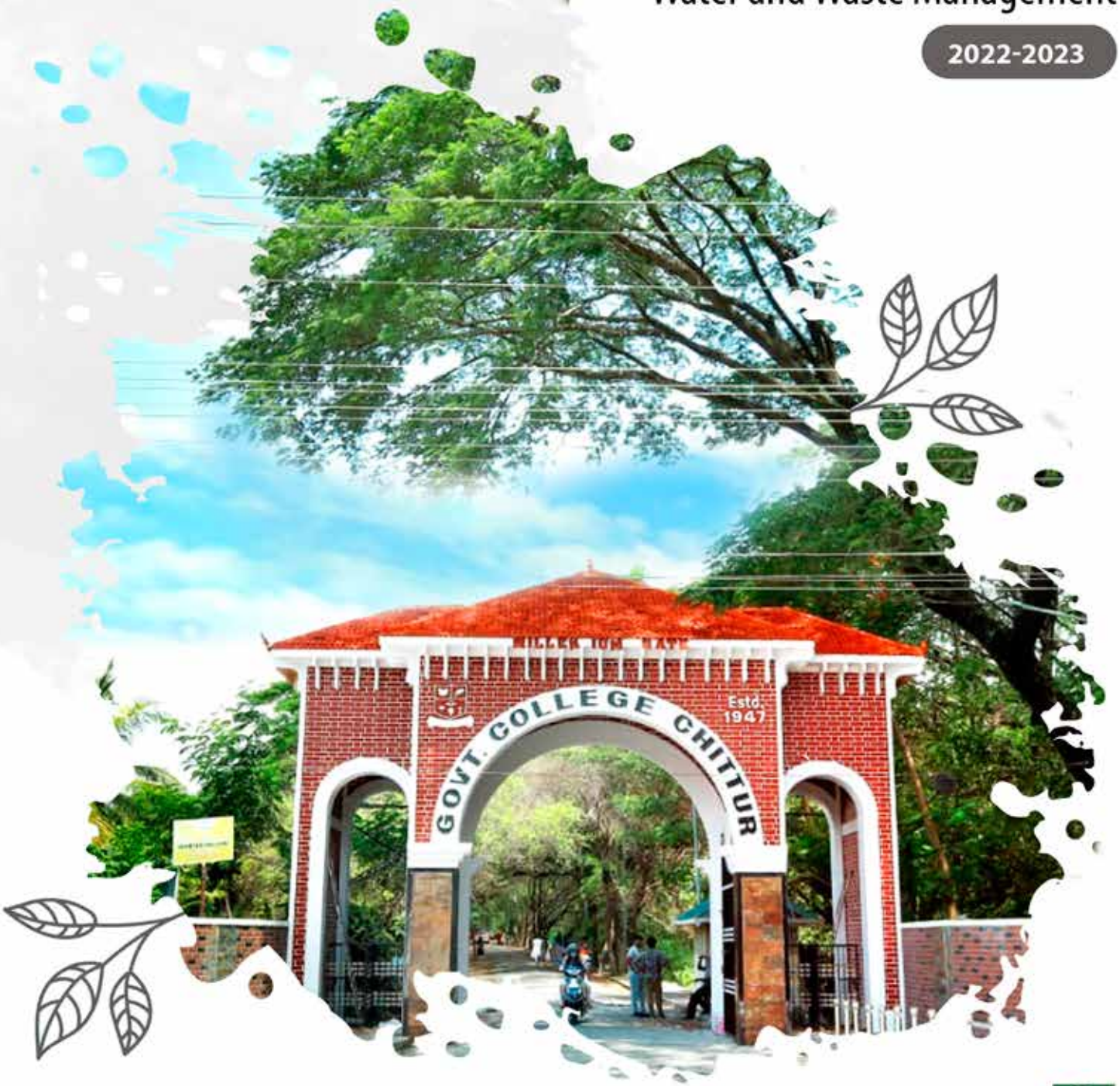
GOVT. COLLEGE, CHITTUR,
PALAKKAD, KERALA

Green Campus Audit Report

Biodiversity, Carbon, Energy, Water and Waste Management

2022-2023



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Content

Executive Summary

Executive Summary

Green auditing was conducted at Government College, Chittur, Palakkad District, Kerala. In this comprehensive study, environmental practices and sustainability was meticulously examined across five key domains: Biodiversity, energy, carbon storage, water quality and waste management. The biodiversity audit highlights the importance of preserving and enhancing campus's ecological diversity, recommending initiatives such as green spaces development, native plant promotion, and conservation programs. The floristic analysis of revealed the presence of 185 angiosperms belongs to 71 families, 1 gymnosperm and 5 pteridophytes belongs to 3 families. The present assessment recorded the dominance of Fabaceae (20 species) followed by Apocynaceae (12), Poaceae (11), Asteraceae and Rubiaceae (9 species) from the campus.The plant species such as *Oldenlandia corymbosa* L. and *Torenia bicolor*Dalz. found as Endemic to the Western Ghats and *Canthium rheedii* DC., *Holarrhena pubescens* Wall. ex G.D. and *Naregamia alata*, on recordedas Endemic to Peninsular India from the College Campus. The Shannon Wiener Index H' (1.24942) was indicated that, the plant community in the Chittur Government College campus is relatively heterogenous with no dominance of a particular species. It also indicated that, the campus is rich in plant diversity with uniform distribution.

The faunal aspects covered in the assessment include selected groups of invertebrates and vertebrates. Butterflies and moths, Dragonflies and Damselflies are the invertebrate groupsconsidered while reptiles and amphibians, birds and mammals under vertebrates. Different habitats and rich vegetation with varieties of garden and flowering species attract good diversity of butterflies into the campus. A total of 70 species were noted during the assessment. They belong to five different families. 7 species of dragonflies which belonging Libellulidae family and 1 species of damselflies representing Coenagrionidae family were recorded. A total of 135 species of birds belong to 49 families were noted. The campus habitat harbours many species of reptiles, amphibians and mammals. 16 mammals were found belongs to 13 families. From the field assessment and previous records 8 Reptiles snakes belongs to 5 families and 15 amphibians were also noted belongs to 6 family from the campus.

The Energy audit identifies opportunities for optimizing energy consumption through infrastructure upgrades, behavioral adjustments, and the integration of renewable energy sources, aligning the institution with the principles of efficiency and environmental stewardship.

The energy audit conducted at Government College, Chittoor, rigorously adhered to the stringent standards outlined in ISO 50001 and ISO 50002:2014, ensuring a meticulous examination of the campus's energy performance. Through a meticulously planned process and thorough data collection efforts of the year 2023, the audit yielded significant findings that shed light on the college's energy consumption patterns. Notably, it was revealed that the campus consumed a total of 55,396 kWh of energy annually, a figure that was found to be proportionate to the campus's size. Additionally, the audit identified a total of 1952 appliances on campus that consumed electricity, further highlighting the scale of energy usage within the institution. Amidst these findings, several commendable initiatives showcased the college's commitment to energy efficiency and sustainability. For instance, the installation of energy-efficient equipment and the establishment of a solar power plant in the PG block underscored proactive measures taken by the college to reduce energy consumption and environmental impact. Furthermore, the proactive efforts of the Environment Club in organizing four energy conservation awareness programs demonstrated a collective dedication to fostering a culture of sustainability within the college community. However, alongside these positive actions, the energy audit also identified areas where further improvements could be made to enhance energy efficiency. Recommendations included implementing solar hybrid kitchens, improving e-waste management practices, and promoting power-down practices campus-wide. Embracing these suggestions not only has the potential to reduce the college's carbon footprint but also to instill a sense of environmental responsibility among faculty and students.

The transportation audit at Chittur College unveils insights into commuting preferences and behaviors, showcasing a reliance on public transport by 92.01% of individuals, with low usage of cars (1.69%) and bikes (4.5%). Limited electric vehicle (EV) adoption suggests an opportunity for growth in sustainable transportation. Analysis shows a good portion opt for vehicles for short trips, signalling an opportunity for promoting walking and cycling.

Waste Management audit emphasizes the importance of a circular economy approach, urging the implementation of robust recycling programs, waste reduction strategies, and responsible disposal practices. The types of wastes existing on the campus during the time of audit include both biodegradable and non-biodegradable. The waste types include electronic, plastic, paper, chemical, garden waste, and food waste. The waste management audit found that the quantity of waste generated on the campus is 785.194 kg/year. Among Departments, the Dept. of Botany and Physics produces the highest quantity of biodegradable wastes, and the Dept. of Malayalam produces the highest quantity of non-biodegradable wastes. Damaged furniture dumped in many rooms occupying much space, and thus a serious concern. Source-level segregation of solid waste is lacking in some of the pockets. The college has a very active green protocol committee, which is monitoring the overall eco-friendly waste management of the campus. Single-use plastic is strictly banned

on campus which results in the reduction of plastic waste to a considerable amount. The college employs an adequate number of cleaning staff for the collection, Segregation, and disposal of waste. The students respect the value of food, thus the wastage of food in the departments was meagre. Also, a responsible culture of dining is motivated on the campus to avoid wasting food.

Water audit evaluates water use and management practices of the institution and identify interventions for improved water use efficiency. This study help to reduce water consumption for different sections in the institution and identify and quantify the areas of excessive water usage and water losses, suggest ways and means for reduction in water use and losses.

A carbon audit is a comprehensive assessment of an organization's carbon footprint, which is the total amount of greenhouse gases, primarily carbon dioxide, emitted directly or indirectly as a result of its activities. The audit involves quantifying the emissions associated with various aspects of an organization's operations, including energy consumption, transportation, waste management, and other relevant factors.

The comprehensive carbon emissions data from Chittur Government College in Palakkad offers valuable insights into emissions across three scopes according to the Greenhouse Gas Protocol. Scope 1 emissions total 3.28 units, attributed to sources like LPG cylinders, diesel for electricity generation, biomass burning, and waste. Scope 2 emissions, mainly from purchased electricity, stand at 44.87, while Scope 3 emissions, particularly from transportation, reach 48.10. Miscellaneous emissions contribute 10, resulting in a total of 106.25. Additionally, the carbon sequestration potential from tree species alone is estimated at 168 tonnes annually, with 61.75 tonnes of excess tradable carbon. Implementing mitigation measures, including the operation of installed solar panels, could potentially generate 100 tonnes of tradable carbon annually. These findings emphasize the necessity for the college to review its energy procurement and transportation practices to reduce its carbon footprint and improve environmental sustainability.

The college has launched distinctive and impactful green initiatives and outreach programs aimed at fostering environmental sustainability and enhancing human well-being, involving not only the student community but also staff and the general public. As part of the audit, these initiatives and outreach activities have been meticulously identified and documented, underscoring their significance as indicators of the college's dedication to environmental stewardship and societal responsibility.

Collectively, these audits serve as a holistic roadmap for transforming campus into a model of environmental responsibility and sustainability. By integrating the recommendations outlined in this report, we not only enhance the ecological integrity of the institution but also foster a culture of environmental awareness and responsibility among students, faculty, and staff. This comprehensive approach positions institution as a leader in the pursuit of a greener, more resilient future, aligning with global sustainable development goals (SDGs), Kunming-Montreal Global Biodiversity Framework and showcasing our dedication to creating a positive impact on both the local and global environment.

Introduction

Global warming and climate change pose significant threats to our planet and demand immediate attention and action. The consequences of these phenomena are far-reaching, with rising temperatures, erratic rainfall patterns, and more frequent extreme weather events wreaking havoc on ecosystems, wildlife, and human livelihoods. The impact of climate change is not limited to environmental concerns alone; it also exacerbates vulnerabilities and inequalities, hitting marginalised communities the hardest. Displacement and conflicts arise as people are forced to migrate due to the adverse effects of climate change, further destabilising societies. Additionally, climate change is linked to the spread of diseases, as altered weather patterns create favourable conditions for disease vectors and infectious agents to thrive, exemplified by the COVID-19 pandemic. Urgent action is imperative to mitigate the catastrophic consequences of climate change. This includes reducing greenhouse gas emissions, transitioning to renewable energy sources, enhancing resilience to climate impacts, and adopting sustainable practices across various sectors. In the fight against climate change, industries and other institutions can play a pivotal role by incorporating green auditing into their operations. **Considering its importance, the National Assessment and Accreditation Council (NAAC) made a rule that all higher education institutions in India must do a green audit. This is important because NAAC gives a grade to institutions that shows how good their education, facilities, research etc. Now, with the green audit, it also reflects how well they're taking care of the environment.**

Green auditing is a rigorous and methodical procedure that encompasses a thorough evaluation of an organization's environmental performance, scrutinises its adherence to environmental regulations, and assesses its commitment to sustainable practices. Green auditing helps to establish accountability, foster transparency, and promote sustainability across diverse sectors, including industries, organizations, and institutions.

Green audits within educational institutions play a dual role. On one hand, they meticulously examine and evaluate the ecological impact of the institution's operational endeavours, thereby promoting the adoption of sustainable practices. This includes scrutinising resource consumption, waste management, and energy efficiency, among other factors. On the other hand, green audits impart a profound educational experience upon students, instilling within them a sense of environmental responsibility. As students witness their campus embracing environmentally conscious measures, they are encouraged to incorporate similar principles into their own lifestyles. Furthermore, the impact of green audits extends beyond immediate tangible results. These audits contribute to the creation of "green campuses," where the physical environment is consciously moulded to align with sustainable principles. Such campuses exemplify a holistic commitment to environmental welfare, often characterised by energy-efficient buildings, green spaces, waste reduction initiatives, and sustainable transportation options.

The concept of green institutions should not be confined only within the Institution and should be extended to the surrounding areas. In this way, various "inreach" programs or internal-focused initiatives and outreach programs can be conducted as part of spreading the concept of green institutions to rural, tribal and urban communities. Such programs are for activities focused on green enterprise development and environmental protection. Academic research projects, dissertations and theses can be linked to such activities as part of promoting the concept of green colleges for educational institutions and such a trend should be encouraged among students and staff members. Such outreach programs can be implemented in a more efficient manner by integrating them with existing government schemes related to biodiversity conservation. Public scepticism about government schemes related to biodiversity conservation activities is prevalent, especially in rural areas. Hence, government schemes aimed at reaching rural areas to provide clean and safe water, along with initiatives for the conservation of biodiversity and education about the importance of sanitation, will help to inculcate a sense of environmental responsibility among stakeholders and build such a society.

Comprehensive Objectives of Green Auditing in Educational Institutions

Green auditing in educational institutions serves as a pivotal tool for fostering sustainable practices, environmental responsibility, and holistic resource management. The overarching objectives encompass a multifaceted approach to environmental stewardship and sustainability within these institutions:

1. **Prudent Resource Utilisation:** Ensure the prudent utilisation of natural resources in alignment with national environmental policies, emphasizing responsible stewardship of resources among students, faculty, and staff.
2. **Safeguarding the Environment:** Curtail potential threats to human health and safeguard the environment by identifying, analysing, and mitigating environmental challenges while discerning the reciprocal impacts of the institution on its surroundings.
3. **Empowering Informed Decision-Making:** Furnish foundational data that empowers educational institutions to effectively evaluate and manage shifts, hazards, and risks

within the environment, facilitating informed decision-making.

4. **Meticulous Environmental Performance Assessment:** Meticulously assess the institution's environmental performance, evaluating the efficacy of measures adopted to achieve predefined objectives and targets.
5. **Continuous Improvement:** Identify diverse pressures compelling educational institutions to enhance their environmental performance, fostering an ecosystem of continuous improvement in sustainability and harmony between the institution and its environment.

Key Elements of Green Auditing in Educational Institutions

1. **Comprehensive Evaluation:** Conduct a thorough assessment of the institution's environmental performance, covering resource usage, waste management, emissions, and compliance with environmental regulations.
2. **Systematic Approach:** Follow a structured and systematic process, including planning, data collection, analysis, risk identification, and development of improvement strategies.
3. **Data-Driven Objectives:** Adopt standardised criteria for green auditing objectives, tailored to the institution's goals and regulatory requirements, while addressing data challenges related to access, quality, and accuracy.
4. **Compliance and Adherence:** Assess the institution's compliance with environmental regulations and its commitment to sustainable practices, ensuring adherence to legal frameworks and responsible environmental practices.
5. **Objectivity and Independence:** Prefer external environmental audits conducted by independent teams with specialized skills, ensuring objectivity in the assessment of environmental performance.
6. **Long-Term Sustainability:** Recognize that green auditing is a long-term process aimed at achieving sustainable environmental change and improvement, acknowledging that significant changes may take time to implement effectively.
7. **Documentation and Verification:** Rely on supporting documents and verifiable information to ensure compliance with environmental requirements and regulatory standards.
8. **Integration with Management Systems:** Integrate green auditing into the institution's management systems, incorporating it as a vital tool for assessing, evaluating, and managing environmental performance within the educational framework.
9. **Goal-Oriented:** Align the institution's environmental performance with its environmental policy, goals, and objectives, ensuring compliance with relevant standards and regulatory requirements.
10. **Environmental Education and Engagement:** Disseminate environmental information among students and staff, conduct training and awareness programs, and foster engagement through green practices, competitions, and awards.
11. **Continuous Improvement Strategies:** Evaluate current practices, identify necessary adjustments, and develop targeted strategies for promoting sustainability within the institution, spanning areas such as resource consumption, energy efficiency, and waste reduction.

By embracing these objectives and elements, green auditing in educational institutions not only supports environmental conservation but also nurtures a culture of sustainability, knowledge dissemination, and responsible resource management among students, staff, and faculty.

Relevance for Conducting Green Auditing at Educational Institutions

In an era where environmental sustainability has become an imperative, educational institutions are increasingly recognizing their pivotal role in fostering a greener future. The concept of green auditing has emerged as a vital tool for assessing and enhancing the ecological footprint of these institutions. Green auditing, a systematic assessment of an organization's environmental impact and resource consumption, has emerged as a vital instrument for educational institutions to align their operations with ecological sustainability. This detailed note explores the multifaceted relevance of conducting green auditing within educational institutions, emphasizing its significance in mitigating environmental footprint, promoting eco-literacy, and catalyzing positive changes that resonate far beyond campus borders.

Green auditing provides a structured framework to comprehensively assess an institution's Biodiversity, energy usage, water consumption, waste management practices, and overall carbon footprint. By identifying areas of excessive consumption and inefficiency, institutions can strategize targeted measures to minimize resource use, reduce waste generation, and lower their environmental impact. This not only aligns with global Sustainable DevelopmentGoals (SDGs) but also establishes the institution as a responsible steward of the environment. It serves as an educational tool itself, enabling individuals to understand the ecological consequences of their actions and decisions. When students are exposed to the real-world implications of wasteful practices, they are more likely to adopt environmentally friendly behaviors both within and beyond the campus. This cultivates a generation of environmentally aware citizens who are equipped to make informed choices and advocate for sustainable policies in their future endeavors.

Educational institutions often function as influential role models within their communities. By conducting green audits and subsequently implementing sustainable practices, these institutions send a powerful message to students, local businesses, and the general public about the importance of environmental stewardship. When a college or university demonstrates its commitment to sustainability through actions such as energy-efficient infrastructure, waste reduction initiatives, and renewable energy adoption, it encourages others to follow suit. This ripple effect can catalyze broader societal changes and contribute to the normalization of sustainable practices.

Educational institutions are hubs of research and innovation, and green auditing can fuel interdisciplinary studies related to sustainability. Audits provide a wealth of data that can be used to explore innovative solutions to environmental challenges. From developing novel waste management techniques to investigating renewable energy integration, the audit findings can serve as a foundation for students and researchers to devise impactful projects that contribute to a more sustainable future.

Green auditing stands as a pivotal practice for educational institutions aiming to fulfill their role as agents of positive change in the realm of sustainability. By mitigating environmental impact, fostering eco-literacy, inspiring broader community action, enhancing resource efficiency, and contributing to innovation, educational institutions exemplify the transformative potential of green audits. In a world where environmental challenges demand collective efforts, these institutions emerge as beacons of hope, equipping current and future generations with the tools and knowledge needed to navigate the complex landscape of sustainability.

Different Green Auditing Components at Govt. College, Chittur

Palakkad is one of the fourteen districts of Kerala and has no coastal line. The district opens the state to the rest of the country through the Palakkad Gap with a width of 32 to 40 kilometres which has a dominant influence on the climate. It's geographical position, historical background, educational status, tourism hot-spots and above all, the development activities that were carried out are wide and varied. The district is known as the granary of Kerala and its economy is primarily agricultural. The district is also the land of Palmyrahs. As many as eight rivers originate from the Palakkad hills including Bharathapuzha, the longest river in the State. The hilly district has 136257 hectares of reserve forest including Silent Valley. The district which lies at the foot of the Western Ghats has only midland and highland areas. The topography of this district is characterised by high mountain ranges, forests, fertile valleys and rivers.

About the College

A BRIEF HISTORICAL SKETCH

The Chittur College is Second Government College in erstwhile Cochin State, on 11th August, 1947. During initial phase college was hosted by Government Victoria Girls High School in it campus. College was affiliated to University of Madras and offered intermediate level course in Malayalam, Mathematics, Commerce, Accountancy, Logic, Music, and Modern Indian History. At graduation level it offered BA programmes in Philosophy and Economics, Mathematics. Later, in July 1949 it got affiliated to Travancore University after emergence of Travancore-Cochin State. Later, on BA Mathematics complying with regulations of new university was converted to BSc Mathematics.The college was allotted physical space on the banks of Shokanashini River in Chittur-Tattamangalam area. The Campus development started with laying of foundation stone on 18th November 1949 by His Highness Rajapramukh of Cochin.

The campus started taking shape during late forties and early fifties. By 1954 the main building was ready and was probably the largest of the building in the locality. Built with lime mortar as binding material the building still stands all among the modern structures that have come up recently. On 28th June, 1954 this new house of learning was declared open by then Chief Minister of Kerala Shri. Pattom Thanu Pillai.Meantime in 1951-52 B.Com course got introduced and later in 1954 -55 intermediate programme in Science started its initial steps. Chittur College spanned out to become a full-fledged Arts and Science college by 1956-57 with introduction of B.Sc. programmes in Physics, Chemistry, Botany and Zoology. The intermediate courses were also upgraded to Pre-University programmes during the same time and consequently the in 1957-58 graduations programmes were extended to duration of three years. B.A. in Music was also introduced in 1957-58 academic year. On 1st November 1956, State of Kerala dawned into the Indian Union and in the subsequent year the Travancore University was transformed and re-christened as University of Kerala. Thus, Chittur College got affiliated to University of Kerala.

Meantime further infrastructural improved also was carried out. Chittur College was on the only college in Malabar region offering graduation programme in Music, which did attract aspirants from various parts of Kerala. The demand for hostels became a reality on November, 1958, when spacious and well-furnished Men's Hostel was inaugurated by then Governor of Kerala Dr. B Ramakrishna Rao. In March, 1963 the Women's hostel was inaugurated by then Governor of Kerala Shri. V.V Giri.1964 saw another transformation in educational system of Kerala state with Pre-University programmes being replaced by Pre-Degree Programmes. This period also saw emergence of new university in Malabar region. The Chittur College thus got affiliated to the newly formed Calicut University in 1968.

The Seventies decade was a period of great strides for the college, especially in academics. The college was slowly and steadily growing with introduction of several post graduate programme. It all began in 1969-70 with introduction of first post graduate programme in Tamil. This was followed by initiation of M.Com programme in 1971-72. This was Silver Jubilee period of Chittur College, through Celebrations were organized during 1973.

As a Silver Jubilee gift college introduced Graduation Programme in Geography for the very first time in Kerala. Anyone would envy the way Tamil Department's progress in short period, as it was upgraded as Research Centre by University of Calicut during 1976-77. During 1979-80 Post Graduation programmes in Mathematics and Geography got initiated. Post-Graduation in Music and Graduation programme in History started functioning during 1981-82 academic year.

Meantime the infrastructure and facilities were improved as well. In 1994, nearly a decade after new course M.A Philosophy got introduced. Further in 1999 B.Sc. Electronics was initiated. Very recently, in 2012 M.A. in Economics was introduced.Since its, humble beginning in 1947, the college has steadily grown to become one of the finest Arts and Science college in Kerala. It is one of the seven special grade college and has been accredited with 'B+' grade by NAAC in 2009 and secured 'A' grade (CGPA 3.1) in year 2017. Since

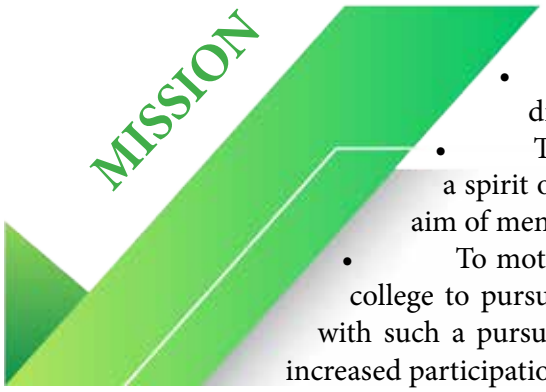
NAAC accreditation in 2017, new academic programmes in BA English, M.Phil in Tamil & Mathematics were initiated recently. The departments of Geography, Mathematics have been upgraded to research departments.

Further, more several new infrastructural developments have been completed and is slowly changing the campus landscape. The college has new academic block, swimming pool, additional building for boys' hostel with better facilities. The college ground is in the phase of improvement and work is progressing at a steady pace. Similarly, improvements in facilities at college girls' hostel is also underway. Above all the Kerala WiFi and LAN connections provide high speed internet connectivity to all departments and students.

MOTTO

The path travelled by Great People is the Right Path

The vision of the college is to provide its students a nurturing environment to the acquisition of knowledge and outlook that will enable them to tread the path trodden by great people.



- To provide a wholesome education in various disciplines
- To train the students to approach knowledge with a spirit of enquiry and questioning, rather than a limited aim of memorizing and rote-learning.
- To motivate youth in the rural-agrarian environs of the college to pursue higher education and ambitious career goals, with such a pursuit resulting in their all round development and increased participation in the larger global economy.

Location of the College

Government College, Chittur is an educational institution located in Chittur-Thattamangalam Municipality, Chittur, Palakkad, Kerala with a land area of 48 Acres (20.17 Hectares) and building area of 10500 sq. meters near Shokanashini River. The Govt. College, Chittur lies between 76°43'6.361" E - 76° 43' 50.038" E Longitude; and 10° 41'

3.018" N - 10° 41' 24.655" N Latitude (Fig. 1). The campus is marked for its greenery and shady trees all around which enhances the teaching - learning ambience. The college is affiliated to the University of Calicut and is recognized as a special-grade college under the Department of Collegiate Education, Government of Kerala.

The college was established on 11th August 1947, by Cherubala Karunakara Menon, ICS, Devan of erstwhile Cochin state. Initially under the University of Madras and got affiliated to Travancore University in 1949. It started functioning in the present 40 acre campus on the bank of Sokanasini river since 1954. The college is well-equipped with all necessary facilities within a nice and spacious campus on the banks of the serene Sokanasini River. Govt. College Chittur is affiliated to the University of Calicut and accredited with a "B" grade certificate by NAAC. The college offers several undergraduate and post graduate courses in arts, science, and commerce faculties. Besides, the college offers doctoral programmes in Tamil Language.

The college provides undergraduate and postgraduate education in science, arts and commerce streams. There are 15 departments: Geography, Botany, Chemistry, Commerce, Economics, Electronics, History, Malayalam, Mathematics, Music, Philosophy, Physics, English, Tamil, and Zoology. The Departments of Tamil, Geography, Philosophy, Music and Mathematics are the research departments under the University of Calicut. It has been accredited by NAAC with an A Grade (CGPA 3.01 out of 4).

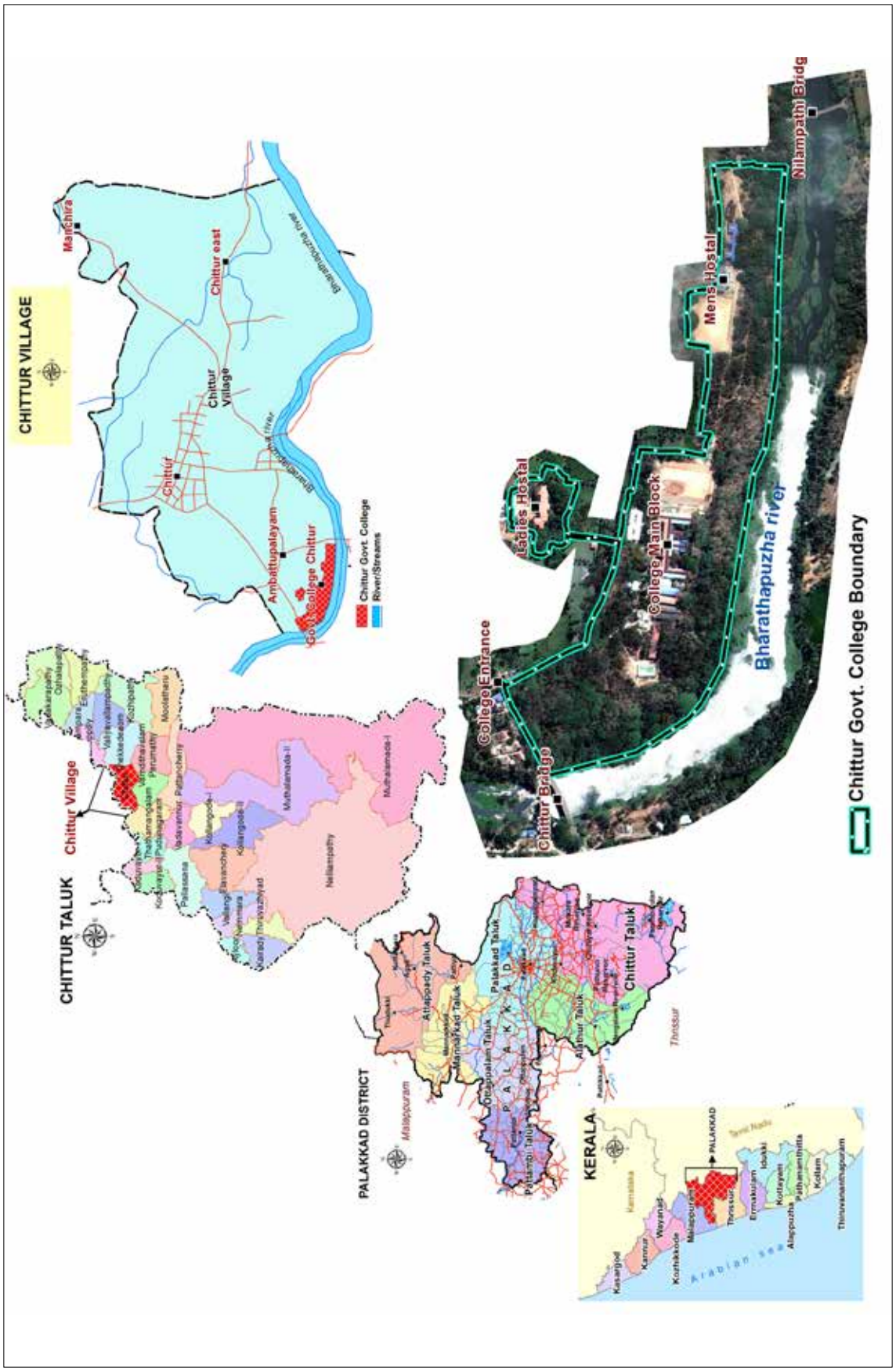


Fig. 1 Location map of Govt.College Chittur

Fig. 2 Google earth image of Govt.College Chittur

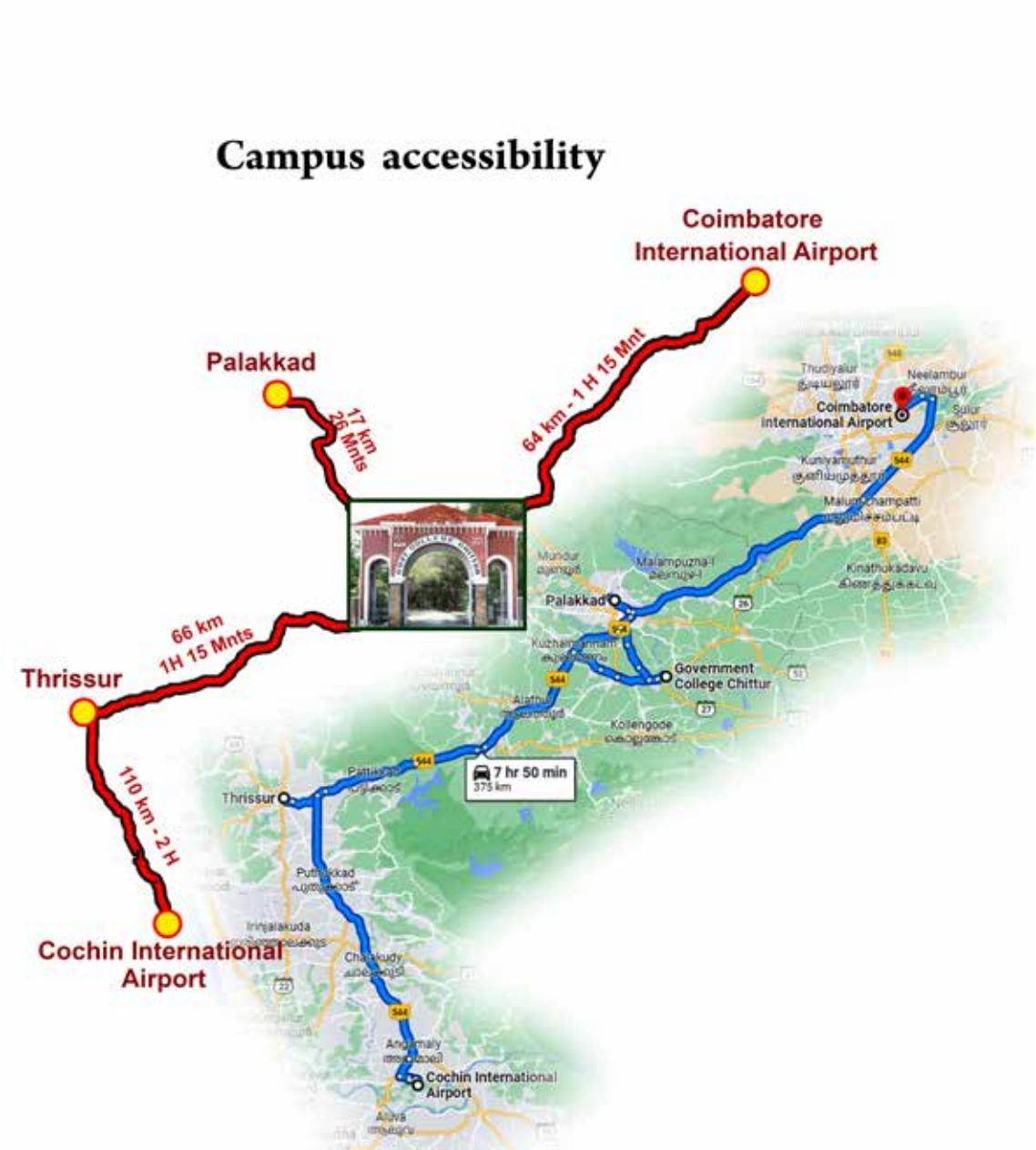


Fig. 3. Accessibility map of Govt. College, Chittur

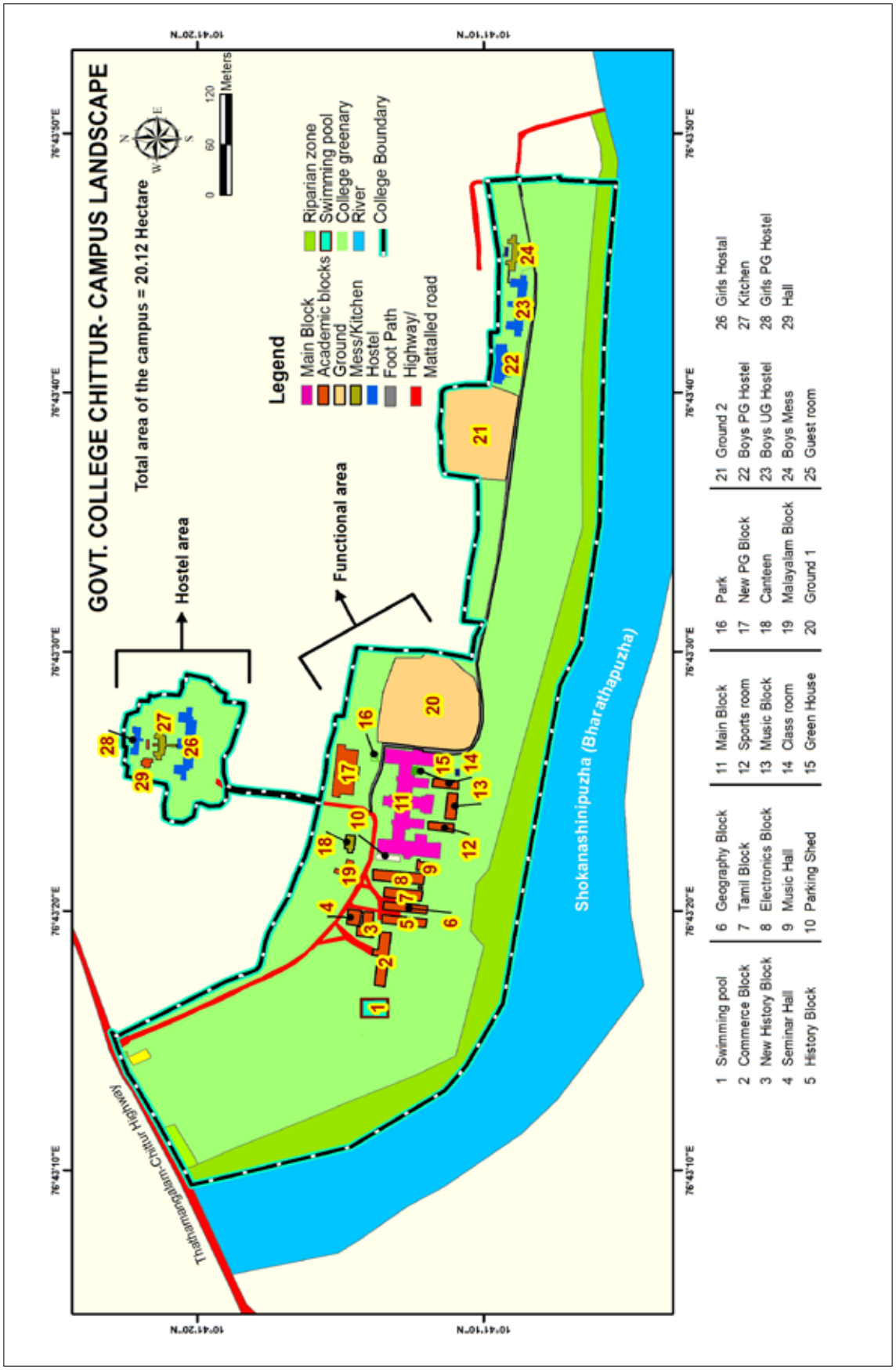


Fig. 4. Layout map showing infrastructure/basic information of Govt. College, Chittur

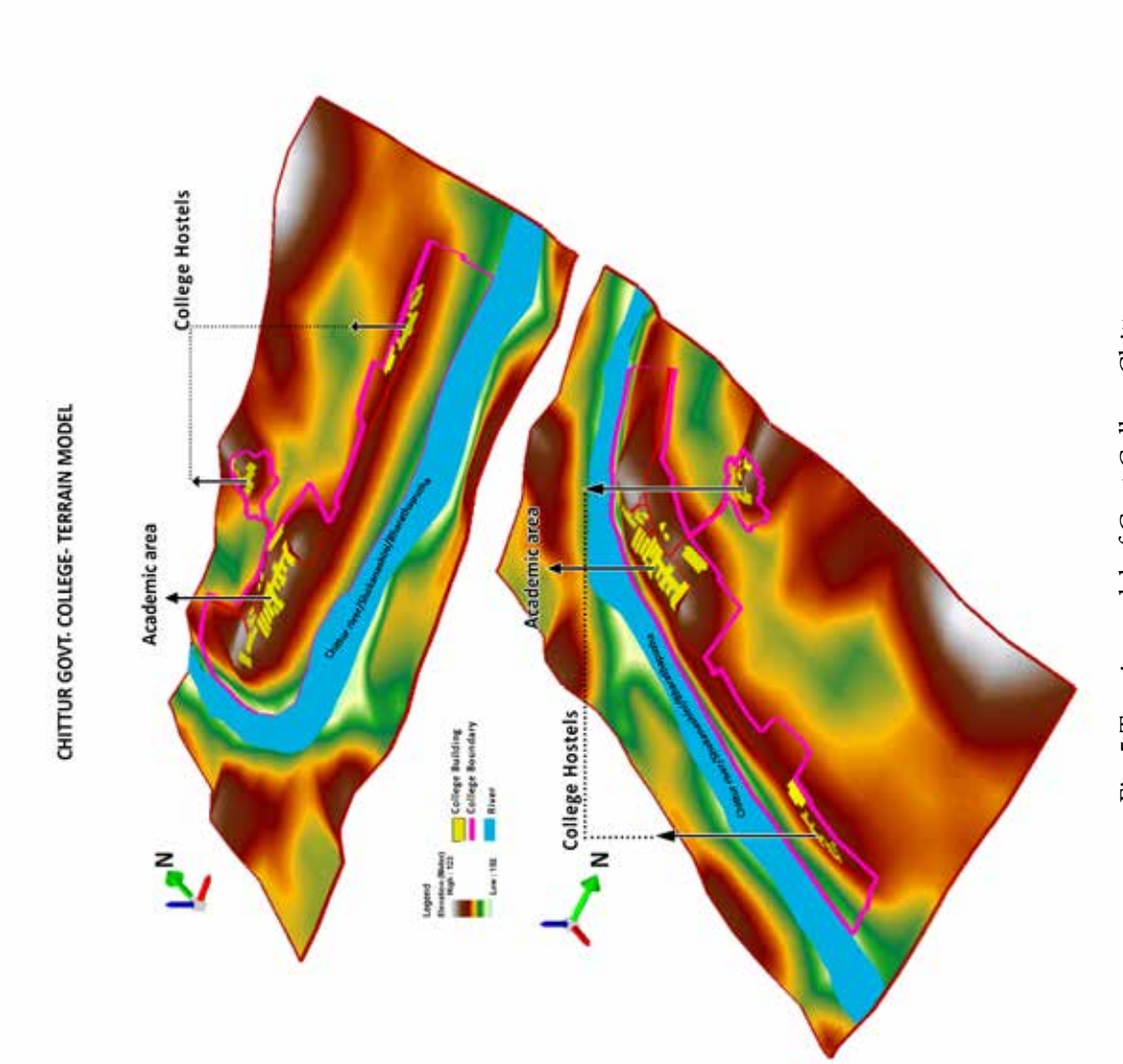


Fig. 5 Terrain model of Govt.College Chittur

Land use pattern of GCC

Table 1& Fig. 6 outlines the land use types and their respective areas of Govt. College, Chittur in hectares and percentages.

