



**ST. XAVIER'S COLLEGE FOR WOMEN
ALUVA**

Audit Report (2021-22) Environment, Energy and Green initiatives



ACESSD
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EXECUTIVE SUMMARY

A successful Environmental Audit is an integrative tool that aids in the revelation towards ecological sustainability in campus and hence an obligatory practice for educational establishments under Criterion VII of NACC. The St. Xavier's College for Women, Aluva, is a torch bearer of environmental stewardship with its various activities giving emphasis on environmental conservancy and sustainability. Moreover, the spirit of eco-consciousness and sense of belonging to nature are perceived from the activities and attitudes of the college. Compared to the previous audit, substantial progress has been achieved by this college and its community towards nurturing the nature through reorienting the activities, initiatives and other programmes. The strengths, weaknesses, opportunities and challenges as identified through the Environmental Audit are highlighted by the SWOC analysis provided.

Present audit was conducted through regular site visits, interviews, facility tours, surveys and questionnaires, besides collecting existing records, reports and documents. Comprehensive laboratory analyses were carried out in the School of Environmental Sciences, Mahatma Gandhi University. Utilisation of sophisticated techniques like Remote Sensing (RS) and Geographic Information System (GIS) were also employed for quality analysis. Meteorological Data that include rainfall, temperature and humidity were collected and assessed. Inclusive field studies were steered to expound the biodiversity in terms of faunal and floral diversity. Using specific performance indicators, this Environmental Audit of St. Xavier's College for Women, Aluva was conducted as a timely gauge to track the progress of the College towards eco-sustainability.

Energy audit

St. Xavier's College has adopted steps to condense its energy utilisation and improve the energy efficiency. Major source of energy for this college is the Kerala State Electricity Board (KSEB) besides LPG and diesel. Furthermore, the campus is equipped with a mini solar power plant and biogas plant that aids in the power supply. During 2020-21 electrical energy consumption of the campus was recorded as 77142 kWh with a monthly average of

6429 kWh. The consolidated specific energy consumption computed for the year 2021-22 is 4.90 kWh/m²/year and 39.22 kWh/person/year respectively. It is observed that the management has given due importance to the proper utilisation of energy through proper optimization of the systems as an effective measure as per the recommendations of earlier audit. Substantial energy saving and monetary benefits were also achieved. The college has realised and established the potential avenues of renewable sources of energy like solar power and biogas on the campus. The college has partially shifted to solar energy by establishing solar panel of 3kW. It is worth noting that the Physics Department of the College is fully operational under solar power. The installation of biogas plant helps to trim down the energy expenditure of the college. The campus can be considered as a judicious energy consumer through the adoption of these alternative energy sources. Precise recommendations for further enhancement in energy competence have also been suggested.

Water audit

Water resource of the campus received due importance and hence notable developments were made in terms of sensible water usage and conservation aiming self-reliant in water. Owing to the peculiar geographical disposition, the college is endowed with surplus water resource. The proximity of Periyar River influences the water availability. Moreover, the college is bestowed with surplus water resources owing to the effective conservation strategies, rain water harvesting and water storage and management techniques. As a residential campus, surplus water is needed to meet the daily requirements. There are 11 storage tanks in the campus including two rainwater harvesting tanks. During the audit it is seen that the water sources are least polluted. The water audit indicated that the water consumption is sensible, with negligible water loss. The college has installed a waste water treatment plant with a treating capacity of approximately 200 L to 300 L per day for treating waste water from the science laboratories. The major water initiatives of the campus identified are rain water harvest system, storage facility, water treatment plant etc. The best practices identified in the campus are the well managed water distribution system, water harvesting, provision for UV filtered drinking water, well maintained water connections, taps etc. Recommendations were also made to enhance the effectiveness of the water management system of the campus.

Waste audit

Auditing the waste generation scenario in an establishment provides an opportunity for better waste management in a more effective manner so as to attain environmental sustainability. It is quite appreciable that the structure of waste management system in the college is well-established and the wastes produced are disposed of, segregated, and utilized for various purposes. An in-depth understanding of the mode St. Xavierians deal with waste is crucial to recommend strategies for further carbon offset.

The major solid waste generated in the campus fall under nine major categories and comprises paper, plastic, glass, damaged furniture, food materials, e-waste, hazardous, biochemical waste, and others (footwears, clothes, etc.). The total waste generated in the college was estimated as 5199 kg/year, of which food waste constituted the major category and accounts for nearly 75% (3919 kg/year). Considering the building-wise waste generation status, among the six buildings (blocks) surveyed, the hostel contributes the maximum (1881 waste kg/year).

Based on the degradability status of generated waste, biodegradable waste constitutes a significant proportion (93%) of solid waste while non-biodegradable components contributed only 7% of the total waste generated. The college has adopted outstanding waste management strategies. Through healthy initiatives of the college considerable reduction and utilisation of waste have been achieved. The campus has well efficient and advanced mechanisms for sorting and treating wastes that include biogas units for food waste, incinerators for bio medical-waste, and selling the plastic to authorized scrap merchants. Microbiological waste like clinical specimens, soiled swabs, and microbial cultures are autoclaved before final disposal in landfills. An integrated effort has been taken from the management to minimise paper usage and wastage through the increased dependence on digital platforms. Campus is provided with vending machines and properly placed bins to collect disposables. Procedures for disposal of worn-out furniture, construction waste, and other unconventional waste are well-established within the campus. Healthy practices include reuse and reduce activities, ban on single use plastics, responsible dinning, solar street lights, promotion of green and healthy campus practices etc. Various green initiatives like cleaning drives, cycle rallies for a pollution-free environment, zero filament drive, etc. are regularly organized in or outside the campus showing the commitment to a clean environment. Such attitudes appear to scale down the

waste to a substantial extent. The idea of ‘reducing, re-using and recycling’ in the campus is revealed through the waste audit. Feasible recommendations were also made to maximise waste reduction in the campus, apart from citing areas for enhancement to accomplish ecological sustainability in terms of organized waste management.

Biodiversity audit

Biodiversity audit highlights the environmental antiquity of the region, existing position of flora (native, introduced, alien and invasive) and fauna (damselflies and dragonflies, butterflies, fishes, reptiles, birds and mammals), best practices observed and recommendations for better management. Four major habitat categories were identified in the campus as: The Riverine habitat, Gardens, Open areas (lawns and play grounds) and Built areas.

Within the limited campus area, an approximate 40% vegetation cover is maintained. The vegetation includes trees, shrubs, climbers, herbs and grass species which could be broadly grouped into native and exotic. Thus it is comprised of native fruit trees, exotic fruit trees, ornamental exotic trees, native herbs, shrubs and climbers, exotic garden species and invasive species. Overall, the garden species predominates in the vegetation of the campus. A total of 150 species of plants belonging to 60 families were recorded which include grass, herb, shrub, climbers and trees.

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. Different micro-habitats and rich vegetation with varieties of garden and flowering species attract good diversity of butterflies into the campus. A total of 34 species were noted during the assessment. They belong to five different families. Thirteen species of dragonflies which belonging Libellulidae and five species of damselflies representing four different families were recorded. The River Heliodor, the forest stream species, is found in the campus near the riverside. A total of 61 species of birds, including some of the winter migrants were noted. However, the fruit trees of the campus attract palm civets, squirrels and bat species. The campus habitat harbours many species of reptiles, amphibians and mammals. From the rapid assessment and discussions with the campus inmates around 13 species of reptiles belong to 10 families were noted.

Practical recommendations were also made through the audit. It is expected that the proper execution of the recommended restoration activities and persistence of the best practices will improve the biodiversity status of the campus.

Carbon audit

The carbon audit establishes a link between human actions that result in greenhouse gas emissions in terms of CO₂ and its impact on the environs. Presently, high intensive activities that result in the emission of carbon dioxide into the atmosphere is an increased pace and henceforth the need of cognizance concerning these discharges is unavoidable. In order to achieve a healthy environment, the understanding on the relation between GHG emissions, climate change and global warming is a prerequisite so as to reduce emissions. The successful execution of the carbon audit revealed that the annual carbon emission of the college is computed as 329.775T CO₂. Besides, the organisation's capacity in offsetting the emissions was also identified. The audit identified and quantified the emission potential of major sources under three emission scopes. LPG and diesel consumption constituted the first scope emission categories. Consumption of purchased electricity constituted the second category and forms the major share in emission, waste disposal and others collectively represented the scope third emission category. Disclosure of the carbon footprint of an educational institute is inevitable to identify the source and sink of emissions and the best possible mitigation measures that can be adopted for the carbon reduction.

Green initiatives

The college has initiated notable and unique green initiatives and outreach programmes towards achieving environment sustainability and human wellbeing in different ways through the involvement of the student community, staff and general public. As a part of the audit, these green initiatives and outreach activities of the college has been identified and documented with due importance as indicators of their environmental stewardship and societal commitment.

The Environmental Audit conducted in the St. Xavier's College for Women, Aluva, revealed that the campus is on the right track towards embracing environmental sustainability through its various initiatives and earnest endeavors. Environmental stewardship includes rekindling the passion and provision for humanity, and social responsibility. The audit aids the College to act judiciously in order to achieve environmental sustainability. The auditing process was made possible only because of the

enormous assistance and generosity which the team received from the college community. Undeniably, the passion, fortitude and stewardship towards nurturing the environment shown by the Xavierians coupled with the efforts of ACCESSD team stand as the major strength of this effort.

INTRODUCTION

Background

Educational establishments stand as a robust podium from where the evolution of a nation flinches and the natural environment is a prime factor that determines the sustainability of further development. Today, educational institutions are becoming more receptive to environmental factors and further notions are being introduced to make them green or eco-friendly in a more sustainable manner. In order to preserve the environmental sustainability within the campus, it is imperative to judge the practices and initiatives of the institution. Hence Environmental audit is considered an effective management maneuverer for evolving sustainable development strategies and has become obligatory since the declaration of the National Environmental Policy 2006.

Environmental audit is a systematic process of identifying and assessing whether the practices and initiatives of any institution or establishment are sustainable and eco-friendly that help in improving human activities which could reduce the adverse effects on the environment. The auditing is envisaged to perceive and screen impacts in the environment to advance the quality in terms of different components such as air, water, soil, pollution levels, energy consumption, water management, biodiversity, carbon footprint as well as human-induced perils. It has been recognized that the conservancy of a healthy environment is the obligation of both the state and its citizen.

As environmental sustainability is becoming an increasingly important issue for the nation, the role of higher educational institutions in relation to environmental sustainability is more prevalent. Owing to these incipient environmental causes, Green Audit or Environmental Audit is assigned to the Criteria 7 of NAAC (National Assessment and Accreditation Council) as a part of accreditation methodologies of higher education institutions in India. Thus, it is imperative that the college gauge its own contributions toward a sustainable future.

Scope of Environmental Audit

Institutes of higher education play a key role in conveying cognizance about the environmental problem and its solutions and are in themselves locus of high-intensive human activities which need to employ eco-friendly measures. Green auditing and the implementation of mitigation measures is a win situation for all the educational institutions, where health consciousness is created which in turn promotes environmental awareness values and ethics.

As an institutional self-inquiry, environmental audits are the natural and necessary outgrowth of quality education and hence should be imperative that prominent and pioneering higher educational institutions evaluate their own contributions toward a sustainable future. As environmental sustainability is becoming an increasingly vital matter for the country, the role of higher educational institutes in relation to environmental sustainability is more rampant.

St. Xavier's College for Women, Aluva is a pioneering institution of higher education that stands profoundly with its vibrant revelation, receptiveness, and responsibility towards environmental stewardship through its visions and multipronged activities.

The environmental audit preparation of this college could not have come to culmination despite the enormous backing and timely assistance that the expert team received directly and indirectly from the college community.

The generated baseline data pertains to the current status of the various environmental compartments of this college and its premises. In detail, the major target areas included in this green auditing are water, energy, waste, biodiversity, and carbon footprint. Besides the various green initiatives and healthy practices of the college were also consolidated so as to illustrate the extent of environmental sustainability of this pretentious institution during the academic year of 2021-2022.

Objectives of Environmental Audit

Upon the enforcement of an effective environmental audit with the following objectives, the advantage that could be adopted from it are prodigious for an educational institution.

- To scrutinize the contemporary practices in the college campus which can impact the environment.
- To recognize and analyse substantial environmental issues present on the campus.

- Create a goal, vision, and mission for green practices on the campus empowering effective conservation and utilization of resources.
- To recognize the cost-saving methods of environmental minimizing and managing strategies thereby implementing an effective environmental management system.
- To substantiate conformity with the implemented laws, permit the organizations to frame a better environmental performance
- To conduct continuous assessment and evaluation for shaping healthy practices that help to nurture a green campus.
- To enhance eco-consciousness and alertness for environmental guidelines and duties

Benefits of Environmental Audit

- Help to protect the environment in the campus.
- Identify cost saving methods through energy conservation, water conservation and waste minimization.
- Enhancement of biodiversity resources.
- Reduction in carbon dioxide emission making the campus climate friendly.
- Impart a good image to the institution through its clean and green campus.
- Empower the College to frame a better environmental performance.

About the College

St. Xavier's College for Women was established in the year 1964 by the Congregation of Teresian Carmelites (C.T.C.) and is currently affiliated with the Mahatma Gandhi University, Kottayam. The present site of the college at the south bank of River Periyar was bought in 1900 by Rev. Fr. Vincent OCD, a Spanish Carmelite missionary, for the establishment of St Francis Xavier's Church at Aluva. By the time it was a rugged and steep land adjoining the river. Later in 1928, it was under the supervision of Rev. Sr. Mary Magdalene a convent building was constructed near the church and by 1930 the sisters started a primary school. However, it took two more years to obtain official orders from the Diwan of Travancore to declare it as the St Francis English Middle School in 1932. There were 300 students, 7 teachers and 5 sisters at the time and Rev. Sr. Magdalene was the manager of the school. When Rev. Fr. Augustin Maveli, a young and dynamic priest, took charge of the church in 1934, who studied the people of the area and nature of the place and collaborated selflessly with the ideas and dreams of Rev. Mother Magdalene to

develop the middle school into St. Francis High school in 1940, St. Antony's Orphanage in 1948 and finally the St. Xavier's college for women in 1964. In the meanwhile, as per the stipulations of the Kerala University, with the existing 10 acres of land, an additional 8 acres was also set apart for the college campus by Most Rev. Dr. Joseph Attipetty, the Arch Bishop of that time. Later it attained the status of Degree College in 1968 and currently, it offers 14 Undergraduate, 6 Postgraduate, and 3 Research Programs along with a number of Add-on courses and skill development Certificate Programmes. The college has now more than 1449 students and 73 faculty members with commendable infrastructure and facilities such as hostels and sports amenities. The college has thrived into a revered establishment in 56 years with its emphasis on excellence in education and the multifaceted advancement of the womenfolk.

Being a socially committed institution it acts as a robust pedestal for various scholar programs and enhances the forte and competencies of students coming from diverse circumstances. Recognizing its contributions in the academic, cultural and social pitch, in 2017, NAAC has accredited the college with A Grade. The institution fosters and upholds a culture of research and innovation thereby rekindling the scientific spark among its student community and faculty. In addition to this, as part of the Institution's Innovation Council, the College was rated Five Stars by the Ministry of Education, Govt. of India in 2020. The institution also provides an inclusive platform that enhances the strength and capabilities of students coming from diverse backgrounds. Through a multitude of effective and outstanding performances, St.Xavier's College for Women has emerged as an embodiment of excellence.



Embellished with its commitment to mother nature by embracing the cardinal principles of three R's- Reduce, Re-use and Recycle, St. Xavier's College of Women adorns the southern banks of River Periyar and sprawls over an area of seven acres as an epitome of changes and chances.



Conservation and protection of the environment are evolved as a culture of this college and the student and faculty of this institution have taken various initiatives and activities

toward the protection of nature. The college has over twenty registered and unregistered clubs. Energy and Environment Conservation Club, Boomithrasena Club, and Nature and Biodiversity Club are the prominent ones that concern the campus environment and its conservation in a more sustainable manner. These green associations and agglomerations are envisaged as a vent to nurture the idea of nature conservation through collective efforts and activities like nature studies, conservation of the natural environment, and adoption of eco-friendly practices. Both faculty and students have taken several initiatives to preserve and protect the environment. The college has both Botany and Zoology departments. Involvement of the student community and faculty in these associations helps to create a sense of belonging and the notion of environmental stewardship in the community which in turn empowers and capacitates the students and faculty to act as environmental volunteers.

Motto

On the path of knowledge, love, and service

Vision

St Xavier's College for women envisions the empowerment of women through academic excellence and spiritual enlightenment for their educational, social, and cultural enhancement.

Mission

The institution provides an ideal academic environment for lifetime learning, nurturing the students as responsible women and resourceful global citizens, committed to national and cultural values.

Quality policy

St. Xavier's College for Women is committed to empowering women through science, commerce, and arts for the spiritual, social and cultural development of the society through the following initiatives

- Strengthening moral, ethical, and environmental consciousness among staff and students
- Learner-centric environment for the holistic development of students

- Upgrading the competence of faculty to global standards and making them espouse all the innovative and model technologies in the teaching-learning process.
- Updating time to time improvement in the quality management system.
- Promoting entrepreneurial skills through classroom sessions and training programs
- Inculcating secular cultural consciousness and unity in diversity through multicultural events.

General view of the college



College campus



Playground (Indoor)



Playground (Outdoor)



Hostel



Convent



Jesus block



St. Joseph block



Mount Carmel block



Library



Seminar hall-1



Seminar hall-2

METEOROLOGICAL STATUS AND AIR QUALITY

Introduction

Clean air is essential for sustaining life. Nevertheless, in the current world, the rapid growth of urbanization, automobile transport, and industrial activities have led to the release of significant quantities of toxic substances into the atmosphere. As per the World Health Organization (WHO), every year 8 million deaths are reported worldwide due to poor air quality. In our country, almost six lakh Indians die due to side effects of pollution every year, thus impacting a significant burden on human health, environment, economies, and well-being of society. Hence, monitoring air quality is vital for the existence of life in this planet.

Air quality monitoring is a measure of how clean or polluted the air is and aids in assessing the pollution load in the surrounding outdoor environment against the ambient air quality standards. Regular monitoring helps to take steps based on pollutants present in the atmosphere to improve air quality. Besides, it may be noted that climatic conditions have a bearing on air pollutants. Therefore, any assessments related to environment should include a study of the local weather patterns (meteorological factors) that helps us to understand the chemical events that occur in the atmosphere.

In view of the above facts, the present audit looks into the few meteorological and air quality parameters in the College locus, thereby revealing the meteorological conditions and air quality of the campus.

Objectives

- To examine the meteorological parameters (rainfall, temperature and relative humidity) within the campus.
- To quantify the ambient air quality parameters such as NO₂, SO₂, PM₁₀, PM_{2.5} of the campus.

Study area

Located on the banks of the Periyar river Aluva in the Ernakulam district, is an important commercial and industrial hub in Kerala. The area is dominated by a tropical humid climate and records an annual mean temperature of 27⁰C and mean annual rainfall of 322 cm.

