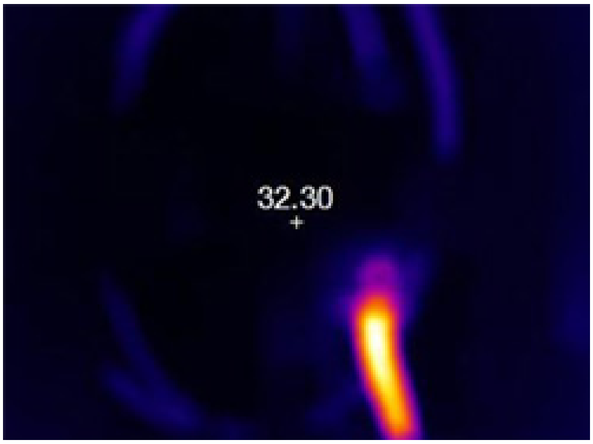
Name	IR000420.IS2
Emissivity	0.95
Background Temperature	20.00 ℃
Calibration Range	-10.00 ℃ to 600.00 ℃
Image Range	31.22 ℃ to 33.63 ℃
IR Sensor Size	320X240
Camera Serial Number	Ti32-13080298 (9Hz)
DSP Version	1.2.19
Image Time	01/05/2012 06:43:46 AM

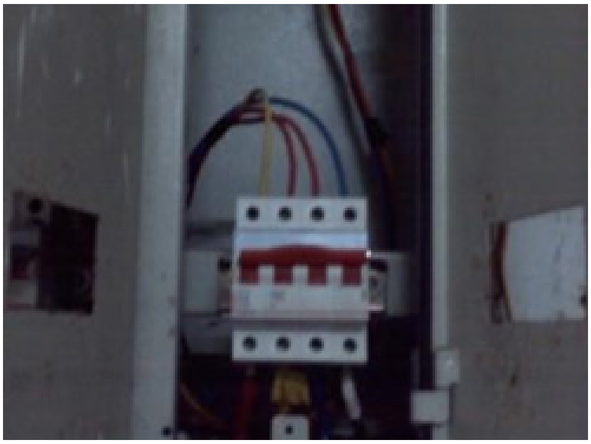
Table 4.28 40 A out 1 PG Block - Image Info

Marker Info

Marker Name	Maximum	Minimum	Average	Emissivity	BG Temp	Std.Dev	Delta-T
Centerpoint	31.3 ℃	31.3 ℃	31.3 ℃	0.95	20.0 ℃	0.00	

Fig. 4.59 Thermal imaging at various electrical points





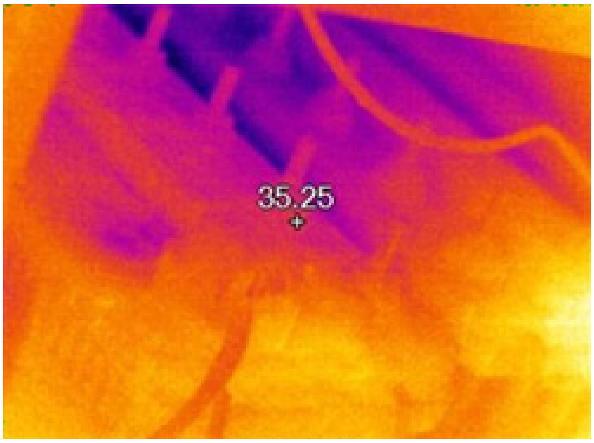
Name	IR000419.IS2
Emissivity	0.95
Background Temperature	20.00 °C
Calibration Range	-10.00 °C to 600.00 °C
Image Range	31.98 °C to 51.70 °C
IR Sensor Size	320X240
Camera Serial Number	Ti32-13080298 (9Hz)
DSP Version	1.2.19
Image Time	01/05/2012 06:42:58 AM

Table 4.29 63 A out PG Block - Image Info

Marker Info

Marker Name	Maximum	Minimum	Average	Emissivity	BG Temp	Std.Dev	Delta-T
Centerpoint	32.3 °C	32.3 °C	32.3 °C	0.95	20.0 °C	0.00	

Fig. 4.60 Thermal imaging at various electrical points



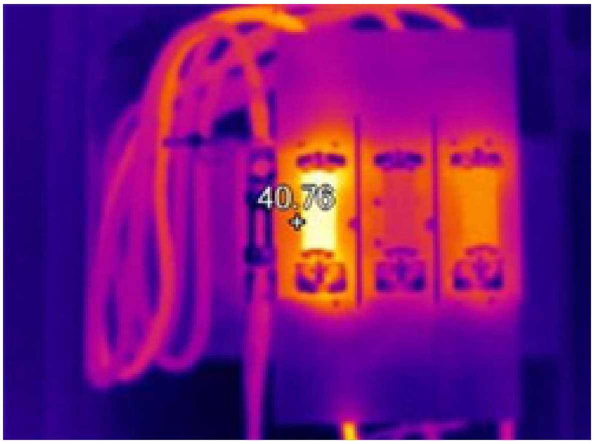
Name	IR000418.IS2
Emissivity	0.95
Background Temperature	20.00 °C
Calibration Range	-10.00 °C to 600.00 °C
Image Range	34.20 °C to 36.58 °C
IR Sensor Size	320X240
Camera Serial Number	Ti32-13080298 (9Hz)
DSP Version	1.2.19
Image Time	30/04/2012 12:44:41 PM

Table 4.30 Battery terminal MCA block - Image Info

Marker Info

Marker Name	Maximum	Minimum	Average	Emissivity	BG Temp	Std.Dev	Delta-T
Centerpoint	35.2 °C	35.2 °C	35.2 °C	0.95	20.0 °C	0.00	

Fig. 4.61 Thermal imaging at various electrical points



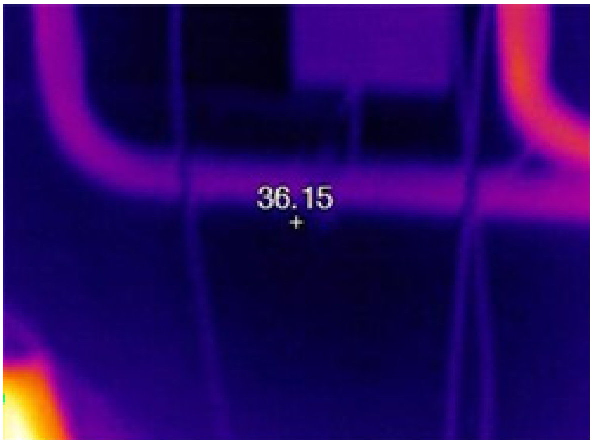
Name	IR000417.IS2
Emissivity	0.95
Background Temperature	20.00 ℃
Calibration Range	-10.00 ℃ to 600.00 ℃
Image Range	36.11 ℃ to 43.95 ℃
IR Sensor Size	320X240
Camera Serial Number	Ti32-13080298 (9Hz)
DSP Version	1.2.19
Image Time	30/04/2012 12:44:03 PM

Table 4.31 Consumer 2 MCA Block - Image Info

Marker Info

Marker Name	Maximum	Minimum	Average	Emissivity	BG Temp	Std.Dev	Delta-T
Centerpoint	40.8 ℃	40.8 ℃	40.8 ℃	0.95	20.0 ℃	0.00	

Fig. 4.62 Thermal imaging at various electrical points



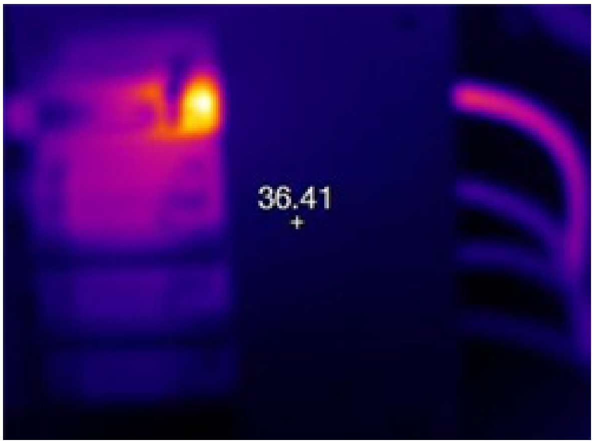
Name	IR000416.IS2
Emissivity	0.95
Background Temperature	20.00 ℃
Calibration Range	-10.00 ℃ to 600.00 ℃
Image Range	35.85 ℃ to 41.79 ℃
IR Sensor Size	320X240
Camera Serial Number	Ti32-13080298 (9Hz)
DSP Version	1.2.19
Image Time	30/04/2012 12:43:42 PM

Table 4.32 MCA Block - Image Info

Marker Info

Marker Name	Maximum	Minimum	Average	Emissivity	BG Temp	Std.Dev	Delta-T
Centerpoint	36.2 ℃	36.2 ℃	36.2 ℃	0.95	20.0 ℃	0.00	

Fig. 4.63 Thermal imaging at various electrical points



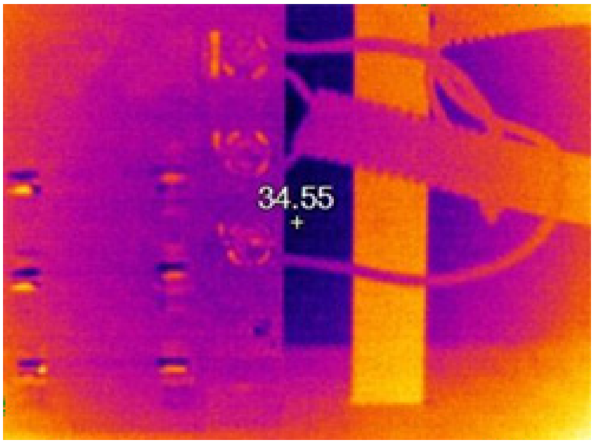
Name	IR000415.IS2
Emissivity	0.95
Background Temperature	20.00 °C
Calibration Range	-10.00 °C to 600.00 °C
Image Range	35.03 °C to 58.60 °C
IR Sensor Size	320X240
Camera Serial Number	Ti32-13080298 (9Hz)
DSP Version	1.2.19
Image Time	30/04/2012 11:14:50 AM

Table 4.33 SSB MCA block - Image Info

Marker Info

Marker Name	Maximum	Minimum	Average	Emissivity	BG Temp	Std.Dev	Delta-T
Centerpoint	36.4 °C	36.4 °C	36.4 °C	0.95	20.0 °C	0.00	

Fig. 4.64 Thermal imaging at various electrical points



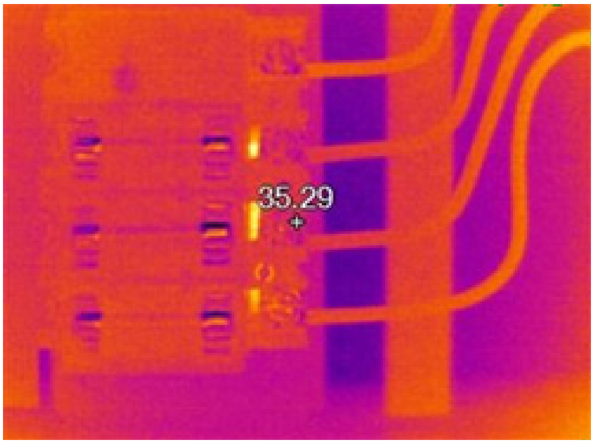
Name	IR000414.IS2
Emissivity	0.95
Background Temperature	20.00 °C
Calibration Range	-10.00 °C to 600.00 °C
Image Range	34.42 °C to 36.63 °C
IR Sensor Size	320X240
Camera Serial Number	Ti32-13080298 (9Hz)
DSP Version	1.2.19
Image Time	30/04/2012 11:14:34 AM

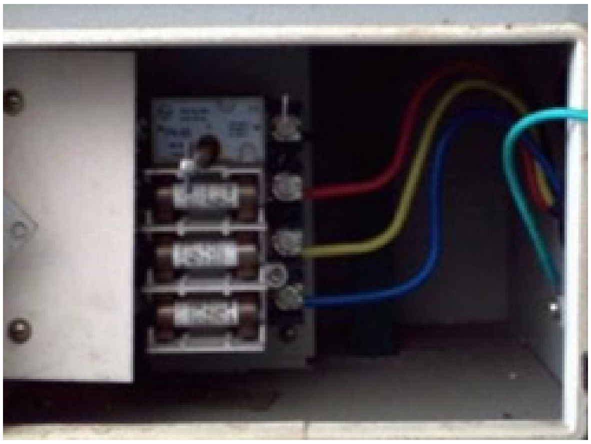
Table 4.34 To LDB 1 MCA Block - Image Info

Marker Info

Marker Name	Maximum	Minimum	Average	Emissivity	BG Temp	Std.Dev	Delta-T
Centerpoint	34.5 °C	34.5 °C	34.5 °C	0.95	20.0 °C	0.00	

Fig. 4.65 Thermal imaging at various electrical points





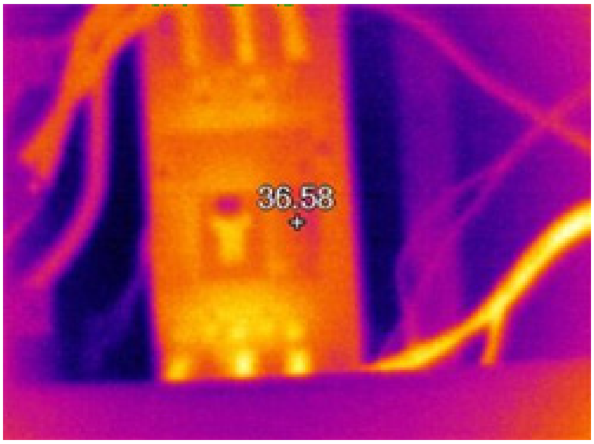
Name	IR000413.IS2
Emissivity	0.95
Background Temperature	20.00 ℃
Calibration Range	-10.00 ℃ to 600.00 ℃
Image Range	34.11 ℃ to 37.27 ℃
IR Sensor Size	320X240
Camera Serial Number	Ti32-13080298 (9Hz)
DSP Version	1.2.19
Image Time	30/04/2012 11:14:26 AM

Table 4.35 To LDB 1 MCA Block - Image Info

Marker Info

Marker Name	Maximum	Minimum	Average	Emissivity	BG Temp	Std.Dev	Delta-T
Centerpoint	35.3 ℃	35.3 ℃	35.3 ℃	0.95	20.0 ℃	0.00	

Fig. 4.66 Thermal imaging at various electrical points



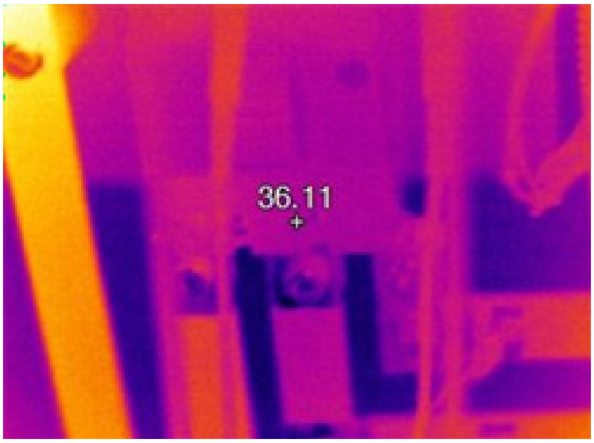
Name	IR000412.IS2
Emissivity	0.95
Background Temperature	20.00 °C
Calibration Range	-10.00 °C to 600.00 °C
Image Range	35.25 °C to 38.16 °C
IR Sensor Size	320X240
Camera Serial Number	Ti32-13080298 (9Hz)
DSP Version	1.2.19
Image Time	30/04/2012 11:13:50 AM

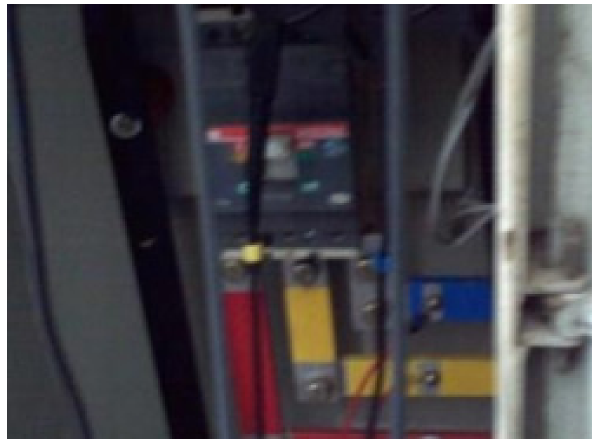
Table 4.36 From Ongrid solar - Image Info

Marker Info

Marker Name	Maximum	Minimum	Average	Emissivity	BG Temp	Std.Dev	Delta-T
Centerpoint	36.6 °C	36.6 °C	36.6 °C	0.95	20.0 °C	0.00	

Fig. 4.67 Thermal imaging at various electrical points





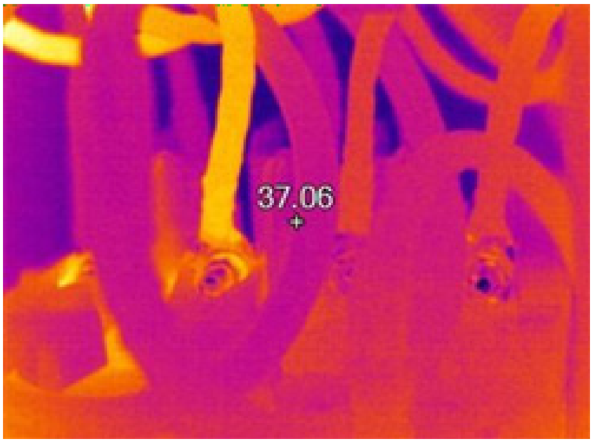
Name	IR000411.IS2
Emissivity	0.95
Background Temperature	20.00 ℃
Calibration Range	-10.00 ℃ to 600.00 ℃
Image Range	35.11 ℃ to 38.59 ℃
IR Sensor Size	320X240
Camera Serial Number	Ti32-13080298 (9Hz)
DSP Version	1.2.19
Image Time	30/04/2012 11:13:12 AM

Table 4.37 MCB Change over MCA Block - Image Info

Marker Info

Marker Name	Maximum	Minimum	Average	Emissivity	BG Temp	Std.Dev	Delta-T
Centerpoint	36.1 ℃	36.1 ℃	36.1 ℃	0.95	20.0 ℃	0.00	

Fig. 4.68 Thermal imaging at various electrical points



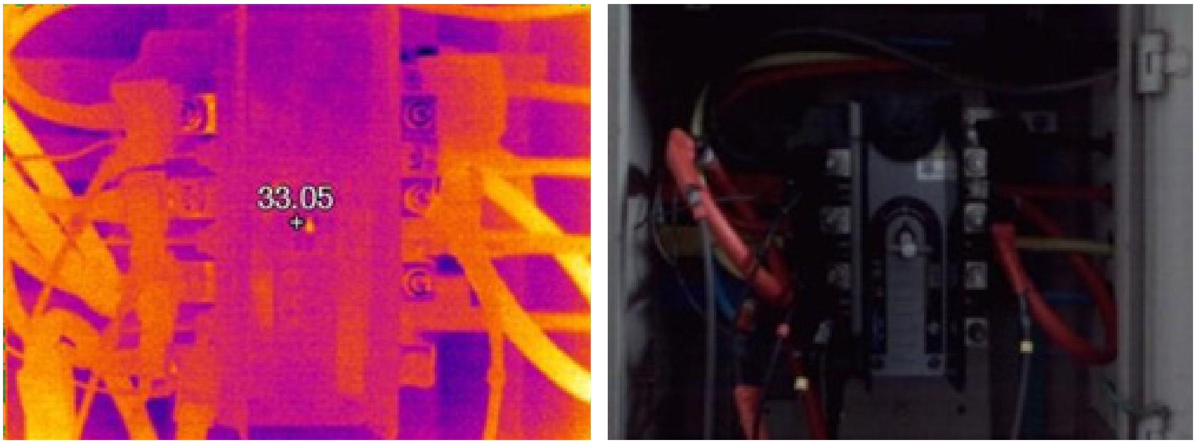
Name	IR000410.IS2
Emissivity	0.95
Background Temperature	20.00 ℃
Calibration Range	-10.00 ℃ to 600.00 ℃
Image Range	35.68 ℃ to 39.13 ℃
IR Sensor Size	320X240
Camera Serial Number	Ti32-13080298 (9Hz)
DSP Version	1.2.19
Image Time	30/04/2012 11:12:54 AM

Table 4.38 Incomer MCA Block - Image Info

Marker Info

Marker Name	Maximum	Minimum	Average	Emissivity	BG Temp	Std.Dev	Delta-T
Centerpoint	37.1 ℃	37.1 ℃	37.1 ℃	0.95	20.0 ℃	0.00	

Fig. 4.69 Thermal imaging at various electrical points



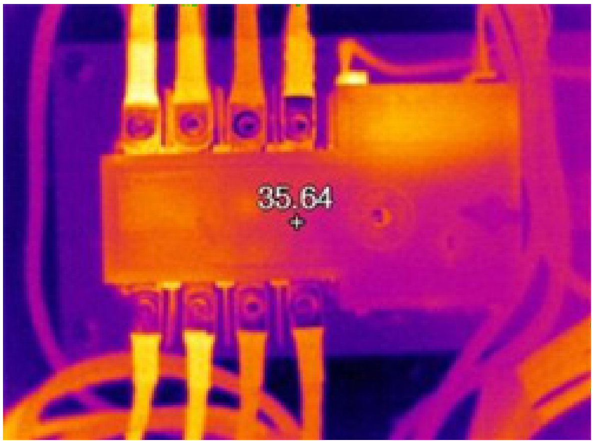
Name	IR000409.IS2
Emissivity	0.95
Background Temperature	20.00 °C
Calibration Range	-10.00 °C to 600.00 °C
Image Range	32.34 °C to 34.46 °C
IR Sensor Size	320X240
Camera Serial Number	Ti32-13080298 (9Hz)
DSP Version	1.2.19
Image Time	30/04/2012 10:36:31 AM

Table 4.39 Library Main Block - Image Info

Marker Info

Marker Name	Maximum	Minimum	Average	Emissivity	BG Temp	Std.Dev	Delta-T
Centerpoint	33.1 °C	33.1 °C	33.1 °C	0.95	20.0 °C	0.00	

Fig. 4.70 Thermal imaging at various electrical points



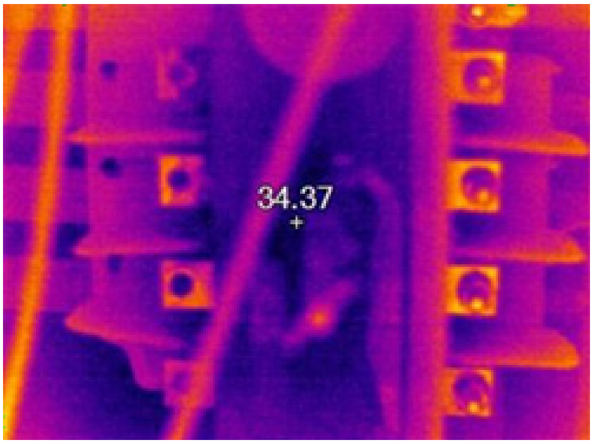
Name	IR000408.IS2
Emissivity	0.95
Background Temperature	20.00 °C
Calibration Range	-10.00 °C to 600.00 °C
Image Range	33.89 °C to 37.99 °C
IR Sensor Size	320X240
Camera Serial Number	Ti32-13080298 (9Hz)
DSP Version	1.2.19
Image Time	30/04/2012 10:34:49 AM

Table 4.40 ATS Main block - Image Info

Marker Info

Marker Name	Maximum	Minimum	Average	Emissivity	BG Temp	Std.Dev	Delta-T
Centerpoint	35.6 °C	35.6 °C	35.6 °C	0.95	20.0 °C	0.00	

Fig. 4.71 Thermal imaging at various electrical points



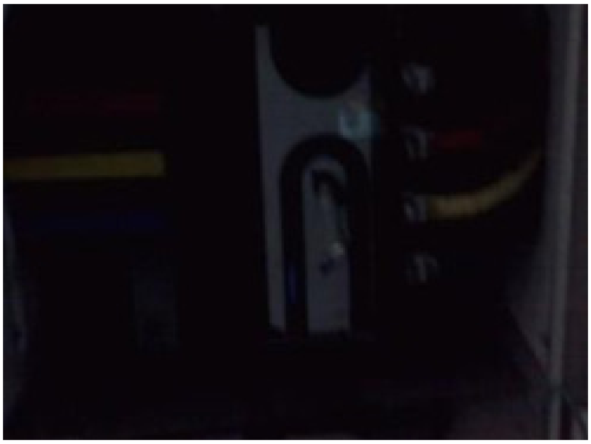
Name	IR000407.IS2
Emissivity	0.95
Background Temperature	20.00 ℃
Calibration Range	-10.00 ℃ to 600.00 ℃
Image Range	34.07 ℃ to 36.20 ℃
IR Sensor Size	320X240
Camera Serial Number	Ti32-13080298 (9Hz)
DSP Version	1.2.19
Image Time	30/04/2012 10:33:29 AM

Table 4.41 Auditorium Main Block - Image Info

Marker Info

Marker Name	Maximum	Minimum	Average	Emissivity	BG Temp	Std.Dev	Delta-T
Centerpoint	34.4 ℃	34.4 ℃	34.4 ℃	0.95	20.0 ℃	0.00	

Fig. 4.72 Thermal imaging at various electrical points



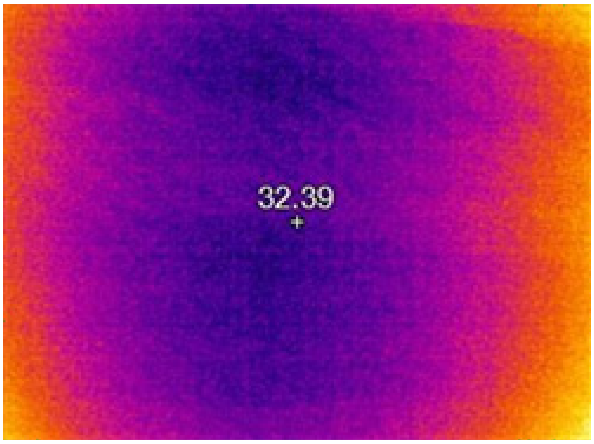
Name	IR000406.IS2
Emissivity	0.95
Background Temperature	20.00 °C
Calibration Range	-10.00 °C to 600.00 °C
Image Range	34.15 °C to 35.85 °C
IR Sensor Size	320X240
Camera Serial Number	Ti32-13080298 (9Hz)
DSP Version	1.2.19
Image Time	30/04/2012 10:33:11 AM

Table 4.42 Main Block - Image Info

Marker Info

Marker Name	Maximum	Minimum	Average	Emissivity	BG Temp	Std.Dev	Delta-T
Centerpoint	34.5 °C	34.5 °C	34.5 °C	0.95	20.0 °C	0.00	

Fig. 4.73 Thermal imaging at various electrical points



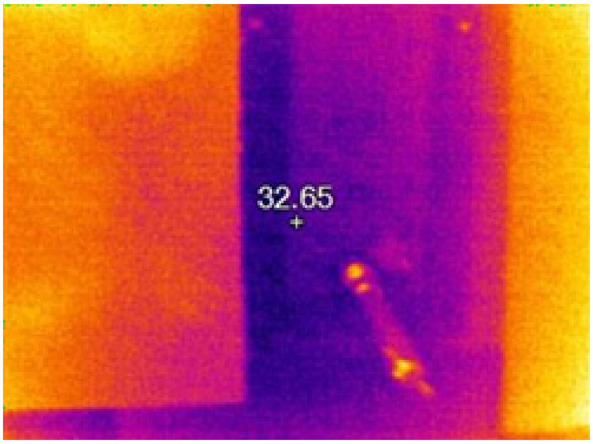
Name	IR000405.IS2
Emissivity	0.95
Background Temperature	20.00 °C
Calibration Range	-10.00 °C to 600.00 °C
Image Range	32.07 °C to 33.36 °C
IR Sensor Size	320X240
Camera Serial Number	Ti32-13080298 (9Hz)
DSP Version	1.2.19
Image Time	30/04/2012 10:07:52 AM

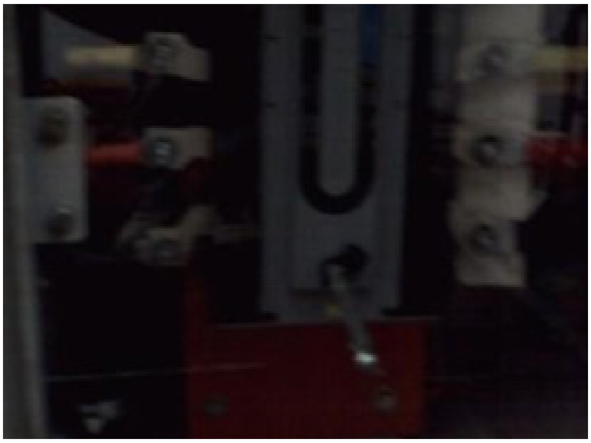
Table 4.43 To GSB 1 MCCB Main block - Image Info

Marker Info

Marker Name	Maximum	Minimum	Average	Emissivity	BG Temp	Std.Dev	Delta-T
Centerpoint	32.4 °C	32.4 °C	32.4 °C	0.95	20.0 °C	0.00	

Fig. 4.74 Thermal imaging at various electrical points





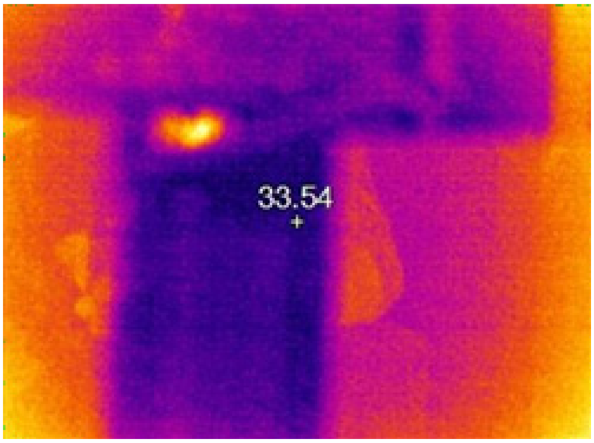
Name	IR000404.IS2
Emissivity	0.95
Background Temperature	20.00 °C
Calibration Range	-10.00 °C to 600.00 °C
Image Range	32.39 °C to 33.89 °C
IR Sensor Size	320X240
Camera Serial Number	Ti32-13080298 (9Hz)
DSP Version	1.2.19
Image Time	30/04/2012 10:07:45 AM

Table 4.44 DG Set 1 COS - Image Info

Marker Info

Marker Name	Maximum	Minimum	Average	Emissivity	BG Temp	Std.Dev	Delta-T
Centerpoint	32.7 °C	32.7 °C	32.7 °C	0.95	20.0 °C	0.00	

Fig. 4.75 Thermal imaging at various electrical points



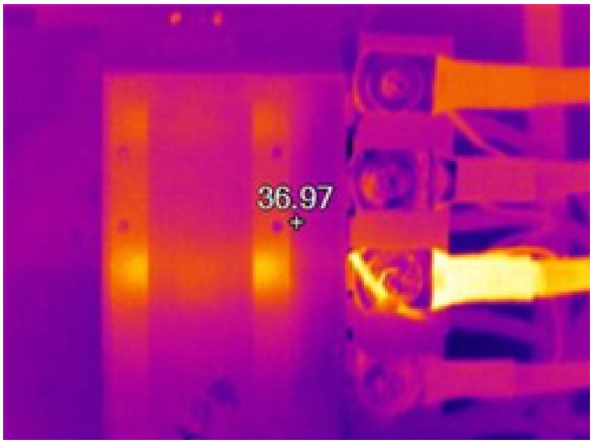
Name	IR000403.IS2
Emissivity	0.95
Background Temperature	20.00 °C
Calibration Range	-10.00 °C to 600.00 °C
Image Range	33.27 °C to 34.94 °C
IR Sensor Size	320X240
Camera Serial Number	Ti32-13080298 (9Hz)
DSP Version	1.2.19
Image Time	30/04/2012 10:06:58 AM

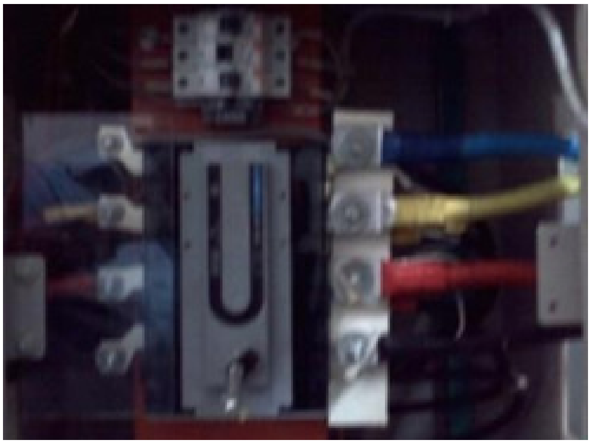
Table 4.45 TO GSB Change over - Image Info

Marker Info

Marker Name	Maximum	Minimum	Average	Emissivity	BG Temp	Std.Dev	Delta-T
Centerpoint	33.5 °C	33.5 °C	33.5 °C	0.95	20.0 °C	0.00	

Fig. 4.76 Thermal imaging at various electrical points





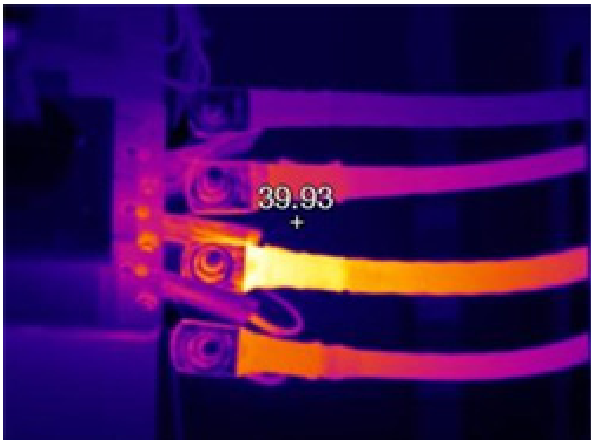
Name	IR000402.IS2
Emissivity	0.95
Background Temperature	20.00 °C
Calibration Range	-10.00 °C to 600.00 °C
Image Range	34.68 °C to 40.47 °C
IR Sensor Size	320X240
Camera Serial Number	Ti32-13080298 (9Hz)
DSP Version	1.2.19
Image Time	30/04/2012 10:05:51 AM

Table 4.46 Main block generator COS - Image Info

Marker Info

Marker Name	Maximum	Minimum	Average	Emissivity	BG Temp	Std.Dev	Delta-T
Centerpoint	37.0 °C	37.0 °C	37.0 °C	0.95	20.0 °C	0.00	

Fig. 4.77 Thermal imaging at various electrical points



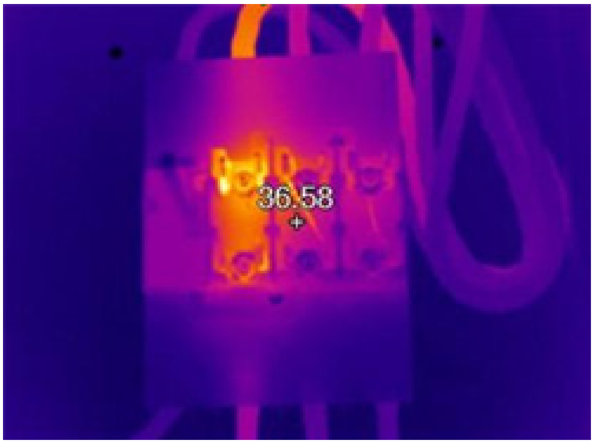
Name	IR000401.IS2
Emissivity	0.95
Background Temperature	20.00 °C
Calibration Range	-10.00 °C to 600.00 °C
Image Range	36.80 °C to 82.41 °C
IR Sensor Size	320X240
Camera Serial Number	Ti32-13080298 (9Hz)
DSP Version	1.2.19
Image Time	30/04/2012 10:05:24 AM

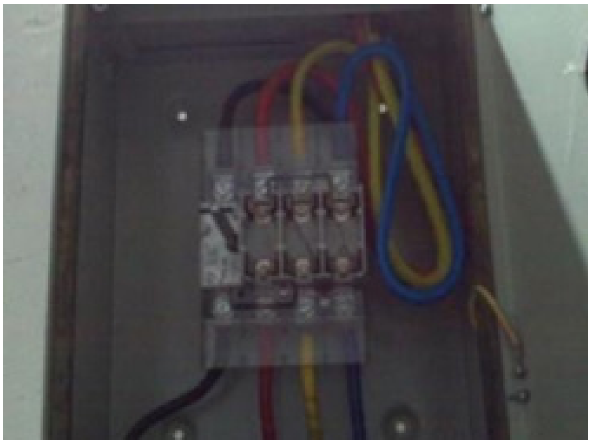
Table 4.47 To MSB 1 Main Block - Image Info

Marker Info

Marker Name	Maximum	Minimum	Average	Emissivity	BG Temp	Std.Dev	Delta-T
Centerpoint	39.9 °C	39.9 °C	39.9 °C	0.95	20.0 °C	0.00	

Fig. 4.78 Thermal imaging at various electrical points





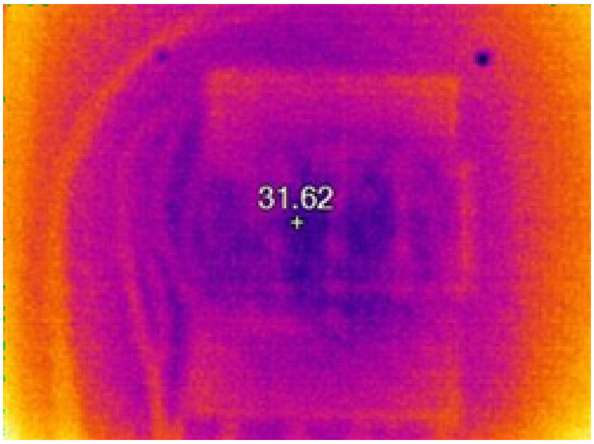
Name	IR000400.IS2
Emissivity	0.95
Background Temperature	20.00 ℃
Calibration Range	-10.00 ℃ to 600.00 ℃
Image Range	31.22 ℃ to 43.79 ℃
IR Sensor Size	320X240
Camera Serial Number	Ti32-13080298 (9Hz)
DSP Version	1.2.19
Image Time	30/04/2012 09:24:40 AM

Table 4.48 FN 63 Main Block feeder - Image Info

Marker Info

Marker Name	Maximum	Minimum	Average	Emissivity	BG Temp	Std.Dev	Delta-T
Centerpoint	36.6 ℃	36.6 ℃	36.6 ℃	0.95	20.0 ℃	0.00	

Fig. 4.79 Thermal imaging at various electrical points



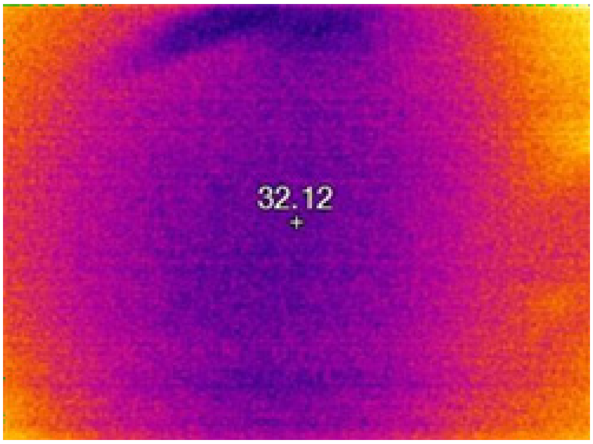
Name	IR000399.IS2
Emissivity	0.95
Background Temperature	20.00 ℃
Calibration Range	-10.00 ℃ to 600.00 ℃
Image Range	31.31 ℃ to 32.87 ℃
IR Sensor Size	320X240
Camera Serial Number	Ti32-13080298 (9Hz)
DSP Version	1.2.19
Image Time	30/04/2012 09:24:25 AM

Table 4.49 Ex . Hall Main block - Image Info

Marker Info

Marker Name	Maximum	Minimum	Average	Emissivity	BG Temp	Std.Dev	Delta-T
Centerpoint	31.6 ℃	31.6 ℃	31.6 ℃	0.95	20.0 ℃	0.00	

Fig. 4.80 Thermal imaging at various electrical points



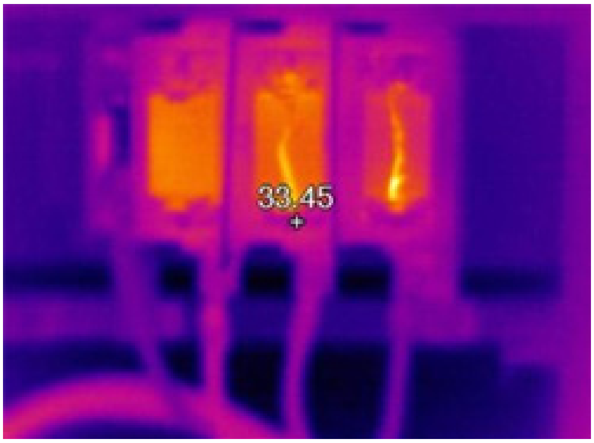
Name	IR000398.IS2
Emissivity	0.95
Background Temperature	20.00 °C
Calibration Range	-10.00 °C to 600.00 °C
Image Range	31.85 °C to 32.96 °C
IR Sensor Size	320X240
Camera Serial Number	Ti32-13080298 (9Hz)
DSP Version	1.2.19
Image Time	30/04/2012 09:23:52 AM

Table 4.50 New bLock main block feeder - Image Info

Marker Info

Marker Name	Maximum	Minimum	Average	Emissivity	BG Temp	Std.Dev	Delta-T
Centerpoint	32.1 °C	32.1 °C	32.1 °C	0.95	20.0 °C	0.00	

Fig. 4.81 Thermal imaging at various electrical points



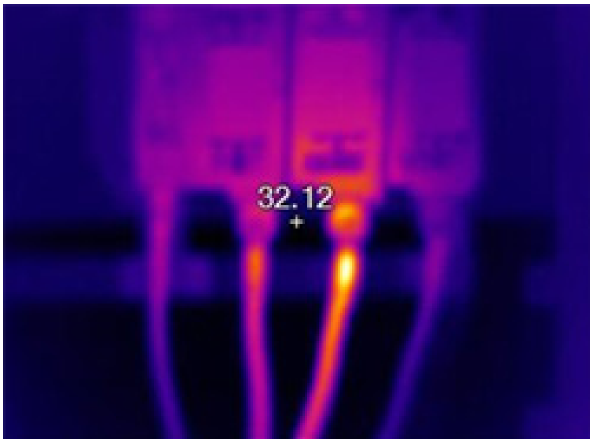
Name	IR000397.IS2
Emissivity	0.95
Background Temperature	20.00 °C
Calibration Range	-10.00 °C to 600.00 °C
Image Range	31.27 °C to 38.08 °C
IR Sensor Size	320X240
Camera Serial Number	Ti32-13080298 (9Hz)
DSP Version	1.2.19
Image Time	30/04/2012 09:23:27 AM

Table 4.51 Auditorium Feeder - Image Info

Marker Info

Marker Name	Maximum	Minimum	Average	Emissivity	BG Temp	Std.Dev	Delta-T
Centerpoint	33.4 °C	33.4 °C	33.4 °C	0.95	20.0 °C	0.00	

Fig. 4.82 Thermal imaging at various electrical points



Name	IR000396.IS2
Emissivity	0.95
Background Temperature	20.00 °C
Calibration Range	-10.00 °C to 600.00 °C
Image Range	31.53 °C to 45.11 °C
IR Sensor Size	320X240
Camera Serial Number	Ti32-13080298 (9Hz)
DSP Version	1.2.19
Image Time	30/04/2012 09:22:34 AM

Table 4.52 New block AC hall feeder - Image Info

Marker Info

Marker Name	Maximum	Minimum	Average	Emissivity	BG Temp	Std.Dev	Delta-T
Centerpoint	32.1 °C	32.1 °C	32.1 °C	0.95	20.0 °C	0.00	

Fig. 4.83 Thermal imaging at various electrical points

4.4.7 Energy Infrastructure of the college

Location No	Instruments	Count	Watt	Hours	Days	kWh	kWh per year
Ladies' washroom	Tube light	4	30	2	6	0.06	21.9
	CFL	12	5	4		0.02	7.3
	Wall mount fan	2	50	2		0.1	36.5
Ladies' restroom	Tube light	6	30	6	6	0.18	65.7
Anti ragging cell	CFL		0.5	3	6	0.0015	0.5475
NTS Restroom(gents)	CFL	3	30	2	6	0.06	21.9
	Tube light	2	30	2		0.06	21.9
	Fan	1	60	2		0.12	43.8
Chemistry research lab	Tube light	4	30	7	6	0.21	76.65
	Fan	1	60	7		0.42	153.3
Chief superintendent of exams	Tube light	4	30	5	6	0.15	54.75
	Fan	2	60	5		0.3	109.5
	Table fan	1	60	5		0.3	109.5
IQAC Office	Tube light	2	30	6	6	0.18	65.7
	Fan	1	60			0	0
PG smart Room	Tube light	2	30	3	4	0.09	32.85
	Fan	4	60			0	0
IQAC Hall	Fan	3	60	3		0.18	65.7
	Tube	2	30	3		0.09	32.85
	Ceiling light	6	30	3		0.09	32.85
	AC duct	8	1200	3		3.6	1314
Counselling Room	Tube	1	30	3	2	0.09	32.85
	Fan	1	60	3		0.18	65.7
MSc lab (inorganic and organic)	Tube	6	30	6	6	0.18	65.7
	Fan(exhaust)	1	100	6		0.6	219
Teachers Restroom	Tube	1	30	2	6	0.06	21.9
	Fan	2	60	2		0.12	43.8
BSc chemistry	Fan	4	60	7	5	0.42	153.3
	Tube	5	30			0	0
BSc chemistry	Smart board	1	200	7	5	1.4	511
	Tube	3	30	7		0.21	76.65
	Fan	2	60	7		0.42	153.3
BSc chemistry	Tube	2	30	7	5	0.21	76.65

	TV	1	200	5		1	365
	Fan	2	60	7		0.42	153.3
BSc chemistry	Smart board	1	200	3	5	0.6	219
	Tube	3	30	7	5	0.21	76.65
	Fan	2	60	7	5	0.42	153.3
MSc Zoology	Tube	5	30	7	5	0.21	76.65
	Fan	4	60	7		0.42	153.3
Zoology staffroom	Tube light	3	30	7	5	0.42	153.3
BSc Zoology	Fan	2	60	7		0.42	153.3
	Tube	1	30	7	5	0.21	76.65
	Speaker	2	30	7		0.21	76.65
Physics staff room	Fan	4	60	7	5	0.42	153.3
	Tube	3	30	7		0.21	76.65
BSc physics	Fan	2	60	7	5	0.42	153.3
	Tube	2	30	7	5	0.21	76.65
	Speaker	1	30	7	8	0.21	76.65
MA Economics	Fan	2	60	7	5	0.42	153.3
	Tube	2	30	7		0.21	76.65
1PV	Fan	2	60	7	5	0.42	153.3
	Led tube	2	24	7	5	0.168	61.32
	Speaker	1	30	7	8	0.21	76.65
1PV	Fan	2	60	7	5	0.42	153.3
	Led tube	3	24	7	5	0.168	61.32
	Speaker	1	30	7	8	0.21	76.65
	Smart board	1	200	7	3	1.4	511
2P	Fan	2	60	7	5	0.42	153.3
	Led tube	3	24	7	5	0.168	61.32
	Speaker	1	30	7	8	0.21	76.65
	Smart board	1	200	7	3	1.4	511
1 Economics	Fan	2	60	7	5	0.42	153.3
	Tube	3	30	7	5	0.21	76.65
	Speaker	1	30	7	8	0.21	76.65
	Smart board	1	200	7	3	1.4	511
2 Economics	Fan	2	60	7	5	0.42	153.3
	Tube	3	30	7	5	0.21	76.65
	Speaker	1	30	7	8	0.21	76.65
	Smart board	1	200	7	3	1.4	511
Economics staffroom	Fan	5	60	7	5	0.42	153.3

	Tube	2	30	7	5	0.21	76.65
	Wallmount fan	1	50	7	5	0.35	127.75
3 BA Economics	Fan	2	60	7	5	0.42	153.3
	Tube	3	30	7	5	0.21	76.65
	Projector	1	100	2	5	0.2	73
	Smart board	1	200	3	5	0.6	219
Outdoor	LED 1	1	100	12	5	1.2	438
	LED 2	3	30	12	5	0.36	131.4
	LED 3	6	9	12	5	0.108	39.42
	LED 4	3	12	12	5	0.144	52.56
1st MA English	Fan	2	60	7	5	0.42	153.3
	LED	1	20	7	5	0.14	51.1
	Speaker	1	30	3	5	0.09	32.85
	CFL	1	30	7	5	0.21	76.65
2nd MA English	Fan	2	60	7	5	0.42	153.3
	Smart TV	1	200	7	5	1.4	511
	Speaker	1	30	3	5	0.09	32.85
	LED	1	20	7	5	0.14	51.1
1 st M. Com	Fan	2	60	7	5	0.42	153.3
	LED	2	20	7	5	0.14	51.1
	Smart TV	1	200	7	5	1.4	511
	Stabilizer	1	500	7	5	3.5	1277.5
	UPS	1	220	3	5	0.66	240.9
	Speaker	1	30	7	5	0.21	76.65
2nd M.Com	Fan	2	60	7	5	0.42	153.3
	Projector	1	800	4	5	3.2	1168
	Speaker	1	30	3	5	0.09	32.85
	LED	2	20	7	5	0.14	51.1
1st BSc BOTANY	LED	1	20	7	5	0.14	51.1
	Fan	2	60	7	5	0.42	153.3
	UPS	1	220	7	5	1.54	562.1
	Smart TV	1	200	7	5	1.4	511
	Speaker	1	30	3	5	0.09	32.85
2nd BSc Botany	Fan	2	60	7	5	0.42	153.3
	Speaker	1	30	3	5	0.09	32.85
	LED	2	20	7	5	0.14	51.1
	Smart TV	1	200	7	5	1.4	511
	Stabilizer	1	500	7	5	3.5	1277.5

3rd BSc Botany	Fan	2	60	7	5	0.42	153.3
	CFL	2	30	7	5	0.21	76.65
	Stabilizer	1	500	7	5	3.5	1277.5
	Smart TV	1	200	7	5	1.4	511
3 rd B. Com	Fan	2	60	7	5	0.42	153.3
	Speaker	1	50	3	5	0.15	54.75
	LED	2	15	7	5	0.105	38.325
	Smart TV	1	200	7	5	1.4	511
314 Room	Fan	3	60	7	5	0.42	153.3
	LED Bulb	1	15	7	5	0.105	38.325
	LED	1	15	7	5	0.105	38.325
3rd B. Com (com-application)	LED Tube	2	15	7	5	0.105	38.325
	Fan	2	60	7	5	0.42	153.3
	TV	1	200	7	5	1.4	511
2nd B.Com	LED	2	15	7	5	0.105	38.325
	Fan	2	60	7	5	0.42	153.3
	Wall Fan	1	60	7	5	0.42	153.3
	Projector	1	800	7	5	5.6	2044
1 st BSc Zoology	tube	2	30	7	5	0.21	76.65
	Fan	2	60	7	5	0.42	153.3
	Smart TV	1	200	7	5	1.4	511
2nd BSc Maths	LED Tube	2	15	7	5	0.105	38.325
	Fan	4	60	7	5	0.42	153.3
	Smart TV	1	200	7	5	1.4	511
Maths Staff Room	LED Tube	3	15	7	5	0.105	38.325
	Fan	1	60	7	5	0.42	153.3
	Wall Mount Fan	2	60	7	5	0.42	153.3
	Table Fan	1	60	7	5	0.42	153.3
	LED Bulb	1	15	7	5	0.105	38.325
1st BSc Maths	Fan	3	60	7	5	0.42	153.3
	LED Tube	2	15	7	5	0.105	38.325
	Smart TV	1	200	7	5	1.4	511
1st BCom	Fan	2	60	7	5	0.42	153.3
	Wall fan	1	60	7	5	0.42	153.3
	Led tube	2	15	7	5	0.105	38.325
	Smart T V	1	200	7	5	1.4	511
Staff room (com)	Led	2	15	7	5	0.105	38.325

	Led tube	3	15	7	5	0.105	38.325
	Fan	4	60	7	5	0.42	153.3
	Wall fan	1	60	7	5	0.42	153.3
219	Fan	2	60	7	5	0.42	153.3
	projector	1	800	7	5	5.6	2044
301 (A)	Fan	1	60	7	5	0.42	153.3
	Led Tube	1	15	7	5	0.105	38.325
301(B)	Fan	1	60	7	5	0.42	153.3
	Led tube	1	15	7	5	0.105	38.325
301(C)	Wall fan	1	60	7	5	0.42	153.3
	Fan	3	60	7	5	0.42	153.3
	Tube	1	30	7	5	0.21	76.65
Ladies Toilet	Led Tube	2	15	7	5	0.105	38.325
							271.1617

Table 4.53 Infrastructure details of Main Block

SL No	Instruments	Count	Watt	Hours	Days	kWh	kWh per year
1	Ceiling light	40	7	3	2	0.021	7.665
2	Ceiling light b	12	7	3	2	0.021	7.665
3	Wall fan	8	30	3	2	0.09	32.85
4	Fan	8	60	3	2	0.18	65.7
5	Speaker b	4	25	3	2	0.075	27.375
6	Speaker s	2	25	3	2	0.075	27.375
7	Speaker Sub	2	25	3	2	0.075	27.375
8	Monitor	1	10	3	2	0.03	10.95
9	Digital lamp	1	24	3	2	0.072	26.28
10	3 pin Socket	50		3	2	0	0
11	5kv Inverter	1	5000	3	2	15	5475
13	Power switch	1		3	2	0	0
14	hslv fan	1	100	2	2	0.2	73
							444.71

Table 4.54 Infrastructure details of Main Auditorium

Location No	Instruments	count	watt	hours	days	kWh	kWh per year
AV Hall	Wall fan	11	30	3	2	0.09	32.85
	Square bulb	6	40	3	2	0.12	43.8
	Round bulb	15	40	3	2	0.12	43.8
	Small red bulb	3	30	3	2	0.09	32.85
	Speaker	5	400	3	2	1.2	438
	Head light	2	55	3	2	0.165	60.225
	Led strip	6m×2	70	3	2	0.21	76.65
		8m×1	48	3	2	0.144	52.56
		20m ×2	192	3	2	0.576	210.24
	AC	small 18	144	3	2	0.432	157.68
		big 2	192	3	2	0.576	210.24
	Smart tv	1	200	3	2	0.6	219
Washroom	Tube light	2	30	1	2	0.03	10.95
	Tube light	1	12	1	2	0.012	4.38
Outside	Tube light	2	30	6	2	0.18	65.7
	Small CFL	1	30	6	2	0.18	65.7
							107.79

Table 4.55 Infrastructure details of AV Hall

Fig. 4.84 Internal audit discussion

Location No.	Instruments	Count	Watt	Hours	Days	kWh	kWh year
1st BA Malayalam	Fan	3	60	7	5	0.42	153
	LED	3	12	7	5	0.08	30.7
	Speaker	1	25	2	5	0.05	18.3
	smart board	1	200	5	5	1	365
2nd MA Malayalam	LED	2	13	7	5	0.09	33.2
	Speaker	1	25	2	5	0.05	18.3
	Fan	2	60	7	5	0.42	153
1st MA Malayalam	Fan	2	60	7	5	0.42	153
	Speaker	2	25	2	5	0.05	18.3
	LED	3	13	7	5	0.09	33.2
	Smart Board	1	200	5	5	1	365
2nd BA Malayalam	Speaker	1	200	2	5	0.4	146
	Fan	2	60	7	5	0.42	153
	LED	3	12	7	5	0.08	30.7
Women Cell	Fan	1	60	7	5	0.42	153
	Speaker	1	205	2	5	0.41	150
	CFL	1	30	5	5	0.15	54.8
	LED	1	12	7		0.08	30.7
3rd BA Malayalam	Fan	1	60	7	5	0.42	153
	LED	2	13	7	5	0.09	33.2
	Smart Board	1	200	5	5	1	365
	Speaker	1	25	2	5	0.05	18.3
Seminar Hall	Smart Board	1	200	5	5	1	365
	Fan	6	60	7	5	0.42	153
	LED	5	13	7	5	0.09	33.2
	Speaker	1	25	3	5	0.08	27.4
Staff Room	Fan	5	60	7	5	0.42	153
	LED	6	13	7	5	0.09	33.2
	Speaker	2	25	2	5	0.05	18.3
	Printer	1	40	2	5	0.08	29.2
	Scanner	1	36	2	5	0.07	26.3
	PC	1	200	2	5	0.4	146
2nd MSc Statistics	Fan	3	60	7	5	0.42	153
	LED tube	3	20	7	5	0.14	51.1
	UPS	**1**	**220**	**2**	**5**	**0.44**	**161**
	Smart Board	**1**	**200**	**5**	**5**	**1**	**365**
2nd DS	Fan	3	60	7	5	0.42	153
	LED tube	6	20	7	5	0.14	51.1

	Speaker	1	25	2	5	0.05	18.3
	Smart Board	1	200		5	0	0
1st MSc Statistics	Fan	2	60	7	5	0.42	153
	LED tube	3	20	7	5	0.14	51.1
	Smart Board	1	200	5	5	1	365
	Speaker	1	25	2	5	0.05	18.3
3rd IPDS	Fan	4	60	7	5	0.42	153
	Speaker	1	25	2	5	0.05	18.3
	Smart Board	1	200	5	5	1	365
	LED tube	2	20	7	5	0.14	51.1
Staff Room	Table fan	2	60	7	5	0.42	153
	TV	2	200	4	5	0.8	292
	LED tube	4	20	7	5	0.14	51.1
	PC	1	200	5	5	1	365
	Printer	1	40	2	5	0.08	29.2
	Speaker	1	25	2	5	0.05	18.3
	Fan	2	60	7	5	0.42	153
Data Science	Fan	1	60	7	5	0.42	153
	LED tube	1	20	7	5	0.14	51.1
	Printer	1	40	2	5	0.08	29.2
	PC	1	200	3	5	0.6	219
	Table fan	1	60	7		0.42	153
IPDS	fan	5	60	7	5	0.42	153
	LED tube	2	20	7	5	0.14	51.1
	Speaker	1	25	2	5	0.05	18.3
	TV	1	200	3	5	0.6	219
Hindi	Table fan	1	60	7	5	0.42	153
	Incandescent bulb	1	60	3	5	0.18	65.7
	Fan	4	60	7	5	0.42	153
	Tube LED	2	20	7	5	0.14	51.1
	Speaker	1	25	2	5	0.05	18.3
	Fan	4	60	7	5	0.42	153
	Speaker	1	25	2	5	0.05	18.3
	Tube light (LED)	2	20	7	5	0.14	51.1
PG-2nd	Fan	2	60	7	5	0.42	153
	Plug	1			5	0	0
	CFL	1	30	6	5	0.18	65.7
	Speaker	1	25	2	5	0.05	18.3
	Smart Board	1	200	5	5	1	365
Hindi	plug	1			5	0	0

	Fan	3	60	7	5	0.42	153
	Light	2	30	7	5	0.21	76.7
	Projector	1	800	5	5	4	1460
	PC	1	200	5	5	1	365
	Printer	1	40	3	5	0.12	43.8
2nd BA Hindi	Fan	4	60	7	5	0.42	153
	Smart board	1	200	5	5	1	365
	UPS	1	220	3	5	0.66	241
	CFL	1	30	5		0.15	54.8
	LED	1	13	7	5	0.09	33.2
	Speaker	1	25	2	5	0.05	18.3
	Plug	3			5	0	0
1st BA Hindi	Plug	3			5	0	0
	UPS	1	220	2	5	0.44	161
	Fan	4	60	7	5	0.42	153
	LED	1	13	7		0.09	33.2
	CFL	1	30	7	5	0.21	76.7
	Smart Board	1	200	5	5	1	365
	Speaker	1	25	2	5	0.05	18.3
2nd MA Hindi	Fan	1	60	7	5	0.42	153
	LED	1	13	7	5	0.09	33.2
	Speaker	1	25	2	5	0.05	18.3
	Plug board	1			5	0	0
Staff Room	Plug	6				0	0
	Table fan	4	60	7	5	0.42	153
	fan	1	60	7	5	0.42	153
	Speaker	1	25	2	5	0.05	18.3
	LED	2	13	7	5	0.09	33.2
	Printer	1	40	3	5	0.12	43.8
	PC	1	200	3	5	0.6	219
	LED bulb	1	13	7	5	0.09	33.2
Ladies' toilet	LED bulb	1	13	5	5	0.07	23.7
	CFL	1	30	5	5	0.15	54.8
Indoor	CFL bulb	1	30	7	5	0.21	76.7
Gents Toilet	Zero bulb	1	30	7	5	0.21	76.7
	led	1	13	7	5	0.09	33.2
Outdoor	LED 1	14	13	12		0.16	56.9
	LED 2	3	13	12		0.16	56.9
							122

Table 4.56 Infrastructure details of S J Block A

Location No	Instruments	Watt	Count	Days	kWh	kWh per year
Computer lab 1	Fan	60	3	7	0.42	153.3
	LED tube	20	4	7	0.14	51.1
	Computer	200	16	5	1	365
	Printer	25	1	5	0.125	45.625
	TV	200	1	5	1	365
	Inverter	500	1	7	3.5	1277.5
Computer lab 2	Fan	60	2	7	0.12	43.8
	AC	1500	2	7	10.5	3832.5
	LED tube	20	2	5	0.1	36.5
	PC	200	16	5	1	365
Computer lab 3	Fan	60	2	7	0.12	43.8
	Led tube	20	2	7	0.04	14.6
	AC	1500	3	7	4.5	1642.5
	Speaker	25	1	7	0.025	9.125

Table 4.57 Infrastructure details of S JLab

Location No.	Instruments	Count	Watt	Hours	Days	kWh/ week	kWh/ year
Dept Of Management studies	LED	3	9	14	5	0.126	45.99
	Fan	3	75	14	5	1.05	383.25
	Tube	1	24	14	5	0.336	122.64
	PC	1	200	7	5	1.4	511
	Speaker	1	25	7	5	0.175	63.875
	Printer	1	200	7	5	1.4	511
BTTM Classroom	Fan	5	75	14	5	1.05	383.25
	Led Tube	4	24	14	5	0.336	122.64
	Speaker	1	25	7	5	0.175	63.875
	Projector	1	100	7	5	0.7	255.5
Classroom	Fan	3	75	14	5	1.05	383.25
	Led Tube	5	24	14	5	0.336	122.64
	Speaker	1	25	7	5	0.175	63.875
	Smart Board	1	200	7	5	1.4	511
BCA Classroom	Fan	1	75	7	5	0.525	191.625
	Led Tube	4	24	7	5	0.168	61.32
	Speaker	1	25	7	5	0.175	63.875

	Projector	1	100	7	5	0.7	255.5
Radio Station	PC	1	200	7	5	1.4	511
	Mic	1		7	5	0	0
	Server Rack	1		7	5	0	0
	AC		1500	6	5	9	3285
1 MTTM	Fan	2	75	7	5	0.525	191.625
	Led Tube	2	24	7	5	0.168	61.32
	Speaker	1	25	5	5	0.125	45.625
	Smart TV	1	385	5	5	1.925	702.625
2 MHRM	Fan	3	75	7	5	0.525	191.625
	Led Tube	1	24	7	5	0.168	61.32
	Speaker	1	25	5	5	0.125	45.625
	Smart Board	1	385	5	5	1.925	702.625
1 MHRM	Fan	3	75	7	5	0.525	191.625
	Led Tube	1	24	7	5	0.168	61.32
	Speaker	1	25	7	5	0.175	63.875
	Smart Board	1	385	7	5	2.695	983.675
Dept Of BCA	Fan	3	75	7	5	0.525	191.625
	Led Tube	2	24	7	5	0.168	61.32
	Speaker	1	25	5	5	0.125	45.625
Washroom Boys	LED	4	12	7	5	0.084	30.66
	LED tube	1	24	7	5	0.168	61.32
Washroom Girls	LED	4	12	7		0.084	30.66
	Tube	1	40	7		0.28	102.2
3 BCOM COMP	Fan	3	75	7	5	0.525	191.625
	Led Tube	2	24	7	5	0.168	61.32
	Speaker	1	25	5	5	0.125	45.625
3 BCOM OMSP	Fan	3	75	7	5	0.525	191.625
	Led Tube	2	24	7	5	0.168	61.32
	Speaker	1	25	5	5	0.125	45.625
3 BHRM	Fan	3	75	7	5	0.525	191.625
	Led Tube	2	24	7	5	0.168	61.32
	Speaker	1	25	5	5	0.125	45.625
	Smart Board	1	385	5		1.925	702.625
Director Room	Exhaust Fan	1	50	5		0.25	91.25
	LED	2	12	7		0.084	30.66
	LED tube	2	24	7		0.168	61.32
	Printer	1	300	2		0.6	219
	Speaker	1	25	5		0.125	45.625

	Smart TV(LG)	1	385	835		321.475	117338
	PC	1	1500	200		300	109500
	Inverter	1	220	220		48.4	17666
Ladies Restroom	Fan	2	75	7		0.525	191.625
	LED tube	1	24	7		0.168	61.32
	Speaker	1	25	5		0.125	45.625
2 MTTM	Fan	2	75	7	5	0.525	191.625
	Tube	1	40	7	5	0.28	102.2
	Speaker	1	25	5	5	0.125	45.625
	Projector	1	100	5		0.5	182.5
1 BCA	Fan	5	75	7	5	0.525	191.625
	Tube	4	40	7	5	0.28	102.2
	LED Tube	1	24	7	5	0.168	61.32
	Speaker	1	25	5	5	0.125	45.625
	Smart Board (Spectron)	1	385	5		1.925	702.625
2 BCA	Fan	5	75	7	5	0.525	191.625
	Tube	2	40	7	5	0.28	102.2
	LED Tube	1	24	7	5	0.168	61.32
	Speaker	1	25	5	5	0.125	45.625
	Projector	1	100	5		0.5	182.5
Veranda	Incandescent	1	14	5	5	0.07	25.55
	Water filter	2		8	5	0	0
	CCTV	2	15	24	5	0.36	131.4
	LED	2	12	7	5	0.084	30.66
Staircase	LED	1	12	7	5	0.084	30.66
1st Floor Classroom	Tube	5	40	7	5	0.28	102.2
	LED tube	1	12	7	5	0.084	30.66
	Fan	8	75	7	5	0.525	191.625
	PC	1	200	5	5	1	365
	Printer	2	300	5	5	1.5	547.5
	LED	1	12	7	5	0.084	30.66
	Speaker	1	25	5	5	0.125	45.625
Classroom	Tube	1	40	7	5	0.28	102.2
	LED tube	3	24	7	5	0.168	61.32
	Fan	5	75	7	5	0.525	191.625
	Speaker	1	25	5	5	0.125	45.625
	Smart Board Samsung	1	385	5	5	1.925	702.625

Classroom	Tube	1	40	5	5	0.2	73
	LED tube	1	24	5	5	0.12	43.8
	Fan	4	75	7	5	0.525	191.625
	Speaker	1	25	5	5	0.125	45.625
	Smart Board Samsung	1	385	7	5	2.695	983.675
Classroom	Tube	1	40	7	5	0.28	102.2
	LED	6	12	7	5	0.084	30.66
Classroom	Fan	3	75	7	5	0.525	191.625
	LED tube	2	24	7	5	0.168	61.32
	Speaker	1	25	5	5	0.125	45.625
Classroom	Fan	3	75	7	5	0.525	191.625
	LED tube	2	24	7	5	0.168	61.32
	Speaker	1	25	5	5	0.125	45.625
Classroom	Fan	3	75	7	5	0.525	191.625
	LED tube	2	24	7	5	0.168	61.32
	Speaker	1	25	5	5	0.125	45.625
Classroom	Fan	2	75	7	5	0.525	191.625
	LED tube	2	24	7	5	0.168	61.32
	Speaker	1	25	5	5	0.125	45.625
	Smart Board Acer	1	385	5	5	1.925	702.625
Classroom	Fan	2	75	7	5	0.525	191.625
	LED tube	2	24	7	5	0.168	61.32
	Speaker	1	25	5	5	0.125	45.625
Classroom	Tube	1	40	7	5	0.28	102.2
	LED tube	1	24	7	5	0.168	61.32
	Fan	3	75	7	5	0.525	191.625
	Projector	1	100	5	5	0.5	182.5
	Speaker	1	25	5	5	0.125	45.625
Classroom	Tube	4	40	7	5	0.28	102.2
	LED tube	1	24	7	5	0.168	61.32
	Fan	5	75	5	5	0.375	136.875
	Speaker	1	25	5	5	0.125	45.625
Classroom	Tube	4	40	7	5	0.28	102.2
	LED tube	1	24	7	5	0.168	61.32
	Fan	5	75	7	5	0.525	191.625
	Speaker	1	25	5	5	0.125	45.625
Veranda	LED	7	12	7	5	0.084	30.66

	CCTV	5	15	24	5	0.36	131.4
	Water Filter	1			5	0	0
2nd Floor Classroom	Tube	1	40	7	5	0.28	102.2
	LED tube	1	24	7	5	0.168	61.32
	LED	1	12	7	5	0.084	30.66
	Fan	4	75	7	5	0.525	191.625
	Speaker	1	25	5	5	0.125	45.625
	PC	1	200	5	5	1	365
Classroom	Tube	1	40	7	5	0.28	102.2
	Fan	3	75	7	5	0.525	191.625
	Speaker	1	25	7	5	0.175	63.875
	Smart Board Samsung	1	385	5	5	1.925	702.625
Classroom	Tube	1	40	7	5	0.28	102.2
	Fan	3	75	7	5	0.525	191.625
	Speaker	1	25	7	5	0.175	63.875
	Projector	1	100	5	5	0.5	182.5
Classroom	LED	3	12	7	5	0.084	30.66
	LED	1	12	7	5	0.084	30.66
Classroom	LED tube	2	24	7	5	0.168	61.32
	Fan	3	75	7	5	0.525	191.625
	Speaker	1	100	5	5	0.5	182.5
	Smart Board Acer	1	385	5	5	1.925	702.625
Classroom	LED tube	2	24	7	5	0.168	61.32
	Fan	3	75	7	5	0.525	191.625
	Speaker	1	100	5	5	0.5	182.5
	Smart Board Acer	1	385	5	5	1.925	702.625
Classroom	LED tube	2	24	7	5	0.168	61.32
	Fan	3	75	7	5	0.525	191.625
	Speaker	1	100	5	5	0.5	182.5
	Smart Board Samsung	1	385	5	5	1.925	702.625
Classroom	LED tube	1	24	7	5	0.168	61.32
	Fan	2	75	7	5	0.525	191.625
	PC	1	200	5	5	1	365
Outdoor	LED	2	20	12	5	0.24	87.6
	LED 2	6	10	12	5	0.12	43.8
							1667.95

Table 4.58 Infrastructure details of D J Block A

Location No.	Instruments	Watt	Count	Days	kWh	kWh
BCA LAB	PC	200	71	5	0.355	129.575
	AC	1200	2	3	0.006	2.19
	Projector	800	1	5	0.005	1.825
	Tube	30	8	7	0.056	20.44
	Fan	60	8	7	0.056	20.44
	Speaker	25	2	4	0.008	2.92
	CCTV	60	1	25	0.025	9.125
Commerce Lab	PC	200	45	3	0.135	49.275
	AC	1200	1	3	0.003	1.095
	Projector	800	1	5	0.005	1.825
	Tube	30	5	7	0.035	12.775
	LED tube	20	3	7	0.021	7.665
	Fan	60	7	7	0.049	17.885
	CCTV	60	2	25	0.05	18.25
	Server Rack	1000	2	7	0.014	5.11
	UPS	220	26	3	0.078	28.47
Auditorium	Fan	60	34	7	0.238	86.87
	Ceiling Light	20	45	7	0.315	114.975
	Large Speaker DJ Dynatec	500	4	3	0.012	4.38
	Ahuja SP5251T Passive Wall Mount Speaker	200	1	3	0.003	1.095
	Spotlight	15	2	5	0.01	3.65
	CCTV	60	4	25	0.1	36.5
	Window		63	0	0	0
	Small Window		63	0	0	0
	Socket		4	0	0	0
						23.05

Table 4.59 Infrastructure details of D J Lab

Fig. 4.85 Internal auditors meeting

Location No.	Instruments	Count	Watt	Hours	Days	kWh	kWh/ year
Ground floor office	BLDC Fan	2	60	8	6	0.48	175.2
	Wall Fan	1	6	8	6	0.048	17.52
	Exhaust Fan	1	0	8	6	0	0
	Fan	1	50	8	6	0.4	146
	Ceiling Light	16	20	8	6	0.16	58.4
	CCTV	1	15	24	6	0.36	131.4
	LED	3	12	8	6	0.096	35.04
	Server Rack	1	500	8	6	4	1460
	PC	4	200	8	6	1.6	584
	Printer	2	25	5	6	0.125	45.625
Office Veranda	Wall Fan		60	8	6	0.48	175.2
	LED Tube		20	8	6	0.16	58.4
	CCTV		15	24	6	0.36	131.4
	Ceiling Light		12	12	6	0.144	52.56
	Ceiling Spotlight S		12	7	6	0.084	30.66
	Ceiling Spotlight		12	7	6	0.084	30.66
	CCTV		15	24	6	0.36	131.4
	Smart TV Panasonic		385	3	6	1.155	421.58
	Modem		15	12	6	0.18	65.7
Board Room	AC	2	1500	5	5	7.5	2737.5
	Ceiling Light	8	12	5	5	0.06	21.9
	Smart Board Samsung	1	385	5	5	1.925	702.63
	Modem	1	15	5	5	0.075	27.375
Veranda	Modem	1	15	5	5	0.075	27.375
	LED	2	12	12	5	0.144	52.56
	CFL	3	20	12	5	0.24	87.6
	CCTV	1	15	24	5	0.36	131.4
	Water Filter	1	120	12	5	1.44	525.6
	Speaker Large	1	100	3	5	0.3	109.5
	Electric Bell	1	24	12	5	0.288	105.12
Gents Toilet	LED	2	12	2	5	0.024	8.76
Ladies Toilet	LED	2	12	2	5	0.024	8.76
Library	Fan	9	60	12	5	0.72	262.8
	CCTV	1	15	24	5	0.36	131.4
	Tube	8	12	12	5	0.144	52.56
	Photostat Machine	1	220	12	5	2.64	963.6
	PC	1	200	12	5	2.4	876

	Fan	4	60	7	5	0.42	153.3
	Wall Fan	2	60	7	5	0.42	153.3
	CCTV	1	15	24	5	0.36	131.4
	Projector	1	25	7	5	0.175	63.875
	Smart Board Samsung	1	385	7	5	2.695	983.68
	LED tube	2	20	7	5	0.14	51.1
	Fan	2	60	7	5	0.42	153.3
	tube	1	20	7	5	0.14	51.1
	LED	4	12	7	5	0.084	30.66
	LED tube	1	20	7	5	0.14	51.1
	Fan	4	60	7	5	0.42	153.3
	Wall Fan	2	60	7	5	0.42	153.3
	CCTV	1	15	24	5	0.36	131.4
	Projector	1	25	7	5	0.175	63.875
	Smart Board Samsung	1	385	7	5	2.695	983.68
	Tube	1	20	7	5	0.14	51.1
	LED tube	3	20	7	5	0.14	51.1
	LED Tube	5	20	7	5	0.14	51.1
	Ceiling Light	15	12	7	5	0.084	30.66
	Refrigerator	1	300	24	5	7.2	2628
	AC	2	1500	5	5	7.5	2737.5
	Smart TV LG	1	385	3	5	1.155	421.58
	Fan	2	60	7	5	0.42	153.3
	PC	1	200	5	5	1	365
	Server Rack	1	500	8	5	4	1460
	Ceiling Spotlight S	8	12	7	5	0.084	30.66
Staffroom Outdoor	Wireless Amplifier	1	200	3	5	0.6	219
	CFL	1	12	5	5	0.06	21.9
	Water Filter	3	60	12	5	0.72	262.8
Seminar Hall	CCTV	1	15	12	5	0.18	65.7
	Fan	8	60	5	5	0.3	109.5
	Speaker	7	25	5	5	0.125	45.625
	Projector	1	312	5	5	1.56	569.4
	CFL	3	12	5	5	0.06	21.9
	LED tube	3	20	5	5	0.1	36.5
	Socket	7			5	0	0
Staffroom Outdoor	Fan	4	60	12	5	0.72	262.8
	LED tube	4	20	12	5	0.24	87.6
	PC	2	200	5	5	1	365

Staffroom Pantry	Fan	1	60	5	5	0.3	109.5
	LED tube	2	20	5	5	0.1	36.5
	LED	2	12	5	5	0.06	21.9
	Socket	6				0	0
MCA 1st Floor Step Outdoor	LED	2	12	12	5	0.144	52.56
	LED tube	1	20	12	5	0.24	87.6
	Ceiling Light	3	12	12	5	0.144	52.56
Outdoor Room	LED	1	12	12		0.144	52.56
Civil Service Academy room	AC	1	1500	5	6	7.5	2737.5
	Fan	2	60	5	6	0.3	109.5
	CCTV	1	15	5	6	0.075	27.375
	Ceiling Light	13	12	5	6	0.06	21.9
	Printer	1	300	55	6	16.5	6022.5
	PC	1	200	5	6	1	365
	Printer	1	300	3	6	0.9	328.5
Computer Lab Outdoor	Speaker	1	25	2		0.05	18.25
	LED	1	12	2	5	0.024	8.76
Ladies Waiting Room	LED	2	12	2	5	0.024	8.76
	LED tube	1	20	2	5	0.04	14.6
	Fan	2	60	2	5	0.12	43.8
Bathroom	LED	1	12	2	6	0.024	8.76
	CFL	1	12	2	6	0.024	8.76
Classroom 3	Fan	4	60	7	5	0.42	153.3
	Wall Fan	2	60	7	5	0.42	153.3
	CCTV	1	12	5	5	0.06	21.9
	Projector	1	312	7	5	2.184	797.16
	Smart Board Samsung	1	385	5	5	1.925	702.63
	LED tube	2	20	7	5	0.14	51.1
Classroom 4 Outdoor	CCTV	1	15	24	5	0.36	131.4
	Modem	1	15	12	5	0.18	65.7
	LED	1	12	12	5	0.144	52.56
	Fan	4	60	12	5	0.72	262.8
	Wall Fan	2	60	12	5	0.72	262.8
	CCTV	1	15	12	5	0.18	65.7
	Projector	1	312	7	5	2.184	797.16
	Smart Board Samsung	1	385	7	5	2.695	983.68
	LED tube	2	20	12	5	0.24	87.6
	CFL	2	12	12	5	0.144	52.56

	LED tube	2	20	12	5	0.24	87.6
Seminar hall Outdoor	Modem	1	15	8	5	0.12	43.8
	CFL	1	12	8	5	0.096	35.04
	Server Rack	1	500	7	5	3.5	1277.5
Classroom 5	Fan	3	60	12	5	0.72	262.8
	CCTV	1	15	24	5	0.36	131.4
	Projector	1	312	5	5	1.56	569.4
	Smart Board Samsung	1	385	5	5	1.925	702.63
	LED tube	2	20	12	5	0.24	87.6
	Fan	4	60	12	5	0.72	262.8
	CCTV	1	15	24	5	0.36	131.4
	Projector	1	312	100	5	31.2	11388
	Ceiling Light	8	12	12	5	0.144	52.56
Reading Room	Fan	3	60	12	6	0.72	262.8
	AC	1	1500	5	6	7.5	2737.5
	Ceiling Light	15	12	12	6	0.144	52.56
	LED Tube	4	20	12	6	0.24	87.6
Classroom 8	Fan	3	60	12	5	0.72	262.8
	LED tube	2	20	12	5	0.24	87.6
	CCTV	1	15	24	5	0.36	131.4
	Speaker	2	25	5	5	0.125	45.625
	Amplifier	1	220	5	5	1.1	401.5
	Projector	1	312	5	5	1.56	569.4
	PC	1	200	5	5	1	365
Stair Case	LED	1	12	7		0.084	30.66
	Tube	1	20	7		0.14	51.1
	LED	3	12	7		0.084	30.66
Staffroom Civil Service	Fan	1	60	7	6	0.42	153.3
	LED Tube	3	20	7	6	0.14	51.1
	PC	1	200	5	6	1	365
	AC	1	1500	3	6	4.5	1642.5
	Printer	1	300	3	6	0.9	328.5
	Exhaust Fan	1	50	7	6	0.35	127.75
	Modem	1	15	7	6	0.105	38.325
	Inverter	1	220	7	6	1.54	562.1
Veranda	Electric Bell	1	5	7		0.035	12.775
	Water Filter	1	60	12		0.72	262.8
	Modem	1	15	12		0.18	65.7
	LED	5	12	7		0.084	30.66

	CFL	2	12	7		0.084	30.66
	Modem s	1	15	7		0.105	38.325
	Speaker m	1	25	3		0.075	27.375
Classroom 7	Fan	3	60	12		0.72	262.8
	LED tube	2	20	12		0.24	87.6
	CCTV	1	15	24		0.36	131.4
	Speaker	2	25	5		0.125	45.625
	Amplifier	1	220	2		0.44	160.6
	Projector	1	312	5		1.56	569.4
	PC	1	200	2		0.4	146
Classroom 9	Fan	3	60	12		0.72	262.8
	LED tube	2	20	12		0.24	87.6
	Electric Kettle (Kelvinator)	1	1200	4		4.8	1752
Toilet	CFL	2	12	6		0.072	26.28
	LED	1	12	6		0.072	26.28
	Exhaust fan	1	50	6		0.3	109.5
Gents Toilet	LED	1	12	6		0.072	26.28
	CFL	3	12	6		0.072	26.28
Ladies	CFL	1	12	6		0.072	26.28
	LED	2	12	6		0.072	26.28
Outdoor Room	LED 1	2	20	12		0.24	87.6
	LED 2	6	10	12		0.12	43.8
							380.04

Table 4.60 Infrastructure details of MCA

Fig. 4.86 EnMS data verification

Location No.	Instruments	Usage Pattern	Watt	Count	Avg Weekly Use (hr)	kWh	kWh/year
Computer Lab	AC		1500	2	5	7.5	2737.5
	Modem		15	1	7	0.11	38.325
	Projector		312	1	5	1.56	569.4
	CCTV		15	1	24	0.36	131.4
	Fan		60	4	7	0.42	153.3
	Ceiling Light		12	14	5	0.06	21.9
	PC		200	43	5	1	365
	Printer			3		0	0
	Internet Router		20	1	7	0.14	51.1
	Socket			99		0	0
	LED Tube		20	1	7	0.14	51.1
	LED		12	1	7	0.08	30.66
Computer Centre	Modem		12	1	25	0.3	109.5
	LED Tube		20	2	5	0.1	36.5
	Ceiling Light		12	12	5	0.06	21.9
	CCTV		15	1	24	0.36	131.4
	Wall Fan		60	2	5	0.3	109.5
	Projector		100	1	3	0.3	109.5
	PC		200	8	3	0.6	219
Computer Lab 2	Server Rack		220	1	7	1.54	562.1
	Modem		15	1	7	0.11	38.325
	Printer		300	1	5	1.5	547.5
	PC		200	4	5	1	365
	AC		1500	1	5	7.5	2737.5
	LED tube		20	2	5	0.1	36.5
	Fan		60	1	5	0.3	109.5
Power Room	Inverter		220	25	7	1.54	562.1
Auditorium	Fan		60	12	7	0.42	153.3
	Projector		312	1	5	1.56	569.4
	Speaker l JBL MRX500		400	2	3	1.2	438
	Speaker m JBL LEON 712		1300	2	3	3.9	1423.5
	Speaker m with mic STUDIO MASTER D400		400	1	3	1.2	438
	Ceiling Spotlight s		12	26	3	0.04	13.14

	Spotlight		12	4	5	0.06	21.9
	Ceiling Light		12	30	7	0.08	30.66
	CFL l		12	3	7	0.08	30.66
	Modem		15	2	7	0.11	38.325
	CCTV		15	1	24	0.36	131.4
	Centralised AC		300	1	5	1.5	547.5
							350.802

Table 4.61 Infrastructure details of MCA Lab

Location No.	Instruments	Count	Watt	Hours	Days	kWh	kWh per year
Library Outdoor	Speaker	1	130	8	6	6.24	2277.6
	Wi-Fi modum	1	15	8	6	0.72	262.8
	Monitor	1	200	8	6	9.6	3504
	LED	2	12	8	6	1.152	420.48
Indoor	LED	4	12	8	6	2.304	840.96
	CCTV	1	15	8	6	0.72	262.8
	CFL	1	12	8	6	0.576	210.24
Ground floor	main switch	1		8	6	0	0
	electric bell	1	5	8	6	0.24	87.6
	fan	16	60	8	6	46.08	16819.2
	LED	46	12	8	6	26.496	9671.04
	CCTV	4	15	8	6	2.88	1051.2
	Wi-Fi modum	1	15	8	6	0.72	262.8
2nd floor	fan	9	60	8	6	25.92	9460.8
	LED	20	12	8	6	11.52	4204.8
	CCTV	3	15	8	6	2.16	788.4
	AC	2	1500	8	6	144	52560
	Speaker	1	130	8	6	6.24	2277.6
	CFL	3	12	8	6	1.728	630.72
	main switch	1		8	6	0	0
Library Circulation room	plug point	6		8	6	0	0
	main switch	1		8	6	0	0
	CCTV	1	15	8	6	0.72	262.8
Library Cabin	LED	2	12	8	6	1.152	420.48
	Wall fan	2	60	8	6	5.76	2102.4
	Pc	1	200	8	6	9.6	3504

	printer	1	300	8	6	14.4	5256
Technical library	Fan	1	60	8	6	2.88	1051.2
	LED	2	12	8	6	1.152	420.48
Book research section	Pc	2	200	8	6	19.2	7008
	LED	3	12	8	6	1.728	630.72
	Fan	1	60	8	6	2.88	1051.2
	Inverter	1	220	8	6	10.56	3854.4
	LED TV	1	385	8	6	18.48	6745.2
Library Power backup	Battery	3	100	8	6	14.4	5256
	UPS	3	360	8	6	51.84	18921.6
Library Physical challenge	PC	1	200	8	6	9.6	3504
	Fan	1	60	8	6	2.88	1051.2
	LED	1	12	8	6	0.576	210.24
	CCTV	1	15	8	6	0.72	262.8
	Wi-Fi mode	1	15	8	6	0.72	262.8
Placement cell	Gaming PC	1	500	7	6	21	7665
	Printer	1	300	7	6	12.6	4599
	Fan	1	60	7	6	2.52	919.8
	LED	1	12	7	6	0.504	183.96
Director of students welfare	Fan	2	60	7	5	4.2	1533
	CFL Tube	2	12	7	5	0.84	306.6
	AC	2	1500	5	5	75	27375
	LED	1	12	5	5	0.3	109.5
	Fan	1	60	5	5	1.5	547.5
Research centre library	CFL	4	12	6	5	1.44	525.6
	Fan	5	60	6	5	9	3285
	LED	2	12	6	5	0.72	262.8
Gymnasium	Bulb	2	12	2	5	0.24	87.6
	LED	2	12		5	0	0
	Fan	2	60		5	0	0
Theatre	AC	2	1500	1.5	5	22.5	8212.5
	Speaker	7	130	1.5	5	6.825	2491.13
	Amplifier	1	100	1.5	5	0.75	273.75
	Ceiling Light	60	12	1.5	5	5.4	1971
	Projector	1	312	1.5	5	2.34	854.1
	Strip light	1	12	1.5	5	0.09	32.85
	CCTV	1	15	24	5	1.8	657

	Table fan	1	60	1.5	5	0.45	164.25
	Mic connected stand speaker	1	100	0	5	0	0
Library indoor	Ceiling Light	2	12	8	5	0.96	350.4
Gents' washroom	LED	1	12	2	5	0.12	43.8
Ladies' washroom	LED	1	12	2	5	0.12	43.8
Director room	AC	1	1500	2	5	15	5475
	Ceiling Light	4	12	2	5	0.48	175.2
	LED	1	12	2	5	0.12	43.8
Canteen	LED	13	12	9	5	7.02	2562.3
	fan	10	60	9	5	27	9855
	LED lamp	5	12	9	5	2.7	985.5
	LED bulb	2	12	9	5	1.08	394.2
	Wi-Fi modem	1	15	9	5	0.675	246.375
	speaker	2	130	9	5	11.7	4270.5
	CCTV	2	15	9	5	1.35	492.75
	CFL tube light	1	20	9	5	0.9	328.5
	Ventilator	14	50	9	5	31.5	11497.5
Canteen outdoor	LED bulb	1	12	3	5	0.18	65.7
MGCV Camp	LED	12	12	5	5	0.06	21.9
	Fan	7	60	5	5	0.3	109.5
	Pc	1			5	0	0
	Ventilator	7				0	0
MGCV Camp (Outdoor)	LED	3	12	5	5	0.06	21.9
	Fan	4	60	0.5	5	0.03	10.95
	LED	1	12	0.5		0.006	2.19
Library hall(lbhm)	Fan	29	60	1	5	0.06	21.9
	CFL	4	12	1	5	0.012	4.38
	LED	2	12	1	5	0.012	4.38
	Speaker	2	130	1	5	0.13	47.45
	CCTV	7	15	1	5	0.015	5.475
	Network board	1		1	5	0	0
	CPU	1	150	1	5	0.15	54.75
	Electric bell	2	5	1	5	0.005	1.825
Mar Punnakotil hall	Speaker	3	130	1	5	1.95	711.75
	Plug point	4		1	5	0	0
	Fan	6	60	1	5	1.8	657
	Projector	1	312	1	5	1.56	569.4
	CFL	4	12	1	5	0.24	87.6

	LED	2	12	1	5	0.12	43.8
	CCTV	3	15	24	5	5.4	1971
	Amplifier	2	100	1	5	1	365
PRO office	Fan	1	60	7	5	2.1	766.5
	LED	3	12	7	5	1.26	459.9
	Pc	1	200	7	5	7	2555
	Wi-Fi mode	1	15	7	5	0.525	191.625
	Printer	1	300	7	5	10.5	3832.5
	Plug point	10		7	5	0	0
ATM	CC tv	5	15	24	7	12.6	4599
	AC	1	1500	24	7	252	91980
	spot light	1	12	24	7	2.016	735.84
	ATM	1	2500	24	7	420	153300
	Alarm	1	5	24	7	0.84	306.6
Controller of examination	Spot light	35	12	6	6	15.12	5518.8
	Fan	16	60	6	6	34.56	12614.4
	CCTV	11	15	6	6	5.94	2168.1
	Pc	4	200	6	6	28.8	10512
	AC	4	1500	6	6	216	78840
	Wi-Fi mode	3	15	6	6	1.62	591.3
	plug point	31		6	6	0	0
	Printer (big)	1	400	6	6	14.4	5256
	Printer (small)	1	300	6	6	10.8	3942
	Exhaust	1	50	6	6	1.8	657
	Monitor	1	200	6	6	7.2	2628
	Punching machine	1	2000	6	6	72	26280
IGNO office	Fan	2	60	8	5	4.8	1752
	LED	2	12	8	5	0.96	350.4
	Plug point	9		8	5	0	0
	Printer	2	300	8	5	24	8760
	Pc	1	200	8	5	8	2920
	Wi-Fi mode	1	15	8	5	0.6	219
IGNOV office(outdoor)	Inverter	1	220		5	0	0
IGNOV store room	Fan	1	60	1	5	0.3	109.5
	LED	1	12	1	5	0.06	21.9
	Plug point	1				0	0
Electrician store	LED	1	12	2	5	0.12	43.8
	Fan	1	60	2	5	0.6	219

	Plug point	1			5	0	0
Digital library	Fan	8	60	3	5	7.2	2628
	projector	1	312	3	5	4.68	1708.2
	CFL	3	12	3	5	0.54	197.1
	LED	1	12	3	5	0.18	65.7
	CCTV	1	15	3	5	0.225	82.125
	Pc	30	200	3	5	90	32850
	UPS	1	360	3	5	5.4	1971
	LCD	1	200	3	5	3	1095
	Battery	2	210	3	5	6.3	2299.5
	Plug point	149		3	5	0	0
	Printer	1	300	3	5	4.5	1642.5
	TV	1	385	3	5	5.775	2107.88
							4866.74

Table 4.62 Infrastructure details of Library Hall

Location No.	Instruments	Count	Watt	Hours	Days	kWh	kWh
auditorium	Fan	18	75	8	2	0.6	219
	Ceiling light	73	10	8	2	0.08	29.2
	Speaker	9	25	8	2	0.2	73
	Computer	1	200	2		0.4	146
office	Fan	13	60	8	6	0.48	175.2
	Ceiling light	33	10	8	6	0.08	29.2
	Computer	16	200	8	6	1.6	584
	Photostat machine	3	240	3	6	0.72	262.8
	Fan	5	75	8	6	0.6	219
	Ceiling light	10	10	8	6	0.08	29.2
	Ac blue star 1.5 ton	1	1500	8	6	12	4380
	TV	1	385	2	6	0.77	281.1
faculty room	Ceiling light	5	10	8		0.08	29.2
	Fan	1	75	0.5	1	0.038	13.69
	CCTV	1	15	24	1	0.36	131.4
	computer	1	200	2	1	0.4	146
	TV	1	385	1	1	0.385	140.5
	ultrasonic weight machine	1	240	5	1	1.2	438
bursar room	Ceiling light	6	10	8	6	0.08	29.2
	Ceiling light	6	10	8	6	0.08	29.2
	AC	1	1500	8	6	12	4380

	Computer	1	200	2	6	0.4	146
	Printer	1	300	1	6	0.3	109.5
	Fan	2	75	8	6	0.6	219
	TV	2	385	8	6	3.08	1124
inner room	Ceiling light	7	10	8	6	0.08	29.2
	Fan	2	75	8	6	0.6	219
	AC	1	1500	8	6	12	4380
	Plug	9		8	6	0	0
Liaison office	Ceiling light	6	10	8	6	0.08	29.2
	Ceiling fan	2	60	8	6	0.48	175.2
	Computer	2	200	8	6	1.6	584
	Printer	1	300	8	6	2.4	876
	Photostat machine	1	240	8	6	1.92	700.8
	Ceiling light	2	10	8	6	0.08	29.2
Server room	Fan	1	75	1	6	0.075	27.38
	Ceiling light	1	10	1	6	0.01	3.65
	Computer	1	200	1	6	0.2	73
	Amplifier	2	160	1	6	0.16	58.4
	TV	1	385	0	6	0	0
washroom	Ceiling light	4	10	5	6	0.05	18.25
vice principal office	Fan	3	75	8	6	0.6	219
	Ceiling light	10	10	8	6	0.08	29.2
	Ceiling light	1	10	8	6	0.08	29.2
	Camera	1	20	8	6	0.16	58.4
	Computer	1	200	2	6	0.4	146
	Printer	1	300	8	6	2.4	876
	AC	1	1500	8	6	12	4380
council room	Ceiling light	11	10	3	6	0.03	10.95
	Ceiling light	8	10	3	6	0.03	10.95
	Screen	1		3	6	0	0
	AC	2	1500	8	6	12	4380
	Fan	1	75	3	6	0.225	82.13
dining hall	Fan	3	75	2	6	0.15	54.75
	Ceiling light	8	10	2	6	0.02	7.3
	AC	1	1500	3	6	4.5	1643
	Dish washer	1	1800	2	6	3.6	1314
	Fridge(4star Samsung)	1	500	5	6	2.5	912.5
	Oven LG	1	2000	3	6	6	2190
	Water cooler	1	440	7	6	3.08	1124

	Induction cooker	1	2000	3	6	6	2190
conference hall	Light (s)	8	12	5	2	0.06	21.9
	AC	1	1500	3	2	4.5	1643
hallway	Fan	1	75	5	2	0.375	136.9
	Ceiling light	4	10	5	2	0.05	18.25
VIP lounge	Fan	2	75	5	2	0.375	136.9
	Ceiling light	8	10	5	2	0.05	18.25
	Ceiling light	4	10	5	2	0.05	18.25
	AC	1	1500	5	2	7.5	2738
	CFL	1	15	5	2	0.075	27.38
Manager	Ceiling light	4	10	5	6	0.05	18.25
	Ceiling light	6	10	5	6	0.05	18.25
	LED	1	9	5	6	0.045	16.43
	AC	1	1500	5	6	7.5	2738
	Fan	3	75	5	6	0.375	136.9
server room	Fan	1	75	5	6	0.375	136.9
	LED	2	9	5	6	0.045	16.43
ABH hall	Fan	9	75	5	6	0.375	136.9
	LED	10	9	5	6	0.045	16.43
	Washing machine	1	500	3	6	1.5	547.5
	Motor	1	746	5	6	3.73	1361
AB room	Ceiling light	5	10	5	6	0.05	18.25
	Ceiling light	4	10	5	6	0.05	18.25
	Fan	2	75	5	6	0.375	136.9
	AC	1	1500	5	6	7.5	2738
	Water heater	1	1125	3	6	3.375	1232
	Fan	2	75	5	6	0.375	136.9
	Ceiling light	4	10	5	6	0.05	18.25
AB room	Fan	1	75	5	6	0.375	136.9
	LED	1	9	5	6	0.045	16.43
	Tube	2	20	5	6	0.1	36.5
AB room	Fan	4	75	5	6	0.375	136.9
	Ceiling light	4	10	5	6	0.05	18.25
car porch	Ceiling light	6	10	4	6	0.04	14.6
	LED tube	2	24	4	6	0.096	35.04
	Camera	2	15	4	6	0.06	21.9
Entrance	Ceiling light	4	10	5	6	0.05	18.25
	Table fan	1	60	5	6	0.3	109.5