Road and Pathways (1.94%): This land use category covers a relatively small area, accounting for only 0.39 hectares out of the total 20.17 hectares. This suggests that the area has limited road and pathway infrastructure.

Building and Other Infrastructures (8.40%): This category encompasses a slightly larger area, with 1.69 hectares dedicated to buildings and various infrastructure. This indicates that there is some level of urban development or built environment within the area.

Green Cover (79.40%): The largest portion of the land, a substantial 16.01 hectares, is devoted to green cover. This includes parks, gardens, forests, and other forms of vegetation. The high percentage of green cover suggests that the area is generally well-preserved and emphasizes environmental sustainability.

Open Area Including Playground (10.26%): Approximately 2.07 hectares are designated as open areas, which may include spaces for recreational activities like playgrounds or simply undeveloped land. This category signifies a balance between area development and open spaces for community use and enjoyment.

Overall, the results indicate that the given area has a strong emphasis on preserving green spaces, with a significant portion of the land dedicated to green cover. The presence of buildings and infrastructure suggests some level of urbanization, while open areas provide opportunities for recreational activities and community use. Additionally, the relatively small percentage of land allocated to road and pathways may indicate limited transportation infrastructure within the area.

Table 1. Land use pattern of GCC

Sl.No.	Land use Type	Area (Hectare)	Area in %
1.	Road and pathways	0.39	1.94
2.	Building and other infrastructures	1.69	8.40
3.	Green cover	16.01	79.40
4.	Open area including play ground	2.07	10.26
	Total	**20.17**	**100**

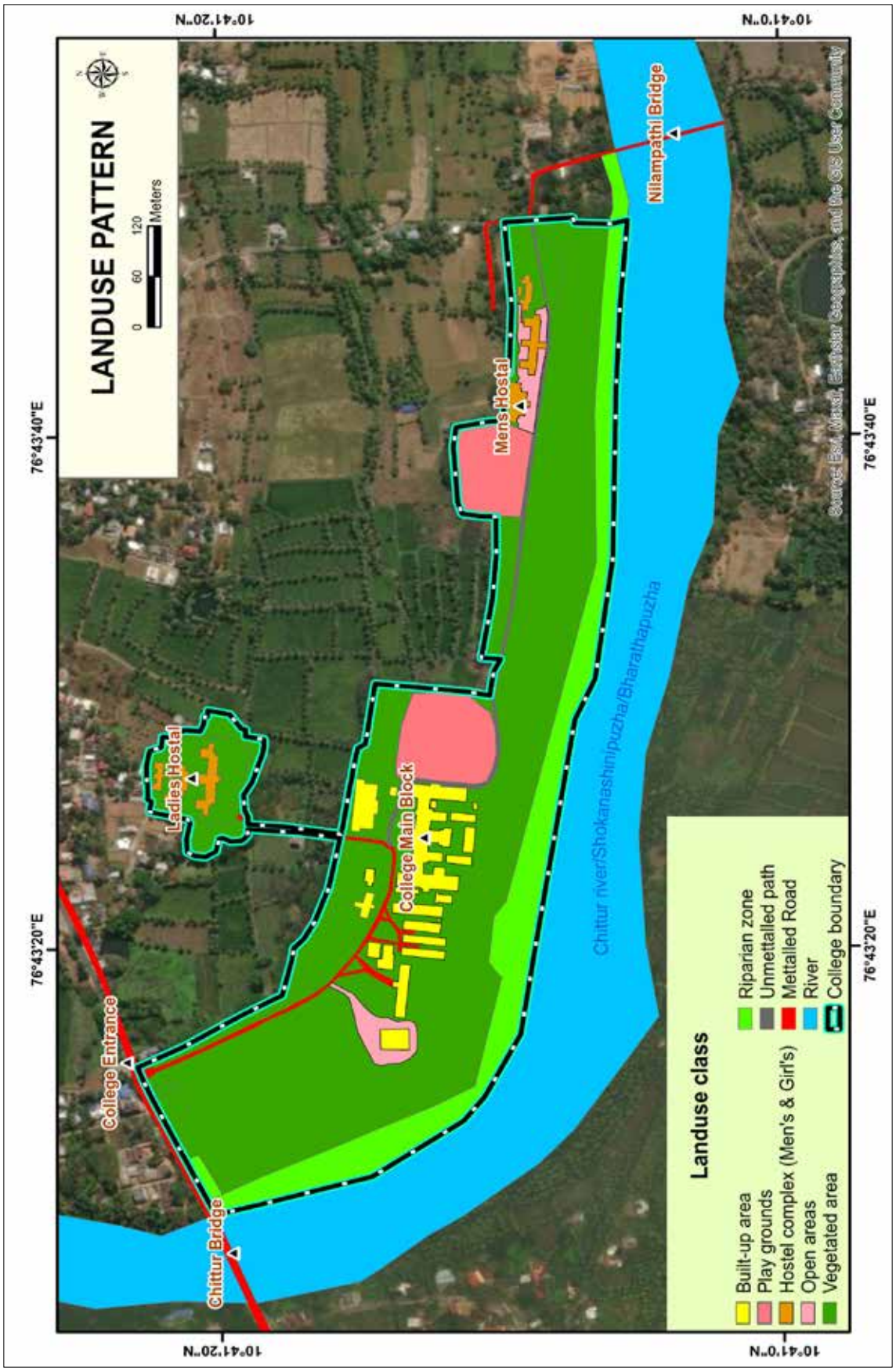


Fig. 6 Map showing the current land use pattern of Govt. College, Chittur

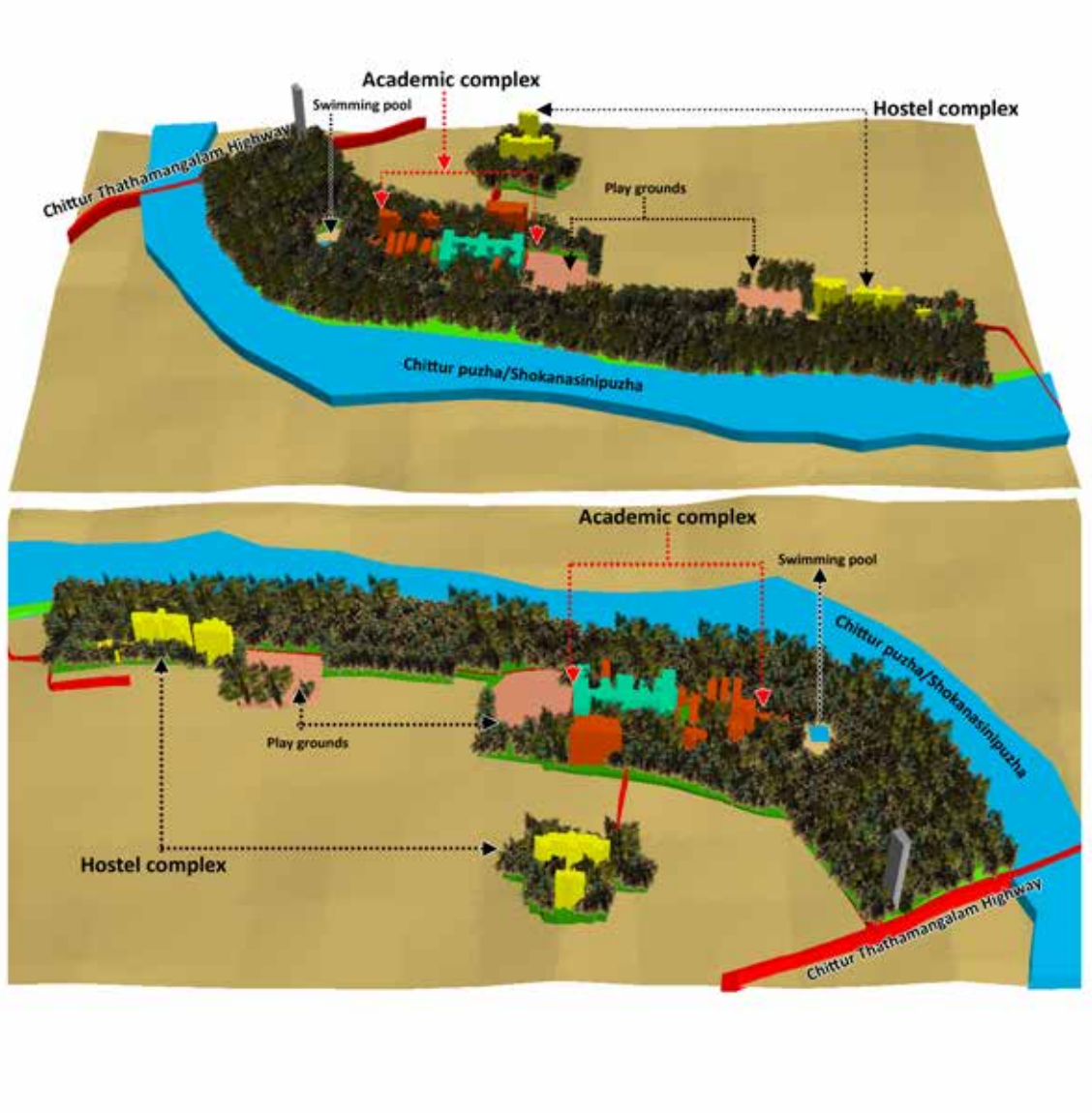


Fig. 7 General landscape of Govt. College, Chittur

ACADEMIC FACILITIES

Laboratories

Botany: The Department offers UG programme in Botany. The department is maintaining a B.Sc laboratory consists of compound and dissection microscopes for practical and other project related work for students. The department also has a research laboratory with modern equipment including Stereo Zoom Microscope, Digital Photospectrometer, UV Chamber, Digital PH pen, waterbath, Sauxlet Apparatus, Laminar Airflow, Calorie Meter, Hot air owen, Digital Camera, Binocular Microscopes, Horizontal Agarose, Gel Electrophoresis, Hot plate owen, monocular microscopes, micro pipette etc.

Chemistry: Department of Chemistry has two well-equipped and well-furnished B.Sc. Laboratory containing TDS meter, pH meter, Spectrophotocalorimeter and electric balance.

Electronics: The department has a well-equipped and furnished laboratory with adequate devices and instruments required for practical classes in the UG level. Further, there are instruments, which are purchased under various research schemes, like Network Analyzer, UV exposure unit, Digital and analog IC tester, Communication trainer kit, Digital signal processing trainer kit, PIC programmer, Universal device programmer, Digital storage oscilloscopes and television demonstration unit etc. are available in the laboratory for facilitating research work.

Physics: Department has two well-equipped and well-furnished UG Laboratory containing Spectrometers, Laser, Ballistic galvanometer.

Zoology: In the subject Zoology also, the college offers only B.Sc. programme. The department maintains a laboratory with various modern equipment including Stereo zoom microscope, PAGE electrophoresis unit, Colorimeter, Oven, Digital camera, UV

spectrophotometer, pH meter, Rotary shaker, Centrifuge, Binocular microscope, Hot Plate oven, DLP Projector, monocular microscope, Micropipette, Trinocular Microscope, Water and soil testing kits, blood test kit, distillation units, and dissection microscope.

Museum: Department of Zoology maintains a Museum of rare specimens, representative types of different group of invertebrates and vertebrates, stuffed birds and animals, specimens of insects, specimens showing different foetal development stages and other biologically significant specimens Department of History maintains a heritage museum highlighting the need for collecting and preserving the antiques and materials which are of historical value. The materials preserved in the Museum are collected, categorized and displayed with the joint efforts made by both the teachers and students of the department.

Computer Laboratory: Three computer labs are functional in the college. One with 25 computers is used for the practical classes of computer science subsidiary class and for the physics and mathematics classes. Another computer lab with sixteen has recently become functional which was implemented as a part of DST FIST award to the college.

ASAP Computer Lab: As the college is a regional centre for the ASAP scheme of the higher education department of Kerala, a computer lab with thirty computers is set up in the college. These systems can be used by the students of the college on working days.
Botanical Garden cum Vegetable Garden: A botanical garden cum Vegetable Garden is maintained by the department of Botany with some rare collections of medicinal plants.
Star Tree Conservatory: A star Tree Conservatory representing the 27birth star trees has setup in front of the main building for the purpose of conserving the endangered trees.

Green house: Department of Botany maintains a Greenhouse for germplasm conservation of Orchids and ferns collected from different parts of the Kerala part of Western Ghats.

Herbarium: For the effective studies on floristic surveys, an excellent collection of preserved plant specimens in the form of herbarium is maintained by the department of Botany.

METHODOLOGY OF GREEN AUDIT

PRE - AUDIT ACTIVITIES

Select and Schedules
Facilities to Audit

Based on

- Selection criteria
- Priorities assigned

Select audit team members

- Confirm their availability
- Assignment audit responsibilities

Contact facility and plan audit

- Discuss audit program
- Obtain background information
- Prepare questionnaire (if necessary)
- Define scope
- Determine applicable requirement
- Note priority topics
- Modify or adopt protocols

ACTIVITIES AT SITE

Identify and understand management control system

- Review background information
- Opening meeting
- Orientation tour of facility
- Review audit plan
- Confirm understanding of internal controls

Assess management control systems

- Identify strengths and weaknesses of internal controls
- Adapt audit plan and resource allocation
- Define testing and verification strategies

Gather audit evidence

- Apply testing and verification strategies
- Collect data
- Ensure protocol steps are completed
- Review all findings and observations
- Ensure that all findings are factual
- Conduct further testing if required

Evaluate audit findings

- Develop complete list of findings
- Assembles working papers and documents
- Integrate and summarize findings
- Prepare report for closing meeting

Report findings to facility

- Present findings at closing meting
- Discuss findings with plant personnel

POST - AUDIT ACTIVITIES

Issues draft report

- Correct closing report
- Determine distribution list
- Distribute draft report
- Allow time for corrections

Issue final report

- Correct draft report
- Distribute final report
- Highlight requirement for action plan
- Determine action plan preparation deadline
- Action plan preparation and implementation
- Based on audit findings in final report

Follow-up on action plan

Source: International Chamber of Commerce- Position paper on Environmental Audit adopted November 29, 1989.

PRE - AUDIT ACTIVITIES

First Online meeting held on 14th July 2023. During the meeting the basic idea of the Green auditing was given by Dr. Vimalkumar CS, Principal Scientific Officer, KSBB. During the meeting the Principal, Govt. College, Chittur and other faculties from various departments were participated.

Preliminary discussion with the officials of Govt. College, Chttur, Palakkad on 20th July 2023

ACTIVITIES AT SITE

Opening meeting

Audit Team with College officials and students

BIODIVERSITY AUDIT

Biodiversity, the variety of life on Earth, is essential for the functioning and stability of ecosystems, providing numerous ecological, economic, and social benefits. However, in recent years, biodiversity loss has become a significant global concern due to human activities, such as habitat destruction, overexploitation of natural resources, pollution, and climate change. To address this issue effectively, there is a growing need to assess and monitor biodiversity through comprehensive evaluations known as biodiversity audits.

Biodiversity assessment involves the systematic collection and analysis of data to quantify and understand the diversity of species, ecosystems, and genetic variability within a given area. It serves as a fundamental tool for identifying and evaluating changes in biodiversity over time, identifying critical habitats and species, and setting conservation priorities. Biodiversity audits, on the other hand, are the specific processes by which organizations, governments, or conservation groups evaluate and measure the status of biodiversity within a defined region, be it a specific ecosystem, protected area, or an entire country.

Flora assessment is a critical component of biodiversity audits, focusing specifically on the plant life within a given area. It involves the systematic inventory and evaluation of plant species, their distribution, abundance, and ecological roles. Flora assessment is crucial for identifying rare, endangered, or endemic plant species. Conservation efforts can then be targeted to protect these species and their habitats, ensuring the preservation of biodiversity. Flora assessment plays a vital role in biodiversity audits as it provides crucial information about the plant life within an ecosystem. By understanding the diversity and distribution of plant species, conservationists and policymakers can make informed decisions to protect and manage ecosystems effectively, contributing to the overall preservation of biodiversity and ecological sustainability.

Objectives

- To assess the vegetation and floral components
- To estimate the abundance of each species, such as rare, common, or dominant, to assess their ecological importance.
- To enumerate the invertebrate fauna (Birds/dragonflies/damselflies and butterflies)
- To document the vertebrate fauna (reptiles, birds and mammals)
- To identify and document the invasive alien species
- To suggest suitable conservation measures

METHODOLOGY

FLORA ASSESSMENT:

Identify Plant Species: Conduct plant surveys to identify and document plant species present on campus. Use field guides, expert botanists, and digital apps for species identification.

Collect Specimens: Collect plant specimens for further identification and verification, if required.

Note Distribution: Record the location of each plant species to create species distribution maps.

Quantify Abundance: Estimate the abundance of each species, such as rare, common, or dominant, to assess their ecological importance.

Quadrat method: This is a simple method for estimating species richness and abundance in a community. It involves randomly placing quadrats (square or rectangular plots) in the study area and recording the number and identity of all species found within each quadrat. The total number of species and the average number of individuals per species can then be used to calculate diversity indices such as the Shannon-Wiener index.

Shannon-Wiener index: This is a diversity index that measures the diversity of a community by taking into account both the number of species and the relative abundance of each species. It is calculated as follows:

$H' = -\Sigma(ni/N)\ln(ni/N)$

where:

- H' is the Shannon-Wiener index
- ni is the number of individuals of species i
- N is the total number of individuals in the community
- ln is the natural logarithm

A higher Shannon-Wiener index indicates a more diverse community.

FLORAL ASSESSMENT







FLORAL ASSESSMENT






Floristic Composition

Vegetation and floristics are the study of the composition, structure, and function of plant communities. It is an important tool for understanding and managing ecosystems. Vegetation and flora analysis can be used to understand how ecosystems function. By understanding the composition and structure of plant communities, we can better understand how they interact with other components of the ecosystem, such as soil, water, and wildlife. It can be used to monitor environmental change. By tracking changes in plant communities over time, we can identify the impacts of human activities, such as climate change, pollution, and deforestation. Besides, it can be used to plan land use by understanding the potential impacts of different land use practices on plant communities, we can make informed decisions about how to use our land in a sustainable way. It is important that, vegetation and flora analysis can be used to conserve biodiversity. By identifying areas with high biodiversity and understanding the factors that are important for their conservation, we can protect these important ecosystems.

QUALITATIVE VEGETATION ANALYSIS

The taxonomic survey of the Study area has been conducted and plants were collected and identified with the help of standard floras (Hooker 1872-1897, Gamble & Fischer 1915-1936) and e-floras like India Biodiversity Portal (www.indiabiodiversity.org), e-flora of India (www.efloraofindia) and Flowers of India (www.flowersofindia.net) and nomenclature validation with IPNI (www.ipni.org) and Plants of the World Online (https://powo.science.kew.org/). Photographs were taken using Nikon Coolpix L330 digital camera.

QUANTITATIVE VEGETATION ASSESSMENT

The quantitative parameters such as frequency, density, abundance, diversity indices were calculated for plant diversity and floristic structure. It is not possible to study the quantitative characters of all the individual plants of a community. So the sampling strategy involves selected plots (Sampling units) study and based on this study a approximate estimate of the species content of the community is made.

Frequency

Frequency refers to the degree of dispersion in terms of percentage occurrence. It is the number of sampling units in percentage which a particular species. Frequency is determined by the formula:-

$$\text{Frequency} = \frac{\text{Total number of sampling units in which the species occur}}{\text{Total number of sampling units studied}} \times 100$$

Or

$$\frac{\text{No. of quadrates in which the species occurred}}{\text{Total number of quadrats studied}} \times 100$$

Density

Density is the ecological strength of a species in a community in relation to a definite unit area or space. Density is determined by the formula:

$$\text{Density} = \frac{\text{Total number of individuals of a species in all the sample plots}}{\text{Total number of sample plots studied}}$$

Or

$$\frac{\text{Total number of individuals of a species}}{\text{Number of quadrats studied}}$$

Abundance

Abundance is the estimated number of individuals of a species per unit area. To find out abundance, random sampling is done by quadrat method at many places and the total number of individuals of a species in all sample plots is calculated. Abundance is determined by the formula:

$$\text{Abundance} = \frac{\text{Total number of individuals of the species in the entire sampling unit}}{\text{Total number of sampling units in which the species has occurred}}$$

Or

$$\frac{\text{Total number of individuals of the species}}{\text{Total number of individuals of the Number of quadrat in which species}}$$

Diversity indices

Diversity indices are a quantitative measure of species diversity in a given community. It provides more information about community composition than simply species richness. Shannon Wiener index is one of the major diversity indices. The Shannon index is an information statistic index, which means it assumes all species are represented in a sample and that they are randomly sampled.

Shannon Wiener index $H' = -\Sigma\, pi \log pi$

pi is the proportion of the total no. of individuals that occur in the species i, i.e. (ni/N). ni is the no. of individuals of a species i and i =1 to K. K is the total no. of individuals of the species; N is the total no. of individuals of all species in the sample.

Importance Value Index

Importance Value is a measure of how dominant a species is in a given forest area. It is a standard tool used by foresters to inventory a forest. Foresters generally do not inventory a forest by counting all the trees, but by locating points in the forest and sampling a specified area around those points. Three kinds of data are collected:

1. Relative frequency, the percent of inventory points occupied by species A as a percent of the occurrence of all species.
2. Relative density, the number of individuals per area as a percent of the number of individuals of all species.
3. Relative basal area. The total basal area of a Species as a percent of the total basal area of all species.
4. Each of these values is expressed as a percent, and ranges from 0 to 100.
5. The Importance Value is the sum of these three measures, and can range from 0 to 300.

$$\text{Basal area} = \frac{(\text{GBH})\ 2}{4\pi}$$

Where, GBH is the girth at breast height

$$\text{Relative basal area} = \frac{\text{Sum of basal area of all individuals of a species in the sample}}{\text{Total basal area of all species in the sample}} \times 100$$

IVI = Relative density + Relative frequency + Relative basal area

RESULTS

QUALITATIVE VEGETATION ANALYSIS

The floristic analysis of study area according to APG IV system revealed the presence of 185 angiosperms belongs to 71 families, 1 gymnosperm and 5 pteridophytes belongs to 3 families.

FLORISTIC COMPONENTS

The synoptic account of study area revealed that there are 185 angiosperms belongs to 71 families and 5 pteridophytes belong to 3 families and 1 gymnosperm. Most of the authors have reported the dominance of family Poaceae in the Western Ghats (Arora 1964, Nayar 1980, 1984, 1996, Karthikeyan 1983, 1996, Parthasarathy 1988, Ahmedullah & Nayar 1986, Nair & Daniel 1986, Sreekumar & Nair 1991, Vajravelu & Vivekananthan 1996, Venu 1998). In contrast to the above observation, the present study recorded the dominance of Fabaceae (20 species) followed by Apocynaceae (12), Poaceae (11), Asteraceae and Rubiaceae (9 species) from the campus (Fig. 8).

The plant species such as *Oldenlandia corymbosa* L. and *Torenia bicolor* Dalz. found as Endemic to the Western Ghats and *Canthium rheedii* DC., *Holarrhena pubescens* Wall. ex G.D. and *Naregamia alata*, on recorded as Endemic to Peninsular India from the College Campus.

Table: 2. List of plants identified form the Chittur Government College Campus.

Sl. No.	Botanical Name	Common Name	Family	Habit	Status
1	*Abrus precatorius* L.	Kunnikuru	Fabaceae	C	
2	*Acalypha indica* L.	Kuppameni/ Kuppamani	Euphorbiaceae	H	
3	*Acampe praemorsa* (Roxb.) Blatt. & McCann	Maravazha / Upputhali	Orchidaceae	E	
4	*Adiantum philippense* L.	Walking maidenhair fern	Pteridaceae	H	
5	*Ailanthus excelsa* Roxb.	Pongiliam	Simaroubaceae	T	
6	*Alangium salviifolium* (L.f.) Wangerin	Ankolam	Cornaceae	T	
7	*Albizia lebbeck* (L.) Benth.	Nenmenivaka	Fabaceae	T	
8	*Alpinia galanga* (L.) Willd.	Chitta-ratta	Zingiberaceae	H	
9	*Alstonia scholaris* (L.) R. Br.	Ezhilamppala	Apocynaceae	T	
10	*Alternanthera philoxeroides* (Mart.) Griseb.	Alligator weed	Amaranthaceae	H	
11	*Alternanthera sessilis* (L.) DC.	Kozhuppa	Amaranthaceae	H	
12	*Alysicarpus vaginalis* (L.) DC.	Nila-orila	Fabaceae	H	
13	*Ananas comosus* (L.) Merr.	Kaithachakka	Bromeliaceae	H	
14	*Andrographis paniculata* (Burm.f.) Wall. ex Nees	Nilamkanjiram/ Nilavepu	Acanthaceae	H	
15	*Annona reticulata* L.	Netted custard apple	Annonaceae	T	
16	*Antidesma montanum* Blume	Putharaval / Thathalamaram	Phyllanthaceae	S	
17	*Arachnothryx leucophylla* (Kunth) Planch.	Panama Rose	Rubiaceae	S	
18	*Aristolochia indica* L.	Garudakodi	Aristolochiaceae	C	
19	*Artocarpus heterophyllus* Lam.	Plavu	Moraceae	T	
20	*Asparagus racemosus* Willd.	Sathavari	Asparagaceae	C	
21	*Axonopus compressus* (Sw.) P.Beauv.	Kaalappullu/ Carpet Grass	Poaceae	H	
22	*Azadirachta indica* A.Juss.	Veppu	Meliaceae	T	
23	*Bambusa bambos* (L.) Voss	Mula	Poaceae	B	
24	*Biophytum sensitivum* (L.) DC.	Mukkutti	Oxalidaceae	H	
25	*Bauhinia purpurea* L.	Mantharam	Fabaceae	T	
26	*Blepharis maderaspatensis* (L.) B.Heyne ex Roth	Creeping Blepharis	Acanthaceae	H	
27	*Bombax ceiba* L.	Elavu	Bombacaceae	T	
28	*Borassus flabellifer* L.	Karimbana	Arecaceae	T	
29	*Bougainvillea spectabilis* Willd.	Great bougainvillea	Nyctaginaceae	S	

30	*Bridelia retusa* (L.) A.Juss.	Mulluvenga	Phyllanthaceae	T	
31	*Brunfelsia americana* L.	Lady of the Night	Solanaceae	S	
32	*Butea monosperma* (Lam.) Kuntze	Flame of the forest / Chamatha	Fabaceae	T	
33	*Caladium bicolor* (Aiton) Vent.	Heart of Jesus	Araceae	H	
34	*Calotropis gigantea* (L.) W.T.Aiton	Erikku	Apocynaceae	S	
35	*Canthium rheedei* DC.	Edalimaram	Rubiaceae	S	Endemic to Peninsular India
36	*Cardiospermum halicacabum* L.	Uzhinja	Sapindaceae	C	
37	*Carica papaya* L.	Papaya	Caricaceae	H	
38	*Cascabela thevetia* (L.) Lippold	Lucky Bean	Apocynaceae	T	
39	*Cassia fistula* L.	Kanikkonna	Fabaceae	T	
40	*Casuarina equisetifolia* L.	Choolamaram	Casuarinaceae	T	
41	*Catharanthus roseus* (L.) G.Don	Shavam Naari	Apocynaceae	H	
42	*Causonis japonica* (Thunb.) Raf.	Sorrel Vine	Vitaceae	C	
43	Ceiba pentandra (L.) Gaertn.	Panjimaram	Malvaceae	T	
44	*Centrosema pubescens* Benth.	Kattupayar	Fabaceae	C	
45	*Chassalia curviflora* (Wall.) Thwaites	Karutha-amalppori	Rubiaceae	S	
46	*Chloris barbata* Sw.	Kodappullu	Poaceae	H	
47	*Chlorophytum comosum* (Thunb.) Jacques	Spider plant	Asparagaceae	H	
48	*Chromolaena odorata* (L.) R.M.King & H.Rob.	Communist-pacha	Asteraceae	S	
49	*Cissampelos pareira* L.	Velvetleaf	Menispermaceae	C	
50	*Clematis zeylanica* (L.) Poir.	Ceylon Clematis	Ranunculaceae	C	
51	*Cleome rutidosperma* DC.	Neelavela	Cleomaceae	H	
52	*Clerodendrum infortunatum* L.	Perivelam	Lamiaceae	S	
53	*Clitoria ternatea* L.	Sangu Pushpam / Butterfly Bean	Leguminosae	C	
54	*Coccinia grandis* (L.) Voigt	Koval	Cucurbitaceae	C	
55	*Codiaeum variegatum* (L.) Rumph. ex A.Juss.	Garden Croton	Euphorbiaceae	S	
56	*Coleus barbatus* (Andrews) Benth. ex G.Don	Panikoorka	Lamiaceae	H	
57	*Combretum indicum* (L.) DeFilipps	Chinese honeysuckle	Combretaceae	C	
58	*Commelina benghalensis* L.	Vazhaplaachi	Commelinaceae	H	
59	*Commelina diffusa* Burm.f.	Creeping dayflower	Commelinaceae	H	
60	*Cordia dichotoma* G.Forst.	Naruvari	Boraginaceae	T	
61	*Couroupita guianensis* Aubl.	Nagalingam	Lecythidaceae	T	
62	*Curculigo orchioides* Gaertn.	Nilappana	Hypoxidaceae	H	

63	*Cyanthillium cinereum* (L.) H.Rob.	Poovamkurunal	Asteraceae	H	
64	*Cycas revoluta* Thunb.	Sago palm	Cycadaceae	T	
65	*Cyperus mindorensis* (Steud.) Huygh	White Kyllinga	Cyperaceae	H	
66	Cyperus sphacelatus Rottb.	Roadside flatsedge	Cyperaceae	H	
67	Dactyloctenium aegyptium (L.) Willd.	Kakkakalan pullu	Poaceae	H	
68	*Delonix regia* (Hook.) Raf.	Gulmohar	Fabaceae	T	
69	*Dendrophthoe falcata* (L.f.) Ettingsh.	Ithilkanni	Loranthaceae	P	
70	*Dioscorea pentaphylla* L.	Kattukizhangu	Dioscoreaceae	C	
71	*Diospyros ebenum* J.Koenig	Ebony wood	Ebenaceae	T	
72	*Drynaria quercifolia* (L.) J.Sm.	Basket fern	Polypodiaceae	E	
73	*Eleusine indica* (L.) Gaertn.	Raahi/ Kattuthina	Poaceae	H	
74	*Emilia sonchifolia* (L.) DC.	Muyalchevian	Asteraceae	H	
75	*Eragrostis unioloides* (Retz.) Nees ex Steud.	Karayampullu	Poaceae	H	
76	*Eucalyptus tereticornis* Sm.	Eucalyptus	Myrtaceae	T	
77	*Euphorbia hirta* L.	Nilappaala	Euphorbiaceae	H	
78	*Evolvulus alsinoides* (L.) L.	Vishnu Kranthi	Convolvulaceae	H	
79	*Ficus hispida* L.f.	Erumanakku/ Parakam/	Moraceae	T	
80	*Ficus racemosa* L.	Aththi	Moraceae	T	
81	*Ficus religiosa* L.	Arayal	Moraceae	T	
82	*Ficus tinctoria* G.Forst.	Humped fig	Moraceae	T	
83	*Fimbristylis quinquangularis* (Vahl) Kunth	Grasslike Fimbry	Cyperaceae	H	
84	*Garcinia gummi-gutta* (L.) Robs.	Kodampuli	Clusiaceae	T	
85	*Gloriosa superba* L.	Menthonni	Liliaceae	C	
86	*Glycosmis pentaphylla* (Retz.) DC.	Panal	Rutaceae	S	
87	*Gomphrena celosioides* Mart.	Bachelor's Button	Amaranthaceae	H	
88	*Grona triflora* (L.) H.Ohashi & K.Ohashi	Creeping Tick Trefoil	Fabaceae	H	
89	*Hellenia speciosa* (J.Koenig) S.R.Dutta	Crepe Ginger	Costaceae	H	
90	*Hemidesmus indicus* (L.) R.Br.	Nannaari/ Naruneendi	Apocynaceae	C	
91	*Hemionitis arifolia* (Burm.f.) T.Moore	Heart Leaf Fern	Pteridaceae	H	
92	*Hibiscus rosa-sinensis* L.	Chembarathi	Malvaceae	S	
93	*Holarrhena pubescens* Wall. ex G.Don	Kudagapala	Apocynaceae	T	Endemic to Peninsular India