Data source

i. Weather Data

The weather data was collected from the webportal of NASA <https://disc.gsfc.nasa.gov/> . NASA provides the global scale observational data sets on oceans and ice, their forcings, and the interactions with the entire Earth system for the climate variability study. The Second Modern Era Reanalysis for Research and Applications (MERRA-2) is a NASA atmospheric reanalysis for the satellite era using the Goddard Earth Observing System Model, Version 5 (GEOS-5) with its Atmospheric Data Assimilation System (ADAS), version 5.12.4. The MERRA project focuses on historical climate analyses for a broad range of weather and climate time scales and places the NASA EOS suite of observations in a climate context. MERRA-2 was initiated as an intermediate project between the aging MERRA data and the next generation of Earth system analysis envisioned for the future coupled reanalysis. Without a substantial investment to update MERRA's data assimilation routines, the system lacked the capability to analyze the latest observations. In addition, numerous advances to the GEOS5 system had been implemented since freezing the MERRA system in 2008. Therefore, new full reanalysis integration was undertaken. MERRA-2 covers the period 1980 - present, continuing as an ongoing climate analysis as resources allow.

ii. Air quality data

The air quality data was also collected from the webportal of NASA <https://disc.gsfc.nasa.gov/> GES DISC Atmospheric Composition Dataset Timeline. The

GES DISC archives atmospheric composition data from many remote sensing instruments and model assimilations dating back to 1970. These include datasets from the Orbiting Carbon Observatory 2 (OCO-2) on LEOSTAR-2; the Ozone Monitoring Instrument (OMI), the Microwave Limb Sounder (MLS), and the High Resolution Dynamic Limb Sounder (HIRDLS) aboard EOS Aura; the Thermal And Near-infrared Sensor for carbon Observation (TANSO)'s Fourier Transform Spectrometer (TANSO-FTS) on the Greenhouse gases Observing SATellite (GOSAT), the Atmospheric Infrared Sounder (AIRS) on EOS Aqua; a series of Total Ozone Mapping Spectrometers (TOMS) on the Nimbus-7, Meteor-3 and Earth Probe (EP) satellites; the Solar Backscatter Ultraviolet series of instruments (BUV: on Nimbus-4, SBUV: on Nimbus-7, and SBUV2 on the NOAA-9, NOAA-11, NOAA-14, NOAA-16, NOAA-17, NOAA-18, and NOAA-19 Polar Orbiters, as well as eight Shuttle SBUV or SSBUV instruments on the STS-34, STS-41, STS-43, STS-45, STS-56, STS-62, STS-66, and STS-72 missions); the Sea-viewing Wide Field-of-view Sensor (SeaWiFS) on SeaStar; Cryogenic Limb Array Etalon Spectrometer (CLAES), the Halogen Occultation Experiment (HALOE), Improved Stratospheric and Mesospheric Sounder (ISAMS), and Microwave Limb Sounder (MLS) aboard the Upper Atmosphere Research Satellite (UARS); the Limb Infrared Monitor of the Stratosphere (LIMS) on Nimbus-7; as well as modelling data from the Modern-Era Retrospective analysis for Research and Applications (MERRA).

Another key component of GES DISC Atmospheric Composition data archives is multiple-sensor long-term Earth System Records (ESDRs) promoted by the NASA Making Earth System Data Records for Use in Research Environments (MEaSUREs) project. These types of datasets include the Global Ozone Chemistry and Related trace gas Data Records for the Stratosphere (GOZCARDS), the Multi-Decadal Sulfur Dioxide (SO₂) Climatology from Satellite Instruments, the Long-Term Multi-Sensor Ozone (O₃) Data Record, and the Consistent Long-Term Aerosol Data Records over Land and Oceans from SeaWiFS. Monthly average data of resolution 0.1° x 0.1° were downloaded for the period 2015- 2020 and used for the analysis.

iii. Satellite image used

Table 1 Details of Satellite image used

SI No:	Year	Image Acquisition Date	Satellite/ Sensor	Resolution (m)	Bands
1	2022	28-Feb	Landsat 9/ OLI-2	30	3,4,5

a. Analysis performed

The weather and atmospheric data files downloaded (.netcdf format) from the data portal were converted to raster file using Arc GIS Software and the spatial position of St. Xavier's College, Aluva was overlaid on it. The pixel values of the corresponding location were estimated using extract value function in the software.

b. Normalised Difference Vegetation Index (NDVI)

The Spectrally-based Normalized Difference Vegetation Index (NDVI) derived from RS platforms, is a common indicator used to monitor biophysical conditions and vegetation cover. NDVI computed using following formula

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

c. Estimation of change in Carbon Sequestration potential and Carbon dioxide emission

Carbon sequestration is the process involved in carbon capture and the long-term storage of atmospheric carbon dioxide. The Carbon sequestration potential of the study area can be estimated through regression equation of the carbon storage and the vegetation index

$$\text{Carbon} = 107.2e^{(\text{NDVI} \times 0.0194)}$$

The Quantification of CO₂ is done by multiplying carbon storage with 3.67; it is the ratio between Carbon dioxide mass and Carbon mass.

I. Rainfall, Temperature and Humidity recorded from the campus

Examining the annual data for the last six years (2016-2021), the year 2021 recorded a maximum rainfall of 387.5 cm while 2016 recorded a minimum (230.6 cm) with a mean annual rainfall of 322 cm. during the period 2016-2021 the mean annual temperature of generally falls in the range of 27⁰C - 28⁰C without much fluctuation. Examining the

annual data of different years (2016 to 2021), the results showed that humidity levels remained high without considerable fluctuations during the monsoon months (June, July, August) whereas January and February recorded the minimum in relative humidity levels.

Table 2 Rainfall data of various years (2016-2021)

Months/Year	2016	2017	2018	2019	2020	2021
January	1.10	1.60	0.10	0.00	1.50	9.10
February	8.10	0.00	0.70	0.80	2.10	2.80
March	0.30	9.50	5.20	0.50	5.30	10.50
April	4.40	3.20	19.30	11.70	14.00	15.50
May	32.20	30.60	32.40	7.50	23.80	50.50
June	62.40	70.60	83.30	39.10	50.10	33.50
July	62.00	43.50	104.40	55.80	54.90	63.50
August	23.80	41.50	65.20	95.60	62.80	72.50
September	8.60	44.50	6.40	47.90	57.60	34.50
October	16.00	29.30	40.20	59.70	23.40	55.50
November	8.50	13.20	12.50	12.30	11.00	35.50
December	3.20	9.50	4.50	4.20	3.50	4.10

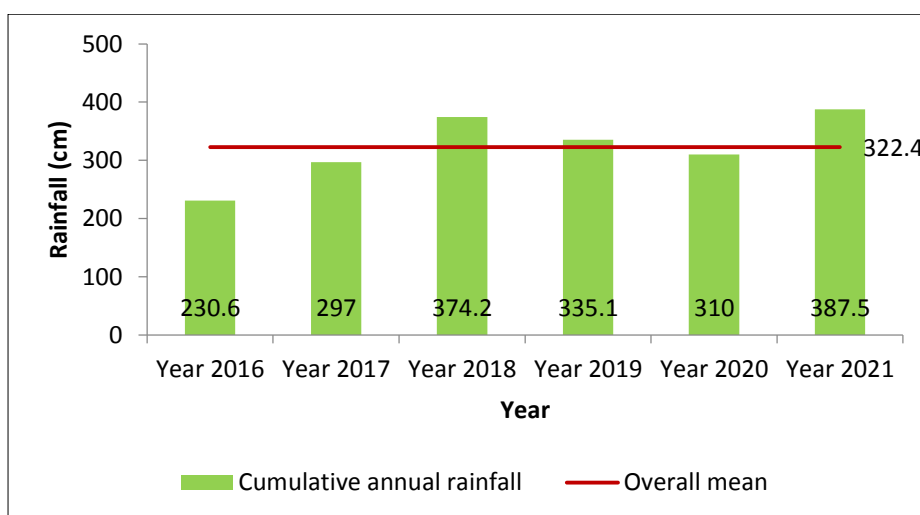


Fig. 1 Cumulative annual rainfall (2016-2021) of college campus

Table 3 Temperature data of various years (2016-2021)

Months/Year	2016	2017	2018	2019	2020	2021
January	26.30	25.60	26.20	25.60	25.80	25.60
February	27.40	28.40	27.50	28.50	27.90	27.50
March	29.30	30.50	30.30	29.30	29.60	30.20
April	29.90	29.80	28.50	28.60	28.80	27.80
May	28.80	28.40	28.50	27.90	27.20	26.00
June	26.30	25.20	24.80	26.50	25.50	25.80
July	25.90	25.60	24.90	25.80	25.60	25.50
August	26.30	25.20	24.90	26.00	26.10	26.30
September	26.80	26.80	29.50	30.70	28.50	28.30
October	26.70	26.70	28.00	27.20	28.40	27.60
November	27.40	27.20	27.20	27.30	27.10	27.00
December	27.30	27.10	27.30	27.20	27.30	27.20

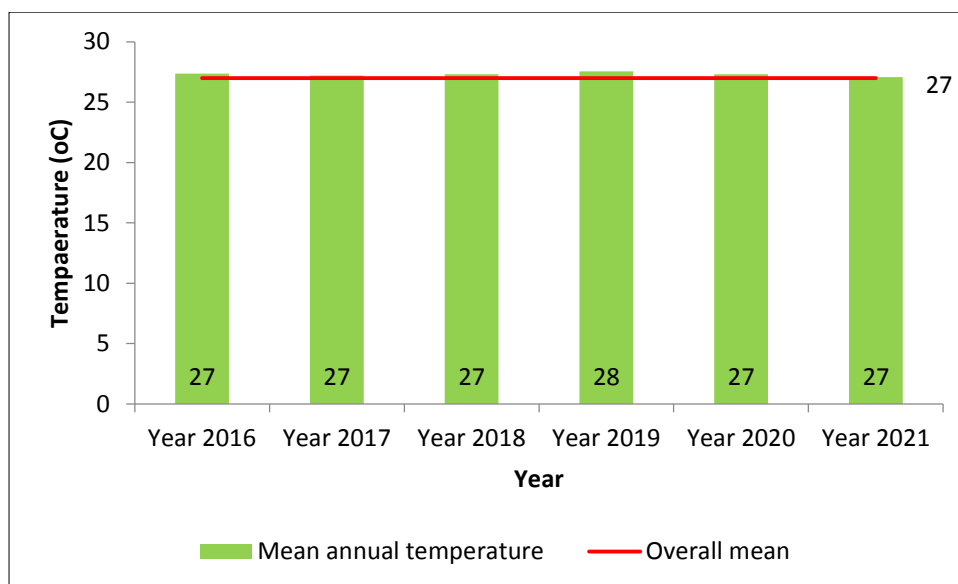


Fig. 2 Mean annual temperature (2016-2021) of college

Table 4 Relative humidity data of college (2016 -2021)

Months/ Year	2016	2017	2018	2019	2020	2021
January	69	65.8	66.5	68.5	70.2	69.5
February	67	68	67.8	68.5	66.7	66.6
March	70	73.5	74.1	72.5	71.2	74.5
April	80	82.5	88.9	84.2	81.2	81.5
May	86	87.5	88.1	88.5	87.1	87.1
June	91	92.5	90.1	89.5	91.5	91.5
July	91	93.5	94.5	93.8	94.5	92.3
August	90	94.3	95.3	94.3	93.5	94.5
September	88	87.6	88.5	87.5	87.5	89.5
October	88	88.9	86.5	86.7	87.9	87.5
November	85	88.5	86.5	87.8	88.9	86.7
December	76	74.5	73.2	77.4	76.5	77.2

II. Air quality

1. Nitrogen dioxide (NO₂)

Nitrogen dioxide (NO₂) is one of the major atmospheric pollutants coming under the group of highly reactive gases known as nitrogen oxides (NO_x). Nitrogen dioxide usually forms when nitrogen oxide (NO) and other nitrogen oxides (NO_x) react with other chemicals in the air to form nitrogen dioxide in the atmosphere. The main source of nitrogen dioxide resulting from anthropogenic activities is the combustion of fossil fuels (coal, gas and oil) especially from motor vehicles. Long-term exposure to NO₂ levels may leads to respiratory abnormalities.

Examining the 2021-2022 gaseous pollutants data, it was noted that NO₂ concentration in the region showed maximum value in the month of April (44.1 µg/m³) and minimum in July (33.2 µg/m³). The average NO₂ concentration in the region is calculated as 39.6 µg/m³ (Table 5). The ambient air quality data pertaining to region show that concentration of nitrogen di oxides are not consistent within the permissible limit (40 µg/m³) as stipulated by Central Pollution Control Board (CPCB). Taking 8 months into consideration (January, February, March, April, May, September, October and December) NO₂ slightly exceeded the National Ambient Air Quality Standards (NAAQS) of 40 µg/m³ in residential / industrial / rural area. Meanwhile the study noted that months (especially July and August)

that witnessed greater amount of rainfall had lower concentration of pollutants in the region. In contrast to the above information it was observed that those months (eg. May and October) that received copious amount of rainfall also showed a marginal increase in the concentration of NO₂ in the region. This kind of results is expected in Aluva as the region is the major industrial hotspot of Kerala. The general trend observed suggest that NO₂ concentration is almost at the brim of permissible limit.

Table 5 Monthly status of NO₂ level

Sl. No.	Months	NO ₂ (µg/m ³)*
1	January	40.2
2	February	40.6
3	March	41.2
4	April	44.1
5	May	40.2
6	June	39.5
7	July	33.2
8	August	34.2
9	September	41.5
10	October	41.3
11	November	38.5
12	December	40.5
	Mean	39.6

* CPCB Standard of NO₂ level is 40 µg/m³

2. Sulphur dioxide (SO₂)

Sulfur dioxide (SO₂) is a colorless, soluble reactive gas with a pungent odor which forms sulphuric acid when dissolves in water. The emission of this reactive gas occurs mainly from the activities such as burning of coal and oil at power plants and from smelting of mineral ores (aluminum, copper, zinc, lead, and iron) that contain sulfur. Sulphur dioxide has been linked to respiratory problems and cardiovascular diseases.

In the current investigation (2021-2022 period) it was found that monthly wise SO₂ concentration value falls within the range of 1.5 -2.9 µg/m³ with maximum value recorded in the month of March (2.9 µg/m³) and minimum in June (1.5 µg/m³). Unlike the NO₂, the monthly values and its mean annual SO₂ concentration observed in the institutional area were found much lower (2.3µg/m³) than the limit of CPCB standards (50µg/m³) (Table 6).

Table 6 Monthly status of SO₂ level

Sl. No.	Months	SO ₂ (µg/m ³)*
1	January	2.6
2	February	2.5
3	March	2.9
4	April	2.8
5	May	2.1
6	June	1.5
7	July	1.8
8	August	2.5
9	September	2
10	October	2.1
11	November	2.2
12	December	2.3
	Mean	2.3

* CPCB Standard of SO₂ level is 50 µg/m³

3. Particulate matter

In addition to gaseous pollutants, atmosphere also has particles in the form of pollutants. Airborne particulate matter (PM) is not a single pollutant but a complex mixture of many chemical species mainly solids and aerosols consisting of small droplets of liquid, dry solid fragments, and solid cores with liquid coatings. Among these particles some are directly emitted from different sources mainly from construction sites, road activities, fields, smokestacks, fires etc. Whereas, most particles result from the complex reactions of various gaseous compounds (sulfur dioxide and nitrogen oxides) that are emitted from various industrial and automobile sectors.

These particles have a divergent composition and size and sometimes particles such as dust, dirt, soot, or smoke, are large or dark enough to be seen with the naked eye while some others are so small that can only be detected using an electron microscope. Larger particles being emitted into the atmosphere quickly get down by the force of gravity or washed out by rain. Smaller particles remain in the atmosphere for longer period of time and can be transported over longer distances that may alter the composition and change the characteristics of the particles because of physicochemical processes.

The adverse effects on health (toxic effect on blood, allergy, respiratory symptoms etc.) due to microscopic particulate matter (PM) depend upon their particles diameter (different particle sizes like PM_{2.5} and PM₁₀) that may become critical for air quality regulatory purposes. Those with a diameter of 10 microns or less (PM₁₀) are inhalable into the lungs and can induce health issues while PM 2.5 is defined as fine particles that are 2.5 microns or less in diameter (PM 2.5). Consequently, PM 2.5 comprises a portion of PM₁₀.

3.1. Particulate Matter (PM 2.5)

These are fine particular matter of 2.5 microns or less in diameter. In the present work (2021-2022 period) the concentration of PM 2.5 ranged between 15 to 58 $\mu\text{g}/\text{m}^3$ with summer month March ($\mu\text{g}/\text{m}^3$) showing the greater value while July (monsoon month) having the minimum (15 $\mu\text{g}/\text{m}^3$). The mean annual concentration of PM 2.5 in the region was estimated to be 28.3 $\mu\text{g}/\text{m}^3$. The study revealed that the particular matter concentration during the month of March (58 $\mu\text{g}/\text{m}^3$) and April (45 $\mu\text{g}/\text{m}^3$) surpassed permissible limit of PM 2.5 (40 $\mu\text{g}/\text{m}^3$) as specified by the Central Pollution Control Board (CPCB). This may attribute to the higher temperature, scarce rainfall, little or no wind, grater photochemical reactions at elevated temperature in the dry periods. At the same time monsoon months (June- September) had comparatively lower concentration of pollutant (PM 2.5) in the area.

Table 7 Monthly status of fine particulate matter (PM 2.5)

Sl. No.	Months	PM 2.5 ($\mu\text{g}/\text{m}^3$)*
1	January	37
2	February	38
3	March	58
4	April	45
5	May	24
6	June	18.5
7	July	15
8	August	21
9	September	20.3
10	October	23.1
11	November	22
12	December	18.7
	Mean	28.3

* CPCB Standard of PM 2.5 level is 40 $\mu\text{g}/\text{m}^3$

3.2. Particulate Matter (PM 10)

PM10 are particles, with diameters that are generally 10 micrometers or smaller. More or less similar observation detected with PM 2.5 can be noticed in the case of PM 10. Here also summer months (especially March and April) had greater concentration of particulate matter even exceeding the permissible limit of CPCB standard ($60 \mu\text{g}/\text{m}^3$) while monsoon months witnessed a sharp reduction in pollutant concentration during 2021-2022 tenure. The maximum pollutant load was observed in the month of March while minimum in July with mean annual concentration touching the mark of $44.4 \mu\text{g}/\text{m}^3$. The result suggests that particle pollution (PM 10) becomes more critical in the dry season as compared to monsoon periods.

Table 8 Monthly status of fine particulate matter (PM 10)

Sl. No.	Months	PM 10 ($\mu\text{g}/\text{m}^3$)*
1	January	45
2	February	52
3	March	115
4	April	89.5
5	May	40.1
6	June	23.5
7	July	19.5
8	August	26.5
9	September	28.5
10	October	29.5
11	November	31.5
12	December	32.5
	Mean	44.4

* CPCB Standard of PM 10 level is ($60 \mu\text{g}/\text{m}^3$)

Green initiatives

- Electronic vehicles and bicycles are encouraged in the campus
- Car pool facility is adopted in the campus
- Green energy in the form of solar panel and solar heater is utilized.
- College has got adequate housekeeping staff for maintaining cleanliness on the campus

- Vegetation on the riverside functions as a green belt that helps to improve the air quality.