	Ceiling light	12	10	5	6	0.05	18.25
SV hall	Table fan	4	60	5	6	0.3	109.5
	Tube	4	40	5	6	0.2	73
SV hall	Table fan	26	60	4	2	0.24	87.6
	Led	18	20	4		0.08	29.2
	Camera	2	15	4		0.06	21.9
	Speaker	2	25	4		0.1	36.5
Principal's room	Ceiling light	11	10	8	6	0.08	29.2
	light (s)	4	12	8		0.096	35.04
	AC	1	1500	8		12	4380
	Fan old	1	75	8		0.6	219
	Fan	1	75	8		0.6	219
	Ceiling light	4	10	8		0.08	29.2
Outdoor	LED 1	1	100	8		0.8	292
	LED 2	3	20	8		0.16	58.4
	LED 3	3	30	8		0.24	87.6
							532.4

Table 4.63 Infrastructure details of Admin A

Location No.	Instruments	Count	Watt	Hours	Days	kWh/week	kWh
Ground floor Guest Room 1	Fan		75	12		0.9	328.5
	LED tube	1	24	12		0.288	105.12
	Tube	1	40	12		0.48	175.2
	LED B	1	22	12		0.264	96.36
	LED	2	9	12		0.108	39.42
Guest Room 2	Fan	2	75	12		0.9	328.5
	LED tube	1	24	12		0.288	105.12
	Tube	1	40	12		0.48	175.2
	LED B	1	22	12		0.264	96.36
	LED	2	9	12		0.108	39.42
Guest Room 3	Fan	2	75	12		0.9	328.5
	LED tube	1	24	12		0.288	105.12
	Tube	1	40	12		0.48	175.2
	LED B	1	22	12		0.264	96.36
	LED	2	9	12		0.108	39.42
Guest Room 4	Fan	2	75	12		0.9	328.5
	LED tube	1	24	12		0.288	105.12

	Tube	1	40	12		0.48	175.2
	LED B	1	22	12		0.264	96.36
	LED	2	9	12		0.108	39.42
Warden Room	Fan	2	75	12		0.9	328.5
	Tube	1	40	12		0.48	175.2
	LED	2	9	12		0.108	39.42
Office	Fan	1	75	8		0.6	219
	LED	1	9	8		0.072	26.28
Single Room	Fan	62	75	14		1.05	383.25
	LED	62	9	8		0.072	26.28
Double Room 19,18,34	Fan	3	75	14		1.05	383.25
	LED tube	3	24	14		0.336	122.64
Store Room	LED	1	9	2		0.018	6.57
Toilet	LED	2	9	6		0.054	19.71
Veranda	Inverter	1	220	12		2.64	963.6
	LED	9	9	12		0.108	39.42
	LED tube	3	24	12		0.288	105.12
	Electric Bell	3	5	12		0.06	21.9
	Electric Bell B	1	5	12		0.06	21.9
First floor Double Room 82,77,74	Fan	3	75	14		1.05	383.25
	LED tube	3	24	14		0.336	122.64
	Tube	3	14	14		0.196	71.54
	LED	3	9	14		0.126	45.99
Dormitory	Fan	14	75	14		1.05	383.25
	LED tube	14	24	14		0.336	122.64
Toilet	LED	3	9	6		0.054	19.71
Dormitory 78,75	Fan	8	75	6		0.45	164.25
	LED tube	6	24	6		0.144	52.56
Drying Room	LED tube	2	24	2		0.048	17.52
Drying Room	LED tube	2	24	2		0.048	17.52
Drying Room	LED tube	2	24	2		0.048	17.52
Study Hall 1	Fan	3	75	5		0.375	136.875
	LED tube	3	24	5		0.12	43.8
Study Hall 2	Fan	2	75	5		0.375	136.875
	LED tube	4	24	5		0.12	43.8
Study Hall 3	LED	1	9	5		0.045	16.425
	LED tube	1	24	5		0.12	43.8
Chapel & Veranda	LED	1	9	12		0.108	39.42

	Fan	5	75	12		0.9	328.5
	Wall fan	2	60	12		0.72	262.8
	LED tube	8	24	12		0.288	105.12
Veranda	Inverter	1	220	12		2.64	963.6
	LED	8	9	12		0.108	39.42
	LED tube	1	24	12		0.288	105.12
	Tube	1	40	12		0.48	175.2
	CFL	1	12	12		0.144	52.56
	Water filter	1	60	3		0.18	65.7
	Iron Box	1	500	6		3	1095
Kitchen	Wall Fan	1	60	1		0.06	21.9
	LED	2	9	1		0.009	3.285
Dining Hall	Fan	5	75	4		0.3	109.5
	LED tube	4	24	4		0.096	35.04
	Tube	1	40	4		0.16	58.4
	Speaker s	2	130	4		0.52	189.8
	Smart TV	1	200	4		0.8	292
	Amplifier	1	100	4		0.4	146
Staff Dining	Tube	2	40	4		0.16	58.4
	LED	2	9	4		0.036	13.14
	LED tube	2	24	4		0.096	35.04
	Wall Fan	2	60	4		0.24	87.6
Kitchen	Refrigerator LG	1	300	24		7.2	2628
	LED tube	4	24	8		0.192	70.08
	LED	7	9	8		0.072	26.28
	Wall fan	1	60	8		0.48	175.2
	Fan	2	75	8		0.6	219
	Freezer Bluestar	1	100	8		0.8	292
	Electric Bell	1	5	8		0.04	14.6
	Exhaust Fan	1	50	8		0.4	146
Outdoor	LED	5	9	14		0.126	45.99
	Street light	1	35	14		0.49	178.85
	Tube	1	40	14		0.56	204.4
	CCTV	14	15	24		0.36	131.4
							181.06

Table 4.64 Infrastructure details of Jeeva Joythi

Location No.	Instruments	Count	Watt	Hours	Days	kWh	kWh
Kitchen	LED bulb	1	12	8		0.096	35.04
	zero bulb	1	15	5		0.075	27.375
	Fan	1	60	8		0.48	175.2
	LED tube	3	12	8		0.096	35.04
Kitchen	LED tube	1	12	7		0.084	30.66
Kitchen	Fan	2	60	7		0.42	153.3
	LED tube	4	12	7		0.084	30.66
	LED bulb	1	12	7		0.084	30.66
	TV	1	200	5		1	365
	Socket	5				0	0
	Induction cooker	1	2000	3		6	2190
	Fridge	1	300	8		2.4	876
Dining hall	Speaker	1	130	4		0.52	189.8
	CFL bulb	2	12	4		0.048	17.52
	CFL tube	1	12	4		0.048	17.52
	LED bulb	5	12	4		0.048	17.52
	TV	1	200	4		0.8	292
	Socket	4				0	0
	LED tube	2	12	4		0.048	17.52
	Fan	10	60	4		0.24	87.6
						0	0
Ground floor room	Fan	2	60	14		0.84	306.6
	LED bulb	3	12	7		0.084	30.66
Ground floor room	Fan	1	60	7		0.42	153.3
	LED tube	1	12	7		0.084	30.66
Ground floor room	Fan	1	60	7		0.42	153.3
	LED tube	1	12	7		0.084	30.66
Ground floor room	Fan	1	60	7		0.42	153.3
	LED tube	1	12	7		0.084	30.66
Ground floor room	LED tube	1	12	12		0.144	52.56
Ground floor room	Socket	51		14		0	0
	PC	1	200	3		0.6	219
	MCB	1				0	0
Front veranda	LED tube	4	12	12		0.144	52.56
	LED bulb	2	12			0	0
	Socket	14				0	0
	Generator battery	2	1000	7		7	2555
	Ups with socket	1	220	7		1.54	562.1

Ground floor room	CFL	1	12	14		0.168	61.32
	LED tube	2	12	7		0.084	30.66
	Fan	2	60	7		0.42	153.3
	Cooler	1	200	7		1.4	511
Bathroom	LED bulb	1	12	6		0.072	26.28
Chapel	Lamb light	2	15	10		0.15	54.75
	fan	2	60	5		0.3	109.5
	LED tube	3	12	5		0.06	21.9
	LED bulb	3	12	5		0.06	21.9
Veranda	Speaker	1	130	12		1.56	569.4
	CCTV	1	15	12		0.18	65.7
	LED tube	4	12	12		0.144	52.56
Room	Speaker	1	130	14		1.82	664.3
	Fan	1	60			0	0
	LED bulb	1	12	7		0.084	30.66
	LED tube	1	12	7		0.084	30.66
Room	Socket	4				0	0
	Fan	1	60	7		0.42	153.3
	LED tube	1	12	5		0.06	21.9
	washing machine	1	500	2		1	365
Bedroom 11, 51,16,17	LED bulb	1×3	12	5		0.06	21.9
	Fan	1×3	60	5		0.3	109.5
Veranda	LED tube	1	12	5		0.06	21.9
Room	Fan	5	60	5		0.3	109.5
	LED bulb	4	12	5		0.06	21.9
	Led tube	2	12	5		0.06	21.9
Warden room	Fan	2	60	5		0.3	109.5
	Wi-Fi modem	1	15	7		0.105	38.325
	heater with plug	1	1500	3		4.5	1642.5
	LED tube	1	12	7		0.084	30.66
Veranda	speaker	2	130	5		0.65	237.25
	LED tube	1	12	7		0.084	30.66
Room	LED bulb	1	12	7		0.084	30.66
	LED tube	1	12	7		0.084	30.66
	Fan	1	60	7		0.42	153.3
	Table fan	1	60	5		0.3	109.5
	Fan	4	60	5		0.3	109.5
	Led bulb total	4	12	5		0.06	21.9
Veranda	LED tube	2	12	7		0.084	30.66

	LED bulb	1	12	7		0.084	30.66
	Speaker	1	130	7		0.91	332.15
	LED bulb	5	12	3		0.036	13.14
Bedroom	LED bulb	1×4	12	3		0.036	13.14
	Fan	1×4	60	3		0.18	65.7
Bedroom	Fan	4	60	5		0.3	109.5
	Led bulb	1	12	5		0.06	21.9
	CFL	1	12	5		0.06	21.9
	LED tube	2	12	5		0.06	21.9
Warden area (right side)	Fan	2	60	7		0.42	153.3
	LED tube	3	20	7		0.14	51.1
	CCTV	1	15	24		0.36	131.4
veranda	LED tube	2	20	7		0.14	51.1
Bedroom	LED bulb	5	12	7		0.084	30.66
	Fan total =5	10	60	7		0.42	153.3
Bedroom	CCTV	1	15	24		0.36	131.4
	LED bulb	3	12	7		0.084	30.66
	Fan	3	60	7		0.42	153.3
Bedroom	Fan	10	60	7		0.42	153.3
	LED tube	5	20	7		0.14	51.1
veranda	LED tube	1	20	7		0.14	51.1
	Socket	1				0	0
	LED bulb	1	20	7		0.14	51.1
bedroom	LED bulb	11	12	7		0.084	30.66
Secon floor step	LED bulb	1	12	7		0.084	30.66
veranda	MCB	1				0	0
	Socket	1				0	0
	Ups with battery	1	210	7		1.47	536.55
	LED tube	2	20	7		0.14	51.1
	LED bulb	1	12	7		0.084	30.66
	Speaker	2	130	7		0.91	332.15
	CFL tube	1	12	7		0.084	30.66
Bedroom	Fan	10	60	14		0.84	306.6
	LED bulb	1×5	12			0	0
Bedroom	Fan	1	60	7		0.42	153.3
	LED bulb	1	12	7		0.084	30.66

Bedroom	Fan	8	60	7		0.42	153.3
	LED bulb	4	12	7		0.084	30.66
Bedroom	LED bulb	12	12	7		0.084	30.66
	Speaker	1	130	5		0.65	237.25
Bedroom	Fan	4	60	7		0.42	153.3
	LED bulb	3	12	5		0.06	21.9
Bedroom	Fan	2	60	5		0.3	109.5
	Socket	1				0	0
	LED bulb	1	12	7		0.084	30.66
	Led tube	1	20	7		0.14	51.1
Bedroom	Fan	1	60	7		0.42	153.3
	LED bulb	2	12	7		0.084	30.66
Bedroom	fan	3	60	7		0.42	153.3
	LED bulb	1	12	7		0.084	30.66
Veranda	Speaker	1	130	5		0.65	237.25
	LED bulb	6	12	7		0.084	30.66
	LED tube	1	20	7		0.14	51.1
	MCB	1				0	0
Study hall	Fan	2	60	7		0.42	153.3
	LED tube	3	20	7		0.14	51.1
Bedroom	Fan	2×2	60	7		0.42	153.3
	LED bulb	1×2	12	7		0.084	30.66
Bedroom	Fan	2×4	60	7		0.42	153.3
	LED bulb	1×4	12	7		0.084	30.66
Bedroom	Fan	2×5	60	7		0.42	153.3
	Led bulb	1×5	12	7		0.084	30.66
Bedroom	Fan	1	60	7		0.42	153.3
	Led bulb	1	12	7		0.084	30.66
Bedroom	Fan	2	60	7		0.42	153.3
	LED bulb	1	12	7		0.084	30.66
bathroom	LED bulb	11	12	7		0.084	30.66
							144.17

Table 4.65 Infrastructure details of little flower

Location No.	Instruments	Count	Watt	Hours	Days	kWh	kWh
Kitchen	LED tube	2	20	8		0.16	58.4
	LED bulb	1	12	8		0.1	35
	Fan	1	60	8		0.48	175
	Fridge	1	300	8		2.4	876
	Freezer	1	100	8		0.8	292
Dining area	Fan	9	60	4		0.24	87.6
	LED Tube	4	20	4		0.08	29.2
	LED bulb	3	12	4		0.05	17.5
Veranda	Plug	1		14		0	0
	LED bulb	2	12	14		0.17	61.3
	LED tube	1	20	14		0.28	102
	Washing machine	1	500	4		2	730
	Plug	2				0	0
	LED bulb	2	12	7		0.08	30.7
Door (main room)	Plug	2				0	0
	Fan	1	60	8	7	0.48	175
	LED bulb	1	12	8	7	0.06	20.4
Room (door)	Fan	1	60	8	14	0.11	40.9
	Plug	1				0	0
	LED bulb	2	12	8	7	0.06	20.4
	LED bulb	2	12	8	7	0.06	20.4
	LED tube	3	20	8	7	0.06	20.4
Room	LED bulb	1	12	8	14	0.11	40.9
	Fan	1	60	8	14	0.11	40.9
Room	Fan	2	60	8	14	0.11	40.9
	LED bulb	2	12	8	14	0.11	40.9
Room	Fan	2	60	8	12	0.1	35
	LED tube	1	20	8	12	0.1	35
Room	LED bulb	4	12	8	14	0.11	40.9
Veranda	LED bulb	2	12	8	14	0.11	40.9
	LED tube	5	20	8	14	0.11	40.9
Library	LED bulb	1	12	8	14	0.11	40.9
Door main	LED bulb	1	12	8	14	0.11	40.9
	Power board	1				0	0
room	Fan	1	60	8	14	0.11	40.9
	LED Bulb	1	12	8	14	0.11	40.9
	LED tube	1	20	8	14	0.11	40.9
	Socket	6				0	0

	PC	1	200	8	5	0.04	14.6
	Extension board	1	50		3	0	0
Varanda	LED bulb	1	12	8	7	0.06	20.4
Main door hostel	LED bulb	1	12	8	7	0.06	20.4
Room	LED bulb	1	12	8	7	0.06	20.4
	Fan	1	60	8	7	0.06	20.4
Prayer hall	LED bulb	2	12	8	7	0.06	20.4
	LED tube	10	12	8	3	0.02	8.76
	Fan	6	60	8	3	0.02	8.76
	Speaker	1	130	8	3	0.02	8.76
	Socket	3				0	0
Room (8,201,202,203,204)	Fan	2	60	8	14	0.11	40.9
	LED bulb	3	12	8	14	0.11	40.9
2nd floor Veranda	Fan	1	60	8	14	0.11	40.9
	power board	1				0	0
	LED tube	5	20	8	14	0.11	40.9
	LED bulb	1	12	8	14	0.11	40.9
Office	LED tube	1	20	8	7	0.06	20.4
	LED bulb	2	12	8	7	0.06	20.4
	Fan	2	60	8	7	0.06	20.4
room (301,302,303,304,305,306	Fan	2	60	8	14	0.11	40.9
veranda	CFL	1	15	8	7	0.06	20.4
	LED tube	1	20	8	7	0.06	20.4
	LED bulb	1	12	8	7	0.06	20.4
	Fan	1	60	8	7	0.06	20.4
veranda	LED tube	4	20	8	7	0.06	20.4
	Power board	1				0	0
bathroom door-1	CFL bulb	1	15	8	7	0.06	20.4
	LED bulb	2	12	8	7	0.06	20.4
room 308	Fan	1	60	8	7	0.06	20.4
	LED bulb	1	12	8	7	0.06	20.4
	Extension board	1	50		5	0	0
Terrace	LED bulb	1	12	8	7	0.06	20.4
Ground floor	Fan	2	60	8	14	0.11	40.9
	LED tube	1	20	8	14	0.11	40.9
							56

Table 4.66 Infrastructure details of St. Jospeh Hostel

Location No.	Instruments	Count	Watt	Hours	Days	kWh	kWh
Hostel outdoor	Spot light	4	15	14		0.21	76.65
	LED bulb	12	12	14		0.168	61.32
	Fan	13	60	14		0.84	306.6
	LED	8	12	14		0.168	61.32
	LED bulb	1	12	14		0.168	61.32
	Internet board	1	150	14		2.1	766.5
	CCTV	1	15	24		0.36	131.4
	Speaker	1	130	1		0.13	47.45
Study hall (2)	Fan	8	60	14		0.84	306.6
	LED	6	12	14		0.168	61.32
	LED bulb	1	12	14		0.168	61.32
	CCTV	1	15	24		0.36	131.4
Gym	Fan	4	60	3		0.18	65.7
	CCTV	1	15	24		0.36	131.4
	LED	2	12	14		0.168	61.32
	Fan	2	60	14		0.84	306.6
	LED bulb	1	12	14		0.168	61.32
	LED	1	12	14		0.168	61.32
	Fan	2	60	14		0.84	306.6
	LED bulb	1	12	14		0.168	61.32
	LED	1	12	14		0.168	61.32
Dining hall	Speaker	1	130	2		0.26	94.9
	Fan	16	60	3		0.18	65.7
	LED	13	12	3		0.036	13.14
	CCTV	1	15	24		0.36	131.4
kitchen	Fridge	1	300	6		1.8	657
	Freezer	1	100	6		0.6	219
	Switch board	3				0	0
	LED	5	12	14		0.168	61.32
	TV	1	200	7		1.4	511
	Fan	1	60	14		0.84	306.6
	LED bulb	1	12	14		0.168	61.32
Double bedroom x70	Fan	140	60	14		0.84	306.6
	LED bulb	140	12	14		0.168	61.32
washroom	LED bulb	3	12	3		0.036	13.14
kitchen staff room	Fan	1	60	5		0.3	109.5
	LED	1	12	5		0.06	21.9

Ground floor	LED	7	12	14		0.168	61.32
	Fan	4	60	14		0.84	306.6
	Speaker	1	130	7		0.91	332.15
	CCTV	1	15	24		0.36	131.4
	MCB	1				0	0
	LED bulb	7	12	14		0.168	61.32
	Internet board	2	150	14		2.1	766.5
1 floor veranda	Fan	3	60	14		0.84	306.6
	Spotlight	32	15	7		0.105	38.325
	CCTV	1	15	24		0.36	131.4
	LED bulb	14	12	14		0.168	61.32
Prayer room	Fan	6	60	3		0.18	65.7
	Spotlight	18	15	3		0.045	16.425
	Table fan	1	60	3		0.18	65.7
Guest room	Fan	1	60	14		0.84	306.6
	LED bulb	1	12	14		0.168	61.32
first aid room	Fan	1	60	1		0.06	21.9
	LED bulb	1	12	5		0.06	21.9
office	Fan	1	60	8		0.48	175.2
	LED bulb	1	12	8		0.096	35.04
Bathroom First floor	LED bulb	8	12	6		0.072	26.28
	Heater	1	1125	2		2.25	821.25
Bathroom Second floor	LED bulb	8	12	6		0.072	26.28
	Heater	1	1125	2		2.25	821.25
Bathroom third floor	LED bulb	8	12	6		0.072	26.28
	Heater	1	1125	2		2.25	821.25
Bathroom First floor	LED bulb	8	12	6		0.072	26.28
Bathroom second floor	LED bulb	8	12	6		0.072	26.28
Bathroom third floor	LED bulb	8	12	6		0.072	26.28
Single roomx9	Fan	9	60	14		0.84	306.6
	LED	9	12	14		0.168	61.32
		574					157.27

Table 4.67 Infrastructure details of Nirmala Hostel

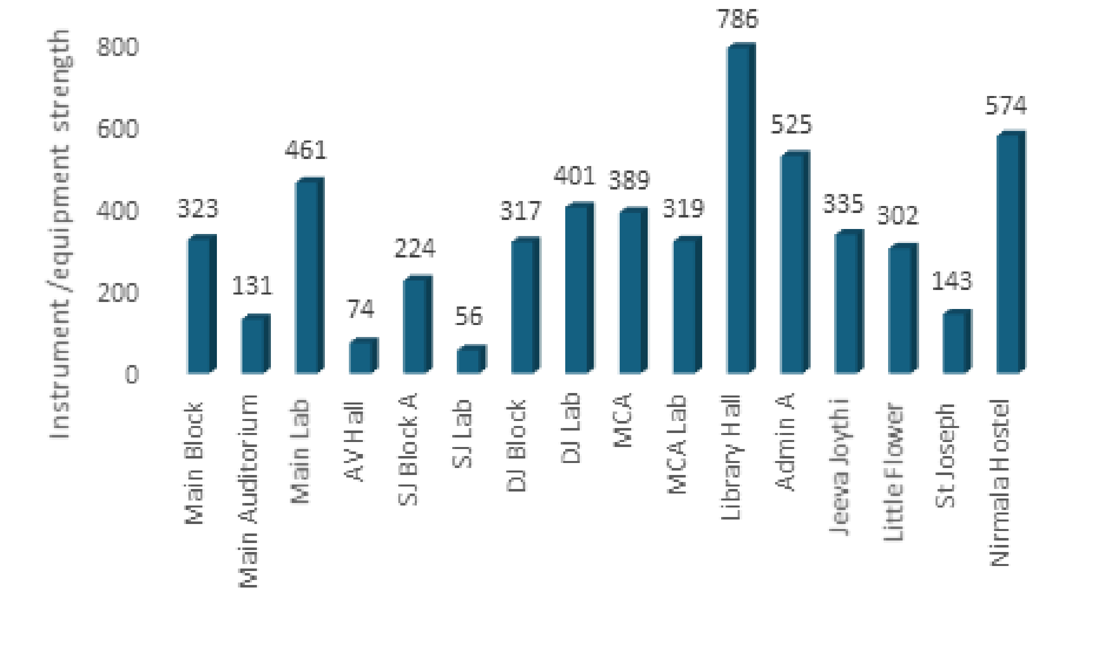


Fig 4.87 Block-Level Infrastructure Assessment

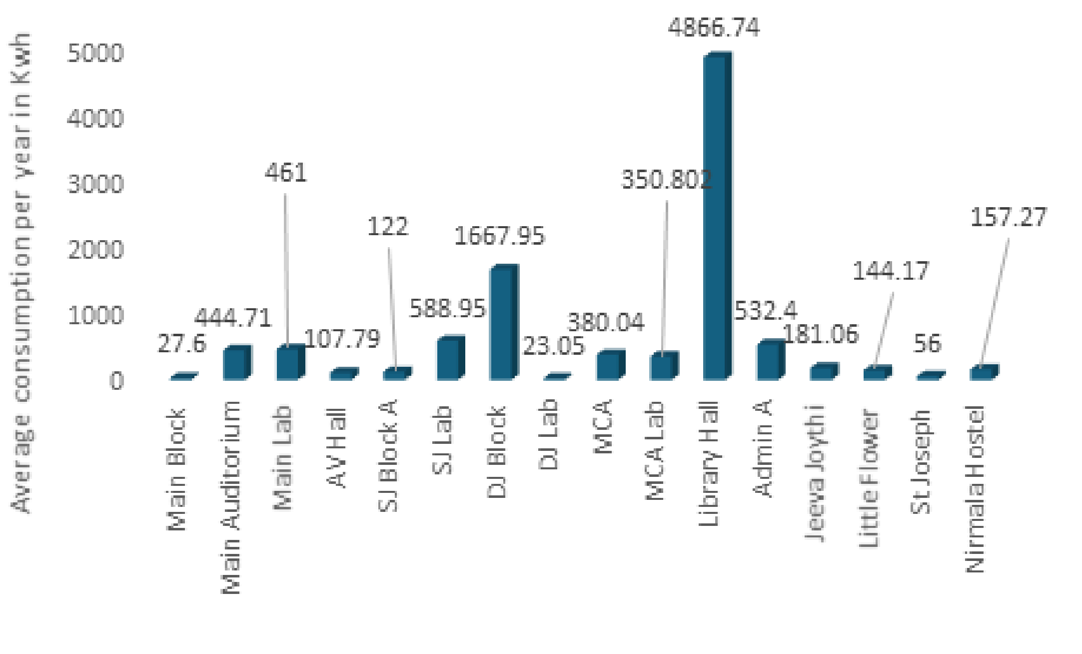


Fig 4.88 Average Infrastructure kWh Consumption per Block

The assessment indicates a significant concentration of instruments and equipment within the Library Hall. This observation is substantiated by the direct correlation between the hall's average kilowatt-hour (kWh) consumption and the quantity of electrical devices. Furthermore, the data was developed through calculations based on device usage patterns, ensuring the final values correspond to both the operational behaviour of the equipment and the occupancy patterns of the college community.

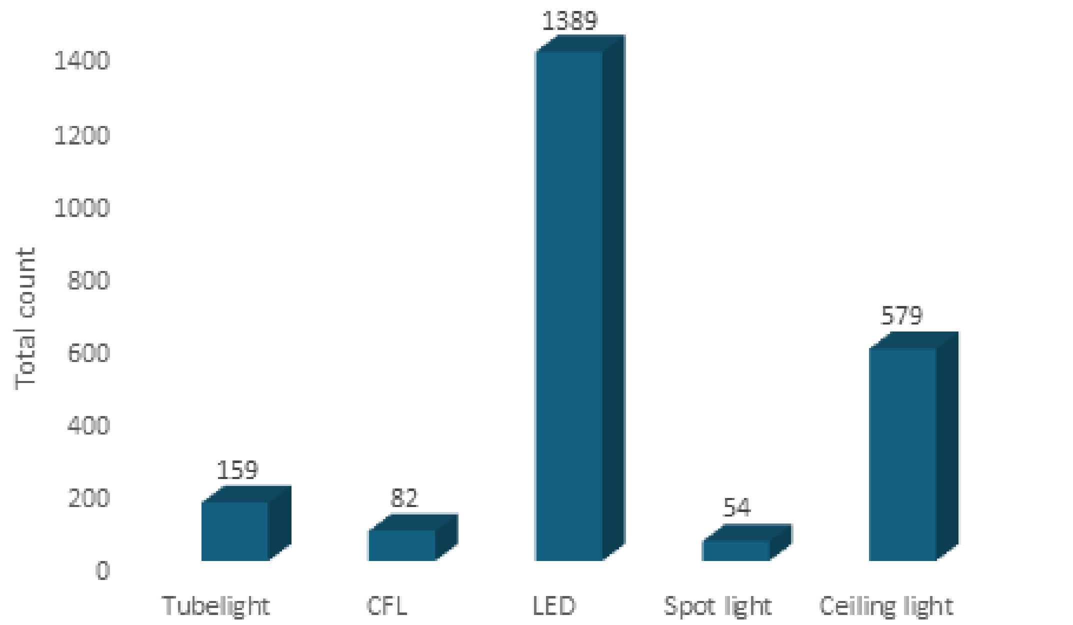


Fig 4.89 Average Infrastructure kWh Consumption per Block

The college has installed a total of 1,389 LED lights. However, the audit also identified several non-LED fixtures still in operation, including 82 Compact Fluorescent Lamps (CFLs), two incandescent bulbs, and one zero-watt bulb. The immediate replacement of these units with LED alternatives is essential to reduce energy consumption. Furthermore, to achieve comprehensive energy efficiency, it is recommended that all remaining ordinary tube lights, ceiling lights, and spotlights be upgraded to LED.

Fig 4.90 Infrastructure data collection

4.4.8 Analysis of KSEB bill data (2022,2023 and 2024)

Sl No	Meter consumer number	Location	Area covered	Periodicity of billing
1	1155910000209	Main Building	Classrooms, Laboratory, science research labs, Chapel, washrooms, Conference halls, seminar halls, medical room, Controller of examination, ladies restroom, Auditorium, Dining Hall, Gym, Bank and ATM	Monthly
2	1155915022207	MCA	Computer lab, classrooms, library, auditorium, washrooms, sickroom, guestroom	
3	1155913023693	MCA	Computer lab, classrooms, library, auditorium, washrooms, sickroom, guestroom,	Monthly
4	1155911000857	Auditorium	Auditorium, Admin, AV hall	Monthly
5	1155912008235	PG Block	Classrooms, washrooms	Bi-monthly
6	1155959025451	DJ Block	Classrooms, computer labs, washrooms, auditorium	Monthly
7	1155911000336	L F Hostel	rooms, chapel, mess, kitchen, washing area, toilets, bathrooms	Monthly
8	1155910000232	Jeeva Jyothi	rooms, chapel, mess, kitchen, washing area, toilets, bathrooms	Bi-monthly
9	1155915028013	Nirmala Pharmacy Hostel	rooms, chapel, mess, kitchen, washing area, toilets, bathrooms	Monthly

10	1155912000751	St Joseph Hostel	rooms, chapel, mess, kitchen, washing area, toilets, bathrooms	Bi-monthly
11	1155910001805	Main Entrance	Entrance area outdoor	Bi-monthly
12	1155910006281	Entrance	Entrance area outdoor (Sub entrance)	Bi-monthly
13	1155912027716	SBI	SBI Bank	
14	1155918003650	Motor Jeeva Jyothi	Jeeva Jyothi water pumping motor	Bi-monthly
16	1155918000157	Rubber Plantation Motor	Rubber plantation pumping motor	Bi-monthly
17	1155917002946	Motor L F hostel	Little flower water pumping motor	
18	1155919028926	Entrance Gate	Entrance Gate	Bi-monthly
19	1155919021412	Library	Library	Monthly

Table 4.68 KSEB Connections of Nirmala College

Three electricity meters (1155912027716 for SBI, 1155910006281 for the entrance, and 1155910001805 for the main entrance) were excluded from the quality assessment. The SBI bill is paid directly by the bank, and the other two meters only cover the entrance gates. The assessment was instead conducted on the primary meter for the main facility.

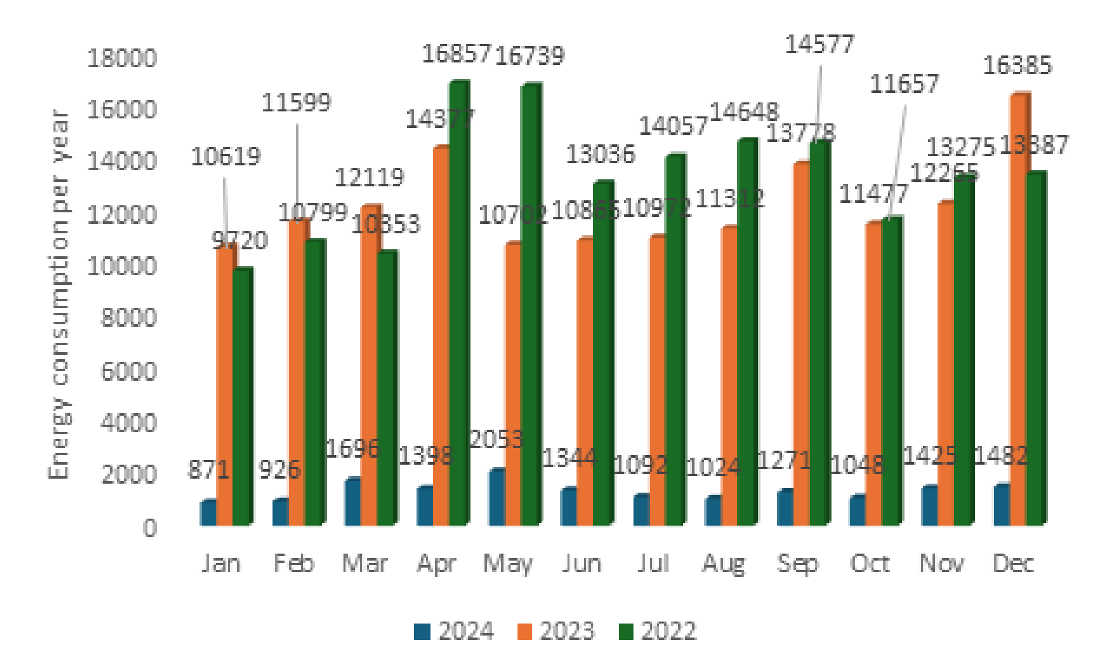


Fig 4.91 Year wise unit of consumption of each month - 1155915022207

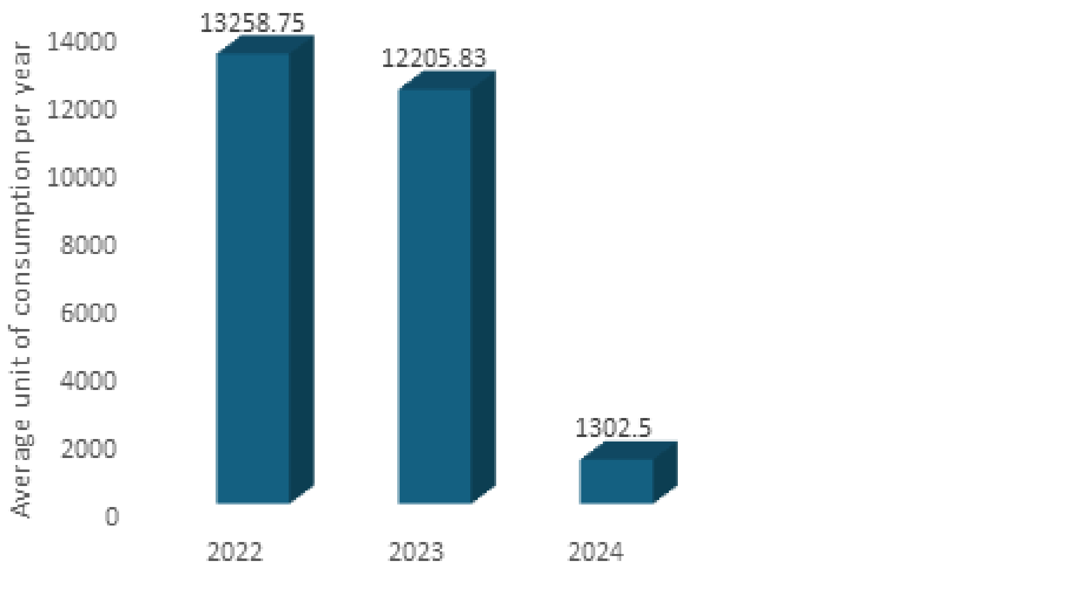


Fig 4.92 Average consumption per year of 1155915022207

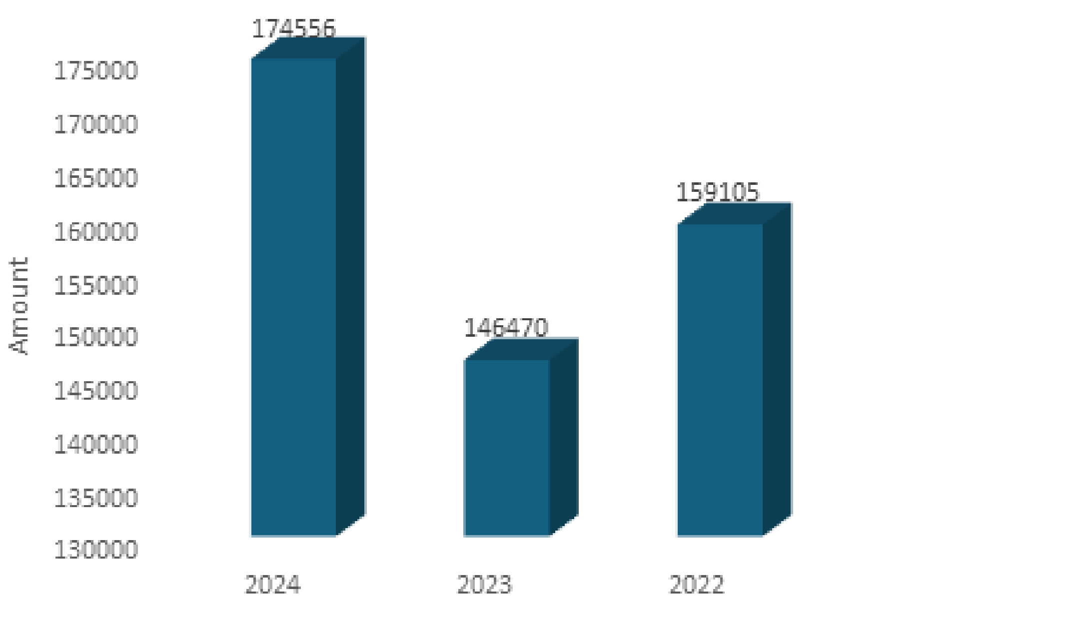


Fig 4.93 Yearly electricity bill of 1155915022207

In 2024, the MCA block recorded a lower average electricity consumption. The block includes two consumer connections 1155915022207 and 1155913023693 of which only the latter is equipped with a 15 kW solar power system. The MCA block comprises a computer lab, classrooms, departmental offices, a library, auditorium, washroom, sickroom, and guest room. Additionally, regular classes were conducted on Saturdays and Sundays. Solar panels were installed in 2022, primarily covering the area under consumer number 1155913023693, while the remaining areas were not yet included at that time. Consequently, solar power production was initially low but has gradually increased through 2023 and 2024. Correspondingly, electricity consumption from the grid has shown a year-on-year decline.

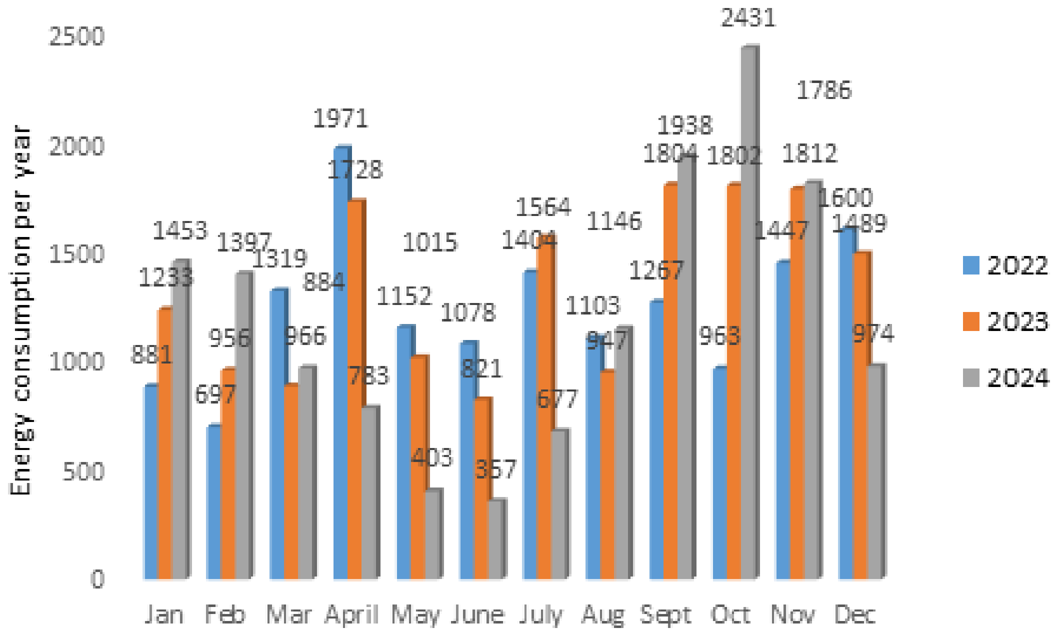


Fig 4.94 Year wise unit of consumption of each month - 1155959025451

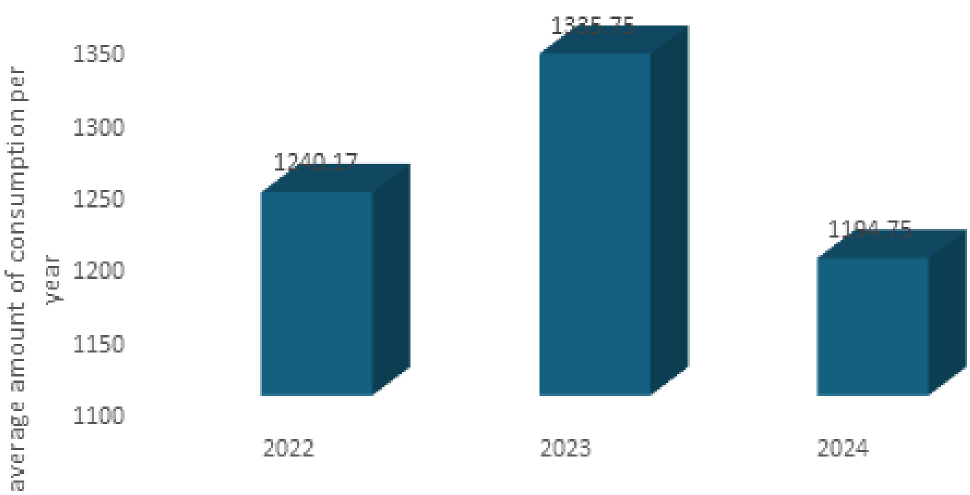


Fig 4.95 Average consumption per year of 1155959025451

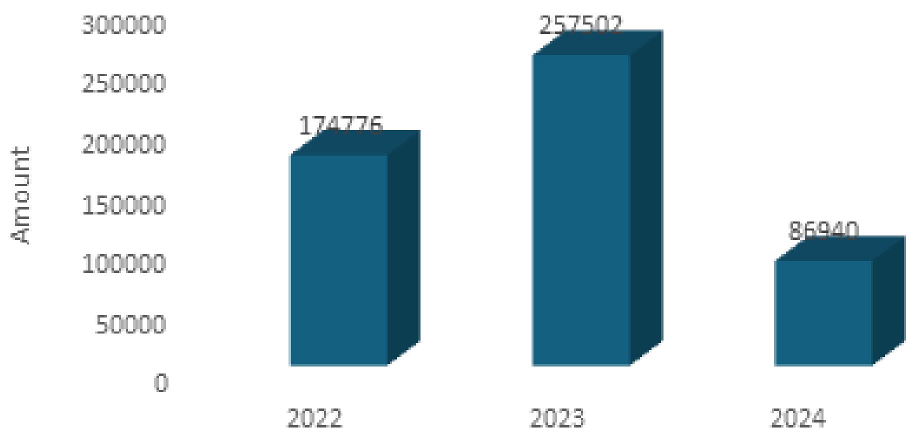


Fig 4.96 Yearly electricity bill of 1155959025451

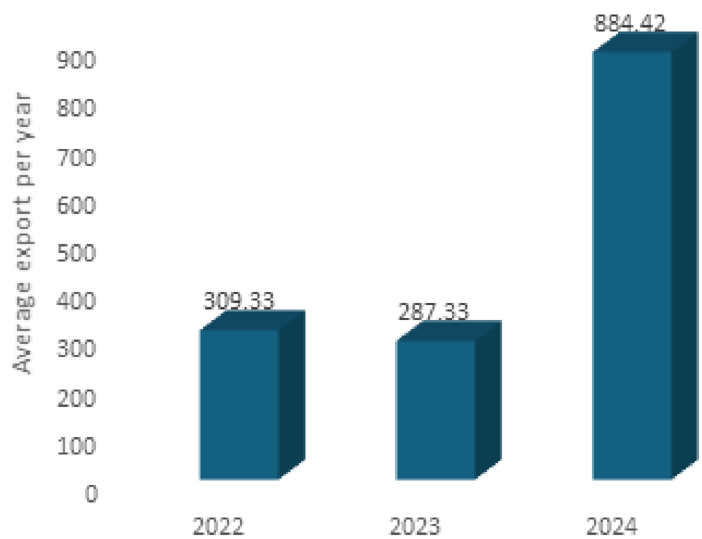


Fig 4.97 Average export per year of 1155959025451

Fig 4.98 Electrical distribution point

Sl No	Months	Consumer number	Location Name	Installed capacity	Power distribution	Export (kWh) as per KSEB
1	October	1.16E+12	DJ	19KW	DJ	396
2	November	1.16E+12	DJ	19KW	DJ	330
3	December	1.16E+12	DJ	19KW	DJ	202

Table 4.69 Solar export of 1155959025451 in 2022

Sl No	Months	Consumer number	Location Name	Installed capacity	Power distribution	Export (kWh) as per KSEB
1	January	1.16E+12	DJ	19KW	DJ	432
2	February	1.16E+12	DJ	19KW	DJ	303
3	March	1.16E+12	DJ	19KW	DJ	271
4	April	1.16E+12	DJ	19KW	DJ	359
5	May	1.16E+12	DJ	19KW	DJ	398
6	June	1.16E+12	DJ	19KW	DJ	381
7	July	1.16E+12	DJ	19KW	DJ	162
8	August	1.16E+12	DJ	19KW	DJ	267
9	September	1.16E+12	DJ	19KW	DJ	327
10	October	1.16E+12	DJ	19KW	DJ	160
11	November	1.16E+12	DJ	19KW	DJ	229
12	December	1.16E+12	DJ	19KW	DJ	159

Table 4.70 Solar export of 1155959025451 in 2023

Sl No	Months	Consumer number	Location Name	Installed capacity	Power distribution	Export (kWh) as per KSEB
1	January	1.16E+12	DJ	19KW	DJ	369
2	February	1.16E+12	DJ	19KW	DJ	235
3	March	1.16E+12	DJ	19KW	DJ	781
4	April	1.16E+12	DJ	19KW	DJ	1286
5	May	1.16E+12	DJ	19KW	DJ	1428
6	June	1.16E+12	DJ	19KW	DJ	1038
7	July	1.16E+12	DJ	19KW	DJ	624
8	August	1.16E+12	DJ	19KW	DJ	463
9	September	1.16E+12	DJ	19KW	DJ	973
10	October	1.16E+12	DJ	19KW	DJ	1380
11	November	1.16E+12	DJ	19KW	DJ	913
12	December	1.16E+12	DJ	19KW	DJ	1123

Table 4.71 Solar export of 1155959025451 in 2024

The increase in average annual consumption in 2023 is directly attributable to the full operation of the college's DJ block, which contains classrooms, staff rooms, computer lab and auditorium. This trend was reversed in 2024, with a notable decline in electricity purchased from the Kerala State Electricity Board (KSEB). This reduction is attributed to the enhanced performance of the 19 kW on-grid solar installation commissioned on the block in October 2022. Higher solar generation and subsequent export of surplus power to the KSEB grid effectively lowered the college's reliance on utility power.

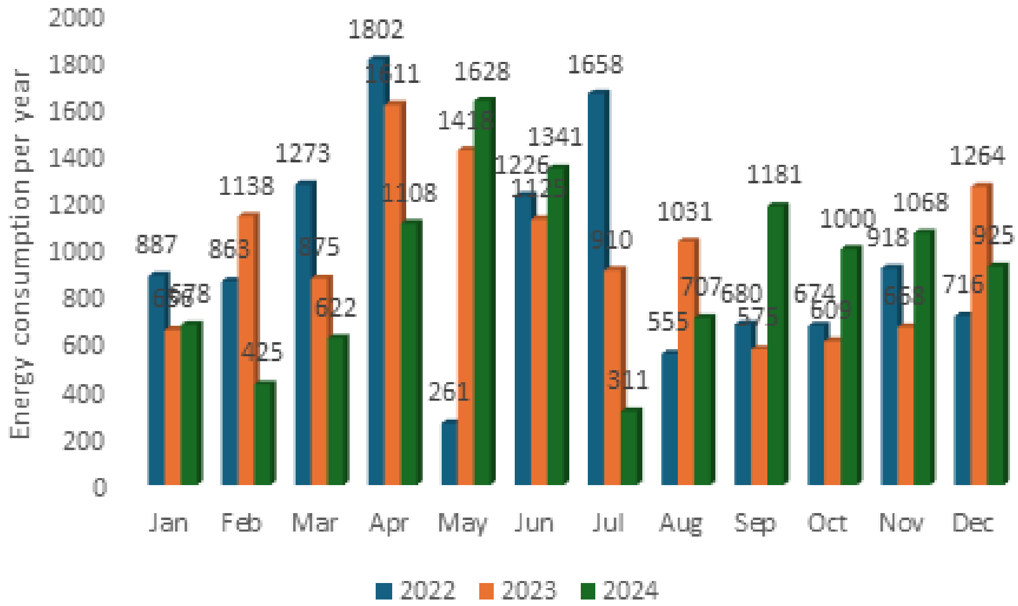


Fig 4.99 Year wise unit of consumption of each month - 1155913023693

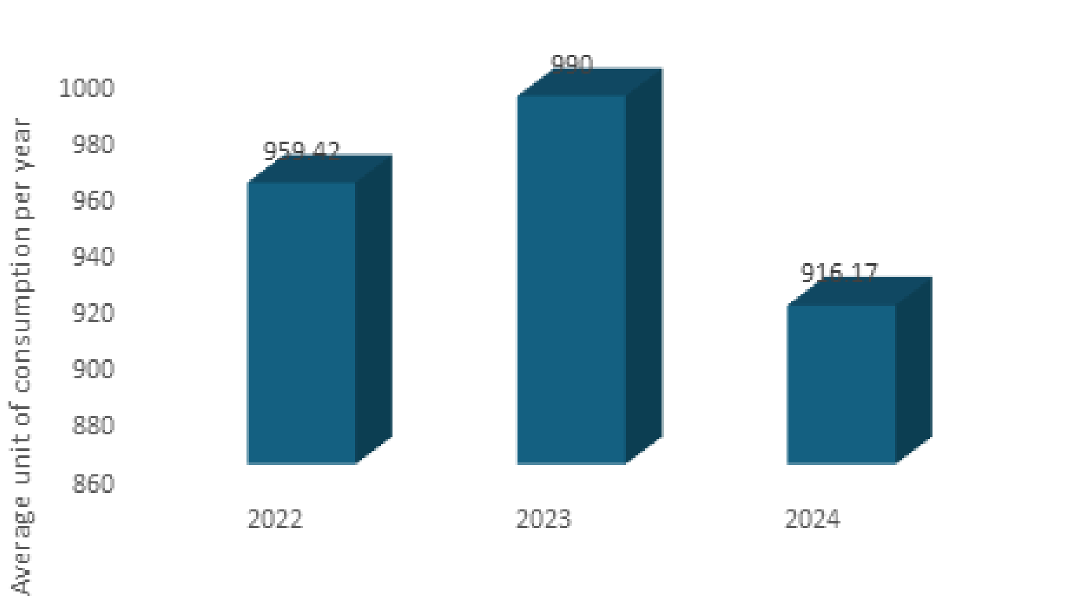


Fig 4.100 Average unity of consumption per year of 1155913023693

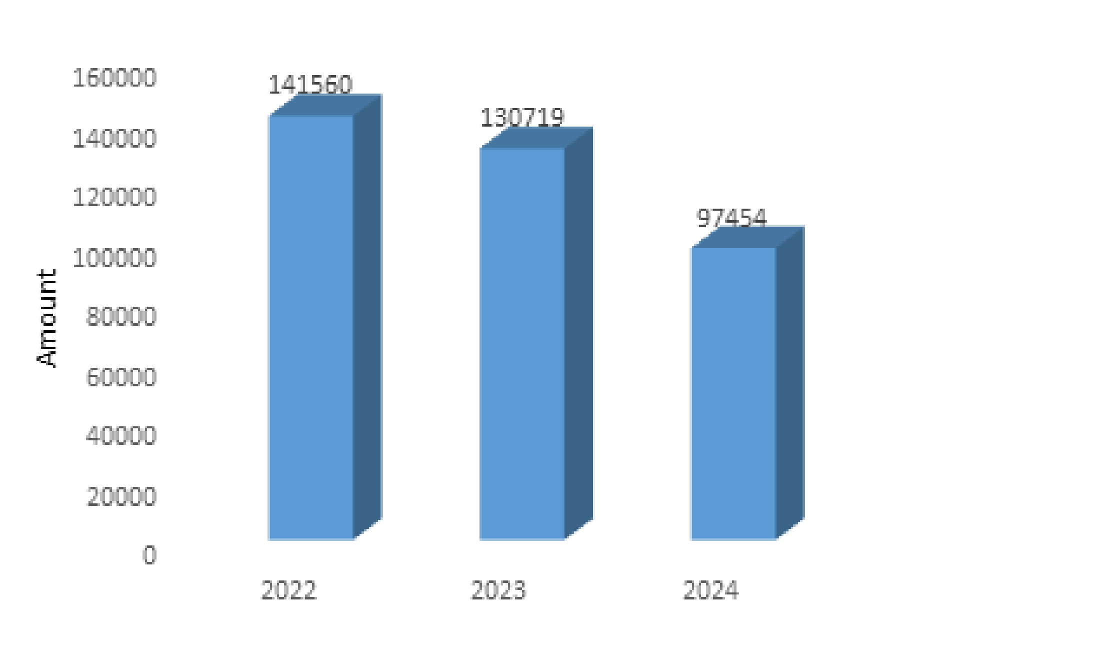


Fig 4.101 Yearly electricity bill of 1155913023693

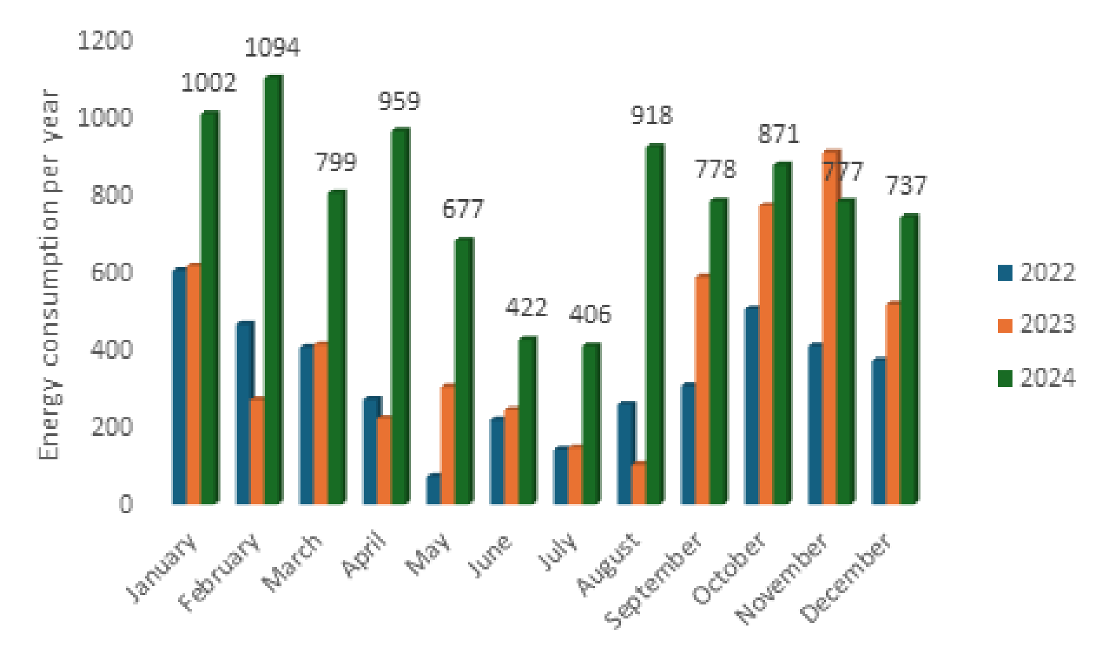


Fig 4.102 Year wise export of each month -1155913023693

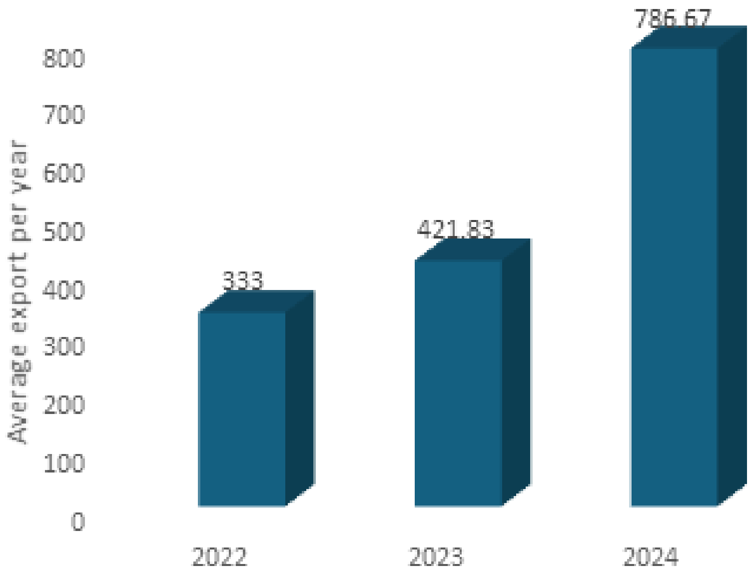


Fig 4.103 Average export each year - 1155913023693

Sl No	Consumer number	Location Name	Installed capacity	Power distribution	Export (kWh) as per KSEB
1	1.15591E+12	MCA	15	MCA	600
2	1.15591E+12	MCA	15	MCA	462
3	1.15591E+12	MCA	15	MCA	402
4	1.15591E+12	MCA	15	MCA	269
5	1.15591E+12	MCA	15	MCA	71
6	1.15591E+12	MCA	15	MCA	216
7	1.15591E+12	MCA	15	MCA	140
8	1.15591E+12	MCA	15	MCA	256
9	1.15591E+12	MCA	15	MCA	304
10	1.15591E+12	MCA	15	MCA	501
11	1.15591E+12	MCA	15	MCA	406
12	1.15591E+12	MCA	15	MCA	369

Table 4.72 Solar export of 1155913023693 in 2022

Sl No	Consumer number	Location Name	Installed capacity	Power distribution	Export (kWh) as per KSEB
1	1.15591E+12	MCA	15	MCA	612
2	1.15591E+12	MCA	15	MCA	268
3	1.15591E+12	MCA	15	MCA	409
4	1.15591E+12	MCA	15	MCA	220
5	1.15591E+12	MCA	15	MCA	301
6	1.15591E+12	MCA	15	MCA	242
7	1.15591E+12	MCA	15	MCA	144
8	1.15591E+12	MCA	15	MCA	101
9	1.15591E+12	MCA	15	MCA	583
10	1.15591E+12	MCA	15	MCA	766
11	1.15591E+12	MCA	15	MCA	903
12	1.15591E+12	MCA	15	MCA	513

Table 4.73 Solar export of 1155913023693 in 2023

Sl No	Consumer number	Location Name	Installed capacity	Power distribution	Export (kWh) as per KSEB
1	1.15591E+12	MCA	15	MCA	1002
2	1.15591E+12	MCA	15	MCA	1094
3	1.15591E+12	MCA	15	MCA	799
4	1.15591E+12	MCA	15	MCA	959
5	1.15591E+12	MCA	15	MCA	677
6	1.15591E+12	MCA	15	MCA	422
7	1.15591E+12	MCA	15	MCA	406
8	1.15591E+12	MCA	15	MCA	918
9	1.15591E+12	MCA	15	MCA	778
10	1.15591E+12	MCA	15	MCA	871
11	1.15591E+12	MCA	15	MCA	777
12	1.15591E+12	MCA	15	MCA	737

Table 4.74 Solar export of 1155913023693 in 2024

In 2023, the MCA block recorded a significantly higher electricity consumption. This increase is primarily attributed to specific usage patterns under consumer number 1155913023693, which is equipped with a solar power installation of capcity15 kw and serves the computer lab, classrooms, staff rooms, library, auditorium, sickroom, and guest room. A key factor for the high usage in 2023 was the hosting of competitive exam classes on Saturdays and Sundays, which required the continuous operation of the auditorium's air conditioning. Conversely, in 2024, a reduction in net consumption from the KSEB grid was observed. This was a direct result of increased solar energy export, which offset the block's overall usage and led to fewer units being purchased from the utility.

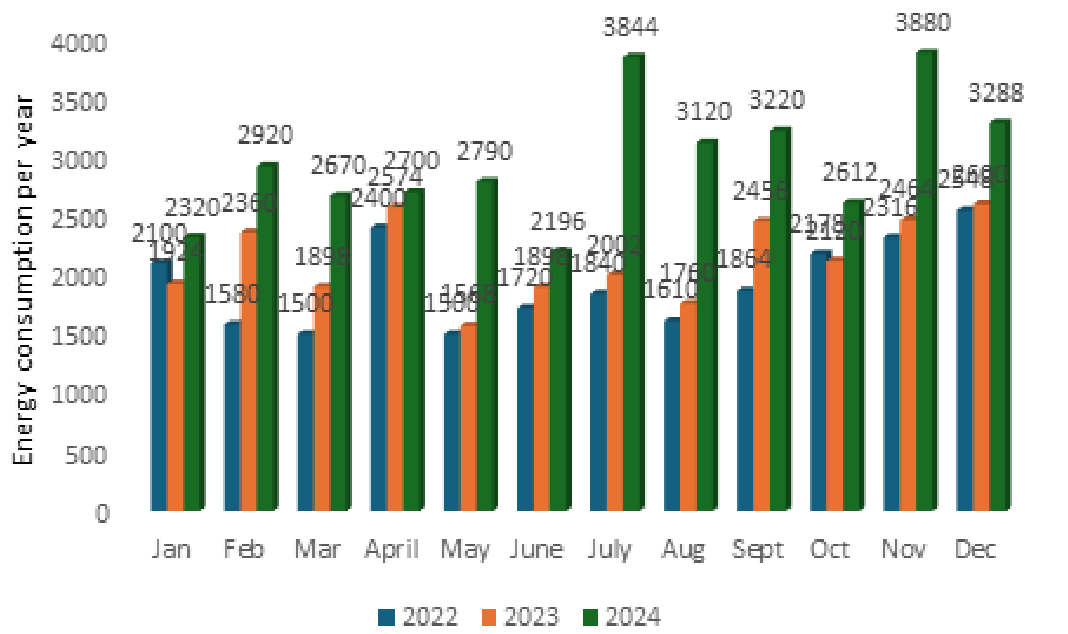
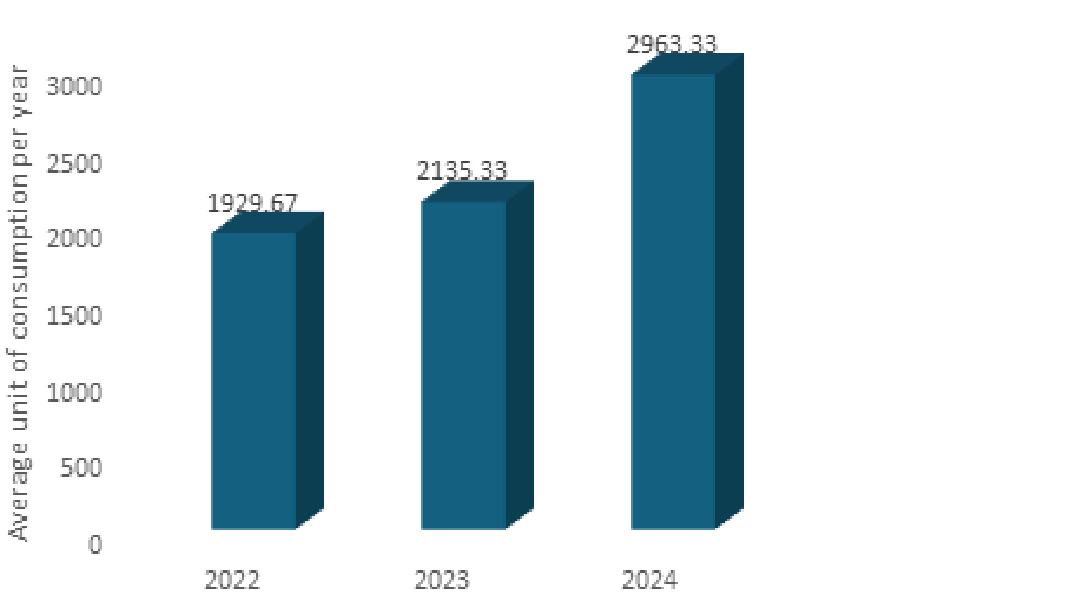


Fig 4.104 Year wise unit of consumption in each month of 1155911000857



Graph 4.105 Average unit of consumption per year of 1155911000857

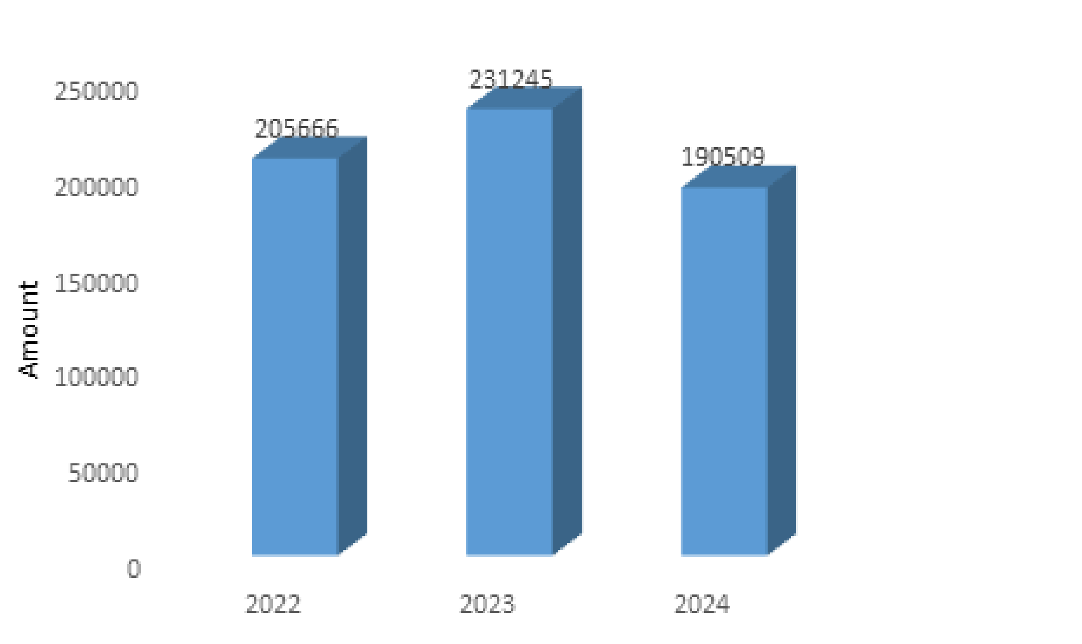


Fig 4.106 Yearly electricity bill of 1155911000857

Consumer account 11559119000857, encompassing the Administration, Auditorium, and AV Hall facilities, has demonstrated a consistent annual increase in usage. This growth correlates directly with the operational frequency of the Auditorium and AV Hall. The volume of events, such as programs, seminars, and conferences, fluctuates based on evolving academic needs and institutional priorities, which in turn drives the overall usage.

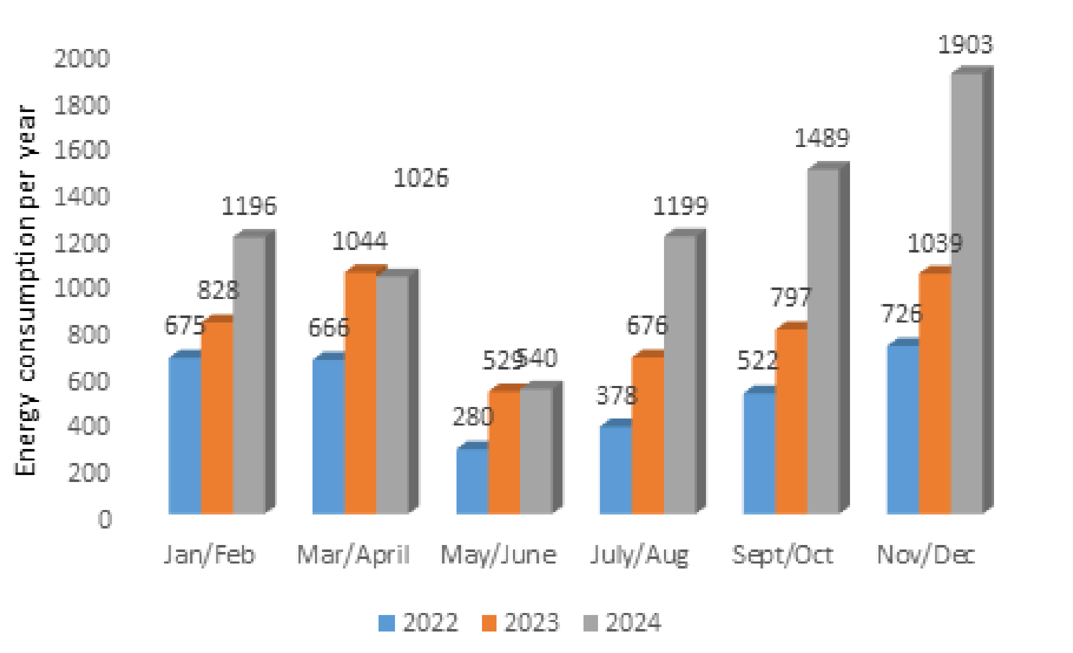


Fig 4.107 Year wise unit of consumption of each month - 1155912008235

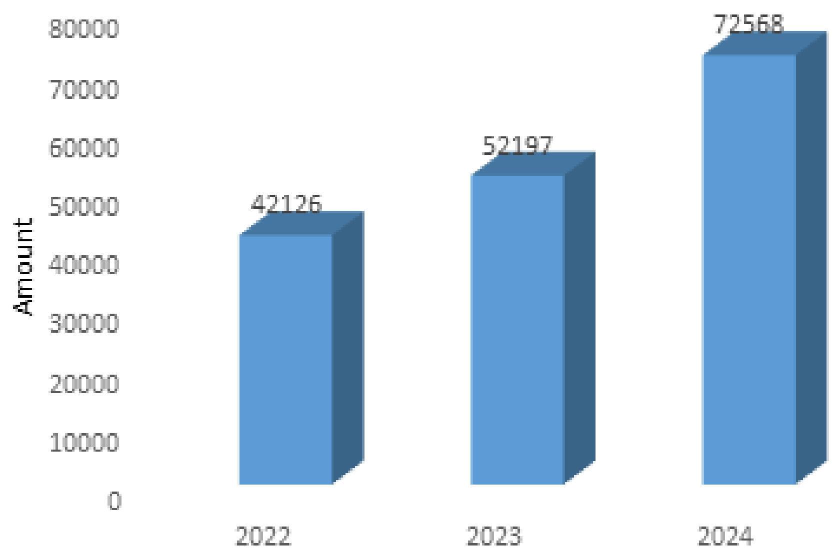


Fig 4.108 Yearly electricity bill of 1155912008235

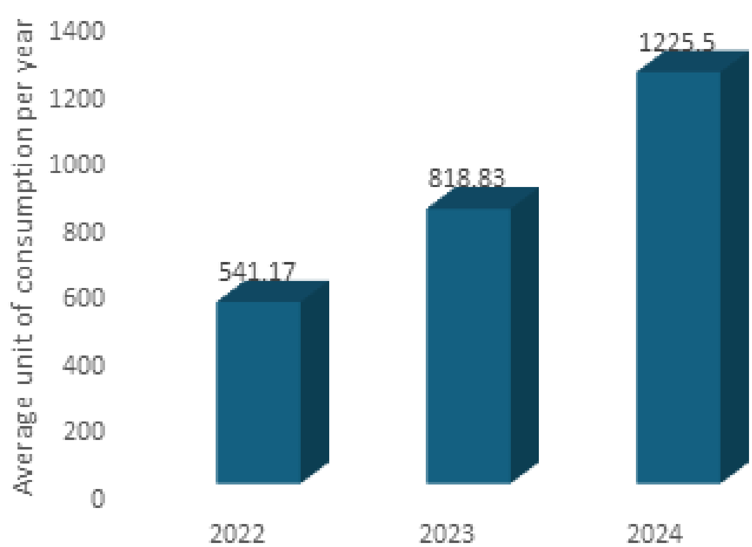


Fig 4.109 Average unit of consumption per year of 1155912008235

In 2024, the Postgraduate (PG) Block recorded a higher average electricity consumption. This increase is attributed to significant facility upgrades across its classrooms, staff rooms, and washrooms, which are all powered by the KSEB connection. Key factors include the widespread installation of smartboards and an increased number of lights and fans to meet the growing demand for modern amenities.

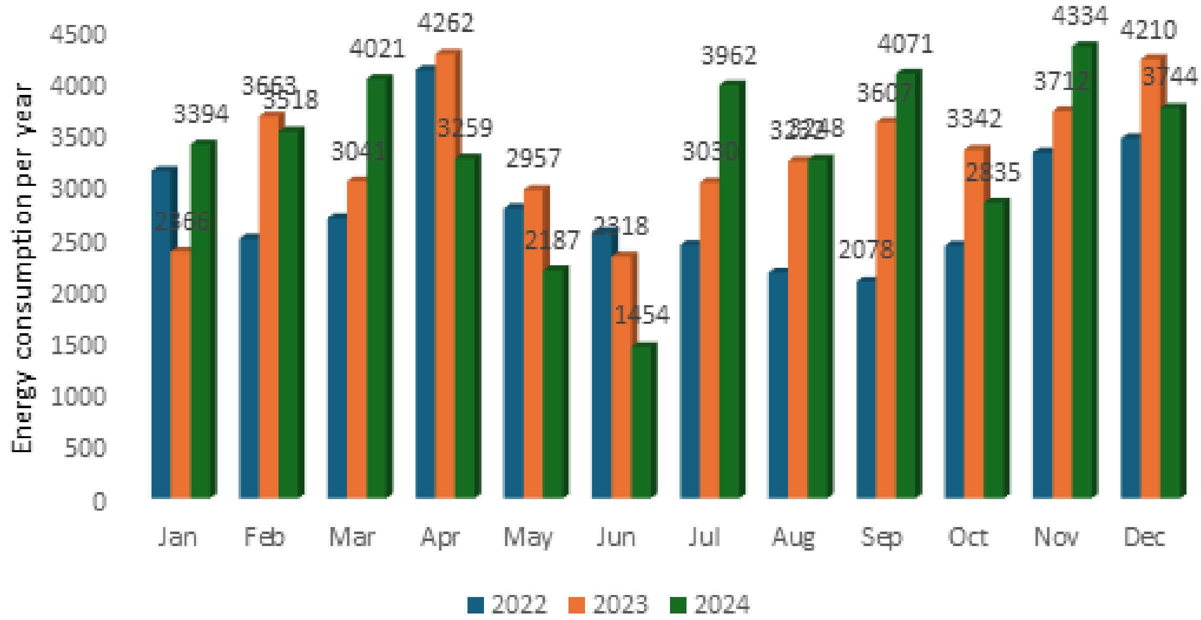


Fig 4.110 Year wise unit of consumption of each month - 1155911000336

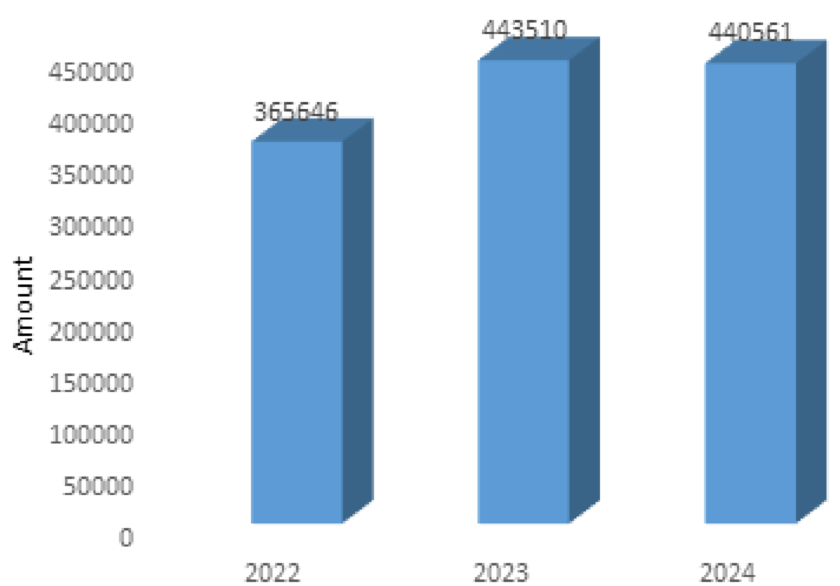
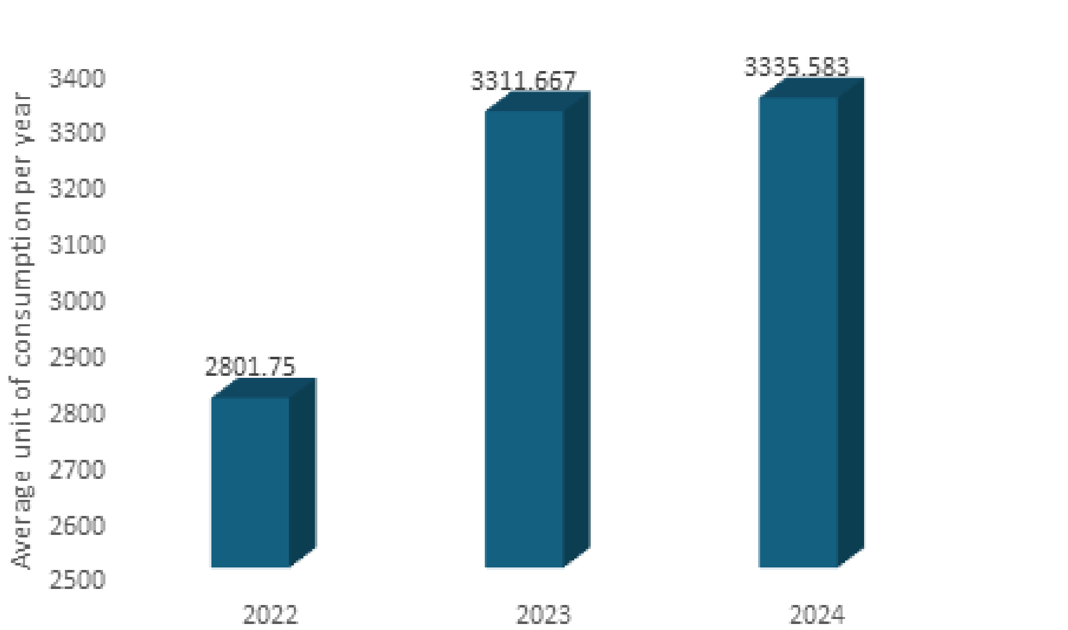
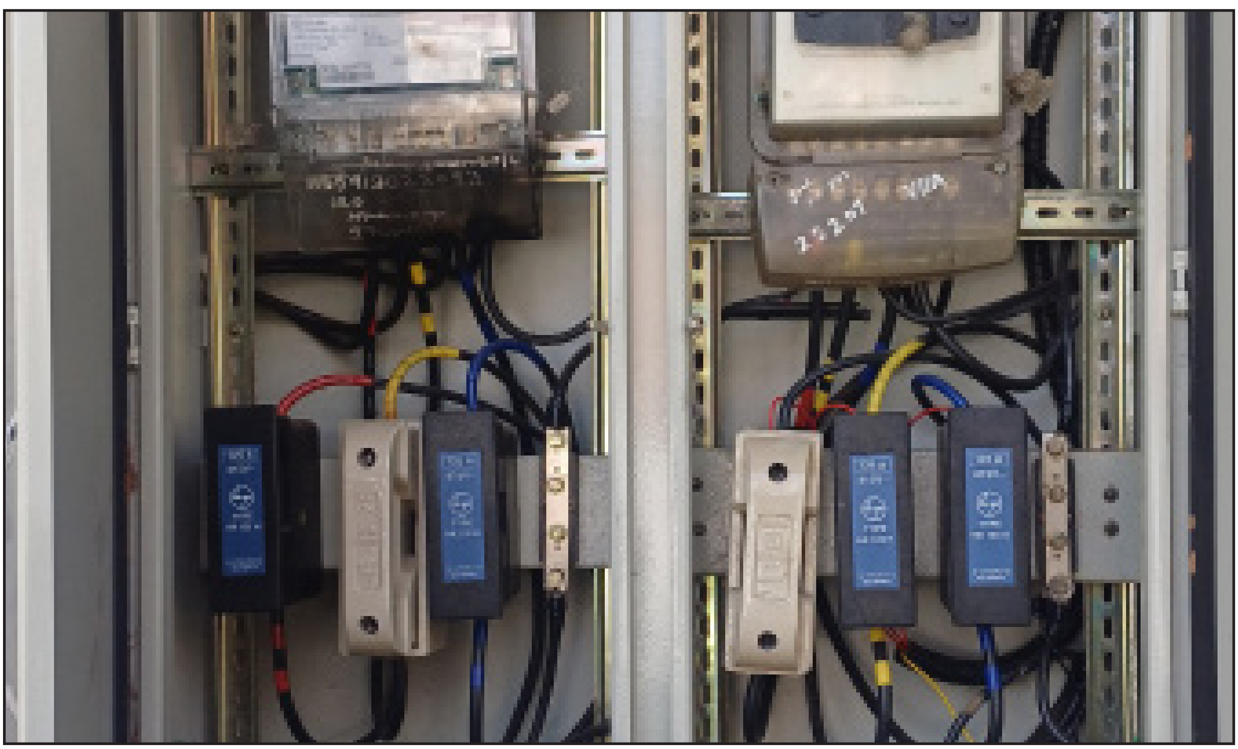


Fig 4.111 Yearly electricity bill of 1155911000336



Graph 4.112 Average energy consumption per year of 1155911000336

In 2024, there was a slight increase in average energy consumption compared to the previous year. This rise is primarily due to an increase in the number of residents, with the hostel now accommodating 240 individuals. The expanded use of facilities including rooms, chapel, dining hall, and kitchen as well as a number of appliances, have also contributed to the higher demand.



Graph 4.113 Three phase electric meter

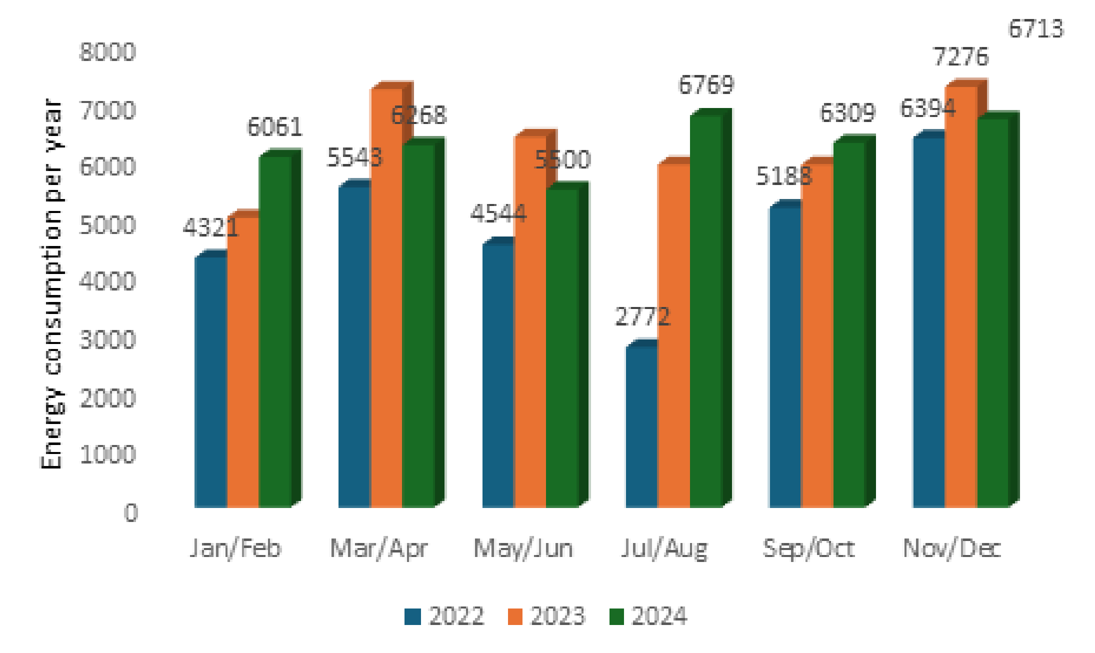


Fig 4.114 Year wise unit of consumption year of each month - 1155910000232

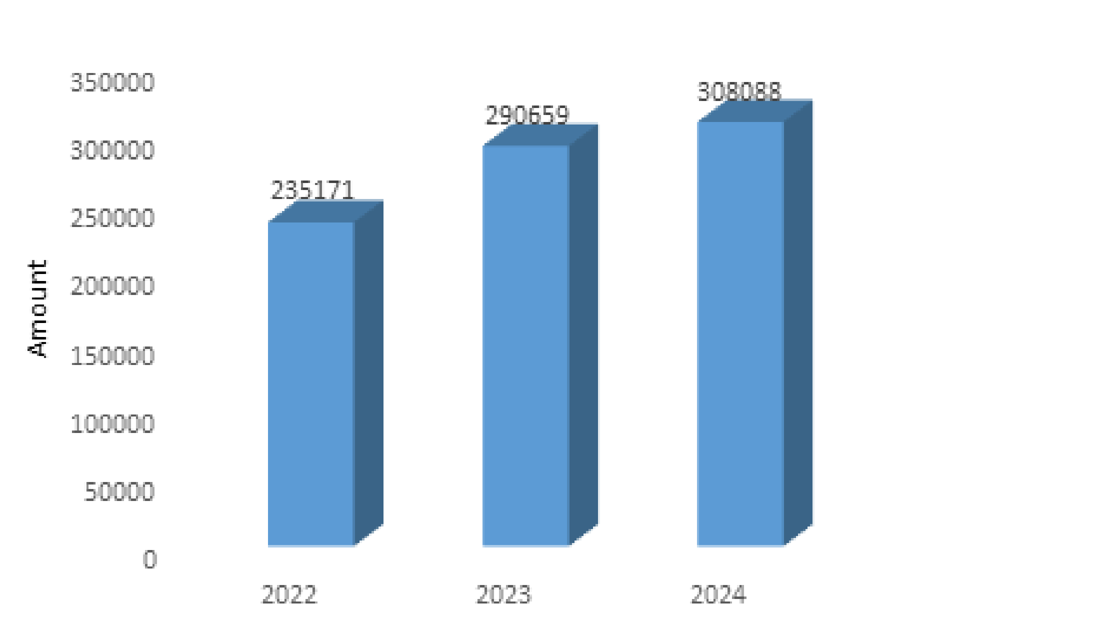


Fig 4.115 Yearly electricity bill of 1155910000232

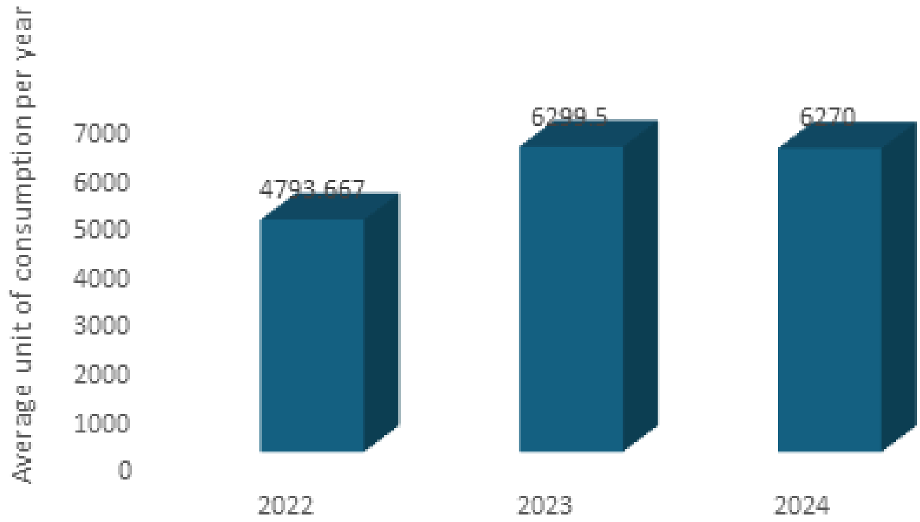


Fig 4.116 Average energy consumption per year of 1155910000232

In 2023, there was a slight increase in average energy consumption compared to the previous year. This is largely attributed to the hostel's outdated infrastructure, which currently serves 123 residents.

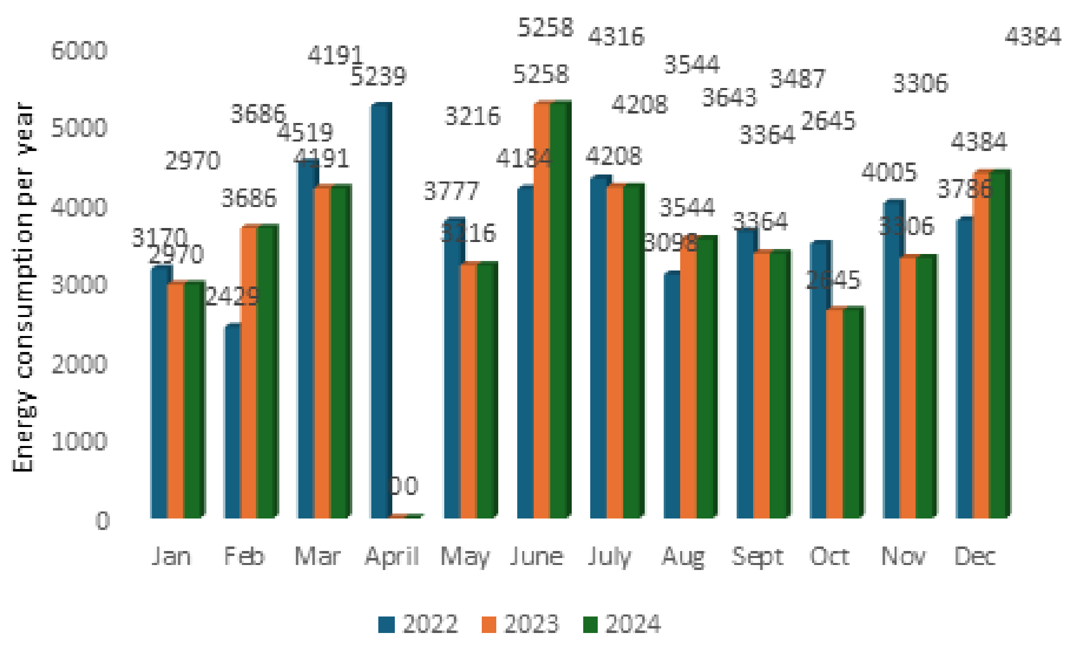


Fig 4.117 Year wise energy consumption per year of each month - 1155915028013

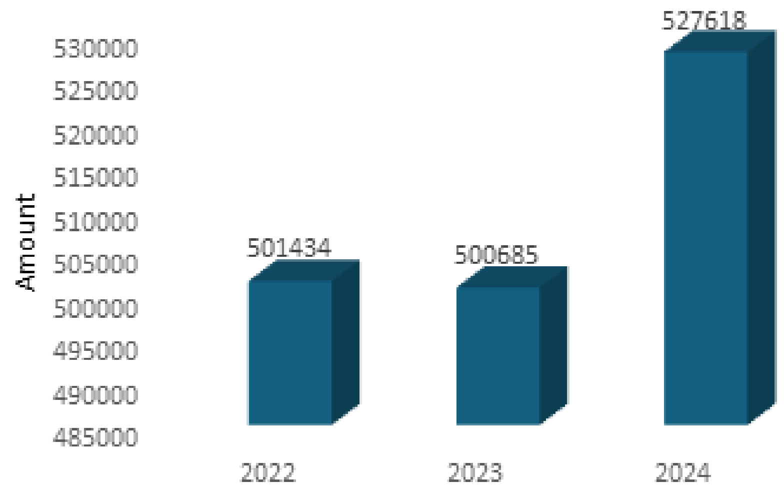


Fig 4.118 Yearly electricity bill of 1155915028013

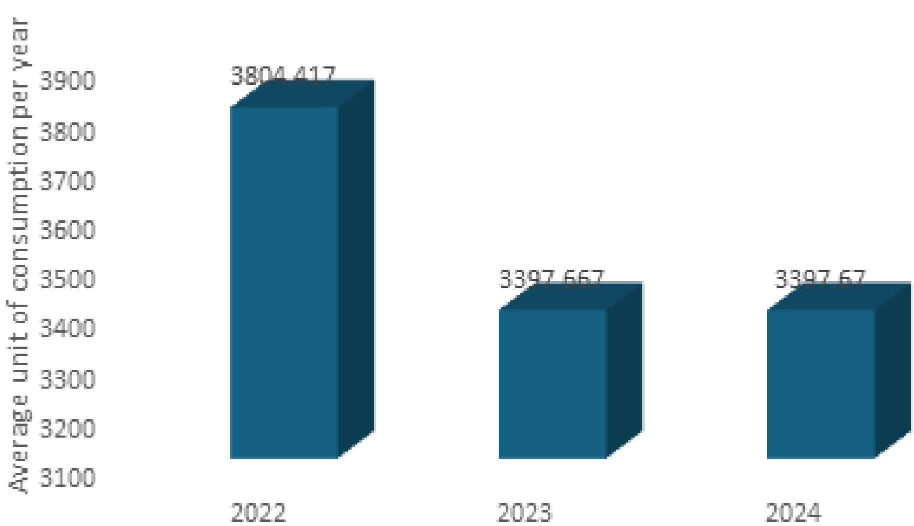


Fig 4.119 Average energy consumption per year of 1155915028013

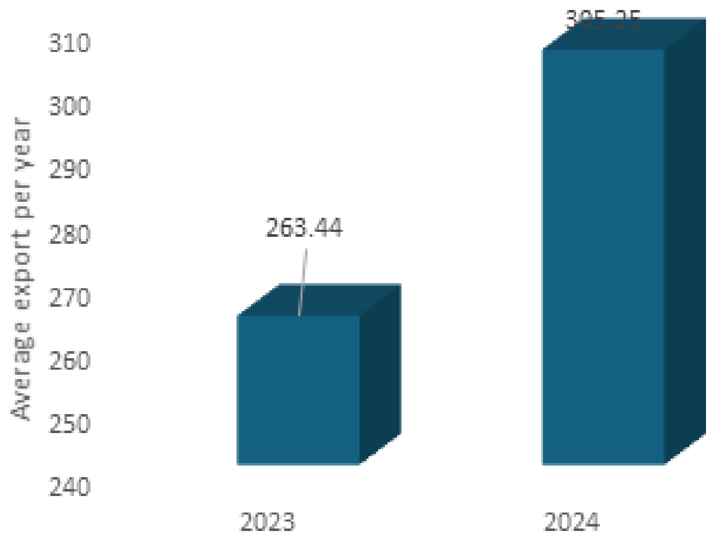


Fig 4.120 Average export per year of 1155915028013

Nirmala Hostel's electricity consumption from KSEB was high in 2022, driven by the needs of its 240 residents and numerous facilities. However, following the 2023 installation of a 9kW solar power system, grid consumption decreased significantly through 2024. The new system enabled the hostel to export more power, thereby reducing its overall reliance on KSEB.