94	*Holoptelea integrifolia* Planch.	Njettaval/Aavil	Ulmaceae	T	Native
95	*Ichnocarpus frutescens* (L.) W.T.Aiton	Palvalli	Apocynaceae	C	
96	*Ipomoea carnea* Jacq.	Neyveli katta	Convolvulaceae	S	
97	*Ipomoea obscura* (L.) Ker Gawl.	Thiruthali/ Cherutali	Convolvulaceae	C	
98	*Ixora coccinea* L.	Thechi/ Chethi	Rubiaceae	S	
99	*Jasminum sambac* (L.) Aiton	Mulla	Oleaceae	C	
100	*Jatropha integerrima* Jacq.	Peregrina Jatropha	Euphorbiaceae	S	
101	*Justicia gendarussa* Burm. f.	Karunochchi	Acanthaceae	H	
102	*Kalanchoe blossfeldiana* Poelln.	Christmas Kalanchoe	Crassulaceae	H	
103	*Lagerstroemia speciosa* (L.) Pers.	Poomaruthu/ Manimaruthu	Lythraceae	T	
104	*Laportea interrupta* (L.) Chew	Anachorianam	Urticaceae	H	
105	*Lepisorus nudus* (Hook.) Ching		Polypodiaceae	H	
106	*Leucaena leucocephala* (Lam.) de Wit	Lead Tree	Fabaceae	T	
107	*Leucas zeylanica* (L.) W.T.Aiton	Thumba	Lamiaceae	H	
108	*Ludwigia peruviana* (L.) H.Hara	Peruvian primrose-willow	Onagraceae	S	
109	*Mangifera indica* L.	Mavu	Anacardiaceae	T	
110	*Manilkara zapota* (L.) P.Royen	Sappota	Sapotaceae	T	
111	*Megathyrsus maximus* (Jacq.) B.K.Simon & S.W.L.Jacobs	Guinea grass	Poaceae	H	
112	*Mesosphaerum suaveolens* (L.) Kuntze	Wild Spikenard	Lamiaceae	H	
113	*Microstachys chamaelea* (L.) Müll.Arg.	Kodiyavannakku/ Njettavanakku	Euphorbiaceae	H	
114	*Mikania micrantha* Kunth	Vayara	Asteraceae	C	
115	*Millingtonia hortensis* L. fil.	Katesam	Bignoniaceae	T	
116	*Mimosa diplotricha* C.Wright	Aanathottavadi	Fabaceae	C	
117	*Mimosa pudica* L	Thottavadi	Fabaceae	H	
118	*Mimusops elengi* L.	Elenji	Sapotaceae	T	
119	*Monoon longifolium* (Sonn.) B.Xue & R.M.K.Saunders	Arananmaram	Annonaceae	T	
120	*Morinda citrifolia* L.	Mannapavatta	Rubiaceae	T	
121	*Moringa oleifera* Lam.	Muringai	Moringaceae	T	
122	*Muntingia calabura* L.	Pancharappazham	Muntingiaceae	T	
123	*Murraya koenigii* (L.) Sprengel	Curry Leaf Tree	Rutaceae	T	
124	*Mussaenda erythrophylla* Schumach. & Thonn.	Ashanti blood	Rubiaceae	S	
125	*Naregamia alata* Wight & Arn.	Nilanaragam	Meliaceae	H	Endemic Peninsular India

126	*Naringi crenulata* (Roxb.) D.H. Nicolson	Dadhiphala/ Narinarakam/ Kattunarakam	Rutaceae	T	
127	*Nerium oleander* L.	Scented Oleander	Apocynaceae	S	
128	*Nymphaea rubra* Roxb. ex Andrews	Water Lily	Nymphaeaceae	H	
129	*Oldenlandia corymbosa* L.	Diamond Flower	Rubiaceae	H	Endemic to Southern Western Ghats
130	*Oplismenus compositus* (L.) P.Beauv.	Running mountaingrass	Poaceae	H	
131	*Parthenium hysterophorus* L.	Famine weed	Asteraceae	H	
132	*Passiflora foetida* L.	Poochapazham	Passifloraceae	C	
133	*Peltophorum pterocarpum* (DC.) Backer ex K.Heyne	Yellow Flame Tree	Fabaceae	T	
134	*Phyllanthus emblica* L.	Nelli maram	Phyllanthaceae	T	
135	*Phyllanthus niruri* L.	Keezharenelli	Phyllanthaceae	H	Medicinal
136	*Phyllanthus reticulatus* Poir.	Neeruri, Nirnelli	Phyllanthaceae	S	
137	*Plumbago indica* L.	Scarlett Leadwort	Plumbaginaceae	H	
138	*Plumeria pudica* Jacq.	White Frangipani	Apocynaceae	S	
139	*Polytrias indica* (Houtt.) Veldkamp	Java grass	Poaceae	H	
140	*Pongamia pinnata* (L.) Pierre	Ungu	Fabaceae	T	
141	*Psidium guajava* L.	Pera	Myrtaceae	T	
142	*Pupalia lappacea* (L.) Juss.	Creeping Cock's Comb	Amaranthaceae	H	
143	*Ricinus communis* L.	Aavannakku/ Chittavanakku	Euphorbiaceae	S	
144	*Ruellia prostrata* Poir	Irula	Acanthaceae	H	
145	*Ruellia tuberosa* L.	Meadow Weed	Acanthaceae	H	
146	*Saccharum spontaneum* L.	Kans Grass	Poaceae	H	
147	*Samanea saman* (Jacq.) Merr.	Rain Tree	Fabaceae	S	
148	*Santalum album* L.	Chandanam	Santalaceae	T	
149	*Saraca asoca* (Roxb.) W.J.de Wilde	Asokam	Fabaceae	T	
150	*Scoparia dulcis* L.	Kallurukki	Plantaginaceae	H	
151	*Senegalia pennata* (L.) Maslin	Climbing wattle	Fabaceae	C	
152	*Senna siamea* (Lam.) H.S.Irwin & Barneby	Siamese Cassia	Fabaceae	T	
153	*Sida acuta Burm*.f.	Malamkurunthotti /Malatanni/ Kurunthotti	Malvaceae	H	
154	*Sida rhombifolia* L.	Anakurunthotti	Malvaceae	S	
155	*Simarouba glauca* DC.	Paradise-tree	Simaroubaceae	T	

156	*Solanum torvum* Sw.	Anachunda	Solanaceae	S	
157	*Spermacoce ocymoides* Burm.f.	Tharakeera	Rubiaceae	H	
158	*Spermacoce remota* Lam.	Woodland false buttonweed	Rubiaceae	H	
159	*Sphagneticola trilobata* (L.) Pruski	Yellow Creeping Daisy	Asteraceae	H	
160	*Spondias pinnata* (L.f.) Kurz	Ampazham / Indian Hog Plum	Anacardiaceae	T	
161	*Sporobolus diandrus* (Retz.) P.Beauv.	Indian dropseed	Poaceae	H	
162	*Stachytarpheta jamaicensis* (L.) Vahl	Brazilian Tea	Verbenaceae	S	
163	*Stephanotis volubilis* (L.f.) S.Reuss, Liede & Meve	Madagascar jasmine	Apocynaceae	C	
164	*Stereospermum colais* (Buch.-Ham. ex Dillwyn) Mabb.	Paathiri	Bignoniaceae	T	
165	*Streblus asper* Lour.	Paruvamaram	Moraceae	T	
166	*Strychnos nux-vomica* L.	Kanjiram	Loganiaceae	T	
167	*Swietenia mahagoni* (L.) Jacq.	Mahagony	Meliaceae	T	
168	*Synedrella nodiflora* (L.) Gaertn.	Cinderella Weed	Asteraceae	H	
169	*Syzygium cumini* (L.) Skeels	Indian Blackberry	Myrtaceae	S	
170	*Tabebuia rosea* (Bertol.) DC.	Rosy Trumpet Tree	Bignoniaceae	T	
171	*Tabernaemontana divaricata* (L.) R.Br. ex Roem. & Schult.	Nandiyar-vattom	Apocynaceae	S	
172	*Tagetes erecta* L.	African marigold	Asteraceae	H	
173	*Tectona grandis* L.f.	Thekku	Lamiaceae	T	
174	*Tephrosia purpurea* (L.) Pers.	Kozhuva	Fabaceae	S	
175	*Terminalia arjuna* (Roxb. ex DC.) Wight & Arn.	Neermaruthu	Combretaceae	T	
176	*Terminalia catappa* L.	Badam	Combretaceae	T	
177	*Tinospora cordifolia* (Willd.) Hook.f. & Thomson	Amrthu	Menispermaceae	C	
178	*Torenia bicolor* Dalz.	Kakkapoovu	Scrophulariaceae	H	
179	*Tradescantia spathacea* Sw.	Oyster Plant	Commelinaceae	H	
180	*Tragia involucrata* L.	Valli choriyanam / Kodithoova	Euphorbiaceae	C	
181	*Tridax procumbens* L.	Odiyancheera	Asteraceae	H	
182	*Trigastrotheca pentaphylla* (L.) Thulin	Five Leaved Carpetweed	Molluginaceae	H	
183	*Triumfetta rhomboidea* Jacq.	Ottukayal/ Oorpam	Malvaceae	H	
184	*Urena lobata* L.	Uram	Malvaceae	H	
185	*Vitex negundo* L.	Karinochi	Verbenaceae	S	
186	*Wodyetia bifurcata* A.K.Irvine	Foxtail Palm	Arecaceae	T	
187	*Wrightia tinctoria* (Roxb.) R.Br.	Dandappala	Apocynaceae	T	

188	*Xenostegia tridentata* (L.) D.F.Austin & Staples	Arrow-leaf Morning Glory	Convolvulaceae	C	
189	*Ziziphus jujuba* Mill.	Jujube	Rhamnaceae	T	
190	*Ziziphus mauritiana* Lam.	Indian jujube	Rhamnaceae	T	
191	*Ziziphus oenopolia* (L.) Mill.	Thodalli	Rhamnaceae	S	

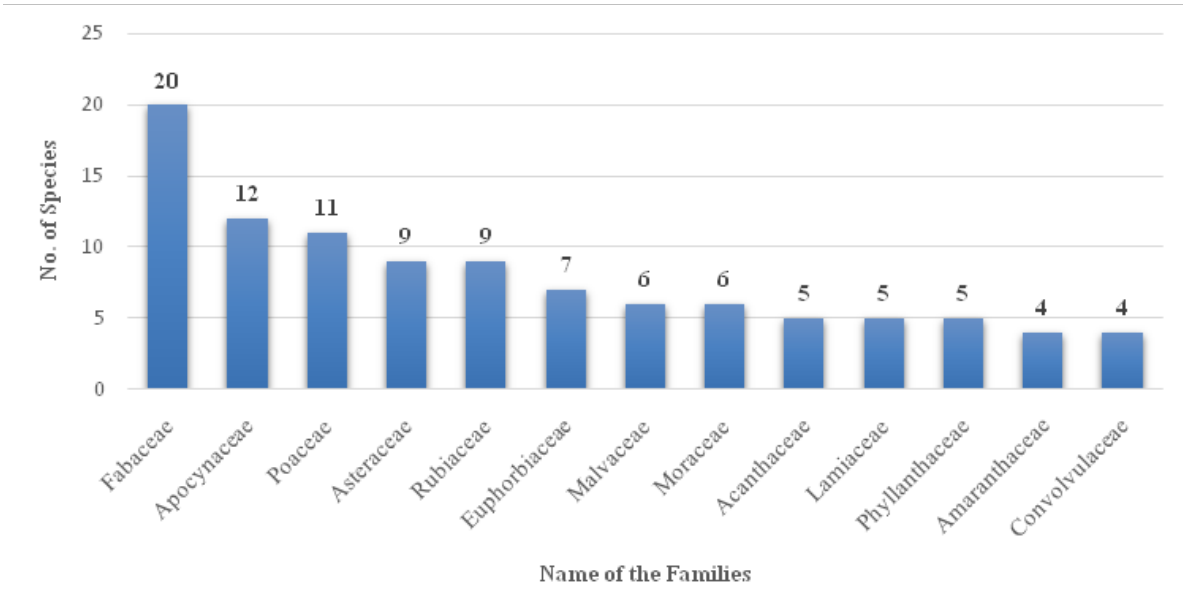


Fig. 8: Dominant Plant families in the Chittur Government College Campus

Vegetation profile and community structure

The vegetation profile of Chittur Government College Campus includes Herbs (70 Nos), Shrubs (30 Nos), Trees (62 Nos), Climbers (25 Nos), Epiphyte (2 Nos), bamboo (1 No.) and parasitic species (1 No.)(Table: 2 & Fig. 2). The number of herb species in the campus has higher, followed by Trees, Shrubs and Climbers.

Table: 3. Vegetation profile of the Chittoor Government College Campus

Sl. No.	Habit	Number of species
1	Herb	70
2	Climber	25
3	Shrub	30
4	Tree	62
5	Epiphyte	2
6	Bamboo	1
7	Parasite	1
Total		**191**

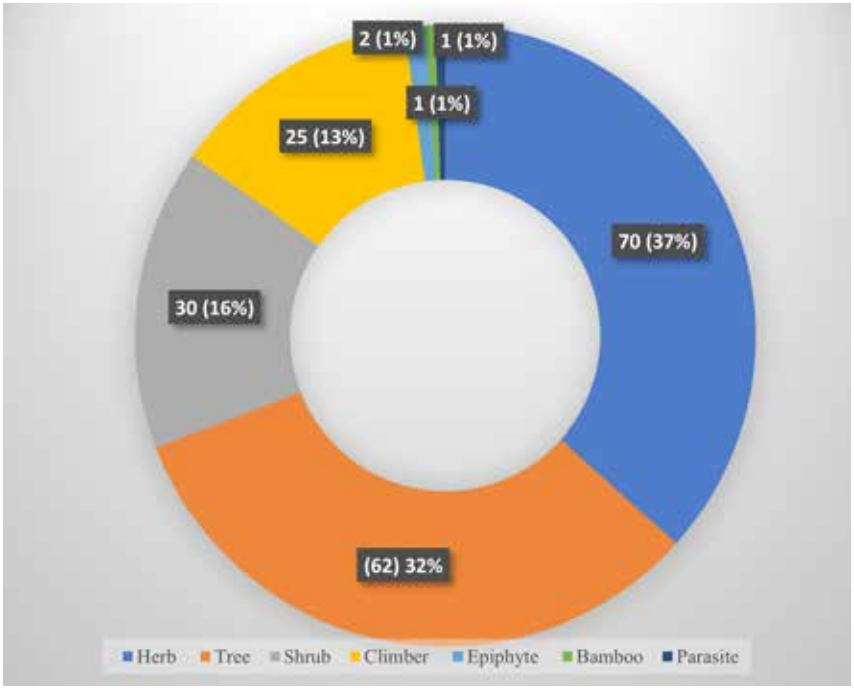


Fig. 9. Vegetation profile of the Chittur Government College Campus

QUANTITATIVE VEGETATION ANALYSIS

Quantitative parameters such as frequency, density, abundance, dominance, IVI and diversity indices (Shannon Wiener index) were calculated for all species from all the quadrats. A total of three 20x20 mts quadrats for trees, twelve 5x5 mts quadrats for shrubs and climbers and twenty 1x1 mtr quadrats for herbs were laid based on the total area of the college campus.

Table 4. Relative frequency, Relative density, Abundance, Relative Basal Area and Importance Value Index (IVI) of Chittur Government College campus vegetation

Sl. No.	Botanical name	Habit	Relative frequency	Relative density	Abun-dance	RBA	IVI
A	**20×20 (Trees)**						
1	*Ailanthus excelsa*	T	3.125	1.408	1.000	0.091	4.624
2	*Alangium salviifolium*	T	6.250	10.000	4.000	3.542	19.792
3	*Albizia lebbeck*	T	6.250	3.750	1.500	27.534	37.534
4	*Alstonia scholaris*	T	3.125	1.250	1.000	0.014	4.389
5	*Azadirachta indica*	T	6.250	2.500	1.000	0.122	8.872
6	*Bombax ceiba*	T	6.250	10.000	4.000	15.186	31.436
7	*Bridelia retusa*	T	6.250	5.000	2.000	0.777	12.027
8	*Canthium rheedi*	T	3.125	1.250	1.000	0.020	4.395
9	*Cassia fistula*	T	3.125	1.250	1.000	0.033	4.408

10	*Delonix regia*	T	6.250	2.500	1.000	0.086	8.836
11	*Eucalyptus tereticornis*	T	3.125	11.250	9.000	42.792	57.167
12	*Ficus hispida*	T	3.125	2.500	2.000	0.060	5.685
13	*Garcinia gummi-gutta*	T	3.125	1.250	1.000	0.086	4.461
14	*Holoptelea integrifolia*	T	3.125	1.250	1.000	0.038	4.413
15	*Morinda citrifolia*	T	6.250	7.500	3.000	6.099	19.849
16	*Murraya koenigii*	T	6.250	3.750	1.500	0.200	10.200
17	*Naringi crenulata*	T	3.125	3.750	3.000	0.717	7.592
18	*Polyalthia longifolia*	T	3.125	1.250	1.000	0.024	4.399
19	*Pongamia pinnata*	T	6.250	7.500	3.000	0.932	14.682
20	*Streblus asper*	T	3.125	6.250	5.000	1.101	10.476
21	*Strychnos nux-vomica*	T	3.125	1.250	1.000	0.165	4.540
22	*Syzygium cumini*	T	3.125	1.250	1.000	0.082	4.457
23	*Ziziphus mouritiana*	T	3.125	1.250	1.000	0.298	4.673
B	**5×5 mts (Shrubs and Climbers)**						
1	*Abrus precatorius*	C	1.449	1.026	6.000		
2	*Alangium salvifolium*	S	1.449	0.171	1.000		
3	*Albizia lebbek*	S	1.449	0.684	4.000		
4	*Albizia saman*	S	1.449	0.171	1.000		
5	*Bombax ceiba*	S	1.449	0.342	2.000		
6	*Canthium rheedi*	S	15.942	17.265	9.182		
7	*Cassia fistula*	S	1.449	0.171	1.000		
8	*Cayratia japonica*	C	8.696	2.051	2.000		
9	*Centrosema pubescens*	C	7.246	3.419	4.000		
10	*Chromolaena odorata*	S	4.348	4.103	8.000		
11	*Cissampelous peraeria*	C	5.797	1.538	2.250		
12	*Clerodendrum infortunatum*	S	8.696	34.359	33.500		
13	*Dioscorea pentaphylla*	C	1.449	0.171	1.000		
14	*Eugenia jambolana*	S	1.449	0.171	1.000		
15	*Ficus hispida*	S	1.449	0.171	1.000		
16	*Glycosmis pentaphylla*	S	11.594	15.214	11.125		

17	*Holoptelia integerifolia*	S	1.449	0.171	1.000		
18	*Marsdenia volubilis*	C	1.449	0.171	1.000		
19	*Mikania micrantha*	C	1.449	0.855	5.000		
20	*Morinda citrifolia*	S	1.449	0.171	1.000		
21	*Murraya koenigii*	S	8.696	7.350	7.167		
22	*Naravelia zeylanica*	C	1.449	1.197	7.000		
23	*Polyalthia longifolia*	S	4.348	5.470	10.667		
24	*Pongamia pinnata*	S	1.449	0.342	2.000		
25	*Streblus asper*	S	1.449	0.171	1.000		
26	*Tinospora cordifolia*	C	1.449	0.342	2.000		
27	*Ziziphus oenoplia*	S	7.246	3.761	4.400		
C	**1×1 mts (Herbs)**						
1	*Blepharis maderaspanensis*	H	3.333	3.987	6.000		
2	*Curculigo orchioides*	H	1.667	0.332	1.000		
3	*Justicia gendarussa*	H	6.667	3.322	2.500		
4	*Oplismenus compositus*	H	23.333	25.249	5.429		
5	*Plumbago indica*	H	11.667	7.309	3.143		
6	*Pupalia lappacea*	H	13.333	6.645	2.500		
7	*Ruellia prostrata*	H	31.667	46.512	7.368		
8	*Synedrella nodiflora*	H	1.667	0.664	2.000		
9	*Tragia involucrata*	H	1.667	3.654	11.000		
10	*Urena Lobata*	H	5.000	2.326	2.333		
			Shannon-Wiener Index H'		**1.2494**		

Relative Frequency

The vegetation analysis showed that, highest relative frequency among the trees shown by *Alangium salviifolium, Albizia lebbeck, Bombax ceiba, Bridelia retusa, Delonix regia, Morinda citrifolia, Murraya koenigii and Pongamia pinnata* (Table 4. & Fig. 10). The relative frequency values for these trees showed an average of 6.25 indicated that most of the trees are distributed uniformly among the campus. Among the shrubs and climbers category, *Canthium rheedi* showed the highest relative frequency (15.94), followed by *Glycosmis pentaphylla* (11.59), *Cayratia japonica,Clerodendrum infortunatum and saplings of Murraya koenigii* (Table 4 & Fig. 11). The relative frequency among the herbs indicated that, *Ruellia prostrata* showed the highest value (31.66), followed by *Oplismenus compositus* (23.33) and *Pupalia lappacea* (13.33) (Table 4 & Fig. 12).

Relative Density

The numerical strength of a species can be inferred from the value of its Relative density and among the trees, it showed highest for *Eucalyptus tereticornis* (11.24), followed by *Bombax ceiba* and *Alangium salviifolium* (10.00) (Table 4 & Fig. 10). Among the shrubs and climbers, *Clerodendrum infortunatum* showed highest relative density (34.35), followed by *Canthium rheedi* (17.26) and *Glycosmis pentaphylla* (15.21) (Table 4 & Fig. 11). Among the herbs category, *Ruellia prostrata* exhibited the maximum value (46.51) followed by *Oplismenus compositus* (25.24) and *Plumbago indica* (7.30) (Table 4 & Fig. 12.).

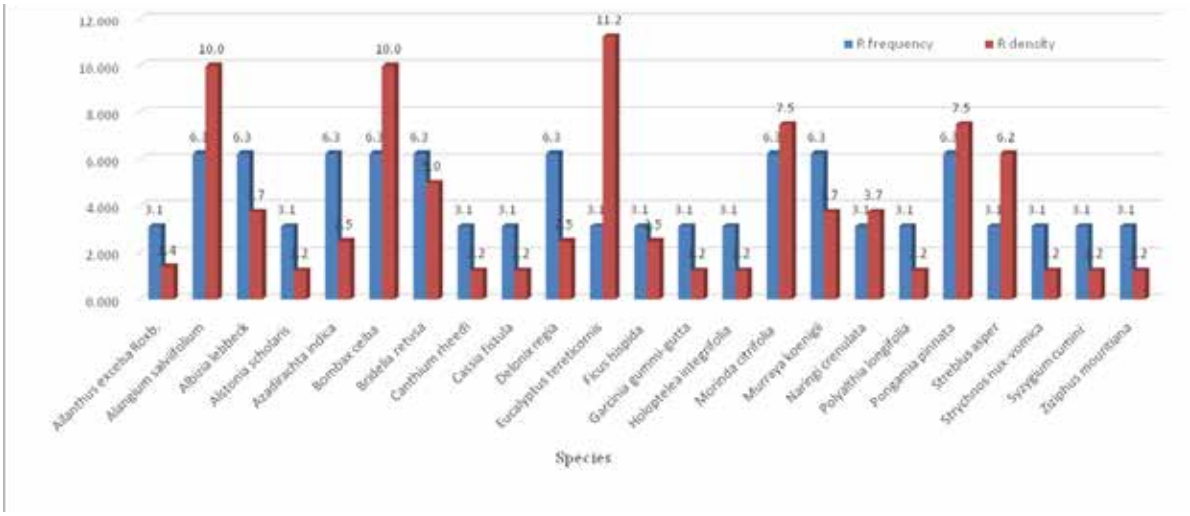


Fig. 10. Relative Frequency and Relative Density of Trees in the Chittur college campus

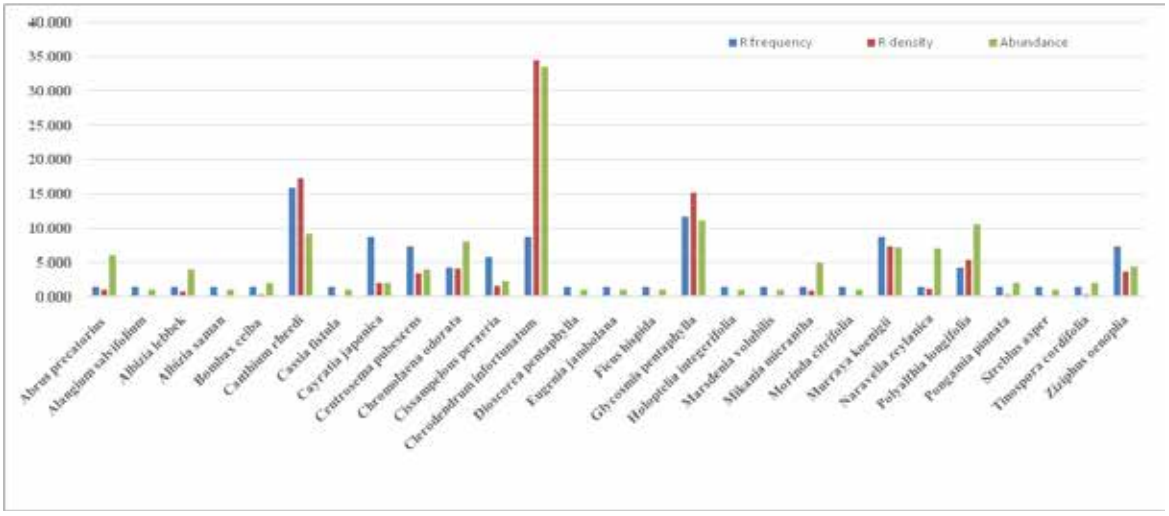


Fig. 11. Relative frequency, Relative density and Abundance of Shrubs and Climbers in the Chittur college campus

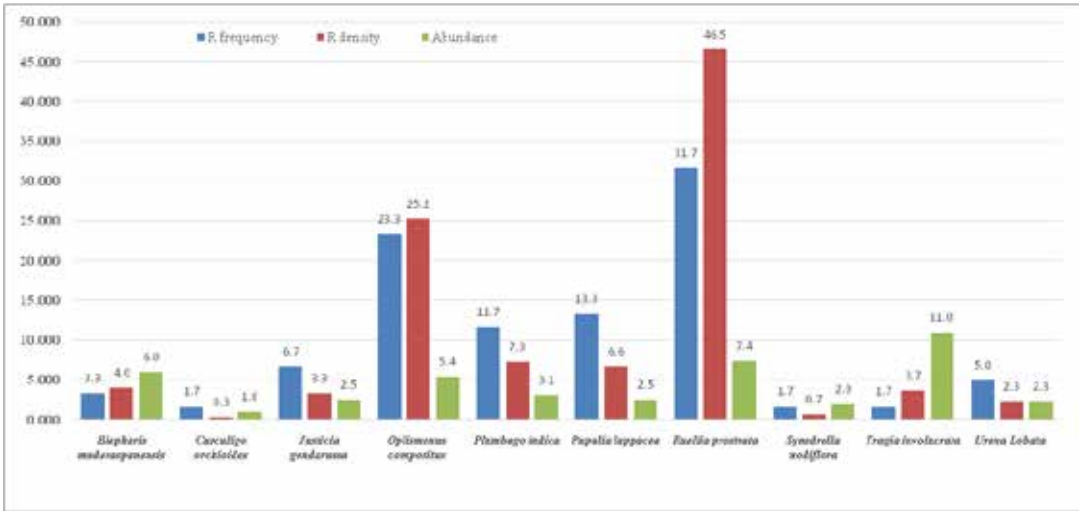


Fig. 12. Relative frequency, Relative density and Abundance of Herbs in the Chittur college campus

Abundance

The abundance of different trees in the campus indicated that, *Eucalyptus tereticornis* showed highest values (9.00) followed by Streblus asper (5.00), *Alangium salviifolium* and *Bombax ceiba* (4.00) (Table 4 & Fig 10). Amongst the shrubs and climbers, *Clerodendrum infortunatum* exhibited the highest value (33.50) followed by *Glycosmis pentaphylla* (11.125) and *Polyalthia longifolia* (5.47) (Table 4 & Fig. 11). Among the herbs, highest abundance shown by *Tragia involucrata* (11.00) followed by *Ruellia prostrata* (7.36) and *Blepharis maderaspanensis* (6.00) (Table 4 & Fig. 12). The abundance of different species can be used to assess the diversity of an ecosystem. A diverse ecosystem will have a high abundance of different species, and the campus shows a moderate abundance.

Relative Basal Area

The relative basal area of trees from the campus indicated that, *Eucalyptus tereticornis* has acquired the highest value (42.79) followed by *Albizia lebbeck* (27.53), and *Bombax ceiba* (15.18) (Table 4 & Fig 13). The relative basal area can be used to identify dominant tree species in a vegetation. Dominant tree species are those that have a high relative basal area and therefore make up a large proportion of the vegetation's biomass.

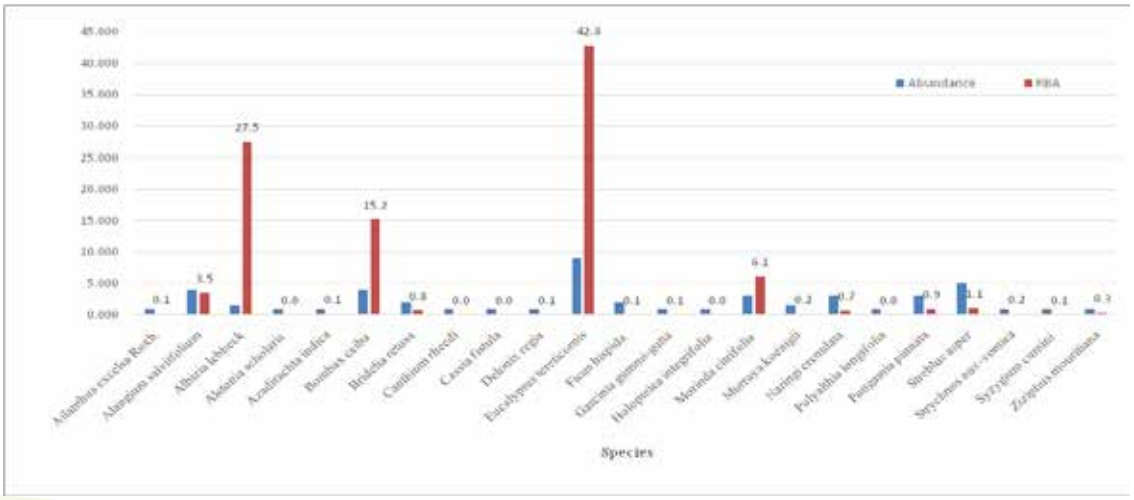


Fig. 13. Abundance and Relative Basal Area of Trees in the Chittur college campus

Importance Value Index (IVI)

The Relative frequency, Relative density and Relative basal area of different species can be compared for the subsequent IVI calculation and comparison with any other species with similar range of IVI values for the assessment of association. The IVI profile indicated that, the *Eucalyptus tereticornis* showed the highest value (57.16), followed by *Albizia lebbeck* (37.53), *Bombax ceiba* (31.43), *Alangium salviifolium* (19.79) and *Morinda citrifolia* (19.79) (Table 4 & Fig. 14).

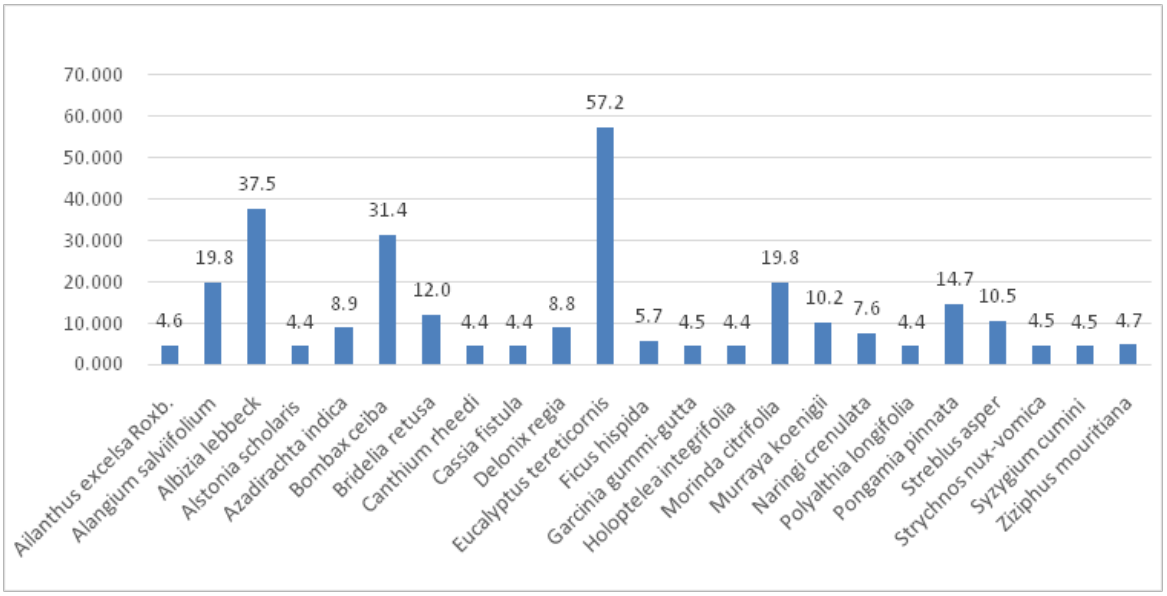


Fig. 14. Importance Value Index of Trees in the Chittur campus

Shannon Wiener Index

The calculated Shannon Wiener Index H' (1.24942) was indicated that, the plant community in the Chittur Government College campus is relatively heterogenous with no dominance of a particular species. It also indicated that, the campus is rich in plant diversity with uniform distribution.


Calotropis gigantea


Sphagneticola trilobata


Ficus hispida


Caladium bicolor


Laportea interrupta


Couroupita guianensis


Clerodendrum infortunatum


Mikania micrantha


Chassalia curviflora


Mimosa pudica


Centrosema pubescens


Ixora coccinea


Gloriosa superba


Leucas aspera


Euphorbia hirta


Biophytum sensitivum


Eragrostis unioloides


Ludwigia perennis


Cleome rutidosperma


Hibiscus rosa-sinensis


Emilia sonchifolia


Torenia bicolor


Hibiscus sps


Passiflora foetida


Grona Triflora


Lagerstroemia speciosa


Tridax procumbens


Carica papaya


Nerium oleander


Albizia saman


Catharanthus roseus


Pedalium murex


Quisqualis indica


Spermacoce latifolia


Naregamia alata


Ipomoea obscura


Melastoma malabathrum


Aristolochia indica


Holarrhena antidysenterica


Annona reticulata


Clerodendrum paniculatum


Morinda tinctoria


Helicteres isora


Santalum album


Lantana camara


Urena lobata

FAUNA ASSESSMENT

Fauna assessment is a crucial aspect of biodiversity audits, focusing on the evaluation of animal life within a specific area. It involves the systematic study of animal species, their populations, habitats, and ecological interactions.The presence, abundance, and diversity of animal species can serve as indicators of the overall health and stability of ecosystems. Fauna assessment helps identify ecological imbalances and potential threats to biodiversity. Fauna assessment helps identify endemic species, which are found exclusively in a particular geographic region. Protecting these unique species is crucial for preserving the distinctiveness of local biodiversity. Assessing fauna allows for the identification of invasive animal species that can negatively impact native ecosystems. Detecting and managing invasive species is essential for preventing biodiversity loss and ecosystem disruption. Fauna assessment is a vital component of biodiversity audits as it offers critical information about animal species and their interactions within ecosystems. This knowledge aids in making informed decisions for conservation and sustainable management, ensuring the long-term survival and well-being of both animal populations and the broader biodiversity of the region.

Methodology

Camera Trapping: Use camera traps to capture images of elusive and nocturnal animals, helping identify different species.

Bird watching: Conduct birdwatching surveys to record various bird species present on campus.

Habitat Specific Surveys: Conduct specific surveys for reptiles, mammals, insects, and other fauna groups, using appropriate methods for each.

Data Analysis:

Identify Endangered or Threatened Species: Cross-reference the recorded species with regional and national red lists to identify endangered or threatened species.

Calculate Species Richness: Calculate the species richness for each habitat type to assess biodiversity hotspots.

Analyze Species Distribution: Use GIS tools to map the distribution of various species across the study area.

Results

The faunal aspects covered in the assessment include selected groups of invertebrates and vertebrates. Butterflies and moths, Dragonflies and Damselflies are the invertebrate groups considered while reptiles and amphibians, birds and mammals under vertebrates.

Butterfly

Different habitats and rich vegetation with varieties of garden and flowering species attract good diversity of butterflies into the campus. In the present assessment, A total of 70 species of butterflies belongs to five families were identified from the campus. Nymphalidae

was the dominant family with 31 species followed by Pieridae (14), Papilionidae (12) and Lycaenidae (10) whereas Hespiridae represented the least number with 3 species (Table 5).

Dragonflies and Damselflies

In the present study, 7 species of dragonflies which belonging Libellulidae family and 1 species of damselflies representing Coenagrionidae family were recorded from the campus.

Birds

In the present study, A total of 135 species of birds belong to 18 orders and 49 families have been recorded from the campus. The order Passeriformes showed the maximum species and family richness (61 species and 25 families). Out of the total species recorded from the campus, four birds are recorded as IUCN Near Threatened category during the study (Table 6).

Mammals, Reptiles and amphibians

The campus habitat harbours many species of Mammals, Reptiles and amphibians. 16 mammals were found belongs to 13 families. From the field assessment and previous records 8 Reptiles snakes belongs to 5 families and 15 amphibians were also noted belongs to 6 family from the campus (Table 7, 8 & 9).

Table: 5. Checklist of Butterflies at Govt. College Chittur.

