GOA UNIVERSITY

GREEN ENERGY AND ENVIRONMENT AUDIT

2024-25

Prepare By :
Green Energy Audit Committee

GOA UNIVERSITY
Taleigon Plateau
GOA-403 206

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PREFACE

The Green Audit-cum-Energy Audit represents a crucial step in our commitment to sustainable development and environmental responsibility. It acts as both a benchmark and a roadmap, helping to assess the environmental and energy-related initiatives implemented across the campus while providing insights to efficiently mobilize resources to address any identified gaps. This collective effort seeks to foster sustainable growth while safeguarding and enhancing the unique ecological wealth of the region.

Goa University's campus stands as a symbol of the seamless integration of development and nature. Rich in biodiversity, the campus is home to diverse flora and fauna, with well-maintained afforestation zones, rainwater harvesting systems, and conservation practices that protect the integrity of local species. These initiatives, supported by both internal management and external partnerships, have played a vital role in making the campus environmentally sustainable. However, the ongoing challenges posed by climate change and environmental degradation highlight the need for continuous monitoring and assessment to mitigate negative impacts and optimize environmental health.

This Green Audit-cum-Energy Audit offers a thorough analysis of the measures taken to enhance and sustain the campus environment. The report evaluates key environmental parameters, assesses progress made, and identifies areas requiring further attention and improvement. Drawing on factual data, the findings and recommendations presented are aligned with both global best practices and local environmental standards, with the goal of strengthening the university's role as a leader in sustainability.

The observations and suggestions outlined in this report are designed to guide university authorities in crafting actionable strategies that build on existing successes while addressing areas for improvement. This document reflects our shared commitment to maintaining a balance between academic excellence and ecological responsibility. We trust that it will serve as a valuable resource in achieving the university's environmental objectives and promoting a sustainable future for our community.

Prof. R. S. Gad

Chairperson

Green Energy Audit Committee

FOREWARD

Environmental degradation and the increasing global health challenges posed by waste management highlight an urgent need for sustainable practices. With dumpsites receiving 40% of global waste, and e-waste generation surpassing 50 million tonnes annually, addressing issues such as inadequate waste collection, low recycling rates, and poor treatment methods is imperative. The solution lies in adopting a circular economy approach, robust legal frameworks, and policies aligned with the Sustainable Development Goals (SDGs).

At Goa University, we are committed to environmental sustainability and have taken significant strides toward creating a greener campus. Over the years, the university has embraced eco-friendly technologies, including rainwater harvesting, hazardous waste management, and renewable energy initiatives such as solar panel installations. These efforts reflect our dedication to resource conservation and energy efficiency.

The plantation of local and endemic species, though a challenging endeavor, has been an ongoing priority. Initiatives like the Swachh Bharat Summer Internship (SBSI) have furthered this mission, engaging students in meaningful community development activities across Goa. These collective efforts exemplify the university's leadership in fostering environmental awareness and its role in conserving the environment for future generations.

I am pleased to present this Green Energy Audit Report, a pioneering effort by Goa University. It serves as both a benchmark for our achievements and a roadmap for future improvements in sustainability practices. I trust this report will inspire continued progress and deeper commitment to green initiatives, enabling Goa University to remain a leader in environmental conservation and sustainable development.

Prof. (HAG). Harilal B. Menon

Vice Chancellor,

Goa University

INDEX

CHAPTER-I

INTRODUCTION: GREEN ENERGY AND ENVIRONMENT AUDIT

INTRODUCTION: GREEN ENERGY AND ENVIRONMENT AUDIT

1. Introduction

An environmental audit is a systematic evaluation of an institution's impact on the environment. It helps in identifying areas of concern, assessing compliance with environmental regulations, and suggesting improvements for sustainability. This report highlights key environmental parameters that are crucial in minimizing environmental degradation and promoting eco-friendly practices.

2. Preamble for Conducting Environment Audit

The environment audit aims to assess various environmental aspects, including energy consumption, waste management, water conservation, and biodiversity. Conducting such audits allows institutions to adopt sustainable solutions, improve resource efficiency, and align with environmental standards. This report outlines the significance of 19 environmental audit parameters, their environmental impact, and measures to mitigate negative effects.

3. Environmental Audit Parameters

3.1 Preliminary Site Assessment & Data Collection

A preliminary site assessment involves collecting baseline data on environmental conditions, existing infrastructure, and resource consumption. This initial evaluation helps in identifying potential risks and formulating appropriate mitigation strategies.

3.2 Energy Consumption Analysis & Benchmarking

This audit assesses energy usage patterns and compares them with industry benchmarks to identify inefficiencies. Implementing energy-saving measures like using LED lighting and efficient appliances can significantly reduce energy wastage.

3.3 Electrical Load Analysis

Analyzing the electrical load helps in understanding power consumption trends and identifying overloaded circuits. Optimizing electrical distribution improves efficiency and prevents excessive energy consumption.

3.4 Lighting System Audit

Assessing the efficiency of lighting systems helps in reducing electricity usage. Using energy-efficient lighting solutions like LED bulbs and motion-sensor lighting can lower energy demand.

3.5 Renewable Energy Feasibility Study

Evaluating the feasibility of renewable energy sources such as solar or wind power reduces dependence on fossil fuels. Adopting green energy solutions contributes to sustainability and lower carbon emissions.

3.6 Water Pumping & Motor Efficiency Audit

Examining the efficiency of water pumps and motors helps in conserving both energy and water. Upgrading to energy-efficient pumps and implementing automation can enhance performance and reduce resource wastage.

3.7 Power Factor & Harmonics Analysis

Power factor correction improves energy efficiency by minimizing losses. Installing capacitors and filters can help in optimizing electrical consumption and reducing overall power wastage.

3.8 Carbon Footprint & Emission Analysis

Assessing carbon emissions from various activities like transportation and energy use highlights areas for improvement. Implementing carbon reduction strategies such as afforestation and clean energy adoption can mitigate environmental impact.

3.9 Report Preparation & Recommendations

A well-structured audit report consolidates findings and provides actionable recommendations. It serves as a guideline for implementing sustainable solutions and improving environmental performance.

3.10 Water Audit

Evaluating water consumption and conservation methods helps in reducing wastage. Implementing rainwater harvesting, wastewater recycling, and fixing leaks contribute to sustainable water management.

3.11 Waste Management Audit

Analyzing waste generation and disposal methods promotes proper waste segregation and recycling. Encouraging composting and reducing landfill waste minimizes environmental pollution.

3.12 Air Quality Audit

Measuring air quality levels helps in identifying pollution sources. Implementing air purification systems, controlling emissions, and increasing green cover enhance air quality.

3.13 Noise Pollution Audit

Monitoring noise levels in different zones ensures compliance with permissible limits. Using noise barriers and soundproofing solutions helps in minimizing noise pollution.

3.14 Biodiversity Audit

Documenting flora and fauna on the premises supports ecological balance. Conservation efforts, such as protecting native species and creating green zones, help maintain biodiversity.

3.15 Green Cover Assessment

Evaluating tree cover and afforestation initiatives promotes environmental sustainability. Expanding green spaces improves air quality and reduces urban heat effects.

3.16 Carbon Footprint Assessment

Measuring greenhouse gas emissions from various activities highlights areas for improvement. Switching to cleaner energy sources and reducing fossil fuel use contribute to carbon footprint reduction.

3.17 Compliance Audit

Reviewing adherence to environmental regulations ensures legal compliance and promotes sustainability. Regular audits help organizations stay aligned with eco-friendly policies.

3.18 Sustainable Practices Audit

Assessing initiatives such as rainwater harvesting and solar energy adoption promotes resource conservation. Encouraging green infrastructure enhances sustainability efforts.

3.19 E-Waste Management Audit

Proper disposal and recycling of electronic waste prevent hazardous material contamination. Encouraging responsible e-waste management mitigates environmental risks and supports circular economy practices.

4.0 The Objectives, Scope and Methodology

1. Introduction

This section provides an overview of the purpose and importance of conducting the Green Energy and Environment Audit at Goa University.

2. Objectives of the Audit

- To assess the environmental performance of the institution.
- To identify areas for improving sustainability and energy efficiency.
- To ensure compliance with environmental regulations.
- To promote awareness and best practices among stakeholders.

3. Scope of the Audit

The audit covers energy consumption, water usage, waste management, biodiversity, Air Pollution, Noise Pollution, Carbon Foot prints, and pollution control measures within Goa University's campus.

4. Methodology

The audit follows guidelines such as ISO and involves data collection through site visits,

interviews, and analysis of energy, water, and waste records.

5. Institutional Details

• Name of Institution: Goa University

• Address: Taleigao Plateau, Goa- 403 206

• Campus Area: 427.90 Acres

• Total Number of Students and Staff: 5465/ Day

• Environmental Policies Implemented: Yes

6. Energy Audit

• Electricity Consumption Analysis

• Renewable Energy Sources

• Energy Efficiency Measures Implemented

7. Water Audit

• Water Consumption Patterns

• Rainwater Harvesting Systems

• Water Conservation Initiatives

8. Waste Management Audit

• Segregation and Disposal Practices

• Recycling and Composting

• Hazardous Waste Management

9. Biodiversity and Green Campus Audit

• Green Cover Analysis

• Conservation of Native Species

• Sustainable Landscaping

10. Air and Noise Pollution Audit

• Air Quality Monitoring

• Noise Pollution Levels and Control Measures

11. Recommendations and Action Plan

This section outlines suggested improvements based on the audit findings and an action plan for implementation.

12. Conclusion

Summary of key findings, overall assessment, and future directions for environmental

sustainability at Goa University.

13. CERTIFICATE OF GREEN ENERGY AND ENVIRONMENT AUDIT

The audit is done in line with the **ISO 19011:2018 - Guidelines for Auditing Management Systems**, the following key points are incorporated into an **Environmental Audit Report**:

1. Introduction

- Purpose of the audit
- Scope of the audit (what is covered)
- Audit criteria (ISO 14001, local environmental laws, internal policies)
- Audit methodology

2. Audit Process

- **Planning:** Defining scope, criteria, and audit team
- **Execution:** Data collection, site visits, interviews, document verification
- **Analysis:** Evaluating compliance and identifying non-conformities
- **Reporting:** Compiling findings and recommendations

3. Key Parameters for Environmental Audit

Sr. No	Parameter	Description
1	**Energy Efficiency**	Usage of renewable energy, energy conservation measures
2	**Water Management**	Rainwater harvesting, wastewater treatment, usage efficiency
3	**Waste Management**	Segregation, recycling, disposal practices
4	**Air Quality**	Monitoring of air pollution sources, emissions control
5	**Biodiversity Conservation**	Green cover, plantation drives, ecosystem protection
6	**Carbon Footprint**	Reduction strategies, offset programs
7	**Sustainability Practices**	Green procurement, eco-friendly policies
8	**Legal Compliance**	Adherence to environmental laws and regulations
9	**Environmental Training**	Awareness programs for students and staff

CHAPTER-II

ABOUT GOA UNIVERSITY

Edited by Dr. Siddhi Jalmi

1.1 ABOUT GOA UNIVERSITY

Goa University, established under the Goa University Act of 1984 (Act No. 7 of 1984), commenced its operations on 1st June 1985. Situated on the Taleigao Plateau, the university overlooks the picturesque Zuari estuary, offering a scenic and tranquil environment conducive to academic pursuits. The campus spans an expansive 427.9 acres, featuring state-of-the-art infrastructure and diverse habitats that are integral to its unique identity.

Strategically located on the outskirts of Panaji, Goa's capital city, the university campus is geographically fragmented by infrastructure, such as the Bambolim-Dona Paula highway and the recently constructed Dr. Shyamaprasad Mukherjee Indoor Stadium. This fragmentation mirrors the broader developmental pressures faced by plateau ecosystems in Goa, which are often undervalued due to their dry and barren appearance during the drier months. Developmental activities in the region have led to significant encroachment and loss of natural vegetation, raising concerns about the ecological integrity of these habitats.

Despite these challenges, Goa University stands out as an important resource center for research on the flora and fauna endemic to the Western Ghats and the Arabian Sea. Recognized for its contributions to marine and ecological sciences, the university houses a Centre of Excellence in Marine Microbiology, established by the Ministry of Earth Sciences. Its various departments are well-equipped with advanced research facilities, supported by generous funding from national agencies such as the University Grants Commission, Department of Science & Technology, Ministry of Earth Sciences, and Department of Biotechnology.

The university’s commitment to ecological research has yielded significant insights into the biodiversity of the Taleigao Plateau. A year-long study by Desai, M. & A.B. Shanbhag (2012) documented 114 bird species on the plateau, including 19 migratory species and six distant migrants, as published in the Journal of Threatened Taxa. Additionally, the campus itself supports over 180 avian species, accounting for nearly 40% of Goa's recorded bird species. Notably, the Yellow Wattled Lapwing, a species confined to plateaus, finds a sanctuary here, highlighting the ecological richness of the area.

The diverse habitats within and around the campus of grasses, shrubs have been extensively catalogued. Prof. M. K. Janarthanam, a renowned botanist, has made significant contributions to documenting the flora of the Goa. Research efforts have also focused on avian populations, lepidopterans, arachnids, and herpetofauna, underscoring the campus’s role as a prime habitat for both local and migratory species. Significant studies, such as those by Shanbhag, A.B. & A. Gramopadhye (1993) on the changing ecology of the Taleigao Plateau, further demonstrate the university’s dedication to conserving its ecological heritage. The combined efforts of faculty and researchers, such as Prof. M. K. Janarthanam and others, highlight Goa University's leadership in ecological research and its unwavering commitment to sustainability.

Figure 1.1: The administrative building of Goa University and the google map view of university campus

CHAPTER-III

THE BUILDINGS AND INFRASTRUCTURE

Edited by Dr. Anthony Viegas

3.1 THE BUILDINGS AND INFRASTRUCTURE

The Goa University is spread over 427.9 acres of land. The administrative and academic department and sections are located in 38 buildings located across the campus. The entire campus has rich flora and fauna, water bodies, plantation. The buildings are identified by certain codes and has different department/section in each building. The details are shown below in the Table No. 3.1 and Table No. 3.2.

Table 3.1: The details of each block including the various departments and sections.

Sr. No.	Name of Building	Building Code
1	Pure Science building	Block-A
2	Arts Faculty Building	Block –B
3	Applied science building	Block –C
4	Old management Building	Block –D
5	New Science Building	Block –E
6	New Commerce Faculty	Block –F
7.	Women's Hostel- I	
7a	PhD Girls Hostel -I	
7b	PhD Girls Hostel -II	
8	Guest House	
9.	International Guest House	
10.	Men's Hostel-I	
11.	Renovated ladies Hostel	
12.	Ph. D. Boys Hostel - II	
13.	International Masters in Business Administration Building	I.M.B.A Building
14.	University Science instrumentation centre Building	U.S.I.C Building
15.	Zoology building(old)	
16.	Library Building	
17.	Faculty Canteen	
18.	Administrative Building	
19.	Animal House (applied zoology bldg..)	
20.	New (A)& (B) Flats/Quarters	
21.	Old A & B type Qtrs.	
22.	C- Type Quarters	
23.	D-type Quarters	
24.	Gymnasium building	
25.	Computer Science Lab building	
26.	Shopping Centre complex	
27.	Sports Building	
28.	New sports Changing room building	
29.	New Health Centre building	
30.	Examination Building.	
31	Bungalow no 1	
32	Bungalow no 2	

33	Post Office building	
34	Centre for Latin American Studies Building	C.L.A.S Building
35	Human Resource Development Centre Building	H.R.D.C building
36	New Transit Accommodation type Quarters.	New TA Qtrs
37	Old A& B Type Qtrs	
38	Electrical Substation Building	
39	Manohar Parrikar School of Law, Governance and Public Policy	Block G
40	Lecture Halls for Faculty Block F	
41	Computer Science Block in Goa Business School	

Table 3.2: The categorization of department in different buildings

Sr. No.	NAME OF BUILDING	DEPARTMENT/SECTION
1	Pure Science building	Botany , Mathematic, Physics department
2	Arts Faculty Building	Hindi, English, Marathi, Konkani, Philosophy, sociology, economics, French, Portuguese, history, Political science, Women's Studies department
3	Applied science building	School of Earth Ocean and Atmospheric science, M.C.A department
4	Management Building (Old)	Under Renovation
5	New Science Building	School of Chemical Sciences, Biotechnology, Microbiology and Zoology department
6	New Commerce Faculty	Goa Business School/ M.B.A & commerce
7	Women's Hostel- I	Accommodation for P.G students
8	PHD Girls Hostel -I	Accommodation for Research Scholars
9	Women's Hostel -II	Accommodation for P.G Students
10	Guest House	Accommodation for Examiners, HRDC Participants, Guests, Invited Speakers
12	International Guest House	Accommodation for Examiners, Guests, Invited Speakers
13	Men's Hostel-I	Accommodation for P.G Students
14	Renovated ladies Hostel	Accommodation for I. C. C. R Students (Under renovation)
15	Phd. Boys Hostel - II	Accommodation for Research Scholar
16	International Masters in Business Administration Building	Goa Business School (Dept of IMBA)
17	University Science instrumentation centre Building	Electronics, USIC
18	Zoology building(old)	Goa Business School (Dept of IMBA)

19	Library Building	Library Office, Reading Room, Office of Estate Admin.& Allied Services
20	Faculty Canteen	Canteen facility
21	Administrative Building	Office of Vice-Chancellor,Office of the Registrar, Administration(NT), Administration(T), Finance, Academic, computer Centre, Purchase, legal, Conference Hall, I.Q.A.C, Placement, Senate hall, DDLI section
22	Animal House (applied zoology bldg..)	Examination Annex(Currently under renovation)
23	New (A)& (B) Flats/Quarters	Accommodation for Professors, Associate Professors, Assistant Professors, Officers of Goa University
24	Old A & B type Qtrs	…..do…..
25	C- Type Quarters	Accommodation for Non-teaching…Group C Employees
26	D-type Quarters	Accommodation for Non-teaching…Group D Employees
27	Gymnasium building	Engineering & technical Division, Gymnasium
28	Old research Scholars Hostel	Security Staff accommodation
29	Computer Science Lab building	Computer Science
30	Shopping Centre complex	S. B .I branch, S.B.I ATM, Stationary & Xerox , General Store
31	Sports Building	Sport's Section
32	New sports Changing room building	Changing Room
33	Health Centre building	Health Centre, Clinic for Doctor, Clinic for homeopathy & Ayurveda resident accommodation of 108
34	Examination Building.	Office of C.O.E, Exam Post graduate (P.G), Exam Under graduate (U.G) & Professional section
35	Bungalow no 1	Used for residential Accommodation for V.R.P.P section
36	Bungalow no 2	Not in use
37	Post Office building	Sub Post Office, Goa University
38	Centre for Latin American Studies Building	Department of Centre of Latin American (C.L.A.S)
39	Human Resource Development Centre Building	H.R.D.C office, classrooms & canteen facility
40	TA type Quarters	Transit Accommodation for new recruit staff of teaching / Non-teaching till the time of allotting quarter as per eligibility
41	Electrical Substation Building	Substation of Goa University

CHAPTER-IV

GREEN GOA AND GREEN CAMPUS

Edited by Dr. Siddhi Jalmi

4.1 GREEN GOA AND GREEN CAMPUS

Goa University has established itself as a model for sustainability and environmental stewardship through its efforts to maintain a green campus and contribute to the broader vision of a "Green Goa." Located on the Taleigao Plateau, the campus serves as a biodiversity hotspot, offering a natural refuge for flora and fauna amid increasing urbanization. The university's green initiatives have been carefully designed to harmonize with its unique ecological surroundings, promoting environmental conservation alongside academic excellence.

Goa is located in the western ghats region well known for its biodiversity, with forests covering approximately 1,424 km², most of which are government-owned. The Western Ghats, which form the eastern boundary of the state, have been internationally acknowledged as one of the world's biodiversity hotspots. Goa's rich ecological diversity has drawn comparisons to the Amazon and Congo basins, as highlighted by National Geographic in its February 1999 issue. The state boasts a remarkable variety of flora and fauna, including the **state animal Gaur (*Bos gaurus*)**, the **state bird Ruby-throated Yellow Bulbul (*Rubigula dispar*)**, and the **state tree Matti (*Terminalia Elliptica*)**. *Terminalia Elliptica* or The 'Indian Laurel' which is known as water reserving tree of forest.

Figure 4.1: The Goa state animal Gaur (*Bos gaurus*), the state bird Ruby-throated Yellow Bulbul (*Rubigula dispar*), and the state tree Matti (*Terminalia Elliptica*).

The Goa University campus exemplifies this biodiversity. Its rocky lateritic plateau is transformed into a verdant landscape during the monsoon season, supporting diverse grass, ephemerals, shrubs, and trees. The plateau serves as a seasonal resting habitat for migratory birds, adding to its ecological significance. The campus also supports a rich avifauna, wild animals, and sporadically distributed tall trees, further enhancing its biodiversity.

In collaboration with many of foundations and companies like Western Ghats Kokum Foundation, Deccan Fine Chemicals Pvt. Ltd., Goa University has undertaken a Biodiversity Enrichment Program, which includes the development of a mango orchard, plantation of 200 Banyan and Peepal trees for carbon neutralization along the periphery of the campus, as part of its permanent greening efforts. Annual plantation drives, held under the "Vanamahotsav" initiative and Mission LiFE as a part of Vasudha Vandhan under “Meri Maati Mera Desh” campaign, have significantly contributed to increasing green cover and biodiversity on campus. The plantation block established in 1994 under the Energy Plantation Program (funded by the Department of Non-Conventional Energy Sources, DNES) houses 12 different tree species, reflecting a well-planned approach to sustainable greening.

Figure 4.2: The Annual plantation drives, held under the "Vanamahotsav" initiative and Mission LiFE as a part of Vasudha Vandhan under “Meri Maati Mera Desh” campaign

4.2 KEY GREEN INITIATIVES AT GOA UNIVERSITY

i. Rainwater Harvesting:

The university has implemented a rainwater harvesting system since last six years that recharges the groundwater reservoir to the tune of about 40 million liters per year.

ii. Renewable Energy Usage:

The campus features a 5 KVA hybrid wind and solar power plant that powers the University Science Instrumentation Center (USIC) building. Additionally, 83 solar lamps illuminate the campus streets, reducing reliance on conventional energy sources and lowering the carbon footprint.

iii. Biodiversity Conservation:

The university has taken concerted efforts to preserve the existing biodiversity despite ongoing construction activities for academic and residential facilities. Habitats such as grasslands, shrublands, and forest patches are actively maintained, ensuring the survival of various endemic and migratory species.

iv. E-Waste and Hazardous Waste Management:

Safe disposal practices for e-waste and hazardous materials have been implemented, further strengthening the university's commitment to environmental responsibility.

v. Biodiversity Plantations:

The university has successfully implemented scientifically planned biodiversity plantations, even on the hard lateritic terrain of the plateau. These plantations contribute to the ecological balance of the region while enhancing the aesthetic appeal of the campus.

vi. Sustainability-Oriented Maintenance:

Regular maintenance of the green areas, including wild grass cutting and seasonal plantation activities, is conducted to sustain the ecological health of the campus.

Goa University's efforts align with the broader goal of creating a "Green Goa" while setting an example for other educational institutions in India. The integration of biodiversity conservation, renewable energy, and sustainable resource management has made it a leader in the domain of green campuses. The university's visible commitment to maintaining the ecological balance of its unique plateau ecosystem ensures that it remains a hub for ecological research, innovation, and environmental advocacy.

3.3 ORGANIZED ENERGY PLANTATION AT GOA UNIVERSITY

i. Plantation of trees within the Goa University Campus has been a regular feature since the inception of the University. Besides, the World Environment Day is observed on 5th June and "Vanamahostav" is also celebrated every year.

ii. Goa University's Energy plantation programme initiated as early as in 1994 and funded by the Department of Non-Conventional Energy Sources (DNES), New Delhi has been a success

story. A total of 12 different species of trees are found growing in the DNES plantation block. Presently there are about 800 fuel wood plant species growing at the site.

iii. Goa University has also made concerted efforts towards increasing the plantation on the campus. Initially, this hard-lateritic plateau had very sparse vegetation. The Biodiversity Plantations in the University campus was a joint initiative involving Goa University, Western Ghats Kokum Foundation (an agro-eco promotion NGO), and State Bank of India, M/s Sesa Goa, M/s Chowgule industries and the Forest Department, Government of Goa. A total of 2100 plants were planted with selected tree species covering an area of 60 acres in the last 7 years.

iv. To mitigate the acute shortage of water, a new bore-well was dug. Four temporary ponds were set up to store the pumped-out water. Each plant was covered with shade net and adequately protected from monsoon wind, rain and stray cattle. Weedy grasses were cut by grass cutting machines and the plants were regularly watered throughout the winter and summer months. Presently sizeable portion of the campus is contiguously green. iv. Residents on the University campus have been encouraged to plant various fruit trees. This has added to the diversity and beauty of the campus. The faculty residential area as well residences occupied by non-teaching staff, the Hostels, the faculty canteen among others sport good diversity of fruit plants. Many residents have kitchen gardens.

v. By natural composting of litter, the campus permits natural mineralization of aboveground plant litter in mixed natural plant communities to conserve biodiversity and capture nutrients

vi. Raising plantations on the University campus has been difficult due to its hard-lateritic surface which hardly supports plant growth. Earlier afforestation efforts have met with little success as they encountered a high mortality rate. Besides stray cattle and campus fires were the other important constraints for plant growth and survival. Therefore, an innovative approach to initiate biodiversity plantations on the lateritic plateau of the campus was followed. Excavation of 2100 pits (1mx1mx1m), filling with garden soil and manure, and planting with selected tree species resulted in high (>90%) survival rate. The “Ratnagiri Irrigation System” was adopted to water each and every plant. In this system each plant was provided with 2-3 equidistantly positioned earthen pots at the base. These pots were manually filled with water once in every three days all through the summer months.

4.4 EFFORTS FOR CARBON NEUTRALITY

The Goa University campus and its surrounding area has a good vegetative cover with low vehicular traffic and hence the resultant emissions are minimal. However, University has undertaken activities like MoU with Deccan Chemicals Pvt. Ltd. for plantation of 200 trees along the periphery of the campus for a step towards carbon neutralization. This Corporate Social Responsibility (CSR) activity underscores the commitment to sustainable development and ecological balance. The partnership with Deccan Chemicals underscores the importance of academic-industry collaboration in addressing the environmental challenges.

The primary objective of this plantation drive was to enhance the green cover around the periphery of Goa University's campus, neutralize carbon emissions and enhance the ecological and aesthetic value of the campus environment. This was achieved by digging 200 pits of 2x2x2 meter dimension and planting 200 tree saplings, predominantly of the Ficus species such as Peepal (*Ficus religiosa*),

Banyan (*Ficus benghalensis*), and other species like Jackfruit (*Artocarpus heterophyllus*) and Cashew (*Anacardium occidentale*). This work of digging pits and plantation of saplings was completed in by 15th of October 2024. The GPS coordinates was marked to each sapling planted and the details of the same is given in the table below along with photographs of the saplings.

4.5 HIGHLIGHTS OF THE GOA UNIVERSITY'S GREEN CAMPUS

i. Greenery on the campus is taken care by regular maintenance and also conducts annual plantation program under "Vanamahosthav", "Meri Matti Mera Desh", "Ek Ped Maa ke Naam", etc.

ii. Development of efficient water harvesting system on the campus facilitated recharging of groundwater reservoir on the campus for its use.

iii. Scientifically planned and successfully implemented biodiversity plantations on hard lateritic campus and sincere efforts have/are being carried out towards campus greening.

iv. Safe disposal of e-waste and proper hazardous waste management.

v. Conservation of the existing rich biodiversity on the campus.

Figure 4.3: Yearly maintenance of University campus for wild grass. Stock of grass piles.

Figure 4.4: Photo of planned forestation 800 fuel wood plant species.

Figure 4.5: Plantation of 200 numbers of Peepal and Banyan tree saplings carried out at the periphery of the campus as effort for carbon neutralization

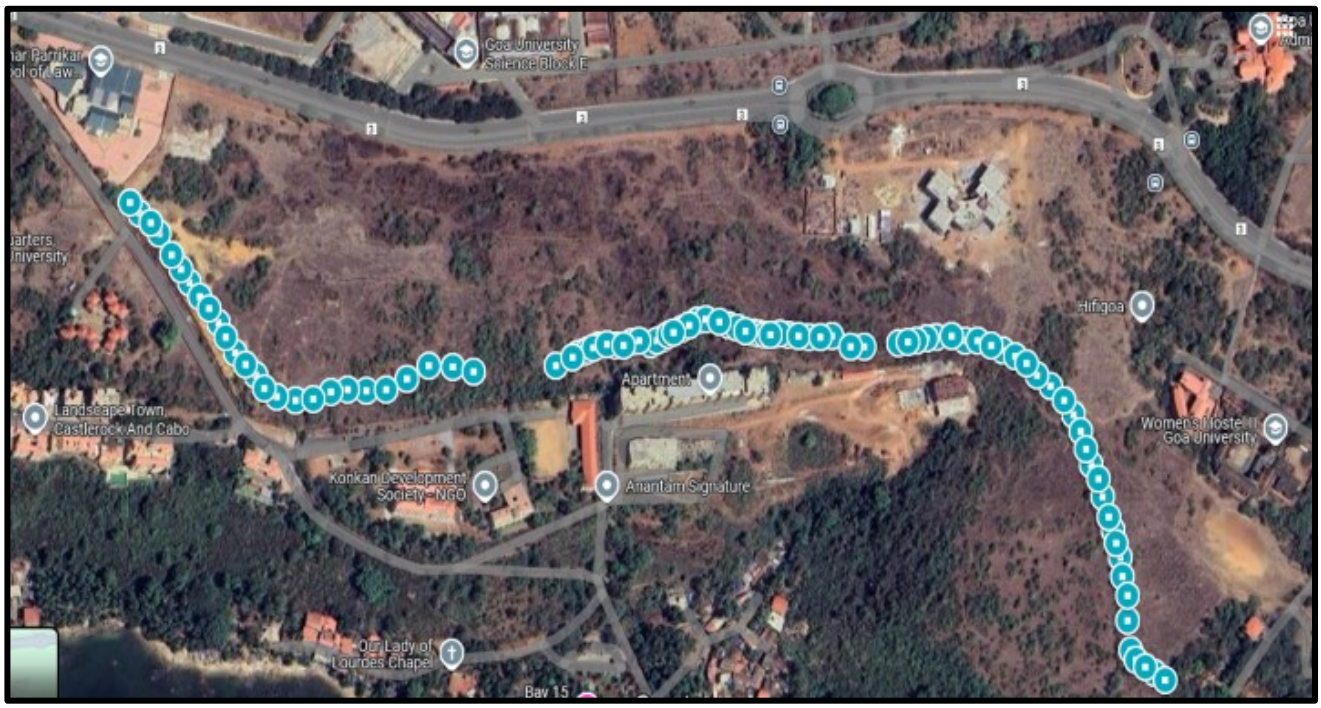

Figure 4.6: GPS coordinates of plantation of Peepal and Banyan tree saplings carried out at the periphery of the campus

CHAPTER-V

FLORA, FAUNA and AVIANS ON UNIVERSITY CAMPUS

Edited by Dr. Siddhi Jalmi,

Dr. Nitin Sawant and Dr. Minal Desai Shirodkar

5.1. FLORA ON THE UNIVERSITY CAMPUS

The flora of the Goa University campus is a rich blend of natural vegetation and cultivated species, reflecting the biodiversity of the surrounding Taleigao plateau and the broader ecosystem of Goa. The campus hosts a unique mixture of moist deciduous forests, evergreen species, and specialized lateritic plateau vegetation, creating a vibrant habitat for various species and supporting conservation initiatives.

5.1.1 Vegetation Composition

The campus vegetation predominantly consists of moist deciduous species, interspersed with patches of evergreen trees and open lateritic grasslands. Lateritic plateaus, characteristic of this region, harbor unique flora due to their shallow soil cover and rocky terrain. These areas are dominated by grasses, shrubs, and scattered trees such as *Ficus benghalensis* and *Ficus religiosa*. Exotic invasive species, including *Lantana camara* and *Parthenium* spp., can also be observed throughout the campus.

The university has actively contributed to afforestation, incorporating native and exotic species into its landscape. Notable species planted during various drives include:

- Fruit-bearing trees like *Mangifera indica* (Mango), *Syzygium cumini* (Jamun), and *Garcinia indica* (kokum).
- Timber and shade-providing species such as *Samanea saman*, *Terminalia* spp., *Cassia fistula*, and *Acacia auriculiformis*.
- Medicinal plants like *Azadirachta indica* (neem) and *Tamarindus indica* (tamarind), *Andrographis paniculata*, *Phyllanthus emblica* (amla) and *Terminalia* sp.
- Rare native trees such as *Bombax malabaricum* and *Dalbergia sissoo*.

Additionally, plantations in areas like the faculty enclave and near the Computer Science building showcase a mix of fruit, ornamental, and timber species, enhancing the biodiversity and aesthetic appeal of the campus.

The energy plantation program, initiated in 1994 and supported by the Department of Non-Conventional Energy Sources (DNES), marked a significant step toward promoting sustainable practices. This program has introduced 12 different tree species across the campus.

Also the plantation drive of planting 200 tree saplings around the periphery of the campus for the carbon neutralization was carried out. This initiative was a part of CSR activity by Deccan Fine Chemicals Pvt. Ltd.

The afforestation drives and energy plantations contribute not only to the ecosystem's integrity but also to the educational and research opportunities for students and faculty alike. Moreover, the campus's open nature, allowing cattle grazing, aids in natural seed dispersal and soil enrichment.

5.1.2 Flora Studies and Conservation Efforts

A detailed project, co-authored by Dr. Siddhi Kashinath Jalmi and Ms. Ashweta Ashok Gaude, systematically documented the floral diversity in the book Nature's Palette. This initiative was part of Goa University’s Green Energy Audit, which focused on cataloging plant species across various locations on campus. There were 75 species of trees, 41 species of shrubs, 70 species of herbs and 16 species of vines on the campus. Some of the key plant species observed were:

Tree Species

The tree species documented include a mix of native and exotic plants. Some prominent species include:

- Fruit Trees: *Mangifera indica* (Mango), *Syzygium cumini* (Jamun), *Phyllanthus emblica* (Amla), *Garcinia indica* (Kokum), *Manilkara zapota* (Chiku).
- Forestry Species: *Acacia auriculiformis*, *Terminalia elliptica*, *Casuarina equisetifolia*, *Bombax malabaricum* (Silk Cotton), *Alstonia scholaris* (Saptaparni), *Samanea saman* (Rain Tree), *Dalbergia sissoo* (Sheesham).
- Ornamental and Shade Trees: *Delonix regia* (Gulmohar), *Cassia fistula* (Golden Shower), *Peltophorum ferruginea*.

Shrubs and Herbs

The documentation of shrubs and herbs reveals the diversity of undergrowth plants that thrive on the campus. Commonly observed species include:

- *Chromolaena odorata*, *Ocimum tenuiflorum* (Holy Basil), *Clerodendrum infortunatum*, Justicia adhatoda

These species provide food and shelter for a variety of insects and birds, contributing to the ecosystem's complexity.

Climbers and Vines

Several climbers and vines have also been identified, adding to the aesthetic and ecological richness of the campus. Notable examples are:

- *Thunbergia grandiflora*, *Cissus quadrangularis*, *Ipomoea cairica*, *Bauhinia vahlii*

Flowering plants

The Goa University campus is rich in biodiversity. Though 55 tree species with ≥ 30 cm GBH is recorded the total number of species recorded from the campus is 531 (Yadav & Janarthanam, 1994: Flowering plants of Taleigao Plateau – Checklist). Several species have been added to the list later and several other species have been planted subsequently. The campus is also known for herbaceous endemic species. The list of endemic species is given in Table 4.2.

Alstonia scholaris

Spathodea campanulata

Cassia Fistula

Tamarindus indica

Figure 5.1.1: Selected pictures of trees found on the campus documented in the book "Nature's Palette"

Figure 5.1.2: Selected pictures of herbs found on the campus documented in the book "Nature's Palette"

Table 5.1.1: Plant species found on Goa University campus

TREES		
Anacardium occidentale	*Phyllanthus emblica*	*Acacia mangium*
Lannea coromandelica	*Syzygium caryophyllatum*	*Bauhinia purpurea*
Plumeria alba	*Tectona grandis*	*Bombax ceiba*
Alstonia scholaris	*Adenanthera pavonine*	*Strychnos nux-vomica*
Brahea edulis	*Trema orientalis*	*Cordia dichotoma*
Heterophragma quadrioculare	*Lagerstroemia speciosa*	*Samanea saman*
Markhamia lutea	*Terminalia arjuna*	*Manilkara zapota*
Spathodea campanulata	*Adansonia digitata*	*Muntingia calabura*
Mammea suringa	*Ficus microcarpa*	*Ficus hispida*
Terminalia catappa	*Ficus exaperata*	*Santalum album*
Terminalia paniculata	*Ficus arnottiana*	*Zanthoxylum rhetsa*
Cassia Fistula	*Annona muricata*	*Cinnamomum tamala*
Delonix regia	*Ziziphus mauritiana*	*Caryota urens*
Leucaena leucocephala	*Terminalia bellirica*	*Ficus racemosa*
Peltophorum pterocarpum	*Sterculia urens*	*Ficus religiosa*
Pitthacellobium dulce	*Acacia auriculiformis*	*Psidium guajava*
Tamarindus indica	*Mangifera indica*	*Pongamia pinnata*
Careya arborea	*Phyllanthus acidus*	*Ziziphus xylopyrus*
Grewia tilifolia	*Polyalthia longifolia*	*Mimusops elengi*
Acacia chundra	*Erythrina indica*	*Grewia multiflora*
Albizia lebbeck	*Syzygium cumini*	*Acacia schweinfurthii*
Artocarpus heterophyllus	*Roystonea regia*	*Firmiana colorata*
Ficus bengalensis	*Plumeria rubra*	*Azardirachta indica*
Garcinia indica	*Gmelina arborea*	*Cocos nucifera*
Gliricidia sepium	*Moringa oleifera*	*Carallia brachiate*

SHRUBS		
Allamanda cathartica	*Raulfia serpentina*	*Mesosphaerum suaveolens*
Calotropis gigantea	*Tecoma stans*	*Abelmoschus manihot*
Calycopteris floribunda	*Cassia tora*	*Hibiscus rosa-sinesis*
Carissa carandas	*Combretum indicum*	*Memecylon umbellatum*
Catharanthus roseus	*Bridelia stipularis*	*Ochna integerrima*
Holarrhena pubescens	*Jatropha integerrima*	*Jasminum malabaricum*
Microcos paniculata	*Ricinus communis*	*Breynia retusa*
Durenta erecta (variegata)	*Indigofera hirsuta*	*Flueggea leucopyrus*
Lantana camara	*Tephrosia purpurea*	*Phyllanthus myrtifolius*
Ziziphus oenopolia	*Bougainvillea sp.*	*Ziziphus rugosa*
Jatropha gossypiifolia	*Crotalaria longirostrata*	*Chaenomeles speciosa*
Pseuderanthemum carruthersii	*Premna serratifolia*	*Gardenia jasminoides*
Antidesma acidum	*Allophylus cobbe*	*Ixora coccinea*
Clerodendrum infortunatum	*Russelia equisetiformis*	
HERBS		
Acalypha indica	*Stylosanthes hamata*	*Physalis minima*
Waltheria indica	*Microstachys chamaelea*	*Desmodium triflorum*
Impatiens balsamina	*Xenostegia tridentata*	*Jatropha podagrica*
Musa paradisiaca	*Amaranthus spinosus*	*Leucas aspera*
Carica papaya	*Lindernia crustaceae*	*Scoparia dulcis*
Synedrella nodiflora	*Alysicarpus vaginalis*	*Murdannia nudiflora*
Spigelia anthelmia	*Alysicarpus ovalifolius*	*Murdannia semiteres*
Borreria laevis	*Alysicarpus longifolius*	*Melochia corchorifolia*
Euphorbia hirta	*Eriocaulon heterolepis*	*Cleome rutidosperma*
Cyanthillium cinereum	*Mollugo pentaphylla*	*Portulaca oleraceae*
Tridax procumbens	*Rhamphicarpa fistulosa*	*Evolvulus nummularius*
Cleome viscosa	*Crinum viviparum*	*Corchorus aestuans*

Indigofera dalzellii	*Phyllanthus niruri*	*Sphaneticola trilobata*
Tecca leontopetaloides	*Micrococca mercurialis*	*Andrographis paniculata*
Chlorophytum tuberosum	*Impatiens minor*	*Celosia argentea*
Aeschynomene americana	*Neanotis subtilis*	*Sesamum indicum subsp. Malabaricum*
Phyllanthus urinaria	*Polygala elongata*	*Cassia mimosoides*
Alternanthera ficoidea	*Geissaspis cristata*	*Oldenlandia corymbose*
Desmodium incanum	*Lepidagathis lutea*	*Striga asiatica*
Commelina diffusa	*Curculigo orchioides*	*Euphorbia heterophylla*
Utricularia praeterita	*Phyllanthus tenellus*	*Melanthera nivea*
Commelina benghalensis	*Bonnaya ciliata*	*Mimosa pudica*
Ocimum sanctum	*Biophytum sensitivum*	*Boerhavia diffusa*
Tricholepis glaberrima		
VINES		
Cansjera rheedei	*Cryptolepsis dubia*	*Cucumis trigonus*
Vigna vexillata	*Tinospora cordifolia*	*Clitoria ternatia*
Ipomoea quamoclit	*Ichnocarpus frutescens*	*Gloriosa superba*
Passiflora foetida	*Celastrus paniculatus*	*Dragea volubilis*
Hemidesmus indicus	*Thunbergia laurifolia*	*Ampelocissus latifolia*
Smilax ovalifolia		

Table 5.1.2: List of herbaceous endemic species in Goa University Campus.

Sr. No.	Family	Name of the taxa
1	Hydatellaceae	*Trithuria konkanensis*
2	Alismataceae	*Wiesneria triandra*
3	Commelinaceae	*Murdannia dimorpha*
4	Eriocaulaceae	*Eriocaulon belgaumensis*
5	Eriocaulaceae	*Eriocaulon eurypeplon Körn.*
6	Eriocaulaceae	*Eriocaulon kolhapurense*

7	Eriocaulaceae	*Eriocaulon palghatense*
8	Eriocaulaceae	*Eriocaulon sp.*
9	Cyperaceae	*Fimbristylis dauciformis*
10	Poaceae	*Bhidea burnsiana*
11	Poaceae	*Danthonidium gammiei*
12	Poaceae	*Dimeria blatteri*
13	Poaceae	*Dimeria woodrowii*
14	Poaceae	*Glyphochloa acuminata*
15	Poaceae	*Glyphochloa acuminata var. woodrowii*
16	Poaceae	*Glyphochloa talbotii*
17	Fabaceae	*Crotalaria lutescens*
18	Euphorbiaceae	*Euphorbia notoptera*
19	Lythraceae	*Rotala malampuzhensis*
20	Rubiaceae	*Neanotis subtilis*
21	Gentianaceae	*Canscora shrirangiana*
22	Apocynaceae	*Ceropegia attenuata*
23	Acanthaceae	*Lepidagathis keralensis*
24	Lentibulariaceae	*Utricularia malabarica*
25	Lentibulariaceae	*Utricularia praeterita*
26	Asteraceae	*Senecio belgaumensis*

5.1.3 Ecological Significance

The flora of Goa University plays a pivotal role in supporting the campus's faunal diversity. The abundant host and nectar plants provide resources for *Lepidoptera* species, including butterflies and moths, with a recorded 98 butterfly species. Future plans to establish a mini butterfly garden further emphasize the commitment to conserving biodiversity.

The diversity of the flora also indirectly supports herpetofaunal populations, including snakes, geckoes, and amphibians, by maintaining a healthy trophic structure. These species, alongside the flora, contribute to a balanced ecosystem, underscoring the need for conservation efforts on the campus.

In conclusion, the Goa University campus is a thriving repository of plant diversity, reflecting the ecological richness of Goa's landscapes. Its well-documented flora, coupled with ongoing conservation and afforestation efforts, ensures the preservation of this biodiversity hotspot for future generations.

5.2 FAUNA ON THE UNIVERSITY CAMPUS

Plateaus, also referred to as terrestrial islands, are frequently thought of as arid wastelands that are best suited for development, yet they are actually dynamic ecosystems with a wealth of species. Plateaus are vital to the ecosystem because they act as a sponge to rehydrate and nourish plants of all sizes. Additionally, they are characterized by their rapid seasonal variations and thin, low-nutrient soil, which leads to the highest concentration of herbaceous endemism on plateaus.