Recommendations

1. It is recommended to carry out a periodic monitoring of the air quality (indoor and outdoor) of the campus with the help of research organizations.
2. College can install an automatic weather station and display air quality measurement boards (digital) in the campus.
3. Use eco- friendly paints and other products wherever possible.
4. Since the college is situated in an urban environment and within amited space, preservation of existing tree cover or vegetation is essential for maintaining the quality of air in the campus. If the space or area permits, tree planting and development of green belts around the campus can be considered to alleviate air pollution.
5. As per the Government norms vehicles older than 15 years should be banned. New vehicles should follow the latest emission standards (BS IV or BS VI) adopted by the Government of India.
6. Car pool, use of public transportation, or walk should be encouraged.
7. Reward or encourage the people who act for environmental cause.

The present study indicates that the air quality of St. Xavier's College (located in the industrial city of Aluva) is found satisfactory in the case of gaseous compounds (NO₂ and SO₂) while particle pollution is a matter of concern. In the case of meteorology, the rainfall has increased over the last four years while temperature and relative humidity remained more or less same considering the last six years' data (2016-2021). Regarding air pollutants, NO₂ concentration remained within the permissible limit with values of few months slightly above CPCB standard during the period 2021-2022. The pollution load of another major pollutant SO₂ remained stable during the period of 2021-2022. Regarding the particle pollution (both PM 2.5 and PM 10), pollutant load remained high (beyond the safer level) during the months of summer (March and April) and the concentration of particles vary with the weather condition. The present audit indicates that the results, observations and recommendations provided can improve the understanding on air quality that helps to take steps towards breathing a safer and pure air.

Component Audits (Healthy Practices and Recommendations)

1

ENERGY AUDIT

Energy is one of the major inputs for economic development and hence the energy sector receives critical importance in the long-sighted view of ever-increasing energy needs, particularly in higher education institutions. Energy-saving certainly reduces the burden on energy resources and the economy and also saves money with energy-efficient appliances. It requires optimum use of energy by minimizing wastage and avoiding loss or excess use without compromising the quality of output and comfort.

An energy audit is an effective tool to manage energy more systematically. It regulates the amount of energy consumption associated with a building and the probable investments linked with that energy consumption. The audit makes aware of saving energy and encouraging renewable energy techniques and technologies in general, besides the use of energy-efficient materials in particular. Besides, it acts as a tool to estimate and analyze energy consumption and its pattern. It identifies all the energy streams in a system and quantifies the use of energy according to its discrete functions. The audit inspects energy losses and wastage through an energy survey and provides provisions to elucidate Energy Conservation Opportunities and suggests technically feasible energy-saving measures to curtail energy losses and wastage. The audit benefits the owners and industries to reduce their billing cost and implementing best possible and cost-effective energy saving measures.

Objectives

- Generation of energy consumption profile of the campus
- Identification of major energy resources of the campus
- Identification of sustainable energy avenues existing in the campus

Methodology

A team from ACESSD visited St. Xavier's College for Women, Aluva to assess the energy resources and their consumption pattern. The faculty and non-teaching staff members of St. Xavier's College assisted the team with data collection. Information on energy sources, the quantity of consumption, its pattern of use, wastage, etc. were entered in standard data sheets. Besides, rigorous field visits, interviews, and discussions were conducted with the authorities of the institution.

1. Electrical Energy

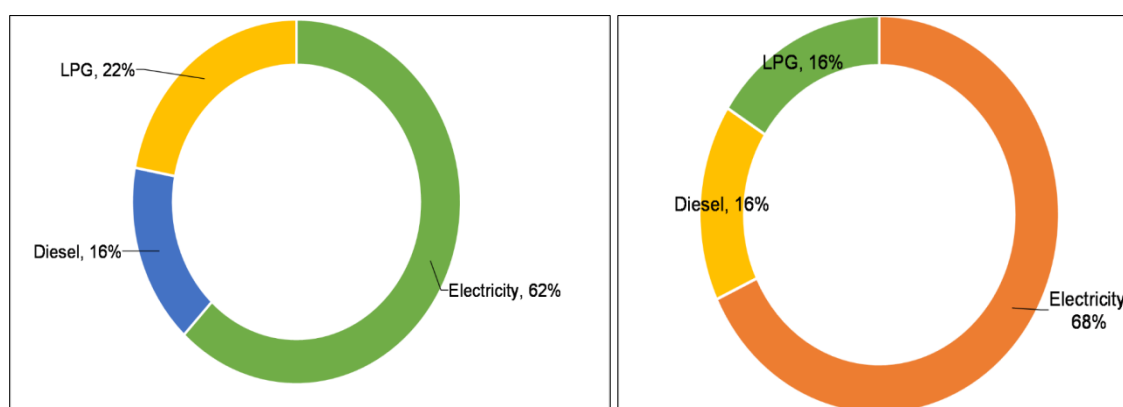
Table 1 Energy sources and consumption profile during 2021-22

Contract demand	72 kVA
Power Unit	kWh
Zone	Cumulative
Annual electricity consumption	77142 kWh
Annual electricity charge	Rs. 637154
Average energy charges at the campus	Rs. 8.26 / kWh
Annual diesel consumption (DG set)	1560 Liters
Annual LPG consumption	1963 kg
Annual fuel cost (LPG, & Diesel)	Rs. 293670

Electricity from Kerala State Electricity Board (KSEB) is the prime source of energy on the campus, besides LPG and diesel. Furthermore, the campus is equipped with a mini solar power plant and biogas plant that aids in the power supply (Table 2).

Table 2 Energy inputs, annual consumption, and cost during 2021-22

Energy inputs	Unit	Annual consumption	Energy equivalent		Average cost/unit (Rs)	Total cost	
Unit			kWh	%	Rs	Rs	%
Electrical	kWh	77142	77142	62	8.26	637154	68
Diesel	Litre	1560	19953	16	7.22	144144	16
LPG	kg	1963	27391	22	5.46	149526	16
Total			124486	100		930824	100

**Fig. 1** Energy distribution and energy cost distribution of the campus during 2021-22**Specific electrical energy consumption**

The specific electrical energy consumption was calculated as the electrical energy consumption per person (kWh/person) and per square meter of built-up area (kWh/m²) of the campus. To calculate the specific energy consumption, the total number of persons present on campus (including students, staff, and non-teaching staff) and the total built-up area are considered.

The consolidated **specific energy consumption** computed for the year 2021-22 is **4.90 kWh/m²/year** and **39.22 kWh/person/year** respectively. The monthly difference in the specific energy consumption (Fig. 2 and Fig. 3) reveals the changing activities of the campus.

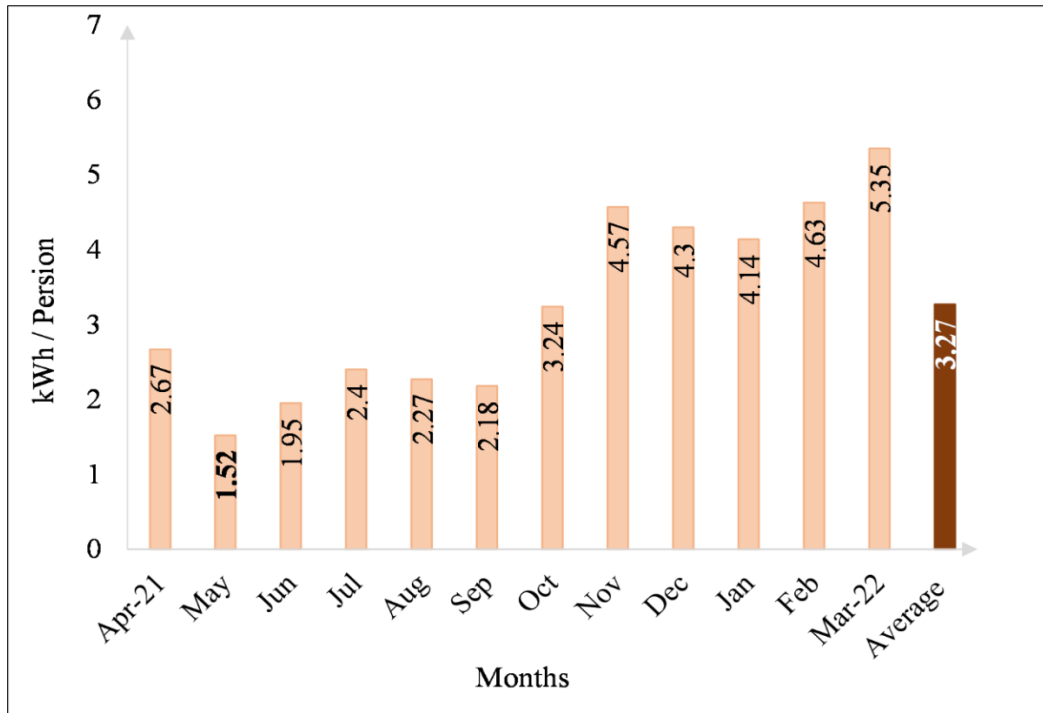


Fig. 2 Monthly specific energy consumption per person during 2021-22

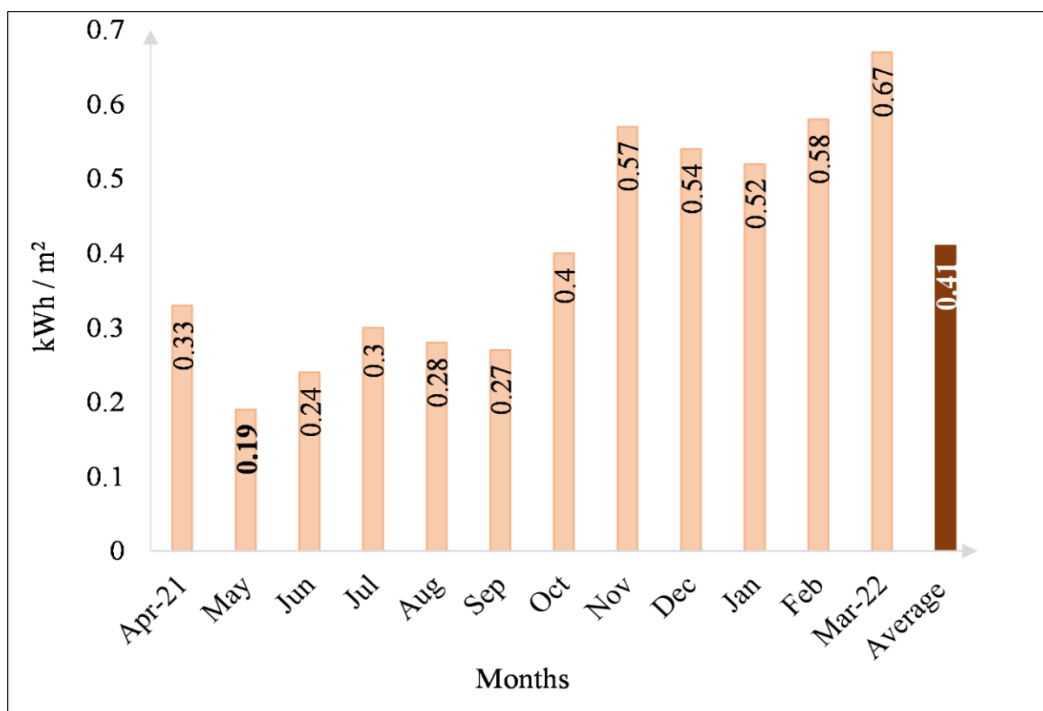


Fig. 3 Monthly specific energy consumption per sq. meter during 2021-22

During 2020-21 electrical energy consumption of the campus was recorded as 77142 kWh (Table 2) with a monthly average of 6429 kWh. Maximum energy consumption was noted during the month of March while May recorded the minimum. Month-wise electricity consumption is presented in Fig. 4.

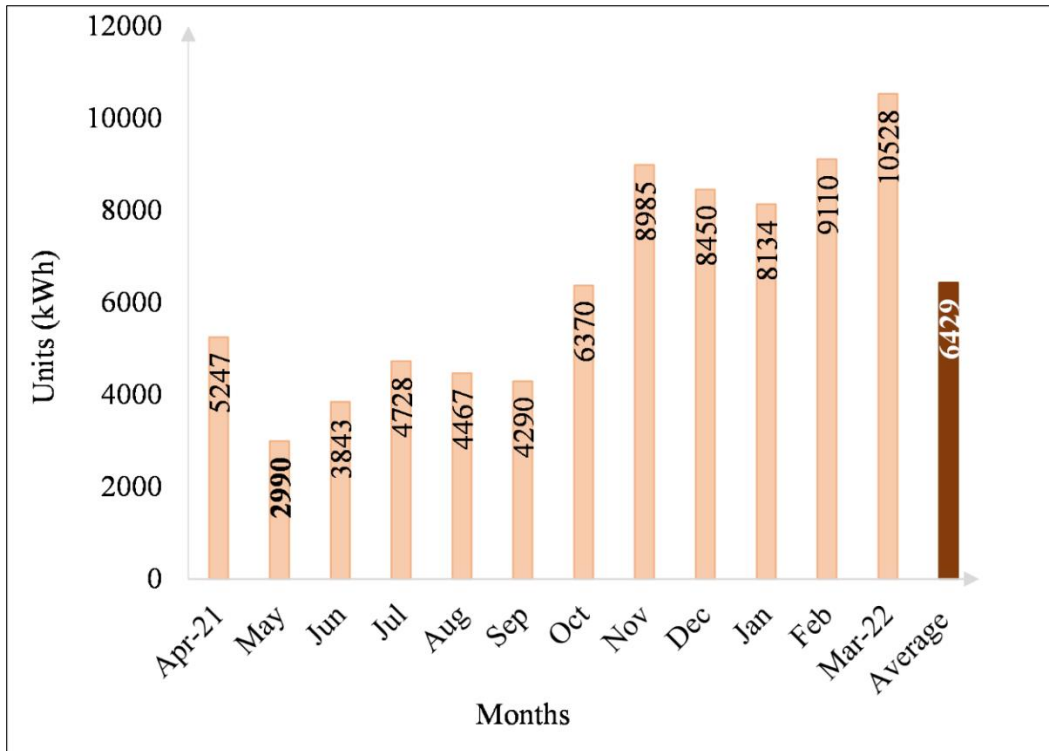


Fig. 4 Monthly electrical energy consumption (kWh) during 2021-22

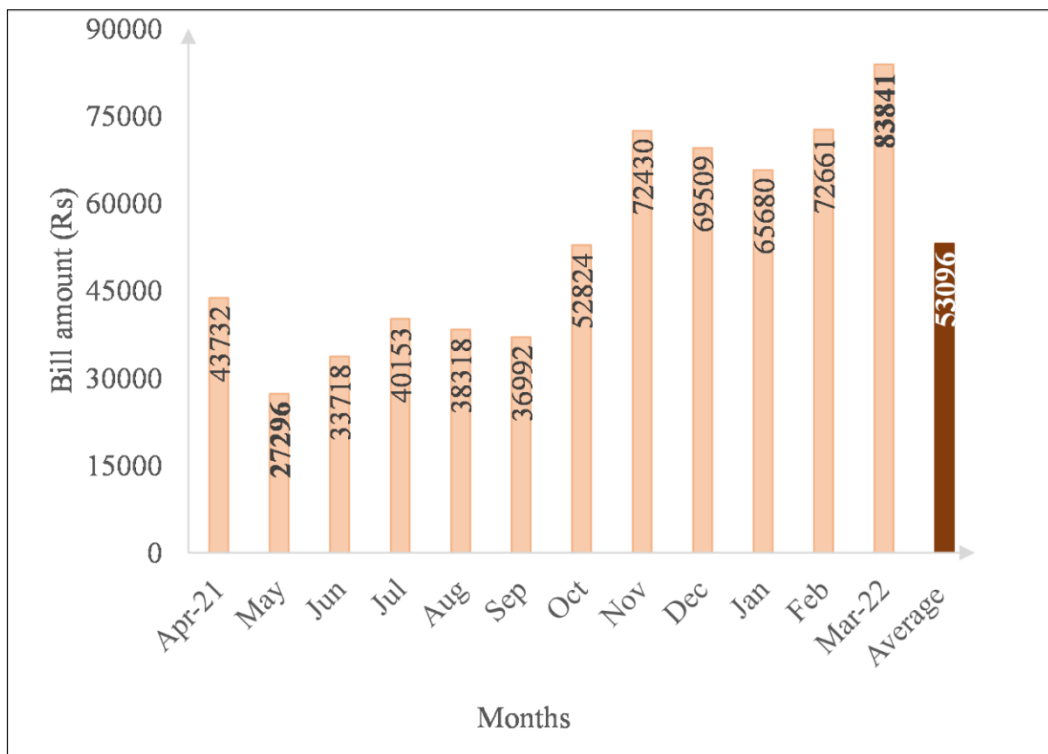


Fig. 5 .Monthly incurred costs (Rs) during 2021-22

Fig. 5 reveals the monthly incurred cost for power consumed which is quite proportional to the consumption.

Block wise energy consumption

The college is well equipped with adequate electrical facilities and installations. Block or building-wise electricity consumption (in terms of Watts) is presented in Figure 6. It is noted that on the campus, the Jesus building is the prime power consumer (83044 W) followed by the St. Joseph building (73306 W).