Sl. No.	Scientific Name	Common Name	Status
	Nymphalidae		
1	*Acraea terpsicore*	Tawny Coster	C
2	*Ariadne ariadne*	Angled castor	NE
3	*Ariadne merionae*	Common castor	NE
4	*Athyma perius*	Common sergeant	NE
5	*Charaxes bharata*	Indian /Common Nawab	Fairly Common
6	*Charaxes psaphon*	Tawny Raja	R
7	*Cirrochroa thais*	Tamil Yeoman	Uncommon
8	*Cupha erymanthis*	Rustic	LC
9	*Cyrestis thyodamas*	Common Map	Fairly common
10	*Danaus chrysippus*	Plain tiger	LC
11	*Danaus genutia*	Striped Tiger, Common tiger	LC, NE
12	*Discophora lepida*	Southern Duffer	Uncommon
13	*Euploea core*	Common Crow	C
14	*Euthalia aconthea*	Common baron	NE
15	*Hypolimnas bolina*	Great Eggfly	Fairly common

16	*Idea malabarica*	Malabar Tree nymph	LC
17	*Junonia atlites*	Grey Pansy	LC
18	*Junonia iphita*	Chocolate Pansy	LC
19	*Junonia lemonias*	Lemon Pansy	LC
20	*Lasippa viraja*	Yellow Jack Sailer	Rare
21	*Lethe drypetis*	Tamil Treebrown	Uncommon.
22	*Mycalesis junonia*	Gladeye Bushbrown	Fairly common.
23	*Neptis hylas*	Common Sailer	C
24	*Orsotriaena medus*	Medus Brown	C
25	*Pantoporia hordonia*	Common Lascar	Fairly common
26	*Parantica aglea*	Glassy tiger	NE
27	*Parthenos sylvia*	Clipper	Uncommon
28	*Tanaecia lepidea*	Grey Count	Uncommon
29	*Tirumala limniace*	Blue tiger	NE
30	*Ypthima baldus*	Common Five - ring	Fairly common.
31	*Zipaetis saitis*	Tamil Catseye	LC
Papilionidae			
32	*Graphium agamemnon*	Tailed Jay	LC
33	*Graphium antiphates*	Five-bar Sword tail	LC
34	*Graphium doson*	Common Jay	LC
35	*Graphium teredon*	Narrow-banded Blue Bottle	C
36	*Pachliopta aristolochiae*	Common Rose	Fairly common
37	*Pachliopta hector*	Crimson rose	LC
38	*Papilio clytia*	Common Mime	Uncommon.
39	*Papilio demoleus*	Lime Butterfly	LC
40	*Papilio dravidarum*	Malabar Raven	LC
41	*Papilio polytes*	Common Mormon	Common
42	*Papilio poymnestor*	Blue Mormon	Uncommon
43	*Troides minos*	Southern birdwing	LC
Lycaenidae			
44	*Amblypodia anita*	Purple Leaf Blue	R
45	*Caleta decidia*	Angled Pierrot & Common Pierrot	LC
46	*Castalius rosimon*	Common Pierrot	C, NE
47	*Curetis thetis*	Indian Sunbeam	Uncommon
48	*Loxura atymnus*	Yamfly	C
49	*Nacaduba beroe*	Opaque Six-Line blue	Rare
50	*Neopithecops zalmora*	Common Quaker	LC
51	*Spindasis lohita*	Long-Banded Silverline	Uncommon
52	*Talicada nyseus*	Red pierrot	C

53	*Zeltus amasa*	Fluffy Tit	LC
Hespiridae			
54	*Borbo cinnara*	Rice swift	NE
55	*Cephrenes acalle*	Plain palm dart	NE
56	*Taractrocera maevius*	Common grass dart	NE
Pieridae			
57	*Appias albina*	Common Albatross	LC
58	*Appias indra*	Plain Puffin	LC
59	*Appias lyncida*	Chocolate Albatross	LC
60	*Belenois aurota*	Pioneer	LC
61	*Catopsilia pomona*	Common emigrant	NE
62	*Cepora nadina*	Lesser Gull	C
63	*Ctopsilia pyranthe*	Mottled emigrant	NE
64	*Eurema andersoni*	One-spot Grass yellow	LC
65	*Eurema blanda*	Three spotted grass yellow	NE
66	*Eurema hecabe*	Common grass yellow	LC
67	*Hebomoia glaucippe*	Great Orange Tip	Uncommon
68	*Leptosia nina*	Psyche	C
69	*Pareronia hippia*	Common wanderer	LC
70	*Prionerissita*	Painted Sawtooth	LC

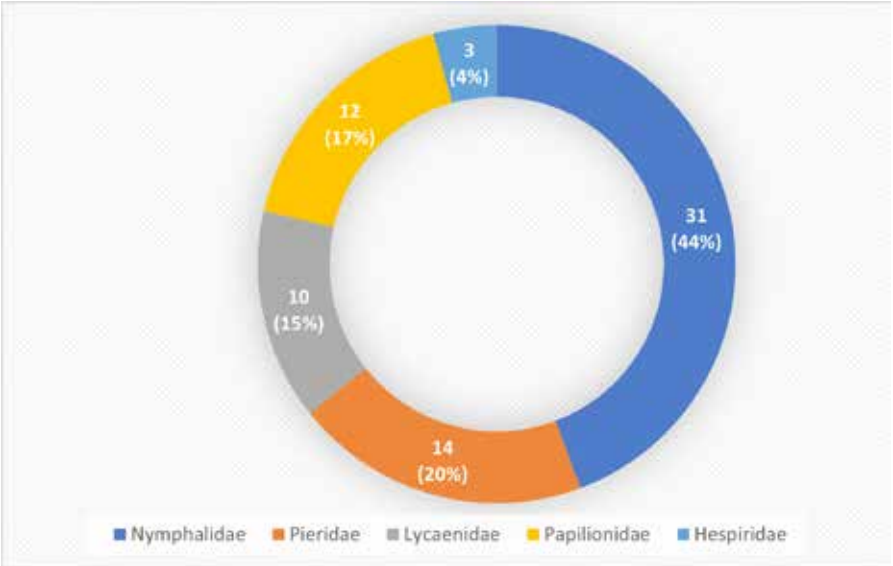


Fig. 15. Family distribution of butterflies in the Chittur College Campus


Castalius rosimon


Castalius rosimon


Talicada nyseus


Talicada nyseus


Troides ninos


Junoniaiphita


Attacus atlas (Atlas moth)


Cephrenes acalle


Leptosia nina


Junonia lemonias


Parantica aglea


Junonia iphita


Hypolimnas bolina


Tirumala limniace


Catopsilia pomona


Danaus chrysippus


Brachythemis contaminata


Aethriamanta brevipennis


Pantala flavescens


Potamarcha congener


Rhyothemis variegata


Ceriagrion coromandelianum

Table: 6. Checklist of Birds at Govt. College Chittur.

Sl. No.	Scientific Name	Common Name	Family	Status
1	*Accipiter badius* J.F. Gmelin, 1788	Shikra	Accipitridae	LC
2	*Acridotheres tristis* Linnaeus, 1766	Common Myna	Sturnidae	LC
3	*Acrocephalus dumetorum* Blyth, 1849	Blyth's Reed Warbler	Acrocephalidae	LC
4	*Acrocephalus stentoreus* Hemprich & Ehrenberg,1833	Clamorous Reed Warbler	Acrocephalidae	LC
5	*Actitis hypoleucos* Linnaeus, 1758	Common Sandpiper	Scolopacidae	LC
6	*Aegithina tiphia* Linnaeus, 1758	Common Iora	Aegithinidae	LC
7	*Aerodramus unicolor* Jerdon, 1864	Indian Swiftlet	Apodidae	LC
8	*Alcedo atthis* Linnaeus, 1758	Common Kingfisher	Alcedinidae	LC
9	*Amandava amandava* Linnaeus, 1758	Red Avadavat	Estrildidae	LC
10	*Amaurornis phoenicurus* Pennant, 1769	White-breasted Waterhen	Rallidae	LC
11	*Anastomus oscitans* Boddaert, 1783	Asian Openbill	Ciconiidae	LC
12	*Anhinga melanogaster* Pennant, 1769	Oriental Darter	Anhingidae	NT
13	*Anthus rufulus* Vieillot, 1818	Paddyfield Pipit	Motacillidae	LC
14	*Ardea cinerea* Linnaeus, 1758	Gray Heron	Ardeidae	LC
15	*Ardea intermedia* Wagler 1829	Intermediate Egret	Ardeidae	LC
16	*Ardea purpurea* Linnaeus, 1766	Purple Heron	Ardeidae	LC
17	*Ardeola grayii* Sykes, 1832	Indian Pond-Heron	Ardeidae	LC
18	*Artamus fuscus* Vieillot, 1817	Ashy Woodswallow	Artamidae	LC
19	*Bubulcus ibis* Linnaeus, 1758	Cattle Egret	Ardeidae	LC
20	*Cacomantis sonneratii* Latham, 1790	Banded Bay Cuckoo	Cuculidae	LC
21	*Centropus sinensis* Stephens, 1815	Greater Coucal	Cuculidae	LC
22	*Ceryle rudis* Linnaeus, 1758	Pied Kingfisher	Alcedinidae	LC
23	*Chalcophaps indica* Linnaeus, 1758	Asian Emerald Dove	Columbidae	LC
24	*Chloropsis aurifrons* Temminck, 1829	Golden-fronted Leafbird	Chloropseidae	LC
25	*Chloropsis jerdoni* Blyth, 1844	Jerdon's Leafbird	Chloropseidae	LC
26	*Ciconia episcopus* Boddaert, 1783	Asian Woolly-necked Stork	Ciconiidae	NT
27	*Cinnyris lotenius* Linnaeus, 1766	Loten's Sunbird	Nectariniidae	LC
28	*Cisticola juncidis* Rafinesque, 1810	Zitting Cisticola	Cisticolidae	LC
29	*Clamator jacobinus* Boddaert, 1783	Pied Cuckoo	Cuculidae	LC
30	*Columba livia* Gmelin, JF, 1789	Rock Pigeon	Columbidae	LC
31	*Copsychus fulicatus* Linnaeus, 1766	Indian Robin	Muscicapidae	LC
32	*Copsychus saularis* Linnaeus, 1758	Oriental Magpie-Robin	Muscicapidae	LC

33	*Coracias benghalensis* Linnaeus, 1758	Indian Roller	Coraciidae	LC
34	*Coracina macei* Horsfield, 1821	Large Cuckooshrike	Campephagidae	LC
35	*Corvus macrorhynchos* Wagler, 1827	Large-billed Crow	Corvidae	LC
36	*Corvus splendens* Vieillot, 1817	House Crow	Corvidae	LC
37	*Cyornis rubeculoides* Vigors, 1831	Blue-throated Flycatcher	Muscicapidae	LC
38	*Cypsiurus balasiensis* J.E. Gray, 1829	Asian Palm-Swift	Apodidae	LC
39	*Dendrocitta vagabunda* Latham, 1790	Rufous Treepie	Corvidae	LC
40	*Dendrocygna javanica* Horsfield, 1821	Lesser Whistling-Duck	Anatidae	LC
41	*Dendronanthus indicus* J.F. Gmelin, 1789	Forest Wagtail	Motacillidae	LC
42	*Dicaeum erythrorhynchos* Latham, 1790	Pale-billed Flowerpecker	Dicaeidae	LC
43	*Dicrurus aeneus* Vieillot, 1817	Bronzed Drongo	Dicruridae	LC
44	*Dicrurus hottentottus* Linnaeus, 1766	Hair-crested Drongo	Dicruridae	LC
45	*Dicrurus leucophaeus* Vieillot, 1817	Ashy Drongo	Dicruridae	LC
46	*Dicrurus macrocercus* Vieillot, 1817	Black Drongo	Dicruridae	LC
47	*Dicrurus paradiseus* Linnaeus, 1766	Greater Racket-tailed Drongo	Dicruridae	LC
48	*Dinopium benghalense* Linnaeus, 1758	Black-rumped Flameback	Picidae	LC
49	*Egretta garzetta* Linnaeus, 1766	Little Egret	Ardeidae	LC
50	*Eudynamys scolopaceus* Linnaeus, 1766	Asian Koel	Cuculidae	LC
51	*Ficedula ruficauda* Swainson, 1838	Rusty-tailed Flycatcher	Muscicapidae	LC
52	*Fulica atra* Linnaeus, 1758	Eurasian Coot	Rallidae	LC
53	*Gallinago gallinago* Linnaeus, 1758	Common Snipe	Scolopacidae	LC
54	*Gallinula chloropus* Linnaeus, 1758	Eurasian Moorhen	Rallidae	LC
55	*Galloperdix spadicea* Gmelin, JF, 1789	Red Spurfowl	Phasianidae	LC
56	*Geokichla citrina* Latham, 1790	Orange-headed Thrush	Turdidae	LC
57	*Halcyon capensis* Linnaeus, 1758	Stork-billed Kingfisher	Alcedinidae	LC
58	*Halcyon smyrnensis* Linnaeus, 1758	White-throated Kingfisher	Alcedinidae	LC
59	*Haliastur indus* Boddaert, 1783	Brahminy Kite	Accipitridae	LC
60	*Hieraaetus pennatus* J.F. Gmelin, 1788	Booted Eagle	Accipitridae	LC
61	*Hierococcyx varius* Vahl, 1797	Common Hawk-Cuckoo	Cuculidae	LC
62	*Hirundo rustica* Linnaeus, 1758	Barn Swallow	Hirundinidae	LC
63	*Hydrophasianus chirurgus* Scopoli, 1786	Pheasant-tailed Jacana	Jacanidae	LC
64	*Hypothymis azurea* Boddaert, 1783	Black-naped Monarch	Monarchidae	LC

65	*Ixobrychus cinnamomeus* J.F. Gmelin, 1789	Cinnamon Bittern	Ardeidae	LC
66	*Ixobrychus flavicollis* Latham, 1790	Black Bittern	Ardeidae	LC
67	*Ketupa zeylonensis* J.F. Gmelin, 1788	Brown Fish-Owl	Strigidae	LC
68	*Lalage melanoptera* Rüppell, 1839	Black-headed Cuckooshrike	Campephagidae	LC
69	*Lanius cristatus* Linnaeus, 1758	Brown Shrike	Laniidae	LC
70	*Leptocoma zeylonica* Linnaeus, 1766	Purple-rumped Sunbird	Nectariniidae	LC
71	*Lonchura malacca* Linnaeus, 1758	Black-headed Munia	Estrildidae	LC
72	*Lonchura striata* Linnaeus, 1758	White-rumped Munia	Estrildidae	LC
73	*Megalaima haemacephala*	Coppersmith Barbet	Megalaimidae	LC
74	*Megalaima viridis* Boddaert, 1783	White-cheeked Barbet	Megalaimidae	LC
75	*Merops orientalis* Latham, 1801	Asian Green Bee-eater	Meropidae	LC
76	*Merops philippinus* Jardine & Selby, 1828	Blue-tailed Bee-eater	Meropidae	LC
77	*Metopidius indicus* Latham, 1790	Bronze-winged Jacana	Jacanidae	LC
78	*Microcarbo niger* Vieillot, 1817	Little Cormorant	Phalacrocoracidae	LC
79	*Milvus migrans* Boddaert, 1783	Black Kite	Accipitridae	LC
80	*Mirafra affinis* Blyth, 1845	Jerdon's Bushlark	Alaudidae	LC
81	*Motacilla cinerea* Tunstall, 1771	Gray Wagtail	Motacillidae	LC
82	*Motacilla maderaspatensis* J.F. Gmelin, 1789	White-browed Wagtail	Motacillidae	LC
83	*Muscicapa dauurica* Raffles, 1822	Asian Brown Flycatcher	Muscicapidae	LC
84	*Muscicapa muttui* E.L. Layard, 1854	Brown-breasted Flycatcher	Muscicapidae	LC
85	*Mycteria leucocephala* Pennant, 1769	Painted Stork	Ciconiidae	NT
86	*Nectarinia asiatica* Latham, 1790	Purple Sunbird	Nectariniidae	LC
87	*Nycticorax nycticorax* Linnaeus, 1758	Black-crowned Night-Heron	Ardeidae	LC
88	*Nyctyornis athertoni* Jardine & Selby, 1828	Blue-bearded Bee-eater	Meropidae	LC
89	*Ocyceros birostris* Scopoli, 1786	Indian Gray Hornbill	Bucerotidae	LC
90	*Oriolus oriolus* Sykes, 1832	Eurasian Golden Oriole	Oriolidae	LC
91	*Oriolus xanthornus* Linnaeus, 1758	Black-hooded Oriole	Oriolidae	LC
92	*Orthotomus sutorius* Pennant, 1769	Common Tailorbird	Cisticolidae	LC
93	*Ortygornis pondicerianus* Gmelin, JF, 1789	Grey Francolin	Phasianidae	LC
94	*Pastor roseus* Linnaeus, 1758	Rosy Starling	Sturnidae	LC
95	*Pavo cristatus* Linnaeus, 1758	Indian Peafowl	Phasianidae	LC
96	*Perdicula asiatica* Latham, 1790	Jungle Bush-Quail	Phasianidae	LC

97	*Pericrocotus cinnamomeus* Linnaeus, 1766	Small Minivet	Campephagidae	LC
98	*Pericrocotus flammeus* J.R. Forster, 1781	Orange Minivet	Campephagidae	LC
99	*Pernis ptilorhynchus* Temminck, 1821	Oriental Honey-buzzard	Accipitridae	LC
100	*Phaenicophaeus viridirostris* Jerdon, 1840	Blue-faced Malkoha	Cuculidae	LC
101	*Phalacrocorax carbo* Linnaeus, 1758	Great Cormorant	Phalacrocoracidae	LC
102	*Phalacrocorax fuscicollis* Stephens, 1826	Indian Cormorant	Phalacrocoracidae	LC
103	*Phylloscopus nitidus* Blyth, 1843	Green Warbler	Phylloscopidae	LC
104	*Phylloscopus trochiloides*	Greenish Warbler	Phylloscopidae	LC
105	*Picus xanthopygaeus* J.E. & G.R. Gray, 1846	Streak-throated Woodpecker	Picidae	LC
106	*Pitta brachyura* Linnaeus, 1766	Indian Pitta	Pittidae	LC
107	*Prinia inornata* Sykes, 1832	Plain Prinia	Cisticolidae	LC
108	*Prinia socialis* Sykes, 1832	Ashy Prinia	Cisticolidae	LC
109	*Psittacula cyanocephala* Linnaeus, 1766	Plum-headed Parakeet	Psittaculidae	LC
110	*Psittacula krameri* Scopoli, 1769	Rose-ringed Parakeet	Psittaculidae	LC
111	*Pycnonotus cafer* Linnaeus, 1758	Red-vented Bulbul	Pycnonotidae	LC
112	*Pycnonotus jocosus* Linnaeus, 1758	Red-whiskered Bulbul	Pycnonotidae	LC
113	*Pycnonotus luteolus* Lesson, 1841	White-browed Bulbul	Pycnonotidae	LC
114	*Spilornis cheela* Latham, 1790	Crested Serpent-Eagle	Accipitridae	LC
115	*Streptopelia chinensis* Scopoli, 1786	Spotted Dove	Columbidae	LC
116	*Strix ocellata* Lesson, 1839	Mottled Wood-Owl	Strigidae	LC
117	*Sturnia blythii*	Malabar Starling	Sturnidae	LC
118	*Sturnia malabarica* J.F. Gmelin, 1789	Chestnut-tailed Starling	Sturnidae	LC
119	*Sturnia pagodarum* J.F. Gmelin, 1789	Brahminy Starling	Sturnidae	LC
120	*Surniculus dicruroides* Horsfield 1821	Fork-tailed Drongo-Cuckoo	Cuculidae	LC
121	*Tachybaptus ruficollis* Pallas, 1764	Little Grebe	Podicipedidae	LC
122	*Tephrodornis pondicerianus* J.F. Gmelin, 1789	Common Woodshrike	Vangidae	LC
123	*Tephrodornis* sylvicola Temminck, 1824	Malabar Woodshrike	Vangidae	LC
124	*Terpsiphone paradisi* Linnaeus, 1758	Asian Paradise - Flycatcher	Monarchidae	LC
125	*Threskiornis melanocephalus* Latham, 1790	Black-headed ibis	Threskiornithidae	NT
126	*Treron affinis* J.F. Gmelin, 1789	Gray-fronted Green-Pigeon	Columbidae	LC
127	*Treron phoenicopterus* Frivaldszky, 1838	Yellow-footed Green-Pigeon	Columbidae	LC
128	*Tringa glareola* Linnaeus, 1758	Wood Sandpiper	Scolopacidae	LC

129	*Tringa nebularia* Gunnerus, 1767	Common Greenshank	Scolopacidae	LC
130	*Tringa ochropus* Linnaeus, 1758	Green Sandpiper	Scolopacidae	LC
131	*Turdus simillimus* Jerdon, 1839	Indian Blackbird	Turdidae	LC
132	*Tyto alba* Scopoli, 1769	Barn Owl	Tytonidae	LC
133	*Vanellus indicus* Boddaert, 1783	Red-wattled Lapwing	Charadriidae	LC
134	*Vanellus malabaricus* Boddaert, 1783	Yellow-wattled Lapwing	Charadriidae	LC
135	*Yungipicus nanus* J.F. Gmelin, 1788	Brown-capped Pygmy Woodpecker	Picidae	LC

Table: 7. Checklist of Mammals at Govt. College Chittur.

Sl. No.	Scientific Name	Common Name	Family
1	*Bandicota indica* (Bechstein)	Large Bandicoot Rat	Muridae
2	*Canis familiaris* L.	Dog	Canidae
3	*Cynopterus sphinx* (Vahl, 1797)	Greater short-nosed fruit bat	Pteropodidae
4	*Felis catus* L.	Domestic cat	Felidae
5	*Felis chaus* Guldenstaedt	Jungle cat	Felidae
6	*Funambulus palmarum* (L.)	Three striped palm squirrel	Sciuridae
7	*Herpestes edwardsii* Geoffroy	Common mangoose	Herpestidae
8	*Hystrix indica* Kerr, 1792	Indian Porcupine	Hystricidae
9	*Kerivoula picta* (Pallas)	Painted bat	Vespertilionidae
10	*Lapus nigricolis* F. cuvier	Indian hare	Lagomorpha, Leporidae
11	*Macaca radiata* (Geoffroy)	Bonnet macaque	Cercopithecidae
12	*Paradoxurus hermaphroditus* (Pallas, 1777)	Asian Palm Civet	Viverridae
13	*Pteropus giganteus* (Temminck, 1825)	Indian flying fox	Viverridae
14	*Rattus rattus* (L.)	Common House Rat	Muridae
15	*Suncus murinus* (L.)	House shrew, Grey muk shrew	Soricidae
16	*Sus scrofa* L.	Indian wild boar	Suidae

Table: 8. Checklist of Reptiles snakes at Govt. College Chittur.

Sl. No.	Scientific Name	Common Name	Family	Venomosity	Status
1.	*Ahaetulla nasuta* (Lacépède, 1789)	Green Vine snake	Colubridae	Harmless	LC
2.	*Calliophis melanurus Shaw,* 1802	Slender Coral snake	Elapidae	Venomous	NE

3.	*Daboia russelii* Shaw & Nodder, 1797	Russels viper	Viperidae	Venomous	NE
4.	*Eryx conicus* Schneider, 1801	Common and boa	Boidae	Harmless	NT
5.	*Fowlea piscator* Schneider, 1799	Checkered keelback	Colubridae	Harmless	NE
6.	*Lycodon aulicus* (Linnaeus, 1758)	Common Wolf Snake	Colubridae	Harmless	NE
7.	*Ptyas mucosa* Linnaeus, 1758	Indian rat snake	Colubridae	Harmless	LC
8.	*Python molurus* Linnaeus, 1758	Indian rock python	Pythonidae	Harmless	NT

Table: 9. Checklist of Amphibians at Govt. College Chittur.

Sl. No.	Scientific Name	Common Name	Family	Status
1.	*Duttaphrynus* melanostictus (Schneider 1799)	Common Indian ToadA	Bufonidae	LC
2.	*Duttaphrynus* scaber (Schneider, 1799)	Ferguson's Toad	Bufonidae	LC
3.	*Euphlyctis* cyanophlyctis (Schneider, 1799)	Skittering frog	Dicroglossidae	LC
4.	*Fejervarya* species		Dicroglossidae	LC
5.	*Hoplobatrachus tigerinus* (Daudin, 1803)	Indian Bull frog	Dicroglossidae	LC
6.	*Hylarana aurantiaca* (Boulenger, 1904)	Golden frog	Ranidae	VU
7.	*Hylarana malabarica* (Tschudi, 1838)	Fungoid frog	Ranidae	LC
8.	*Kaloula taprobanica* (Parker, 1934)	Sri Lankan Kaloula	Microhylidae	LC
9.	*Microhyla ornata* (Dumeril and Bibron, 1841)	Ornate Nar-row-mouthed frog	Microhylidae	LC
10.	*Microhyla* rubra (Jerdon, 1854)	Red Narrow -mouthed frog	Microhylidae	LC
11.	*Polypedates* maculatus (Gray, 1834)	Chunam frog	Rhacophoridae	LC
12.	*Pseudophilautus* kani (Biju and Bossuyt, 2009)	Kani Bush Frog	Rhacophoridae	LC
13.	*Sphaerotheca* breviceps (Schneider, 1799)	Indian Burrowing frog	Dicroglossidae	LC
14.	*Uperodon* variegatus (Stoliczka, 1872)	Variegated Rama-nella	Microhylidae	LC
15.	*Uraeotyphlus* menoni Annandale, 1913	Menon's Caecilian	Ichthyophidae	DD

The Kunming-Montreal Global Biodiversity Framework (GBF)

1. Reducing threats to biodiversity

TARGET 1: Plan and Manage all Areas To Reduce Biodiversity Loss
TARGET 2: Restore 30% of all Degraded Ecosystems
TARGET 3: Conserve 30% of Land, Waters and Seas
TARGET 4: Halt Species Extinction, Protect Genetic Diversity, and Manage Human-Wildlife Conflicts
TARGET 5: Ensure Sustainable, Safe and Legal Harvesting and Trade of Wild Species
TARGET 6: Reduce the Introduction of Invasive Alien Species by 50% and Minimize Their Impact
TARGET 7: Reduce Pollution to Levels That Are Not Harmful to Biodiversity
TARGET 8: Minimize the Impacts of Climate Change on Biodiversity and Build Resilience

2. Meeting people's needs through sustainable use and benefit-sharing

TARGET 9: Manage Wild Species Sustainably To Benefit People
TARGET 10: Enhance Biodiversity and Sustainability in Agriculture, Aquaculture, Fisheries, and Forestry
TARGET 11: Restore, Maintain and Enhance Nature's Contributions to People
TARGET 12: Enhance Green Spaces and Urban Planning for Human Well-Being and Biodiversity
TARGET 13: Increase the Sharing of Benefits From Genetic Resources, Digital Sequence Information and Traditional Knowledge

3. Tools and solutions for implementation and mainstreaming

TARGET 14: Integrate Biodiversity in Decision-Making at Every Level
TARGET 15: Businesses Assess, Disclose and Reduce Biodiversity-Related Risks and Negative Impacts
TARGET 16: Enable Sustainable Consumption Choices To Reduce Waste and Overconsumption
TARGET 17: Strengthen Biosafety and Distribute the Benefits of Biotechnology
TARGET 18: Reduce Harmful Incentives by at Least $500 Billion per Year, and Scale Up Positive Incentives for Biodiversity
TARGET 19: Mobilize $200 Billion per Year for Biodiversity From all Sources, Including $30 Billion Through International Finance
TARGET 20: Strengthen Capacity-Building, Technology Transfer, and Scientific and Technical Cooperation for Biodiversity
TARGET 21: Ensure That Knowledge Is Available and Accessible To Guide Biodiversity Action
TARGET 22: Ensure Participation in Decision-Making and Access to Justice and Information Related to Biodiversity for all
TARGET 23: Ensure Gender Equality and a Gender-Responsive Approach for Biodiversity Action

GCC Library And Environment Related Books

ENERGY AUDIT

An energy audit comprises a detailed analysis of the energy performance of an organization, equipment, system(s) or process(es). It is based on appropriate measurement and observation of energy use, energy efficiency and consumption. Energy audits are planned and conducted as part of the identification and prioritization of opportunities to improve energy performance, reduce energy waste and obtain related environmental benefits. Audit outputs include information on current use and performance and they provide ranked recommendations for improvement in terms of energy performance and financial benefits (ISO 50002:2014).

The significance of an energy audit extends well beyond its procedural elements, encompassing a documented analysis of energy efficiency, consumption, and use. Rooted in meticulous data scrutiny, this comprehensive assessment stands as a cornerstone for identifying sustainable energy usage and a novel path to enhance energy performance. Integral to the energy audit process is the analysis of energy sources, energy review, evaluating energy efficiency technologies etc, assuming central role in establishing key facets of energy management. These analysis and reviews lays the groundwork for defining energy performance indicators, offering quantitative measures of an organization's energy efficiency journey, and setting the stage for outlining an energy baseline, a pivotal reference point for gauging future progress. The energy audit, with its comprehensive analysis and review, represents a transformative influence, empowering organizations to make informed decisions that pinpoint inefficiencies, reduce energy waste, and advance environmental stewardship. By furnishing a well-structured framework for assessment and action, energy audits nurture a dynamic cycle of continuous enhancement. In a world focused on resource optimization and ecological responsibility, energy audits emerge as potent tools propelling sustainability and economic prudence. This methodical approach not only equips organizations with strategic insights but also contributes to a global shift towards a greener, more sustainable future. As an integral facet of energy management,

energy audits catalyze change, fostering a culture of conscious energy consumption and positioning organizations on a path towards elevated energy performance.

The ultimate aim of the energy audit is to comprehensively analyze energy performance, consumption patterns, and utilization, while adhering to global standards such as ISO 50001 and ISO 50002:2014, with the goal of enhancing efficiency, reducing waste, and promoting a sustainable future.The campus energy audit conducted by Kerala State Biodiversity Board at Government College, Chittoor adheres to the global standards outlined in ISO 50001 (Energy Management) and ISO 50002:2014 (Energy Audits -Requirements with Usage Guidance). ISO 50001 operates within the continuous improvement framework, facilitating the seamless integration of energy management into broader quality and environmental enhancement endeavors. This standard offers a structured set of mandates for organizations, encompassing the formulation of an efficient energy utilization policy, goal setting, data-driven decision-making, outcome measurement, strategy evaluation, and perpetual refinement of energy management practices. The ISO 50002:2014 outlines the procedural guidelines for conducting energy audits concerning energy performance, it is universally applicable to diverse establishments and organizations, encompassing all energy types and consumption scenarios. The standard outlines the fundamental principles of executing energy audits, necessitates standardized processes during audits, outlines expected outcomes, and furnishes informative recommendations for its practical implementation. During this audit, the energy audit planning and data collection adhered to the guidelines outlined in sections 5.2 and 5.4 of the ISO 50002:2014 standard. The analysis of the present energy performance and the identification of potential enhancement opportunities were carried out in accordance with the instructions provided in sections 5.7.2 and 5.7.3 of the ISO 50002:2014. The energy audit report was meticulously prepared following the precise directives detailed in sections 5.8.1 and 5.8.2 of the ISO 50002:2014.

Objectives

- To perform an exhaustive assessment of the campus's energy performance
- To measure and observe energy utilization, efficiency, and consumption
- To detect opportunities for augmenting energy performance and minimizing wastage
- To furnish comprehensive insights into existing energy usage to inform decision-making
- To offer suggestions for enhancing energy efficiency, yielding both monetary and energy-related advantages
- To cultivate a mindset of mindful energy usage and ecological responsibility within the institution
- To participate in the worldwide move towards a more environmentally conscious and sustainable future by optimizing energy assets.

Methodology

KSBB has developed an innovative approach for performing energy audits. This method integrates principles from the International Chamber of Commerce's Environmental Audit recommendations and follows the guidelines outlined in section 5 (Performing an

energy audit) of the ISO 50002:2014 standard, as illustrated in the energy audit process diagram. The energy audit process, in line with ISO 50002:2014, includes energy audit planning, initiating meetings and data collection, creating a measurement plan, conducting on-site assessments, conducting in-depth analysis, producing an energy audit report, and concluding meetings.The integrated energy audit processadopted by KSBB follows a step-by-step sequence as furnished below.

Energy audit planning : The planning of the energy audit activities should be carried out well before the site visit, based on the scope and objective of the audit.

Opening meeting : Initial discussions has to be carried out to brief authorities regarding the energy audit objectives, defined energy audit scope, boundaries and methods, and to review the arrangement for the energy audit.

Audit team constitution and training : A comprehensive team with competent officials and students with competent officials and students can be formulated to conduct audit. They team may be trained about the modalities of energy audit, their roles, responsibilities, cooperation and other expected requirements from them.

Preparation of formats and questionnaires It is essential to prepare structured formats and pre-prepared questionnaires tailored to the audit's scope. This rich data forms the foundation for rigorous analysis and actionable recommendations to enhance energy performance and sustainability. Preparation of a clear cut check list is highly essential. It includes key documents to be collected and key person to be interviewed of the client organisation, who may provide significant detail about operational routines, recent and planned changes, technical improvements, or specific areas of concern is also critical.

Site Visit & Data collection : Data collection is a pivotal phase in the energy audit, involving a meticulous approach to gather comprehensive information on energy consumption, equipment use, operational patterns, and other relevant parameters.

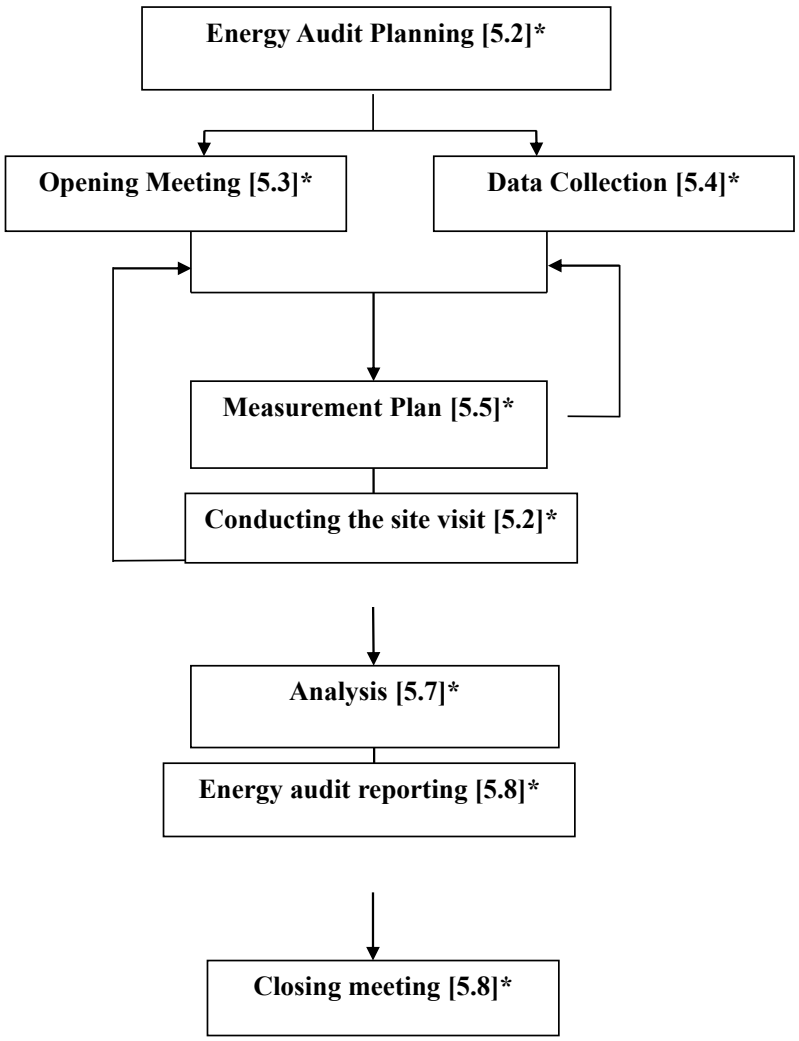
Measurement plan : A meticulous measurement plan is a crucial aspect of the energy audit methodology, outlining the strategic approach for quantifying energy consumption, usage, and efficiency. It should include tools, techniques, and parameters for on-site assessment.

Data Analysis and Recommendations: Meticulously analyze all collected data to understand energy usage patterns and areas with the highest energy consumption. Formulate actionable recommendations based on energy-saving potential, costs, technical feasibility, and compatibility.

Energy audit reporting : An exhaustive energy audit report needs to be generated, leveraging the data and information acquired throughout the energy audit procedure. This report will encompass a detailed examination of energy consumption patterns, equipment efficiency, and recommendations for energy-saving measures based on the data and insights obtained during the audit process.

Action Plan : After conducting a thorough energy audit at the college, several noteworthy findings and recommendations have emerged to enhance energy efficiency and sustainability. To put these insights into action, a robust action plan is imperative.

Follow-up activities: Maintain open communication with senior stakeholders to provide updates on progress and savings, fostering ongoing engagement and support for energy management initiatives. This transparent approach encourages participation from all levels of the organization, including teachers and students, in achieving energy management goals.



Flow Chat 1 : Energy audit process flow Diagram as per ISO 50002:2014
** Represents the corresponding sections of ISO 50002:2014*

PRE-AUDIT STATE

Energy audit planning

The planning of the energy audit activities were carried out during the July 2023, based on the scope and objective of the audit. In this regard, preliminary data on the college were collected from their website and also by the telephonic interaction with the college authorities.

Opening meeting

A virtual meeting took place on July 14th, 2023, followed by an offline meeting on July 20th, 2023. The purpose of the opening meeting is to brief college authorities regarding the energy audit objectives, defined energy audit scope, boundaries and methods, and to review the arrangement for the energy audit.

Audit team constitution and training

A comprehensive team with competent officials and students is constituted for the purpose and the team is designated as the lead energy auditor. An online awareness and training session was held on 20th July, 2023.They were initially trained about the modalities of energy audit, their roles, responsibilities, cooperation and other expected requirements from them.

Preparation of formats and questionnaires

Based on the preliminary inputs provided by the college authorities a comprehensive Format is prepared for the data collection. In addition, a semi-structured questionnaire was meticulously designed to capture qualitative insights and perspectives.The Criteria for evaluation and time period were preplanned. The facilities, equipment and services required for the audit was informed to the institute. A clear cut check list is prepared in connection with the energy audit with key documents to be collected and key person to be interviewed of the college, who may provide significant detail about operational routines, recent and planned changes, technical improvements, or specific areas of concern.

DURING THE AUDIT

Site Visit & Data collection

Site visits for data collection were carried out from August 3rd to August 5th, 2023. The process of gathering data utilized organized templates and questionnaires that were prepared in advance. It covers diverse factors, from energy sources and utilization patterns to facility layout and equipment specs. Visited all departments and interacted with department heads, librarian, hostel warden etc. Collaborative interactions with stakeholders ensured a thorough grasp of the organization's energy landscape.

Measurement plan :It covered actual metering of certain points in the electrical system along with areas of major consumption. It allowed confirming data collected and identify patterns/issues in energy consumption. As it is being an educational organization no other measuring instruments is used usually use in the industries. when necessary, and wireless tech for real-time data collection to ensure accuracy without constant on-site presence.