In addition to being plain territory, plateaus are home to important microhabitats such as exposed rock, loose rocks, ephemeral flush vegetation, ephemeral pools, soil-filled depression, exposed scope, intermediate shrubs and bushes, and peripheral vegetation, all of which are necessary for the survival of faunal species unique to the plateau (Thorpe & Watve, 2015).

Plateaus are the essence of Goa, linking the Western Ghats to the coastal plains. Among the valuable prominent plateaus of Goa, the Taleigao plateau is an exceptional habitat for uncountable species. It is spread over 296 ha with moist deciduous forest mixed with evergreen species, scrub jungle and lateritic vegetation. It is encircled by sloping valleys and alluvial plains of the river Mandovi in the north and the river Zuari towards the south (Bowalkar et al., 2017).

The Taleigao plateau fosters the huge campus of Goa University, Dr. Shyama Prasad Mukherjee Indoor Stadium, residential buildings and essential public stores in it. The 173 ha of stretched land is well documented for its floral and faunal species (Bowalkar et al., 2017).

The plateau nurses numerous herbaceous endemic floral species due to their close association with ephemerals on the plateau (Joshi & Janarthanam, 2004).

The available literature suggests the Taleigao plateau has 24 dragonfly species (Pai, 2019), 74 spider species (Pandit & Pai, 2017), 200 moth species (Gurule & Brookes, 2021) and 114 bird species (Desai & Shanbhag, 2012) documented.

Altogether the entire plateau showcases completely two different kinds of ecosystems as per the seasonal variations. The dry season showcases a rich avian and insect diversity while it transforms into a lush green land in monsoons, providing breeding grounds, feeding sources, and other bio services to various species of amphibians, snakes, and other faunal diversity.

The University plateau also holds a special niche due to recent discoveries of new species of gecko *Hemiphyllodactylus goensis*,

The Goa University campus celebrates and appreciates the floral and faunal diversity of the plateau, but a lot of information is lacking over it. As the change in land use pattern due to anthropogenic stress, accidental fires, invasive species, global warming and destruction of habitat are enormously impacting the flora and fauna on the plateau. There is a prompt need to document the floral and fauna of the plateau and understand the pattern of change and take necessary steps toward its conservation. This book addresses the same issue by documenting different fauna on single platform so that the young researchers can use this as foundational work for their future studies.

At Goa University, situated on the Taleigao Plateau, mammals play an essential role in the local ecosystem. This low-altitude lateritic rock outcrop habitat is home to a diverse range of mammals that contribute to the ecological balance and health of the environment.

Herbivorous mammals such as Wild Boars, Hares, Palm Squirrels, Gerbils, Mice, Rats, Porcupines, and Musk Shrews are crucial for seed dispersal and nutrient cycling on the plateaus. These animals feed on a variety of plants and fruits, helping to spread seeds throughout the area. This natural process enhances plant diversity and contributes to the stability of the ecosystem. Additionally, their foraging habits help aerate the soil and promote nutrient recycling, further supporting plant growth and overall habitat health.

Carnivorous mammals, including the Civet Cat, various species of Bats, Mongooses, and Jackals, also contribute significantly to the food web on the plateau. These predators help regulate populations of smaller mammals and insects, maintaining a balanced ecosystem. The Golden Jackal (Canis aureus), in particular, is a specialist of the grass vegetation found on the plateaus. Its adaptability to this specific habitat enables it to thrive and play a vital role in the local food chain.

Among the four bat species reported on campus, the Painted Bat (*Kerivoula picta*) is of particular interest due to its rarity. This small bat is an important pollinator and plays a role in controlling insect populations. The presence of such rare species highlights the unique biodiversity of the Taleigao Plateau and underscores the importance of habitat conservation for maintaining these delicate populations.

Historically, the plateaus have been utilized as grazing grounds for domestic bovines such as goats and cattle. This traditional practice not only supports agricultural livelihoods but also influences the composition of the mammal community. Grazing activities can create open habitats that benefit certain species while also contributing to nutrient cycling through manure, enriching the soil and promoting plant growth.

Taleigao Plateau, reptiles play an important role in the local ecosystem. This low-altitude lateritic rock outcrop habitat is home to a variety of reptile species, each adapted to thrive in this unique environment.

Among the most notable reptiles found on the Taleigao Plateau are the "Big Four" snakes: the King Cobra, Cobra, Krait, and Vipers. These snakes are abundant in the area and significantly contribute to the ecological balance. They play a crucial role as both predators and prey in the food web, helping to control the populations of small mammals and other creatures. The presence of these snakes indicates a healthy ecosystem, as they require diverse habitats and food sources to thrive.

One species of particular interest is the Saw-scaled Viper, which is a specialist of plateau habitats. This viper is well adapted to the rocky terrain and vegetation of the Taligao Plateau, allowing it to hunt effectively for its prey. Its presence in this ecosystem underscores the importance of conserving plateau habitats that support such specialized species.

Additionally, a new species of gecko, *Hemiphylodactylus goaensis*, was described from the Goa University campus in 2021. This discovery highlights the rich biodiversity of reptiles in the area and the potential for finding new species within relatively unexplored habitats. The identification

of new species contributes to our understanding of the ecological uniqueness of the Taleigao Plateau and emphasizes the importance of ongoing research and conservation efforts.

The Buff-striped Keelback (*Amphiesma stolatum*) is another important reptile found on the plateau. This species utilizes loose rocks and cavities along the plateau for laying its eggs. These nesting sites are crucial for the survival of the offspring, providing protection from predators and environmental extremes. The reproductive habits of reptiles like the Buff-striped Keelback reflect their adaptability to the specific conditions of the Taleigao Plateau.

One of the most remarkable aspects of amphibian life on Taleigao Plateau is their seasonal mass breeding behaviour. During the monsoon season, many amphibian species come together to breed in large numbers. This phenomenon is crucial for their reproductive success, as it increases the chances of fertilization and enhances genetic diversity within populations. The synchronized breeding events often lead to vibrant choruses of calls from male frogs, attracting females and creating a lively atmosphere in the surrounding environment.

Ephemeral pools also play a significant role in the life cycles of amphibians at Taleigao Plateau. These temporary water bodies form during the rainy season and provide vital habitats for tadpoles. The shallow, warm waters of ephemeral pools create ideal conditions for tadpole development, offering abundant food resources such as algae and detritus. Since these pools are temporary, they often have fewer predators, allowing tadpoles to grow and metamorphose into adult frogs more safely.

The reliance on ephemeral pools highlights the importance of seasonal rainfall for amphibians in this habitat. These water bodies not only serve as breeding sites but also support the early life stages of many species, ensuring the continuity of their populations. As amphibians are sensitive indicators of environmental health, their presence in these pools reflects the overall well-being of the ecosystem.

Dragonflies and Damselflies play an essential role in the local ecosystem. The low-altitude lateritic rock outcrop habitat provides a unique environment that supports the diverse life cycles and behaviors of these fascinating insects.

One of the key habitats for Odonata in this area is the ephemeral pool. These temporary water bodies are crucial for breeding, as they provide the ideal environment for female Odonates to lay their eggs. The shallow waters of these pools offer a safe haven for the developing larvae, allowing them to thrive before emerging as adults. The presence of ephemeral pools enhances the reproductive success of Odonata species, contributing to their population dynamics.

Another noteworthy species found on the plateau is the Granite Ghost (*Bradinopyga geminata*). This dragonfly is often observed in areas with exposed laterite, which serves as its preferred habitat. The unique characteristics of this environment—such as open sunlight and proximity to water sources—create optimal conditions for the Granite Ghost. By establishing themselves in such habitats, Odonates can effectively hunt for prey and engage in territorial displays, which are critical for their survival and reproduction.

Additionally, the Wandering Glider (*Pantala flavescens*) is notable for its remarkable migration patterns. This species is known for traveling vast distances, making the plateaus an important breeding and refuge ground during their journeys. The availability of suitable habitats, such as the ephemeral pools, allows the Wandering Glider to rest and reproduce before continuing its migration. This adaptability demonstrates how Odonata utilize the unique features of the Taleigao Plateau to support their life cycles.

The Taleigao Plateau like other low altitude lateritic plateaus is renowned for its mass blooming of herbaceous vegetation, which provides essential resources for Lepidoptera. These flowering plants attract a variety of pollinators, with butterflies and moths being particularly prominent. As they feed on nectar, these insects facilitate the pollination of many plants, promoting biodiversity within the ecosystem.

Moreover, the herbaceous grasses and flowering plants on the plateau serve as crucial larval host plants for various Lepidopteran species. Many butterflies and moths depend on specific plants for their larvae to feed and develop. For example, caterpillars of certain butterfly species may require particular types of plants for nourishment, highlighting the interdependence between the plants and Lepidoptera. The availability of suitable host plants is essential for the survival of these larvae and, consequently, for the persistence of butterfly populations.

The presence of diverse Lepidoptera enriches the campus environment, contributing to the beauty of the landscape while enhancing ecological interactions. Their role as pollinators is significant, as they help ensure the reproduction of flowering plants, which in turn supports other wildlife, such as birds and small mammals. This interconnectedness underscores the importance of preserving Lepidoptera and their habitats.

Lepidoptera at Goa University exemplify the intricate relationships within the ecosystem of the Taleigao Plateau. By understanding their role as pollinators and larval host dependencies, we can appreciate the significance of these insects in maintaining ecological balance and promoting biodiversity on our campus.

Figure 5.2.1: Phython species on Goa University campus

5.2.1 Green Audit Profiling for Fauna of Goa University campus

Below is analysis & statistical interpretation for Faunal diversity found in goa university campus which provides a **baseline for biodiversity assessment** in green audits, helping evaluate ecosystem health and conservation needs.

Mammals

A total of 19 mammalian species distributed across seven taxonomic orders. Rodents (Order Rodentia) dominate, comprising 36.8% of species, followed by bats (Order Chiroptera) and carnivores (Order Carnivora) at 21.1% each. Herbivores, omnivores, and carnivores are functionally classified, with omnivores forming the largest group (47.4%).

Functional grouping highlights key ecological roles: rodents aid in seed dispersal and soil aeration, bats contribute to pollination and insect control, and carnivores regulate prey populations. Primates and large mammals, such as the Black-Footed Gray Langur and Wild Boar, serve as habitat health indicators.

Habitat association suggests human-adapted species like the House Mouse and Small Indian Civet thrive in urban areas, while forest-dependent species such as the Indian Gray Mongoose and Golden Jackal reflect natural ecosystem integrity. Rocky outcrops host rodents like the Indian Gerbil, and cave-dwelling bats contribute to ecosystem functioning.

This study underscores the importance of conserving diverse mammalian communities across different habitats, as they collectively support ecosystem stability and health through their varied ecological functions.

Table: 5.2.1 Taxonomic Profile of Mammals

Order	Number of Species	Percentage
Rodentia	7	36.80%
Eulipotyphla	1	5.30%
Lagomorpha	1	5.30%
Chiroptera	4	21.10%
Carnivora	4	21.10%
Artiodactyla	1	5.30%
Primates	1	5.30%

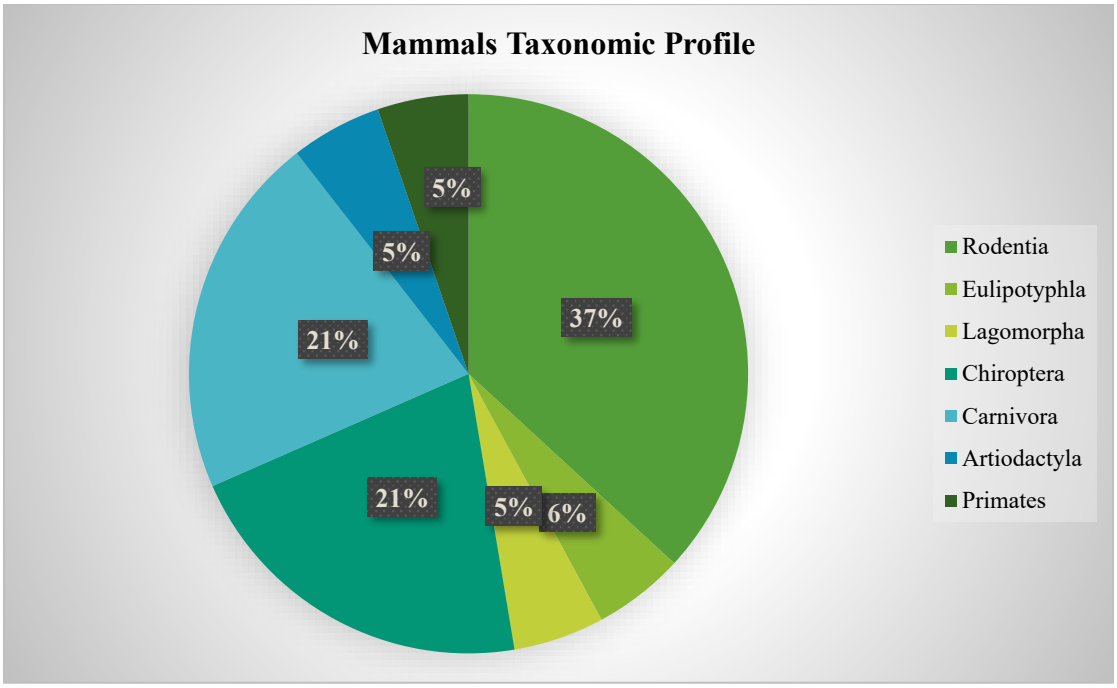

Figure 5.2.2: Mammals taxonomic profile

Table 5.2.2: Functional Diversity of Mammals

Functional Category	Number of Species	Percentage	Examples
Herbivores	6	31.60%	Indian Palm Squirrel, Indian Crested Porcupine, Indian Hare, Black-Footed Gray Langur, Wild Boar
Carnivores	4	21.10%	Small Indian Civet, Asian Palm Civet, Indian Gray Mongoose, Golden Jackal.
Omnivores	9	47.40%	rodents, shrews, and bats.

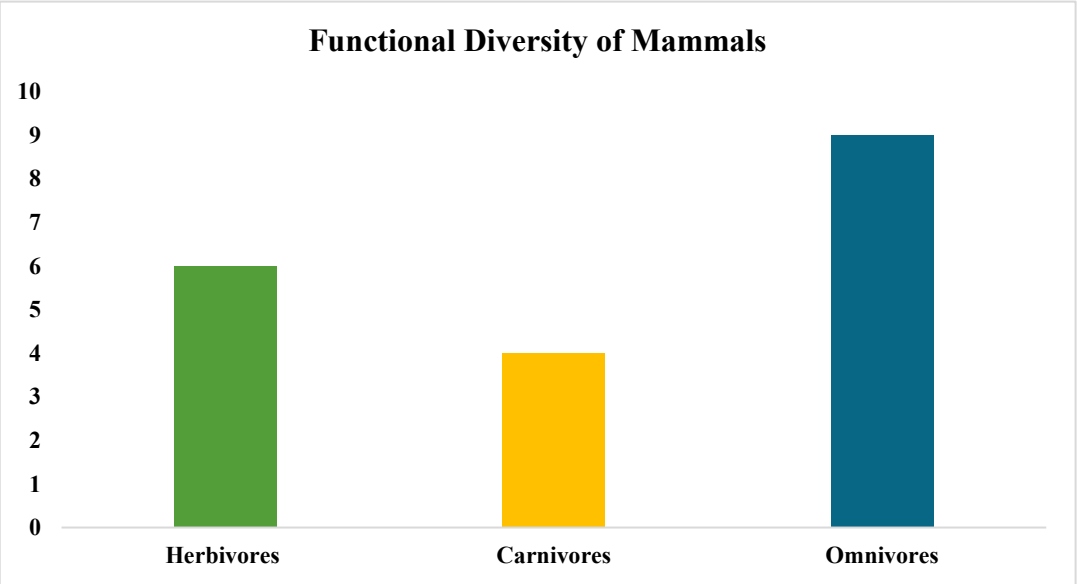

Figure 5.2.3: Functional diversity of Mammals

Reptiles

The reptilian fauna comprises 33 species, with 6.1% belonging to the order Testudines (turtles and tortoises) and 93.9% to the order Squamata (scaled reptiles). Within Squamata, lizards and geckos make up 39.4%, while snakes dominate at 54.5%. High species richness indicates a well-balanced and ecologically significant reptile community.

Reptiles play diverse functional roles in ecosystems. Aquatic and semi-aquatic species, such as the Indian Black Turtle and Checkered Keelback, contribute to wetland health. Arboreal species like Vine Snakes and Bronzeback Snakes thrive in tree canopies, while terrestrial species, including Garden Lizards and Bengal Monitors, support ground-level biodiversity. Fossorial reptiles like Sand Boas and Kukri Snakes help maintain soil health, and venomous species such as Cobras and Vipers regulate prey populations, ensuring ecological balance.

Reptile distribution reflects habitat quality. House Geckos and Rat Snakes adapt to urban settings, while forest-dwelling species like the Goa Slender Gecko indicate intact natural habitats. Lateritic and rocky areas provide refuge for species like the Bengal Monitor and Kukri Snakes. The presence of apex predators and burrowing reptiles highlights the ecological significance of these habitats. Conserving reptilian diversity is essential for maintaining ecosystem stability and biodiversity.

Table 5.2.3 Taxonomic Profile of Reptiles

Order	Sub-order	Number of Species	Percentage
Testudines		2	6.10%
Squamata		31	93.90%
	Lacertilia	13	39.40%
	Serpentes	18	54.50%

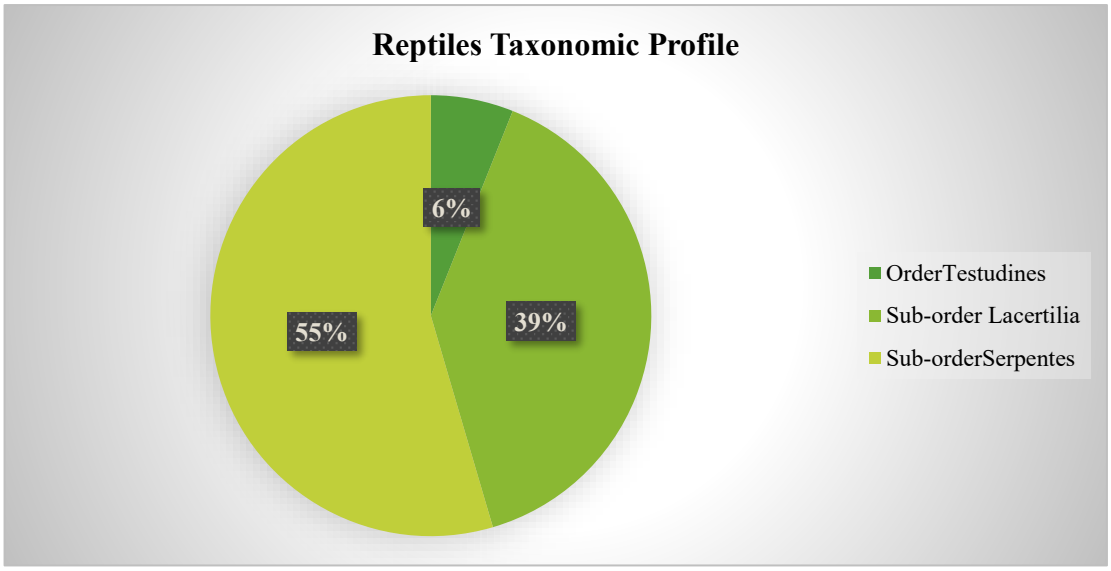

Figure 5.2.4 Taxonomic Profile of Reptiles

Table 5.2.4: Functional Diversity of Reptiles

Functional Category	Number of Species	Percentage	Examples
Aquatic & Semi-Aquatic Reptiles	5	15.20%	Indian Black Turtle, Flapshell Turtle, Checkered Keelback
Arboreal (Tree-Dwelling) Reptiles	6	18.20%	Vine Snake, Bronzeback Snakes, Goa Slender Gecko
Terrestrial Reptiles	14	42.40%	Garden Lizard, Bengal Monitor, Kukri Snakes
Fossorial (Burrowing) Reptiles	4	12.10%	Brahminy Blind Snake, Sand Boa, Tillack's Kukri Snake
Venomous Snakes	5	15.20%	Russell's Viper, Saw-Scaled Viper, Cobra, Krait

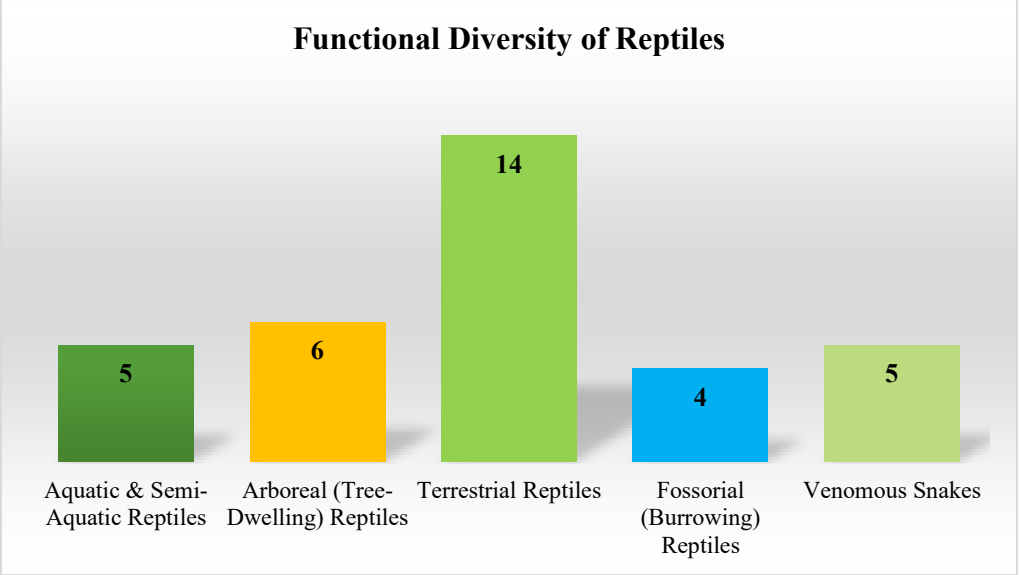

Figure 5.2.5: Functional diversity of Reptiles

1. Amphibians

The amphibian community comprises 16 species, all belonging to the order Anura (frogs and toads). Among them, Dicroglossidae (true frogs) is the most represented family (37.5%), followed by Rhacophoridae (tree and shrub frogs) at 25%. Microhylidae (narrow-mouthed frogs) and fossorial species such as burrowing frogs make up 18.75%, while Bufonidae (toads) and Ranixalidae (leaping frogs) contribute smaller proportions.

Frogs fulfill critical ecological roles. Terrestrial species, including cricket frogs and toads, aid in pest control, while aquatic frogs such as pond frogs and bullfrogs indicate freshwater ecosystem health. Semi-aquatic species like the Whipping Frog and Fungoid Frog bridge terrestrial and aquatic environments. Fossorial species, such as burrowing frogs, contribute to soil aeration and moisture retention.

Habitat associations highlight frogs as bioindicators of ecosystem quality. Species like the Asian Toad and Cricket Frogs are adaptable to urban and agricultural landscapes, while shrub frogs and pond frogs thrive in forested wetlands. Lateritic and rocky outcrop specialists, such as the Amboli Shrub Frog and Konkan Bush Frog, require specific conservation attention.

With multiple endemic species, high species richness, and habitat-specific amphibians, protecting these frogs is crucial for maintaining ecological stability. Their presence signals healthy ecosystems, emphasizing the need for conservation efforts to mitigate habitat destruction and pollution.

Table 5.2.5: Taxonomic Profile of Amphibians

Family	No. of Species	Percentage
Bufonidae	1	6.25%
Dicroglossidae	6	37.50%
Microhylidae	3	18.75%
Ranixalidae	1	6.25%
Rhacophoridae	4	25%
Nasikabatrachidae	1	6.25%

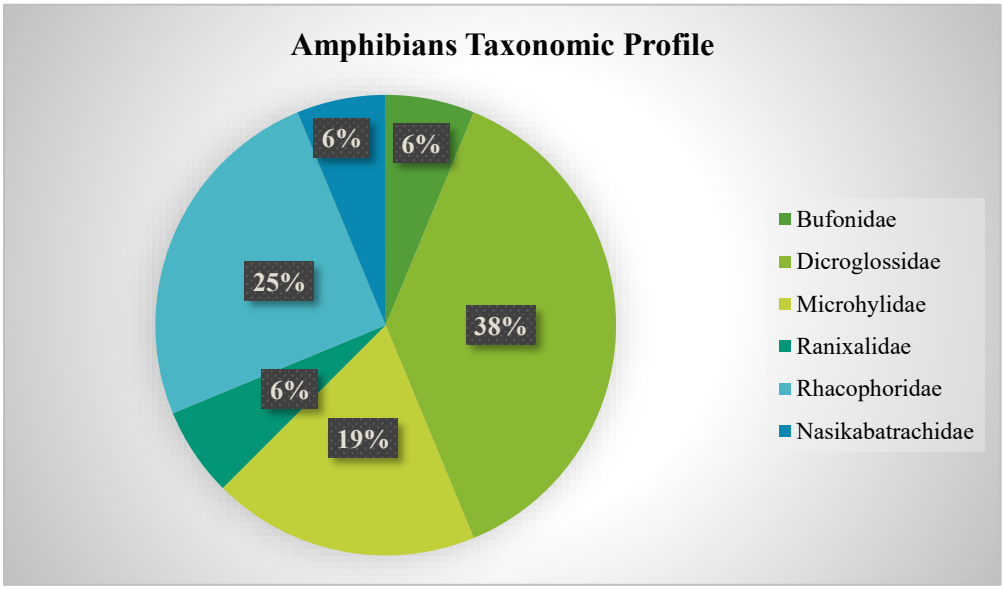

Figure 5.2.6: Taxonomic Profile of Amphibians

Table 5.2.6: Functional Diversity of Amphibians

Ecological Category	Number of Species	Percentage	Examples
Terrestrial Amphibians	5	31.25%	Cricket Frogs, Common Toad, Bush Frogs
Aquatic Amphibians	5	31.25%	Pond Frogs, Bull Frog, Skipper Frog
Semi-Aquatic Amphibians	3	18.75%	Fungoid Frog, Whipping Frog, Amboli Shrub Frog
Fossorial (Burrowing) Amphibians	3	18.75%	Balloon Frogs, Burrowing Frog

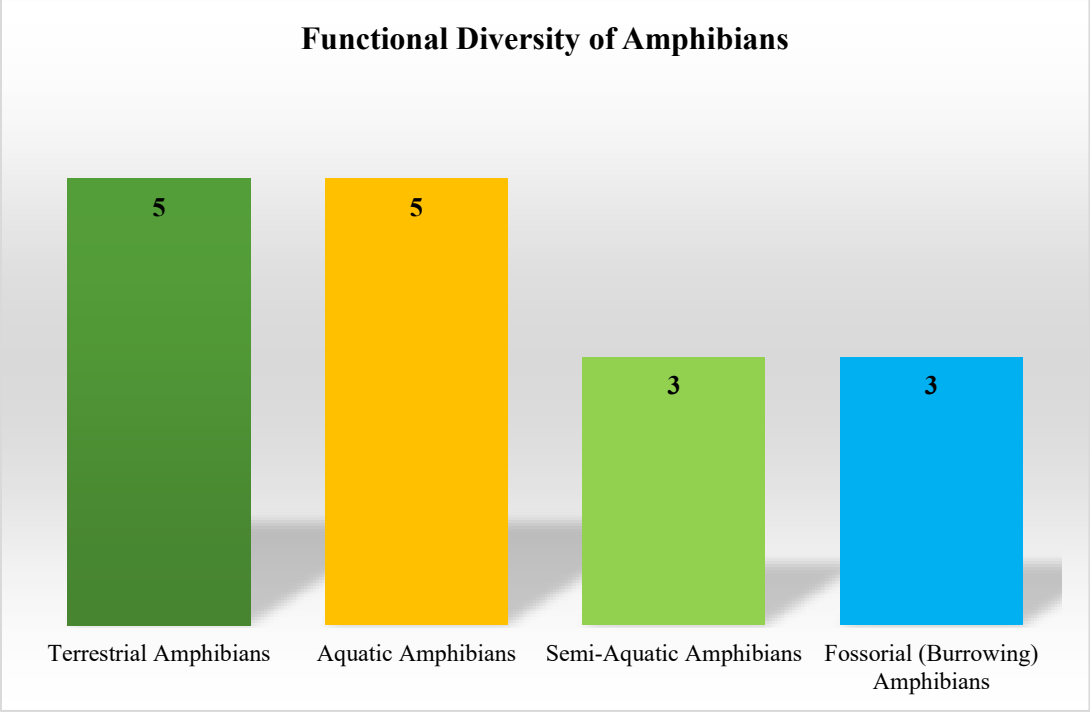

Figure 5.2.7: Functional diversity of Amphibians

2. Odonates

The odonate community consists of 25 species, predominantly from the family Libellulidae (88%), followed by Aeshnidae (8%) and Gomphidae (4%). The dominance of Libellulidae suggests a strong association with marshy and freshwater habitats. Species richness (S) of 25 reflects high diversity, with Shannon-Weiner and Simpson's indices confirming a balanced distribution without dominance by a single species.

Dragonflies and damselflies play key ecological roles. Nearly 48% of species, including the Ruddy Marsh Skimmer and Green Marsh Hawk, are wetland-dependent, highlighting the importance of marsh conservation. Pond and lake species, such as the Ditch Jewel and Fulvous Forest Skimmer, thrive in still water, while stream dwellers like the Black Stream Glider indicate clean, flowing ecosystems. Wandering species, such as the Pantala flavescens, contribute to global wetland connectivity.

Odonates serve as bioindicators of water quality and riparian health. Species like Trithemis festiva reflect pristine streams, while mosquito-predatory species, such as Orthetrum sabina, aid in controlling vector-borne diseases. The presence of migratory species underscores the ecological link between wetlands.

Conservation efforts should focus on protecting marshes, riparian vegetation, and ephemeral pools, as nearly 50% of species rely on these habitats. Maintaining water quality and preserving wetland ecosystems is essential for sustaining odonate diversity and ecological balance.

Table 5.2.7: Taxonomic Profile of Odonates

Family	Common name	No. of Species	Percentage
Gomphidae	Clubtails	1	4.00%
Aeshnidae	Darners	2	8.00%
Libellulidae	Skimmers and Gliders	22	88.00%

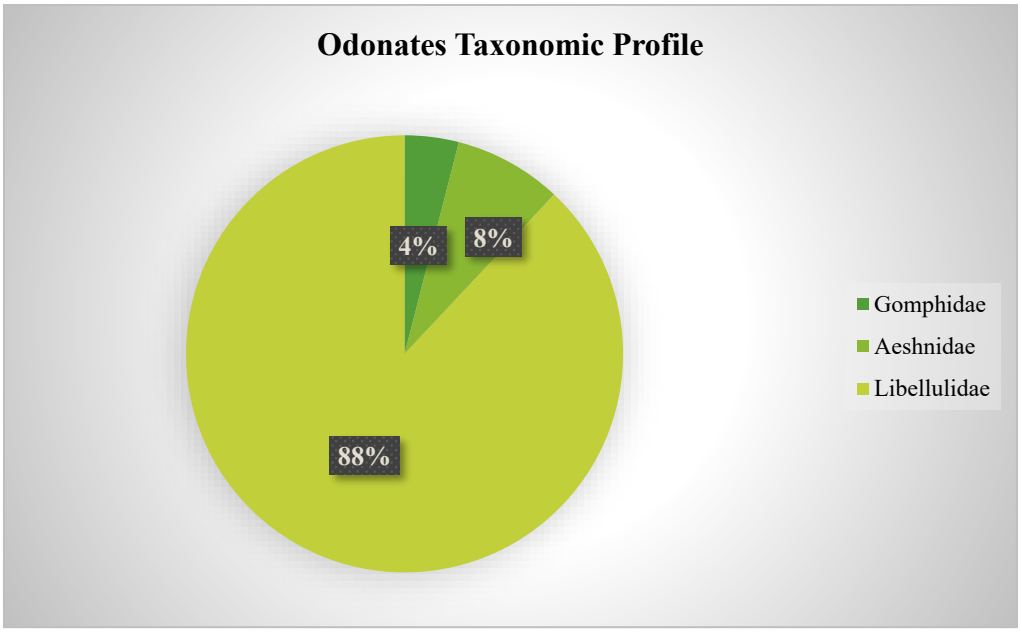

Figure 5.2.8: Taxonomic profile of Odonates

Table 5.2.8: Functional Diversity of Odonates

Ecological Category	Number of Species	Percentage	Examples
Marsh and Wetland Species	12	48%	Ruddy Marsh Skimmer, Green Marsh Hawk, Red Marsh Trotter
Pond and Lake Species	6	24%	Ditch Jewel, Emerald Banded Skimmer, Fulvous Forest Skimmer
River and Stream Species	4	16%	Black Stream Glider, Long-legged Marsh Glider, Brown Darter
Wandering/Gliding Species	3	12%	Wandering Glider, Black Marsh Trotter, Crimson Marsh Glider

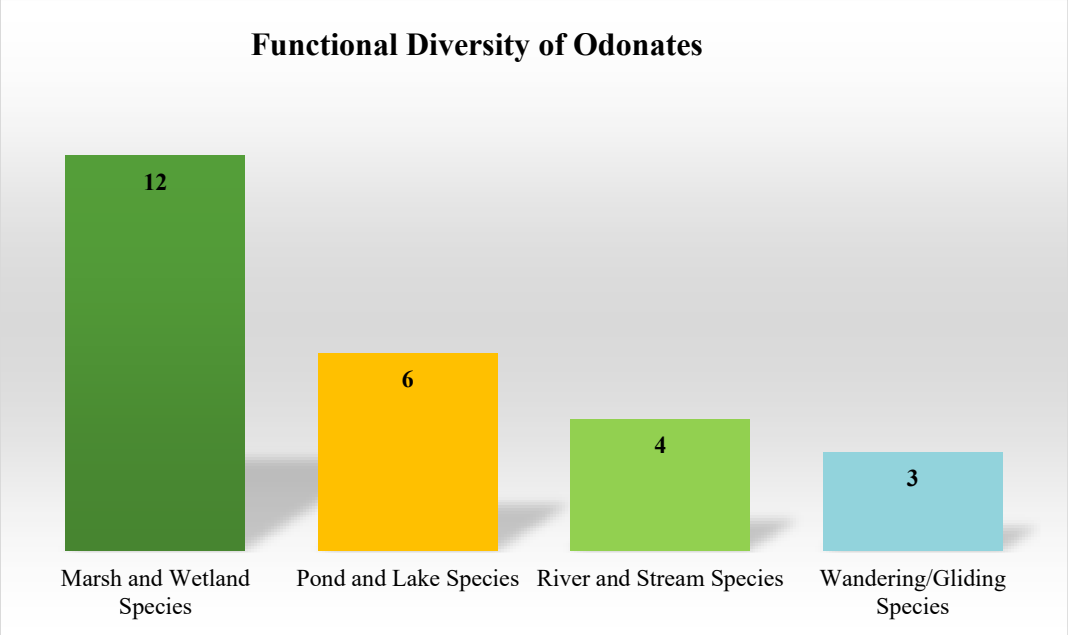

Figure 5.2.9: Functional Diversity of Odonates

3. Lepidoptera

The Lepidopteran community consists of 79 species, distributed across five families: Nymphalidae (40.5%), Lycaenidae (26.6%), Pieridae (15.2%), Papilionidae (12.7%), and Hesperiidae (5.1%). The dominance of Nymphalidae indicates a strong association with forested landscapes, while Lycaenidae and Pieridae contribute to open and urban environments. High species richness (S = 79) reflects a well-balanced and ecologically significant butterfly population.

Butterflies play a vital role in pollination, ecosystem stability, and biodiversity monitoring. Forest species such as the Southern Birdwing and Malabar Banded Peacock indicate intact woodland ecosystems, while grassland specialists like Tawny Coster suggest open habitat connectivity. Urban-tolerant species, including the Lime Butterfly and Common Grass Yellow, demonstrate adaptability to human-modified landscapes. Riparian-associated species like the Blue Tiger highlight the importance of wetland habitats.

Lepidoptera serve as bioindicators of environmental health. The presence of migratory species such as the Common Crow and Plain Tiger suggests habitat connectivity across regions. Conservation priorities should focus on protecting forest-dependent species and maintaining native host plants. The diversity of butterflies across multiple ecosystems underscores the need for habitat preservation, making them valuable indicators for green audits and ecosystem assessments.

Table 5.2.9: Taxonomic Profile of Lepidoptera

Family	Common Name	No. of Species	Percentage
Papilionidae	Swallowtails	10	12.70%
Pieridae	Whites & Yellows	12	15.20%
Nymphalidae	Brush-footed Butterflies	32	40.50%
Lycaenidae	Blues & Coppers	21	26.60%
Hesperiidae	Skippers	4	5.10%

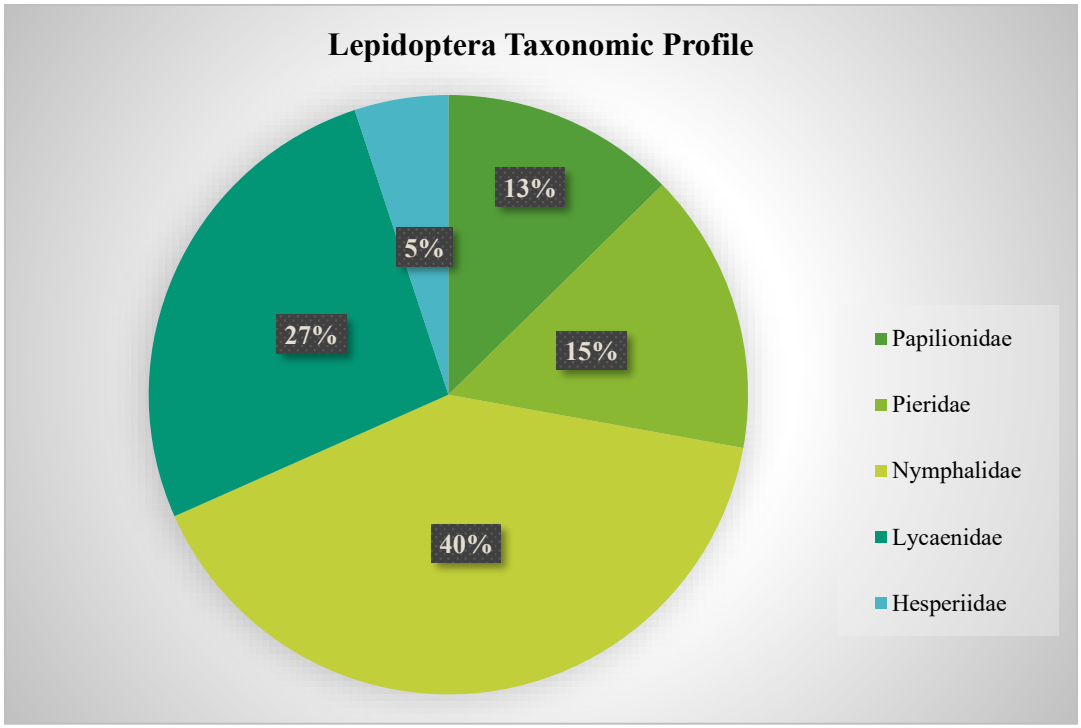

Figure 5.2.10: Taxonomic profile of Lepidoptera

Table 5.2.10: Functional Diversity of Lepidoptera

Ecological Category	Number of Species	Percentage	Examples
Forest Butterflies	34	43.00 %	Southern Birdwing, Malabar Banded Peacock, Common Tree brown
Open Grassland & Scrub Butterflies	18	22.80 %	Common Emigrant, Tawny Coster, Striped Tiger
Urban & Agricultural Landscapes	14	17.70 %	Lime Butterfly, Common Crow, Common Grass Yellow
Riparian & Wetland-associated Species	10	12.70 %	Blue Tiger, Glassy Tiger, Great Eggfly
Fast-flying & Skippers	4	5.10%	Common Banded Awl, Indian Skipper, Rice Swift

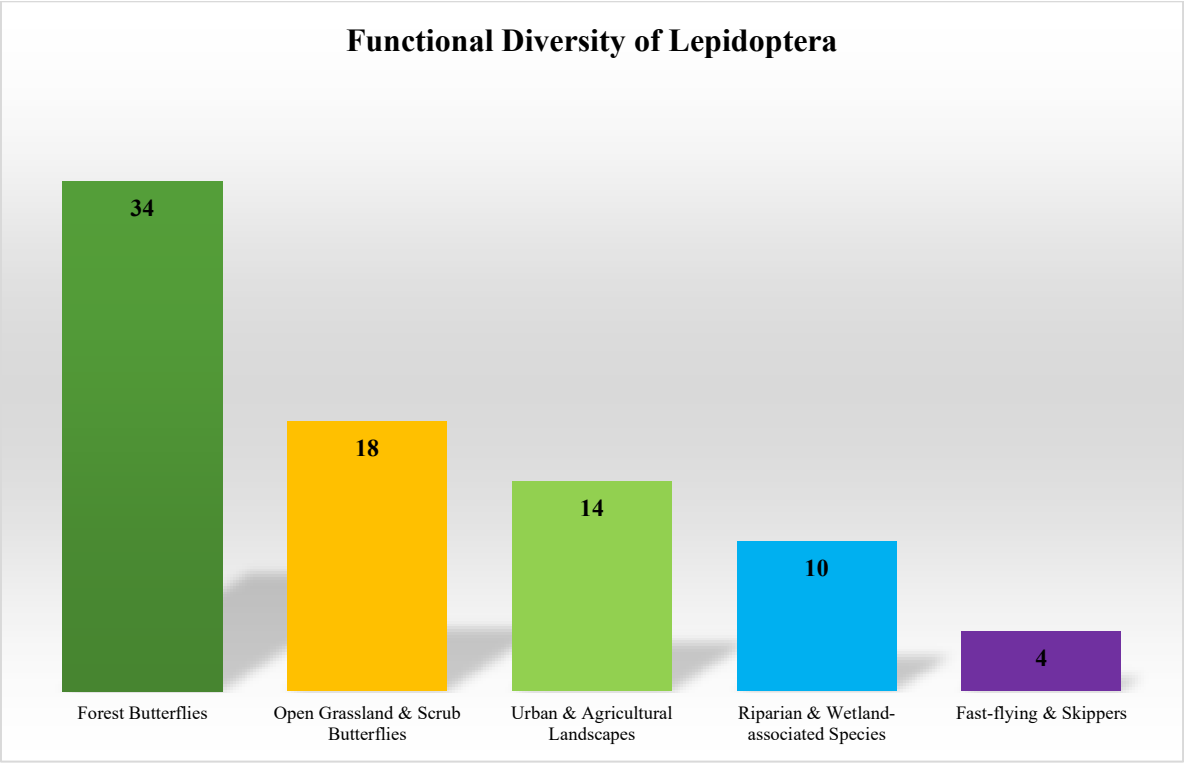

Figure 5.2.11: Functional Diversity of Lepidoptera

5.3 AVIANS UNIVERSITY CAMPUS

The Goa University campus, a blend of academic structures and thriving natural habitats, serves as a remarkable refuge for a diverse avian community.

The campus is situated on a lateritic plateau, a distinct geological formation. This unique topography, coupled with the region's tropical climate, has given rise to a mosaic of habitats within the campus. A mix of scrub jungles, lateritic outcrops, pockets of evergreen species, patches of moist deciduous forests, and interspersed built environments, supports an estimated 150 bird species, with the potential for even more discoveries. The plateau's relatively flat terrain interspersed with rocky outcrops and depressions creates microclimatic variations, further contributing to habitat diversity. The plateau's edges, bordering the Mandovi and Zuari rivers, attracts a different suite of bird species, adding another layer of complexity to the campus ecosystem. This distinct geography is a crucial factor in shaping the distribution and abundance of the campus avifauna.

The campus plateau's heterogeneous landscape provides a variety of ecological niches, each attracting a distinct suite of bird species. The open lateritic areas, characterized by sparse vegetation and exposed rock, are favoured by ground-foraging birds like the Indian Roller, *Coracias benghalensis* (Fig. 4.3 A), Paddy-field Pipit, *Anthus rufulus* (Fig. 4.3 B). These birds utilize the elevated perches, such as electric wires, to scan for insects, showcasing a clear adaptation to this specific habitat. The lateritic ground also provides excellent camouflage for the eggs of ground-nesting birds like the Red-wattled Lapwing, *Vanellus indicus*. These open areas also provide habitat for species adapted to those conditions.