Sl No	Months	Consumer number	Location Name	Installed capacity	Power distribution	Export (kWh) as per KSEB
1	January	1.156E+12	Pharmacy Hostel	9KW	Pharmacy Hostel	0
2	February	1.156E+12	Pharmacy Hostel	9KW	Pharmacy Hostel	485
3	March	1.156E+12	Pharmacy Hostel	9KW	Pharmacy Hostel	192
4	April	1.156E+12	Pharmacy Hostel	9KW	Pharmacy Hostel	122
5	May	1.156E+12	Pharmacy Hostel	9KW	Pharmacy Hostel	174
6	June	1.156E+12	Pharmacy Hostel	9KW	Pharmacy Hostel	428
7	July	1.156E+12	Pharmacy Hostel	9KW	Pharmacy Hostel	312
8	August	1.156E+12	Pharmacy Hostel	9KW	Pharmacy Hostel	404
9	September	1.156E+12	Pharmacy Hostel	9KW	Pharmacy Hostel	254

Table 4.75 Solar export of 1155915028013 in 2023

Sl No	Months	Consumer number	Location Name	Installed capacity	Power distribution	Export (kWh) as per KSEB
1	January	1.156E+12	Pharmacy Hostel	9KW	Pharmacy Hostel	419
2	February	1.156E+12	Pharmacy Hostel	9KW	Pharmacy Hostel	539
3	March	1.156E+12	Pharmacy Hostel	9KW	Pharmacy Hostel	413
4	April	1.156E+12	Pharmacy Hostel	9KW	Pharmacy Hostel	524
5	May	1.156E+12	Pharmacy Hostel	9KW	Pharmacy Hostel	224
6	June	1.156E+12	Pharmacy Hostel	9KW	Pharmacy Hostel	203
7	July	1.156E+12	Pharmacy Hostel	9KW	Pharmacy Hostel	155
8	August	1.156E+12	Pharmacy Hostel	9KW	Pharmacy Hostel	138
9	September	1.156E+12	Pharmacy Hostel	9KW	Pharmacy Hostel	225
10	October	1.156E+12	Pharmacy Hostel	9KW	Pharmacy Hostel	382
11	November	1.156E+12	Pharmacy Hostel	9KW	Pharmacy Hostel	217
12	December	1.156E+12	Pharmacy Hostel	9KW	Pharmacy Hostel	224

Table 4.76 Solar export of 1155915028013 in 2024

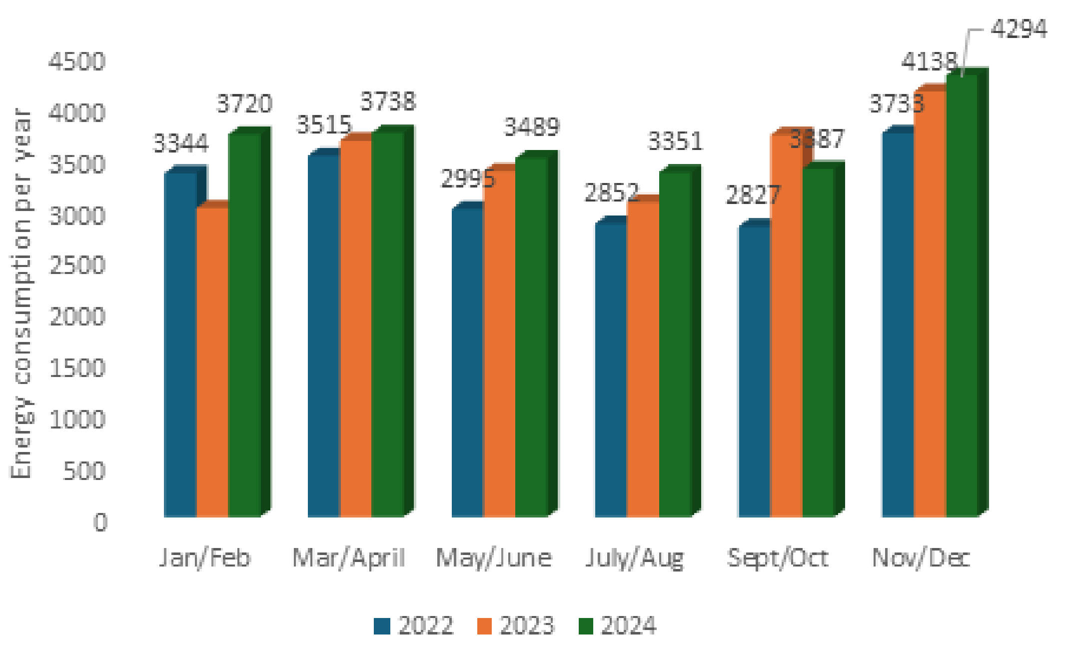


Fig 4.121 Year wise unit of consumption per year of each month - 115591240751

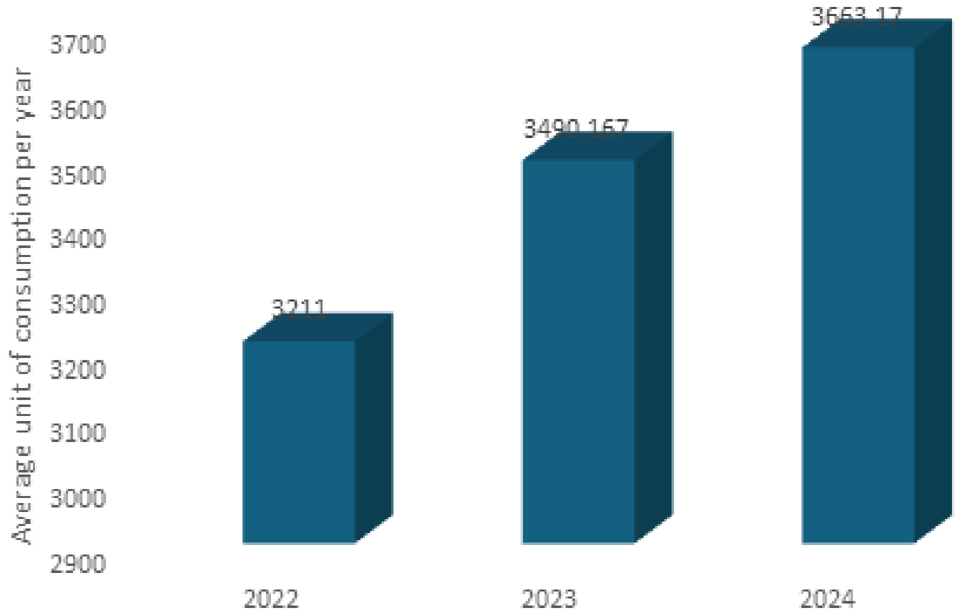


Fig 4.122 Average unit of consumption per year of 115591240751

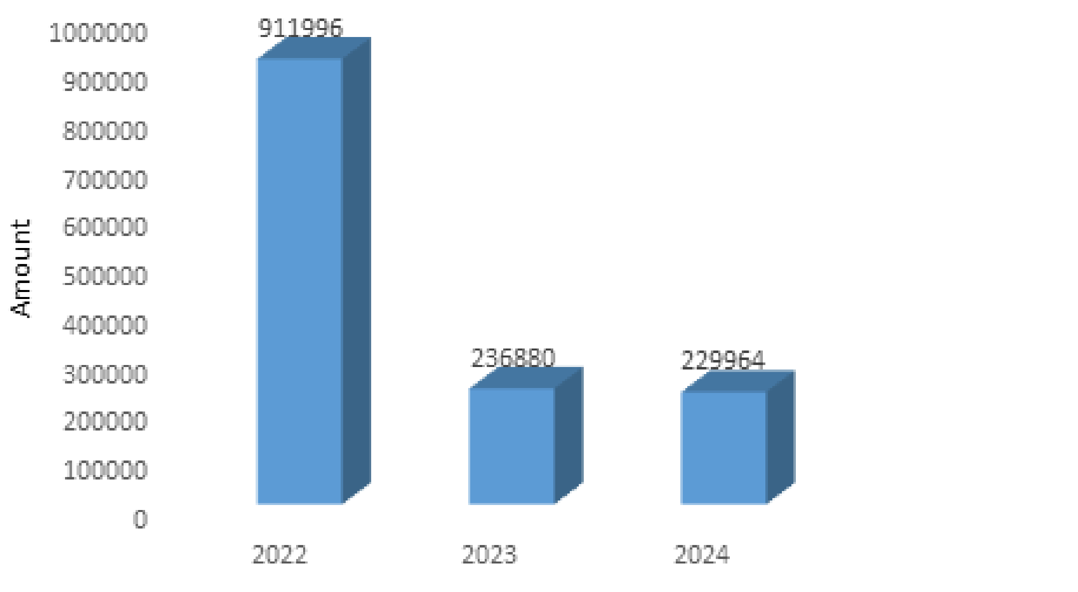
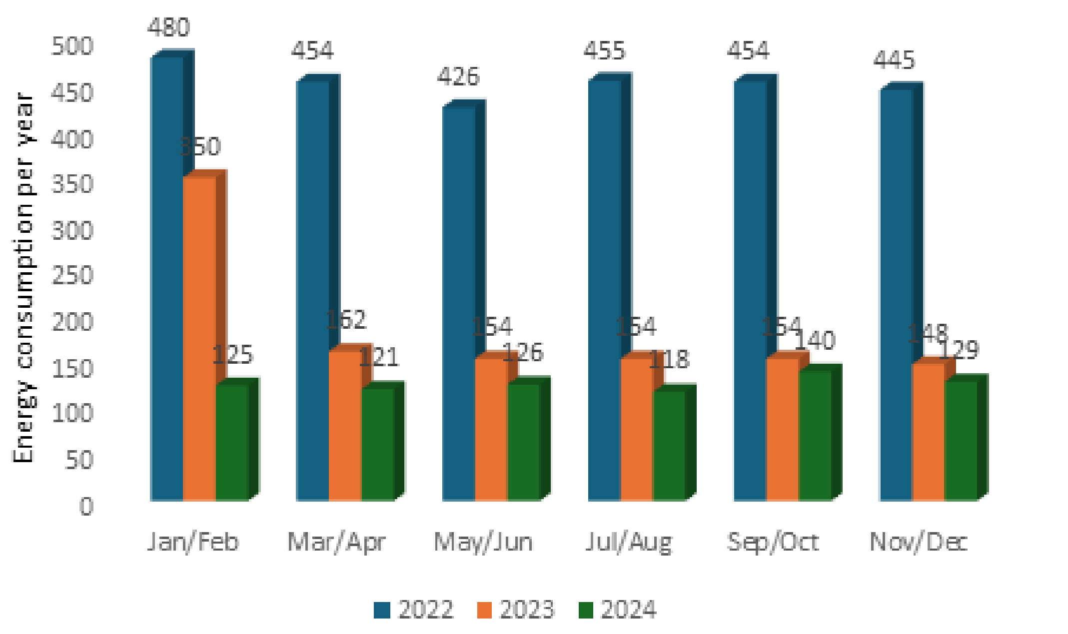


Fig 4.123 Yearly electricity bill of 115591240751



Graph 4.124 Year wise energy consumption of each month - 1155910001805

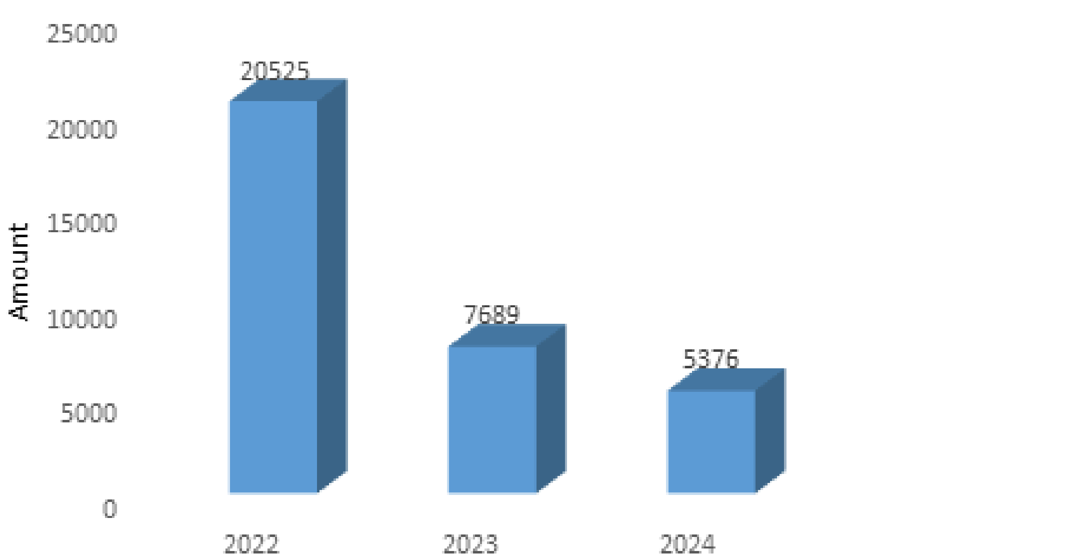
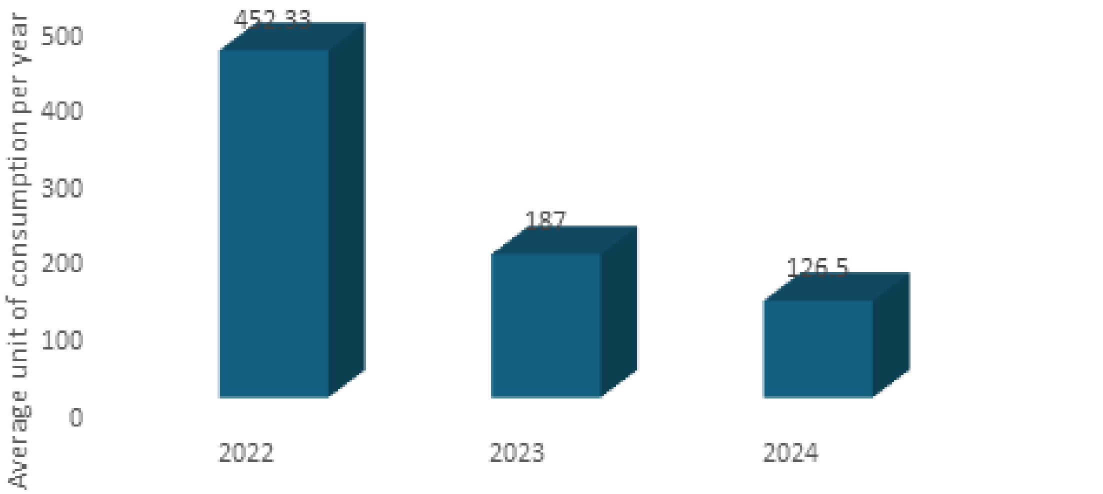


Fig 4.125 Yearly electricity bill of 1155910001805



Graph 4.126 Average unit of energy consumption of 1155910001805

In 2022, average consumption was higher than in prior years. However, the main entrance area, which was upgraded to controlled LED lighting, experienced a steady decrease in usage

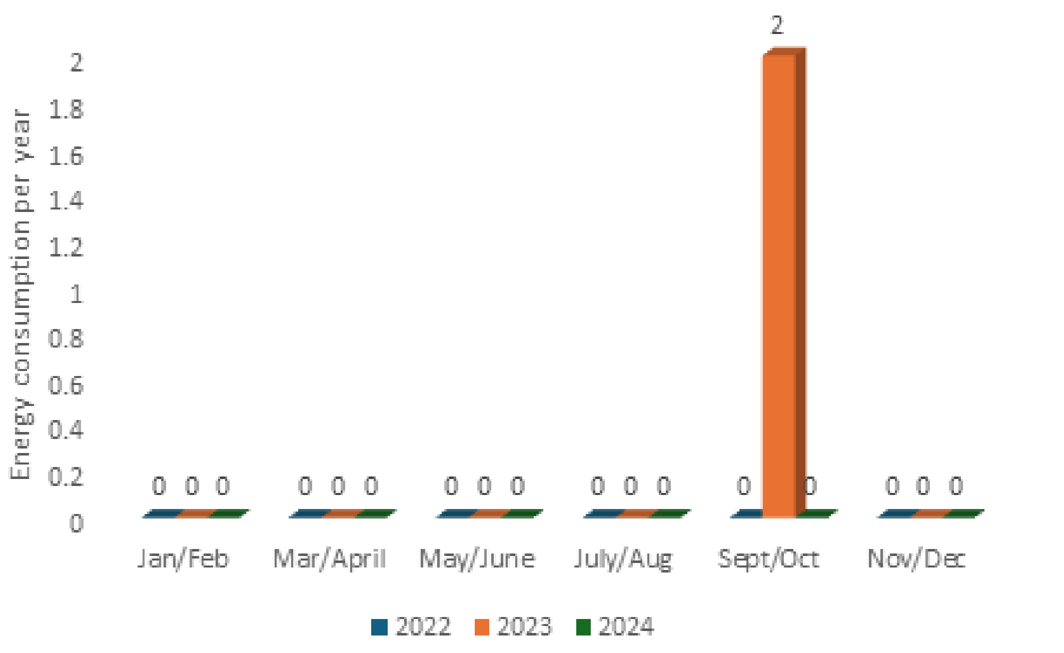


Fig 4.127 Yearly unity of consumption of each month - 1155910001805

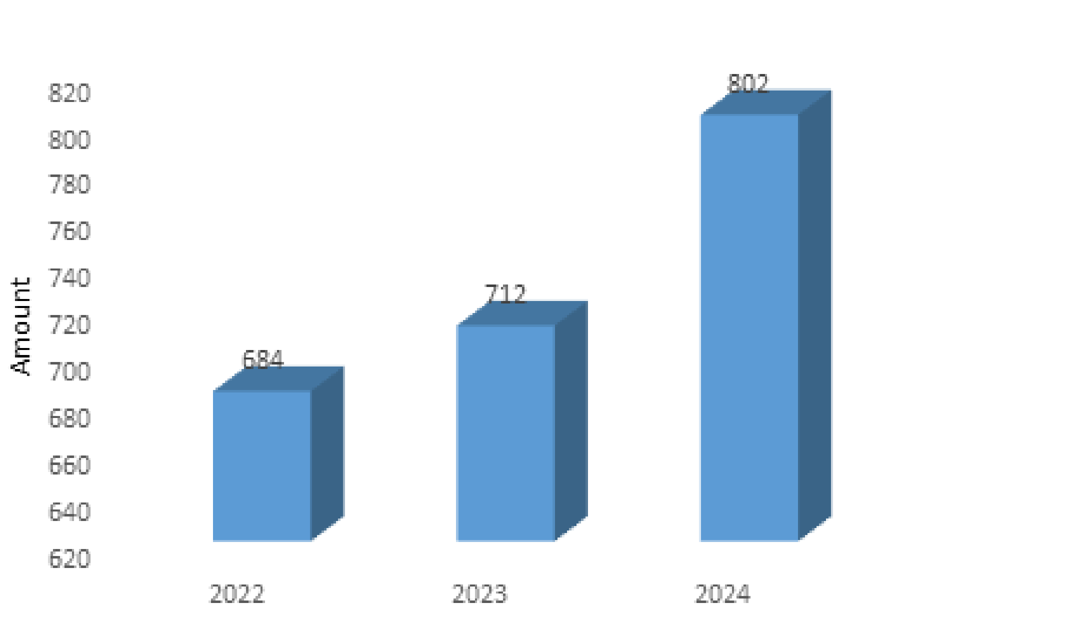


Fig 4.128 Yearly electricity bill of 1155910001805

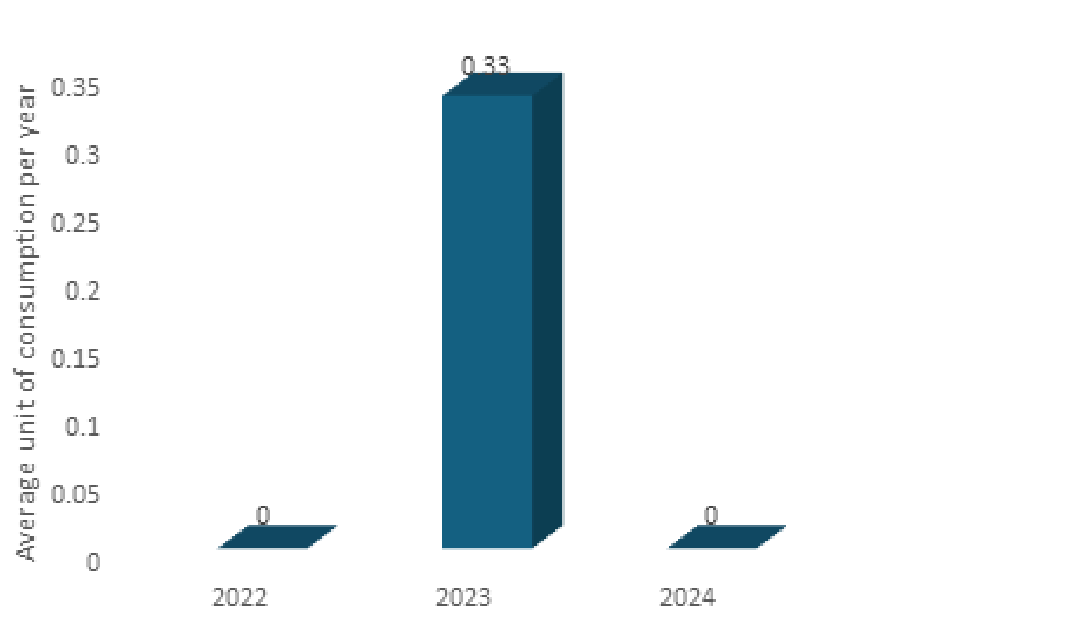


Fig 4.129 Average unit of energy consumption of 1155910001805

In 2023, the overall average consumption was higher compared to previous years. However, the entrance area upgraded with LED lighting showed a fluctuating trend, with periods of both steady decrease and increase in usage.

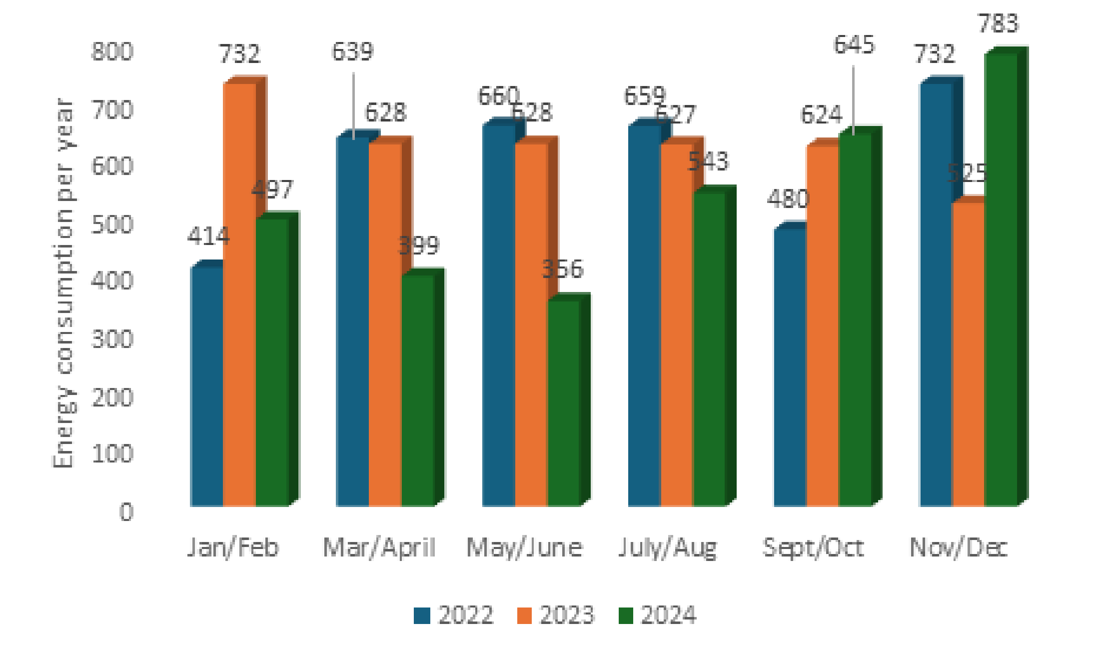


Fig 4.130 Unity of consumption per year of each month - 1155918003650

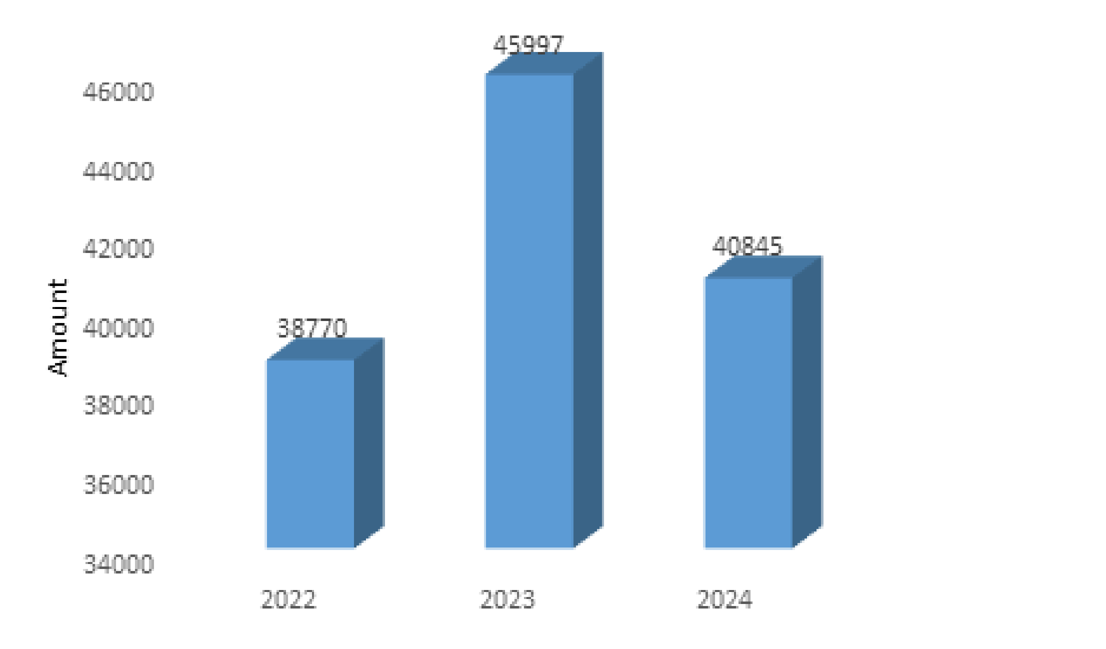


Fig 4.131 Yearly electricity bill of 1155918003650

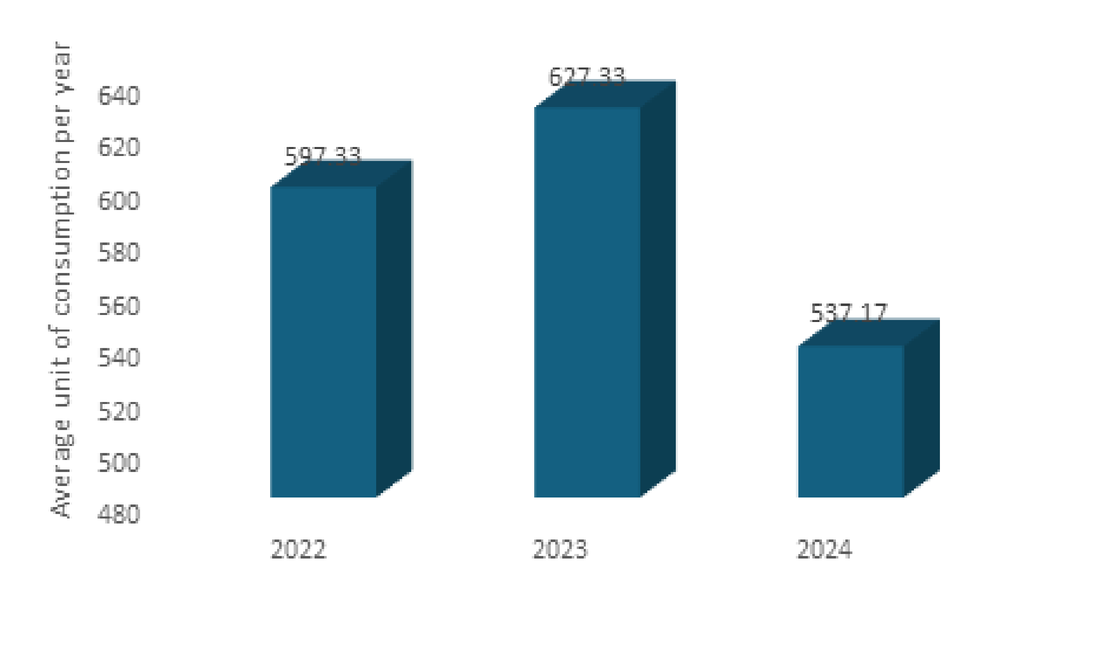


Fig 4.132 Average unit of consumption per year of 1155918003650

In 2023, higher consumption was observed compared to other two years, primarily due to increased usage of the Jeeva Jyothi motor pump, which operated based on specific demand requirements.

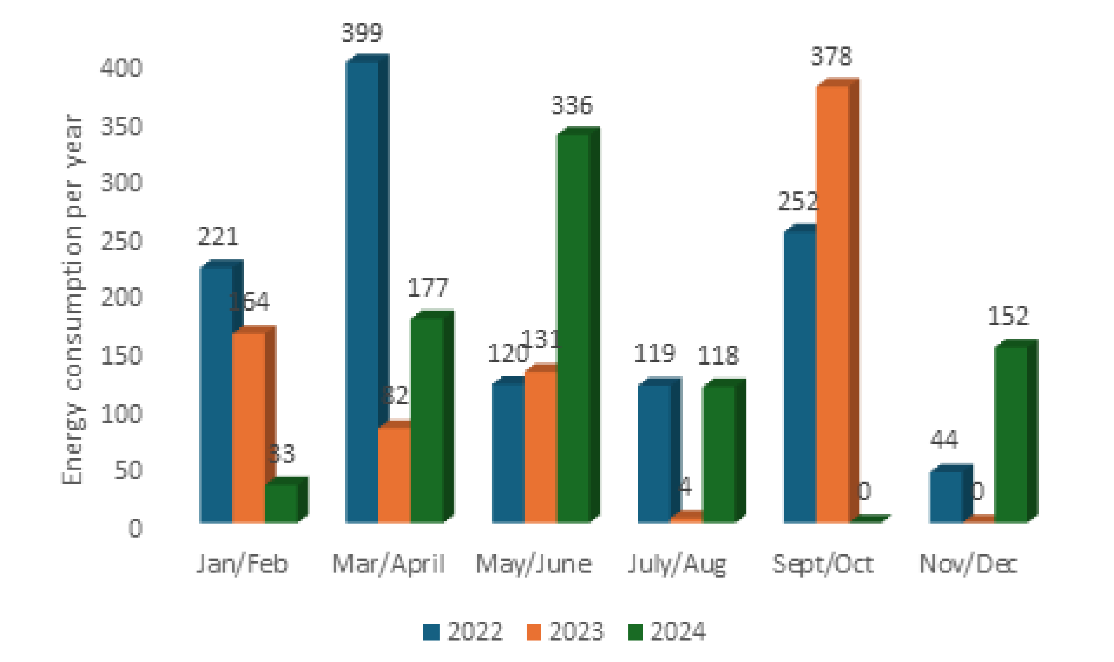


Fig 4133 Year wise unit of energy consumption of each month - 1155918000157

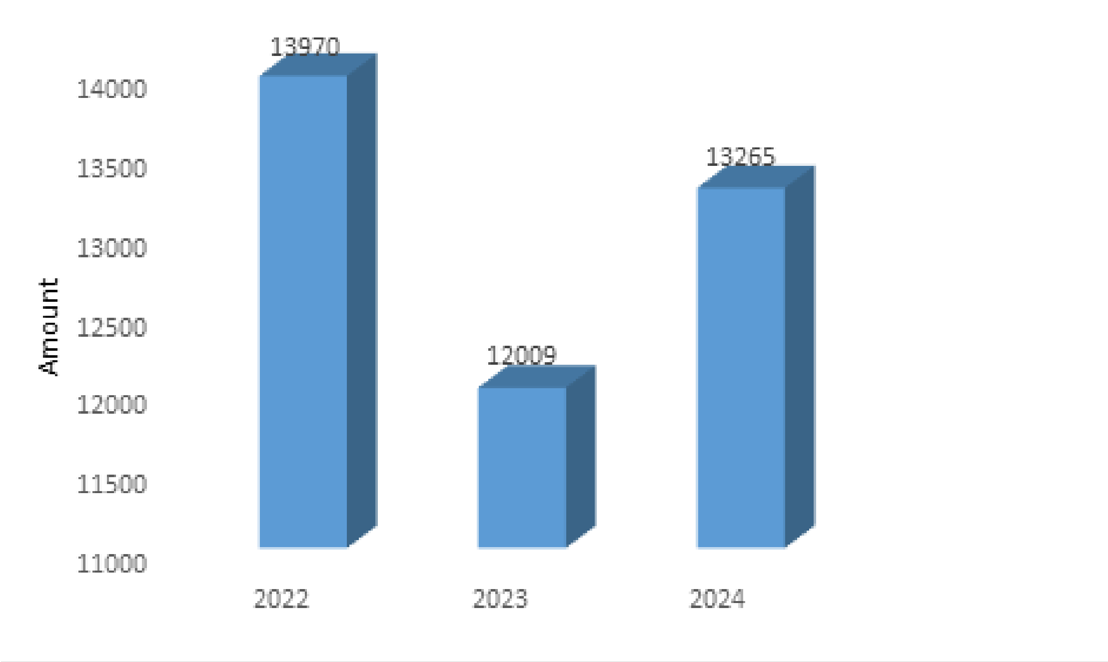
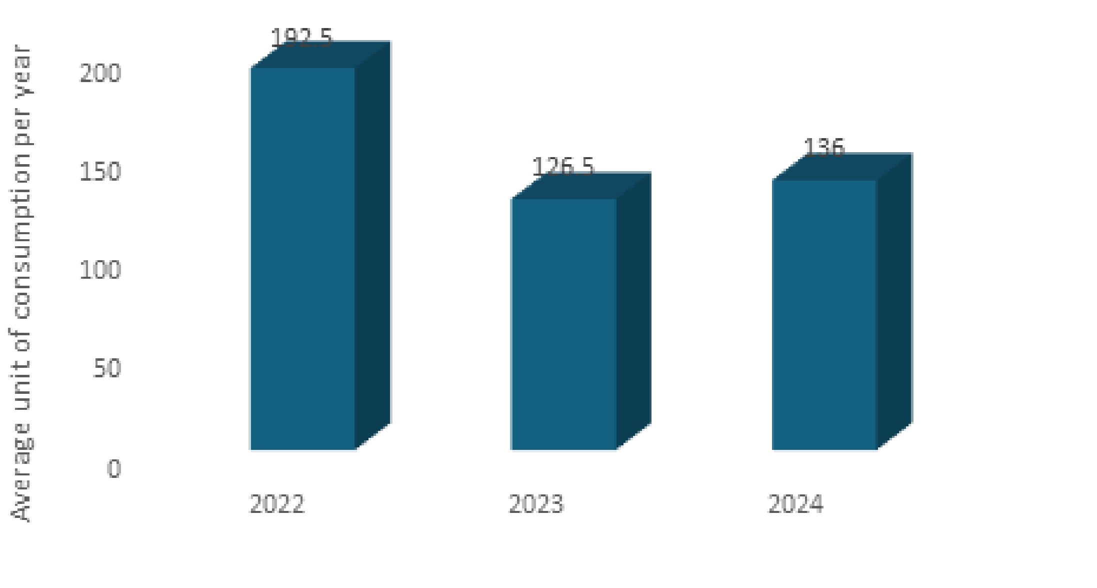
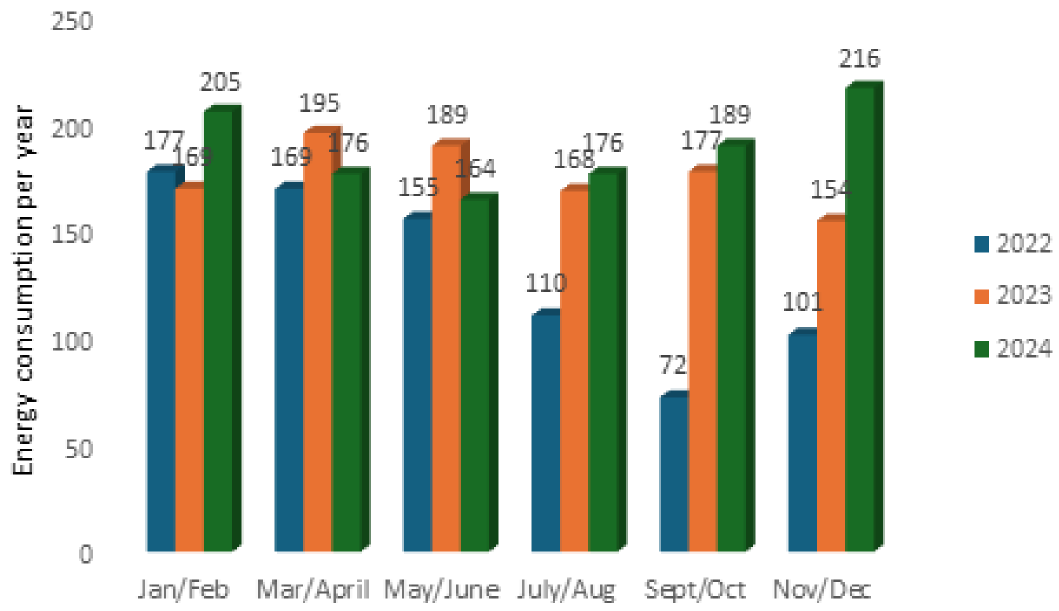


Fig 4.134 Yearly electricity bill of 1155918000157

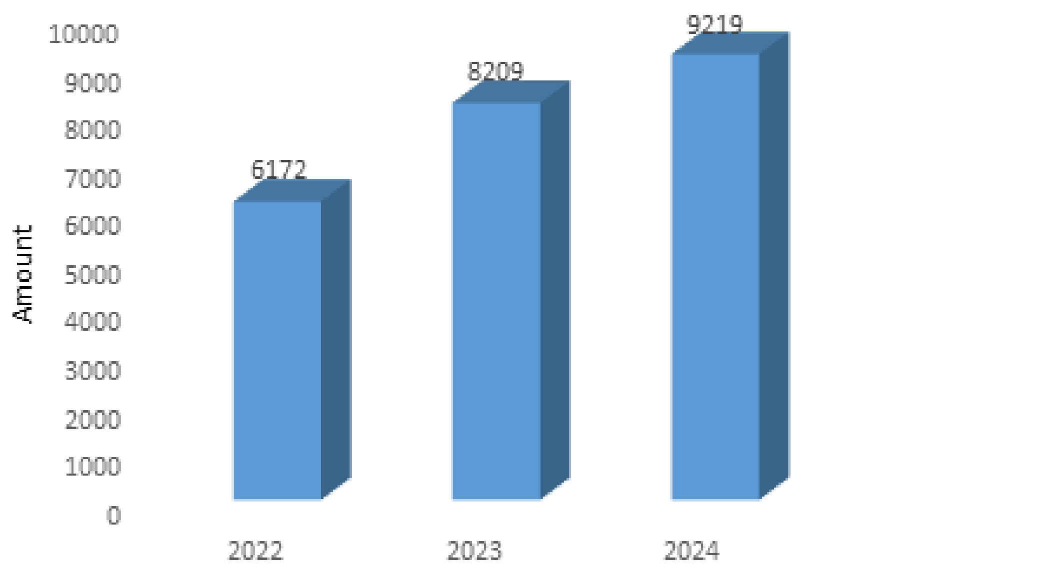


Graph 4.135 Average unit of energy consumption per year 1155918000157

In 2022, consumption was observed to be higher compared to other two years, which totally depend on the working motor pump in rubber planation



Graph 4.136 Year wise unit of energy consumption of each month - 1155917002926



Graph 4.137 Yearly electricity bill 1155917002926

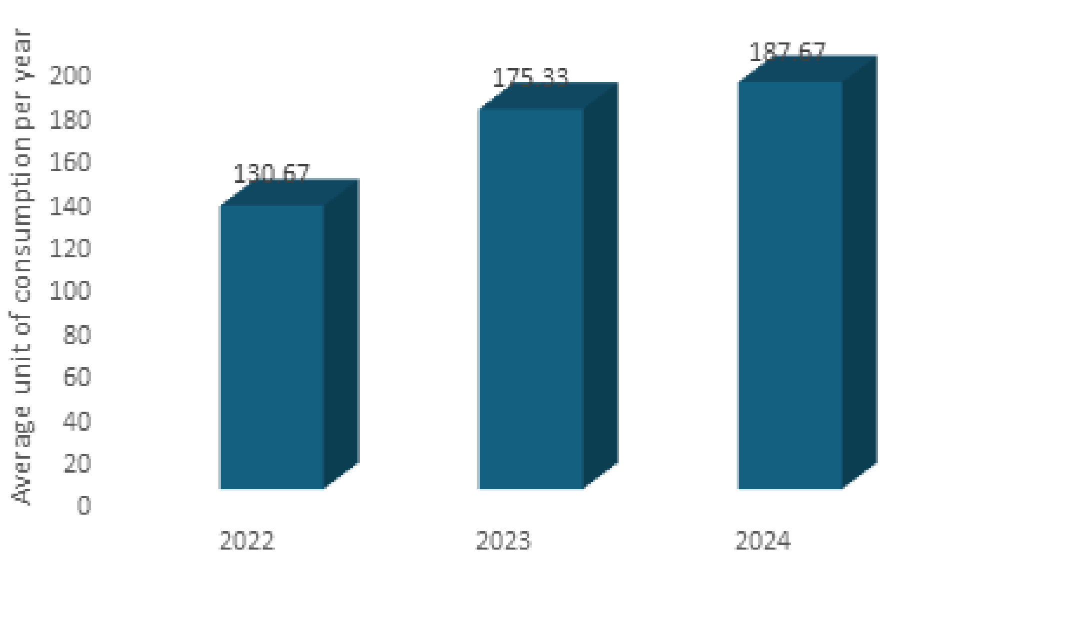


Fig 4.138 Average unit of energy consumption per year - 1155917002926

In 2024, consumption continued its steady increase, a trend driven by significant infrastructure upgrades and rising user demand

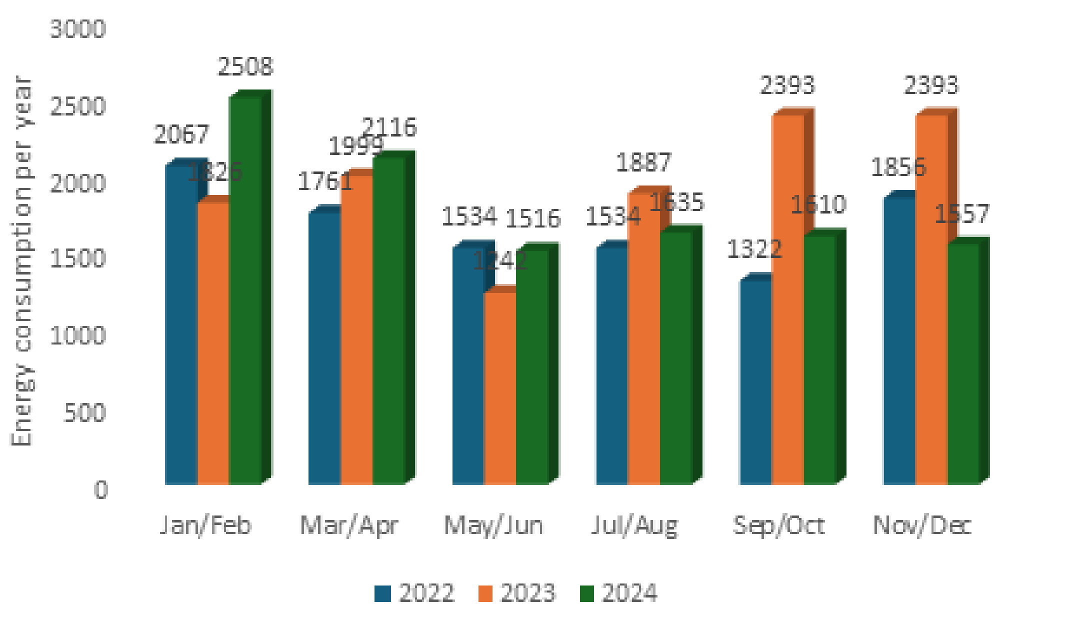


Fig 4.139 Year wise unit of energy consumption of each month - 1155917002946

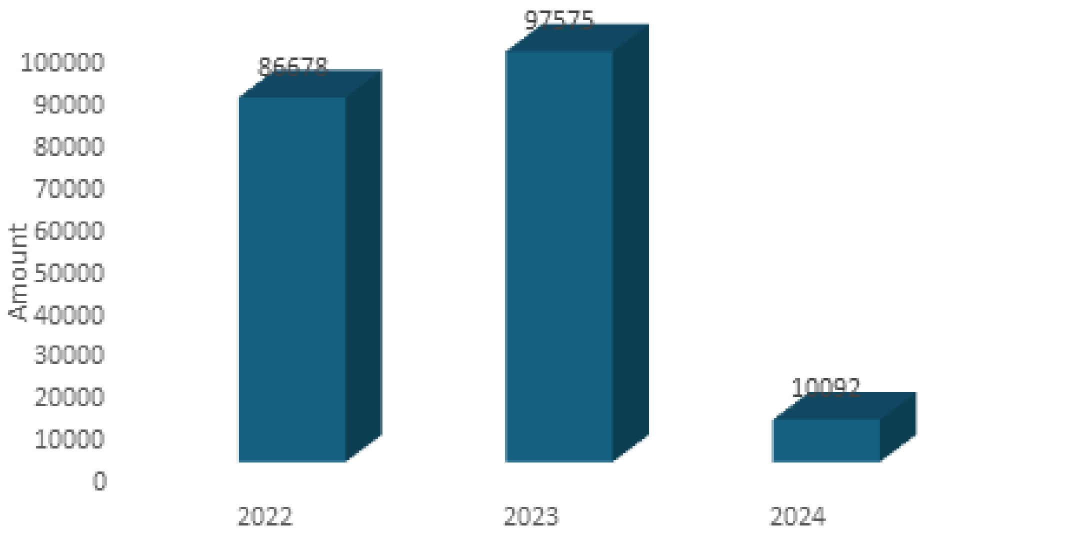


Fig 4.140 Yearly electricity bill - 1155917002946

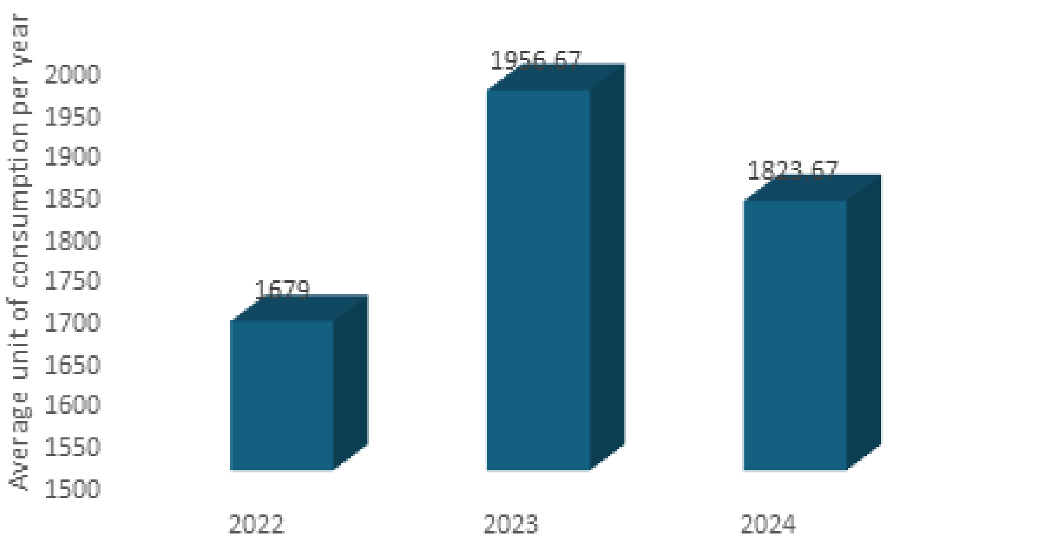


Fig 4.141 Average unit of energy consumption per year - 1155917002946

In 2023, the Little Flower Hostel recorded high consumption due to fluctuating usage patterns. Projections for 2024 indicate that consumption levels will be primarily determined by the operational performance of the motor.

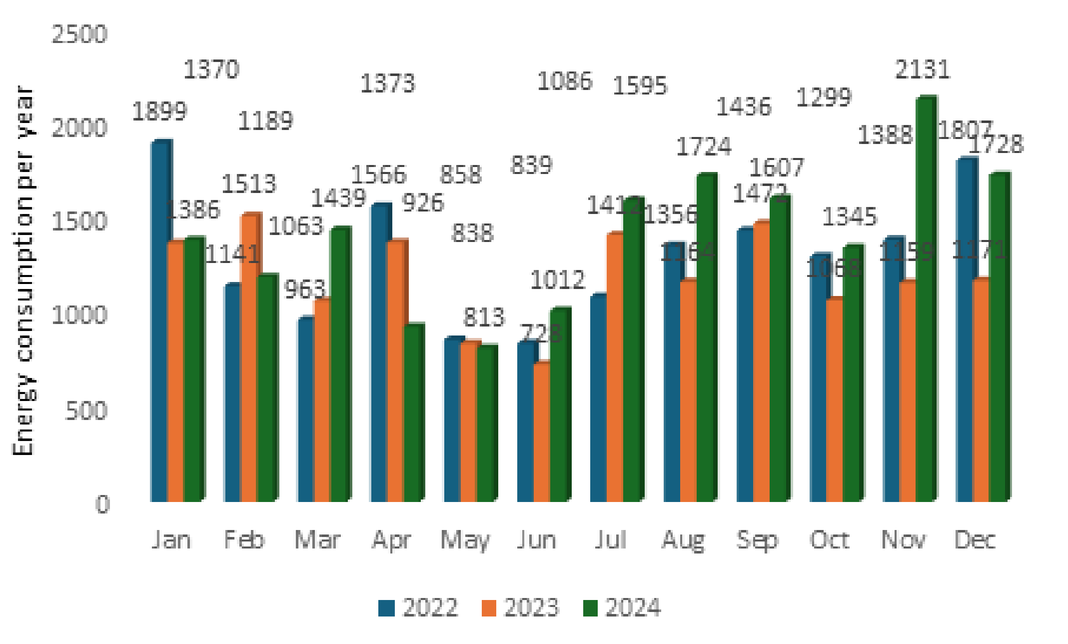


Fig 4.142 Year wise unit of energy consumption of each month - 1155919021412

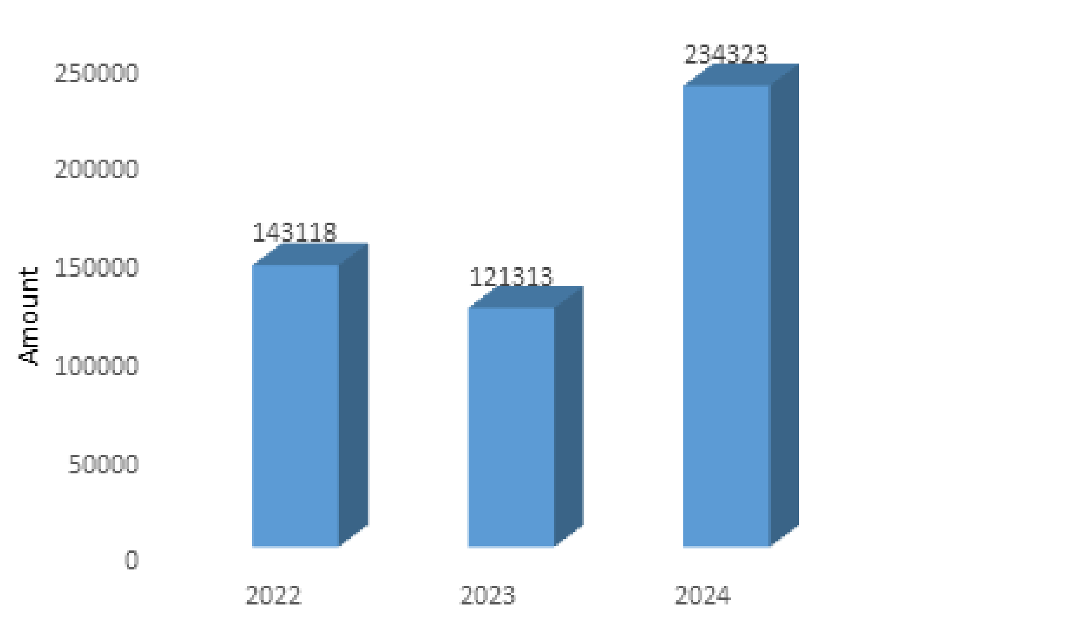


Fig 4.143 Yearly electricity bill of 1155919021412

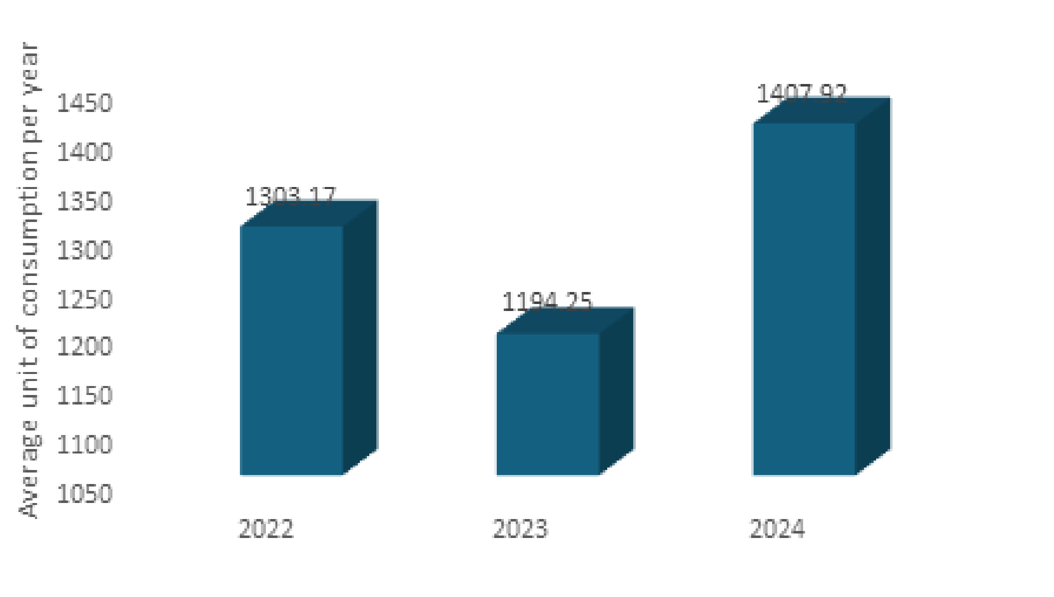


Fig 4.144 Average energy consumption per year of 1155919021412

A notable shift in energy consumption patterns was observed in the college library during 2024. This increase is a direct result of rising student numbers and the intensified use of the library's extensive facilities. The greater demand on resources such as lighting, climate control, computer workstations, printers, and the digital theatre has led to this variation.

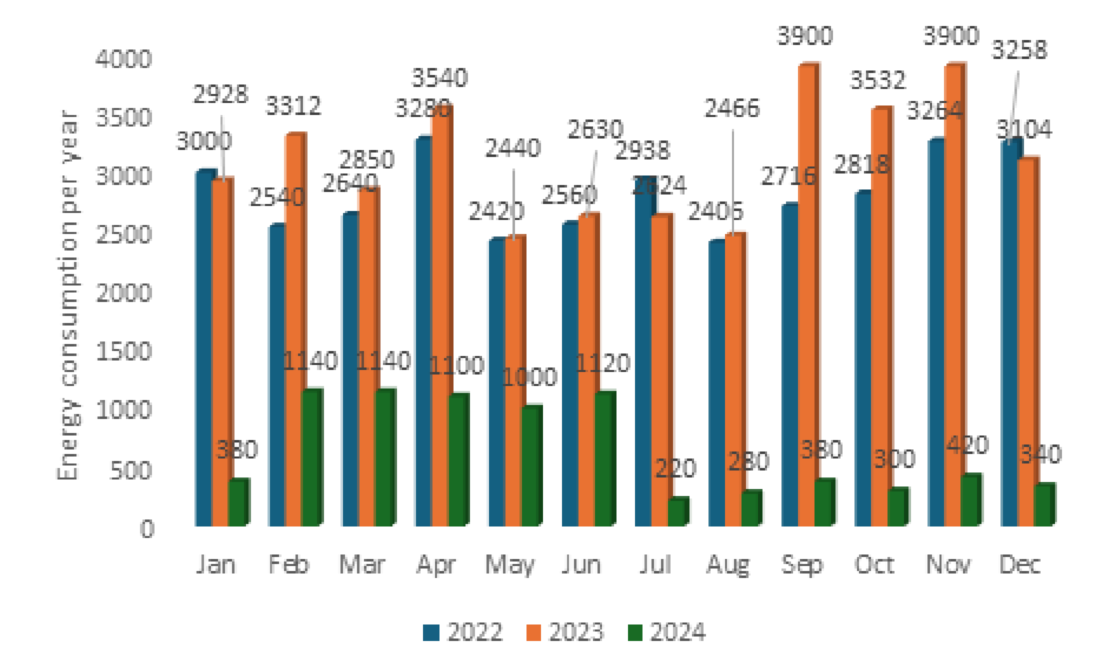


Fig 4.145 Year wise unit of energy consumption of each month - 1155910000209

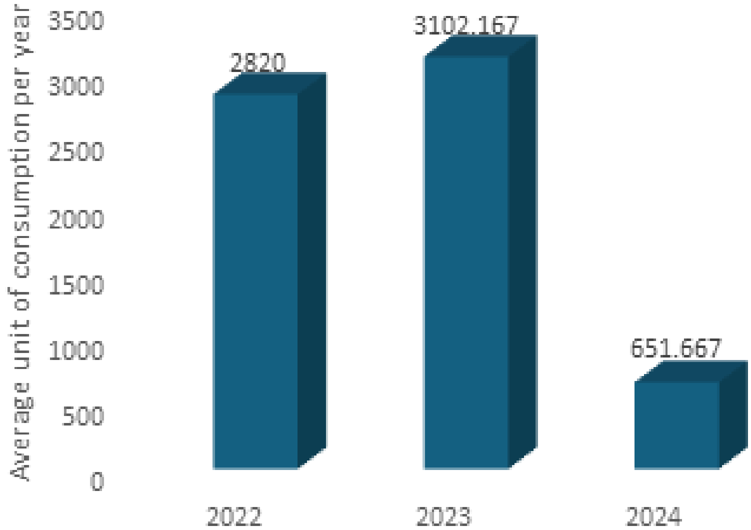


Fig 4.146 Average unit of energy consumption per year of 1155910000209

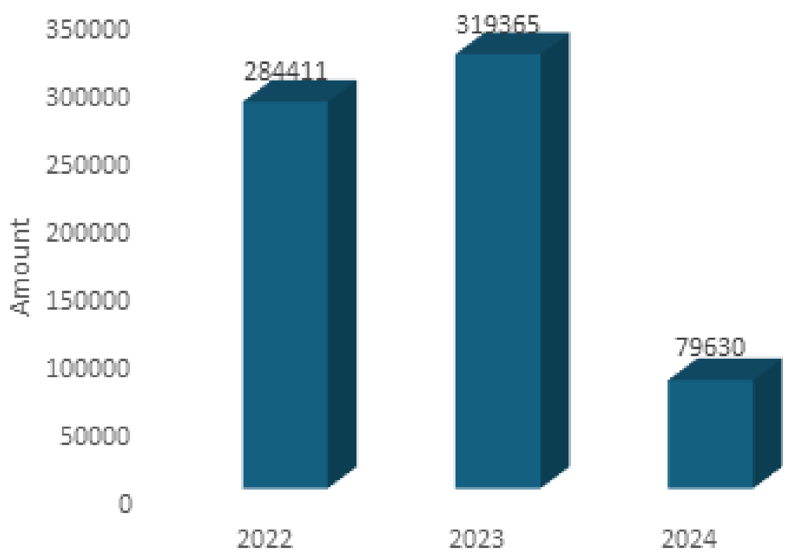


Fig 4.147 Yearly electricity bill - 1155910000209

Sl No	Months	Consumer number	Location Name	Installed capacity	Power distribution	Export (kWh) as per KSEB
1	January	1.156E+11	Main Block	40KW	Main Block	3440
2	February	1.156E+11	Main Block	40KW	Main Block	3060
3	March	1.156E+11	Main Block	40KW	Main Block	1100
4	April	1.156E+11	Main Block	40KW	Main Block	4360
5	May	1.156E+11	Main Block	40KW	Main Block	2740
6	June	1.156E+11	Main Block	40KW	Main Block	3420
7	July	1.156E+11	Main Block	40KW	Main Block	4360
8	August	1.156E+11	Main Block	40KW	Main Block	2740
9	September	1.156E+11	Main Block	40KW	Main Block	2020
10	October	1.156E+11	Main Block	40KW	Main Block	1740
11	November	1.156E+11	Main Block	40KW	Main Block	2700
12	December	1.156E+11	Main Block	40KW	Main Block	2460

Table 4.77 Solar export of 1155910000209 in 2024

In 2023 recorded high consumption main block due to functioning of following facilities Classrooms, Laboratory, science research labs, Chapel, washrooms, Conference halls, seminar halls, medical room, Controller of examination, ladies restroom, Auditorium, Dining Hall, Gym, Bank and ATM in 2024 install solar of capacity 40W and it get reflected in the decline in KESB consumption an average export of 2845 per year.

An internal assessment of electricity bills for our 14 consumer numbers was conducted to evaluate the effectiveness of our solar power initiative. Historically, all locations were fully dependent on the Kerala State Electricity Board (KSEB) for their power needs, with consumption levels influenced by usage patterns, infrastructure, and operational capacity. Following the installation of solar power systems at four key locations, a significant reduction in dependency on the KSEB grid has been observed. The operational model involves prioritizing on-site consumption of solar-generated electricity, with any surplus energy being exported to the KSEB grid.

Main Block consist of 40 kW solar plant was installed in early 2024. Prior to this installation, the block was entirely reliant on KSEB, with consumption showing a marked increase in 2022 and 2023. Since commissioning, the system has exported an average of 2,845 units of surplus energy per billing cycle. This has resulted in a substantial decrease in electricity drawn from the grid compared to the previous two years, establishing this installation as a successful benchmark for the project.

MCA Block consist of 15 kW solar plant was installed in 2022. Solar energy generation has steadily increased from 2022 to 2024. The system now exports an average of 787 units, leading to a corresponding and significant decline in KSEB grid consumption by 2024.

DJ Block consist of 19 kW solar plant was installed in mid-2022 (October). Since installation, solar generation has consistently grown. The system now exports an average of 884 units, which is directly reflected in the reduced reliance on KSEB power by 2024.

Nirmala Pharmacy consist of 9 kW solar plant was installed in 2023. Between 2023 and 2024, solar production has increased, resulting in an average export of 305 units. This has effectively lowered the pharmacy's consumption from the KSEB grid.

The data confirms that the phased implementation of solar power systems has been highly effective in reducing our overall electricity consumption from the KSEB grid, lowering operational costs, and increasing energy self-sufficiency of the institution

A key observation is that in some cases, while average electricity consumption was reported as high in 2023, the financial amount billed in 2024 is disproportionately higher. This suggests that factors beyond mere consumption volume, such as tariff adjustments, may be influencing billing outcomes. Deviations in electricity bills, whether resulting in lower or higher charges than expected, can be attributed to a range of underlying causes:

Reasons for Lower-than-Anticipated Consumption/Billing:

- Meter Malfunction: The utility meter may be faulty and inaccurately under-registering the true electricity consumed.
- Reduced Actual Usage: Consumption may be genuinely lower than projected due to factors such as the adoption of energy-efficient appliances, conscious reductions in usage, or new energy-saving practices.

Reasons for Higher-than-Anticipated Consumption/Billing:

- Meter Tampering: Evidence of meter manipulation could indicate artificially inflated readings.
- Increased Appliance Utilisation: Elevated consumption can result from the introduction of new electrical appliances, increased duration of use for existing appliances, or the operation of less energy-efficient units.
- Tariff Structure Modifications: Changes implemented in electricity tariff rates can lead to higher overall bills, even if energy consumption levels remain static.
- Malfunctioning Appliances: Defective appliances may consume significantly more electricity than their standard operational parameters.
- Phantom Energy Loads: Devices that remain plugged in and draw power even when not in active use (e.g., chargers, televisions in standby mode) contribute to cumulative energy consumption.
- Building Envelope Inefficiencies: Suboptimal building insulation, inadequate ventilation, or significant air leakage can necessitate increased energy use for climate control (heating and cooling).

Fig 4.148 Auditorium energy infrastructure

4.4.9 Meter Reading Analysis

Sampling days	Average per day mean consumption	Average mean consumption per year
Working day	2	400
semi holiday	5	475
Holiday	5	350

Table 4.78 Average consumption of 1155910000209

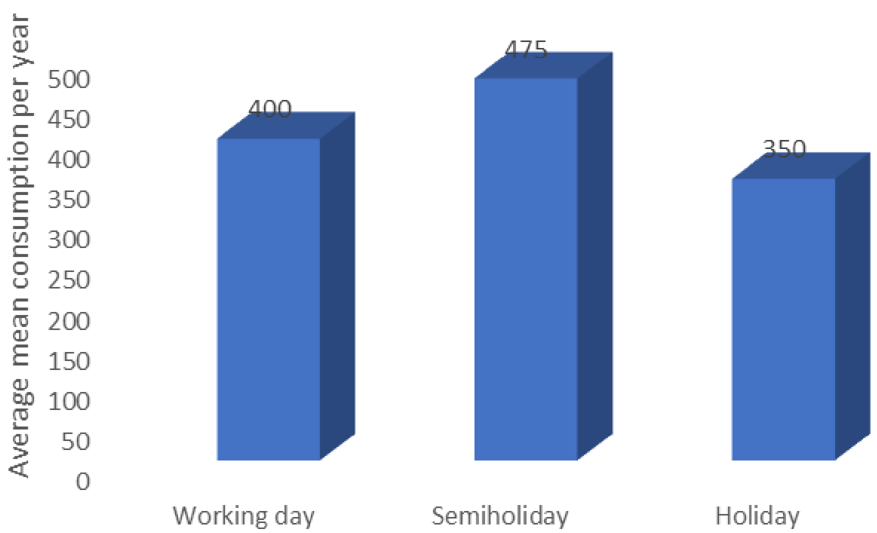


Fig 4.149 Average mean consumption of 1155910000209

Mean daily consumption is minimized on standard working days. This correlates with the implementation of energy-saving measures and the selective operation of high-load equipment. Energy usage profiles suggest primary reliance on essential services only (e.g., baseline lighting, ventilation, minimal process machinery).

A significant increase in energy consumption profile is observed on semi-holidays, representing more than a twofold increase over the working day baseline. This pattern indicates substantial ongoing activity, potentially reflecting either partial operations institution-wide or concentrated full-day activity within key administrative or support centers. Facilities contributing disproportionately to this load are likely to include: central administration offices, executive suites (Principal, Bursar), the Controller of Examinations office, laboratories (potential ad-hoc usage), conference venues, the chapel, and dining services. Anomalous consumption peaks in dining areas may be linked to specific events or variable efficiency in appliance management.

Holiday Consumption Levels, Periods designated as holidays demonstrate significantly reduced energy consumption, consistent with minimized operational activity across the campus.

1155911000857

Sampling days	Average per day consumption	Average mean consumption per year
Working day	10.27	2053.33
Semi holiday	4	380
Holiday	3	210

Table 4.79 Average consumption of 1155911000857

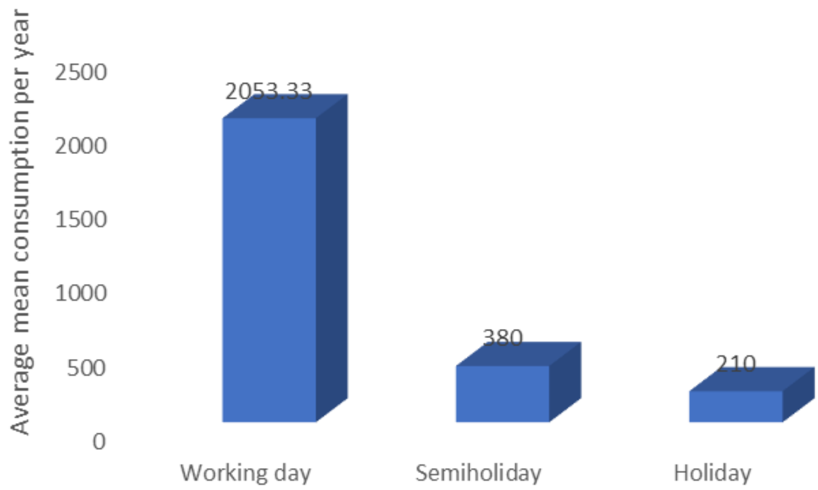


Fig 4.150 Average mean consumption of 1155911000857

Working Days: Peak daily energy consumption occurs on working days, correlating with full operational capacity. This includes standard building systems (lighting, HVAC, computers), operational machinery, and active use of specialized facilities (AV halls, auditoriums). Intermediate energy consumption levels are observed on semiholidays. This usage pattern is consistent with reduced operational activity, potentially due to shortened schedules or restricted area access. The lowest daily energy consumption is recorded on holidays. This baseline usage typically represents essential building services and power draw from standby equipment only.

Sampling days	Per day mean consumption	Average mean consumption per year
Working day	31.33	6266.67
Semi holiday	21	1995
Holiday	8.33	583.33

Table 4.80 Average consumption of 1155919021412

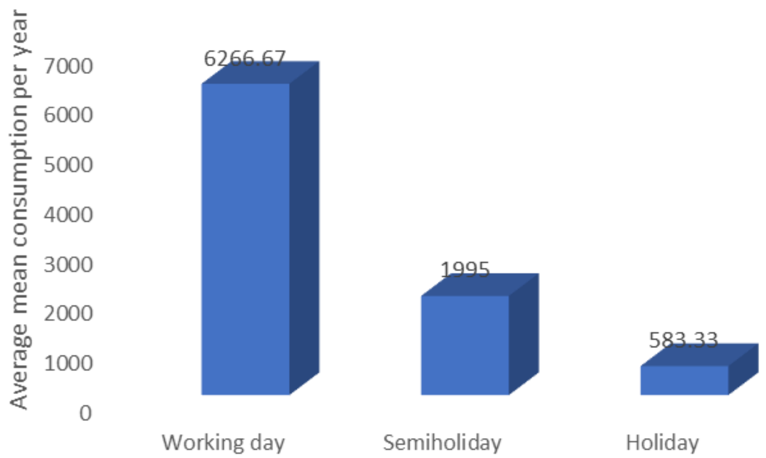


Fig 4.151 Average mean consumption of 1155919021412

The institution operational patterns reveals that the institution functions predominantly during standard working days. These days are characterized by significant library engagement, encompassing the use of both physical and digital resources by staff and students pursuing research, project work, assignments, and reference activities. Therefore, the most impactful energy or resource optimization efforts should target consumption. Furthermore, low-activity periods like holidays and semi holidays present distinct opportunities for adopting reduced consumption protocols, potentially applicable even during partial working schedules on these days.

Sampling days	Average per day mean consumption	Average mean consumption per year
Working day	10	2000
Semi holiday	68	6460
Holiday	74	5180

Table 4.81 Average consumption of 1155915028013

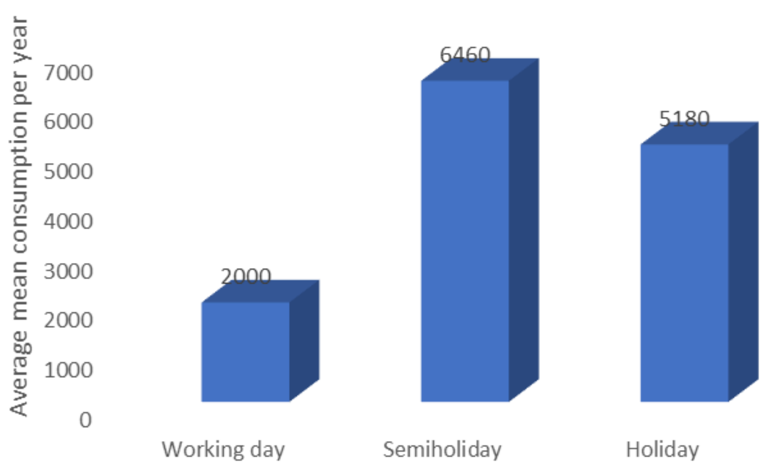


Fig 4.152 Average mean consumption of 1155915028013

Analysis of energy usage patterns within the college hostel reveals distinct variations based on day type. Working days exhibit the lowest average daily energy consumption. This correlates with students spending the majority of their time on campus for academic activities, leading to reduced energy demand within the hostel during these periods. Conversely, weekends and partial holidays show the highest average daily consumption, reaching. This peak is attributed to the continuous presence of residents within the hostel throughout the day. Similarly, full holidays register significantly elevated energy usage compared to working days, driven by increased occupancy and the associated rise in the operation of personal electronic devices, lighting, and potentially high-consumption appliances in common areas like kitchens.

Sampling days	Average mean consumption per day	Average mean consumption per year
Working day	32.27	6453.33
Semi holiday	3975.64	377686.12
Holiday	0	0

Table 4.82 Average consumption of 1155913023693

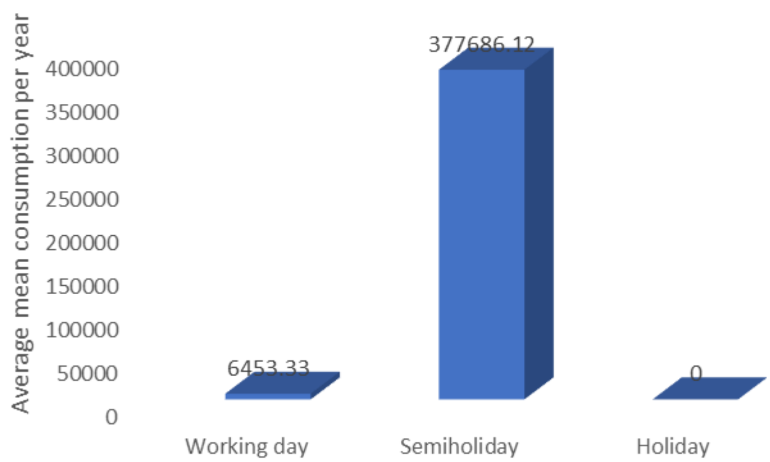


Fig 4.153 Average mean consumption of 1155913023693

Energy consumption during typical full working days exhibits a predictable and moderate pattern. This is primarily attributed to routine operations, including lighting, HVAC, and standard equipment usage in classrooms and offices. Semi-Working Days, Energy consumption significantly increases during periods involving non-standard schedules or specific events (e.g., semi-working days). Consumption frequently reaches peak levels, driven by scheduled, energy-intensive activities outside the normal academic timetable. Examples include the operation of specialized equipment and programs like civil service coaching, often requiring large venues (e.g., the auditorium). This leads to substantially higher HVAC usage (especially cooling) due to increased occupancy and prolonged operating times compared to standard days. Holidays, Energy consumption during official holidays is recorded at near-zero levels. A potential contributing factor is the bidirectional metering system in the MCA building, which nets energy import against solar export. If minimal consumption coincides with solar generation (potentially supplying limited circuits), the net reading could approach zero.

The observed near-zero consumption on holidays strongly indicates successful energy conservation practices, likely involving comprehensive shutdowns or power management strategies. This points to effective energy management during non-operational periods. Verification of these findings is contingent upon confirming the consistent accuracy and functionality of the energy monitoring systems year-round.

Fig 4.154 Electricity meter reading by internal auditor zone 1

Sampling days	Average mean consumption per day	Average mean consumption per year
Working day	57739.49	11547898.67
Semi holiday	10.32	980.72
Holiday	313.51	21945.93

Table 4.83 Average consumption of 1155912008235

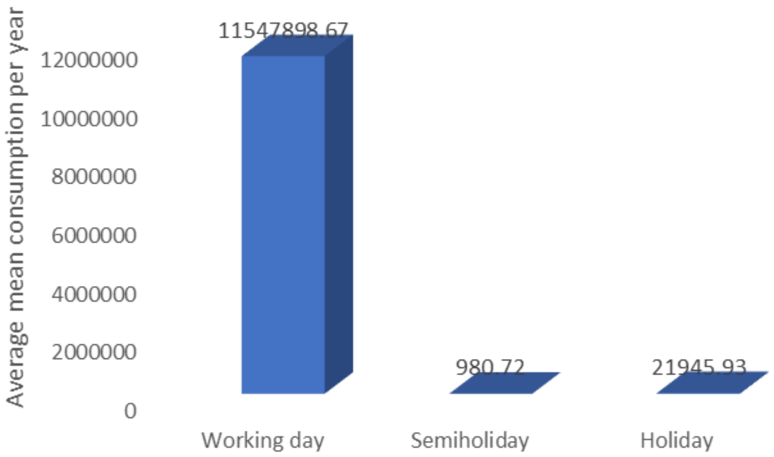


Fig 4.155 Average mean consumption of 1155912008235

Energy consumption data indicates a stark contrast between different operational periods. Working days are characterized by significantly high energy usage, constituting the overwhelming majority of the annual total. This is primarily attributed to the intensive daily use of classrooms and other essential facilities. Semi-holidays, in comparison, show markedly lower daily consumption, indicative of minimal operational activity. Interestingly, energy usage during full holidays, despite the absence of regular academic and administrative functions, is consistently higher than during semi-holidays. While a smaller fraction of overall annual use, this holiday consumption is non-negligible and points towards sustained operation of essential building systems.

Fig 4.156 Electricity meter reading by internal auditor zone 2

Sampling days	Average mean consumption per day	Average mean consumption per year
Working day	0.67	133.33
semi holiday	1	95
Holiday	0.67	46.67

Table 4.84 Average consumption of 1155919028926

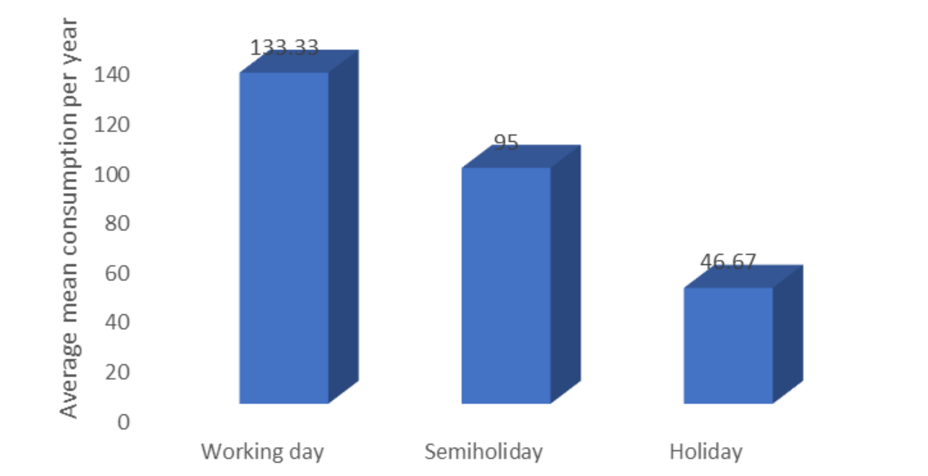


Fig 4.157 Average mean consumption of 1155919028926

Energy consumption data for the college entrance gate indicates that working days contribute most significantly to the overall annual usage, reflecting the consistent functioning of entrance systems during regular operational hours. However, when analysing average daily consumption, weekends (or designated semi-holidays) show the highest levels. This pattern suggests that core essential services, such as security lighting and the continuously staffed security post, operate 24/7. Their constant energy draw becomes more prominent proportionally on days, otherwise reduced activity (like weekends), leading to a higher average daily figure compared to weekdays where other, potentially variable, loads are also present. Consumption is lowest on full holidays.

Sampling days	Average mean consumption per day	Average mean consumption per year
Working day	50	10000
Semi holiday	29.33	2786.67
Holiday	26.67	1866.67

Table 4.85 Average consumption of 1155911000336

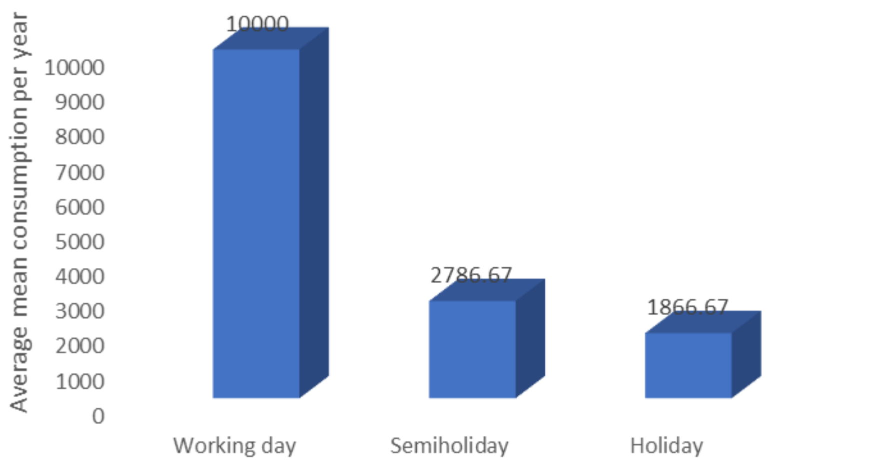


Fig 4.158 Average mean consumption of 1155911000336

A clear correlation exists between the type of day and energy consumption within the hostel. Working days, being more numerous and coinciding with peak operational activity and occupancy, demonstrate the highest energy usage. Consequently, weekends and holidays are characterized by a steady reduction in consumption, reflecting lower activity levels and a significant decrease in the number of residents present.

Sampling days	Average mean consumption per day	Average mean consumption per year
Working day	6	1200
Semi holiday	13.33	1266.67
Holiday	11.33	793.33

Table 4.86 Average consumption of 1155917002946

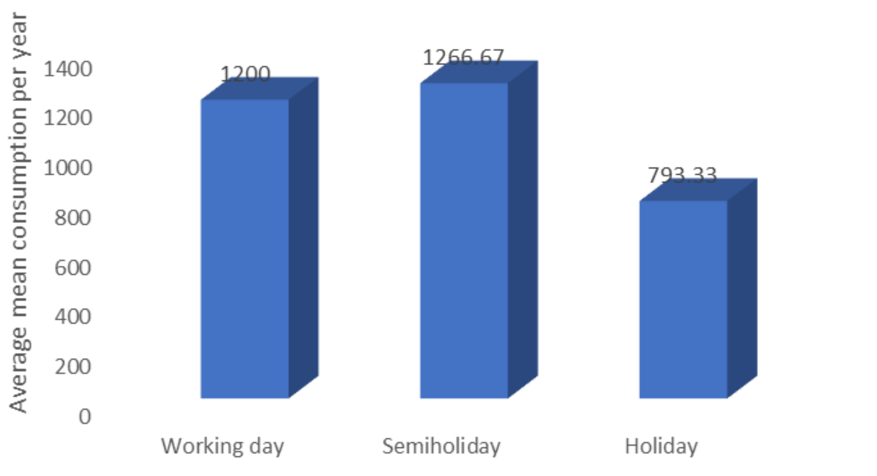


Fig 4.156 Average mean consumption of 1155917002946

Little Flower Hostel's water pump motor shows energy consumption patterns linked to occupancy and pumping schedules. Peak per-day energy consumption is observed during semi-holidays, followed by working days, with the lowest consumption occurring during full holidays. The hostel's water supply relies on a combination of manual and automatic pumping typically, two manual activations per day supplement and an automatic system filling of two tanks based on demand. The data strongly suggests that higher occupancy levels during semi-holidays, and potentially some holiday periods due to water demand. This increased demand translates into more frequent or prolonged motor operation, explaining the higher corresponding energy usage compared to periods with potentially lower occupancy or different usage patterns.

Sampling days	Average mean consumption per day	Average mean consumption per year
Working day	6.33	1266.67
Semi holiday	16	1520
Holiday	15	1050

Table 4.87 Average consumption of 1155912000751

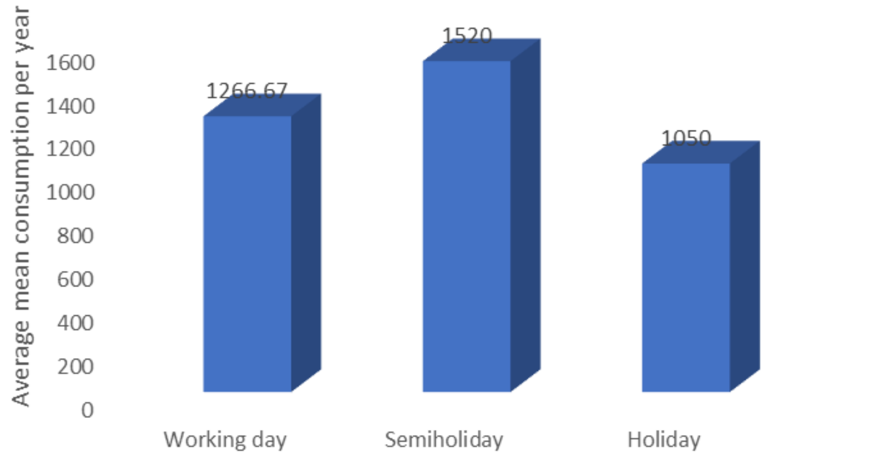


Fig 4.157 Average mean consumption of 1155912000751

An analysis of energy consumption data for the college hostel indicates clear patterns correlated with day type. The highest average daily energy usage is recorded on Semi-holidays. Working Days register the second-highest daily consumption, marginally lower than Semi-holidays, while standard Holidays show the lowest usage. It is noteworthy that although Working Days account for a substantial portion of the cumulative energy consumption owing to their regular occurrence, their average daily rate is surpassed by that of Semi-holidays. The elevated energy demand during Semi-holidays is primarily linked to sustained student presence, leading to increased utilization of electrical loads such as personal gadgets and kitchen appliances. Furthermore, the condition of the hostel's older infrastructure and electrical systems may be a contributing factor to heightened energy use during these periods.

Sampling days	Average mean consumption per day	Average mean consumption per year
Working day	15.67	3133.33
Semi holiday	16.67	1583.33
Holiday	21	1470

Table 4.88 Average consumption of 1155910000232

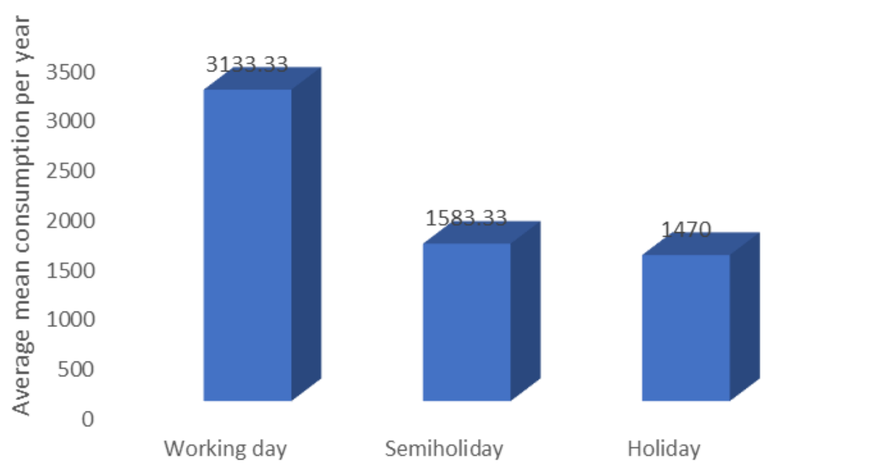


Fig 4.158 Average mean consumption of 1155910000232

Observations indicate a clear correlation between the day type and energy consumption levels within the college hostel, which houses 123 residents. Working Days demonstrate the highest energy consumption. This is attributed to the convergence of students within the hostel premises during non-lecture hours, following the regular academic timetable. This sustained occupancy leads to increased utilization of electrical systems and personal appliances. Weekends and Holidays, Exhibit comparatively lower energy consumption. This reduction corresponds with decreased occupancy rates, as residents frequently depart the hostel for personal travel or external recreational activities, resulting in diminished use of electrical equipment. Variations in the daily resident count are recognized as an additional factor influencing overall energy demand patterns.

Sampling days	Average mean consumption per day	Average mean consumption per year
Working day	5.67	1133.33
Semi holiday	4.67	443.33
Holiday	16	1120

Table 4.89 Average consumption of 1155918003650

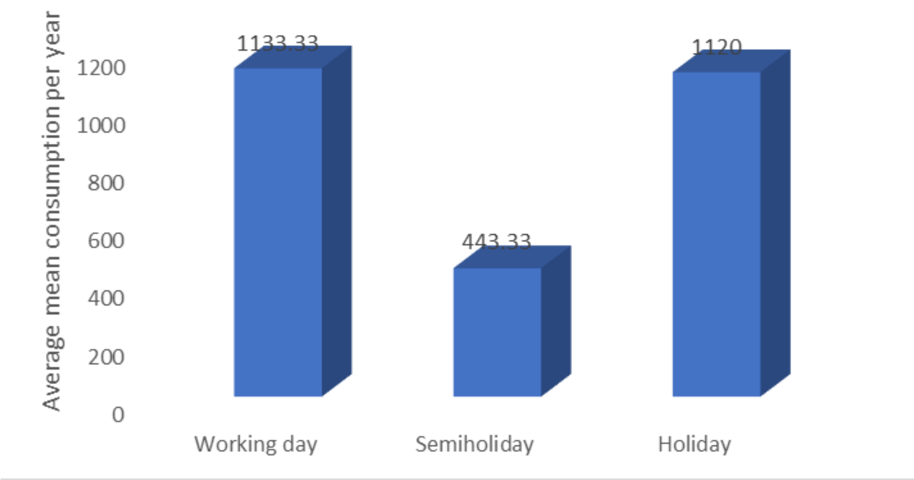


Fig 4.159 Average mean consumption of 1155918003650

An assessment of the energy consumption patterns associated with the college hostel's water pump motor indicates significant variations based on the type of day. Peak energy consumption is consistently observed on standard working days. Holidays are characterized by moderate consumption levels, while semi-holidays register the lowest energy usage on an annual basis. This observed pattern is directly attributable to water demand fluctuations within the hostel. Despite the presence of two automated water pumping systems designed to maintain water supply, their operational cycles and therefore overall energy consumption are fundamentally governed by the residents' water usage patterns.

Sampling days	Average mean consumption per day	Average mean consumption per year
Working day	39	7800
Semi holiday	0.33	31.67
Holiday	0	0

Table 4.90 Average consumption of 1155959025451

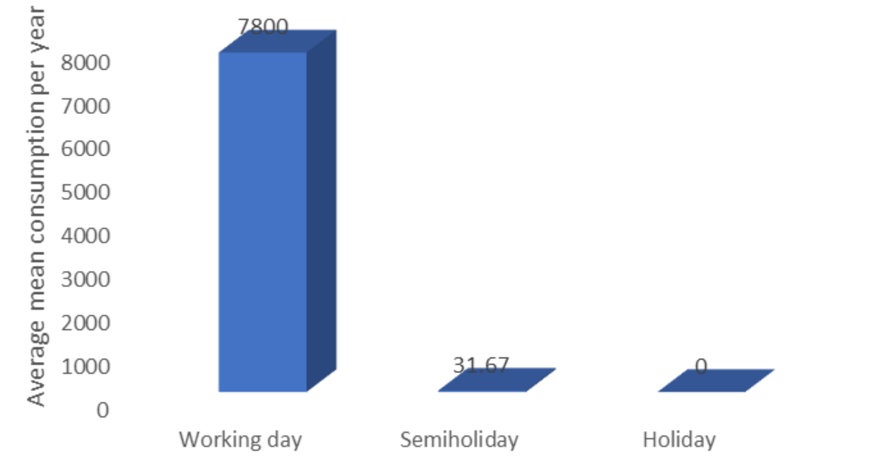


Fig 4.160 Average mean consumption of 1155959025451

Energy consumption during working days is significantly high, accounting for a substantial portion of the institution's annual energy usage. This pattern clearly indicates that major operational loads – including lighting, equipment, and HVAC systems – are fully active during these periods. Consequently, working day activity is the primary driver of the facility's overall energy demand. Consumption trends during semi-holidays are minimal, reflecting significantly reduced operational activity. Energy usage during these times likely consists of essential background loads, such as servers, security systems, or other continuously operating critical equipment. Recorded energy consumption on holidays is effectively zero, both on a daily and cumulative annual basis. This strongly suggests a near-complete shutdown of non-essential systems. Such low levels imply the implementation of strict energy conservation measures, potentially including the deactivation of main electrical circuits, during designated holiday periods.

Important Consideration: It is crucial to note that construction activities were taking place during the observation period. These activities likely introduced variations and temporary increases to the typical energy usage patterns described above, representing an additional factor influencing overall consumption.

Sampling days	Average mean consumption per day	Average mean consumption per year
Working day	8.9	1779.33
Semi holiday	16.42	1559.9
Holiday	245.13	17159.33

Table 4.91 Average consumption of 1155915022207

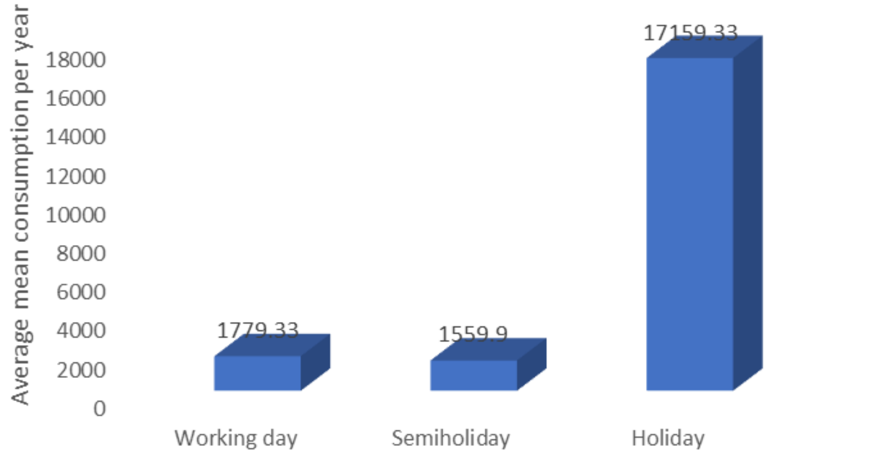


Fig 4.161 Average mean consumption of 1155915022207

Analysis of energy consumption data indicates clear patterns linked to operational schedules. Peak daily energy demand occurs during Holiday periods, surpassing consumption levels observed on typical Working Days. Working Days consistently represent the period of lowest energy usage. Semi-holidays demonstrate an intermediate level of consumption. The notably higher energy use during Holidays and certain Semi-holidays is primarily driven by auxiliary events, including competitive exam coaching sessions. These activities often necessitate the use of large venues like auditoriums and require continuous, full-day air conditioning, significantly increasing the energy load. Additionally, daily energy consumption in classrooms fluctuates depending on student occupancy.

Fig 4.162 Electricity meter reading zone 3

4.4.9.1 Motor pumping data

Location	Storage capacity (L)	Average pumping duration per day
Little flower hostel	20000	30.2 ± 7.42
DJ Block	34000	67.67 ± 29.02
Main block	3000	98.18 ±23.58
St. Joseph hostel	7000	68. 89 ± 23.29
Nirmala hostel	45000	234.17 3± 3.66
MCA Block	10000	67.67 ± 29.02
Jeeva Jyothi hostel	12000	67.67 ±29.02

Table 4.92 Motor pumping duration

The Main Block is a primary concern. It features the system's smallest tank (3,000 L) yet records the longest pumping duration (98.18 units for Metric 1), resulting in the lowest fill rate. The extended duration is likely attributable to the pump's dual responsibility of servicing a connected 15,000 L sub-tank. This configuration points to a highly inefficient or undersized pumping system creating a significant performance bottleneck. DJ Block (34,000 L), MCA Block (10,000 L), and Jeeva Jyothi Hostel (12,000 L) all register the exact same pumping durations (67.67 and 29.02 units). This uniformity across different volumes strongly suggests the pumps are not operating based on tank levels but are instead controlled by a fixed-duration timer. Such a setup is inefficient and risks either incomplete fills or energy wastage. Nirmala hostel's long pumping duration is expected, as its pump is responsible for filling five main tanks, making its operational demand logically higher than the others

4.4.10 Other Energy Sources of the College

4.4.10.1 Fuel Purchase of the college

Sl No	Date	Total Volume purchased per year
1	2022-23	3200
2	2023-24	3200

Table 4.93 Fuel purchase data of Nirmala college

The institution utilizes an average of 3,200 liters of diesel per year for the purpose of generator operation. Records documenting this consumption are available for the 2022-23 and 2023-24 periods. There is no historical data prior to this period is unavailable for a comprehensive examination.