Analyzing Energy Sources and Consumption Patterns: During the energy audit, a comprehensive analysis was conducted to investigate the college's current energy sources and comprehend the corresponding consumption patterns. The assessment encompassed electricity, fossil fuels, renewable energy options, and distinct energy inputs tailored for specific purposes. Detailed records were compiled for each energy source, encompassing its category, quantity, and designated application.

Reviewing energy bills: In the course of its daily activities, an organization employs a range of energy types such as electricity, diesel, gasoline, liquefied petroleum gas (LPG), natural gas, etc. These energy bills offer a valuable means to evaluate the organization's total energy utilization and the specific equipment's consumption tendencies. Consequently, during the audit process, these relevant bills were thoroughly examined, providing valuable insights into the volume of energy expended. Moreover, they facilitated the identification of discernible patterns in energy usage linked to different energy sources and equipment units.

Evaluating Energy Efficiency Technologies and Measures

During the energy audit, a comprehensive assessment was conducted to explore potential alternative energy sources and innovative energy-saving measures. This involved examining the feasibility of adopting technologies such as solar panels, energy-efficient lighting, insulation improvements, and upgraded equipment.



NICITA




HAVELLS
GPS Map Camera
Chittur, Kerala, India
Google

Data Analysis

In the energy audit's analysis phase, data collected from the college's website, phone interviews, and site visits were meticulously examined. This provided a comprehensive understanding of the institution's energy landscape, including sources and consumption patterns. Total energy use and equipment consumption were assessed to identify potential efficiency improvements. Data from different sectors were scrutinized based on criteria like energy-saving potential, costs, payback time, technical feasibility, and compatibility. This strategic framework established energy-saving measures by identifying consumption patterns. Overall, the analysis phase offered a holistic overview of the college's energy usage, guiding actionable recommendations for enhanced efficiency and sustainability.

Recommendations

The energy audit team has observed that the college has already begun implementing energy-efficient practices on its campus. They have taken steps such as using solar-powered streetlights and installing three 5-star energy-rated air conditioners, which align with their initial plans. Additionally, they **have properly covered most of the electrical wires, switch boxes, and stabilizers, ensuring there is no damage.** The college has also started the installation of LED lights and tube lights and has established a solar power plant in the PG block. Furthermore, the Environment Club organized four energy conservation awareness programs this year. All of these actions indicate that the campus has taken proactive steps towards energy conservation. However, there are some additional recommendations provided below that could further enhance the overall energy efficiency of the campus.

- **Develop and Implement an Energy Management Policy:** Create and enforce an energy management policy for the institution. This policy should outline energy-saving practices, equipment usage guidelines, and energy conservation initiatives.
- **Solar Hybrid Kitchen in New Canteen and Hostels:** Given the upcoming replacement of the current canteen, consider incorporating a solar hybrid kitchen in the new facility. Explore the feasibility of implementing similar solar hybrid kitchen setups in the hostels.
- **Properly Arrange UPS Batteries :** The UPS batteries in the library are appropriately organized and positioned on stands, but in a few instances, some batteries are placed on the floor. Therefore, it is recommended to also arrange those batteries on stands.
- **Mitigate Phantom Load:** The audit team has noted that the overall energy consumption of the institute aligns with the total number of devices and their usage duration, indicating that there are no significant energy leaks. Nevertheless, it is advisable to detect and rectify devices that continue to draw power from outlets even when not in use, a phenomenon known as "phantom load." If identified, take measures to minimize this concealed energy consumption, which can result in potential cost savings and energy conservation.
- **Transition to LED Lighting:** Replace outdated lighting fixtures with modern, energy-efficient alternatives such as LED bulbs and fixtures. This shift not only enhances comfort but also aligns with sustainability goals.

- **Upgrade to Energy-Efficient Appliances:** Replace older devices with highly energy-efficient alternatives rated 4-5 stars. These appliances are designed to minimize energy consumption, resulting in reduced utility expenses and greater ecological sustainability.
- **Effective E-Waste Management:** Address the substantial accumulation of electronic waste (e-waste) within various departments like physics and geography. While adhering to government regulations for e-waste disposal may take time, promptly implement rigorous measures for e-waste disposal. Establish a designated e-waste storage area with accurate documentation until the complete disposal process is carried out.
- **Establish Student and Teacher Energy Management Group:** Following ISO 50001 standards, create a dedicated student and teacher group within the college to promote energy consciousness. They will integrate energy management into the college's overarching endeavors.
- **Data-Driven Energy Management:** Implement meticulous documentation of the campus's energy consumption data over time. This practice enables the identification of emerging trends, seasonal fluctuations, peak demand periods, and potential energy wastage. Customized strategies can then be formulated to optimize energy usage effectively.
- **Energy Conservation Awareness Program:** Conduct an energy conservation awareness program to sensitize all stakeholders. This collaborative initiative empowers students with invaluable knowledge and fosters a profound sense of responsibility toward energy conservation, contributing to a more environmentally friendly future.
- **Power Management for Computers:** Encourage students to power off computers, projectors, and other devices when not in active use. Additionally, suggest lowering the brightness settings of computer screens to conserve energy.
- **Promote "Power-Down" Practices:** Initiate "power-down" exercises to promote the practice of switching off lights, devices, and machines when they're not actively needed. This simple habit can effectively minimize energy wastage.
- **Explore Funding Opportunities:** Explore potential monetary rewards, funding opportunities, or financial support available for initiatives focused on enhancing energy efficiency. These resources can assist in mitigating the initial expenses associated with adopting energy conservation measures.
- **Enhance Natural Light and Airflow:** Identify key campus areas like auditoriums, libraries, seminar rooms, conference halls, hallways, cafeterias, and gyms, where students often gather and usually depend on electric lighting. Promote studentsto correctly use windows and doors. Explore the feasibility of replacing traditional light fixtures with skylights to harness natural light and warmth effectively. Ensure the efficient functioning of ventilation and exhaust systems. Abundant natural light significantly reduces the necessity for artificial lighting in corridors and rooms, promoting energy efficiency.
- **HVAC Maintenance:** Maintain heating, ventilation, and air conditioning (HVAC) systems optimally. Regularly clean or replace air filters as recommended to prevent energy waste and excessive consumption. Implement a maintenance schedule and label filters with installation dates for easy tracking.
- **Efficient Cooling and Heating Systems:** Ensure that cooling and heating systems operate efficiently. Regular servicing and upkeep of these systems can result in reduced energy consumption.

- **Engage Students in Energy Conservation:** Involve students in energy-saving initiatives through class projects and meter monitoring duties. Fostering a sense of responsibility among students can lead to a collective effort to reduce energy consumption.

POST-AUDIT STATE

Energy audit reporting

A comprehensive audit report has been prepared, drawing upon the data and information gathered during the audit process. This report serves as a thorough record of the college's present energy landscape, encompassing various aspects related to energy consumption, sources, and operational practices. The report highlights the college's commendable efforts to enhance energy efficiency, showcasing several noteworthy initiatives. The report extends beyond acknowledging these positive actions; it adopts a forward-thinking approach by offering a set of carefully considered recommendations. These recommendations are tailored to further fortify the college's commitment to energy conservation and overall sustainability. They provide practical insights and actionable strategies that, if put into practice, have the potential to yield substantial energy savings, reduce environmental impact, and foster a heightened sense of energy responsibility within the college community.

Action Plan

To operationalise the findings and recommendations of energy audit, a robust action plan is imperative. The plan presents a comprehensive approach for the college to implement energy-saving measures, elevate sustainability efforts, and cultivate a sense of energy responsibility within its community. By adopting these proposals, the college can reduce its carbon footprint, lower energy expenditures, and contribute to fostering a greener future.

Follow-up activities

Implementing the recommendations derived from the energy audit plays a pivotal role in curbing energy consumption, consequently leading to a reduction in carbon emissions. This contributes significantly to the organization's broader efforts to diminish its carbon footprint. The recommendations stemming from the energy audit adopt a 'top-down' approach, ensuring that senior stakeholders, such as the principal and department heads, grasp and engage with the objectives. This, in turn, motivates other staff members to actively participate in the college's energy management initiatives, providing a structured framework for involving both teachers and students in the collective pursuit of energy management. Following an energy audit, it is crucial to carry out a series of follow-up activities aimed at implementing the identified energy-saving opportunities. These measures not only result in measurable reductions in energy expenses but often lead to substantial cost savings within the first year, surpassing the initial implementation costs.

Table: 10. Energy Consumption and Conservation Summary for the Chittur College

Sl.No	Parameters	Response
1.	Electricity bill amount for the last year	Rs.510680/-
2.	Total energy consumption last year	55396 KWh
3.	Average monthly energy usage	4616 KWh
4.	Amount paid for LPG cylinders for last year	Rs.6000/-
5.	Fire wood used per month and amount of money spent?	50Kg and Rs.250/-
6.	Mention Amount spent for petrol/diesel/ others for generators?	30 litre and Rs.3000/-
7.	Are there any energy saving methods employed in your campus?	Promotes use of LED tubes and bulbs instead of CFL and incandescent lamps.Street lights are solar powered
8.	Does the institution have an energyman-agement policy?	No.
9.	How do you manage and track energycon-sumption?	NA
10.	How frequently institution conduct ener-gy audits?	Not done yet.
11.	No.of streetlights in your campus?	55
12.	Are there any alternative energy sources/ non-conventional energy sources installed in your campus?	Non-Conventional energy source- In collaboration with KSEB a Solar Power plant has been implemented in PG Block and Solar powered streetlights. Alternative energy source-Power Generator for Main-block.
13.	Do you run “switch off” drillsat campus?	No.
14.	Is the institution actively engaged in ener-gy efficiency programs?	Yes (Environment Club has conducted 4 energy conservation awareness programme last year)
15.	Energy Efficient Lighting Fixtures	LED Bulbs and Tubelights.
16.	Energy Efficient Fans	Nil.
17.	Energy Efficiency in Appliances & Equip-ment	5 Starrated 8Air Conditioners
18.	Energy Sub-Metering	Nil.
19.	Solar water heating system	Nil.
20.	Others	NA

Table :11. Monthly Energy Consumption by Appliances in the Institution

Appliances	No.of Appliances	Units of Current
Computers and Laptops	215	10750
Air conditioners	8	8000
CFL bulbs	24	216
Photocopiers	27	21600
LED lights	46	414
Incandescent bulbs	3	180
Fans	569	34140
Tubelights	833	16660
Electrical Equipment	10	400
Inverters	18	31000
Heaters	8	8120
CCTV DVR	8	40
Water pumps	4	9000
Refrigerators	9	2700
Other appliances	140	12700
Total Energy usage per month (kWh)		**4616**

A draft Energy Management Policy suggested for Government College,Chittur

Introduction: As a responsible institution committed to academic excellence and sustainable practices, Government College Chitturis dedicated to fostering an environment that prioritizes energy efficiency, conservation, and environmental consciousness. This Energy Management Policy, which strictly follows ISO 50001 (Developing an Energy Management System), outlines our institution's commitment to effectively manage energy resources, reduce energy consumption, and contribute to a greener and more sustainable future.

POLICY STATEMENT: At Government College Chittur, we pledge to

1. **Energy Conservation Awareness Program:** Conduct regular energy conservation awareness programs to educate students, staff, and faculty members about the importance of energy conservation, efficient energy usage, and sustainable practices.
2. **Formation of Energy Management Group:** Establish an Energy Management Group comprising dedicated students and teachers to lead and oversee energy-related initiatives, campaigns, and projects within the college.
3. **Optimized Energy Utilization:** Develop and implement a comprehensive energy management plan that focuses on optimizing energy utilization across campus facilities, including classrooms, laboratories, administrative areas, and hostels.
4. **Setting Tangible Targets:** Set quantifiable energy consumption reduction targets in alignment with national and international standards, and continuously strive to achieve these goals through proactive measures.
5. **Data-Driven Decision-Making:** Utilize energy consumption data to make informed decisions regarding energy-saving measures, identify opportunities for improvement, and implement effective strategies.
6. **Regular Energy Audits:** Conduct periodic energy audits to assess energy usage patterns, identify areas of inefficiency, and develop action plans to address energy wastage.
7. **Continuous Improvement:** Foster a culture of continuous improvement by regularly reviewing and refining energy management practices, policies, and initiatives based on feedback, new technologies, and best practices.
8. **Renewable Energy Integration:** Explore and invest in renewable energy sources such as solar power, wind energy, and other sustainable alternatives to reduce our carbon footprint and reliance on non-renewable energy sources.
9. **Green Infrastructure Development:** Incorporate energy-efficient designs and technologies in new construction and renovation projects to enhance the overall energy performance of campus buildings and facilities.
10. **Stakeholder Engagement:** Collaborate with students, staff, faculty, and local communities to raise awareness, share knowledge, and actively involve all stakeholders in energy management efforts.

Conclusion: The Energy Management Policy of Government College Chitturunderscores our commitment to create a sustainable and environmentally conscious campus. Through concerted efforts, we aim to optimize energy utilization, minimize wastage, and contribute to a cleaner and greener Kerala. By embracing energy-efficient practices and fostering a culture of environmental responsibility, we envision a future where Government College, Chitturstands as a shining example of energy conservation and sustainability in education.

This policy shall be communicated to all stakeholders, integrated into the college's operational framework, and periodically reviewed and updated to ensure its effectiveness and alignment with changing energy management needs.

Annual energy savings if the college's switch from 24 CFL bulbs to LED lights.

1. Power saved per LED = 24 W (CFL) - 11 W (LED) = 13 W
2. Expected power saving on shift from CFL to LED = 24 x 13 W = 312 W = 0.312 kW
3. Average use of CFL per year = 230 days/year x 6 hours/day = 1380 hours
4. Energy saved per year = 0.312 kW x 1380 hours = 430.56 kWh
5. Saving of Rs per year = 430.56 kWh x Rs. 9/kWh = Rs. 3875/-
6. Average cost of LED light to replace CFL = Rs. 110
7. Total cost of replacing all CFLs = 24 CFLs x Rs. 110 = Rs. 2640

TRANSPORTATION

The transportation audit at Chittur Government College in Palakkad is significant due to Kerala's distinctive transportation landscape, as extensively documented in various research studies. Kerala boasts a vast road network of 2,30,934.18 kilometers, resulting in a road density three times the national average at 548 kilometers per 100 square kilometers (Kumar & Srinivasan, 2017). This extensive network, while reflecting Kerala's connectivity, also poses unique challenges. Notably, the surge in motor vehicle registrations, reaching 155.65 lakh vehicles as of March 2022, underscores the state's increasing dependence on personal vehicles and the complexity of its transportation system (Kerala Economic Review, 2022). This growing trend aligns with findings from the study by Sreenivasan *et al*. (2019), emphasizing the significance of sustainable transportation practices in Kerala's educational institutions, including colleges like Chittur Government College. These challenges highlight the necessity for transportation audits to ensure accessible, efficient, and safe commuting options for students and staff. Safety remains a paramount concern, particularly in light of alarming statistics reported by the State Crime Records Bureau (SCRB) website, revealing 43,910 accidents in Kerala in 2022, resulting in 4,317 fatalities and 49,307 injuries. These accidents often stem from traffic rule violations and poor road conditions, as underscored by research conducted by Rajan *et al*. (2018), emphasizing the need for improved road safety measures in Kerala. Addressing road safety emerges as a multifaceted challenge that requires persistent, collaborative efforts from various stakeholders (Joseph & Soman, 2017), including educational institutions. Moreover, the transportation audit emphasizes the significance of eco-friendly transportation methods in reducing Kerala's carbon footprint and promoting environmental sustainability. Public transportation, electric vehicles (EVs), cycling, and walking have been extensively discussed in the context of sustainable transportation in Kerala. Research by Nair *et al*. (2020) highlights the potential of EVs in reducing greenhouse gas emissions in the state. Additionally, the Kerala Sustainable Urban Development Project (KSUDP) has emphasized

the importance of promoting public transportation and non-motorized modes like cycling and walking to alleviate traffic congestion and reduce environmental impacts.

The methodology adopted for collecting transportation data as part of Chittur College's green auditing process was systematic and comprehensive. This data collection effort was organized on a departmental basis, encompassing a wide range of transportation modes used by both students and staff. From each department and the college office, the number of individuals opting for various transportation methods, which included auto-rickshaws, bikes, cars, cycles, public transport, and walking, was recorded. Additionally, the distances covered by each mode of transportation were diligently recorded. This meticulous approach facilitated a detailed assessment of transportation preferences and patterns within the college community. The data collection process was executed in such a way as to capture transportation behaviors accurately. Subsequently, the compiled information was used to calculate the total distances covered by each mode of transportation. This comprehensive data not only provided valuable insights into the transportation landscape of Chittur College but also serves as a foundational resource for assessing the environmental impact of transportation choices and developing strategies to promote sustainable and eco-friendly commuting options within the campus community.

The transportation audit conducted at Chittur College has brought to light a significant issue concerning the arrangement and availability of parking spaces within the campus. It is evident that vehicles are randomly spread throughout the campus, indicating a lack of organized parking infrastructure. Moreover, the audit has revealed a shortage of sufficient parking space to accommodate vehicles used by students and staff. When vehicles are dispersed without a structured parking system, they often remain running or repeatedly start and stop, resulting in increased fuel consumption and emissions. This practice not only contributes to air pollution but also wastes valuable resources. To address these challenges, it is imperative for Chittur College to prioritize the establishment of a well-planned and adequately sized parking facility. Such a facility should be strategically located and designed to accommodate the current and anticipated future demand for parking spaces. Implementing designated parking can streamline vehicle placement and reduce the carbon footprint associated with parking. Furthermore, the creation of dedicated parking zones with EV charging stations can encourage the adoption of eco-friendly transportation options. EV charging stations within the parking facility would not only support sustainable mobility but also reflect the college's commitment to environmental responsibility.

Table. 12. Transportation Preferences in Chittur College (in %)

Auto	Bike	Car	Cycle	Public Transport	Walking
0.24	4.5	1.69	0.08	92.01	1.48

The transportation choices at the Chittur college, reveal interesting insights into how students and staff prefer to get around, shedding light on sustainable mobility within the campus community. An overwhelming 92.01% of individuals rely on public transport, such as buses or other private vehicles. This high usage of public transport aligns with the idea that it's an eco-friendly and cost-effective way to commute, which is crucial for a sustainable future. Research by Ahmed and Ahmed (2017) emphasizes the benefits of public transportation in reducing the environmental footprint and traffic congestion in urban areas. However, the low percentages for car (1.69%) and bike (4.5%) usage suggest that many individuals understand the drawbacks of private vehicles, such as pollution and traffic, and opt for more sustainable alternatives. Studies by Yadav et al. (2018) and Ghose et al. (2019) underline the importance of promoting bike sharing and carpooling as ways to reduce individual car usage, thereby reducing air pollution and the burden on limited parking resources. The absence of a permanent bike or carpooling system between students and staff at Chittur College highlights a missed opportunity to promote sustainable transportation practices and foster a stronger sense of community within the campus. Bike-sharing programs and carpooling initiatives not only reduce the environmental impact of commuting but also offer economic benefits and encourage social interaction. Additionally, the data indicates that walking and cycling, at 1.48% and 0.08% respectively, though relatively low, contribute to healthier and greener transportation choices. Promoting walking and cycling within the campus can further reduce the dependence on motorized vehicles. Kumar et al. (2020) discuss the importance of creating pedestrian-friendly environments in educational institutions and advocate for the inclusion of dedicated cycling paths and bike-sharing programs.

Upon analyzing the collected data, it becomes evident that only two electric scooters and one electric car are currently in use within the entire Chittur College campus. However, this finding underscores a significant opportunity for enhancing the adoption of electric vehicles (EVs) within the college community. While these numbers may appear limited, they represent a noteworthy step toward sustainability and the reduction of the carbon footprint associated with transportation. The presence of these electric vehicles signifies a progressive approach to transportation within the college. EVs offer several advantages, including lower greenhouse gas emissions, reduced air pollution, and decreased reliance on fossil fuels. Moreover, they align with the broader global push for sustainable mobility and the reduction of carbon emissions.

The data analysis also offers a valuable glimpse into the commuting patterns of both students and staff, shedding light on their preferences and behaviors when it comes to transportation. Notably, a significant portion of the college community, totalling 307 individuals, opts for the most eco-friendly mode of transportation – walking. These pedestrians cover an average distance of approximately 700 meters, indicating that the majority of them reside within a mere 1 kilometer range of the campus. However, the remaining members of the college community rely on vehicles for their daily commute. Among this group, a substantial 494 individuals travel relatively short distances, approximately 5 kilometers or less, to reach the college. Delving deeper into this category, we find that 165 individuals live within a mere 2.5 kilometers from the college, while

an additional 329 cover distances between 2.5 and 5 kilometers. The intriguing aspect here is that despite residing in such close proximity to the college, all of these individuals predominantly choose to use either public transport or, in some instances, opt for bikes or auto-rickshaws. This observation gives rise to a profound opportunity for Chittur College to encourage and promote more sustainable and eco-friendly commuting options, primarily focused on walking and cycling, for individuals traveling these short distances. Embracing and promoting alternative transportation modes at Chittur College carries multifaceted advantages. Firstly, it holds the potential to substantially reduce carbon emissions associated with commuting, aligning perfectly with global and local environmental goals aimed at mitigating climate change and reducing pollution. By decreasing reliance on motorized vehicles, the college can positively impact both the local and global environment. Furthermore, these initiatives encompass more than just environmental benefits; they also promote physical health and well-being among students and staff. Encouraging individuals to walk or cycle short distances can lead to a healthier and more active campus community, offering benefits like improved cardiovascular health, enhanced mental well-being, and a lower risk of chronic diseases. Lastly, the promotion of walking and cycling aligns seamlessly with the broader sustainable development agenda, contributing to the creation of a greener and more eco-conscious campus environment.

Recommendations

- Given the current disorganized arrangement of vehicles and insufficient parking space within the campus, it is essential to undertake the construction of additional parking facilities. Design and create well-structured parking lots to accommodate the growing

number of vehicles, promoting orderliness and convenience for students and staff.

- Encourage and raise awareness among students and staff about the benefits of sustainable transportation modes, such as walking, cycling, and the use of public transport.
- Invest in the development of dedicated cycling paths within the campus. Create a cycling friendly environment with well-marked lanes and crossings to ensure the safety and convenience of pedestrians and cyclists.
- Implement a bicycles sharing program within the college to make bicycles readily available to students and staff for short-distance commuting. This initiative can significantly reduce the dependence on motorized vehicles and promote physical activity.
- Encourage students and staff of the college to engage in bike sharing and carpooling arrangements. Implement a carpooling platform or app to facilitate ride-sharing and reduce the number of single occupancy vehicles on campus.
- Encourage the adoption of electric scooters, cars, and bikes by providing charging facilities and incentives.
- Collaborate with local authorities to implement traffic safety measures around the college, including speed limits, proper signage, and regular maintenance of roads. Continuously monitor transportation patterns and conduct regular transportation audits to assess the effectiveness of sustainability initiatives. Use the data collected to make informed decisions and improvements.
- Organize awareness campaigns, workshops, and incentives to promote eco-friendly commuting options. Offer workshops on sustainable mobility, environmental consciousness, and the benefits of adopting eco-friendly transportation modes. Raise awareness about responsible road behaviour and the consequences of traffic violation. Collaborate with behavioural psychologists to design and implement behaviour change programs that motivate individuals to choose eco-friendly transportation options.

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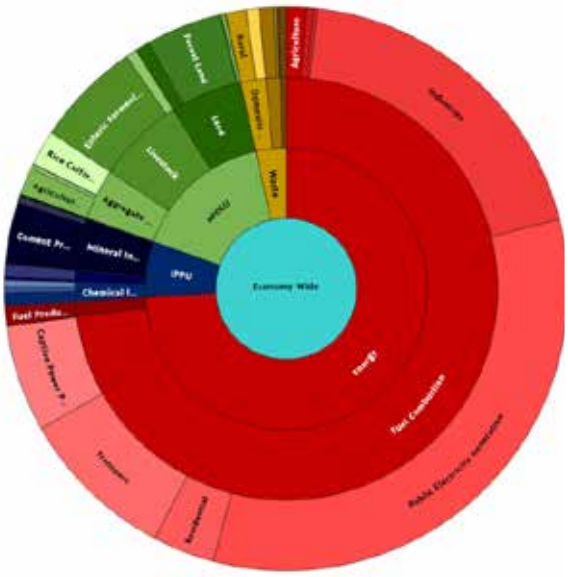
CARBON ACCOUNTING: EMISSIONS AND SEQUESTRATION

Greenhouse gas (GHG) emissions, primarily resulting from human activities, are the primary drivers of global climate change. These emissions, including carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O), create a greenhouse effect in the Earth's atmosphere, resulting in elevated global temperatures and consequential environmental impacts. It is imperative to comprehend and address these emissions to effectively combat climate change. To comprehensively calculate carbon emissions and manage their environmental impact, organizations and institutes need to follow a structured framework. Calculating carbon emissions is a crucial process in understanding and mitigating the impact of human activities on the environment. It involves gathering accurate data related to specific activities, such as energy consumption, transportation, or industrial processes, and then applying appropriate emission factors to quantify the amount of greenhouse gases released into the atmosphere. These emission factors, often provided by organizations like the Intergovernmental Panel on Climate



Economy Wide Emissions in India,
Source : GHG Platform, India

Change (IPCC), represent the emissions intensity of those activities. The resulting calculation, typically expressed in units of carbon dioxide equivalent (CO2e), serves as a valuable tool for assessing an entity's environmental footprint, setting reduction targets, and designing strategies to combat climate change. Accurate carbon emission calculations are essential for governments, businesses, and individuals to take informed steps towards a more sustainable and low-carbon future. This pivotal practice empowers stakeholders to comprehend and address the far-reaching impacts of human activities on the planet's climate, as detailed in this report, with a primary focus on the methodology prescribed by the IPCC. The IPCC's methodology involves two key components: "Activity Data" and "Emission Factors." Activity data represents quantitative measurements of specific activities, such as energy consumption and transportation, while emission factors are numerical values that express the emissions intensity associated with these activities. Accurate data collection and application of emission factors enable the quantification of greenhouse gas emissions in units of carbon dioxide equivalent (CO2e). This practice forms the foundation for understanding environmental impact, setting reduction targets, and shaping sustainable practices and policies. Inventories." The basic equation for calculating emissions is:

Emissions (in Co2e) = Activity Data x Emission Factor

Activity Data: This component of the equation refers to quantitative measurements of the specific activity or process under consideration. It essentially answers the question: "How much of this activity occurred?" Activity data can take various forms depending on the nature of the emission source:

- **Energy Consumption:** If you are calculating emissions from energy use, such as electricity or fuels, you need data on the amount of energy consumed. This data is typically measured in units like kilowatt-hours (kWh) for electricity or gallons or liters for fuels. It represents the activity of energy consumption.
- **Vehicle Use:** For emissions related to vehicle use, you'll need data on factors such as the distance traveled (in miles or kilometers) and fuel consumption (in gallons or liters). This data quantifies the activity of driving or operating vehicles.
- **Fugitive Emissions:** In cases involving fugitive emissions, like refrigerants leaking from air conditioning systems, you might need data on the type of refrigerant used, leak rates, and equipment specifications. This data characterizes the fugitive emissions activity.

Emission Factor: Emission factors, as defined by the Intergovernmental Panel on Climate Change (IPCC), are integral to global efforts in addressing climate change. They serve as representative values linking the release of greenhouse gases (GHGs) to specific human activities or processes. These factors are crucial components in the development of national greenhouse gas inventories, forming the basis for climate action and policy formulation at both national and international levels. Emission factors, often expressed as emissions per unit of activity, enable the estimation of GHG emissions from diverse sources such as energy production, transportation, and industrial processes. Their specificity and accuracy are paramount in assessing progress toward emission reduction goals.

In the realm of greenhouse gas (GHG) inventories and climate change mitigation, the concept of "tiers" is a critical framework that enables countries and organizations to systematically classify and assess the level of detail and accuracy in estimating GHG emissions. These tiers, often associated with the guidelines outlined by the Intergovernmental Panel on Climate Change (IPCC), serve as a valuable tool for improving the transparency, comparability, and reliability of GHG data.

Tier 1: At the foundational level, Tier 1 involves using default values or generic emission factors. These factors are generally broad and may not capture the unique characteristics of a specific region or activity. Tier 1 is often employed by countries or organizations with limited resources or data availability. While it provides a basic estimate of emissions, it may not reflect the intricacies of local conditions.

Tier 2: Tier 2 represents an intermediate level of estimation. In this tier, emission factors are tailored to the specific country or region. This approach takes into account more localized data and characteristics, resulting in a more accurate assessment of GHG emissions. Tier 2 is suitable for regions with access to some data but not yet fully detailed inventories.

Tier 3: At the highest level of detail and accuracy, Tier 3 involves using country-specific or site-specific data and emission factors. This tier requires comprehensive data collection and analysis, often involving direct measurements and precise calculations. Tier 3 inventories are considered the most accurate and are essential for regions committed to robust emissions reporting.

The choice of tier depends on the country's or organization's capacity, data availability, and the desired level of accuracy. While Tier 1 provides a basic estimate, Tier 2 enhances the precision, and Tier 3 offers the highest level of confidence in GHG emissions estimation. Over time, the goal is for countries and organizations to progress towards higher tiers as they develop more sophisticated data collection and analysis capabilities.

Understanding GHG Scopes: A Framework for Emissions Categorization

In the realm of greenhouse gas (GHG) accounting and reporting, the concept of "scope" plays a pivotal role in systematically categorizing and understanding emissions. These scopes serve as distinct lenses through which organizations and entities view their carbon footprint. The three scopes, as defined by the Intergovernmental Panel on Climate Change

(IPCC), offer a structured approach to dissecting GHG emissions. Scope 1 encompasses direct emissions stemming from sources under the organization's ownership or control. Scope 2 shifts the focus to indirect emissions related to purchased electricity consumption, arising from sources external to the organization but integral to its operations. Lastly, Scope 3 casts the widest net, covering a multitude of indirect emissions from activities across the entire value chain, extending beyond the organization's immediate control. This framework not only aids in precise emissions measurement and reporting but also empowers organizations to develop comprehensive strategies for reducing their overall carbon footprint. By delineating emissions into these scopes, organizations can holistically assess their environmental impact and make informed decisions to mitigate climate change effectively.

- **Scope 1** accounts for direct GHG emissions originating from sources directly owned or controlled by the institute, such as emissions from internal combustion processes or their own vehicle fleet. Notably, this scope includes emissions from fossil fuel combustion but separates direct CO2 emissions from biomass combustion and other GHGs not covered by the Kyoto Protocol for separate reporting.
- **Scope 2** addresses GHG emissions indirectly linked to purchased electricity consumption. These emissions occur at the facilities where electricity is generated and are tied to the electricity purchased by the organization.
- **While Scope 1 and Scope 2** are fundamental, Scope 3 is optional but valuable. It encompasses all other indirect emissions resulting from the institute's activities but originating from sources beyond their direct ownership or control. Scope 3 widens the perspective, covering emissions related to supply chains, employee commutes, business travel, and more.

Calculation of carbon emission from

A. Carbon emission from LPG cylinders used in the college (Scope 1)

Total number of LGP cylinder used during the year	volume of the domestic LPG cylinder	Emission CO_2e/year*	Emission ton CO_2e/ year
6	14.2	251.34	0.25

B. Carbon emission from diesel used for electricity generation (Scope 1)

Total annual Consumption of diesel (Litre)	Emission CO_2e/year*	Emission ton CO_2e/ year
30	79.59	0.07959

C. Carbon emission from purchased electricity (Scope 2)

Total annual Consumption	Unit	Emission Factor* kg CO_2e/kWh	Emission ton CO_2e/year	Emission ton CO_2e/year
55396	kWh	0.81	44870.76	44.87076

** Tire 2 Emission factor (India specific) as per Baseline Carbon Dioxide Emission Database Version 18.0 for the Indian Power Sector, Government of India Ministry of Power, Central Electricity Authority has been taken*

D. Emission from transport (Scope 3)

Mode of Transport	Distance Travelled one day	Number of working days	Annual Distance	Emission CO_2e/year*	Emission ton CO_2e/year
Bike	1324	204	270096	12154.32	12.15432
Auto	71	204	14484	1100.784	1.100784
Car	497	204	101388	15512.364	15.512364
Public Transport	27076	204	5523504	19332.264	19.332264
				Total	**48.1**

**http://www.ghgprotocol.org/calculation-tools/alltools & 2006 IPCC Guidelines for National Greenhouse Gas Inventories were followed, and average mileage of car was taken as 15, for bike 50, for auto rickshaw 30, and number of passengers per bus in public transport system was taken as 50.*

E. Carbon emission from burning of woody biomass (Scope 3)

Total annual wood Consumption	Carbon emission**
50 kg	0.0822 tonne Carbon

***For calculation of Carbon emission from the burning of woody biomass, IPCC-LULC Guidelines was followed (Carbon emission from woody biomass = Quantity of non-renewable biomass × Net calorific value of the non-renewable biomass × CO2 emission factor for the biomass fuel). Where Tire 1 IPCC default values for NCV biomass of 0.015 TJ/tonne and CO2 emission factor of 109.6 tCO2/TJ were taken (IPCC, 1996).*

F. Carbon emission from waste(Scope 1)

Waste generation	Emission factor	Emission	Global Warming Potential	Carbon equivalent	Emission CO_2e/year	Emission ton CO_2e/year
270 kg	0.355	95.85 CH_4	27.2	2607	2874.57	2.87
	0.991	267.57 CO_2	1	267.57		

(Ramachandra et al.2014)

Table. 13. Total Carbon emission

Sl. No	Activity	Emission in Tonnes
A	Carbon emission from LPG cylinders used in the college (Scope 1)	0.25
B	Carbon emission from diesel used for electricity generation (Scope 1)	0.079
C	Carbon emission from purchased electricity (Scope 2)	44.87
D	Emission from transport (Scope 3)	48.10
E	Carbon emission from burning of woody biomass (Scope 3)	0.082
F	Carbon emission from waste (Scope 1)	2.87
G	Emissions from various events and miscellaneous emissions	10.00
	Total	**106.25**

Table. 14 List of trees and Carbon stock

Sl. No.	Scientific name of the tree species	GBH	DBH	AGB	BGB	Total Biomass Green	Dry Wt.	Carbon Content	CO_2 equ.t	CO_2 equ.t in Ton
1	*Alstonia scholaris* (L.) R. Br.	17	5.41	8.48	2.29	10.77	7.81	3.91	14.34	0.01434
2	*Bombax ceiba* L.	58	18.47	189.4	51.14	240.54	174.39	87.2	319.73	0.31973
3	*Bombax ceiba* L.	31	9.87	38.8	10.48	49.28	35.73	17.87	65.52	0.06552
4	*Bombax ceiba* L.	22	7.01	16.33	4.41	20.74	15.04	7.52	27.57	0.02757
5	*Bombax ceiba* L.	17	5.41	8.48	2.29	10.77	7.81	3.91	14.34	0.01434
6	*Bombax ceiba* L.	58	18.47	189.4	51.14	240.54	174.39	87.2	319.73	0.31973
7	*Polyalthia longifolia* (Sonn.) Thwaites	22	7.01	16.33	4.41	20.74	15.04	7.52	27.57	0.02757
8	*Ficus hispida*L.f.	20	6.37	12.81	3.46	16.27	11.8	5.9	21.63	0.02163
9	*Ficus hispida*L.f.	15	4.78	6.2	1.67	7.87	5.71	2.86	10.49	0.01049
10	*Delonix regia* (Hook.) Raf.	16	5.1	7.3	1.97	9.27	6.72	3.36	12.32	0.01232
11	*Alangium salviifolium* (L.f.) Wangerin.	29	9.24	32.84	8.87	41.71	30.24	15.12	55.44	0.05544
12	*Alangium salviifolium* (L.f.) Wangerin.	23	7.32	18.21	4.92	23.13	16.77	8.39	30.76	0.03076
13	*Alangium salviifolium* (L.f.) Wangerin.	15	4.78	6.2	1.67	7.87	5.71	2.86	10.49	0.01049
14	*Alangium salviifolium* (L.f.) Wangerin.	55	17.52	165.71	44.74	210.45	152.58	76.29	279.73	0.27973
15	*Alangium salviifolium* (L.f.) Wangerin.	31	9.87	38.8	10.48	49.28	35.73	17.87	65.52	0.06552
16	*Azadirachta indica*Adr. Juss.	32	10.19	42.06	11.36	53.42	38.73	19.37	71.02	0.07102
17	*Strychnos nux-vomica* L.	58	18.47	189.4	51.14	240.54	174.39	87.2	319.73	0.31973
18	*Murraya koenigii* (L.) Sprengel	19	6.05	11.25	3.04	14.29	10.36	5.18	18.99	0.01899

19	*Murraya koenigii*(L.) Sprengel	15	4.78	6.2	1.67	7.87	5.71	2.86	10.49	0.01049
20	*Garcinia gummi-gutta* (L.) Robs.	42	13.38	83.78	22.62	106.4	77.14	38.57	141.42	0.14142
21	*Ziziphus oenoplia*	78	24.84	400.82	108.22	509.04	369.05	184.53	676.61	0.67661
22	*Pongamia pinnata* (L.) Pierre	31	9.87	38.8	10.48	49.28	35.73	17.87	65.52	0.06552
23	*Pongamia pinnata* (L.) Pierre	32	10.19	42.06	11.36	53.42	38.73	19.37	71.02	0.07102
24	*Pongamia pinnata* (L.) Pierre	19	6.05	11.25	3.04	14.29	10.36	5.18	18.99	0.01899
25	*Morinda citrifolia* L.	28	8.92	30.04	8.11	38.15	27.66	13.83	50.71	0.05071
26	*Morinda citrifolia* L.	29	9.24	32.84	8.87	41.71	30.24	15.12	55.44	0.05544
27	*Bridelia retusa* (L.) Spreng.	23	7.32	18.21	4.92	23.13	16.77	8.39	30.76	0.03076
28	*Alangium salviifolium* (L.f.) Wangerin.	35	11.15	52.82	14.26	67.08	48.63	24.32	89.17	0.08917
29	*Canthium*	20	6.37	12.81	3.46	16.27	11.8	5.9	21.63	0.02163
30	*Bombaxceiba* L.	55	17.52	165.71	44.74	210.45	152.58	76.29	279.73	0.27973
31	*Bombaxceiba* L.	61	19.43	215.3	58.13	273.43	198.24	99.12	363.44	0.36344
32	*Syzygium cumini* (L.) Skeels	41	13.06	78.8	21.28	100.08	72.56	36.28	133.03	0.13303
33	*Delonix regia* (Hook.) Raf.	26	8.28	24.88	6.72	31.6	22.91	11.46	42.02	0.04202
34	*Azadirachta indica*Adr. Juss.	18	5.73	9.8	2.65	12.45	9.03	4.52	16.57	0.01657
35	*Naringi crenulata* (Roxb.) D.H. Nicolson	42	13.38	83.78	22.62	106.4	77.14	38.57	141.42	0.14142
36	*Naringi crenulata* (Roxb.) D.H. Nicolson	33	10.51	45.49	12.28	57.77	41.88	20.94	76.78	0.07678
37	*Naringi crenulata* (Roxb.) D.H. Nicolson	46	14.65	105.39	28.46	133.85	97.04	48.52	177.91	0.17791
38	*Murraya koenigii* (L.) Sprengel	30	9.55	35.7	9.64	45.34	32.87	16.44	60.28	0.06028
39	*Pongamia pinnata* (L.) Pierre	19	6.05	11.25	3.04	14.29	10.36	5.18	18.99	0.01899
40	*Pongamia pinnata* (L.) Pierre	19	6.05	11.25	3.04	14.29	10.36	5.18	18.99	0.01899

41	*Pongamia pinnata* (L.) Pierre	18	5.73	9.8	2.65	12.45	9.03	4.52	16.57	0.01657
42	*Cassia fistula* L.	26	8.28	24.88	6.72	31.6	22.91	11.46	42.02	0.04202
43	*Eucalyptus tereticornis*	168	53.5	2792.23	753.9	3546.13	2570.94	1285.47	4713.39	4.71339
44	*Eucalyptus tereticornis*	90	28.66	575.6	155.41	731.01	529.98	264.99	971.63	0.97163
45	*Eucalyptus tereticornis*	137	43.63	1666.76	450.03	2116.79	1534.67	767.34	2813.58	2.81358
46	*Eucalyptus tereticornis*	92	29.3	608.68	164.34	773.02	560.44	280.22	1027.47	1.02747
47	*Eucalyptus tereticornis*	62	19.75	224.39	60.59	284.98	206.61	103.31	378.8	0.3788
48	*Streblus asper* Lour.	38	12.1	64.96	17.54	82.5	59.81	29.91	109.67	0.10967
49	*Streblus asper* Lour.	20	6.37	12.81	3.46	16.27	11.8	5.9	21.63	0.02163
50	*Streblus asper* Lour.	28	8.92	30.04	8.11	38.15	27.66	13.83	50.71	0.05071
51	*Holoptelea integrifolia* Planch.	28	8.92	30.04	8.11	38.15	27.66	13.83	50.71	0.05071
52	*Morinda citrifolia* L.	28	8.92	30.04	8.11	38.15	27.66	13.83	50.71	0.05071
53	*Morinda citrifolia* L.	180	57.32	3324.53	897.62	4222.15	3061.06	1530.53	5611.94	5.61194
54	*Morinda citrifolia* L.	38	12.1	64.96	17.54	82.5	59.81	29.91	109.67	0.10967
55	*Bridelia retusa* (L.) Spreng.	21.5	6.85	15.4	4.16	19.56	14.18	7.09	26	0.026
56	*Bridelia retusa* (L.) Spreng.	40	12.74	74.01	19.98	93.99	68.14	34.07	124.92	0.12492
57	*Bridelia retusa* (L.) Spreng.	41	13.06	78.8	21.28	100.08	72.56	36.28	133.03	0.13303
58	*Alangium salviifolium* (L.f.) Wangerin.	57	18.15	181.21	48.93	230.14	166.85	83.43	305.91	0.30591
59	*Alangiums alviifolium* (L.f.) Wangerin.	24	7.64	20.3	5.48	25.78	18.69	9.35	34.28	0.03428
60	*Albizia lebbeck* (L.) Benth.	130	41.4	1459.58	394.09	1853.67	1343.91	671.96	2463.85	2.46385
61	*Albizia lebbeck* (L.) Benth.	135	42.99	1605.59	433.51	2039.1	1478.35	739.18	2710.33	2.71033
62	*Albizia lebbeck* (L.) Benth.	128	40.76	1403.16	378.85	1782.01	1291.96	645.98	2368.59	2.36859
63	*Bombax ceiba* L.	135	42.99	1605.59	433.51	2039.1	1478.35	739.18	2710.33	2.71033

AR-AMS0001/Version 04 : Simplified baseline and monitoring methodologies of clean development mechanism: Afforestation and Reforestation Working Group of United Nations Framework Convention on Climate Changeis followed.