In contrast, the denser vegetation areas, particularly the large jujube tree, *Ziziphus jujuba* creates a microhabitat preferred by the Orange-headed Thrush, *Geokichla citrina*, Puff-throated Babbler, *Pellorneum ruficeps* (Fig. 4.3 C). The fallen jujubes and leaf litter provide ample foraging opportunities, while the canopy offers shelter and nesting sites. This area also exemplifies predator-prey dynamics, with the Shikra, *Accipiter badius* occasionally preying on the thrushes. The canopy of jujube and cashew trees, *Anacardium occidentale*, further supports species like Indian Koels, *Eudynamys scolopaceus*, House Crows, *Corvus splendens*, and various Drongo species (*Dicrurus* spp.), each occupying slightly different niches within the arboreal environment. The fruits of shrubs *Ziziphus rugosa*, *Z. oenoplia, Carissa carandus,* attracts frugivorous birds, contributing to seed dispersal within the campus ecosystem.

The India Laburnum, *Cassia fistula* and Silk Cotton trees, *Bombax ceiba*, entices migratory birds like Ashy Drongo, *Dicrurus leucophaeus*, Rosy Starling, *Pastor roseus*, and Chestnut-tailed Starling, *Sturnus philippensis* (Fig. 4.3 D). These trees likely provide both food resources (insects, nectar) and safe perching sites. The presence of Blue-tailed Bee-eaters, *Merops philippinus*, Indian Golden Oriole, *Oriolus orioluS* (Fig. 4.3 E), and the occasional sighting of the elusive Asian Paradise Flycatcher, *Terpsiphone paradisi* (Fig. 4.3 F) further underscore the importance of this area for both migratory and resident species. The laburnum and silk cotton trees, with their vibrant flowers, also attract a variety of insects, further enriching the food web.

The surrounding bushes offer habitat for smaller birds like, White-rumped Munia, Common Ioras, *Aegithina tiphia* (Fig. 4.3 G), and Nilgiri Flowerpecker, *Dicaeum concolor*. The presence of Brahminy Kite, *Haliastur indus* soaring overhead and Rock Pigeon, *Columba livia* roosting on the building edges highlights the diverse ecological roles supported by even a relatively small area. The edges of buildings and other man-made structures also provide nesting sites for some species like Spotted Owlet, *Athene Brama*, Scaly-breasted Munia, *Lonchura punctulata* (Fig. 4.3 H), demonstrating the adaptability of birds to human-modified environments.

Plant-animal interactions are integral to the functioning of the campus ecosystem. Fruit-eating birds contribute to seed dispersal, playing a crucial role in plant regeneration and maintaining the diversity of the campus flora while the insectivorous birds control the insect population. After the monsoon season, the abundance of caterpillars, particularly those of the Lime Butterfly and Tiger Butterfly on *Cassia* species trees and milkweed plants, provides a rich food source for many bird species. The caterpillars themselves are an important part of the campus food web, serving as a food source for a variety of birds.

Insects, particularly butterflies and their larval stages, play a critical role as pollinators and a vital food source for insectivorous birds. The abundance of caterpillars, especially after the monsoon, highlights the seasonal pulse of resources and its impact on the avian community. This interconnectedness extends to the soil itself, where microorganisms and invertebrates contribute to nutrient cycling, further supporting the plant life that sustains the entire ecosystem. The presence of herpetofauna (reptiles and amphibians) adds another layer of complexity to the food web, providing prey for larger birds and contributing to the overall biodiversity of the campus. This intricate web of life underscores the importance of preserving the campus ecosystem in its entirety, as the loss of any one component can have cascading effects on the others.

The campus avifauna exhibits distinct seasonal variations in species composition and abundance, reflecting changes in resource availability and environmental conditions. The dry season sees the lateritic areas teeming with insect diversity and flowering plants, attracting species like Orioles, Indian Paradise Flycatchers, Bee-eaters, and Starlings. The lush greenery of the monsoon season allows various herpetofauna to breed, which in turn attracts water birds such as Kingfishers, Egrets, and Sandpipers to the campus periphery, particularly along the Mandovi and Zuari rivers. The artificial waterbody created by forming a bund to prevent flowing rainwater, attracted Lesser whistling Ducks to the campus. The presence of migratory birds, such as the Black headed Cuckooshrike, *Lalage melanoptera* (Fig. 4.3 I), Brown and Long-tailed Shrikes (winter visitors) and the Jacobin Cuckoo (monsoon visitor), further highlights the seasonal dynamics of the campus avifauna. Changes in temperature, rainfall, and food availability all influence the distribution and abundance of different bird species throughout the year.

The remarkable avian diversity on campus is a result of niche partitioning, where species minimize competition by specializing in different resources or utilizing the same resources in unique ways. This is evident in the foraging strategies of insectivorous birds, such as Rollers that perch and swoop, Bee-eaters that hawk insects mid-air, and Thrushes that glean insects from the ground and leaf litter. Even within a single tree, different species may forage on various parts like the canopy, branches, or trunk, sometimes specializing on specific insect types. For example, the Woodpecker,

Barbets (*Psilopogon malabaricus, Micropternus brachyurus*) on the truck on the tree, Warblers (*Phylloscopus nitidus, Phylloscopus affinis*) in the canopy and Fowls (*Pavo cristatus*, *Galloperdix spadicea*) in the roots/ leaf litter of the tree. Contributing to this diverse ground-foraging guild, the Eurasian hoopoe, *Upupa epops* (Fig. 4.3 J), with its distinctive crest and probing beak, can often be observed foraging for insects in the campus's open grassy areas. Habitat utilization also plays a vital role, with different bird species occupying different sections of the same tree or distinct habitat types within the campus. This spatial partitioning further reduces competition and maximizes resource availability. For example, ground-foraging birds utilize open lateritic areas, while arboreal species prefer denser vegetation. Ecotones, the transition zones between habitats, can be particularly diverse due to the resources available from both adjacent habitats.

While the Goa University campus provides a valuable refuge for birds, it is important to consider its role within the broader landscape. The campus is not an isolated entity but rather a part of a larger network of green spaces, albeit fragmented by development. These green spaces, including other vegetated areas and even the nearby rivers, can serve as corridors for bird movement, allowing for gene flow and dispersal between populations. The campus may also act as a stopover point for migratory birds, providing essential resources during their long journeys. Understanding the connectivity of the campus to the surrounding landscape is crucial for effective conservation planning. Maintaining and enhancing these connections, through the creation of green corridors and the protection of other nearby habitats, can further strengthen the role of the campus in preserving regional avian diversity. Research into the movement patterns of birds both within and outside the campus boundaries would be invaluable in understanding this connectivity and informing conservation strategies.

Documenting and evaluating the avifauna of the Goa University campus is crucial for several reasons. Birds are excellent indicators of environmental health. Changes in their populations, distribution, or behaviour can reflect broader changes in the ecosystem, such as habitat degradation, pollution, or climate change. Regular monitoring of bird populations provides valuable data for assessing the effectiveness of conservation efforts and identifying potential threats to biodiversity. Understanding the ecological roles of different bird species – as pollinators, seed dispersers, insectivores, or scavengers – is essential for managing and maintaining a healthy ecosystem. This information can inform management decisions related to landscaping, pest control, and habitat restoration. Furthermore, documenting the campus avifauna contributes to our overall understanding of regional biodiversity and helps track changes in species composition over time.

The Goa University campus is not only a haven for birds but also a place where people appreciate and study them. Frequent bird walks organized by student birding groups and the eBird campus count initiative demonstrate the interest in avian diversity. Students and faculty alike enjoy the natural ambience of the campus, recognizing its value as a green space within an urbanizing landscape.

Bird activity on campus follows a daily rhythm. The early morning hours, particularly from 7:00 AM to 9:30 AM, witness a flurry of avian activity. Birds are most vocal and active during this period, foraging and engaging in social interactions. As the day progresses and students populate the campus, the birds tend to become less conspicuous. While they may appear to fall silent, close

observation reveals their continued presence, quietly perching, feeding, and moving within the trees. This change in activity patterns is likely a response to increased human activity and noise levels.

Previous biodiversity studies conducted on the Goa University campus, while valuable, may not accurately reflect the current state of the avifauna. Habitat changes, both natural and anthropogenic, are constantly reshaping the campus landscape. As vegetation patterns change and built structures increase, some species may thrive while others decline. The present study highlights the importance of revisiting and updating these baseline surveys. Indeed, anecdotal evidence suggests that certain species, such as quails and the Yellow-wattled Lapwing, *Vanellus malabaricus* have experienced population declines on campus. This underscores the need for continuous monitoring to track these changes and understand their underlying causes. The presence of IUCN-listed species, such as the Near Threatened Alexandrine Parakeet, *Psittacula eupatria*, the Vulnerable Malabar Grey Hornbill, *Ocyceros griseus* and the Malabar Lark, *Galerida malabarica* adds further urgency to these efforts. Protecting these vulnerable species and their habitats requires a thorough understanding of their ecological needs and the factors that threaten their survival. The Goa University campus, with its unique blend of natural and developed areas, provides an ideal setting for studying the impacts of habitat change on avian communities and developing effective conservation strategies.

The Goa University campus plateau, despite being interspersed with buildings and roads, retains significant elements of its original ecosystem. The lateritic soil, characteristic of the region, supports a unique flora adapted to these conditions. The scrub jungle and forest patches provide valuable habitat for a variety of wildlife, including not just birds but also insects, reptiles, amphibians, and small mammals. The plateau ecosystem plays an important role in regulating local climate, preventing soil erosion, and maintaining water quality. Preserving this plateau ecosystem is crucial for conserving the biodiversity of the region.

Hence, by fostering a culture of respect for nature, the Goa University campus can truly become a model for how humans and wildlife can share the same space.

A

B

C

D

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G

H

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J

Figure 5.3: A. Indian Roller *(Coracias benghalensis),* B. Paddy field Pipit *(Anthus rufulus)*, C. Puff-throated Babbler *(Pellorneum ruficeps*), D. Chestnut-tailed Starling *(Sturnus philippensis), E.* Indian Golden Oriole *(Oriolus oriolus)* Female, F. Asian paradise Flycatcher *(Terpsiphone paradisi)* Male, G. Common Iora *(Aegithina tiphia)* Female H. Flock of Scaly-breasted Munias *(Lonchura punctulata),* I Black headed Cuckooshrike *(Lalage melanoptera*), J. Eurasian Hoopoe *(Upupa epops)*

CHAPTER-VI

THE UTILIZATION OF ENERGY

Conventional and Renewable Energy

Edited by Dr. Marlon Sequeira

and Dr. Pranav Naik

The energy utilization by different administrative sections, Discipline under various schools and sub sections is shown in the tabular form. The data is classified into non equipment items (LED bulbs/tubes, CFL bulbs, fans, AC) and laboratory equipments' are shown in the series of tables below.

Table 5.1 Vice Chancellor's Secretariat

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED: 26	20	520
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 5 Wall: 1	80 50	400 50
3	Air Conditioners	1.5 Tr: 4	1600	6400
	Office & Laboratory EQUIPMENT			
4	Computer	3	200	600
5	Laptop	2	45	90
6	Xerox Machine	1	2000	2000
7	Printer	3	200	600
8	UPS (connected to PC)	VA	4	
9	Refrigerator	1	300	300
10	Induction	1	2500	2500
11	Electric Kettle	1	1200	1200
12	TV Screen	1	65	65

Table 5.2 Engineering and Technical Division

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT			
1	Bulbs (LED, CFL, Incandescent etc.)	LED: 10 LED: 3 Tube light: 11 LED: 1 LED: 2	20 10 36 9 36	200 30 396 9 72
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 11 Ceiling (BLDC): 1 Pedestal: 1 Exhaust: 2	75 30 60 50	825 30 60 100
3	Air Conditioners	1.5 Tr: 4 2.0 Tr: 1	1500 2000	6000 2000
4	Water purifier	1	20	20
5	Network Switch Rack	1	22	22
6	Refrigerator	1	300	300
7	Induction cook top	1	1600	1600
	Office & Laboratory EQUIPMENT			
1	Desktop	9	200	1800
2	Laptop	1	50	50
3	Printer	2	200	400
4	Xerox machine	1	2000	2000

Table 5.3 IT Cell in Examination Division (Basement of Old Exam Building)

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT			
1	Bulbs (LED, CFL, Incandescent etc.)	LED: 12	20	240
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Wall: 2	50	100
3	Air Conditioners	1.5 Tr: 5	1500	7500
4	Water filter	1	1000	1000
	Office & Laboratory EQUIPMENT			
1	Computer	13	200	2600
2	Laptop	1	50	50
3	Printer	3	200	600
4	UPS	1	5 KVA	5 KVA

Table 5.4 Examination - UG Section

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT			
1	Bulbs (LED, CFL, Incandescent etc.)	Tube light: 12	36	432
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 7 Wall: 4	80 50	560 200
3	Air Conditioners	1.5 Tr: 6	1500	9000
4	Water purifier	1	25	25
	Office & Laboratory EQUIPMENT			
1	Desktop	15	200	3000
2	Printer	Canon: 2 Brother: 2 HP: 2	594 510 250	1188 1020 500

Table 5.5 Purchase Section

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT			
1	Bulbs (LED, CFL, Incandescent etc.)	LED: 34 CFL: 3	23 42	782 126
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 11 Wall: 4	80 53	880 212
3	Air Conditioners	1.5 Tr: 6	1500	9000
	Office & Laboratory EQUIPMENT			
1	Desktop	6	200	1200
2	Laptop	1	65	65
3	Xerox Machine	2	1500	3000
4	Printer	10	259	2590
5	UPS (PC Connected)	15	600	9000

Table 5.6 Women's Hostel (Warden's Qtr)

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT			
1	Bulbs (LED, CFL, Incandescent etc.)			
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 4 Pedestal: 3	80 60	320 180

	Office & Laboratory EQUIPMENT			
4	Computer	1	200	200
5	Printer	2	200	400
5	UPS (connected to PC)	1	VA (600)	600 VA

Table 5.7 University Quarter, BLOCK A -18- III

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT			
1	Bulbs (LED, CFL, Incandescent etc.)	LED: 12 Tube light: 5	12 20	144 100
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 6 Exhaust: 3	80 40	480 120
3	Refrigerator	1	300	300
4	Washing Machine	1	1000	1000
5	5 ltr Water heater	1	2200	2200
6	Exhaust Fans	3	40	120

Table 5.8 Faculty Quarters B23V

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT			
1	Bulbs (LED, CFL, Incandescent etc.)	LED: 15 LED: 5	10 10	150 50
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 5	80	400
4	Laptop	1	70	70
5	LED TV	1	190	190
6	Refrigerator	1	90	90
7	Washing machine	1	2100	2100
8	Geyser	1	2000	2,000
9	Mixture Grinder	1	750	750
10	Electric iron	1	2400	2400

Table 5.9 Examination - Confidential Building

Sr. No.	Loads	Total Number	~Watts	Total Wattage
	NON-EQUIPMENT			
1	Bulbs (LED, CFL, Incandescent etc.)	LED: 77	20	1540
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 21 Wall: 8 Exhaust: 6	80 53 40	1680 424 240
3	Air Conditioners	1.5 Tr: 13	1600	20800
	Office & Laboratory EQUIPMENT			
4	Computer	6	150	9000
5	Laptop	1	65	65
6	Xerox Machine	2	1500	300
7	Printer	3	200	600
8	UPS (connected to PC)	6	VA (600)	3600 VA
9	UPS	1	20 KVA	20 KVA

Table 5.10 Malaviya Mission Teacher Training Centre Goa University

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED: 58 CFL: 6	20 20	1160 120
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 26 Pedestal: 2	80 80	208 160
3	Air Conditioners	1. Tr: 02 1.5 Tr: 02 2.0 Tr: 01	1200 1600 2300	2400 3200 2300
	Office & Laboratory EQUIPMENT'S			
7	Computer	05	150	750
8	Laptop	04	70	280
10	Printer	03	250	750
11	UPS (connected to PC)	02	VA (600)	1200
12	UPS	01	20 KVA	20 KVA
15	Water Purifier	01	625	625
16	Refrigerator	01	300	300

Table 5.11 1st Floor MMTTC Building (Used by DISHTAVO)

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED: 41	20	820
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 09 Pedestal: 01	80 80	720 80
3	Air Conditioners	1.5 Tr: 01 2.0 Tr: 07	1600 2300	1600 16100
	Office & Laboratory EQUIPMENT			
4	Printer	01	250	250
5	Laptop	03	70	350
6	Computer	13	150	2145
7	Studio Lights		06	
8	Camera		02	

Table 5.12 Residence: B22/3 Goa University Staff Qtrs

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED: 11	20	220
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 5 Exhaust: 2	80 40	400 80
4	Geyser	1	2000	2000
5	Mixer grinder	1	750	750
6	Iron box	1	750	750
7	Washing machine	1	420	420
8	refrigerator	1	240	240
9	TV	1	130	130

Table 5.13 University Quarters No: A18/1

Sr. No.	Loads	Total Number	~Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED: 8	6	48
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 5	80	400
3	Air Conditioners	1.5 TR: 2	1600	3200
4	Refrigerator	1	240	240
5	Washing Machine	1	1000	1000
6	Laptop	2	50	100
7	geyser (2 litre capacity)	1	1000	1000

Table 5.14 Office: Directorates

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED Tube: 12	20	240
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 05	80	400
3	Air Conditioners	1.5 Tr: 2	1600	3200
	Office & Laboratory EQUIPMENT			
4	Desktop(Monitor)	4	200	800
5	Printer(L3110)	1	200	200
6	Laptop	1	45	45
7	Refrigerator	1	300	300
8	Printer(Laser Jet M1136 MFP)	2000	1	2000
9	Copier Machine	2000	1	2000

Table 5.15 Office: Directorate of Student Placement and Alumni Relations

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED tube: 3	20	60
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 2	80	160
3	Air Conditioners	1.5 Tr: 1	1600	1600
	Office & Laboratory EQUIPMENT			
1	Desktop	1	200	200
2.	Printer	1	2000	2000

Table 5.16 Office: Public Relations

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED tube: 3	20	60
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 1	80	80
3	Air Conditioners	1.5 Tr: 1	1600	1600
	Office & Laboratory EQUIPMENT			
1	Desktop (Monitor)	1	200	200
3	Printer(L3110)	1	200	200
5	Refrigerator	1	300	300

Table 5.17 Quarter No C-2

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED: 9 Bulb: 5	20 12	180 60
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 04	60	240
3	Air Conditioners			
4	Iron	1	750	750
5	Electric Kittle	1	70	70
6	Mixer	1	1200	1200

Table 5.18 Office: Directorate of Students Welfare & Cultural Affairs (DSW&CA) and Directorate of Rashtriya Uchattar Shiksha Abhiyaan (DRUSA)

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED: 3	20	60
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 1	80	80
	Office & Laboratory EQUIPMENT			
1.	Desktop(Monitor)	2	200	400
2.	Printer)Laserjet M1136MFP)	1	2000	2000
3.	Aquaguard	1	90	90

Table 5.19 GU Quarters A-17/1

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED: 7 CFL: 8	20 9	140 72
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 5	80	400
3	Air Conditioners	1.5 Tr: 1	1600	1600
4	Refrigerator (300L)	1	150	150
5	Mixer	1	300	300
6	Induction	1	1200	1,200
7	Microwave Oven	1	1000	7,000
8	TV	1	100	100
9	Geyser	2	1000	2,000

Table 5.20 C-8 quarter

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED: 9 Bulb: 5	20 12	180 60
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 3 Pedestal: 1	80 60	240 60
5	TV	1	65	65
6	Refrigerator	1	300	300
7	Washing machine	1	1000	1000
8	OTG	1	1400	1400
9	Induction	1	2500	2500
10	Mixer Grinder	1	500	500
11	Iron	1	1200	1200

Table 5. 21 B/23 -IV – Goa University Quarters

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED: 13 CFL: 5	20 8	260 40
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 5	80	400
1.	Computer	1	150	150
2.	Laptop	1	65	65
3.	Exhaust fan	3	40	120
4.	Geyser	1	3000	3000
5.	Refrigerator	1	220	220
6.	Washing machine	1	220	220

Table 5.22 Academic Admissions Section

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED: 13 CFL: 2 Tubelight: 3	20 12 40	260 24 120
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 3 Pedestal:1	80 60	240 60

3	Air Conditioners	1.5 Tr: 03	1600	4800
	Office & Laboratory EQUIPMENT			
4	Computer (in use)	7	200	1400
5	Laptop	2	45	90
6	Xerox machine	1	2000	2000
7	Printer	2	200	400
8	Shredder	1	200	200

Table 5.23 TA- 16 Quarter

Sr. No.	Loads	Unit	No.	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED: 6 CFL: 2	20 10	120 20
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 3 Exhaust: 1	80 40	240 40
3	Air Conditioners	1.0 Tr: 1	1200	1200
4	Laptop	2)	65	130
5	Printer	1	100	100
6	Ovens	1	1000	1,000
7	Geyser	1	1000	1,000
8	TV	1	40	40

Table 5.24 Section: Administration (Teaching/Non-Teaching)

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED bulb: 3 LED: 35	12 20	260 120
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 13 Pedestal:12	80 60	240 60
3	Air Conditioners	1.5 Tr: 05	1600	8000
	Office & Laboratory EQUIPMENT			
4	Computer with 21" LED monitor	20	200	4000
5	Laptop (15.6")	12	45	540
6	Not used regularly. Used only during interviews.			
7	Xerox Machine	1	2000	2000
8	Printer (200W)	11	200	2200
9	UPS (15KVA)	1	15KVA	15 KVA
10	Refrigerator (190 Litre)	1	300	300

Table 5.25 SECTION 2: Directorate of Digital Learning & Initiatives(DDLI)

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)			
MAIN ADMIN STUDIO	LED Lights(In rooms)(2x2)	4	36	144
	LED Tube Lights(In rooms)	6	20	120
	CFL	10	55	550
	Studio Lights			
	Tube lights - cool	20	55	1100
	Spot Lights - warm	6	600	3600
	Bi-color COB LED lights	4	292	1168
	Andbon 125L Dry cabinet	1	10	10
BLOCK D	LED Tube Lights(In rooms)	14	20	280
	Studio Lights - Tube Lights -Cool	8	55	440
2 BLOCK D	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 6	70	420
3	Air Conditioners			
MAIN ADMIN STUDIO	1.0 Ton(Split)	2	1000	2000
	3.0 Ton(Ductable)	1	3000	3000
	6.0 Ton(Ductable)	1	6000	6000
BLOCK D	1.5 Ton(Split)	2	1500	3000
	2.0 Ton(Split)	4	2000	8000
	Office & Laboratory EQUIPMENT			
	COMPUTER SYSTEMS			
MAIN ADMIN STUDIO	Apple Machines	2	350	700
	Windows Machines	6	250	1500
	Laptop	3	65	195
	UPS			
MAIN ADMIN STUDIO	For Studio & PCR	2	10000	20000
	VIDEO MONITORING			
BLOCK D	Interactive Touch Screen	1	140	140
MAIN ADMIN STUDIO	65 in TV	2	170	340
	24 in TV	1	14.5	14.5
	24 inch	1	14.5	14.5
	27 inch	1	25	25
	Eizo monitor 279X	1	111	111
	Network Storge			
MAIN ADMIN STUDIO	Qnap	1	111	111
	Tyrone	1	1200	1200
	Video Devices			
MAIN ADMIN STUDIO	Blackmagic Design ATEM Television studio pro HD	1	40	40

	Blackmagic Design Hyperdack Studio HD mini Video recorder	2	50	100
	Blackmagic Design Hyperdack studio HD pro Video recorder	1	100	100
BLOCK D	Blackmagic Design Studio HD Hyperdack+ Video recorder	1	100	100
	Audio Devices			
MAIN ADMIN STUDIO	Mixpre 6 II Audio Recorder	1	15	15
	KRK Rookit G4 Studio Monitor	2	55	110
	Allen & Heath Qu-16	1	82	82
BLOCK D	Zoom Audio recorder	1	2.5	3
				54733

Table 5.26 Quarter B25 V

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED: 17	20	340
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 5	80	400
4	Washing machine	1	1000	1000
5	Refrigerator	1	300	300
6	Induction stove	1	2500	2500
7	Mixer Grinder	1	500	500

Table 5.27 QUARTER TA 15

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED big: 05 LED Small:4	20 10	100 40
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 04	80	320
4	Induction	1	2500	2500
5	Refrigerator	1	300	300
6	Laptop	1	45	45
7	Mixer	1	500	500
8	Geyser	1	2000	2000

9	Washing Machine	1	1000	1000
10	mobile charger and door bell	1	40	40

Table 5.28 Faculty Quarters A18/II.

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED Bulb:20	12	240
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 06 Wall: 1	80 65	480 65
3	Air Conditioners	1.0 Tr: 02	1200	2400
4	Computer	1	150	150
5	Geyser(water heater)	2	1000	2000
6	Mixer grinder	1	1000	1000
7	Refrigerator	1	350	350
8	Television	1	140	140
9	Washing Machine	1	2400	2400
10	Vacuum cleaner	1	1500	1500

Table 5.29 Directorate of Visiting Research Professors Programme (D-VRPP)

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED: 17	20	340
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 9	80	720
3	Air Conditioners	1.5 Tr: 5	1600	8000
	Office & Laboratory EQUIPMENT			
6	Computer	2	200	400
7	Laptop	3	45	135
8	Xerox Machine	1	2000	2000

9	Printer	2	200	400
11	Audio Mixing Console	1	30	30
12	Speakers	3	80	240
14	Podium (electric)	1	100	100
15	LED TV	1	65	65
16	Refrigerator	1	300	300
17	Projector	1	600	600

Table 5.30 Office of Registrar (INWARD/ OUTWARD)

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED: 09	20	180
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 04 Pedestal: 1	80 60	320 60
3	Air Conditioners	1.5 Tr: 1	1600	1600
	Office & Laboratory EQUIPMENT			
4	Computer	2	200	400
5	Fridge (170 Ltr)	1	300	300
6	Induction cook top	1	2500	2500
7	Electric kettle (1.5 Ltr)	1	1200	1200
8	Printer	1	200	200
9	Xerox machine	1	2000	2000
10	Passage LED light	4	12	48

Table 5.31 Cabin of Assistant Registrar

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED: 4	20	80
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 1	80	80
3	Air Conditioners	1.5 Tr: 1	1600	1600
	Office & Laboratory EQUIPMENT			
1	Computer	Watt (200)	1	200
2.	Printer	Watt (200)	1	200
3.	Ceiling fans	Watt (80)	1	80

Table 5.32 Registrar's Cabin

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED: 16	20	320
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Wall: 04 Pedestal:1	60 60	240 60
3	Air Conditioners	1.5 Tr: 04	1600	6400
	Office & Laboratory EQUIPMENT			
4	Paper Shredder	1	200	200
5	Printer	1	200	200
6	Laptop	1	45	45
7	TV	1	65	65

Table 5.33 Quarter B 24-III

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	CFL: 11	10	110
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 6	80	480
3	Air Conditioners	1.5 Tr: 1	1600	1600
4.	Laptops	2	45	90
5.	Inverter	1		
6.	Refrigerator		300	300
7.	Washing Machine	1	1000	1000

Table 5.34 Goa University Quarters - B-22/I

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED bulb:9 LED tube:6	9 20	81 120
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 5	70	350
3	Air Conditioners	1.5 Tr: 2	1600	3200
4	42 inch LED TV	1	110	110
5	Refrigerator 228 Litre	1	260	260
6	Geyser 6 litre	1	3000	3,000

Table 5.35 Goa University - Finance Division

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED tube:43 CFL: 1	20 12	860 12
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 23 Wall: 32 Exhaust: 2	80 60 40	1840 1920 80
3	Air Conditioners	1.5 Tr: 14	1600	22400
	Office & Laboratory EQUIPMENT			
4	Computer	24	200	4800
5	Laptop	2	45	90
6	Xerox Machine	2	2000	4000
7	Printer	15	200	3000
8	UPS (connected to PC)	15		-
9	UPS	1	15 KVA	15 KVA
10	Electric kettle	2	1200	2400
11	Induction	1	2500	2500

Table 5. 36 Quarter B22-V

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED tube:8	20	160
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling:5 Ceiling small:1 Exhaust:3	80 39 50	400 39 150
3	Air Conditioners	1.0 Tr: 1	1200	1200
4	Refrigerator	1	300	300

5	Mixer	1	500	500
9	Washing Machine	1	1000	1000
10	Water Geyser	1	2200	2200
11	electric Dry Iron	1	1000	1000
13	Electric cooker	1	550	550

Table 5.37 Section: Academic PG Section and Deputy Registrar (Academic)

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED: 3 LED tube:7 LED light:13	12 20 23	36 140 299
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 7 Wall: 2 Pedestal: 5	80 53 53	560 106 265
3	Air Conditioners	1.5 Ton: 4	1600	6400
	Office & Laboratory EQUIPMENT			
4	Xerox Machine	1	800	800
5	Printer	9	200	1800
6	Scanner	1	15	15
7	Computer	14	200	2800
8	UPS connected to PC	14	350 watt 600 watt 360 watt	5760
9	Laptop	3	45	135
10	Projector	1	156	156
11	Refrigerator	1	300	300
12	Induction	1	1400	1400

Table 5.38 B24/IV-Goa University Quarters

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED tube: 7	20	140
		LED bulb: 3	12	36
		FL: 5	40	200
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 5	80	400
		Wall:1	50	50
		Exhaust: 3	40	120
3	Air Conditioners	1.0 Tr: 1	1200	1200
4	Washing Machine	1	380	380
5	Fridge	1	240	240
6	Mixer	1	1000	1000
7	Water Purifier	1	90	90

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Table 5.39 Section: Men's Hostel I & II

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED L: 506	20	10120
		LED S: 215	10	2150
		LED SL: 10	45	450
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Pedestal:1	60	60
		Wall: 8	100	800
		Exhaust:4	40	160
		Ceiling: 220	80	17600
3	Air Conditioners	1.5 Tr: 1	1600	1600
	Office & Laboratory EQUIPMENT			

4	Computer	2	150	300
5	Printer	1	240	240
6	Washing Machine	8	425	3400
7	Water Heater	6	2000	12000
8	Water Purifier UV	8	625	5000
9	Insect killer	2	40	80
10	Television	2	100	200
11	Refrigerator	5	500	2500
12	Wall Mount Water Purifier	1	100	100

Table 5.40 Section: Men's Hostel III

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED panel: 10 LED big: 125 LED small: 6 LED street: 32 LED bulb: 16 LED fl: 1	32 18 10 75 7 50	320 2250 60 2400 112 50
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Exhaust:29 Ceiling: 71	50 80	1450 5680
3	Data Rack	4	25	100
4	Geyser 15 Litre	9	2000	18000

Table 5.41 Section: Library Building

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED L: 300 Flo tube: 53	20 40	6000 2120
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 164 Wall: 3 Exhaust: 26	80 75 50	13120 225 1300

		Pedestal: 8	55	440
3	Air Conditioners	1.5 Tr: 9	1600	14400
	Office & Laboratory EQUIPMENT			
4	Computer	44	100	4400
5	Printer	5	20	100
6	UPS	2	2 KVA	4 KVA
7	Xerox machine	1	200	200
8	Book scanner	1	130	130
9	Pump motor	1	3 HP	2238

Table 5. 42 11 KV Substation Building

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED tube:22 Flo. Tube: 01 LED bulb: 02 LED bulb: 01 LED street:02	20 36 12 3 75	440 36 24 03 150
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 7 Exhaust: 5	60 350	420 1750
4	Heater	1000 W	01	1000

Table 5.43 33 KV Substation Building

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED tube: 28 Flo tube: 08	20 40	56 320
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 02 Pedestal: 02	60 100	120 200

Table 5.44 International Guest House

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED tube: 57 LED small: 68 LED SL: 4 Flo tube: 9 LED bulb: 36	20 10 100 40 12	1140 680 400 360 432
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 40 Exhaust : 1	60 350	2400 350
3	Air Conditioners	1.5 Tr: 27	1600	43200
4	Geyser	26	2000	52000
5	Incinerator	1	1200	1200
6	Projector	1	300	300
7	Refrigerator	1	250	250
8	Water cooler	1	650	650
9	Kettle	4	70	280

Table 5.45 Old Guest House

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED big: 68 LED small: 52 Flo tube: 15 LED bulb: 59 LED SL: 7	20 10 40 12 100	1360 520 600 708 700
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 72 Exhaust: 02	60 350	4320 700
3	Air Conditioners	1.0 Tr: 26	1000	26000
4	Geyser	32	2000	64000
5	Incinerator	1	1200	1200
6	Water cooler	3	650	1950

Table 5.46 Pump House

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED tube: 4 LED SL: 3 Flo tube: 2	20 100 40	80 300 80
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 1	60	60
5	Motor pump (7.5 Hp)	4	5600	22400

Table 5.47 Conference Hall

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED panel: 40 Flo tube: 30	24 40	960 1200
2	Air-conditioner	4.0 Tr: 2	4000	8000
3	Projector	1	300	300
4	Sound system speaker	2	80	160
5	Sound system mixer	1	50	50

Table 5.48 Council Hall

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED tube: 18 Flo tube: 01 LED bulb: 08	20 40 12	360 40 960
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 07	60	420
3	Air Conditioners	a. Tr: 01 1.5 Tr: 04	1100 1600	1100 6400
4	Speaker	4	350	1400
5	TV	1	200	200
6	Projector	1	300	300
7	Sound system mixer	1	50	50
8	Amplifier	1	415	450

Table 5. 49 Seminar Hall

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED panel: 18 LED step li: 24	40 2	720 48
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Wall: 11	80	880
3	Air Conditioners	1.5 Tr: 04	1600	6400
4	Sound system speaker	2	350	700
5	Projector	1	300	300
6	UPS	1	720	720
7	Sound system speaker	2	200	400
8	Sound system mixer	1	50	50
9	Mixer amplifier	1	415	415

Table 5.50 Health Centre

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED tube: 06 LED bulb: 8 LED bulb: 01 Flo tube: 10	20 12 20 40	120 96 20 400
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling:09 Exhaust: 03	60 50	540 150
3	Air Conditioners	1.5 Tr: 01	1600	1600
	Office & Laboratory EQUIPMENT			
4	Kettle	2	70	140
5	Biometric machine	1	3.5	3.5
6	Bell	2	40	80
7	Refrigerator	1	200	200
8	Water purifier	1	60	60
9	Tabletop sterilizer	1	1500	1500

Table 5.51 Women's Hostel I

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED tube: 231 LED small: 59 LED bulb: 62 LED SL: 05	20 10 12 75	4620 590 744 375
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 141 Exhaust small: 12 Exh. Big: 3 Pedestal :01	60 60 150 60	8460 720 450 60
3	Geyser	4	2000	8000
4	Water cooler	5	500	2500
5	Refrigerator	1	230	230
6	Mixer	3	1000	3000
7	Washing machine	3	1200	3600
8	Data rack	4	20	80
9	Incinerator	4	1000	4000
10	Pump motor	1	1500	1500

Table 5.52 Women's Hostel II

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED tube: 97 LED small: 25 LED bulb: 85 LED SL:05	20 10 12 75	1940 250 1020 375
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 80 Exhaust: 6 Pedestal: 1	60 60 60	4800 360 60
3	Geyser	6	2000	12000
4	Water cooler	2	500	1000
5	Washing machine	3	1200	3600
6	Data rack	1	20	20
7	Incinerator	4	1000	4000
8	Pump motor	1	1500	1500

Table 5.53 Women's Hostel III

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED tube: 75 LED bulb: 57 LED small: 36 LED SL: 8	20 12 10 75	1500 684 360 600
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 28 Exhaust: 4 Pedestal: 1	60 31 60	1680 124 60
3	Geyser	6	2000	12000
4	Water cooler	6	500	3000
5	Washing machine	3	1200	3600
6	Data rack	1	20	20
7	Pump motor	1	1500	1500

Table 5.53 Shopping Centre

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED tube L: 21 LED tube S:10 LED bulb: 8	20 10 12	420 100 96
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 10	80	800
3	Air conditioner	1.5 Tr: 06	1600	9600
4	Internet hub	1	50	50
5	Xerox machine	2	800	1600
6	Refrigerator	3	900	2700
7	ATM machine	1	2500	2500
8	Passbook printer	1	180	180
9	Street light	4	75	300

Table 5.54 Gymnasium

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED Tube: 09 LED bulb: 05 LED SL: 02	20 12 100	180 60 200
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 6 Exhaust: 2	80 50	480 100
3	Air conditioner	1.5 Tr: 03	1600	4800
4	Water filter	1	50	50

Table 5.55 Sports Building

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED L: 25 LED S: 12	20 10	500 120
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 9 Pedestal: 1 Exhaust: 8	80 55 45	720 55 360
3	Air conditioner	1.5 Tr: 1	1600	1600
	Office & Laboratory EQUIPMENT			
4	Desktop	11	200	2200
5	Printer	1	200	200
6	Xerox	1	1000	1000
7	Cooler	2	650	650
8	Fridge	1	100	100
9		1	1500	1500

Table 5.56 Directorate of Equal Opportunities (DEO) and Directorate of Extra Mural Studies and Extension Services (DEMS&ES)

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED tube: 3	20	60
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 1	80	80

Table5.57 Directorate of Foreign Students (DFS)

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED Tube: 3	20	60
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling:1	80	80
3	Air conditioner			
4	Water filter			

Table 5.58 Directorate of International Cooperation and Exchange (DICE) and Directorate of Unnat Bharat Abhiyaan (DUBA)

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED Tube: 3	20	60
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 1	80	80

Table 5.59 Directorate of Internal Quality Assurance (DIQA)

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED tube: 10	20	200
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 6	80	480
3	Air conditioner	1.5 Tr: 2	1600	3200
4	Projector	1	250	250
5	Fridge	1	250	250

Table 5.60 Directorate of Research & Development and Resource Mobilization (DRDRM)

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED Tube: 3	20	60
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 1	80	80

Table 5.61 Faculty Canteen

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED tube: 10	20	200
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 13 Exhaust: 2	80 450	1040 900
3	Fridge	Small: 1 Big: 1	200 1000	200 1000
4	Induction	1	2500	2500
5	Freezer	1	400	400
6	Cooler	1	625	625

Table 5.62 Goa Business School

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED tubes: 655 Flo tubes: 53 LED bulb: 24	20 36 12	13100 1908 288
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 268 Wall: 35 Exhaust: 18	80 50 45	21440 1750 810
3	Air conditioners	1.5 Tr AC: 122 3.0 Tr AC: 3	1600 3000	195200 9000
	Office & Laboratory EQUIPMENT			
4	COMPUTER	10	200	2000
5	LAPTOP	55	50	2750
6	XEROX MACHINES	1	2000	2000
7	PRINTER	19	200	3800
8	OVEN	1	1000	1000
9	REFRIGERATOR	3	300	900
10	PROJECTOR	21	250	5250
11	WATER PURIFIER	9	90	810
12	VENDING MACHINE	2	510	1020
13	ROUTER	4	10	40
14	PODIUM	4	100	400
15	SERVER	7		
16	UPS	1		
17	LIFT	1	9000	9000
18	CAMERA	3	10	30
19	TV	1	65	65

Table 5.63 Block F (Lecture Hall Building)

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT			
1	Bulbs (LED, CFL, Incandescent etc.)	LED: 36	6	216
		LED: 48	36	1728
		LED: 75	18	1350
		LED: 11	100	1100
		LED: 6	45	270
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Wall: 24	60	1440
		Ceiling: 12	75	900
		Exhaust: 4	50	200
3	Air Conditioners	2.5 Tr: 4	2500	10000
		3.0 Tr: 12	3000	36000
4	Data rack	2	25	50
5	On line UPS (1 KVA)	1	1 KVA	1 KVA
6	Inverter (1600 VA)	1	1600 VA	1600 VA

Table 5.64 Block F (New Computer Science Building)

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT			
1	Bulbs (LED, CFL, Incandescent etc.)	LED: 26	30	780
		LED: 61	18	1098
		LED: 32	18	576
		LED: 182	40	7280
		LED: 6	10	60
		LED: 16	36	576
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 72	75	5400
		Exhaust: 6	50	300

		Exhaust: 4	400	1600
3	Air Conditioners	1. Tr: 21 2. Tr: 8 2.5 Tr: 2 11.0 Tr: 2 5.5 Tr: 6	1000 2000 2500 11000 5500	21000 16000 5000 22000 33000
4	Lift	1	9000	9000
5	Data rack switch	10	25	250
6	Submersible pump (1.5 HP)	2	1120	2240

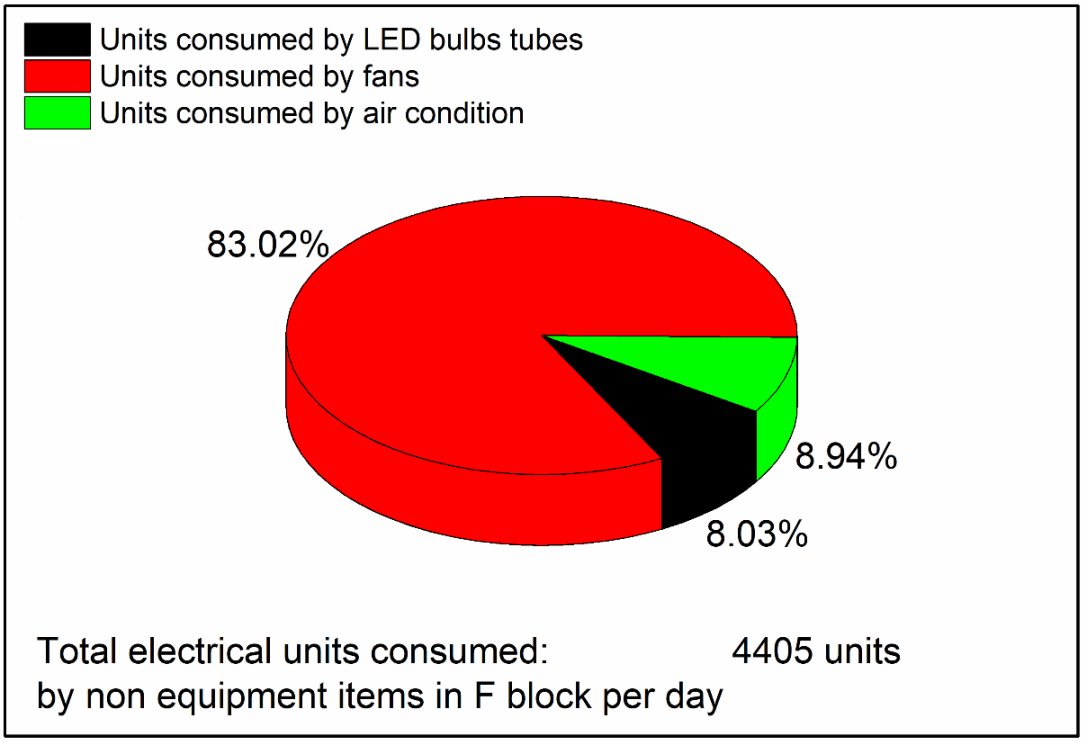

Figure 5.1 Chart of F block

School of Biological Sciences and Biotechnology

Table 5.65 Biotechnology

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED PL: 50 Flo PL: 26 LED tube: 12	36 36 20	1800 936 240
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	ceiling :3 exhaust: 6	80 80	240 480
3	Air conditioners	1.5 Tr: 6	1600	9600
4	VRV AC	3.3 TR:18 4.1 Tr: 6	3.3 TR 4.1 TR	59.4 TR 24.6 TR
	Office & Laboratory EQUIPMENT			
5	Desk Top PC	14	150	2,100
6	Printer & All in One	04	259	1,036
7	Photocopier Machine	1	250	250
8	Bacteriological Incubator	3	300	900
9	Incubator Shaker	1	500	500
10	Water Purification System	1	450	450
11	Inverted Microscopes	2	80	160
12	Compound Microscopes	16	80	1,280
13	RT - PCR	1	400	400
14	Elisa Plate Reader	1	259	259
15	Fluorescence Microscope	1	150	150
16	Protein Purification System	1	250	250
17	Refrigerated Incubator Shaker	1	500	500
18	Lyophilizer	1	500	500

19	Deep Freezer – 80 deg	1	750	750
20	Deep Freezer – 20 deg	3	500	1500
21	Refrigerated Centrifuge	1	750	750
22	Ultra Sonic Cell Chamber	1	450	450
23	Refrigerated Centrifuge 2ml	1	500	500
24	High Speed Cooling Centrifuge	2	750	1500
25	Refrigerators	6	157	942
26	U V Spectrophotometer	1	80	80
27	Gel Doc System	1	250	250
28	Thermal Cycler	1	250	250
29	Electrophoresis units	2	80	160
30	Ice Flake Machine	1	400	400
31	Rotary Evaporator System	1	500	500
32	Water Circulating Bath	1	350	350
33	Muffle Furnace	1	2000	2000
34	Hot Air Oven	2	1500	3000
35	Magnetic Stirrer	2	80	160
36	Ph . Meter	3	80	240
37	Bio Safety Cabinet	3	800	2400
38	Laminar Air Flow	6	800	4800
39	Analytical Weighing Balance	3	80	240
40	Visi Cooler	7	250	1750
41	Vertical Autoclave	2	500	1000
42	Spinning Centrifuge	1	300	300
43	Micro Wave Oven	1	1000	1000
44	Plant Growth Chamber	1	500	500
45	Spinner Dryer	1	150	150
46	Mixer	1	150	150
47	Constant Temp. Water Bath	1	500	500
48	Vertex Mixer	1	120	120