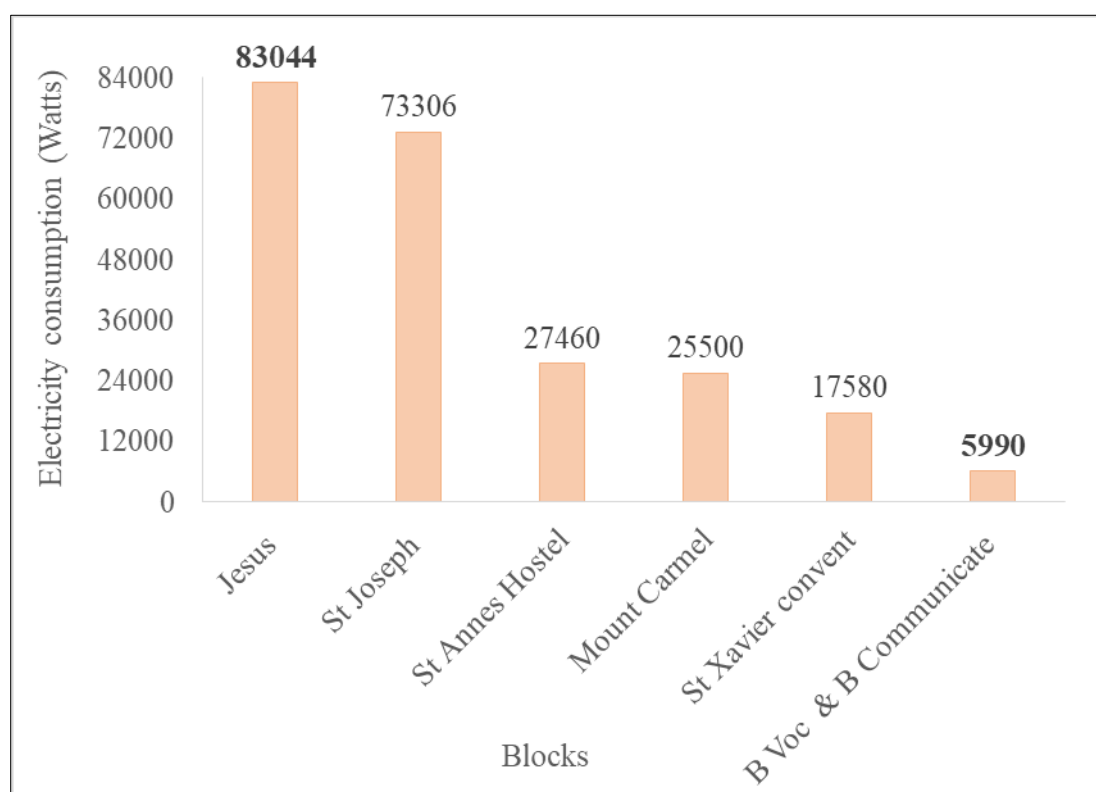


Fig 6 Building wise electricity consumption (Watts)

A. Electricity consumption in Jesus Block

The Jesus block is a massive structure on the campus and encompasses several amenities like classrooms, faculty rooms, various departments viz., Physics, Zoology, Botany and Chemistry, Conference room, Principal room, Main office, Vice-principal / Manager room/ printing room, Reception, Computer Centre, IQAC room, Indoor stadium, etc and hence consumes a significant proportion of electricity (83044 W). A list of electrical appliances/equipment noted in the block is given in Table 3.

Table 3 List of electrical equipment in Jesus Block

Jesus block	Physics	Zoology	Botany	Chemistry	Conference room	Principal room	Main Office	Manager / Vice principal / printing room	Reception	Computer Centre	IQAC	Indoor stadium
TV						1	1					
Computer	33	2					10	1		50	3	
Laptop	3											
speakers	14	13									1	
Scanner										1		
Projector	5	5	3	4	1					1		
Water purifier							1					
Printer + Photostat							4					
Big printers								2				
Photostat machine									1			
LED lamps	20	25		42	6	17	4	16	6			3
CFL lamps	1	1		1						8		
Incandescent lamps	10	3										
Tube light	33	23	6	23			9			6		
Fan	55	36		20	4	4	13	5	2	7		
Mike Set	1	1										
Air cooler							2					
Amplifier (250 W)							2					
AC					1	1		1				
Wifi modem							2		1			
Photo bulb							1					
Generator(6.5 KVA)												1
MH light												6
Heavy duty fan												3

Since this block encloses the major labs of various departments like Physics, Zoology, Botany, and Chemistry, an array of various lab-based infrastructures and equipment are present. The detailed list of equipment recorded from each lab is listed in Tables 4 - 8.

Table 4 List of equipment in the Physics Lab

Sl. No	Equipment	Number
1	Distillation Unit	2
2	Function Generator	24
3	DC Power Supply	23
4	Battery Charger	2
5	Battery Eliminator	25
6	Table Lamp	7
7	IC Trainer Kit	12
8	Microprocessor	18
9	Arc unit	1
10	High Voltage Transformer	1
11	Millikan Oil Drop Setup	2
12	Sonometer Source	5
13	Dimmerstat	8
14	Ballistic Galvanometer	12
15	Dual Power Supply	24
16	CRO	22
17	Electronic Balance	1
18	Vaccum Coating Unit	1
19	Magnetic Stirrer	3
20	Stabilizer	3
21	Air Conditioner	2
22	Ultrasonic Cleaner	1
23	Vacuum Pump	1
24	IC Regulated Source	1
25	PH Analyser	1
26	Dip Coating Unit	1
27	UV-Vis spectrophotometer	1
28	FTIR Spectrometer	1
29	Hot Air Oven	1
30	Muffle Furnace	1
31	Source Meter	1
32	Power Amplifier	2
33	Stefan's Constant Apparatus	1
34	e/m Apparatus	6
35	Optoelectronic Kit	1
36	Zeeman Effect Apparatus	1
37	BH Curve Apparatus	2
38	Four Probe Apparatus	1
39	RF Oscillator	2
40	Planck's Constant Apparatus	1
41	Capacitance Measuring Unit	2
42	Constant Current Source	2
43	Frank Hert's Apparatus	2
44	Laser Source	7
45	Mercury Lamp	2
46	Sodium Lamp	3

Table 5 List of equipment in the Zoology Lab

Sl. No	Equipment	Number
1	Binocular Stereo Microscope	1
2	Bacteriological Incubator	2
3	Water Bath	1
4	Cyclomixer	1
5	Trinocular Stereo Microscope	1
6	Trinocular Compound Microscope	1
7	Deep Freezer	1
8	Distillation Unit	1
9	pH meter	1
10	Cooling Centrifuge	1
11	Spectrophotometer	1
12	Hot Air Oven	1
13	Laminar Air Flow (For PCR)	1
14	Autoclave	1
15	Angular Rotor	1
16	Microwave Oven	1
17	Needle and Syringe Destroyer	1
18	OHP	1
19	Candling Apparatus	1
20	Electronic Balance	1
21	Induction Top	1
22	DVD Player	1
23	Cooling Centrifuge	1
24	Refrigerated microcentrifuge	1

Table 6 List of equipment in the Botany Lab

Sl. No	Equipment	Number
1	Autoclave	1
2	Hot air oven	2
3	Balance	1
4	Binocular microscope	1
5	Centrifuge	1
6	Soxhlet Apparatus	2
7	Refrigerator	1
8	Spectrophotometer	1
9	trans u v	1
10	Magnetic stirrer	1
11	Water bath	1
12	Colourimeter	1
13	Inoculation Hood	1
14	pH meter	2
15	Microcentrifuge	1
16	Electrophoresis unit-Horizontal	1
17	Electrophoresis unit-Vertical	1
18	Powerpack	1
19	Refrigerator	2
20	Microscope-compound-Binocular	1
21	Deep Freezer	1
22	Single distillation Unit	1
23	Rotary evaporator-machine	1
24	Rotary evaporator-Vaccum pump	1
25	Rotary evaporator-Chiller	1
26	Heating mantle	1

Table 7 List of equipment in the Chemistry Lab

Sl. No	Equipment	Number
1	Melting Point Apparatus	3
2	Potentiometer	6
3	Bunsen Burner Electrical	3
4	Vacuum Pump	3
5	Cordless Vacuum Pump	2
6	Heating Mantle	2
7	Magnetic Stirrer	2
8	Magnetic Stirrer	1
9	Water Bath	1
10	Homogeniser	1
11	Autoclave	1
12	Ph Meter	1
13	Impact Testing Machine	1
14	Hume Hood Cupboard	1
15	Hot Air Oven	2
16	Muffle Furnace	1
17	Tds Meter	1
18	Dissolved Oxygen Analyser	1
19	Sugar And Oil Refractometer	1
20	Cordless Vacuum Pump	2
21	Copper Calorimeter	4
22	Polarimeter	4
23	Conductivity Meter	1
24	Stirrer	1
25	Hot Plate	1
26	Magnetic Stirrer	1
27	Colorimeter-Photoelectric	1
28	Refractometer	1
29	Centrifuge	1

Table 8 List of equipment in the Computer Center

Sl. No	Equipment	Number
1	Computer	50
2	Fan	5
3	Bulb CFL	8
4	Tube	10
5	Stabilizer	3
6	Router jig	1WC
7	D-link modem	1WC
8	switchboard	3 WC

B. Electricity consumption in St. Joseph Block

The electricity consumption in the St. Joseph block is 73306 W, which accounts for a substantial proportion of the total utilization of the campus. This block encloses various departments like Physical education, Hindi, Malayalam, Mathematics, Microbiology, Economics, and Commerce sections as well as facilities like office, kinder garden, prayer hall, lift, canteen, micro-biology lab, seminar halls etc. The detailed list of electrical appliances recorded in this block is given in Table 9.

Table 9. List of electrical equipments in St. Joseph Block

St Joseph block	Physical education	Hindi	Malayalam	Mathematics	Microbiology	Commerce regular	Economics	Commerce Self financing	Office	Kindergarten	Prayer hall	Lift	Seminar hall-1	Seminar hall-2	Canteen
Computer	1	2	2	7	3	13	3	2	1						
Laptop					2										
LCD projector			3	3	3	5	3	5							
overhead projector					2										
Printer	1	1	1	1	1	3									
SPEAKER					4										
LED lamps -	1	2	5					17	1	1	2	4	40	55	1
CFL lamps -	2	2				1			1						
Tube	2	1	5		3		4	25	1		1				21
Incandescent lamps -	2		2	1	10	1									
Fan	1		12	10	16	18		52	1	1	4		16	5	19
A/C					1								6	4	
Speaker				7	6					1				5	2
Camera												1			1
Intercom												1			
Exhaust fan												1			
Projector														1	
UPS (1 KW)														1	
Amplifier(250 W)														1	
Fridge															1
Freezer															3
Grinder															1

A well-equipped microbiology lab with sophisticated infrastructure facilities and equipment is a major portion of this block. The list of equipment recorded in the microbiology lab is depicted in the Table 10.

Table 10 List of equipment in Microbiology Lab

Sl. No	Equipment	Number
1	Autoclave- Big	2
2	Autoclave -Small	1
3	Laminar air flow	2
4	Hot air oven	1
5	Water bath	2
6	Hot plate	1
7	Colony counter	1
8	Microscope (illuminated)	1
9	Binocular (illuminated)	5
10	Incubator	2
11	Electronic balance	4
12	Centrifuge	2
13	Colorimeter	4
14	pH meter	2
15	Electrophoretic power pack	1
16	UV Transilluminator	3
17	Double Distillation	1
18	Kahn Shaker	1
19	Microwave Oven	1
20	Induction cooker	1
21	Vortex	1
22	Refrigerator	5
23	Stabiliser	1
24	PCR	1
25	BOD Incubator	1
26	Heating Mantle	1
27	Magnetic Stirrer	1
28	Fridge (1 -4star, 1 -2 star)	2
29	AC	1
30	Needle incinerator	1
31	Cooling centrifuge	1

C. Electricity consumption in St. Annes Hostel

St Annes Hostel boards about 128 students and provides required amenities so as to meet the basic needs of the inmates. Currently, 27460 W electricity is being utilised in this hostel in order to meet the requirements. The list of electrical appliances noted in the hostel is given in Table 11.

Table 11. List of equipments in St Annes Hostel

Sl. No	Equipment	Number
1	Fan	76
2	Tube	65
3	LED tube	15
4	LED bulb	52
5	Spot light	1
6	Plug	30
7	Fridge	1
8	Cooler	1
9	Freezer	1
10	Oven	1
11	Grinder	1
12	Water heater	1
13	Washing Machine	1
14	Mixy	1
15	TV	1
16	Computer	7
17	Camera	1
18	Photo stat machine	1
19	Projector	1
20	Motor	2

D. Electricity consumption in Mount Carmel Block

Mount Carmel is the third academic block in St. Xavier's and consumes 25500 W of electric energy under various sections like integrated chemistry, AV room, English department, Library, Auditorium, Health center, Sports Hall. The detailed list of electrical appliances present in this block is given in Table 12.

Table 12 List of equipment in Mount Carmel Block

Mount Carmel block	Integrated chemistry	AV room	English	Library	Auditorium	Health center	Sports view Hall
TV		1	14	11			
Computer			13				
Printer			2	2			
Projector	3		5		1		
Scanner				1			
Wifi				1			
Motor (1/2 Hp)					1		
Speaker		2			6		
Amplifier (400 watts)					1		
RFID door				1			
KIOSK				1			
LED lamb			3	30	42	1	4
LED tube		4					
Incandescent lamps			17				
Tube			27				
Fan		2	27	31	4	1	11
MH light (250 W)					5		
MH LED light (250 W)					4		

E. Electricity consumption in St. Xavier's Convent

St Xavier's Convent utilises nearly 17580W of electricity and the list of electrical appliances noted in the hostel is provided in Table 13.

Table 13 List of equipments in St. Xavier's Convent

Sl. No	Equipment	Number
1	Fan	38
2	Fan	3
3	Tube	33
4	LED tube	12
5	LED bulb	35
6	Spot light	1
7	Plug	30
8	Fridge	2
9	Cooler	1
10	Freezer	1
11	Oven	1
12	Grinder	1
13	Water heater	4
14	Washing Machine	1
15	Mixy	1
16	TV	1

F. Electricity consumption in B Voc & B Communicative Block

B Voc & B Communicative block is a major section in the college and is constituted by classrooms, staff room, food processing lab etc., consumes about 5990 W of electricity. The list of electrical appliances recorded in this block is given in Table 14.

Table14, List of equipments in B Voc & B Communicative Block

Sl. No	Equipment	Number
1	Fan	14
2	Tube	10
3	LED tube	5
4	LED bulb	5
5	Projector	1
6	Plug	10
7	Fridge	1
8	Cooler	1
9	Computer	1
10	Oven	1
11	Mixy	1

2. Diesel consumption

in St. Xaviers's campus, diesel is used as the major fuel for energy sources mainly for transportation and power generation using generators. The institution owns two buses and a minibus for traveling purposes. In addition, the institution has two diesel generators (DG) for an uninterrupted power supply.

The annual diesel consumption of the campus was approximately 1560 L which accounts for about 22% (19953 kWh) of the total energy equivalent and is responsible for a total annual expenditure of about 1,44,144 Rupees.

3. LPG

LPG consumption contributes nearly 22% (27391kWh) of the total annual energy utilization and is hence a potential energy source owned by the campus. Mainly LPG is utilized in the canteen, convent for cooking purposes, and also in labs. It is noted that about 122 cylinders of each 14.2 (74 nos) and 19 kg (48 nos) capacity are currently been used for these purposes. The annual LPG utilization of the campus was computed as 1963 kg and incurred a total expence of Rs. 1,49,526.

Table 15 LPG consumption in St. Xavier's campus

Particulars	No of cylinders		Total
	14.2kg capacity	19 kg capacity	
Convent	12	0	12
Hostel	48	48	96
Lab	14	0	14
No of cylinders	74	48	122
Total cost (Rs.)	64,420	85,106	1,49,526
Total weight (kg)	1051	912	1963

Renewable energy avenues of the campus

Renewable energy

Renewable energy plays a significant role in energy security and in reducing greenhouse gas emissions. St. Xavier's campus has visualized the avenues of renewable sources of energy and their environmental output. Consequently, it searched for the appropriate technologies and possible subsidies. Further, its usage helps to reduce energy demand and reduce fossil fuel use, which is the largest source of carbon dioxide emission. Owing to their energy conservation perception, the College campus took the following avenues and morphed into a smart energy consumer.

1. Solar power unit
2. Biogas plants

1. Solar power unit

The institution has installed a solar power unit as they are much conscious about the need of energy conservation. It shares a fraction of the annual power requirement of the college. The institution hopes to extend further its pursuit of solar energy in future. The college is planning to convert into grid solar system on the campus.

Now the college is partially shifted to solar energy by establishing solar panel of 3kW and solar water heaters (Gig 7). It is worth noting that the Physics Department of the College is fully operational under solar power.



Fig. 7 Solar power Unit

2. Biogas plants

Biogas plant has been recognized as a suitable technology for improving energy access, waste management, and sanitation. The campus has three biogas units, of which two are located in the convent (Fig 8a & 8b) and the other in the hostel (Fig 8c). The details are given in Table 16 and Fig 8a,b, &c. The generated gas from the biogas plant is used for cooking purposes. Biogas plants also provide a residue of organic waste after anaerobic digestion which has superior nutrient qualities and considerable environmental benefits by reducing GHG emissions.

Table 16 Biogas plant in the St. Xavier's campus

Blocks	Waste absorption capacity / day (kg)	Gas generation /day
Convent	10-12 kg	2-3 hrs
	8-10 kg (Occasional usage)	≥ 1 hrs
Hostel	10 kg	1-2 hrs



Fig. 8a Biogas plants near Convent



Fig. 8b Biogas plant near the Convent



Fig. 8c Biogas plant in the hostel

Healthy practices

- The college harness alternative energy through Solar Photo Voltaic (SPV) System and Biogas plant
- Installation of Sensor based lamps.
- Solar LED street lights with sensor features are installed in the campus
- Replaced the non-usable CFLs with LED bulbs through the KSEB energy-saving program.
- Promoting the procurement and purchase of energy-efficient appliances (5 star rated)
- Replaced the ordinary ceiling fans with energy-efficient (5 stars rated) fans.
- Replacement of incompetent machineries with new ones.
- Replaced energy-saving appliances to conserve energy.

Recommendations

- Use smart power strips to avoid “Phantom loads,”
- Make a regular check-up on the gadgets to improve their efficiency.
- Unplug and turn off electrical appliances when not in use or after use.

WATER AUDIT

Water is a necessary requirement for life, and according to UN, the access to clean water is a fundamental right. However, millions of people in India live without direct access to potable water, and given the country's rapid population increase and finite water supply, water will become an extremely precious and scarce resource in a matter of years. In this backdrop, decision-makers must act quickly to enhance the circumstances for the Indian people's effective use and supply of water today and in the future.

The National Water Policy – 2012 emphasizes the importance of disclosing water accounts and water audit reports that identify leaks and pilferages. The policy encourages systems to develop benchmarks for water consumption for various purposes, such as water footprints and water auditing, to ensure effective water use.

The water audit is a well-established method for identifying both productive and wasteful usage of water. It is a process that evaluates the quality and quantity of water flowing in simple and complex systems with the aim of reducing water usage and often saving money on otherwise unnecessary water usage. A water-saving plan can be designed if one understands where water is consumed and lost. The water audit of St. Xavier's focuses on the availability, utilisation, purification, and recycling of the water resources on the campus. Healthy practices that are adopted are also examined.

Objectives

- To list out the water resources 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
- To assess the quality of available water
- To suggest remedial measures and water conservation practices

Methodology

A team from ACESSD visited St. Xavier's College, to provide the prepared standard datasheets and to assess the state of the campus's water resources. The students, faculty and non-teaching personnel along with the members of ACESSD collected the data. The standard datasheets created include the information on the sources, the pattern and quantity of water usage, storage etc. The water samples collected were brought to ACESSD in Mahatma Gandhi University for physio-chemical analysis. Important physio-chemical parameters like pH, EC, TDS, salinity, and MPN (Coliforms) of the water samples from the campus were analysed and assessed.

Source of water

During the assessment, it is found that two open wells on the campus form the major water source for the college community. However, presently only one well (well I) is utilized completely on a regular basis whereas well II is used occasionally. The well which is situated in the proximity of Jesus Block on the campus (well III) is found abandoned owing the poor quality of water. It is reported that the collage relay upon Kerala Water Authority only since 2021 onwards for its water requirements. In addition, the college owns two rainwater harvesting plants for collecting and storing rainwater. Water is also taken directly from Periyar for watering purposes on the campus.