Fig 4.163 Diesel Generator of the college

4.4.11 LPG Purchase of the college

Sl No	Department	Capacity Per Year (Kg)	Capacity per year (Kg)
1	Chemistry Lab	48	792
2	Zoology Lab	24	396
3	Botany Lab	2	10
4	Physics Lab	12	96
5	Jeeva Jyothi Hostel	108	2052
6	Little flower Hostel	144	2736
7	St. Joseph Hostel	110	2736
8	Nirmala Hostel	168	2736
9	Canteen	48	2736
10	Cafeteria	12	2736
	Total	676	17026

Table 4.94 LPU usage data of Nirmala college

The institution purchases grant total of 676 LPG cylinders with a capacity of 17026 kg for Lab use, kitchen use for both the canteen and cafeteria

4.4.12 Vehicle details of the college

Sl No	Two-Wheeler	Distance travelled	Fuel Required	Shared status
1	1	50	1.666666667	Yes
2	1	11	0.366666667	Yes
3	1	35	1.166666667	Yes
4	1	20	0.666666667	Yes
5	1	20	0.666666667	Yes
6	1	20	0.666666667	Yes
7	1	30	1	Yes
8	1	30	1	Yes
9	1	10	0.333333333	Yes
10	1	10	0.333333333	Yes
11	1	10	0.333333333	Yes
12	1	5	0.166666667	Yes
13	1	6	0.2	Yes
14	1	5	0.166666667	Yes
15	1	50	1.666666667	Yes
16	1	18	0.6	Yes
17	1	60	2	Yes
18	1	24	0.8	Yes
19	1	25	0.833333333	Yes
20	1	20	0.666666667	Yes

21	1	30	1	Yes
22	1	40	1.333333333	Yes
23	1	55	1.833333333	Yes
24	1	120	4	Yes
25	1	12	0.4	Yes
26	1	30	1	Yes
27	1	50	1.666666667	Yes
28	1	10	0.333333333	Yes
29	1	5	0.166666667	Yes
30	1	5	0.166666667	Yes
31	1	30	1	Yes
32	1	85	2.833333333	Yes
33	1	15	0.5	Yes
34	1	52	1.733333333	Yes
35	1	7	0.233333333	Yes
36	1	60	2	Yes
37	1	15	0.5	Yes
38	1	30	1	Yes
39	1	12	0.4	Yes
40	1	5	0.166666667	Yes
41	1	20	0.666666667	Yes
42	1	20	0.666666667	Yes
43	1	8	0.266666667	Yes
44	1	30	1	Yes
45	1	30	1	Yes
46	1	80	2.666666667	Yes
47	1	6	0.2	Yes
48	1	30	1	Yes
49	1	20	0.666666667	Yes
50	1	23	0.766666667	Yes
51	1	7	0.233333333	Yes
52	1	10	0.333333333	Yes
53	1	8	0.266666667	Yes
54	1	30	1	Yes
55	1	33	1.1	Yes
56	1	42	1.4	Yes
57	1	20	0.666666667	Yes
58	1	10	0.333333333	Yes
59	1	10	0.333333333	Yes

61	1	25	0.833333333	Yes
62	1	25	0.833333333	Yes
63	1	30	1	Yes
64	1	20	0.666666667	Yes
65	1	40	1.333333333	Yes
66	1	30	1	Yes
Total	65		57.8	
		Fuel Saved	57.8	

Table 4.95 Two-wheeler data of Nirmala college

Total 91 two-wheeler from which 65 vehicle were shared through which average 57.83 fuel is saved by covering 7328.6

Sl No	Four-Wheeler	Distance travelled (Km.)	Shared status	Fuel Required (in L)
3	1	50	Yes	5
4	1	35	Yes	3.5
5	1	40	Yes	4
6	1	50	Yes	5
9	1	30	Yes	3
13	1	9	Yes	0.9
14	1	15.9	Yes	1.59
20	1	30	Yes	3
25	1	120	Yes	12
27	1	12	Yes	1.2
32	1	3	Yes	0.3
35	1	30	Yes	3
41	1	15	Yes	1.5
46	1	15	Yes	1.5
49	1	6	Yes	0.6
54	1	30	Yes	3
55	1	20	Yes	2
57	1	10	Yes	1
60	1	10	Yes	1
61	1	32	Yes	3.2
62	1	100	Yes	10
70	1	6	Yes	0.6
71	1	15	Yes	1.5
73	1	23	Yes	2.3
75	1	7	Yes	0.7

78	1	60	Yes	6
83	1	4	Yes	0.4
84	1	40	No	4
85	1	10	No	1
86	1	25	Yes	2.5
87	1	25	Yes	2.5
Total	31			87.79
			Fuel saved	43.895

Table 4.96 Four-wheeler data of Nirmala college

Total 245 four-wheeler from which 31 vehicle were shared through which average 43.9 fuel is saved from 7328.6

Sl No	Count	Distance travelled	Sharing status	Save
1	1	10	No	
2	1	1	No	
3	1	12	no	
4	1	0.5	No	
5	1	30	Yes	
6	1	40	No	
7	1	80	Yes	
8	1	23	Yes	
9	1	10	Yes	
10	1	30	No	
Total	10			

Table 4.97 Bicycles data of Nirmala college

Ten students are using bicycle and four of them were sharing which indicate best practice of students for encouraging sustainable modes of transportation. It has numerous benefits in the form of zero dependence on fossil fuels, zero emissions and pollution, health benefits from increased physical activity, besides being affordable travel

Sl No	Count	Distance travelled
1	1	40
1	1	80
Total	2	120

Table 4.98 Electric vehicles data of Nirmala college

Total two count of electric vehicles is used by college community contribute to air reduce pollution or greenhouse gas emissions.

4.4.13 Energy Conservation measures

4.4.13.1 Replacing the fluorescent tubes with led lights

Energy Saving through replacement of conventional lights to LED Lights of 20 / 9 Watts in future. Most of the places the facility is having LED Light Fittings. But a number of conventional lights were identified during the energy audit field survey. One 9 Watts LED light will produce a lumen of 800 lumen which is equivalent to the lumen of a 60W Incandescent lamp or equal to the lumen of 15 /16 W CFL.

Average Power of Fluorescent Lamp, T-12, kW	0.055
Number of Fluorescent Lamp, T-12	50
Average Power of Fluorescent Lamp, T-8, kW	0.032
Number of Fluorescent Lamp, T-8	96
Average Power of Incandescent Lamp, kW	0.06
Number of Incandescent Lamp	1
Average Power of CFL, 45W, kW	0.045
Number of CFL, 45W	3
Average Power of CFL, 16W, kW	0.016
Number of CFL, 16W	22
Total Power of all the lamps, kW	6.37
Total Energy Consumption, 6 Hours a Day, kWh	38.21
Annual Energy Consumption, 200 Days, kWh	7,643
Unit Cost of Electricity, ₹	10.29
After Replacing with LED Lamps	
Annual Energy Consumption for 149 Nos of 20W Lamps, kWh	3,576
Annual Energy Consumption for 23 Nos of 9W Lamps, kWh	248.40
Annual Savings in Energy Consumption after the replacement, kWh	3,818.40
Annual Savings in Energy Charges after the replacement, ₹	39,291.34
Investment Required for replacing the lamps, 20W LED, 149 Nos, ₹	37,250.00
Investment Required for replacing the lamps, 9W LED, 23 Nos, ₹	2,300.00
Total Investment Required, ₹	39,550.00
Pay Back in Months	12
Reduction in CO2 Emission in Tons	3.02

Table 4.99 Energy infrastructure details

4.4.13.2 Replacing the regular fans with bldg fans

The regular Ceiling Fans consume 70 Watts of Power where the BLDC Fans only takes 27 -30 Watts of Power. Replace the existing fans with Energy Efficient fans. Energy efficient fans have energy efficient BLDC motors. Their operation is more reliable, efficient, less noisy and lighter compared to conventional fans with the same power output. They produce much less heat and result in significant efficiency improvement. They work on unity power factor and will help reduce your reactive energy requirement. As the working hours of the institution is 6 Hours for 200 Calendar year, replacing the regular fans with BLDC Fans will not be viable. Recommend to replace the faulty fans than repairing and rewinding again with BLDC Fans will reduce the energy consumption. Also, in place of ordinary regular fans, choose BLDC fans in places where usage is around 6 Hours. There are lot of faulty fans in the institution and recommend to replace at least 10 Nos in the first phase with BLDC Fans.

Power drawn by Regular Fans (kW) (70W)	0.07
Annual working (Hrs) 6 Hrs / Day for 200 Days	1200
Annual Energy Consumed (kWh)	84
Power drawn by BLDC Fans (kW) (30W)	0.03
Annual Energy Consumed by Energy Efficient Fan (kWh)	36
Estimated Energy saving after implementation (in kWh) for 10 Fans	480
Average Cost of Electricity per unit (Rs.)	10.29
Annual saving in (Rs.) for 10 Fans	4,939
Additional Investment required ₹(Approximate)	13000
Simple Pay Back (in Months)	32
Life Cycle Savings (7 Years)	25690
CO_2 Emission Reduction, Tons / Year	0.38

Table 4.100 Infrastructure analysis

4.4.13.3 Choosing five star inverter split air conditioners

The facility is having fixed speed, 3 Star Split Air Conditioners of varying cooling capacity in all the places. There are two numbers of Window Type Air Conditioners are also in place. The five-star, variable speed (Inverter) Split Air Conditioners are energy efficient and uses less energy compared to its fixed speed counterpart. The cooling output will be increased with reduced energy consumption. But replacing the existing units with new will not be economical. Also, there are a number of air conditioners which are older than 10 years. 21 out of the 26 units are older than 10 Years. Recommend to replace these older units when they are faulty with new five-star rated variable speed air conditioner. Sample calculation for the proposal is given below:

SAMPLE ENERGY CALCULATION			
Average Monthly Energy Consumption of per Equipment			
SL No	Equipment	Videocon	Voltas
1	Cooling Output (Watts)	5011	4750
2	Average Wattage of Equipment (Watts)	1842	1583
3	Average Wattage running per hour (Watts)	921	792
4	Avg. No. of Hrs Running Per Day	5	5
5	Total Wattage /Day (kWh)	4.61	3.96
7	Cost of Electricity / Unit (Rs)	10.29	10.29
8	Estimated Cost / Day (Rs)	47	41

Table 4.101 Sampling energy calculation

SAMPLE ENERGY CALCULATION		
Average Monthly Energy Consumption of per Equipment		
SL No	Equipment	Daikin
1	Cooling Output (Watts)	5280
2	Power Consumption Full Capacity	1325
3	Power Consumption Half Capacity	460
4	Avg. No. of Hrs Running Per Day	5
5	Energy Consumption /Day (kWh)	2.46
6	Cost of Electricity / Unit (Rs)	10.29
7	Estimated Cost / Day (Rs)	25

Table 4.102 Sample energy calculation

The cooling capacity is increased to 5% and 11% respectively.

- The energy consumption is reduced to 47% and 38% respectively.

Annual Energy Consumption by the two AC Units, 5 Hours, 200 Days	1712.50
Estimated Energy saving after implementation (in kWh)	729.33
Average Cost of Electricity per unit (Rs.)	10.29
Annual saving in ₹ for 2 A/C Units	7504.81
Additional Investment required ₹(Approximate) for 2 Units	20000.00
Simple Pay Back (in Months)	31.98
CO2 Emission Reduction, Tons / Year	0.58

Table 4.103 Annual energy consumption

4.4.13.4 Biogas plant for canteen

The canteen is generating around 15 KG of food waste average in a day. There is a biogas plant of 0.5m3 is in place. Enhancing the capacity of the Biogas plant to 15Kg will help to reduce the LPG Consumption to a large extent.

The financial calculation of the proposal is shown below:

Average Daily Generation of Food Waste, Kg	15.00
Average Annual Generation of Food Waste, 200 Days	3,000.00
Average estimated production of Biogas, m3 / Annum	4,800.00
Average Calorific Value of Biogas, Kcal /m3	10,400.00
Average Calorific Value of LPG, Kcal / m3	21,500.00
Amount of LPG can be replaced, m3	2,321.00
Average Price for LPG, ₹ / m3	156.00
Annual Savings in ₹	3,62,076.00
Investment Required for revamping the existing Bio Gas Plant	1,50,000.00
Payback period in Months	5.0
Reduction in CO2 Emission in Tons	12.58

Table 4.104 Biogas generation (Hostel)

4.4.13.5 Off-grid polar PV

The facility is having p Off Grid Solar Power Plant. In the current usage pattern, 100kWp plant is required for entire campus for net zero electricity consumption from the utility. The facility is having the feasibility for installing at least 50kWp Off Grid Solar Power Plant now.

Financial calculation for the proposal is:

Proposed Solar installed Capacity (kWp)	50.00
Average kW per day expected (3.5kWh/day average)	175.00
otal annual Generating Capacity (For 365 days) (kWh)	63,875
Estimated Average Monthly Consumption	10,720
Yearly Energy Consumption (kWh) - Estimated	1,28,640
Cost of Energy /Unit (Supplied by KSEB)(₹)	10.29
Savings on Annual Energy Consumed (₹)	6,57,274
nvestment required (Lakhs ₹.)(Approx.) (₹ 65,000 per kW)	32,50,000
Simple Pay Back (in Years)	5
Life cycle in years	25
otal Saving in Life Cycle (Approx.) ₹. (Estimated as for 10 years 100 % efficiency, or 15 years 70 % efficiency)	1,02,24,112
CO2 Emission Reduction, Tons it's life cycle (25 Years)	1,034.46

Table 4.105 Solar production details

4.5 ENERGY MANAGEMENT PLAN

4.4.1 Introduction

Nirmala College (Autonomous), Muvattupuzha, is deeply committed to fostering a culture of sustainability through responsible energy management practices. As an academic institution, the college recognises its vital role in setting an example for environmental stewardship. This Energy Management Plan has been developed to ensure efficient energy use, minimise environmental impact, and engage the entire campus community in sustainable practices. The plan outlines strategic actions, responsible governance, monitoring systems, and long-term goals to achieve a significant reduction in energy consumption and promote renewable energy adoption across the campus.

4.4.2 Establish an Adept Energy Management Team

To oversee the successful implementation of the energy management plan, the college has constituted an adept Energy Management Team. This team includes representatives from teaching staff, technical personnel, administrative staff, and students. The primary responsibility of the team is to coordinate all energy-related activities on campus, ensure alignment with sustainability goals, and monitor progress regularly. The team also plays a key role in identifying opportunities for improvement, responding to audit findings, and motivating all departments to participate actively in energy-saving measures. Their leadership ensures the plan remains focused, collaborative, and effective.

4.4.3 Formulate a Comprehensive Strategy for Sustainable Energy Management

4.4.3.1 Climate-Responsive Campus Planning

Future campus developments will incorporate climate-sensitive design. Passive strategies such as planting shade trees, using reflective building materials, and designing structures to maximise airflow will help reduce indoor temperatures and lower the need for artificial cooling.

4.4.3.2 Faculty-Led Sustainability Innovation Hub

An internal platform will support faculty-driven initiatives related to sustainable energy practices. This hub will encourage applied research and promote campus-level innovations that reduce energy consumption or improve environmental stewardship.

4.4.3.3 Energy-Efficient Procurement Practices

Procurement policies will be revised to favour products and services that meet energy-efficiency standards. The college will prioritise suppliers with recognised environmental certifications and sustainable manufacturing practices.

4.4.3.4 Readiness for Energy Regulations and Reporting

The college will initiate basic assessments of its energy use and carbon footprint in preparation for emerging environmental regulations. This effort will guide future planning and demonstrate institutional commitment to responsible energy management.

4.4.3.5 Sustainable Mobility Practices

Efforts will be made to encourage low-energy mobility within the campus by promoting walking and the use of bicycles, while reducing reliance on private motor vehicles. These steps aim to reduce transport-related energy usage, even in small and feasible ways.

4.4.4 Implement Effective Methods to Attain Set Objectives

4.4.4.1 Awareness Campaigns:

A core component of the plan is building awareness among students, faculty, and staff. Regular campaigns will be organised within departments and across campus to highlight the importance of energy conservation. These will include seminars, posters, competitions, and classroom discussions that empower the community to adopt responsible energy habits.

4.4.4.2 Infrastructure Development:

The college will prioritise upgrading existing infrastructure to ensure maximum energy efficiency. This includes replacing conventional lighting with LED fixtures, using 5-star-rated electrical appliances, and designing new buildings with natural ventilation and thermal insulation. Solar panels will be expanded to cover additional blocks, thereby increasing the share of renewable energy in the campus energy.

4.4.4.3 Partnerships with Energy Management Agencies:

The institution will collaborate with recognised energy management agencies and green building consultants to guide its transition toward more sustainable systems. These partnerships will provide technical advice, training, and access to audit services that enhance institutional capacity.

4.4.4.5 Encouraging Student Involvement:

Students are central to the energy management strategy. They will participate as energy monitors, audit team members, and campaign organisers. Students will be encouraged to generate ideas through clubs and competitions, conduct micro-research projects, and propose solutions to enhance campus energy efficiency.

4.4.4.6 Monitoring and Evaluation:

Regular monitoring and evaluation mechanisms will be established to assess the implementation of planned activities. The effectiveness of awareness drives, infrastructure changes, and behavioural shifts will be tracked, documented, and reported to the college council. These evaluations will shape future strategies and identify gaps requiring immediate attention.

4.4.4 Establish Robust Communication Channels and a Governing Body

4.4.4.1 Designating Responsibility:

Clear roles and responsibilities will be assigned to team members and departmental representatives. Each department will nominate a coordinator responsible for promoting and monitoring energy practices at the local level, under the guidance of the central team.

4.4.4.2 Establishing Communication Channels:

Internal communication will be maintained through regular meetings, circulars, notice boards, and digital platforms. These will help disseminate instructions, share data, and maintain transparency throughout the system.

4.4.4.3 Regular Feedback Mechanisms:

Suggestions and grievances from students, staff, and stakeholders will be regularly collected and reviewed. Feedback forms, discussion forums, and suggestion boxes will be institutionalised to ensure the system remains responsive and participatory.

4.4.4.4 Documentation and Reporting:

All actions taken under the energy management plan will be carefully documented. Periodic reports, audit summaries, and photographic evidence of activities will be submitted to the governing body and archived for future reference. This documentation will ensure accountability and support accreditation, grant applications, and policy updates.

4.4.5 Objectives

4.4.5.1 Long-Term Objectives:

The long-term vision of the plan includes reducing the total energy consumption of the college by 10% annually, ensuring that all major buildings are powered at least partially by renewable sources, and integrating energy-conscious practices into every aspect of institutional functioning. The college also aims to become a recognised model for sustainable campus management within the state.

4.4.5.2 Short-Term Objectives:

In the short term, the plan seeks to conduct internal audits, implement basic conservation measures, replace outdated equipment with energy-efficient alternatives, and initiate at least one energy awareness activity in the college every month. These actions will create the foundation for long-term transformation.

4.4.6 Continuously Monitor and Enhance the System

4.4.6.1 Periodic Audits:

Internal energy audits will be conducted regularly by trained student and faculty teams. These audits will focus on energy bills, appliance conditions, and metering accuracy.

4.4.6.2 Performance Tracking:

Key performance indicators such as monthly electricity consumption, solar output, and awareness programme reach will be tracked systematically. A dashboard or spreadsheet system will be used to visualise trends and detect irregularities.

4.4.6.3 Adapting to New Technologies:

The college will remain open to adopting emerging technologies that improve energy efficiency. Proposals involving smart systems, energy automation, or sensor-based lighting will be evaluated and implemented wherever feasible.

4.4.6.4 Community Involvement:

The plan also includes outreach components involving the local community. The college will spread energy conservation awareness beyond the campus through extension activities and collaborations, and contribute to broader environmental goals.

4.4.7 Conclude and Conduct Follow-ups on the System

4.4.7.1 Assessing Success Rates:

At the end of each academic year, the Energy Management Team will assess the effectiveness of implemented strategies. This will be based on consumption data, audit results, participation levels, and feedback received.

4.4.7.2 Feedback Collection:

Stakeholders will be invited to reflect on the strengths and weaknesses of the plan. Students and staff will contribute their observations and suggestions, ensuring that ground-level perspectives shape future improvements.

4.4.7.3 Reviewing Policies:

Based on audit findings and feedback, existing policies and procedures will be reviewed and revised. New protocols will be introduced where gaps are identified, and older ones will be updated to match current requirements.

4.4.7.4 Recognizing Achievements:

Departments, staff, and students who show exceptional commitment to energy conservation will be recognised publicly. Awards and appreciation certificates will be used to motivate continued participation and innovation.

4.4.7.5 Future Planning:

Each annual cycle will conclude with planning for the next year. This will include setting new targets, proposing new infrastructure investments, and identifying opportunities for external funding. A clear roadmap will ensure that energy management remains an ongoing institutional priority.

4.4.8 Conclusion

The Energy Management Plan of Nirmala College, Muvattupuzha, reflects the institution's dedication to environmental sustainability and responsible resource use. Through the establishment of a management team, a well-structured strategy, active community involvement, and a strong monitoring framework, the college is taking concrete steps toward energy efficiency. The systematic and inclusive approach ensures that this plan will not only reduce energy consumption but also create a lasting culture of sustainability within the campus community.

4.6 CONCLUSION

- The total annual consumption of the entire campus is 227639 kWh. The campus is electrified by multiple LT connections. The annual Energy Charges for the entire campus is Rs.24.22 Lakh. There is total 17 consumers in the campus most of the consumers are under Educational Institution Tariff. Main connection is for the entire administrative block and college block, one connection is for MCA block and others are for various hostels and small single phases like ATM centres and branding purposes. The total annual consumption of the entire campus is 227639 kWh.

- The assessment indicate There are no proper Electrical drawings or schematics are present in the campus. The Current Harmonics exceeds the limit. The Current unbalance is present. There is no voltage unbalance or voltage drop. Need to test, calibrate, and document the protection relays in the HT Panel and MSB. Earth pits are not identified. Need to identify, test and document the earth pits in an interval of once in a year. Absence of Single Line Diagram of the facility approved by the Electrical Inspectorate; Kerala it must exhibit in the substation. The earth pit lay out is also not available. The panels are full of dust, cobwebs and the U Beading for the IP Protection are missing. There are chances for an accident due to temporary or extension wiring. Authorized persons should be present in campus for operation and maintenance of electrical systems. The rubber mats are damaged in most of the places and there is no mat provided in some panels. Reported the absence of identifications and labelling. Tracing of electrical circuit is difficult, if an accident occurs. Harmonics present in electrical system need to improve the quality of supply.

- An analysis of energy consumption indicates a strong correlation between peak usage and standard business days, which is attributed to the college operating at full capacity. While this trend is primarily linked to ongoing campus activities, notable variations exist. For instance, the MCA block recorded greater energy consumption during a semi-holiday than on a standard workday due to its use for competitive exam coaching. Furthermore, the student hostels represent another area of significant and sustained consumption, which fluctuates based on resident occupancy and individual usage habits.

- The internal assessment confirms that the strategic, phased implementation of solar power systems has been a definitive success. The installation of a combined 83 kW of solar capacity across four key locations the Main Block (40 kW), MCA Block (15 kW), DJ Block (19 kW), and Nirmala Pharmacy (9 kW) has fundamentally shifted energy profile of the college. Collectively, these systems export an average of 4,821 units of surplus energy to the KSEB grid per billing cycle, demonstrating a significant reduction in grid dependency and an increase in energy self-sufficiency. The Main Block's system, exporting 2,845 units on average, stands out as a particularly successful benchmark for the project. The analysis highlights, reducing consumption does not always lead to proportional cost savings, as evidenced by disproportionately high bills in 2024. This indicates that external factors, primarily KSEB tariff adjustments, are significantly influencing financial outcomes.

- The solar initiative has successfully achieved its primary goal of reducing reliance on the KSEB grid, a complete picture of its financial benefits requires further investigation. Future actions should focus on auditing the identified anomalies, including potential meter malfunctions, building inefficiencies, and the precise impact of tariff changes, to fully optimize our energy costs. The Library Hall is a critical area of energy consumption, a fact directly attributable to its significant concentration of instruments and equipment. This assertion is substantiated by the proven correlation between the quantity of electrical devices and the hall's kilowatt-hour usage. Because the data was meticulously calculated based on the real-world operational behaviour of the equipment and the occupancy patterns of the college community, these findings provide a reliable and accurate picture of the hall's energy profile, identifying it as a key focal point for energy management.

- The assessment confirms that the Library Hall is a significant contributor to the college's overall energy load. The high concentration of electrical instruments and equipment directly correlates with its substantial kilowatt-hour (kWh) consumption. The data, validated against equipment usage and building occupancy patterns, provides a reliable basis for this conclusion. This area requires targeted attention for future energy management strategies.

- The college has made a substantial investment in energy efficiency by installing 1,389 LED lights. However, this transition is incomplete. The audit identified 85 non-LED fixtures (82 CFLs, 2 incandescent bulbs, and 1 zero-watt bulb) that are still in operation. These obsolete units consume significantly more energy than their LED counterparts and represent a source of unnecessary energy waste. Beyond the immediately replaceable bulbs, the continued use of standard tube lights, ceiling lights, and spotlights that have not yet been upgraded to LED technology presents a major untapped potential for energy savings.

- Based on available records from the 2022-23 and 2023-24 periods, the institution's annual diesel consumption for generator operation averages 3,200 litters. This figure establishes a clear and current baseline for energy reliance during power outages. While this data is crucial for understanding recent operational costs and environmental impact, the absence of historical data prior to this period prevents a long-term trend analysis. Therefore, it is essential to continue meticulous tracking of this consumption to monitor for any future increases or decreases in dependency.

- Based on the findings, the institution demonstrates a significant and consistent reliance on Liquefied Petroleum Gas (LPG) for its core operations, with an annual procurement of 676 cylinders totalling 17,026 Kg. The consumption is distributed across essential functions, including laboratory work and food preparation in both the canteen and cafeteria. Volume of usage underscores a critical operational dependency and represents a substantial recurring financial expenditure, as well as a notable environmental footprint. Therefore, suggest a strong case for a detailed review of energy consumption patterns to identify potential efficiencies and explore more sustainable or cost-effective alternatives.

- The analysis reveals a significant and positive trend towards sustainable transportation within the college community, resulting in measurable environmental and economic benefits. The practice of vehicle sharing contribute particularly among two-wheeler users, where 65 out of 91 vehicles were shared, leading to an average fuel saving of 11560 litre/year . Although participation was lower for four-wheelers, the sharing of 31 vehicles still achieved an average fuel saving of 8779 litre/year, with these combined sharing initiatives covering a total of 20,338L per year. The habit of cycling by ten students is a standout best practice, championing a mode of transport with numerous advantages such as zero emissions, health benefits, and affordability. The inclusion of two electric vehicles further complements these efforts by directly reducing air pollution. Collectively, these findings demonstrate a clear, multi-faceted commitment to greener transport, driven by resource sharing and the adoption of zero-emission alternatives.

4.7 RECOMMENDATION

4.7.1 Develop Comprehensive Electrical Documentation: Immediately engage a certified electrical engineering consultant to survey the entire campus and create a professional Single Line Diagram (SLD) and detailed electrical schematics. This SLD must be approved by the Electrical Inspectorate of Kerala and prominently displayed in the substation as required by law.

4.7.2 Conduct an Electrical Safety Assessment: Immediately undertake a thorough cleaning of all electrical panels to remove dust and cobwebs. Replace all missing or damaged "U-Beadings" to restore their IP protection rating.

4.7.3 Replace Temporary Wiring: Systematically identify and remove all temporary and extension cord wiring, replacing them with permanent, compliant electrical installations.

4.7.4 Replace Safety Mats: Procure and install new, certified rubber safety mats in front of all electrical panels, especially where they are currently damaged or missing.

4.7.5 Identify and Test Earth Pits: Immediately locate, identify, and test all earth pits on campus. Create a master layout diagram and establish a formal, documented annual testing schedule.

4.7.6 Calibrate Protection Relays: Hire a qualified technician to test, calibrate, and document the performance of all protection relays in the HT Panel and Main Distribution Boards (MSBs).

4.7.7 Improve Power Quality: Engage an electrical expert to install appropriate harmonic filters at key points in the network to bring current harmonics within permissible limits. Meanwhile, conduct load balancing across the phases to resolve the current unbalance.

4.7.8 Appoint Authorized Personnel: Designate and formally appoint specific individuals as "authorized persons" for the operation and maintenance of electrical systems. Ensure they receive appropriate training and are available on campus.

4.7.9 Investigate Billing and Metering Anomalies: Formally contact KSEB to understand the precise tariff changes that led to disproportionately high bills in 2024. Simultaneously, commission an independent audit of the main energy meters to rule out malfunctions.

4.7.10 Transition to LED Lighting: Immediately purchase and replace the remaining 82 CFLs and 3 other non-LED bulbs. Develop a phased plan to upgrade all remaining standard tube lights, spotlights, and other fixtures to their LED equivalents over the next 12-24 months.

4.7.11 Reduce Fossil Fuel Dependency: Conduct a feasibility study to replace LPG usage in the canteen and cafeteria. Prioritize exploring commercial induction cooking equipment or the possibility of a Piped Natural Gas (PNG) connection, if available in the area.

Continue to meticulously track generator diesel consumption. Evaluate the feasibility of integrating a Battery Energy Storage System (BESS) with the existing solar installations. A BESS could store surplus solar energy and deploy it during power outages, drastically reducing generator usage. Reducing reliance on LPG and diesel will lead to substantial cost savings, improve campus safety (eliminating cylinder storage), and significantly lower the institution's carbon footprint.

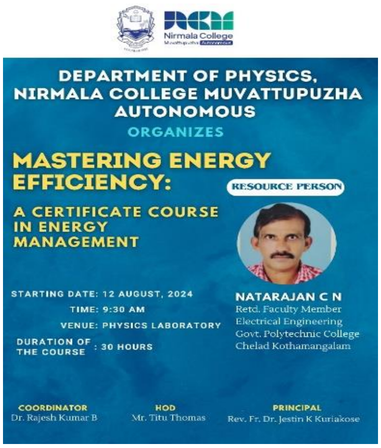
4.7.12 Promote Sustainable Transport: Create a formal platform (e.g., a simple app or internal portal) to make vehicle sharing easier and more visible. Install secure, covered bicycle racks and publicize the benefits of cycling.

4.7.13 Optimize and Expand Solar Infrastructure: Use the high-performing 40 kW system on the Main Block as a benchmark. Analyse the performance of the other three solar systems to identify opportunities for optimization. Furthermore, conduct a feasibility study for expanding solar capacity onto other large, unutilized rooftops (e.g., hostels).

Fig 4.164 Electrical assessment by external auditors

4.8 ACTIVITIES CONDUCTED

Certificate course titled "Mastering Energy Efficiency

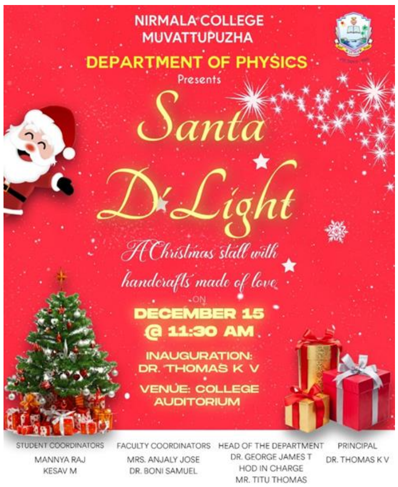


The Department of Physics, Nirmala College, Muvattupuzha, organized a certificate course titled "Mastering Energy Efficiency: A Certificate Course in Energy Management" starting on 12th August 2024. The course aimed to provide in-depth knowledge and practical insights into energy management and efficiency, equipping participants with the necessary skills to optimize energy usage in various applications.

The inaugural session commenced at 9:30 AM in the Physics Laboratory. The resource person for the course was Mr. Natarajan CN, a retired faculty member from the Electrical Engineering Department, Govt. Polytechnic College, Chelad, Kothamangalam. With his vast experience in the field, Mr. Natarajan provided valuable insights into energy management strategies, conservation techniques, and sustainable energy practices. During the sessions, participants were introduced to various aspects of energy management, including energy auditing, renewable energy sources, efficiency improvement techniques, and cost-effective energy solutions. The interactive nature of the course allowed students to engage in discussions, ask questions, and gain practical knowledge applicable to real-world scenarios. The course, was coordinated by Dr. Rajesh Kumar B, with support from the Head of the Department, Mr. Titu Thomas, and the Principal, Rev. Fr. Dr. Jestin K Kuriakose. The initiative highlighted the commitment of Nirmala College's Department of Physics to promoting sustainable practices and advancing knowledge in the field of energy management.

Best Practices of the Department of Physics (2022-2023)

As part of the Christmas celebrations, the students of the Department of Physics organize Christmas stall showcasing their handmade items, including LED stars, eco-friendly cribs, a sustainable décor products on December 15, 2022. With the guidance and support of th faculty, the students created these innovative items, and the stall was opened for all colle students to visit. The official inauguration of the stall was conducted by Dr. K. V. Thomas, t Principal of the College. The first sale of an LED star, crafted by the students, was made to t College Bursar, Fr. Justin Kannadan.



Chapter V

WATER EFFICIENCY MANAGEMENT SYSTEM (We MS): AUDIT REPORT

WATER EFFECIENCY MANAGEMENT SYSTEM
(WEMS 2024-25)

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5

Water Efficiency Management System Audit Report

5.1 INTRODUCTION

Water is an essential natural resource that is critical for the survival of all living organisms. Both animals and plants rely on water to support life, as it is fundamental to their daily metabolic functions. For plants, water is indispensable for photosynthesis, allowing them to generate their own food and promote growth. Water resources include all natural bodies of water on Earth, regardless of their state vapour, liquid, or solid that can be utilized by humanity. The most readily available sources are oceans, rivers, and lakes, while additional reserves consist of groundwater, deep subsurface waters, glaciers, and permanent snowfields. On average, an individual uses about 600 to 700 litters of water each day. Although humans can survive for several days without food, the absence of water is unimaginable; similarly, plants will wilt and lose their leaves without it.

India receives an average annual precipitation of 4,000 billion cubic meters (BCM), which is distributed unevenly across different regions and times. Approximately 75% of this rainfall occurs during the four months of the monsoon season, with nearly half of it falling within a mere 15 days and under 100 hours. Kerala, recognized for its substantial annual rainfall of around 3,000 mm, experiences about 60% of this precipitation during the two monsoon periods, while the remaining 40% comes from summer showers. Nevertheless, recent alterations in weather patterns have disrupted this established cycle, resulting in more localized rainfall and flooding, which present considerable challenges for the state. ISO standards provide a cohesive framework for technology and terminology, facilitating effective collaboration among nations that share water resources. These standards offer practical solutions and best practices for sustainable water management, addressing areas such as the measurement and optimization of water usage, wastewater treatment and reuse, and the management of water services and irrigation in sectors like agriculture, manufacturing, and construction. Furthermore, they establish a basis for public policies that tackle the impacts of climate change, sanitation, and commitments to water management.

ISO environmental management guidelines, which encompass water footprint assessment, assist organizations in evaluating the effects of their water consumption and pinpointing strategies to improve efficiency and minimize usage. These standards also outline procedures for the management and treatment of sludge and by-products generated from urban wastewater systems, storm water, and water treatment facilities, thereby fostering sustainable practices in the management of water and wastewater.

5.1.1 What is Water Audit?

A water audit comprehensively assesses the water utilization of an entity, starting from the point of water intake to its discharge, meticulously scrutinizing every aspect of usage. This examination determines the quantity of water utilized, identifies any wastage or leakage, and pinpoints areas for consumption reduction. Furthermore, it evaluates existing treatment systems and practices, proposing enhancements to enhance efficiency and decrease usage. Drawing from these insights, the audit provides recommendations to minimize wastage and consumption, improve treatment methodologies, and conduct cost-benefit analyses. Additionally, it suggests implementing a system to monitor water intake, distribution, and utilization.

The requirements that must be fulfilled for a water audit are:

- A record of the amount of water supplied/consumed (total water supply) in the college/university
- Water loss and suggested measures to address water loss (through leakages, overflow and other unaccounted water losses through misuse etc.)
- Sustainable water conservation plan (habitual modifications, promotion of reuse of water; recycling waste water; harnessing alternate water sources etc.).

The water audit involves systematically obtaining a water balance by measuring the flow of water from the point of extraction or treatment, through the distribution network, to its various usage points, and eventual discharge. This process entails calculating the water balance, assessing water consumption, and pinpointing opportunities for water conservation.

5.1.2 Need for Water Audit

Water audits serve as a tool to pinpoint areas with higher specific water consumption, evaluate the burden of wastewater pollutants, and devise strategies for mitigation by employing the principles of 3R (Reduce, Reuse, and Recycle). Our water audit services have empowered industries to choose viable methods for reducing water consumption, curtailing wastewater production, and optimizing resource recovery. These audits offer comprehensive water efficiency solutions, leading to cost savings while aiding in internal policy adherence, legal compliance, and showcasing dedication to sustainability.

The functions of the water audit are:

- Reduced water losses
- Improved financial performance
- Improved reliability of supply system (quality water)
- Enhanced performance of the distribution system
- Better safeguard to public health and property
- An effective educational and public relations tool for the water
- System reduced legal liability, and
- Reduced disruption, thereby improving level of service to the entire college/university community

Creating awareness among water users (students, staff, guests) the water audits employ a multi-staged approach aimed at delivering short-term and long-term sustainable water management solutions. Throughout this process, analytical, design, and engineering experts collaborate to scrutinize the audit findings and devise enhanced strategies for water management and sustainability.

5.1.3 Benefit of water efficiency management system

Effective implementation of a water efficiency management plan results in substantial savings in water and energy, therefore reducing the environmental impact of both water discharge and the need to pump water over long distances. The adoption and proper implementation of a water efficiency management system are intended to result in improved water efficiency and can help to achieve the following outcomes:

- Identifying water as a resource can be considered part of organisational and budgetary planning.
- Assisting an organisation to manage water use better and optimise water demand.
- Recognising the impact on others that can occur with changing water use.

- Ensuring a greater level of accountability in water use.
- Providing a process for regular review for possible improvement and adoption of opportunities arising in water efficiency.
- Savings in operation by reducing water consumption through sustainable and efficient design, use of water conservation devices and proper monitoring.

5. 2 WATER EFFICIENCY MANAGEMENT POLICY

5.2. 1 Statement of commitment

Water management is essential for sustaining life, supporting economic development, and preserving the environment. It ensures access to clean and safe water for drinking, sanitation, and agriculture, which are critical for public health and food security. Effective water management also protects ecosystems by maintaining the health of rivers, lakes, and wetlands, which are home to diverse species. As climate change intensifies, managing water resources becomes even more important to mitigate the impacts of droughts, floods, and water scarcity. Furthermore, effective water management in industrial and urban settings promotes sustainable development by minimizing pollution and conserving vital resources. To ensure the availability and sustainable management of water and sanitation for all, it is essential to recognize that access to safe water, sanitation, and hygiene constitutes a fundamental human need for health and well-being. The Water (Prevention and Control of Pollution) Act in India 1947, along with the subsequent Water (Prevention and Control of Pollution) Cess Act of 1977 underscores the prerequisite for effective management and conservation practices to safeguard water resources. (Nirmala College's pioneering vision is to emphasize the importance of water management among its stakeholders by implementing an Institutional Water Management Policy that fosters innovative technologies and promotes conservation practices, ultimately securing this vital resource for future generations)

5.2.2 Goal

To promote sustainable water use across the campus by reducing consumption, enhancing conservation practices, fostering community awareness, and ensuring the protection, conservation and efficient management of water resources.

5.2.3 Objectives

- To achieve a 20% reduction in overall water consumption within five years through the implementation of effective conservation practices.
- To raise awareness among students, faculty, and staff about the importance of sustainable water management.
- To incorporate water conservation principles into academic curricula, research projects, and campus activities.
- To promote student engagement in water audit programs and related initiatives.
- To develop and maintain comprehensive systems for water recycling and conservation across campus facilities.
- To ensure the sustainable and safe management of all campus water sources, with an emphasis on preventing contamination.

5.2.4 Resource Management

A periodic water usage assessment must be carried out which include current water consumption rates and patterns, recognizing the areas of high usage and evaluating current infrastructure and areas to improve. The following assessment measures were to be implemented.

5.2.4.1. Replenishment systems to implement measures to reduce and reuse water

This could involve installing water-efficient taps, promoting water-saving practices such as rainwater harvesting, and encouraging the use of recycled water for non-potable purposes.

5.2.4.2. Infrastructure Updates

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

5.2.4.3. Emergency Preparedness

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

5.2.4.4. Water conservation measures

5.2.4.4.1. Ensure the conservation of water resources by implementing techniques such as rain water harvesting in the campus.

5.2.4.4.2. Establishment of water recharge facilities to promote the recycling of water resources, thereby contributing to water conservation and energy savings

5.2.4.4.3. Encourage the adoption of holistic approaches to water management that take into account environmental, social, and economic factors.

5.2.5 Curriculum Integration

Design and implement comprehensive educational initiatives aimed at raising awareness about water conservation among students, faculty, and staff. These initiatives may include workshops, seminars, and awareness campaigns that emphasize the critical importance of water conservation and provide practical strategies for reducing water consumption. It is essential to translate this awareness into actionable behaviours that promote the prudent use of water resources. Furthermore, integrate water management objectives into the academic curriculum by offering specialized courses on topics such as rainwater harvesting and water quality assessment. Additionally, foster research and innovation in water conservation technologies and practices to support sustainable water management solutions.

5.2.6 Green Initiatives

Green initiatives such as drip irrigation and mulching are already in place, which will be widened and other techniques such as xeriscaping will be implemented in the campus.

5.2.6.1 Xeriscaping: Replace traditional grass lawns with drought-tolerant, native plants that require less water and maintenance.

5.2.6.2 Drip Irrigation: Use drip irrigation systems instead of sprinklers to deliver water directly to plant roots, minimizing water wastage.

5.2.6.3 Mulching: Apply mulch around plants to retain soil moisture and reduce the need for frequent watering.

5.2.7. Research and Innovation

The institution aims to promote research and innovation in water conservation strategies that can be adopted for our institution, and for the general public. Research on developing technologies for the reuse of grey water for house hold, and industrial applications is a theme which is actively pursued in our research centres. The research activities in these areas will be widened and the results will be published in nationally and internationally recognized journals. Analysis of contaminants in the wells and rivers of the surrounding areas will be conducted periodically using the facility available in the institution, and the data will be made available to the concerned local authorities for remedial actions.

5.2.7 Community Engagements

As an institution committed to using its resources for the benefit of society, we will collaborate with local bodies on initiatives such as conducting training in rainwater harvesting, organic farming, and other sustainable practices, utilizing the expertise of our faculty. We will also offer services such as quality testing of well water samples and provide recommendations for remedial measures that local residents can adopt.

5.2.8 Monitoring and Reporting

Implement a comprehensive system for monitoring water usage and appoint representatives to oversee and report on conservation efforts. This process may include the installation of flow meters to track water consumption, conducting infrastructure assessments with necessary maintenance, setting consumption reduction targets, and periodically evaluating progress toward achieving these objectives.

5.2.9 Compliance and Review

Ensure adherence to applicable water regulations and standards. Develop comprehensive guidelines and protocols for effective water management, while offering support to facilitate compliance efforts. Integrate necessary modifications and update the policy in accordance with evolving requirements.

5.2.10 Leadership and Accountability

This policy will serve as the reference document for all green initiatives on water efficiency management. A time frame will be set up for the activities proposed in this policy document and the efficient implementation of the same will be ensured. A team designated by the head of the institution will monitor and review the progress in various initiatives.

5.2.11 Conclusion

In conclusion, the Water Efficiency Management System (WEMS) Policy at Nirmala College stands as a critical initiative to promote sustainable water usage, foster environmental stewardship, and ensure the preservation of this vital resource for future generations. By setting ambitious yet achievable goals, such as reducing overall water consumption by 20% within the next five years, and integrating water conservation practices into campus activities, the policy envisions a comprehensive approach to water management. Through resource management, curriculum integration, green initiatives, and community engagement, Nirmala College aims to lead by example and encourage its students, faculty, and staff to embrace innovative solutions for sustainable water use. The institution's commitment to research, innovation, and collaboration with local bodies will further contribute to the broader objective of safeguarding water resources and enhancing the quality of life in the surrounding community. With strong leadership, accountability, and periodic reviews, this policy will not only meet current needs but also set a sustainable path forward, ensuring a positive impact on both the environment and the well-being of future generations.

5.3 METHODOLOGY

A comprehensive water efficiency audit, crucial for sustainable development, assessed water usage and maintenance practices across the college. The audit methodology involved a ground level survey by a 10-member team (8 students, 3 faculty) conducted as per a pre fixed schedule. The team was then segmented into specialized groups to execute tasks such as documenting proceedings, inspecting plumbing fixtures, and conducting block-by-block site evaluations. The structured audit relied upon eight distinct registers and five key guiding documents.

5.3.1 Internal Audit Training

Green audit training employs comprehensive, participatory approaches to foster a sense of institutional ownership and engagement. To equip the college for this process, the established Environmental Management System (EMS) selects students and faculty members for internal audit training. This one-day program certifies participants as internal auditors, qualifying them to conduct a water audit. The internal water audit process encompasses several key stages: assessment, risk analysis, data collection, policy generation, and the documentation of registers and programs for water conservation and resource management.

5.3.2 Water Infrastructure Survey

The internal audit team conducted a comprehensive water infrastructure survey. This involved inventorying taps and faucets by type and quantity, assessing their condition, and specifically recording the location and number of leaks. The team mapped all water sources for each block, including external ones, and documented water storage systems, noting type, capacity, installation year, and location. This data facilitated an assessment of infrastructure functionality (taps, faucets, pumping lines). The audit also encompassed water quality analysis, evaluation of water risk management strategies, and a review of maintenance practices.

5.3.3 Sampling Data Collection of Nine Water Meters

In order to monitor water distribution, flow meters were deployed at five locations where main lines originate from their respective sources or tanks. Meter readings were acquired over a three-week timeframe during scheduled sampling days. Concurrently or separately, depending on the actual process, pump run times and associated water volumes were documented in triplicate across a nine-day observation period. The collected data, encompassing date, time, volume, and duration metrics, facilitated subsequent flow rate calculations.

5.3.4 Registers for the Monitoring and Analysing

The audit encompassed an assessment of water footprint registers, analysis of usage patterns, grey water recycling systems, water loss mitigation, and comprehensive water resource management. Furthermore, systematic documentation of meetings and programs focused on water conservation and sustainability established a clear baseline of the college's current water resources and practices.

5.3.5 External Auditing

Upon completion of the internal audit, an external auditor visits the college to evaluate conformity and identify any non-conformities with water management audit requirements. If only minor non-conformities are found, the external auditor may then approve the institution for certification against relevant ISO standards

Fig 5.1 Infrastructure data collection

Fig 5. 2 Manual discharge of water from tap

Fig 5. 3 Collecting flow meter reading data

Fig 5. 4 Manual discharge of water from toilet taps

Fig 5. 5 Collecting flow meter reading data

Fig 5. 6 Manual discharge of water from college labs

5.3.6 Assumption

Global water scarcity stands as a critical and escalating challenge, demanding proactive solutions. To mitigate this issue and advance water conservation within non-domestic sectors, organizations must implement sustainable water management strategies. Persistently limited freshwater availability, exacerbated by consumption patterns, intensive agricultural/industrial demands, and climate change, necessitates more effective resource stewardship. While water resources cannot be increased, their management can be optimized through a structured framework encompassing water efficiency enhancements, consumption analysis tools, and systematic conservation measures. Such a framework not only drives significant water and energy savings but also reduces environmental footprints.

Aligning water management plans with established principles, such as those outlined in ISO 46001, yields substantial benefits. This includes integrating water resource identification into organizational planning and financial decision-making, optimizing water demand, improving usage management, and fostering accountability by highlighting potential social impacts. Regular evaluation protocols identify opportunities for efficiency gains, translating into operational savings via conservation technologies, sustainable design, and diligent monitoring. Comprehensive audits across key infrastructure points from sources and treatment plants to distribution networks and end-users are essential for identifying water losses, supporting system upgrades, and ensuring water quality through strategic monitoring, which informs the design of appropriate treatment systems. Leakage assessments form an integral part of this evaluation process.

5.3.7 Water Footprint Verification

The strategic importance of water use within national sustainability frameworks underscores the requirement for dependable and comparable data to support effective regulation. ISO 14046 fulfils this requirement by offering a standardized methodology for water footprint assessment and reporting, emphasizing accuracy through independent verification protocols. Stakeholder, consumer, and international organizational interest in corporate water performance is rising, focusing on the comprehensive water footprint, which includes both direct and indirect water consumption and related environmental impacts. Consequently, the ISO 14046 standard was established to provide a robust framework for these assessments. It facilitates the determination of water footprints for organizations, processes, and products, evaluating not just water consumption volumes but also potential environmental consequences. ISO 14046 assessments can be conducted independently, concentrating solely on water impacts, or as part of a comprehensive life cycle assessment (LCA). As pressures mount in the 21st century due to factors like climate change reducing water availability, adopting efficient water management practices becomes imperative for businesses.
Utilizing ISO 14046 and associated verification, often complemented by training programs (e.g., SGS), allows organizations to credibly demonstrate 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 water conservation policy of the institution)
- Discusses with the responsible persons of each location (staff, teachers, lab assistants, sweepers, watchmen, students etc.) about the usage pattern and habits related to water consumption.

This phase includes following specific activities:

System audit (inventory of infrastructure)

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

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

- Water audit comprises of preparation of 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 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:

Source sustainability audit

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

<u>Discharge audit</u>

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

5.3.8.4 Schedule of water audit

Week	Week Days	Weekly Work Plan
First Week	07-01-25 to12.01.25	Conduct team meeting to developing policies and action plan. Forming subgroups of water audit members and place registers on required areas for data collection.
Second Week	14-01-25 to 18-01-25	Divide the campus into distinct sections and carry out the survey to determine the number of types of taps, faucets, tanks and water sources located in each area.
Third Week	21.01.25 to 26.01.25	Construct a water map of the whole campus by combining and analyzing the survey data. Conduct team meeting to review the collected data.
Fourth Week	28.01.25 to 02.02.25	Inspect the equipment's and the water source's present states. (Include in a good, poor or moderate category).
Fifth Week	04.02.25 to 08.02.25	Identify the water loss and problems by conducting a walk through audit and filing a request to address the situation.
Sixth Week	11.02.25 to 16.02.25	Measure the water flow rate of each user points.
Seventh Week	18.02.25 to 22.02.25	Install water meters at each user point.
Eighth Week	25.02.25 to 02.03.25	Record water flow meter reading from each block and assessing water consumption.
Nineth Week	03.03.25 to 08.03.25	Analyzing the physical, chemical, and biological quality parameters of various water resources within the campus. Implementation of water conservation and sustainability strategies
Tenth Week	11.03.25 to 16.03.25	Compile all data collected and capture photographs. A meeting will be held to analyse the progress of water audit.
Eleventh Week	18.03.25 to 22.03.25	Ensuring all registers and documents are completed before finalizing report.

Table 5.1 Work plan for the audit of the water efficiency management

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

5.3.9.2 . 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 tern and short term
- Final report & certification as per ISO standards.

5.3.9.4 Schedule of water audit

Activities	Frequency	Dates of study	Mode of data collection
Water meter reading (for every meter in the college) OR manual one time evaluation	9 days; three times a day	Three (Holiday) 26/8/2025, 28/8/2025,1/9/2025 Three semi holidays as 24/8/2025, 31/8/2025,7/9/2025 Three working days as 27/8/2025, 3/9/2025 ,4/9/2025 (complete by three weeks)	Entry in the given format
Usage pattern and quantity of water. Documentation of current WEMS practices. Grey water quantity from each section	Walk through audit and interviews with system managers (controlling or responsible staff or teachers)	Collect data on water usage from each section of every divisions of the college (for eg., in canteen, how much water is used for hand wash, cooking and its preparation, cleaning utensils, floor, table etc.	Entry in the given formats
Details of present water sources & Water tank details	Type (open well, pond, tube well etc.), external sources (water supply)	Prepare a detailed inventory on each and every current water 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 water audit data collection process

5.4 RESULTS & OBSERVATION

5.4.1 Water Infrastructure of the college –Fixture & Gadgets

Ground Floor					
Location	Tap	Flush	Faucet	Shower	Sprinkler
ABMH hall	9	0	0	0	0
ABMH Washroom	1	1	1	0	0
AV Hall Washroom (Ladies)	3	2	0	0	0
AV Hall Washroom (Gents)	3	2	0	0	0
AV Hall Washroom (Common)	2	1	0	0	0
AV Hall Washroom (Common)	2	1	0	0	0
Total	20	7	1	0	0
First Floor					
Location	Tap	Flush	Faucet	Shower	Sprinkler
Guest room 1	2	1	1	1	0
Guest room 2	2	1	1	1	0
Guest room 3	2	1	1	1	0
Guest room 4	2	1	1	1	0
Principal’s personal room	2	1	1	1	0
Total	10	5	5	5	0
Second Floor					
Location	Tap	Flush	Faucet	Shower	Sprinkler
Dining Hall	2	0	0	0	0
VIP Lounge	2	1	1	1	0
Manager room	2	1	1	1	0
Server room	2	1	1	1	0
Server room	2	1	1	1	0
Total	10	4	4	4	0
Third Floor					
Location	Tap	Flush	Faucet	Shower	Sprinkler
Office	1	0	0	0	0
Principal room	2	1	1	0	0
Vice-Principal room	2	1	1	0	0
Washroom (Gents)	5	1	1	1	0
Washroom (Ladies)	3	1	1	1	0
Bursar Room	2	1	1	0	0
Total	15	5	5	2	0
Fourth Floor					
Location	Tap	Flush	Faucet	Shower	Sprinkler
SV hall (wash room 1)	1	1	1	0	0
SV hall (wash room 1)	1	1	1	0	0
Total	2	2	2	0	0

Table 5.3 Infrastructure of Administrative block

Ground Floor					
Location	Tap	Flush	Faucet	Shower	Sprinkler
Ladies Toilet	31	7	7	0	0
Wash Area	12	0	0	0	0
Rest Room	6	1	1	0	0
Chemistry Research Lab	4	0	0	0	0
Water purifier	2	0	0	0	0
Water purifier	2	0	0	0	0
MSc Chemistry Lab I	11	0	0	2	0
MSc Chemistry Lab II	1	0	0	0	0
BSc Chemistry Lab	25	0	0	2	0
Chemistry Staff Room	2	1	0	0	0
Dining Area	1	0	0	0	0
Gents Toilet	7	5	5	0	0
Gents Toilet (Urinal)	0	5	0	0	0
Wash Area	12	0	0	0	0
Cafeteria	3	0	0	0	0
Outside	1	0	0	0	0
Garden	3	0	0	0	0
Total	123	19	13	4	0
First Floor					
Location	Tap	Flush	Faucet	Shower	Sprinkler
Water purifier	2	0	0	0	0
Gents Toilet	14	7	0	0	0
Gents Toilet (Urinal)	0	5	0	0	0
MSc Zoology Classroom	3	0	0	0	0
Zoology Museum	1	0	0	2	0
Zooology Lab	5	0	0	0	0
Zoology Staffroom	2	1	1	0	0
Zoology Research Lab	1	0	0	0	0
Nano Research Centre	1	0	0	0	0
Physics Staffrrom	2	1	0	0	0
Economics Staffrrom	2	1	1	0	0
Total	33	15	2	2	0
Second Floor					
Location	Tap	Flush	Faucet	Shower	Sprinkler
Water purifier	2	0	0	0	0
Washroom (Ladies)	6	4	0	0	0
Mathematics Staffroom	2	1	0	0	0
Commerce Staffroom	2	1	0	0	0
English Staffroom	2	1	0	0	0
Botany Staffroom	2	1	0	0	0
Botany Lab	4	0	0	0	0
Room	1	0	0	0	0
Total	21	8	0	0	0

Table 5.4 Infrastructure of Main block

Ground Floor (Canteen)					
Location	Tap	Flush	Faucet	Shower	Sprinkler
Kitchen	10	0	0	0	0
Washing area	7	0	0	0	0
Washroom	2	2	0	0	0
Outside	13	0	0	0	0
Total	32	2	0	0	0
First Floor					
Location	Tap	Flush	Faucet	Shower	Sprinkler
Washroom 1	2	2	0	0	0
Washroom 2	3	1	1	0	0
Total	5	3	1	0	0
Second Floor					
Location	Tap	Flush	Faucet	Shower	Sprinkler
Library	1	0	0	0	0
Water Purifier	1	0	0	0	0
Total	2	0	0	0	0

Table 5.5 Infrastructure of Library Golden Jubilee Block

Ground Floor					
Location	Tap	Flush	Faucet	Shower	Sprinkler
Director Room	3	2	2	0	0
BCA Department	2	1	0	0	0
Washroom (gents)	25	21	10	0	0
Washroom (gents urinal)	0	5	0	0	0
Washroom (ladies)	10	8	0	0	0
Water Purifier	2	0	0	0	0
Washroom (Common)	3	2	4	0	0
Garden	0	0	0	0	2
Total	45	39	16	0	2
First Floor					
Location	Tap	Flush	Faucet	Shower	Sprinkler
Commerce Department	2	1	1	0	0
Water Purifier	2	0	0	0	0
Washroom (gents)	10	9	8	0	0
Washroom (gents urinal)	0	4	0	0	0
Washroom (ladies)	10	8	8	0	0
Total	24	22	17	0	0
Second Floor					
Location	Tap	Flush	Faucet	Shower	Sprinkler
Comm. English Department	2	1	1	0	0
Washroom (gents)	5	4	4	0	0
Washroom (gents urinal)	0	4	0	0	0
Washroom (ladies)	5	4	4	0	0
Total	12	13	9	0	0

Table 5.6 Infrastructure of Diamond jubilee

Ground Floor					
Location	Tap	Flush	Faucet	Shower	Sprinkler
Physical Education Dept	1	0	0	0	0
Toilet	6	6	0	0	0
Total	7	6	0	0	0
First Floor					
Location	Tap	Flush	Faucet	Shower	Sprinkler
Bathrooms	5	0	0	5	0
Total	5	0	0	5	0

Table 5.7 Infrastructure of Sports Hostel

Ground Floor					
Location	Tap	Flush	Faucet	Shower	Sprinkler
Office	2	0	0	0	0
Administrative wing	2	1	1	0	0
Library	1	0	0	0	0
Water purifier	2	0	0	0	0
Guest Room	2	0	0	0	0
Sick Room	2	1	1	0	0
Classroom	2	1	1	0	0
Garden	5	0	0	0	0
Office Washrooms (gents)	3	1	1	0	0
Office Washrooms (ladies)	2	1	1	0	0
Washroom (gents urinal)	0	4	0	0	0
Washroom	21	3	0	0	0
Total	44	12	5	0	0
First Floor					
Location	Tap	Flush	Faucet	Shower	Sprinkler
Washroom (ladies)	17	6	0	0	0
MCA department	4	2	2	0	0
Water purifier	2	0	0	0	0
Total	23	8	2	0	0
Second Floor					
Location	Tap	Flush	Faucet	Shower	Sprinkler
Washroom (ladies)	9	4	4	0	0
Washroom (gents)	8	4	4	0	0
Washroom (gents urinal)	0	4	0	0	0
Water purifier	2	0	0	0	0
Total	19	12	8	0	0

Table 5.8 Infrastructure of MCA block

Ground Floor					
Location	Tap	Flush	Faucet	Shower	Sprinkler
Malayalam Department	2	1	0	0	0
Women Cell	2	1	0	0	0
Washroom (gents)	16	2	2	0	0
Washroom (gents' urinal)	0	5	0	0	0
Washroom (ladies)	11	1	0	0	0
Water Purifier	2	0	0	0	0
Garden	2	0	0	0	21
Total	35	10	2	0	21
First Floor					
Location	Tap	Flush	Faucet	Shower	Sprinkler
Data Science Department	2	1	0	0	0
Water Purifier	2	0	0	0	0
Statistics Department	2	1	0	0	0
Total	6	2	0	0	0
Second Floor					
Location	Tap	Flush	Faucet	Shower	Sprinkler
Hindi Department	2	1	1	0	0
Classroom	1	1	0	0	0
Washroom	2	1	0	0	0
Water Purifier	3	0	0	0	0
Total	8	3	1	0	0

Table 5.9 Infrastructure of Silver Jubilee Block

Ground Floor					
Location	Tap	Flush	Faucet	Shower	Sprinkler
Kitchen	4	0	0	0	0
Washrooms	12	8	8	8	0
Verenda	4	0	0	0	0
Water purifier	1	0	0	0	0
Dining Hall	14	0	0	0	0
Hand washing	26	0	0	0	0
Garden	7	0	0	0	0
Washing area	6	0	0	0	0
Cow shed	2	0	0	0	0
Total	76	8	8	8	0
First Floor					
Location	Tap	Flush	Faucet	Shower	Sprinkler
Veranda	4	0	0	0	0
Bathrooms	12	8	8	8	0
Total	16	8	8	8	0

Table 5.10 Infrastructure of Jeeva jyothi Men's hostel

Ground Floor					
Location	Tap	Flush	Faucet	Shower	Sprinkler
Kitchen	9	0	0	0	0
Teachers room	12	4	4	0	0
Parlour	2	1	1	0	0
Water purifier	2	0	0	0	0
Steamer	4	0	0	0	0
Dining Hall	9	0	0	0	0
Washing Machine	1	0	0	0	0
Garden	6	0	0	0	0
Verenda	1	0	0	0	0
Washing area	28	0	0	0	0
Cow shed	1	0	0	0	0
Total	75	5	5	0	0
First Floor					
Location	Tap	Flush	Faucet	Shower	Sprinkler
Warden Room	3	1	1	0	0
Bathrooms	27	4	4	3	0
Total	30	5	5	3	0
Second Floor					
Location	Tap	Flush	Faucet	Shower	Sprinkler
Teachers room	4	2	1	0	0
Bathrooms	29	2	1	0	0
Total	33	4	2	0	0
Third Floor					
Location	Tap	Flush	Faucet	Shower	Sprinkler
Bathrooms	29	8	8	0	0
Total	29	8	8	0	0

Table 5.11 Infrastructure of Little Flower hostel

Ground Floor					
Location	Tap	Flush	Faucet	Shower	Sprinkler
Kitchen	4	0	0	0	0
Dining Hall	13	0	0	0	0
Washing Machine	1	0	0	0	0
Outside	11	0	0	0	0
Wardens dining room	2	0	0	0	0
Common bathroom	13	0	0	0	0
Wardens room	7	4	0	4	0
Total	51	4	0	4	0

First Floor					
Location	Tap	Flush	Faucet	Shower	Sprinkler
Bath attached rooms	20	10	0	10	0
Common room	1	0	0	0	0
Common bathrooms	13	0	0	0	0
Total	34	10	0	10	0
Second Floor					
Location	Tap	Flush	Faucet	Shower	Sprinkler
Bath attached rooms	14	7	0	7	0
Common bathrooms	12	0	0	0	0
Total	26	7	0	7	0
Terrace					
Location	Tap	Flush	Faucet	Shower	Sprinkler
Cloth drying area	4	0	0	0	0
Total	4	0	0	0	0

Table 5.12 Infrastructure of St. Joseph hostel

Ground Floor					
Location	Tap	Flush	Faucet	Shower	Sprinkler
Kitchen	5	0	0	0	0
Teachers room 1	2	1	1	1	0
Teachers room 2	2	1	1	1	0
Outside	1	0	0	0	0
Cooler	2	0	0	0	0
Dining hall washing	35	0	0	0	0
Helpers Bathroom	2	1	1	0	0
Total	49	3	3	2	0
First Floor					
Location	Tap	Flush	Faucet	Shower	Sprinkler
Warden Room	2	1	1	0	0
Washroom 1	27	6	6	8	0
Washroom 2	25	5	5	7	0
First Aid Room	2	1	1	1	0
Near First Aid Room	1	0	0	0	0
Guest Room	2	1	1	1	0
Office Room	2	1	1	1	0
Outdoor	3	0	0	0	1
Total	64	15	15	18	1

Second Floor					
Location	Tap	Flush	Faucet	Shower	Sprinkler
Washroom 1	27	6	6	8	0
Guest Room	2	1	1	1	0
Near Guest Room	1	0	0	0	0
Warden Room	2	1	1	1	0
Washroom 2	25	5	5	7	0
Total	57	13	13	17	0
Third Floor					
Location	Tap	Flush	Faucet	Shower	Sprinkler
Washroom 1	25	5	5	7	0
Guest Room	2	1	1	1	0
Near Guest Room	1	0	0	0	0
Warden Room	2	1	1	1	0
Warden Room 2	25	5	5	7	0
Special Room 1	2	1	1	1	0
Special Room 2	2	1	1	1	0
Total	59	14	14	18	0
Terrace					
Location	Tap	Flush	Faucet	Shower	Sprinkler
Washing Area	8	0	0	0	0
Total	8	0	0	0	0

Table 5.13 Infrastructure of Nirmala hostel

The college campus comprises a total of 1,904 taps, 301 flush units, 174 faucets, 107 showers, and 23 sprinklers distributed across 11 locations. This infrastructure reflects the scale and diversity of the college's facilities. However, not all taps are uniform, as the campus includes a mix of older and recently renovated buildings.

Taps: Nirmala Hostel has the highest count (237), followed by the Main Block (177) and Little Flower Hostel (167).

Toilets/Flushes: Diamond Jubilee block reports the most (74), followed by Nirmala Hostel (45) and the Main Block (42).

Faucets: Nirmala Hostel leads with 45, followed by Diamond Jubilee block (42) and Little Flower Hostel (20).

Showers: Nirmala Hostel has the highest number (73), followed by St. Joseph Hostel (21) and Jeevajyothi Hostel (16).

Sprinklers: These were reported only in Silver Jubilee (21) and Diamond Jubilee (20) Hostels (Table 5.3 to 5.13)

Fig 5. 7 Water infrastructure assessment

5.4.2 Water usage pattern and trends

Fixtures	Measurement of water use							
	Count	Rate of discharge (L/min)	Average duration of use	Average quantity per use (L)	No. of uses	Total daily uses (in L)	Per capita daily use (in L)	Yearly usage
Utility tap 1 (U)	47	5.5	0.25	64.625	25	1616	1.384	276.8
Utility tap 2 (U)	87	2.2	0.25	47.85	30	1436	1.23	246
Utility tap 3 (U)	24	21.8	0.25	130.8	30	3924	3.36	672
Faucet (U)	11	6.2	0.2	13.64	80	1091	0.935	187
Flush 1 (U)	10	2 L in single use	1 time	20	200	4000	3.43	686
Flush 2 (U)	32	6 L in single use	1 time	192	20	3840	3.29	658
Water purifier (U)	8	3.68	0.2	5.888	500	2944	2.52	504
Lab Safety Shower (U)	2	35	2	140	1	140	0.12	24
Total								3253.8

Table 5.14 Yearly water discharge from Main block

Fixtures	Measurement of water use							
	Count	Rate of discharge (L/min)	Average duration of use	Average quantity per use (L)	No. of uses	Total daily uses (in L)	Per capita daily use (in L)	Yearly usage
Utility tap 1 (U)	13	6.4	0.25	20.8	30	624	19.5	3900
Utility tap 2 (U)	24	5.6	0.25	33.6	10	336	10.5	2100
Faucet (U)	16	5.8	0.2	18.56	40	742.4	23.2	4640
Flush (U)	21	7 L in single use	1 time	147	2	294	9.19	1838
Shower (U)	10	9.5	1 time	95	3	285	8.9	1780
Total								14258

Table 5.15 Yearly water discharge from Administrative Block

Fixtures	Measurement of water use							
	Count	Rate of discharge (L/min)	Average duration of use	Average quantity per use (L)	No. of uses	Total daily uses (in L)	Per capita daily use (in L)	Yearly usage
Utility tap 1 (U)	11	5.4	0.25	14.85	110	1633.5	3.267	653.4
Utility tap 2 (U)	14	5.9	0.25	20.65	100	2065	4.13	826
Utility tap 3 (U)	13	6.1	0.25	19.825	150	2973.8	5.948	1189.5
Faucet (U)	1	4.8	0.2	0.96	300	288	0.576	115.2
Flush (U)	5	6 L in single use	1 time	30	100	3000	6	1200
Water Purifier (U)	1	3.48	0.1	0.348	500	174	0.348	69.6
Total								4053.7

Table 5.16 Yearly water discharge from Library Golden Jubilee Block

Fixtures	Measurement of water use							
	Count	Rate of discharge (L/min)	Average duration of use	Average quantity per use (L)	No. of uses	Total daily uses (in L)	Per capita daily use (in L)	Yearly usage
Utility tap 1 (U)	44	6.2	0.25	68.2	25	1705	1.35	270
Utility tap 2 (U)	33	5.8	0.25	47.85	20	957	0.759	151.8
Faucet (U)	42	5.5	0.2	46.2	50	2310	1.83	366
Water purifier (U)	4	3.78	0.1	1.512	300	453.6	0.36	72
Flush 1 (U)	61	6 L in single use	1 time	366	4	1464	1.162	232.4
Flush 2 (U)	13	2 L in single use	1 time	26	10	260	0.206	41.2
Springler (U)	2	8	30	480	2	960	0.762	152.4
Total								1285.8

Table 5.17 Yearly water discharge from Diamond Jubilee Block

Fixtures		Measurement of water use						
	Count	Rate of discharge (L/min)	Average duration of use	Average quantity per use (L)	No. of uses	Total daily uses (in L)	Per capita daily use (in L)	Yearly usage
Utility tap 1 (U)	12	5.9	0.25	17.7	32	566.4	17.69	3538
Flush (U)	6	6 L in single use	1 time	36	50	1800	56.25	11250
Shower (U)	5	8.5	5	212.5		1700	53.125	10625
Total								25413

Table 5.18 Yearly water discharge from Sports Hostel

Fixtures	Measurement of water use							
	Count	Rate of discharge (L/min)	Average duration of use	Average quantity per use (L)	No. of uses	Total daily uses (in L)	Per capita daily use (in L)	Yearly usage
Utility tap 1 (U)	15	6.3	0.25	23.625	50	1181	4.2	840
Utility tap 2 (U)	54	5.4	0.25	72.9	30	2187	7.783	1556.6
Utility tap 3(U)	11	4.8	0.25	13.2	10	132	0.469	93.8
Faucet (U)	22	5.8	0.2	25.52	20	510.4	1.82	364
Flush 1	24	6 L IN single use	1 time	144	9	1296	4.61	922
Flush 2	8	2 L IN single use	1 time	16	30	480	1.71	342
Water purifier (U)	6	3.76	0.2	4.512	50	225.6	0.803	160.6
Total								4279

Table 5.19 Yearly water discharge from MCA block

Fixtures		Measurement of water use						
	Count	Rate of discharge (L/min)	Average duration of use (minutes)	Average quantity per use (L)	No. of uses	Total daily uses (in L)	Per capita daily use (in L)	Yearly usage
Utility tap 1 (U)	29	5.8	0.1	16.82	50	841	1.97	394
Utility tap 2 (U)	11	6	0.1	6.6	100	660	1.55	310
Utility tap 3 (U)	2	5.6	0.1	1.12	100	112	0.263	52.6
Faucet (U)	3	5.7	0.2	3.42	25	85.5	0.2	40
Flush 1 (U)	15	6 L in single use	1 time	80	60	480	1.127	225.4
Flush 2 (U)	5	0.5 L in single use	1 time	2.5	200	500	1.174	234.8
Water purifier (U)	7	3.78	0.1	2.646	100	164.6	0.3858	77.16
Sprinkler (U)	21	7.5	5	787.5	1	787.5	1.849	369.8
Total								1703.76

Table 5.20 Yearly water discharge from Silver Jubilee Block

Fixtures	Measurement of water use							
	Count	Rate of discharge (L/min)	Average duration of use	Average quantity per use (L)	No. of uses	Total daily uses (in L)	Per capita daily use (in L)	Yearly usage
Utility tap 1 (U)	61	5.8	0.25	88	60	5307	43	8628
Utility tap 2(U)	15	6	0.25	23	60	1350	11	2194
Faucet (U)	16	6.4	0.2	20	50	1024	8.3	1666
Flush (U)	16	6 L in single use	1 time	96	35	3360	27	5462
Water purifier (U)	2	3.78	0.1	0.8	123	92.988	0.8	151.2
Shower (U)	16	8.5	0.5	68	34	2312	19	3758
Total								21859

Table 5.21 Yearly water discharge from Jeevajyothi Men's hostel

Fixtures	Measurement of water use							
	Count	Rate of discharge (L/min)	Average duration of use (minutes)	Average quantity per use (L)	No. of uses	Total daily uses (in L)	Per capita daily use (in L)	Yearly usage
Utility tap 1 (U)	121	5.9	0.25	178.48	90	16063	66.925	13385
Utility tap 2 (U)	27	6.2	0.25	41.85	60	2511	10.46	2092
Utility tap 3 (U)	2	18.2	0.25	9.1	70	637	2.65	530
Faucet (U)	20	5.8	0.2	23.2	70	1624	6.767	1353.4
Flush (U)	22	6 L in single use	1 time	132	13	1716	7.15	1430
Water purifier (U)	2	3.6	0.1	0.72	200	144	0.6	120
Shower (U)	3	8.2	0.5	12.3	120	1476	6.15	1230
Utility tap 1 (U)	17	Not working						
Total								20140.4

Table 5.21 Yearly water discharge from Little Flower hostel

Fixtures	Measurement of water use							
	Count	Rate of discharge (L/min)	Average duration of use	Average quantity per use (L)	No. of uses	Total daily uses (in L)	Per capita daily use (in L)	Yearly usage
Utility tap 1 (U)	38	5.4	0.25	51	10	513	3.77	754
Utility tap 2 (U)	16	5.6	0.25	22	30	672	4.94	988
Utility tap 3 (U)	57	6.2	0.25	88	15	1325.3	9.744	1948.8
Utility tap 4 (U)	4	18.5	0.25	19	5	92.5	0.68	136
Shower (U)	21	10.2	0.5	107	7	749.7	5.513	1102.6
Flush (U)	21	6 L in single use	1 time	126	6	756	5.56	1112
Total								6041.4

Table 5.22 Yearly water discharge from St. Joseph Hostel

Fixtures	Measurement of water use							
	Count	Rate of discharge (L/min)	Average duration of use	Average quantity per use (L)	No. of uses	Total daily uses (in L)	Per capita daily use (in L)	Yearly usage
Utility tap 1 (U)	5	7.4	0.2	7.4	50	370	1.54	308
Utility tap 2 (U)	181	6.1	0.2	220.82	8	1766.6	7.36	1472
Utility tap 3 (U)	49	5.4	0.2	52.92	10	529.2	2.205	441
Utility tap 4 (U)	1	19	0.2	3.8	50	190	0.792	158.4
Faucet (U)	45	8.9	0.2	80.1	40	3204	13.35	2670
Flush	45	6L in single use	1 time	270	18	4860	20.25	4050
Water Purifier	2	3.52	0.1	0.704	250	176	0.733	146.6
Shower	55	10.2	0.5	280.5	5	1402.5	5.844	1168.8
Sprinkler	1	8.2	30	246	2	492	2.05	410
Total								10824.8

Table 5.23 Yearly water discharge from Nirmala Hostel

5.4.3 Water Leakage status

Sl. No.	Location	Type	Count	Quantity of water leaking (ml per minute)	Quantity of water leaking (litre per minute)
1	Zoology Lab (Main Block)	Utility Tap	1	90	0.09
2	BSc Chemistry Lab (Main Block)	Utility Tap	1	6.9	0.0069
3	LF Hostel	Utility Tap	1	15	0.015
4		Utility Tap	1	20	0.02
5		Utility Tap	1	40	0.04
6		Utility Tap	1	25	0.025
7		Utility Tap	1	18	0.018
8		Utility Tap	1	35	0.035
9		Utility Tap	1	30	0.03
10		Utility Tap	1	8	0.008
11		Utility Tap	1	12	0.012
12		Utility Tap	1	10	0.01
13		Utility Tap	1	55	0.055
	Total				0.3649

Table 5.24 Total water leakage in college

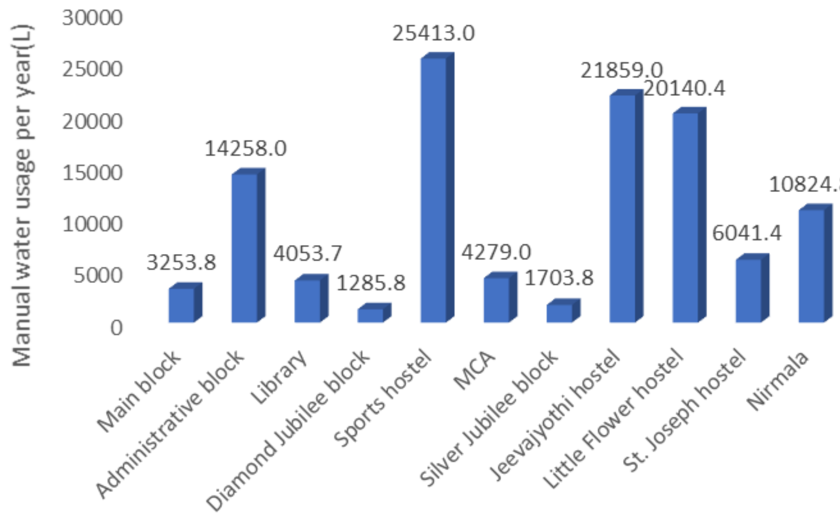


Fig 5.8 Manual water usage trends

Water consumption and discharge patterns vary across the institution's locations, influenced by factors such as occupant density and operational activities. Overall annual water usage correlates with the scale of infrastructure. An inventory of water fixtures reveals significant variations. A leakage has been identified in a laboratory located within the main block. To address water loss and enhance efficiency, the institution could consider transitioning to sensor-based taps and upgrading the pumping infrastructure.

The Sports Hostel and Jeevajyothi Men's Hostel exhibit high water discharge rates, and leakage has been noted in a laboratory within the main block. These issues are characteristic of older buildings, which may utilize outdated manual fixtures prone to leaks or overflow during operation. Transitioning to modern, efficient fixtures, including the potential implementation of sensor-activated systems, offers a significant opportunity to reduce water overflow and thereby lower the institution's overall water footprint (Table 5.14 to 5.24)

Even though the number of inmates is higher in women's hostel little flower hostel, 240, St Joseph hostel, 136, Nirmala hostel 240 than men's hostel 123 and sports hostel 33 the higher usage of water is reported. A habitual modification among the inmates of these hostel is highly recommended in order to avoid water wastage.

5.4.4 Water Storage facilities of the college

No	Type	Capacity (litres)	Year of Installation	Location	Water Source	Building to which delivery	Purpose of water	How many times daily filled
1	Main tank (Polyethylene) 1	10000	2014	Roof top of LF hostel	Pond 1	LF hostel	All kind of usages	Twice daily
2	Main tank (Polyethylene) 2	10000	2014	Roof top of LF hostel	Pond 1	LF hostel	All kind of usages	Twice daily
	Sub tank (Polyethylene)	1000	2014	Roof top of LF hostel	Main tank 1	LF hostel	All kind of usages	Automatic filling
	Sub tank (Polyethylene)	1000	2014	Roof top of LF hostel	Main tank 1	LF hostel	All kind of usages	Automatic filling
	Sub tank (concrete)	10000	1958	Roof top of LF hostel	Main tank 2	LF hostel	All kind of usages	Automatic filling
	Main tank (concrete) 3	17000	2016	Roof top of DJ block	Pond 2	DJ block	Drinking, Washing, Cleaning	Twice daily
3	Main tank (concrete) 4	17000	2016	Roof top of DJ block	Pond 2	DJ block	Drinking, Washing, Cleaning	Twice daily
4	Main tank (concrete) 5	12000	1978	Roof top of Jeevajyothi Hostel	Pond 2	Jeevajyothi Hostel	All kind of usages	Automatic filling
	Sub tank (Polyethylene)	2000	2015	Roof top of Jeevajyothi Hostel	Main tank 5	Jeevajyothi Hostel	All kind of usages	Automatic filling
5	Main tank (Polyethylene) 6	3000	2000	Roof top of main Block	Pond 3	Main Block	All kind of usages	Twice daily
	Sub tank (concrete) 1	15000	2015	Roof top of main Block	Main tank 6	Main Block, Canteen	All kind of usages	Automatic filling
6	Sub tank (concrete tank)	8000	1978	Roof top of Silver jubilee Block	Sub tank 1	Silver Jubilee Block	Drinking, Washing, Cleaning	Automatic filling
	Sub tank (concrete tank)	8000	1978	Roof top of Silver jubilee Block	Sub tank 1	Silver Jubilee Block	Drinking, Washing, Cleaning	Automatic filling
	Sub tank (Polyethylene)	5000	2022	Roof top of SV hall	Sub tank 1	Administrative Block,	Drinking, Washing, Cleaning	Automatic filling

	Sub tank (Polyethylene)	5000	2022	Roof top of SV hall	Sub tank 1	Administrative Block,	Drinking, Washing, Cleaning	Automatic filling
	Sub tank (Polyethylene)	5000	2022	Roof top of SV hall	Sub tank 1	Administrative Block,	Drinking, Washing, Cleaning	Automatic filling
	Sub tank (Polyethylene)	5000	2022	Roof top of SV hall	Sub tank 1	Administrative Block,	Drinking, Washing, Cleaning	Automatic filling
	Sub tank (Polyethylene)	3000	2007	Roof top of Library hall	Sub tank 1	Library Block	Drinking, Washing, Cleaning	Automatic filling
	Sub tank (Polyethylene)	3000	2007	Roof top of Library hall	Sub tank 1	Library Block	Drinking, Washing, Cleaning	Automatic filling
	Sub tank (Polyethylene)	3000	2007	Roof top of Library hall	Sub tank 1	Library Block	Drinking, Washing, Cleaning	Automatic filling
7	Sub tank (Polyethylene)	3000	2000	Near Sports Hostel	Sub tank 1	Sports hostel	All kind of usages	Automatic filling
	Sub tank (Polyethylene)	3000	2000	Near Sports Hostel	Sub tank 1	Sports hostel	All kind of usages	Automatic filling
8	Main tank (Polyethylene) 7	2000	2013	Roof top of MCA block	Pond 2	MCA block	Drinking, Washing, Cleaning	Twice daily
	Main tank (Polyethylene) 8	2000	2013	Roof top of MCA block	Pond 2	MCA block	Drinking, Washing, Cleaning	Twice daily
	Main tank (Polyethylene) 9	2000	2013	Roof top of MCA block	Pond 2	MCA block	Drinking, Washing, Cleaning	Twice daily
	Main tank (Polyethylene) 10	2000	2021	Roof top of MCA block	Pond 2	MCA block	Drinking, Washing, Cleaning	Twice daily
	Main tank (Polyethylene) 11	2000	2021	Roof top of MCA block	Pond 2	MCA block	Drinking, Washing, Cleaning	Twice daily

	Main tank (Polyethylene) 12	2000	2019	Roof top of St. Joseph Hostel	Pond 4	St. Joseph Hostel	All kind of usages	Twice daily
	Sub tank (concrete tank)	20000	2000	Roof top of St. Joseph Hostel	Main tank 12	St. Joseph Hostel	All kind of usages	Automatic filling
	Main tank (concrete tank) 13	5000	2019	Roof top of St. Joseph Hostel	Pond 4	St. Joseph Hostel	All kind of usages	When required
	Main Tank (concrete) 14	25000	1998	Roof top of Nirmala Hostel	Pond 5	Nirmala Hostel	All kind of usages	Twice daily
	Main tank (Polyethylene)	5000	2020	Roof top of Nirmala Hostel	Pond 5	Nirmala Hostel	All kind of usages	When required
	Main tank (Polyethylene)	5000	2020	Roof top of Nirmala Hostel	Pond 5	Nirmala Hostel	All kind of usages	When required
	Main tank (Polyethylene)	5000	2020	Roof top of Nirmala Hostel	Pond 5	Nirmala Hostel	All kind of usages	When required
	Main tank (Polyethylene)	5000	2020	Roof top of Nirmala Hostel	Pond 5	Nirmala Hostel	All kind of usages	When required
	Water purification tank	10000	2020	Outside	Waste Water	Nirmala Hostel	Irrigation	

Table 5.25 Water storage capacity

5.4.5 Water Source, Motor and Pumps

5.4.5.1. Water sources of the college

Sl No	Location	Physical appearances	Capacity	Purpose
1	Near LF Hostel	Stone-lined square shaped open well	Moderate (~ 100000 L)	All kind of uses
2	Near Nirmala Matha Church	Stone-lined rectangle shaped open well	Moderate (~ 100000 L)	Drinking, washing, cleaning
3	Rubber plantation near Nirmala College of Pharmacy	Stone-lined rectangle shaped open well	Large (~ 200000 L)	Drinking, washing, cleaning
4	Near St. Joseph Hostel	Stone-lined rectangle shaped open well	Moderate (~ 100000 L)	All kind of uses
5	Near Nirmala College of Pharmacy	Stone-lined round shaped open well	Small (~ 50000 L)	All kind of uses

Table 5.26 Water Sources of the college

The main water source for the college comprises five ponds. Water is pumped from these ponds into a distribution system consisting of 18 main storage tanks and 15 sub-tanks. Within this system. The manual filling schedule varies: some tanks are pumped regularly (e.g., twice daily/weekly), while others are filled on an as-needed basis (table 5.25)

5.4.5.2. Motor pumping duration data of the college

Date	Time on	Time off	Duration in minutes
28-02-2025	7.30 a.m.	8.00 a.m	30
	2.00 p.m.	2.35 p.m	35
	6.00 p.m.	6.25 p.m	25
01-03-2025	7.20 a.m.	7.55 a.m	35
	2.05 p.m.	2.35 p.m	30
	6.10 p.m.	6.30 p.m	20
02-03-2025	7.15 a.m.	7.40 a.m	25
	1.55 p.m.	2.25 p.m	30
	6.05 p.m.	6.30 p.m	25
07-03-2025	7.20 a.m.	8.00 a.m	40
	2.00 p.m.	2.35 p.m	35
	6.00 p.m.	6.45 p.m	45
08-03-2025	7.30 a.m.	8.00 a.m	30
	2.00 p.m.	2.20 p.m	20
	6.05 p.m.	6.30 p.m	25
09-03-2025	7.35 a.m.	8.05 a.m	30
	2.10 p.m.	2.30 p.m	20
	6.15 p.m.	6.40 p.m	25
14-03-2025	7.15 a.m.	8.00 a.m	45
	2.00 p.m.	2.40 p.m	40
	6.00 p.m.	6.35 p.m	35
15-03-2025	7.25 a.m.	8.00 a.m	35
	1.50 p.m.	2.20 p.m	30
	6.00 p.m.	6.25 p.m	25
16-03-2025	7.30 a.m.	7.50 a.m	20
Average time			30.2

Table 5.27 Duration of water pumping of little flower hostel

Date	Time on	Time off	Duration in minutes
28-02-2025	8 a.m.	9.30 a.m.	90
	10 a.m.	10.25 a.m.	25
	4.30 p.m.	6.15 p.m.	105
01-03-2025	8.10 a.m.	9 a.m.	50
02-03-2025	4 p.m.	5 p.m.	60
07-03-2025	8.10 a.m.	9.40 a.m.	90
	11.30 a.m.	12 a.m.	30
	3.30 p.m.	5.20 p.m.	110
08-03-2025	8 a.m.	9.00 a.m.	60
	3 p.m.	4 p.m.	60
14-03-2025	8.05 a.m.	9.30 a.m.	85
	3 p.m.	3.30 p.m.	30
	3.10 p.m.	5 p.m.	110
15-03-2025	8.10 a.m.	9. a.m.	50
16-03-2025	9.30 a.m.	10.30 a.m.	60

Table 5.28 Duration of water pumping of DJ, MCA and Jeevajyothi

Date	Time on	Time off	Duration in minutes
28-02-2025	8.00 a.m	10.00 a.m	120
	3.00 p.m	4.30 p.m	90
01-03-2025	8.00 a.m	10.00 a.m	120
02-03-2025	2.00 p.m	4.00 p.m	120
07-03-2025	8.30 a.m	10.00 a.m	90
	3.00 p.m	4.00 p.m	60
08-03-2025	12.30 p.m	2.00 p.m	90
09-03-2025	10.00 a.m	11.30 a.m	90
14-03-2025	3.00 p.m	5.00 p.m	120
15-03-2025	2.00 p.m	4.00 p.m	120
16-03-2025	3.00 p.m	4.00 p.m	60

Table 5.29 Duration of water pumping of Main block

Date	Time on	Time off	Duration in minutes
28-02-2025	5.30 a.m.	6.45 a.m.	75
	5.15 p.m.	6.45 p.m	95
01-03-2025	5.45 a.m.	6.30 a.m.	45
	6.00 p.m.	7.00 p.m	60
02-03-2025	5.50 a.m.	6.45 a.m.	55

	6.05 p.m.	7.10 p.m	65
07-03-2025	5.30 a.m.	6.45 a.m.	75
	5.15 p.m.	6.45 p.m	90
08-03-2025	5.45 a.m.	6.40 a.m.	55
	5.30 p.m.	6.45 p.m	75
09-03-2025	6.00 a.m.	6.45 a.m.	45
	5.30 p.m.	6.45 p.m	75
14-03-2025	5.15 a.m.	6.30 a.m.	75
	5.10 p.m.	7.30 p.m	140
15-03-2025	5.45 a.m.	6.45 a.m.	60
	6.15 p.m.	7.00 p.m	45
16-03-2025	6.00 a.m.	7.05 a.m.	65
	6.15 p.m.	7.00 p.m	45

Table 5.30 Duration of water pumping of St. Joseph Hostel

Date	Time on	Time off	Duration in minutes
28-02-2025	4.00 a.m	7.30 a.m	210
	3.00 p.m	7.45 p.m.	285
01-03-2025	4.05 a.m	7.25 a.m	190
	3.10 p.m	7.30 p.m.	260
02-03-2025	4.00 a.m	7.20 a.m	200
	3.15 p.m	7.35 p.m.	260
07-03-2025	4.15 a.m	7.40 a.m	205
	3.00 p.m	7.30 p.m.	270
08-03-2025	4.05 a.m	7.30 a.m	205
	3.10 p.m	7.20 p.m.	250
09-03-2025	4.00 a.m	7.25 a.m	205
	3.10 p.m	7.20 p.m.	250
14-03-2025	4.10 a.m	7.45 a.m	215
	3.15 p.m	7.45 p.m.	270
15-03-2025	4.00 a.m	7.20 a.m	200
	3.00 p.m	7.35 p.m.	275
16-03-2025	4.15 a.m	7.30 a.m	195
	3.00 p.m	7.30 p.m.	270
Average			234.17

Table 5.31 Duration of water pumping of Nirmala Hostel

The college manages a water storage system comprising 35 tanks distributed across 11 campus locations. Of these, all are manual. The manually filled tanks are located at Little Flower Hostel, DJ Block, MCA Block, Jeevajyothi Men's Hostel, Main Block, St. Joseph Hostel, and Nirmala Hostel. Tank capacities vary considerably, ranging from 1,000 Liters to 20,000 Liters.

The current interconnected system causes all sub-tanks to fill concurrently. To address this, strongly recommend implementing an advanced, decentralized automation system. This would involve equipping each tank with a dedicated sensor and control mechanism to eliminate overflow reduce water pumping duration, conserve water, and significantly strengthen the overall water management infrastructure.

This automation provides key benefits:
Water Conservation: Prevents wastage caused by overflows common in manual systems where pumps might be left running.

Energy Efficiency: Ensures pumps operate only for the required duration, eliminating unnecessary electricity consumption associated with manual operation or non-adaptive timers.

By preventing water spillage and optimizing pump operation, these automatic systems reduce resource consumption, lower utility costs, and contribute to the overall sustainability of the campus infrastructure, particularly noticeable in high-demand areas like hostels.

Campus infrastructure, particularly noticeable in high-demand areas like hostels.

Location	Storage capacity (L)	Average puping duration per day
Little flower hostel	20000	30.2 ± 7.42
DJ Block	34000	67.67 ± 29.02
Main block	3000	98.18 ±23.58
St. Joseph hostel	7000	68. 89 ± 23.29
Nirmala hostel	45000	234.17 3± 3.66
MCA Block	10000	67.67 ± 29.02
Jeeva Jyothi hostel	12000	67.67 ±29.02

Table 5.32 Motor Pumping data

The Main Block is a primary concern. It contains the smallest tank in the system (3,000 L), yet it shows the longest pumping time (98.18 units for Metric 1), resulting in the slowest fill rate. The prolonged duration is likely due to the pump's dual role of servicing a connected 15,000 L sub-tank. Sub-tanks have a greater capacity than the main tank. The filling of the main tank takes longer when sub-tanks are being filled because multiple sub-tanks are connected to each main tank, which contributes to the extended fill duration. DJ Block (34,000 L), MCA Block (10,000 L), and Jeeva Jyothi Hostel (12,000 L) all register the same pumping durations (67.67 and 29.02 units). This uniformity across different volumes strongly suggests the pumps are not operating based on tank levels but are instead controlled by a fixed-duration timer. Such a setup is inefficient and risks either incomplete fills or energy wastage. Nirmala hostel's long pumping duration is expected, as its pump is responsible for filling five main tanks, making its operational demand logically higher than the others (Table 5.27 to 5.31)

5.4.6 Sample Study on Water Usage Pattern in the College

Flow meters were installed at five key locations, specifically at the origin points of main lines from their respective sources or tanks. Meter readings were recorded over a three-week period during scheduled sampling days.

5.4.6.1 Main block- water flow meter

Monitoring days	Average use of water per day in (L)	Total average per consumption per year in (L)
Holiday	666.67	46666.9
Semi holiday	13666.67	1298333.65
Working day	15333.33	3066666

Table 5.33 Water usage in Main block

The Main Block and Administrative areas are served by a water storage system consisting of one main tank (3000 L capacity) and five sub-tanks (capacities specified as 5000 L, 3000 L, and 1500 L). Key facilities within this block include laboratories, science research labs, examination control offices, staff rooms, administrative offices (Vice Principal, IQAC, and Principal), washrooms, ladies' restrooms, and a dining hall.

Water consumption patterns demonstrate a clear correlation with operational schedules. The highest demand is observed on standard working days, which is attributable to the full operational status of labs, offices, and other facilities, leading to increased occupancy and institutional water use. Water consumption is markedly lower on holidays, reflecting minimal activity when the facilities are largely non-operational. Usage levels on semi-holidays fall between those of working days and holidays, indicating partial facility function on these occasions.

5.4.6.2 DJ block- water flow meter

Monitoring days	Average use of water per day	Total average per consumption per year
Holiday	3333.33	233333.1
Semi holiday	22333.33	2121666.35
Working day	6666.67	1333334

Table 5.34 Water usage in D J block

DJ Block consists of two main tank of capacity 1700L. which include classroom, washroom, computer lab seminar hall, comparatively low water usage depend of the using of washroom. Semi-holidays have the highest daily and total annual water usage, suggesting that the activities on these days may involve higher water-dependent processes, currently construction were take place which maintaining take along with the working semi holiday resulted in high water usage compare to other Holidays show minimal consumption, reflecting expected reductions in demand. Working days show a middle-range consumption level, implying that operational efficiency and structured water use could be factors.

5.4.6.3. MCA block water flow meter- 1

Monitoring days	Average use of water per day in (L)	Total average per consumption per year in (L)
Holiday	3666.67	256666.9
Semi holiday	4000	380000
Working day	5500	1100000

Table 5.35 Water usage in MCA block

MCA Block consists of Five main tank of capacity 2000 L, it has also has two flow water meter to record the flow of water to two area. Working days consume the most water for washroom, guestroom and sickroom likely due to more people being present and engaged in activities requiring water usage, such as drinking, sanitation, cleaning, and office use. Holidays see significantly lower usage, indicating fewer occupants or reduced operational needs. This suggests that when facilities (such as offices, institutions, are closed, water consumption drops drastically. Semi-Holiday Consumption is Closer to Holiday Levels. The semi-holiday consumption is only slightly above holiday usage indicating that operations on these days are minimal, possibly limited to partial staff or reduced activities.

5.4.6.4. Water flow meter- 2

Monitoring days	Average use of water per day in (L)	Total average per consumption per year in (L)
Holiday	3000	210000
Semi holiday	4000	380000
Working day	5500	1100000

Table 5.36 Water usage in MC block meter (2)

Water consumption is highest on working days, likely due to increased human activity, including staff, students, or workers using facilities such as restrooms, canteens, and laboratories. Semi-holidays show moderate water usage, which could indicate reduced workforce or student presence, possibly weekends with partial activity. Holidays have the lowest consumption, consistent with minimal or no occupancy. Annual total consumption aligns with daily usage trends, confirming that the highest daily consumption corresponds to the highest yearly usage.

5.4.6.5. Sports hostel - water flow meter

Monitoring days	Average use of water per day in (L)	Total average per consumption per year in (L)
Holiday	2333.33	163333.1
Semi holiday	1333.33	126666.35
Working day	1083.33	216666

Table 5.37 Water usage in Sports hostel

Sport hostels consist of two sub tank of capacity 3000 L. The total inmates consist of 33 The highest daily consumption on holidays suggests full occupancy of the hostel, possible of student remaining in the hostel staff back due to practice or if remaining student when few left their hostel use more water for personal use, sports activities, and recreational purposes. The drop in water usage on semi-holidays might indicate a mix of student presence and absence, leading to moderate water demand. The lowest daily usage on working days is likely due to students spending most of their time in classes and sports activities, reducing overall hostel water consumption. Despite the lowest daily average, working days contribute the most to total annual usage due to their higher occurrence in a year.

5.4.6.6. Jeeva jyothi hostel(men's)- water flow meter

Monitoring days	Average use of water per day in (L)	Total average per consumption per year in (L)
Holiday	8000	560000
Semi holiday	3666.67	348333.7
Working day	7333.33	1466666

Table 5.38 Water usage in Jeeva Jyothi hostel

Jeeva Jyothi hostel one main tank of capacity 12000 L and sub tank of 2000 L Higher total 123 inmates in the hostel. The highest usage on holidays suggests that students remain in the hostel longer and engage in water-intensive activities such as laundry, bathing, and recreational use, kitchen purpose. Lower Usage on Semi-Holidays these could be partial working days or weekends when students spend time outside the hostel, reducing water usage might have the possible of student leave hostel due weekend holiday Working Days the relatively high consumption suggests consistent hostel occupancy, though students may spend more time in classrooms, leading to slightly lower water usage than holidays.

5.4.6.7. Little flower hostel(women's) - water flow meter -1

Monitoring days	Average use of water per day in (L)	Total average per consumption per year in (L)
Holiday	5000	350000
Semi holiday	4500	427500
Working day	1500	300000

Table 5.39 Water usage in little flower hostel

Two main tanks 10000 L, three sub tanks of 10000L and 1000L. The hostel consists of 240 inmates. Due to the flow of water to different area of building by main tank to sub tank. Two water meter had taken slight difference can notice in meter one and two both indicate the high usage in holiday changes depends on the functioning status.