49	Interactive Display	1	200	200
50	L C D Projector	2	150	300
51	Waterproof Cyber Scan	1	80	80
52	Read Bug Homogenizer	1	200	200
53	Water Bath	1	300	300
54	Labtop	2	150	300
55	Pedestal Fan	40	53	2,120
56	Wall Mount Fan	24	53	1272
57	Water Bath Tissue Floating	01	150	150
58	Podium inbuilt Sound	1	250	250
59	Glass Dryer	1	150	150

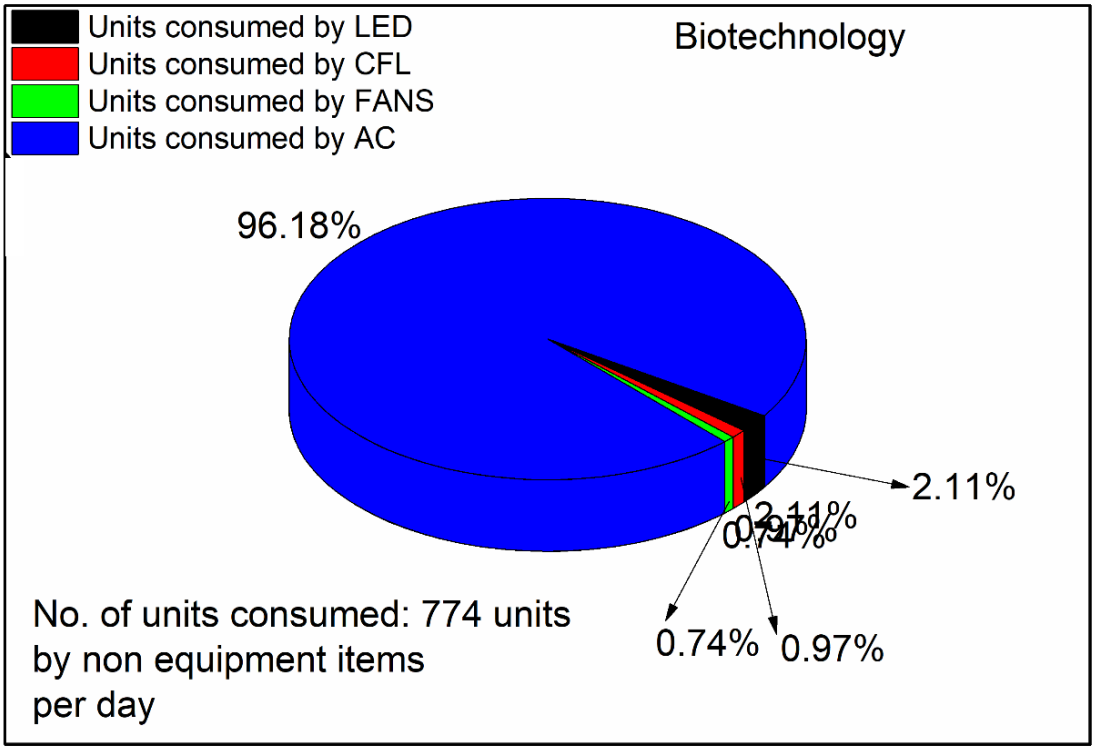

Figure 5.2 Chart of Biotechnology

Table 5.66 **BOTANY**

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED tube: 164 LED T small: 15 Flo tube: 22 LED bulb: 2	 20 10 40 9	3280 150 880 18
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 73 Exhaust :02 Pedestal: 01	75 60 55	5475 120 55
3	Air conditioners	1. Tr: 02 1.5 Tr: 07 2. Tr: 21	1200 1600 2480	2400 11200 52080
	Office & Laboratory EQUIPMENT			
4	Desktop Computers	33	150	4950
5	Printers	12	250	3000
6	UPS	600VA :26 1000 VA: 4 2000 VA:1 3000 VA: 3 3500 VA: 1	600 VA 1000 VA 2000 VA 3000 VA 3500 VA	15600 VA 4000 VA 2000 VA 9000 VA 3500 VA
7	Laptop	5	70	35
8	LCD Projector	3	300	900
9	LED TV	2	70	140
10	Orbital Shaker	1	1500	1500
11	Oven	1	2000	2000
12	Gel Electrophoresis Unit	1	80	80
13	Magnetic Stirrer with Hot plate	1	1115	1115
14	Stereo Microscope	3	5	15
15	Fluroscence Microscope	1	5	5
16	Vortex Shaker	1	150	150
17	pH Meter	1	2	2
18	Weighing Balance	1	2	2
19	DubbleDistilation Unit	1	2000	2000
20	Heating Mantle (1 Ltr.)	1	200	200
21	Heating Mantle (5 Ltr.)	1	600	600

22	Water Bath	2	1000	2000
23	Magnetic Stirrer with Hot plate	1	500	500
24	Sonicator	1	100	100
25	Fourier Transform Infrared Spectrometer (FTIR)	1	150	150
26	Dehumidifier	1	320	320
27	Refrigerator	13	150	1950
28	Dehumidifier	1	20	20
30	Microscope	14	5	70
31	Scanner	2	2.5	5
32	Xerox Machine	1	1200	1200
33	Stereo Microscope	3	5	15
34	Compound Microscope	18	5	90
35	Refrigerated Centrifuge	1	1650	1650
36	Muffle Furnace	1	5000	5000
37	Refrigerated Centrifuge	1	1000	1000
38	Oven	1	2000	2000
39	Deep Freezer (−20°C)	1	1000	1000
40	Weighing Balance	1	2	2
41	pH Meter	1	4	4
42	Spectroflurometer	1	200	200
43	Microwave Oven	1	1350	1350
44	Plant Growth Chambor	1	1500	1500
45	Orbital Shaker Incubator	1	1500	1500
46	Heating Mantle (500 ml.)	1	200	200
47	Heating Mantle (500 ml.)	1	200	200
48	Heating Mantle (1 Ltr.)	2	300	600
49	Single Distilation Unit	1	3500	3500
50	Laminar Air Flow	7	450	3150
51	Shaker	1	150	150
52	Mixer Grinder	3	250	750
53	P.C.R.	1	500	500
54	Micro Centrifuge	1	15	15
55	B.O.D. Shaking Incubator	1	900	900
56	Autoclave	1	3000	3000
57	Autoclave	1	2000	2000
58	DubbleDistilation Unit	1	2000	2000
59	Plant Growth Chambor	1	4800	4800
60	Weighing Balance	2	2	4
61	pH Meter	1	2	2
62	Oven	1	2000	2000
63	Oven	1	1750	1750

64	Orbital Shaker	1	1500	1500
65	BOD Incubator	1	1540	1540
66	DubbleDistilation Unit	1	2000	2000
67	Weighing Balance	1	2	2
68	Digital Water Bath	1	1000	1000
69	Sonicator	1	400	400
70	Centrifuge	1	350	350
71	Orbital Shaker	1	1500	1500
72	Magnetic Stirrer with Hot plate	2	1170	2340
73	Vortex Shaker	1	50	50
74	Baby Fermentor	1	50	50
75	Autoclave	1	3000	3000
76	Autoclave	1	4000	4000
77	Autoclave (Automatic)	1	3000	3000
78	UV-VIS Spectrophotometer	1	200	200
79	Gas Chromatography	1	200	200
80	Vortex Shaker	1	50	50
81	Vortex Shaker	1	50	50
82	Magnetic Stirrer with Hot plate	1	390	390
83	Weighing Balance	1	2	2
84	Gel Drop system	1	95	95
85	HPLC	1		
86	Ultra Sonicator	1	400	400
87	Dry Water bath	1	300	300
88	Rotary Shaker	1	500	500
89	Centrifuge	1	500	500
90	pH Meter	1	15	15
91	Stabilizer	1	200	200
92	Centrifuge	1	90	90
93	Deep Freezer (−20°C)	1	350	350
94	Homogenizer	1	850	850
95	Mini PCR	1	400	400
96	RT PCR	1	240	240
97	Chlorophyll fluorometer	1	300	300
98	Infra Red Gas Analyzer	1		
99	Oven	1	1750	1750
100	Oven (Small)	1	1450	1450
101	Water Bath	1	1500	1500
102	Deep Freezer (−20°C)	1	2000	2000
103	Deep Freezer (−20°C)	1	1500	1500
104	Ice Flake Machine	1	3000	3000

105	Cold Room	1	4000	4000
106	COD Digester	1	1400	1400
107	Portable Autoclave	1	1800	1800
108	Laminar Air Flow	1	230	230
109	UV-VIS Spectrophotometer	1	200	200
110	Ice Flake Machine	1	440	440
111	Refrigerated Centrifuge	1	1200	1200
112	UV-Cabinet	1	35	35
113	Water bath	1	1500	1500
114	Western Blot Unit	1	5	5
115	pH Meter	2	2	4
116	Oven	1	2250	2250
117	Centrifuge	1	350	350
118	Magnetic Stirrer with Hot plate	1	600	600
119	Magnetic Stirrer with Hot plate	1	310	310
120	Weighing Balance	1	2	2
121	Weighing Balance	1	5	5
122	Compound Microscope	7	5	35
123	Stereo Microscope	2	5	10
124	Stereo Microscope	1	5	5
125	Stereo Microscope (Cameralucida)	1	30	30
126	Rotary Evaporator	1	1400	1400
127	Frezzer Drier	1	800	800
128	Vacuum Pump	1	250	250
129	DubbleDistilation Unit	1	2000	2000
130	Weighing Balance	1	2	2
131	pH Meter	1	2	2
132	pH Meter	1	2	2
133	Centrifuge	1	500	500
134	Incubator	1	24	24
135	Compound Microscope	2	5	10
136	Stereo Microscope	2	5	10
137	Magnetic Stirrer with Hot plate	1	500	500
138	Water Bath with Shaker	1	1500	1500
139	Water Bath	1	1500	1500
140	Hot Plate	1	1500	1500
141	Fuming Chamber	1	1500	1500
142	Microwave Oven	1	1500	1500
143	UV Transmitor	1		
144	Desktop Computers	1	150	150

145	UV-VIS Spectrophotometer	1	500	500
146	Split AC	1	2300	2300
147	Split AC	1	5120	5120
148	Mixer Grinder	1	500	500

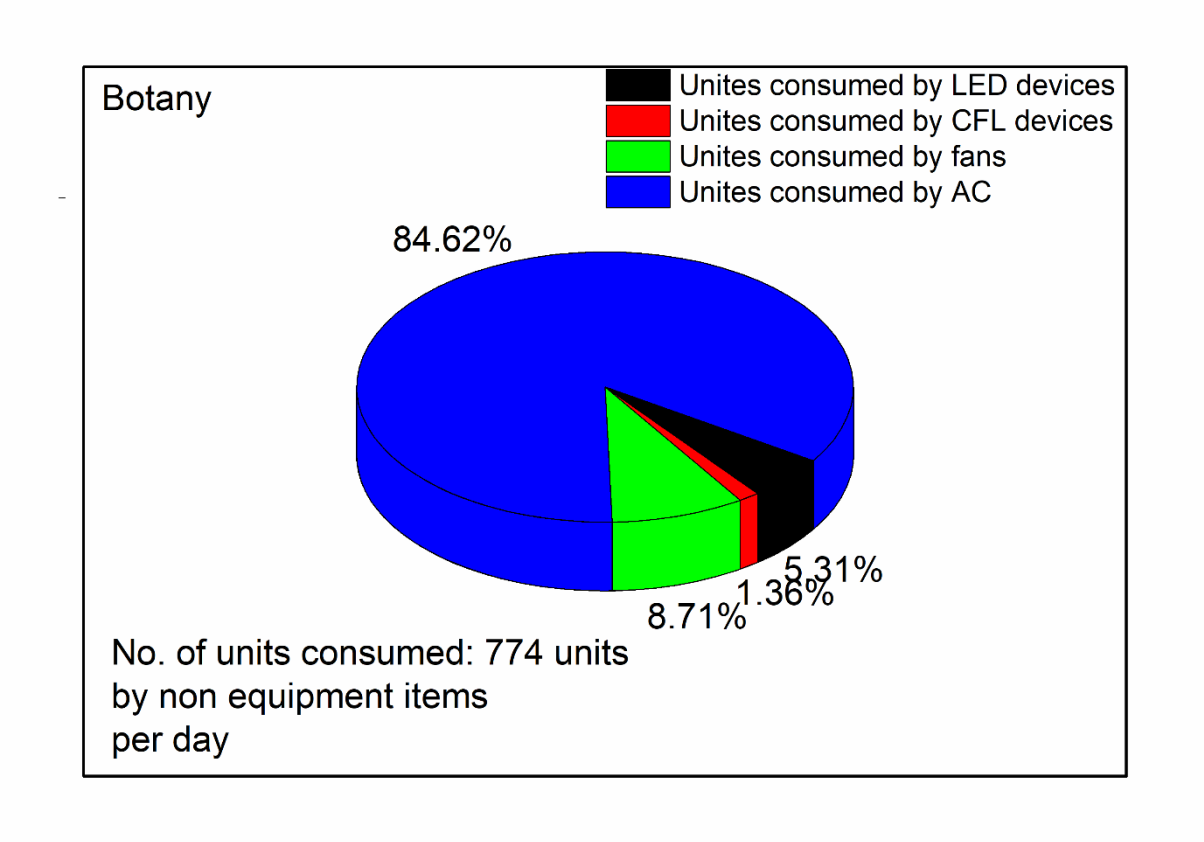

Figure 5.3 Chart of Botany

Table 5.67 Marine Biotechnology

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	FL lights:27 LED FL: 27	36 36	972 972
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 12 Pedestal: 2	80 55	960 110
3	Air conditioners	1.5 Tr: 8	1600	12800
	Office & Laboratory EQUIPMENT			

4	Computer	8	150	1200
5	Refrigerator	2	600	1200
6	Oven	2	2000	4000
7	Water heater	2	2000	4000
8	Printer	2	250	500

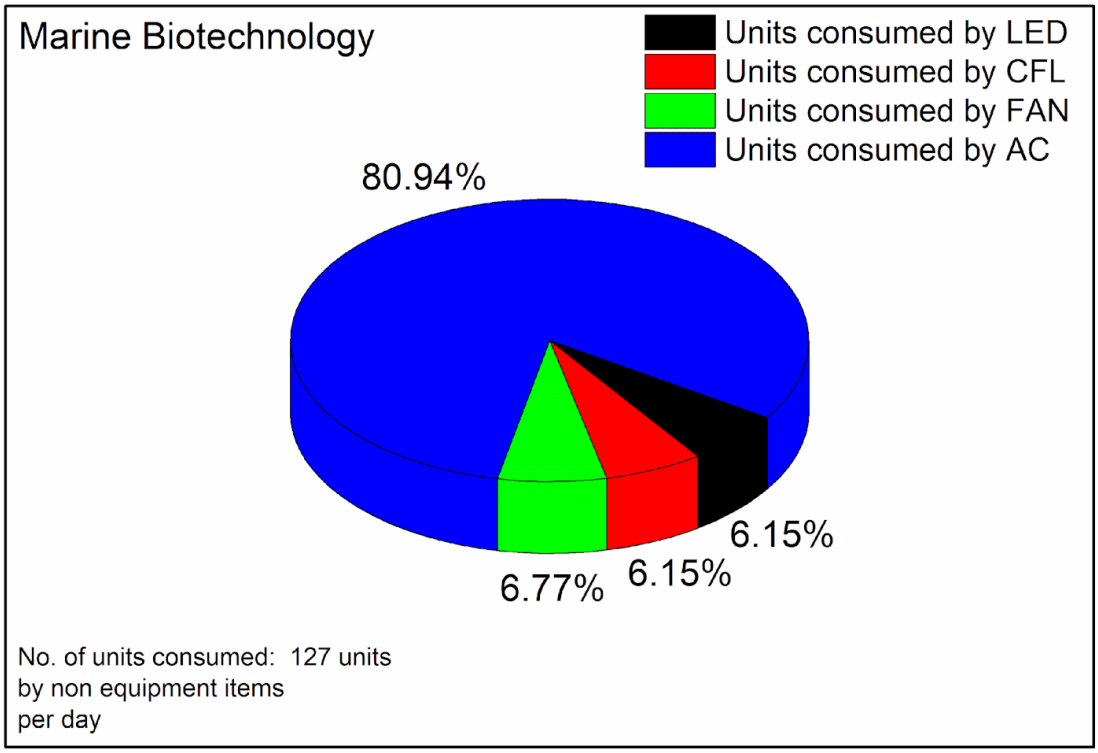

Figure 5.4 Chart of Marine Biotechnology

Table 5.68 Microbiology

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED tube:124	20	2480
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 32 Wall: 6 Exhaust: 2	80 50 40	2560 300 80

3	Air conditioners	1.5 Tr: 17	1600	27200
4	VRV Cassette AC	4.1 TR:6 3.3 Tr: 22	4.1 Tr 3.3 Tr	24.6 Tr 72.6 Tr
	Office & Laboratory EQUIPMENT			
5	Computer	5	150	750
6	Laptop	2	65	130
7	Xerox Machine	1	1500	1500
8	Printer	4	259	1036
9	TV (65 Inch)	1	70	70
10	Projector	3	150	450
11	UPS (connected to PC)	5	600 VA	3000 VA
12	UPS	3	4000 VA	12000 VA
13	UPS	2	20000 VA	40000 VA
14	Oven	3	1750	5250
15	Water –bath	4	1000	4,000
16	Water- bath(Proj)	1	1480	1480
17	Refrigerator	10	180	1800
18	Showcase coolers	3	210	630
19	Deep freezer (-20º C)	1	1000	1000
20	Centrifuge	3	100	300
21	Refrigerated Centrifuge	2 2	700 1650	1400 3300
22	Water purification	1	1700	1,700
23	Magnetic Stirrer	3	500	1500
24	Thermo Cycler	1	700	700
25	Biospectrometer	1	25	25
26	Eporator	1	20	20
27	Master Cycler	1	700	700
28	Microscope	4	360	1440
29	Lab Microscope	3	250	750
30	Nanodrop Spectrophotometer	1	30	30
31	Spectrophotometer	4	15	60
32	Gel Documentation System	1	90	90
33	pH Meter	2	2.5	5
34	Incubator Shaker	9	860	7740
35	Mini autoclave	1	1500	1500
36	Big autoclave	2	1800	3600
37	Ice flake machine	1	550	550
38	LAF	4	500	2000
39	CO_2 Incubator	1	500	500
40	Induction	3	1600	4800

41	Weighing Balance	4	80	320
42	Bacteriological Incubator	2	250	500
43	Rotary Evaporator	1	1200	1200
44	Biosafety Cabinet	1	1000	1000
45	Microwave	1	970	970

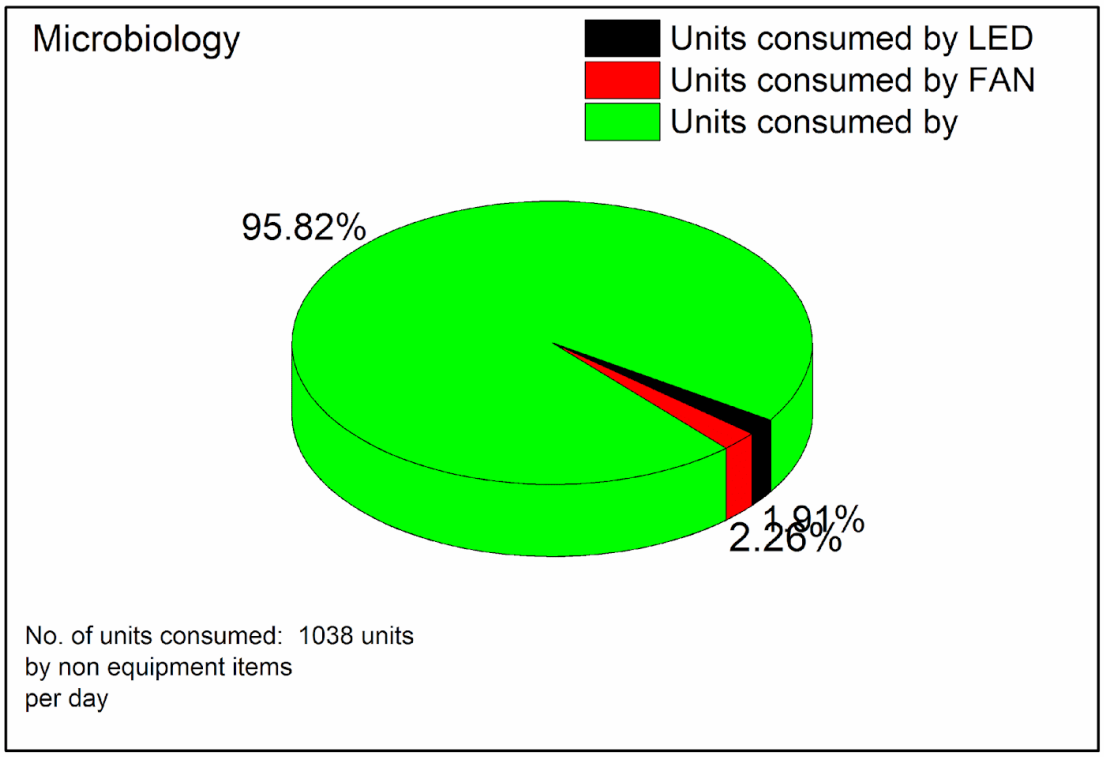

Figure 5.5 Chart of Microbiology

Table 5.69 Zoology

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED PL: 43 FL. PL: 50	36 36	1548 1800
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 13 Exhaust: 2	80 80	1040 160
3	Air conditioners	1.5 Tr: 5	1600	8000
4	VRV cassette AC	1. TR: 12 2.65 TR: 4	2.1 TR 2.65 TR	25.2 Tr 10.6 Tr

	Office & Laboratory EQUIPMENT			
1	Distillation Unit	1		
2	Hot air Oven	1		
3	Rotary Microtome	1		
4	Visible spectrophotometer	2		
5	Centrifuge Machine	2		
6	Homoginizer	1		
7	Magnetic Stirrer with heater	2		
8	Flame Photometer	1		
9	Water-bath	1		
10	Hot plate	1		
11	Mixer Grinder	1		
12	Compound Microscope	1		
13	Stereozoom microscope	2		
14	Memory Drum	2		
15	Vaccum Pump	2		
16	Micro-centrifuge	3		
17	Respirometer	1		
18	Refrigerator	2		
19	Vortex machine	1		
20	Electrophoresis Unit	2		
21	Weighing analytical Balance	1		
22	Centrifuge Machine	1		
23	Hot plate	1		
24	Autoclave	1		
25	Distillation Unit	1		
26	Visible spectrophotometer	1		
27	Hot air Oven	1		
28	Water-bath	1		
29	Refrigerator	1		
30	Magnetic Stirrer with heater	1		
31	pH meter	2		
32	Micro-centrifuge	1		
33	Muffle furnace	2		
34	Laminar Airflow	2		
35	pH meter	1		
36	Hot Air Oven	2		
37	Autoclave	1		
38	Magnetic Stirrer with heater	2		
39	Hot Plate	1		
40	Deep Freezer	1		
41	Refrigerator	1		
42	Egg Incubator	1		
43	Centrifuge Machine	1		

44	Micro-centrifuge	1		
45	Magnetic stirrer	1		
46	BOD incubator	3		
47	Refrigerator	1		
48	Laboratory Incubator	1		
49	Weighing analytical balance	1		
50	Laboratory Incubator	1		
51	Inverted Microscope with PC & Printer	1		
52	Water-bath	1		
53	Carbondioxide incubator	1		
54	Orbital Shaker	1		
55	Magnetic stirrer	1		
56	Laminar Airflow	3		
57	Vortex mixer	1		
58	Hot air Oven	1		
59	Test Tube rotator	1		
60	Cooling Centrifuge	1		
61	Compound Microscope	1		
62	Thermobath	1		
63	Deep freezer	2		
64	Osmometer	1		
65	Weighing analytical balance	1		
66	Hot water bath	1		
67	Personal Computer	8		
68	Computers	1		
69	Overhead projector	1		
70	Animal Incinerator	1		
71	Egg Incubator(2)	2		
72	split Ac	1		
73	Weighing Balance			
74	Gas Chromatography with Mass Spectroscopy (GCMS)	1		
75	Florescence Microscope with PC	2		200
76	Split AC	1		
77	Real Time PCR	1		
78	Stereozoom Microscope	2		
79	Stereo-microscope	1		
80	Inverted Microscope	2		
81	Ultra centrifuge	1		
82	UV-Visible Spectrophotometer	1		
83	Gel-Doc	1		
84	UV-Visible uv-2450 spectrophotometer	1		
85	HPLC	1		
86	Cooling Centrifuge	1		

87	Nanodrop	1		
88	PCR	1		
89	Sonicator	1		
90	Rotary Evaporator	1		
91	Lyophilizer	1		
92	Spectrofluorophotometer	1		
93	Xerox machine	1		
94	PC		2	
95	Freeze		1	
96	Laptop		7	
97	Printer		4	

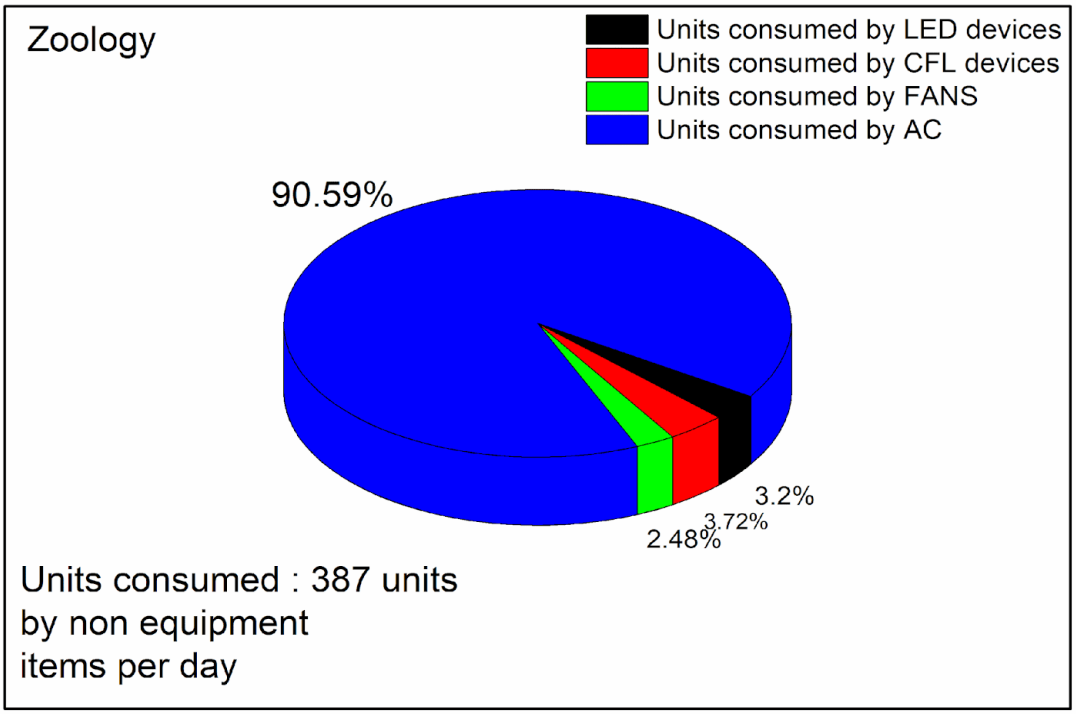

Figure 5.6 Chart of Zoology

School of Chemical Sciences

Table 5.70 Analytical Chemistry

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED PL: 54	36	1944

2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 36 Exhaust: 11 Pedestal: 3	80 55 50	2880 605 150
3	Air conditioners	1.5 Tr: 3	1600	4800
4	Cassette AC	1.3 Tr:12 2.1 Tr:2 0.8 Tr:1 3.3 Tr:13 4.1 Tr:2 1.0 Tr:1	1.3 Tr: 2.1 Tr: 0.8 Tr: 3.3 Tr: 4.1 Tr: 1.0 Tr:	15.6 4.2 0.8 42.9 8.2 1.0
	Office & Laboratory EQUIPMENT			
4	Rotavap	1	4000	4000
5	Hotplate cum stirrer	4	400	1600
6	M Furnance	1	3500	3500
7	UV Chamber	1	50	50
8	centrifuge	1	300	300
9	vacuum Pump	1	400	400
10	Hot Plate	2	2000	4000
11	Waterbath	2	1000	2000
12	Hot Air Oven	4	1500	6000
13	Chiller Zero	2	300	600 watts
14	Distillation Unit	2	3000	6000 Watts
15	Lab Refrigerator	1	1000	1000 watts
16	Fridge	2	500	1000 Watts
18	Analytical Balance	3	20	60 watts
19	Deep freezer	1	200	200 watts
20	Stabilizer	1	2000	2000 watts
21	Induction	1	1000	1000 watts
22	Hotplate cum stirrer	1	400	400 Watts
23	UV Chamber	1	50	50 Watts
24	Fridge	1	600	600 Watts
25	Analytical Balance	1	20	20 Watts
26	Stabilizer	1	2000	2000 Watts
27	Hot Air Oven	2	1500	3000 Watts
28	M. Furnance	1	3500	3500 Watts
29	Dehumidifier	2	650	1300 Watts
30	Speaker	1	100	100 Watts
31	Projector	1	500	500. tts

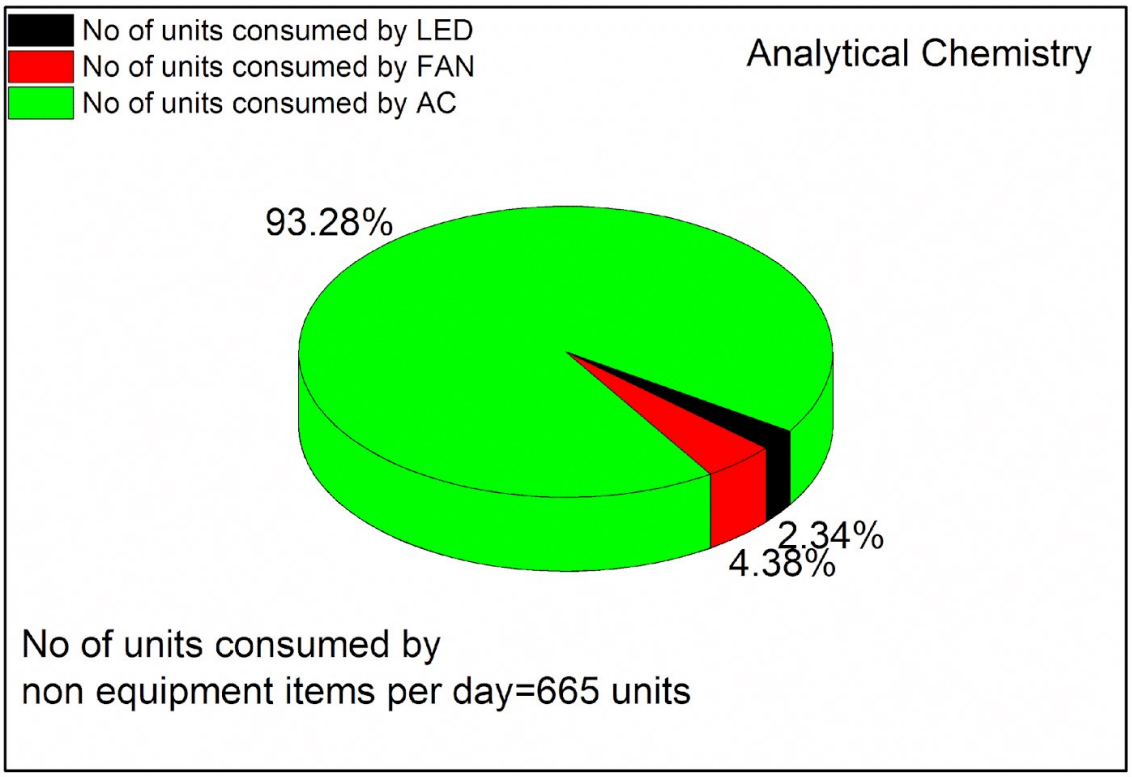

Figure 5.7 Chart of Analytical Chemistry

Table 5.71 Biochemistry

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED PL: 9	36	
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 6	80	
3	Air conditioners	1.5 Tr: 3	1600	
	Office & Laboratory EQUIPMENT			
4	Speaker	1	100	100 Watts
5	Projector	1	500	500 watts

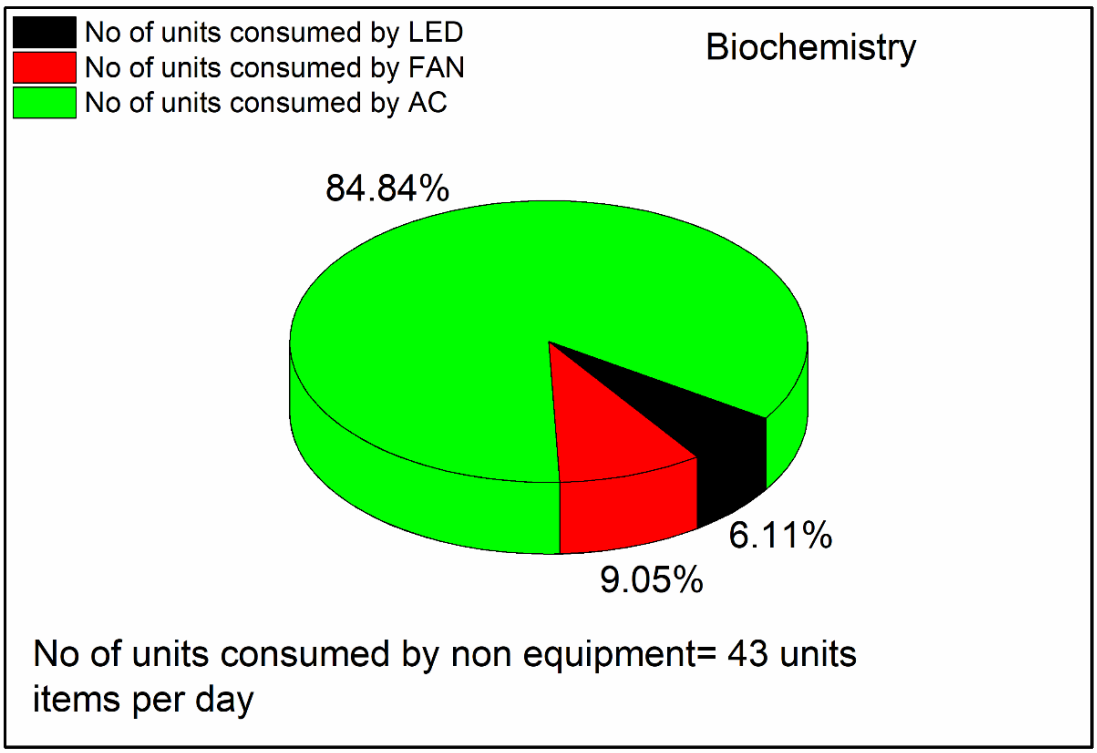

Figure 5.8 Chart of Biochemistry

Table 5.72 Inorganic Chemistry

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED PL: 47 LED tube: 27	36 20	1692 540
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 46 Exhaust big: 2 Exh Small: 15 Table: 8 Wall : 6 Pedestal: 3	80 410 50 55 55 55	3680 820 750 440 330 165

3	Cassette AC	0.8 Tr:10 1.3 Tr: 17 2.1 Tr:2	0.8 Tr: 1.3 Tr: 2.1 Tr:	8 22.1 4.2
	Office & Laboratory EQUIPMENT			
1	DOUBLE DISTILLATION UNIT	1	5000	5000
2	DISTILLATION CHILLER	1	2500	2500 W
3	HOT AIR OVEN	1	2000	2000 Watts
4	CENTRIFIGE	1	1000	1000
5	WATER BATH	2	1000	2000W
6	MUFFLE FURNACE	1	2000	2000W
7	VACCUM PUMP	2	200	400 watts
8	MUFFLE FURNACE	1	3000	3000W
9	FUMEHOOD	3	1500	4500
10	REFIGERATOR	1	600	600 Watts
11	ROTARAP CHILLER	1	300	300 Watts
12	ROTARAP Motor	1	3500	3500 watts
13	LABORATORY REFRIGERATOR	1	800	800 Watts
14	MAGNETIC STIRRER WITH HOT PLATE 150 DEGREE CENT.	24	345	8280 Watts
15	MAGNETIC STIRRER WITH HOT PLATE 300 DEGREE CENT.	5	400	2000 Watts
16	HOT PLATE	6	400	2400
17	REFRIGERATOR 415 LTR	1	1000	1000
18	REGRIGERATOR 253 LTR	1	580	580
19	FUME HOOD	3	1500	4500
20	WATER BATH	2	2000	4000
21	HOT AIR OVEN	1	2000	2000
22	DISTILLATION CHILLER	1	300	300
23	ROTARY VACCUM PUMP	1	400	400
24	WEIGHIN BALANCES	5	75	375
25	COMPUTER	3	200	600
26	PRINTER	2	100	200
27	FUMEHOOD	1	1500	1500
28	COOLER	1	200	200
29	MICROWAVE OVEN	1	1500	1500
30	WATER BATH	1	2000	2000
31	HOT PLATE	1	400	400
32	MAGNETIC STIRRER	2	375	750
33	HEATING MANTLE	2	200	400
34	SONICATOR	1	1000	1000
35	HOT AIR OVEN	1	1500	1500
36	BALANCE	1	15	15

37	DISTILLATION UNIT-CHILLER	1	3000	3000
38	HOT PLATE	2	400	800
39	MAGNETIC STIRRER	5	400	2000
40	PROGRAMMABLE FURNACE	1	3000	3000
41	REFRIGERATOR	1	600	600
42	PC SETUP	3	200	600
43	PRINTER	2	100	200
44	DEHUMIDIFIER	2	620	1240
45	DEHUMIDIFIER	1	600	600
46	TWO PROBE HEATER	10	100	1000
47	FOUR PROBE (DEP/03)	6	170	1020
48	RSISITIVITY: DIGITAL NANOMETER	2	50	100
49	SUSCEPTIBILITY :SUBMERSIBLE PUMP	2	80	160
50	BALANCE	1	20	20
51	GOUYS EXOT SETUP	1	100	100
52	DIGITAL GAUSEMETER	1	100	100
53	WATER BATH	1	2000	2000
54	UV CHAMBER	1	50	50
55	FUMEHOOD	1	1500	1500
56	MAGNETIC STIRRER	2	400	800
57	HEATING MANTLE	1	450	450
58	MUFFL FURNACE	1	3000	3000
59	HAIR DRYER	1	50	50
60	HOT AIR OVEN	1	1500	1500
61	ROTATORY FLASK SHAKER	1	300	300
62	VACCUM PUMP	1	50	50
63	PHOTO CAT	1	500	500
64	MAGNETIC STIRRER	2	800	1600
65	MICRO FUGE	1	600	600
66	WATER BATH	1	175	175
67	PRINTER	1	200	200
68	PC DELL	1	200	200
69	UV CHAMBER	1	50	50
70	HOT AIR OVEN	1	1500	1500
71	MAGNETIC STIRRER	5	400	2000
72	WEIGHING BALANCE	1	15	15
73	ROTAWEB CHILLER +MOTOR	1	4000	4000
74	FUMEHOOD	1	1500	1500
75	VACCUME PUMP	1	200	200
76	PRINTER	2	200	400
77	PC	2	200	400

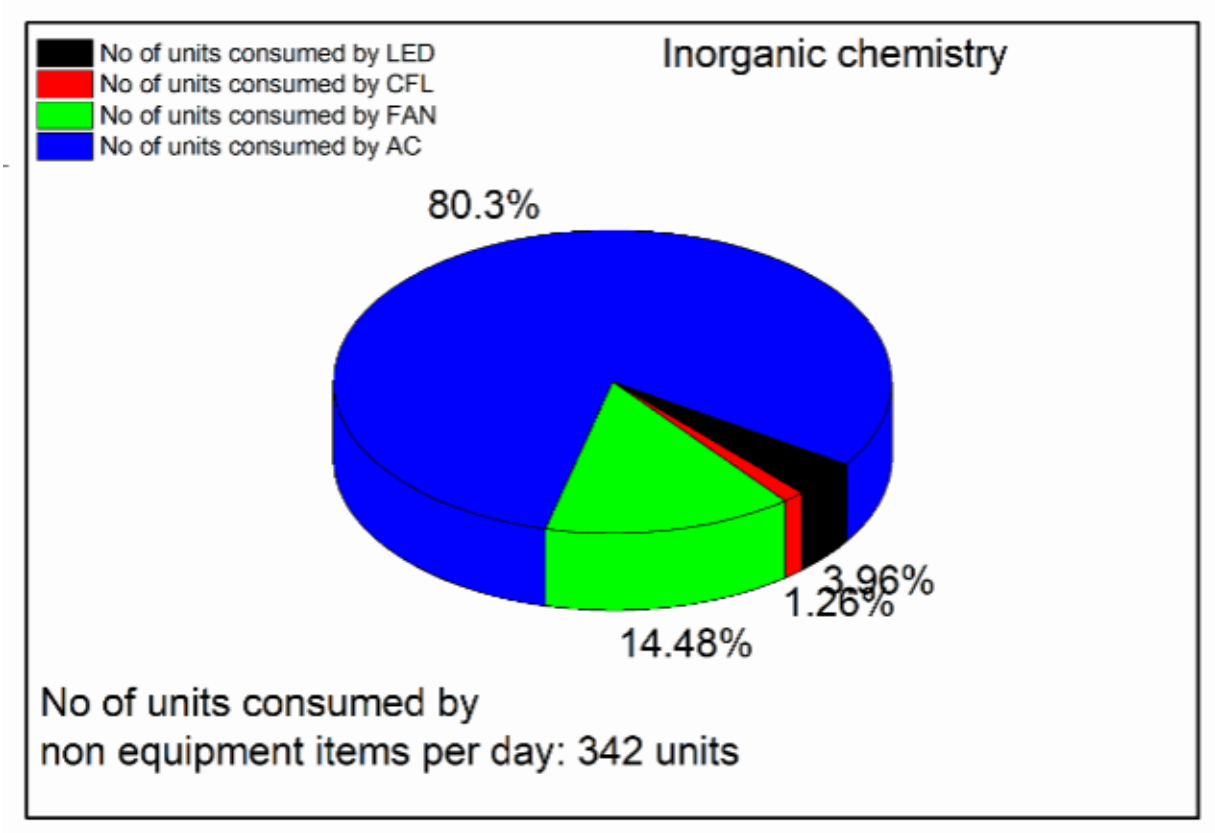

Figure 5.9 Chart of Inorganic Chemistry

Table 5.73 Organic Chemistry

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED PL: 43 LED tube: 38	36 20	1548 760
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Exhaust: 2 Exh.Small: 15 Ceiling: 52 Pedestal: 10	410 50 80 50	820 750 4160 500
3	Air conditioners	1.5 Tr: 3	1600	4800
4	**Office & Laboratory EQUIPMENT**			

5	PROJECTOR	1	500	500 Watts
6	FUMEHOOD	3	1.5KW	4.5 KW
7	CENTRIFUGE	1	400	400
8	UV CABINET	1	50	50 Watts
9	WATER BATH	1	1000	1000 Watts
10	OVEN	1	1500	1500 Watts
11	FUMEHOOD	3	1.5 KW	4.5 KW
12	ROTAVAP	1	4000	4000 W
13	VACCUM PUMP	1	370	370 W
14	FUMEHOOD	3	1500	4500
15	HOT AIR OVEN	1	2000	2000
16	PROBE SONICATOR	1	800	800
17	SUCTION PUMP	1	50	50
18	UV CABINET	1	50	50 Watts
19	FUMEHOOD	4	1500	6 KW
20	REFRIGERATOR	1	600	600 Watts
21	HOT AIR OVEN	1	2000	2000 Watts
22	VACCUM OVEN	1	1500	1500 W
23	FUMEHOOD	4	1500	6 KW
24	SONICATOR	1	1000	1000 Watts
25	ROTAVAP	1	4000	4000 Watts
26	FRIDGE	1	600	600 Watts
27	REFRIGERATOR	1	600	600 Watts
28	FUMEHOOD	3	1500	4.5 KW
29	HOT AIR OVEN	1	1500	1500 W
30	DISTILLATION UNIT	1	3000	3000W
31	HOT PLATE	1	2000	2000 W
32	DRYER	1	600	600 W
33	WATER BATH	1	2000	2000 W
34	VACCUME PUMP	4	185	740 Watts
12	REFRIGERATOR	1	6000	6000 W
13	FUMEHOOD	3	1500	4.5 KW
14	HOT AIR OVEN	1	1500	1500W
15	Waing BALANCE	2	15	30 Watts
16	DRYER	1	600	600W
17	WATER BATH	1	1500	1500W
18	VACCUME PUMP	1	350	350 W
19	VACCUME PUMP	1	350	350 W
20	ROTA	2	4000	8000 Watts
21	MICROWAVE	1	1000	1000 Watts