Two ground-level water storage tanks adjacent to the open wells stores water for further usage on the campus. Presently, Well I, Kerala Water Authority and Rainwater Harvesting Plants serves the water needs of the college and its community,



Well I and associated storage tank



Well II and associated storage tank



Well III

Water outlets

A total of 182 taps, 14 purifiers, 27 flush tanks and 6 faucets were installed in the main three academic blocks. As Jesus block comprises various labs and administrative sections, it possess maximum connections and taps. Since the taps are in good condition, the water loss due to leakage is noted minimal in the campus. The details of the outlets are shown in the Table1.

Table 1. Details of the outlets in the campus

	Taps	Purifiers	Flush tanks	Faucets
St. Joseph's Block	32	8	15	3
Mt. Carmel Block	15	2	7	0
Jesus Block	110	4	5	3
Outside the Buildings	25			
Total	182	14	27	6

Water quality

Sampling sites and sample code

Water samples were collected from 15 representative sampling locations including wells, tapwater, and purifiers were collected and brought to ACCESSD in Mahatma Gandhi University for physico-chemical analysis. The sampling sites and sample codes are as follows:

Table 2. Details of sampling sites and codes

Sl. no	Sampling sites	Sample codes
1	Well I	S ₁
2	Well II	S ₂
3	Kerala Water Authority (KWA)	S ₃
4	Purifier - St. Joseph block	S ₄
5	Rainwater Harvesting Plant	S ₅
6	Periyar	S ₆
7	Tap water - Jesus block	S ₇
8	Tap water - St. Joseph block	S ₈
9	Tap water - Mt. Carmel block	S ₉
10	Tap water - Convent	S ₁₀
11	Tap water - Hostel	S ₁₁
12	Cooler - Jesus block	S ₁₂
13	Cooler - Mt. Carmel block	S ₁₃
14	Cooler - Convent	S ₁₄
15	Cooler - Hostel	S ₁₅

The collected samples were analysed by means of probe and the enumeration of coliforms was done by the MPN method. The results of water analysis are depicted in Table 3.

Table 3. Physico-chemical parameters of water

Sample	pH	EC (μS)	TDS(ppm)	Salinity(ppm)
WHO standard	6.5-8.5	- -	500	500
S₁	7.70	146.0	104	73.0
S₂	7.23	144.5	102	72.2
S₃	7.37	157	112	78.1
S₄	8.20	76.0	53.9	41.5
S₅	8.43	79.4	56.4	43.1
S₆	8.30	41.1	29.1	26.7
S₇	7.06	164.4	116	81.7
S₈	7.52	162.3	115	80.6
S₉	7.34	156.6	111	78
S₁₀	7.06	145.5	103	72.6
S₁₁	7.91	50.7	35.9	30.6
S₁₂	7.92	95.3	67.6	50.1
S₁₃	8.31	65.5	46.2	37.0
S₁₄	7.82	151.7	107	75.6
S₁₅	8.14	43.0	30.2	27.4

The Table 3 gives a clear picture of the water quality of the college. The values of the physicochemical parameters were found to be within the WHO permissible limits during the study.

Total coliforms

Coliforms are bacteria found in the environment as well as in the faeces of all warm blooded animals including humans. They are not likely to cause illness but on the other hand, their existence in drinking water indicates that pathogens may be present in the system. The total coliforms were enumerated by Most Probable Number (MPN) method. The total coliforms of six out of the 15 samples were analysed. The number of coliforms present in the water samples is as follows:

Table 4. Microbiological parameter (MPN) of water

Samples	MPN/100ml
S ₁	150
S ₂	64
S ₃	39
S ₄	3
S ₅	43
S ₆	1100

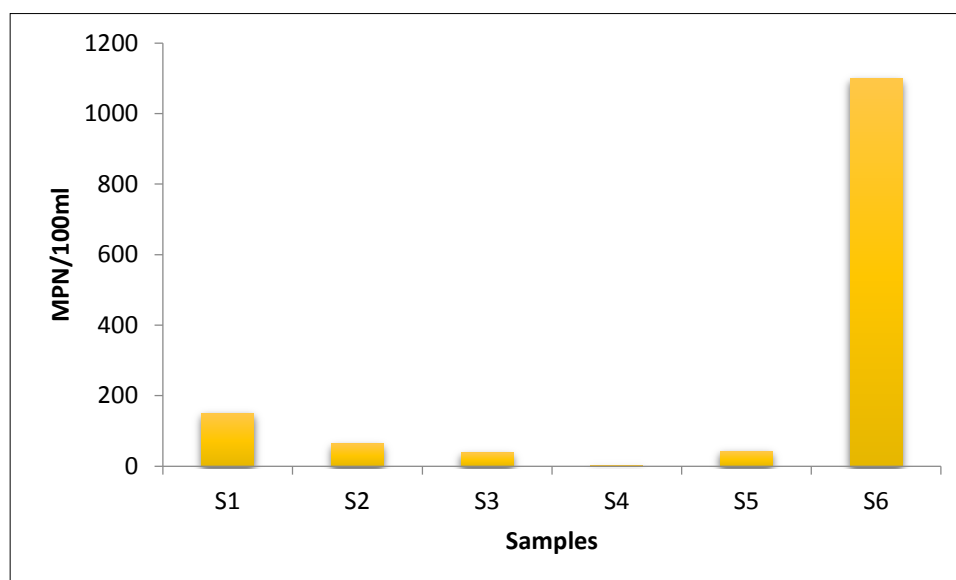


Fig. 1 Graphical representation of microbiological parameter (MPN) of water samples

According to World Health Organization (WHO), a zero percent *E. coli* level per 100 ml of water is considered to be potable. A value of 1–10 MPN/100 ml is considered low danger, whereas 11–100 MPN/100 ml is considered medium risk. All the six samples collected from the campus have shown the presence of coliforms. The sample collected from the Periyar (S₆) has the maximum *E. coli* concentration (1100 MPN/100ml) and the water drawn from Periyar is used for watering the plantations. While considering the samples collected from the campus compound, the Well I (S₁) showed the maximum coliform concentration (150 MPN/100 ml). Sample from RWH tank (S₅) also showed the presence of coliform bacteria and this may be due to droppings by birds or animals, or mixing of water from other sources.

Since all the water samples including the water purifier contain the presence of coliform bacteria, it is advised to have periodic water quality monitoring and its appropriate control measures.

As the campus has well equipped laboratories, various departments in the campus can take up the regular water analysis (Microbiology department can take up the microbial parameters of water while chemistry department can monitor the physico-chemical parameters).

Water usage

The entire amount of water withdrawn from its source to be used is referred to as "water use." Water usage measurements assist in determining the level of demand from industrial, agricultural and domestic users.

The main uses of water in the college are for drinking, bathroom and toilet, science laboratories, gardening, and construction. Water from open well, KWA and RWH tank meets these daily needs of the campus. The water consumption details of KWA water for different months (bimonthly) is given in Table 5.

Table 5. Details of Water bill

Month	Water consumption (kL)	Water charge (Rs.)
June 2021	48	980
August 2021	29	592
October 2021	56	1151
December 2021	22	452
February 2022	13	419
April 2022	83	2358
Total consumption	251 kL	
Average consumption	41.8 kL	

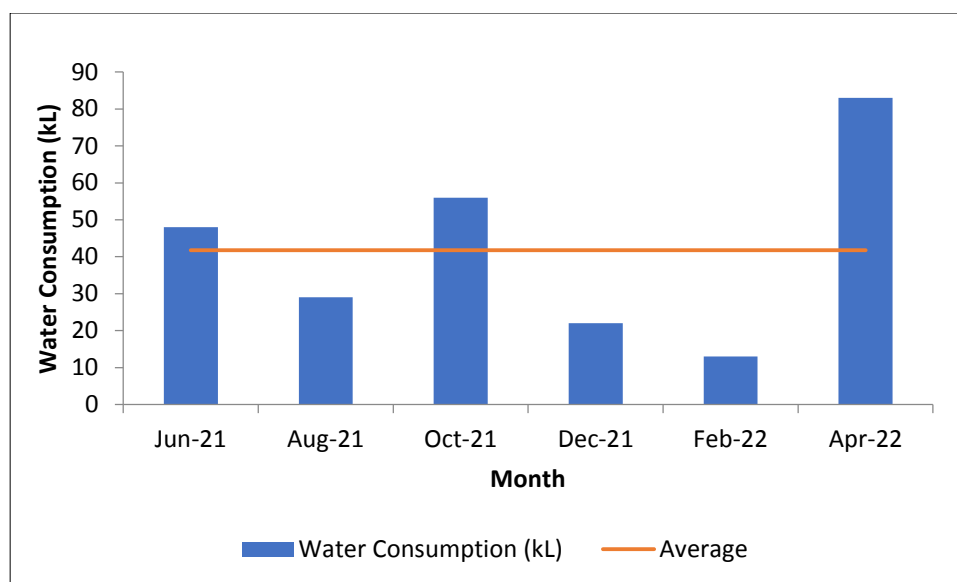


Fig. 2 Diagrammatic representation of KWA water consumption in the campus

The graph reveals that the maximum water consumed during the year 2021-22 was in April 2022 and was due to the renovation and construction activities on the campus. The average KWA water consumption was noted as **41.8 kL**.

Water storage

As a residential campus, surplus water is needed to meet the day requirements including hostel facilities and canteens. There are 11 storage tanks in the campus including two rainwater harvesting tanks. Water from Well I, KWA and the rainwater are stored in these different tanks.

Table 6. Details of water storage

Sl. No	Location	Capacity (L)	Type of water
1	Jesus Block	7000	Well water
2	Jesus Block	5000	Well water
3	Jesus Block	2000	Well water
4	Jesus Block	2000	Well water
5	Jesus Block	2000	Well water
6	Jesus Block	750	KWA
7	Jesus Block	5000	KWA
8	Jesus Block	5000	Rainwater
9	Jesus Block	1000	Rainwater
10	St. Joseph Block	750	KWA
11	St. Joseph Block	12,000	Well water
12	St. Joseph Block (Fire and Safety tank)	10,000	Rainwater + Well water
13	St. Joseph Block	20,000	Rainwater
14	Hostel	2500	Well water
15	Hostel	9000	Well water
16	Convent	5000	Well water
17	Convent	5000	Well water

Rainwater Harvesting Plant

Rainwater Harvesting is a method of collecting rainwater to meet daily needs. There are two rainwater harvesting plants are constructed in the campus and the rainwater collected is used for their daily requirements.

Table 7. Details of Rainwater Harvesting Plants

Sl. No.	Location	Capacity (L)
1	St. Joseph Block	20,000
2	Jesus Block	5000

St. Joseph Block and Jesus Block possess rainwater harvesting plants, whereas the Mount block in the campus any such facility was noted.



Rainwater Harvesting Tank (20000L)



Rainwater Harvesting Tank (5000L)



Rainwater collecting pipes

Waste water treatment plant

The college has installed an efficient waste water treatment plant for treating waste water from the science laboratories in Jesus block. The plant has a capacity for treating approximately 200L to 300L waste water per day.



Waste water treatment plant

Healthy practices

- Rainwater Harvesting
- Waste water treatment facility
- Awareness boards on water management practices are displayed within the campus premises
- Well maintained water distribution system
- Limited water loss through leakages
- Provision of UV filtered water for drinking purposes



Awareness boards on water management practices

Recommendations

- Proper maintenance of wells in the campus
- Rejuvenation of Well III
- Periodic removal of the leaves and other materials from the net used to cover/protect well
- Install high quality pipes for collecting waste water from the labs
- Conduct of regular analysis of water quality
- Chlorinate main water sources periodically
- Plant *vetivers* along the banks of Periyar and around the wells, this will aid in the removal of pollutants from the water source and to solve deep gully erosion

Conclusion

Water auditing is a well-known method for assessing both effective and inefficient water usage. It also provides scientific solutions for improving water conservation by reducing water loss and irrational consumption.

It is found that the campus has ample water sources mainly in the form of well water, rainwater, and KWA water for meeting the daily requirements of the campus.

The existing water conservation and management practices of the campus deserve appreciation since the water scenario of the campus is well managed. As the taps and other faucets in the college are in good condition, water loss through leakages was minimal. Moreover, there is a well-resourced waste water treatment plant in the campus with a treating capacity of about 200 to 300L waste water daily that aids in the sustainable utilization of water.

Regarding the water quality, the physico-chemical parameters are found within in the safer limits, however, the microbial level (MPN) is a matter of great concern. This reminds the need for taking effective control measures and periodic water monitoring for maintaining healthy water management in the campus.

WASTE AUDIT

Introduction

Generally, wastes are substances or products that no longer find any use or purpose and need to be discarded and have been getting increased attention as a continually growing menace, globally, regionally, and locally. The term waste is tied to the concept of disposal under the national waste regulation framework. According to “The Basel convention” wastes are substances or objects that are intended to be disposed of or are required to be disposed of by the provisions of national laws.

Presently, anthropogenic activities give rise to a large variety of wastes from various sources and 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. Globally the annual generation of municipal solid waste stands to be 2.01 billion tonnes of which 33% is not properly handled in an environmentally safe manner. As per government estimates, about 65 million tonnes of waste is generated annually in India while in Kerala, the total MSW generation in the state is estimated to be 3.7 million tonnes per annum. The increasing standard of living and trends in consumption and production patterns by the continuing global urbanization has posed alarming threats to the environment. If waste is not managed properly, it can create an unintended and negative consequence on human and environmental health as well. Hence it is necessary for people and organizations to understand the importance of waste management.

A waste audit is the first step toward a waste management system. It is the periodic, documented, and systematic approach to the management of waste. A waste audit focuses on the waste generated by the institution/ organization to determine the types, sources, and amounts of waste that are being generated and disposed of within a given time frame. Besides these practices can decide the various approaches for reducing the waste and cost involved, determine the effectiveness of the current waste management practices in place,

and identify and implement new strategies for waste minimization in an environmentally responsible manner.

Completing a waste audit provides full insight into the detailed information regarding the waste management policies in place, and also the scope for further refinement. In this way, an institution can ensure that the waste is being properly treated in a most sustainable manner and also ensures organization's responsibility for their own waste. In addition, an organization can endorse the waste audit data in order to show a quantifiable commitment to sustainability and environmental conservancy.

Objectives

- 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.

Methodology

Data collection for the present audit was executed through frequent field visits, direct observations, and assessments, communication with responsible persons, etc. Information was also collected using structured data sheets and also from various institutional reports. Photo documentation of various aspects of college-related audits was also done as part of the study. For the study purpose, the college campus was divided into six buildings (blocks) that constitute academic complexes like Jesus block, St. Joseph block, Mount Carmel block, B.VOC and B communicative block, and residential sectors like Hostel and Convent.

Status of waste generation in the college

From the study, it was found that the major solid wastes generated on the campus fall under nine major categories (Table 1, Fig. 1). The waste mainly comprises paper, plastic, glass, damaged furniture, food materials, e-waste, hazardous (chemicals, fluorescent lamps, batteries, etc.), biochemical waste (medicines, gloves, sanitary napkins, syringes, needles, microbiology waste, etc., and others (sandals, clothes, etc.).

Considering the various waste categories from different blocks (Jesus block, St. Joseph block, Mount Carmel block, B.VOC and B communicative block, Hostel and Convent),

the total waste generated in the college was estimated as 5199 kg/year (Table 1). The investigation revealed that, among the various waste categories, food waste constituted the maximum and accounts for nearly 75% (3919 kg/year) of the total waste generated (Table 1, Fig. 1) followed by paper 13% (692 kg/year), damaged furniture 4% (217 kg/year), plastic 4% (193 kg/year), e-waste 2% (84 kg/year), biomedical waste 1% (42 kg/year), other waste 1%, 40.25 kg/year (sandals, clothes etc.), glass 0.15% (7.95 kg/year) and hazardous waste 0.09% (5 kg/year) respectively.

Table 1 Waste generation in the campus

SI No	Waste categories	Amount (kg/year)
1	Paper waste	692
2	Plastic waste	193
3	Glass waste	8
4	Food waste	3919
5	E-waste	84
6	Hazardous waste	5
7	Bio medical waste	42
8	Other waste	40
9	Damaged furniture	217
	Total	5199

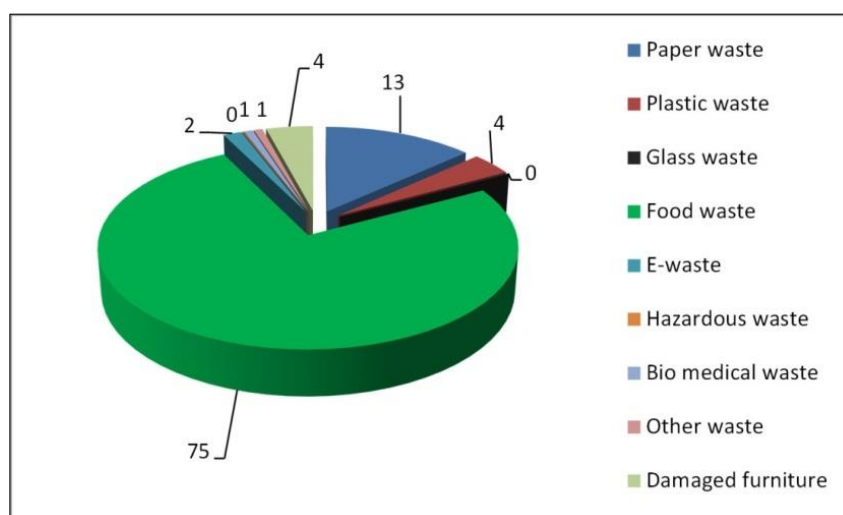


Fig. 1 Percentage (%) waste composition

Total solid waste generated from different buildings

Among the six buildings (blocks) surveyed, waste from Hostel contributes the maximum of 1881 kg/year (38%) as this block is the main residential center holding a considerable population while Mount Carmel Block showed the least in the waste generation with 102 kg/year (2%,) (Table 2, Fig. 2).