Table. 15. List trees and number of Quadrants Occurrence

Sl No.	Name of sps.	Quadrats laid down			Total number of individual sp	Total number of quadrants occur-rence
		1	2	3		
1.	*Alstonia scholaris* (L.) R . Br.	1	0	0	1	1
2.	*Bombax ceiba* L.	5	3	0	8	2
3.	*Polyalthia longifolia* (Sonn.) Thwaites	1	0	0	1	1
4.	*Ficus hispida* L.f.	2	0	0	2	1
5.	*Delonix regia* (Hook.) Raf	1	1	0	2	2
6.	*Alangium salviifolium* (L.f.) Wangerin	6	0	2	8	2
7.	*Azadirachta indica* Adr. Juss.	1	1	0	2	2
8.	*Strychnos nux-vomica* L.	1	0	0	1	1
9.	*Murraya koenigii* (L.) Sprengel	2	1	0	3	2
10.	*Garcinia gummi-gutta* (L.) Robs.	1	0	0	1	1
11.	*Albizia lebbeck* (L.) Benth	1	2	0	3	2
12.	*Ziziphus oenoplia*	1	0	0	1	1
13.	*Pongamia pinnata* (L.) Pierre	3	3	0	6	2
14.	*Morinda citrifolia* L.	2	0	3	5	2
15.	*Bridelia retusa* (L.) Spreng	1	0	3	4	2
16.	*Canthium*	1	0	0	1	1
17.	*Syzygium cumini* (L.) Skeels	0	1	0	1	1
18.	*Naringi crenulata* (Roxb.) D.H. Nicolson	0	3	0	3	1
19.	*Cassia fistula* L.	0	1	0	1	1
20.	*Eucalyptus tereticornis*	0	0	5	5	1
21.	*Streblus asper* Lour.	0	0	3	3	1
22.	*Holoptelea integrifolia* Planch.	0	0	1	1	1
	Total				**63**	

*Prepared based on the report on "Carbon Sequestration Study at Eco-restoration Sites of BCCL", Department of Environmental Science & Engineering Centre of Mining Environment, INDIAN SCHOOL OF MINES, Dhanbad.

No of trees in 1200 m^2 = 63 nos
No of trees in 1 ha = (63/1200)*10000 = 525 trees/ha.
Total number of trees = 525 x 16 = 8400 nos

Out of the total campus area of 20.17 hectares, 16 hectares of thick forest cover are taken into consideration for calculation.

Carbon sequestration potential Estimation
Carbon sequestration potential of a tree taken for the calculation = 22 Kg CO_2/year
Carbon sequestration potential of a trees of the campus = 8400x 22 Kg CO2 = 168000 kg
= 168 tonnes **

**As the campus is carbon neutral only sequestration of the tree species were considered, it can be increased further if consider soil carbon, shrubs, herbs, grass etc.

The detailed carbon emissions data from Chittur Government College in Palakkad provides a comprehensive and insightful overview of the institution's environmental impact, organized into three scopes according to the Greenhouse Gas Protocol. In Scope 1, which encompasses direct emissions from sources under the college's control, the breakdown includes 0.25 from LPG cylinders, 0.08 from diesel for electricity generation, 0.08 from the burning of woody biomass, and 2.87 from waste. These findings underscore the substantial contributions to the overall carbon footprint attributed to the college's energy sources and waste management practices. Moving to Scope 2 emissions, which represent the indirect emissions from purchased electricity, the notable figure of 44.87076 highlights a critical area for improvement. The Scope 3 emissions, particularly the substantial 48.10 from transport, further underscores the significance of addressing the college's transportation practices in its overall sustainability strategy. Additionally, miscellaneous emissions from various events contribute to a collective total of 10, culminating in a comprehensive carbon emissions tally of 106.25.

The most striking findings from the carbon emissions data of Chittur Government College in Palakkad are centeredaround Scope 2 and Scope 3 emissions. The carbon emission figure of 44.87 from purchased electricity (Scope 2) underlines a critical area for improvement. This emphasizes the urgent need for the college to reassess its energy procurement strategy and consider transitioning to cleaner and more sustainable sources, thereby significantly reducing its indirect carbon footprint. However, during the assessment, it was also noted that the college has installed solar panels on the campus, and once it started functioning, considerable reduction can be achieved in this sector. Furthermore, the substantial carbon emissions from transport activities, amounting to 48.1 (Scope 3), pose another notable concern. Addressing transportation emissions is crucial, and the college could explore eco-friendly transportation options, promote carpooling, or incentivize the use of public transportation among students and staff. By prioritizing initiatives in these high-impact areas, the college can make substantial strides in mitigating its overall environmental impact.

In conclusion, our study utilized various methodologies to roughly assess the campus's total emissions, revealing a significant value of 106.25. Additionally, a rough estimation of the carbon sequestration potential of the tree species alone showcased an annual sequestration capacity of 168 tonnes, with an excess tradable carbon of 61.75 tonnes. Furthermore, upon implementing the aforementioned mitigation measures, our observations indicate a notable potential for the campus to reach a commendable level of 100 tonnes of tradable carbon on an annual basis. These findings underscore the significance of integrating

sustainable practices and afforestation strategies within the campus environment. This audit contributes valuable insights to the broader discourse on mitigating carbon emissions and highlights the potential for educational institutions to play a pivotal role in fostering environmental stewardship. As we move forward, it is crucial for decision-makers to consider and implement these measures to enhance the campus's environmental sustainability and contribute to global efforts in combating climate change.

CARBON STOCK ASSESSMENT IN CHITTUR GOVERNMENT COLLEGE USING GEOSPATIAL TECHNIQUES

As an integral part of terrestrial ecosystem, the natural vegetation has a noteworthy contribution in earth's energy cycle and is regarded as the storehouse of terrestrial ecosystem carbon. The plants store carbon in the form biomass in its different body parts known as carbon pool. Carbon sequestration is the process in which carbon is removed from the atmosphere and stored in the carbon pools of specific habitats, such as above ground biomass, roots and soil. Among these the above-ground biomass (AGB) pool has been considered as a crucial indicator of many ecosystem processes.

The trees play significant role by acting as the lung spaces by absorbing the atmospheric carbon dioxide and fixing it by photosynthesis and converting it into biomass. In a well-defined environment the balance between the amount of the emissions and the trees that act as a natural sink is very important. In a college system development is very necessary, so that the change infrastructure and the land use vary often. These changes are primarily due to human influences. But once the trees grow old and decay the carbon stored in these trees will be further released into the atmosphere which in turn adds on to the carbon dioxide level in the atmosphere. Hence this shows clean evidence on how the urban greeneries influence the air temperature and energy use in the buildings and consequently alter carbon emissions from numerous urban sources (e.g., power plants). This shows the direct relationship between the urban trees and the local climate, climate change, energy use and mineral cycles.

To address the regional carbon stock and carbon sequestration potential, it is necessary to assess the biomass of the region. Among the available methods of biomass assessment, direct measurement is the traditional way of measurement and is most accurate; however, it is laborious and costly. The remote-sensing-based approach has now become the most widely accepted method of biomass assessment due to its spatial, spectral and temporal advantages over the traditional measurements. The satellite remote sensing method can analyse current and near-present carbon-stock dynamics through spectral band imaging. Parameter of satellite imagery used in the process of estimating the biomass is vegetation index. Vegetation index is an index obtained through mathematical operations such as subtraction, addition and the ratio between the near infrared band with a red band of satellite imagery. The use of vegetation indices commonly used to estimate the biomass of which is normalized difference vegetation Index (NDVI).

This part of the report exercised to estimate and predict the biomass, carbon stock, and sequestration potential of College campus through spatial modelling.

The Sky view of Chittur Govt. College

Chittur Government College is situated in a lush green area on the banks of Shokanasini River, a tributary of Bharathapuzha, spread over an area of about 21.12 hectares. The undisturbed riparian zone of the river that flows through the south-western side of the college merges with the college boundary provides a unique environment and aesthetic. By including the riparian zone of the river, the area college is estimated to be approximately 24.5 hectare. Considering the green cover, about 60% area of the college campus is having thick vegetation with diversely enriched trees, herbs, shrubs, climbers, grass and parasites. The high growing trees are the major attraction of the college campus and the tree canopies provides moderate temperature, shade to peoples and more it also reduces pollution.

Fig. 16. **The Sky view**

Methodology

The estimation of the potential of carbon stock of the college campus is measured by the Above Ground Carbon stock i.e. the storage and sequestration potential of the area. Remotely sensed satellite data is a technology to calculate the biomass and ultimately carbon sequestration value of plants in a larger area in quick turnaround time and is cost effective. The vegetation indices (VI) are frequently used to verify the above ground carbon stock calculation (AGC). Landscape scale method (NDVI) is a method of estimation of carbon stocks and were calculated ArcGis software with their specified equations. The map images and spectral data were obtained through Earth Explorer, which is operated by the U.S. Geological Survey (USGS). Landsat 8-9 OLI/TIRS 18th March 2023 were utilized to estimate the vegetation indices (VI) with a resolution of 30 × 30 m.

Vegetation Indices

The Normalized Difference Vegetation Index (NDVI) is a measure of the amount and vigour of vegetation on the land surface. The vegetation index is obtained through mathematical operations such as subtraction, addition and the ratio between the near infrared band with a red band of satellite imagery.

$$NDVI = \frac{(NIR-Red)}{(NIR+Red)}$$

NIR- Near Infrared Band; Red- Red Band

In general, NDVI values range from -1.0 to 1.0, with negative values indicating clouds and water, positive values near zero indicating bare soil, and higher positive values of NDVI ranging from sparse vegetation to dense green vegetation

Carbon Sequestration Potential

In recent times using NDVI to monitor the biomass is found effective. The carbon storage was found to be function of Vegetation Indices. A regression equation was developed to quantify the carbon storage in trees using NDVI as the independent variable and the carbon storage in Mg/pixel. The nonlinear regression equation was derived to estimate the total carbon storage (Lai.2008).

Carbon = a*e (NDVI*b) (where a & b = Coefficient a & b)

The above-ground biomass (AGB) was estimated using doubled the value of Carbon. The Below Ground Biomass (BGB) was 26% of the Above Ground Biomass and the sum of AGB + BGB is Total Biomass. The biomass value was converted into carbon stock by using the conversion factor with the equation (Whittaker & Likens, 1973). Biomass values were multiplied by 0.475 to get carbon storage values of the trees.

Result

The Landsat-derived normalized difference vegetation index (NDVI) has been carried in the study area. The NDVI values varied across the study area and it ranged between 0.14 and 0.42. An NDVI map presented in Figure 1.

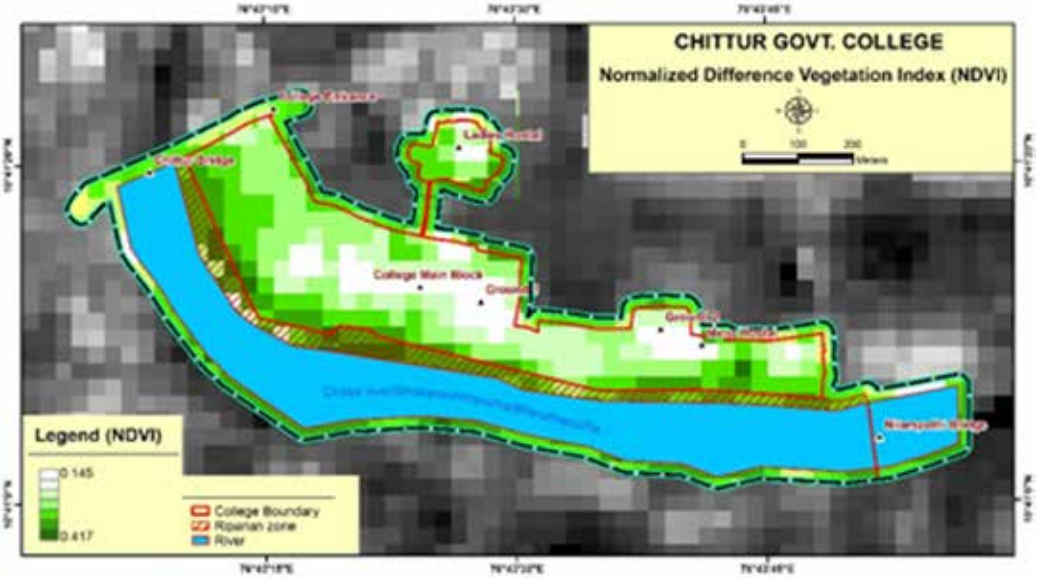


Fig. 17. Vegetation indices map of Chittur Govt. College

The standing biomass of the ground vegetation is a major component capable of storing an immense quantity of atmospheric carbon through the process of carbon sequestration. The college campus is having thick vegetation with woody trees, undisturbed eucalyptus and teak plantation, enormous herbs, shrubs, climbers. creepers, grass and even mushrooms. Based on the vegetation index analysis the green space or green cover areas of the college is about 80 of the total college area. The high growing plant density of the campus is a good indication of the carbon storage potential of the college in terms of its standing biomass. The Above Ground Biomass (AGB) and Carbon Estimation (CS) of the college is calculated using GIS technique and the details are shown below.

Table. 16. Ground Biomass (AGB) and Carbon Estimation (CS)

Sl. No	Parameter	Estimated values (Tonnes)
1.	Above Ground Biomass (AGB)	553.94
2.	Below Ground Biomass (BGB)	144.03
3.	Total Biomass	697.98
4.	Carbon sequestration	314.08
5.	Total CO_2	1152.37

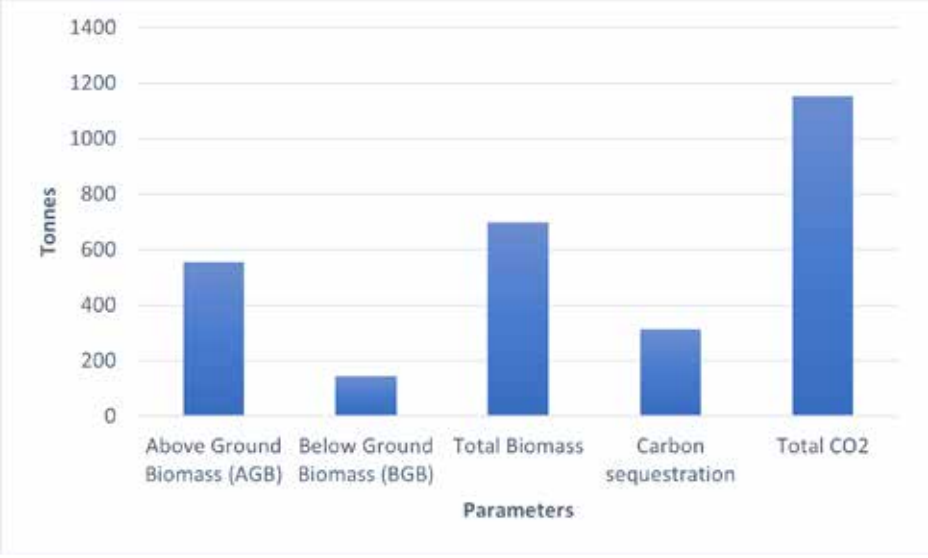


Fig.18. Carbon Stock Assessment in Chittur Government College

The results of the present study shows that the total biomass holding by the campus vegetation is about 697.98 Tonnes and the carbon storage capacity and the amount of total CO_2 is 314 T/Ha and 1152.37 Tonnes, respectively. The green cover of the campus provides better opportunity to sequester carbon and thereby substantially reduce carbon dioxide emission to the atmosphere.

A water audit is a comprehensive assessment of water consumption, usage patterns, and potential inefficiencies within a given system or facility. In the context of educational institutions, conducting a water audit is a crucial step towards promoting water conservation, reducing operational costs, and fostering environmental sustainability. Educational institutions, being centers of learning and influence, have a responsibility to set an example in resource management. A water audit serves as a tool to understand and optimize water usage, thereby contributing to overall sustainability goals.

A water audit is an on-site survey and assessment of water-using hardware, fixtures, equipment, landscaping, and management practices to determine the efficiency of water use and to develop recommendations for improving water-use efficiency (Newcomb, 2008). In simple words, a water audit is a systematic review of a site that identifies the quantities and characteristics of all the water uses. The site may vary from a public water utility, facility (institutional or commercial properties like malls, office, schools etc.) or a household. The overall objective of conducting a water audit is to identify opportunities to make system or building water use more efficient. Since water uses vary greatly from one type of business or institution to another and from site to site, therefore water audit is crucial to determine quantity, nature and quality of water consumption. Water audit for a water utility refers to tracking, assessing and validating all components of flow from the site of withdrawal or treatment through the water distribution system and into the consumer's properties. On the other hand, water audit of an office building would review direction and quantity of water used for domestic, cooling/heating, sanitary and landscaping processes. Whereas, a domestic water use audit examines the major areas in which a facility uses water, including human consumption, personal hygiene & sanitation, washing, cleaning, laundry, gardening etc.

Purpose of a Water Audit: The primary objectives of conducting a water audit in educational institutions are as follows:

Resource Efficiency: Educational institutions often have a substantial water footprint due to numerous buildings, amenities, and large student populations. A water audit helps identify areas where water is being used inefficiently or excessively, allowing for targeted improvements.

Cost Reduction: By identifying leaks, wasteful practices, and inefficient systems, educational institutions can reduce water consumption, leading to significant cost savings in utility bills.

Environmental Sustainability: Efficient water management contributes to the institution's environmental goals by reducing the strain on local water resources, promoting responsible water usage, and decreasing the institution's overall ecological impact.

Benefits and Outcomes: The benefits of conducting a water audit in educational institutions are numerous:

Water Conservation: Reduced water consumption leads to preservation of local water resources and a reduced ecological footprint.

Financial Savings: Lower water consumption results in reduced utility bills, freeing up resources for other essential activities.

Educational Value: The audit process itself can raise awareness about water conservation among students, staff, and faculty, promoting a culture of sustainability.

Public Image: Demonstrating commitment to environmental responsibility enhances the institution's reputation and attractiveness to environmentally conscious students and stakeholders.

Regulatory Compliance: Complying with local and national water regulations and guidelines is essential for avoiding penalties and legal issues.

Steps in Conducting a Water Audit: A thorough water audit involves several key steps:

Data Collection: Gather information about water bills, infrastructure, water-using equipment, and facilities on the campus. This includes assessing the number of water fixtures (faucets, showers, toilets), landscape irrigation systems, cooling systems, and other potential water-consuming sources.

Water Flow Measurement: Install water meters at strategic points throughout the campus to measure water flow accurately. This helps identify patterns of usage and potential leaks.

Site Inspection: Physically inspect the facilities to identify leaks, inefficient fixtures, and wasteful practices. Leaks can be a major source of water loss, and identifying and fixing them promptly is crucial.

Behavioral Analysis: Assess the behavior of staff, students, and faculty members regarding water usage. This can include habits such as leaving taps running or overwatering lawns.

Data Analysis: Analyze the collected data to determine areas of high water consumption, identify trends, and pinpoint inefficiencies. Compare water consumption across different buildings and areas to identify anomalies.

The objective of present study is to evaluate water use and management practices of the institution and identify interventions for improved water use efficiency. This study will help to reduce water consumption for different sections in the institution and identify and quantify the areas of excessive water usage and water losses, suggest ways and means for reduction in water use and losses.

Objectives

- To identify the water sources of the campus
- To find out the pattern and quantity of water usage in the Campus
- To trace the quantity of water wastage in the Campus

Methodology

The water audit for GCC campus included both primary and secondary data collection for various identified water uses.Primary data collection included the following components

- Questionnaire was prepared for various water usage activities.
- Questionnaire survey was conducted.
- Flow rate calculation from the taps flow rates and number of all water using fixtures/ equipment was also undertaken.

The methodology was followed to carry out water audit is described step by step below:

Step 1: Walk through survey

This walk through survey of the facility is to understand the locations of various water supply sources, schematic layout of water supply pipeline networks, intake raw water and process water use etc. Following activities was covered:

» Understanding of existing water sourcing, storage and distribution facility
» Assessing the water demand and water consumption areas/processes within the facility

Step 2: Secondary data collection through discussion with officials and other members of the institute.

This entails collection of secondary data information covering aspects related to layout of the institute and different unit processes, source(s) of water, the supply schematics and available instrumentation along with technical details related to supply (such as capacity of pumps); water supply network diagrams and operational capacities, etc.

Step 3: Data analysis and preparation of detailed water audit report

- Documentation of collected & analyzed water balancing and measurement details; analysis if secondary data and field survey and measurements
- Determine key opportunities for water use reduction, reuse & recycle with paybacks
- Listing of opportunities identified for water conservation based on with cost benefit analysis of each identified option
- Recommendations to maximize water savings and minimize/eliminate water losses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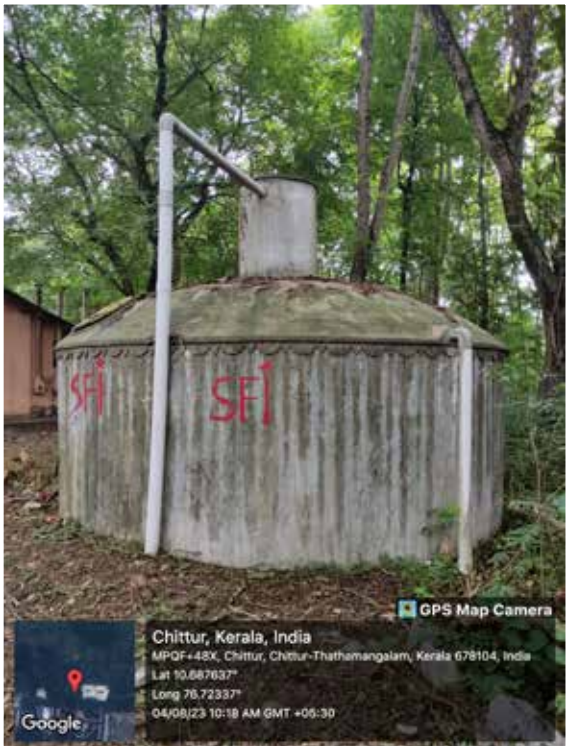
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Table 17 : Seasonal and Monthly Rainfall data (mm) (2011 - 2020)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Rainfall	Winter	Summer	SWM	NEM
2011	0	50	3	78	34	485	329	240	111	58.5	219	24	1631.5	50	115	1165	301.5
2012	0	0	0	62	26	164.4	156	165.7	72.7	149.4	89.4	0	885.6	0	88	558.8	238.8
2013	0	6.6	0.6	9.2	36.8	432.2	590.6	177.8	143.5	91.3	48	17	1553.6	6.6	46.6	1344.1	156.3
2014	0	0	0	3	144.3	251.6	512.3	374.8	205.6	268	21.4	6.2	1787.2	0	147.3	1344.3	295.6
2015	0	0	4.2	243.2	229	267.8	169.8	196	157.8	78.8	71.4	10.2	1428.2	0	476.4	791.4	160.4
2016	0	0	0	0	76.2	212.6	232.5	123	24.4	95.6	13.2	49	826.5	0	76.2	592.5	157.8
2017	0	0	44	10.4	110.5	188.6	160.5	261.4	220.8	23.2	35.1	8	1062.5	0	164.9	831.3	66.3
2018	0	38.8	26.2	89.1	296	338.8	588.4	603.6	50.6	161.7	40	0	2233.2	38.8	411.3	1581.4	201.7
2019	0	0	9.6	95.2	41.2	150.3	172.4	311.71	50.6	282.7	124.6	9	1247.31	0	146	685.01	416.3
2020	0	0	0	140.5	26	128.4	254.4	341	197.2	87.3	42.6	39.2	1256.6	0	166.5	921	169.1
Total	**0**	**95.4**	**87.6**	**730.6**	**1020**	**2619.7**	**3165.9**	**2795.01**	**1234.2**	**1296.5**	**704.7**	**162.6**	**13912.21**	**95.4**	**1838.2**	**9814.81**	**2163.8**

The figure 19 shows the monthly rainfall data during the last 10 years (2011 -2020). The maximum amount of rainfall received in the month of July (3165.9mm), the minimum in the month of March (87.6 mm) and no rainfall in the month of January. From 2011 to 2020 the maximum rainfall was in 2018 (2233.2mm) and minimum in 2016 (826.5mm).The figure 20 shows that the maximum seasonal rainfall was during the South west monsoon season with its peak in the month of July and least during winter.

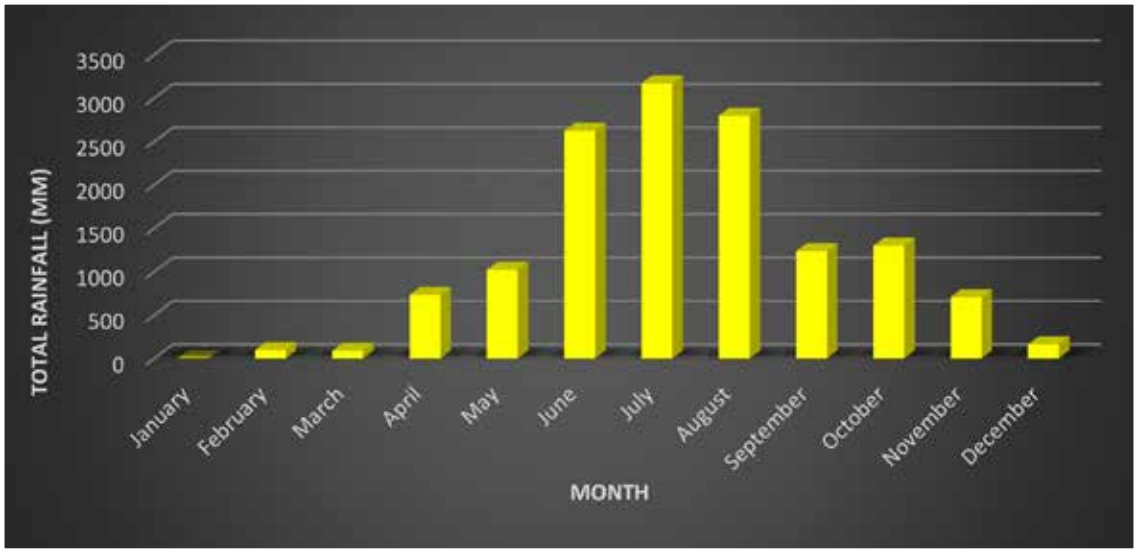


Fig.19 : Monthly Rainfall data (mm) (2011 - 2020)

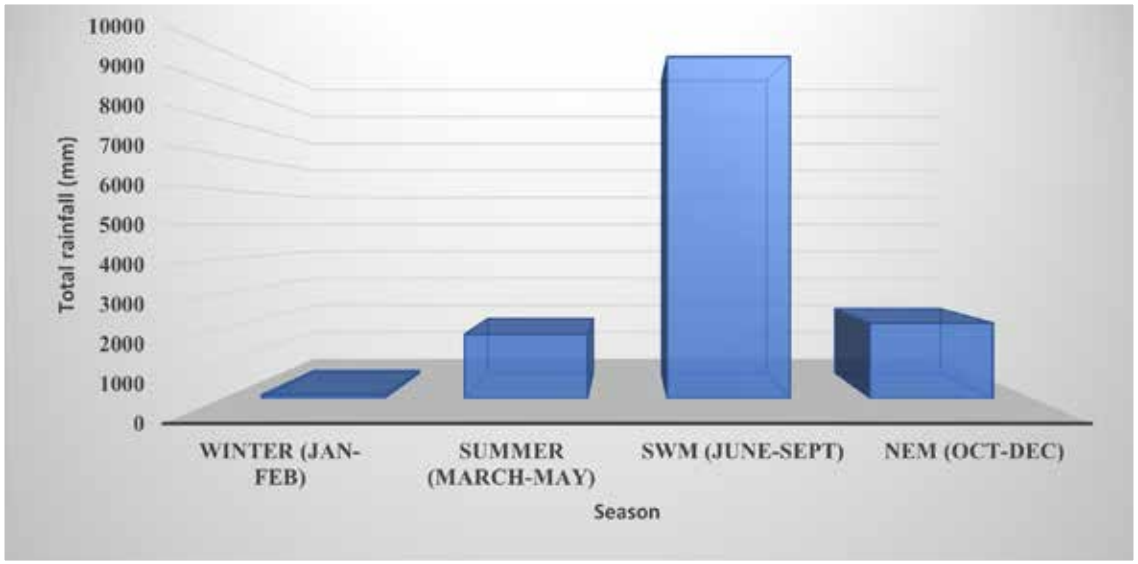


Fig. 20: Seasonal Rainfall data (mm) (2011 - 2020)

BASIC DATA

The total number of students in the campus during the academic year 2022-23 is 2161. The total staff strength of the campus is 135, which includes 95 teaching and 40 non-teaching staffs.

SOURCES OF WATER

The major sources of water for the campus is an open well and 4 borewells (depth). The water from the wells are pumped out using 6 motors ie., 3 for the campus, 2 for girls hostel and 1 for boys hostel (working time).

WATER STORAGE

Table 18 : Storage Capacity (in litres)

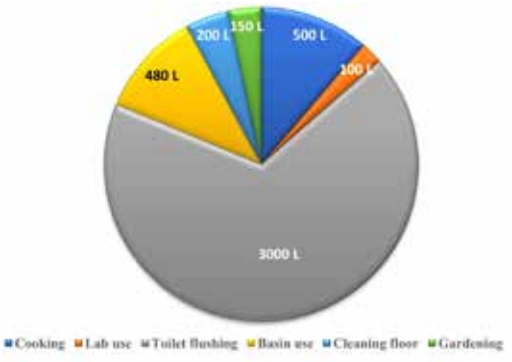
Sl. No.	Capacity of tank	Nos	Total
1.	500	5	2500
2.	1000	5	5000
3.	2000	8	16000
4.	3000	8	24000
5.	5000	1	5000
Total		**29**	**52500**

WATER USAGE

The water usage can be referred to as water used for various activities like usage in the canteen, hostels, academic blocks, gardens etc. The water usage in the campus include both drinking purpose and non-drinking purposes. The non-drinking purposes include, laboratory use, toilet, gardening, cleaning etc. The campus has an administrative office, academic blocks, conference and cultural infrastructure and canteen.

Table:19 Activity wise water use

Sl. No.	Activity	Water use in litres/day	Water use in litres/year	% of total use
1.	Cooking	500	102000	11.3
2.	Lab use	100	20400	2.26
3.	Toilet flushing	3000	612000	67.7
4.	Basin use	480	97920	10.83
5.	Cleaning floor	200	40800	4.51
6.	Gardening	150	30600	3.4
	Total	4430	903720	100



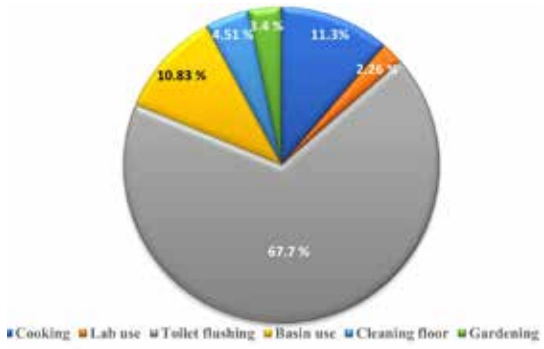


Fig: 21. Total water use in the campus (in litres) Fig: 22.Total water use in the campus (in percentage)

A total of 4430 and 903720 litre water is used daily and yearly respectively in the campus. From the data gathered, it is evident that the major portion of water is consumed for toilet flushing (3000 litres/day). 5000 litres of water is used for cooking and 480 litres of water is found to be used for basin use, followed by 200 litres for floor cleaning daily.150 litres used for gardening and 100 litres for laboratory purpose.

Water management practices in the Campus

Water management in college campuses is a vital aspect of promoting sustainability, responsible resource usage, and environmental consciousness. With a significant population of students, faculty, and staff, as well as various facilities, college campuses have the potential to consume substantial amounts of water. Implementing effective water management practices not only reduces water consumption and operational costs but also sets an example for the community and fosters a culture of environmental stewardship.

Key Water Management Practices:

Water-efficient Landscaping:

Opt for native or drought-resistant plants that require less water for irrigation.

Install efficient irrigation systems, such as drip irrigation or smart controllers that adjust watering schedules based on weather conditions.

High-efficiency Fixtures:

Replace old and inefficient faucets, toilets, and showers with WaterSense-certified fixtures that use less water without compromising performance.

Install automatic faucets and motion-sensor flush systems to reduce unnecessary water wastage.

Leak Detection and Repair:

Regularly inspect plumbing systems for leaks and promptly address any issues.

Utilize water meters to monitor usage patterns and detect abnormal consumption, indicating potential leaks.

Greywater Recycling:

Implement systems to treat and reuse greywater (wastewater from sinks, showers, and

laundry) for non-potable purposes like landscape irrigation and toilet flushing.

Rainwater Harvesting:
Collect rainwater from rooftops and other surfaces to be stored and used for landscape irrigation, reducing the need for potable water.

Awareness and Education:
Conduct educational campaigns to raise awareness about responsible water usage among students, faculty, and staff.

Organize workshops, seminars, and events that promote water conservation practices and provide practical tips.

Monitoring and Data Analysis:
Utilize water meters and monitoring systems to track water consumption across different buildings and areas.

Analyze consumption data to identify trends, anomalies, and areas where improvements can be made.