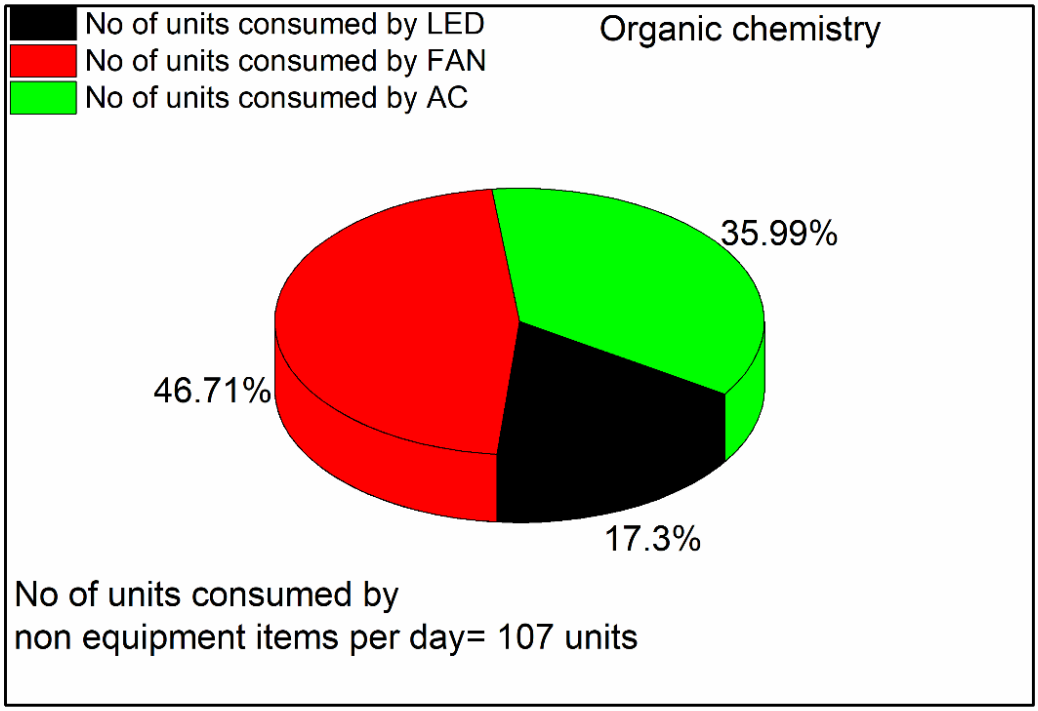

Figure 5.10 Chart of Organic Chemistry

Table 5.74 Physical Chemistry

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED tubes: 76	20	1520
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 30 Exhaust S: 11 Pedestal: 1	80 100 55	2400 1100 55
	Office & Laboratory EQUIPMENT			
3	Fume HoodMotor	3	1500	4.5 KW
4	Hot Air Oven	1	1500	1500 watts

5	Hot Plate	1	500	500 watts
6	water Bath	1	2000	2000 watts
7	Water Bath	1	1000	1000 watts
8	MillipreElix10	1	80 VA	80 VA
9	Refrigerator	1	500	500
10	Refrigerator	1	600	600
11	Weighing Balance	3	15	45
12	MuffleFurnace	1	4000	4000 Watt
13	Centrifuge	1	1000	1000 watts
14	Water Bath	1	2000	2000 Watts
15	Refrigerator	1	600	600 Watt
16	Fume HoodMotor	3	1500	4.5 KW
17	Refrigerator	2	600	1200 watts
18	Inverter UPS	1	5 KVA	5 KVA
19	UPS	1	10 KVA	10KVA
20	Refrigerator	1	600	600 watts
21	PC	1	200	200
22	Laptop	1	50	50

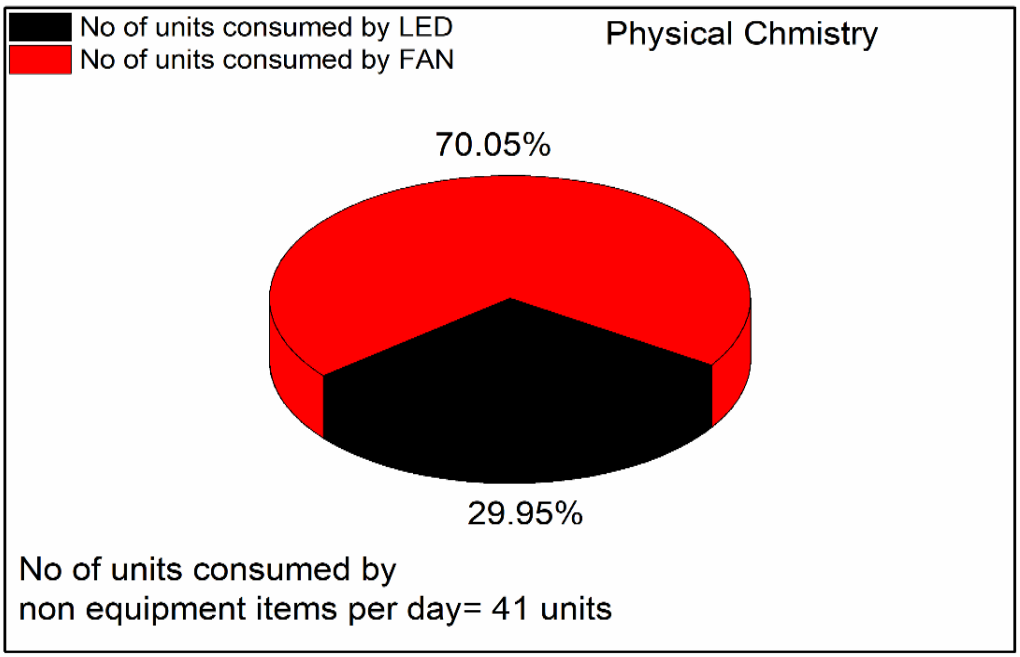

Figure 5.11 Chart of Physical Chemistry

Table 5.75 General

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED PL:154 LED PL S: 38 LED bulb S:2 LED bulb: 243 LED tube L:94 LED tube S:8	36 12 9 12 20 10	5544 456 18 2916 1880 80
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 51 Exh S: 28 Exh M: 2	80 40 250	4080 1120

		Exh L: 2 Pedestal: 1 Wall: 6 Table: 3	410 55 55 55	500 820 55 330 165
3	Air conditioners	1.5 Tr: 20 2.0 Tr: 1	1600 2200	32000 2200
4	Cassette AC	1.65 Tr: 2 1.3 Tr: 4 3.3 Tr: 6 2.1 Tr: 4	1.65 Tr 1.3 Tr 3.3 Tr 2.1 Tr	3.3 Tr 5.2 Tr 19.8 Tr 8.4 Tr
	Office & Laboratory EQUIPMENT			
1	Electrochemical Workstation	2	100	200
2	PC for Electrochem Workstation	2	3300	6600
3	UV 1800	1	140 VA	140 VA
4	UV 4000	1	110 VA	110 VA
5	UV 4000 PC	1	3300	3300
6	Vario Micro Cube	1	1500	1.5 KW
7	Vario Micro Cube computer	1	3300	3300
8	Vario Micro Cube UPS	1	5 KVA	5 KVA
9	Fluorescence Spectrometer	1	180 VA	180 VA
10	Fluorescence Spectrometer PC	1	3300	3300
11	UV 2450	1	190 VA	190 VA
12	UV 2450 Computer	1	3300	3300
13	Karl Fisher Titrator	1	550	550
14	HPLC 1260	1	180 VA	180 VA
15	HPLC 1260 UPS	1	2 KVA	2 KVA
16	HPLC 1260 PC	1	3300	3300
17	Dehudidifier	2	650	1300 Watts
18	false Ceilling Light	8	36	288 Watts
19	AES Instrument	1	2.1	2.1 KVA
20	AES Instrument PC	1	3300	3300
21	AES Instrument UPS	1	10 KVA	10 KVA
22	Dehudidifier	2	650	1300 Watts
23	Nitrogen Gen for AES	1	22	22 Watts

24	Compressor for AES	1	2200	2200
25	XRD	1	2000	2000
26	XRD UPS	1	11 KVA	11 KVA
27	XRD Computer	1	3300	3300
28	Microscope	1	120	120
29	Ice Flake Machine	1	400	400 Wats
30	Water dispensor	1	700	700 Watts
31	Fumewood	2	1500	3 KW
32	Combiflash	1	440	440
33	Glove Box	1	1000	1KW
34	UV Chamber	1	50	50 Watts
35	Hoteplate Cum Stirrer	1	1170	1170 Watts
36	Hoteplate Cum Stirrer	2	345	690 Watts
37	Waterbath	1	2000	2000 Watts
38	Hoteplate Cum Stirrer	2	325	650 Watts
39	IR	1	800	800
40	PC to IR	1	3300	3300
41	FTIR	1	880	880
42	PC for FTIR	1	3300	3300
43	AIR DRYER	1	330	330
44	BET	1	1100 VA	1100 VA
45	PC for BET	1	3300	3300
46	DEHUMIDIFIER	5	650	3250 W
47	TG/DSC	1	940 VA	940 VA
48	CHILLER for TG	1	2640	2640
49	PC for TG/DSC	1	3300	3300
50	UPS for I3	1	10 KVA	10 KVA
51	AFM	1	2000	2000
52	PC for AFM	1	3300	3300
53	FURNACE	2	3500	7000
54	M. FURNACE	3	3000	9000
55	OVEN H. AIR	3	1500	4500
56	M.FURNACE	3	4000	12000
57	GC 2014	1	220	220
58	PC for GC	1	3300	3300
59	HPLC	1	185 VA	185 VA
60	PC for HPLC	1	3300	3300
61	DEHUMIDIFIER	1	650	650 W
62	UPD -5 KVA VMS	2	5 KVA	10KVA
63	VMS	1	3300	3300
64	PC for VMS	1	6600	6600
65	DEHUMIDIFIER	4	650	2600 W
66	TG/DSC	1	800	800
67	PC TO TG DSC	1	3000	3000

68	LCMS	1	160VA+300 VA	160VA+300 VA
69	ACC for LCMS	1	2KVA	2KVA
70	GENERATOR for LCMS	1	200	200
71	UPS for LCMS	1	10 KVA	10 KVA
72	PC for LCMS	1	15A	15A
73	UPS for SERVER	1	1KVA	1KVA
74	COMPUTER	1	300	300
75	PRINTER	1	400	400
76	SCANNER	1	900	900
77	PC	4	200	800
78	XEROX MACHINE SMALL	1	1000	1000
79	XEROX MACHINE-BIG	1	1800	1800
80	PC	1	300	300
81	PRINTER	1	100	100
82	INTERNET HUB	1	100	100
83	PC	2	200	400
84	LAPTOP	3	65	195
85	WATER DISPENSER	1	700	700
86	PROJCTORS	1	500	500
87	HOMETHEATRE	1	90	90
88	PC	3	200	600
89	INTERNET HUB BOX	1	100	100
90	PC	2	200	400
91	LAPTOP	4	65	260
92	PRINTER	4	200	800
93	FRIDGE	1	300	300
94	PROJECTOR BIG	1	1000	1000
95	SOUND SYSTEM	1	1000	1000
96	PROJECTOR SCREEN	1	80	80
97	INTERNET HUB	1	100	100
98	BALANCE	2	15	30
99	STIRRER	15	20	300
100	FRIDGE	3	700	2100
101	Hot Air OVEN	2	2000	4000
102	ROTAVapor	1	3500	3500
103	UV Chamber	1	50	50
104	PROJECTORS	1	1000	1000
105	TV	1	90	90
106	HOME THEATRE	1	100	100
107	NMR Instrument	1	2000	2000
108	Compressor	1	2200	2200
109	PC	1	200	200

110	DEHUMIDIFIER	1	630	630
111	FRIDGE	2	600	1200
112	OVEN	1	1000	1000
113	PC	16	20	320 Watts

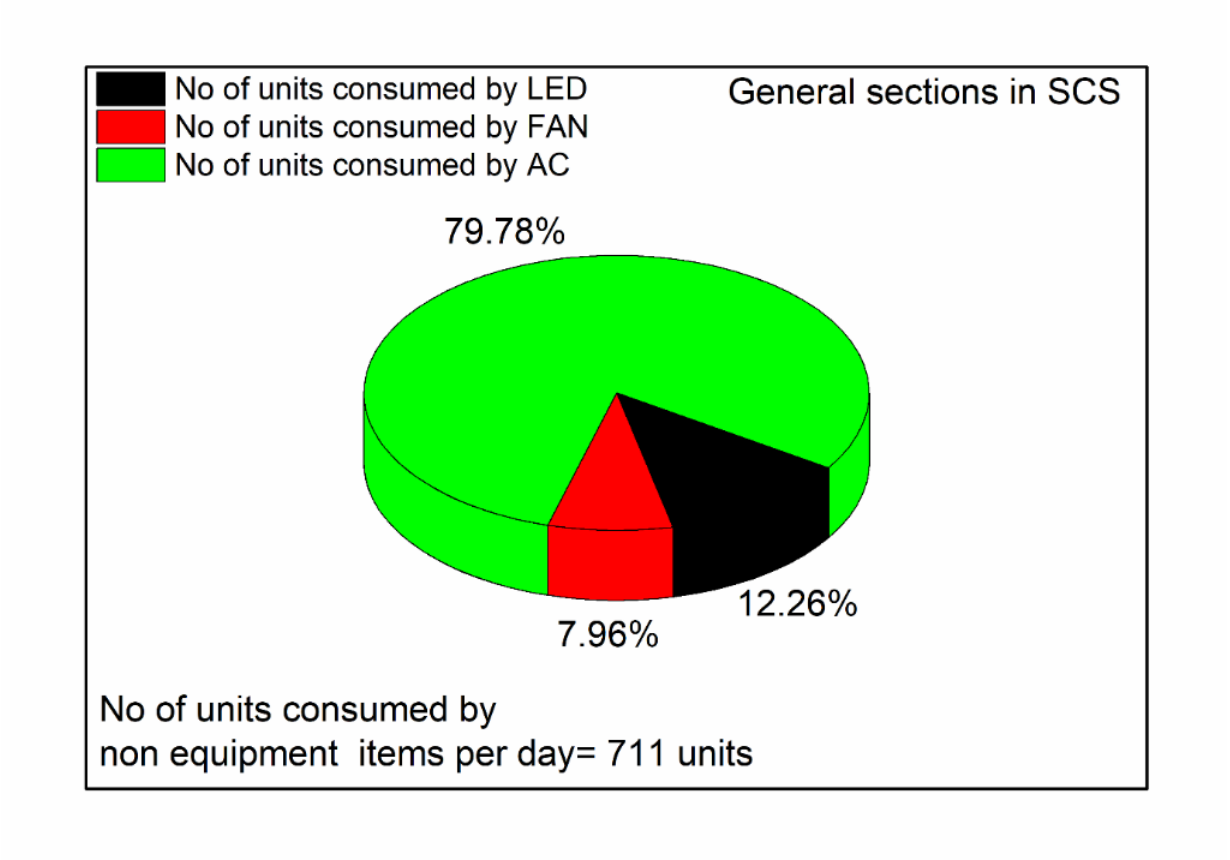

Figure 5.12 Chart of General section in SCS

School of Earth, Ocean and Atmospheric Sciences

Table 5.76 Environmental Science

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED tube B:14	20	280
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 6	80	480
3	Air conditioners	5. Tr: 2	1600	3200 2200

		2.0 Tr: 1	2200	
	Office & Laboratory EQUIPMENT			
4	Laptop	1	45	45
5	Printer	1	200	200
6	LED TV	1	138	138
7	cylox mixer	1	32	32

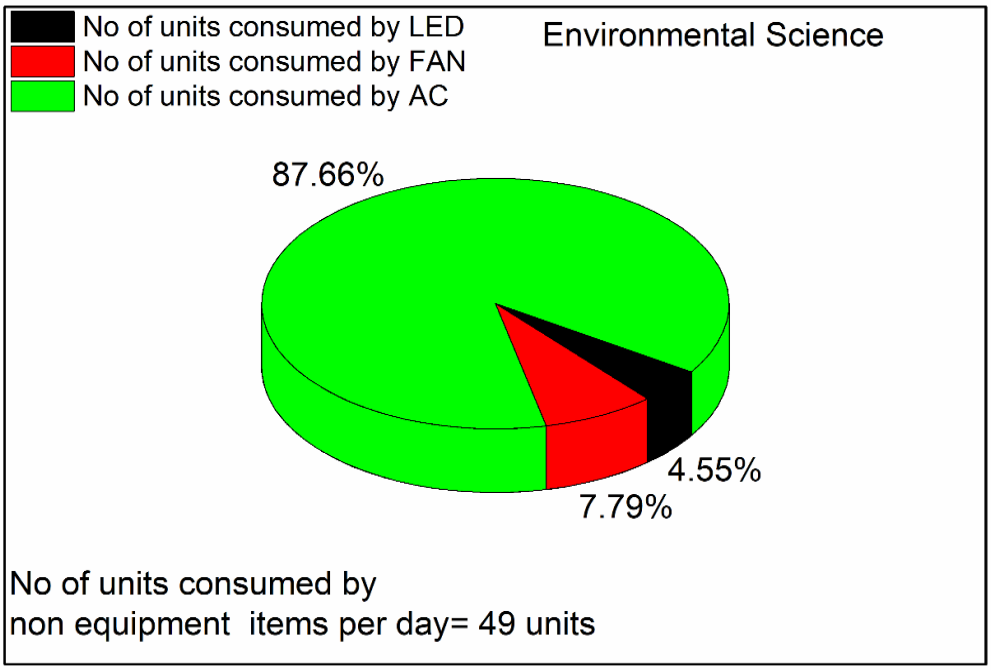

Figure 5.13 Chart of Environmental science

Table 5.77 APPLIED GEOLOGY

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED Tube: 98	20	1960
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 34 Wall: 9 Exhaust: 9	80 50 45	2720 450 405
3	Air conditioners	1. Tr: 4 1.5 Tr: 5	1250 1709	1250 8545
	Office & Laboratory EQUIPMENT			
4	Computer	15	200	3,000
5	Laptop	7	200	1,400
6	Xerox Machine	1	450	450
7	Printer	7	450	3,150
8	UPS (connected to PC)	9	600	5,400
9	UPS	6	1100	6,600
10	Ovens	1	1000	1,000
11	Ultrasonic bath	1	500	500
	Laboratory Equipment's			
12	Microscopes	8	5	40
13	Dehumidifier	1	270	270
14	Thin Section Unit	1	90	90
15	Polishing Machine	1	1200	1200
16	Hot Plate	3	600	1800
17	Distillation Unit	1	3000	3000
18	Vibratory Cup mill	1	1500	1500
19	Hot Air Oven	1	1000	1000
20	Refrigerator	2	900	1800
21	UV Spectrophotometer	1	600	600
22	Flame Photometer	1	250	250

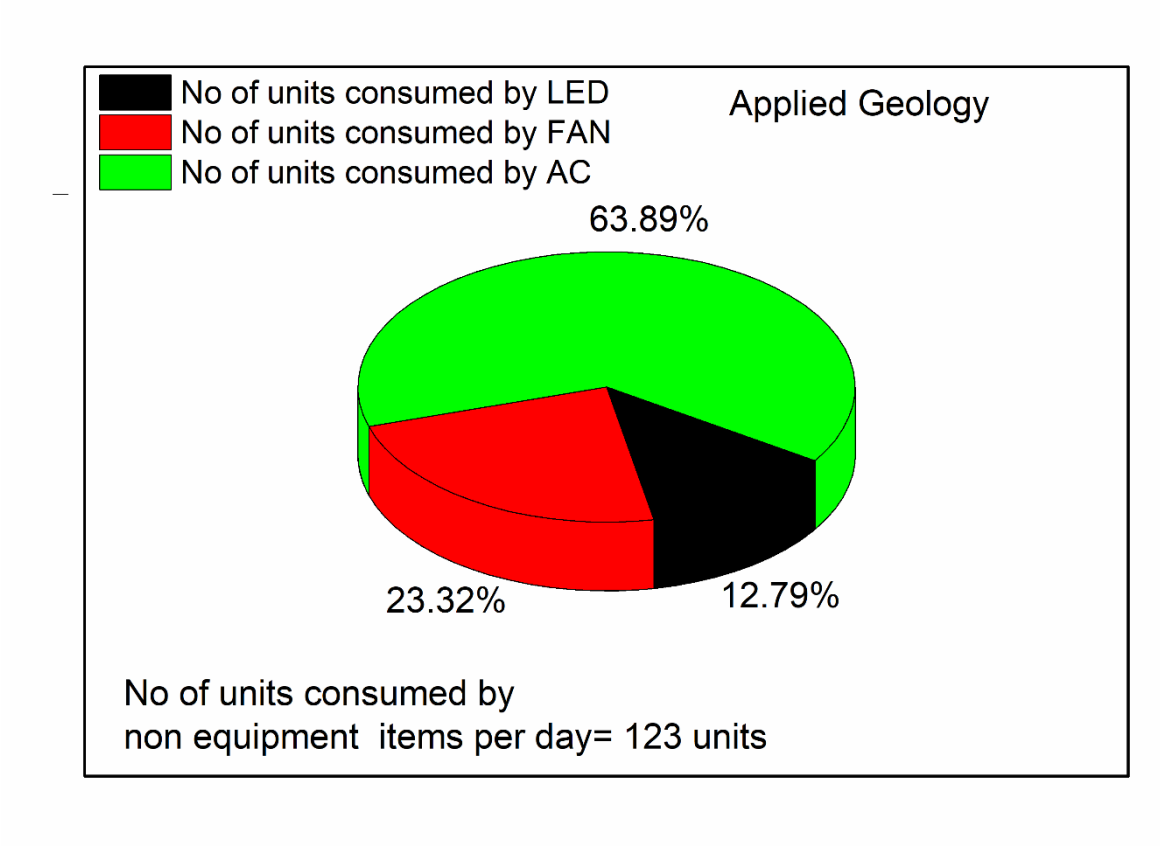

Figure 5.14 Chart of Applied Geology

Table 5.78 MARINE SCIENCE

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED: 85 Flo. Tube: 8	20 36	1700 288
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling:38 Exhust: 5 Pedestal: 1 Wall: 2	80 50 50 50	3040 250 50 100
3	Air conditioners	1.5 Tr: 11	1600	17600
	Office & Laboratory EQUIPMENT			
1	orbital shaker	1	1000	1000
2	Deep freezer	1	400	400

3	Deep freezer	1	400	400
4	Hot plate	1	1250	1250
5	merk water purification system	1	230	230
6	centrifuge	1	710	710
7	watman water purification system	1	250	250
8	Hot plate	1	2000	2000
9	Refrigerated centrifuge	1	220	220
10	Analytical balance	1	20	20
11	Eutech Ph meter	2	5	10
12	Analytical balance	1	20	20
13	Analytical balance	1	20	20
14	water bath	1	1100	1100
15	Deep freezer	1	550	550
16	Hot air oven	1	1500	1500
17	Uv-1800 spectrophotometer	1	200	200
18	Eutech Ph meter	1	5	5
19	Analytical balance	1	20	20
20	Hot plate	1	1200	1200
21	uv-1900 spectrophotometer	1	250	250
22	Atomic Absorption Spectrophotometer	1	7000	7000
23	Total organic carbon Analyser	1	1700	1700
24	fluorescence microscope	1	130	130
25	UPS 10 KVA	1	60	60
26	UPS 5 KVA	1	30	30
27	UPS 3 KVA	1	20	20
28	Uv -visible Spectrophotometer	1	220	220
29	Olympus fluoroscence microscope	1	250	250
30	computer system	1	250	250
31	Nikon Microscope Epi fluorescence	1	220	220
32	Labomed Compound Microscope	1	100	100
33	compound microscope	1	120	120
34	compound microscope	1	120	120
35	Labomed Compound Microscope	1	100	100
36	compound microscope	1	120	120
37	Radical Face contrast microscope	3	100	300
38	Dehumidifier	1	300	300
39	olympus Stereo zoom microscope	2	100	200
40	Labomed Compound Microscope	1	100	100
41	Personal Computer Acer	18	250	4500
42	Personal Computer HP	4	250	100
43	Printer	1	40	40

44	monitor samsung 55"	1	145	145
45	Projector	2	282	564
46	Spectrophotometer	1	170	170
47	Deep Freezer	1	400	400
48	Laminar Air Flow	1	400	400
49	Hot Air Oven	1	1000	1000
50	Particle Size Analyser	1	50	50
51	Nephalometer	1	60	60
52	Multiwavelength Radiometer	1	800	800
53	PM Sampler	1	650	650
54	computer system	4	200	800
55	printer	3	40	120
56	Xerox Machine	1	400	400
57	Laptops	5	70	350.

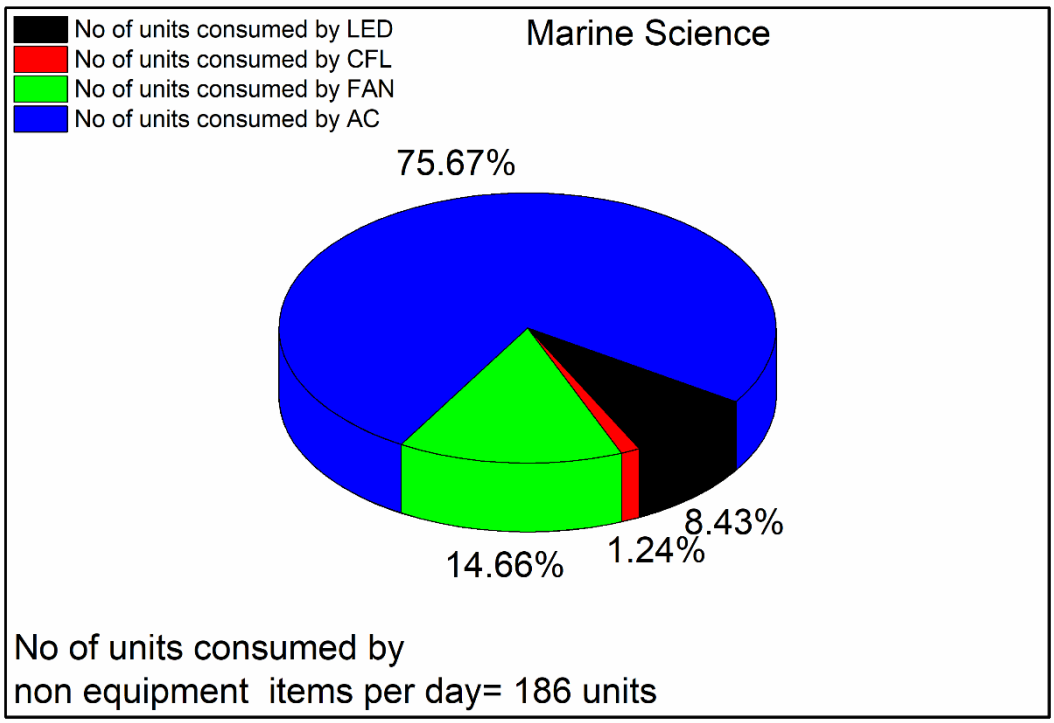

Figure 5.15 Chart of Marine Science

Table 5.73 MARINE MICROBIOLOGY

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED Tube:22	20	440
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 8 Wall: 2	80 50	640 100
	Office & Laboratory EQUIPMENT			
3	Projector	2	200	400
4	Auto Photo Colorimeter	1		
5	Autoclave	1		
6	Bacteriological Incubator	1		
7	balance (Kern FCB bench scale)	1		
8	Biosafety cabinet (class II)	1		
9	Centrifuge	1	900	900
10	Centrifuge	1	900	900
11	Digital Power supply	1		
12	Digital Thermometer	1		
13	Gel Electrophoresis Unit Vertical	1		
14	Gel System	1		
15	Heating block	1	270	270
16	Homogenizer	1	90	90
17	Hot plate	1	1200	1200
18	Ice Flaking Machine	1	550	550

19	Kern EMB Balance	1		
20	Kern PCB Bench scale Pre-tare	1		
21	Kjeldhal apparatus	1		
22	Laboratory Oven	1		
23	Lux Meter	1		
24	magnetic stirrer	1		
25	microcentrifuge	1		
26	microwave	1	500	500
27	minicentrifuge (quick spin)	1	150	150
28	Minicoolers -20C	1	120	120
29	Miniphor UVT System	1	350	350
30	Muffle Furnace	1	400	400
31	orbital shaker	1	350	350
32	orbital shaker incubator (cooling)	1	1000	1000
33	pH/Eh meter	1	50	50
34	Phase Contrast Microscope	1	60	60
35	Probe sonicator	1	800	800
36	Projector	1	650	650
37	Refractometer	1		
38	refrigerator	1	900	900
39	refrigerator	1	900	900
40	Sedgewick Rafter	1		
41	Sedgewick Rafter	1		
42	simple Microscope	1		
43	Thermal cycler	1	3000	3000
44	UV Transilluminator	1	200	200
45	vacuum pump poratble	1	200	200
46	Vortex mixer	1	450	450
47	Water bath	1	450	450
48	weighing balance	1	600	600
49	UV Spectrophotometer	1	600	600

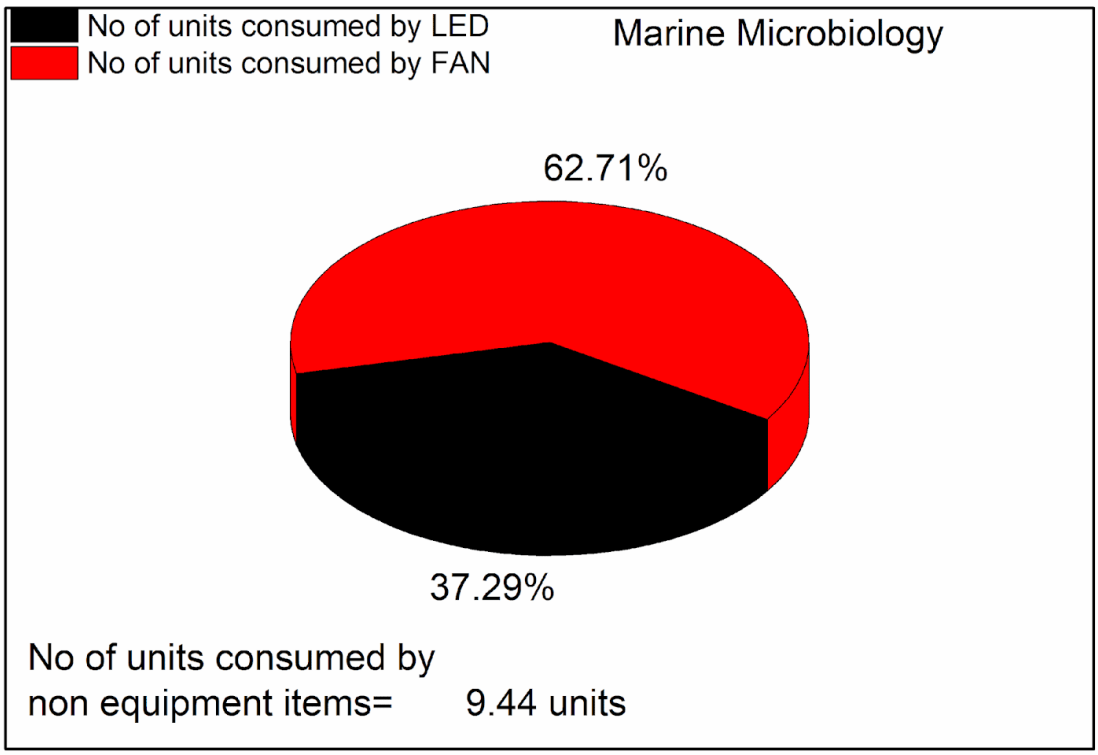

Figure 5.16 Chart of Marine Microbiology

School of International and Area Studies

Table 5.79 School of International and Area Studies

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT			
1	Bulbs (LED, CFL, Incandescent etc.)	LED: 46	20	920
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 17 Exhaust: 5	60 40	1020 200
3	Air Conditioners	1. Tr: 3 1.5 Tr: 4	1200 1600	3600 6400
	Office & Laboratory EQUIPMENT			
1	Desktop	3	150	450

2	Laptop	2	45	90
3	Xerox Machine	1	2000	2000
4	Printer	2	200	400
9	UPS (connected to PC)	3		
10	Microwave	1	1400	1400
11	Refrigerator	1	300	300
12	Water Purifier	1	90	90
13	LED TV	5	65	325

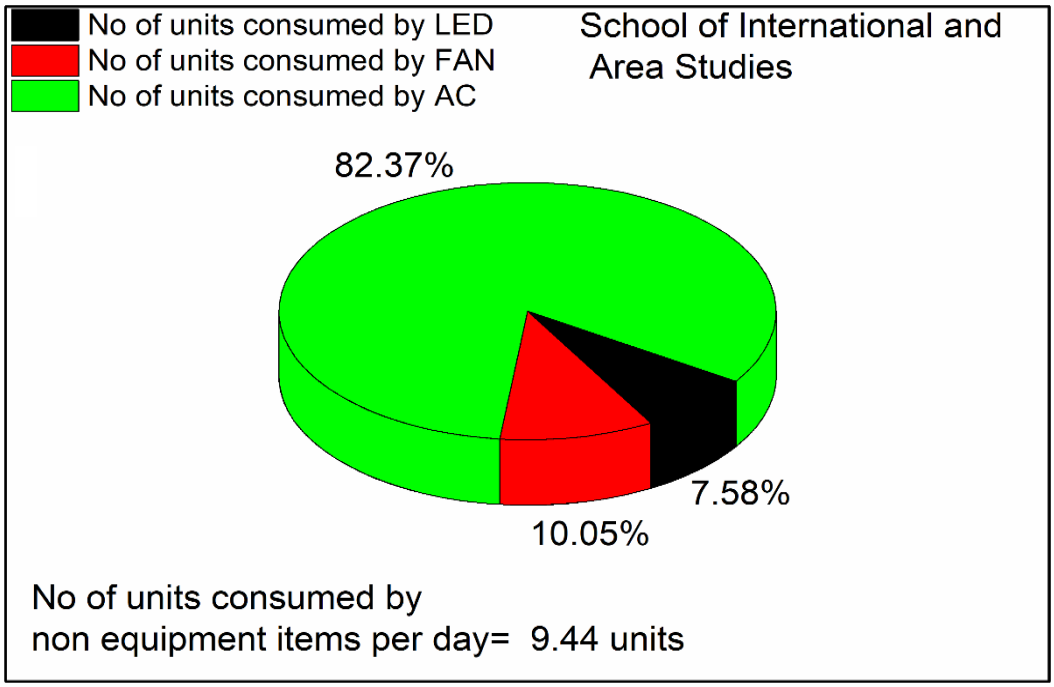

Figure 5.17 Chart of School of International and Area Studies

Table 5.80 Manohar Parrikar School of Law, Governance & Public Policy

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT			
1	Bulbs (LED, CFL, Incandescent etc.)	LED: 6	18	108
		LED: 5	40	200
		LED: 3	50	150
		LED: 68	30	2040
		LED: 161	18	2898
		LED: 6	40	240
		LED: 2	120	240
		LED: 18	18	324
		LED: 14	10	140
		LED: 392	40	15680
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 179	75	13425
		Exhaust: 25	50	1250
3	Air Conditioners	1. Tr: 41	1000	41000
		1.5 Tr: 6	1500	9000
		3.0 Tr: 2	3000	6000
4	Data Rack switch	19	25	475
5	Lift	2	9000	18000
6	Submersible pump (5 HP)	2	3730	7460
	Office & Laboratory EQUIPMENT			
1	Computer	3	120	360 Watts
2	Laptop	2	65	130 Watts
3	Printer	1	250	Watt 250

4	UPS (not connected)	2	30 KVA	60 KVA
5	UPS	12 Watts	60	720 Watts

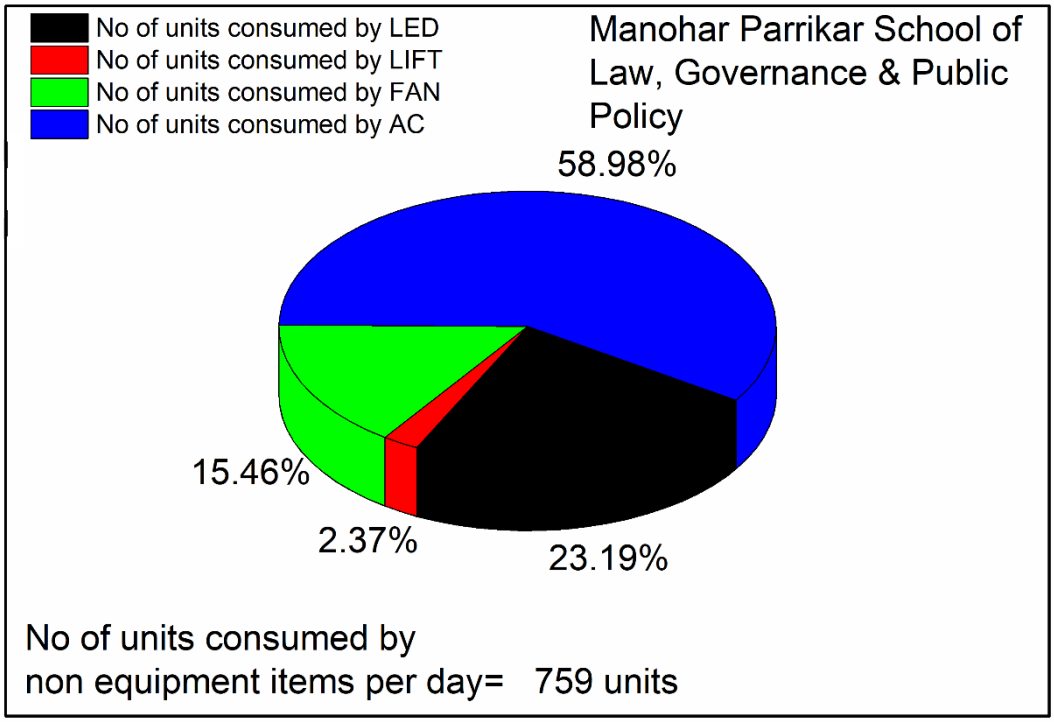

Figure 5.18 Chart of Manohar Parrikar School of Law, Governance & Public Policy

School of Physical and Applied Sciences

Table 5.81 ELECTRONICS

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED tube: 67	20 20	1340 20

		CFL: 1		
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 42 Wall: 5 Exhaust: 1	80 50 40	3360 250 40
3	Air conditioners	1.5 Tr: 7	1600	11200
	Office & Laboratory EQUIPMENT			
4	Computer	38	150	5,700
5	Laptop	5	65	325
6	Xerox Machine	1	1500	1,500
7	Printer	4	259	1036
8	UPS (connected to PC)	2	600 VA	1,200 VA
9	UPS	1	3 KVA	3 KVA
10	UPS	2	15 KVA	30 KVA
11	Water purifier	1	200	200
12	Network Switch Rack	2	100	200
13	TV 65"	1	120	120
14	Projector	2	150	300

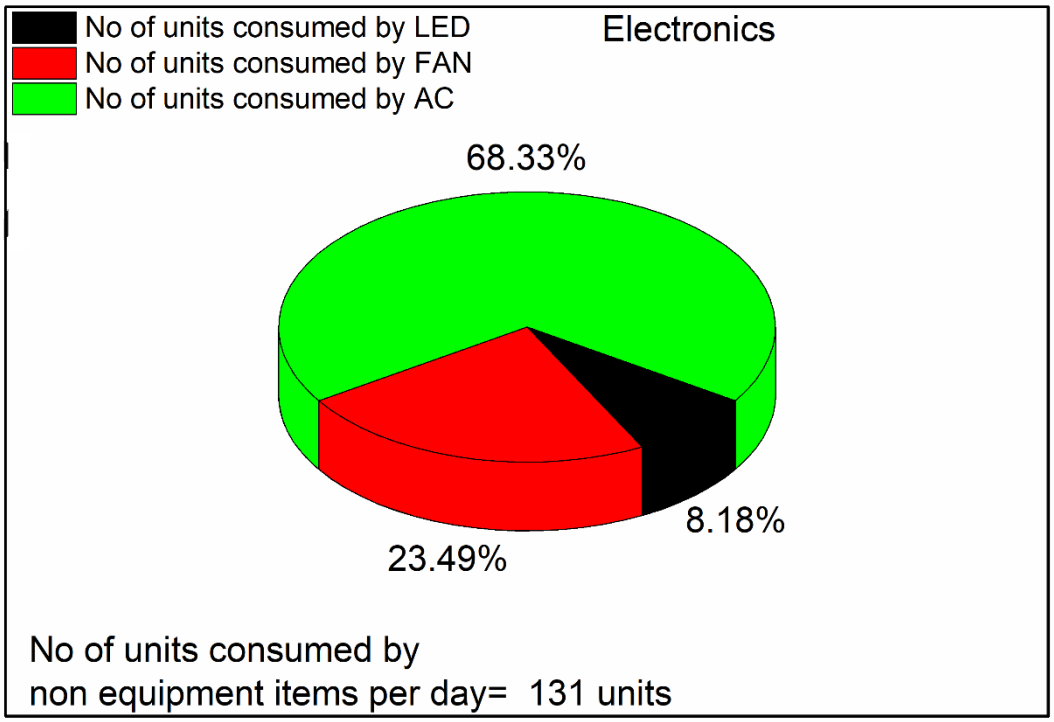

Figure 5.19 Chart of Electronics

Table 5.82 PHYSICS

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED tube: 213	20	4260
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 87 Wall: 7 Exhaust: 4	80 53 40	6960 371 160
3	Air conditioners	1.5 Tr: 17	1600	27200
	Office & Laboratory EQUIPMENT			
4	Computer	80	150	12,000
5	Laptop	26	65	1690

6	Xerox Machine	1	1500	1,500
7	Printer	10	259	2590
8	UPS (connected to PC)	10	600 VA	6,000
9	UPS	1	4 KVA	4000
10	UPS	1	10 KVA	10000
11	UPS	3	40 KVA	120000
12	Ovens	2	1000	2,000
13	Water –bath	1	1000	1000
PG Laboratory Equipment's (List separately)				
1	Fume Hood	2	60	120
2	Weighing balance	2	6	12
3	Clinical Centrifuge	1	300	300
4	Heating Mentle	3	220	660
5	UV visible Spectrophotometer	1	1000	1000
6	IR spectrometer	1	200	200
7	UV Inspection cabinet	1	150	150
8	UV-Visible Photochemical Reactor	1	250	250
9	Hot Plates	1	1200	1200
10	Water Purifier	1	40	40
11	PLD	1	40	40
12	Diamond Wheel cutter	1	400	400W
13	Lapping Polishing Machine	1	150	150W
14	X-Ray Generator	1	17000	17000
15	DMA	1	1,440	1,440
16	DSC	1	150W	150W
17	Close Cycle Refrigerator	2	3750	7500
18	Resistivity setup	1	1380	1380
19	LED Magnifying Lamp	1	23	23
20	Elephant Lubricated Air Compressor	1	1491	1491
21	Hall effect setup	2	115	230
22	Resistivity	2	110	220
23	B-H curve	2	110	220
24	Magnetic susceptibility	2	110	220
25	Dielectric constant	2	100	200
26	Composite Piezoelectric Osillator	2	110	220
27	Resistivity of semionductor material	2	110	220
28	Magnetoresistance	2	110	220
29	Lock in amplifier	2	110	220