In holidays the highest average daily usage indicates that on these days, water is used more intensively. This could be due to increased activities or special events where more water is required. Semi-holidays: With an average of these days see a slightly lower usage than holidays. They might involve fewer activities than full holidays but still have elevated water use compared to regular days. Working Days: Despite, working days have the lowest average usage. This lower daily consumption might be due to more controlled or essential water use. Working days, while having the lowest daily usage, still contribute a significant portion of the total annual consumption due to possible of the presence of intimates on working days due to regular function of college.

5.4.6.8. Water flow meter – 2

Monitoring days	Average use of water per day in (L)	Total average per consumption per year in (L)
Holiday	4500	315000
Semi holiday	3000	285000
Working day	3666.67	733334

Table 5.40 Water usage in little flower hostel meter (2)

The highest average daily usage suggests that on holidays, the hostel uses more water per day. This could be due to factors such as, special events or cleaning routines increased usage in common areas or extra services provided on holidays. In semi holiday the consumption is lower than on holidays. These days might represent partial operational days where some activities continue while others are reduced. Although the average daily consumption is moderate in working days but working days contribute the most to the annual total because there are significantly more of these days where the presence of inmates

5.4.6.9. St. Joseph hostel(women's)- water flow meter

Monitoring days	Average use of water per day in (L)	Total average per consumption per year in (L)
Holiday	1000	70000
Semi holiday	1333.33	126666.4
Working day	833.33	166666

Table 5.41 Water usage in St. Joseph hostel

St. Joseph hostel consists of Two main tank of 2000L and 5000 L one sub tank of 20000 the hostel includes 136 intimates. The highest average daily water consumption is observed on semi-holidays. This suggests that during semi-holidays, activities or behaviours such as special events, additional amenities usage, or possibly high range of water usage occurs drive up water usage per day. Although holidays have a lower average daily consumption compared to semi-holidays, they still contribute significantly when aggregated. This might indicate that even on holidays, a base level of water usage is maintained (possibly for essential services or maintenance or student return to their house for holidays. Working days contribute the largest portion to the annual. This is expected because even though the daily usage is lower, the high number of working days amplifies the total consumption.

5.4.6.10. Nirmala hostel(women's)- water flow meter 1

Monitoring days	Average use of water per day in (L)	Total average per consumption per year (in L)
Holiday	1833.33	128333.1
Semi holiday	6666.67	633333.7
Working day	4833.33	966666

Table 5.42 Water usage in Niramala hostel

Nirmala hostel consists of five main tank of 2500, 5000, 5000, 5000, 5000L. Hostel consist of 240 inmates five tank with the water usage cover in two area. Hostel has two water meters.

Holidays With an average daily use show the lowest water consumption. Likely, fewer residents or reduced hostel activities contribute to the lower usage. Semi Holidays the highest daily average consumption suggests that on these days, there might be events, gatherings, or increased usage for other purposes. Despite being fewer than working days the high daily rate results in a significant share of the annual consumption. Working Days, Although the average daily use on working days is lower than on semi holidays, the fact that there are days makes them the largest contributor to the annual total.

5.4.6.11. Nirmala hostel – water flow meter 2

Monitoring days	Average use of water per day in (L)	Total average per consumption per year in (L)
Holiday	2166.67	151666.9
Semi holiday	1666.67	158333.65
Working day	1166.67	233334

Table 5.43 Water usage in Nirmala hostel meter (2)

On holidays, the average water usage is highest, suggesting that on holidays, when students may have fewer scheduled activities or more free time, water usage is higher. This might be due to activities like extra bathing, cooking, or other recreational uses. Semi holiday days have an average this is lower than on full holidays but still significantly higher than working days, indicating a moderate increase in usage when the schedule is partly relaxed. Working days have the lowest daily consumption, this likely reflects a more disciplined or time-constrained routine where water usage is minimized, possibly due to scheduled classes, shorter breaks. The water usage patter is varied in same hostel first flow meter indicates high consumption in semi holiday but in second flow meter indicate high in holiday depends on usage pattern.

The usage tends in hostel always show changes depends on their use sometimes, it might be higher in semi holiday because it may be due to class for student like special class or program, or remaining inmates utilize for personal needs, sometimes it might be higher. On holiday, occasionally student went to their home or stay back. On working day, inmates don't spend full day in hostel but will raise because working is more than holiday and cooking is also comparatively high which resulted high water usage. Five hostel show significant trends in water usage is proportional to the strength and usage pattern.

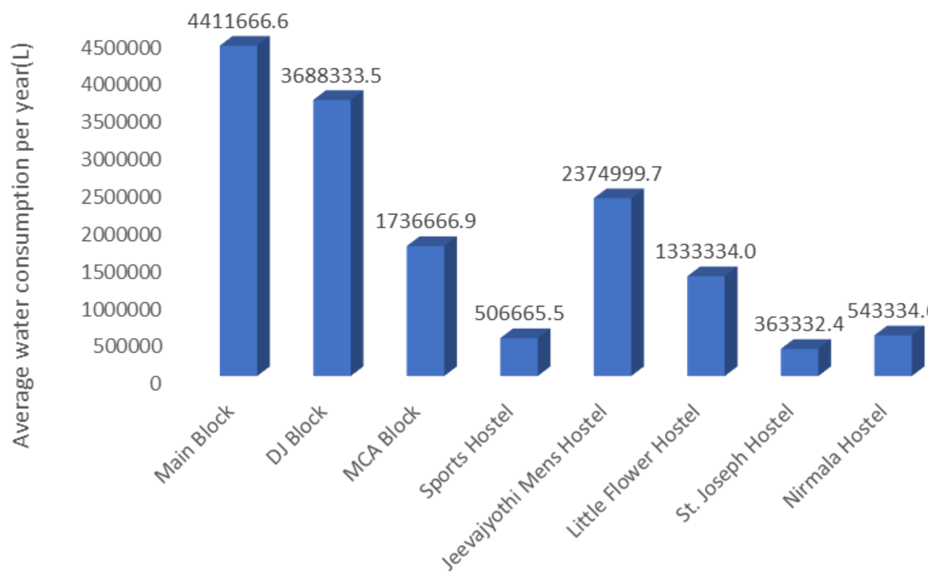


Fig 5.9 Total average per consumption per year

Location	Average water consumption per year in (L)	Average per capita in (L)
Main Block	4411666.55	1922.29
DJ Block	3688333.45	1607.12
MCA Block	1736666.9	756.72
Sports Hostel	506665.45	220.77
Jeeva Jyothi Men's Hostel	2374999.65	1034.86
Little flower Hostel	1333334	580.97
St. Joseph Hostel	363332.35	158.31
Nirmala Hostel	543334.55	236.75

Table 5.44 Per capita consumption of water in the college

An analysis of water discharge rates indicates higher usage within the Sports Hostel, followed by the Jeevayothi Hostel. Both facilities are older buildings featuring aging infrastructure. Specifically, the Sports Hostel, accommodating 33 residents, utilizes an older pumping system and has a water storage capacity of 3000 L (potentially across two tanks). Its fixtures include 12 taps, 6 flush toilets, and 5 showers. The Jeevayothi Hostel, with 123 residents, has a combined tank capacity of 3200 L (1200 L and 2000 L tanks) and is equipped with 92 taps/faucets, 16 flush toilets, and 16 showers. The higher discharge rates are likely attributable to the older pumping systems, which may lead to water wastage during use. The significant number of showers is also noted as a potential major factor in overall consumption. To mitigate water loss, upgrading to sensor-activated taps and modernizing the pumping systems is recommended

An assessment of flow meter readings reveals significant variations in water consumption across campus blocks. The Main Block exhibits the highest usage, followed by the DJ Block and the Jeevajyothi Block. Main Block, incorporating the administrative section, its high consumption correlates with extensive infrastructure (232 taps, 97 flush systems [assuming 65+32 combined], 17 showers) and substantial water storage (4x 5000L, 1x 3000L, 1x 15000L). This block houses critical functions including administration, dining, classrooms, major labs, the auditorium, and numerous washrooms, contributing to its significant water demand. DJ Block, as the second-largest consumer, this block contains 81 taps, 6 flush systems, and 5 showers, with two 1700L storage tanks. Consumption aligns with occupancy, further increased by recent maintenance activities. Jeevajyothi Block elevated water usage is primarily attributed to aging infrastructure and reliance on less efficient manual fixtures.

To address inefficiency and reduce water waste, particularly in the Jeevajyothi Block, strategic retrofitting with sensor-activated water systems is recommended. This measure offers a practical means to conserve water, enhance resource management, and lessen the institution's environmental impact.

Table 5.40 presents the per capita water consumption assessment for the college. The findings indicate that the Main Block, which includes administrative offices, registered the highest annual water usage. This peak consumption is attributed to extensive infrastructure, full operational demands of laboratories, classrooms, and offices, and usage correlating with population density. Additionally, ongoing maintenance activities contributed to the higher consumption figures. Separately, strategic retrofitting is recommended for the Jeevajoythi area to address identified inefficiencies and reduce water waste.

5.4.7 Grey water usage data

Sections/Departments	Rate of discharge (L)/day
College Main Blocks	
Chemistry lab	1200
Zoology lab	200
Botany lab	150
Washing area	8800
Toilets	17500
Cleaning (floor)	300
Total	28150
Hostel	
Hostel mess	4500
Washing area	5500
Bathing	29500
Toilets	13500
Laundry	3000
Cow shed	800
Cleaning (floor)	300
Total	57100
Administrative block	
Toilets	1000
Guest rooms/personal rooms	300
Dining hall	200
Laundry	50
Cleaning (floor)	100
Total	1650
Other	
Cafeteria	600
Canteen	3500
Library/Examination halls	80
Cleaning (floor)	50
Total	4230

Table 5.45 Quantity of grey water released

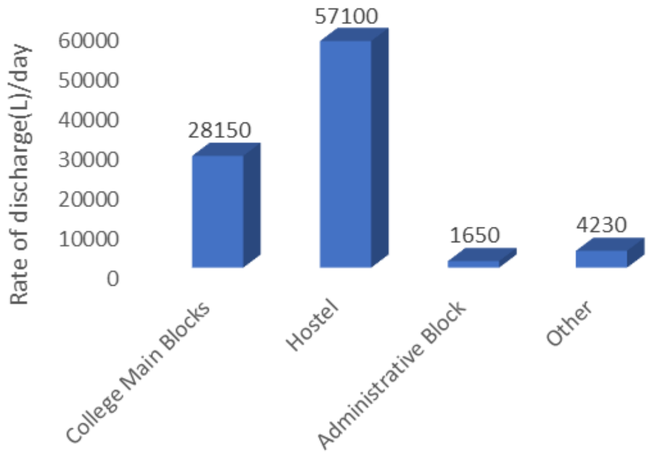


Fig 5.10 Grey water rate of discharge (L)/day

Grey water generation is dominated by hostels, which account for approximately two-thirds of the total volume. Factors contributing to this high volume include increased residential occupancy and elevated water consumption from activities such as cooking, cleaning, bathing, and washing, the latter potentially amplified by climatic conditions. Following hostels, College Main Blocks represent the second-largest source. This may be attributed to factors such as the addition of new facilities, more frequent cleaning schedules, or the expansion of activities and infrastructure (e.g., new laboratories or cafeterias). Contributions from administrative and other areas are comparatively minimal.

Fig 5. 11 Data collection of manual water discharge

5.4.8 Water Quality Analysis Report

Sl. No.	Parameter	Unit	Test Method APHA/IS 3025	Desirable limit for drinkingwater (IS 10500:2012)	Limit of detection	Test result of the sample
Physical Characteristics						
1	Colour	HU	APHA 2120-B	5	1 to 100	1
2	Odour	-	IS 3025 (Part 5)-2018	-	Agreeable	Agreeable
3	Taste	-	IS 3025 (Part 8)-1984 (2023 reaffirmed)	-	Agreeable	Agreeable
4	Turbidity	NTU	IS 3025 (Part 10)-1984 (2023 reaffirmed)	1	5	4
5	Electrical conductivity	µS/cm	APHA 2510-B	110	-	90.7
6	Total Dissolved Solids [TDS] (at 180^0C)	mg/l	IS 3025 (Part 16)-1984 (2023 reaffirmed)	500	2000	57.8
Chemical characteristics						
7	pH (at 25^0 C)	-	IS 3025 (Part 11)-1984 (2022 reaffirmed)	6.5-8.5	2 to 12	6.68
8	Total alkanity (as $CaCO_3$)	mg/l	IS 3025 (Part 23)-1986 (2019 reaffirmed)	200	5 to 2000	5
9	Total Hardness (as $CaCO_3$)	mg/l	IS 3025 (Part 21)-2009 (2019 reaffirmed)	200	1 to 5000	15
10	Calcium (as Ca^+)	mg/l	IS 3025 (Part 40)-1991 (2019 reaffirmed)	75	1 to 2000	15
11	Magnesium (as Mg^+)	mg/l	APHA 3500 B (Mg)	30	1 to 1000	0
12	Chloride (as Cl^-)	mg/l	IS 3025 (Part 32)-1988 (2019 reaffirmed)	250	1 to 5000	35.5
13	Total Iron (as Fe^+)	mg/l	APHA 3500 B (Fe)	0.3	1.0	0.12
Microbiological characteristics (bacteria)						
14	Total coliforms(TC)	MPN/ 100ml	IS1622-1981 (1996reaffirmed)	0	0 to 2400	2400
15	Faecal Coliforms (FC)	MPN/ 100ml	IS1622-1981 (1996reaffirmed)	0	0 to 2400	460
16	E.coli	-	IS1622-1981 (1996reaffirmed)	0	Present/ absent	Present

Table 5.46 Quantity of water quality report of sample one

Sl. No.	Parameter	Unit	Test Method APHA/IS 3025	Desirable limit for drinkingwater (IS 10500:2012)	Limit of detection	Test result of the sample
Physical Characteristics						
1	Colour	HU	APHA 2120-B	5	1 to 100	1
2	Odour	-	IS 3025 (Part 5)-2018	-	Agreeable	Agreeable
3	Taste	-	IS 3025 (Part 8)-1984 (2023 reaffirmed)	-	Agreeable	Agreeable
4	Turbidity	NTU	IS 3025 (Part 10)-1984 (2023 reaffirmed)	1	5	2
5	Electrical conductivity	µS/cm	APHA 2510-B	110	-	114.3
6	Total Dissolved Solids [TDS] (at 180^0 C)	mg/l	IS 3025 (Part 16)-1984 (2023 reaffirmed)	500	2000	73.6
Chemical characteristics						
7	pH (at 25^0 C)	-	IS 3025 (Part 11)-1984 (2022 reaffirmed)	6.5-8.5	2 to 12	6.06
8	Total alkanity (as $CaCO_3$)	mg/l	IS 3025 (Part 23)-1986 (2019 reaffirmed)	200	5 to 2000	20
9	Total Hardness (as $CaCO_3$)	mg/l	IS 3025 (Part 21)-2009 (2019 reaffirmed)	200	1 to 5000	40
10	Calcium (as Ca^+)	mg/l	IS 3025 (Part 40)-1991 (2019 reaffirmed)	75	1 to 2000	20
11	Magnesium (as Mg^+)	mg/l	APHA 3500 B (Mg)	30	1 to 1000	20
12	Chloride (as Cl^-)	mg/l	IS 3025 (Part 32)-1988 (2019 reaffirmed)	250	1 to 5000	35.5
13	Total Iron (as Fe^+)	mg/l	APHA 3500 B (Fe)	0.3	1.0	0.14
Microbiological characteristics (bacteria)						
14	Total coliforms(TC)	MPN/ 100ml	IS1622-1981 (1996reaffirmed)	0	0 to 2400	93
15	Faecal Coliforms (FC)	MPN/ 100ml	IS1622-1981 (1996reaffirmed)	0	0 to 2400	11
16	E.coli	-	IS1622-1981 (1996reaffirmed)	0	Present/absent	Present

Table 5.47 Quantity of water quality report of sample two

Sl. No.	Parameter	Unit	Test Method APHA/IS 3025	Desirable limit for drinkingwater (IS 10500:2012)	Limit of detection	Test result of the sample
Physical Characteristics						
1	Colour	HU	APHA 2120-B	5	1 to 100	1
2	Odour	-	IS 3025 (Part 5)-2018	-	Agreeable	Agreeable
3	Taste	-	IS 3025 (Part 8)-1984 (2023 reaffirmed)	-	Agreeable	Agreeable
4	Turbidity	NTU	IS 3025 (Part 10)-1984 (2023 reaffirmed)	1	5	8
5	Electrical conductivity	µS/cm	APHA 2510-B	110	-	81.9
6	Total Dissolved Solids [TDS] (at 180^0 C)	mg/l	IS 3025 (Part 16)-1984 (2023 reaffirmed)	500	2000	52.8
Chemical characteristics						
7	pH (at 25^0 C)	-	IS 3025 (Part 11)-1984 (2022 reaffirmed)	6.5-8.5	2 to 12	6.52
8	Total alkanity (as $CaCO_3$)	mg/l	IS 3025 (Part 23)-1986 (2019 reaffirmed)	200	5 to 2000	5
9	Total Hardness (as $CaCO_3$)	mg/l	IS 3025 (Part 21)-2009 (2019 reaffirmed)	200	1 to 5000	20
10	Calcium (as Ca^+)	mg/l	IS 3025 (Part 40)-1991 (2019 reaffirmed)	75	1 to 2000	15
11	Magnesium (as Mg^+)	mg/l	APHA 3500 B (Mg)	30	1 to 1000	5
12	Chloride (as Cl^-)	mg/l	IS 3025 (Part 32)-1988 (2019 reaffirmed)	250	1 to 5000	39.05
13	Total Iron (as Fe^+)	mg/l	APHA 3500 B (Fe)	0.3	1.0	0.05
Microbiological characteristics (bacteria)						
14	Total coliforms(TC)	MPN/ 100ml	IS1622-1981 (1996reaffirmed)	0	0 to 2400	15
15	Faecal Coliforms (FC)	MPN/ 100ml	IS1622-1981 (1996reaffirmed)	0	0 to 2400	9
16	E.coli	-	IS1622-1981 (1996reaffirmed)	0	Present/absent	Present

Table 5.48 Quantity of water quality report of sample three

Sl. No.	Parameter	Unit	Test Method APHA/IS 3025	Desirable limit for drinkingwater (IS 10500:2012)	Limit of detection	Test result of the sample
Physical Characteristics						
1	Colour	HU	APHA 2120-B	5	1 to 100	1
2	Odour	-	IS 3025 (Part 5)-2018	-	Agreeable	Agreeable
3	Taste	-	IS 3025 (Part 8)-1984 (2023 reaffirmed)	-	Agreeable	Agreeable
4	Turbidity	NTU	IS 3025 (Part 10)-1984 (2023 reaffirmed)	1	5	1
5	Electrical conductivity	µS/cm	APHA 2510-B	110	-	105.5
6	Total Dissolved Solids [TDS] (at 180^0 C)	mg/l	IS 3025 (Part 16)-1984 (2023 reaffirmed)	500	2000	68.0
Chemical characteristics						
7	pH (at 25^0 C)	-	IS 3025 (Part 11)-1984 (2022 reaffirmed)	6.5-8.5	2 to 12	6.04
8	Total alkanity (as $CaCO_3$)	mg/l	IS 3025 (Part 23)-1986 (2019 reaffirmed)	200	5 to 2000	10
9	Total Hardness (as $CaCO_3$)	mg/l	IS 3025 (Part 21)-2009 (2019 reaffirmed)	200	1 to 5000	25
10	Calcium (as Ca^+)	mg/l	IS 3025 (Part 40)-1991 (2019 reaffirmed)	75	1 to 2000	10
11	Magnesium (as Mg^+)	mg/l	APHA 3500 B (Mg)	30	1 to 1000	15
12	Chloride (as Cl^-)	mg/l	IS 3025 (Part 32)-1988 (2019 reaffirmed)	250	1 to 5000	46.15
13	Total Iron (as Fe^+)	mg/l	APHA 3500 B (Fe)	0.3	1.0	0.20
Microbiological characteristics (bacteria)						
14	Total coliforms(TC)	MPN/ 100ml	IS1622-1981 (1996reaffirmed)	0	0 to 2400	28
15	Faecal Coliforms (FC)	MPN/ 100ml	IS1622-1981 (1996reaffirmed)	0	0 to 2400	11
16	E.coli	-	IS1622-1981 (1996reaffirmed)	0	Present/absent	Present

Table 5.49 Quantity of water quality report of sample four

Sl. No.	Parameter	Unit	Test Method APHA/IS 3025	Desirable limit for drinkingwater (IS 10500:2012)	Limit of detection	Test result of the sample
Physical Characteristics						
1	Colour	HU	APHA 2120-B	5	1 to 100	1
2	Odour	-	IS 3025 (Part 5)-2018	-	Agreeable	Agreeable
3	Taste	-	IS 3025 (Part 8)-1984 (2023 reaffirmed)	-	Agreeable	Agreeable
4	Turbidity	NTU	IS 3025 (Part 10)-1984 (2023 reaffirmed)	1	5	4
5	Electrical conductivity	µS/cm	APHA 2510-B	110	-	71.6
6	Total Dissolved Solids [TDS] (at 180^0 C)	mg/l	IS 3025 (Part 16)-1984 (2023 reaffirmed)	500	2000	47.5
Chemical characteristics						
7	pH (at 25^0 C)	-	IS 3025 (Part 11)-1984 (2022 reaffirmed)	6.5-8.5	2 to 12	6.51
8	Total alkanity (as $CaCO_3$)	mg/l	IS 3025 (Part 23)-1986 (2019 reaffirmed)	200	5 to 2000	10
9	Total Hardness (as $CaCO_3$)	mg/l	IS 3025 (Part 21)-2009 (2019 reaffirmed)	200	1 to 5000	15
10	Calcium (as Ca^+)	mg/l	IS 3025 (Part 40)-1991 (2019 reaffirmed)	75	1 to 2000	10
11	Magnesium (as Mg^+)	mg/l	APHA 3500 B (Mg)	30	1 to 1000	5
12	Chloride (as Cl^-)	mg/l	IS 3025 (Part 32)-1988 (2019 reaffirmed)	250	1 to 5000	35.5
13	Total Iron (as Fe^+)	mg/l	APHA 3500 B (Fe)	0.3	1.0	0.2
Microbiological characteristics (bacteria)						
14	Total coliforms(TC)	MPN/ 100ml	IS1622-1981 (1996reaffirmed)	0	0 to 2400	2400
15	Faecal Coliforms (FC)	MPN/ 100ml	IS1622-1981 (1996reaffirmed)	0	0 to 2400	1100
16	E.coli	-	IS1622-1981 (1996reaffirmed)	0	Present/absent	Present

Table 5.50 Quantity of water quality report of sample five

To ensure water quality, the College routinely monitors its water resources, including five ponds, testing conducted by certified laboratories. Comprehensive analysis includes physical, chemical, and bacteriological parameters. Test results have identified trace levels of E. coli bacteria; however, established management strategies, involving chlorination and cleansing of biofilm in water pipes remediation within the water distribution system, are implemented to mitigate this finding and maintain water safety.

5.4.9 Water conservation measure

The institution operates multiple water conservation systems, including four(DJ Block and Main block)

rainwater harvesting (two artificial, one natural). One of these systems boasts a significant storage capacity of over 100,000 [Specify Units, e.g., litres]. This harvested water supports non-potable needs such as landscape maintenance, facility cleaning, and toilet flushing. Furthermore, a water recycling system processes hostel wastewater for reuse in irrigation and cleaning activities.

5.5 WATER EFFIECIECY MANAGEMENT PLAN

5.5.1 Introduction

The Water Efficiency Management Plan (WEMP) outlines strategies to reduce water consumption, improve water management, and foster sustainable practices in a higher education institution. This plan covers critical areas such as hostels, canteens, student dining facilities, and toilet facilities, where water usage can be significant. The goal is to improve water efficiency across all these areas, minimizing waste and lowering overall water consumption.

An internal audit team comprising of faculty, administrative staff, and students have been set up to study the water usage and for developing strategies for efficient water usage. The team conducted surveys to count the number and types of taps and faucets, assessing their condition (water infrastructure survey). Each block was mapped to identify water sources, including any located outside the campus. The audit also involved documenting water storage systems, noting their type, capacity, year of installation, and location.

The leaking taps and respective quantity also were recorded specifically. Additionally, the team conducted water quality analysis, evaluated water risk management strategies, and reviewed maintenance practices for the water infrastructure.

5.5.2.1 Primary Goal: To reduce the overall water consumption of the institution by 30% within the next 3 years.

5.5.2.2 Specific Objectives:

- o Implement water-saving technologies and practices in hostels, canteens, dining areas, and toilets.
- o Create awareness among students and staff about the importance of water conservation.
- o Monitor and evaluate water usage regularly to track progress.
- o Achieve water usage reductions while maintaining user comfort and hygiene.

5.5.2 Formulate a comprehensive strategy for sustainable water efficiency management

Conduct a thorough water audit across all campus facilities, including:

- **Hostels:** Measure water consumption in bathrooms, showers, laundry facilities, and kitchenettes.
- **Canteens & Dining:** Assess water use in kitchens, dishwashing areas, and food preparation.
- **Toilets:** Analyse water consumption per flush, water leaks, and efficiency of flushing systems.

Key data to collect:

- Monthly water usage data from water bills.
- Identify areas with the highest water consumption.
- Review plumbing infrastructure and potential for leaks or inefficiencies.

5.5.2.1 Based on the recommendations of the audit team, the following Water Conservation Strategies have been put forward

A. Infrastructure and Equipment Improvements

1. Install Low-Flow Fixtures:

- o **Hostels:** Replace showerheads and faucets with low-flow models to reduce water wastage.
- o **Dining Areas & Canteens:** Use low-flow dishwashing equipment and faucets to minimize water use.
- o **Toilets:** Replace existing toilets with dual-flush or low-flow toilets to reduce per-flush water use.

2. Leak Detection and Repair:

- o Conduct regular inspections water audit representatives
- o to detect and repair leaks in plumbing, faucets, toilets, and dishwashing units.
- o Use water meters in key areas (hostels, canteens, toilets) to detect excessive water use or leaks.

3. Rainwater Harvesting:

- o Implement a rainwater harvesting system for non-potable uses such as landscape irrigation and toilet flushing.

4. Greywater Recycling:

- o Reuse greywater from sinks and showers in hostels for landscaping or toilet flushing.

5.5.2.2 . Behaviour Change & Awareness Initiatives

1. Student & Staff Engagement:

- o Rainwater conservation awareness campaigns in hostels, canteens, and dining areas.
- o Post water-saving tips in visible areas like toilets and common spaces.
- o Hold workshops or seminars on water conservation practices.

2. Water-Saving Etiquette:

- o Encourage students and staff to report leaks, use water efficiently, and be mindful of water use in canteens, dining areas, and hostels.

3. Water Use in Canteens:

- o Implement best practices for water management in kitchen areas (e.g., using efficient dishwashing techniques and equipment, reusing water where possible).

5.5.3 Establish robust communicate channel and governing body

The Water Audit Team has proposed the following action plan for the institution, outlining both short-term and long-term goals. To ensure the proper implementation of the action plan, the following team was constituted. This team is entrusted with the responsibility of conducting periodic assessments of water usage, accurate data collection, smooth coordination, and effective implementation of water conservation strategies and reporting any maintenance needs or infrastructure improvement requirements.

Rev. Dr. Jestin K. Kuriakose (Chairperson)
Dr. Gigi K. Joseph (EMS Representative)
Dr. Lincy Tom (Water Audit Coordinator)
Dr. Jyothish Kuthanapillil (Faculty, Dept. of Chemistry)
Mr. Joby Xavier (Maintenance Staff)
Ansa Maria Joshy (Student Representative)

5.5.4 Long term and short term goal

5.5.4.1 Short-Term Actions (0-6 months)

- Conduct an initial water audit to establish baseline water consumption data.
- Begin the installation of low-flow fixtures in hostels, canteens, and toilets.
- Launch a water conservation awareness campaign to engage students and staff.
- Repair leaks and implement water meters in key areas (hostels, dining, and toilets).
- Provide educational materials on water-saving tips in common areas.
- Encourage further involvement from students, faculty, and staff in sustainability initiatives.

5.5.4.2 Medium-Term Actions (6-12 months)

- Install water-efficient appliances (washing machines, dishwashers) in hostels and canteens.
- Implement rainwater harvesting systems for non-potable use, particularly for irrigation and flushing toilets.
- Introduce a grey water recycling system where feasible in hostels and campus facilities.
- Start monitoring and analysing monthly water

consumption data.

- Enhance research efforts to develop innovative technologies for greywater reuse in household and industrial applications. Focus will be placed on advancing research activities, with outcomes disseminated through publications in nationally and internationally recognized journals to foster wider adoption and impact
- Conduct periodic analysis of contaminants in the wells and rivers of the surrounding areas using the institution's available facilities. Compile and share the collected data with the concerned local authorities to facilitate timely and effective remedial actions.
- Expand awareness campaigns, including targeted workshops for hostel residents and canteen staff.

5.5.4.3 Long-Term Actions (1-3 years)

- Review progress and assess overall water consumption reduction.
- Implement more advanced water-saving technologies (e.g., smart irrigation systems, water-efficient cooling systems).
- Continue to replace inefficient water fixtures and appliances as part of the campus renovation projects.

5.5.5 Continuously monitor and enhance the System

5.5.5.1 Install Water Meters:

- o Install sub-metering in critical areas such as hostels, dining areas, and canteens to track real-time water usage.
- o Monitor water consumption trends to identify anomalies and areas for improvement.

5.5.5.2 Monthly Reporting:

- o Internal auditors monitor water usage regularly and provide reports to the campus management, identifying areas with higher-than-expected water usage.
- o Record motor usage register for identify the average time take to refill the tank and the number of time tank were refilled daily.
- o Set targets for reduction and evaluate progress on a quarterly basis.

5.5.5.3 Feedback and Evaluation:

- o Collect feedback from students and staff to continuously improve water-saving strategies.
- o Evaluate the success of water-saving measures annually and make adjustments as needed.

5.5.6 Conclude and conduct follow up on the System

5.5.6.1 Water Consumption Tracking: Monitor monthly water usage data and compare it against historical data to evaluate progress toward water-saving goals.

5.5.6.2 Annual Review: Conduct an annual review of the water efficiency strategies, track results, and adjust the plan as needed.

5.5.6.3 Campus Feedback: Solicit feedback from the campus community on the effectiveness of the water conservation initiatives and provide suggestions for improvements.

5.5.6.4 Water Conservation Goals: Set specific annual water reduction targets, such as a 10% reduction in water usage each year.

5.5.7 Conclusion

The Water Efficiency Management Plan (WEMP) aims to promote sustainable water use across the institution through a combination of infrastructure improvements and awareness initiatives. The internal and external audits have helped identify key areas of water consumption and opportunities for efficiency. By implementing low-flow fixtures, leak detection systems, rainwater harvesting, and greywater recycling, the institution can significantly reduce water waste. The successful implementation of this plan will create a culture of water conservation among students and staff, ensuring that water is used responsibly across campus facilities, including hostels, canteens, dining areas, and toilets. Regular monitoring, reporting, and community engagement will ensure the continued success of these efforts.

5.6 CONCLUSION

- The college's water source is derived from five ponds and is delivered through pumps to 18 primary tanks and 15 secondary tanks. Of these, 12 are filled manually, 12 are pumped twice, and 5 are activated as needed. A major challenge in operations involves the automated filling system for the sub-tanks. Many of these sub-tanks are connected to a single main tank (for instance, one main tank serves two sub-tanks). The capacity of the sub-tanks exceeds that of the main tank. This arrangement results in extended hours required to fill the main tank. Once the main tank reaches a specific level, it automatically fills the connected sub-tank.
- Water usage displays distinct trends, directly linked to the levels of activity on campus, with consumption significantly increasing during regular weekdays compared to semi-holidays or times of lower activity. An evaluation of water consumption indicates considerable differences across the college, with Main Block having the highest per capita usage (1922.29) due to its substantial infrastructure and operational requirements. This analysis provides a solid, data-informed foundation for action. By undertaking targeted measures, such as the proposed strategic upgrades in the Jeevajoythi area and concentrating conservation initiatives on high-usage areas, the college can successfully minimize water waste, improve operational efficiency, and further its commitment to sustainable resource management.
- Significant water loss has been identified as a major concern, largely related to aging plumbing fixtures and the decline of the water infrastructure (such as pipes and showerheads) in certain locations. A marked difference in water usage has been noted between buildings, with older facilities including the Jeevajyothi men's hostel and the sports hostel exhibiting much higher water discharge rates compared to newly upgraded buildings outfitted with more efficient fixtures. To lessen the college's water impact, strengthening the infrastructure is crucial. This involves specifically targeting the replacement or enhancement of outdated plumbing in older buildings and introducing a centralized automation system for concurrently filling multiple sub-tanks from the main tank instead of having individual automation for each.
- The current water pumping system is operating under significant, costly inefficiencies caused by two main issues: improper equipment sizing and a lack of automated, demand-driven control. The Main Block represents a critical performance bottleneck, where an inadequately sized or poorly designed pump struggles to handle a total volume that far exceeds its capacity, resulting in excessive run times and the system's lowest fill rate. The pumping durations for the DJ Block, MCA Block, and Jeeva Jyothi Hostel, despite varying tank sizes, demonstrate clear evidence of a basic timer-based approach. This method guarantees inefficiency, either wasting energy and water through over-pumping or risking water shortages by under-filling. The system operates on fixed schedules rather than actual demand, leading to unnecessary operational expenses and poor resource management.
- According to the assessment, the college's three rainwater harvesting facilities are in significant disrepair. Issues include excessive grass growth and the mixing of harvested rainwater with water from other sources. As a result, there is a high risk of contamination, and the collected water is unsuitable for drinking. The auditing body has emphasized the need for conducting water quality testing, a practice that had not been previously undertaken. Subsequent test results revealed trace amounts of E. coli bacteria. However, the established management strategies, such as chlorination and biofilm remediation within the water distribution system, are being implemented to address this issue and ensure water safety.
- The implementation of additional water conservation measures, including the exploration and potential installation of groundwater recharge facilities, is suggested to enhance long-term water sustainability. It is also essential to promote awareness of water conservation and encourage responsible usage practices among all college stakeholders (students, faculty, and staff) through awareness programs to optimize resource management.

5.7 RECOMMENDATION

Enhance and expand on-campus water conservation initiatives, explicitly recognizing their role in shaping student understanding and behaviour through institutional example. (Rainwater harvesting, water conservation signage in user point

- Establish a regular maintenance schedule for water systems to guarantee operational efficiency and prevent water loss.
- To minimise overflow risks, shift from the current multi-tank semi-automatic system to dedicated, fully automatic systems installed in each individual tank.
- Introduce a schedule for periodic monitoring and maintenance of rainwater harvesting facilities, conducted by the responsible personnel. Key aspects include ensuring the physical integrity of the system to prevent cross-contamination from other water sources and protecting it from adverse conditions such as direct sunlight.
- Institute routine biannual testing of campus water sources to ensure the safety standards and responsible resource.
- Implementing ongoing educational campaigns and awareness initiatives designed to empower students, faculty, and staff to adopt and maintain water-conservation practices.
- Prioritize the regulation of sustainable water management solutions across campus, leveraging these as practical, experiential learning opportunities that reinforce sustainability principles.
- Replace the existing pump with a higher-capacity model appropriate for the total 18,000 L volume. Install a second, dedicated pump to service the 15,000 L sub-tank, allowing the original pump to efficiently handle the 3,000 L main tank.

5.8 ACTIVITIES CONDUCTED

River Pollution Survey

The NSS unit of Nirmala College joined hands with Muvattupuzha Municipal Cooperation and conducted a survey on river pollution on 30th October 2021. Municipality president P.P. Eldos flagged off the program. Municipal welfare committee Chairperson Rajyasree president over. Councillors Jinu Antony, Jaffar, Sudhi, Health Supervisor Dileep, Health inspectors Ashraf A, Lata M, Subair also attended the program. Nirmala College NSS program officers Dr. Biji M. P., Dr. Rajesh Kumar B. presided over the program. Huge support from the locals for the Thelineer project, which ensures the safety of Muvattupuzha water sources.

The River Pollution Survey took place on October 30, 2021. The NSS volunteers were instructed to assemble at Puzhakkara Kavu Devi Temple at 9 am to kickstart the initiative. The survey was flagged off by Municipal President P.P. Eldhose, with the presence of other esteemed guests, adding significance to the event. Following the inaugural function, the volunteers were divided into five groups, with three members in each team. The teams ventured into the community to visit approximately 15 houses each. The objective was to inquire and record information about the waste disposal methods of the households. Through the survey, the volunteers gained insights into the concerns and challenges faced by families regarding effluents and odors from neighboring drainages. The recorded details from the survey were diligently compiled to provide a comprehensive understanding of the river pollution situation in the area. The data collected would serve as valuable inputs for further analysis and planning measures to address river pollution effectively. The River Pollution Survey conducted by the NSS unit of Nirmala College, in association with Muvattupuzha Municipal Corporation, exemplified the spirit of youth-led environmental stewardship. The initiative aimed to understand and address the pollution of rivers, recognizing the crucial role that individuals play in preserving and maintaining clean rivers for the long term. By engaging with the community and involving municipal authorities, the survey sought to raise awareness and encourage collective action towards river conservation. The active participation of NSS volunteers reflected their dedication to fulfilling their obligation to nature and contributing to a better tomorrow for the environment and society as a whole. The event concluded on a positive note, with the hope that the survey findings would serve as a stepping stone towards effective river pollution abatement measures and inspire further initiatives for environmental protection


മൂവാറ്റുപുഴയാർ: സർവേയ്ക്ക് തുടക്കം


പുഴസംരക്ഷണം: മൂവാറ്റുപുഴ നഗരസഭയും നിർമല കോളേജും കൈകോർക്കുന്നു

Puneet Sagar Abhiyaan

National Cadet Corps (NCC) and United Nations Environment Program (UNEP) signed a Memorandum of Understanding (MoU) in the presence of Défense Minister Shri Rajnath Singh in New Delhi on September 22, 2022 to tackle the issue of plastic pollution and achieve the universal goal of clean water bodies through 'Puneet Sagar Abhiyan'. On 22nd November, the cadets of Nirmala College NCC took an oath to uphold the principles of the Puneet Sagar Abhiyan, On 25th November the cadets of Nirmala NCC 1st COY conducted a river cleaning program at the Triveni Sangamam in Muvattupuzha. Around 40 cadets took part in the cleaning program. The activity was done to spread social awareness to the public as well as to ensure a clean environment.

The cadets collected all the plastic bottles & other plastic scraps and properly cleaned the Riverside walkway and it's surroundings. Equipped with gloves, bags, and other cleaning tools, the cadets worked systematically to ensure that no pollutants were left behind. As the cleaning came to an end the cadets gathered all the waste collected. The wastes collected was removed and disposed of properly to prevent further pollution. The "PUNEET SAGAR ABHIYAN" campaign organized by NCC Nirmala COY propagates the message to 'Keep Sea shores/ beaches/riversides free from plastic & other waste materials'. It increases the awareness about the importance of keeping seashores and riversides free of plastic wastes across the country amongst the local population and the future generation

Pond cleaning drive

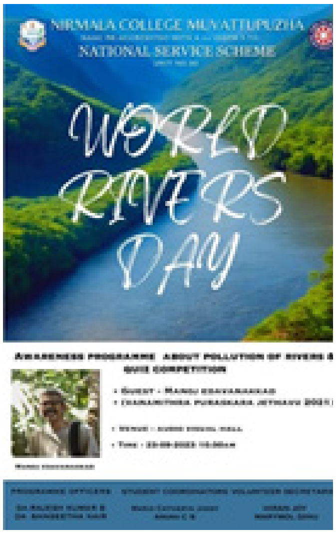
The NCC cadets of Nirmala College are nurtured to become responsible individuals, instilled with a deep understanding of ecological sustainability. Their training empowers them to take tangible actions that contribute to a cleaner, greener environment. One such impactful initiative was the pond-cleaning drive held at Chirappadi, Anicadu. Known for its natural beauty, the Chirappadi pond is a crucial water source for the local community. However, in recent times, it faced pollution threats from plastic and other waste. In response, the cadets stepped forward to restore and preserve this essential resource. On 1st December 2022, the NCC cadets assembled at the Chirappadi pond, prepared to carry out an extensive cleanup. Directed by Battalion staff, Associate NCC Officers (ANOs), and senior cadets, the team gathered waste materials that had accumulated in and around the pond. The cadets, equipped with gloves, bags, and other cleaning tools, meticulously removed plastic and other pollutants. Following a systematic approach, they worked together to ensure that no waste was left behind. The pond-cleaning drive had a transformative effect on the Chirappadi pond, not only restoring its visual appeal but also protecting it as a vital water source. The initiative received praise and appreciation from local residents, who recognized the cadets' efforts to preserve the pond's natural beauty and ecological significance. The cadets' actions also raised awareness in the community about the importance of keeping local water bodies free from pollution.

World Environment Day

Environment day is celebrated by millions of people across the world. "Only One Earth" is the campaign slogan, with the focus on "Living Sustainably in Harmony with nature ". Environment day acts as a reminder to people to be more considerate and aware of the Earth's existing conditions, in terms of the environment. People take action to spread awareness about the environment and motivate others to do the same, in hopes of creating a better future. On June 5th 2023 NCC Alpha COY of Nirmala College Muvattupuzha celebrated environment day. The program was based on the theme 'LIFESTYLE FOR ENVIRONMENT'. The program was conducted in the presence of ANO Lt. Dr. Albish K Paul and respected principal Prof. Dr. THOMAS K.V. The program started with the valuable words of ANO about the ways to save our mother earth by protecting our waterbodies and soil. Then our respected principal along with ANO planted a new tree inside the college campus and explained the importance of sustainable development and our responsibility on protection of nature. With the initiative of U/O Ardra S Kallarackal everyone took an oath. Environment Day celebration by Nirmala NCC unit raised awareness of the value of resources on our planet and the need to protect them

World rivers day september 23, 2023

World Rivers Day was observed by the unit by conducting an awareness programme on pollution of rivers. The programme was led by the Vanamithra Puraskara Jethavu of 2021 Mr. Manoj Edavakkad. He shared his views and opinions about the pollution and conservation of rivers. In regard of the day, a quiz programme was also conducted by the volunteers.

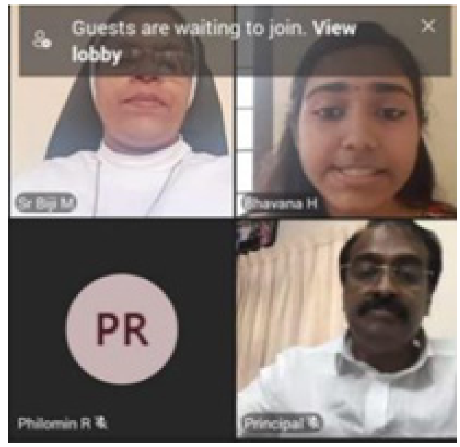


Go green campaign

Department of Tourism studies conducted Go Green programme on 21st July 2023 at Areekal waterfalls and Kochareeckal Caves.The programme highlighted the concept of 'Keep green and keep our planet clean'. The programme was conducted to inculcate the need for reduce, reuse and recycle among students and society.

Karuthal 2021

The objective of the first day of the Nirmala College NSS unit Seven-day camp Karuthal 21, was Youth for sustainable development with special focus in watershed management. At 4:30 pm the inauguration ceremony began. The welcome speech was delivered by NSS program officer Dr. Sr Biji M P. The presidential address was delivered by Dr K.V. Thomas, Principal, Nirmala College. The program was officially inaugurated by MG University NSS Coordinator Dr. Rekha Raj. Greetings were given by Smt. Shelmy Johns, president Avoly panchayat, Rev. Fr. Francis Kannadan, College Bursar and professor Saji Joseph, College Vice Principal. Secretary Jerin K John expressed his gratitude on behalf of the NSS volunteers.



Nature camp

NSS volunteers visited Idukki water reservoir and its premises on 15th March 2023 as part of nature camp. Along the way the volunteers were able to experience the vast flora and fauna surrounding the reservoir followed by a trekking inside the Idukki Wild-life Sanctuary. The forest officers gave detailed information about the different kinds of plants and animals of the forest. They also helped the volunteers understand the need to preserve the forest and wildlife present in the forest. After lunch various activities and classes were organized to spread awareness about forest acts and laws. After dinner the day came to an end with cultural activities performed by the volunteers on the theme of forest preservation.

World water day- awareness of water conservation

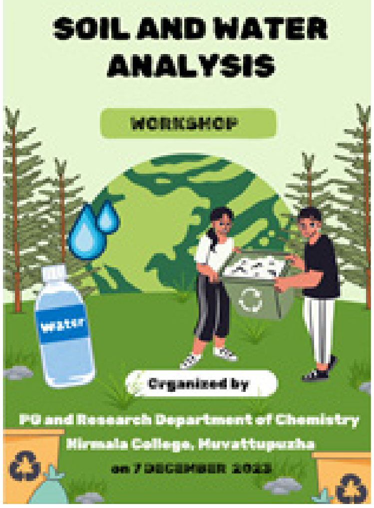
World Water Day is held annually on 22nd march as a means of focusing attention on the importance of fresh water and advocating for the sustainable management of fresh water resources. Nirmala NSS unit 30, in association with Vazhakulam and Kalloorkad Panchayath, conducted a programme under the motto: "Save each drop" on 28th March 2023 to give awareness on water conservation. NSS volunteers performed a flash mob to gain attention of the public at the Vazhakulam and Kalloorkad town junctions and then displayed placards and charts showing the importance of saving fresh water.

Government - academia knowledge collaboration

This collaboration started on 2023, seeks to unravel the intricate patterns and insights hidden within 35 years of invaluable daily rainfall data collected from 147 diverse locations across the state of Kerala. By synergizing the expertise of the Department of Irrigation's water management prowess with the analytical finesse of the Department of Statistics, this endeavour aspires to forge a deeper understanding of Kerala's rainfall dynamics.

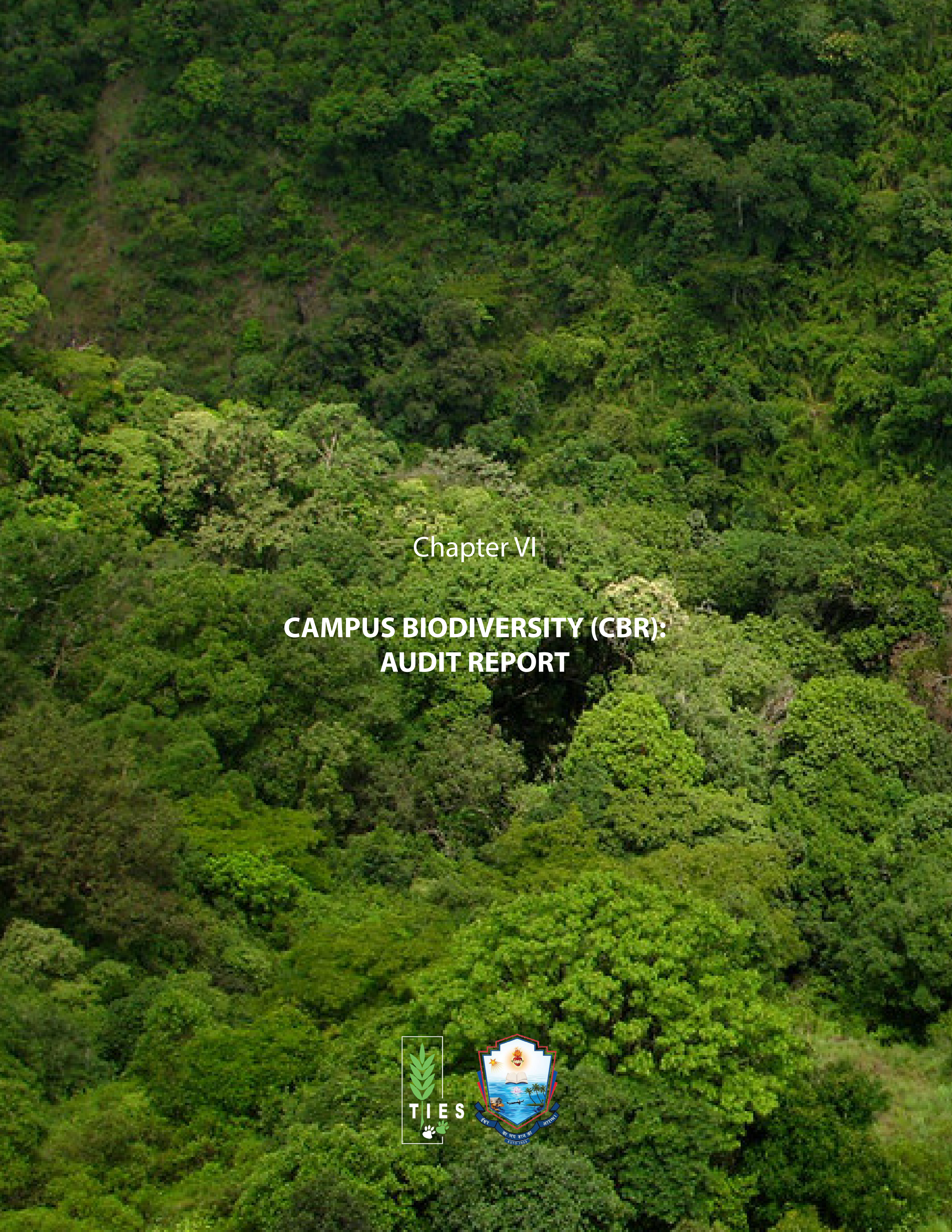
Workshop on soil and water analysis

The Department of Chemistry successfully conducted a one-day workshop on Soil and Water Analysis on December 7, 2023. The workshop aimed to provide students with practical exposure to various techniques related to water quality assessment, soil analysis, and treatment methods. A total of 20 students attended the program, which was facilitated by Dr. Lincy Tom, Dr. Jijo V.J. and Anirudhan, Aswin Research Scholar. The workshop covered essential topics, including water treatment methods, key water quality testing parameters such as pH measurement, conductivity, TDS, hardness, alkalinity, heavy metal presence, and microbial contamination. Hands-on laboratory sessions provided participants with experience in standard water testing procedures and advanced instrumental techniques. The interactive sessions and practical demonstrations helped students enhance their analytical skills and understanding of environmental chemistry.



Thousands have lived without love,
not one without water.

- H Auden



Chapter VI

CAMPUS BIODIVERSITY (CBR): AUDIT REPORT

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(BMC 2024-25)

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Fathima Kareem
Hridya Pradeep
Josemin Chacko
Niveditha P G
Tintu Thomas
Vrinda Pradeep
Sajana Moideenkunju

Students

6

Campus Biodiversity Audit Report

6.1 INTRODUCTION

Biodiversity is essential for the maintenance of life, providing critical ecosystem services such as the supply of food, purification of water, regulation of floods and droughts, cycling of nutrients, and stabilization of the climate. These services are vital for human health and economic development. Biodiversity serves as a holistic representation of the biosphere, closely interconnected with the planet's physical components, including soil, rocks, water, and air, all energized by solar power. Over the course of 2 to 3 billion years, a highly intricate and balanced cyclic system has developed, facilitating the exchange of energy, materials, and information between living organisms and the Earth's physical environment. Despite its immense ecological, economic, and cultural importance, biodiversity is being lost globally at an accelerating pace due to factors such as pollution, habitat degradation, urbanization, industrialization, population growth, and overexploitation of species. Habitat destruction—primarily driven by development activities—and the exploitation of specific species for economic or recreational purposes are major contributors to this decline. Biodiversity loss disrupts ecosystems, leading to species extinction or depletion and affecting ecosystem functionality and food chains. This has far-reaching consequences, including reduced agricultural productivity and weakened resilience to natural disasters such as floods and droughts. Safeguarding biodiversity is critical, as its decline poses severe threats, including:

- Loss of genetic diversity,
- Homogenization of flora and fauna

Disruption of vital ecosystem functions that are crucial for human existence, including the generation of food, pharmaceuticals, timber, and the filtration of air and water, poses a significant concern. Ecosystem services provide a wide array of advantages, which can be classified into provisioning services (such as food, water, timber, and genetic resources), regulating services (including climate regulation, flood control, disease management, and water purification), cultural services (encompassing recreation, aesthetic enjoyment, and spiritual fulfilment), and supporting services (like soil formation, pollination, and nutrient cycling). Nevertheless, the demand from humans for these services is escalating rapidly. The Millennium Ecosystem

Assessment indicates that around 60% of the ecosystem services assessed comprising 70% of regulating and cultural services are experiencing degradation or unsustainable use, jeopardizing their availability for future generations.

Standardization of biodiversity management systems to establish principles, frameworks, requirements, guidance, and supporting tools through a holistic and global approach for organizations, enhancing their contributions to sustainable development

6.1.2 What is Biodiversity Audit?

The Biodiversity Audit involves a thorough assessment of the importance of biodiversity throughout the campus. The objective of implementing a Biodiversity Audit Strategy is to create a solid foundation for future initiatives. Evaluation of the potential of the campus's green spaces to sustain significant and protected habitats and species is essential. Furthermore, the audit provides customized recommendations for enhancing and maximizing biodiversity. This evaluation will identify existing site habitats, create habitat maps for each designated area, and assess the status of each habitat type. In addition, we will examine current management practices and, when necessary, propose strategies for improving existing conditions. Our primary objective is to measure tangible advancements in biodiversity, thus facilitating future gains in this area.

6.1.3 Why measuring Biodiversity?

- Degradation of habitats at alarming rate- urgent to estimate the current status before extinction
- Measures of biodiversity regarded as indicators of the wellbeing of ecological systems
- Currently biodiversity is the central theme of ecology and development
- Varied tools and techniques are essential for measuring biodiversity in diverse habitats
- Mandatory- as a signatory of Convention on Biological Diversity (1992)

6.1.4 Need for Biodiversity Audit

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

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

6.2 CAMPUS BIODIVERSITY MANAGEMENT SYSTEM POLICY

6.2.1 Statement of Commitment

Nirmala College (Autonomous) recognizes the intrinsic value of biodiversity and its crucial role in fostering a healthy and sustainable environment. In alignment with the UN Sustainable Development Goals for life on land, the college is committed to integrating sustainable practices and policies across all operations. This commitment includes actively conserving and enhancing biodiversity on our campus. The institution pledge to incorporate biodiversity management into our operational framework, academic curriculum, and outreach initiatives, cultivating a culture of environmental responsibility among students, faculty, staff, and wider stakeholders.

6.2.2 Goals

6.2.2.1 Biodiversity Goal: Enhance biodiversity on campus by achieving a 10% increase in plant and animal species diversity over the next five years, using baseline data established through initial biodiversity surveys and verified through subsequent regular assessments.

6.2.2.2 Sustainability Goal: Reduce the college's environmental impact by minimizing waste generation and water consumption by 15% within the next three years, measured against established baseline data and tracked through ongoing monitoring programs.

6.2.3 Objectives

6.2.3.1 Biodiversity and Environmental Awareness: Enhance understanding of biodiversity and environmental issues among students, faculty, and staff through curriculum integration, workshops, and outreach programs. Achieve a 50% participation rate in biodiversity-related awareness initiatives.

6.2.3.2 Green Space Development: Expand and maintain green spaces on campus to provide wildlife habitats and enhance the aesthetic environment. Establish a minimum of two new green spaces or gardens annually.

6.2.3.3 Sustainable Landscaping Practices: Implement sustainable landscaping practices to achieve a 20% annual reduction in pesticide and herbicide use.

6.2.4 Resource Management

Nirmala College recognizes the critical role of sustainable natural resource management in supporting and enhancing biodiversity on campus. We prioritize the efficient and responsible use of land, water, soil, and biological resources to maintain ecological balance and promote conservation. Our key initiatives include:

6.2.4.1 Protecting Native Ecosystems Through Sustainable Land Use: Employ land management practices designed to protect native vegetation, prevent soil erosion, and enhance natural habitats for local flora and fauna. This includes [Example: Implementing a no-till farming approach].

6.2.4.2 Conserving Water Resources for Aquatic Biodiversity: Implement rainwater harvesting systems, promote water-efficient landscaping techniques (xeriscaping), and actively conserve wetland ecosystems to support aquatic biodiversity and reduce overall water consumption.

6.2.4.3 Promoting Soil Health Through Reduced Chemical Inputs: Minimize the use of synthetic fertilizers and pesticides by transitioning to organic and eco-friendly alternatives that protect soil microorganisms and promote overall soil biodiversity.

6.2.4.4 Prioritizing Native Species in Landscaping and Habitat Creation: Focus on the use of native and endemic plant species in all campus landscaping projects to create self-sustaining ecosystems that provide crucial support for pollinators and local wildlife.

6.2.4.5 Transforming Waste into a Resource for Soil Enhancement: Strengthen composting and organic waste recycling programs to convert waste into valuable resources for enhancing soil fertility and minimizing habitat degradation through responsible waste management practices.

6.2.4.6 Restoring Degraded Ecosystems for Biodiversity Recovery: Develop and implement comprehensive strategies for restoring degraded areas on campus. These strategies will include targeted reforestation efforts, the strategic removal of invasive species, and the creation of diverse microhabitats designed to maximize biodiversity support.

6.2.5 Curriculum Integration

6.2.5.1 Curriculum Integration of Environmental and Sustainability Themes: The institution will integrate environmental and sustainability topics across the curriculum, including the development of interdisciplinary courses focused on biodiversity, ecology, and environmental conservation. Students will be required to complete a supplementary course offered as a one-month intensive program in either an offline or online format—to deepen their understanding of these critical areas.

6.2.5.2 Experiential Learning through Biodiversity and Sustainability Internships: The institution will provide internship opportunities during semester breaks and vacations at reputable organizations focused on biodiversity conservation and environmental sustainability. These internships will enable students to conduct case studies, participate in ongoing projects, and gain hands-on experience. Students will integrate their real-world insights into their academic coursework.

6.2.5.3 Fostering a Culture of Research and Publication: The institution will encourage students and faculty to engage in research projects focused on campus biodiversity and sustainability. Students will be supported in publishing their thesis work in academic journals or college publications, thereby fostering a culture of academic contribution to the field of sustainability.

6.2.5.4 Faculty Development and Enhanced Learning Opportunities: Faculty will receive training and resources to effectively integrate environmental themes into their teaching. Students will have opportunities to participate in field visits and hands-on training sessions at relevant organizations, enriching their learning experience with practical insights.

6.2.6 Green Initiatives

6.2.6.1 Cultivating Sustainable Green Spaces: The college is committed to establishing and maintaining diverse green spaces on campus, including specialized native plant and butterfly gardens. An initial intensive effort, designated as a "Nature Drive," will focus on revitalizing the existing botanical garden. A dedicated groundskeeper will be responsible for ensuring the long-term sustainability of these spaces, including the proper maintenance of plant collections and support for local wildlife habitats.

6.2.6.2 Engaging in Tree Planting for a Greener Future: The college will organize regular tree planting events to actively engage students, faculty, and staff in enhancing campus biodiversity and sequestering carbon dioxide. These events will serve as opportunities for environmental education and community building.

6.2.6.3 Closing the Loop: A Campus-Wide Composting Program: The college will implement a comprehensive composting program to reduce organic waste generation and produce nutrient-rich soil for enriching campus gardens. This program will minimize the reliance on synthetic fertilizers, encourage the use of organic pest control methods, and prioritize the cultivation of native plant species to support local wildlife and small habitats.

6.2.6.4 Leveraging Data for Enhanced Biodiversity Management: The college will conduct regular biodiversity audits, utilizing internal expertise, to ensure the accurate maintenance of biodiversity registers and update species checklists. A comprehensive biodiversity data bank will be developed to inform conservation efforts. The implementation of tree naming with QR codes will empower students and visitors to access detailed information about the campus's flora and fauna, fostering appreciation for their ecological significance and associated benefits.

6.2.7 Purchasing and Procurement

6.2.7.1 Prioritizing Environmentally Preferable Products: The college will prioritize the purchase of environmentally preferable products that support sustainable construction, enhance campus greenery, and promote responsible landscaping practices.

6.2.7.2 Establishing Sustainable Procurement Guidelines: Develop and implement comprehensive sustainable procurement guidelines, submitted to the college council for approval, to prioritize purchasing decisions based on a thorough assessment of the environmental and social impacts of products and services.

6.2.7.3 Supporting Local and Ethical Suppliers: The college is committed to supporting local and ethical suppliers who demonstrate a commitment to quality and long-term sustainability, thereby contributing to their market viability and promoting responsible business practices that integrate commercial benefits with social responsibility.

6.2.7.4 Integrating Lifecycle Assessment into Procurement Decisions: Incorporate lifecycle assessment principles into purchasing decisions, considering the environmental impacts of products from raw material extraction to end-of-life disposal, while integrating suggestions from EnMS, WEMS, WMS, OHS, and other relevant committee members.

6.2.8 Research and Innovation

6.2.8.1 Supporting Interdisciplinary Research on Sustainability: The institution will prioritize research projects and dissertations that address key issues in campus biodiversity, conservation, and sustainable practices, providing research grants to faculty and students engaged in interdisciplinary scholarship.

6.2.8.2 Optimizing Research Infrastructure for Environmental Inquiry: The institution will optimize research infrastructure, offering workshops and experiential learning opportunities through field visits, to support rigorous environmental inquiry and the pursuit of innovative solutions.

6.2.8.3 Cultivating Collaborative Networks for Addressing Environmental Challenges: The institution will cultivate collaborative networks between academic departments and external organizations to foster interdisciplinary approaches to addressing complex environmental challenges through impactful research projects.

6.2.8.4 Disseminating Research Findings Through Scholarly Outlets: The institution will promote the dissemination of research findings by encouraging publication in peer-reviewed journals and facilitating student and faculty participation in conferences, quizzes, and debates at the national and international levels.

6.2.9 Community Engagement

6.2.9.1 Building Partnerships for Community-Based Conservation: The institution will develop and sustain partnerships with local environmental organizations, community groups, and government agencies, encouraging the active participation of students, faculty, and alumni in collaborative biodiversity conservation efforts.

6.2.9.2 Empowering Communities Through Environmental Education: The institution will empower communities through the implementation of impactful community outreach programs, such as workshops, guided nature walks, and engaging educational events designed to raise awareness about biodiversity and pressing environmental challenges.

6.2.9.3 Utilizing Citizen Science for Data-Driven Conservation: The institution will actively engage students and college stakeholders in citizen science initiatives, harnessing their collective efforts to monitor campus biodiversity and collect valuable data for informing evidence-based conservation strategies.

6.2.9.4 Disseminating Knowledge and Resources to the Wider Community: The institution will disseminate its knowledge, resources, and expertise in biodiversity and sustainability to the wider community through open programs, public exhibitions, and engaging competitions designed to foster environmental literacy and action.

6.2.10 Monitoring and Reporting

6.2.10.1 Implementing Measurable Key Performance Indicators (KPIs): Implement measurable KPIs, aligned with the goals and objectives of this policy and informed by auditor recommendations and college council approval, to track and evaluate progress in environmental performance.

6.2.10.2 Publicly Reporting on Environmental Progress: The college will publicly report its environmental progress annually through a comprehensive environmental report published in college publications, documenting key performance indicators, energy and water consumption, waste generation statistics, and biodiversity metrics.

6.2.10.3 Conducting Regular Internal Environmental Assessments: The college will conduct regular internal environmental assessments through independent audits to rigorously evaluate the effectiveness of its environmental management practices and identify areas for enhancement.

6.2.10.4 Engaging Stakeholders in Environmental Performance Enhancement: The College will actively solicit feedback from students, faculty, staff, and community stakeholders through annual surveys to assess its environmental performance and identify opportunities for continuous improvement, thereby enhancing holistic participation.

6.2.11 Compliance and Review

6.2.11.1 Upholding Environmental Legal Standards: The college is committed to upholding all applicable environmental laws, regulations, and mandates.

6.2.11.2 Regular Policy Evaluation and Enhancement: This policy will undergo a comprehensive review and update at least every three years, or more frequently as necessary, to reflect current environmental conditions, adopt best practices, and align with the college's strategic vision.

6.2.11.3 Involving Stakeholders in Policy Refinement: The college will actively involve students, faculty, staff, and community members in the policy review and refinement process, ensuring a collaborative and inclusive approach to environmental governance.

6.2.12 Leadership and Accountability

6.2.12.1 Creating a Governing Environmental Management Committee: The college will create an Environmental Management Committee, comprised of students, faculty, staff, and administrators, to govern the implementation and ongoing oversight of this policy.

6.2.12.2 Empowering a Sustainability Coordinator: A highly qualified Sustainability Coordinator, reporting to Upper Body EMS, will be empowered to coordinate environmental initiatives, meticulously monitor progress towards established goals, and provide expert technical guidance to support the success of this policy.

6.2.12.3 Defining Departmental Accountabilities: Clear and specific accountabilities for implementing environmental practices will be defined for individual departments and units, fostering a culture of responsibility and ownership.

6.2.12.4 Investing in Employee Environmental Education: The college will invest in providing employees with comprehensive training on environmental best practices, empowering them to effectively contribute to the implementation of this policy.

6.2.12.5 Celebrating Environmental Stewardship: The college will formally recognize and celebrate individuals and departments that demonstrate outstanding leadership in environmental stewardship.

By encompassing these elements, this biodiversity management policy for Nirmala College (Autonomous) serves as a roadmap for integrating sustainability into its operations, education, and broader community engagement, fostering a campus environment that celebrates and protects biodiversity for future generations

6.3 METHODOLOGY

Integrating biodiversity conservation into its core sustainability framework, the college has established a formal strategy for its protection and enhancement. Implementation is guided by a Biodiversity Audit Team, consisting of seven members (five students and two faculty), which is mandated to conduct detailed biodiversity assessments and oversee internal review processes related to conservation efforts.

6.3.1 Internal Audit Training

Green audit training utilizes comprehensive, participatory approaches to cultivate institutional ownership and engagement. To prepare the college for this, the Environmental Management System (EMS) selects students and faculty for internal audit training. This one-day program certifies participants as internal auditors, empowering them to conduct water audits. The internal biodiversity audit process involves several key stages: assessment, risk analysis, data collection, policy development, and the documentation of water conservation registers and programs.

6.3.2 Data sampling by categorizing the area in different zone

Key activities focused on collecting detailed taxonomic data through systematic, repetitive field surveys. Flora data (for herbs, shrubs, and trees) were gathered using random sampling, spot surveys, and transect walks. Fauna data collection employed transects for birds and quadrat studies for butterflies and insects.

6.3.3 Calculating the campus diversity

Quadrat sampling and transect methods are employed to collect floral and faunal data, which is then used to compute biodiversity indices like Simpson's Diversity Index. These calculations quantify species richness and evenness, serving as key indicators of the biological community's condition

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

The audit group proactively identifies threats to campus biodiversity, formulating strategic management plans informed by both primary data collection and secondary source analysis. Ongoing monitoring occurs via regular meetings, which include reviews of sustainability programs and awareness initiatives. Responsibility for documenting these activities rests with assigned students and faculty, ensuring a coordinated approach to embedding a culture of sustainability on campus and promoting its adoption within the surrounding community.

6.3.5 External Audit

An external auditor visits to evaluate conformity with biodiversity management audit requirements and identify any non-conformities. If only minor non-conformities are found, the external auditor can approve the institution for certification against relevant ISO standards

6.3.6 Assumption of Biodiversity audit ISO standards

Global biodiversity is declining at an unprecedented rate, significantly impacting ecosystem stability, environmental health, and human well-being. This rapid loss of species is largely driven by escalating demand for biological resources due to population growth and consumption patterns.

Human societies are fundamentally dependent on biodiversity for essential ecosystem services. These range from provisioning services like food, fresh water, timber, and medicinal resources, to regulating services such as climate stabilization, air and water purification, pollination, and flood control. Healthy ecosystems also provide supporting services like soil formation and nutrient cycling, alongside crucial cultural and aesthetic benefits. Protecting biodiversity is therefore essential for human survival and prosperity.

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

Aligned with global conservation goals to combat habitat destruction and land transformation, this standard emphasizes the critical role of urban and surrounding areas. By integrating ecological principles into all land-use decisions, we can protect and restore vital natural capital, contributing to 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.

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

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.

Fig 6.1 quadrat sampling

Schedule of biodiversity audit

Week	Week days	Weekly Work Plan
First Week	Jan 6, 2025	• Organizing campus areas into Five zones for biodiversity auditing. • Conduct a briefing session for survey participants to overview the survey areas and methodology • Assign teams to zones 1-5 for quadrate study of the campus for flora & fauna identification. • Attend weekly group meetings, capture photographs, and prepare meeting minutes.
Second Week	Jan 10, 2025	• Data collection from zone 1 and 2. • Attend weekly group meetings, take photographs, and prepare meeting minutes.
Third Week	Jan 19, 2025	• Analysis of the data collected from zone 1 and 2. • Data collection in zone 3 and 4 with data recording. • Attend weekly group meetings, take photographs, and prepare meeting minutes.
Fourth Week	Jan 28, 2025	• Conduct thorough surveys of creepers and climbers in the campus. • Analysis of the data collected from zone 3 and 4. • Data collection in zone 5 with data recording. • Attend weekly group meetings, document findings with photographs, and prepare meeting minutes.
Fifth Week	Feb 3, 2025	• Analysis of the data collected from zone 5. • Search for odonates and lepidopterans using transect method. • Enter collected data from quadrates by the end of the fourth week. • Thorough survey of herbs and shrubs of the campus. • Hold weekly team meeting, take photographs, and prepare meeting minutes.
Sixth Week	Feb 10, 2025	• Comprehensive survey for amphibians, reptiles, birds and mammals using transect method. • Enter collected data from transects by the end of the fifth week. • Survey of trees of the campus. • Attend weekly group meetings, take photographs, and prepare meeting minutes.

Seventh Week	Feb 21, 2025	• Analysis of faunal and floral data obtained from transect and quadrate study. • Enter data on excel (floral and faunal survey) • Conduct weekly group meetings, take photographs, and prepare meeting minutes.
Eighth Week	Mar 5, 2025	• Identify threats and initiate conservation activities for various plant and animal species. • Attend weekly group meetings, capture photographs, and prepare meeting minutes.
Nineth Week	June 10 to June 24	• Compile all data collected. • Ensure all registers and documents are completed before preparing the final report.
Tenth week	June 10,2025 June 13,2025	• Revisited the fields and collected the data • Revisited the fields and collected the data
Eleventh week	June 18, 2025 June 19, 2025 June 20, 2025	• Revisited the fields and collected the data of amphibians, insects and bird • Revisited the fields and collected the data of invertebrates,Amphibians, birds and reptiles • Revisited the fields and Collected the data of odonates, butterflies and other vertebrates
Twelfth week	June 24, 2025	• Compiled all data collected • Entered data on Excel

Table 6.1 Schedule of the biodiversity audit

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 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.)

Work plan of biodiversity audit

Activities	Frequency	Dates of study	Mode of data collection
Quadrat sampling & Transect sampling	() days; three times a day	2/01/2025- 15/01/2025 16/01/2025- 29/01/2025 30/0/2025- 11/2/2025 12/02/2025- 5/03/2025	Entry in the given format

Table 6.2 Workplan of Biodiversity audit

6.4 RESULTS AND DISCUSSION

6.4.1 Checklist of selected fauna and flora

6.4.1.1 Checklist of birds

No	ENGLISH NAME	SCIENTIFIC NAME	MALAYALAM NAME	DENSITY
1	SHIKRA	*Accipiter badius*	പുള്ള്	3
2	COMMON MYNA	*Acridotheres tristis*	നാട്ടു മൈന	8
3	INDIAN POND HERON	*Ardeola grayii*	കുളക്കൊക്ക്	2
4	CATTLE EGRET	*Bubulcus ibis coromandus*	കാലിമുണ്ടി	11
5	GREATER COUCAL	*Centropus sinensis*	ചെമ്പോത്ത്	7
6	PURPLE SUNBIRD	*Cinnyris asiaticus*	കറുപ്പൻ തേൻകുരുവി	5
7	ROCK PIGEON	*Columba livia*	അമ്പലപ്രാവ്	21
8	ORIENTAL MAGPIE ROBIN	*Copsychus saularis*	മണ്ണാത്തിപ്പുള്ള്	5
9	LARGE BILLED CROW	*Corvus macrorhynchos*	ബലികാക്ക	10
10	HOUSE CROW	*Corvus splendens*	പേനകാക്ക	70
11	ROUFUS TREE PIE	*Dendrocitta vagabunda*	ഓലേഞ്ഞാലി	5
12	BLACK DRONGO	*Dicrurus macrocerus*	ആനറാഞ്ചിപക്ഷി	10
13	GREATER RACKET TAILED DRONGO	*Dicrurus paradiseus*	ഇരട്ടവാലൻപക്ഷി	4
14	BLACK RUMPED FLAMEBACK	*Dinopium benghalense*	നാട്ടുമരംകൊത്തി	2
15	JUNGLE OWLET	*Glaucidium radiatum*	ചെമ്പൻനത്ത്	1
16	WHITE-THROATED KINGFISHER	*Halcyon smyrnesis*	മീൻകൊത്തിച്ചാത്തൻ	2
17	BRAHMINY KITE	*Haliastur indus*	കൃഷ്ണപരുന്ത്	4
18	INDIAN PEAFOWL	*Pavo cristatus*	മയിൽ	1
19	WHITE CHEEKED BARBET	*Psilopogon viridis*	ചിന്നകുട്ടുറുവൻ	4
20	ROSE RINGED PARAKEET	*Psittacula krameri*	മോതിരത്തത്ത	3
21	RED VENTED BULBUL	*Pycnonotus cafer*	നാട്ടുബുൾബുൾ	9
22	RED-WHISKERED BULBUL	*Pycnonotus jocosus*	ഇരട്ടത്തലച്ചി	6
23	JUNGLE BABBLER	*Turdoides striata*	കരിയിലകിളി	10
Simpson's index				0.14

Table 6.3. Checklist of birds

Jungle babbler

Oriental magpie robin

Indian pond heron

Rock pigeon

Greater coucal

Rose-ringed parakeet

Black drongo


Brahminy kite


Asian koel


Common myna


Black rumped flameback


Red whiskered bulbul


Red vented bulbul


White- throated kingfisher

6.4.1.2 Checklist of odonates

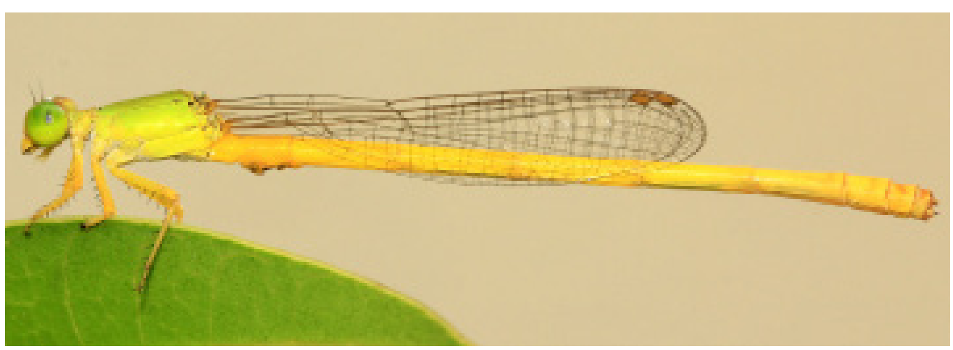
No	ENGLISH NAME	SCIENTIFIC NAME	MALAYALAM NAME	DENSITY
1	TRUMPET TAIL	*Acisoma panorpoides*	മകുടി വാലൻ	6
2	SCARLET MARSH HAWK	*Aethriamanta brevipennis*	ചോപ്പൻ കുറുവാലൻ	2
3	GRANITE GHOST	*Bradinopyga geminata*	മതിൽത്തുമ്പി	2
4	GROUND SKIMMER	*Diplacodes trivialis*	നാട്ടുനിലത്തൻ	2
5	PIED PADDY SKIMMER	*Neurothemis tullia*	സ്വാമിത്തുമ്പി	8
6	BROWN-BACKED RED MARSH HAWK	*Orthetrum chrysis*	ചെന്തവിടൻ വ്യാളി	1
7	COMMON PICTUREWING	*Rhyothemis variegata*	ഓണത്തുമ്പി	6
8	PYGMY DARTLET	*Agriocnemis pygmaea*	നാട്ടുപുൽചിന്നൻ	2
9	ORANGE-TAILED MARSH DART	*Ceriagrion cerinorubellum*	കനൽവാലൻ ചതുപ്പൻ	3
10	COROMANDEL MARSH DART	*Ceriagrion coromandelianum*	നാട്ടുചതുപ്പൻ	2
11	SLENDER BLUE SKIMMER	*Orthetrum luzonicum*	ത്രിവർണൻവ്യാളി	1
12	SCARLET BASKER	*Urothemis signata*	പാണ്ടൻ വയൽത്തെയ്യൻ	6
13	COMMON CLUBTAIL	*Ictinogomphus rapax*	നാട്ടുകടുവ	2
14	RUFOUS-BACKED MARSH HAWK	*Brachydiplax chalybea*	തവിട്ടു വെണ്ണീറാൻ	6
15	CRIMSON TAILED MARSH HAWK	*Orthetrum pruinosum*	പവിഴവാലൻ വ്യാളി	2
16	GOLDEN DARTLET	*Ischnura aurora*	മഞ്ഞ പുൽമാണിക്യൻ	2
17	YELLOW BUSH DART	*Copera marginipes*	മഞ്ഞക്കാലി പാൽത്തുമ്പി	3
18	WHITE DARTLET	*Agriocnemis pieris*	വെള്ള പുൽച്ചിന്നൻ	1
Simpson's index				0.06

Table 6.4. Checklist of odonates

Aethriamanta brevipennis

Ceriagrion cerinorubellum

Acisoma panorpoides



Ceriagrion coromandelianum

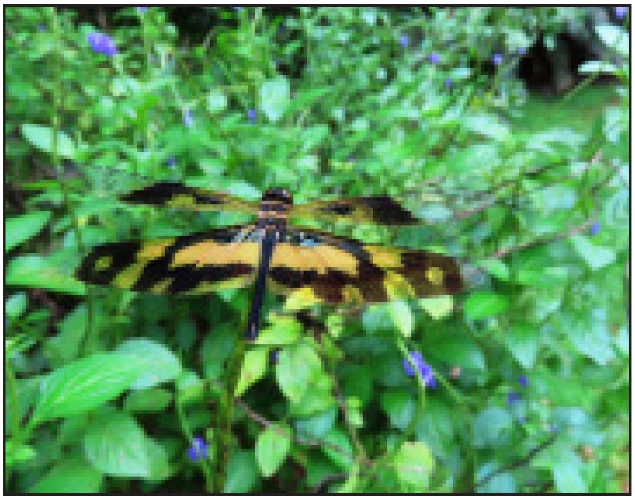

Diplocodes trivialis


Neurothemis tullia male


Orthetrum sabina


Neurothemis tullia female


Aethriamanta brevipennis


Rhyothemis varigata

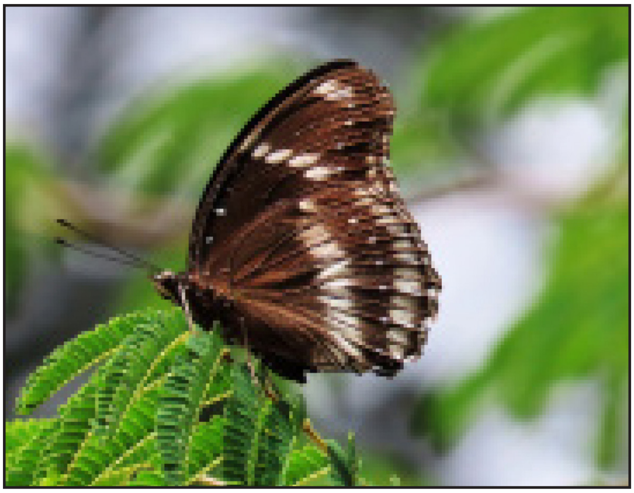
6.4.1.3 Checklist of butterflies

No	ENGLISH NAME	SCIENTIFIC NAME	MALAYALAM NAME	DENSITY
1	TAWNY COASTER	*Acraea terpsicore*	തീച്ചിറക്കൻ	2
2	COMMON PIERROT	*Castalius rosimon*	നാട്ടുകോമാളി	2
3	COMMON EMIGRENT	*Catopsilia pomona*	മഞ്ഞതകരമുത്തി	5
4	MOTTLED EMIGRANT	*Catopsilia pyranthe*	തകരമുത്തി	1
5	PLAIN TIGER	*Danaus chrysippus*	എരുക്കുത്തപ്പി	4
6	COMMON JEZEBEL	*Delias eucharis*	വിലാസിനി	3
7	COMMON PALM FLY	*Elymnias hypermnestra*	ഓലക്കണ്ടൻ	5
8	COMMON CROW	*Euploea core*	അരളിശലഭം	5
9	COMMON GRASS YELLOW	*Eurema hecabe*	മഞ്ഞപാപ്പത്തി	4
10	TAILED JAY	*Graphium agamemnon*	വിറവാലൻ ശലഭം	1
11	BLUEBOTTLE	*Graphium sarpedon*	നീലകുടുക്ക	3
12	THE DANAID EGG FLY	*Hypolymnas misipus*	ചൊട്ടശലഭം	2
13	COMMON CERULEAN	*Jamides celeno*	പൊട്ടുവാലാട്ടി	6
14	CHOCOLATE PANSY	*Junonia iphita*	കരിയില ശലഭം	10
15	CHESTNUT BOB	*Lambrix salsala*	ചെംകുറുമ്പൻ	3
16	PSYCHE	*Leptosia nina*	പൊട്ടുവെള്ളാട്ടി	12
17	COMMON EVENING BROWN	*Melanitis leda*	കരിയില ശലഭം	3
18	DARK BAND BUSHBROWN BUTTERFLY	*Mycalesis mineus*	ഇരുൾവരയൻ തവിടൻ	1
19	COMMON BUSHBROWN	*Mycalesis perseus*	തവിടൻ	4
20	COMMON SAILOR	*Neptis hylas*	പൊന്തച്ചുറ്റൻ	6
21	COMMON ROSE	*Pachliopta aristolochiae*	നാട്ടുറോസ്	5
22	CRIMSON ROSE	*Pachliopta hector*	ചക്കരശലഭം	3
23	BLUE MORMON	*Papilio polymnestor*	കൃഷ്ണശലഭം	1
24	COMMON MORMON	*Papilio polytes*	നരകക്കാളി	1
25	DARK SMALL BRANDED SWIFT	*Pelopidas mathias*	ചെറുവരയൻ ശലഭം	2
26	COMMON LEOPARD	*Phalanta phalanta*	പുലിത്തെയ്യൻ	5
27	INDIAN PALM BOB	*Suastus gremius*	പനകുറുമ്പൻ	3
28	COMMON SNOW FLAT	*Tagiades japetus*	നാട്ടുപരപ്പൻ	1
29	BLUE TIGER	*Tirumala limniace*	നീലക്കടുവ	1
30	SOUTHERN BIRDWING	*Troides minos*	ഗരുഡശലഭം	1
31	WHITE FOUR RING	*Ypthia ceylonaca*	പുൽവരയൻ	1
32	COMMON FOUR-RING	*Ypthima huebneri*	നാല്ക്കണ്ണി	5
33	COMMON FIVE RING	*Yptima baldus*	പഞ്ചനേത്രി	2
34	DARK GRASS BLUE	*Zizeeria karzandra*	ഇരുളൻപുൽനീലി	1
Simpson's index				0.04

Table 6.5. Checklist of butterflies

Common bushbrown

Common crow



Great eggfly

Common cerulean

Psyche

Blue tiger

6.4.1.4 Checklist of reptiles

No	ENGLISH NAME	SCIENTIFIC NAME	MALAYALAM NAME	DENSITY
1	COMMON HOUSE LIZARD	*Hemidactylus frenatus*	പല്ലി	30
2	ORIENTAL RAT SNAKE	*Ptyas mucosa*	ചേര	3
3	ORIENTAL LIZARD	*Calotes versicolor*	ഓന്ത്	10
4	DUSSUMIERS FOREST SKINK	*Sphenomorphus dussumieri*	അരണ	10
5	INDIAN DAY GECKO	*Cnemaspis indica*	ഇന്ത്യൻ മരപ്പല്ലി	5
6	KEELED INDIAN MABUYA	*Eutropis carinata*	അരണ	15
7	BROOK'S HOUSE GECKO	*Hemidactylus brookii*	ചെറിയ പല്ലി	15
8	SPECTACLED COBRA	*Naja naja*	മൂർഖൻ	1
9	COMMON INDIAN KRAIT	*Bungarus caeruleus*	ശംഖുവരയൻ	1
10	BENGAL MONITOR	*Varanus bengalensis*	ഉടുമ്പ്	4
11	CHECKERED KEELBACK	*Xenochrophis piscator*	നീർക്കോലി	2
12	COMMON BRONZEBACK TREE SNAKE	*Dendrelaphis tristis*	വില്ലൂന്നി	2
13	COMMON WOLF SNAKE	*Lycodon aulicus*	വെള്ളിവരയൻ പാമ്പ്	1
	Simpson's index			0.16

Table 6.6. Checklist of reptiles

Eutropis carinata

Ptyas mucosa

Calotes versicolor

6.4.1.5 Checklist of amphibians

No	ENGLISH NAME	SCIENTIFIC NAME	MALAYALAM NAME	DENSITY
1	INDIAN BULLFROG	*Hoplobatrachus tigerinus*	പോക്കാച്ചിത്തവള	4
2	PAINTED FROG	*Uperodon taprobanica*	ചിത്രത്തവള	4
3	DARK SIZED CHORUS FROG	*Microhyla heymonsi*	കുറിയവാലൻ തവള	3
4	GREEN POND FROG	*Euphlyctis hexadactylus*	പച്ചതവള	10
5	MALABAR GLIDING FROG	*Rhacophorus malabaricus*	ഇളിത്തേമ്പൻ തവള	6
6	SMALL HANDED FROG	*Indirana semipalmata*	ചെറുകാലൻ പാറത്തവള	2
7	COMMON INDIAN TOAD	*Duttaphrynus melanostictus*	ചൊറിത്തവള	3
Simpson's index				0.14

Table 6.7. Checklist of amphibians

Duttaphrynus melanostictus

6.4.1.6 Checklist of molluscs

No	ENGLISH NAME	SCIENTIFIC NAME	DENSITY
1	BROWN SLUG	*Mariaella dussumieri*	5
2	GIANT AFRICAN SNAIL	*Lissachatina fullica*	2
3	GARDEN SNAIL	*Allopeas gracile*	3
4	LEATHERLEAF SNAIL	*Semperula sp*	1
5	BLACK FACED SNAIL	*Ariophanta sp*	2
6	TERRESTRIAL SNAIL	*Euplecta sp*	3
7	EURYCHLAMYS	*Eurychlamys sp*	6
Simpson's index			0.14

Table 6.8. Checklist of molluscs

6.4.1.7 Checklist of insects

No	ENGLISH NAME	SCIENTIFIC NAME	DENSITY
1	NYGMIINE TUSSACK MOLT	*Orvassca subnotata*	1
2	INDIAN SOLDIER FLY	*Ptilocera continua*	1
3	ASIAN COCKROACH	*Blattella asahinai*	2
4	BANANA STALK FLY	*Telostylinus lineolatus*	1
5	NON BITING MIDGE	*Chironomus javanus*	1
6	WASP	*Ropalidia marginata*	15
7	FLESH FLY	*Sarcophagidae*	25
8	RICE EAR BUG	*Leptocorisa oritoria*	2
9	BLOW FLY	*Lucilia cuprina*	5
10	COMMON GREEN BOTTLE FLY	*Lucilia sericata*	2
11	TERMITE	*odonototermes feae*	50
12	EPILAMPRID COCKROACH	*Thorax porcellana*	2
13	STILT LEGGED FLIES	*Rainieria antennaepes*	3
14	LANG BRAND BUSH BROWN INSECT	*mycalesis visala*	4
15	HANDSOME TRIG	*phyllopalpus pulchellus*	1
16	CRICKET	*Acheta domesticua*	1
17	COMMON STILT BUG	*Berytinus minor*	1
18	LOCUST	*Schistocerca gregaria*	1
19	FLESH FLY	*Sarcophaga carnaria*	5
20	SQUASH BEE	*Peponapis pruinosa*	4
21	GREEN GEM	*Microchrysa flavicornis*	1
22	MARRMALADE HOVER FLIES	*Episyrphus balteatus*	2
23	FLOWER CHAFER BEETLE	*Protaetla aurichalcea*	3
24	HAIRY MAGGOT BLOW FLY	*Chrysomya rufifacies*	4
25	SOLDIERFLY FAMILY	*Ptilocera continua*	2
26	BEACH FLY	*Homoneura unguiculata*	3
27	BRACHYMERIA WASP	*Brachymeria podagrica*	2
Simpson's index			0.16

Table 6.9. Checklist of insects

6.4.1.8 Checklist of mammals

No	ENGLISH NAME	SCIENTIFIC NAME	MALAYALAM NAME	DENSITY
1	INDIAN FLYING FOX	*Pteropus medius*	ഇന്ത്യൻ പഴവവ്വാൽ	10
2	INDIAN GREY MONGOOSE	*Herpestes edwardsii.*	കീരി	4
3	INDIAN PALM SQUIRREL	*Funambulus palmarum*	അണ്ണാൻ	4
4	COMMON PALM CIVET	*Paradoxurus hermaphroditus*	മരപ്പട്ടി	1
5	BLACK NAPED HARE	*Lepus nigricollis*	കാട്ടു മുയൽ	1
6	BANDICOOT RAT	*Bandicota indica*	തൊരപ്പൻ	2
7	BLACK RAT	*Rattus rattus*	കറുത്ത എലി	7
8	TREE SHREW	*Anathana ellioti*	മരനച്ചെലി	1
9	KELAART'S PIPISTRELLE	*Pipistrellus ceylonicus*	അടക്ക വവ്വാൽ	5
Simpson's index				0.15

Table 6.10. Checklist of mammals

6.4.1.10 Checklist of moths

No	ENGLISH NAME	SCIENTIFIC NAME	DENSITY
1	OLEANDER HAWKMOTH	*Daphnis nerii*	5
2	BLUE TIGER MOTH	*Dysphania percota*	2
3	ATLAS MOTH	*Attacus atlas*	2
4	PAINTED HAND MAIDEN MOTH	*Euchromia polymena*	3
5	PLUME MOTH	*Diacrotricha fasciola*	2
6	HAWAIIAN BEET WEBWORM MOTH	*Spoladea recurvalis*	4
7	PETITE WAVE	*Scopula minorata*	1
8	NYGMIINE TUSSOCK MOTH	*Orvasca subnotata*	1
9	COMMON GRASS VENEER	*Agriphila tristella*	5
10	ELLOSPHINX	*Erinnyis ello*	1
11	AURANTIACA	*Tricyanaula aurantiaca*	1
12	NOCTUID MOTH	*Achaea serva*	2
13	SCOPULA	*Scopula opicata*	2
14	TUSSOCK MOTH	*Nygmia icilia*	2
Simpson's index			0.07

Table 6.11. Checklist of moths

6.4.1.9 Checklist of beetles

No	ENGLISH NAME	SCIENTIFIC NAME	DENSITY
1	LEAF BEETLE	*Altica oleracae*	10
2	PUMPKIN BEETLE	*Aulacophora femoralis*	5
3	COCONUT RHINOCEROS BEETLE	*Oryctes rhinoceros*	8
4	LEAF BEETLE	*Oides affinis*	4
5	LONG HORN BEETLE	*Epepeotes uncinatus*	3
6	SPOTTED POTATO LADYBIRD	*Henosepilachna vigintiopunctata*	4
7	TRANSVERSE LADYBIRD	*Coccinella transversalis*	4
8	FLEA BEETLE	*Oulema melanopus*	1
9	RUBBER BEETLE	*Luprops tristis*	25
10	TWICE-STABBED LADY BEETLE	*Chilocorus rubidus*	12
11	LADYBIRD BEETLE	*Stictobura semipolita*	15
12	RED PALM WEEVIL	*Rhynchophorus ferrugineus*	5
13	CERVUS'S DUNG BEETLE	*Onthophagus cervus*	8
14	FAVREI'S DUNG BEETLE	*Onthophagus favrei*	1
15	TURBATUS DUNG BEETLE	*Onthophagus turbatus*	3
16	RECTECORNUTUS DUNG BEETLE	*Onthophagus rectecornutus*	2
17	QUADRIDENTATUS DUNG BEETLE	*Onthophagus quadridentatus*	4
18	UNIFASCIATUS DUNG BEETLE	*Onthophagus unifasciatus*	8
19	FASCIATUS DUNG BEETLE	*Onthophagus fasciatus*	4
20	PARVULUS DUNG BEETLE	*Onthophagus parvulus*	2
21	MALABAR DUNG BEETLE	*Onthophagus.malabarensis*	2
22	PYGMAEUS DUNG BEETLE	*Onthophagus. Pygmaeus*	5
23	FURCILLIFER DUNG BEETLE	*Onthophagus furcillifer*	6
24	MERIDIONALIS DUNG BEETLE	*Caccobius meridionalis*	9
25	VULCANUS DUNG BEETLE	*Caccobius vulcanus*	3
26	UNICORNIS DUNG BEETLE	*Caccobius unicornis*	3
27	ULTOR DUNG BEETLE	*Caccobius ultor*	1
28	ATERRIMUS DUNG BEETLE	*Caccobius aterrimus*	2
29	MOLOSSUS DUNG BEETLE	*Catharsius molossus*	5
30	WALKER'S DUNG BEETLE	*Para copris signatus*	5
31	REPERTUS DUNG BEETLE	*Copris repertus*	4
32	SUBOPECUS DUNG BEETLE	*Onitis subopecus*	2
33	BORDERED DUNG BEETLE	*Oniticellus cinctus*	1
34	SETOSUS DUNG BEETLE	*Tibiodrepanus setosus*	1
35	SINICUS DUNG BEETLE	*Tibiodrepanus sinicus*	2
36	PARACOPRID DUNG BEETLE	*Tiniocellus spinipes*	4
Simpson's index			0.04

Table 6.12. Checklist of beetles

6.4.1.11 Checklist of ants

No	ENGLISH NAME	SCIENTIFIC NAME	DENSITY
1	QUEENLESS ANT	*Diacamma sp*	100
2	INDIAN BLACK ANTS	*Tanaemyrmex sp*	50
3	ASIAN WEAVER ANT	*Oecophylla smaragdina*	750
4	COMMON ORIENTAL TRAP -JAW ANT	*Odontomachus simillimus*	70
5	FIRE ANT	*Solenopsis invicta*	200
6	ODOROUS HOUSE ANT	*Tapinoma sessile*	50
7	CARPENTER ANT	*Camponotus sp*	250
8	BROWN DROPTAIL ANT	*Myrmicaria brunnea*	46
Simpson's index			0.3

Table 6.13. Checklist of ants

6.4.1.13 Checklist of grasshopper

No	ENGLISH NAME	SCIENTIFIC NAME	DENSITY
1	CARINATE LOCUST	*Tritophidia annulata*	5
2	COMMON GREEN GRASSHOPPER	*Omocestus viridulus*	3
3	BAGHIA KASO	*Chitaura indica*	4
4	PAINTED GRASSHOPPER	*Poekilocerus pictus*	2
5	SPUR - THROAT TOOTHPICK GRASSHOPPER	*Cornops frenatum*	2
6	SHORT HORNED GRASSHOPPER	*Oxya chinensis*	9
7	SHORT HORNED GRASSHOPPER	*Spathosternum prasiniferum*	1
8	PACIFIC DUCETIA	*Ducetia japonica*	2
9	ROUFUS LEGGED GRASSHOPER	*Xenocatantops humilis*	2
Simpson's index			0.14

Table 6.14. Checklist of grasshopper

6.4.1.14 Checklist of millipedes

No	ENGLISH NAME	SCIENTIFIC NAME	DENSITY
1	YELLOW SPOTTED MILLIPEDE	*Harpaphe haydeniana*	25
2	ASIAN MILLIPEDE	*Trigoniulus corallinus*	9
3	RED LEGGED MILLIPEDE	*Epibolus pulchripes*	5
4	GIANT AFRICAN MILLIPEDE	*Archispirostreptus gigas*	2
5	GREEN HOUSE MILLIPEDE	*Oxidus gracilis*	3
6	PILL MILLIPEDE	*Glomeris marginata*	1
7	RED SPINED MILLIPEDE	*Xenobolus carnifex*	1
Simpson's index			0.34

Table 6.15. Checklist of millipedes

6.4.1.12 Checklist of spiders

No	ENGLISH NAME	SCIENTIFIC NAME	DENSITY
1	GRASS LYNX SPIDER	*Oxyopes sertatus*	3
2	PANTROPICAL JUMPER	*Plexippus paykulli*	1
3	WOLF SPIDER	*Purdosa pseudoannulata*	1
4	DARK FISHING SPIDER	*Dolomedes tenebrosus*	1
5	HASSELTS SPINY SPIDER	*Macracantha hasselti*	1
6	SMALL ORB WEAVER SPIDER	*Anepsion maritatum*	1
7	ST ANDREWS CROSS SPIDER	*Argiope keyserlingi*	1
8	BLACK BANDED CRAB SPIDER	*Synema parvulum*	1
9	GREEN HUNTMAN SPIDER	*Micrommata virescens*	2
10	HEAVY BODIED JUMPER	*Hyllus semicupreus*	1
11	LEOPARD SPIDER	*Pardosa laura*	1
12	ORANGE AND BLACK PEAR SPIDER	*Leucauge fastigata*	1
13	PANTROPICAL JUMPING SPIDER	*Plexippus paykulli*	1
14	TWO STRIPED TELAMONIA	*Telamonia dimidiata*	2
15	ANT-MIMIC SPIDER	*Myrmarachne platakoides*	2
16	GARDEN CROSS SPIDER	*Argiope pulchella*	1
17	ANT-MIMICKING JUMPING SPIDER	*Mymaplata plataleoides*	5
Simpson's index			0.05