Table 2 Waste generation from different buildings

Sl No.	Block	Total waste (kg/year)
1	Jesus Block	650
2	St Joseph Block	1195
3	Mount Carmel Block	102
4	B.VOC & B. communicative	195
5	Hostel	1881
6	Convent	959
7	Total	4982
8	Damaged furniture*	217
9	Grand total	5199

*from the entire campus

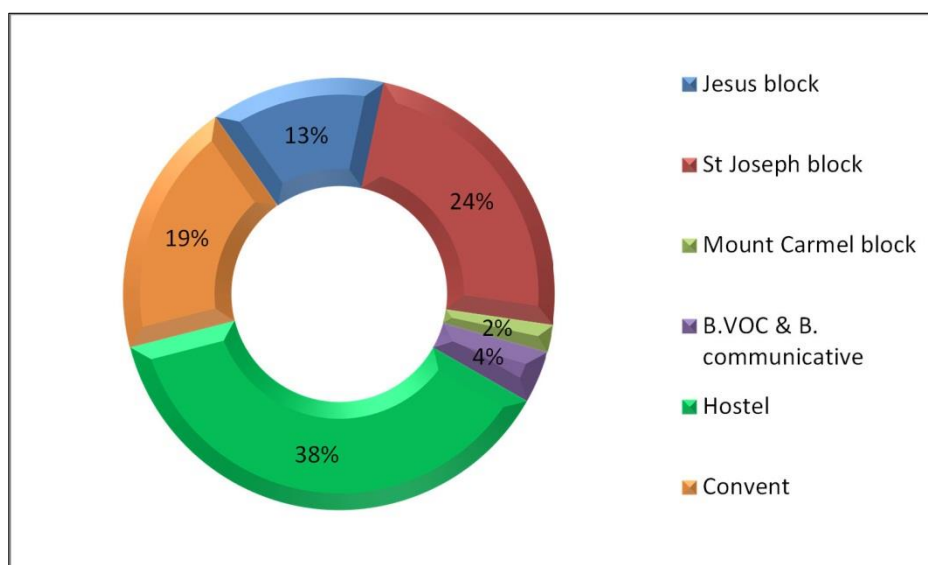


Fig. 2 Details of total waste generated (%) from different buildings

Building-wise contribution of different categories of solid wastes

In Jesus block, the quantity of waste generated ranges from 0.25 to 252 kg/year (Table 3) with the paper category recorded the maximum (39 %) whereas other waste category (sandals, cloths, etc.) is minimum (0.04%). This particular block is one of the main epicenters of various academic and administrative activities which may have contributed to the maximum paper waste. The amount of other categories of waste generated is as follows (Table 3): food waste (228.6 kg/year – 35%), plastic waste (88.2 kg/year – 13.6%), e-waste (74 kg/year – 11%), glass waste (3.6 kg/year – 0.6%), hazardous waste (2.81kg/year – 0.4%), bio medical waste (0.9 kg/year – 0.1%)

Food waste forms a major category of waste in the St. Joseph Block and is estimated at 765 kg/year (64% of total solid wastes) while hazardous waste is recorded as the least category at 0.8 kg/year (0.1%) (Table 3). Besides Jesus Block, this particular block is another major academic complex with a maximum number of people working per day. In addition, the canteen of the college is also functioning in this block and all these contributed significantly towards the generation of a considerable amount of food waste. Details of other wastes recorded from this building are shown in Table 3.

In the Mount Carmel Block, food waste recorded a maximum value of 45 kg/year (44%) followed by paper and plastic wastes (Table 3). Biomedical and hazardous waste were negligible whereas glass waste and other waste categories were absent in this block (Table 3).

B.VOC and B. communicative is a new block and the smallest among academic complexes in the college. However, the food waste category forms the major group and is recorded as 180 kg/year that representing about 92% of total waste produced in this building (Table 3). Wastes from the food science labs are also contributing to total food waste in the block. E-waste, hazardous waste, and other waste were absent in this building.

In residential sectors like hostels and convent, food waste forms the major chunk of the waste and recorded nearly 1800 and 900 kg/year respectively constituting more than 90% of the total waste liberated from these buildings (Table 3).

Table 3 Building (Block) - wise contribution of different categories solid waste

Sl No .	Block	Paper waste (kg/year)	Plastic waste (kg/year)	Glass waste (kg/year)	Food waste (kg/year)	E-waste (kg/year)	Hazardous waste (kg/year)	Bio medical waste (kg/year)	Other waste (kg/year)
1	Jesus Block	252 (39%)	88.2 (14%)	3.6 (1%)	228.6 (35%)	74 (11%)	2.81 (0)	0.9 (0)	0.25 (0)
2	St Joseph Block	306 (25.6%)	72 (6%)	3 (0.3%)	765 (64%)	8 (0.7%)	0.8 (0.1%)	40 (3.3%)	
3	Mount Carmel Block	33.6 (33%)	21 (21%)		45 (44%)	2 (2%)	0.3 (0)	0.16 (0)	
4	B.VOC & B. communicative	10.8 (6%)	3.6 (2%)	0.45 (0)	180 (92%)			0.05 (0.05%)	
5	Hostel	60 (3%)	4.5 (0)	0.6 (0)	1800 (96%)		0.68 (0)	0.3 (0)	15 (1%)
6	Convent	30 (3%)	3.6 (0)	0.3 (0)	900 (94%)		0.16 (0)	0.2 (0)	25 (3%)

Details of biodegradable and non-biodegradable wastes

In this audit, paper and food wastes were classified as biodegradable while all other categories (except damaged furniture) of waste were put under the non-biodegradable category. The results showed that biodegradable waste constitutes a significant proportion (4611 kg/year, 93%) of solid waste while non-biodegradable components contributed only 7% (371 kg/year) of the waste generated in the campus. (Table 4, Fig. 3.). In the building-wise classification also, biodegradable components dominated (Fig. 7).

Table 4 Bio-degradable and non-biodegradable wastes classification

Block	Bio-degradable* (Kg/year)	Non- biodegradable# (Kg/year)	Total waste generated (Kg/year)
Jesus Block	480.6	169.76	650.36
St Joseph Block	1071	123.8	1194.8
Mount Carmel Block	78.6	23.46	102.06
B.VOC & B. communicative	190.8	4.098	194.898
Hostel	1860	21.08	1881.08
Convent	930	29.26	959.26
Total waste generated (Kg/year)	4611	371.458	4982.458

*Paper and food only

all other waste categories (except damaged furniture)

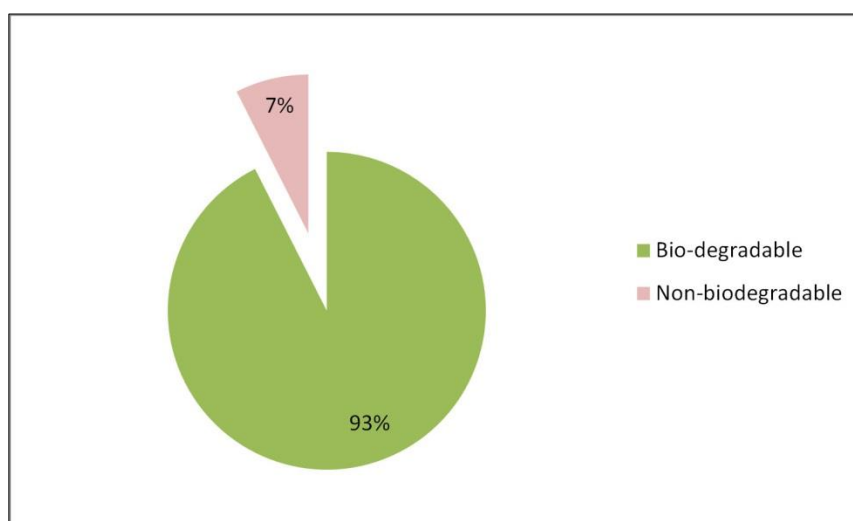


Fig.3 Status of bio-degradable and non-biodegradable waste (%)

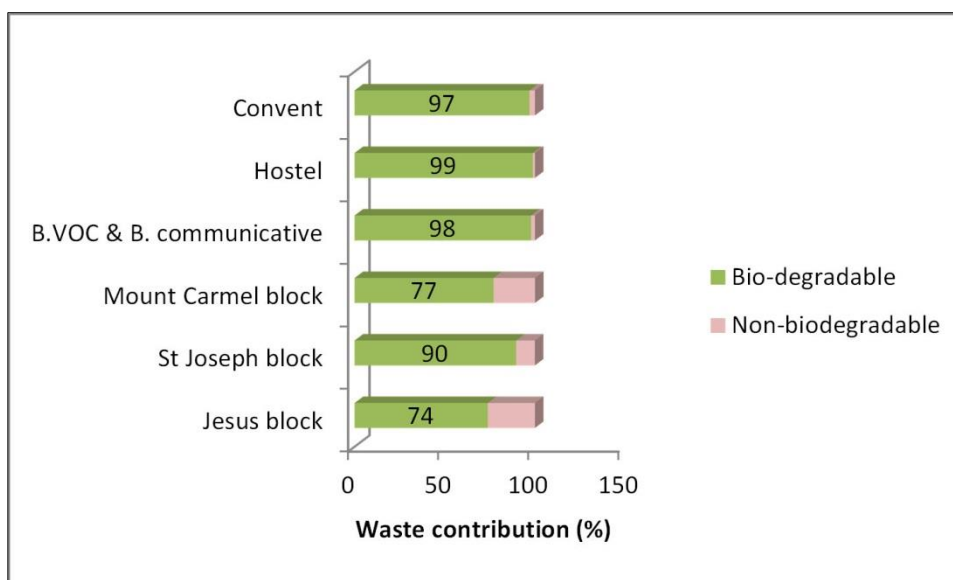


Fig. 7 Status of biodegradable, non-biodegradable waste from various buildings

Major waste categories and their disposal strategies

The college has adopted outstanding waste management strategies that include biogas units for food waste, incinerators for bio medical-waste, and selling the plastic to authorized scrap merchants safety tanks and waste water recycling system etc. (Table 5). The gas produced from the biogas plants is used for cooking purposes in the hostel and canteen kitchen. Paper, glass, and e-waste generated are collected, segregated, and sold to scrap merchants periodically. Repair and reuse of damaged furniture is another noteworthy best practice implemented in the college. Microbiological waste like clinical specimens, soiled swabs, and microbial cultures are autoclaved before final disposal in landfills is another appreciable approach practiced. The college has efficiently utilized non-usable tyres and empty paint tins for gardening purposes. The present audit omitted the construction and demolition wastes that account for the major waste category on the campus, but these wastes are found to be properly managed through landfilling, reclamation activities, or even unusable wood pieces used as firewood in hostels and convents. The wastewater from science labs is collected properly in the appropriate pits or tanks in the concerned departments (Table 5).

Table 5 Major waste categories and their disposal strategies

Sl No	Categories of waste	Particulars	Types of disposal
I	Solid waste		
1	Food waste		Food waste is comparatively less in Jesus, St Joseph, Mount Carmel block as students will leave the campus after 1.30 pm completing their class hours (class time - 8.30 am to 1.30 pm). Other food wastes are effectively managed in biogas plants
2	Plastic waste	Food wrappers, food containers, carry bags, bottles etc.	Taken by the plan @ earth private agency for recycling
3	Paper waste	Discarded paper materials, old newspapers, card board, cartons, magazines, envelopes, packages	Sold as scrap to vendors
4	Glass waste		Handed over to vendors
5	Damaged furniture	Table, chair, shelves etc..	Repair and reuse of furniture to the maximum possible level, If not sold as scrap to vendors
6	Electronic waste (e-waste)	Old computer, monitor, CPU, AC, printer, circuit board, clock, fridge, TV, calculator etc.	Sold to vendors
7	Hazardous waste	Chemicals	Chemicals collected in specified pits or tanks.
		Battery, UPS, LED/CFL lamp , tube light etc	Sold to vendors
8	Biomedical waste	Clinical specimens, soiled swabs, microbial cultures	Autoclaved before disposal into landfills
		Syringes & needles	Syringe Incinerator, needle destroyer
		Sanitary pads, diapers, gloves etc.	Incinerator (Sanitary Napkin Destroyer@ Max care India Pvt. Ltd)
9	Other waste	Table cloths, towels, curtains, sandals, etc.	Sold in scrap
		Nonusable tyres, paint tin etc.	Used in garden arrangement
10	Construction and Demolition (C&D) waste	Concrete , cement, tiles, bricks, paint, insulation materials, cable, and pipes etc.	Used for landfilling, wood materials are used as firewood in hostel and canteen
II.	Liquid waste		
		Wastewater from labs	Collected in specific tanks. New Sewage Treatment Plant installed

Healthy practices implemented in the college

- The campus has efficient mechanisms for collecting and treating both solid and liquid wastes. Proper segregation of waste into biodegradable and non-biodegradable categories is practiced.
- The college employs an adequate number of cleaning staff for the collection, segregation, and disposal of waste.
- The institute adopts a policy to produce less waste and reduce waste generation through recycling and reuse.
- Color-coded waste bins for waste segregation is promoted in the campus.
- Paperless culture is encouraged in the campus by the use of digital platforms for communication, e- filling, administration, class lectures, etc
- A responsible culture of dining is motivated in the campus that avoids wasting food.
- 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 and other plastic hoardings are the major highlights of the campus.
- A public address system is used for general communications
- Single-use plastic is strictly banned on the 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 staffs take the wastes regularly.
- Girls' toilets are provided with napkin vending machines and waste bins are cleared on daily basis by hygiene staff. Incinerators are installed on the campus to dispose of sanitary napkins and biomedical needles.
- The liquid wastes from laboratories, bathrooms, toilets, canteens, etc. are effectively managed. The liquid waste is collected and disposed properly in safely built pits or tanks.
- Exhaust fans are fixed in the labs to expel hazardous vapors if any, produced there.
- Vermicomposting practices are also encouraged in the campus

- Various outreach activities like the paper bag-making program, cloth bag distribution, educational talks, etc. were conducted to give awareness on the dangerous impacts of the use of plastic.
- The use of steel plates and glasses for dining purposes is encouraged.
- Various green initiatives like cleaning drives, cycle rallies for a pollution-free environment, zero filament drive, etc. are regularly organized in or outside the campus showing the commitment to a clean environment.
- It is highly appreciable that the college has active student clubs like ‘Green Army’ for addressing the problem of plastic waste, ‘Bhoomithrasena’ helps in strengthening the commitments of the student towards environmental protection, UBA cell, and NSS unit.
- The college deserves credit for installing a new small-scale sewage treatment plant for treating wastewater from laboratories which were recommended in the previous audit. A new incinerator is also placed in the campus for the controlled burning of certain wastes.

Recommendations

1. Effective waste management programs of the campus require a periodic appraisal of different kinds of waste and its quantified data. This can be performed through various student clubs.
2. A waste management committee involving faculties and students should be formed for the proper monitoring of waste management activities of the campus.
3. Green protocols should be strictly followed.
4. Instead of going for a new purchase, a buy-back policy with electronic dealers for technology up-gradation and handing over the old configuration computers (in working condition) to schools and hardware training labs are a few practices that can be implemented for reducing the quantity of e-waste in the campus
5. Electronic wastes and hazardous wastes should be handed over to authorized e-waste collection centers that are approved by Kerala State Pollution Board (KSPCB). Details can be obtained from the KSPCB website.

6. For the collection and disposal of plastic and glass waste, a tie-up is recommended with the Municipal Corporation of the region.
7. Plastic and glass waste can be handed over to Haritha Karma Sena (HKS) members of the concerned municipal body. This campaign is being executed with the support of Suchithwa Mission, Haritha Kerala Mission, Clean Kerala Company (CKC), local bodies, and Kudambashree Mission.
8. It is advisable to follow the Green buildings rating system for the construction of new buildings in the future that facilitates a holistic approach to the creation of environment-friendly buildings.
9. Ash remaining at the bottom of the combustion chambers of incinerators should be properly disposed of at safety pits.
10. Housekeeping staff working in the areas of waste management should be given awareness of the health hazards related to their work and the importance of wearing the safety gear. A periodic health check-up for cleaning staff is required as part of health and safety measures.
11. College can initiate various kinds of start-up programs related to waste management (toy making from waste raw materials, decorative items and other fancy items from waste materials, etc.).
12. Popularize various Waste Management Act and Rules, themes, days and years of importance, national level and state level campaigns (e.g. *Swachh Bharat Mission*, *Suchithwa Keralam* etc.), and a slogan like My waste, My responsibility, which is adopted from the 'Polluter Pays Principle' in the campus.
13. Proper maintenance of biogas plants and incinerators is important for better waste management programs.
14. A kind of accountability is mandatory regarding the construction and demolition waste produced in the campus. The collection, transportation, processing, and disposal of these wastes should in compliance with the provisions of the Construction and Demolition Waste Management Rules, 2016.

Conclusion

The findings, observations, best practices, and recommendations highlighted in this waste audit report will serve to improve the waste management practices and resource usage at the college. This may help to guide the authorities in formulating suitable policies for green campus and sustainable environment.

Waste management avenues in the College



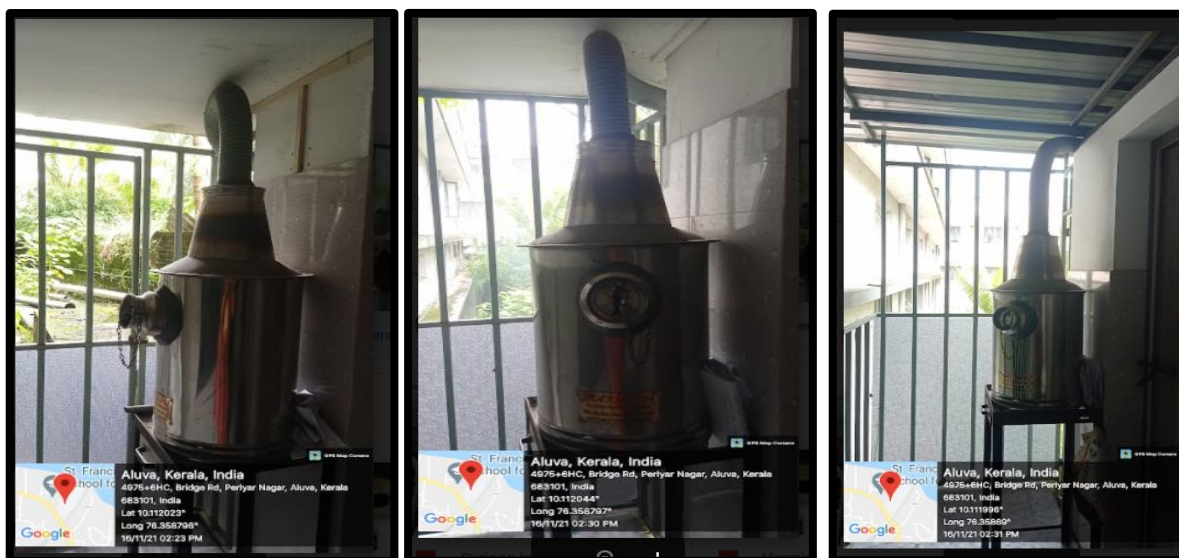
Waste bins



Incinerator (New)



Incinerator (Old)



Incinerator (Sanitary napkin destroyer)



Needle destroyer



Biogas unit-1



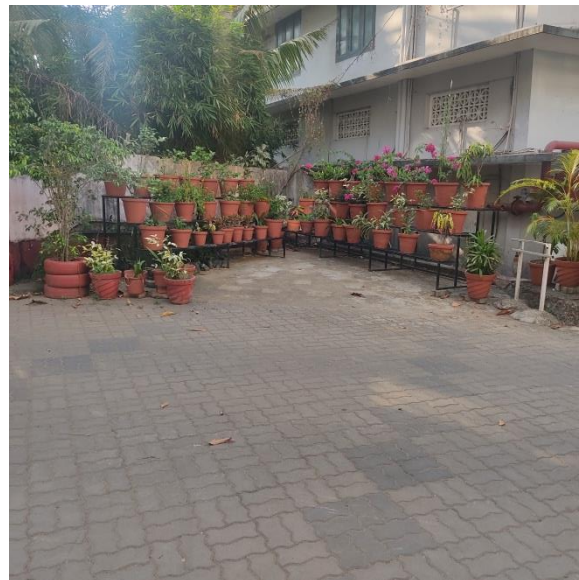
Biogas unit-2



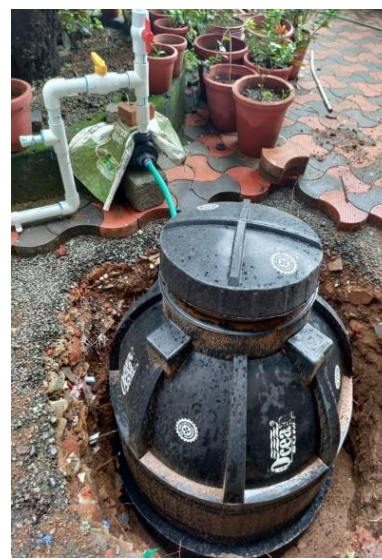
Biogas unit-3



Waste collection facility (canteen)



Front garden



Liquid waste disposal facility (new)

BIODIVERSITY AUDIT

Any studies, documentation and assessment of the biotic components and the threat that touches on ecosystems, watersheds, forests, agricultural practices, environments, and other related areas, could be considered an audit of biodiversity. Biodiversity Audit have now assumed greater significance as ecologists try desperately to document global biodiversity in the face of unprecedented perturbations, habitat loss and extinction rates. It is in these backgrounds a biodiversity audit must be able to deliver authoritative advice on the status of diversity and suggestions for interventions which may be helpful to the conservation of important habitats and associated biotic communities.