30	Geiger muller counter	3	110	220
31	Thermal Diffusivity of brass	2	110	220
32	Thermo emf analyser	2	110	220
33	Thermal relaxation	2	115	230
34	Measurement of low resistant	2	115	230
35	Feigunbaum circuit	2	115	230
36	chua circuit	2	115	230
37	Optic Kits	2	115	230
38	Thermal Conductivity	2	115	230
39	Lattice Dynamic Kit	2	115	230
40	DSO	25	30	750
41	Function Generators	20	13	260
42	Power supplies	20	115	2300
43	Glove Box	1	370	370
44	Turbo Molecular pumping station	1	690	690
45	Muffle furnace	1	3500	3500
46	Carbolite ceramic tube furnace	1	5500	5500
47	Carbolite quartz tube furnace	1	2500	2500
48	Carbolite box furnace	1	4500	4500
49	Single zone tube furnace	1	3000	3000
50	Split tube furnace	1	5800	5800
51	Carbolite box furnace	1	2203	2203
52	Water Chiller	2	4500	9000
53	DIA Chiller	1	2800	2800
54	Vacuum Thin Film Evaporation	1	400	400
55	Vacuum System	1	370	370
56	Diode Laser	1	81	81
57	Laser table	1	500	500
58	Optical microscope	4	230	920
59	High voltage Dc power supply	1	460	460
60	LCR Meter	1	440	440

61	Electrochemical Workstation	1	230	230
62	Thermoelectric Power setup	1	220	220
63	Dielectric Constant Measurement setup	1	200	200
64	3D Printer	1	220	220
65	Oil free diaphragm vacuum pump	1	370	370
66	Delta spin	1	220	220
67	Circulation Bath System	1	4500	4500
68	Shaker Incubator	1	500	500
69	PH Meter	1	2.5	2.5
70	Biochemical Incubator	1	500	500
71	Gel Rocker orbital Shaker	1	100	100
72	UV Transilluminator	2	230	460
73	Magnetic Stirrer hot plate	5	1200	6000
74	Interactive Touch Screen Display	2	110	220
75	Refrigerator	4	125	500
76	HIPace 80 Turbo drag pump	1	500	500
77	Ultrasonic Interferometer	1	220	220
78	Schlenk Line System	1	30	30
79	Michelson Interferometer	2	220	440

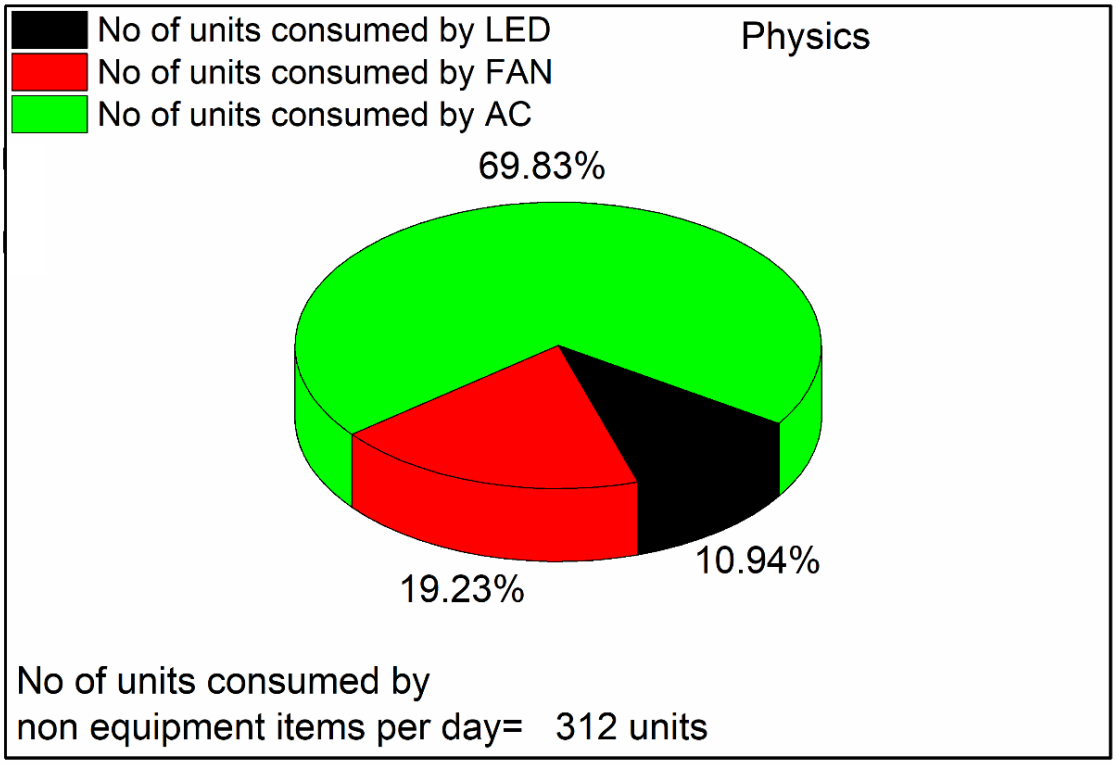

Figure 5.20 Chart of Physics

Table 5.83 MATHEMATICS

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED tube: 44	20	880
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 18 Wall: 10 Pedestal: 1	80 50 50	1440 500 50
3	Air conditioners	1.5 Tr: 1 2.0 Tr: 2	1600 2200	1600 4400
	Office & Laboratory EQUIPMENT			
4	Laptop	4	65	260W

5	Xerox Machine/Printer	1	1500	1500W
6	Printer	3	259	777W
7	Smart T.V.	1	70	70
8	Scanner	2	259	518W
9	Computer	10	150	1,500
10	UPS	11	600 VA	6,600 VA

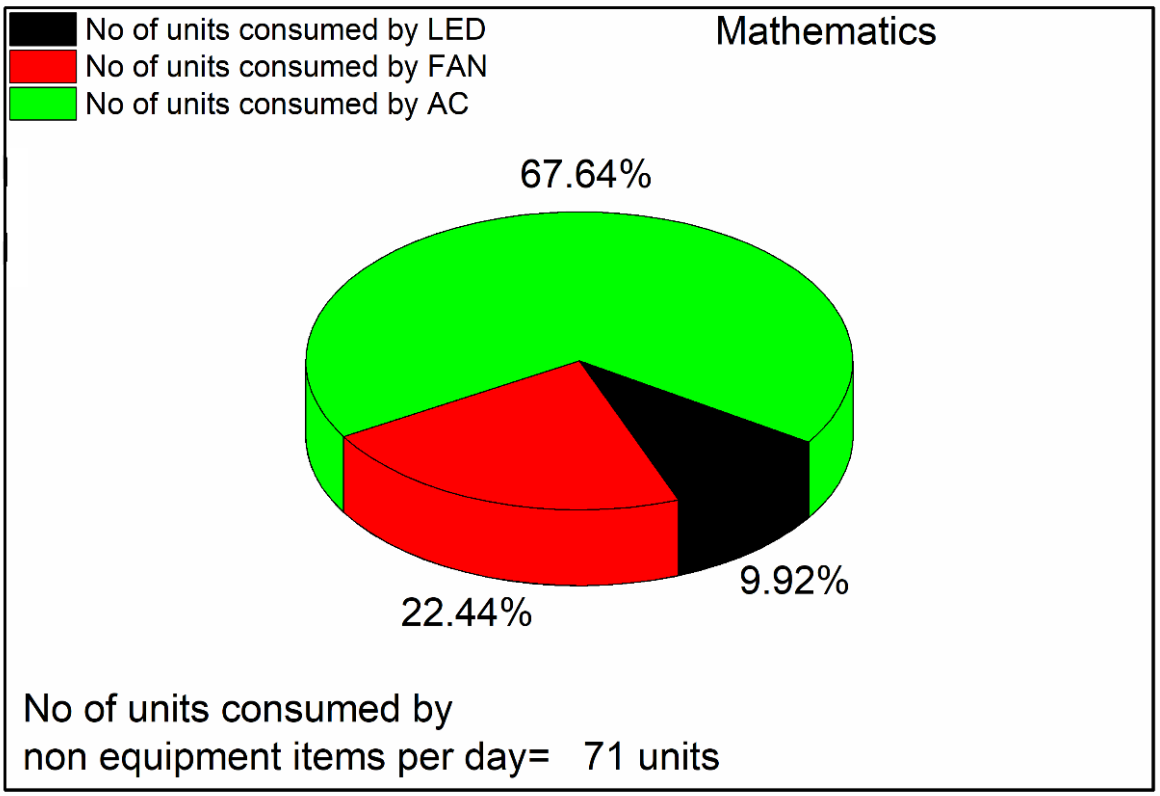

Figure 5.21 Chart of Mathematics

Table 5.84 **B. VOC.**

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			

1	Bulbs (LED, CFL, Incandescent etc.)	LED Tube: 18	20	360
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 14	80	1120
3	Air conditioners	1.0 Tr: 1	1100	1100
	Office & Laboratory EQUIPMENT			
4	Printer	1	259	259W
5	Projector	2	230	460W
6	DGS - 3610-26	2	70	140W
7	DGS - 1210-28	4	251.3	1005.2W
8	INVERTER	1	230	230V
9	UPS	1	1000	1000W
10	WASHINNG MACHINE	1	360	360W
11	INDUCTION COOK TOP	1	1800	1800W
12	ELECTRIC KETTLE	1	1500	1500
13	MIXER GRINDER	1	800	800
14	REFRIGERATOR	1	125	125W
15	LED TV	1	70	70
16	GYZER	1	3000	3000W
17	MICROWAVE OVEN	1	1200	1200W
18	OVEN TOASTER	1	1200W	1200W
19	STEAM IRON	1	1200W	1200W
20	ELECTRIC RICE COOKER 1.5	1	350W	350W
21	DISH T.V	1	10	10
22	CCTV PACKAGE	1	10	10
23	WATER PURIFIER	1	30W	30W
24	KENT HAND BLENDER	1	400W	400W
25	HAND DRILL	1	400W	400W
26	DESKTOP	5	750W	750W
27	FUNCTION GENERATOR	5	20	100

28	LCR METER, 4 DIGIT LED 7 SEGMENT DISPLAY	2	1	2
29	DC REGULATED POWER SUPPLY	4		230V
30	DIGITAL STORAGE OSSILLOSCOPE	5	30	150W
31	PLC TRAINER KIT	1	20	20
32	DGS-1510-28X-24 PORT	1	70	70W
33	DGS-1510-28P-24 PORT	1	70	70W

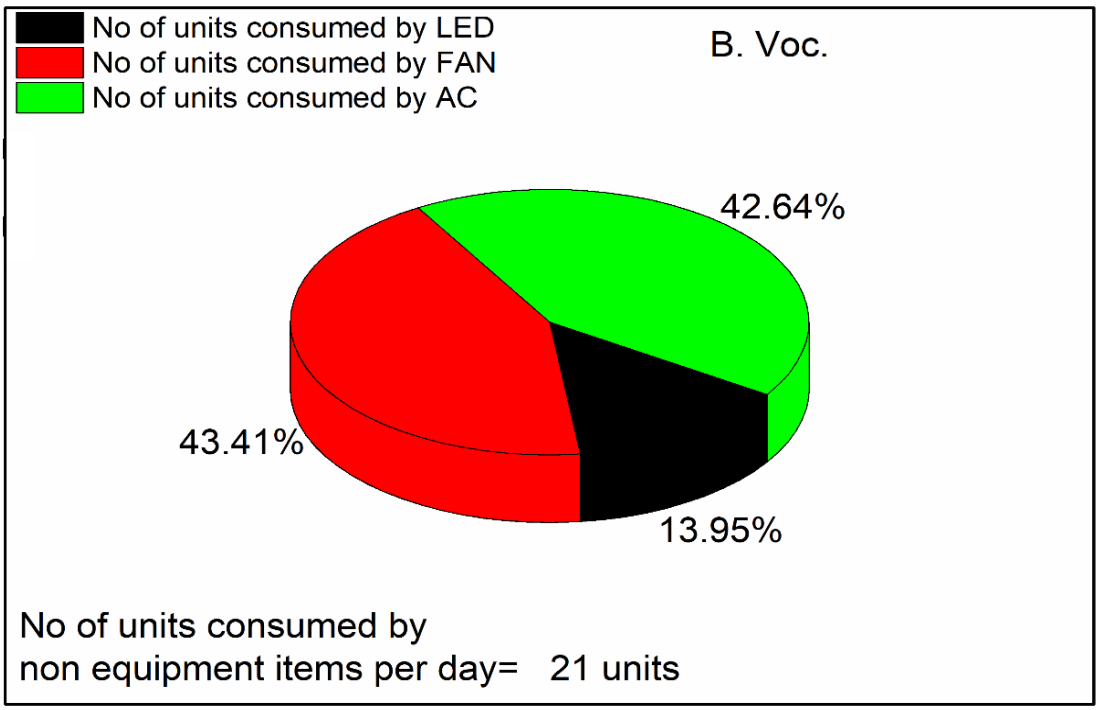

Figure 5.22 Chart of B.Voc

Table 5.85 USIC, SPAS

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT			
1	Bulbs (LED, CFL, Incandescent etc.)	LED: 02 Tube: 12	20 50	40 600
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 12 Exhaust: 04	80 40	960 160
3	Air Conditioners	1.5 Tr: 02	1600	3200
	Office & Laboratory EQUIPMENT'S			
4	Computer	1	150	150
5	UPS (connected to SEM-EDAX)	1	7.5 KVA	6750
6	Oven	1	1000	1000
7	SEM-EDAX	1	1200	1200
8	Lathe Machine	1	415	415
9	Drilling machine	2	415	830
10	Milling machine	1	1200	1200
11	Kettle	1	1500	1500
12	Dehumidifier	1	530	530
13	Weighing balance	1	10	10
14	Grinder	1	0.75HP	559

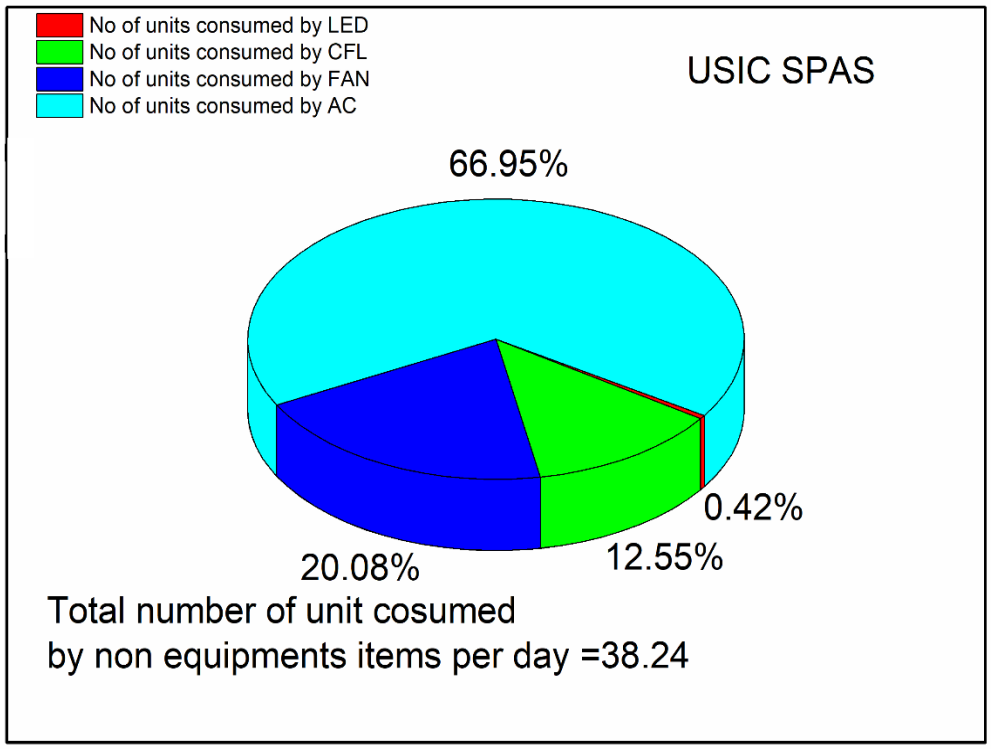

Figure 5.23 Chart of USIC SPAS

School of Sanskrit, Philosophy and Indic Studies

Table 5.86 PHILOSOPHY

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED tube: 28	20	560
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 14 Pedestal: 1	80 60	1120 60
3	Air conditioners	2.0 Tr: 1	2300	2300
	Office & Laboratory EQUIPMENT			
3	Projector	1	300	300
4	Desktop computer	1	200	200
5	Printer	1	250	250

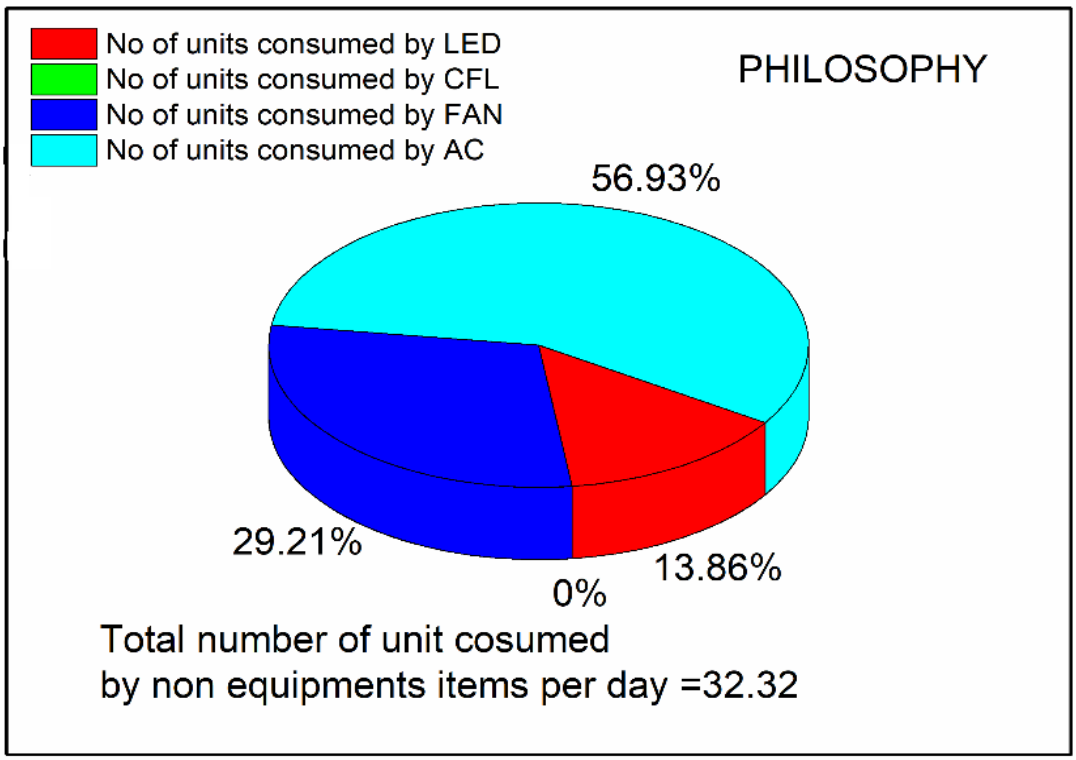

Figure 5.24 Chart of Philosophy

Table 5.87 SANSKRIT

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED tube: 8 LED bulb: 2	20 15	160 30
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 6	80	480
	Office & Laboratory EQUIPMENT			
3	Projector	1	300	300
4	Desktop computer	1	200	200
5	TV	1	320	320

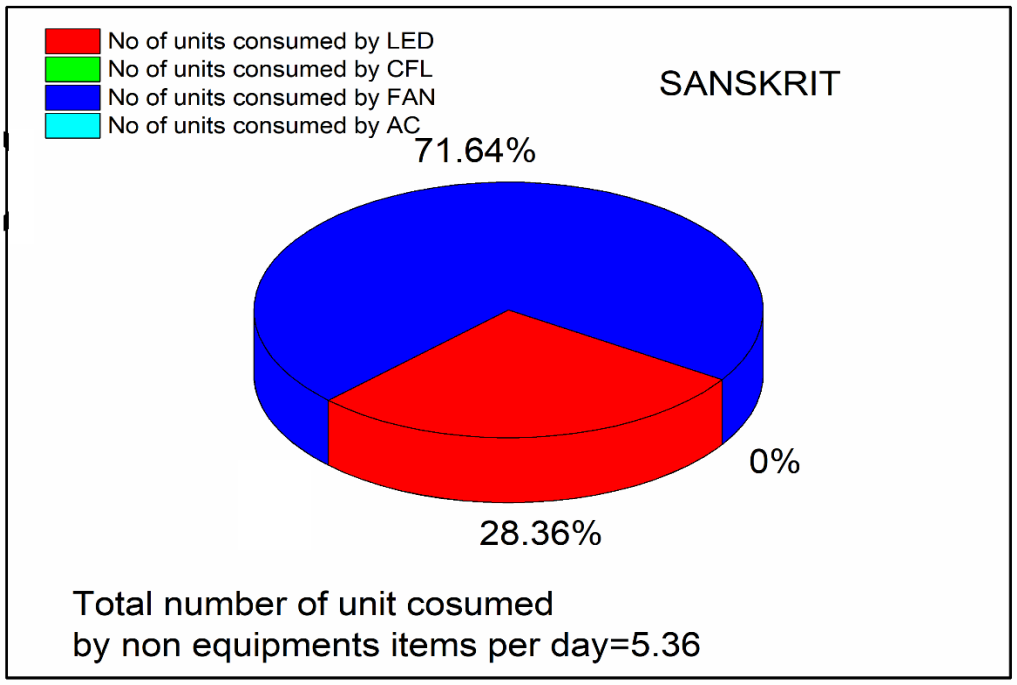

Figure 5.25 Chart of Sanskrit

Shenoi Goembab School of Languages and Literature

Table 5.88 FRENCH (M.A. AND B.A. (HONORS))

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED tube:28 Flo tube: 8	 20 36	 560 288
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 15 Pedestal: 4 Wall: 2	80 60 60	1200 240 120
3	Air conditioners	1.5 TR: 3	1600	4800
	Office & Laboratory EQUIPMENT			
4	LED TV	1	65	65
5	Laptop	1	45	45
6	Laptop (seed money)	1	45	45

7	Projector	2	600	1200
8	Desktop computer	4	200	800
9	Printer	4	200	800
10	Xerox machine & stabilizer	1	2000	2000
11	Speaker	3	80	240

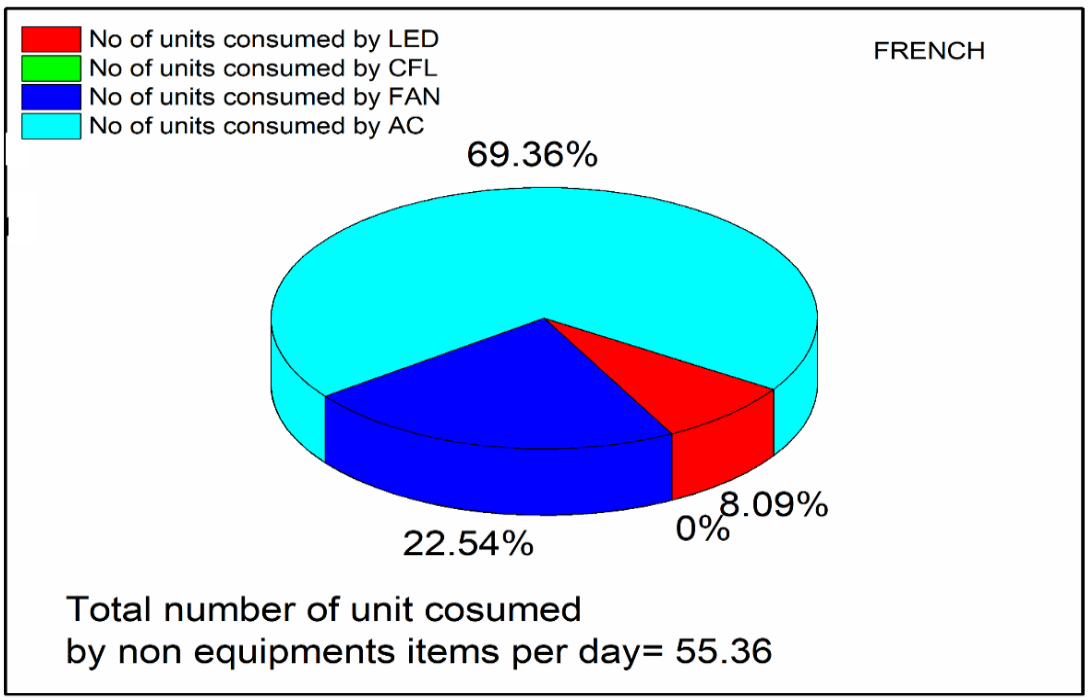

Figure 5.26 Chart of French

Table 5.89 PORTUGUESE

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			

1	Bulbs (LED, CFL, Incandescent etc.)	LED tube: 29	20	580
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 15 Wall: 02	80 50	1200 100
3	Air conditioners	1.5 Tr: 3	1600	4800
	Office & Laboratory EQUIPMENT			
4	Computer	02	200	400
5	Laptop	02	45	90
6	Printer	06	200	1200
7	Televisions	03	65	195

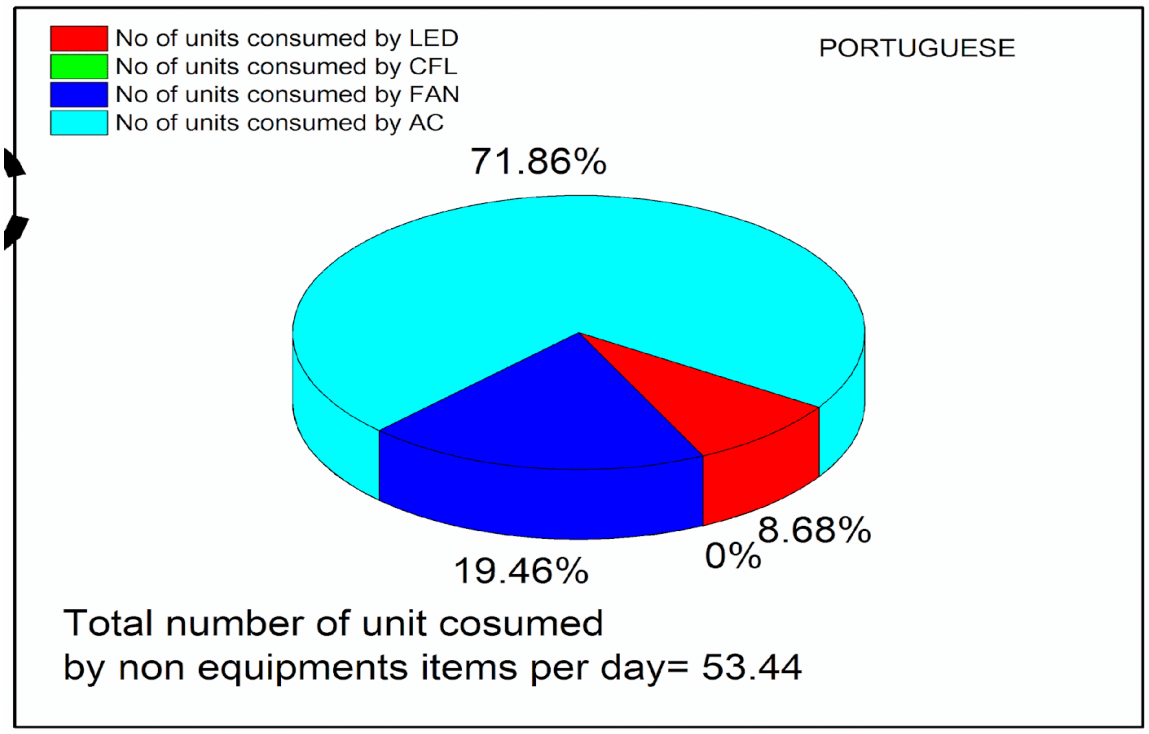

Figure 5.27 Chart of Portuguese

Table 5.90 ENGLISH

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED tube:44	20	880
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 19 Wall: 2	80 50	1520 100
3	Air conditioners	1.5 Tr: 4 2.0 Tr: 1	1600 2200	6400 2200
	Office & Laboratory EQUIPMENT			
4	Computer	3	150	600
5	Laptop	3	65	195
6	Printer	4	259	1036
7	UPS	1	600 VA	600 VA
8	UPS	2	1 KVA	2 KVA

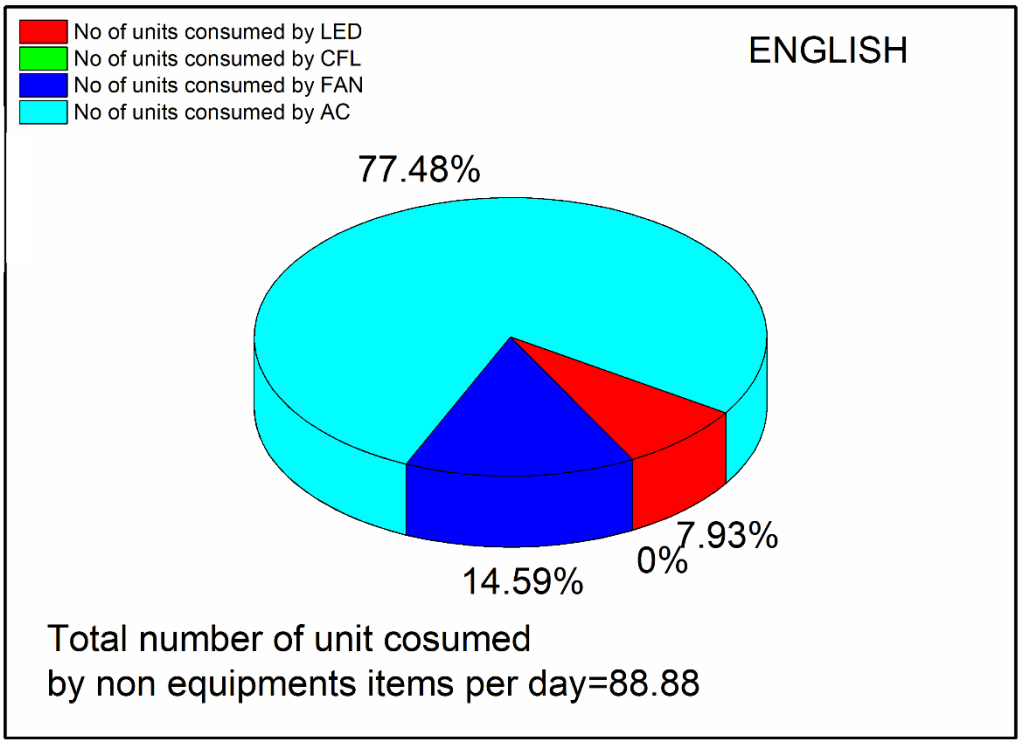

Figure 5.28 Chart of English

Table 5.91 **KONKANI**

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	Flo tube: 20 LED PL: 8	36 24	720 19
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 25 Wall: 14	80 55	2000 770
3	Air conditioners	1.5 Tr: 3	1600	4800
	Office & Laboratory EQUIPMENT			
7	Computer	12	200	2400

8	Projector	01	300	300
10	Xerox	01	550	550
12	Printer	2	250	500

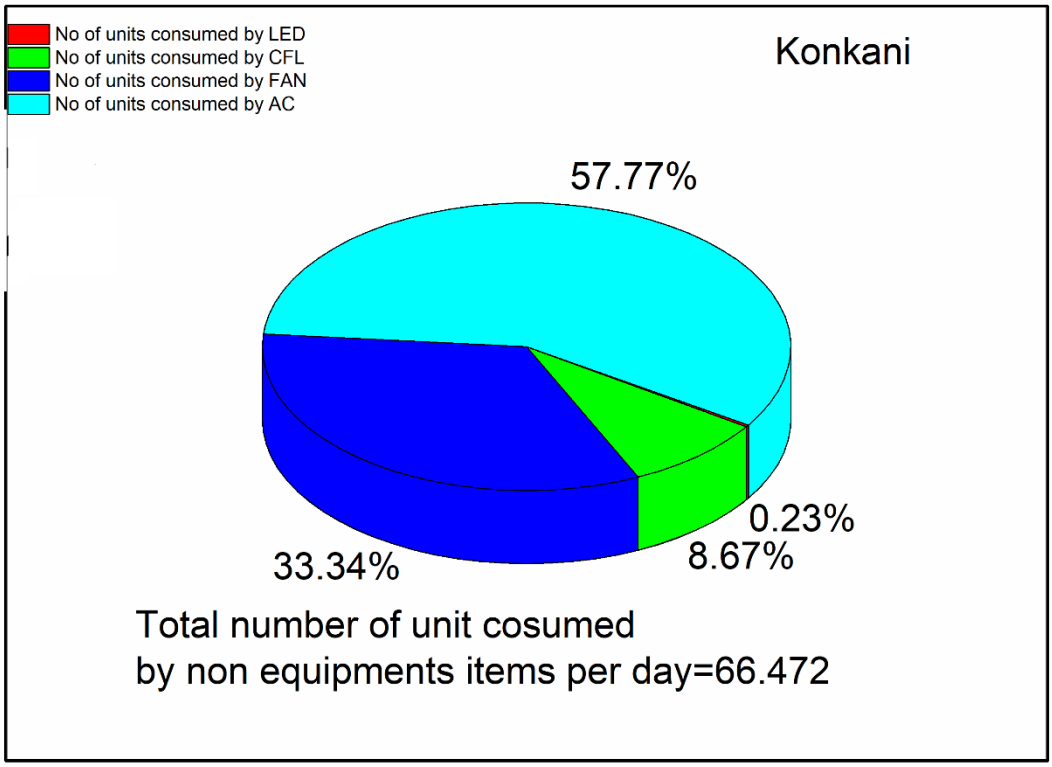

Figure 5.29 Chart of Konkani

Table 5.92 MARATHI

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED tube: 37	20	740
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 17 Wall: 03	80 50	1360 150
3	Air conditioners	2.0 Tr: 04	2300	9200
	Office & Laboratory EQUIPMENT			
4	Computer	05	200	1000
5	Laptop	09	45	405
6	Xerox Machine	01	2000	2000
7	Printer	06	200	1200

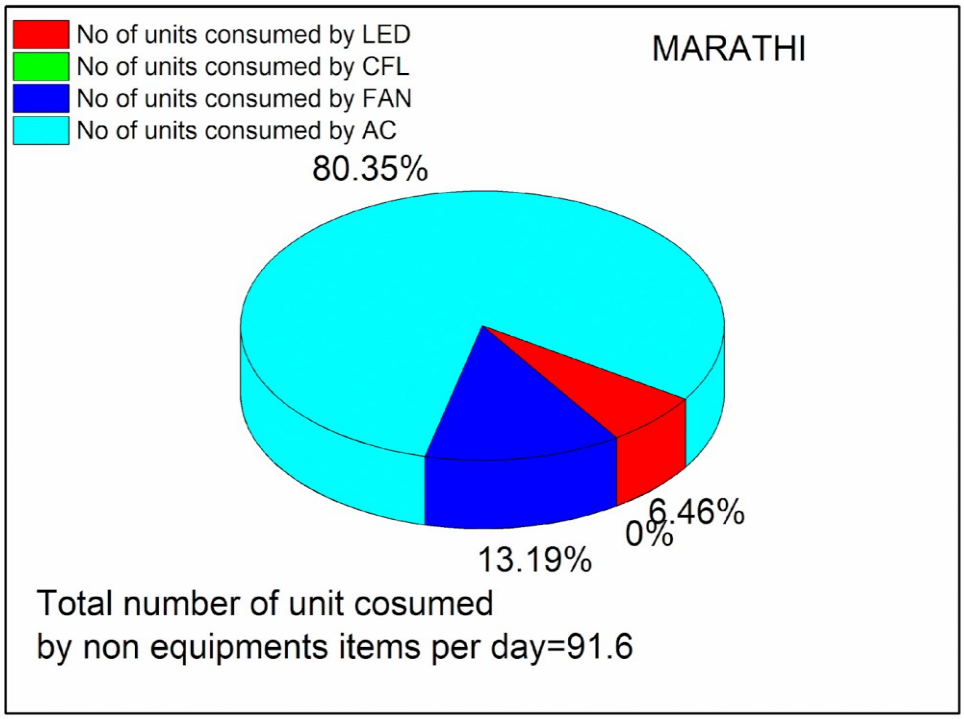

Figure 5.30 Chart of Marathi

Table 5.93 **HINDI**

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED tube: 26	20	520
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 19 Wall: 7	80 50	1520 350
3	Air conditioners	2.0 Tr: 3	2100	6300
	Office & Laboratory EQUIPMENT			
7	Computer	7	200	1400
8	Laptop	1	45	45
9	Xerox Machine	1	2000	2000
10	Printer	6	200	1200

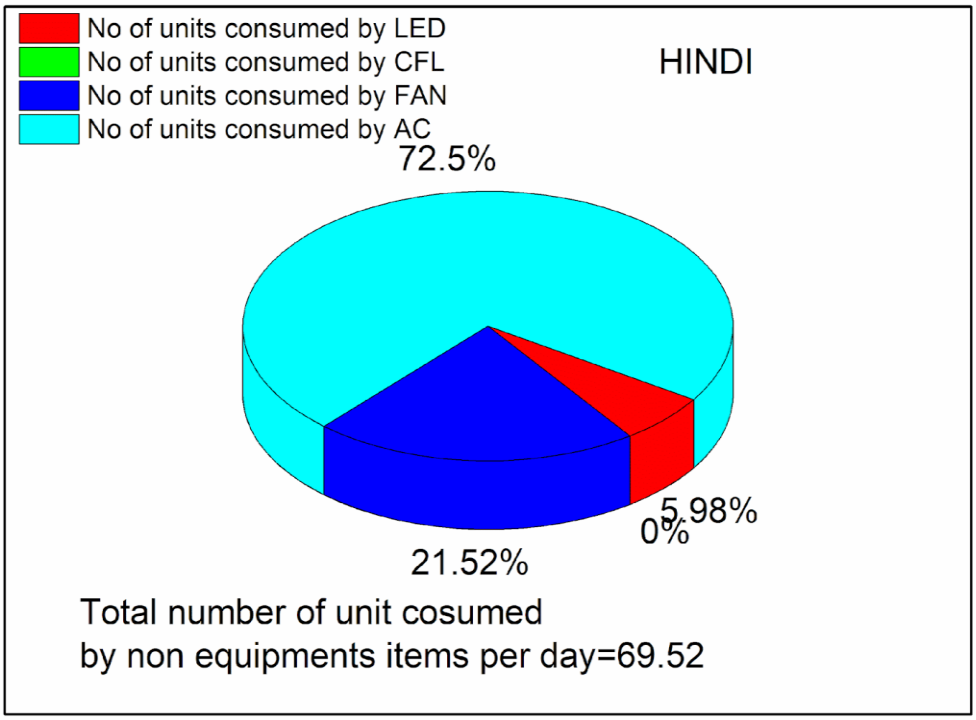

Figure 5.31 Chart of Hindi

D D Kosmbi School of Social Sciencesand Behavioural Studies

Table 5.94 **HISTORY**

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED tube: 28	20	560
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 16 Pedestal: 01	80 55	1280 55
3	Air conditioner	1.5 Tr: 04	1600	6400
	Office & Laboratory EQUIPMENT			
3	Computer	8	150	1200
4	Projector	2	100	200

5	Printer	3	250	750

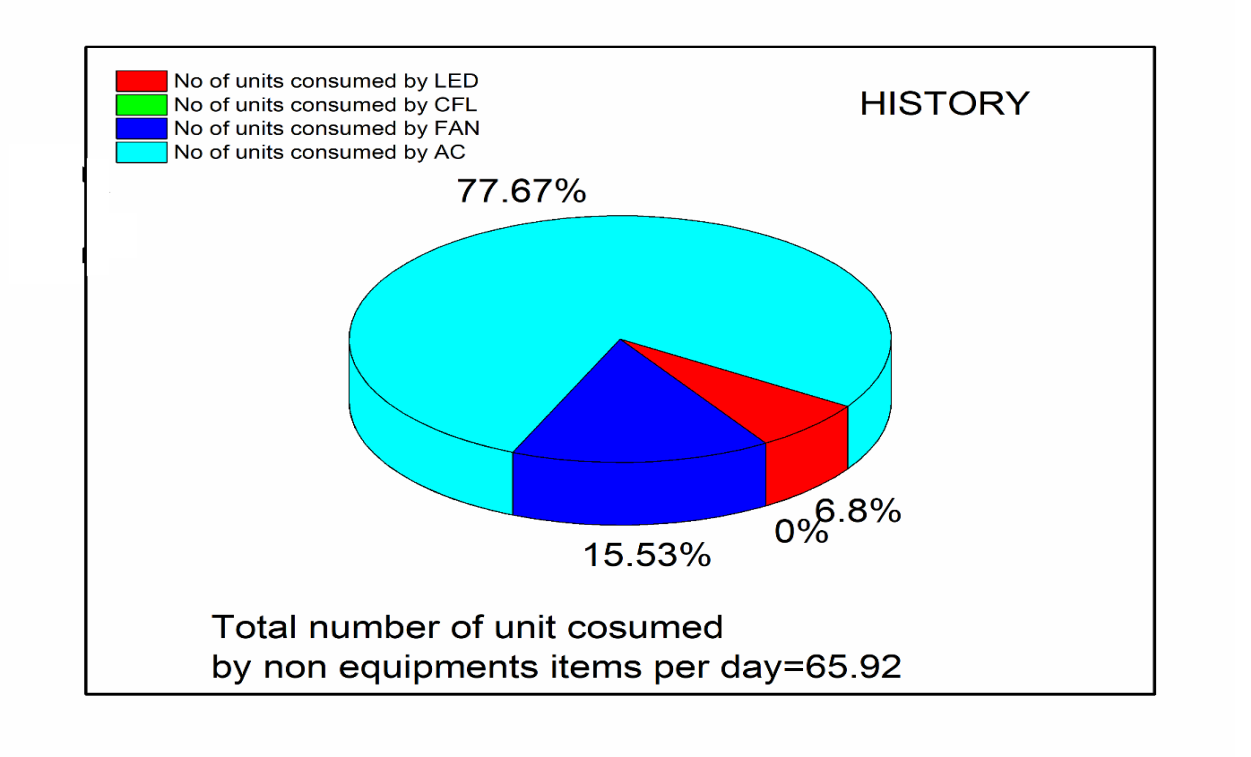

Figure 5.32 Chart of History

Table 5.95 **POLITICAL SCIENCE**

Sr. No.	**Loads**	**Total Number**	**Watts**	**Total Wattage**
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED tube: 31	20	620
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 18	80	1440
	Office & Laboratory EQUIPMENT			
3	Computer	1	150	150
4	Laptop	6	65	390
5	Printer	1	259	259

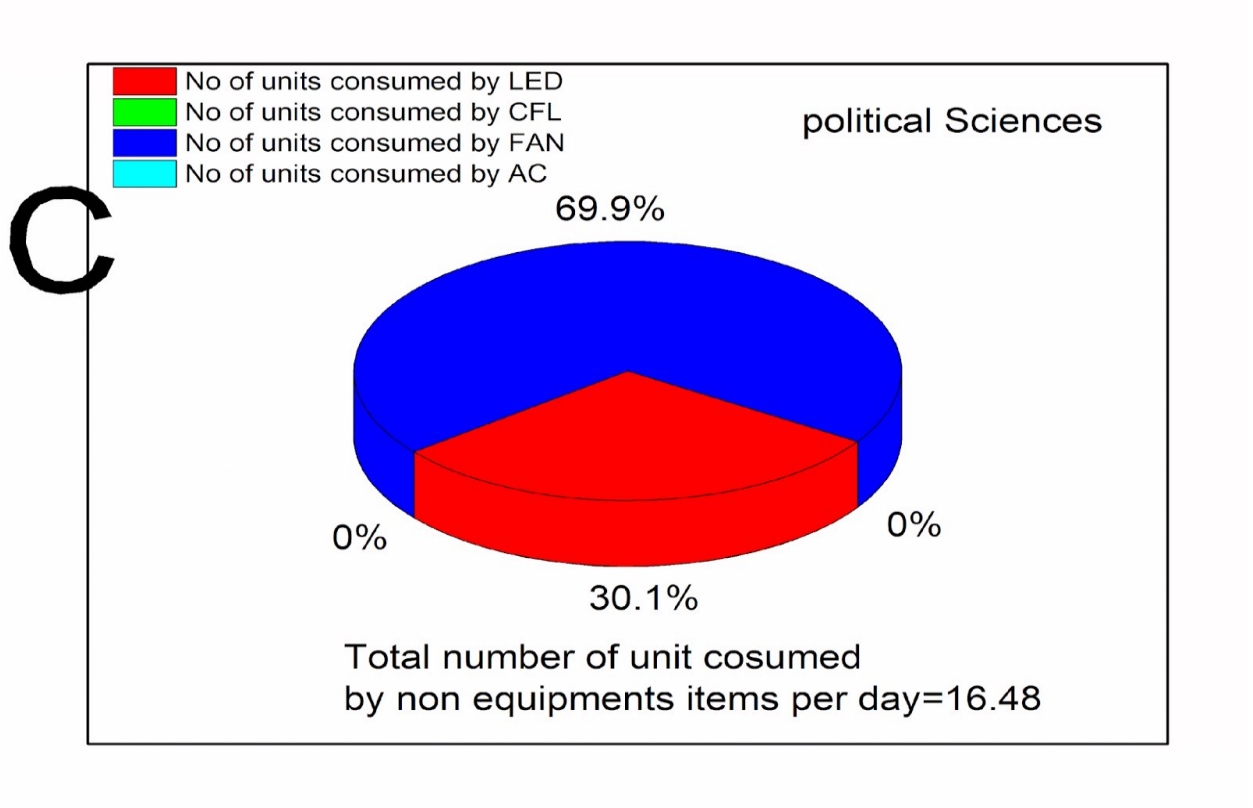

Figure 5.33 Chart of Political Sciences

Table 5.96 **SOCIOLOGY**

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED tube:30	20	600
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 20 Wall: 1	60 60	1200 60
3	Air conditioners	2.0 Tr: 4	2200	8400
	Office & Laboratory EQUIPMENT			
1.	Computer	02	150	300
2.	Laptop	06	65	390
3.	Printer	02	259	518
4.	UPS	1 KVA 3 KVA	2 1	2 KVA 3 KVA