Table 6.16. Checklist of spiders

Phintella vittata

6.4.2 Checklist of selected flora

6.4.2.1 Checklist of trees

No	ENGLISH NAME	SCIENTIFIC NAME	MALAYALAM NAME	DENSITY
1	INDIAN BAEL	*Aegle marmelos*	കൂവളം	1
2	BLACK MURDAH	*Ailanthus triphysa*	മട്ടി	4
3	APOROSA	*Aporosa lindleyana*	വെട്ടി	2
4	ARAUCARIA	*Araucaria heterophylla*	ക്രിസ്തുമസ് ട്രീ	2
5	WILD JACK FRUIT TREE	*Artocarpus hirsutus*	ആഞ്ഞിലി	40
6	THORNY BAMBOO	*Bambusa bambos*	ഇല്ലി	2
7	YELLOW BAMBOO	*Bambusa vulgaris*	മഞ്ഞമുള	4
8	SPINOUS KINO TREE	*Bridelia retusa*	മുള്ളുവേങ്ങ	1
9	FLAME OF THE FOREST	*Butea monosperma*	പ്ലാശ്	1
10	DIVI DIVI	*Caesalpinia coriaria*	ഡിവി ഡിവി	5
11	BLACK DAMMAR	*Canarium strictum*	കറുത്ത കുന്തിരിക്കം	1
12	FISHTAIL PALM	*Caryota urens*	ചൂപ്പന	4
13	PINK SHOWER	*Cassia javanica*	പിങ്ക് കൊന്ന	3
14	BROWN TAMARIND	*Castanospora alphandii*	കാസ്റ്റാണോസ്പോറ	1
15	PEACOCK FLOWER	*Ceasalpinia pulcherrima*	രാജമല്ലി	6
16	STAR APPLE	*Chrysophyllum oliviforme*	സ്റ്റാർ ആപ്പിൾ	5
17	FIDDLE WOOD	*Citharexylum spinosum*	പാരിജാതം	2
18	CANNON BALL TREE	*Couroupita guianensis*	നാഗലിംഗമരം	1
19	RED PALM	*Cyrtostachys renda*	അലങ്കാര പന	5
20	GULMOHAR	*Delonix regia*	പൂമരം	3
21	VELVET APPLE	*Diospyros blancoi*	വെൽവെറ്റ് ആപ്പിൾ	4
22	INDIAN EBONY	*Diospyros ebenum*	കരിമരം	1
23	OIL PALM	*Elaeis guineensis*	എണ്ണപ്പന	1
24	ELEPHANT EAR FIG TREE	*Ficus auriculata*	വലിയ അത്തി	1
25	BANYAN TREE	*Ficus benghalensis*	പേരാൽ	2
26	WEEPING FIG	*Ficus benjamina*	വെള്ളാൽ	9
27	HAIRY FIG	*Ficus hirta*	ചിത്തിര പാല	2
28	INDIAN FIGTREE	*Ficus recemosa*	അത്തി	1
29	PEEPAL TREE	*Ficus religiosa*	അരയാൽ	2
30	CAMBOGE TREE	*Garcinia gummi-gutta*	കുടംപുളി	3
31	MANGOSTEEN	*Garcinia mangostana*	മാംഗോസ്റ്റീൻ	4
32	GLIRICIDIA	*Gliricidia sepium*	ശീമക്കൊന്ന	2
33	MALABAR IRON WOOD	*Hopea parviflora*	തമ്പകം	1
34	HYDNOCARPUS	*Hydnocarpus pentandrus*	മരോട്ടി	1
35	QUEEN'S CRAPE MYRTLE	*Lagerstroemia speciosa*	പൂമരുത്	15
36	DIVI DIVI	*Libidibia cariaria*	ഡിവി ഡിവി	12

37	SHEILD LEAF TREE	*Macaranga peltata*	വട്ട	24
38	MAHUA	*Madhuca longifolia*	ഇലിപ്പ	1
39	JOY PERFUME TREE	*Magnolia champaca*	ചെമ്പകം	1
40	CEYLON IRON WOOD	*Mesua ferrea*	നങ്ക്	4
41	INDIAN CORK TREE	*Millingtonia hortensis*	ആകാശവേപ്പ്	2
42	SPANISH CHERRY	*Mimusops elengi*	ഇലഞ്ഞി	1
43	FALSE ASHOKA	*Monoon longifolium*	അരണമരം	2
44	ORANGE JASMINE	*Murraya paniculata*	മരമുല്ല	1
45	NUTMEG	*Myristica fragrans*	ജാതി	3
46	INDIAN TRUMPET FLOWER	*Oroxylum indicum*	പലകപ്പയ്യാനി	2
47	COPPER-POD	*Peltophorum pterocarpum*	മഞ്ഞവാക	16
48	INDIAN GOOSEBERRY	*Phyllanthus emblica*	നെല്ലി	3
49	ALLSPICE	*Pimenta dioica*	സർവവസുഗന്ധി	1
50	INDIAN BEECH	*Pongamia pinnata*	ഉങ്ങ്	1
51	ROYAL PLAM	*Roystonea regina*	രാജപന	4
52	ASHOKA TREE	*Saraca asoca*	അശോകം	2
53	PARADISE TREE	*Simarouba glauca*	ലക്ഷ്മി തരു	6
54	TRUMPET FLOWER	*Stereospermum tetragonum*	പാതിരി	1
55	MAHAGONI	*Sweietenia macrophylla*	മഹാഗണി	25
56	BLACK PLUM	*Syzygium cumini*	ഞാവൽ	5
57	ARJUN TREE	*Terminalia arjuna*	നീർമരുത്	4
58	TROPICAL ALMOND	*Terminalia catappa*	ഇന്ത്യൻ ബദാം	5
59	MADAGASCAR ALMOND TREE	*Terminalia neotaliala*	മഡഗാസ്കർ മരുത്	5
60	WHITE DAMAR	*Vateria indica*	വെള്ളക്കുന്തിരിക്കം	1
61	PALA INDIGO PLANT	*Wrightia tinctoria*	ദന്തപ്പാല	2
62	ROSE OF VENEZUELA	*Brownea grandiceps*	ബ്രൗണിയ	1
63	CEYLON CINNAMON	*Cinnamomum verum*	കറുവ	2
64	FRESH WATER MANGROVE	*Carallia brachiata*	വല്ലഭം	2
Simpson's index				0.05

Table 6.17. Checklist of trees

6.4.2.2 Checklist of herbs

43No	ENGLISH NAME	SCIENTIFIC NAME	DENSITY
1	CHINESE VIOLET	*Asystasia gangetica*	75
2	KUDZU	*Pueraria montana*	30
3	PEPPER	*Piper nigrum*	4
4	BITTER VINE	*Mikania micrantha*	67
5	CHAFF FLOWER	*Achyranthes aspera*	17
6	BRAZILIAN JOYWEED	*Alternanthera brasiliana*	73
7	STONE BREAKER	*Phyllanthus niruri*	37
8	TOUCH ME NOT	*Mimosa pudica*	81
9	BITTER BUSH	*Chromolaena odorata*	29
10	COAT BUTTON	*Tridax procumbens*	31
11	BIRDS EYE CHILLI	*Capsicum annuum*	8
12	VENUS HAIR FERN	*Adiantum capillus - veneris*	28
13	CINDRELLA WEED	*Syindrella nodiflora*	42
14	CHARUNA	*Phychotria viridis*	11
15	ALLIGATOR WEED	*Alternanthera philoxeroides*	42
16	BUTTERFLY PEA	*Clitoria ternatea*	9
17	INDIAN COPPER LEAF	*Acalypha indica*	23
18	ROCK WEED	*Pile microphyllan*	6
19	BLOOD BERRY	*Rivina humilis*	3
20	EYE BANE	*Euphorbia nutans*	13
21	IXORA RED	*Ixora coccinea*	2
22	EMILIA	*Emilia sonchifolia*	15
23	LEUCAS	*Leucas aspara*	11
24	CREEPING TICK TREFOIL	*Grona triflora*	16
25	PRICKLY HIBISCUS	*Hibiscus diversifolius*	1
26	COMMON PERIWINKLE	*Catharanthus roseus*	6
27	SWEET LEAF PLANT	*Sauropus androgynous*	4
28	WILD HOP	*Flemingia strobilifera*	8
29	INDIAN HELIOTROPE	*Heliotropium indicum*	27
30	PRICKLY CHAFF FLOWER	*Achyranthes aspera*	17
31	VIRGINIA SNAKE ROOT	*Aristolochia serpentaria*	21
32	LICORICE WEED	*Scoparia dulcis*	38
33	HOLLY BASIL	*Ocimum tenuiflorum*	9
34	FALSE MONEY WORT	*Alysicarpus ovalifolius*	10
35	BUFFALO GRASS	*Bouteloua dactyloides*	40
36	DEODEOK	*Codonopsis lanceolata*	10
37	INDIAN GOOSE GRASS	*Eleusine indica*	1
38	BASKET GRASS B	*Oplismenus hirtellus*	50
39	BLACK NIGHT SHADE	*Solanjm nigrum*	11
40	NOOD WEED	*Synedrella nadiflora*	70
41	BENGAL ARUM	*Typhonium roxburghii*	37

42	BUSHVELD ARUM	*Stylochaeton natalensis*	3
43	BIOPHYTUM	*Biophytum sensitivium*	56
44	INDIAN SHOT	*Canna indica*	3
45	INDIAN PENNY WORT	*Centla asiatica*	5
46	DUMB CANE	*Dieffenbachia seguine*	11
47	LUMBAH RIMBA	*Molineria latifolia*	3
48	SIMILOX	*Similox zeylanica*	5
49	ELEPHANT EAR	*Colocasia esculenta*	50
50	COPPER LEAF	*Alternanthera sessilis*	300
51	SPANISH CLOVER	*Desmodium incanum*	200
52	OLD WORLD DIAMOND FLOWER	*Oldenlandia corymbosa*	10
53	EASTERN BLACK SHADE	*Solanum ptychanthum*	5
54	CLIMBING HEMPWEED	*Milkania scamdens*	100
55	PAINTED SPIRAL GINGER	*Costus pictus*	100
56	INSULIN PLANT	*Chamaecostus cuspidatus*	100
57	CRACKER PLANT	*Ruellia tuberosa*	50
58	GRAPE LEAF WOOD ROSE	*Merremia vitifolia*	50
59	SHAMROCK	*Oxalis*	130
60	SPREADING DAY FLOWER	*Commenlina diffusa*	60
61	INDIAN PENNYWORT	*Centella asiatica*	200
62	CLIMBING AROID	*Pothos scandens*	8
63	ROUNDLEAF BINDWEED	*Evolvulus nummularius*	50
64	MALABAR MELASTOMA	*Melastoma malabathricum*	60
65	MARSH PARA CRESS	*Acmella uliginosa*	200
67	CALICO PLANT	*Alternanthera bettzickiana*	200
68	SHINY BUSH	*Paperomia pellucida*	60
69	LITTLE IRONWEED	*Cyanthillium cibereum*	80
70	DIAMOND FLOWER	*Sclerometrion diffusum*	10
71	FLOWER BEGGER WEED	*Desmodium triflorum*	5
72	CREEPING SLITWORT	*Lindernia diffusa*	5
73	COW GRASS	*Axonopus compressus*	50
74	CRESTED WOOD FERN	*Drypoteris crystata*	2
75	SINGAPORE DAISY	*Sphagneticola trilobata*	1
76	CUTTLEAF GROUND CHERRY	*Physalis angulata*	1
77	MAT CHAFF	*Alternanthera caracasana*	25
78	COIN LEAF DESMODIUM	*Desmodium styracifolium*	30
79	CRIMSON COMFREY	*Symphytum officinale*	8
80	LOTUS	*Nelumbo nucifera*	3
81	MEXICAN FIRE PLANT	*Euphorbia heterophilla*	5
82	INDIAN SNAKE ROOT	*Rauvolfia serpentina*	6
83	WILD SNAKE ROOT	*Rauvolfia tetraphylla*	30
84	GREEN POINSETTIA	*Euphorbia dentata*	15
Simpson's index			0.04

Table 6.18. Checklist of herbs

6.4.2.3 Checklist of shrubs

43No	ENGLISH NAME	SCIENTIFIC NAME	DENSITY
1	KILALA	*Cordyline fruticosa*	1
3	GAMBOGE	*Garcinia mangostana*	1
4	GOLDEN TRUMPET	*Allmanda cathartica*	64
5	INDIAN TARO	*Colocasia indica*	13
6	CURRY LEAVES	*Murraya koenigii*	5
7	CLIMBING AROID	*Pothos scandens*	9
8	TICK BERRY	*Lantana camara*	31
9	CALICO PLANT	*Alternanthera bettzickiana*	203
10	PEACOCK FLOWER	*Caesalpinia pulcherrima*	3
11	TRUMPET VINE	*Campsis radicans*	6
13	JUNGLE FLAME	*Jungle geranium*	7
14	SLEEPING HIBISCUS	*Malvaviscus arboreus*	7
15	ARROWHEAD PLANT	*Syngonium podophyllum*	16
16	CORN PLANT	*Dracaena fragrans*	5
17	MALABAR MELASTOMA	*Melastoma malabathricum*	50
18	CREEP JASMINE	*Tabernaemontana divaricata*	5
19	CHINESE IXORA	*Ixora chinensis*	8
20	GRINIAN POLYTAIL PALM	*Beaucarnea recurvata*	1
21	WINTER HAZEL	*Distylium buxifolium*	1
22	ADAMS NEEDLE	*Yucca filamentosa*	2
23	LILLY PILLY	*eugenia myrtifolia*	17
24	SHOE FLOWER	*Hibiscus rosa sinensis*	2
25	SWEET AUTUMN	*Clematis terniflora*	1
26	OLEANDER	*Nerium oleander*	2
27	CORAL SWIRL	*Wrightia antidysenterica*	1
28	TRUE INDICO	*Indigofera tinctoria*	1
29	WILD JASMINE	*Jasminum angustifolium*	3
30	RED FLAG BUSH	*Mussaenda erythrophylla*	3
31	RUBBER VINE	*Cryptostegia grandiflora*	1
32	CHINESE HAT	*Holmskioldia sanguinea*	1
33	WILD COFFEE	*Psychotria rubra*	2
34	PLANTAIN	*Musa paradisica*	8
Simpson's index			0.18

Table 6.19. Checklist of shrubs

6.4.2.4 Checklist of crops

43No	ENGLISH NAME	SCIENTIFIC NAME	DENSITY
1	MANGO TREE	*Magifera indica*	30
2	JACKFRUIT TREE	*Artocarpus heterophyllus*	2500
3	COCONUT TREE	*Coco nucifera*	600
4	PINEAPPLE	*Ananas comosus*	4000
5	GUAVA TREE	*Psidium guajava*	5
6	FIG	*Ficus carica*	3
7	GOOSEBERRY	*Phyllanthus acidus*	2
8	PAPAYA	*Carica papaya Linn*	8
9	BANANA	*Musa paradisiaca*	400
10	RAMBUTAN	*Nephelium lappaceum Linn*	60
11	SUGARCANE	*Saccharum officinarum*	4
12	ROSE WATER APPLE	*Syzygium jambos*	2
13	BILIMBI	*Averrhoa bilimbi Linn*	1
14	TAMARIND	*Tarmarindus indica*	2
15	BREAD FRUIT	*Artocarpus altilis*	2
16	NONI	*Morinda citrifolia*	2
17	AVOCADO	*Persea americana*	35
18	TAPIOCA	*Manihot esculenta Crantz*	200
Simpson's index			0.37

Table 6.20. Checklist of crops

No	Table No	Fauna/Flora	Abundance	Density
1	6.3	Birds	23	0.14
2	6.4	Odonate	18	0.06
3	6.5	Butterflies	34	0.04
4	6.6	Reptile	13	0.16
5	6.7	Amphibian	7	0.14
6	6.8	Mollusca	8	0.14
7	6.9	Trees	69	0.05
8	6.10	Herbs	43	0.04
9	6.11	Shrubs	40	0.18
10	6.12	Insects	27	0.16
11	6.13	Mammal	9	0.15
12	6.14	Beetle	36	0.04
13	6.15	Moth	15	0.07
14	6.16	Ants	9	0.30
15	6.17	Spider	17	0.05
16	6.18	Grasshopper	9	0.14
17	6.19	Millipede	7	0.34
18	6.20	Crops	18	0.18

Table 6.21 Biodiversity of the college campus

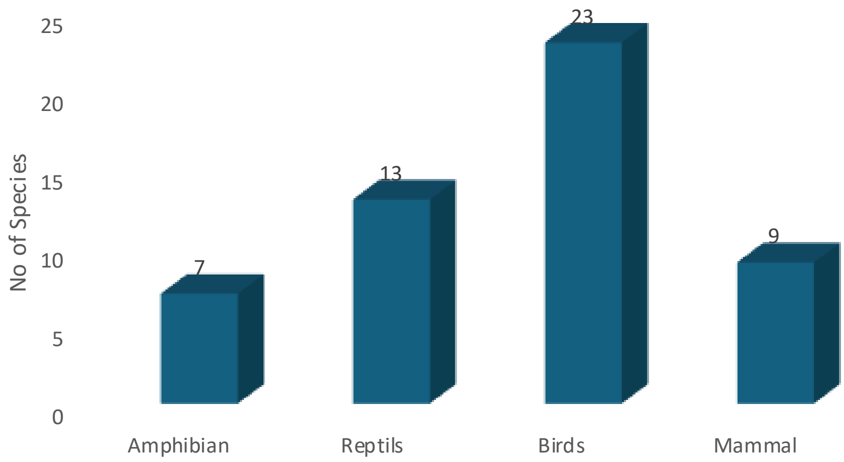


Fig 6.2 Faunal diversity of the campus

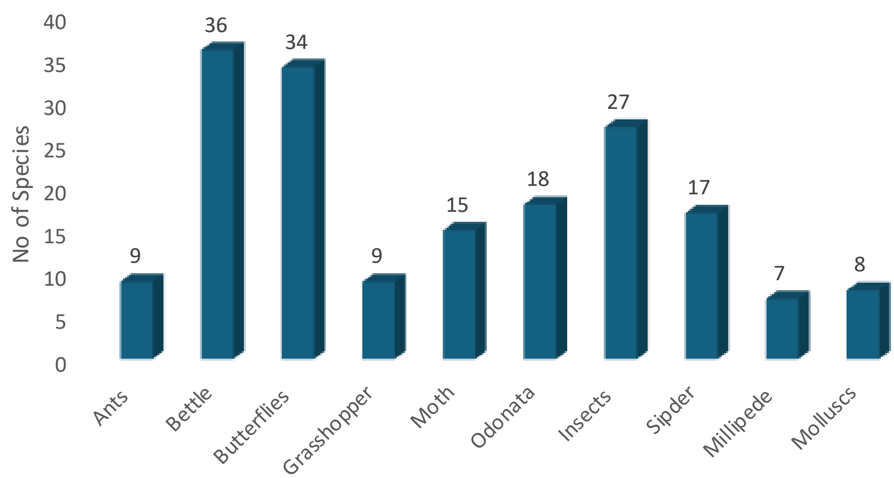


Fig 6.3 Faunal diversity of the campus

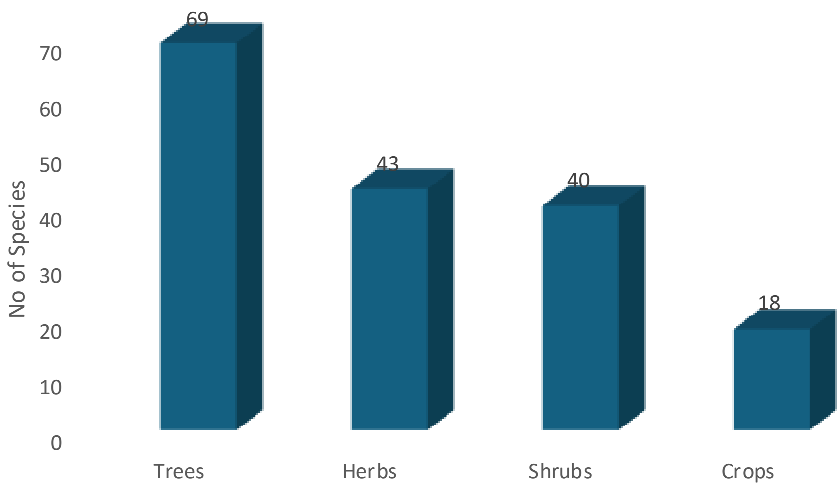


Fig 6.4 Floral diversity of the campus

6.5 BIODIVERSITY MANAGEMENT PLAN

6.5.1 Introduction

The Biodiversity Management Plan (BMP) of Nirmala College Muvattupuzha (Autonomous), aims to conserve, restore, and sustainably manage the rich biodiversity within and around the campus. As a higher education institution nestled in the Western Ghats region, the college acknowledges its ecological responsibility and is committed to enhancing native species diversity, promoting environmental stewardship, and integrating biodiversity conservation into academic and co-curricular activities. This plan focuses on campus green spaces, water bodies, gardens, and surrounding natural habitats.

6.5.2 Establish an Adept Biodiversity Management Team

Establishing an adept Biodiversity Management Team involves creating a multidisciplinary group of individuals dedicated to planning, implementing, and supervising all biodiversity-related initiatives on the campus. This team should include faculty members from departments such as Botany, Zoology, and Environmental Science; trained gardeners and campus maintenance staff; student representatives; and external biodiversity or ecological experts. Their responsibilities include:

- Coordinating biodiversity audits and conservation activities.
- Monitoring progress towards biodiversity goals.
- Ensuring community engagement and student participation.
- Advising on habitat restoration, invasive species control, and native species introduction.
- Liaising with local biodiversity boards and government agencies for compliance and support. By assembling a skilled and committed team, the college ensures that biodiversity management becomes a structured, science-based, and community-driven process.

6.5.3 Implement effective methods to attain set objective

PrimaryGoal

To enhance and protect the biodiversity of the campus ecosystem and develop it into a model green campus within the next 3 years.

Specific Objectives:

- Identify and document the flora and fauna on campus.
- Protect and increase native biodiversity through habitat conservation and species introduction.
- Integrate biodiversity into student learning and community outreach.
- Encourage behavioural change among students and staff through awareness programs.
- Monitor, evaluate, and adapt biodiversity initiatives over time.

6.5.4 Formulate a Comprehensive Strategy for Sustainable Biodiversity Management

Conduct a thorough Biodiversity Audit covering:

- **Flora:** Campus trees, herbs, shrubs, medicinal plants, aquatic plants, and cultivated vegetation.
- **Fauna:** Birds, butterflies, insects, reptiles, amphibians, and small mammals.
- **Habitats:** Garden zones, ponds, microhabitats (such as deadwood, leaf litter zones), and rooftop vegetation.

Key data to collect:

- Number and type of native vs exotic species.
- Distribution of species across microhabitats.
- Health of plant species and green cover trends.
- Threats to biodiversity (e.g., habitat fragmentation, pollution, invasive species).

6.5.5 Biodiversity Conservation Strategies

A. Infrastructure and Habitat Improvements

1. **Habitat Restoration and Creation**
   - Develop butterfly and pollinator gardens using native flowering plants.
   - Create small water bodies or wetland patches to attract amphibians and aquatic life.
   - Use organic compost and ban synthetic pesticides and herbicides.
   - Establish vertical and rooftop gardens using native species.
2. **Invasive Species Management**
   - Identify and systematically remove invasive alien species.
   - Replace with ecologically important native plants.
3. **Native Tree Plantation**
   - Plant region-specific species (e.g., Ficus, Terminalia, Syzygium) that support multiple animal taxa.
   - Develop a mini sacred grove model to conserve culturally and ecologically significant species.

B. Awareness and Behavioural Change Initiatives

1. **Green Literacy Campaigns**
   - Host biodiversity days, tree-planting drives, and eco-poster competitions.
   - Display plant name boards with QR codes for interactive learning.
2. **Capacity Building**
   - Conduct workshops for students, staff, and gardeners on biodiversity and sustainable landscaping.
   - Involve students in biodiversity clubs and student research projects on local flora and fauna.
3. **Cultural Integration**
   - Promote folk knowledge and traditional conservation practices through exhibitions and lectures.

C. Biodiversity Monitoring and Governance

1. **Establish a Biodiversity Management Committee (BMC)**
   - Include faculty, students, and external biodiversity experts.
   - Meet quarterly to review progress and plan future initiatives.
2. **Monitoring and Reporting**
   - Maintain a biodiversity register updated annually.
   - Monitor species trends and habitat health using GIS and photographic documentation.
   - Conduct annual biodiversity audits and submit reports to the College IQAC and local biodiversity boards.

6.5.6 Establish Robust Communicate Channel and Governing Body

This statement refers to creating formal structures and channels that ensure effective governance, transparency, and stakeholder engagement in biodiversity initiatives. A robust communication system would include:

- Regular meetings of the Biodiversity Management Committee (BMC) to review progress and plan strategies.
- Creation of digital platforms such as a biodiversity blog, website, or e-journal to share updates, findings, and awareness content.
- Annual and quarterly reporting mechanisms to

inform the College Internal Quality Assurance Cell (IQAC), stakeholders, and regulatory bodies.

- Interactive methods such as workshops, feedback surveys, and biodiversity walks to involve the college community.
  The governing body—primarily the BMC—should have clear roles, responsibilities, and authority to oversee biodiversity projects, allocate resources, and make decisions. Together, the communication system and governing body ensure coordination, accountability, and inclusiveness in biodiversity conservation efforts.

6.5.7 Set Both Long Term and Short Tram Goals

A. Short-Term Actions (0–6 months)

- Conduct a detailed biodiversity audit and habitat mapping.
- Initiate signage, biodiversity walks, and awareness programs.
- Begin native species plantations and establish butterfly gardens.
- Form the Biodiversity Management Committee.
- Launch a campus biodiversity e-journal/blog to document progress.

B. Medium-Term Actions (6–12 months)

- Develop thematic gardens (e.g., herbal garden, pollinator garden).
- Integrate biodiversity themes into coursework and student research.
- Collaborate with local bodies for outreach in surrounding ecosystems.
- Create a biodiversity trail with interpretation boards for visitors and students.

C. Long-Term Actions (1–3 years)

- Expand green areas and connect fragmented habitats within campus.
- Develop a biodiversity museum or digital archive.
- Publish biodiversity status reports and submit data to national databases (e.g., India Biodiversity Portal).
- Work towards recognition as a 'Biodiversity Heritage Site' or a certified 'Green Campus'.

6.5.8 Continuously Monitor and Enhance the System

- Species Tracking: Maintain species lists with seasonal updates and conduct periodic surveys.
- Annual Review: Conduct an annual evaluation of biodiversity health and the effectiveness of conservation measures.
- Stakeholder Feedback: Gather feedback from students, staff, and visitors to refine initiatives.
- KPI Tracking: Monitor metrics like increase in green cover, rise in pollinator numbers, decrease in exotic species, and student participation rates.

6.5.9 Conclude and Conduct Follow Up on the System

Through the successful implementation of this Biodiversity Management Plan, Nirmala College aims to build a vibrant, sustainable, and ecologically responsible campus. This initiative will foster a conservation culture among students and staff, contribute to the preservation of local biodiversity, and serve as a model for academic institutions across the region. Continuous follow-up, community involvement, and adaptability will ensure the longevity and success of the plan.

6.6 CONCLUSION

- The campus exhibits a notable level of diversity. The abundance of biodiversity is evident through the variety of herbs, shrubs, birds, ants, insects, butterflies, and reptiles present.

- Ornamental plants, which are primarily exotic, are prevalent in the area, leading to a decrease in the vitality of native plants, which in turn impacts the diversity of insects, butterflies, and birds. However, as the population of native plants gradually increases, it impacts the diversity of fauna.
- It is noted that crop plants outnumber wild plants on campus, indicating how the land is being utilized by the college, as wild crops are being replaced by agricultural varieties.

6.7 RECOMMENDATION

- Coordinated initiatives should be established to track the existing biodiversity and enhance its condition through various campaigns.
- The campus community needs to be informed about the diverse biodiversity present on campus, and ongoing IEC programs, along with collaborative conservation projects, are suggested.
- The agricultural area should be transformed into a model for organic farming techniques.
- Install labels with QR codes for all trees, shrubs, etc. Additionally, place boards displaying images and names of common campus biodiversity in various locations.
- Encourage student, faculty, and staff participation in citizen science projects to observe biodiversity on campus. This could include organized birdwatching activities, insect surveys, or plant identification initiatives.
- Install nesting boxes and bird feeders at key locations throughout the campus to provide extra resources for bird species, particularly during nesting periods and severe weather conditions.
- Promote a sense of responsibility and community engagement in biodiversity preservation through outreach initiatives, volunteer programs, and educational workshops.
- Enhance the cultivation of indigenous plants to attract the fauna of the campus.
- Curated and maintained the campus's diverse botanical collections, including butterfly, herb, medicinal plant, spice garden and orchid gardens
- Oversee the operations of the mushroom farming and beekeeping projects on campus to boost both biodiversity and honey production.

6.8 ACTIVITIES CONDUCTED

Field Visit Report

As part of our academic enrichment and commitment to experiential learning, the P.G. and Research Department of Zoology, Nirmala College, has consistently organised field visits to important biodiversity hotspots in Kerala. The department has conducted natural history inventory studies as part of the MSc Zoology dissertation work at the

Idukki Wildlife Sanctuary (2013)
Pampadum Shola National Park (2014)
Periyar Tiger Reserve(Vallakkadav) (2015)
Periyar Tiger Reserve(Thekkadi)(2016)
Anamudi Shola National Park. (2019)

These visits were integral to the postgraduate and research curriculum, offering students first-hand exposure to various ecosystems, conservation practices, endemic flora and fauna, and sustainable wildlife management.

Objectives of the Visits

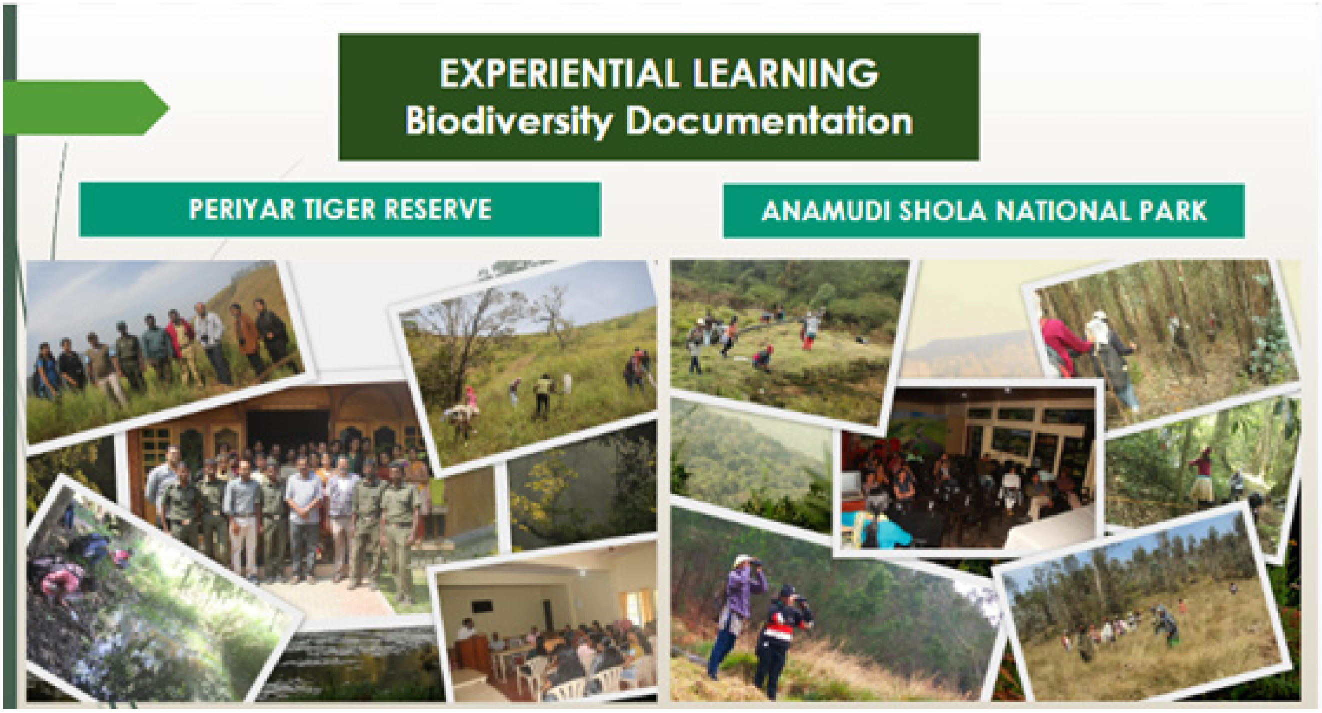
To study the biodiversity and ecological dynamics of different protected areas.

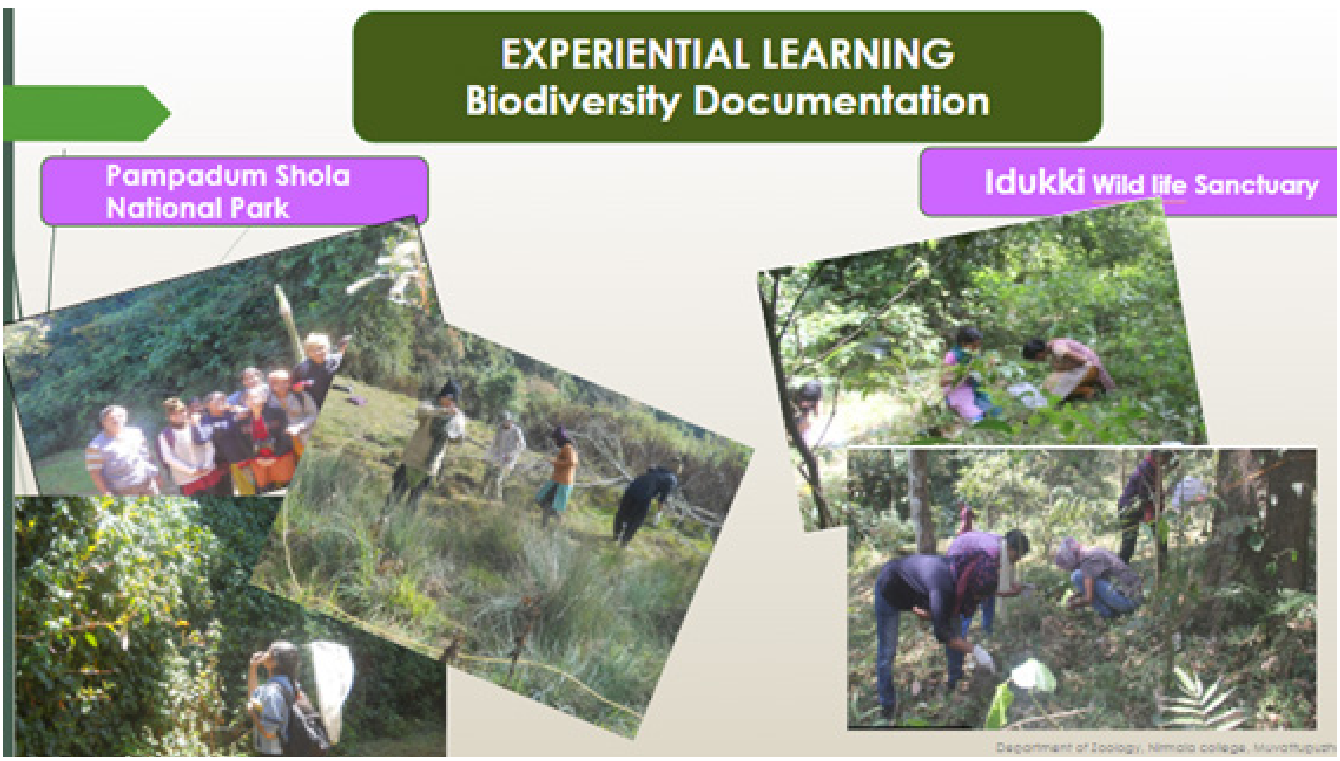
To understand conservation efforts and challenges in protected areas.

To observe and document the flora and fauna, with special reference to invertebrates

To provide students with practical field experience in wildlife research and environmental monitoring.

To promote environmental awareness and stewardship among students and researchers.


EXPERIENTIAL LEARNING
Biodiversity Documentation
PERIYAR TIGER RESERVE
ANAMUDI SHOLA NATIONAL PARK


EXPERIENTIAL LEARNING
Biodiversity Documentation
Pampadum Shola
National Park
Idukki Wild life Sanctuary

WORLD EARTH DAY CELEBRATION

Every year on April 22 the world celebrates Earth Day to create awareness about protecting and preserving our planet. It shows us a vital need to protect our planet from pollution. Activities such as collecting garbage that pollute the land and planting trees are done on this day. The Volunteers of Nirmala College NSS unit have a strong sense of passion to contribute to the protection of our planet. The volunteers have always done many activities in preserving the environment. On this World Earth Day, the volunteers decided that every volunteer would plant a tree near their house. Trees provide more oxygen and also cleanses the air around us thus reducing pollution to a very high extent.Therefore all the volunteers planted a tree near their house in order to show support for the great deed of protecting our planet from pollution.

ENVIRONMENT DAY CELEBRATION
5 June 2022

"Only One Earth". This was the theme of this year's World Environment Day. The theme was chosen to focus on the world's togetherness for building a world with peace, harmony, prosperity and health by taking care of nature and life.

On this year's World Environment Day, the volunteers of Nirmala College NSS unit joined with the Avoly Panchayath to plant saplings on the roadsides of the Anicad town premises. The programme was inaugurated by Muvattupuzha MLA Dr. Mathew Kuzhalnadan. The MLA talked about the importance of nature. After that everyone set off to work

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COLLEGE GARDENING
4 February 2023

Volunteers of Nirmala College NSS Unit gathered to weed and maintain the vegetable patch that was earlier planted. The cultivation area was well cleaned and fertilized. The programme was coordinated by NSS programme officers Dr. Rajesh Kumar B and Dr. Sangeetha Nair, as well as volunteer secretaries Devasenan K. R and Avani R Nair.

GINGER CULTIVATION: PHASE 1
13 September 2022

On 13 September 2022, Nirmala NSS volunteers gathered togetherfor weeding out and gardening ginger saplings. The ginger cultivation was initiated by the volunteers during NSS Three Day camp,'Oppam'. A group of more than fifteen volunteers stepped forward for the gardening. The area under cultivation was cleared out and nurtured.



GINGER CULTIVATION: PHASE 2
14 September 2022

On the second day of the gardening drive, the volunteers fertilized the ginger seedlings. Over 60 ginger growbags were enriched with fertilizers. The active involvementof the volunteers manifested the NSS synergy.

CASSAVA CULTIVATION
15 September 2022

On 13th September 2022, the volunteers of NSS Unit:30 of Nirmala College Muvattupuzha weeded out the cassava cultivated area. More than fifteen volunteers joined to clear out and nurture the cultivation area. The programme was coordinated by NSS Programme officers Dr. Rajesh Kumar B and Dr. Sangeetha Nair, and NSS Volunteer secretaries Devasenan K. R. and Avani R Nair.




VEGETABLE CULTIVATION
8 January 2023

On 8th January 2023, volunteers of Nirmala NSS unit planted vegetables like tomato, chilly, ginger, etc.

BUTTERFLY GARDEN MAINTENANCE
8 January 2023

The volunteers of to maintain the 'Butterfly garden' at Muvattupuzha Nirmala College campus on 8th January 2023. As a part of this programme, the volunteers cleaned and planted a variety of flowering plants in the garden.

വിളവെടുപ്പ്

16 March 2023

On 28th February 2023, volunteers of Nirmala NSS Unit 30 harvested the crops which were cultivated earlier promoting organic farming at the college. Different types of vegetables including tomato, chilly and bean were grown and harvested. Volunteers had the opportunity to harvest the crops themselves and sold them.

തണ്ണീർക്കുടം:

BIRDS CLUB GENESIS 23 March 2023

As an initiative to spread awareness on global warming and bird-health, Nirmala College NSS Unit volunteers established several earthen bowls filled with water at various resting places in the premises of the college on 23rd march 2023. Following this, a birds' club was formed to tend to the maintenance of the water bowls for the birds.

NURTURING NTURE FOR A BETTER FUTURE

On 5th June 2021,the NSS Volunteers of Nirmala College celebrated Environment day by planting saplings and by cleaning our surroundings contaminated by the early monsoon. The volunteers were asked by the seniors to take pictures of them planting a sapling and send it to respective group leaders before 1.30 pm . Covid has made everything difficult for us, but with social media on our right hand, we were able to cope with the stressful situations. All the First year NSS volunteers actively participated and photos were merged together. For the very next day they were asked to send the cleaning video by 1.30 pm that too was merged together and posted in the NSS unit of Nirmala College official Instagram page. The surroundings looked much more cleansed after the work. It also created an awareness among themselves about the threat to the environment due to rising pollution levels and climate change

VAZHA KRUSHI

On December 2ND 2021 NSS volunteers planted banana saplings.They took the initiative for making pits for planting and also manured the saplings with cow dung and ash. They also gave a regular check on the plantation. It was a great experience for the volunteers

ENVIRONMENTAL DAY

Nirmala College Muvattupuzha NSS unit celebrated Environment day on June 5 2020.NSS is a community that never fails to invoke the importance of environment and nature among the volunteers .On june 5 th a day celebrated world wide, our NSS unit also organized several programmes for the volunteers. Every volunteer planted asampling each in their own house.The day was celebrated by creating awareness on those things that affect the world and environment in positive and negative ways . Through the simple deed of planting a sapling every volunteer pledged their responsibility towards preserving and enhancing the environment.

FARMERS DAY

Farmers form the backbone of our nation’s economy as indian economy is primarily agriculture based country.Statistics reveal that Indian agriculture sector accounting to 18% of India’s GDP and provide employment to nearly 50% of workers. Farmers day is celebrated across country on December 23 to honour India’s farmers and make the birthanniversary of our nation’s fifth prime minister Charan singh.

NSS unit observed this day by organising a program called ‘A Day with Farmer’ . This program was aimed to bring forth the main issues and challenges faced by farmers.The day is of utmost importance as it reflects the unwavering spirit of farmers who hopefully sow after each drought or deluge. The volunteers spent a day with a farmer in their neighbourhood,talked with them about various things such as the challenges and issues in the agriculture sector in the present society, Chapter VII

WASTE MANAGEMENT SYSTEM (WMS): AUDIT REPORT

WASTE MANAGEMENT COMMITTEE (WMC 2024-25)

Dr. Meera R
Assistant Professor
Alphonsa K Joy
Assistant Professor

Students
Joyal Gijo
Nithin Sunny
D Vyshnav
Shafseena Shaji
Shiva Babu
Josemon Shaji
Amia Elza Biju
Anna Jikku
Arya P R
Olga Joseph John
Ann Mariya Benny
Ann Mariya Babu
Elizabeth Saji
Jeena Mol Jaimon

7 Waste Management System Audit Report

7.1 INTRODUCTION

Solid waste management (SWM) represents a considerable challenge for governments and local authorities, especially in developing nations where inadequate management systems intensify social, environmental, and health issues. On a global scale, approximately 2.01 billion tons of waste are produced each year, with the East Asia and Pacific region accounting for 468 million tons annually, a weight comparable to that of 46,337 Eiffel Towers or 4.5 million blue whales. The increasing volume and complexity of waste, resulting from contemporary consumption and economic expansion, pose serious risks to ecosystems and public health. The decomposition of organic waste alone is responsible for around 5% of global greenhouse gas emissions. India, recognized as one of the fastest-growing economies, generates 62 million tons of waste each year, with 70% of this waste collected; however, only 12 million tons are treated. Consequently, 31 million tons are disposed of in landfills, resulting in significant air, water, and soil pollution. Projections indicate that municipal solid waste (MSW) generation in India could reach 165 million tons by 2030, driven by changing consumption habits and rapid urbanization. Key challenges include inadequate collection systems, open and unsanitary landfills, and insufficient treatment facilities. E-waste, which contains hazardous materials, is an urgent issue, with substantial growth anticipated in both developed and developing regions.

In India, the informal sector plays a crucial role in deriving value from waste. However, shortcomings in the collection, sorting, and recycling processes result in significant amounts of recyclable materials being disposed of in landfills. Urban areas, home to 377 million individuals, generate substantial waste, yet only 43 million tonnes are collected annually, leaving a large volume untreated. The inadequacy of infrastructure is evident, with only 21 million waste collectors compared to China's 700 million. Moreover, only 30% of waste is effectively sorted.

Solid waste management in India falls under the purview of the Union Ministry of Environment, Forests, and Climate Change, guided by principles of "sustainable development," "precaution," and "polluter pays." The Environmental Protection Act of 1986 provides the legal framework for regulating waste management, emphasizing the obligation of cities and businesses to minimize environmental damage and adopt sustainable practices. Within educational institutions, Municipal Solid Waste (MSW) generated on campuses includes items such as stationery, food and organic waste, metals, packaging materials, hazardous material containers, and electronic waste. Sustainable waste management strategies on campuses focus on MSW, alongside water audit initiatives to manage liquid waste effectively. Higher Education Institutions (HEIs) play a pivotal role in advancing sustainability by integrating knowledge with community engagement and fostering societal development through research and innovation.

The ISO 14001 standard, an internationally recognized framework for environmental management systems, provides guidelines to establish and maintain effective waste management practices. This framework aids institutions in reducing waste, minimizing environmental impact, and improving overall efficiency. It evaluates the performance of waste management systems, promotes the effective utilization of resources, and identifies opportunities for improvement to ensure future progress in waste elimination and sustainability efforts.

7.1.1 What is Waste Management Audit?

A waste audit is a systematic review of all waste that is generated within a workplace. It gives an organisation a clear idea of what they are throwing out, how much, and what common contaminants people are producing. It helps determine how effective a waste management system already is, and identify areas for implementing new strategies.

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

7.1.2 Need for Waste Management Audit

Waste management and environment policy aims to provide an education and awareness in a clean environment to the stakeholders with regard to environmental compliance. Scope of the policy applies to all employees and students of the college/ university to provide an eco-friendly atmosphere. Waste Management Policy dealt with cleanliness of the campus maintained through proper disposal of wastes and steps to be followed to recycle the biodegradable wastes and utilization of eco-friendly supplies to maintain the campus free from hazardous wastes /pollutants (Cardenas and Halman, 2016). The concept of eco-friendly culture is disseminated among the students as well as rural community through various awareness programmes. Head of the Organization, Departmental Heads and Senior Managers/ Management Representatives are responsible for monitoring the "waste management" initiatives of the College / University and maintain a clean campus while each and every individuals of the organisation should adhere to the policy.

Waste Management may be beneficial to the campus in improving the greenery activities which in turn useful to save the planet for future generation. It is necessary to conduct Waste Management audit frequently at least once in three years in campus because students and staff members should aware of the Waste Management and its beneficial effects in order to save planet by means of 'Go green concept' which in turn support the institution to set environmental models ('icon') for the community. Waste Management is a professional and useful measure for an Organization to determine how and where they are retaining the campus eco-friendly manner (Kaseva and Gupta, 1996).

7.1.3. Waste Management in a College in align with SDGs

Effective waste management in colleges involves reducing, reusing, and recycling waste generated on campus through awareness, segregation, and sustainable practices. It supports to achieve Sustainable Development Goals (SDGs) such as:

- SDG 11: Sustainable Cities and Communities

- SDG 12: Responsible Consumption and Production
- SDG 13: Climate Action

Implementing eco-friendly waste systems helps create a cleaner campus and instills environmental responsibility in students.

7.2 WASTE MANAGEMENT POLICY

7.2.1. Background

Waste management is a crucial component of sustainable development, ensuring responsible consumption and production. Proper waste management is essential to maintaining environmental balance, reducing pollution, and conserving natural resources. Educational institutions have a significant role in promoting sustainable waste management practices by educating students and staff about their environmental responsibilities and adopting best practices in waste reduction.

Nirmala College Muvattupuzha (Autonomous), is committed to implementing a comprehensive waste management policy that promotes environmental responsibility among students, faculty, and staff. This policy aims to create a cleaner and more sustainable campus while fostering awareness about the environmental impact of waste. The policy aligns with national and international best practices in waste management and supports the larger goal of environmental conservation.

7.2.2 Goal

To develop a sustainable, participatory, and educational waste management system at Nirmala College, Muvattupuzha that, minimizes environmental impact, promotes responsible consumption, and fosters a culture of ecological responsibility on campus.

7.2.3 Objectives

The waste management policy aims to achieve the following objectives:

- To reduce overall waste generation by 30% within five years by promoting responsible consumption and sustainable practices.
- To establish an effective waste segregation, collection, and disposal system based on the 5Rs – Reduce, Reuse, Recycle, Respect, and Rethink.
- To raise awareness about the environmental and health impacts of improper waste disposal through academic integration and campus outreach.
- To foster active participation from students, staff, and the community in waste reduction initiatives and regularly evaluate program effectiveness.

7.2.4 Resource Management

Resource management is implemented through a structured three-phase approach, beginning with the classification of waste based on its material composition. Waste is categorized into Non-Biodegradable Waste (paper, plastic, glass, and metal), Biodegradable Waste (organic waste), Hazardous Waste (miscellaneous waste), and Electronic Waste (e – waste). This systematic process facilitates a circular economy by maximizing opportunities for reducing, reusing, recycling, respect and rethink while also promoting responsible consumption and production. To ensure efficient waste management, the college will classify waste into these categories and designate eight specific locations across the campus for waste collection. The categorized waste will be managed through donations to charitable organizations, biomass utilization, and collaboration with Haritha Karma Sena for responsible disposal and recycling.

7.2.4.1 Infrastructure Development

A suitable infrastructure will be developed for the collection, transportation, and processing of waste, or for transferring it to authorized vendors.

- Install color-coded bins for effective waste segregation across the campus, along with a designated waste collection centre to manage and temporarily store waste before final disposal. Clear and visible signage should be installed to guide individuals on proper waste disposal practices.

- To ensure compliance, CCTV surveillance can be implemented to monitor the area and identify individuals who violate waste management guidelines.
- Adopt smart waste management strategies, such as introducing e-waste recycling kiosks on campus. These kiosks, similar to EcoATM kiosks, allow users to safely and conveniently dispose of unwanted electronics. If the devices such as phones, tablets, or computers are in good working condition, the kiosks may offer monetary incentives in exchange for the items, encouraging responsible e-waste disposal and helping to improve overall recycling rates.

7.2.5 Curriculum Integration

Integrating waste management concepts into academic disciplines offers significant benefits by incorporating subject-specific knowledge such as decomposition processes, recycling techniques, waste disposal management, economic implications, cost analysis, and relevant civic policies and regulations.

The institution encourages participation in additional courses (certificate courses; diploma programmes; skill courses) that enhance skills relevant to commercial and technological advancements in waste management.

Furthermore, students are provided with opportunities to collaborate with both governmental and non-governmental organizations, fostering responsible waste management initiatives (internships, student projects, research projects etc.).

The institution also organizes national and international conferences to highlight emerging research opportunities and career prospects in waste management, with a special focus on professional students from fields such as commerce, marketing, and management (MBA), among others. College shall conduct various Information, Communication, Education (IEC) programmes for the community and students will be made to participate in such programmes.

7.2.6 Green Initiatives

7.2.6.1 Promotion of Paperless Communication and Digital Documentation

The college will actively promote paperless communication and digital documentation across the campus, covering both academic and administrative processes. A formal circular will be issued by the Principal, under the initiative of the Internal Auditors, to all departments to encourage the adoption of these practices. As part of this initiative, an assessment will be conducted to analyse the average paper usage within the campus, with a specific focus on identifying areas where paper waste is generated in significant volumes. Based on this assessment, designated Paper Recycling Stations will be established at key locations to encourage paper recycling and minimize waste.

7.2.6.2 Waste Management and 'Keep Green' Circular

A 'Keep Green' circular will be introduced to promote sustainable waste management practices among faculty, staff, and students. This circular will highlight alternative practices aimed at reducing paper consumption, including:

- Encouraging digital communication for both internal and external correspondence.
- Promoting double-sided printing wherever printing is necessary.
- Reusing paper for non-official purposes to extend its lifecycle.
- Transitioning academic submissions such as assignments, class activities, and reports to digital platforms, preferably using an institutional website or learning management system (LMS) such as Moodle, rather than relying on physical submissions or mobile-based platforms.
- Encouraging faculty and students to make effective use of the computer lab facilities for accessing and uploading academic materials,

thus reducing dependence on personal printing.

7.2.6.3 Digitization of Administrative and Academic Processes

Administrative processes such as leave applications, fee payments, and internal communications will be gradually digitized to minimize paper usage. Academic processes, including lesson plans, internal circulars, and student notices, will also transition to digital formats wherever possible.

7.2.6.4 Recycling and Creative Reuse of Paper

Remaining paper waste will be collected and creatively repurposed into small carry bags, office stationery, and craft products through student and faculty-led initiatives. Additionally, recycled paper will be prioritized for all essential printing and stationery requirements within the campus.

7.2.6.5 Behaviour Modification Approach

7.2.6.5.1 Workshops and Training Programs: Conduct regular workshops and training sessions on effective waste management practices, utilizing both internal expertise from college faculty and external experts from other institutions. These sessions will help sensitize students and faculty to the causes and consequences of increasing waste generation and highlight the critical role of the college in mitigating these issues.

7.2.6.5.2 Awareness Campaigns and Clean-up Drives: Organize awareness campaigns and campus clean-up drives to foster a sense of responsibility among students and staff. Additionally, host inter-departmental competitions promoting innovative waste management practices, with awards and recognition to encourage active participation and sustained engagement from all college stakeholders.

7.2.6.5.3 Formation of Swachhata Club or Clean Ambassador Club: Establish a dedicated Swachhata Club or Clean Ambassador Club to regularly coordinate programs such as competitions, exhibitions, and eco-friendly initiatives. These can include the cultivation of vegetable and medicinal gardens in collaboration with the Biodiversity Management Committee.
The club can focus on selecting low-maintenance medicinal and aromatic plants, utilizing organic manure produced from compost pits (food and leaf waste), and thereby demonstrating practical, low-cost waste management models with potential commercial benefits. This hands-on approach will help students develop skills in sustainable practices and environmental entrepreneurship.

7.2.6.5.4 Grey water Management Initiatives: Implement segregated wastewater treatment facilities in college laboratories, canteens, and other relevant areas to facilitate greywater treatment and recycling. Collaborate with water efficiency management experts to explore feasible systems for greywater reuse, contributing to the college's water conservation efforts and promoting practical learning opportunities for students.

7.2.6.5.5 Promotion of recycled and upcycled products : College shall promote recycling of wastes-both solid and liquid- and upcycling innovations.

7.2.7 Purchasing and Procurement

7.2.7.1 Promote Responsible Consumption and Utilization: Prior to any procurement—whether for administrative, academic, or renovation purposes—the Waste Management Committee shall submit a report to optimize resource usage. Special emphasis should be placed on minimizing plastic consumption and the use of hazardous waste materials that are difficult to dispose of. The committee should also encourage the adoption of eco-friendly alternatives.

7.2.7.2 Implement Sustainable Alternatives to Single-Use Plastics: Organize large scale initiatives to replace single-use plastic products with sustainable alternatives, such as steel plates and cups. This can be achieved by mobilizing support from the management, alumni, and Parent-Teacher Association (PTA). Promote the use of reusable steel bottles, tiffin carriers, and cloth or jute bags for daily use. During college events, the principal should formally announce a Green Protocol, discouraging plastic decorations and advocating for sustainable materials like cloth, paper, or organic leaves.

Additionally, departments that effectively implement these sustainability measures during festivals and events may be recognized with awards or other incentives.

7.2.7.3 Enhance Menstrual Hygiene and Waste Management: Establish incinerator facilities for the safe disposal of sanitary napkins. Install sanitary napkin vending machines that allow students to access menstrual hygiene products by inserting a coin, ensuring convenience and accessibility. This initiative should be undertaken in collaboration with the Occupational Health and Safety Management team. Additionally, implement a Waste Disposal Logbook to systematically track waste generation and disposal activities on campus.

7.2.8 Research and Innovation

7.2.8.1 Encourage research initiatives focused on waste management technologies and sustainable practices, including opportunities for dissertations, scholarships, and student projects aimed at enhancing knowledge and skills. Promote active participation of both students and faculty in publishing research articles in national and international journals, as well as in college publications.

7.2.8.2 Facilitate student participation in national and international conferences to present innovative technical solutions in waste management. Promote the development of innovative waste-to-energy solutions for efficient waste utilization.

7.2.8.3 Foster collaborations with industry experts and environmental organizations to explore advanced waste management techniques through industrial visits, observation visits, and internships. These engagements will provide students with practical, hands-on experience and exposure to cutting-edge developments, thereby enhancing their career prospects in the field of waste management.

7.2.9 Community Engagement

7.2.9.1 Collaborate with industries and organizations to implement sustainable initiatives and activities that provide students with real-world experience, enabling them to apply modern technologies to enhance the college's infrastructure, contribute to social causes, and foster environmental responsibility.

7.2.9.2 Establish partnerships with municipal authorities and private agencies to enhance waste management processes, including disposal and recycling. Explore opportunities to install in-house machinery that can convert waste into revenue-generating products.

7.2.9.3 Adopt a village in collaboration with the local governing body, encouraging active participation from students and faculty to create a model community. This includes beautification projects such as wall paintings, clean-up drives, and biodiversity enhancement initiatives like developing butterfly gardens or vertical wall gardens. These activities aim to inspire environmentally responsible behavior among stakeholders and transform neglected areas into vibrant community spaces, such as evening walkways.

7.2.10 Monitoring and Reporting

7.2.10.1 The Waste Management Committee will conduct monthly audits to assess progress in waste reduction efforts. Responsibility for regular waste monitoring will be assigned to the housekeeping staff, in coordination with the internal auditor. The internal auditor will also monitor compliance using CCTV footage and identify individuals violating waste management guidelines.

7.2.10.2 Feedback from students and staff will be regularly collected and analyzed to enhance waste management practices. An annual report summarizing waste management initiatives, achievements, and areas for improvement will be submitted to the college authorities.

7.2.9.3 Periodic assessments of waste management infrastructure will be conducted, and necessary updates to facilities will be implemented to ensure efficiency. Key Performance Indicators (KPIs) will be introduced to systematically measure waste reduction, recycling rates, and overall success of the waste management program.

7.2.11 Compliance and Review

7.2.11.1 Ensure compliance with local, national, and international waste management regulations.

7.2.11.2 Display clear and informative signage to define the roles and responsibilities of faculty, students, and staff in adhering to waste management policies. Additionally, ensure strict compliance with hazardous waste disposal guidelines.

7.2.11.3 Regularly review and update the waste management policy based on performance data provided by internal audits.

7.2.11.4 Circulate waste management system (WMS) guidelines within each department to promote awareness of responsibilities and implement appropriate penalties for non-compliance with waste segregation and disposal protocols.

7.2.11.5 Conduct periodic audits to monitor compliance with sustainability standards and relevant government regulations.

7.2.12 Leadership and Accountability

7.2.12.1 Waste Management Team: A dedicated waste management team comprising faculty, staff, and students will be responsible for the effective implementation and continuous monitoring of the institution's waste management policy.

7.2.12.2 Defined Roles and Responsibilities: Clear roles and responsibilities will be assigned to ensure the efficient execution of waste management activities, including regular waste audits, comprehensive reporting, and campus-wide awareness campaigns.

7.2.12.3 Accountability Framework: Institutional leadership will ensure that all departments and individuals are held accountable for optimizing resource usage and minimizing waste generation. Regular performance evaluations will be conducted to assess progress and ensure the achievement of waste management objectives.

7.2.13 Conclusion

Nirmala College, Muvattupuzha (Autonomous), is committed to fostering a sustainable and environmentally responsible campus. Through structured waste management initiatives, the institution aims to significantly reduce waste, enhance recycling efforts, and create a culture of environmental stewardship. By engaging students, faculty, and the broader community, this policy will contribute to a cleaner and greener future. With dedicated leadership, active participation from all stakeholders, and ongoing policy evaluation, this waste management plan will play a key role in promoting sustainability at Nirmala College. It is imperative that all members of the college community work together to ensure the successful implementation of this policy, making the campus an exemplar of responsible waste management practices.

7.3 METHODOLOGY

Effective waste management is vital for maintaining clean environments, reducing pollution, conserving resources, and protecting public health. A dedicated 16-member Waste Management Group (comprising 14 student representatives and 2 faculty members), functioning with internal oversight responsibilities, directs these efforts according to a comprehensive policy. This policy outlines clear objectives, action plans, and strategies, which are regularly reviewed and refined in group meetings to ensure optimal efficiency.

7.3.1 Internal Audit Training

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

7.3.2 Data sampling and categorization of waste

The waste management audit assesses the annual generation of various waste categories, including food waste, plastic, litter, and e-waste. Separate records are maintained for each category, documenting quantities generated from key areas such as the canteen and campus.

Waste collected are segregated and categorized into six distinct streams: (1) Plastic, Paper, (2) Bio-waste, (3) E-waste, (4) Chemical Waste (specify) and (5) Other Waste (encompassing materials such as broken glass, construction debris, textiles, packaging, and stationery). Analysis of the collected data provides valuable insights into annual campus waste generation patterns, distinguishing between periods such as working days, holidays, and semi-holidays.

7.3.3 Registers and Documents to monitor the process

Comprehensive waste disposal records are maintained, tracking quantities directed to recycling facilities, composting operations, and alternative disposal streams. Oversight of records associated with recycling facilities and waste processing units is assigned to student representatives.

7.3.4 External Audit

External auditors visit the college to evaluate conformity with waste 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.

7.3.5 Stages of Waste Management Audit

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

7.3.5.1. Pre audit phase

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

7.3.5.2. 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

7.3.5.3. 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

7.3.6.1 Schedule of Waste Audit

Week	Week Days	Weekly Work Plan
First Week	Jan2 to Jan 8	1. Organize college areas into 7 zones for waste management auditing. 2. Conduct a briefing session for waste management team members. 3. Assign teams to zones for waste assessment and mapping. 4. Conduct weekly team meetings, capture photographs, and prepare meeting minutes.
Second Week	Jan 9 to Jan15	1. Conduct waste assessment in zones 1 and 2. 2. Identify types and quantities of waste generated. 3. Conduct weekly team meetings, take photographs, and prepare meeting minutes.
Third Week	Jan 16 to Jan 22	1. Analyse waste assessment data from zones 1 and 2. 2. Conduct waste assessment in zones 3 and 4. 3. Identify areas for improvement in waste management practices. 4. Conduct weekly team meetings, take photographs, and prepare meeting minutes.
Fourth Week	Jan 23 to Jan 29	1.Conduct waste audits in zones 3 and 4. 2.Conduct waste assessment in zones 5 and 6. 3. Identify opportunities for waste reduction, reuse, and recycling. 4. Develop a waste management plan for the college. 5. conduct weekly team meetings, document findings with photographs, and prepare meeting minutes.
Fifth Week	Jan 30 to Feb 5	1. Conduct waste audits in zones 5 and 6. 2.Conduct waste assessment in zone 7. 3. Finalize the waste management plan for the college. 4. Identify stakeholders for implementing the waste management plan. 5. conduct weekly team meetings, take photographs, and prepare meeting minutes.
Sixth Week	Feb 6to Feb 12	1. Implement the waste management plan in all zones. 2. Conduct awareness programs for students, staff, and faculty. 3. Monitor and evaluate the effectiveness of the waste management plan. 4. Conduct weekly team meetings, take photographs, and prepare meeting minutes.
Seventh Week	Feb 13to Feb 19	1. Analyse data on waste reduction, reuse, and recycling. 2. Identify areas for improvement in the waste management plan. 3. Develop strategies for continuous improvement. 4. Attend weekly team meetings, take photographs, and prepare meeting minutes.
Eighth Week	Feb 20 to Feb 26	1. Finalize the waste management report for the college. 2. Prepare recommendations for future improvements. 3. Conduct weekly team meetings, capture photographs, and prepare meeting minutes.
Ninth Week	Feb 27 to March 4	1. Compile all data and reports. 2. Ensure all documents and registers are completed. 3. Prepare the final waste management report for submission

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

the entire college/university community well informed through regular communications, monitoring through periodical evaluation programmes etc.

7.3.6 Steps of Waste Management Audit

7.3.6.1. 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
- Data verification- identifying non conformities
- Action plan –long tern and short term

Final report & certification as per ISO standards.

7.3.6. 4 Work plan of Waste Audit

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

Fig 7.1 Waste segregation point

in the campus. Data on quantity and type of processing of each kind of waste is recorded

7.3.6.2. 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

7.3.6. 3. Final audit by external audit team

7.4. RESULTS AND DISCUSSION

7.4.1. Data survey on solid waste collection

The college quantify total annual waste generation, the college has established designated collection points at seven strategic locations: (1) the Main Block and Administration; (2) Diamond Jubilee Block; (3) Silver Jubilee Block; (4) Canteen/Cafeteria; (5) Parking Areas/ Grounds/Open Spaces; (6) Hostels; and (7) the MCA block.

7.4.1.1. Zone 1. Main Block & Administration

Sampling days	Average waste generated per day	Average per year consumption (Kg)
Working day	0.6	120 ± 72
Semi holiday	0.18	17.42 ± 7.25
Holiday	0.15	10.5 ± 12.61

Table 7.3 Bio-waste generation at Main block and administration

Waste generation patterns are strongly correlated with operational activity levels. Working days exhibit the highest waste production, suggesting significant bio-waste generation stemming from increased occupancy and usage of offices, laboratories, classrooms, guest rooms, and the dining hall. Conversely, minimal to negligible waste is observed during non-operational periods, indicating limited activity. Semi-holidays demonstrate a moderate level of waste generation, primarily attributed to intermittent activity in classrooms (special classes), laboratories (essential research), and administrative offices. Food waste, the primary waste stream, originates mainly from the canteen, washing areas, administrative offices, and dining hall. While weekday waste production is substantial, measures are in place to divert this organic waste to a pig farm for beneficial reuse

Sampling days	Waste generation (in Kg)	Average waste generation per year (in Kg.)
Working day	1.27	253.33 ± 50.33
Semi holiday	0.18	17.42± 7.25
Holiday	0.07	4.67± 4.04

Table 7.4 Plastic waste generation at Main block and administration

Waste generation patterns are significantly influenced by operational schedules and human activity levels. Peak waste production occurs on working days, correlating directly with increased consumption of products packaged in plastic, plastic goods, and pre-packaged food items. Conversely, holidays exhibit the lowest waste generation due to reduced activity and, in some cases, delayed waste removal. Semi-holidays demonstrate moderate waste levels, likely reflecting partial operational activity and potential events such as special classes or office functions. Specific areas, including classrooms, washrooms, conference halls, seminar halls, medical rooms, the Controller of Examinations office, ladies' restrooms, auditoriums, and gyms, generate a substantial amount of plastic waste. Waste quantities fluctuate based on usage patterns. For example, events held in the AV hall can lead to a temporary increase in waste, which is then collected and segregated by appointed housekeeping staff. The segregated waste is subsequently transferred to the Haritha Karma Sena and a plastic crushing area on a monthly basis.

Sampling days	Average waste generated per day	Average per year consumption (Kg)
Working day	8.5	2133.33± 1389.2
Semi holiday	1.17	17.42 ±72.55
Holiday	1.17	11.67± 20.20

Table 7.5 Paper waste generation at Main block and administration

Waste generation patterns exhibit a clear correlation with operational activity levels within the institution. Working days demonstrate significantly higher waste production, indicating peak waste generation attributable to regular institutional and office functions. Specifically, paper waste is the dominant component during working days, originating from sources such as classrooms, washrooms, conference and seminar halls, the medical room, the Controller of Examinations office, ladies' restrooms, the auditorium, the dining hall, and the bank/ATM. This underscores the considerable contribution of students, employees, and visitors to waste accumulation. Conversely, waste generation is minimal on holidays, suggesting near-negligible paper waste production during periods of institutional closure. Semi-holidays exhibit moderate waste generation, reflecting a reduced level of activity and associated paper usage compared to full working days, positioned between the waste levels observed on working days and holidays. The institution currently generates revenue by selling monthly remaining newspapers before eventual disposal.

Sampling days	Average waste generated per day	Average per year consumption (Kg)
Working day	0.17	34.67 ± 5.03
Semi holiday	0	0
Holiday	0	0

Table 7.6 Chemical wastes generation at Main block and administration

Chemical waste includes, old chemical stocks, solvents, acids, laboratory regents, chemical bottles, oil and pharmaceuticals, silica gel so on, generation is predominantly confined to working days, indicating a direct correlation with laboratory activities and institutional experiments conducted during standard operational hours. No chemical waste is recorded on holidays or semi-holidays, suggesting that laboratory or industrial activities responsible for chemical waste generation are suspended during these periods. Compared to overall waste generation, chemical waste volume is relatively low, reflecting controlled or minimal chemical usage practices. The college currently lacks dedicated effluent treatment facilities. To mitigate environmental impact, chemical waste, segregated into organic and inorganic streams, is collected in designated drums and subsequently transferred to Kerala Enviro Infrastructure Ltd. for proper disposal. This arrangement also includes the handling and disposal of chemically contaminated glassware.

Sampling days	Waste generation in Kg	Average waste generation per year (in Kg.)
Working day	1.17	233.33 ± 152.75
Semi holiday	0.13	12.67 ± 11.95
Holiday	0	0

Table 7.7 Other waste generation at Main block and administration

Other Waste includes, metal, steel, wood, cloths, batterie, bulb, tube light generation is significantly higher on working days, indicative of its association with regular institutional operations, packaging materials, and general administrative activities. A minimal amount of "Other Waste" is recorded on semi-holidays, suggesting limited operations or partial occupancy due to reduced staff/ student presence or the potential for maintenance activities. Notably, no "Other Waste" is generated on holidays, consistent with the suspension of institutional and workplace activities.

Type of waste	Average waste generation per year (in Kg.)
Bio- waste	5732.7
Plastic waste	841.25
Paper waste	6362.5
Chemical waste	104
Other waste	728

Table 7.8 Type of waste generation at Main block and administration

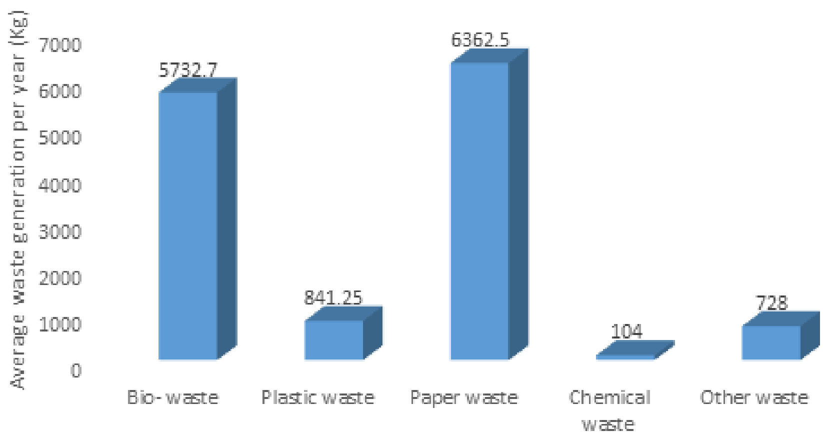


Fig 7.2 Average waste generation per year at Main block and administration

The waste stream generated at the administrative block is primarily composed of paper waste followed by and bio-waste, collectively accounting for the total waste volume. This indicates a significant consumption of organic and paper-based materials, likely stemming from food waste, office supplies, and packaging. Plastic waste constitutes a relatively small proportion of the overall waste stream. While the operation of an incinerator contributes to plastic waste reduction, the institution should continue to implement and enhance effective recycling and reduction strategies to minimize plastic waste generation. Chemical waste represents the smallest fraction of waste generated. This low % is a positive indicator, reflecting controlled usage and appropriate disposal practices for hazardous chemicals. The institution segregates chemical waste into organic and inorganic streams, which are then collected in designated drums and transferred to Kerala Enviro Infrastructure Ltd. for proper disposal, including chemically contaminated glassware. Other Waste amounting to 728 kg per year, warrants further investigation to determine its specific composition. This category likely encompasses diverse materials such as e-waste, hazardous materials, textiles, or general debris. Implementing improved waste segregation and disposal mechanisms could potentially lead to a further reduction in this waste stream.

7.4.1.2. Zone 2. Diamond Jubilee Block

Sampling days	Average waste generated per day	Average per year consumption (Kg)
Working day	7.33	1466.67 ± 115.47
Semi holiday	1.17	110.83 ± 72.55
Holiday	0.17	11.67 ± 20.20

Table 7.9 Bio-waste generation at Diamond jubilee block

Bio-waste generation is highest on working days, suggesting that sources linked to human activity, such as classrooms and washrooms, are the primary contributors. Minimal bio-waste generation on holidays indicates a direct correlation between bio-waste production and food-related operations and human presence. Moderate bio-waste generation on semi-holidays reflects reduced staff and student presence and limited operational activities. Bio-waste generation is negligible on holidays. During working days, the large quantity of bio-waste generated is directly supplied to a local pig farm for beneficial reuse.

Sampling days	Average waste generated per day	Average per year consumption (Kg)
Working day	4.5	300 ± 264.57
Semi holiday	0.1	9.5 ± 9.5
Holiday	0	0

Table 7.10 Plastic generation at Diamond jubilee block

Higher plastic waste generation is observed on working days, indicating a widespread use of plastic items such as packaging, disposable cutlery, plastic bags, and PET bottles associated with daily activities in areas like classrooms, computer labs, washrooms, and the auditorium. Plastic waste generation in the auditorium may fluctuate depending on the specific programs and events held and this might be a reason for waste generation in semi holidays. The absence of plastic waste generation on holidays suggests a direct link between plastic waste and human presence and operational activities. Negligible plastic waste on semi-holidays indicates limited operations with fewer plastic-consuming activities.

Sampling days	Average waste generated per day	Average per year consumption (Kg)
Working day	3.33	666.67 ± 115.47
Semi holiday	0.58	55.42 ± 13.71
Holiday	0	0

Table 7.11 Paper generation at Diamond jubilee block

Elevated paper waste generation is observed on working days, suggesting significant paper consumption in classrooms, staff rooms, computer labs, washrooms, and the auditorium. Paper waste generation patterns may fluctuate on working days depending on the regular usage habits of faculty, students, and visitors. The absence of paper waste on holidays indicates a direct correlation between paper usage and daily work activities. Moderate paper waste generation on semi-holidays, lower than that of working days, suggests limited operations or reduced work intensity.

Sampling days	Average waste generated per day	Average per year consumption (Kg)
Working day	0.12	23.33 ± 25.16
Semi holiday	0.02	1.58 ± 2.742
Holiday	0	0

Table 7.12 Other waste generation at Diamond jubilee block

Other waste production levels exhibit a strong correlation with campus activity. Elevated waste generation on working days suggests that student and staff presence, cafeteria usage, and academic activities are significant contributors. The absence of waste generation on holidays indicates an effective waste management system with no residual accumulation during periods of campus inactivity. Variations in waste production on working days may be attributed to specific campus events, examination periods, or administrative operations. Low waste generation on semi-holidays suggests a reduction in overall activity, reflecting partial faculty presence or limited campus functions.

Type of waste	Average waste generation per year (Kg)
Bio- waste	4692.5
Plastic waste	1121
Paper waste	2192.5
Other waste	73.5

Table 7.13 Bio-waste generation at Diamond jubilee block

Fig 7. 3 Handovering waste to scrap dealers

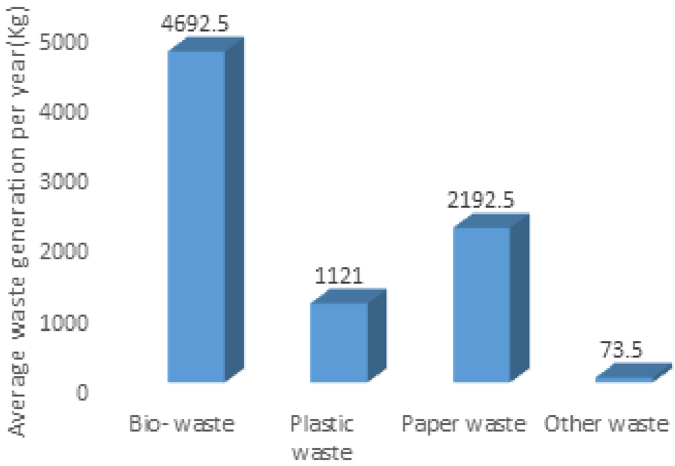


Fig 7.4 Average waste generation per year at Diamond jubilee block

Bio-waste constitutes the dominant fraction of the overall waste stream, indicating significant generation of food waste and other biodegradable materials primarily from classrooms, the seminar hall, and the staff room. The amount of food waste generally correlates with the number of occupants (or people/students/staff) in these areas. Waste quantities increase noticeably during events in the seminar hall. Furthermore, food waste may be attributed to maintenance crews or other labourer's consuming meals on campus. Paper waste forms another substantial portion, indicating significant use of paper products in daily operations. Although less abundant than bio-waste or paper, plastic waste is also a noteworthy segment, underscoring the need for better management practices.

7.4.1.3. Zone 3. Silver Jubilee Block

Sampling days	Average waste generated per day	Average per year consumption (Kg)
Working day	3.33	666.67 ± 2.74
Semi holiday	0.58	55.42 ± 13.71
Holiday	0.5	35 ± 35

Table 7.14 Bio-waste generation at silver jubilee block

The highest levels of bio-waste generation occur on working days, likely due to the presence of food waste, organic materials, and other biodegradable waste resulting from regular activities in classrooms, staff rooms, and washrooms. This bio-waste is routinely transferred to a local pig farm for beneficial reuse. Bio-waste generation patterns on holidays exhibit irregularity. Some holidays show bio-waste production, while others record zero. This variability suggests that limited activities, such as the operation of classrooms, seminar halls, staff rooms, and washrooms, may occur on certain holidays. However, on other holidays, no bio-waste is generated. A slight quantity of bio-waste may occasionally be present if complete removal was not achieved on previous days.

Sampling days	Average waste generated per day	Average per year consumption (Kg)
Working day	0.83	166.67 ± 57.73
Semi holiday	0.32	30.08 ± 15.26
Holiday	0.07	4.67 ± 8.08

Table 7.15 Plastic waste generation at silver jubilee block

Moderate plastic waste generation is observed on working days, indicating consistent plastic usage in locations such as classrooms, computer labs, washrooms, seminar halls, and staff rooms. However, some working days exhibit significantly lower plastic waste generation per day, suggesting variations in plastic consumption levels. Plastic waste production on holidays is inconsistent, implying that specific holidays involve activities that generate plastic waste, while others do not. The presence of noticeable plastic waste suggests ongoing but reduced activities. The generated plastic waste is collected, segregated, and handed over to the Hritha Karam Sena on a monthly basis.

Sampling days	Average waste generated per day	Average per year consumption (Kg)
Working day	3	600 ± 200
Semi holiday	0.67	63.33 ± 27.42
Holiday	0	0

Table 7.16 Paper waste generation at silver jubilee block

Elevated paper waste generation is characteristic of working days, reflecting significant paper consumption during daily operations in classrooms, computer labs, washrooms, and seminar halls. The absence of paper waste on holidays indicates a complete cessation of paper-related activities, contributing to a reduction in overall waste. Moderate paper waste generation on semi-holidays, significantly lower than that of working days, suggests a reduction in operational activities. The college currently disposes of paper waste through incineration. Newspapers are sold on a monthly or annual basis.

Holiday	Average waste generated per day	Average per year consumption (Kg)
Working day	0.58	116.67 ± 76.37
Semi holiday	0.02	1.58 ± 2.74
Holiday	0	0

Table 7.17 Other waste generation at silver jubilee block

The majority of "Other Waste" is generated on working days, indicating that office, institutional, or operational activities are the primary contributors to its accumulation. The absence of waste on holidays confirms that waste generation is directly activity dependent. Negligible waste generation on semi-holidays suggests that minimal activities occur on these days.

Type of waste	Average waste generation per year (in Kg.)
Bio- waste	1566.25
Plastic waste	674.25
Paper waste	1690
Other waste	4.75

Table 7.18 Waste generation trends at Silver jubilee block

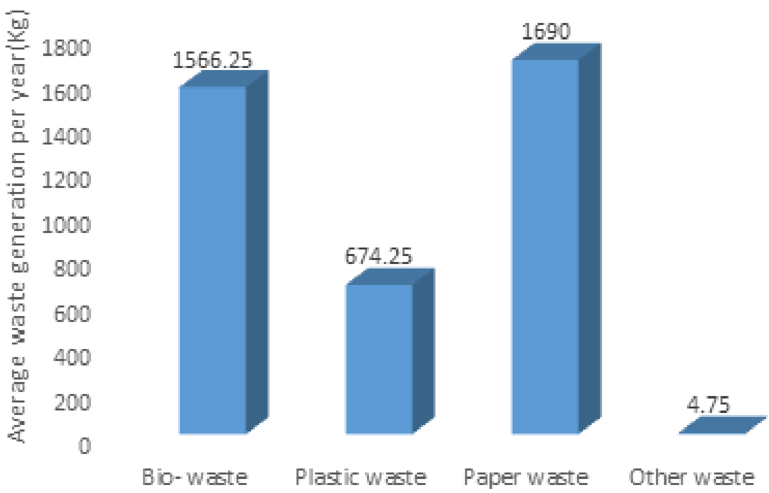


Fig 7.5 Average waste generation per year at silver jubilee block

Paper waste constitutes the largest proportion of the waste representing a substantial fraction of the overall waste, and suggesting considerable paper consumption, potentially including packaging, documents, and disposable items. Bio-waste follows closely, indicating a significant generation of food waste and other biodegradable materials. Plastic waste is present at a moderate level. "Other Waste" comprises a negligible portion, likely representing minimal hazardous, electronic, or miscellaneous waste.

7.4.1.4. Zone 4. Canteen & Cafeteria

Sampling days	Average waste generated per day	Average per year consumption (Kg)
Working day	20	633.33 ± 400
Semi holiday	6.33	601.66 ± 145.1
Holiday	0	443.33 ± 225.01

Table 7.19 Bio- waste generation at canteen & cafeteria

The college operates one central canteen and four cafeterias, with the exception of one located in the administrative block. The combined food service operations contribute significantly to bio-waste generation. The majority of bio-waste is generated on semi holiday followed by working days. This is attributed to heightened human activity during these periods, resulting in increased food waste and organic material disposal related to food preparation and dining services. Holidays contribute less to bio-waste generation, indicating reduced food service activities, likely due to lower occupancy and potentially incomplete removal of waste from previous days. While Sunday is generally a holiday, bio-waste from previous days may still be present. The total volume of food waste generated is substantial. However, all bio-waste is currently redirected for beneficial reuse at a local pig farm.

Sampling days	Average waste generated per day	Average per year consumption (Kg)
Working day	3.17	633.33 ± 550.75
Semi holiday	0.67	63.33 ±27.42
Holiday	0.42	29.17 ±26.73

Table 7.20 Plastic waste generation at canteen & cafeteria

The highest levels of plastic waste generation are observed on working days, indicating a strong correlation between plastic usage and daily operational activities. The canteen and cafeterias contribute significantly to this, primarily due to the sale of plastic-wrapped food items, packaged foods, chocolates, and soft drinks. Plastic waste generation is minimal on holidays. On certain holidays, plastic waste generation is completely absent, suggesting a cessation of activities that contribute to plastic disposal. Plastic waste generation on semi-holidays is considerable, varying depending on the extent of classroom utilization, public examinations, and college programs scheduled.

Sampling days	Waste generation in Kg	Average waste generation per year (in Kg.)
Working day	1	200 ± 100
Semi holiday	0.22	20.58 ± 2.74
Holiday	0.1	7± 12.12

Table 7.21 Paper waste generation at canteen & cafeteria

The majority of paper waste is generated on working days, indicating that paper consumption is primarily linked to work-related activities. The use of paper in canteens and cafeterias, including disposable items and packaging materials, contributes to significant waste generation. However, a reduction in paper usage has been observed in these areas due to the implementation of serving food on reusable steel, glass, and ceramic tableware. Paper waste generation is minimal on holidays. On most holidays, no paper waste is generated, suggesting a direct correlation between paper use and active workdays. Moderate paper waste generation on semi-holidays indicates that some paper consumption still occurs during these periods, albeit at a reduced rate compared to working days.

Sampling days	Average waste generated per day	Average per year consumption (Kg)
Working day	1.17	233.33 ± 152.75
Semi holiday	0.25	23.75 ± 23.75
Holiday	0	0

Table 7.22 Other waste generation at canteen & cafeteria

In addition to food scraps, canteens generate a variety of other waste types, including plastic packaging, paper waste, disposable cutlery, and organic waste such as vegetable peels and leftovers. The highest levels of "Other Waste" generation occur on working days, suggesting a correlation with work-related activities. These likely include the use of office supplies, packaging materials, and miscellaneous disposable items. The absence of recorded waste on holidays indicates that activities responsible for waste production are not conducted on non-working days. Moderate levels of "Other Waste" generation on semi-holidays suggest that these days contribute to waste production, although to a lesser extent than working days.

Type of waste	Average waste generation per year (in Kg.)
Bio- waste	15135
Plastic waste	2577.5
Paper waste	682.75
Other waste	257.08

Table 7.23 Waste generation tends at canteen & cafeteria

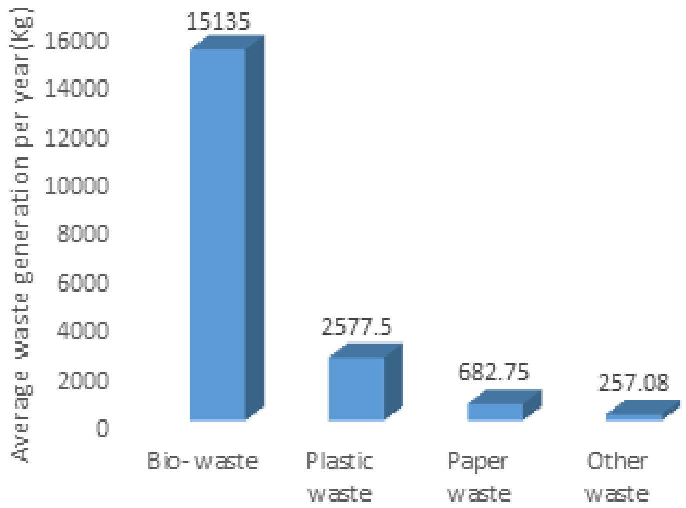


Fig 7.6 Average waste generation per year at Canteen & cafeteria

Bio-waste constitutes the dominant portion of the food service area waste stream indicating significant food and organic waste generation. To improve sustainability, the implementation of bio-gas conversion methods should be explored to convert the large quantity of organic waste into biomass. This would offer a potential alternative to relying solely on a pig farm for waste disposal and could contribute to a reduction in carbon footprint through the on-site production and reuse of cooking fuel. Plastic waste represents a concerning of the waste stream, suggesting a significant reliance on disposable plastic products. Efforts should be focused on reducing plastic consumption and promoting the use of reusable or biodegradable alternatives. Paper waste is relatively low suggesting that existing digitalization initiatives and paper recycling programs may already be effective. These efforts should be maintained and potentially expanded. Other Waste, comprising of the waste stream, requires attention to ensure the proper disposal of non-recyclable and potentially hazardous materials, adhering to relevant regulations and best practices.

7.4.1.5. Zone 5. Parking space, Ground, open spaces

Sampling days	Average waste generated per day	Average per year consumption (Kg)
Working day	0.67	133.33 ± 57.73
Semi holiday	0.15	14.25 ± 8.22
Holiday	0.05	3.5 ± 3.5

Table 7.24 Plastic waste generation at Parking space, Ground, open spaces

Plastic waste generation is significantly higher on working days, correlating directly with the number of people present on campus (students, staff, etc.). Daily waste volume fluctuates based on both population size and specific usage patterns. Consequently, lower quantities of plastic waste are observed on holidays and partial holidays, reflecting reduced campus attendance during these times.

Sampling days	Average waste generated per day	Average per year consumption (Kg)
Working day	0.67	133.33 ± 76.37
Semi holiday	0.15	14.25 ± 4.75
Working day	0.03	2.33 ± 2.02

Table 7.25 Paper waste generation at Parking space, Ground, open spaces

Standard working days contribute to higher paper waste generation, proportional to the daily campus population. Paper consumption varies depending on the number of individuals present and their usage habits. Consequently, lower quantities of waste are recorded on semi-holidays and holidays, reflecting the reduced attendance on those days.

Sampling days	Average waste generated per day	Average per year consumption
Working day	0.05	10 ± 17.32
Semi holiday	0	0
Holiday	0	0

Table 7.26 Other waste generation at Parking space, Ground, open spaces

Analysis indicates that waste generation volumes are elevated during standard working days, a phenomenon attributable to higher campus occupancy by students and personnel. Daily fluctuations in waste are observed, influenced by population density and specific usage patterns. Reduced waste generation is characteristic of semi-holidays and holidays, coinciding with periods of lower campus attendance.

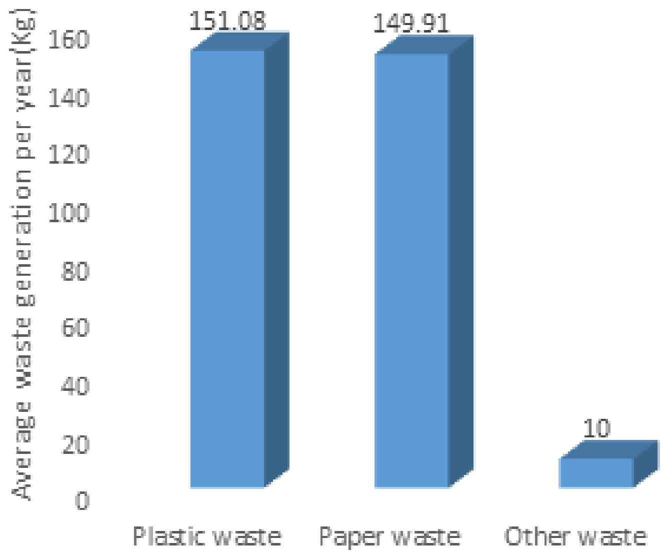


Fig 7.7 Average waste generation per year at parking space, ground open space

A waste stream analysis reveals that plastic is the most significant component of waste on campus indicating typical thrown away culture of the college community, followed by paper. This composition, evident even in parking lots and open spaces, points to a prevalent single-use or "disposable" culture within the college community. Plastic is regularly collected and segregated; the high volume underscores a strong dependence on these products. To improve sustainability, strategies must shift from post-use management to proactive reduction by minimizing consumption and promoting reusable alternatives. For the paper stream, the current practice of open burning is an environmentally unsound disposal method and should be discontinued immediately. Instead, the institution must prioritize paperless alternatives, enhance recycling programs, and foster responsible usage. Although other waste materials constitute a minimal portion of the stream, they require diligent management to ensure the safe disposal of non-recyclable and potentially hazardous items in compliance with all relevant regulations.

Fig 7. 8 Bottle booth collecting plastic bottle

7.4.1.6. Zone 6. Hostel

Sampling days	Waste generation in Kg	Average waste generation per year (in Kg.)
Working day	48.33	9666.67 ± 702.37
Semi holiday	48.67	4623.33 ± 219.39
Holiday	32	2240 ± 185.20

Table 7.27 Bio-waste generation at college collage hostel

Bio-waste volume is highest on working days, coinciding with full operational activity and suggesting sources such as food waste from the kitchen and mess, as well as organic material from daily operations. Significant bio-waste generation occurs on semi-holidays, approaching levels seen on working days. This may be attributed to continued food production, mess operations, and other activities contributing to the waste load. Furthermore, fewer students may leave the hostel during weekends due to special classes, examinations, college programs, or the distance of their homes. Bio-waste generation is lower yet still notable on holidays. This indicates ongoing waste management needs even when activity levels are reduced. Reduced occupancy may be due to students leaving the hostel to return home or for outings. Although the canteen has biogas plants to manage food waste, the institution should also initiate strategies to reduce overproduction of food items and promote behavioural changes among students to limit food waste.

Sampling days	Waste generation in Kg	Average waste generation per year (Kg)
Working day	4.17	833.33 ± 152.75
Semi holiday	3	285 ± 47.5
Holiday	3.83	268.33 ± 88.08

Table 7.28 Plastic waste generation at college hostel

Elevated plastic waste generation is observed on working days. This is likely due to daily operations, food packaging, packaged food items, and disposable stationery materials. High plastic waste generation also occurs on holidays. This may be attributed to the consumption of food items in plastic containers, soft drinks in cans, kitchen operations, or other external factors influencing waste production. Plastic waste generation on semi-holidays is near working day levels. This indicates that similar activities and consumption patterns persist on these days, resulting in only a slightly lower volume of plastic waste compared to working days. Despite the high quantity of plastic waste generated, it is collected and handed over to the Haritha Karma Sena for proper disposal and recycling.

Sampling days	Waste generation in Kg	Average waste generation per year (Kg)
Working day	4.67	933.33 ± 152.75
Semi holiday	4	380 ± 95
Holiday	4.1	287 ± 37.04

Table 7.29 Paper waste generation at college hostel

Consistently high levels of paper waste are observed on working days. This is likely due to printing, note-taking, packaging from food packets, and discarded printed materials such as finished notebooks. High paper waste generation also occurs on holidays, indicating that paper-intensive activities continue even when the institution is not fully operational. Paper waste generation on semi-holidays is comparable to working days, suggesting that partial work or events significantly contribute to paper waste, even as the number of residents in the hostel may decline during these periods.

Sampling days	Waste generation in Kg	Average waste generation per year (Kg)
Working day	0.5	100 ± 173.20
Semi holiday	0.67	63.33 ± 54.84
Holiday	0	0

Table 7.30 Other-waste generation at college hostel

The diverse activities of students in a college hostile environment result in the potential generation of various waste types. Organic waste, such as food scraps, is commonly produced in hostel mess halls and individual rooms. Non-biodegradable waste, including wrappers, packaging materials, and electronic waste from personal gadgets, as well as printed materials, represents another major component of the waste stream. Additionally, sanitary waste, including used hygiene products, requires careful management. Other Waste generation is sporadic in hostels, with only one working day and semi-holidays contributing to its production. No "Other Waste" is generated on holidays, indicating low or no operational activities during these periods. Elevated "Other Waste" generation is observed on certain semi-holidays but not others, suggesting occasional events, maintenance work, or specific activities contributing to its presence.

Type of waste	Average waste generation per year (Kg)
Bio- waste	4370
Plastic waste	4207.5
Paper waste	4801
Other waste	490

Table 7.31 Waste generation trends at college hostel

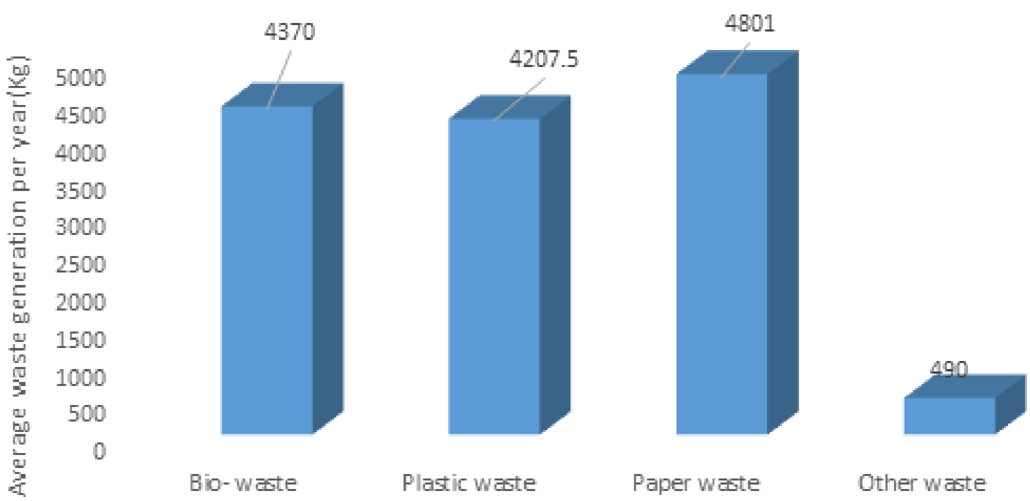


Fig 7.9 Average waste generation trend at Hostel

The college's four hostels, housing 772 residents, generate waste in direct proportion to occupancy and activity levels. The composition of this waste stream is as follows, Paper Waste is the largest contributor indicating significant paper consumption within the hostels. To improve sustainability, the implementation of increased recycling programs, the promotion of digital alternatives, and the encouragement of sustainable paper usage practices are recommended. Plastic Waste represents a major concern closely following paper waste in terms of volume. This highlights a significant dependence on plastic products within the hostel environment. Despite the presence of incinerator facilities, reduction strategies, increased recycling efforts, and the adoption of eco-friendly replacements are crucial for mitigating the impact of plastic waste. Bio-Waste constitutes a substantial portion of the hostel waste stream. This likely originates from food waste, organic materials, and biodegradable products. This waste stream is currently managed through a biogas plant. Other Waste represents a relatively low proportion of the total waste. However, it still requires proper disposal methods to ensure the safe management of miscellaneous non-recyclable materials, adhering to relevant waste management practices.