Historical Background

Aluva is a thickly populated suburb town of Kochi, situated on the banks of River Periyar. Currently it is a busy transport hub with many industries and commercial establishments. St Xavier's College is situated on the south bank of the river. Just after the college area, the river bifurcates into Mangalappuzha and the Periyar River which makes a large sandbank. The sandbank is religiously significant due to its traditional Aluva Sivarathri festival and seasonal ceremonies. Archaeological evidences shows that the area has human settlements as far back as 250 BC. Later it gained its historical significance during the period of Travancore Kingdom. At Aluva, the southern bank of the River became a commercial port of Travancore kingdom, which received boats and ferry from the high ranges loaded with spices and other commodities of high value.

Ecology and Biogeography

Being close to the Arabian Sea, the Aluva region falls under the "coastal plains" eco-region of the State. According to historians, up to AD 1341, the place used to be a continuous area of land spread across Kakkanad and Alangad. Until recently, Aluva is well known for its large river banks of Periyar River. The town is divided into two halves by the river, making the commercial town towards southern side of river and residential areas towards northern side. The historical Aluva Summer Palace and St. Xavier's College for Women are situated on the Southern Bank. The Shiva Temple, located on the middle

sandbank gets submerged under river, during monsoon season (May–September). Whereas in recent years, the institutional and residential areas situated along both the river banks are also prone to flooding, particularly during heavy monsoons.

The college is situated along the riverine ecosystem of River Periyar, with orchards, rich artificial gardens and open lawns. The gardens along the river banks attract and host considerable amount of biodiversity including mammals, birds, reptiles and amphibians and fishes. The invertebrate fauna represents varieties of butterflies and moths, dragonflies and damselflies, and other insects and subterranean fauna such as earthworms. Being adjacent to the railway line and major road system, the alien and invasive species are also common.

Objectives

- To assess the vegetation and floral components
- To enumerate the invertebrate fauna (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

METHODS

Study sites

Following are the major landmarks of St. Xavier's College: Main Building, Science Building, Golden Jubilee Building, P.G. Building, Memorial Auditorium, Play grounds, Women's Hostel, Convent and the Riverside. The vicinity of convent and P. G. Block are surrounded by rich gardens and vegetation. All these areas were included in this biodiversity assessment.

Biodiversity assessment methods

The biodiversity assessment team perambulated the campus covering all the paths, roads and criss-crossed repeatedly the habitats wherever it is necessary for detailed or specific observations of flora and fauna. Standard protocols were followed for the assessment of faunal and floral components. Focal animal sampling, visual encounter method, point

count and visual estimation, transect walk etc. are the specific assessment methods followed. Informal talks with the staff, inmates, security personnel and gardeners were made to get additional information.

Visual estimation of vegetation cover was made during the transect walks across the campus. Enumerations of individual species of trees, shrubs, herbs, climbers, garden species; alien and exotic species were noted and categorised into native species, garden as well as introduced species and the invasive-exotic species. Photographs were taken in certain cases for identification and confirmation of species. A systematic survey of fauna was carried out by direct observations and indirect evidences. Regional flora and authentic field guides were used for the identification. Field gadgets such as Nikon Ranger 8x40 binoculars, Nikon SLR camera, Garmin Global Positioning System (GPS) etc. were used in the field assessment.

Habitat Types

Based on the structure of the St. Xavier's College Campus, it can be broadly classified into four major categories: 1) The Riverine habitat, 2) Gardens, 3) Open areas (lawns and play grounds) and 4) Built areas.

1) Riverine habitat

The Periyar River serves as the northern boundary of the campus and the riverine stretch has some good vegetation including old trees and a vegetable garden with plantains. A portion of the stretch is left natural and is covered with invasive plants and some grasses. The area is rich with odonates (Dragon flies and damselflies) and herpeto-fauna (reptiles and snakes). However, this part is prone to get submerged during monsoon seasons.



2. Gardens

The college has rich and diverse gardens with exotic ornamental plants, fruit trees, spices, medicinal plants, kitchen garden and a butterfly garden. The garden around the convent and chapel is maintained well and harbour varieties of organisms.



3. Open areas and lawns

There are two major play grounds in the campus. Each has ample open space, which facilitate good growth of seasonal grasses and other ephemerals. Therefore, a good diversity of butterflies, spiders and other insect fauna could be seen in all seasons.



4. Built Areas

The campus has paucity of space and a considerable portion is allotted for the construction of various academic, residential and for other amenities. Development of infrastructure is also on going. In spite of these constructions, the management maintains possible greenery through indoor and outdoor garden initiatives. Even though the exotic plant pots may not support much diversity, it adds to the varieties of rare garden plants. A typical example is the Elephant-ear fig (*Ficus auriculata*) planted right at the entrance of the campus by the former President of India, Dr A.P.J. Abdul Kalam, on the occasion of the College's Golden Jubilee.



Floristic Composition

Within the limited campus area, an approximate of 40% vegetation cover is maintained by the management. The vegetation composition includes trees, shrubs, climbers, herbs and grass species. The vegetation could be broadly grouped into native and exotic. Thus it is comprised of native fruit trees, exotic fruit trees, secondary growth, ornamental exotic trees, native herbs, shrubs and climbers, exotic garden species and invasive species. Overall, the garden species predominates in the vegetation of the campus. A total of 154 species of plants belonging to 60 families were recorded which include grass, herb, shrub, climbers and trees.

List of Plants

Sl. No	Scientific Name	Common Name	Family	Habit
1.	<i>Acalypha hispida</i>	Chenille plant	Euphorbiaceae	Shrub
2.	<i>Acampe praemorsa</i>	Warty Acampe	Orchidaceae	Epiphytic Shrub
3.	<i>Acmella paniculata</i>	Toothache Plant	Asteraceae	Herb
4.	<i>Adiantum latifolium</i>	Broadleaf Maidenhair	Pteridaceae	Fern
5.	<i>Agave vivipara</i>	Caribbean agave	Asparagaceae	Herb
6.	<i>Allamanda cathartica</i>	Golden Trumpet	Apocynaceae	woody shrub
7.	<i>Alocasia macrorrhizos</i>	Giant Taro	Araceae	Shrub
8.	<i>Alocasia × mortfontanensis</i>	Elephants Ear plant	Araceae	Herb
9.	<i>Aloe vera</i>	Aloe vera	Asphodelaceae	Succulent Herb
10.	<i>Alstonia scholaris</i>	Ezhilam Pala	Apocynaceae	Tree
11.	<i>Alternanthera sessilis</i>	Joy weed	Amaranthaceae	Herb
12.	<i>Amorphophallus paeoniifolius</i>	Elephant foot yam	Araceae	Shrub
13.	<i>Annona muricata</i>	Soursop	Annonaceae	Tree
14.	<i>Annona reticulata</i>	Bullock's heart	Annonaceae	Tree
15.	<i>Annona squamosa</i>	Custard Apple	Annonaceae	Tree
16.	<i>Anthurium andraeanum</i>	Flamingo flower	Araceae	Herb
17.	<i>Araucaria heterophylla</i>	Christmas Tree	Araucariaceae	Tree
18.	<i>Aristolochia indica</i>	Garudakkodi	Aristolochiaceae	Climber
19.	<i>Artabotrys zeylanicus</i>	Manoranjini	Annonaceae	Climbing Shrub
20.	<i>Artocarpus heterophyllus</i>	Jack	Moraceae	Tree
21.	<i>Asparagus racemosus</i>	Sathavari	Asparagaceae	Climber

22.	<i>Asystasia gangetica</i>	Creeping Foxglove	Acanthaceae	Herb
23.	<i>Averrhoa bilimbi</i>	Tree Sorrel	Oxalidaceae	Tree
24.	<i>Azadirachta indica</i>	Neem Tree	Meliaceae	Tree
25.	<i>Bauhinia variegata</i>	Camel's foot	Caesalpiniaceae	Tree
26.	<i>Bambusa ventricosa</i>	Buddha Belly Bamboo	Poaceae	Woody grass
27.	<i>Bambusa vulgaris</i>	Common bamboo	Poaceae	Woody grass
28.	<i>Begonia coccinea</i>	Scarlet Begonia	Begoniaceae	Herb
29.	<i>Bletia purpurea</i>	Pine Pink Orchid	Orchidaceae	Herb
30.	<i>Browallia sp.</i>	Bush Violet	Solanaceae	Herb
31.	<i>Caladium bicolor</i>	Elephant's ear	Araceae	Herb
32.	<i>Callistemon lanceolatus</i>	Common Red Bottlebrush	Myrtaceae	Tree
33.	<i>Calotropis gigantea</i>	Crown Flower	Apocynaceae	Shrub
34.	<i>Carica papaya</i>	Pappaya	Caricaceae	Tree
35.	<i>Cassia fistula</i>	Indian Laburnum	Fabaceae	Tree
36.	<i>Casuarina equisetifolia</i>	whistling pine	Casuarinaceae	Tree
37.	<i>Catharanthus roseus</i>	Periwinkle	Apocynaceae	Herb
38.	<i>Cheilocostus speciosus</i>	crêpe ginger	Costaceae	Shrub
39.	<i>Cinnamomum malabattrum</i>	Country cinnamon	Lauraceae	Tree
40.	<i>Cinnamomum zeylanicum</i>	Ceylon Cinnamon	Lauraceae	Tree
41.	<i>Citrus limon</i>	Lemon	Rutaceae	Tree
42.	<i>Citrus maxima</i>	Pomelo	Rutaceae	Tree
43.	<i>Clerodendrum paniculatum</i>	Pagoda Flower	Lamiaceae	Shrub
44.	<i>Clitoria ternatea</i>	Butterfly Pea	Fabaceae	climber
45.	<i>Crotalaria retusa</i>	Rattleweed	Fabaceae	Shrub
46.	<i>Cocos nucifera</i>	coconut tree	Arecaceae	Tree
47.	<i>Codiaeum variegatum</i>	Garden croton	Euphorbiaceae	Shrub
48.	<i>Coffea arabica</i>	Arabian Coffee	Rubiaceae	Shrub
49.	<i>Coffea canephora</i>	Robusta Coffee	Rubiaceae	Shrub
50.	<i>Coleus aromaticus</i>	Mexican mint	Lamiaceae	Herb
51.	<i>Coleus scutellarioides</i>	Coleus	Lamiaceae	Shrub
52.	<i>Colocasia esculenta</i>	Taro	Araceae	Shrub
53.	<i>Cordyline fruticosa</i>	Tiplant	Asparagaceae	Shrub
54.	<i>Crateva magna</i>	Varuna	Capparaceae	Shrub
55.	<i>Cressa cretica</i>	Littoral bind weed	Convolvulaceae	Herb
56.	<i>Crossandra infundibuliformis</i>	Shrub	Acanthaceae	Shrub

57.	<i>Cuphea hyssopifolia</i>	False heather	Lythraceae	Shrub
58.	<i>Cyanthillium cinereum</i>	Little Ironweed	Asteraceae	Herb
59.	<i>Cycas circinalis</i>	Queen Sago	Cycadaceae	Tree
60.	<i>Cynodon dactylon</i>	Bermuda grass	Poaceae	Grass
61.	<i>Cyrtostachys renda</i>	lipstick palm	Arecaceae	Tree
62.	<i>Dactyloctenium aegyptium</i>	Egyptian crowfoot grass	Poaceae	Grass
63.	<i>Dendrophthoe falcata</i>	Honey Suckle Mistletoe	Loranthaceae	Shrub
64.	<i>Dracaena reflexa</i>	Song of India	Asparagaceae	Shrub
65.	<i>Duranta erecta</i>	Pigeon Berry	Verbenaceae	Shrub
66.	<i>Eleusine indica</i>	Indian goosegrass	Poaceae	Grass
67.	<i>Eragrostis unioides</i>	Chinese Lovegrass	Poaceae	Grass
68.	<i>Eryngium foetidum</i>	Mexican Coriander	Apiaceae	Herb
69.	<i>Euphorbia cotinifolia</i>	Red Spurge	Euphorbiaceae	Shrub
70.	<i>Euphorbia milii</i>	Crown of Thorns	Euphorbiaceae	Shrub
71.	<i>Euphorbia nivulia</i>	Leafy Milk Hedge	Euphorbiaceae	Shrub
72.	<i>Euphorbia tirucalli</i>	Pencil Cactus	Euphorbiaceae	Shrub
73.	<i>Euphorbia</i> × <i>lomi</i>	Crown-of-Thorns	Euphorbiaceae	Shrub
74.	<i>Ficus auriculata</i>	Elephant Ear Fig	Moraceae	Tree
75.	<i>Ficus microcarpa</i>	Ornamental Fig	Moraceae	Tree
76.	<i>Flacourtia inermis</i>	lovi-lovi	Salicaceae	Tree
77.	<i>Gomphrena globosa</i>	Globe Amaranth	Amaranthaceae	Herb
78.	<i>Garcinia mangostana</i>	Mangosteen	Clusiaceae	Tree
79.	<i>Excoecaria cochinchinensis</i>	Chinese croton	Euphorbiaceae	Shrub
80.	<i>Heliconia psittacorum</i>	Parrot's beak	Heliconiaceae	Shrub
81.	<i>Hibiscus rosa-sinensis</i>	China rose	Malvaceae	Shrub
82.	<i>Hosta plantaginea</i>	Plantain lily	Asparagaceae	Shrub
83.	<i>Ipomoea mauritiana</i>	Morning Glory	Convolvulaceae	climber
84.	<i>Ixora Coccinia Hybrid</i>	Ixora	Rubiaceae	Shrub
85.	<i>Jasminum auriculatum</i>	Mulla	Oleaceae	Climbing shrub
86.	<i>Jasminum grandiflorum</i>	Pitchi	Oleaceae	Climbing shrub
87.	<i>Jatropha curcas</i>	Barbados nut	Euphorbiaceae	Shrub
88.	<i>Juniperus chinensis</i>	Chinese juniper	Cupressaceae	Tree
89.	<i>Kalanchoe pinnata</i>	Air Plant	Crassulaceae	Succulent
90.	<i>Lantana camara</i>	Red-sage	Verbenaceae	Shrub
91.	<i>Limnophila indica</i>	Indian Marsh Weed	Plantaginaceae	Aquatic herb

92.	<i>Ludwigia perennis</i>	Water Primrose	Onagraceae	Herb
93.	<i>Macaranga peltata</i>	Vatta	Euphorbiaceae	Tree
94.	<i>Mangifera indica</i>	Mango	Anacardiaceae	Tree
95.	<i>Manilkara zapota</i>	Sapota	Sapotaceae	Tree
96.	<i>Megathyrsus maximus</i>	Guinea grass	Poaceae	Grass
97.	<i>Magnolia champaca</i>	Chambak	Magnoliaceae	Tree
98.	<i>Melastoma malabathricum</i>	Kathali	Melastomataceae	Shrub
99.	<i>Mimosa pudica</i>	Shame Plant	Fabaceae	Herb
100.	<i>Mirabilis jalapa</i>	Four o'clock flower	Nyctaginaceae	Herb
101.	<i>Moringa oleifera</i>	Drumstick	Moringaceae	Tree
102.	<i>Mukia maderaspatana</i>	Madras Pea Pumpkin	Cucurbitaceae	Climber
103.	<i>Murraya paniculata</i>	Orange Jasmine	Rutaceae	Shrub
104.	<i>Murraya koenigii</i>	Curry leaf tree	Rutaceae	Tree
105.	<i>Musa × paradisiaca</i>	Banana	Musaceae	Shrub
106.	<i>Mussaenda frondosa</i>	Dhobi tree	Rubiaceae	Shrub
107.	<i>Myristica fragrans</i>	Nutmeg	Myristicaceae	Tree
108.	<i>Nephelium lappaceum</i>	Rambutan	Sapindaceae	Tree
109.	<i>Nerium oleander</i>	French willow	Apocynaceae	Shrub
110.	<i>Nyctanthes arbor-tristis</i>	Parijatham	Oleaceae	Shrub
111.	<i>Nymphaea nouchali</i>	Blue Water-lily	Nymphaeaceae	Aquatic herb
112.	<i>Passiflora edulis</i>	Passion fruit	Passifloraceae	Climber
113.	<i>Passiflora foetida</i>	Buah Passion Fruit	Passifloraceae	Climber
114.	<i>Pentas lanceolata</i>	Egyptian starcluster	Rubiaceae	Shrub
115.	<i>Peperomia pellucida</i>	pepper elder	Piperaceae	Herb
116.	<i>Persea americana</i>	Avocado	Lauraceae	Tree
117.	<i>Phyllanthus amarus</i>	Carry Me Seed	Phyllanthaceae	Herb
118.	<i>Phyllanthus emblica</i>	Indian gooseberry	Phyllanthaceae	Tree
119.	<i>Phyllanthus myrtifolius</i>	Mousetail plant	Phyllanthaceae	Shrub
120.	<i>Pimenta dioica</i>	All Spice	Myrtaceae	Tree
121.	<i>Piper longum</i>	Long pepper	Piperaceae	Climbing shrub
122.	<i>Piper ornatum</i>	Celebes pepper	Piperaceae	Climbing shrub
123.	<i>Pistia stratiotes</i>	Water lettuce	Araceae	Herb
124.	<i>Plumbago auriculata</i>	Blue Plumbago	Plumbaginaceae	Shrub
125.	<i>Plumeria alba</i>	Frangipani	Apocynaceae	Tree
126.	<i>Plumeria pudica</i>	Bridal Bouquet	Apocynaceae	Shrub