		5 KVA 10 KVA	1 1	5 KVA 10 KVA
5.	LED TV	01	230	230
6.	Projector	02	600	1200

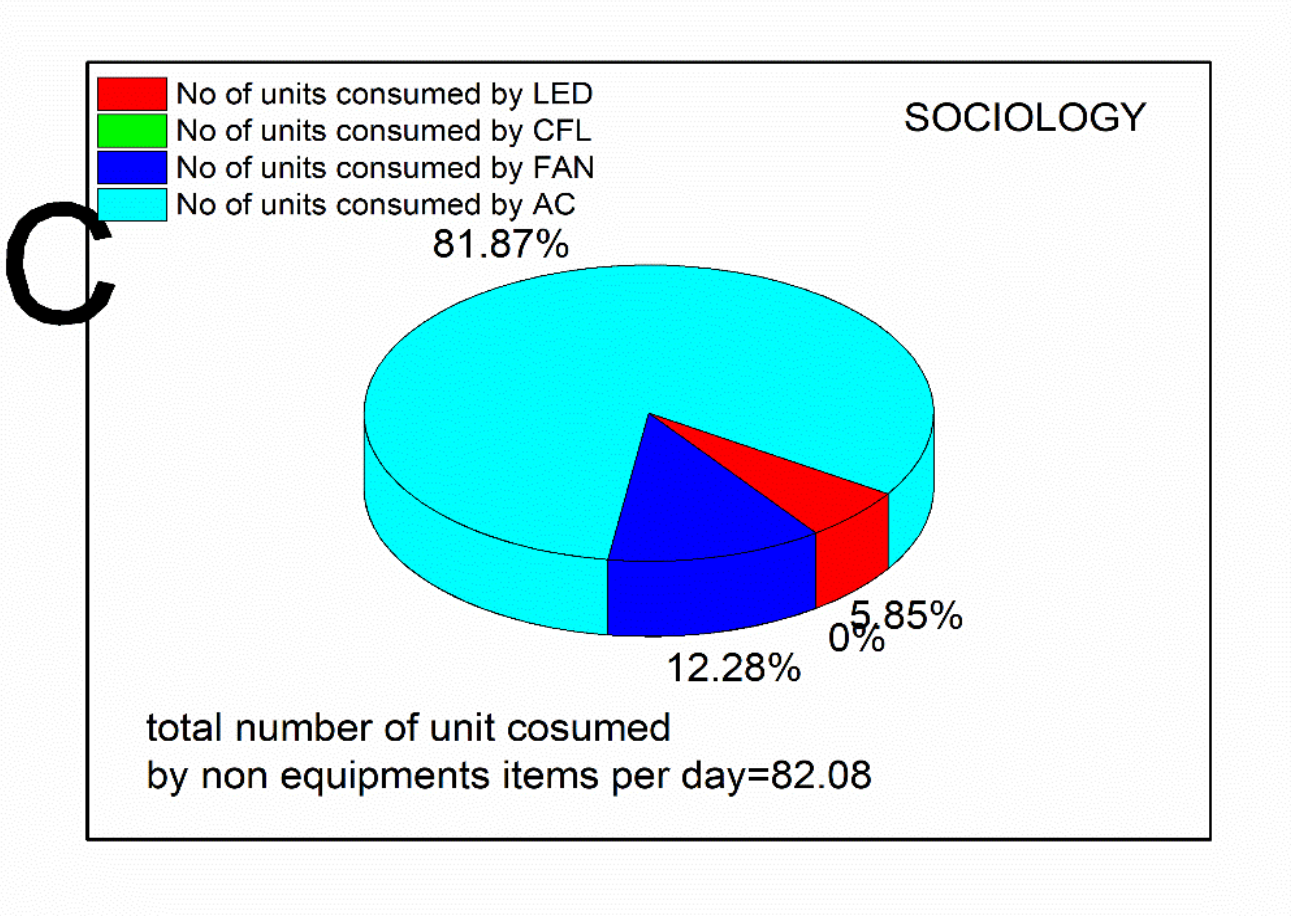

Figure 5.34 Chart of Sociology

Table 5.97 **WOMEN'S STUDIES**

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED tube:6	20	120
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 5	80	400
3	Air conditioners	1.5 Tr: 2	1600	3200
	Office & Laboratory EQUIPMENT			
1.	Computer	03	150	450
2.	Printer	01	250	250

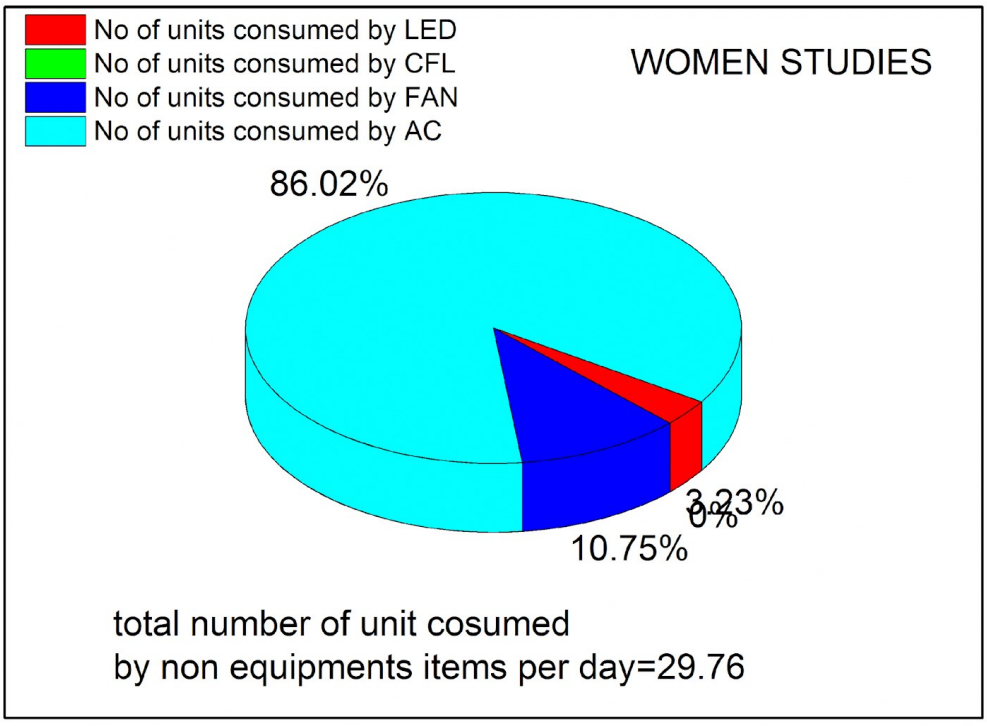

Figure 5.35 Chart of Women Studies

Table 5.98 **MASTER OF SOCIAL WORK (M.S.W.)**

Sr. No.	Loads	Total Number	Watts	Total Wattage
	NON-EQUIPMENT'S			
1	Bulbs (LED, CFL, Incandescent etc.)	LED tube: 10	20	200
2	Fans (Ceiling , Table , Wall mount, Exhaust etc.)	Ceiling: 3 Pedestal: 4	80 55	240 220
	Office & Laboratory EQUIPMENT			
3	Computer	2	150	300
5	Printer	2	250	500

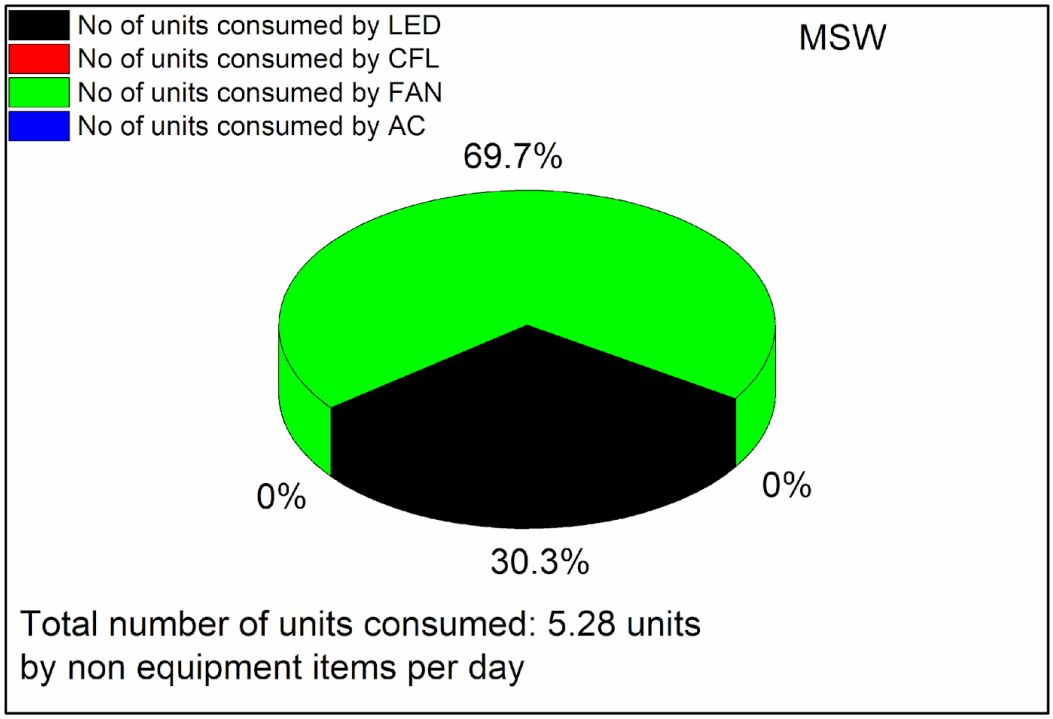

Figure 5.36 Chart of MSW

CHAPTER-VII

THE UTILIZATION OF WATER ON THE UNIVERSITY CAMPUS

Edited by

Dr. Anthony Viegas

and

Dr. Mahesh Mayekar

The University campus is utilized by the students, teaching and non-teaching staff, habitants staying at hostel and quarters and the visitors. There are 2800 students studying at university and 901 population are provided with the residential facilities in hostels/quarters and Guest houses. The campus has facility of centralized canteen serving food for 1000 students per day. The total population served on campus and the water utilization is shown in the table below. The University has also developed rain water harvesting system for collection of rain fall water.

Table No. 6.1 : Rainwater harvested on the University campus.

Sr. No	Site location	Recharge capacity in Liters /year
1	Opposite USIC Building	2,50,00,000
2	Next to Exam section	3,90,00,000
3	At Science Building	7,87,500
	Total	**6,47,87,500**

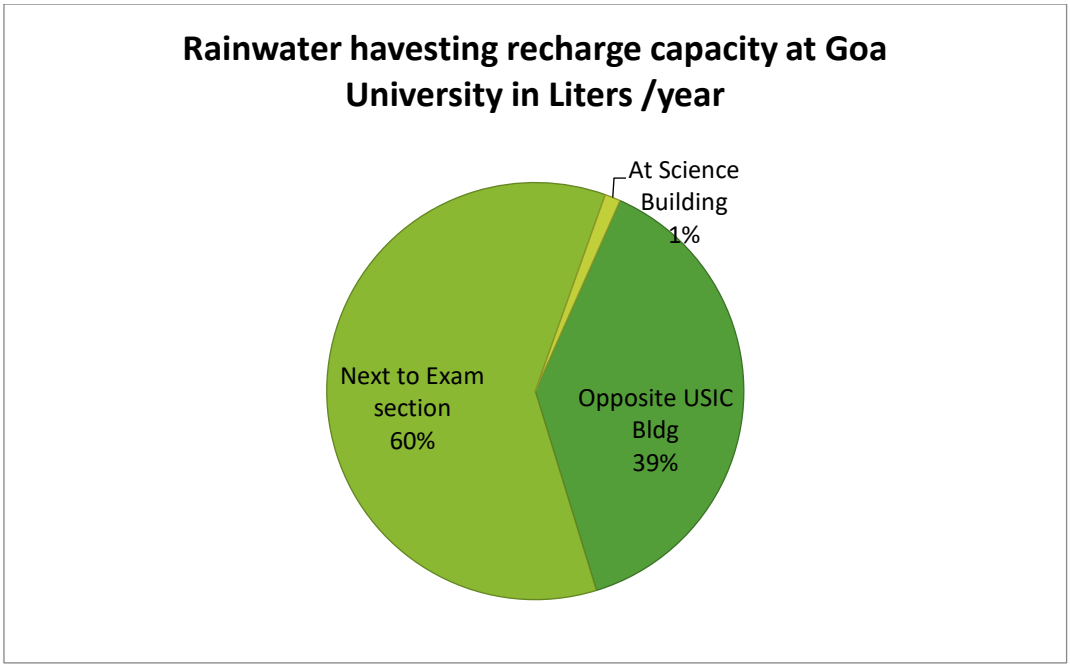

Figure 6.1: Graph representing recharge capacity of each site at Goa University

Table No. 6.2 : The theoretical water consumption details for Goa University campus

Sr. No	Particulars	Occupants (nos.)	Consumption per head/ liters/day	Total Liters/day
1	Men's Hostel	Hostel I – 168 Hostel II – 28 Hostel III – 56 Total = 252	150.00	37,800.00
2	Women's Hostel	Hostel I – 200 Hostel II – 50 Hostel III – 36 Total = 286	150.00	42,900.00
3	Centralized Canteen (cooking food for 1000 people)	1000	10.00	10,000.00
4	Daily use of drinking water on campus	Students - 2800 Teaching staff – 251 Non Teaching Staff –513 Total = 3564	3.20	11,404.80
5	6	A type -27 B type - 87 C type – 36 D type - 36 TA type -33 Old GH- 92 IGH- 52 Total = 363	150.00	54,450.00
			TOTAL	**1,56,554.80**

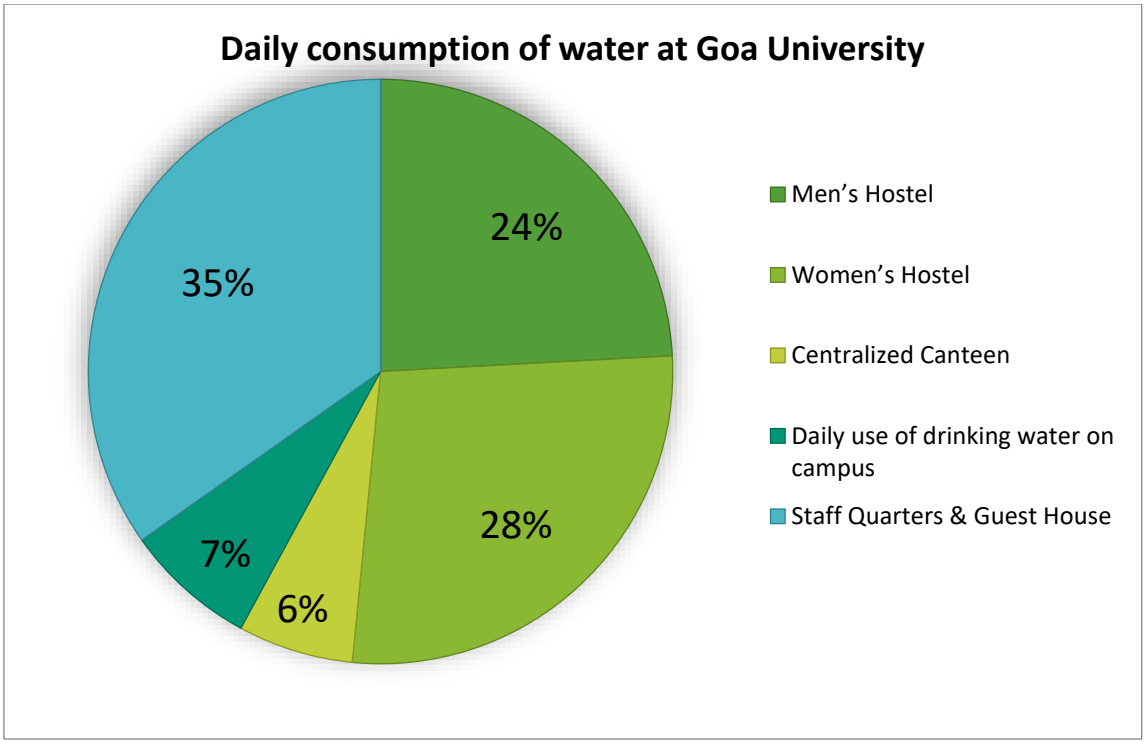

Figure 6.2 : Graph representing daily consumption of water at Goa University

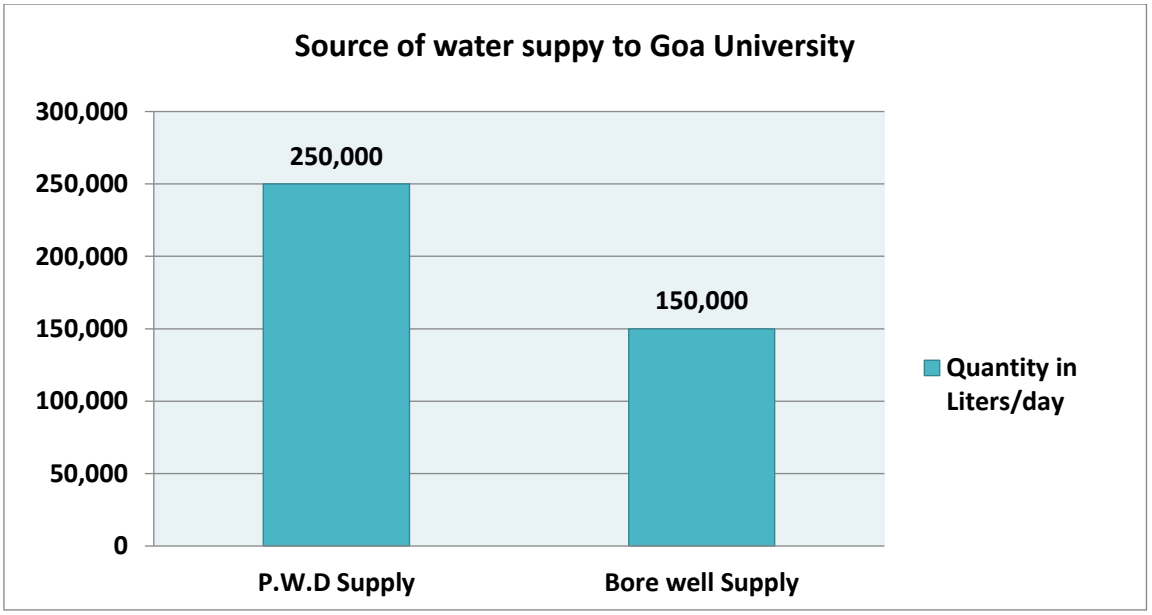

Figure 6.3 : Graph representing water supply details for Goa University

Table No. 6.4 : The Rain water harvesting details for Goa University

Sr. No.	Location	Catchment Area in Sq. M.
1	Opposite USIC Building	400 m2
2	Next to Exam section	17,30,000 m2
3	At Science Building	350 m2

6.1 Rain Water Harvesting at Goa University

The University located on the Taleigao Plateau has a picturesque campus spread over 420 acres which hosts student, teaching and non-teaching staff as well as families of resident staff. The University has taken initiatives in environmental research among students and has also aroused interest in energy and water conservation from its inception. The University draws its water supply from number of bore-well units located within the precincts of the campus. During the summer months of April-May, there is a depletion in the water table on the plateau, during times the water supply is augmented by drawing water from Public Works Department (PWD) pipeline.

The first Roof-top harvesting (Figure 6.4) is carried out from the buildings of the Department of Electronics.

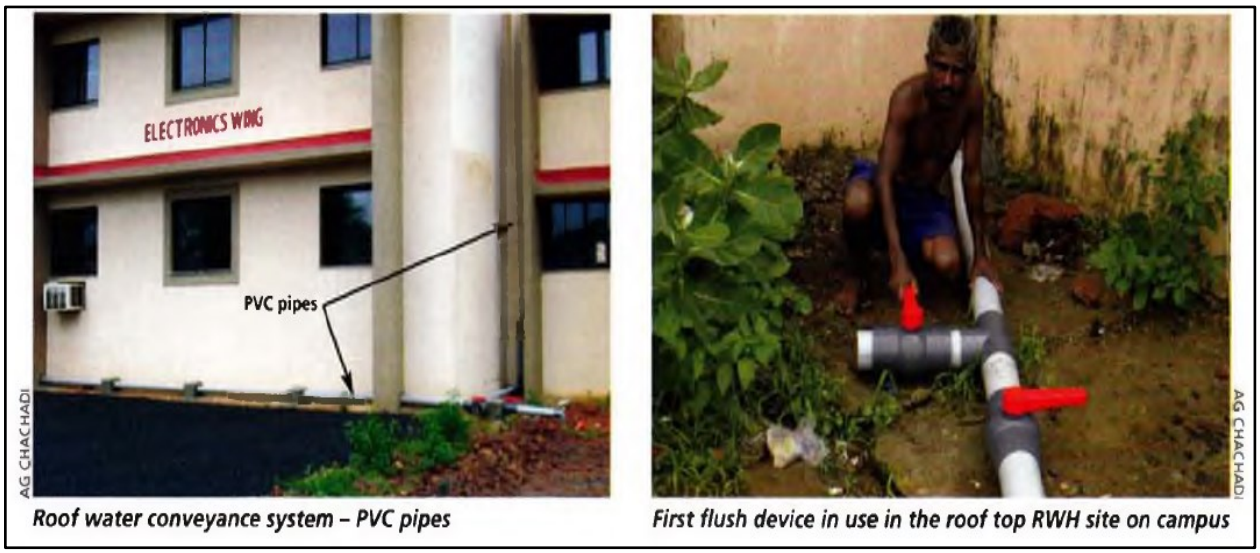

Figure 6.4: USIC building under rainwater harvesting.

The groundwater harvesting and recharge structure is built to augment six operational bore wells whose combined capacity totaled 75000 cubic meters of ground water every year, with the total drainage area contributing surface run off of 30000 square meters. The average surface run of collected per day is about 300 cubic meters. The ratio calculated for recharge to run off collection

is 250/300 square meters, the remaining being lost due to seepage evapotranspiration and other factors.

Figure 6.5: Open area water harvesting and recharging.

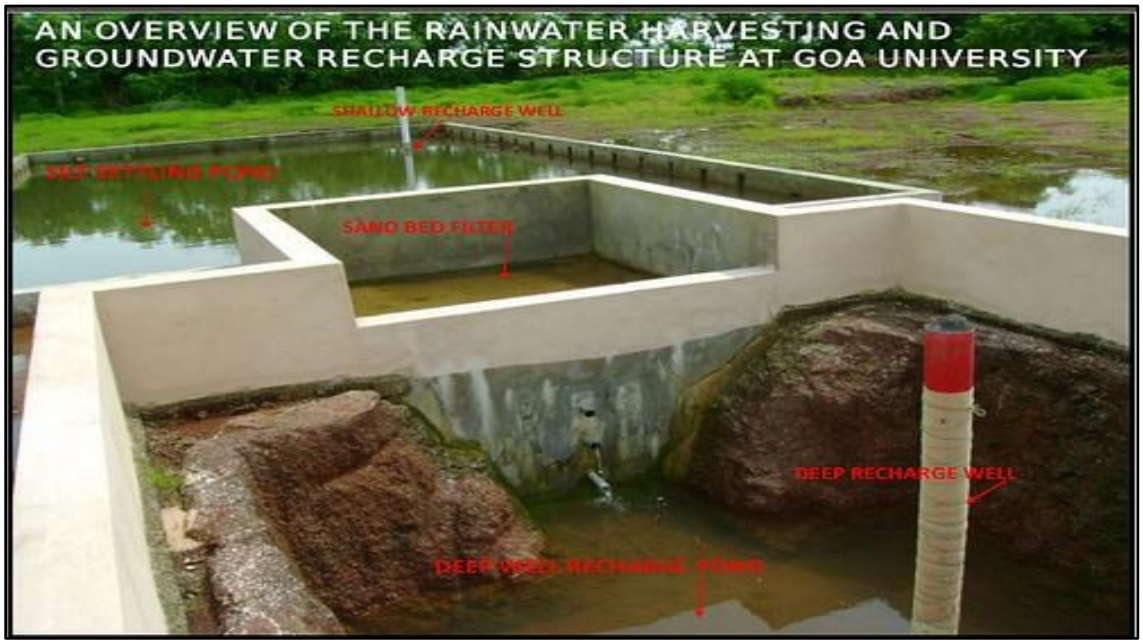

Figure 6.6: Recharging well of open water harvesting and recharging.

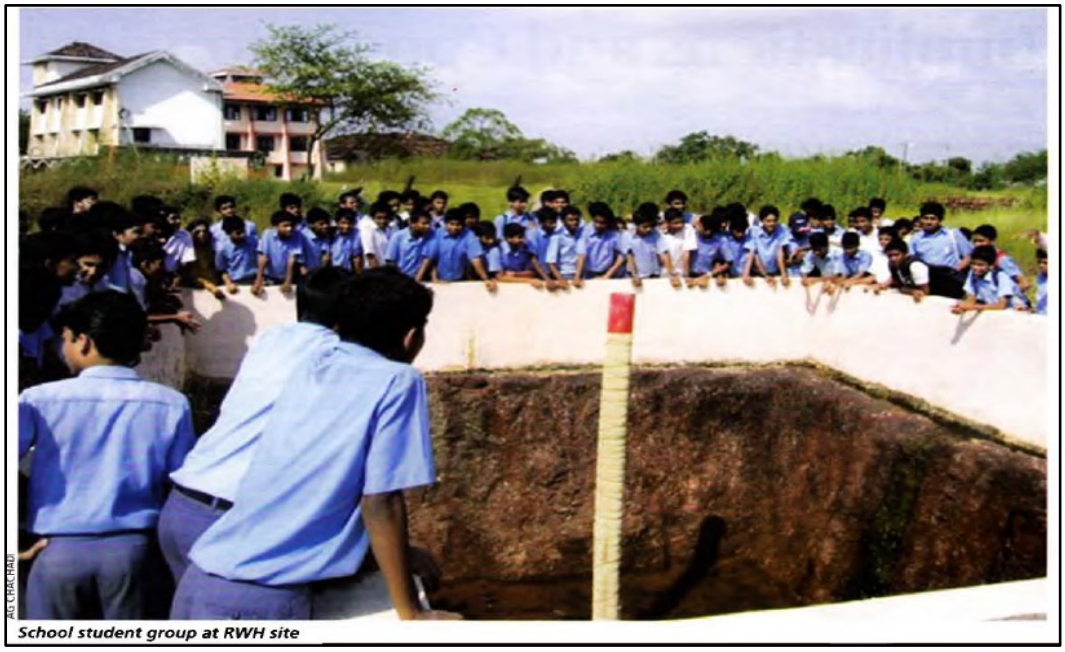

Figure 6.7: Youth awareness on Science day on water harvesting.

The rainwater harvesting project at the New Science Building taking the collected roof-top rainwater from the roof top and channelized through the down take pipes of the roof to the siltation chamber. The filtration chamber filters the water and this purified water is then recharged into the ground.

Figure 6.8 : Installations of Siltation, Filtration Chamber and Borewell Pits

Figure 6.9: School of Chemical Science building under rainwater harvesting

Figure 6.11: School of Chemical Science building under rainwater harvesting piping Connections from Roof for downtakes

Figure 6.12: School of Chemical Science building under rainwater harvesting and recharging final Layout

Figure 6.13: Water harvesting bandhara(bandh) implemented. (Back view)

Figure 6.14 : Water harvesting bandhara(bandh) implemented. (Front view)

Figure 6.15: Reservoir formed during monsoons at water harvesting bandhara(bandh)

CHAPTER-VIII

THE WASTE MANAGEMENT

Edited by

Dr. Dviti Mapari and

Dr. Bhakti Salgaonkar

7.1 Hazardous Waste Management

Goa University Monitoring Committee in accordance with UGC guidelines supervises the procurement, storage, usage and disposal of radioactive and other hazardous materials/chemicals etc. The Department of Biotechnology has the facility to carry out radioactive work. All radioactive wastes so far collected have been safely discarded. The Goa University campus is declared as plastic free and tobacco free zone under relevant State Acts.

7.1.1 Hazardous waste management

Raising plantations on the University campus has been difficult due to its hard-lateritic surface which hardly supports plant growth. Earlier afforestation efforts have met with little success as they encountered a high mortality rate. Besides stray cattle and campus fires were the other important constraints for plant growth and survival. Therefore, an innovative approach to initiate biodiversity plantations on the lateritic plateau of the campus was followed. Excavation of 2100 pits (1mx1mx1m), filling with garden soil and manure, and planting with selected tree species resulted in high (>90%) survival rate. The "Ratnagiri Irrigation System" was adopted to water each and every plant. In this system each plant was provided with 2-3 equidistantly positioned earthen pots at the base. These pots were manually filled with water once in every three days all through the summer months.

7.1.2 E-waste management

Every department store the e-waste till sufficient material is available for auctioning to metal scrap dealers. Some parts are cannibalized for recycling in working instruments.

The Goa University has enrolled in Karo Sambhav Bulk Consumer Programme the venture of Goa Waste Management Corporation (GWMC). The University transfer the e-waste material to the Karo Sambhav Pvt. Ltd. For recycling in accordance with the E-Waste (Management) Rules, 2016. In the year 2020, the e-waste weighing 5356.97 Kgs handed over to the agency.

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Table 7.1 : The list of E-Waste items segregated with SBSI internship and Earn While learn program

S.No.	ITEM Category as per e-waste rules, 2016	Item Description	Quantity in Kgs
1	Router	ITEW1	1
2	Switches	ITEW1	30.3
3	UPS	ITEW2	765.5
4	CPU	ITEW2	12.6
5	LCD Monitors	ITEW2	74
6	CRT Monitors	ITEW2	1878
7	Mouse	ITEW2	20
8	SMPS	ITEW2	235.5
9	Mother Boards	ITEW2	229
10	Keyboards	ITEW2	116.3
11	DVD Drive	ITEW2	118.8
12	Floppy Drive	ITEW2	37
13	Hard Disk	ITEW2	13.9
14	Laptop	ITEW3	1
15	MFD Printer	ITEW6	55
16	Printers	ITEW6	300.81
17	Printer Cartridges	ITEW6	60
18	Scanner	ITEW7	30.7
19	Telephones	ITEW12	153.56
20	TV	CEEW1	164
21	Refrigerator	CEEW2	610
22	AC	CEEW4	450
Total Weight – 5356.97 Kgs			

Receipt of Condemned E-Waste Collected

Sr. No.	Equipment	EEE Code	Quantity
1	Router	ITEW1	5
2	Switches	ITEW1	12
3	UPS	ITEW2	169
4	CPU	ITEW2	2
5	LCD Monitors	ITEW2	24
6	CRT Monitors	ITEW2	140
7	Mouse	ITEW2	100
8	SMPS	ITEW2	208
9	Mother Boards	ITEW2	266
10	Keyboards	ITEW2	163
11	DVD Drive	ITEW2	165
12	Floppy Drive	ITEW2	94
13	Hard Disk	ITEW2	121
14	Laptop	ITEW3	1
15	MFD Printer	ITEW6	2
16	Printers	ITEW6	70
17	Printer Cartridges	ITEW6	200
18	Scanner	ITEW7	8
19	Telephones	ITEW12	251
20	TV	CEEW1	5
21	Refrigerator	CEEW2	14
22	AC	CEEW4	14
23	Nikon Camera	NON-SCHEDULED E WASTE	1
24	Dissolved Oxygen	NON-SCHEDULED E WASTE	1
25	Conductivity	NON-SCHEDULED E WASTE	3
26	Colorimeter	NON-SCHEDULED E WASTE	4
27	Chromato Graphy	NON-SCHEDULED E WASTE	1
28	Fan - Only Top Part	NON-SCHEDULED E WASTE	7
29	Centre Fuse	NON-SCHEDULED E WASTE	5
30	Stirrer	NON-SCHEDULED E WASTE	7
31	Furnace	NON-SCHEDULED E WASTE	3

Figure 7.1: E-Waste Segregation at Goa University through SBSI (Swachh Bharat Student Internship) internship.

Figure 7.2: E-Waste collection drive and segregation through SBSI (Swachh Bharat Student Internship) internship at one of the college.

Management and valorisation of canteen waste and grass cuttings into compost using microbial inoculant: A sustainable approach and green initiative of the Goa University Campus.

Composting is one of the most efficient and efficacious treatment methods that can be employed to remove organic fractions of solid waste. It is an economically feasible and environmentally sustainable technique that can be used for the effective treatment of solid waste around the world. Composting primarily converts solid organic wastes into nutrient-rich soil conditioners and organic fertilisers, reducing odour, phytotoxic chemicals, weed seeds, and pathogens.

The objectives proposed in this study involved collecting and segregating waste at the source and developing bio-inoculants to accelerate the composting process, followed by compost application for the campus's greening.

A. Survey of the existing waste segregation and management facility

The existing waste treatment shed at Goa University has a waste treatment capacity of 1000 kg per day with a dry waste storage capacity of 5000 Kg. However, the composting process is carried out through the conventional method, and the mass grass cuttings generated at the campus find no use.

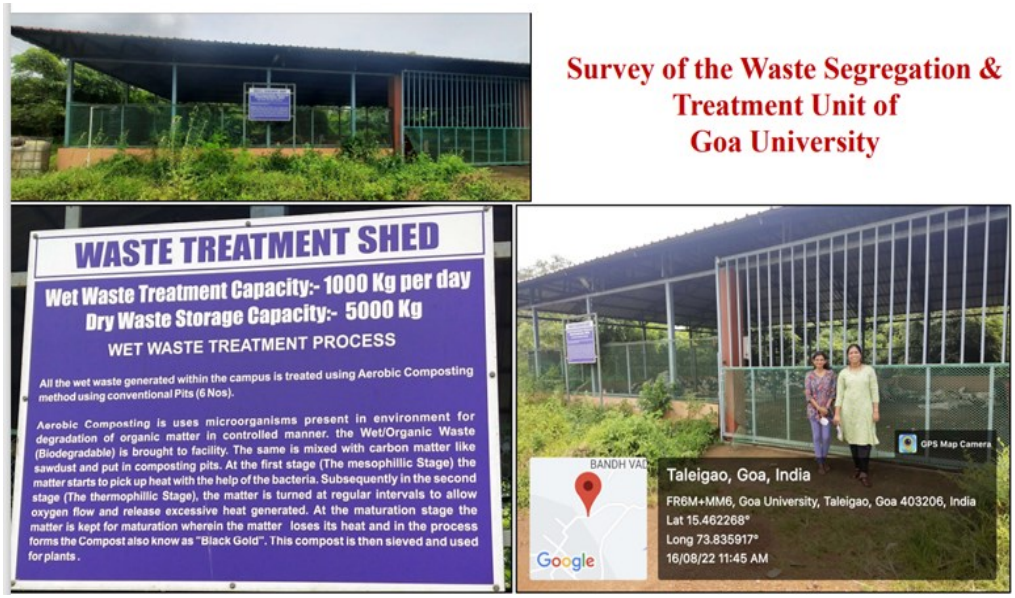


Fig. 7.3. Waste management shade at Goa University

B. Identification of space and raw materials for compost acceleration studies.

The current study focused on using grass cutting and canteen food waste as raw materials for composing.

Fig.7.4. Grass cutting at Goa University campus and collection of grass as brown raw material for composting

The pilot scale studies to check for acceleration of the composting process were planned behind Faculty Block E building, School of Biological Sciences and Biotechnology Goa University.

Fig. 7.5 Identification and space allotted for carrying out pilot plant compost acceleration studies at Faculty block E

C. Microbial Inoculant for compost acceleration studies

The canteen waste was collected in big mud pots, and the grass cuttings were collected in gunny bags. The grass cutting was shredded manually.

The current study used a microbial inoculum to accelerate the composting process using the grass chippings as brown material from the campus and canteen food waste. *Hortaea werneckii* SP DM 15 (Fig. 7.6), a halophilic black yeast belonging to the *Teratosphaeriaceae* family within the *Capnodiales* order, was employed as a microbial inoculant to check for the acceleration of the composting process owing to its plant polymers' degradation ability unveiled through enzymatic screening of diverse enzymes. The enzymes responsible for the degradation of food waste rich in starch, pectin, and chitin were also found to be produced by the isolate SPDM 15. Figure 7.7 summarizes the enzyme-producing potential of the isolate SPDM 15.

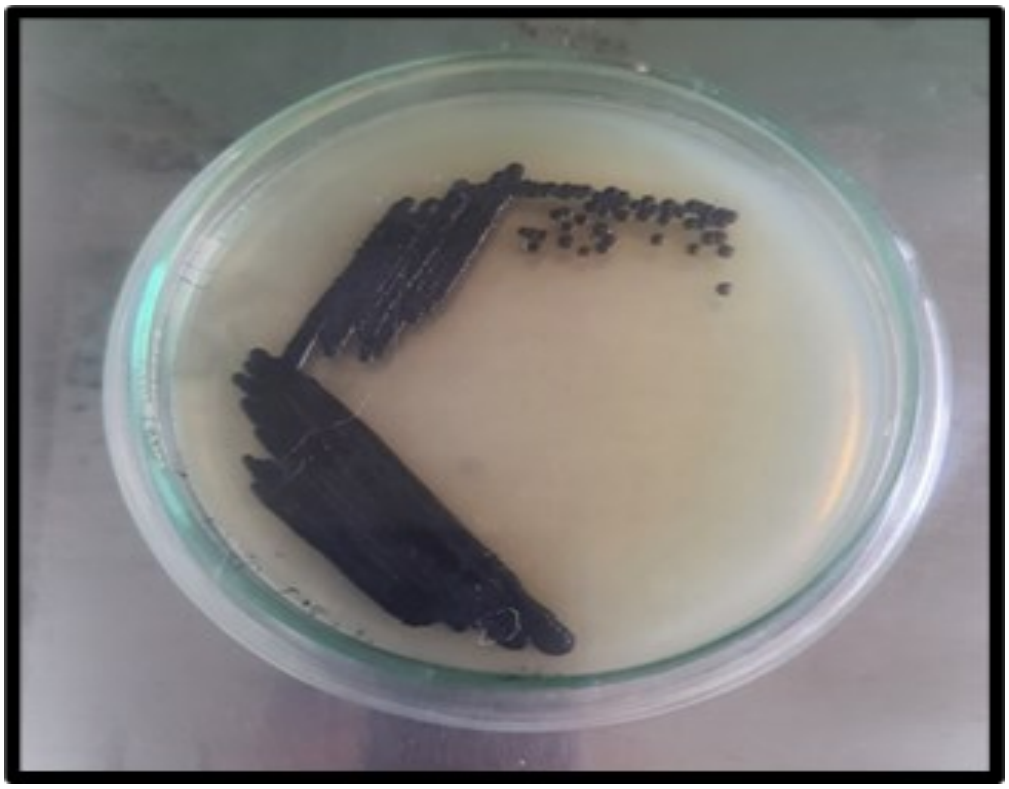


Fig 7.6.: Halotolerant Yeast *Hortaea werneckii* SPDM isolated from the crude salt sample obtained from Solar salterns at Ribandar Goa.

The isolate SPDM15 produced a wide no of plant polymer degrading enzymes. Hence, it could be used to fasten the decomposition of waste, aiding in accelerating the composting process, which can be sustainable and economical.

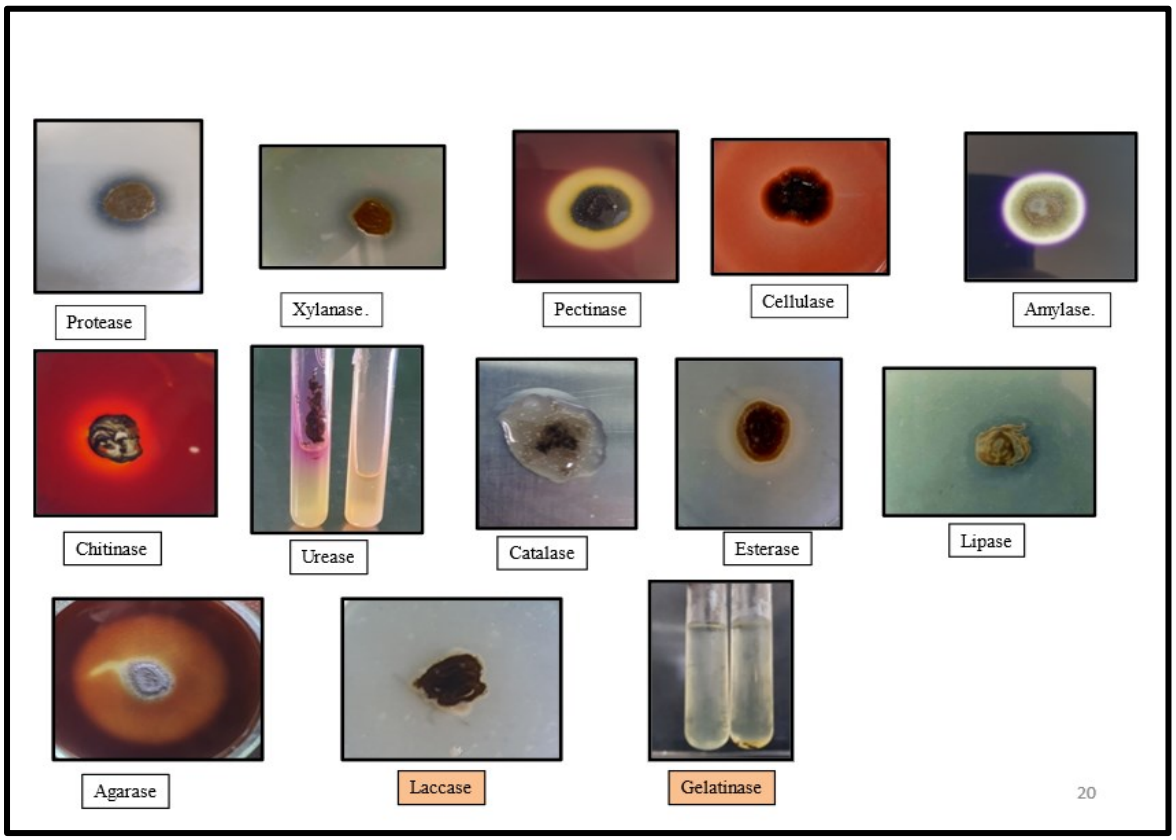


Fig 7.7. Screening for diverse Extracellular enzyme production test. a) protease. b) xylanase. c) pectinase. d) cellulase. e) amylase. f) gelatinase. g) urease. h) catalase. i) esterase. j) laccase. k) agarase. l) lipase m) Chitinase enzymes production by *Hortaea werneckii* SPDM 15

D. Composting

The composting experiment used six raw materials, such as leaves, paper, food waste, sawdust, grass chipping and soil. Different substrates were added to each container, as shown in Fig.7.8., and the C:N ratio was maintained between the range 30:1-20:1. Water was added occasionally to retain the moisture to 45%-70%, and stirring of the waste was done twice a week.PH, ash, Volatile Solids, and Total Solids were initially measured. The temperature was monitored daily. Different raw materials were weighed and incorporated into various compost sets such as T1, T2, T3, T4, T5, and T6. In T1, T2, and T3, quantities of 325g, 12g, 8g, 18g, and 1437g of leaves, paper, sawdust, grass clippings, and food waste were added, respectively. In T4, T5, and T6, quantities of 435g, 6g, 4g, 18g, and 1097g of leaves, paper, sawdust, grass clippings, and food waste

were added, along with 240g of soil. In T4, autoclave soil was used, whereas in T5 and T6 non, autoclaved soil was used. Additionally, in T2, T5,10^9 CFU/g of yeast culture was added once, while in T3, it was added thrice till the compost maturity.

Accelerating composting using SPDM15 as Bio inoculum

The following setups were adopted in the study of compost.