Water-saving Technologies:
Implement technologies like low-flow aerators on faucets, dual-flush toilets, and waterless urinals to minimize water usage.

Sustainable Building Design:
Integrate water-efficient design principles into new construction and renovation projects, such as using water-efficient cooling systems and rainwater collection systems.

Collaboration and Partnerships:
Work with local water authorities, NGOs, and environmental groups to leverage expertise, resources, and funding for water conservation initiatives.

Benefits of Effective Water Management:

Resource Conservation:
Efficient water management reduces strain on local water resources, ensuring their long-term availability.

Cost Savings:
Reduced water consumption translates to lower utility bills, freeing up resources for other campus needs.
Environmental Responsibility: Implementing sustainable water practices demonstrates the institution's commitment to environmental stewardship and sustainability.

Educational Impact:
Campus-wide water conservation efforts educate students and staff about their role in preserving natural resources.

Community Influence:
College campuses can serve as models for the community, inspiring others to adopt water-saving practices.

Water harvesting:
A Tank of 5000 liters has been constructed in the campus, which preserves the rain water from the roof of the main building as an independent watersupply during the summer season. Initiatives have been done to build such tanks infeasible areas.

Conclusion:
A water audit in educational institutions is a strategic approach to sustainable water management. By analyzing water consumption patterns, identifying inefficiencies, and implementing targeted interventions, institutions can contribute to water conservation, cost reduction, and environmental sustainability. A successful water audit not only benefits the institution itself but also sets an example for students and the community at large, promoting responsible resource management for a more sustainable future. Water management practices in college campuses are integral to creating a sustainable, eco-friendly environment that aligns with global efforts to conserve water resources. By implementing water-efficient technologies, promoting responsible usage behaviors, and fostering a culture of conservation, college campuses can play a significant role in reducing water consumption, minimizing their environmental impact, and educating future generations about the importance of water stewardship.

WATER QUALITY ASSESSMENT

Background

Water is basic forever. From the time that primeval species ventured from the oceans to live ashore. Chemically, it is transparent, colorless, tasteless compound of hydrogen and oxygen (H_2O). Water is additionally found in strong state as ice and gaseous state as vapors (Popkin et al., 2010 and Linton, 2010). All living beings, including humans require water for their survival. Therefore, guaranteeing that sufficient supplies of water are accessible is fundamental for person. A typical clarification is that despite the fact that there is a considerable measure of water on earth, just around 2.5% is freshwater, and in light of the fact that the majority of water is put away as icy masses or profound ground water just a little measure of water is effortlessly available (Oki and Kanae, 2006).

Human activities consume and pollute a lot of water. At a global scale, most of the water use occurs in agricultural production, but there are also substantial water volumes consumed and polluted in the industrial and domestic sectors. Water consumption and pollution can be associated with specific activities, such as irrigation, bathing, washing, cleaning, cooling and processing. Total water consumption and pollution are generally regarded as the sum of a multitude of independent water demanding and polluting activities.

Water quality can be defined as the chemical, physical, biological, and radiological characteristics of water, and it is a measure of the condition of water relative to the requirements of one or more biotic species and or to any human need or purpose. It is most frequently used by reference to a set of standards against which compliance, generally achieved through treatment of the water, can be assessed. The most common standards used to assess water quality relate to health of ecosystems, safety of human contact, and drinking water. Bureau of Indian standard, World health organization (WHO) and Indian standards are the most commonly using standards of water.

The water quality analysis is mainly based on physical factor, chemical factor and biological factor.

- Physical Factors/physical parameter- including Temperature, pH, colour, conductivity, odour, taste, turbidity, suspended solids, dissolved solids etc
- Chemical Factors/ chemical parameters- including Hardness, fluoride, calcium, Alkalinity, magnesium, nitrate, chloride, phosphate, sulphate, BOD, COD, Nitrate
- Biological Factors /biological parameters- including Total Coliform, Faecal Coliform, MPN etc.

Methodology

The water sample collection was carried out during the field visits. The water samples from Bore well, open well and River water sources were taken from three different places of the campus. The sample collection, preservation, and analysis were done in the scientific manner as prescribed by the standard procedures.

Results

Water samples from three different locations were collected and analyzed for its quality parameters. The samples include Bore well, well water which are the main water source of the college campus and river water. The samples were collected, preserved and transported to Environmental Monitoring and Analysing Laboratory (EMAL) and analyzed for various physio-chemical and bacteriological parameters. The major parameters analyzed include dissolved oxygen, acidity, alkalinity, chloride, hardness, pH, conductivity, total dissolved solids and salinity. The results are presented in the Table 20. The results are comparable with the values of drinking water standards prescribed by different agencies.

Bore well water: Total Dissolved Solids, Total Hardness, Total Alkalinity, Calcium and Magnesium of the water sample are found to be above the acceptable limit as per IS10500-2012. All the other tested water quality parameters are found to be within the acceptable limit as per IS10500-2012 drinking water specification.

Well water: Total Dissolved Solids, Total Hardness, Total Alkalinity, Calcium and Magnesium of the water sample are found to be above the acceptable limit as per IS10500-2012. All the other tested water quality parameters are found to be within the acceptable limit as per IS10500-2012 drinking water specification.

River water : Total Hardness and Total Coliform of the water sample are found to be above the acceptable limit as per IS10500-2012. All the other tested water quality parameters are found to be within the acceptable limit as per IS10500-2012 drinking water specification.

Table 20. Results of the physico, chemical and bacteriological parameters of GCC Campus

No	Parameters	Bore Well	Well water	River Water
1.	pH	7.4	7.8	7.9
2.	Colour (CU)	BDL	BDL	4
3.	Odor	Agreeable	Agreeable	Agreeable
4.	Turbidity (NTU)	BDL	BDL	BDL
5.	Conductivity (µS/cm)	988	898	453
6.	Total Dissolved Solids (mg/L)	636	594	303
7.	Total Hardness as CaCO3 (mg/L)	368	360	208
8.	Total Alkalinity as CaCO3 (mg/L)	350	364	190
9.	Calcium (mg/L)	87	84	54
10.	Magnesium (mg/L)	36	36	17
11.	Chloride (mg/L)	106	77	37
12.	Nitrate - NO3 (mg/L)	2	4	5
13.	Iron (mg/L)	0.1	0.1	0.2
14.	Sulphate (mg/L)	32	25	29
15.	Total Coliform (CFU/100mL)	Absent	Absent	150
16.	Faecal Coliform (CFU/100mL)	Absent	Absent	Absent

pH

pH is one of the most important and frequently used test in water chemistry. It is a measure of intensity of acidity or alkalinity. pH is an important water quality parameter, which influences the biological, physical and chemical process within a water body. The pH variations of three water sources are shown in table 20 & Fig. 23 In the present study, the pH values of Bore well, Well water and river water samples are 7.4, 7.8 and 7.9 respectively. The results of the pH value are found to be within the acceptable limit as per IS10500-2012 drinking water specification.

Electrical Conductivity (EC)

Electrical conductivity is a measure of the concentration, dissociation as well as the migration of ions in the solution. It is directly proportional to dissolved mineral matter content and becomes an indicator of dissolved ions present in the water samples.

The EC variations of three water sources are shown in Table 20 & Fig. 24 In the present study, the EC values of Bore well, Well water and river water samples are 988 µS/cm, 898 µS/cm and 453 µS/cm respectively. In the present study, the values of electrical conductivity of various water sources were within the permissible limits for drinking water.

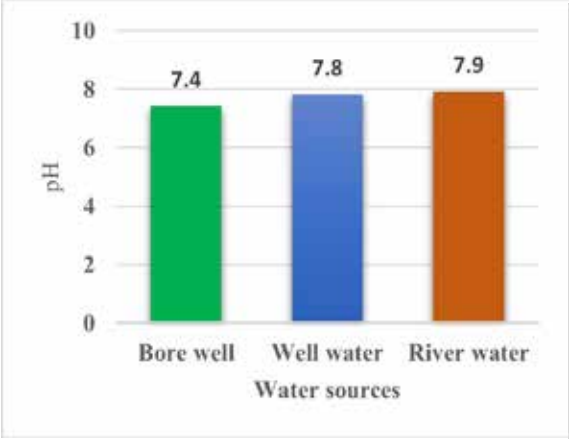


Fig. 23. pH of different water sources of Government College, Chittur

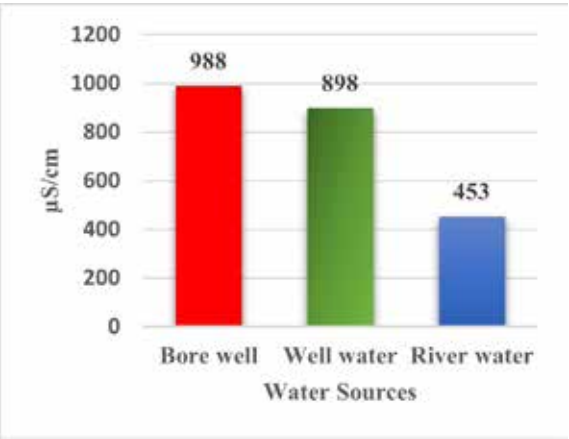


Fig.24 Electrical Conductivity of different water sources of Government College,Chittur

Total Dissolved Solids (TDS)

Total Dissolved Solids is a measure of the combined content of all inorganic and organic substances. Total Dissolved Solids were measured by using a digital TDS meter. Among the samples, the highest values of TDS was found at Bore well water (636 mg/L) and well water (594 mg/L) and the lowest at river water (303 mg/L). The water samples of Bore well and well water are found to be above the acceptable limit as per IS10500-2012 (Table 20 & Fig. 25).

Total Hardness (TH)

The total hardness is an index of water quality with considerable significance in connection with the discharge of agricultural wastes. Hardness of water is not a specific constituent but is a variable and complex mixture of cations and anions. It is caused by dissolved polyvalent metallic ions.The results of the present study showed that the value of total hardness of ground water samples was maximum at Bore well water (368 mg/L) and well water (360 mg/L) and the lowest at river water (208 mg/L). The water samples of all water samples are found to be above the acceptable limit as per IS10500-2012 (Table 20 & Fig. 26).

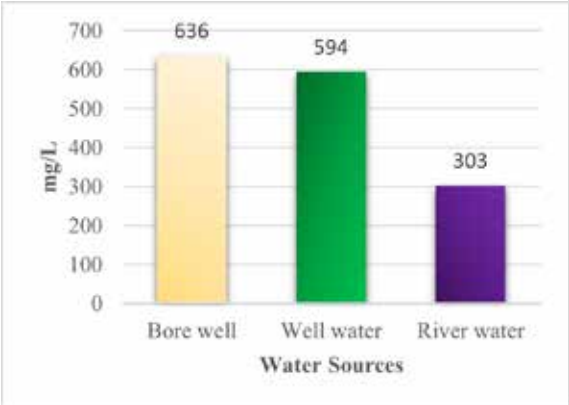


Fig. 25 TDS of different water sources of Government College, Chittur

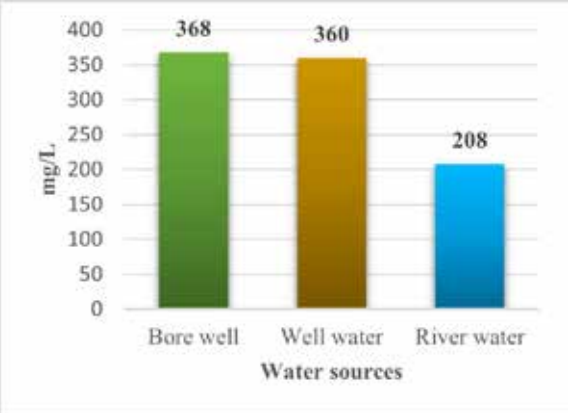


Fig. 26 Total Hardness of different water sources of Government College, Chittur

ALKALINITY

The alkalinity of a water is a measure of its capacity to neutralize acids. The alkalinity of natural or treated water is due to the presence of bicarbonate, carbonate and hydroxide compounds of calcium magnesium, sodium and potassium, Borates Phosphates and silicate also contribute to alkalinity. The determination of alkalinity provides an idea of the nature of salts present.The alkalinity of Bore well, well and river water samples are 350 mg/L, 364 mg/L and 190 mg/L respectively (Table 20 & Fig. 27). The alkalinity of Bore well and well water are found to be above the acceptable limit as per IS10500-2012.

Chloride (Cl-)

Chloride in the form of chlorine ions is one of the major inorganic ions in water. The presence of chloride in natural waters can be attributed to the dissolution of salt deposits, discharges of effluents from chemical industries, sewage discharges etc. Table 20 & Fig. 28 shows the concentrations of Chloride in various water sources of Chittur college. In bore well water, the concentration of Cl-was 106 mg/L. The well water sample the Cl-concentration was77 mg/L and river water 37 mg/L.

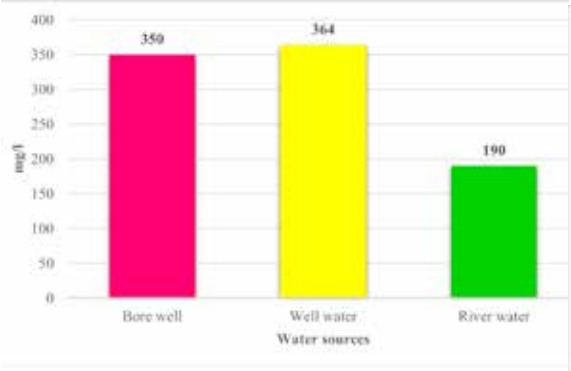


Fig.27 Total Alkalinity of different water sources of Government College, Chittur

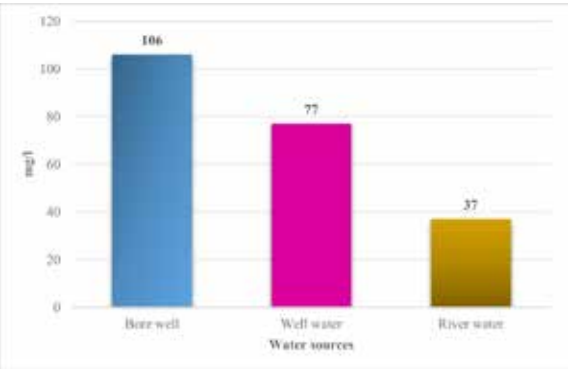


Fig.28 Chloride of different water sources of Government College, Chittur

Sulphate, Calcium and Magnesium

Sulphates occur naturally in water as a result of leaching from gypsum and other common minerals. In addition, sulphates may be added to water system in several treatment processes. Sulphate cause a problem of sealing in industrial water supplies and problem of odour and corrosion in waste water treatment due to its hydrogen sulphide.The sulphate concentration of Bore well, well water and river water samples are 32 mg/L, 25 mg/L and 29 mg/L respectively. The calcium concentrations of Bore well, well water and river water samples are 87 mg/L, 84 mg/L and 54 mg/L respectively. The magnesium concentrations of Bore well, well water and river water samples are shown as 36 mg/L, 36 mg/L and 17 mg/L respectively (Table 20 & Fig.29).

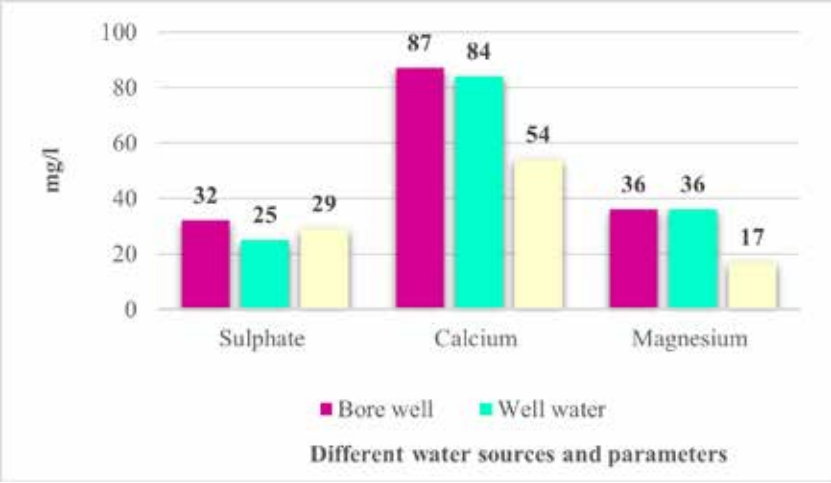


Fig. 29 Sulphate, Calcium and Magnesium of different water sources of Government College, Chittur

Iron

Iron is the most abundant element in the earth's crust. In water it occurs mainly in the divalent and trivalent (ferrous and ferric) states. Iron is present in significant amounts in soils and rocks, principally in insoluble forms.The Fe concentration of the water samples are 0.1 mg/L (both bore well and well water samples) and 0.2 mg/L of river water sample (Table 20 & Fig.30).

Nitrate

The presence of nitrate in water indicates organic pollution. Significant sources of nitrate are chemical fertilizers, domestic effluents, industrial discharge etc. Excessive concentration in drinking water is considered hazardous for infants because in their intestinal track nitrates are reduced to nitrites which may cause methemoglobinaemia. Nitrate is determined by cadmium-reduction techniques as well as phenol disulphonic acid method.Nitrate concentration in the water samples from 2mg/l (Bore well), 4 mg/L (well water) and 5 mg/l (river water) respectively (Table 20 & Fig.31).

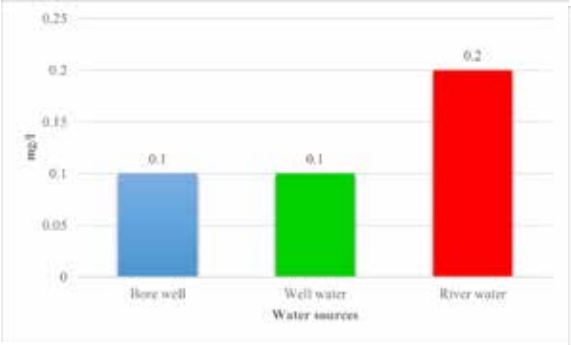


Fig.30 Iron of different water sources of Government College, Chittur

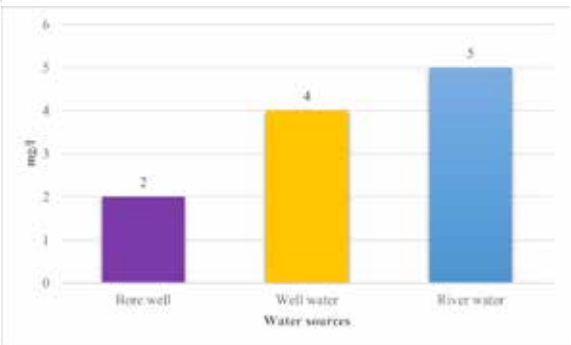


Fig. 31 Nitrate of different water sources of Government College, Chittur

Bacteriological Analysis (Total coliform and Faecal coliform)

The table 20 shows that results of TC and FC of different water samples at Govt. college Chittur. The TC and FC were absennt in both the bore well and well water samples. In the case of river water sample, TC was present and the FC was absent. The absence of TC and FC suggests that the water samples are not in bacteriological contamination. But in the case of river water sample, the Total Coliform of the water sample is found to be above the acceptable limit as per IS10500-2012.

Environmental Monitoring and Analytical Laboratory
Approved by Kerala State Pollution Control Board
Approval No. PCB/LAB/C54/2022
28/112, T& T Residency, Near R V Clinics, West Fort Road, Palakkad, Kerala- 678001
Email: emal.plkd@gmail.com, Ph.No : 9188309331

TEST REPORT

REPORT NO : EMAL/WA 852/2023

REPORT DATE : 21-08-2023

CLIENT NAME & ADDRESS

Dr. Richard Scaria
Associate Professor
Dept. Geography
Government College
Chittur

SAMPLE REFERENCE ID: WA 852

SAMPLE RECEIPT DATE : 17-08-23

PERIOD OF ANALYSIS : 17-08-2023 to 21-08-2023

SAMPLE DRAWN BY : Customer

SAMPLE SOURCE : Bore Well

I. TEST RESULTS

Sl. No	Parameter	Unit	Test Method	Acceptable Limit as per IS 10500-2012	Result
1	pH	-	*APHA 2017-4500H⁺ B*	6.5-8.5	7.4
2	Colour	CU	*APHA 2017-2120B*	5	BDL
3	Odor	-	*IS:3025 (part5)*	Agreeable	Agreeable
4	Turbidity	NTU	*APHA 2017-2130B*	1	BDL
5	Conductivity	µS/cm	*APHA 2017- 2510B*	-	988
6	Total Dissolved Solids	mg/L	*APHA 2017-2540C*	500	**636**
7	Total Hardness as $CaCO_3$	mg/L	*APHA 2017- 2340C*	200	**368**
8	Total Alkalinity as $CaCO_3$	mg/L	*APHA 2017- 2320B*	200	**350**
9	Calcium	mg/L	*APHA 2017-3500-Ca B*	75	**87**
10	Magnesium	mg/L	*APHA 2017- 3500-Mg-B*	30	**36**
11	Chloride	mg/L	*APHA 2017-4500 Cl B*	250	106
12	Nitrate - NO_3	mg/L	*APHA 2017- 4500 NO_3 B*	45	2
13	Iron	mg/L	*APHA 2017- 3500-Fe B*	1	0.1
14	Sulphate	mg/L	*APHA 2017-4500-SO_4^{2-}*	200	32
15	Total Coliform	CFU/100mL	APHA 2017-9222B	Shall not be detectable in any 100 ml sample	Absent
16	Faecal Coliform	CFU/100mL	APHA 2017- 9222D	Shall not be detectable in any 100 ml sample	Absent

BDL: Below Detection Level

Inferences: **Total Dissolved Solids, Total Hardness, Total Alkalinity, Calcium and Magnesium of** the water sample are found to be above the acceptable limit as per IS10500-2012. All the other tested water quality parameters are found to be within the acceptable limit as per IS10500-2012 drinking water specification.

Analyst

EMAL PALAKKA

Authorized Signatory

Disclaimer: a) The Test results listed refer only to the tested samples and application parameters. b) Total Liability of the lab is to invoiced amount only. c) The test report refers to the sample submitted to the lab and not drawn by EMAL unless mentioned otherwise. d) The test report is not to be reproduced wholly or in part without written permission of the laboratory.

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Email: emal.plkd@gmail.com, Ph.No : 9188309331

TEST REPORT

REPORT NO : EMAL/WA 853/2023

REPORT DATE : 21-08-2023

CLIENT NAME & ADDRESS

Dr. Richard Scaria
Associate Professor
Dept. Geography
Government College
Chittur

SAMPLE REFERENCE ID: WA 853

SAMPLE RECEIPT DATE : 17-08-23

PERIOD OF ANALYSIS : 17-08-2023 to 21-08-2023

SAMPLE DRAWN BY : Customer

SAMPLE SOURCE : Open Well

I. TEST RESULTS

Sl. No	Parameter	Unit	Test Method	Acceptable Limit as per IS 10500-2012	Result
1	pH	-	*APHA 2017-4500H⁺ B*	6.5-8.5	7.8
2	Colour	CU	*APHA 2017-2120B*	5	BDL
3	Odor	-	*IS:3025 (part5)*	Agreeable	Agreeable
4	Turbidity	NTU	*APHA 2017-2130B*	1	BDL
5	Conductivity	µS/cm	*APHA 2017- 2510B*	-	898
6	Total Dissolved Solids	mg/L	*APHA 2017-2540C*	500	**594**
7	Total Hardness as $CaCO_3$	mg/L	*APHA 2017- 2340C*	200	**360**
8	Total Alkalinity as $CaCO_3$	mg/L	*APHA 2017- 2320B*	200	**364**
9	Calcium	mg/L	*APHA 2017-3500-Ca B*	75	**84**
10	Magnesium	mg/L	*APHA 2017- 3500-Mg-B*	30	**36**
11	Chloride	mg/L	*APHA 2017-4500 Cl⁻ B*	250	77
12	Nitrate - NO_3	mg/L	*APHA 2017- 4500 NO_3^- B*	45	4
13	Iron	mg/L	*APHA 2017- 3500-Fe B*	1	0.1
14	Sulphate	mg/L	*APHA 2017-4500-SO_4^{2-}*	200	25
15	Total Coliform	CFU/100mL	APHA 2017-9222B	Shall not be detectable in any 100 ml sample	Absent
16	Faecal Coliform	CFU/100mL	APHA 2017- 9222D	Shall not be detectable in any 100 ml sample	Absent

BDL: Below Detection Level

Inferences: **Total Dissolved Solids, Total Hardness, Total Alkalinity, Calcium and Magnesium** of the water sample are found to be above the acceptable limit as per IS10500-2012. All the other tested water quality parameters are found to be within the acceptable limit as per IS10500-2012 drinking water specification.

Analyst

Authorized Signatory

EMAL PALAKKAD

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28/112, T& T Residency, Near R V Clinics, West Fort Road, Palakkad, Kerala- 678001
Email: emal.plkd@gmail.com, Ph.No : 9188309331

TEST REPORT

REPORT NO : EMAL/WA 854/2023
REPORT DATE : 21-08-2023

CLIENT NAME & ADDRESS

Dr. Richard Scaria
Associate Professor
Dept. Geography
Government College
Chittur

SAMPLE REFERENCE ID: WA 854
SAMPLE RECEIPT DATE : 17-08-23
PERIOD OF ANALYSIS : 17-08-2023 to 21-08-2023
SAMPLE DRAWN BY : Customer
SAMPLE SOURCE : River Water

I. TEST RESULTS

Sl. No	Parameter	Unit	Test Method	Acceptable Limit as per IS 10500-2012	Result
1	pH	-	*APHA 2017-4500H⁺ B*	6.5-8.5	7.9
2	Colour	CU	*APHA 2017-2120B*	5	4
3	Odor	-	*IS:3025 (part5)*	Agreeable	Agreeable
4	Turbidity	NTU	*APHA 2017-2130B*	1	BDL
5	Conductivity	µS/cm	*APHA 2017- 2510B*	-	453
6	Total Dissolved Solids	mg/L	*APHA 2017-2540C*	500	303
7	Total Hardness as $CaCO_3$	mg/L	*APHA 2017- 2340C*	200	208
8	Total Alkalinity as $CaCO_3$	mg/L	*APHA 2017- 2320B*	200	190
9	Calcium	mg/L	*APHA 2017-3500-Ca B*	75	54
10	Magnesium	mg/L	*APHA 2017- 3500-Mg-B*	30	17
11	Chloride	mg/L	*APHA 2017-4500 Cl^-B*	250	37
12	Nitrate - NO_3	mg/L	*APHA 2017- 4500 NO_3^- B*	45	5
13	Iron	mg/L	*APHA 2017- 3500-Fe B*	1	0.2
14	Sulphate	mg/L	*APHA 2017-4500-SO_4^{2-}*	200	29
15	Total Coliform	CFU/100mL	APHA 2017-9222B	Shall not be detectable in any 100 ml sample	150
16	Faecal Coliform	CFU/100mL	APHA 2017- 9222D	Shall not be detectable in any 100 ml sample	Absent

BDL: Below Detection Level

Inferences: **Total Hardness and Total Coliform** of the water sample are found to be above the acceptable limit as per IS10500-2012. All the other tested water quality parameters are found to be within the acceptable limit as per IS10500-2012 drinking water specification.

Analyst

EMAL PALAKKA

Authorized Signatory

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WASTE MANAGEMENT AUDIT

Introduction

Anthropogenic and natural modes are there for the production of the so-called 'unwanted' substances known as wastes. There are different types of anthropogenic wastes which include municipal solid waste (MSW), bio-medical waste (BMW), construction and demolition (C&D) waste, e-waste, industrial waste, and hazardous waste by virtue of their nature. Solid and liquid forms of waste are produced mainly as a result of manmade activities. Scientific and effective management of waste is one of the prior areas for attaining sustainability. Waste management is a serious concern for major countries and governments across the globe. A major share of finance is always allotted or used for the solid waste management of various systems. In many parts of the world, biodegradable waste is occupying a major share of the solid wastes produced. There are many options for sustainable management of biodegradable wastes and such methods are always well appreciated by the governments and concerned departments in the form of fund relaxations or subsidies. Non-biodegradable wastes are also a serious concern, especially in the case of single-use plastics. Presently there is a lack of an effective alternative for plastics which is the main reason behind the extensive and excessive use of single-use plastics. Researchers are seriously trying to find an effective alternative to plastics.

According to recent findings, the annual global production of municipal solid wastes is 2.01 billion tons and is expected to reach 3.40 billion in another 30 years, if time-bound and effective management options are not adopted. One of the highly recommended management options for solid wastes, especially plastics is recycling. However, findings show that the practice of recycling is meager when considering the total production of plastic waste, ie., less than 20 % of the produced waste is properly recycled worldwide annually, remaining 80% end up in landfills or open dumps. According to The Energy and Resources Institute (TERI), India generates over 62 million tons (MT) of waste in a year. Only 43 MT of total waste generated gets collected, with 12 MT being treated before

disposal, and the remaining 31 MT simply discarded in waste yards. The total generation of solid waste in Kerala is 3.7 million tons annually. The total share of biodegradable and non-biodegradable waste is at 69% and 31 % respectively. Waste management must be scientific and sustainable otherwise it can create both environmental, health, and economic drawbacks.

A waste audit is a process for assessing an institution/organization's waste management strategies and actions. The aim is to find out the various types and quantities of waste (paper, plastic, food, e-waste, hazardous, etc.) produced within the campus of the firm, during a specific period. The generation of waste types and waste amounts are explained by the process of waste management audit. The waste audit can bring to attention the current waste performances of the firm, and the existing loopholes of the system and can recommend scientific and sustainable alternatives to address the existing problems.

Significance of Waste Management Audit

- Improper waste management practices can deteriorate the overall environmental status of the campus.
- Waste audit supports a firm to understand the pros and cons of existing waste management systems in the organization.
- Waste auditing helps an organization to adopt better waste management options.
- Enhancing reduce, reuse and recycling practices.
- Overall improvement of the environment.

Objectives of waste audit

- To investigate the current status of solid and liquid waste generated in the campus.
- To examine the status of biodegradable and non-biodegradable waste
- To appraise the prevailing waste disposal methods and suggest measures to improve the existing waste management strategies.

Waste Management Audit of the College

Pilot-level assessment of the waste management activities started at the end of July 2023. Overall waste management activities were enlisted during the pilot level study. Following this, an integrated waste management audit was done by the audit team from 3-5 August 2023.

Methods adopted

The audit team has done campus walks, visited all the buildings and compounds, and has done direct field observations. The team has collected the details of existing waste management practices on the campus. Recording of the existing waste management practices was done in the form of photographs and video. The generation of the waste and its management measures in each department, block, office, and hostel were recorded. Face-to-face interaction and discussion with staff involved in the waste management activities of the campus were also conducted. Both pros and cons of the existing waste management activities were noted down by the audit team.

The waste management audit team

Audit team interacts with staffs involved in waste management

Observations and Findings

Different types of waste are generated from the different departments and blocks of the college. The campus is trying for source-level waste reduction to control the quality and quantity of solid waste. Source-level segregation of solid wastes, especially paper and plastic is well appreciated on the campus. The waste bins were labelled properly for the convenience of the users.

Properly labelled waste bins for source level waste collection

Properly labeled waste bins for source level waste collection

The campus has a green campus committee, which strictly regulates the use of single-use plastics in the campus. The green campus committee has insisted the students and staff adhere to the green protocols for various campus activities and programs. Also, the committee has a lead role in establishing waste bins in each department. The audit team noticed that a total of 131 waste bins were placed in specific points for source-level disposal and segregation of solid wastes. The campus is sincerely trying for the source level segregation of the solid wastes especially used papers and plastics. The green protocol committee has placed many sign boards on the campus which create awareness among the campus fraternity about the importance of waste management.

Name board carrying green messages placed in the Main building

Green message display board placed near 'Vanajam Auditorium

The types of wastes existing on the campus during the time of audit include both biodegradable and non-biodegradable. The waste types include electronic, plastic, paper, chemical, garden waste, and food waste. The waste management audit found that the quantity of waste generated on the campus is 785.194 kg per year.

Table 21: Status of solid wastes in the campus

Types of Waste	Particulars	Disposal Method
E- waste	Computers, Electrical and electronic parts	It is dumped in the departments itself.
Plastic waste	Pen, Refill, Plastic water bottles, Otherplastic containers, Wrappers, etc.	Collected by Municipality
Solid waste	Damaged furniture, Paper waste, Paperplates, Food waste	Non bio degradable wastes are collected by municipality and bio wastes are disposed in the campus itself.
Chemical waste	Lab waste	Recycling
Waste water	Washing, Bathrooms	To septic tank
Glass waste	Broken glass wares from the lab	Dumping in the campus
Sanitary napkin	Pads and clothes from washrooms	Vending machines
Food Waste	From canteen	Disposed and composted in campus itself
Waste Paper	Answer sheets, assignments note etc.	Burning

The chemical waste generated on the campus through chemistry laboratories is in both solid form and liquid form. Usually, there is a practice in the laboratories to store these hazardous chemicals in containers and cans for safe disposal.

Outdated chemicals & broken glass vessels kept for sorting and safe disposal

E-waste generated in the institute for many decades is recently kept ready for handing over for recycling. Approximately 300 kilograms of E-waste is kept in the Physics department for handing over to the concerned agencies. Plastic waste was collected by the municipality at regular intervals. Toilet wastes were stored in the septic tanks and were collected by the municipality by using vacuum collection units at regular intervals.

The wastage of food is minimal on campus due to the strict sense implementation of the green protocol. The biodegradable wastes from the canteen were subjected to open dumping and composting processes. The study team could find a biogas plant placed near the canteen, but not in a working condition. Proper maintenance of the biogas plant can be adopted and can use the biogas plant as a good source of renewable energy from wastes. The food wastes from the men's hostel are used for feeding cattle in the nearby locality and were also carried to a cattle farm regularly. The required supply of feed for the biogas plant can be met by collecting food wastes from various departments, hostels, and canteen and dry leaves and plant debris from the campus.

Biogas plant near the canteen which requires maintenance

Table 22 : Department wise waste generation and quantity (kg/year)

Department	Biodegradable (kg/year)	Non bio degradable (kg/year)	E-wastes
Botany	40.8 kg	8.16	300kg e wastes dumped in the Dept.
Physics	40.8 kg	9.18	
English	18.36	8.16	
Electronics	6.12	9.18	
Mathematics	3.06	3.06	
Chemistry	3.06	1.02	
Zoology	2.04	2.04	
Philosophy	8.16	3.06	
Tamil	0.53	3.06	
Economics	1.02	2.04	
History	20.4	4.08	
Geography	3.264	8.16	20 Kg
Malayalam	24.48	10.2	8 kg
Music	2.04	9.18	
Commerce	20.4	4.08	
Office	19.2	57.6	
Laboratories	54	8.4	20
Canteen/ Kitchen	2.4	14.4	2kg
Grand Total	**270.134**	**165.06**	

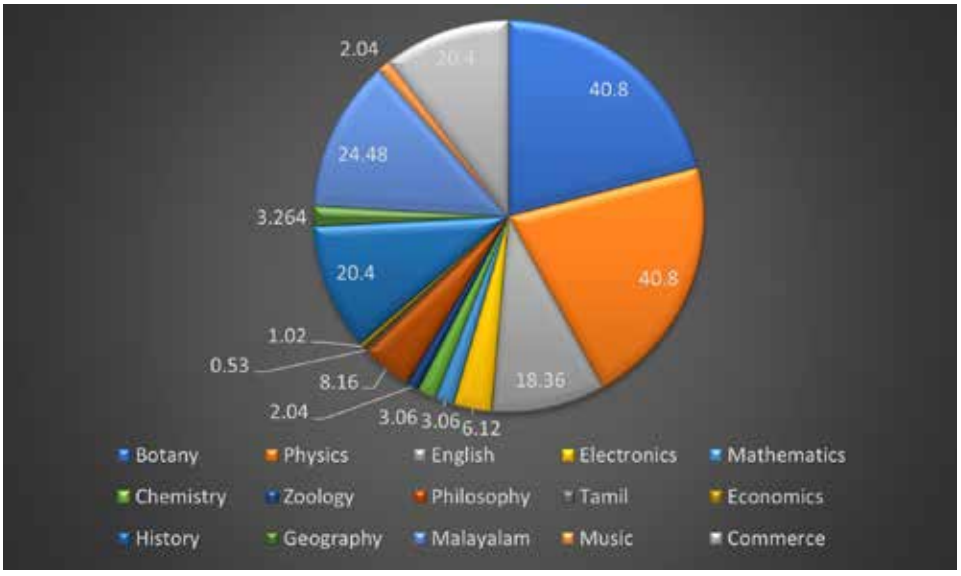

Fig. 32 : Dept. wise biodegradable waste generation (kg/year)

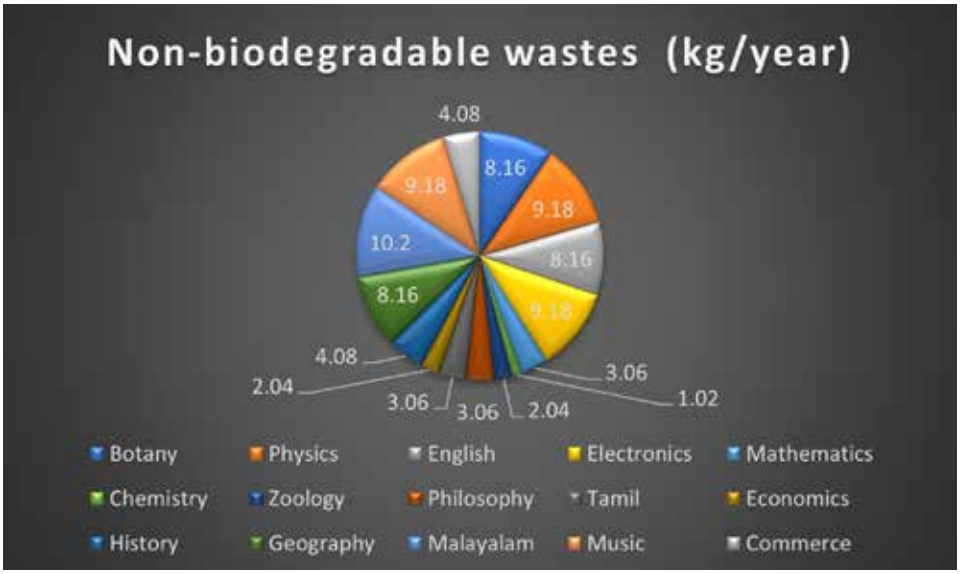

Fig. 33: Dept. wise non-biodegradable waste generation (kg/year)

Among Departments, the Botany and physics generate the highest quantity of biodegradable wastes, and the Dept. of Malayalam produces the highest quantity of non-biodegradable wastes. For many decades, electronic waste has been dumped in the physics Dept. and the college is planning for its scientific recycling by handing it over to concerned agencies.