The hostel currently utilizes a bio-gas plant, and Bio waste tank of 1000L, data indicate that hostel bio-waste is the second-largest contributor to the college's total waste generation. This waste is effectively managed through the bio-gas plant, and the resulting slurry is carefully managed to maximize its beneficial use. The slurry is either directed to a constructed cow dung yard for immediate collection as organic manure, thereby preventing unpleasant odors, or it is collected in a large holding tank. Once the tank reaches capacity, the slurry is processed and utilized as organic manure for campus gardens. These practices ensure efficient utilization of bio-gas plant by products and minimize any potential environmental impact.

7.4.1.7. Zone 7. MCA Block

Sampling days	Waste generation in Kg	Average waste generation per year (in Kg)
Working day	2.83	566.67 ± 152.75
Semi holiday	1.83	174.17 ± 27.42
Holiday	1.5	105 ± 35

Table 7.32 Bio-waste waste generation at MCA

Bio waste generation is demonstrably higher on working days, reflecting increased human activity, food preparation, and the associated disposal of organic waste. Conversely, waste generation decreases during semi-holidays, suggesting a reduction in operational capacity or activity levels. This pattern highlights the direct relationship between facility usage and waste output.

Sampling days	Waste generation in Kg	Average waste generation per year (Kg)
Working day	1.08	216.67 ± 76.37
Semi holiday	0.5	47.5± 23.75
Holiday	1.08	75.83± 56.25

Table 7.33 Plastic waste generation of at MCA

Increased plastic waste production on working days is directly attributable to heightened consumption of packaged materials, plastic bottles, and disposable plastic products. Fluctuations in plastic waste during holidays suggest intermittent periods of increased consumption, potentially related to packaging waste or the use of disposable cutlery at events. The reduction in plastic waste on semi-holidays likely stems from decreased operational activities and lower demand for plastic-based consumables.

Sampling days	Waste generation in Kg	Average waste generation per year (Kg)
Working day	3	600 ± 56.25
Semi holiday	0.92	87.08± 13.71
Holiday	2.78	64.75± 9.09

Table 7.34 Paper waste generation at MCA

Paper waste generation demonstrates a strong correlation with workplace activity. The elevated levels of paper waste observed on semi holiday followed by working days reflect increased consumption within offices, library, auditorium and classroom. Highlighting the potential for targeted waste reduction strategies in these settings. The significant reduction in paper waste during holidays underscores the predominantly work-related nature of paper consumption.

Sampling days	Waste generation in Kg	Average waste generation per year (Kg)
Working day	0.27	53.33± 50.33
Semi holiday	0.25	23.75 ± 23.75
Holiday	0	0

Table 7.35 Other waste generation at MCA

The volume of "other waste" produced is substantially less than that of bio waste, plastic, or paper. The complete absence of this waste stream on holidays reinforces the hypothesis that its generation is almost exclusively linked to workplace processes rather than domestic consumption. The sporadic presence of "other waste" during working day and semi-holidays suggests its creation is tied to intermittent or specialized activities within those operational contexts.

Type of waste	Average waste generation per year (Kg)
Bio- waste	2537.5
Plastic waste	1020
Paper waste	2253.75
Other waste	231.25

Table 7.36 Waste generation trends at MCA

Fig 7. 10 Biogas plant of Nirmala hostel

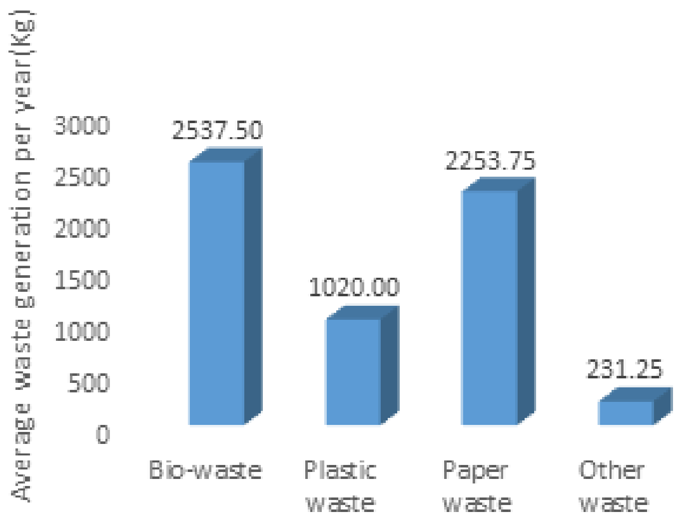


Fig 7.11 Average waste generation per year at MCA

Bio waste represents the most significant component of the overall waste stream attributable to food waste, organic matter, and biodegradable materials. The prevalence of bio waste necessitates the implementation of comprehensive waste management strategies, including composting programs, biogas production facilities, and waste-to-energy conversion technologies. Paper waste constitutes a substantial suggesting a potential inefficiency in paper consumption practices. Focused efforts on promoting paper recycling, transitioning to digital workflows, and reducing unnecessary printing are essential. Although plastic waste represents a smaller % than bio waste and paper waste, its persistence and environmental impact demand focused attention. Strategies for mitigating plastic waste should include the promotion of plastic-free alternatives, expansion of recycling infrastructure, and education on responsible plastic usage behaviours. The minimal "other waste" fraction still requires proper segregation and disposal protocols. It is important to note that the MCA's operational schedule deviates from typical organizations, with 363 working days annually and minimal holiday closures. The reduced waste generation observed on holidays reflects the impact of reduced operational capacity, lower personnel numbers, and decreased food waste production. Furthermore, weekend coaching activities related to civil service examinations influence waste generation patterns.

Fig 7. 12 Segregated paper wastes in office

7.5.1.8. Total quantity of waste generated in the college campus

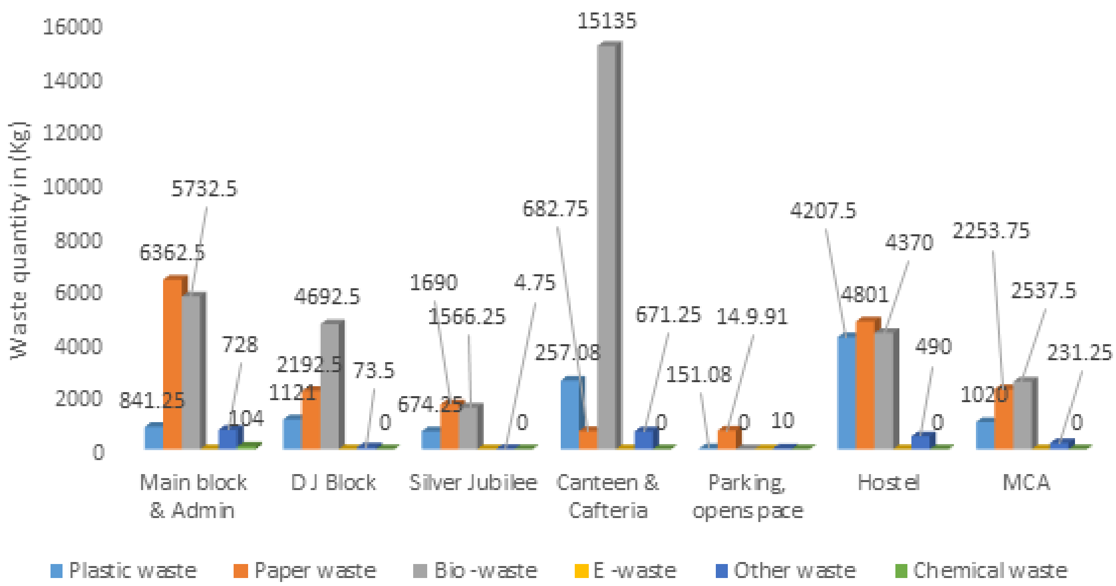


Fig 7.13 Total quantity of waste generated in each location of Nirmala College

	Plastic waste	Paper waste	Bio -waste	E -waste	Other waste	Chemical waste
Main block & Admin	841.25	6362.5	5732.5	0	728	104
D J Block	1121	2192.5	4692.5	0	73.5	0
Silver Jubilee	674.25	1690	1566.25	0	4.75	0
Canteen & Cafeteria	2577.5	682.75	15135	0	257.08	0
Parking, opens pace	151.08	149.91	0	0	10	0
Hostel	4207.5	4801	4370	0	490	0
MCA	1020	2253.75	2537.5	0	231.25	0
	10592.58	18132.41	34033.75	2400	1794.6	104

Table 7.37 Total quantity of waste generated in college campus

Type of waste	Total quantity of waste in (kg	Per capita waste generation per year (Kg)
Plastic waste	10592.58	3.54
Paper waste	18132.41	6.05
Bio-waste	34033.75	11.36
E-waste	2400	0.8
Other waste	1794.6	0.6
Chemical waste	104	0.03

Table 7.38 Per capita waste generation per year in college campus

Nirmala College, comprising a total population of 4,002 (including faculty, staff, students, and hostel residents), must address the substantial volume of waste it generates. Annually, this amounts to approximately 34,034 kg of bio-waste and 18,132 kg of paper waste. The current disposal strategy, which relies on diverting organic materials to a pig farm and minimal composting, is inefficient and fails to capture the inherent value of the biomass. To optimize waste management, the installation of an on-campus biogas plant is essential. This facility would establish a self-sufficient model by converting organic waste into renewable energy (biogas) for institutional use and high-quality organic fertilizer for gardening and grounds maintenance. Such an initiative supports the college's strategic goals of financial prudence and environmental sustainability.

7.4.2 Current status of waste management

College has colour coded bin for the disposal of waste for bio waste, paper waste, plastic waste, chemical waste, meatal waste

Graph 7.10 and Table 7.39, which detail the total quantity of waste generated per location and the annual per capita waste generation, both show a high concentration of biowaste, followed by paper, plastic, and other waste.

- Bio-waste is by far the largest component, making up 50.7% of the total waste. This indicates that waste management strategies should heavily prioritize organic waste. The Canteen & Cafeteria is the single largest generator of waste, contributing 27.8% of the total. Its output is driven almost exclusively by bio-waste. The Hostel and Main block & Admin are also significant contributors. There is a major discrepancy in the E-waste data. A total of 2,400 units are recorded, but none are attributed to a specific location. This is a critical tracking failure that needs immediate investigation. Paper waste is concentrated in the Main block & Admin, while Chemical waste originates exclusively from this location. This allows for highly targeted reduction and management efforts.
- Bio-waste is the predominant component of waste generated in several key areas of the college, including the main canteen, the cafeteria, Nirmala Hostel, and the main administrative block. The significant volume originating from these locations, particularly the main block which generates a waste volume comparable to the Silver Jubilee block, results in a high overall concentration of bio-waste. Furthermore, the college's four canteens collectively generate a substantial quantity of this waste stream. Currently, the college employs several bio-waste management strategies. These include Thumboormuzhi model aerobic composting, vermicomposting, and the collection of bio-waste from hostels for supply to a local pig farm. Specifically focusing on hostel waste management: three of the four hostels (Nirmala Hostel, Little Flower Hostel, and St. Joseph Hostel) operate biogas facilities for energy generation from biomass. Additionally, Nirmala Hostel utilizes a 1000-liter collection tank for bio-waste. This collected material is subsequently mixed with cow dung to produce organic manure, which supports the college's organic farming and gardening initiatives. The high volume of waste generated at Nirmala Hostel is directly correlated with its larger resident population.
- As the second leading contributor, paper waste currently lacks effective management strategies, Waste paper is thermally treated in an incinerator. Presently the waste management policy establishes and implement a specific policy focused on reducing paper generation through methods including enhanced recycling and reuse programs, increased adoption of digital communication, and efficient document management This contrasts with past practices where discarded paper was often burned
- In terms of waste composition, plastic waste is the third most prevalent category. College regulation restricts plastic usage on academic and administrative premises, though hostel facilities exhibit higher volumes correlating with occupant

Fig 7. 14 Incinerator facilities an Nirmalam hostel

use. Waste management procedures involve collection of all plastic waste by the Haritha Karma Sena. Plastic bottles enter a recycling pathway via the college's shredding unit, with the processed material being beneficially reused for on-campus road surfacing and as a component in brick manufacturing.

- Chemical waste originates predominantly from the Main Block, which houses the main laboratory, and the Administrative Block, containing key offices. This waste is stored and subsequently collected by Kerala Infrastructure Ltd. under a Memorandum of Understanding (MoU) signed with the college for periodic waste disposal.

- Addressing the challenge of managing electronic waste (e-waste), for which precise institutional records are currently unavailable (though caretaker estimates suggest up to 2400kg annually), the Department of Computer Science launched the 'E-REVIVE' initiative. As part of this program, a five-year Memorandum of Understanding (MOU) was formalized with MSH E Waste Collection, Erattupetta. The initiative facilitated the collection of unusable e-waste from 150 households within the Nirmala Valley and Nirmala Nagar Residence Associations. This effort successfully raised Rs.10,000, designated for scholarships for deserving departmental students. Furthermore, suitable electronic items collected were retained and repurposed for internal office use.

- The 'Other Waste' category comprises items limited to, wood fragments, discarded footwear (sandals), apparel, various metals, aluminum foil, mats, glass, and ceramics. Suitable materials within this category, such as glassware and other reusable items, are segregated for reuse in crafting and decorative projects. All residual waste is consolidated in the plastic shredding facility prior to transfer to authorized scrap dealers or if it usable donate to charity organisation

7.4.3 Conclusion

- This study determined that bio-waste constitutes the primary component of the generated waste stream, followed by paper waste. Data analysis indicates a positive correlation between the total occupant population and the overall volume of waste produced. High levels of bio-waste are significantly influenced by food wastage practices, particularly within the canteen and cafeteria, with the administrative block also being a notable contributor. The Main and Administration blocks were identified as the largest contributors mainly due to clubbing one more block into it for the collecting of waste to the overall waste stream and the primary sources of paper waste, followed by the Hostel and MCA blocks. Paper waste originates from diverse sources, including academic materials, administrative documents, and packaging. This is attributed to these locations housing major college departments with substantial administrative and academic paper consumption.

- Based on these findings, several recommendations are proposed Primarily, in light of the high prevalence of bio-waste, it is imperative that the on-site anaerobic digestion system (biogas plant) already installed at the hostel be maintained effectively to ensure its optimal performance. This would enable the conversion of organic waste into biomass, offering a sustainable alternative to current disposal methods (e.g., supply to piggeries) and potentially reducing reliance on purchased Liquefied Petroleum Gas (LPG) by an estimation one to four cylinders per month, while also producing organic compost. To address paper waste, strategies should include promoting digital communication, providing accessible document binding facilities (to encourage double-sided printing/reuse), and actively encouraging paper reuse and recycling initiatives. Implementing these measures through supportive institutional policies is crucial for effective waste reduction

7.4.4 Limitation of Waste Management

Based on the information of waste management team the college has 2400 kg of e waste but there is actual record to substantiate the quantity, currently there is no management segregation or store for e waste. College has to segregate and required to maintain a store room for storing e-waste and record the quantity annually and the way for managing.

7.5 WASTE MANGEMENT PLAN

7.5.1 .Introduction

Waste management is a crucial aspect of sustainability that requires a systematic approach to handling waste, reducing environmental impact, and promoting responsible disposal methods. At Nirmala College, Muvattupuzha, an efficient waste management plan is essential to ensure a clean and green campus. This plan aims to introduce a structured framework to manage waste efficiently, minimize environmental degradation, and foster a culture of sustainability among students, faculty, and staff.

7.5.2 Establish an Adopt Waste Management Team

The first step in implementing a successful waste management strategy is to establish a dedicated energy management team. This team should comprise faculty members, student representatives, administrative staff, and environmental experts. The primary responsibilities of this team include:

- Overseeing waste management initiatives within the college.
- Ensuring compliance with environmental regulations.
- Encouraging participation from the college community.
- Conducting regular meetings to assess and update waste management practices.
- Collaborating with external agencies for better waste disposal and recycling techniques.

The establishment of this team will provide the foundation for an effective waste management system, ensuring accountability and active participation from all stakeholders.

7.5.3 Formulate a Comprehensive Strategy for Sustainable Waste Management

A well-structured strategy is essential for implementing sustainable waste management. This strategy should focus on:

- Waste segregation at source: Clearly marked bins for biodegradable, non-biodegradable, recyclable, and hazardous waste should be installed at various points across the campus.
- Reduction of waste generation: Encouraging the use

of reusable materials, minimizing paper usage, and promoting digital alternatives for communication and record-keeping.

- Recycling initiatives: Setting up recycling programs in collaboration with local waste management organizations.
  - Composting organic waste: Utilizing food and garden waste to produce compost for campus gardens.
- Expand training offerings to include a specialized course or certified workshop on waste management.
- Facilitate research project development and scholarly publication opportunities for staff and students.
- Hazardous waste disposal: Safe disposal mechanisms for laboratory and medical waste by formulating collaboration with external agencies ensuring they do not pose a threat to the environment or human health.

By formulating a strategy that includes these key components, the college can ensure effective waste management while fostering an environmentally conscious campus culture.

7.5.4 Implement Effective Methods to Attain Set Objectives

Once the strategy has been formulated, it is crucial to implement practical methods to achieve the outlined objectives. Some of these methods include:

7.5.4.1 Awareness campaigns: Organizing workshops, seminars, and awareness drives to educate students and staff about waste segregation and reduction.

7.5.4.2 Infrastructure development: Installing proper waste bins, composting units, and recycling stations to facilitate efficient waste disposal.

7.5.4.3 Partnerships with waste management agencies: Collaborating with local municipal bodies and NGOs for proper waste collection and processing.

7.5.4.4 Encouraging student involvement: Forming eco-clubs and student-led initiatives to promote sustainable practices.

7.5.4.5 Monitoring and evaluation: Maintain comprehensive records, including registers and documents, to support regular assessments of the waste management process, enabling the identification of improvement areas and verification of policy compliance.

Implementing these methods will create an effective waste management system that is sustainable and adaptable to evolving needs.

7.5.5 Establish Robust Communication Channels and Governing Body

Effective communication and governance are critical for the successful implementation of any waste management plan. The college should set up a dedicated governing body responsible for overseeing waste management activities and ensuring smooth coordination among various stakeholders.

Key elements of this governing structure include:

7.5.5.1 Designating responsibility: Assigning specific roles to faculty members, students, and administrative staff for monitoring waste management efforts.

7.5.5.2 Establishing communication channels: Develop a feedback mechanism through official departmental groups (via email or messaging) enabling stakeholders to report waste concerns and offer improvement ideas.

7.5.5.3 Regular feedback mechanisms: Employ surveys and facilitate feedback sessions to ascertain difficulties encountered by students and staff regarding compliance with waste management protocols.

7.5.5.4 Documentation and reporting: Employ surveys and facilitate feedback sessions to ascertain difficulties encountered by students and staff regarding compliance with waste management protocols.

A well-structured governance system will ensure transparency and efficiency in managing waste, making it easier to address challenges and implement necessary changes.

7.5.6 Objectives

To ensure continuous progress, it is essential to set objectives for waste management at Nirmala College. These goals should be specific, measurable, achievable, relevant, and time-bound (SMART).

7.5.6.1 Long-term objectives:

- Achieve zero waste to landfill by increasing recycling and composting efforts.
- Establish a model eco-friendly campus with sustainable waste management practices.
- Develop partnerships with local businesses for sustainable waste disposal.
- Integrate waste management topics into the college curriculum to promote long-term awareness and responsibility.

7.5.6.2 Short-term objectives:

- Implement waste segregation across all departments.
- Conduct awareness campaigns on waste reduction and recycling.
- Establish a composting unit for organic waste.
- Reduce paper usage by promoting digital alternatives.

By setting realistic and clear objectives, the college can systematically progress toward a sustainable waste management system.

7.5.7 Continuously Monitor and Enhance the System

Waste management is an ongoing process that requires continuous evaluation and enhancement. Regular monitoring mechanisms should be implemented to ensure that the system remains effective and adaptable to changing needs.

7.5.7.1 Periodic audits: Regular waste audits should be conducted on a semi-annual to annual basis to assess the efficiency of waste management systems, including segregation, recycling, and disposal.

7.5.7.2 Performance tracking: Analysis of recorded data and checklists was conducted to measure the impact of waste management initiatives and identify areas for improvement.

7.5.7.3 Adapting to new technologies: Exploring innovative waste management solutions, such as biogas production from organic waste and advanced recycling methods that extend beyond conventional practices.

7.5.7.4 Community involvement: Foster participation in waste management initiatives among the college community, local residents, businesses, and government agencies through public-private partnerships and collaborative events or programs

By continuously monitoring and improving waste management practices, the college can maintain a high standard of sustainability and environmental responsibility.

7.5.8 Conclude and Conduct Follow-ups on the System

The waste management plan should conclude with a thorough evaluation of its effectiveness and necessary follow-up actions. This involves:

7.5.8.1 Assessing success rates: Measuring the extent to which waste reduction, recycling, and composting targets have been achieved.

7.5.8.2 Feedback collection: Engaging with students, faculty, and staff to gather insights on challenges faced and areas needing improvement.

7.5.8.3 Reviewing policies: Periodically revising waste management policies to incorporate new regulations, technologies, and best practices.

7.5.8.4 Recognizing achievements: Acknowledging and rewarding efforts made by individuals and groups in contributing to sustainable waste management.

7.5.8.5 Future planning: Developing new initiatives and action plans to further improve waste management on campus.

7.5.9 Conclusion

A well-executed waste management plan at Nirmala College Muvattupuzha (Autonomous), will not only contribute to environmental sustainability but also instil a sense of responsibility among students and staff. By establishing a strong governance system, setting clear goals, and continuously enhancing waste management practices, the college can serve as a model institution for sustainable waste disposal and management. This plan lays the foundation for a cleaner, greener, and eco-friendlier campus, ensuring that future generations inherit a sustainable environment.

7.6 CONCLUSION

- The assessment finds that the volume of waste generated by the institution is proportionate to the size of its population, indicating a predictable pattern of consumption and disposal.
- A strong commitment to the Green Campus initiative is evident through visible and structured waste management practices already in place.
- Waste segregation is effectively carried out using colour-coded bins and clearly labelled signage across the campus to differentiate between plastic, food, paper, and chemical waste streams.
- An analysis of waste streams at the college reveals that bio-waste, primarily consisting of food waste, constitutes the largest component, amounting to 34,033.75 kg annually, or 11.36 kg per capita. Paper waste is the second most significant category, with an annual generation of 18,682.25 kg (6.24 kg per capita). The college effectively manages its bio-waste through composting, vermicomposting, and its application as organic manure for institutional gardening, with surplus material provided to local pig farms. While biogas plant facilities are installed in four hostels, they are not yet present within the main college. These existing methods contribute to manure production for gardening and biomass-related activities. The institution could further enhance sustainability by installing a biogas plant to generate energy, thereby reducing the current annual purchase of approximately 60 LPG cylinders for the canteen (monthly 4) and cafeteria (monthly 1). This would decrease reliance on external agencies and improve the college's self-sufficiency in waste and energy management.
- Chemical waste, consisting mainly of bottles, along with electronic waste, is collected annually by authorized external agencies. Disposal of chemical waste involves payment, reflecting adherence to proper environmental compliance.
- Plastic waste is generated in relatively low quantities and is managed by shredding bottles on-site. The Haritha Karma Sena is responsible for periodic collection, while other categories of recyclable waste are collected by local scrap dealers.
- Despite the existence of these management systems, the audit identifies a gap in the form of inadequate quantitative documentation. Waste recording practices are often limited to counting items rather than measuring their mass or volume.
- To address this shortfall, a new monitoring system has been introduced. The campus is now divided into eight zones, each equipped with a dedicated register to document quantitative data for plastic, paper, chemical, bio-waste, and other waste types.
- The zonal, data-driven approach is expected to enhance waste management efficiency by pinpointing areas of high waste generation and enabling the implementation of targeted waste-reduction strategies.

7.7 RECOMMENDATIONS

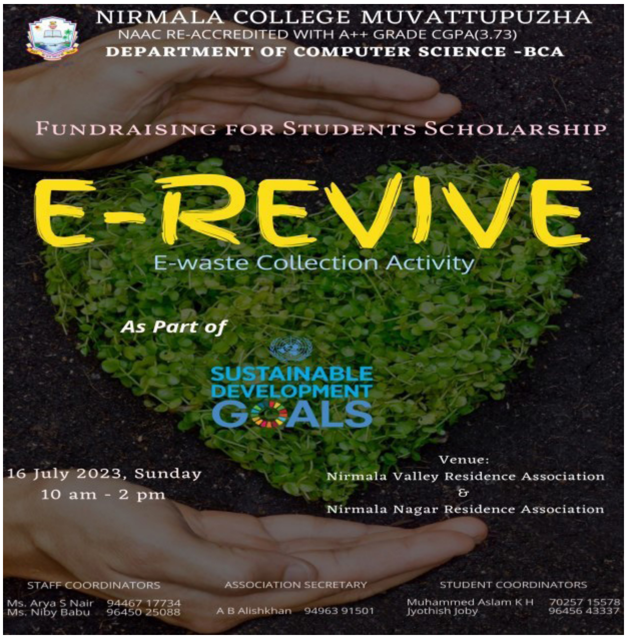
college has bio compost pit and vermicompost for manging biowaste they can also check the possibility of introducing bio gas plant for generating bio -mass and thereby reduce the purchase of LPG for canteen and cafeteria and integrate multiple farming activities utilizing organic manure derived from the biogas plant, and consider biomass as a fuel source, thereby promoting resource circularity.

Promote digital documentation workflows to minimize printing, encourage double-sided printing and paper reuse, and implement a comprehensive recycling program to significantly reduce paper consumption across the college.

Prioritize the adoption of reusable or biodegradable materials throughout the college and strictly restrict the use of single-use plastics to minimize environmental impact.

Establish and implement a robust framework for the responsible management of electronic waste, featuring systematic annual recording and reporting, and a dedicated e-waste holding facility within the campus

7.8s ACTIVITIES CONDUCTED



WASTE MANAGEMENT CERTIFICATES

Nirmala College Muvattupzha Autonomous

FOUNDED 1953

DEPARTMENT/PROGRAMME ACTIVITY REPORT FOR THE YEAR 2024 - 2025

Name of the Event	E-REVIVE	
Organised by(Dep/Cell)	BCA	
Date&Time	24/08/2024 – 10 AM	
Venue	Ward1, Avoly Panchayath	
Duration(Hrs/Days)	**5 hrs**	
Number of Participants	**Students :23**	**Faculty : 4**
Platform ✓	**Online**	**Offline** ✓
Objectives of the Event	To collect unused electronic wastes from college and ward1 of Avoly panchayath for the purpose of raising funds for student scholarship in our department.	
Outcomes of the Event	Collected Rs. 9000 for student scholarship.	
Names and Signature of Coordinator(s)	1. Ms. Neenu Jose – Association In charge 2. Liya Antony	

Resource person(s) : -

1. **Name & Signature** : -
2. **Designation** : -
3. **Name of Instituition** : -
4. **Email/Mob** : -
5. **Topic** : -

Summary of the Programme :

Department of Computer Science – BCA organized and E-waste collection on 23rd and 24th August. On 23rd the drive took place at Nirmala College by collecting E-waste from staff and students. On 24th students visited approximately 350 houses of Ward 1 in Avoly panchayath to collect the waste items. The e-waste collection was a resounding success . Department raised the fund for the purpose of students scholarship, while the environmental benefits contribute to a cleaner and more sustainable community. The enthusiasm and dedication of the students involved made this event a valuable learning experience and had a positive impact on society.

Signature

Name of HoD: Preethy George

To be attached with this form: -

1. List of Participants
2. Photograph of the programme :

(Email to iqacdocs@nirmalacollege.ac.in , pro@nirmalacollege.ac.in)

Name of the Event:E-REVIVE Organised by (Dep/Cell) : BCA

LIST OF PARTICIPANTS			
SL. No	**Name of student**	**M/F**	**Programme & Batch**
1	HIRAN JOY	M	BCA BATCH 2022-25
2	JOSE TOM	M	
3	JINS JOGY	M	
4	JYOTHISH JOBY	M	
5	ALBERT BENNY	M	
6	A B ALISH KHAN	M	
7	SHONE BINU	M	
8	ALBIN PIOUS	M	
9	AIEN PAUL DAMI	M	
10	PARTHIV M	M	
11	ALLEN BINOY	M	
12	BALATHARA B S	F	
13	JISNA THOMAS	F	

14	KRISHNENDU V M	F	
15	LAMIYA AJIMS	F	BCA BATCH 2022-25
16	MEENADEVI RAVIKUMAR	F	BCA BATCH 2023-26
17	NEHA SERIN ELDOSE	F	
18	ASWIN MANOJ	M	
19	BASIL GEORGE	M	
20	BESTO VARGHESE B	M	
21	JUDE GIGIMON	M	
22	MAHIN KABEER	M	
23	MURSHID IQBAAL.K.M	M	

CAMPUS CLEANING

The students who were passionately waiting to join NSS team of Nirmala College, Muvattupuzha were gathered in front of the NSS office on 9th November 2021. With the aim to maintain a clean college environment, the students were requested to clean the campus in groups.There were about 140 students who were eagerly waiting to be a part of the Nirmala College NSS unit. Since there were many students, the cleaning process was conducted in three days. According to their enthusiasm and dedication the students were sorted. This was the first step in the selection process.

POLLUTION CONTROL DAY SCRAP COLLECTION

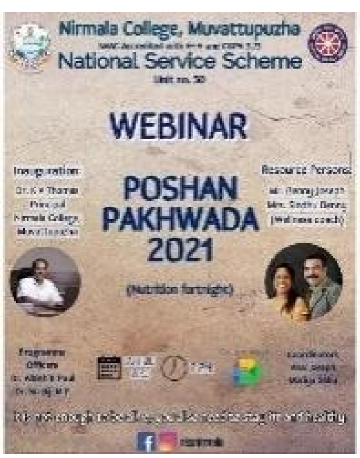
As responsible citizens of today's world, we must keep our environment clean and make our earth a better place to live in. Reusable and recyclable wastes should be reused and recycled to ensure the balance of our biodiversity. As a part of National Pollution Control Day on December 2nd 2021, remembering the three R's Reduce Reuse and Recycle, NSS volunteers of Nirmala College Muvattupuzha collected scraps including paper wastes, plastic wastes etc and sold them to the rag pickers for further use.v

GANDHI JAYANTHI

We celebrate Gandhi Jayanthi on the 2nd of October to honour the legendary leader, Mahatma Gandhi.The NSS Unit of Nirmala college Muvattupuzha has celebrated Gandhi Jayanthi on 2/10/2021. As a part of this special day, the NSS volunteers participated in a cleaning programme in their own houses and surroundings. The NSS program secretaries Delna Jose and Jerin K John put forward this to clean the surroundings.

BLOCK PANCHAYAT PREMISES BEAUTIFICATION

On February 19 the volunteers took on the mission of cleaning the block panchayat. It wasn't an easy task to clean the enormous premises of the block panchayat but the Volunteers did not back out from the task. The volunteers were split into several groups and were allotted to clean different sections of the premises. The sun was shining bright and heat was intense but it wasn't as strong as the burning will power inside the courageous NSS volunteers of Nirmala. The volunteers wore safety gloves and started their jobs. They collected all the waste and then they also separated the plastic and organic wastes. The panjayat authorities would recycle the plastic wastes. they set out to complete the work they had started. With a group effort the huge task was easily completed. After that the volunteers got to meet



Wow Waste

Recycling is very important as waste has a huge negative and hazardous impact on the natural environment. Recycling helps to reduce pollution caused by waste.'WOW WASTE ' is an initiative taken by NSS volunteers of Nirmala College to promote the ideaof maximum use of waste material by recycling and reusing.This would in turn help ourplanet. On October 20 , National Reuse Day , all NSS volunteers made useful and decorative products out of both plastic and e-waste and sent photos of their works via google forms.150 volunteers

participated in this program and a total of 146 responses came. Wow Waste was also able to bring forth the creativity in each volunteer as they were able to make useful materials from waste products and in turn manage waste materials efficiently.

SUCHITWA MISSION - CLEANING DRIVE
1 October 2022

On 1 October 2022 Nirmala Nss Volunteers gathered together for a Suchitwa Mission in the adjoining locality of Avoly Panchayat. The Panchayat provided necessary cleaning equipment for the volunteers with which both sides of the road and nearby localities were cleaned. The collected wastes

(plastic,cans,bottles) were handed over to the Panchayat. The Panchayat members and the local men appreciated the Nss volunteers for their wholehearted effort and expressed their opinion about the Suchitwa Mission- cleaning drive. Avoly Panchayat President Smt. Shelmi Johnson delivered a talk regarding the significance of a clean environment.

PLASTIC RECYCLING
31 October 2022

On behalf of 'Clean India Drive' in connection with the 'Clean India Campaign', Nirmala College NSS Unit organised a cleaning drive in the college campus. The drive mainly focused on recycling plastic bottles and other plastic materials. A group of fifteen volunteers collected all the used plastic bottles from the campus and dispatched them for recycling .

SCRAP COLLECTION WEEK
5-12 November 2022

On behalf of `zero waste campaign' the Nirmala College NSS unit conducted a scrap collection programme from November 5th – November 12th 2022. All the Nirmalites were requested to bring scrap from their respective houses and carried out door- to-door collection in the nearby localities. Along with this, the campus waste was also collected by the volunteers. The collected waste included paper waste, plastic, E-waste etc. These were segregated and sold, thereby creating a plastic free – green campus. It was not only a campaign but also a fund-raising programme for the overall functioning of the NSS unit.

Chapter VIII

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

OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT SYSTEM (2024-25)

Dr. Ms. Sreeja G R
Dr. Anjaly Joseph
(Assistant Professors)

Shreya Mary Ramoe
Hridhya Tessa Tom
Aswathy K Sajeev
Gopika Biju
Anaswara Shibu
Asna Yasmin
Pooja Samgi
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8

Occupational Health & Safety Management System Audit Report

8.1 INTRODUCTION

An Occupational Health and Safety (OHS) Audit was conducted at Nirmala College Muvattupuzha (Autonomous), with the objective of assessing the institution's compliance with standard safety protocols and identifying potential risks in the campus environment. The audit as per ISO 45001 protocol focused on evaluating infrastructure, emergency preparedness, chemical handling, waste management, and overall awareness of safety practices among staff and students. This report summarizes the key findings, observations, and recommendations aimed at enhancing the safety and well-being of all campus stakeholders.

ISO 45001 serves as the global benchmark for Occupational Health and Safety (OH&S) management systems. It prioritizes the prevention of risks, encourages innovation, and promotes ongoing improvement, thereby providing organizations with a framework to enhance their resilience and operational effectiveness. Attaining this international standard not only bolsters an organization's capacity to manage OH&S efficiently but also cultivates increased involvement among students, faculty, and staff by visibly affirming a commitment to sustainable practices aimed at fostering a safe and healthy environment. Furthermore, conducting health and safety audits aids institutions in evaluating the efficacy of their internal safety measures, offering a comprehensive insight into their internal controls. These audits facilitate the early identification of hazards, allowing for the timely implementation of corrective actions to reduce risks, which in turn diminishes the chances of injuries and unexpected incidents. This proactive strategy lessens potential disruptions, boosts motivation among stakeholders, and strengthens an institution's reputation while safeguarding it from negative publicity that could adversely affect its operations or partnerships.

ISO 45001 integrates organizations' occupational health and safety management systems with their strategic goals, enhancing performance in occupational health and safety while conveying a robust commitment to the welfare of employees to customers, shareholders, and stakeholders. Additionally, its alignment with the United Nations Sustainable Development Goals (SDGs) further enhances its significance. By implementing ISO 45001, organizations can showcase their leadership in sustainable development and their steadfast dedication to safeguarding and valuing their workforce.

8.1.1 What is Health and Safety Audit?

A health and safety audit entails evaluating an organisation's systems, procedures, and policies concerning students and staff's health and safety to ensure adherence to prevailing regulations. Audit aim to pinpoint potential health or safety risks, assess the efficiency of internal controls for hazard management, and verify regulatory compliance

8.1.2 Need of Occupational Health and Safety Audit

Identifying vulnerabilities and weaknesses in an institution's safety measures, reviewing compliance with regulatory legislation, and recommending improvements for safeguarding the health and safety of its workforce. Additionally, ensuring that machinery, equipment, and facilities meet safety requirements through thorough inspection.

8.2 OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT SYSTEM POLICY

8.2.1 Statement of Commitment

Nirmala College Muvattupuzha (Autonomous) is committed to creating a safe and supportive environment for all students, staff, and visitors. Recognizing the importance of health and safety in educational institutions, the college prioritizes the implementation of preventive measures to mitigate risks. This policy reflects our dedication to fostering a culture of safety and well-being, both physical and mental, through proactive initiatives and continuous improvement.

8.2.2 Goal

To establish a safe and health-conscious campus by ensuring compliance with relevant laws, identifying potential risks, promoting safety awareness, and providing the necessary training and resources for effective health and safety management.

8.2.3 Objectives

- Ensure adherence to health and safety regulations.
- Provide a secure and hazard-free campus environment for all.
- Identify and address risks through structured assessments.
- Foster a culture of safety and prevention.
- Offer regular training and resources to manage safety effectively.
- Enhance mental health awareness and provide supportive services.

8.2.4 Responsibilities

8.2.4.1 College Management

- Ensure health and safety policies through structured protocols and drills. Common announcements will be made by the principal through official channels, including what's App groups, and will be passed on to the concerned teachers and respective class groups.
- Under the supervision of the internal audit, adequate resources will be provided for safety training, including fire drills and first aid sessions. In addition, the Yoga Club will conduct regular meditation and yoga programs to promote mental well-being. Staff tours and student field trips will also be organized to support mental health and foster relaxation. The Women's Cell will host various programs, including awareness talks and interactive activities, aimed at enhancing overall well-being and promoting a healthy campus environment. Ensure accessibility for individuals with disabilities by maintaining ramps, handrails, and clear signage.
- Regularly review and update safety policies to align with current standards. Important safety-related updates will be communicated through designated groups. If issues are not addressed at this level, they will be escalated to the principal for necessary action.

- Ensure Noise Pollution Policy compliance by implementing monitoring systems, designating silent zones, setting restrictions, and raising public awareness to prevent excessive noise.

8.2.4.2 Staff and Faculty

- Adhere to safety procedures and promptly report hazards. Each department will maintain a health-related register, with a designated in-charge responsible for addressing concerns. If any issue is unresolved, it will be escalated to the principal or a dedicated committee.
- Contribute proactively to safety training initiatives to build a safer environment. The college in collaboration with the Women's Cell and NSS, will organize programs such as Emergency Preparedness and Response (EPR) training and disaster management sessions.
- Ensure you are equipped with appropriate protective gear to maintain safety in hazardous conditions. The college will provide for all essential health and safety requirements. If any safety need is unmet, it will be addressed by the designated in-charge or escalated to the college council for further action.
- Students are required to strictly adhere to the code of conduct and all safety protocols outlined in the college calendar and prospectus. This includes guidelines related to general safety, proper use of labs and equipment, and adherence to anti-ragging policies, ensuring a safe and secure campus environment
- Participate in drills and awareness programs and stay informed through communication channels such as what's App groups, class teachers, HODs, and other concerned authorities who play a key role in disseminating important safety information.
- Report unsafe conditions to the designated help desk coordinated by internal auditors or the concerned authority, ensuring compliance with lab safety measures, warning notices, and precautionary guidelines established by the institution to safeguard student well-being

8.2.4.3 Visitors and Parents

- Comply with safety policies during campus visits; a mandatory visitor register is maintained by the gatekeeper to ensure proper documentation and security
- Notify authorities of any safety concerns regarding themselves or others by contacting the emergency help desk. Updates and guidelines will be displayed at the entrance of the college campus to provide information for visitor awareness.

8.2.5 Risk Management

- Conduct continuous evaluations of risks associated with different environments such as laboratories, construction sites, kitchens, hostels, etc. Each department should maintain a safety register, which must be updated every six months by internal auditors. Regular safety inspections should be carried out. Additionally, students should receive safety training programs, including practical sessions on fire extinguisher usage, facilitated under the NSS.
- Indoor Environment Management: Ensure classrooms, staff offices, and kitchens have proper ventilation, lighting, humidity levels, space, and cleanliness. Regular maintenance programs must be conducted to uphold a safe and conducive environment.
- Building Safety: Doors and transparent windows should be clearly marked and constructed from suitable materials to prevent accidents. Regular maintenance should be conducted, especially during the rainy season, with updates provided to the principal through common announcements. The Occupational Health and Safety Management (OHSM) team will share information through what's App to the HOD, class tutor, and then to students, ensuring a structured communication channel.
- The auditing team will conduct a preliminary observation visit before initiating any new

renovation work. This visit will help ensure that only safer materials are purchased and procured for the project. In addition, the team will implement clear safety signage, proper demarcation of work zones, and precautionary measures to prevent accidents involving students, staff, and visitors in and around the renovation area. Furthermore, suitable alternative facilities will be arranged to minimize disruption to regular activities.

- Control Measures: Implement appropriate measures to reduce risks, such as ensuring that safety protocols for operating machines and handling chemicals are clearly displayed. A stock register is maintained in the laboratory to record details of lab equipment and chemicals, including the date of purchase and expiry date. Noise pollution control measures should be enforced by creating designated silent zones, setting noise limits for vehicles and events, implementing soundproofing measures, and organizing awareness programs. Providing personal protective equipment (PPE) for students and staff further helps to minimize potential risks.

- First-Aid Availability: Ensure a well-stocked first-aid kit is kept in an easily accessible location. It is also essential to have on-call doctor facilities, and these facilities should be communicated to each department to ensure proper coordination during emergencies.

- Fall Prevention: Special attention should be given to preventing falls in areas such as balconies and staircases. Clear signage will be displayed to encourage caution. Installing railings and other safety features in high-risk areas helps create a safer environment

- Communication of Emergency Procedures: Ensure that emergency evacuation and safety protocols are clearly communicated to all involved. For minor incidents, the OHS Coordinator will convey the message through the respective department. In case of major emergencies, the announcement will be made directly by the principal

Campus Traffic Management and Safety Guidelines: Ensure pedestrian pathways speed limit and humps for regulating and reducing vehicular accidents on campus.

8.2.6 Awareness and Education

1. Health & Safety Training

Provide ongoing training in safety protocols for staff and students.

2. Disaster Management Training

Include disaster management training with practical drills and risk communication strategies.

8.2.7 Emergency Procedures

Develop and maintain evacuation plans, including regular emergency drills. Identify and assign responsible personnel for Occupational Health and Safety (OHS) to oversee emergency procedures. These responsible personnel will report to the College Council, which holds the ultimate authority for implementing emergency procedures. All official announcements related to emergencies will be made by the principal.

8.2.8 Accident and Incident Reporting

- Establish a transparent system for reporting accidents and near-miss incidents, overseen by the OHS Coordinator.

- Conduct thorough investigations of all reported incidents to identify root causes. Based on the findings, submit a detailed report to the College Council. The Council will review the report, establish appropriate preventive measures, and implement necessary actions to avoid similar incidents on campus.

8.2.9 Health and Well-being

To ensure holistic well-being, various initiatives are undertaken, including yoga sessions, counselling, and stress management workshops. These programs are conducted through NSS and other service-oriented platforms, organizing awareness classes and training sessions. The Yoga Club arranges meditation and yoga programs for students and staff to promote mental peace and physical fitness. A confidential counselling service is available for students and staff, ensuring privacy and emotional support. Various mental well-being activities are also conducted, including stress relief programs and workshops. The Sports Committee promotes physical and mental well-being by organizing aerobics and fitness activities. In addition, field trips and cultural yatras are organized to provide students with experiential learning and exposure to diverse cultures. These trips contribute to mental well-being, social engagement, and cultural enrichment. To further support faculty and staff, staff tours are arranged, fostering relaxation, teamwork, and stress relief.

8.2.10 Monitoring and Review

- Routine audits and inspections will be conducted every six months to monitor health and safety practices. Updates and findings will be communicated through What's App, email, and official announcements, passing through designated representatives for necessary actions.
- Policies will be updated annually or as required, based on feedback, observations, and inspection reports, ensuring continuous improvement in safety standards.

8.2.11 Communication

Utilize available communication channels, including common announcements, What's App groups, emails, and display in official notice board, to share updates and encourage open dialogue about safety concerns.

8.2.12 Compliance

Ensure full compliance with local, state, and national health and safety laws, staying updated with any legislative changes. A designated safety committee or related authority will be available for addressing concerns, and individuals can directly approach them for assistance regarding health and safety matters.

8.2.13 Conclusion

Nirmala College Muvattupuzha (Autonomous) remains steadfast in its mission to provide a safe and healthy environment for all. By fostering a culture of safety and emphasizing continuous improvement, the institution aims to protect the physical and mental well-being of its community.

8.3 METHODOLOGY

The OHS Management Committee, which serves as the internal audit team, consists of nine members, two faculty and seven student representatives. A comprehensive register and documentation system has been established to facilitate periodic analysis and monitoring of safety practices for staff, students, and campus visitors. Two registers and four solid documents. This system operates in alignment with the institution's OHS policy, which details specific objectives, action plans, and safety management strategies. The committee meets regularly to evaluate progress and ensure the effectiveness of these safety efforts.

8.3.1 Internal Audit Training

Green audit training builds institutional ownership and engagement through comprehensive, participatory approaches. To prepare for this, the college's Environmental Management System (EMS) selects students and faculty for a one-day internal audit program. This certifies them as internal auditors qualified to conduct a Occupational Health and Safety audit, which involves assessment, risk analysis, data collection, policy development, and documenting water conservation programs and registers.

8.3.2 List of register and document to monitor OHS

An internal audit assessed the organization's Occupational Health and Safety (OHS) framework, encompassing policies, procedures, and compliance records. This assessment included a review of: (1) safety guidelines, (2) communication strategies, (3) emergency response plans, and (4) incident reports. Potential hazards were identified in various campus areas, notably: chemical storage practices in laboratories, physical hazards within workshops/laboratories and general activity areas of the campus; food safety, hygiene and sanitation concerns; management of vehicular traffic and pedestrian movement on and adjacent to campus, and ergonomic concerns within campus environments.

8.3.3 Respondent's comments and observation

The Internal Audit team conducted comprehensive inspections of campus facilities to assess safety practices, maintenance conditions, and compliance with safety standards. Concurrently, the team engaged staff, faculty, and students to gather feedback on their health and safety experiences and perceptions. The audit also included a detailed review of existing risk control measures, evaluating their effectiveness in mitigating identified hazards, and an assessment of documentation related to staff and student health and safety training protocols.

8.3.4 Campus Noise & Tree Mitigation Study

The assessment quantifies noise level variations on the college campus using a structured sampling methodology. Measurements were taken at ten selected locations, including high-noise zones near roadsides and areas adjacent to significant tree presence, using handheld digital sound level recorder. The data is recorded in Decibel (db). Sound levels will be measured in triplicate (minimum and maximum values) during the morning, noon, and evening. The primary objective is to identify high-noise areas on campus and analyse the data to evaluate the efficacy of urban trees as noise-mitigating barriers.

8.3.5 External Audit

An external auditor evaluates conformity with Occupational Health and Safety management requirements. If only minor non-conformities are found, the institution may be approved for ISO certification

8.3.6 Assumption

Integrating robust occupational health and safety (OHS) practices is a strategic imperative for the sustained success and reputation of educational institutions. The physical and psychological well-being of staff and students is intrinsically linked to institutional performance, both presently and prospectively. Adopting a formalized OHS management system, particularly one certified to the ISO 45001 standard, provides a framework for creating safe, motivating, and productive environments.

Such systems proactively mitigate risks, aiming to prevent injuries and illnesses among all personnel and students. This commitment translates into numerous advantages: a demonstrably safe learning environment, assured compliance with national/local laws and sector-specific regulations, reduced institutional liability and legal exposure, increased operational efficiency, and an enhanced public image as a responsible and sustainable institution.

Through diligent OHS audits, critical areas requiring attention—such as laboratory and classroom safety, ergonomic risks, chemical/biological hazards management, fire prevention, emergency readiness, and fall prevention—are systematically identified and addressed. This fosters a pervasive culture of safety, positively impacting employee morale, job satisfaction, and attendance. Measurable outcomes often include decreased staff and student compensation claims, strengthened community trust, improved talent retention, and optimized productivity.

Achieving these outcomes requires active participation from all stakeholders: Administration leads policy development and implementation; faculty and staff ensure adherence to protocols and hazard reporting; students comply with safety guidelines. Continuous improvement is driven by monitoring OHS performance, conducting regular risk assessments, identifying diverse hazards, implementing controls (including equipment and training), providing initial OHS orientation and ongoing education (with specialized modules where necessary), and maintaining comprehensive, well-rehearsed emergency response plans. In essence, prioritizing OHS is fundamental to safeguarding individuals, fulfilling regulatory duties, and building a thriving, reputable educational institution

8.3.7 Stages of Occupational Health and Safety Management Audit

Occupational health and safety management audit has three phases: Pre audit, audit and post audit.

<u>8.3.7.1. Pre audit phase</u>

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

occupational health and safety 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.
- 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 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 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 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.

8.3.7.4 Schedule of Occupational Health and Safety Audit

Week	Weekdays	Weekly Work Plan
First Week	16/12/25 to 19/12/25	• Record the List of external origin. • Documentation of maintenance Register in each department
Second Week	30/12/25 to 3/01/25	• Record the List of First aid product and their Expiry period • Documentation of First aid Register in each department
Third Week	6/01/25 to 10/01/25	• Record the List of Lab Equipment's • Documentation of Lab register in each Lab
Fourth Week	13/01/25 to 17/01/25	• Prepare calibration Register in Labs
Fifth Week	20/01/25 to 24/01/25	• Record the List and Expiry of Food Items in Canteen
Sixth Week	18/02/25 to 28/01/25	• Risk assessment -Identifying Potential risk, hazards • Documentation of Medical Register for Health hazards
Seventh Week	15/03/25 to 20/03/25	• Record the List of Emergency Rescue Measures taken by the College
Eighth Week	19/04/25 to 22/04/25	• Report Preparation and Presentation

Table 8.1 Schedule occupational health and safety audit

8.3.8 Steps of Occupational Health & Management Audit

8.3.8.1. Site assessment

Collection of contour map and campus diagram; For ensuring safety infrastructure and alternative method applied during renovation of campus.

Walk through survey; Identification of risks and their nature, category etc.: recording existing practices and provisions regarding 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 tern and short ter

8.3.8.4 Work Plan of Occupational Health and Safety Audit

Activities	Frequency	Dates of study	Mode of data collection
Sound recording data	9 days; three times a day	06/02/2025 (working day) 04/04/2025 (working day) 23/04/2025 (working day)	Entry in the given format

Table 8.2 Final report & certification as per ISO standards.

8.4 RESULT AND DISCUSSION

Maintaining campus safety is a non-negotiable legal duty for academic institutions, governed by Occupational Health and Safety (OHS) regulations. Failure to comply invites serious consequences like lawsuits and reputational damage. Conversely, adhering to OHS guidelines provides legal protection and builds vital trust. This commitment extends to safeguarding students, especially youth, from potential harm through well-kept facilities, and ensuring a secure workplace for all staff, which boosts morale and effectiveness. Ultimately, a strong safety culture is not only legally and ethically sound but also reassures parents, strengthens community ties, and enhances the institution's image and enrolment prospects.

8.4.1 OHS system of the college

To foster a safe and productive environment for its entire community, the college employs an Occupational Health and Safety (OHS) management system compliant with ISO 45001 standards. This comprehensive framework guides systematic efforts to monitor health hazards, ensure the operational safety and validity of resources like laboratory equipment, canteen provisions, and first-aid supplies, and manage visitor access for enhanced security.

Clearly defined emergency protocols are also in place. This approach not only safeguards well-being but also strengthens institutional credibility. In line with international guidelines (EU-OSHA, HSE, OSHA), the college further embeds OHS principles directly into the educational experience using a "whole-institute" model. This involves integrating risk awareness, health promotion, and respect initiatives into the curriculum and overall campus culture, promoting a holistic understanding of safety beyond treating it as an isolated topic. Collaboration with relevant authorities supports this integrated strategy.

8.4.2 Risk Assessment and Emergency Preparedness Response and Crises Management system in college

Sl.No.	Risk Area	Type of risk	Hazards	Existing OHS system
1	Chemistry, Zoology, Botany, Biochemistry laboratories	Chemical, physical, biological	Toxins Burning chemicals Pathogenic organisms	Proper instruction on the use of Personal Protective Equipment (PPE) is communicated . In the event of an injury, immediate first aid will be administered. If the individual's condition does not improve, they will be transported to a hospital for further medical evaluation.
2	Physics, compute and language laboratories	Electrical	Shock	No incidents of this nature have been recorded. Responsibility for overseeing the situation has been assigned to two team members.
3	Roads and campus safety	Vehicle accidents	Health issues including fatality	The incident will be formally documented in the accident register, and all required follow-up procedures will be carried out until resolution. Signages of speed limit and caution
4	Canteen, Hostel mess and other food serving areas	Sanitation, hygiene and food safety issues; drinking water quality	Food poisoning; health issues	Expired products are strictly prohibited. Furthermore, we are committed to upholding rigorous standards of cleanliness and hygiene throughout the canteen and cafeteria.
5	General issues Water quality related issues	Water borne or water related diseases	Infections; water borne diseases	Conduct periodic water quality assessment from certified lab and do necessary according to the needs
	Electrical distribution system related	Improper earthing Unbalanced and lack of harmonious	Shocks; damages to equipment	Warning signage must be posted in all designated high-risk areas. Additionally, all flammable materials must be removed from the generator room
	Ragging Sexual harassment Violence	Mental well being	Conflict between the college students	Counselling sessions Stress relieving programmes
	Health issues	Physical well being	Infections Diseases Accidents Mental stress	Yoga Physical fitness centre Sports

6	Women safety	Psychological well being	Safety Health Social support	Women rest room, counselling cell and extracurricular activities
7	Emergency response system	Safety protocol	Diseases Disaster Medical emergency	The Principal communicates major announcements, while the Office of Health and Safety (OHS) handles minor cases.
8	First Aid Facilties	Emergency medical support	Injuries Diseases Accident	First aid facilities are staffed by medically trained personnel.
9	Infrastructure facilities	Emergency physical Support	Body injury, accident, wall falling	Comprehensive safety system with fire extinguishers in 20 strategic locations. Four clearly marked emergency exits. Signages for facilities available. Caution displayed in construction areas
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.	Medical record register specifically for the health hazards like accident, chronic health issues occurred inside the campus Record the details of lab equipment and chemical used like date of purchased, expiry date) Calibration register (should be keep for each lab) Register of emergency rescue measures Register to record the list of first aid products and their expiry period Record the list and expiry of food items in canteen, college and cafeteria Record of external origin

Table 8 .3 The risk areas and hazards of Nirmala College

This section provides detailed assessments of various hazards identified during the audit.

8.4.2.1 Health

- The institution has enough and separate toilet facilities for women and men. Facilities for the disposal of pad disposing are arranged in girls' toilets. Napkin wending facilities also arranged the girl's toilet and the toilet was periodically to maintain the sanitation and hygiene and spread of odor by assigned housekeeping staffs in each block. The information about the facilities is communicated by the non-teaching faculties and housekeeping staffs and in some area, signage is placed as indicator students become more familiar with the facilities when they take part in campus tour it was the initial activities given for new comers to get an understanding of the college.

Fig 8.1 College Cafeteria

- Menstrual hygiene practices awareness class were conducted in college in collaboration with NSS once in an year for shifting the safener use practice
- The college has two FSSAI-certified dining facilities: a cafeteria and a canteen. While the Occupational Health and Safety (OHS) department maintains registers for food items and their expiry dates, an assessment revealed several areas for improvement. Key hygiene protocols, such as the use of gloves and masks, are not being followed by canteen staff. However, hairnets and aprons are appropriately used in the main canteen. A significant compliance gap exists, as staff in the DJ Block canteen and the Kiosk do not have health cards. Furthermore, an OHS risk assessment identified dust accumulation as an issue. It is recommended to install shutters to mitigate this problem and to replace the current water cooler with an improved model.
- Annual water quality analysis is conducted to assess physical, chemical, and bacteriological parameters. The most recent assessment detected trace levels of E. coli bacteria. In accordance with established management strategies, corrective procedures including enhanced chlorination and remediation of biofilm within the water distribution system are being implemented to mitigate this finding and ensure the water remains safe for consumption.
- A robust first aid system is in place, supported by readily accessible and well-equipped kits in high-traffic areas, laboratories, and offices. Ms Aswathy Prabhakaran, a trained nurse in the Administrative Office, is responsible for providing immediate assistance during medical emergencies. To ensure supply effectiveness, we perform meticulous inventory management, including regular checks and tracking of expiration dates in a dedicated log. While our on-site service addresses minor injuries, fever, and headaches, individuals with severe conditions are immediately transported to Nirmala Medical Centre, accompanied by a faculty member from respective department

Fig 8.2 First aid room facilities

Fig 8. 3 First aid box

- Procedures are established for rapid access to external Emergency Medical Services (EMS) and collaboration with local hospitals, notably Nirmala Hospital, for transportation and treatment of individuals requiring hospital-level care. More over OHS maintain the medical record register specifically for the health hazards like accident, chronic health issues occurred inside the campus to update the follow up procedure. Essential emergency contact information is clearly posted throughout the campus and on official notice boards. This should be given in website and campus diary too.
- Internal audit coordinator of Occupational Health and Safety (OHS) team leads the crisis communication protocol in an emergency, timely alerts and information are disseminated to the campus community through various means, including public address systems, institutional emails, and text messaging services.
- In the event of an emergency, the principal will issue a direct announcement to all classrooms and administrative departments. Furthermore, emergency drills and mock exercises are conducted periodically as needed. These drills are initiated and led by the Physical Education department in close coordination with the National Service Scheme (NSS) and the National Cadet Corps (NCC), under the guidance of their respective coordinators.

Fig 8. 4 Laboratory facilities of the college

8.4.2.2 Environmental Health

- The college campus spans 52 acres, with its buildings thoughtfully divided into seven blocks to minimize congestion, preserve open space, and integrate the natural topography and greenery. This design facilitates easy access to facilities and resources for the college community, fostering connectivity and encouraging social interaction.

Fig 8. 5 Workout facilities of the college

- The physical environment is a significant factor influencing comfort. A well-designed campus integrates architectural features with human comfort considerations such as adequate spacing, colour, and building arrangement to enhance aesthetic beauty. Nirmala College, one of Kerala's older educational institutions, retains historic infrastructure while concurrently undergoing modifications. These changes, including the development of versatile gathering spaces and improved ambiance, aim to benefit the college community. For example, the main block features large windows, doors, and spacious white verandas that promote natural ventilation, lighting, and social interaction. In contrast, the newer MCA block includes an inner courtyard, providing a relaxing space for study and socializing, enhancing natural light, and improving air circulation to mitigate heat. Drainage system for the flow of water to avoid water logging inside the campus.
- The institution sustains its landscape topography and associated ecosystem services (e.g., trees, lawns, water bodies), recognizing their importance for the physical and mental well-being of the campus community. Green spaces specifically offer benefits such as air temperature moderation, noise reduction, aesthetic enhancement, and habitat provision for diverse flora and fauna. The campus biodiversity management team ensures the stewardship of the institution's ecological health. ecological diversity is integrated within the modern campus design, creating functional spaces optimized for teaching, learning, and collaboration. College has the facilities clearly specified by UGC and it's classified into academic facilities, safety and security, students living accommodations, health and wellness, entertainment and recreational, personal and professional development space.

- The institution offers comprehensive academic facilities, including well-equipped classrooms, a library, laboratories, and an IT lab, furnished with appropriate technology and adequate space for instruction and collaboration. Operational oversight includes a dedicated Energy Management Team responsible for infrastructure efficiency and technology risk assessment. Laboratory safety is paramount, overseen by the Occupational Health and Safety (OHS) team through clear signage, PPE protocols, and rigorous maintenance schedules. Detailed records, including purchase/expiry dates and calibration logs, are kept for all laboratory equipment and chemicals.

Fig 8. 6 Napkin vending machine


Fig 8. 7 Computer lab

- The college employs a comprehensive Waste Management System to ensure responsible disposal and maintain campus hygiene. This system is supported by dedicated housekeeping staff who ensure meticulous cleanliness, alongside rigorous protocols for waste segregation. Chemical waste, including glassware and bottles, is collected in designated containers and transferred to our certified partner, Kerala Enviro Infrastructure Ltd. Specific procedures are also followed for biomedical waste to prevent pollution and health hazards. To minimize waste at its source, laboratory instructors guide students on the optimal use of chemicals. Adherence to this framework ensures regulatory compliance, promotes environmental stewardship, facilitates recycling, and conserves resources.

- Dedicated housekeeping team, consisting of ten staff members, implements rigorous cleaning routines to maintain a hygienic environment and prevent the spread of infectious diseases. This commitment to cleanliness mitigates health risks associated with pathogens and minimizes physical hazards, such as slips and falls. To ensure accountability and consistent quality, a register is maintained in the Bursar's Office to log cleaning frequency and monitor staff performance. While a formal, standalone protocol is not in place, all job responsibilities and cleaning standards are clearly delineated in each employee's contract. Furthermore, prioritize sustainability by procuring the majority of the eco-friendly cleaning supplies from a local, ethical vendor.

Fig 8. 8 Wheel chair and walking rail

8.4.3 Training and Awareness Programs

8.4.3.1 Mental Health

- The College places a high priority on the safety, health, and well-being of its students, staff, and visitors. Comprehensive training programs are regularly conducted, including yoga and physical exercise sessions facilitated by experts under the guidance of NSS and NCC units. Collaborations with external agencies, such as the Kerala State Fire Force, ensure periodic and professional fire extinguisher training. Furthermore, specific safety protocols for laboratories, encompassing the safe handling of chemicals and glassware, emergency procedures, and facility guidelines, are communicated officially to Department Heads, who are responsible for subsequent dissemination within their departments via established channels.

- To foster a supportive campus environment, the College has launched a Counselling Cell to assist students, staff, and faculty in managing stress, burnout, and other mental health concerns. This service is staffed by a consulting psychiatrist and a clinical psychologist, Ms. Aida, who provide expert consultation and psychological support. To strengthen the confidentiality protocols, we have implemented a new secure appointment system. Individuals can now schedule private consultations through a dedicated Google Form, ensuring the utmost discretion. Information regarding these services is disseminated to students by their instructors, and all client documentation is maintained with strict confidentiality by our counselling professionals.
- To enhance student well-being, the College organizes targeted health programs. Recent

examples include workshops promoting the use of menstrual cups and campaigns addressing substance abuse awareness. Physical safety across the campus is reinforced through strategically placed signage indicating emergency contact points, directing traffic flow with speed limits and speed bumps in permitted areas, and warning against potential hazards, such as prohibiting sitting on open balcony ledges.

- Beyond internal safety measures, the College promotes community welfare and social responsibility through various service-oriented initiatives. Regular events such as blood donation drives, medical camps, and hair donation programs are organized on campus. These activities provide tangible benefits to the community while fostering civic engagement and a sense of social responsibility among the student body.

- College operates various club for provide opportunities of recreational activities notable among them was art club, nature club where selected students were grant opportunities to paint attractively the college wall, and also promoted craft making with the use of waste materials. Like beach seater with plastic bottles.
- The college is committed to fostering the physical and mental health of its female students through dedicated, state-of-the-art gym facilities. These secure and supportive environments are instrumental in promoting physical fitness, managing stress, and improving overall well-being, creating a strong foundation for academic success.
- The institution offers extensive sports facilities to encourage a balanced and active student life. With resources for basketball, football, cricket, and volleyball, students can enhance their physical health, develop critical social skills, and learn the principles of teamwork and leadership. These programs boost student engagement and contribute to a positive and dynamic campus environment.

8.4.3.2 Infrastructure Assessment

- Total 35 Fire extinguishers, with capacities of 2.5 kg are strategically positioned in key locations and high-risk areas across the campus. These units undergo regular inspection and maintenance, managed by a specialized external company Cochin fire guard ensuring they are operational, within their expiry dates, and readily accessible. The institution utilizes an automated system, coordinated with the service provider, which tracks extinguisher expiry dates and prompts timely refilling or replacement. Furthermore, all emergency exits must be clearly marked, kept unobstructed, and designed to be easily accessible to facilitate a swift evacuation. In key areas such as the Seminar Hall, DJ Corridor, and the first floor of the Main Block, prominent directional signage guides individuals to the nearest exits. The institution also maintains comprehensive records, including a register of emergency response actions and a log of on-campus health incidents like accidents or medical emergencies.

Sl No	Count	Capacity	Location
1	1	2.5	MSC Lab
2	1	2.5	MSC Chemistry Physical Lab
3	2	2.5	BSc Chemistry Practical Lab
4	1	2.5	Main Block Ground floor
5	1	2.5	Physics Staff Room
6	1	2.5	Physics Lab
7	2	2.5	Main Block Second Floor
8	1	2.5	SJ Ground Floor
9	7	2.5	Main Auditorium
10	1	2.5	Library Block
11	2	2.5	Library
12	1	2.5	DJ Block Ground Floor
13	1	2.5	DJ Block First Floor
14	1	2.5	DJ Block Second Floor
15	1	2.5	MCA Hall
16	3	2.5	Audio Visual Hall
17	2	2.5	Conference Hall
18	2	2.5	S V Hall
19	2	2.5	D J Hall
20	2	2.5	Library Hall
	35	50	

Table 1.1 Fire extinguisher in college campus

- Experienced Resident Advisors (RAs), primarily drawn from campus caretakers and office assistants, play a vital role in supporting students' transition to campus life. They are responsible for ensuring resident safety and security on their assigned floors and maintain designated 'on-call' shifts to effectively handle emergencies.
- To ensure the safety of students, staff, and visitors, the college maintains two secured entrance points. Visible security personnel are stationed at both gates to regulate and monitor access, requiring visitors to sign a register detailing the purpose of their visit. The main entrance, which provides direct access to the administrative building, is equipped with a remote-controlled vehicle boom barrier and is the primary access point for the wider community. The second gate is predominantly used by students and faculty. This security protocol is mandated by a clear campus policy that outlines the responsibilities of all individuals.
- The institution provides extensive residential facilities, including four hostels (three for female students with a capacity of 618, and one for male students with a capacity of 110), which are supported by 44 staff members. These facilities are maintained to high standards of cleanliness and repair, offering comfortable living quarters, modern washrooms, dining services, and recreational spaces scaled to meet student enrolment needs.

Total Strength of Hostel

Sl No	Hostel	Inmates' category			
		Students	Staff	Total no	Hostel strength capacity
1	Jeeva Jyothi Men's Hostel	110	13	123	150
2	Little Flower Ladies Hostel	231	9	240	250
3	St. Joseph Ladies Hostel	127	9	136	200
4	Nirmala Ladies Hostel	228	12	240	250
5	Sports Hostel	32	1	33	150
	Total	728	44	772	

Table 8.4 Strength of College Hostel

- Current campus signage for hazards such as falling debris, slippery surfaces, the 30 km/h speed limit, and pedestrian walkways Sis non-standard and text based. It is strongly recommended that all signs be replaced with legally compliant, official traffic signage to ensure safety and regulatory adherence. Basic first aid stations are maintained in each department. Designated personnel in office who was qualified in nursing manage these supplies, provide initial assistance, and monitor product expiry dates using a detailed inventory register.
- The institution offers a variety of recreational and co-curricular opportunities. Facilities include dedicated spaces for sports and fitness, such as a gymnasium. Student common areas, including 'Horegellow'(Outdoor seating arrangements) and the Auditorium, serve as venues for diverse events and programs. These activities, often featuring guest speakers or performers, cultural festivals, and competitions, are designed to integrate entertainment with academic enrichment. Furthermore, the institution facilitates experiential learning and community engagement through organized visits to aged care and disability support facilities, fostering social responsibility and respect. Academic and professional development are enhanced via industrial site visits and college tour both for students and faculties. Opportunities for relaxation, stress reduction, and entertainment are also provided to support student well-being.

Fig 8. 9 Ramp facilities

8.4.3.3 Empowering Inclusivity System in College Facilities

The college is committed to an inclusive environment and provides accessible facilities for individuals with disabilities. These include wheelchair-accessible ramps and accessible washrooms, electrical exam table designed to ensure their safety, reserved parking space, security, and equitable participation on campus

Fig 8. 10 Electric examination table

Sl No	Facilities offer	Location
1	Rails and Ramps	SJ Block, Ground Floor, Second Floor, Main Auditorium, Library Block, Main Block
2	Electric Examination Table	Library
3	Wheelchair	Main Block and Near Exam Hall
4	Fire Exit	Seminar Hall, DJ Corridor, Main Block First Floor

Table 8.5 Inclusive facilities offered by college

8.4.3.4 Vehicle Details of the Institution

Sl No	Number of two-wheelers	Number of four-wheelers	Number of electric vehicles	Number of bicycles
	245	91	2	10

Table 8.6 Vehicle details of the college

The college provides designated parking areas for staff and students 12 cent for staff, 18 cent for students, boys, 3 cent for students, girls. Comprehensive signage is displayed to clearly delineate areas reserved for each user category (staff/student) and specific vehicle types. The college campus currently supports a total of 388 vehicles belonging to the community, which includes 245 two-wheeled vehicles, 91 four-wheeled vehicles, 2 electric vehicles, and 10 bicycles.

Fig 8. 11 Parking facilities for staff

8.4.3.5 Noise Recording of the College

Sl No	Location	Sound (in dB)		Average
		Max	Min	Mean (In dB)± S.D.
1	Silver jubilee block	253.74	152.5	202.12 ± 71.59
2	Statue of Mary	258.8	149.07	23.94 ± 77.59
3	Main Gate	282.67	179.33	231 ± 73.07
4	Pharmacy	252.2	144.54	198.37 ± 76.13
5	Girls hostel	258.47	149.2	203.84 ± 77.27
6	Sports boys hostel	249.31	159.6	204.46 ± 63.43
7	Library	243.13	147.07	195.1 ± 67.92
8	Main canteen	250.2	151.6	2009 ± 69.72
9	Boys hostel	271.36	154.1	212.73 ± 82.92
10	College entrance (second)	266.3	147.97	207.14 ± 83.67

Table 8.7 Noise recoding of ten location of the college

8.4.3.6 Detailed Findings:

Fig 8. 12 Noise recording data collection

- **Highest Sound Levels:**
  The highest mean sound level was recorded at the Boys Hostel (212.73 ± 82.92 dB), followed by the Main Gate (202.12 ± 71.59 dB). The Main Gate also registered the highest peak sound levels, likely attributable to its proximity to the main road and consistent vehicular traffic. The sound levels are not expected to impact the college building, as it is located 500 meters away from the roadside.
- **Lowest Sound Levels:**
  Conversely, the lowest mean sound levels were observed in the Library (195.1 ± 67.92 dB) and the Pharmacy (198.37 ± 76.13 dB). These lower levels are anticipated, as these areas are intentionally designed for quietude. Effective enforcement of restricted vehicle entry may also contribute to these lower levels.
- **Sound Level Variability:**
  The College's second entrance (standard deviation ±83.67 dB) and the Boys Hostel (standard deviation ±82.92 dB) exhibited the largest fluctuations in sound levels. This variability is likely due to

intermittent loud events such as passing groups or vehicles. In contrast, the Sports Boys Hostel (standard deviation ±63.43 dB) and the Library (standard deviation ±67.92 dB) demonstrated more consistent sound levels, although their range of variation remains considerable.

8.4.3.7 Contributing Factors:

- Vehicular Traffic: The primary contributor to elevated sound levels across campus, particularly near campus roads and entrances. The second entrance gate, providing access to the chapel and special school, experiences occasional vehicular flow which can elevate noise.
- Construction Activities: Ongoing construction and maintenance, notably the new building construction near the DJ block, are likely contributing to the high ambient sound levels.
- Vegetation: The presence of trees, particularly along the route to the Boys Hostel and near parking areas/pathways to other blocks, appears to have a positive influence in reducing noise levels, even in proximity to vehicular activity.

8.4.3.8 Summary

This report details an assessment of sound levels across various campus locations. Findings indicate that the Boys Hostel and Main Gate exhibit the highest mean sound levels, while the Library and Pharmacy are the quietest. Significant fluctuations were noted at the College's second entrance and Boys Hostel. All recorded levels substantially exceed WHO and Indian national guidelines, primarily due to vehicular traffic and construction activities. The presence of trees appears to offer some noise reduction. Recommendations include establishing silent zones, managing vehicle access, promoting carpooling, and installing appropriate signage.

8.4.3.9 Comparison with Recommended Standards:

The recorded sound levels are significantly by orders of magnitude higher than established health and environmental guidelines.

- The World Health Organization (WHO) recommends a maximum of 35 dB in unoccupied classrooms to ensure speech intelligibility and a limit of 55 dB for college campuses during daytime. Libraries typically aim for levels similar to or quieter than classrooms.
- Indian national standards recommend a 50 dB(A) limit for educational institutions during daytime.

  The observed sound levels drastically exceed these specified standards.

8.4.3.10 Recommendations for Noise Mitigation:

To address the excessive noise levels, the institution should consider implementing the following strategies:

- **Designate "Silent Zones":** Clearly demarcate areas (e.g., around the library, study halls) where noise is strictly controlled.
- **Manage Vehicle Access:** Implement stricter controls on vehicle entry and movement within the campus, particularly in sensitive areas.
- **Promote Vehicle Sharing:** Encourage carpooling and the use of shared transport to reduce the overall number of vehicles.
- **Install Signage:** Place clear signage in high-noise prone areas (e.g., near the second entrance) and to indicate «Silent Zones.» Consider symbols to alert individuals to potentially high sound level areas.
- **Enhance Green Buffers:** Continue and expand the strategic planting of trees and vegetation to act as natural noise barriers.

8.5 OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT SYSTEM PLAN

8.5.1 Establish an Occupational Health and Safety (OHS) Management Committee

Foster a safe and secure environment for students, staff, and visitors on campus. Develop and implement a comprehensive system a

ligned with institutional policies to address needs and enhance overall performance excellence. Clearly communicate the responsibilities of college authorities and campus users to uphold the code of conduct, ensuring adherence to legal and statutory OHS requirements

8.5.2 Formulate Risk Management Plan

Continuously evaluate risks across various environments such as labs (Chemistry, Zoology, Physics, and Botany), construction zones, kitchens, hostels, and classrooms. This includes regular checks on electrical connections, plugs, and switches. Maintenance logs should be consistently updated, ensuring all safety features are intact and risks are minimized.

8.5.3 Establish Robust Communication Channel and Administrative Over

Establish clear and visible emergency evacuation routes and safety protocols for all campus members. Regular drills, along with adequate signage, will ensure everyone is prepared in case of an emergency. The availability of emergency exits should be clearly marked, especially in laboratories and classrooms.

8.5.4 Set both Long Term Goal and Short-Term Goal

8.5.4.1 Short term goals

- Indoor Environment Management: In classrooms, staff offices, and kitchens, ensure proper ventilation, lighting, humidity control, space management, and cleanliness. These factors contribute to a safe and conducive environment for both students and staff. Clean, well-maintained spaces reduce the chances of accidents or health hazards.

- Building Safety: All doors and transparent windows should be clearly marked and made of suitable materials to prevent accidents. Floors and surfaces should be free from hazards. Special attention should be given to high-risk areas like balconies and staircases by installing railings and safety features to prevent falls.

- Control Measures: Implement protocols to reduce risks in laboratory settings, such as displaying clear safety guidelines for operating machinery or handling chemicals. For instance: In Chemistry, Zoology, and Botany, chemicals like HCL, H2SO4, and alcohol are flammable, so fire extinguishers and fire safety measures, including spirit lamps, should be strictly monitored. Personal protective equipment such as gloves and lab coats must always be worn. Ensure awareness programs are conducted about fire safety and proper handling of chemicals. In Physics, safety protocols should address electrical connections, ensuring all are safe and that the area is equipped with a fire extinguisher.

- First-Aid Availability: Maintain accessible, well-stocked first-aid kits throughout the campus, especially in laboratories and high-risk areas. Ensure that emergency response protocols are in place, with clear guidelines for handling accidents, especially those related to chemical exposure or electrical hazards.

8.5.4.2 Long term goals

- Fall Prevention: Focus on fall prevention in high-risk areas such as balconies, staircases, and high platforms. Install railings, safety barriers, and non-slip surfaces to minimize fall-related injuries. Special care should be taken in labs where hazardous substances or flammable materials are present.

- Campus Traffic Management and Safety Guidelines: Regulate campus traffic by ensuring clear pedestrian pathways, speed bumps, and humps to reduce vehicular accidents. Provide clear guidelines on vehicle speed limits within campus grounds, and implement silent zones where necessary. Establish guidelines for safe parking and manoeuvring to ensure student and staff safety.

- Fall Prevention: Focus on fall prevention in high-risk areas such as balconies, staircases, and high platforms. Install railings, safety barriers, and non-slip surfaces to minimize fall-related injuries. Special care should be taken in labs where hazardous substances or flammable materials are present.

- Inclusive infrastructure facilities: presently college has ramp for walking and friendly toilets. Additionally required to implement lift to replace the benefits of staircase, wheelchair and well-equipped infirmary room

8.5.5 Implement Continuous Monitoring and Improvement System

Ensure continuous monitoring by the occupational health and management team through periodic risk assessments, introducing strategies to resolve identified risks, incorporating advanced data analytics for trend analysis, ensuring real-time feedback mechanisms, conducting regular training sessions for employees on risk mitigation, and fostering a culture of proactive safety and health management within the organization.

8.5.6 Ensure Proper Termination Procedure and Follow Up

Systematically address all safety and compliance aspects related to the discontinuation of activities, services which includes conducting a thorough risk assessment to identify potential hazards during the termination phase, ensuring proper disposal of hazardous materials, deactivating equipment safely, and updating all records to reflect the changes. Employees, staff, and stakeholders must be notified and provided with clear instructions to ensure a smooth transition. Adequate follow-up to evaluate the process, ensure compliance with legal and institutional policies and address any lingering risks or concerns. Moreover, documenting lessons learned during termination can help improve future OHSMS processes and uphold safety standards across the institution

By systematically addressing these areas, the campus will ensure a safer environment for both students and staff, reducing potential risks and fostering an atmosphere conducive to learning and research.

8.6 CONCLUSION

- The institution demonstrates a strong and commendable commitment to the health, safety, and well-being of its campus community, underscored by well-established systems for emergency response and sanitation. Strengths are particularly reflected in the robust first aid and emergency protocols, which include a trained on-site nurse, meticulous inventory management, and clear procedures for collaborating with external medical services like Nirmala Hospital. The crisis communication plan and periodic emergency drills further fortify the institution's preparedness. Additionally, the college has created an inclusive and hygienic environment through excellent gender-separate toilet facilities, complete with menstrual hygiene provisions and awareness programs the assessment also highlights critical areas that require immediate and focused attention to mitigate health risks and ensure full compliance. The most significant concerns are in food and water safety. The failure of some canteen staff to adhere to basic hygiene protocols (gloves, masks) and the absence of mandatory health cards for all food handlers present a direct health risk. Similarly, the detection of E. coli in the water supply, although being addressed, is a serious finding that necessitates vigilant monitoring and sustained corrective action.
- The findings portray Nirmala College as an institution that has meticulously cultivated a physical and operational environment conducive to learning, well-being, and sustainability. The college's campus design is a standout feature, strategically balancing its 52-acre expanse with thoughtfully placed buildings and abundant green spaces to foster community and connect with nature. This is complemented by robust, systematic management across all critical areas. Proactive teams oversee academic facility efficiency and laboratory safety to a comprehensive, environmentally responsible waste management system and rigorous campus hygiene protocols. The deliberate integration of historic and modern architecture, the stewardship of its natural landscape, and the adherence to clear safety and cleanliness standards collectively demonstrate a holistic philosophy. Nirmala College does not merely provide facilities; it actively curates a safe, supportive, and inspiring ecosystem where academic excellence, environmental consciousness, and community health are intrinsically linked and mutually reinforcing.
- College prioritizes the health, safety, and holistic

development of its entire community. The institution's commitment is evident in its multi-layered approach, which begins with a strong foundation of physical safety enforced through professional training, clear protocols, and campus-wide infrastructure improvements. Beyond physical security, the College demonstrates a deep understanding of modern wellness needs by providing professional and confidential mental health services through its Counselling Cell. The commitment is further enriched by programs promoting physical fitness and recreational engagement via dedicated sports facilities, gyms, and student clubs. The College extends its mission beyond its own campus, fostering a culture of social responsibility through impactful community service initiatives. Collectively, these efforts create a nurturing platform where students are not only feel safe but are also actively encouraged to grow into well-rounded, healthy, and civically minded individuals prepared for future success. The institution demonstrates a comprehensive approach to campus safety, security, and student well-being, which includes stringent fire safety measures, controlled campus access with organized parking, and well-maintained residential facilities. Basic first aid is accessible, and while specific hazard signage exists. Furthermore, the institution actively promotes holistic student development through diverse recreational, co-curricular, and community engagement programs, underpinned by a commitment to inclusivity and accessible facilities.

- The College demonstrates a profound and multi-faceted commitment to fostering a holistic, safe, and supportive environment that extends far beyond academic instruction. The findings illustrate a deliberate strategy that integrates physical safety, mental health, personal development, and social responsibility into the core of the student experience. A structured framework for well-being is foundational to the institution's ethos. This is evident by proactive measures ranging from professional safety training and rigorous lab protocols to the establishment of a confidential and professionally staffed Counselling Cell. The emphasis is not only on preventing harm but also on actively promoting health through targeted workshops, physical exercise, and state-of-the-art sports and gym facilities, with a notable commitment to providing dedicated resources for female students. The College successfully cultivates a culture of engagement and purpose. By offering diverse recreational opportunities through clubs and promoting civic responsibility via community service initiatives, it nurtures students' creative talents and sense of social consciousness. Collectively, these initiatives paint a picture of an institution that prioritizes the complete well-being of its community. The College is not merely a place of learning, but a nurturing ecosystem designed to develop resilient, healthy, and socially responsible individuals prepared for success both within and beyond its walls.
- The institution has successfully established a robust and multi-faceted framework for ensuring the safety, security, and holistic well-being of the students, staff, and visitors. Strengths are particularly evident in its proactive fire safety management, which includes a well-maintained network of extinguishers managed by a specialized external company and supported by an automated tracking system. This is complemented by clearly marked emergency exits, a structured residential support system with experienced Resident Advisors, and controlled campus access through manned security points. Furthermore, the college provides extensive residential facilities and a rich array of co-curricular and experiential learning opportunities that foster both personal and professional development. Critical area requiring immediate attention is the non-standard, text-based campus signage for hazards and traffic control. This represents a significant gap in safety protocol and regulatory compliance. The institution demonstrates a strong commitment to its community through excellent operational protocols in security, emergency response, and student life, the immediate priority must be to replace all current hazard and traffic signs with legally compliant, official signage. Addressing this crucial recommendation will mitigate potential risks, ensure regulatory adherence, and fully align

the campus's physical safety infrastructure with its otherwise high standards.

- The Boys Hostel exhibited a higher range of measured sound levels (212.73 ± 82.92 dB), followed by the Main Gate (202.12 ± 71.59 dB). The Main Gate also registered the highest peak sound levels, likely attributable to its proximity to the main road and consistent vehicular traffic. Nevertheless, these sound levels are not anticipated to impact the college building, as it is situated 500 meters from the roadside. The sound levels at the Boys Hostel are a point of concern due to its adjacency to other campus blocks. The observed wide fluctuations in sound levels at the hostel may be influenced by its characteristics as an open area with sparse tree cover, potentially compounded by ongoing construction activities

8.7 RECOMMENDATION

Enhance Food Safety Compliance: Immediately enforce the mandatory use of gloves, masks, and health cards for all staff in every dining facility, including the Kiosk. Proceed with the recommended infrastructure upgrades, such as installing shutters to control dust and replacing the water cooler.

Ensure Water Purity: Rigorously follow through with the corrective chlorination and remediation procedures. It is crucial to conduct follow-up water quality analysis to confirm the complete eradication of E. coli and ensure the long-term safety of the water supply.

Strengthen Communication Channels: As recommended, publish all emergency contact information prominently on the institutional website and in the student diary to ensure universal and easy access for all community members.

Standardization: Transitioning all campus traffic management signage to universally recognized symbols. This includes clear visual indicators for speed limits, restricted parking, vehicle entry/exit points, and advisories for sound-sensitive areas or required noise levels.

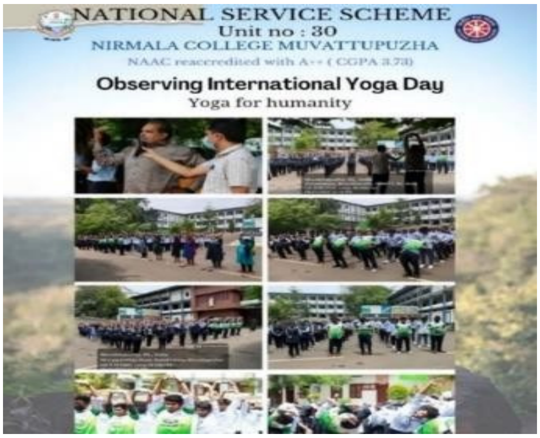
Targeted Improvements: Ensuring these standardized signs are effectively deployed, with particular attention to areas currently lacking optimal signage or where existing signs need upgrading, such as in locations with high ambient noise where visual cues are paramount.

Occupational Health and Safety System: audit highlighted the need for a more comprehensive OHS management system. In response, the institution has developed and implemented a foundational framework. This framework systematically addresses emergency preparedness, response, and crisis management, encompassing physical, chemical, biological, and psychological hazards. The institution is committed to the ongoing evolution of this system, adapting proactively to new requirements to ensure the continued safety and inclusivity of the entire campus community.

8.8 ACTIVITIES CONDUCTED

S
21 June 2022

As a part of celebrating International Yoga Day, volunteers of Nirmala College NSS unit, in association with the Yoga club and Botany department of Nirmala College, performed Yoga under the instructions of Yogacharya Sri. Paul Madathikandam. The instructor taught the volunteers different Yoga postures and also, it's positive effects on the human body and mind.



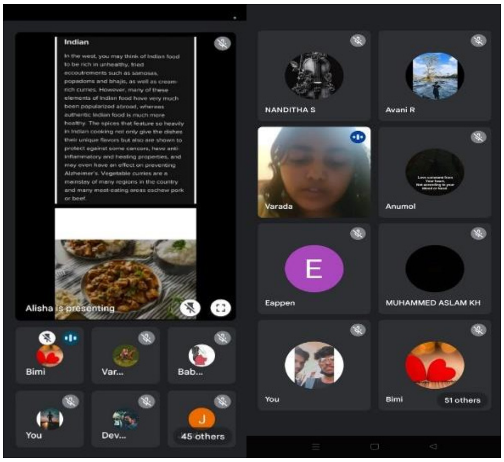
BLOOD DONATION CAMP REPORT
12 August 2022

As part of International Youth Day, NSS unit no. 30 of Nirmala College in association with Nehru Yuva Kendra, Ernakulam, and Blood Bank, District Hospital, Aluva conducted a blood donation camp at Nirmala College. The programme was inaugurated by Adv. Dr. Mathew Kuzhalnadan, MLA, Muvattupuzha Constituency and was presided by Dr. Thomas K.V., Principal, Nirmala College. Students from various departments of the college, including many NSS volunteers, donated their blood during the camp. 65 units of blood were collected.

NUTRITION AWARENESS CLASS
10 September 2022

As part of celebrating the "National Nutrition Week", NSS volunteers organised a nutrition awareness class on 10th September 2022. The volunteers were split into 5 groups and were given different topics to present. The topics included:

1. Role of nutrition in growth and development
2. Healthy foods and its advantages
3. Modern food habits and how it affects health
4. Discussing cuisines worldwide
5. How eating habits reflect one's personality.



Each group presented their topic after much research and effort which resulted in a very informative session. The programme was coordinated by NSS Programme officers Dr. Rajesh Kumar B and Dr. Sangeetha Nair, and NSS Volunteer secretaries Devasenan K.R. and Avani R Nair.

WORLD OZONE DAY: AWARENESS
16 September 2022

On 16th September 2022, Nirmala NSS Unit observed World Ozone Day by organizing an awareness class on the topic 'Plastic free society'. The session was taken by Dr. Rajesh Kumar B, Assistant Professor of Physics Department, Nirmala College Muvattupuzha. The session discussed various plastic engendered problems and effective management measures. New innovative ideas were brought up to promote an eco-friendly, plastic free campus.

PANDAPPILLY HEALTHCARE CENTER MAINTENANCE
21 September 2022

On 21 September 2022, NSS volunteers of Muvattupuzha Nirmala College took an initiative to repair & paint around 40 medical bedcots at Pandappilly Healthcare Center. The volunteers also stepped forward to clean the neighbouring areas of the health center. Timely intervention of Nirmala NSS unit helped in the renovation of the health center.

WORLD ROSE DAY: CANCER AWARENESS CLASS
22 September 2022

On the occasion of "World Rose Day", volunteers of NSS unit 30 organised two events to promote the welfare of cancer patients. The Cancer Awareness Class had an objective of creating awareness among the students and the general public about the importance of early detection, prevention, and treatment of cancer. The resource person, analyst Siby Paulose, provided valuable information on the different types of cancer, its symptoms, causes and methods of prevention. The session discussed various treatment options available and the importance of early detection for the successful treatment of cancer. After the informative session by Siby Paulose, the audience had the privilege of listening to Bindhu Rony, owner of Achus Bridal Villa, who shared her personal experience with cancer. She shared her journey on how she battled against the disease and how she emerged victorious. Bindhu's story of courage and hope inspired the students and left a lasting impact on them. The class ended with a pledge to spread awareness about cancer in our society and promote healthy lifestyles to prevent the disease.

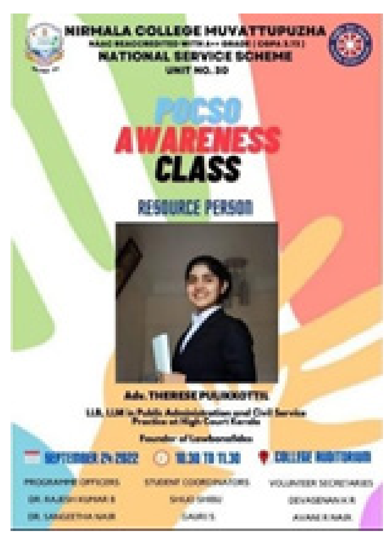
WORLD ROSE DAY: CANCER CENTRE VISIT
22 September 2022

Nirmala NSS unit commemorated World Rose Day on 22 September 2022 as an initiative to ensure the welfare and protection of real-life warriors, battling against deadly cancer. The NSS volunteers visited Vazhakkulam St. George palliative care center with a bunch of hand- made rose flowers, inspirational golden words and greeting cards. The cancer survivors shared their heart-touching memories and struggles. The volunteers earnestly attended the cancer awareness session led by Dr. Sony James.

FOOD PARCEL DISTRIBUTION
Sneha Sparsham Initiative
22 September 2022

In our society a lot of people are starving in the streets, striving day and night to afford a day's meal. The volunteers of NSS unit 30 of Nirmala College, Muvattupuzha set out on 22nd September 2022 to distribute food parcels to the needy as a part of the "Sneha Sparsham Initiative". The volunteers distributed food parcels near the private and public bus stations in Muvattupuzha and also to the labor workers residing near the area. Over 30 parcels of food were collected from the Nirmala College students and distributed.

50th NSS DAY : POCSO AWARENESS CLASS
24 September 2022



Children must be able to lead a safe, healthy, happy and thriving life. Therefore, on the occasion of the 75th NSS day, volunteers of Nirmala College Muvattupuzha organised an awareness class on the POCSO Act headed by Adv. Therese Pulikkottil.

The session explained various types of sexual abuse which are covered under the POCSO Act such as sexual harassment, molestation, rape, and child pornography, emphasizing that the POCSO Act not only covered sexual abuse but also included types of emotional and physical abuse. During the awareness class, the NSS volunteers highlighted the need for creating a safe and supportive environment for children to come forward and report any incidents of abuse. The importance of educating children about their rights and empowering them to speak up against any form of abuse became the need of the hour .The session concluded with a Q&A session which offered the participants a platform to clarify their doubts and share personal experiences.

50th NSS DAY : OUTDOOR SALE OF HANDMADE ITEMS
24 September 2022

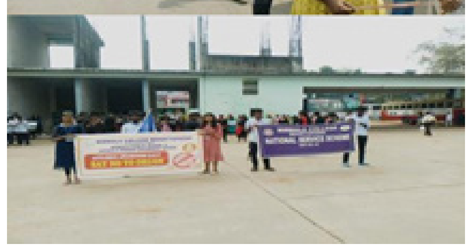
The NSS unit of Nirmala College celebrated its 50th anniversary on September 24th, 2022. In order to raise funds for further activities of the unit, volunteers conducted an outdoor sale. Eco-friendly washing lotion and paper bags were manually made by the volunteers which raised awareness against plastic pollution and cleanliness.

This was then distributed for reasonable prices in and around the college premises. The amount collected was used to fund further activities. The programme was coordinated by programme officers Dr Rajesh Kumar B. and Dr. Sangeetha Nair along with volunteer secretaries Devasenan K. R. and Avani R. Nair

ANTI-DRUG AWARENESS CLASS
24 September 2022

In association with Nirmala College Anti-Narcotic Cell, Nirmala's NSS Unit no:30 organized an awareness programme on "Drug abuse prevention among youth". The program officially commenced with the welcome address delivered by NSS Programme Officer Dr. Rajesh Kumar B and with the presidential address by the College Principal Prof. Dr. Thomas K. V. The chief guest of the program, Sir. C. P Basheer, Sub Inspector of Police, Muvattupuzha, graced the occasion. The Asst. Sub Inspector of Police, Sir. Sibi Achuthan conducted a class highlighting the increasing drug abuse cases in society and the need for the younger generation to be aware of them

ANTI DRUGS AWARENESS DAY
31 October 2022



On 31st October 2022, as a part of the Anti-drug campaign launched by the Kerala Government, NSS volunteers of Nirmala College stepped forward to promulgate the objectives of the campaign by organizing a street-play, rally and flashmob at various locations including Muvattupuzha KSRTC bus stand, Nirmala Higher Secondary School and Nirmala Public School. The programme was coordinated by NSS programme officers Dr. Rajesh Kumar B and Dr. Sangeetha Nair, and NSS volunteer secretaries Devasenan K.R. and Avani R Nair.

NATIONAL CANCER AWARENESS DAY
7 November 2022

The volunteers of NSS unit 30 organized a campaign on "National Cancer Awareness Day" on 7th November 2022. As a part of the campaign, a poster making competition was conducted. Selected posters were put up on a poster wall. Dr Sangeetha Nair delivered the presidential address followed by the inaugural address by Dr. K. V. Thomas, college prinicipal.

FIRE AND SAFETY AWARENESS PROGRAMME
10 November 2022

Nirmala NSS Unit organised a programme to spread awareness on fire and safetymeasures on 10th November 2022. Fire and safety officer K. M. Ibrahim inaugurated the programme followed by a session on precautions and first-aid, by fire and safety officers Rathish Kumar and Anas. The programme was presided by the principal of Nirmala college Dr. K. V. Thomas.The fire and safety officers also demonstrated on how a CPR must be given during emergency.

SPEAK UP ON VIOLENCE AGAINST WOMEN
25 November 2022

'The International Day for the Elimination of Violence Against Women' is observed on 25th November 2022, aiming to mobilize the society to create activists for the prevention of violations against women. The volunteers of NSS unit of Nirmala College initiated a ' Speak Up ' programme on the college campus. The students expressed their perspectives on the topic 'How to prevent the violence against women'.

BLOOD DONATION CAMP
6 December 2022

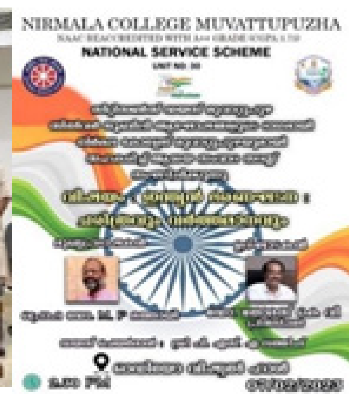
NSS unit of Nirmala College in association with HDFC Bank and Blood Bank of MOSC Medical College, Kolenchery conducted a blood donation camp at Nirmala college on 6th December 2022.The camp was inaugurated by Dr. K.V Thomas, college Principal. Apart from NSS volunteers, students from various departments contributed in donating blood

DRUG ABUSE OATH TAKING
8 December 2022

An Oath-taking ceremony against drug abuse was set up by the Nirmala NSS unit in association with Smile Dental Clinic, Pink police , Rotary Club Muvattupuzha, Bike and Bullet Lady Riders, Kochi and Royal Enfield, Veliyath Motors on 8th December 2022. The programme focused on creating awareness for a healthier future generation devoid of drugs and alcohol.

ഇന്ത്യൻ ഭരണഘടന: ചരിത്രവും വർത്തമാനവും

On 7th February 2023, Nirmala NSS Unit, in regards with National Constitution Day and Silver Jubilee Celebrations of Citizen's Dias Muvattupuzha, organized a session on the topic Indian Constitution: History and Present. Dr. Rajesh Kumar B, programme officer, welcomed the gathering and Sri P.S.A. Lateef, Chairman, Citizen's Dias delivered the presidential address. The programme was inaugurated by Dr. Thomas K .V, college principal. The session was headed by Prof. Dr. M. P. Mathayi, a Gandhian and an active learner of the Constitution. The session provided insights about the constitution and its significance in a diverse country like India. The seminar progressed through the history of Constitution and the great men behind the drafting of the law and order



CANCER CENTRE VISIT
13 February 2023

In relation with the World Cancer Day, the NSS volunteers of Nirmala College, visited Bethany Shalom Bhavan, a palliative care centre at Pothanicad. The volunteers interacted with the residents and the authorities discussing about functioning and difficulties.