T1 : RM

T2 : RM + SPDM15 added once (10 ^{9} CFU/g)

T3 : RM + SPDM15 added subsequently after 7 days (10 ^{9} CFU/g)

T4 : RM + Autoclaved soil

T5 : RM + unautoclaved soil + SPDM15 added once

T6 : RM + unautoclaved soil

Composting process with different sets containing different raw material.

Raw material(RM)	T1 (g)	T2 (g)	T3 (g)	T4 (g)	T5 (g)	T6 (g)
Leaves	325	325	325	435	435	435
Paper	12	12	12	6	6	6
Sawdust	8	8	8	4	4	4
Grass clippings	18	18	18	18	18	18
University canteen Food waste	1437	1437	1437	1097	1097	1097
Soil	-	-	-	240	240	240
SPDM15	-	+	+	-	+	-
Total weight	1800					

21

Fig.7.8.Combinations of raw materials for the Composting process.

Fig. 7.9. Compost acceleration process at Pilot Scale using Khamba assembly

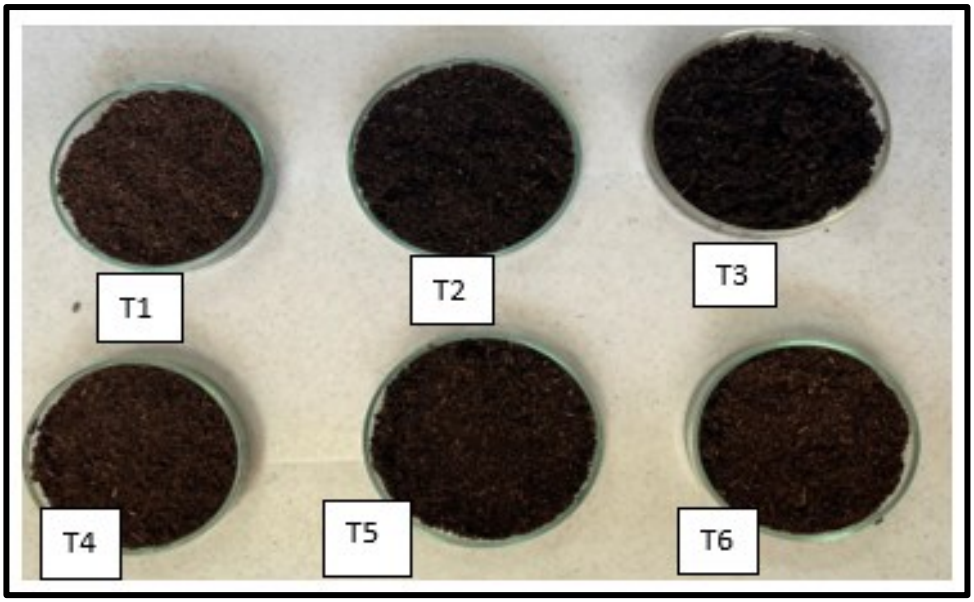


Fig 7.10 Compost after 40 days

E. CHNS analysis of different compost sets to evaluate the maturity of compost

The 40th-day compost samples (T1, T2, T3, T4, T5 and T6) in dried powdered form were sent for CHNS analysis. The sample was analysed through the CHNS Elemental Analyzer of model Elementar Vario Micro Cube. The composting experiment demonstrated that compost T3 (having a repeated spray of Yeast inoculum added after 7 days for 3 weeks) showed good maturity with a C: N ratio of 11.43, found using CHNS in 25 days.

F. Propagation of plants using compost

Plant propagation at the pilot scale was studied using the compost produced using microbial inoculant.

Fig 9. Application of the compost at pilot scale for propagating plants

G. Conclusion

The composting experiment demonstrated efficient organic waste decomposition with optimal moisture content achieved in all sets except for Set 5, requiring additional water maintenance. No foul odour production was noted throughout the experiment. Analysis of volatile solids and ash content revealed varying degrees of biodegradable substances and inorganic residues among the compost sets, with Set 3 containing the highest biodegradable substances and Set 6 exhibiting the highest inorganic residues. pH levels transitioned from acidic to neutral and eventually alkaline, indicating the progression of composting phases. Temperature monitoring revealed distinct mesophilic, thermophilic, and cooling phases, crucial for assessing composting progress.

These findings indicate the efficacy of composting in organic waste management. The C: N ratio in all compost sets was below 15, indicating good mature compost. The lowest C: N ratio was in set 3, indicating faster decomposition than the other compost sets in which the culture was subsequently added for 7 days.

This pilot study indicates the potential employability of the microbial inoculant for accelerating the composting process at a large scale. Alternatively, searching for more microorganisms with organic waste degradation capabilities and forming a consortium to work as bio inoculum for accelerating the composting process has to be worked upon.

CHAPTER-IX

THE ENERGY AUDIT

The University uses both conventional and non-conventional sources of energy. The University also practice the use of energy conserving devices/units such as LED bulbs and tubes. The energy conservation practices such as minimum use of air conditioners, instructions for optimum use, etc. are adopted by the University. Goa University has a 605 KwP rooftop solar panel system installed in the campus. These panelsare installed over 7 buildings with following capacities.

Table No. 8.1 : The sites of installtion of solar panels and its capacities

Building	PV capacity in KwP
Block A	60
Block B	40
Block C	40
Silver Jubilee Hall	60
Library	40
Block E	200
Block F	165
TOTAL:	605

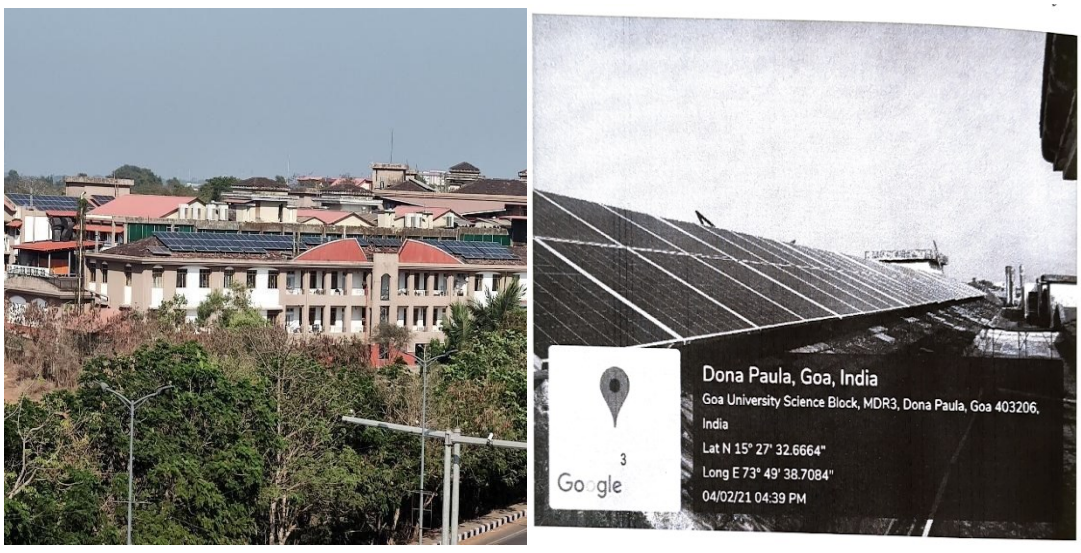


Fig 8.1: Solar panels fitted on E block

Fig 8.2 Solar panels fitted on F block

The utilization of energy and the average monthly energy bill for the year 2020-2021, 2021-2022, 2022-2023, 2023-2024 is as follows. The details of utilization of energy and power bill is shown in the table below.

Table No. 8.2: The table showing the details of utilization of energy and bill paid to the agency (2020-21)

Month	Units consumed	Monthly bill in Rs. Lakh
April-2020	138720	1282319
May-2020	188060	1562376
June-2020	150980	1353335
July-2020	159630	1428649
August-2020	145920	624901
September-2020	145240	1337538
October-2020	122890	1228455
November-2020	98650	453269
December-2020	88810	394669
January-2021	86660	1970351
February- 2021	74260	922695
March-2021	118580	1171061

Table No. 8.3 : The table showing the details of utilization of energy and bill paid to the agency (2021-22)

Month	Units consumed	Monthly bill in Rs. Lakh
April-2021	107145	1132103
May-2021	68840	908271
June-2021	104300	1118943
July-2021	123470	1281153
August-2021	120620	1285271
September-2021	115790	1276967
October-2021	129610	1344618
November-2021	135340	1364621
December-2021	130740	1336016
January-2022	110680	1219577
February- 2022	102930	1150146
March-2022	182595	1596016

Table No. 8.4: The table showing the details of utilization of energy and bill paid to the agency (2022-23)

Month	Units consumed	Monthly bill in Rs. Lakh
April-2022	194735	1843293
May-2022	185910	1909013
June-2022	169410	1653020
July-2022	170900	1706860

August-2022	171470	1725027
September-2022	168125	1693660
October-2022	181410	1885499
November-2022	198210	2037936
December-2022	184610	1945277
January-2023	179180	1775843
February- 2023	185190	1797433
March-2023	230685	2116296

Table No. 8.5: The table showing the details of utilization of energy and bill paid to the agency (2023-24)

Month	Units consumed	Monthly bill in Rs. Lakh
April-2023	244725	2198804
May-2023	242115	2181592
June-2023	232140	2103669
July-2023	224830	2164929
August-2023	238490	2266122
September-2023	221640	2151740
October-2023	305115	2855988
November-2023	205760	2106585
December-2023	214160	2194684
January-2024	225865	2061584
February- 2024	227815	2090805
March-2024	247400	2209594

In order to enhance the energy monitoring throughout the university campus, an initiative of installing local energy meters has been implemented. This ensures a check on energy consumption at every building on the campus.

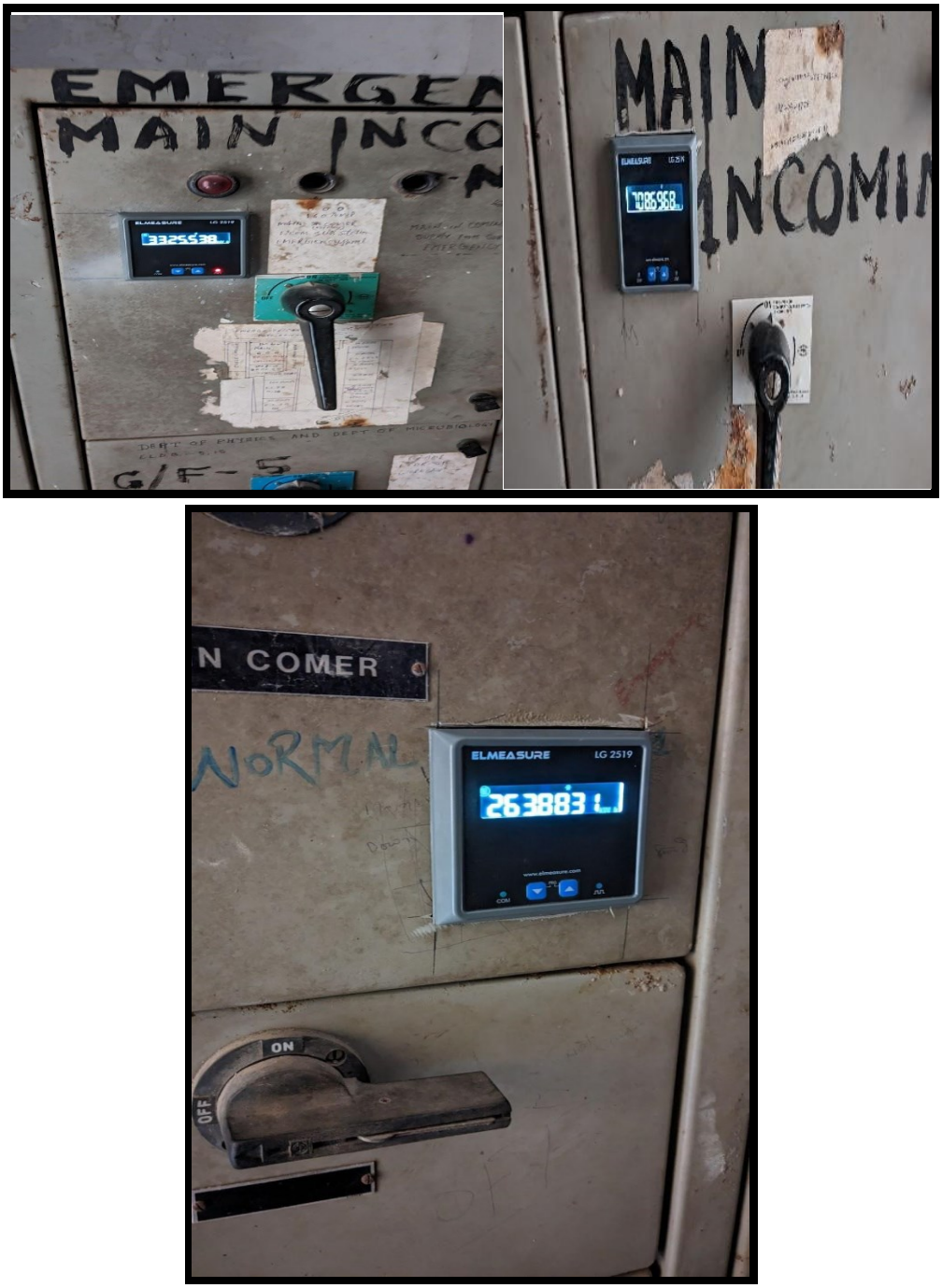


Fig 8.3 Local energy meters fitted for electricity consumption monitoring (2 meters are installed in Block A, 1 meter is installed in Block B)

The implementation of individual electricity meters across every building on the university campus is a crucial step towards effective energy management. This initiative aims to provide precise, building-specific data on electricity consumption, enabling the university to identify areas of high usage and potential inefficiencies. Installation of more such meters will allow real-time monitoring and data collection, which can be analyzed later to create detailed consumption reports. This data will empower the university to implement targeted energy-saving strategies, such as optimizing HVAC systems, upgrading lighting, and educating building occupants on energy conservation. Furthermore, the installation of these meters will facilitate accurate billing for individual departments or faculties, promoting accountability and encouraging responsible energy use throughout the campus. This step is a key component of the university's commitment to sustainability and reducing its environmental footprint.

CHAPTER-X

THE WATER AUDIT

The variables and parameters with respect to the utilization of water on the campus are number of habitants, the water storage capacity, the utilization of water for drinking purpose and the water collected from the rain water harvesting system. These different parameters are shown in the table below.

Table No. 9.1: The water consumption details of Goa University

Sr. No	Particulars	Occupants (nos.)	Consumption per head/ liters/day	Total Liters/day
1	Men's Hostel	Hostel I – 168 Hostel II – 28 Hostel III – 56 Total = 252	150.00	37,800.00
2	Women's Hostel	Hostel I – 200 Hostel II – 50 Hostel III – 36 Total = 286	150.00	42,900.00
3	Centralized Canteen (cooking food for 1000 people)	1000	10.00	10,000.00

4	Daily use of drinking water on campus	Students - 2800 Teaching staff – 251 Non Teaching Staff –513 Total = 3564	3.20	11,404.80
5	Staff Quarters & Guest House	A type -27 B type - 87 C type – 36 D type - 36 TA type -33 Old GH- 92 IGH- 52 Total = 363	150.00	54,450.00
			TOTAL	**1,56,554.80**

Table No. 9.2 : The Water supply details of Goa University

Sr. No.	Source	Qty Liters/day
1	P.W.D Supply	2,50,000.00
2	Bore well Supply	1,50,000.00
	Total	**4,00,000.00**

There are 2800 students, 251 Teaching staff and 513 Non teaching staff coming on campus every day. The University is providing the Hostel/ residential facility to approximately 252 Men students, 286 women students and 363 residents in the staff quarters and Guest houses. The centralized canteen cooks food for 1000 end users each day. By assuming average per capita consumption of water as 150 liters per head per day, average consumption of drinking water as 3.20 liters per person per day and the daily water required on campus for the centralized canteen to cook food as 10 liters per person per day; The per day requirement of water in the University Campus comes to an approx. 1,56,554.00 Liters/day as depicted in table 9.1.

The monthly water requirement on campus is 48,53,205.00 liters (1,56,554.80 x 31 days).

Table No. 9.3 : Rainwater harvested on the University campus.

Sr. No	Site location	Recharge capacity in Liters /year
1	Opposite USIC Bldg	2,50,00,000.00
2	Next to Exam section	3,90,00,000.00
3	At Science Building	7,87,500.00
	Total	**6,47,87,500.00**

The water collection from the rain water harvesting system is used for the watering of plants. The amount of water collection from the rain water harvesting is 6,47,87,500 liters per year.

Global warming, enhanced by carbon emissions, is a major threat to the World. Trees play a key role in carbon sequestration and act as carbon sinks. There is an awareness towards understanding their role in urban areas. The Higher Educational Institutes in rural areas with urban character such as Goa University shall play a prominent role by setting an example. As there are several documented benefits of biotic carbon sequestration, Goa University carefully nurtured the greenery in the campus. In spite of area being hard lateritic rocks, efforts have been made to convert this savannah type habitat into a wonderful oasis without changing the unique habitat rich in herbaceous endemics.

It is observed from the research work carried out at University, all the trees (except the ones in the residential areas of the campus) with ≥ 30 cm GBH have been measured and documented. The parameters such as GBH and height of the trees have been measured in the field and above ground biomass (AGB) and below ground biomass (BGB), total biomass and sequestered carbon have been worked out. For each individual using allometric analysis based on the models developed by Brown et al (1989) for AGB, MacDicken (1997) for BGB, using average wood density value from Warran and Patwardhan (2001). For Carbon sequestration formula of Ravindranath et al (1997) has been used.

Table 10.1: Biomass and Carbon sequestration potential of trees (with ≥ 30 cm GBH) in Goa University Campus (Jaydeep, 2014. MSc dissertation)

S.No.	Particulars	Quantity
1	Number of tree species with ≥ 30 cm GBH (excluding several species planted and which are < 30 cm GBH)	55
2	Number of individuals with ≥ 30 cm GBH	1826
3	Total biomass	263076 kg
4	Carbon sequestration potential	121014 kg
5	Carbon sequestration potential of GU campus	699.5 kg/ha

Table 10.2: Number of vehicles and their fuel consumption at different Buildings. (Provide building wise and department wise data)

Sr. No.	Vehicle	Four wheelers	Two wheelers	Total fuel liters/month	Total fuel liters/year
1	No. of vehicles	08	02	640 liters	7680 liters
2	Average liters of fuel/ month	580 liters	60 lit		
3	Maximum	700 liters	65 liters		
4	Minimum	500 liters	55 iters		

Table 10.3: Total number of vehicles on campus and their fuel consumption

Sr. No	Name of Building	No. of four-wheeler vehicles	No. of two-wheeler vehicles	Average fuel used by four-wheeler/ month	Average fuel used by two wheelers/month	Total fuel used lit/month	Total fuel used lit/

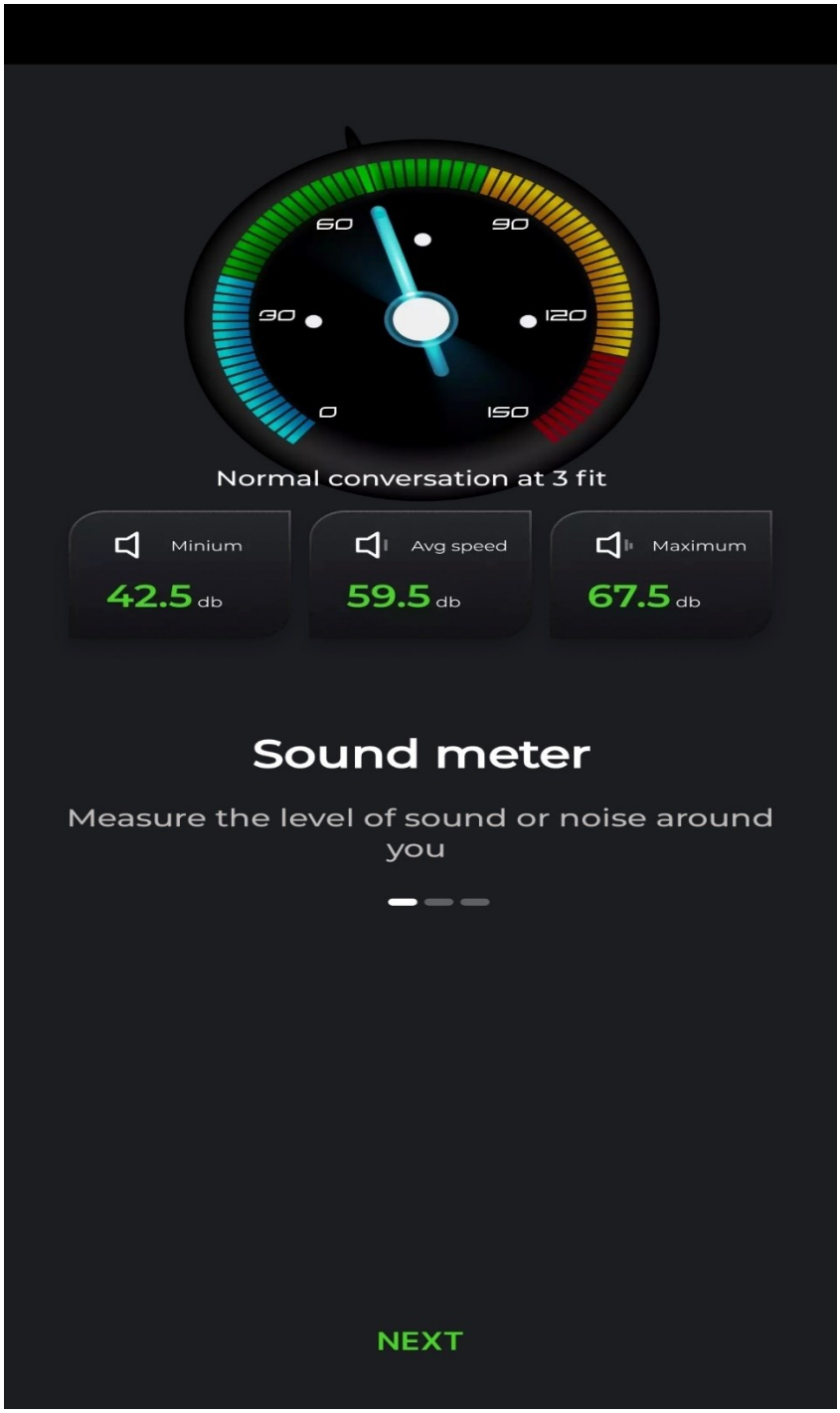
							year
1	EA & AS	06	01	410 liters	35 liters	445	5340
2	Administration	01	01	100 liters	25 liters	125	1500
3	Controller of Exam	01	Nil	70 liters	Nil	70	840

CHAPTER-XI

THE AIR POLLUTION AND NOISE POLLUTION

THE AIR POLLUTION

Air Quality is range from GOOD to SATISFACTORY (Value Range between 45-74 INDEX; 81 IS THE MODERATE VALE).
UV index 7 of 11.



THE NOISE POLLUTION

THE NOISE POLLUTION RANGE

MINIMUM:42.5db

AVERAGE: 59.5db

MAXIMUM: 67.5db


Sound Meter Master
76
dB
88
0
0:01:45
90
80
70
60
50
40
30
20
Google Cloud
Start a free trial now
SIGN UP

CHAPTER-XII

THE SUSTAINABLE PRACTICES

“Compliance is the first step; continuous improvement is the goal."

CONTRIBUTION TO ENVIRONMENT AND SUSTAINABILITY

Goa University has demonstrated a strong commitment to environmental conservation through the efforts of its various academic and research departments. Below is a department-wise overview of their contributions:

1. Department of Botany

The School of Biological Science & Biotechnology, Botany has been instrumental in conducting research on the plant and fungal biodiversity of the Western Ghats region in Goa. Their work focuses on inventorying, conserving, and utilizing these biological resources, thereby contributing to the preservation of this ecologically significant area.

2. School of Earth, Ocean, and Atmospheric Sciences (SEOAS)

SEOAS offers postgraduate programs in Environmental Science that address various aspects of environmental conservation, including coral reef conservation and climate change resilience. The curriculum emphasizes sustainable development and equips students with the knowledge to tackle environmental challenges effectively.

3. Department of Biological Sciences and Biotechnology and Microbiology :

This department has undertaken studies on conserving coastal resources, particularly focusing on traditional fishing practices like Rampon fishing in Goa. Their research aims to understand the implications of these practices on coastal ecology and promote sustainable fishing methods.

3-1. **Manohar Parrikar School of Law, Governance & Public Policy: Organized National Policy Hakhathon.**

a. National Policy Hackathon conducted in year 2024 and 2025; is an innovative platform designed to engage graduate and post-graduate students in the dynamic process of policymaking, innovation, and collaboration that synchronizes the innovative ideas of the budding experts participating in policymaking exercises. This event aims to produce creative and practical policy solutions to specific societal challenges in the realm of Public Administration and Public Policy.Participants work intensively within a set timeframe to develop practical, data-driven solutions to realworld challenges. The innovative ideas garnered at this event would benefit key stakeholders and contribute to filling in the gaps between the theory and practice of Public Administration and Public Policy

4. School of Biological Sciences & Biotechnology, Botany discipline

Faculty members such as Dr. Nandkumar Kamat have contributed significantly to environmental microbiology, exploring microbial diversity in tropical habitats. Their research includes bioprospecting for microorganisms that can be utilized in environmental conservation efforts.

5. Green Energy Audit Management Committee who has taken up below work

The university's Green Audit Report highlights the campus's rich environmental initiatives, including afforestation, rainwater harvesting, and biodiversity conservation. These efforts are part of the university's commitment to creating a sustainable and eco-friendly campus environment.

6. School of Earth, Ocean, and Atmospheric Sciences (SEOAS))

Through collaborations, such as the Memorandum of Understanding with the Leibniz Institute for Baltic Sea Research, the Department of Marine Sciences aims to enhance marine research and promote coastal sustainability. This partnership focuses on better management and conservation practices for marine ecosystems.

7. School of Biological Sciences and Biotechnology, who organized the 8th International Conference on "Cutting-edge Research Innovation in Sustainable Education, Environment & Agriculture (CRISEA-2025)" on February 24-26, 2025, at Goa University, Goa)

The actively participates in organizing conferences on sustainable energy and environmental conservation, fostering discussions on green technologies and their applications. These initiatives contribute to the broader discourse on environmental sustainability.

8. School of Biological Sciences and Biotechnology, who organized the 8th International Conference on "Cutting-edge Research Innovation in Sustainable Education, Environment & Agriculture (CRISEA-2025)" on February 24-26, 2025, at Goa University, Goa)

In 2025, the university organized the "CRISEA-2025" conference, focusing on sustainable agricultural practices such as natural organic farming, agroecology, soil health management, water conservation, and sustainable pest management. This initiative underscores the university's commitment to promoting environmentally friendly agricultural methods.

9. **School of Earth, Ocean, and Atmospheric Sciences (SEOAS)**

The School of Earth, Ocean, and Atmospheric Sciences has offered programs emphasizing environmental impact assessments, groundwater resource management, solid waste management, biodegradation, and sustainable development, particularly addressing local environmental issues.

Between 2020 and 2025, Goa University has undertaken several initiatives aimed at environmental conservation. Building upon previous efforts, here are ten additional significant contributions:

1. **Establishment of the 'GURU' Research Park:** In 2024, Goa University inaugurated the 'GURU' Research Park, housing incubators in biotechnology, information technology, and health. This facility fosters innovation in sustainable technologies and environmental solutions, providing a platform for research and development in eco-friendly practices.
2. **Adoption of Villages under Unnat Bharat Abhiyan**: The university adopted five villages in Goa as part of the Unnat Bharat Abhiyan initiative. Activities included environmental awareness programs, waste management workshops, and the promotion of sustainable

agricultural practices, directly benefiting local communities and promoting environmental conservation.

3. **Mussel Farming Project in Marcaim Village**: Goa University initiated a mussel farming project in Marcaim village, promoting sustainable aquaculture practices. This project provides an alternative livelihood for local communities while ensuring the conservation of marine ecosystems.
4. **Revival of 'Puran Sheti' in Sattari Taluka**: The university successfully completed a community project aimed at reviving traditional agricultural practices known as 'Puran Sheti' in Sattari Taluka. This initiative enhanced sustainable farming methods and contributed to the conservation of local biodiversity.
5. **Integration of Sustainability in Educational Programs**: Goa University incorporated sustainability topics into its curriculum, emphasizing environmental conservation across various disciplines. This educational approach equips students with the knowledge and skills necessary to address environmental challenges effectively.
6. **Participation in State Action Plan for Climate Change**: **(Yes, Some of our faculties were involved , please see link at page 175 , https://gsbb.goa.gov.in/wp-content/uploads/2023/05/SAPCC%207.pdf)** The university contributed to Goa's State Action Plan for Climate Change by providing research and recommendations on environmental conservation strategies, climate change mitigation, and adaptation measures.
7. **Research on Past Environmental Conditions**: Faculty members conducted research on reconstructing past environmental conditions over glacial-interglacial timescales, contributing to the understanding of climate change and its impacts.
8. **Development of Climate Mitigation Plans for Tourism Projects**: The university assisted in formulating guidelines requiring large tourism projects in Goa to include climate mitigation and adaptation plans, ensuring that new developments consider environmental conservation and climate resilience.

The research conducted by Goa University provided crucial insights into the historical dynamics of climate change and its impacts on the region. The findings emphasized the need for sustainable environmental policies to mitigate modern climate change, drawing lessons from past climatic shifts. Understanding historical patterns of sea-level rise, temperature variations, and monsoon changes can help policymakers develop climate adaptation strategies for coastal regions like Goa. The study also highlighted the importance of conserving natural carbon sinks, such as mangroves and forests, which have played a role in regulating atmospheric CO_2 levels over millennia.

This research underscores the university's role in advancing climate science and contributing to global discussions on climate resilience, sustainability, and environmental conservation.

Goa University has actively contributed to environmental conservation through various initiatives. Here are few significant examples:

1. **Rainwater Harvesting Initiatives**: The university has implemented rainwater harvesting systems across its campus to address water scarcity and promote sustainable water

management. These systems collect and recharge groundwater, ensuring a sustainable water supply for the university community.

2. **Marine Research and Coastal Sustainability Efforts**: Goa University has signed a Memorandum of Understanding (MoU) with the Leibniz Institute for Baltic Sea Research to enhance marine research and coastal sustainability. This collaboration aims to protect fragile ecosystems, address soil erosion, promote sustainable aquaculture, and harness artificial intelligence for environmental conservation.
3. **State-of-the-Art Composting Facility**: In partnership with Ekam Eco Solutions Pvt. Ltd., the university inaugurated a modern composting facility on campus. This initiative focuses on efficient waste management by converting organic waste into compost, thereby reducing landfill usage and promoting environmental sustainability.
4. **Hosting Conferences on Green Technologies**: The university organized a conference titled "Natural Science and Green Technologies for Sustainable Development," bringing together experts to discuss and promote environmentally friendly technologies. Such events underscore the university's commitment to sustainable development and environmental conservation.
5. **Research on Goa's Water Ecosystems**: The university has conducted in-depth studies on Goa's water ecosystems, including the impact of tourism on areas like Morjim and soil erosion in regions such as Chapora. These research efforts aim to understand and mitigate environmental challenges, contributing to the preservation of local ecosystems and sustainable livelihoods.
6. **International Conference on Sustainable Education, Environment & Agriculture (CRISEA-2025):** Held from February 24-26, 2025, this conference brought together researchers, educators, industry professionals, and policymakers to discuss advancements in sustainable practices across education, environmental conservation, and agriculture. The event featured sessions on innovative teaching methodologies, climate change mitigation, renewable energy, waste management, and sustainable agricultural practices.
7. **Short-Term Programme on Sustainable Tourism:** In March 2025, the UGC-Malaviya Mission Teacher Training Centre at Goa University conducted an online short-term program focused on sustainable tourism. Aimed at faculty members from various colleges and universities, the program addressed sustainable tourism practices, emphasizing the integration of sustainability into tourism education and industry practices.
8. **Participation in the State Action Plan for Climate Change:** Goa University contributed to the development of the State Action Plan for Climate Change by providing training and education programs. These initiatives aimed to implement agricultural practices and technologies more resilient to climate change, thereby enhancing the sustainability of the agricultural sector in Goa.
9. **National Conference on Bioentrepreneurship in Microbiology:** Organized by the Microbiology discipline of the School of Biological Sciences and Biotechnology in March 2025, this conference included lectures by experts on developing and commercializing innovative products, services, or technologies derived from microbiological research. The event highlighted the role of bio-entrepreneurship in promoting sustainable practices within the field of microbiology.

10. **Development of Climate Mitigation Plans for Tourism Projects:** Faculty members collaborated with local tourism stakeholders to develop climate mitigation strategies, aiming to reduce the environmental impact of tourism activities in Goa. (Dr. Sulochana Pednekar)
11. **Collaboration with Goa Tourism for Sustainable Practices:** The university partnered with the Goa Tourism Department to implement sustainable tourism practices, focusing on preserving natural resources and promoting eco-friendly tourism.
12. **Participation in State Action Plan for Climate Change:** Goa University contributed to the formulation of the State Action Plan for Climate Change, providing research and expertise to address climate-related challenges in the region.
13. **Research on Past Environmental Conditions:** Faculty members conducted studies to reconstruct past environmental conditions over glacial-interglacial timescales, enhancing the understanding of climate change and its impacts.
14. **Implementation of Renewable Energy Projects:** The university invested in renewable energy sources, such as solar panels, to reduce reliance on non-renewable energy and decrease carbon emissions.
15. **Water Conservation Initiatives:** Programs were established to promote water conservation on campus, including rainwater harvesting systems and awareness campaigns on efficient water usage.
16. **Waste Management Programs:** Initiatives to reduce, reuse, and recycle waste were implemented, aiming to minimize the environmental footprint of the university community.
17. **Biodiversity Conservation Projects:** Efforts were made to preserve and enhance campus biodiversity through tree plantation drives and the creation of green spaces.
18. **Environmental Education and Outreach:** Educational programs and workshops were organized to raise awareness about environmental issues among students, staff, and the local community.
19. **The SBSI (Swachha Bharat Summer Internship) :** The students under SBSI program are contributing for conducting the awareness programs on water management, anti-plastic campaign, cleanliness drive, etc. In addition, the programme aims to engage youth across the country, develop their skills and orientation for Solid Waste Management (SWM), and sustain the momentum of the Swachh Bharat janandolan.

Through these initiatives, Goa University demonstrates its dedication to environmental conservation and sustainable development.

"What gets measured, gets managed." – Peter Drucker

CHAPTER-XIII

THE RECOMMENDATIONS

RECOMMENDATIONS

1. The Coverage of Solar Panel be increased to cover to reach the value of minimum 1000 kWp
2. The Separate Parking Slots be Developed on the University Campus.
3. The E-Vehicles be used on the Campus
4. The Walking Path network be developed.
5. The use of LEDs be enhanced to greater extent.
6. The Green Building eco-system be developed.
7. The use of microprocessor-based control of lights be promoted.
8. The Electrical saving lights/system be developed.
9. The use of plastic be restricted on campus.
10. The mechanism for collection of organic waste needs enhancement.

The **University of Goa** can play a crucial role in supporting the **State Action Plan for Climate Change (SAPCC)** by contributing to research, policy advocacy, education, and community engagement. Below are key areas where the university can align its initiatives with the SAPCC goals:

1. Research and Innovation for Climate Action

- **Conduct climate vulnerability assessments** focused on Goa's ecosystems, water resources, and coastal areas.
- Develop **climate-resilient agriculture techniques** and promote organic farming.
- Research and implement **nature-based solutions** for coastal protection, afforestation, and water conservation.
- Develop **early warning systems** for floods, heatwaves, and other climate risks using AI and predictive modeling.
- Innovate in **renewable energy**, including solar, wind, and tidal energy, tailored for Goa's coastal setting.

2. Sustainable Campus and Carbon Footprint Reduction

- Install **solar panels** and other renewable energy sources on campus to transition toward a carbon-neutral institution.
- Implement a **zero-waste policy**, including solid waste segregation, composting, and a ban on single-use plastics.
- Promote **water conservation** through rainwater harvesting, wastewater recycling, and smart irrigation systems.
- Reduce carbon footprint by **encouraging bicycle use, electric vehicles, and public transport** for students and faculty.

3. Education and Awareness Programs

- Introduce **mandatory climate studies courses** across all disciplines to sensitize students.
- Organize **workshops, conferences, and seminars** on climate change mitigation and adaptation strategies.
- Develop **MOOCs (Massive Open Online Courses)** on climate resilience, sustainable tourism, and environmental policy.
- Train **students and faculty in climate-related policymaking** and governance for effective implementation of SAPCC strategies.

4. Community Engagement and Policy Support

- Collaborate with **local government bodies** to support policy recommendations aligned with SAPCC.
- Develop **citizen science initiatives** to involve local communities in monitoring air and water quality.
- Work with **coastal communities** to implement climate adaptation strategies, such as mangrove restoration.
- Partner with **schools and colleges** to spread climate literacy and instill eco-conscious behavior.

5. Industrial and Government Collaborations

- Establish **a center for climate innovation** that brings together academia, government, and private sectors.

- Develop **internships and projects with industries** focused on green technologies and environmental management.
- Support the **state's renewable energy policy** by offering expertise in solar, wind, and hydroelectric energy research.
- Participate in **Goa's disaster management planning**, providing technical and policy support.

Conclusion

The university campus boasts extensive vegetative cover, contributing to a serene and eco-friendly atmosphere. The area experiences minimal vehicular traffic, resulting in low emission levels. Additionally, the absence of polluting industries in the vicinity further enhances the campus's environmental quality. The university actively engages in initiatives such as annual plantation drives (e.g., Vanamahotsav) and water harvesting projects to promote ecological balance.

Academically, Goa University offers a unique two-year postgraduate program in Environmental Science. This interdisciplinary course is hosted by the School of Earth, Ocean, and Atmospheric Sciences (SEOAS) in collaboration with various departments, including Botany, Biotechnology, Zoology, Microbiology, Philosophy, Sociology, History, the Faculty of Life Sciences, Goa Business School, Manohar Parrikar School of Law, Governance and Public Policy, and the School of Chemical Sciences. The program addresses grand environmental challenges by integrating diverse academic perspectives.

The university's School of Earth, Ocean, and Atmospheric Sciences focuses on providing quality education and research in earth system science through an integrated approach. The curriculum is designed to align with national eligibility standards, making it a preferred choice for postgraduate studies in earth system science.

Environmental Status of Surrounding Areas

Goa, as a state, has been facing environmental challenges due to rapid urbanization, land-use changes, deforestation, and mining activities. These factors have led to soil erosion, loss of soil fertility, and depletion of groundwater resources, posing threats to both environmental and socio-economic well-being.

The state has also experienced environmental degradation resulting from past mining activities, excessive tourism, and significant population migration. These developments have exerted immense

pressure on the land, necessitating concerted efforts toward environmental conservation and sustainable development

In response to these challenges, Goa University has been proactive in conducting research and implementing initiatives aimed at environmental conservation. For instance, the university has undertaken baseline marine environmental monitoring studies in the Cumbarjua Canal, reflecting its commitment to addressing local environmental issues. Goa University not only maintains a green and sustainable campus but also actively contributes to understanding and mitigating environmental challenges in the surrounding regions through education, research, and community engagement.

Goa University has evolved from its historical roots into a modern institution committed to academic excellence, interdisciplinary collaboration, and sustainable development. Its strategic initiatives, quality education, and environmental stewardship position it as a leading university in the region, dedicated to preparing students for the challenges of a rapidly changing world.

"Every audit report is an opportunity to create a more sustainable world."

THE GREEN AUDIT ENERGY COMMITTEE

UNIVERSITY OF GOA

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E-mail : registrar@unigoa.ac.in
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(Accredited by NAAC with Grade 'A')

GU/D-RDRM/Green Energy Audit/Advisory Comm./2022/50 Date: 17/10/2022

ORDER

The Vice-Chancellor is pleased to constitute a Management Committee to take care of the Green Energy Audit of Goa University. The Committee will comprise of the following members:

1. Prof. R.S. Gad, School of Physical & Atmospheric Sciences - Chairperson
2. Dr. Anthony Veigas, School of Earth, Ocean & Atmospheric Sciences - Member
3. Dr. Nitin Sawant, School of Biological Sciences & Biotechnology - Member
4. Dr. Bhakti Salgaonkar, School of Biological Sciences & Biotechnology - Member
5. Dr. Siddhi Jalmi, School of Biological Sciences & Biotechnology - Member
6. Dr. Pranav Naik, School of Physical and Applied Sciences - Member
7. Dr. Marlon Sequeira, School of Physical and Applied Sciences - Member
8. Dr. Minal Desai, School of Biological Sciences & Biotechnology - Member
9. Ms. Dviti Mapari, School of Biological Sciences & Biotechnology - Member
10. Shri Mahesh Mayekar, School of Earth, Ocean & Atmospheric Sciences - Member
11. Director, IQAC, - Member

- Committee will study the Energy Audit report of Goa University and plan a roadmap for incremental upgrades.
- Committee will explore possibility of CSR towards Green Energy Audit themes.

The term of the Committee shall be for a period of three years from the date of issue of this Order.

Nadkarni 17/10/22
(Prof. V.S. Nadkarni)
REGISTRAR

To
The Chairperson and all the above members.

Copy to:
1. Deans/Vice-Deans of Schools 2. AR to R 3. PS to VC

GREEN ENERGY AND ENVIRONMENT AUDIT CERTIFICATE

GREEN ENERGY AND ENVIRONMENT AUDIT CERTIFICATE

Certificate No: ES/GU/24-25/16 **Date: 20/3/2025**

This is to certify that we have conducted Green Audit at Goa University, Taleigao Plateau, Goa in the year 2024-25 for the period of 2020-2025.

The University has adopted following Green Energy, The University has adopted following Eco- Friendly Practices and Sustainable Practices:

Sr. No.	Observation and Remarks
1	Usage of Energy Efficient LED Fittings
2	Usage of BEE STAR Rated Equipment
3	Installation of 605 kWp Grid Solar PV Plant
4	Cost saving in Energy Monthly Bills due to Solar Grid System.
5	Installation of Solar Thermal Water Heating System.
6	Usage of BEE STAR Rated Equipment
7	Application Of Effective E-Governance Measure and thereby significant reduction in use of paper and energy.
8	Annual Maintenance Contract for preventive maintenance of Equipment and Machinery and thereby conservation of energy.
9	The records of energy utilization and the category/segregation of energy usage is monitored and maintained at the department level.
10	Rich Flora, Fauna on the University campus
11	Rich mobility and existence of Avians on the university campus.
12	Use of PWD Water Supply (2,50,000 Liters/day and Bore Well water supply (1,50,000 Liters/day)
13	The average habitatants on the campus on per day basis are 5465 and water utilization per day is 1,56,554.80 Liters per day and hence there is optimum use of water.
14	The Water quality testing practice exist
15	Rain Water Harvesting project for making use of rain water falling on terrace. The total 6,47,87,500 Liters of Rainwater is harvested and used for ground water recharge.
16	Segregation of Waste at source

17	The compositing practice is available on campus and the systematic and scientific measures are used for compositing.
18	Installation of Sanitary Waste Incinerator
19	Provision of Sewage Treatment Plant
20	Construction of Farm Pond exist and construction of dam on campus is in process.
21	E-waste Management is structured and carried out effectively. The E-waste is segregated. The students are involved in the E-waste management.
22	Water Shadae Management exists.
23	The Hazardous Material waste available at Bio-technology department is managed.
24	Tree Plantation in the campus
25	Creation of Awareness on Plastic Free Campus by Display of Boards
26	Installation of Sanitary Waste Incinerator
26	Provision of Ramp & Dedicated Wash rooms for Divyangajan
28	Air Quality is range from GOOD to SATISFACTORY (Value Range between 45-74 INDEX; 81 IS THE MODERATE VALE). UV index 7 of 11.
29	Noise Pollution Range: Minimum-42.5db; Average-59.5db; Maximum-67.5db
30	Carbon Footprint: The Carbon Sequestration potential at Goa University is 699.60 Kg/hector.

Hence Certified

Dr. Ajit R. Thete, Director, Centre for Development of Leadership in Education, Pune.

A Y Mehendale,
B E- Mech, M Tech-Energy, Certified Energy Auditor, EA-8192
ASSOCHAM GEM Certified Professional: GEM: 22/788
UDYAM Regn. No: UDYAM-MH-26-0135636,
MEDA Regn. No: ECN/2023-24/CR-43/1709
ISO: 9001-2015 Certified (Cert No: 23EQKC13),
ISO: 14001-2015 Certified (Cert No: 23EEKW20)

ENGRESS SERVICES * PUNE *