Table 23: Waste generation status at Office

Bio-degradable (kg/year)	Non-biodegradable (kg/year)
19.2	**57.6**

Table 24: Waste generation at Laboratories

Bio-degradable (kg/year)	Non-biodegradable (kg/year)	e-waste (kg/year)
54	**8.4**	**20**

Table 25: Waste generation at Canteen/Kitchen

Bio-degradable (kg/year)	Non-biodegradable (kg/year)	e-waste (kg/year)
2.4	**14.4**	**2kg**

Both biodegradable and non-biodegradable wastes in the ladies' hostel are a serious concern since the scientific management practices are lacking. Among 322 inmates of hostels, 228 inmates were staying in the ladies' hostel and 94 in the gent's hostel. Open burning of plastic wastes and open drains were seen close to the ladies' hostel, creating an unhealthy ambiance in the surroundings of the hostel. It is also noted that the napkin vending machines in the ladies' hostel are not working. Napkin destroyers placed on the campus are also not in working condition.

Open drain with liquid wastes,
close to the ladies' hostel

Shattered plastic wastes
close to the open drain

Waste dumping and burning practices
close to a Ficus tree, near ladies' hostel

Napkin destroyer near women
amenity center in the campus

Open dumps of solid wastes were seen near the Chemistry Department. The solid wastes comprise construction waste, electronic waste, Glass waste, PVC pipes, and the like. Open burning is also noticed in the locality, which is not at all advisable.

Open dump yard in the campus

Damaged furniture dumped in many rooms and roofs of the campus was occupying much space and thus a serious concern. Source-level segregation of solid waste is lacking in some of the pockets.

Broken furniture dumps in the room and roof of the college

Healthy practices of Waste Management on the campus

- The college has a very active green protocol committee, which is monitoring the overall eco-friendly waste management of the campus
- A display board in the front of the campus, near 'Vanajam Auditorium' showcasing the significance of adopting a green campus protocol is well appreciated since it can provide the campus fraternity a sense of keeping the campus clean and green
- Waste bins for paper waste and plastic waste were placed in almost all key points including the departments, office buildings, canteen, hostels, etc.
- The College avoids flowers covered in plastic coverings and flex goods during Public functions.
- Promotes cloth banners, metal boards, and electronic displays instead of flex andother plastic hoardings, thus to reduce the plastic waste mess.
- Single-use plastic is strictly banned on campus which results in the reduction of plastic waste to a considerable amount.
- Solid waste is segregated at the source itself and several dust bins are placed in each building from where housekeeping staff takes the waste regularly.
- The college employs an adequate number of cleaning staff for the collection, Segregation, and disposal of waste.
- The students respect the value of food, thus the wastage of food in the departments was meagre. Also, a responsible culture of dining is motivated on the campus to avoid wasting food.
- Proper labelling of waste bins (plastic/Paper) in most of the places was very well appreciated.
- Overall eco-friendly approach of the campus must be appreciated.
- Color-coded waste bins for waste segregation are promoted on the campus.

Recommendations:

- Open dumps of solid wastes observed by the audit team in several pockets including the backyards of the canteen, near the chemistry gallery, History department, and women's hostel must be addressed seriously
- Mix of paper and plastic waste in bins is noticed at some points. Strict sense source level segregation must be implemented and awareness to students and teachers is mandatory in this regard.

- Solid wastes, food wastes, and liquid wastes were mixed up and formed an open drain near the ladies' hostel. This creates an unhealthy, smelly, and unaesthetic ambiance. This is one of the serious concerns which has to be addressed seriously
- Provide a sufficient number of waste bins for the gent's hostel.
- Old stocks of furniture, books, newspapers, electronic wastes, and chemicals are seen in many premises. Adoption of necessary formalities for clearing out of such old stocks is required.
- Maintenance of Napkin vending machines, napkin destroyers, and biogas plants on the campus must be addressed.
- Effective waste management programs on the campus require periodic appraisal of different kinds of waste and its quantified data. This can be performed through various student clubs.
- A waste management committee involving faculties and students should be formed for the proper monitoring of waste management activities on the campus.

Conclusion:

The practices, findings, remarks, and recommendations emphasized in this waste management audit report will help to improve the waste management practices and resource usage at the college. This may help to guide the authorities in framing appropriate strategies for a green campus and sustainable environment.

GREEN INITIATIVES AND OUT REACH PROGRAMMES

TEAM OUTLOOK

"ഭരണഭാഷ മാതൃഭാഷ"

ചിറ്റൂർ സർക്കാർ കോളേജ് പ്രിൻസിപ്പാളുടെ നടപടിക്രമം
ഡോ .അനുരാധ വി.കെ., സ്പെഷ്യൽ ഗ്രേഡ് പ്രിൻസിപ്പാൾ (PEN - 461665)

സർക്കാർ കോളേജ്, ചിറ്റൂർ - ജീവനക്കാര്യം - 2022 -2023 - Environment club committee കൺവീനർ അംഗങ്ങൾ - നിയമിച്ച് - ഉത്തരവ് - പുറപ്പെടുവിക്കുന്നു

ഉത്തരവ് നമ്പർ:B2/1198/2021/GCCTR തീയതി:02.07.2022

പരാമർശം:-ശരണ്യ കെ.പി., കെമിസ്ട്രി വിഭാഗം അസിസ്റ്റന്റ് പ്രൊഫസറുടെ സമർപ്പണം,.

ഉത്തരവ്

2022-2023 അധ്യയനവർഷത്തേക്കുള്ള Environment club committee കൺവീനർ , അംഗങ്ങൾ എന്നിവരെ നിയമിച്ചു ഉത്തരവാകുന്നു .

കൺവീനർ -

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Approval Valid

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പകർപ്പ്,
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(2) അംഗങ്ങൾക്ക്
(3) ഫാക്കൽറ്റി ഇമെയിൽ ഗ്രൂപ്പിൽ പ്രസിദ്ധീകരിക്കുന്നതിന്

ENVIRONMENT CLUB

An environment club in a college is an organization dedicated to promoting environmental awareness, sustainability, and responsible environmental behavior among the college community. The primary goal of an environment club is to educate students and faculty about environmental issues and to encourage them to take action to protect the environment. An environment club can educate students about the importance of environmental sustainability, and the impacts of human activities on the environment. The club can create awareness campaigns that focus on reducing pollution, conserving resources, and preserving biodiversity. An environment club incolleges can play avital role inpromoting environmental sustainability, fostering civic engagement, and building a community of environmentally conscious individuals.

Programmes organized by Environment club of Government College, Chittur during theyear 2022-2023

- National forest week observation-planting bamboo saplings
- Ozone day observation- Colouring competition
- Champions of Earth-Pickand Plop Down Plastic Pens
- Participation of students in national conference "Youth with Scientists" organizedby SAPCC
- URJJAKIRAN2022-Energy conservation awareness programme - Rally
- URJJAKIRAN2022-Energy conservation awareness programme - Signature Campaign
- URJJAKIRAN2022-Energy conservation awareness programme- Short Video Making Competition
- URJJAKIRAN2022-Energy conservation awareness programme - Seminar

ACTIVITY1: National Forest week (Van Mahotsav) observation (5/7/2022)

Vana Mahotsav is an annual tree planting festival that is celebrated in India during the first week of July. It was first started in 1950 by the then Union Minister for Agriculture, K. M. Munshi, to create awareness about the importance of trees and forests. The festival is now celebrated across India, with people from all walks of life coming together to plant trees. The importance of Vana Mahotsav and planting bamboo samplings cannot be over stated. Trees and forests play acrucial role in maintaining the ecological balance of the planet.

As a part of Vana Mahotsav, Environment Club and Green protocol committee of Government college Chittur planted more than 25 bamboo samplings across the banks of Shokanashini, riverflows through the campus, on 05/07/2022. Ms. Jayanthi C. of History department coordinated the programme and Sri. Suresh Kumar A of Botany department took an awareness class on types of bamboo trees and its importance. Teachers and students of various departments have actively participated in the programme. Planting bamboo samplings as part of Vanamahotsav can help tocombat deforestation and desertification, which are major environmental problems in many parts of the world. By planting more tree sand bamboo, we can also improve the quality of life for people in the surrounding are as by providing them with cleaner air, water, and a source of livelihood.

ACTIVITY 2: OZONE DAY OBSERVATION ON 15/9/2022

Every year, 16th September is observed as the International Day for the Preservation of the Ozone layer (World Ozone Day) to commemorate the signing of the Montreal Protocol.The theme of World Ozone Day 2022 is "Montreal Protocol@35: global cooperation protecting life on earth". Ozone Day observance provides an opportunity to raise awareness among college students about the importance of ozone layer protection and the harmful effects of ozone depletion. Observing Ozone Day in colleges promotes the idea of environmental responsibility among students. It encourages them to take proactive measures to protect the environment and create a sustainable future. Overall, observing Ozone Day in colleges can contribute to creating a more informed and environmentally conscious student body, which can have a positive impact on the future of the planet. Keeping thisin our mind Environment club has organized a coloring competition for College students on the topic "Ozone for Life". Dr. Anuradha V. K. officially inaugurated the function and Dr. Ambili K. U. took an awareness session on ozone and its importance. First and second prize winners were awarded with cash prize.

ചിത്രരചനാ മത്സരവുമായി ചിറ്റൂർ ഗവ. കോളജിന്റെ ഓസോൺ ദിനാചരണം

ചിറ്റൂർ• ഓസോൺ ദിനാചരണത്തിന്റെ ഭാഗമായി ഗവ. കോളജിലെ പരിസ്ഥിതി ക്ലബ്ബിന്റെ ആഭിമുഖ്യത്തിൽ കളർ ചിത്രരചനാ മത്സരം സംഘടിപ്പിച്ചു. 'ഓസോൺ-ജീവനും ജീവിതത്തിനും' എന്ന വിഷയത്തിലായിരുന്നു ചിത്രരചനാ മത്സരം സംഘടിപ്പിച്ചത്.

പ്രിൻസിപ്പൽ ഡോ. വി.കെ.അനുരാധ ഉദ്ഘാടനം ചെയ്തു. തുടർന്ന് 'ഓസോൺ പാളിയുടെ സംരക്ഷണ പ്രാധാന്യം' എന്ന വിഷയത്തിൽ സസ്യശാസ്ത്ര വിഭാഗം അധ്യാപിക ഡോ. കെ.യു.അമ്പിളി വിദ്യാർഥികളുമായി സംവദിച്ചു. പരിസ്ഥിതി ക്ലബ് കോ-ഓർഡിനേറ്റർ കെ.പി.ശരണ്യ, ഡോ. ആർ.നുബി, എ.എ.അസ്ന, എസ്. അശ്വതി, ആർ.അശ്വതി, ബി.ഭാവന എന്നിവർ പ്രസംഗിച്ചു.

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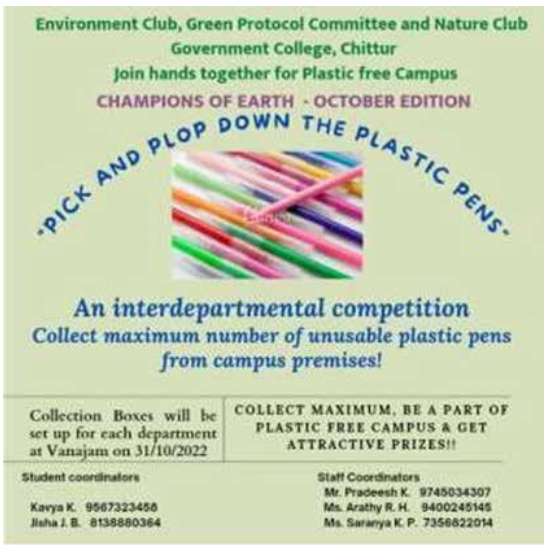
ACTIVITY 3: CHAMPIONS OF EARTH - Pick & Plop Down Plastic Pens (31/10/2022)

Plastic pen pollution is a growing environmental concern that has far-reaching consequences. Every year, billions of plastic pens are produced and disposed of world wide, contributing to the already massive problem of plastic waste. This waste poses significant environmental and health hazards, and it is crucial to take measures to address this issue. plastic pen pollution is a significant environmental concern that requires immediate action. Reducing our use of disposable plastic pens, encouraging sustainable alternatives, and advocating for policies to limit plastic production and disposal can help mitigate the harmful effects of plastic waste.

Environment club and Green Protocol Committee of Govt. College Chittur has taken a step to address this issue and tried to makean awareness among the students of this college by organizingan inter departmental competition titled "Pick and plop down plastic pens". Students of each department were asked to collect maximum unused plastic pens from campus premises and deposit into a separate box set up for each department. The department who collected maximum plastic pens were announced as Champions of earth and Physics department won the title by collecting more than 600 plastic pens from campus premises.



ACTIVITY 4: Participation of students in National Conference organized by SAPACC onDecember18,2022

SAPACC hosted a climate conference on various topics such as Climate and agriculture, Climate and working people, Climate and Adivasi, Dalit and other vulnerable populations, Climate and gender equity, Climate and youth, Climate and coastal Kerala, Climate and the Western Ghats; Kerala focused issues etc. from 2022 December 15-18 at Kozhikode. Five students from Govt.College Chittur has participated in the Climate School Youth with Scientists meet up on 18th December 2022.

ACTIVITY 5: URJA KIRAN 2022 - Energy conservation awareness programme- Rally (17/12/2022)

The Energy Management Centre – Kerala (EMC), is the "State Designated Agency" to co-ordinate, regulate and enforce the provision of the EC Act 200 in the state of Kerala with the concurrence of BEE, Ministry of Power, Govt. of India and for implementing various schemes under the Act EMC initiated URJA KIRAN, Energy Conservation Awareness Campaign in 2015. Centre for Environment and Development is the Resource Agency (RA) for coordinating the activities of URJA KIRAN – Energy Conservation Awareness Campaign (ECAC) in Kerala. The objective of URJA KIRAN is to create awareness among the general public and equip them for efficient management of all forms of energy, to promote energy efficiency and energy conservation and to develop new sources of energy as well as novel energy technologies with a view to increasing the production and facilitating the use of energy on a sustainable basis.

Environment club, Government College Chittur taken up initiation to organize various energy conservation activities "Urjjakiran 2022" in Chittur Legislative assembly. The first programme organized was an energy conservation rally which was jointly organized by environment club and NSS units of Government college Chittur on 17/12/2022. Smt. Kavitha K. L. Chairperson, Chittur-Tattamangalam flag off the rally. The Rally started from Chittur- Tattamangalam municipality and ended at Govt. Boys Higher Secondary School Chittur. More than 70 people were participated in the rally and pamphlets were distributed to general public.

ACTIVITY 6: URJJA KIRAN 2022-Energy conservation awareness programme - signature campaign - 17/12/2022

As a part of energy conservation programmes environment club has organised a signature campaign to the general public. more than 100 people put their signature on the banner and read the energy conservation pledge. The programme was on 17/12/2022. Adv. V Murugadas, special in vitee to the programme, talked about the importance of energy conservation in daily life and inaugurated the signature campaign by putting his signature.

ACTIVITY 7: URJJA KIRAN 2022 - Energy conservation awareness programme - short video making Competition

To create an awareness on energy conservation among the general public, environment club Government college has organized a short video making completion for the residents

of Chittur Taluk. 5 entries were received and sent to judgement. GVHSS, Nemmara and KumareshVadavannur bagged first and second prize respectively.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ACTIVITY 8: URJJA KIRAN 2022 - Energy conservation awareness programme-Seminar-17/12/2022

The final programme in connection with Urjjakiran 2022 was a seminar for general public ofChittur Legislative assembly. The seminar was inaugurated by Smt. Kavitha K. L., ChairpersonChittur-Tattamangalam Municipality on 02/02/2023. Jishnu V Falgunam served as the resourceperson for the seminar, more than 60 people were benefited out of the seminar. LED bulbs weredistributed to the participants to circulate the importance of LED bulb and how it helps to reducetheenergywastage.

ഊർജസംരക്ഷണ ബോധവത്കരണ ശില്പശാല ശ്രദ്ധേയമായി

BHOOMITHRA SENA (BMC/187/PKD/10/12): This body is aimed at the conservation of Nature and natural resources and judicious utilization of the resources for the welfare of the society. Arranging awareness programmes to achieve the objectives, take up programmes for environmental cleanliness through eco-friendly measures – bio degradation of waste organisms- vermi composting etc. are some of the activities of this body. The main objective of the Club is creating awareness among the students and general public about the necessity of conservation of environment.

Best practices followed on Green Campus initiatives in Govt. College Chittur

Chittur College in Kerala has been at the forefront of adopting green campus initiatives to promote sustainability and environmental consciousness among its students, faculty, and staff. Through various innovative approaches, the college has successfully integrated eco-friendly practices into its daily operations. Below are some of the best practices followed in the green campus initiatives at Chittur College:

Native Plantation and Biodiversity Conservation:

Chittur College has undertaken extensive native plantation drives, replacing exotic species with indigenous ones to support local ecosystems.The college has designated green zones as biodiversity hotspots, ensuring the protection and preservation of these areas.

Solar Power Generation:

The college has installed solar panels on rooftops and other suitable locations to harness solar energy for electricity generation.This sustainable energy source not only reduces the institution's carbon footprint but also serves as a practical learning opportunity for students in renewable energy technologies.

Waste Management and Recycling :

Chittur College has implemented a robust waste management system segregate in which they waste at source and promoting recycling.Students actively participate in waste collection and recycling drives, promoting a culture of waste reduction and sustainability.

Water Conservation :

The college has adopted water-saving measures, including rainwater harvesting and water recycling for landscaping purposes.Awareness campaigns educate the campus community about responsible water usage.

Environmental Education and Outreach:

Chittur College integrates environmental education into its curriculum, ensuring that students gain a deep understanding of ecological principles and sustainable practices. Regular seminars, workshops, and awareness programs are conducted to engage the campus community and raise environmental consciousness.

Eco-friendly Infrastructure :

New infrastructure developments are designed with eco-friendly features, such as energy-efficient lighting, natural ventilation, and green building materials.These sustainable construction practices contribute to reduced energy consumption and environmental impact.

Student-Led Initiatives :

Student-led clubs and organizations actively promote green initiatives and encourage fellow students to participate.These initiatives empower students to take ownership of sustainability projects and develop leadership skills in environmental advocacy.

Research and Innovation :

Chittur College encourages faculty and students to conduct research related to environmental issues and sustainable solutions.This research contributes to the college's knowledge base and helps develop practical solutions for environmental challenges.

Community Engagement :

The college actively engages with the local community to share knowledge and collaborate on environmental projects.Outreach programs, tree planting drives, and awareness campaigns extend the college's green initiatives beyond campus boundaries.

Chittur College's commitment to green campus initiatives demonstrates its dedication to environmental sustainability and responsible citizenship. These best practices not only reduce the college's environmental impact but also inspire and educate future generations on the importance of ecological conservation. The institution serves as a model for other educational institutions seeking to implement green initiatives and foster a culture of sustainability.

It is observed that the campus maintaining more than 75% of the green cover area to provide a healthy environment to the stakeholders.

Maintaining small ponds/open water sources and reservoirs will attract these small harmless animals to the campus.

The classrooms and computer laboratories, and parking space is well ventilated.

The organisation leader being a major leading the NCC team has motivated and inculcated strong sense of commitment in protecting and nurturing the environment. The students are involved in planting and cleanliness drive.

SUMMARY

The present green campus audit has evaluated the current environmental status in the campus.Biodiversity, Energy, Carbon storage, water consumption,water quality, waste generationand environmental awareness were assessed. Major findings of the audit are given below:

Biodivesity

- The campus supports rich biodiversity. Total185species of angiosperms, 5 species of pteridophytes and 1 gymnosperm, 70 species of butterfly, 7 species of dragonfly, 1 species of damselflies, 135 species of birds,16 species of mammals, 8 Reptiles snakes and 15 amphibianswere recorded.
- In plants, 2 species which are recorded as endemic to the Western Ghats and 3 species are recorded as Endemic to Peninsular India from the College Campus.
- The Shannon Wiener Index H' (1.24942) was indicated that, the plant community in the Chittur Government College campus is relatively heterogenous with no dominance of a particular species. It also indicated that, the campus is rich in plant diversity with uniform distribution.

Energy Consumption

- Thorough site visits, data collection, and analysis of energy sources and consumption patterns were conducted during the audit process. Various parameters such as electricity bills, energy usage, and existing energy-saving practices were evaluated to provide a holistic view of the college's energy landscape. The findings included an electricity bill amounting to Rs. 510,680/- for the last year, with a total energy consumption of 55,396 kWh and an average monthly usage of 4,616 kWh.
- The college spent Rs. 6,000/- on LPG cylinders, Rs. 250/- on firewood per month, and Rs. 3,000/- on petrol/diesel/others for generators. Additionally, the audit identified a total of 1952 appliances on campus that consumed electricity. The campus has 55 street lights and employed energy-efficient measures such as the promotion of LED bulbs and tubes, along with solar-powered streetlights. Moreover, the Environment Club conducted four energy conservation awareness programs.

Transport

- The transportation preferences at Chittur College illustrate a predominant reliance on public transport, with a staggering 92.01% of individuals opting for this eco-friendly commuting option. The car usage stands at a mere 1.69%, and bikes are utilized by only 4.5% of the campus community. 1.48% of individuals preferring walking, the most sustainable mode of travel. Interestingly, the campus hosts a limited number of electric vehicles, including 2 scooters and 1 car, signaling a progressive shift towards sustainable mobility solutions.

- Delving into commuting patterns reveals that a portion of the college community (307 individuals) opts for walking, indicating a commitment to greener transportation, a substantial number (494 individuals) still rely on vehicles for their daily commute. Notably, these vehicle commuters predominantly cover relatively short distances, averaging approximately 5 kilometers or less. Furthermore, a significant proportion of individuals (494) live within close proximity to the college, with 165 residing within 2.5 kilometers and an additional 329 living between 2.5 and 5 kilometers away.

Carbon auditing

- The carbon emissions audit at Chittoor Government College in Palakkad reveals a breakdown across three scopes: Scope 1 includes emissions from LPG cylinders (0.25 tonnes), diesel for electricity (0.079 tonnes), biomass burning (0.082 tonnes), and waste (2.87 tonnes). Scope 2 emissions from purchased electricity are 44.87 tonnes, while Scope 3 emissions, mainly from transportation, amount to 48.10 tonnes, with miscellaneous emissions contributing 10 tonnes, totaling 106.25 tonnes.
- The carbon sequestration potential of the campus's tree species showcases an annual capacity of 168 tonnes, with 61.75 tonnes of tradable carbon excess. Implementing mitigation measures could potentially result in a commendable level of 100 tonnes of tradable carbon annually.

Water Consumption

- A total of 4430 and 903720 litre water is used daily and yearly respectively in the campus. The major portion of water is consumed for toilet flushing (3000 litres/day). 5000 litres of water are used for cooking and 480 litres of water is found to be used for basin use, followed by 200 litres for floor cleaning daily. 150 litres used for gardening and 100 litres for laboratory purpose.

Water Quality

- Total Dissolved Solids, Total Hardness, Total Alkalinity, Calcium and Magnesium of the water sample are found to be above the acceptable limit as per IS10500-2012 in both well water and bore well water. All the other tested water quality parameters are found to be within the acceptable limit as per IS10500-2012 drinking water specification.
- In River water sample, Total Hardness and Total Coliform are found to be above the

- acceptable limit as per IS10500-2012. All the other tested water quality parameters are found to be within the acceptable limit as per IS10500-2012 drinking water specification.

Waste Generation

- The waste generated on the campus is 785.194 kg/year. Dept. of Botany and Physics produces the highest quantity of biodegradable wastes, and the Dept. of Malayalam produces the highest quantity of non-biodegradable wastes.

Environmental Awareness

Chittur College integrates environmental education into its curriculum, ensuring that students gain a deep understanding of ecological principles and sustainable practices. Regular seminars, workshops, and awareness programs are conducted to engage the campus community and raise environmental consciousness.Chittur College encourages faculty and students to conduct research related to environmental issues and sustainable solutions.This research contributes to the college's knowledge base and helps develop practical solutions for environmental challenges.

RECOMMENDATION

The Green campus audit of the Govt. College Chittur was assessed the present environmental conditions. Based on the study, it is suggested to undertake some measures to improve the management of Biodiversity, Energy, water, waste and environmental awareness.

BIODIVERSITY: -

The campus supports a rich biodiversity evidenced by thepresent study.The suggestions for conserving the biological diversity in the campus are;

- Participatory Mode of Conservation: - To ensure the involvement of people in the campus for conserving biodiversity. The people include students, teachers, non-teaching staff and visitors of theuniversity. Make awareness to the people about the importance of protection of biodiversity.
- Management of Invasive and Alien Species:- Managing invasive and alien species on campus is paramount to preserving native biodiversity and ecosystem health. The introduction and spread of non-native species can disrupt local ecosystems, outcompete native flora and fauna, and alter habitat dynamics. To effectively address this issue, proactive management strategies must be implemented. These strategies may include regular monitoring and early detection of invasive species, rapid response protocols for the removal or containment of new infestations, and ongoing control efforts for established populations.
- Implement Sustainable Development Practices:Ensure that any developmental activities on campus prioritize sustainability and minimize their impact on biodiversity. This could include using eco-friendly construction materials, adopting renewable energy sources, and incorporating green infrastructure into campus designs.
- Establish Protected Areas: Identify and designate specific areas on campus as protected zones where biodiversity can thrive undisturbed. These areas could include natural habitats, green spaces, or specific ecosystems that support diverse flora and fauna.
- Promote Native Plant Species: Encourage the use of native plant species in landscaping and gardening efforts on campus. Native plants are better adapted to local conditions and support native wildlife populations, contributing to overall biodiversity conservation.
- Many native trees may be planted in unutilized areas in the campus. The trees that produce more oxygen and absorb more CO_2 could be planted to maintain a healthy environment for the stakeholders.
- Vegetables, fruits, and greens could be cultivated in the college campus through terrace garden, kitchen garden and indoor garden.

- The name board with QR code may be kept in each Tree plant species in which the common name along with binomial name may be mentioned. The year of planting and economic importance with medicinal values if any may be mentioned in some plants so that the oldest as well as useful herbal plants may be identified in the campus.
- The butterfly garden has to be re-structured with sufficient host plants and proper care should be given.
- Towards the riverine part of the campus, adequate care may be taken to preserve the ecological balance, particularly the erosion.
- Since the location of the campus has proximity to the RiverChittur, it is recommended to choose soil-binding native trees and shrubs where ever it is required replanting.
- Afforestation Programmes: - Planting rare, flowering and fruit-bearing plants in the campus. Otherwise, implement some forestation programmes like star forest (Nakshathra vanam). Promote medicinal gardens and organic vegetable farming in each department.

Water Resources: -

The major water resources in the campus includes wells and bore wells. These resources are sufficient to the needs of campus in all seasons except March-May. The following major water conservation strategies can be considered for the execution in the Govt. College Chittur campus. These strategies will definitely improve the water resources within few years of time.

Rain Water Harvesting System:- As per the report of Central Ground Water Board (CGWB)Chittur block is considered as 'critical' ground water situation. In March and April months water scarcity is high in the campus. So, one of the remedies is to install rain water harvesting systems in the campus. One system is suitable for one or two buildings in the campus. Also the use of harvested rainwater for routine lab work like distillation may help in reducing the wastage of fresh water during all the season.Collect roof water from possible buildings.

Cleaning of Wells: Cleaning and utilisation of wells present in the campus. Recharge these wells with roof water from nearby buildings. These recharging will help in the replenishment of groundwater.

The drinking water facility (RO) need to be monitored so is the quality of water could be checked from other external agencies.

Reuse/recycling of water: Most of the laboratories are having distillation units and other extraction systems which use alarge quantity of water as coolant. The coolant water can be collected in a large tank and can be recycled.

Energy

- **Develop and Implement an Energy Management Policy:** Create a comprehensive energy management policy that outlines specific energy-saving practices,

guidelines for equipment usage, and initiatives for energy conservation across the campus. Ensure that this policy is effectively communicated and enforced among all stakeholders, including faculty, staff, and students.

- **Transition to Renewable Energy Sources:** Given the college's existing initiatives such as solar-powered streetlights and the installation of solar panels in the PG block, prioritize the transition to renewable energy sources. Explore opportunities to expand the use of solar energy and consider integrating other renewable sources like wind or hydroelectric power to further reduce reliance on conventional electricity.

- **Upgrade to Energy-Efficient Appliances and Lighting:** Replace outdated appliances and lighting fixtures with energy-efficient alternatives rated 4-5 stars. This includes upgrading to LED lights and tube lights throughout the campus to minimize energy consumption and enhance sustainability. Additionally, ensure proper maintenance of heating, ventilation, and air conditioning (HVAC) systems to optimize energy efficiency.

- **Effective E-Waste Management:** Establish a robust e-waste management system to address the accumulation of electronic waste within various departments. Adhere to government regulations for e-waste disposal and implement rigorous measures for proper storage, documentation, and disposal of electronic devices. Consider partnering with certified e-waste recycling facilities to ensure responsible handling of electronic waste.

- **Establish Student and Teacher Energy Management Group:** Formulate a dedicated student and teacher group focused on energy management, following ISO 50001 standards. Empower this group to promote energy consciousness and integrate energy management principles into the college's overarching sustainability endeavors. Encourage active participation in energy conservation initiatives and provide resources for ongoing training and awareness programs.

Transport

- **Develop Additional Parking Facilities:** Address the current shortage of parking space within the campus by constructing additional parking facilities. Design these facilities to accommodate the increasing number of vehicles while promoting orderliness and convenience for students and staff.

- **Promote Sustainable Transportation Modes:** Raise awareness among students and staff about the benefits of sustainable transportation modes such as walking, cycling, and public transport. Encourage the adoption of these modes to reduce reliance on motorized vehicles and minimize carbon emissions.

- **Implement Bike Sharing and Carpooling Initiatives:** Establish a bicycle sharing program within the college to make bicycles readily available for short-distance commuting. Encourage students and staff to engage in bike sharing and carpooling arrangements to reduce the number of single occupancy vehicles on campus.

- **Invest in Electric Vehicles and Infrastructure:** Support the adoption of electric scooters, cars, and bikes by providing charging facilities and incentives. Collaborate with local authorities to implement traffic safety measures and invest in infrastructure to support electric vehicles within the campus.

Carbon Auditing

- **Transition to Renewable Energy:** Chittur Government College should make a concerted effort to shift towards renewable energy sources, particularly in light of the significant Scope 2 emissions attributed to purchased electricity, totaling 44.87076 units. By prioritizing the utilization of the installed solar panels and exploring additional renewable energy options such as wind or hydroelectric power, the college can markedly reduce its indirect carbon footprint.

- **Sustainable Transportation Initiatives:** Addressing the substantial Scope 3 emissions stemming from transportation activities, amounting to 48.10 units, necessitates the implementation of sustainable transportation measures. Initiatives such as promoting carpooling among students and staff, offering incentives for the use of public transportation, and investing in eco-friendly alternatives like electric vehicles can significantly mitigate the college's environmental impact. By encouraging sustainable commuting practices, the college can reduce its carbon emissions while fostering a culture of eco-consciousness among its community members.

- **Waste Management Optimization:** With notable emissions arising from waste in Scope 1, totaling 3.28 units, optimizing waste management practices presents a tangible opportunity for carbon reduction. The college can adopt strategies to minimize waste generation, implement comprehensive recycling programs, and introduce composting initiatives for organic waste. By reducing reliance on landfills and incineration, the college can significantly diminish its carbon footprint while promoting a more sustainable approach to waste disposal.

- **Afforestation and Carbon Sequestration:** Recognizing the carbon sequestration potential of the campus's tree species, the college should prioritize afforestation efforts and tree planting initiatives. With an annual sequestration capacity of 168 tonnes and an excess tradable carbon of 61.75 tonnes, afforestation projects offer a promising avenue for carbon offsetting.

Waste Management

- More biogas plants should be installed in the campus in such as way that the generated gas can be used as cooking gas in mess /canteen.
- Drive to segregate waste at source with clear labels stating biodegradable and nonbiodegradable.
- Though there is a MoU signed with Clean Kerala Company. Attention should be given for collecting sanitary waste.
- Inhouse composting such as vermicomposting could be planned.
- Bins to be kept in the washrooms and toilets, different bins for Biodegradable and

nonbiodegradable as wet and dry waste bins can be kept across the campus.

- Provide drinking water facilities at different places of the campus so that the campus can avoid the bottled water and thus reduce plastic menace.
- The use of plastic products pen, carry bags, food cover etc. should be checked.
- Avoid flex boards, thermocol, disposable glass etc. during the celebrations and other programmes.
- Good incinerator should be provided for the treatment of other wastes.
- E-wastes like CFL, tube light and bulbs are properly collected and disposed of safely or hand over E-waste collecting agencies.

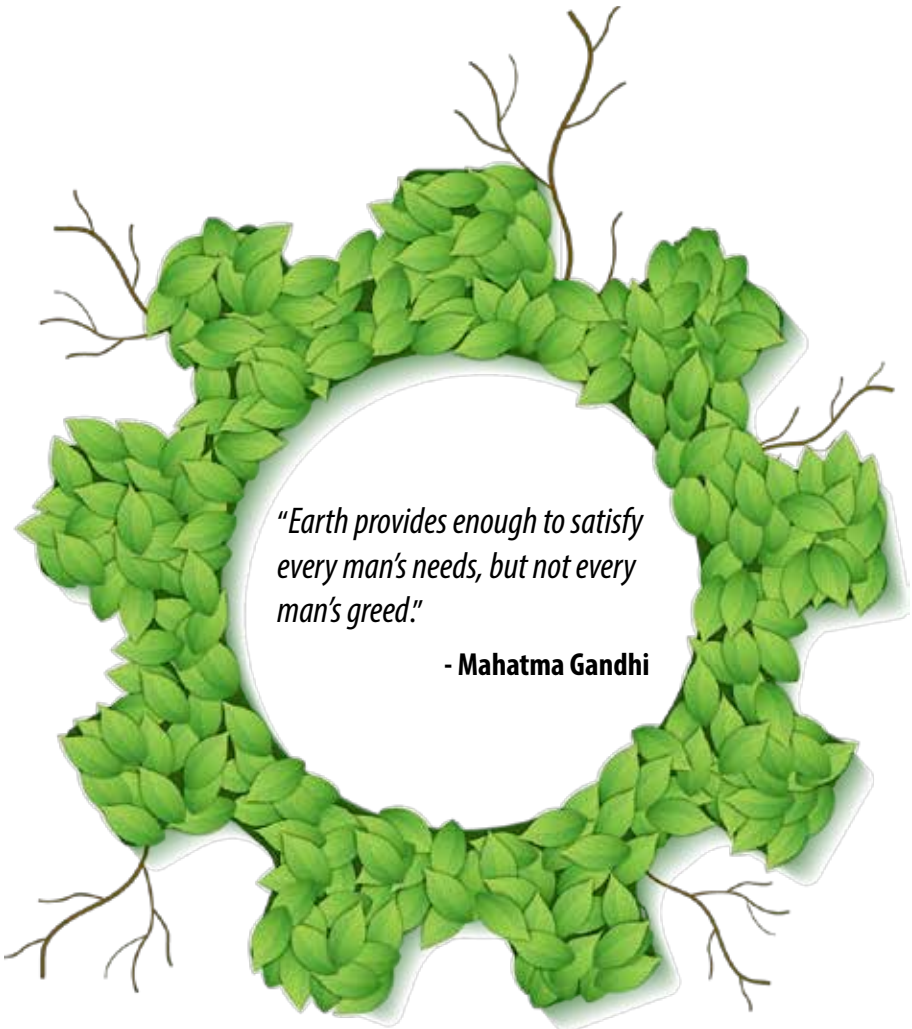
Environmental Awareness

The awareness on theenvironment should be given to students, teachers and non-teaching staff.

- Awareness classes: - Celebrate the important days related to environment and give awareness to people through classes and activities.
- To set down awareness boards about green campus mission.
- To manifestate new campaigns or movements (like 'use only ink pen') for environmental protection
- To start eco/nature/environment clubs/forums in each department and strengthen the activities of each clubs or forums.
- Students can be encouraged to paint the college surroundings with slogans highlighting the nature conservation and environment protection.

CONCLUSION

The comprehensive green campus audit of Govt. College Chittur has shed light on various facets of environmental management, ranging from biodiversity conservation to waste management and energy efficiency. With significant findings indicating rich biodiversity, water quality concerns, energy consumption patterns, and waste generation rates, it is evident that proactive measures are imperative for sustainable campus development. Particularly crucial is the recognition of carbon emissions and sequestration potential, as highlighted by the audit's data. By transitioning to renewable energy sources, implementing sustainable transportation initiatives, optimizing waste management practices, and prioritizing afforestation efforts, the college can significantly reduce its carbon footprint while enhancing its environmental stewardship. The values derived from carbon auditing and the promising carbon sequestration potential of afforestation projects, underscore the importance of prioritizing carbon reduction strategies in the campus's sustainability agenda. With an annual sequestration capacity of 168 tonnes and excess tradable carbon of 61.75 tonnes, afforestation projects can offset significant carbon emissions and contribute to the production of 100 tonnes of tradable carbon. Through concerted efforts guided by the recommendations outlined in the audit, Govt. College Chittur can emerge as a beacon of environmental consciousness and exemplify the transformative impact of sustainable practices in higher education institutions.



GOVT. COLLEGE, CHITTUR,
PALAKKAD, KERALA

KERALA STATE BIODIVERSITY BOARD