NATURE CAMP REPORT
Day 1
14 March 2023

Day two started with a visit to the Idukki water reservoir and its premises. Along the way the volunteers were able to experience the vast flora and fauna surrounding the reservoir followed by a trekking inside the Idukki Wild-life Sanctuary. The forest officers gave detailed information about the different kinds of plants and animals of the forest. They also helped the volunteers understand the need to preserve the forest and wildlife present in the forest. After lunch various activities and classes were organized to spread awareness about forest acts and laws. After dinner the day came to an end with cultural activities performed by the volunteers on the theme of forest preservation.

Day 2
15 March 2023

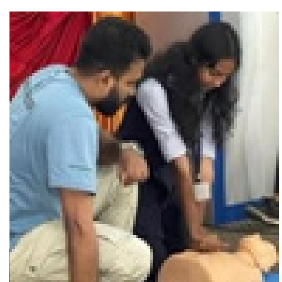
Day two started with a visit to the Idukki water reservoir and its premises. Along the way the volunteers were able to experience the vast flora and fauna surrounding the reservoir followed by a trekking inside the Idukki Wild-life Sanctuary. The forest officers gave detailed information about the different kinds of plants and animals of the forest. They also helped the volunteers understand the need to preserve the forest and wildlife present in the forest. After lunch various activities and classes were organized to spread awareness about forest acts and laws. After dinner the day came to an end with cultural activities performed by the volunteers on the theme of forest preservation.

Day 3
16 March 2023

On the third day, volunteers trekked to 'Vaisali view-point' near Idukki Wildlife Sanctuary. Later, they visited a tourist place in the sanctuary and eliminated the plastic waste present there. The closing ceremony was conducted later under the presence of the forest officers, marking the end of the camp.



CPR TRAINING PROGRAMME
16 March 2023




CPR or Cardiopulmonary Resuscitation is an emergency lifesaving procedure performed when cardiac arrest occurs. Nirmala NSS unit organised a CPR training programme in association with Heart Care Foundation under the motto "Save a life, Save a lifetime" on 16th february 2023. Smt. Limi Rose Tom, Chief Operating Officer, Heart Care Foundation, explained the objective of the training and Dr. Jesdon Henry handled a session on the importance of CPR. Practical training was given to the volunteers using an AI based high fidelity bio feedback mannequin system, 'TOFU', provided by the technical partner BASIC RESPONDERS. CPR proficiency test was conducted and successful volunteers were certified for 6 months. This programme created awareness about the risks of the increasing cardiac arrests and immediate measures to be taken.

സ്നേഹവീട് : വീട് നിർമ്മാണ പദ്ധതി

Volunteers of Nirmala College NSS unit were fortunate enough to be able to help complete the construction of a house for an underprivileged family. Kuzhumbil house is located at Anicad under the Avoly post office region, in Muvattupuzha. A family of four are the residents of the house.

The NSS volunteers decided to step in and conducted various programmes in order to raise funds for the maintenance works of the house which was in a pathetic condition. "Thanneermathan dinam 2.0" and "Scrap collection drive" were among the few fundraising programmes. The house was in a very poor condition with a fragile infrastructure. It was unsafe to live in and had insufficient facilities. The volunteers took the initiative to make the house more stable and safer to live in.The maintenance work started from 1st march 2023 onwards.

Walls were re-constructed and cemented. Finally, the house was freshly painted. Volunteers of Nirmala College NSS unit were an active part of the process. They worked hard for over a month and successfully completed the '**സ്നേഹവീട് നിർമ്മാണ പദ്ധതി**'

AWARENESS ON DEMENTIA
1st March 2023

NSS Unit of Nirmala College Muvattupuzha organised ana awareness session entitled "BODHI- Una^3-jy ku-lr-Z -k-aq-l-¯n-\mbv " 1st March, 2023 in association with the Dept.of Ernakulam District Administration and Social Justice, and Neuroscience center, CUSAT. Dr. K.V Thomas, college Principal inaugurated the programme. The training session was led by BODHI master trainer Shri.Sanjana K.A. Community mobilizer Mr. Aju Alosyus delivered the felicitations. The training session was made available for the entire college faculties.

MITHRA 181

The NSS volunteers of Nirmala College Muvattupuzha had performed a flash mob and a street play based on MITHRA 181 women helpline.The programme was carry out by the members of NSS team and women cell in the college campus and a famous mall in Muvattupuzha on 6th march 2023,.The aim of this programme was to empower and orient women to recognise their true potential and help them to attain their own stand in this competing world.The programme was coordinated by programme officers Dr.Rajeshkumar B and Dr.Sangeetha Nair along with NSS volunteer secretaries Devasenan K.R and Avani.R.Nair

INTERNATIONAL WOMEN'S DAY: AWARENESS SESSION
8th March 2023

Nirmala NSS unit 30, in regards with Women's Day, conducted an awareness session on 8th march 2023.

The programme was inaugurated by Mrs. Shelmi Johns, President, Avoly Grama Panchayath. Member of the 14th ward of Avoly Grama Panchayath, Mr. Rajesh Ponnumpurayidam and Dr. Mini C. Kartha, Superintendent of government homeo hospital Muvattupuzha, addressed the gathering. First, a session titled 'Dealing with Gaslighting' was led by Ms. Nevea Jerome, a psychologist at the 'Seethalayam' government homeo-hospital, Muvattupuzha, where different levels of gaslighting in a relationship was discussed.

The next session was conducted on the topic 'Women Safety and Laws, by Adv. Praveen P, panel lawyer, TLSC, Muvattupuzha. The session discussed on the crimes faced by women and the laws against these crimes. Dr. Indhu M. B, convener of Seethalayam, presented the vote-of thanks.

SAFER INTERNET DAY
27 March 2023

On 27th March 2023, Nirmala college NSS unit observed Safer Internet Day by organizing an awareness session on the topic 'Cyber Security'. The session was taken by Mr. Varghese Benny, Founder and CTO, RABBIT-SQUARE LLP Project Coordinator, Carlo TV. The interactive session entailed the causes, consequences as well as preventive measures of cybercrimes. The programme was coordinated by NSS Programme officers Dr. Rajesh Kumar B and Dr. Sangeetha Nair, and NSS Volunteer secretaries Devasenan K.R. and Avani R Nair.

WORLD WATER DAY: AWARENESS ON WATER CONSERVATION
28 March 2023

World Water Day is held annually on 22nd march as a means of focusing attention on the importance of fresh water and advocating for the sustainable management of fresh water resources. Nirmala NSS unit 30,in association with Vazhakulam and Kalloorkad Panchayath, conducted a programme under the motto: "Save each drop" to give awareness on water conservation. NSS volunteers performed a flash mob to gain attention of the public at the vazhakulam and kalloorkad town junctions and then displayed pluck cards and charts showing the importance of saving fresh water.

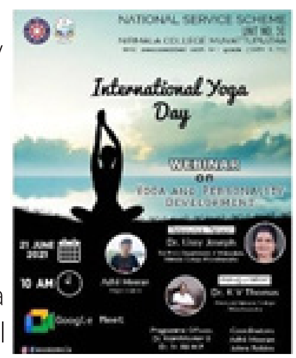
MONSOON CLEANING

As a part of World Environment Day, NSS volunteers cleaned their surroundings contaminated by the early Monsoon. Rains provide relief from the sweltering heat of the summer season. However, monsoons also bring with them certain unwelcome diseases. Coughs, fever, and infections are common in the rains.

ANEMIA PREVENTION AWARENESS

The woman and child development department of government of Kerala in association with NSS unit of Nirmala college Muvattupuzha organized an awareness session on anemia.Anemia being a global public health problem , it is necessary to create a public awareness about the problems caused and its prevention methods. The program was coordinated by ICDS Muvattupuzha.The session was arranged on 12 th June 2020 at 12 pm via Google certificates were issued to those volunteers who attended the session.

YOGA AND PERSONALITY DEVELOPMENT



A webinar was held as a part of Yoga Day by the NSS Unit of Nirmala College Muvattupuzha on 21st June 2021 via google meet. The webinar was on the topic 'Yoga and personality development'. Principal Dr K V Thomas inaugurated the session. Dr Lissy Joseph retired HOD of the Malayalam department, Nirmala college Muvattupuzha, took a session on the importance of yoga. NSS volunteer Adhil Meeran spoke and demonstrated yoga postures at the session.

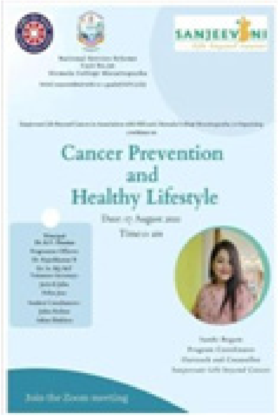
Drug addiction has become a major cause of concern all over the globe. It is a devastating state that has been running riot for a decade and there is an urgent need to put an end to it. As part of International Day against Drug Abuse, NSS Unit of Nirmala College joined hands with the District Legal Service Authority and Department of Social Justice. A webinar was conducted on 30th June 2021 on the topic "Joining hands for drug free Ernakulam" by 11.30 am on Zoom platform.The webinar was inaugurated by Nirmala College Principal, Dr. K V Thomas. The chief guest of the meeting, District Judge and Member Secretary KELSA , Nisar Ahammed KT.

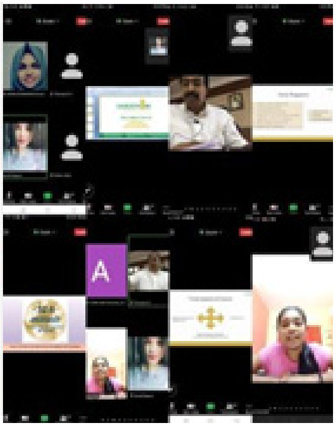
NASHA MUKTH BHARATH ABHIYAN

Drug addiction has become a major cause of concern all over the globe. It is a devastating state that has been running riot for a decade and there is an urgent need to put an end to it. As part of International Day against Drug Abuse, NSS Unit of Nirmala College joined hands with the District Legal Service Authority and Department of Social Justice. A webinar was conducted on 30th June 2021 on the topic "Joining hands for drug free Ernakulam" by 11.30 am on Zoom platform.The webinar was inaugurated by Nirmala College Principal, Dr. K V Thomas. The chief guest of the meeting, District Judge and Member Secretary KELSA , Nisar Ahammed KT.

CANCER AWARENESS PROGRAMME

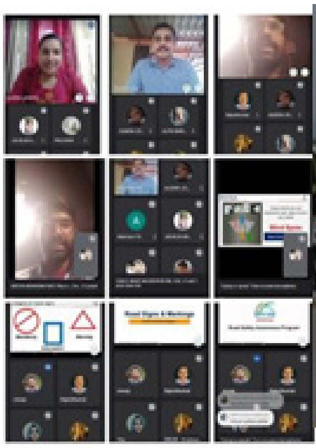
Prevention programs are an important part of the effort to control cancer. The NSS unit of Nirmala College Muvattupuzha in association with 'Sanjeevani -Life Beyond Cancer' organised a webinar on Cancer Prevention and Healthy Lifestyles on 17 August at 11.00 AM. The webinar was conducted on the zoom platform.

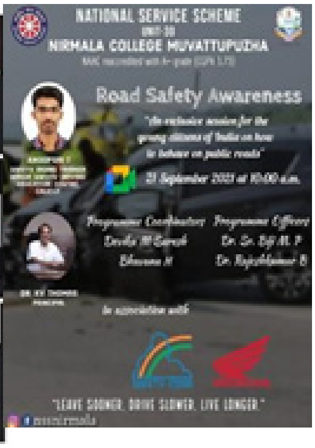




The program was inaugurated by principal Dr K.V Thomas. The coordinator, outreach and counsellor of Sanjeevani-Life Beyond Cancer, Sumki Begum took a fruitful class on cancer prevention. The

webinar was felicitated by programme officers Dr Sr Biji M.P and Dr Rajeshkumar. Around 100 volunteers attended the webinar and were concluded by 12:30 PM with a thank you note





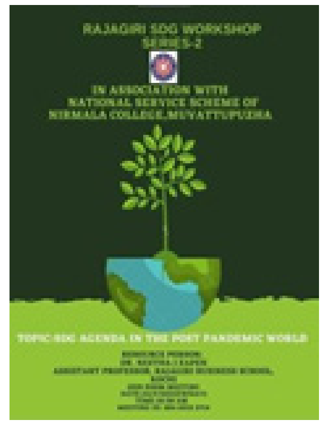
ROAD SAFETY AWARENESS

The NSS unit of Nirmala College of Muvattupuzha in association with Safety-India and Honda organized a webinar on the topic "Road Safety Awareness". The session was conducted on 21th September 2021 through Google Meet platform. The webinar was inaugurated by Principal Dr.K.V Thomas. Renowned AnoopSai Safety riding trainer Honda Safety Driving Education Centre Calicut, gave us insight on the respectful topic. NSS programme officers Dr Rajesh Kumar B, Dr Sr Biji M P felicitated the webinar.

WORLS ROSE DAY

World rose day, celebrated on September 22 is a day of hope for cancer patients all around the world who are facing cancer. This day is observed in honour of a 12-year-old Melinda Rose from Canada, who was diagnosed with a rare form of blood cancer. She brought cheer and hope into the lives of other patients even in the face of her own disease.

WORKSHOP ON SUSTAINABLE DEVELOPMENT GOALS



National Service Scheme, Nirmala College Muvattupuzha in association with Rajagiri College of Social Sciences and Rajagiri Business School organized a workshop on "Sustainable Development Goals (SDG), Agenda in the Post Pandemic World". The 2021 SDGs Learning, Training & Practice workshops aim to advance: knowledge and skills acquisition, networking, sharing experiences and peer to peer collaboration, learning about practical actions and best practices, capacity building, and policy integration and coherence. The webinar waconducted on 24th September at 10:30 AM on zoom platform. The program was inaugurated by Nirmala College principal Dr KV Thomas. Dr Neetha J Eapen, Assistant professor of Rajagiri Business School, Kochi was the resource person. It was an amazing session

THE WORLD ENVIRONMENTAL HEALTH DAY

The environment includes sun, water, air and soil without which human life would not exist. It is high time that the public are given an opportunity to broaden the basis for an enlightenment opinion and responsible conduct by individuals, enterprises and communities in preserving and enhancing the environment.The NSS unit of Nirmala college, under the leadership of program officers Dr.Rajeshkumar B and Dr. Sr. Biji M.P. along with volunteer secretaries Delna Jose and Jerin K John observed World Environmental Health Day by creating awareness and concerns about today's most processed environmental health concerns. The NSS volunteers proved themselves extremely devoted by creating five awareness videos about the 5 methods namely plastic, food, waste, glass, cloth and paper management. Paper wastes should not be burnt instead must be disposed of in a way without hurting the environment.

FIT India Mission has conceptualized 'FIT INDIA FREEDOM RUN 2.0' to commemorate the 75th Independence Day. "Azadi Ka Amrit Mahotsav" is a nationwide camp organized on the concept of "Physical/Virtual Run" in continuum from 13th August to 2nd October 2021. The aim was to encourage fitness and help us from obesity, laziness, stress, disease etc. The mission of the moment is to bring about behavioural change and to move towards a more physically active lifestyle.The NSS unit of Nirmala College in association with the Nirmala college NCC unit, IRCS, Viswajyothi College of Engineering and Technology Vazhakulam and Nehru Yuva Kendra, Ernakulam organized FIT INDIA FREEDOM RUN 2.0 under the leadership

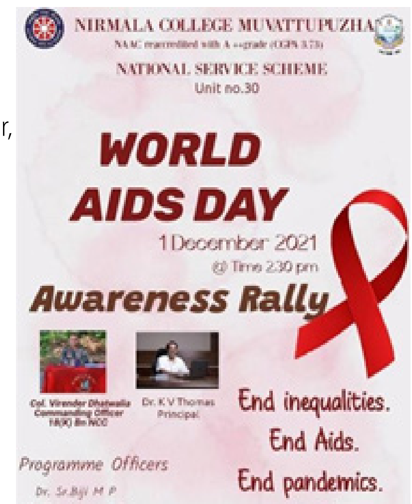
BLODD DONATION CAMP

Every year our nation requires about 5 crore units of blood. Out of which only a meagre 2.5 crore units of blood are available. As blood cannot be manufactured, as socially responsible citizens of the nation it is our duty to donate blood to the needy. A little act of kindness can go a long way; every blood donor is a life saver.

The NSS unit of Nirmala College conducted a blood donation camp in association with Blood Bank District hospital –Aluva. The camp was conducted in the college auditorium from 10 am – 1.30 p.m. The camp was inaugurated by Principal Dr K.V Thomas, by donating blood which promoted the spirit of blood donation among the students. About 50 units of blood was collected from merely 112 students. Since all volunteers are aware of their responsibilities towards the society, the entire programme was a great success.

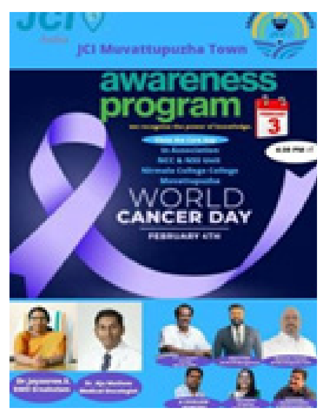
WORLD AIDS DAY

"End Inequality, End AIDS, End Pandemic." These words resonated through the walls of Nirmala college and the surrounding roads on 1st of December, 2021 as a part of the WORLD AIDS DAY awareness rally. To raise the spirits, Col. Virender Dhatwalia Commanding Officer 18(K) Bn NCC, honoured us with his presence. Sir gave spotlight to the relevance of conducting an awareness programme on AIDS as it seems to remain an anticipating crisis even in today's world where mankind has aggressively progressed. To celebrate this optimistic event, all the NSS volunteers were dressed in colours of red and white to represent their amalgamation. Nirmala College principal Dr. K. V. Thomas had also expressed his concern and admired the earnest attempts to make this rally a success



CANCER AWARENESS PROGRAMME

Nirmala College NSS unit conducted a session on 3rd February, 2022. These heroes have taught us numerous life lessons. They've taught us that difficult roads can lead to beautiful destinations and that every day is a chance to create a memory and to love a little more. These are words from inspiring survivors. The awareness programme conducted by JCI, Muvattupuzha town served its purpose to the fullest. It inspired everyone to support the fighters, admire the survivors and to honour the taken.The program was inaugurated by our chief guest – Dr.Jayasree S (DMO ERNAKULAM). The key note address was done by our guest of honour JFP Arjun.K. Nair. Felicitation was given by Dr. K.V Thomas (Principal of Nirmala college) and also J.C Sony Joseph (Founder President). This program was mainly subjected as an awareness session against cancer.



HRIDAYAM - THE BAMBOO HOUSE

Nirmala College Muvattupuzha is known for its nature-friendly campus, to add to this NSS unit during the 7-day camp build a bamboo house. Naming it Hridayam . As the name itself signifies, it shows the importance of the heart of the survival of humanity the-Nature. The main idea was to create awareness among the youth that they are all an integral part of nature. To love nature a little more is a little more care for ourselves. The bamboo house was built in the main attraction area of a college campus, near the garden. The construction work was done by bamboo experts and the NSS volunteers also gave a hand in roof weaving and floor making. Hridayam was completed within 5 days. Later on volunteers adorned it with craft works, decorative bottles and plantation around. There was a small gathering on every Friday in Hridayam. It became an area for students to relieve their stress from academics and relax ,to talk their heart out, making new friends and ponder.

SELF DEFENSE CAMP

The safety of women is one of the most discussed topics in our nation. Even though we have a lot of programs to empower the women of our country and assure their safety, we can still see cases where women are treated badly. The NSS volunteers of Nirmala College Muvattupuzha organized a self defense camp on 17th of March 2022 to teach girls how to protect themselves in the case that someone attacks them. The self defense camp was taken by Renshi Santhosh Augustine,black belt 5th dan. Renshi Santhosh Augustine is well known martial artist and the state chairman of the international Karate school, Kassis Karate Academy. Before starting self defense training, he spoke about the need of self defense training in today's world.

SLOGAN MAKING COMPETITION ON SHAHEEDI DIVAS

On 'Shaheedi Divas', the volunteers of Nirmala College NSS unit,Muvattupuzha organized a Slogan making competition. The competition was for the entire college. A lot of students participated in the competition. A wide variety of slogans were presented in front of the judging panel. Patriotism was filled in all the slogans. The love for our nation and respect towards the martyrs was shining brightly in the words of the students

CANCER AWARENESS

Cancer is one among the deadliest diseases. Cancer is often thought of as an untreatable, unbearable painful disease with no cure. The patients suffer with a great deal of stress, anxiety and depression. The NSS unit of Nirmala college, Muvattupuzha had organised a hair donation camp on 2nd March, 2022 on behalf of this. It was inaugurated by Nirmala College principal Dr KV Thomas followed by an awareness class by the chief guest PK Sebastian.On 18th March,

Our NSS unit and Thrissur Amala medical science institute jointly donated hair to cancer patients under the name 'Keshadanam Snehadanam'. College principal Dr KV Thomas inaugurated the event. The program was coordinated by PK Sebastian and beautician Bindu Roy. Around 22 students donated their hair. College Vice principal and Bursar Fr Justin Kanadan also addressed the gathering

WEBINAR - A FIGHT AGAINST COVID - 19

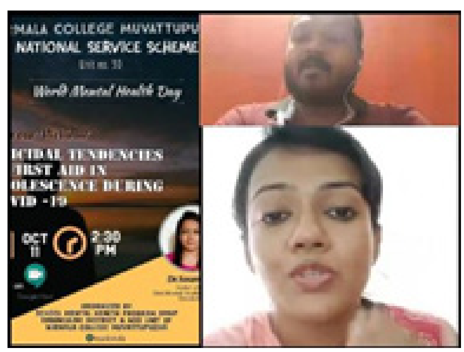
The sudden outbreak of the Covid-19 pushed the people into crisis and panic. Though the lockdowns, stay at home strategies and social distancing were implemented to slow down spreading of the same, people were not really aware about what they can do. The NSS unit of Nirmala College organized a webinar on the topic "Training on Fight against COVID-19" On 24 th July 2020 at 4pm.Dr. K. V. Thomas, principal of Nirmala College inaugurated the function . Program officers Dr. Albish . K. Paul and Sr. Biji. M. Pwere also present at the function. The first and second year volunteers assembled in theonline platform to be the part of the webinar. Though the resource person was Dr. Savitha, Dy. DMO Ernakulam, due to several official duties, Dr. Saumya Raj, Medical officer, substituted Dr. Savitha imparted more and more details and knowledge about thenovel coronavirus

OZONE PLEDGE

"Ozone for life" is the motto of this year's world ozone day which is observed on September 16. As the level of air pollutants increases everyday, the world ozone day brings about a stark reminder to protect our earth and its delicate equilibrium.Nature and its protection has always been one of the major objectives of NSS. Thereforevolunteers took an oath that revealed their solidarity to protect and preserve the ozone layer by reducing the use of substances like CFC's, halons etc.One of the NSS Volunteers Aanet Paul (Maths dept) gave a short speech highlighting the gvity of the issue. A poster was also released for the event.

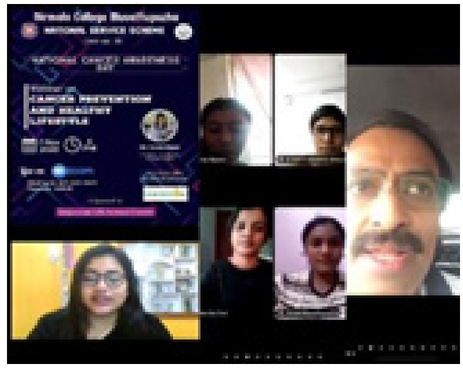
WORLD MENTAL HEALTH DAY

World Mental Health Day is observed on October 10 every year the objective of raising awareness of mental health issues around the world and mobilizing efforts for mental support. The NSS unit organized a webinar on the topic " Suicidal Tendencies And first aid in Adolescence During covid -19" on October 10 at 2:30 pm. The program was headed by Dr Soumya Raj, Nodal officer and District Mental Health programer, Ernakulam.The program casted for one hour and was conducted through Google



Meet with an activeparticipation of overall 150 volunteers. The program was really beneficial. It helped to understand certain fears during pandemic situations and also realize how to overcome from a depressed situation

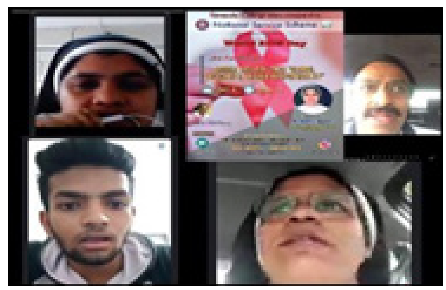
NATIONAL CANCER AWARENESS DAY



National Cancer Awareness day is observed every year on November 07 to raise the awareness of cancer and encourage it's prevention. This year's theme ' I can you can ' acknowledges that everyone has the capacity to address the cancer burden. As part of national cancer awareness day, on 07/11/2020 at 4:00 pm National Service Scheme of Nirmala college conducted a webinar on the topic "Cancer Prevention and Healthy Life" in association

with 'Sanjeevani - Life Beyond Cancer'.The webinar was on the online platform Zoom and the resource person of the program was Mrs. Sumki Bigum, program coordinator outreach Sanjeevani Life Beyond Cancer.The main goal of this program was to create an awareness about the dreadful disease cancer . They made awareness about different types of Cancers and their symptoms and how they affect the human body . Also cancer victims shared their experiences.Through their words they gave others the courage to face cancer .They are really living inspiration to cancer victims .The webinar on cancer prevention and healthy lifestyle ended at 5:00 pm and E- certificate was provided to all participants

AIDS DAY WEBINAR



World AIDS Day, designated on 1 December every year since 1988, is an international day dedicated to raising awareness of the AIDS pandemic caused by the spread of HIVinfection and those who have died of the disease.This year's theme for world AIDS day is "Ending the HIV/AIDs epidemic resilient and impacts ". This theme is also a reminder that people can achieve abandoned things ,if they make a joint effort to deliver high quality

services for treatment and prevention of HIV, to the ones who are in need. A webinar was organised as part of World Aids day on "Global Solidarity Shared Responsibility" on December 5 at 3.00 pm the program was headed by Sr.Jyothi Grancewho is a teacher at St.Thomas College of Nursing,Thrissur.

POLLUTION CONTROL DAY

Nirmala college NSS unit no:30 observed Pollution Control Day on December 2 2020.The main aim was to make the volunteers aware of the importance of controlling pollution.Pollution and its after effect are very significant matters that today's generationmust be aware of ,human has exploiting the nature so much and its impact on mankind is severe .As an NSS volunteer , we are the community to ready to serve the nature and will raise our voice against exploitations. On that day a poster making program was conducted

in which the volunteers made hand made and virtual posters on pollution control.The programme was efficient in bringing forward their ideas on pollution control in a creative way. All the posters were recorded and published on virtual platforms to make awareness.

INTERNATIONAL WOMEN'S DAY

As part of Women's day, the NSS unit of Nirmala College Muvattupuzha conducted an interactive session with Iswarya, a solo cyclist around 4 countries and All India Motocross Racer. The programme was held on 7 March 2021 and inaugurated by principal Dr.K V Thomas. Iswarya shared her travel experiences along with her life experiences.She said thatshe did not identify as a woman just because of her appearance.

SELF DEFENCE

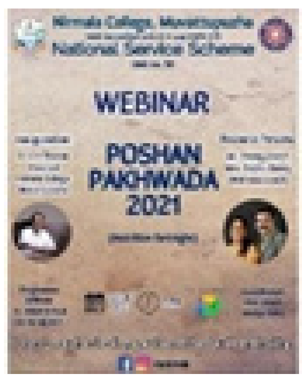
The most significant benefit that can be obtained from a self defense course is that women can learn how to physically defend themselves. NSS Unit of Nirmala college Muvattupuzhaconducted a self defense workshop for women on March 15, 2021. The programme was inaugurated by the college principal Dr. K V Thomas. Mr. James Stephen, Member of karate association of India was there to conduct the program. He taught the volunteers howto deal with an attacker. Defense techniques in karate were also taught.

DONATE BLOOD BEFORE GETTING VACCINATED

The NSS unit of Nirmala College Muvattupuzha conducted a programme to create awareness among people to donate blood beforegetting vaccinated. From 1st May 2021 mass crowd of the age group between 18 -45 will get vaccinated. Post-vaccination minimum of 60 days we cannot donate blood. To create this awareness and to encourage everyone to donate blood before vaccination, the NSS volunteers put up self-made posters on the roads. A video was also made which is posted on the official Instagram page

POSHAN PAKHWADA 2021

NSS Unit of Nirmala College Muvattupuzha conducted a webinar on nutrition as part of 'Poshan Pakhwada 2021' on April 20, 2021.Dr. K V Thomas, Principal Nirmala CollegeMuvattupuzha, inaugurated the session. Mr. Benny Joseph and Mrs. Sindhu Benny, wellness coaches, took class about the importance of nutritious food and health. They explained how to stay fit and healthy.



ENCOURAGING VACCINATION DRIVE

NSS Volunteers of Nirmala college Muvattupuzha had actively taken many initiatives ,encouraging the public to get vaccinated during the covid pandemic. Posters were published that clearly explained' how to register on cowin portal '. Helpdesk was also offered by the volunteers helping and supporting the public to register on the cowin portal.

INDEX

1) PUNEET SAGAR ABHIYAN

I. River cleaning 1

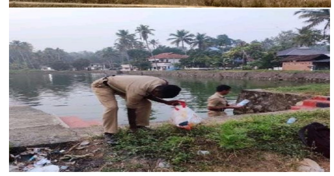
Date: 1st june 2022

Ii. River cleaning 2

Date: 25th november 2022

Iii. Pond cleaning

Date: 1st december 2022



2) DRUG DESTROYS LIFE

I. Anti-drug day rally

Date: 15th october 2022

Ii. Anti-drug awareness rally

Date: 1st novemeber 2022

Iii. Drug awareness mime

Date: 10th december 2022

3) WORLD ENVIRONMENT DAY

Date: 5th june 2022

4) YOGA DAY

Date: 21st june 2022

5) SELF DEFENCE CLASS

Date: 14th december 2022

DRUG DESTROYS LIFE

Anti-drug day rally

Anti drug awareness rally

Blood donation campaign

World Environment Day - Yoga day



Self defence orientation


Chapter IX

CARBON FOOT PRINT : AUDIT REPORT

CARBON FOOT PRINT COMMITTEE
(CFC 2024-25)

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Arya Harikuttan
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Alpha Joemon
Jefy John
Govind Krishna P M
Sreerag R
Pavithra Krishna
Thulasi Krishna

9

Carbon Foot Print

EXECUTIVE SUMMARY: NIRMALA COLLEGE'S CARBON PROFILE

This report presents a comprehensive carbon footprint analysis for Nirmala College Muvattupuzha (Autonomous), based on data provided for a Green Audit conducted by the Tropical Institute of Ecological Sciences (TIES). The assessment follows the Greenhouse Gas (GHG) Protocol framework, quantifying emissions across Scope 1 (direct), Scope 2 (indirect energy), and Scope 3 (other indirect) sources, as well as accounting for carbon sequestration and offsets from the college's proactive environmental initiatives.

The analysis reveals a Net Institutional Carbon Footprint of 184.44 tonnes of carbon dioxide equivalent (tCO2 e) per year. This final figure is the result of significant gross emissions being counterbalanced by the college's substantial mitigation and sequestration efforts.

Total Gross Emissions for the audit period are calculated to be 303.88 tCO2e. The primary contributors to this total are:

- Purchased Electricity (Net Scope 2) : 46.2% (140.32 tCO2e)
- Waste Disposal (Scope 3) : 28.5% (86.60 tCO2e)
- Liquefied Petroleum Gas (LPG) (Scope 1) : 16.7% (50.81 tCO2e)
- Generator Diesel (Scope 1) : 2.8% (8.56 tCO2e)
- Water Consumption (Scope 3) : 1.5% (4.53 tCO2e)

Nirmala College's existing green initiatives demonstrate a strong commitment to sustainability, collectively preventing the emission or actively sequestering 119.44 tCO2e annually. This remarkable achievement is broken down as follows:

- On-site Solar Power Generation: 51.08 tCO2e avoided.
- Vehicle Sharing Program: 49.20 tCO2e avoided.
- Campus Tree Sequestration: 6.58 tCO2e sequestered.
- Biogas Plant Operation: 12.58 tCO2e offset.

The per capita carbon footprint for the college, with a total strength of 2995 individuals, is approximately 61.5 kg CO2e per person per year. This figure serves as a valuable internal benchmark for tracking progress over time.

Based on this detailed inventory, the following strategic imperatives have been identified to guide Nirmala College on its path toward carbon neutrality:

1. Prioritize Biogas Expansion: The most significant opportunity lies in expanding the on-campus biogas plant to process all 34 tonnes of generated bio-waste, up from the current 3 tonnes. This single action would drastically cut potent methane emissions from landfills and further reduce reliance on fossil-fuel-based LPG.
2. Enhance Energy Self-Reliance: Continue the successful expansion of solar power capacity and pursue a full campus transition to LED lighting to further reduce the largest source of emissions—grid electricity.
3. Implement Comprehensive Waste Segregation: A robust segregation system is critical to support the expanded biogas plant, improve the quality of recyclables, and ensure the proper disposal of non-degradable and hazardous materials.
4. Formalize and Grow Green Programs: Strengthen the vehicle-sharing program with better tracking and promote water conservation initiatives to address Scope 3 emissions. Continue the strategic planting of native, high-biomass trees to enhance the campus's role as a carbon sink.

This report provides the detailed methodology and calculations that underpin these findings, offering a clear and actionable roadmap for Nirmala College's sustainability journey.

9.1. INTRODUCTION: ESTABLISHING THE BASELINE FOR A GREENER FUTURE

Introduction to Institutional Carbon Foot printing

9.1.1. Concept and Importance

Carbon foot printing involves the quantitative measurement of greenhouse gas (GHG) emissions associated with an entity's activities, typically expressed in carbon dioxide equivalents (CO2e). This assessment is a critical tool for educational institutions like Nirmala College, as it allows for a clear understanding of their environmental impact. By quantifying emissions, institutions can actively contribute to global efforts to mitigate climate change, align with national and regional sustainability goals, and foster a culture of environmental responsibility among their large populations. For instance, Kerala has set an ambitious target of achieving net-zero emissions by 2050, significantly ahead of India's national goal of 2070. A detailed carbon footprint enables Nirmala College to identify its primary emission hotspots, develop informed strategies for reduction, and enhance its environmental transparency and accountability. This process moves beyond mere compliance, positioning the college as a leader in sustainable practices within the community.

9.1.2. Purpose and Context

This report establishes a comprehensive, data-driven methodology for calculating the institutional carbon footprint of Nirmala College Muvattupuzha (Autonomous). It has been prepared to support the Green Audit initiative undertaken by the Tropical Institute of Ecological Sciences (TIES). The primary objective is to create a transparent, verifiable, and replicable carbon inventory that quantifies the college's greenhouse gas (GHG) emissions and removals. This baseline assessment is an essential first step for identifying key emission sources, evaluating the effectiveness of current mitigation strategies, and charting a strategic course toward enhanced environmental performance and eventual carbon neutrality.

9.1.3. The GHG Protocol Framework

To ensure consistency and global comparability, this analysis adheres to the Greenhouse Gas (GHG) Protocol, the most widely used international accounting standard for quantifying GHG emissions.[1] The framework categorizes emissions into three distinct "scopes," providing a clear and structured approach to the inventory process:

- Scope 1: Direct Emissions. These are emissions released directly from sources that are owned or controlled by the institution. For Nirmala College, this includes the combustion of diesel in backup generators and the use of Liquefied Petroleum Gas (LPG) in canteens and laboratories.
- Scope 2: Indirect Emissions from Purchased Energy. These are indirect emissions generated from the production of purchased electricity consumed by the institution. This represents the emissions produced by the Kerala State Electricity Board (KSEB) to supply power to the campus.
- Scope 3: Other Indirect Emissions. This category encompasses all other indirect emissions that occur in the institution's value chain. This is often the most extensive category and includes emissions from activities such as the disposal of waste generated on campus, the energy used to supply water to the college, and employee and student commuting.

9.2. METHODOLOGICAL APPROACH

The methodology employed in this report integrates direct activity data provided by Nirmala College with a carefully selected set of emission factors derived from authoritative national and international sources. This hybrid approach ensures that the calculations are grounded in the specific operational realities of the college while maintaining scientific rigor. Activity data, such as kilowatt-hours of electricity consumed or kilograms of waste generated, provide the quantitative basis for the assessment. These figures are then multiplied by emission factors—coefficients that quantify the emissions per unit of activity—to calculate the total GHG emissions in terms of carbon dioxide equivalent (CO_2e).

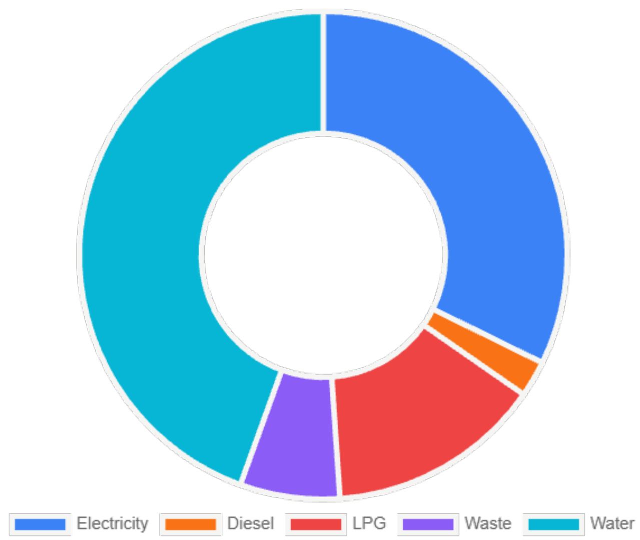


Fig.9.1. Components of Carbon Foot Print calculation of Nirmala College

The credibility of any carbon audit rests on the transparency and justification of its underlying assumptions. To this end, all constants, conversion factors, and emission factors used throughout this report are consolidated and justified in Table 1 below. This master table serves as the foundational reference for all subsequent calculations, ensuring clarity and enabling future recalculations as more refined data becomes available.

Parameter	Value	Unit	Justification
Scope 1: Direct Emissions			
Diesel (Stationary Combustion)	2.675	kgCO2e/litre	India-specific Tank-to-Wheel (TTW) factor for diesel combustion from a comprehensive national GHG values document.
Liquefied Petroleum Gas (LPG)	2.983	kgCO2e/kg	Weight-based factor from a GHG Protocol source, used in a comparable Indian university carbon footprint study.
Scope 2: Indirect Emissions			
Electricity (KSEB Grid)	0.757	kgCO2/kWh	The most recent conservative national weighted average grid emission factor from India's Central Electricity Authority (CEA) for the 2024 vintage. This is a CO_2-only factor.
Scope 3: Other Indirect Emissions			
Petrol (Mobile Combustion)	2.232	kgCO2e/litre	India-specific TTW factor for petrol from a national GHG values document, suitable for calculating avoided emissions from two-wheelers.
Water Supply Energy Intensity	0.4	kWh/m3	A conservative, representative estimate for urban water supply in India, based on academic literature that reports a range of 0.2-1.0 kWh/m^3.
Waste Management (IPCC FOD Model)			
Degradable Organic Carbon (DOC) - Bio-waste	0.15	kg C / kg waste	IPCC 2006 default value for food waste is appropriate for the "Bio-waste" category.
Degradable Organic Carbon (DOC) - Paper	0.40	kg C / kg waste	IPCC 2006 default value for paper and cardboard waste.
Fraction of DOC that Decomposes (DOCF)	0.5	Dimensionless	IPCC default for anaerobic conditions in a landfill.
Methane Correction Factor (MCF)	0.4	Dimensionless	IPCC default for unmanaged, shallow solid waste disposal sites, which is a common practice in India.[11]
Global Warming Potential (GWP) - Methane (CH4)	27.9	kgCO2e/ kgCH4	100-year GWP from the IPCC's Sixth Assessment Report (AR6), representing the latest scientific consensus.
Carbon Sequestration & Offsets			
Tree Sequestration Rate	227	kgCO2/tree/ year	Average annual sequestration rate derived from a peer-reviewed study of 610 trees in the Wayanad region of the Western Ghats, a geographically and ecologically similar area.

Table 9.s1: Master Table of Emission Factors and Key Parameters

9.2.1. Analysis of Direct Emissions (Scope 1 Footprint)

9.2.1.1. Definition

Scope 1 emissions encompass the direct release of greenhouse gases from sources that are owned or controlled by Nirmala College. These emissions are generated on-site through the institution's own activities. Based on the provided data, the primary sources of Scope 1 emissions for the college are the combustion of fossil fuels for power generation and facility operations. Specifically, this includes diesel fuel for backup generators and Liquefied Petroleum Gas (LPG) for use in canteens and laboratories. The emissions avoided through the on-site biogas plant are also accounted for within this scope as a direct offset.

A. Stationary Combustion: Generator and LPG
1. Diesel for Generators

The use of diesel-powered generators provides essential backup power for the campus, but it is also a direct source of GHG emissions.

- Activity Data: The college reports an average annual consumption of 3,200 litres of diesel for generator operation.
- Emission Factor: The 'India Default GHG Emission Values' document provides a robust, India-specific emission factor for the direct combustion of diesel. The Tank-to-Wheel (TTW) factor, which represents emissions at the point of combustion, is 2.675 kg of carbon dioxide equivalent per litre (kgCO2e/litre). This factor is comprehensive as it accounts for not just carbon dioxide (CO2) but also the climate-warming effects of other gases like methane (CH4) and nitrous oxide (N2O) released during combustion, converted to a single CO2e value.
- Calculation: The total annual emissions from generator use are calculated by multiplying the total fuel consumption by the selected emission factor.
    - Total Emissions Diesel = Annual Diesel Consumption × Emission Factor Diesel
    - Total Emissions Diesel = 3,200L/year × 2.675kg CO2e/L = 8,560kg CO2e/year
    - Total Emissions from Generator Diesel = 8.56 tonnes CO2e/year

2. LPG for Canteens and Labs

LPG is a vital fuel for various campus facilities, particularly canteens and science laboratories. Its combustion is another significant source of direct Scope 1 emissions.

- Activity Data: The institution purchases a total of 17,026 kg of LPG annually.
- Emission Factor: A carbon footprint report for a comparable Indian university, citing the GHG Protocol, provides a weight-based emission factor of 2.983 kg CO_2e per kg of LPG.[1] Using a weight-based factor is more precise than a volume-based one, as it is not affected by temperature or pressure variations. This factor is highly credible and appropriate for this calculation.
- Calculation: The total annual emissions from LPG consumption are determined by multiplying the total mass of LPG used by this emission factor.
    - Total Emissions LPG=Annual LPG Consumption × Emission Factor LPG
    - TotalEmissionsLPG=17,026kg/year×2.983kgCO2e/kg=50,813.5kgCO2e/year
    - Total Emissions from LPG = 50.81 tonnes CO2 e/year

B. Biogas Plant: A Key Mitigation Action

The college operates a biogas plant that processes food waste. This initiative directly mitigates GHG emissions by converting organic waste, which would otherwise produce methane in a landfill, into biogas that displaces the use of fossil fuels like LPG.

- Direct Data: The provided dataset for the biogas plant explicitly quantifies the annual emission reduction attributable to its operation.
    - Reduction in CO2 Emission = 12.58 tonnes per year

This value represents a direct offset against the college's Scope 1 emissions. It is a testament to the effectiveness of this technology as a carbon mitigation strategy. However, a deeper analysis of the data reveals a substantial, untapped potential. The college generates a total of 34,033.75 kg of bio-waste annually, but the biogas plant currently processes only 3,000 kg of this waste—a mere 8.8% of the available feedstock. The remaining 31,033.75 kg of organic waste is presumably sent to a landfill, where its decomposition will generate significant methane emissions, a potent greenhouse gas. This highlights a critical disconnect: the college possesses a highly effective solution to a significant waste problem, but the solution is currently underscaled. The data also indicates that revamping the existing plant requires a relatively low investment of Rs.1,50,000 with a rapid payback period of just 5 months. This presents a compelling, economically viable opportunity to dramatically increase emission reductions by expanding the plant's capacity to process a much larger fraction of the campus's bio-waste. Such an expansion would simultaneously reduce Scope 3 emissions (by diverting waste from landfill) and further decrease Scope 1 emissions (by replacing more LPG with biogas).

9.2.2. Analysis of Indirect Emissions from Purchased Energy (Scope 2 Footprint)

9.2.2.1. Definition

Scope 2 emissions account for the greenhouse gases released during the generation of purchased electricity that is consumed by the institution. These emissions do not occur on the college campus itself but are a direct consequence of its energy demand from the regional electricity grid. For Nirmala College, this involves quantifying the emissions associated with the electricity supplied by the Kerala State Electricity Board (KSEB) and subtracting the emissions avoided through the college's own on-site solar power generation.

A. Gross Emissions from Grid Electricity Consumption

This calculation determines the total carbon footprint associated with all electricity purchased from the KSEB before accounting for any on-site generation.

- Activity Data: The college's total annual electricity consumption from the KSEB grid is 227,639 kWh.
- Emission Factor: Identifying a specific, official emission factor for the KSEB grid is challenging, as state-level data is not always readily available or updated.[15] In the absence of a localized factor, the most authoritative and methodologically sound approach is to use the national weighted average grid emission factor published by India's Central Electricity Authority (CEA). The CEA database is the official source for monitoring emissions from the Indian power sector.[16] The most recent data for the 2024 vintage year recommends a conservative factor of
  0.757 tonnes of CO2 per MWh, which is equivalent to 0.757 kg CO2/kWh.[5] It is important to note that this is a
  CO2-the only factor, and does not include other greenhouse gases (CH4, N2O). While this represents a slight underestimation, it is the most robust and current official figure available for the Indian grid.
- Calculation: The gross emissions are calculated by multiplying the total grid electricity consumption by the national average emission factor.
  - Gross Emissions Grid=Annual Grid Consumption × Emission Factor Grid
  - GrossEmissionsGrid=227,639kWh/year×0.757kgCO2/kWh=172,322.7kgCO2/year
  - Gross Emissions from Grid Electricity = 172.32 tonnes CO2e/year

B. Emission Reductions from On-Site Solar Generation

Nirmala College has made a significant investment in renewable energy with solar panel installations across four different blocks. This on-site generation directly displaces electricity that would otherwise be drawn from the carbon-intensive grid, resulting in a substantial emission reduction.

- Activity Data: The provided data on solar generation indicates the total annual output for each installation. Summing these values gives the total campus generation.
  - MCA Block: 18,498 kWh/year

- DJ Block: 8,804 kWh/year
- Main Block: 34,140 kWh/year
- Pharmacy Block: 6,034 kWh/year
- Total Annual Solar Generation = 67,476 kWh

- Methodology: The emissions avoided are calculated by multiplying the total clean energy generated by the same grid emission factor used for consumption. This represents the amount of carbon that was not emitted because the college generated its own power instead of purchasing it from the grid.
- Calculation:
  - Emission Reduction Solar=Total Solar Generation ×Emission Factor Grid
  - EmissionReductionSolar=67,476kWh/year×0.757kgCO2/kWh=51,080.8kgCO2/year
  - Emission Reduction from Solar = 51.08 tonnes CO2e/year

The data for the Main Block's 40 kW system is particularly noteworthy. It is reported to export an average of 2,845 units (kWh) monthly, which totals 34,140 kWh annually—exactly matching its total generation. This suggests a "gross-metered" system where all generated power is sold to the grid, or that its generation consistently exceeds the building's daytime demand. While this is an excellent financial and grid-support model, for carbon accounting purposes, the net effect is the same: 67,476 kWh of fossil-fuel-based grid power was displaced by the college's solar initiatives. This success serves as a powerful internal benchmark, validating the strategy of investing in large-scale solar and suggesting that an analysis of metering arrangements across all installations could optimize financial returns while maximizing carbon benefits.

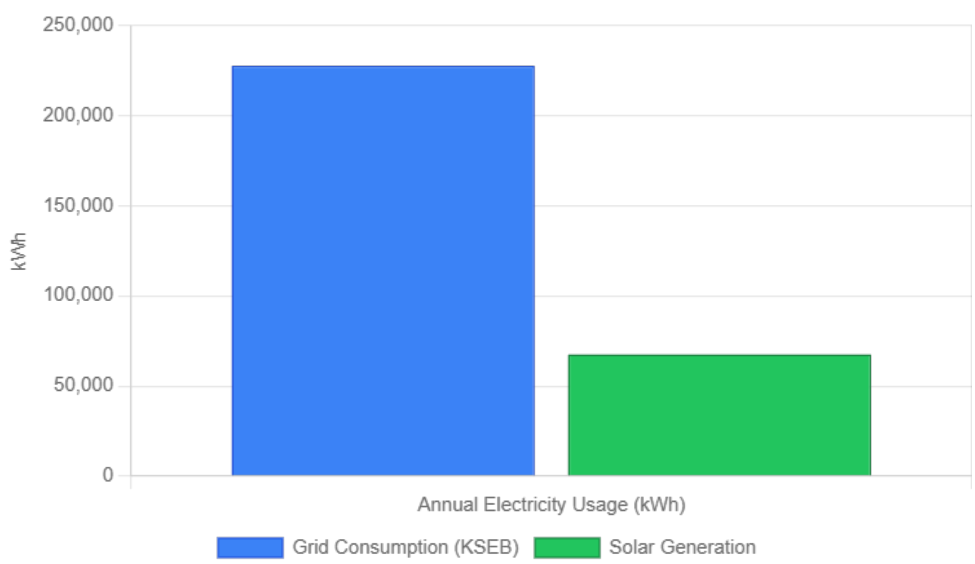


Fig.9.2. Grid consumption Vs Solar Generation

C. Net Scope 2 Emissions

The net Scope 2 footprint is the final measure of emissions from purchased electricity after accounting for the positive impact of on-site renewable energy generation.

- Calculation:
  - NetScope2Emissions=Gross Emissions Grid −Emission Reduction Solar
  - NetScope2Emissions=172.32tCO2 e−51.08tCO2e=121.24tCO2e/year
  - Net Scope 2 Emissions = 121.24 tonnes CO2 e/year

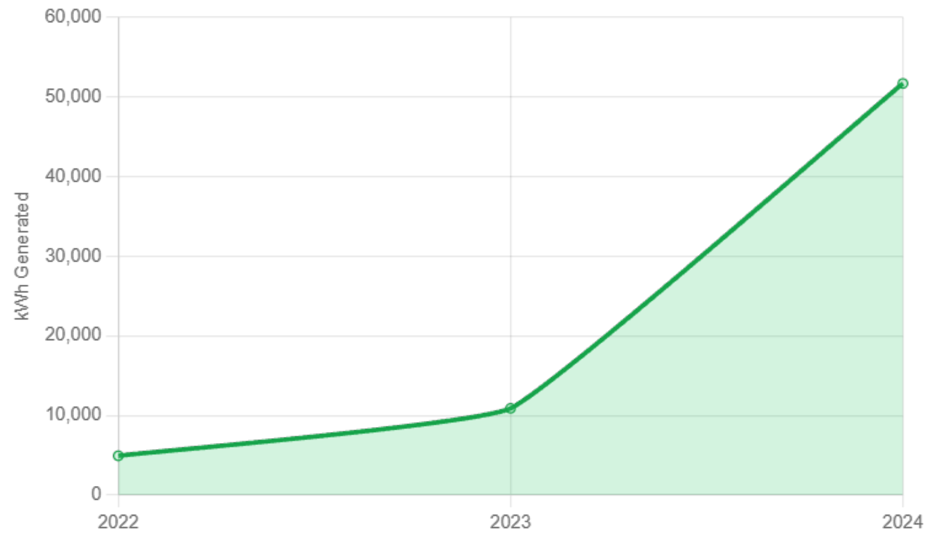


Fig.9.3. Year-wise generation of solar energy at Nirmala College

9.2.3. Analysis of Other Indirect Emissions (Scope 3 Footprint)

9.2.3.1. Definition

Scope 3 encompasses all other indirect emissions that occur within an institution's value chain but are not included in Scope 2. These emissions stem from sources not owned or directly controlled by the institution, such as the disposal of waste, the energy embedded in the water supply, and transportation related to institutional activities. This is often the most challenging scope to quantify fully, but the data provided by Nirmala College allows for a robust assessment of several key categories.

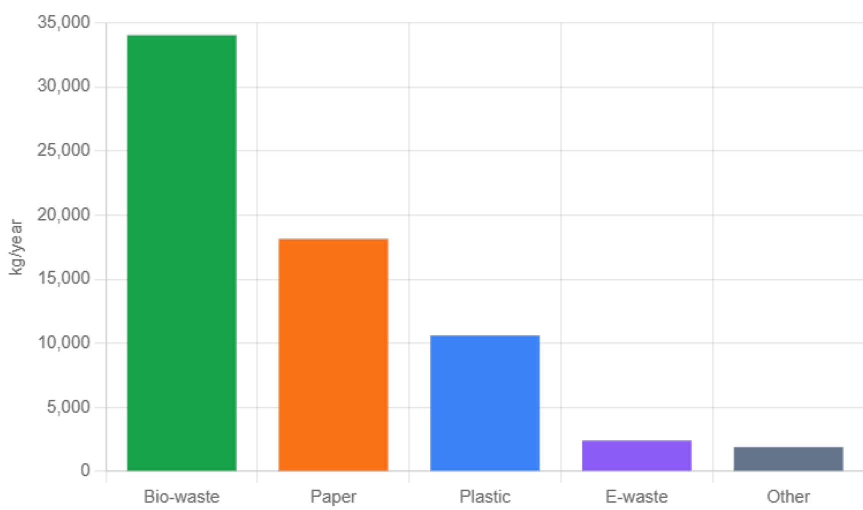


Fig.9.4. Various types of wastes generated at Nirmala College

A. Emissions from Waste Management

The most significant GHG emission from waste disposal in India is methane (CH_4), a potent greenhouse gas produced during the anaerobic decomposition of organic materials in landfills.[12] The methodology for this section is based on the First Order Decay (FOD) model recommended by the Intergovernmental Panel on Climate Change (IPCC), which provides a scientifically credible approach for estimating these emissions.[9]

The simplified FOD calculation for a single year's emissions is:

$$CH_4 Emissions(kg) = Total\ Waste(kg) \times DOC \times DOCF \times MCF \times F$$

Where F is the fraction of CH_4 in landfill gas (default 0.5). The final value is then converted to CO_2e using the GWP for methane.

Calculations by Waste Type

1. Bio-waste (Food and Organic Waste):
   - Activity Data: The college generates 34,033.75 kg of bio-waste annually. However, 3,000 kg is commendably diverted to the on-site biogas plant. Therefore, the net amount of bio-waste sent to landfill is 31,033.75 kg/year.
   - Parameters:
     - Degradable Organic Carbon (DOC) for food waste: 0.15 [9]
     - Fraction of DOC decomposing (DOCF): 0.5 [11]
     - Methane Correction Factor (MCF) for unmanaged landfills: 0.4 [11]
     - GWP for Methane (CH_4): 27.9 [13]
   - Calculation:
     - Methane Generated (CH_4) = $31{,}033.75kg \times 0.15 \times 0.5 \times 0.4 \times 0.5 = 465.5 kgCH_4/year$
     - CO_2e Emissions = $465.5kgCH_4 \times 27.9 = 12{,}987.5 kgCO_2e/year$
     - Emissions from Bio-waste = 12.99 tonnes CO_2e/year
2. Paper Waste:
   - Activity Data: The total annual generation of paper waste is 18,132.41 kg.
   - Parameters:
     - DOC for paper waste: 0.40 [10]
     - Other parameters (DOCF, MCF, GWP) remain the same.
   - Calculation:
     - Methane Generated (CH_4) = $18{,}132.41kg \times 0.40 \times 0.5 \times 0.4 \times 0.5 = 725.3 kgCH_4/year$
     - CO_2e Emissions = $725.3kgCH_4 \times 27.9 = 20{,}235.8 kgCO_2e/year$
     - Emissions from Paper Waste = 20.24 tonnes CO_2e/year
3. Plastic, E-waste, and Other Non-Degradable Waste: The dataset includes significant quantities of plastic (10,592 kg), e-waste (2,400 kg), and chemical waste (104 kg). It is methodologically incorrect to apply a landfill methane emission factor to these streams. Plastic is largely inert in a landfill and does not produce significant methane; its primary GHG impact is from production (a life-cycle emission) or incineration, neither of which is indicated here.20 Similarly, the primary environmental impact of e-waste and chemical waste is their toxicity and potential for soil and water pollution, not direct GHG emissions from landfilling.22 Therefore, these waste streams are excluded from the GHG calculation for disposal, but their proper management is a critical environmental priority. The recommendation must be to focus on robust segregation, recycling programs, and certified hazardous waste disposal protocols as part of a holistic environmental strategy.

Total Emissions from Waste = 12.99 tCO_2e + 20.24 tCO_2e = 33.23 tonnes CO_2e/year

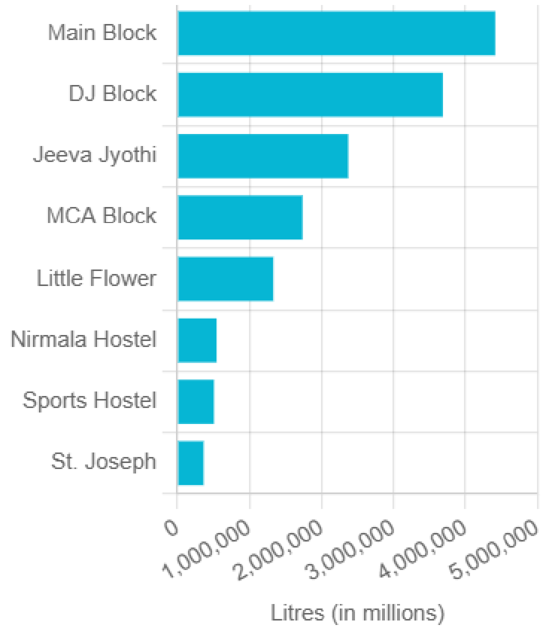


Fig.9.5. Components of Carbon Foot Print calculation of Nirmala College

B. Emissions from Water Consumption

The carbon footprint of water is not from the water itself, but from the energy required to extract, treat, and pump it to the end-user—a concept known as the water-energy nexus.[8] These emissions are a crucial component of the college's Scope 3 footprint.

- Activity Data: The total annual water consumption across all campus blocks and hostels is 1,49,58,332.9 litres, which is equivalent to 14,958.3 cubic meters (m3).
- Energy Intensity Factor: A precise energy intensity for the Muvattupuzha water supply is unavailable. However, Indian academic studies provide a reasonable range. Research indicates the average energy intensity in India is lower than the 0.46 kWh/m3 seen in the UK, with a typical range for conventional water treatment between 0.2 and 1.0 kWh/m3.[7] A conservative and representative value of 0.4 kWh/m3 is adopted for this analysis, reflecting a typical mixed urban supply system in India.
- Electricity Emission Factor: The emissions associated with this energy use are calculated using the same KSEB grid factor as in Scope 2: 0.757 kg CO2/kWh.
- Calculation:
  - Total Energy for Water = 14,958.3m3/year×0.4kWh/m3=5,983.3kWh/year
  - Total Emissions = 5,983.3kWh/year×0.757kgCO2/kWh=4,529.4kgCO2/year
  - Total Emissions from Water Consumption = 4.53 tonnes CO2e/year

C. Avoided Emissions from Vehicle Sharing (Scope 3)

The college's vehicle sharing program is a proactive measure to reduce the carbon footprint of student and staff commuting, a key Scope 3 category. The fuel savings directly translate to avoided GHG emissions.

- Activity Data:
  - Two-wheeler fuel savings: 11,560 litres/year
  - Four-wheeler fuel savings: 8,779 litres/year
- Emission Factor Selection: The India-specific TTW emission factors from the national GHG values document are used.[4]
  - Two-wheelers are assumed to run on petrol, with an emission factor of 2.232 kg CO2e/litre.
  - For four-wheelers, in the absence of a specific fuel mix, the diesel factor of 2.675 kg CO2e/litre is used. This is a conservative choice as it is higher than the petrol factor and many modern cars in India are diesel-powered.
- Calculation:
  - Two-wheeler Avoided Emissions = 11,560L×2.232kgCO2e/L=25,801.9kgCO2e
  - Four-wheeler Avoided Emissions = 8,779L×2.675kgCO2e/L=23,488.8kgCO2e
- Total Avoided Emissions from Vehicle Sharing = 25.80 tCO2e + 23.49 tCO2e = 49.29 tonnes CO2e/year

This significant reduction will be treated as an offset in the final net footprint calculation.

9.3. CARBON SEQUESTRATION AND THE NET INSTITUTIONAL FOOTPRINT

9.3.1. Definition

This section quantifies the college's positive climate actions that actively remove carbon dioxide from the atmosphere or prevent its emission through biological processes and other initiatives. These removals, known as carbon sinks and offsets, are crucial for determining the institution's final net carbon footprint. They represent the counterbalance to the gross emissions calculated in the previous sections.

A. Campus Biodiversity as a Carbon Sink

The trees and green spaces on the Nirmala College campus act as a natural carbon sink, absorbing atmospheric CO_2 through photosynthesis and storing the carbon in their biomass (trunks, branches, leaves, and roots).

- Activity Data: The biodiversity survey provides a detailed census of campus flora, with the most critical data point for this calculation being the total number of trees: 281.
- Sequestration Rate Selection: Accurately determining the carbon sequestration rate is complex, as it varies by tree species, age, size, and local climate conditions. To ensure the most relevant and scientifically defensible estimate, a sequestration rate from a study conducted in a similar geographical and ecological context is essential. Research from the Wayanad region of the Western Ghats in Kerala provides an ideal benchmark.[14] This study of 610 diverse trees found a total annual sequestration of 138.367 tonnes of CO_2. This yields an average rate of 0.227 tonnes of CO_2 per tree per year (or 227 kg CO_2/tree/year).[14] Using this regional average is a far more robust approach than applying a generic global or national factor. Another study from Kerala found a sequestration rate of 2.68 tonnes of Carbon per hectare per year for homestead agroforestry, but applying this would require data on planting density, making the per-tree average from the Wayanad study more directly applicable and reliable.[24]
- Calculation: The total annual carbon sequestration by the campus tree population is calculated by multiplying the number of trees by this average annual sequestration rate.
  - Total Sequestration=Number of Trees $\times$ Sequestration Rate per Tree
  - TotalSequestration=281trees$\times$0.227tCO_2/tree/year=63.787tCO_2/year
  - Total Annual Sequestration from Campus Trees = 6.38 tonnes CO_2e/year

B. Consolidating All Sinks and Offsets

To understand the full positive impact of the college's environmental initiatives, all emission reductions, avoidances, and sequestrations calculated throughout this report are summed here. This total represents the gross amount of GHG emissions the college has successfully mitigated.

1. Emission Reduction from Solar Power (Section IV): 51.08 tCO_2e/year
2. Avoided Emissions from Vehicle Sharing (Section V): 49.29 tCO_2e/year
3. CO_2 Reduction from Biogas Plant (Section III): 12.58 tCO_2e/year
4. CO_2 Sequestration from Campus Trees (Section VI.A): 6.38 tCO_2e/year

- Total Sinks and Offsets = 51.08 + 49.29 + 12.58 + 6.38 = 119.33 tonnes CO_2e/year

C. Calculating the Net Carbon Footprint

The net institutional carbon footprint is the ultimate measure of the college's impact on the climate. It is the final balance achieved by subtracting the total emissions mitigated and sequestered from the total gross emissions generated by the institution's activities.

Gross Emissions Calculation:	○ Gross Scope 1 = Emissions (Diesel + LPG) = 8.56 + 50.81 = 59.37 tCO2e ○ Net Scope 2 = 121.24 tCO2e ○ Gross Scope 3 = Emissions (Waste + Water) = 33.23 + 4.53 = 37.76 tCO2e ○ Total Gross Emissions = 59.37 + 121.24 + 37.76 = 218.37 tonnes CO2e/year
Final Net Footprint Calculation:	○ Net Footprint = Total Gross Emissions−Total Sinks and Offsets ○ NetFootprint=218.37tCO2e/year−119.33tCO2e/year=99.04tCO2e/year ○ Net Institutional Carbon Footprint = 99.04 tonnes CO2e/year

Table 9.2: Calculating Net carbon foot print

9.3.2. Comprehensive Carbon Footprint Summary and Benchmarking

This section synthesizes all the preceding analyses into a single, comprehensive overview of Nirmala College's annual carbon footprint. It provides a clear, disaggregated summary of all emission sources and sinks, culminating in the net institutional footprint. Furthermore, it benchmarks this performance on a per capita basis to provide context and facilitate comparison.

Category	Scope	Activity Data	Emission/ Sequestration Factor	Total (tonnes CO2 e/year)
EMISSIONS (SOURCES)				
Scope 1: Direct Emissions				59.37
Generator Diesel	1	3,200 Litres	2.675 kg/L	8.56
Liquefied Petroleum Gas (LPG)	1	17,026 kg	2.983 kg/kg	50.81
Scope 2: Indirect Emissions (Energy)				121.24
Grid Electricity (Gross)	2	227,639 kWh	0.757 kg/kWh	172.32
Scope 3: Other Indirect Emissions				37.76
Waste (Bio-waste to Landfill)	3	31,033.75 kg	-	12.99
Waste (Paper to Landfill)	3	18,132.41 kg	-	20.24
Water Consumption	3	14,958.3 m^3	-	4.53
TOTAL GROSS EMISSIONS				218.37
REDUCTIONS & SEQUESTRATION (SINKS)				

Solar Power Generation	2	67,476 kWh	-0.757 kg/kWh	-51.08
Biogas Plant Operation	1	-	Direct Data	-12.58
Vehicle Sharing (Two-wheeler)	3	11,560 L saved	-2.232 kg/L	-25.80
Vehicle Sharing (Four-wheeler)	3	8,779 L saved	-2.675 kg/L	-23.49
Campus Tree Sequestration	Sink	281 Trees	-227 kg/tree	-6.38
TOTAL REDUCTIONS & SINKS				-119.33
NET INSTITUTIONAL CARBON FOOTPRINT				99.04

Table 9.3: Nirmala College Annual Carbon Footprint Summary (in tonnes CO2e)

9.3.3. Per Capita Bench marking

To contextualize the college's overall environmental performance and provide a metric for comparison, the net carbon footprint can be expressed on a per capita basis. This is calculated by dividing the total net emissions by the total institutional population.

Total College Strength	2,995 individuals (students and staff)
Net Carbon Footprint	99,040 kg CO2e/year
Per Capita Calculation	Per Capita Footprint=Total College Strength Net Carbon Footprint (kgCO2e) Per Capita Footprint=2,995 persons 99,040kgCO2e =33.0kgCO2e/person/year

Table 9.4 per capita calculation

This per capita footprint of 33.0 kg CO2e is a valuable internal benchmark that Nirmala College can use to track its progress in future audits. When comparing this to other institutions, it is crucial to acknowledge that methodologies, operational boundaries, and regional contexts can vary significantly. For instance, a study of the International Islamic University of Islamabad (IIUI) reported a per capita footprint of 0.16 tCO2e (160 kg CO2e), which was heavily influenced by emissions from a large, university-owned transport fleet—a factor not present to the same degree at Nirmala College.[2] Nonetheless, Nirmala College's relatively low per capita figure reflects the significant positive impact of its existing solar, biogas, and vehicle-sharing initiatives, which successfully offset a large portion of its gross emissions.

9.4. STRATEGIC PATHWAYS TOWARD CARBON NEUTRALITY

The detailed carbon footprint analysis provides a clear, evidence-based foundation for developing a strategic roadmap to further reduce Nirmala College's environmental impact. The following recommendations are designed to build upon existing successes and address the most significant remaining emission sources, guiding the institution on a practical and impactful path toward carbon neutrality.

9.4.1. Energy Systems: Maximizing Self-Reliance

Net purchased electricity remains the largest single contributor to the college's carbon footprint. Therefore, enhancing energy efficiency and expanding renewable generation is the highest-impact area for further action.

- Recommendation 1: Expand Solar Capacity. The success of the existing 83 kW of solar installations, which already offset over 51 tonnes of CO2e annually, provides a compelling case for expansion. The college should conduct a feasibility study for installing additional large-scale solar arrays on available rooftops or ground spaces. The "export-all" model of the Main Block's system should be evaluated for its financial viability to be replicated across campus.

- Recommendation 2: Achieve 100% LED Lighting. The college has already made substantial progress by converting 69% of its lighting to energy-efficient LEDs. A targeted initiative to replace the remaining 31% of conventional lights will yield further reductions in electricity consumption and associated Scope 2 emissions, offering a quick return on investment through energy savings.

- Recommendation 3: Conduct a Detailed Energy Audit. Beyond lighting, a professional energy audit can identify opportunities for reducing "phantom loads" (energy consumed by devices in standby mode) and prioritize the replacement of older, inefficient equipment (e.g., air conditioners, lab equipment, water pumps) with modern, energy-efficient models.

9.4.2. Waste Management: Closing the Loop

Waste management, particularly the landfilling of organic matter, is the second-largest source of emissions. This area offers a profound opportunity for improvement by leveraging an existing, underutilized asset.

- Recommendation 4: Prioritize the Expansion of the Biogas Plant. This is the single most critical and impactful recommendation of this report. The current biogas plant processes only 3,000 kg of the 34,033 kg of bio-waste generated annually. Expanding the plant's capacity to process all organic waste would have a dual benefit: it would nearly eliminate the 13 tonnes of potent methane emissions from landfilled bio-waste (Scope 3) and would further displace the use of 50.8 tonnes worth of fossil-fuel-based LPG (Scope 1). Given the documented low investment cost and rapid 5-month payback period, this is a high-priority, economically sound project.

- Recommendation 5: Implement Rigorous Campus-Wide Waste Segregation. To support the expanded biogas plant and improve overall resource management, a comprehensive waste segregation program is essential. This requires clear, color-coded bins across campus, accompanied by an awareness campaign for students and staff. Effective segregation will ensure a clean organic stream for the biogas plant and increase the quality and value of recyclables like paper and plastic, while also ensuring hazardous materials like e-waste and chemical waste are handled correctly.

9.4.3. Water and Transport: Addressing Hidden Footprints

The Scope 3 emissions from water consumption and transportation, while smaller than energy and waste, are significant and actionable.

- Recommendation 6: Promote Water Conservation. The 4.53 tCO2e footprint from water use can be reduced by launching water conservation campaigns, installing water-saving fixtures in restrooms and hostels, and conducting regular audits for leaks. The college should also investigate the feasibility of a rainwater harvesting system to reduce its reliance on the energy-intensive municipal water supply.

- Recommendation 7: Formalize and Expand the Vehicle Sharing Program. The current program already avoids an impressive 49 tonnes of CO2 e annually. This success can be amplified by formalizing the program. Implementing a simple registration system or a mobile app could help track participation more accurately, quantify fuel savings for official carbon accounting, and potentially gamify the system to encourage wider adoption among students and staff.

D. Biodiversity and Sequestration: Growing the Carbon Sink

The campus's green cover is a valuable asset that actively removes carbon from the atmosphere.

- Recommendation 8: Develop a Strategic Tree-Planting Program. The college should build upon its existing biodiversity by implementing a planned tree-planting initiative. This program should prioritize native, high-biomass species that are known to be effective carbon sinks in the Western Ghats ecosystem, referencing regional studies for species selection.[14] This will not only increase the campus's carbon sequestration capacity but also enhance local biodiversity and aesthetic value.

E. Future Audits: A Roadmap for Continuous Improvement

To enhance the accuracy and scope of future carbon audits, the college should establish systems for more granular data collection.

- Recommendation 9: Enhance Data Collection Protocols.
    - Transportation: Conduct a comprehensive travel survey of students and staff to map commuting patterns (mode of travel, distance, frequency). This will allow for the calculation of the full Scope 3 transportation footprint, providing a more complete picture beyond the current vehicle-sharing savings.
    - Waste Management: Track the final destination of all waste streams. Knowing which specific landfill or recycling facility receives the waste can help refine parameters like the Methane Correction Factor (MCF) and account for emissions from waste transportation.
    - Procurement: Begin tracking the purchase of high-volume goods, starting with paper. This data can be used in future audits to estimate Scope 3 emissions from purchased goods and services, a significant category for most institutions.

By diligently implementing this methodological framework and acting upon these recommendations, Nirmala College can significantly advance its environmental stewardship, contribute meaningfully to Kerala's net-zero ambitions, and serve as a leading example of sustainability within the educational sector.

9.5. CONCLUSION

In conclusion, this comprehensive carbon footprint analysis reveals that Nirmala College Muvattupuzha (Autonomous), has a net annual emission of 184.44 tonnes of CO2e. This final figure is a testament to the institution's proactive environmental stewardship, as an impressive 119.44 tCO2 e significantly counterbalances its gross emissions of 303.88 tCO2e in annual reductions and sequestrations from its existing initiatives.

The college's investments in solar power, vehicle sharing, campus greening, and biogas are delivering substantial, measurable climate benefits. This audit, therefore, serves as both a validation of past efforts and a clear, data-driven roadmap for the future.

The path toward carbon neutrality is well-defined, with the most impactful opportunities lying in the strategic expansion of the on-site biogas plant to manage all organic waste, the continued scaling of solar energy capacity, and the implementation of robust waste segregation programs. By leveraging its established foundation of sustainability and focusing on these key areas, Nirmala College is exceptionally well-positioned to not only achieve its environmental goals but also to serve as a leading model of institutional responsibility and climate action.

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

- Annie Leonardv

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.

- Margret Mead

10 General Conclusions & Recommendations

GENERAL CONCLUSION

- The college's energy management profile reveals a significant paradox. strategic initiatives like the highly successful 83 kW solar power installation and a commendable culture of sustainable transportation demonstrate a strong commitment to sustainability these advancements are severely undermined by critical deficiencies in fundamental operational maintenance and safety. Presently, the campus suffers from a paucity of adequate electrical documentation, hazardous wiring, poor panel upkeep, and non-compliance with safety standards, posing significant risks. Despite proactive measures, considerable inefficiencies persist through the incomplete transition to LED lighting and reliance on diesel and LPG. Therefore, to achieve energy and financial sustainability, the institution must urgently prioritize rectifying these foundational safety and maintenance issues while continuing to address specific high-consumption areas, ensuring that its laudable green initiatives are built upon a safe, efficient, and well-managed electrical infrastructure.

- Water management assessment reveals a significant disparity between the college's extensive water infrastructure and its operational efficiency. The audit identifies critical, interconnected issues, including systemic water loss from aging pipes, inefficient timer-based pumping, and a flawed automated tank-filling system that leads to considerable overflow and wastage. Analysis pinpoints high-consumption zones in Main Block. Under-maintained rainwater harvesting systems and water quality concerns that require immediate attention. By implementing the recommended strategic interventions such as upgrading plumbing, optimizing the pumping system with demand-based controls, and promoting campus-wide conservation awareness the college can drastically reduce its water footprint, enhance sustainability, cut operational costs, and align the institution with best practices in resource management.

- The assessment concludes that the institution's waste management protocols are well-structured and reflect a substantive commitment to environmental stewardship. Strengths are apparent in the systematic segregation of waste and the effective processing of biological, plastic, and chemical materials. However, the audit highlights the necessity for improved quantitative analysis and the potential for greater energy independence. The introduction of a zonal data registry is a pivotal corrective measure to enhance tracking. To achieve a higher level of sustainability, it is recommended that the college supplements its current practices by investing in a biogas plant, thereby closing the loop between waste generation and energy consumption solidifying its position as a leader in campus sustainability and creating a more self-sufficient, circular system.

- The institution demonstrates holistic commitment to fostering a safe, supportive, and sustainable campus environment. This is evident through its well-integrated infrastructure, comprehensive safety and security protocols, and meticulous management of health and sanitation, including commendable annual water quality checks. The college actively promotes the holistic well-being of its community with strong mental and physical health support, diverse recreational programs, and a culture of social responsibility. The assessment highlights specific areas for continuous improvement, notably in enhancing operational canteen hygiene and addressing the significant noise pollution concern at the Boys Hostel. Broadly, the college has successfully established a secure and enriching environment conducive to learning and personal growth, with a clear dedication to ongoing enhancement.

- The institution's net carbon footprint for the year stands at 99.04 tonnes of CO2e. This number is calculated from gross emissions totaling 218.37 tonnes, which are mainly attributed to grid electricity usage (Scope 2) and the direct consumption of Liquefied Petroleum Gas (Scope 1). These emissions are considerably balanced out by effective reduction and sequestration efforts amounting to 119.33 tonnes, with on-site solar energy generation and vehicle-sharing initiatives being the most effective mitigation measures. While these actions represent a strong dedication to sustainability, the data emphasizes that maintaining a focus on decreasing electricity use and reliance on fossil fuels is essential for achieving further carbon reductions and progressing towards carbon neutrality.

GENERAL RECOMMEDATION

- Based on the detailed findings, it is strongly recommended that the campus undertake a comprehensive and immediate overhaul of its electrical infrastructure, safety protocols, and energy management strategy. The first priority is to address critical safety and compliance gaps by engaging a certified electrical engineering consultant to create professional documentation, such as a legally required Single Line Diagram, and to systematically rectify immediate hazards including exposed wiring, unclean panels, and missing safety mats. Concurrently, essential maintenance, including the calibration of protection relays and the testing of all earth pits, must be conducted to ensure system reliability. To improve efficiency and control costs, an expert should be hired to resolve power quality issues while a formal investigation into billing anomalies is launched with the KSEB. Immediate transition to LED lighting and a feasibility study to replace fossil fuels in the canteen, all supported by the formal appointment and training of authorized personnel to oversee these new, safer, and more efficient systems.

- To foster a culture of sustainability and ensure responsible resource management, and comprehensive overhaul of the campus water system is recommended, focusing on infrastructure upgrades, rigorous maintenance protocols. The strategy should begin with critical infrastructure enhancements, including the transition to fully automatic systems for each water tank to prevent overflow and the installation of higher-capacity pumps appropriately sized for their respective tank volumes. Develop a formal, regular maintenance schedule for water systems, including specific protocols for rainwater harvesting facilities to ensure their physical integrity and prevent contamination. These technical improvements should be complemented by enhancing visible conservation initiatives, such as water-saving signage. Crucially, support ongoing educational campaigns to empower students, faculty, and staff with water-conscious practices, and reinforced by routine biannual water testing to guarantee safety and demonstrate a commitment to responsible oversight.

- Enhance commitment to environmental stewardship, the college should adopt a comprehensive, multi-faceted strategy focused on resource circularity and waste reduction. A cornerstone of this approach would be leveraging the campus's potential for biowaste management by exploring the installation of a biogas plant. This initiative would not only generate clean energy to reduce LPG dependency in the canteens but also produce valuable organic manure, creating a closed-loop system that supports integrated farming activities. In parallel, the institution must aggressively tackle material consumption by optimizing paper usage through a shift to digital workflows, mandating double-sided printing, and implementing a robust recycling program. This effort should be complemented by a strict policy to reduce single-use plastics, prioritizing the widespread adoption of reusable and biodegradable alternatives. To address the challenge of electronic waste, it is crucial to establish and maintain a formal e-waste management framework, featuring systematic annual documentation and a dedicated holding facility to ensure all electronic waste is handled responsibly and transparently.

- Based on the review, it is recommended that the institution move forward with a two-pronged approach to enhance overall campus safety and clarity. Standardization of traffic management signage which include transitioning to universally recognized symbols for speed limits, parking, entry/exit points, and advisories for sound-sensitive areas, with a targeted deployment strategy to upgrade or install signs in high-traffic zones or areas where visual cues are most critical. Complementing these physical upgrades, the institution continue to build upon its newly implemented Occupational Health and Safety (OHS) management framework. The ongoing evolution of system it is crucial for addressing the full spectrum of potential hazards through advance emergency preparedness and crisis management, thereby ensuring the continuous development of a secure, responsive, and inclusive environment for all students, staff, and visitors.

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

- David Suzuki

Chapter 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

11.1 INTRODUCTION

The College has a highly effective environmental management system. In the rapidly evolving world college transform and becoming increasingly important to weave sustainable development into the college curriculum. As institutions of higher education, colleges are crucial in preparing students with the knowledge and skills necessary to address the challenges of a sustainable future. By implementing best practices that incorporate sustainability into their academic programs, colleges not only equip students with valuable insights but also initiate a ripple effect that reaches beyond the classroom, impacting their families and communities. This introduction emphasizes the role of colleges as catalysts for significant change, fostering a generation that is prepared to contribute positively to the well-being of society.

11.1.1 Alternative source of energy:

Energy Management System, energy is a resource that is heavily utilized, and conserving it poses a significant challenge on a global scale. To tackle this issue, it has become essential to embrace alternative energy sources. In this regard, our educational institution has made progress by incorporating alternative energy, specifically through the installation of solar panels. At present, the college boasts a solar production capacity of 83 kW, which supplies power to the main building and the self-financing department. Any excess energy produced is fed back to the Kerala State Electricity Board (KSEB). This endeavour not only diminishes the college's carbon footprint but also underscores our dedication to environmental sustainability. The solar installation, linked to meter numbers 1155913023693, 1155919025451, 115591000209, 1155915028013, functions with a three-phase net metering system. So far, it has generated a total of 4,821 units of electricity, averaging 10 kVA kWh in monthly production. Students are actively engaged in tracking the system's readings and documenting its development, which provides them with essential practical experience in grasping the importance of alternative energy sources and their environmental implications.

11.1.2 Vehicle sharing practices:

Energy Management System, faculty and staff have adopted vehicle sharing, resulting in a notable decrease in individual travel across various categories. Specifically, about 43.9% of four-wheeler travel is done through sharing. By further promoting this practice, transportation efficiency can be maximized, emissions can be reduced, and sustainability can be enhanced. Although the sharing rate for two-wheelers is lower at 57.83%, there remains significant potential for increased sharing. The Green Audit Report from Nirmala College Muvattupuzha highlights best practices that focus on decreasing the number of vehicles on the road while reducing fossil fuel use and carbon emissions. Faculty and staff set an example by embracing this effective energy conservation approach.

11.1.2 Water usage monitoring system :

Water Efficiency Management System, managing water resources is crucial for fostering environmental protection and sustainability in educational institutions. Recognizing that water is a limited resource is vital, especially considering the limited availability of freshwater. This necessity drives the need for proactive conservation measures, which can be accomplished through systematic monitoring and resourceful usage. To aid these initiatives, our college has installed eleven water flow meters for accurate measurement. Under the guidance of faculty, students from the internal audit team consistently monitor and document data, playing an essential role in upholding effective water conservation efforts.

The Environmental Management System, of the college community actively engages in the green audit process, promoting sustainable environmental practices within the institution. A team of certified internal auditors at Nirmala College Muvattupuzha (Autonomous) oversees and addresses any non-conformities. The college strives to foster a sustainable lifestyle among its members by incorporating eco-friendly practices, efficient resource management, and conservation efforts into campus activities, curriculum, and operations, thereby ensuring continuous sustainability and environmental stewardship.

11.1.3 Biodiversity :

Sacred Groves are good repositories of biodiversity. Various life forms are being protected based on the unique traditions and cultures prevailing in a locality. In the past, sacred groves were very common in Kerala, and the quality and extent of such areas were well maintained. However, in the recent past, many sacred groves were destroyed and in the remaining ones, the quality and extent have drastically deteriorated. But very few people recognise the significance of reviving such areas for the conservation of many rare species and ultimately for the long-term welfare of mankind. The revival programme of Santhukad Sree Durga Bhadra Naga Temple Sacred Grove is an excellent example of such an attempt to give refugia to the flora and fauna in that locality.

The Management Committee of the temple in collaboration with Social Forestry wing of Kerala Forest Department and the Post Graduate Department of Zoology of Nirmala College Muvattupuzha (Autonomous) organize one day sensitization programme every year and field study to document the flora and fauna of the sacred grove to prepare a plan for restoring the old charm of the area and for the long term conservation of the sacred grove. The programme was started on 11th February 2011 at the Santhukad Sacred Grove premises. It was attended by a good number of local people, including both men and women. The restoration programme was continuing and every year the faculty and students were visiting the area and observing the changes in the flora and fauna. A team of P G students and second-year B.Sc. students, and three faculty members from the postgraduate Department of Zoology attended the programme in 2015. In addition Plus one student from the MKNM HSS, Vengallore, participated in the programme. The programme started at 11 am with a public meeting jointly organised by the temple authorities and the Kerala Forest Department. All the speakers, including Dr. Shaju Thomas, Former HoD Dept. of Zoology, Nirmala College., Mr. Unnikrishnan, Forester, Sri Anilkumar, Principal, N.S.S. HS School., Sri. Regi, V.S., Mr. M.G. Rajan, and Mr. Sabu Sukamaran highlighted the need for conservation, people's participation in conservation and the commitment needed for restoring the past glory of the sacred grove.

Santhukad Sree Durga temple is situated in Nagappuzha, a typical village setting in central Kerala, and its history dates back several hundred years.

The study resulted in identifying 16 species of butterflies, three species of Odonates, five species of other invertebrates, two species of reptiles, 13 species of birds and one species of Mammal. The recommendations were informed to the authority.

We are thankful to the Temple authorities and The Dept. of Forests, Govt. of Kerala for inviting us to associate with the restoration project of the Kavu. We express our sincere thanks for the hospitality and the support given to us.

Plate 1. Various zones of sacred groves

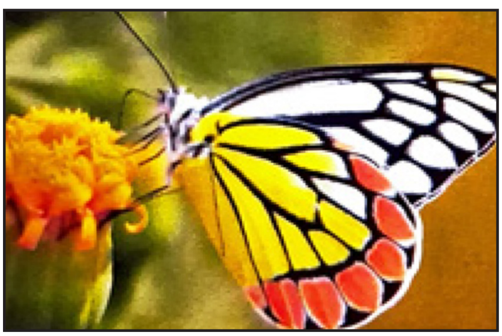
Plate 2. Selected Butterflies observed from Santhukad

Atrophaneura aristolochiae

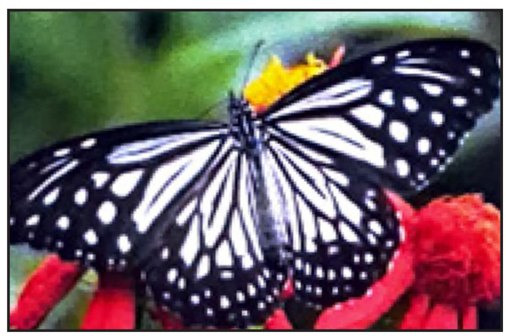
Atrophaneura pandiyana

Atrophaneura hector

Chilasa clytia



Delias eucharis



Pareonia valeria

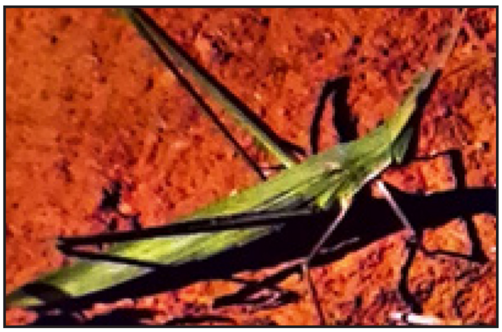
Catopsilia Pomona

Chilades parrhasius

Plate 3. Selected Orthopterans observed from Santhukad

Oxya japonica

Oxya hyla



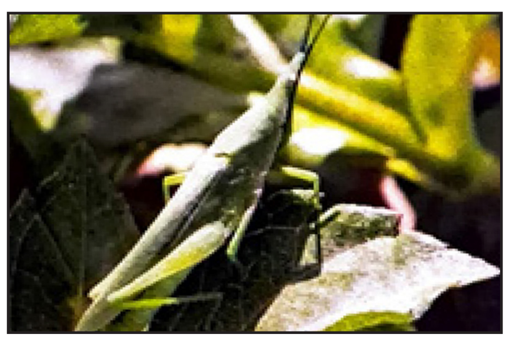
Acrida gigantea

Cercina obtuse

Acrida exaltata

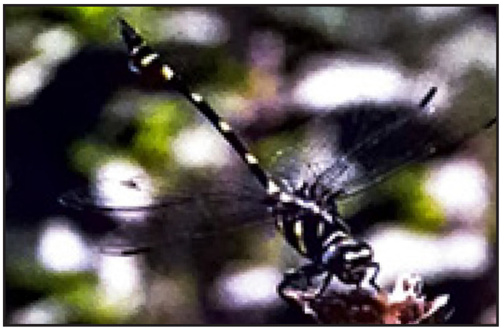
Aularches miliaris

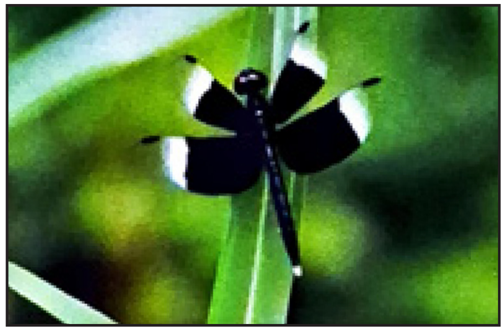
Neorthacris acuticeps



Atractomorpha crenulata

Plate 4. Selected Odonates observed from Santhukad


Ictinogomphus rapax


Neurothemis tullia


Brachythemis contaminate


Rhyothemis variegata


Vestalis apicalis


Pseudogrion indicum


Pseudogrion microcephalum

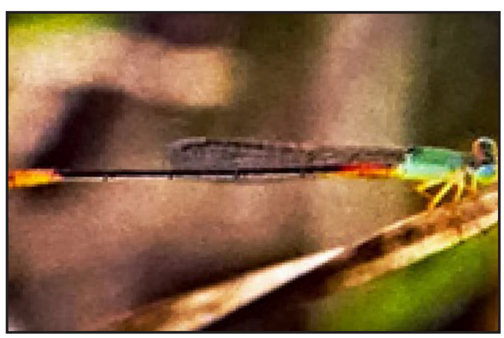

Ceriagrion cerinorubellum

Plate 5. Selected macroinvertebrates observed from Santhukad

Peryonix sp.

Megoscolex sp.

Amynthas corticis

Spirostreptus sp.

Pill millepede

Common centepede

Slug sp.

Apple snail

Plate 7. Various activites as part of the project

11.1.4 Participatory audit approach:

The implementation of an Environmental Management System (EMS) that incorporates solar energy production, car-sharing initiatives, gardens for medicinal plants and butterflies, the use of compost in vertical gardens, agriculture garden, compressive health management system(Physical& psychosocial assistance) water flow monitoring systems, and collaborative audit processes establishes a strong framework for sustainability at the college. By adopting these methods, the college not only reduces its environmental footprint but also fosters a culture of conservation, creativity, and community participation. This comprehensive strategy benefits the institution and acts as an example for others striving for environmental stewardship and sustainability.

Chapter XII

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

The thorough energy and infrastructure audit of the campus provides an in-depth analysis of its present energy consumption, operational efficiency, and sustainability measures. Annually, the campus utilizes 227,639 kWh of electricity, resulting in energy expenses of Rs. 24.22 lakh, delivered through 17 LT connections predominantly under the Educational Institution Tariff. The main areas of energy consumption include administrative buildings, the MCA block, hostels, and other minor utility connections. Nevertheless, the campus is lacking essential electrical infrastructure documentation, such as single-line diagrams and earth pit layout plans. Several electrical safety violations have been identified, including high current harmonics, worn rubber mats, dirty panels, inadequate relay calibration, and unclear circuit labelling, all of which pose risks to safety and operational integrity. A remarkable achievement has been the incremental solar installation, totalling 83 kW across four blocks, which has contributed to an average energy export of 22% back to the KSEB grid and significantly decreased reliance on traditional energy sources. It is highly recommended to prioritize the load unbalance, because electricity bills remain higher even though the institution has solar production. However, there are discrepancies in energy billing, potentially influenced by changes in tariffs and inefficient metering, necessitating further investigation. Locations like the Library Hall, characterized by heavy equipment use, and the student hostels surfaced as significant areas of power consumption. Although 1,389 LED lights have been installed, the transition is not yet complete, with 85 outdated fixtures still in place. The annual diesel consumption for backup power reaches an average of 3,200 liters; however, the absence of historical data limits the ability to analyse trends. Furthermore, the monthly consumption of 676 LPG cylinders for laboratories and food services represents a considerable basis for ongoing costs and environmental impacts. A significant positive change is seen in campus mobility, with 65% of two-wheeler users and a notable number of four-wheeler users engaging in vehicle-sharing, leading to a collective fuel savings of over 20,000 liters each year. The institution has made noteworthy strides in sustainability, particularly in solar energy and eco-friendly transportation. There are still significant opportunities to improve electrical infrastructure, enhance system documentation, and expand energy-efficient practices throughout all areas. The college presents a complex yet essential overview of its water management system, revealing both operational strengths and inefficiencies. The college retrieves water from five ponds and distributes it through pumps to various tanks; however, the automated filling system for sub-tanks creates significant difficulties due to its shared main tank connections, frequently resulting long time duration for water pumping. Water usage varies with the level of campus activity, with the Main Block being identified as the highest consumer due to its extensive operational requirements. The infrastructure in older buildings, such as the Jeevajyothi men's hostel and the sports hostel, shows considerable water loss stemming from outdated plumbing, in contrast to newer buildings that feature modern fixtures. The antiquated pump systems and timer-based operations lead to energy and water inefficiencies, particularly in the Main and DJ Blocks. While rainwater harvesting systems are in place, they suffer from inadequate maintenance and contamination risks, diminishing their overall effectiveness. The detection of E. coli in the system necessitated the implementation of water safety treatments like chlorination and biofilm remediation to ensure the quality and safety of the water supply. The audit also suggests strategic actions such as retrofitting inefficient infrastructure, resizing pumping equipment, and adopting centralized automation for better tank management. It stresses the importance of maintaining rainwater harvesting systems, establishing groundwater recharge systems to bolster long-term sustainability, and launching awareness programs to encourage responsible water usage among students, faculty, and staff. Through tackling these crucial issues, the college can enhance water conservation, lower operational costs, and reinforce its dedication to sustainable resource management.

The evaluation indicates that the institution produces waste in relation to its population size, which reflects steady consumption and disposal patterns. A significant dedication to the Green Campus initiative is apparent through structured waste management efforts, including efficient segregation with color-coded bins and signage for different waste types. The primary waste stream consists of bio-waste, particularly food waste, followed by paper waste. The college successfully handles bio-waste by utilizing composting and vermicomposting methods, but there is no credible evidence to confirm the amount being processed. The internal auditors are only aware that these practices are occurring excess food waste redirected to piggery. While biogas plants have been set up in four hostels, extending this to the main campus could diminish reliance on approximately 60 LPG gas cylinders used each year in the canteen and cafeteria. Plastic and electronic waste are dealt with through on-site processing and by authorized external agencies, while the disposal of chemical waste adheres to compliant protocols. Nonetheless, the audit reveals a deficiency in comprehensive quantitative data, as previous practices concentrated on item counts instead of actual weight or volume. To tackle this issue, the institution has established a zonal waste monitoring system with specific registers to enhance documentation, aiming to improve efficiency and encourage targeted waste-reduction strategies.

The campus showcases a significant degree of diversity. The abundance of biodiversity is apparent through the range of herbs, shrubs, birds, ants, insects, butterflies, and reptiles found here. Exotic ornamental plants are widespread in the area, causing a decline in the health of native plants, which subsequently affects the variety of insects, butterflies, and birds. Despite the population of native plants gradually rising, it influences the diversity of wildlife. It is observed that cultivated plants surpass wild plants on campus, highlighting that the land is being used by the college, as wild varieties are being supplanted by agricultural types.

Well-managed and dedicated system to safeguarding the health, safety, and overall growth of its campus community through a diverse and proactive strategy. The institution is praised for its thorough emergency preparedness system, which includes trained medical staff, efficient crisis communication, and regular practice drills, as well as high sanitation standards and gender-sensitive facilities. A supportive atmosphere is created through solid mental health services, recreational facilities, and extensive community involvement initiatives, all of which reflect a comprehensive philosophy of student development. The college's strategic campus layout, which harmonizes modern facilities with environmental care, further emphasizes this commitment. Nevertheless, significant issues that need immediate attention include breaches in food safety related to the canteen staff's failure to adhere to hygiene protocols and the presence of E. coli in the water supply. There are also safety concerns regarding outdated or non-compliant hazard and traffic signs. Elevated and inconsistent noise levels, particularly at the Boys Hostel, need to be addressed due to their potential to cause disruption. An institution fosters a safe, inclusive, and enriching educational experience. It is crucial to tackle these key weaknesses to achieve overall institutional excellence.

The organization has a yearly net carbon footprint totalling 99.04 tonnes of CO_2e. This final measurement is calculated from overall gross emissions of 218.37 tonnes, largely influenced by Scope 2 emissions from electricity consumption (121.24 tonnes), followed by Scope 1 direct emissions from the use of LPG and diesel (59.37 tonnes), and Scope 3 emissions arising from waste and water (37.76 tonnes). These emissions have been significantly balanced by a cumulative reduction and carbon capture of 119.33 tonnes. Key reduction initiatives include the generation of on-site solar power, which prevents 51.08 tonnes, and vehicle-sharing programs that collectively save 49.29 tonnes of emissions, along with smaller contributions from the biogas facility and tree sequestration on campus.

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

- Annie Leonardv

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