127.	<i>Polyalthia longifolia</i>	False ashoka	Annonaceae	Tree
128.	<i>Polyscias fruticosa</i>	Ming aralia	Araliaceae	Shrub
129.	<i>Pouteria campechiana</i>	Canistel/Egg Fruit	Sapotaceae	Tree
130.	<i>Pouzolzia zeylanica</i>	Pozolz's bush	Urticaceae	Herb
131.	<i>Psidium guajava</i>	Common Guava	Myrtaceae	Tree
132.	<i>Russelia equisetiformis</i>	Firecracker Plant	Plantaginaceae	Shrub
133.	<i>Scadoxus multiflorus</i>	Blood Lilly	Amaryllidaceae	Herb
134.	<i>Saraca asoca</i>	Ashoka	Fabaceae	Tree
135.	<i>Spathiphyllum wallisii</i>	Peace Lilly	Araceae	Herb
136.	<i>Spathoglottis plicata</i>	Philippine ground orchid	Orchidaceae	Shrub
137.	<i>Stenotaphrum secundatum</i>	St. Augustine grass	Poaceae	Grass
138.	<i>Syzygium cumini</i>	Black Plum	Myrtaceae	Tree
139.	<i>Syzygium jambos</i>	White Jamba	Myrtaceae	Tree
140.	<i>Tabernaemontana divaricata</i>	Crape Jasmine	Apocynaceae	Shrub
141.	<i>Tectona grandis</i>	Teak	Lamiaceae	Tree
142.	<i>Thottea siliquosa</i>	Alpam	Aristolochiaceae	Shrub
143.	<i>Thuja occidentalis</i>	White Cedar	Cupressaceae	Tree
144.	<i>Thunbergia grandiflora</i>	Blue Sky Flower	Acanthaceae	Climbing shrub
145.	<i>Tibouchina urvilleana</i>	Princes Flower	Melastomataceae	Shrub
146.	<i>Torenia bicolor</i>	Kakkapoovu	Scrophulariaceae	Herb
147.	<i>Tradescantia spathacea</i>	Oyster Plant	Commelinaceae	Herb
148.	<i>Tridax procumbens</i>	Coatbuttons	Asteraceae	Herb
149.	<i>Turnera ulmifolia</i>	Yellow Alder	Passifloraceae	Shrub
150.	<i>Tylophora asthmatica</i>	Indian ipecac	Apocynaceae	Climber
151.	<i>Verbena X hybrida</i>	Garden Verbena	Verbenaceae	Shrub
152.	<i>Wrightia antidysenterica</i>	Winter Cherry	Apocynaceae	Tree
153.	<i>Zeuxine longilabris</i>	Long-lipped Zeuxine	Orchidaceae	Herb
154.	<i>Zingiber officinale</i>	Ginger	Zingiberaceae	Rhizomatous herb
155.	<i>Zinnia elegans</i>	Common Zinnia	Asteraceae	Herb
156.	<i>Ziziphus jujuba</i>	Jujube	Rhamnaceae	Tree

Some Plants of the Campus



Dendrobium Hybrid



Bletia purpurea



Verbena X hybrida



Spathoglottis plicata



Wrightia antidysenterica



Tibouchina urvilleana



Russelia equisetiformis



Dendrophthoe falcate

Garden Plants



Schefflera arboricola



Thunbergia grandiflora



Cassia fistula



Crossandra infundibuliformis



Nymphaea nouchali



Dracaena reflexa



Euphorbia milii



Codiaeum variegatum



Hosta plantaginea



Phalaris aurindinaceae



Tradescantia spathacea



Piper Ornatum

Alien & Invasive Species



Pistia stratiotes



Sphagneticola Trilobata



Ipomoea purpurea



Ipomoea hederifolia



Alternanthera sessilis



Mikania micrantha

Fauna

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 are included in the vertebrate section.

A. Butterflies and Moths

Different micro-habitats and rich vegetation with varieties of garden and flowering species attract good diversity of butterflies into the campus. A total of 34 species were noted during the assessment. They belong to five different families. During the assessment we noticed large numbers of Tiger Moths assembled in the Nutmeg trees between the hostel and convent. There is no doubt that the campus must be having good diversity of moths too. It requires systematic assessments during night time using different light traps.



List of Butterflies







Sl.No.	Scientific name	Common Name
Family Papilionidae		
1	<i>Pachliopta hector</i>	Crimson Rose
2	<i>Papilio demoleus</i>	Lime Butterfly
3	<i>Troides minos</i>	Sahyadri Birdwing
4	<i>Papilio polytes</i>	Common Mormon
5	<i>Papilio polymnestor</i>	Blue Mormon
6	<i>Graphium agamemnon</i>	Tailed Jay
Family Pieridae		
7	<i>Catopsilia pomona</i>	Common Emigrant
8	<i>Appias albina</i>	Common Albatross
9	<i>Delias eucharis</i>	Common Jezebel
10	<i>Eurema hecabe</i>	Common Grass Yellow
11	<i>Leptosia nina</i>	Psyche

Family Nymphalidae		
12	<i>Euploea core</i>	Indian Common Crow
13	<i>Parantica aglea</i>	Glassy Blue Tiger
14	<i>Tirumala limniace</i>	Blue Tiger
15	<i>Danaus chrysippus</i>	Plain Tiger
16	<i>Junonia iphita</i>	Chocolate Pansy
17	<i>Junonia atlites</i>	Grey Pansy
18	<i>Melanitis leda</i>	Common Evening Brown
19	<i>Parthenos sylvia</i>	Clipper
20	<i>Ariadne merione</i>	Common Castor
21	<i>Mycalesis perseus</i>	Common Bushbrown
22	<i>Ypthima baldus</i>	Common Five-ring
23	<i>Ypthima huebneri</i>	Common Four-ring
24	<i>Hypolimnas bolina</i>	Great Eggfly
25	<i>Euthalia aconthea</i>	Common Baron
26	<i>Neptis hylas</i>	Common Sailor
Family Lycaenidae		
27	<i>Jamides celeno</i>	Common Cerulean
28	<i>Chilades parrhasius</i>	Small Cupid
29	<i>Zizula hylax</i>	Indian Tiny Grass Blue
30	<i>Pseudozizeeria maha</i>	Pale Grass Blue
31	<i>Rathinda amor</i>	Monkey Puzzle
32	<i>Rapala manea</i>	Slate Flash
Family Hesperidae		
33	<i>Borbo cinnara</i>	Rice Swift
34	<i>Hasora chromus</i>	Common Banded Awl

Some of the interesting species includes the Sahyadri Birdwing, Blue Mormon, Tiny Grass Blue, (*Zizula hylax*), is known to be the second smallest butterfly seen in India.

Some Butterflies of the campus

	
<p>Monkey Puzzle</p>	<p>Grey Pansy</p>
	
<p>Indian Common Crow</p>	<p>Blue Tiger</p>
	
<p>Plain Tiger</p>	<p>Common Sailor</p>

	
<p>Common Baron</p>	<p>Common Cerulean</p>
	
<p>Psyche</p>	<p>Slate Flash</p>
	
<p>Small Cupid</p>	<p>Chocolate Pansy</p>

B. Dragonflies and Damselflies

Odonates are important bio-indicators as well as bio-control agents of any ecosystem. Being close to the river and its marshy edges, the campus has considerable number of odonate species. The riverside and the open grounds with grass and herbs host majority of the dragonflies and damselflies. Fourteen species of dragonflies which belong to family Libellulidae were recorded and five species of damselfies which represent four different families. The River Heliodor is the forest stream species which is found in the campus near the riverside.

List of Odonates

Sl. No.	Scientific name	Common Name
A. Dragonflies		
Family Libellulidae		
1	<i>Acisoma panorpoides</i>	Bulb-bodied Skimmer
2	<i>Brachydiplax chalybea</i>	Rufous-backed Marsh Hawk
3	<i>Brachythemis contaminata</i>	Ditch Jewel
4	<i>Diplacodes trivialis</i>	Ground Skimmer
5	<i>Neurothemis tullia</i>	Pied Paddy Skimmer
6	<i>Orthetrum luzonicum</i>	Marsh Skimmer
7	<i>Orthetrum sabina</i>	Green Marsh Hawk
8	<i>Pantala flavescens</i>	Wandering Glider
9	<i>Rhodothemis rufa</i>	Rufous Marsh Glider
10	<i>Rhyothemis variegata</i>	Common Picturewing
11	<i>Tholymis tillarga</i>	Coral-tailed Cloud-wing
12	<i>Tramea limbata</i>	Black Marsh Glider
13	<i>Urothemis signata</i>	Greater Crimson Glider
14	<i>Bradinopyga geminata</i>	Granite Ghost
B. Damselflies		
Family Platycnemididae		
15	<i>Copera marginipes</i>	Yellow Bush Dart
Family Coenagrionidae		
16	<i>Ceriagrion coromandelianum</i>	Coromandel Marsh Dart
17	<i>Agriocnemis pieris</i>	White Dartlet
18	<i>Ceriagrion cerinorubellum</i>	Orange-tailed Marsh Dart
Family Chlorocyphidae		
19	<i>Libellago lineata</i>	River Heliodor

Some of the Common Odonates

Dragonflies and Damselflies



Granite Ghost



Rufous-backed Marsh Hawk



Ditch Jewel Female



Ditch Jewel male



Common Picturewing



Pied Paddy Skimmer



Yellow Bush Dart



White Dartlet



River Heliodor



Orange-tailed Marsh Dart

C. Birds of the Campus

Having diverse habitat types such as gardens, orchards, open lawns and the adjoining river, St Xavier's College has good number of birds. In addition to our rapid assessment, the bird watchers of the campus have been recording the bird sightings and uploaded in the e-bird data base. A total of 59 species of birds, including some of the winter migrants were recorded. The list below is the collective documentation. A nest of purple-romped sunbird with chicks was observed behind the library building.



List of Birds

Sl. No.	Common Name	Scientific Name	Family
1.	House Crow	<i>Corvus splendens</i>	Corvidae
2.	Large-billed crow	<i>Corvus macrorhynchos</i>	Corvidae
3.	Common tailorbird	<i>Orthotomus sutorius</i>	Cisticolidae
4.	Plain prinia	<i>Prinia inornata</i>	Cisticolidae
5.	Glamorous reed warbler	<i>Acrocephalus stentoreus</i>	Acrocephalidae
6.	Blyth's reed warbler	<i>Acrocephalus dumetorum</i>	Acrocephalidae
7.	Green warbler	<i>Phylloscopus nitidus</i>	Phylloscopidae
8.	Barn Swallow	<i>Hirundo rustica</i>	Hirundinidae
9.	Red-whiskered Bulbul	<i>Pycnonotus jocosus</i>	Pycnonotidae
10.	Common myna	<i>Acridotheres tristis</i>	Sturnidae
11.	Oriental magpie-robin	<i>Copsychus saularis</i>	Muscicapidae
12.	Pale-billed flowerpecker	<i>Dicaeum erythrorhynchos</i>	Dicaeidae
13.	Purple-rumped sunbird	<i>Leptocoma zeylonica</i>	Nectariniidae
14.	Purple sunbird	<i>Cinnyris asiaticus</i>	Nectariniidae
15.	Loten's sunbird	<i>Cinnyris lotenius</i>	Nectariniidae
16.	Paddyfield pipit	<i>Anthus rufulus</i>	Motacillidae
17.	Feral pigeon	<i>Columba livia domestica</i>	Columbidae
18.	Grey-fronted green pigeon	<i>Treron affinis</i>	Columbidae
19.	Greater coucal	<i>Centropus sinensis</i>	Cuculidae
20.	Asian koel	<i>Eudynamis scolopaceus</i>	Cuculidae
21.	Indian swiftlet	<i>Aerodramus unicolor</i>	Apodidae
22.	White-breasted waterhen	<i>Amaurornis phoenicurus</i>	Rallidae
23.	Red-wattled lapwing	<i>Vanellus indicus</i>	Charadriidae
24.	Little tern	<i>Sternula albifrons</i>	Laridae
25.	Whiskered tern	<i>Chlidonias hybrida</i>	Laridae
26.	Little cormorant	<i>Microcarbo niger</i>	Phalacrocoracidae
27.	Indian cormorant	<i>Phalacrocorax fuscicollis</i>	Phalacrocoracidae
28.	Purple heron	<i>Ardea purpurea</i>	Ardeidae
29.	Intermediate egret	<i>Ardea intermedia</i>	Ardeidae
30.	Great egret	<i>Ardea alba</i>	Ardeidae
31.	Little egret	<i>Egretta garzetta</i>	Ardeidae

32.	Cattle egret	<i>Bubulcus ibis</i>	Ardeidae
33.	Indian pond heron	<i>Ardeola grayii</i>	Ardeidae
34.	Black-crowned night heron	<i>Nycticorax nycticorax</i>	Ardeidae
35.	Black-headed ibis	<i>Threskiornis melanocephalus</i>	Threskiornithidae
36.	Brahminy kite	<i>Haliastur indus</i>	Accipitridae
37.	Common kingfisher	<i>Alcedo atthis</i>	Alcedinidae
38.	Stork-billed kingfisher	<i>Pelargopsis capensis</i>	Alcedinidae
39.	White-throated kingfisher	<i>Halcyon smyrnensis</i>	Alcedinidae
40.	Pied kingfisher	<i>Ceryle rudis</i>	Alcedinidae
41.	Asian green bee-eater	<i>Merops orientalis</i>	Meropidae
42.	Blue-tailed bee-eater	<i>Merops philippinus</i>	Meropidae
43.	Coppersmith barbet	<i>Megalaima haemacephala</i>	Megalaimidae
44.	White-cheeked barbet	<i>Megalaima viridis</i>	Megalaimidae
45.	Common flameback	<i>Dinopium javanense</i>	Picidae
46.	Black-rumped flameback	<i>Dinopium benghalense</i>	Picidae
47.	Rose-ringed parakeet	<i>Psittacula krameri</i>	Psittaculidae
48.	Indian golden oriole	<i>Oriolus kundoo</i>	Oriolidae
49.	Black drongo	<i>Dicrurus macrocercus</i>	Dicruridae
50.	Ashy drongo	<i>Dicrurus leucophaeus</i>	Dicruridae
51.	Greater racket-tailed drongo	<i>Dicrurus paradiseus</i>	Dicruridae
52.	Rufous treepie	<i>Dendrocitta vagabunda</i>	Corvidae
53.	Barred jungle owlet	<i>Glaucidium radiatum</i>	Strigidae
54.	Oriental Honey-buzzard	<i>Pernis ptilorhynchus</i>	Accipitridae
55.	Shikra	<i>Accipiter badius</i>	Accipitridae
56.	Indian Paradise Flycatcher	<i>Terpsiphone paradisi</i>	Monarchidae
57.	Yellow-billed babbler	<i>Turdoides affinis</i>	Leiotherichidae
58.	White-browed wagtail	<i>Motacilla maderaspatensis</i>	Motacillidae
59.	Ashy Wood Swallow	<i>Artamus fuscus</i>	Artamidae

Common Birds



Red-whiskered Bulbul



Greater Racket-tailed Drongo



Purple-rumped Sunbird



Oriental Magpie-Robin



Great Egret



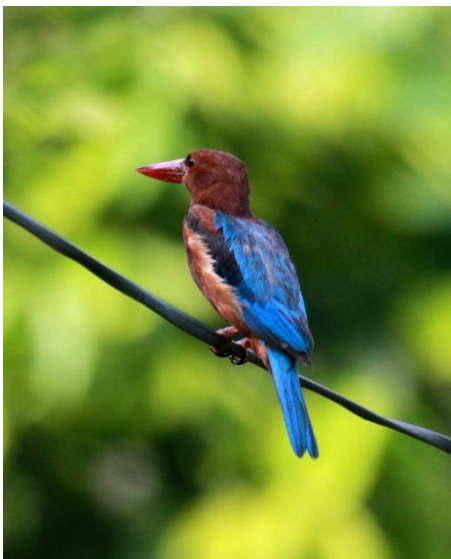
Pond Heron



Common Myna



Brahminy Kite



White-throated Kingfisher



Indian Paradise-Flycatcher



White-browed wagtail



Yellow-billed Babbler

D. Mammals

The limitation of space in the campus naturally restricts the habitat and movements of mammalian species. The busy urban premises of the campus with high transporting modes may also limit the mammalian species in the campus. However, the fruit trees of the campus attract palm civets, squirrels and bat species.



List of Mammals

Sl. No.	Common Name	Scientific Name	Family
1.	Palm Civet	<i>Paradoxurus hermaphroditus</i>	Viverridae
2.	Grey Mongoose	<i>Herpestes edwardsii</i>	Herpestidae
3.	Layard's striped Squirrel	<i>Funambulus Layardi</i>	Sciuridae
4.	Lesser Bandicoot-Rat	<i>Bandicota bengalensis</i>	Muridae
5.	House Rat	<i>Ratus rattus</i>	Muridae
6.	House mouse	<i>Mus musculus</i>	Muridae
7.	Indian Flying Fox	<i>Pteropus giganteus</i>	Pteropodidae
8.	Fulvous Fruit Bat	<i>Rousettus leschenaulti</i>	Pteropodidae

E. Other Vertebrates

The campus habitat harbours many species of reptiles, amphibians and mammals. Systematic and seasonal study would add many interesting species to the campus

checklist. From the rapid assessment and discussions with the campus inmates, around 13 species of reptiles belong to 10 families were noted from the campus area.



The reptilian species found in the campus includes, Common garden lizard, Monitor Lizard, Common skink, Dussumier's Litter Skink (photo) and snake varieties such as Indian Cobra (*Naja naja*), Rat Snake (*Ptyas mucosa*), Common Krait (*Bungarus caeruleus*), Wolf Snake (*Lycodon aulicus*), Checkered Keelback (*Xenochrophis piscator*), Common Vine snake (*Ahetulla nasuta*), Common Kukri snake (*Oligodon arnensis*) and Bronze backed tree snake (*Dendrelaphis tristis*).

List of Herpeto-fauna

Sl. No	Scientific name	Common Name
Family Geomydidae		
1	<i>Melanochelys trijuga</i>	Indian Black Turtle
Family Agamidae		
2	<i>Calotes versicolor</i>	Indian Garden Lizard
Family Gekkonidae		
3	<i>Hemidactylus</i> sp.	House Gecko
Family Scincidae		
4	<i>Eutropis carinata</i>	Common Keeled Skink
5	<i>Sphenomorphus dussumieri</i>	Dussumier's Litter Skink

Family Varanidae		
6	<i>Varanus bengalensis</i>	Indian Monitor Lizard
Family Pythonidae		
7	<i>Python molurus</i>	Indian Rock Python
Family Colubridae		
8	<i>Ptyas mucosa</i>	Indian Rat Snake
9	<i>Lycodon</i> sp.	Wolfsnake
Family Natricidae		
10	<i>Xenochrophis piscator</i>	Checkered Keelback
Family Elapidae		
11	<i>Bungarus coeruleus</i>	Common Krait
12	<i>Naja naja</i>	Spectacled Cobra
Family Viperidae		
13	<i>Daboia russeli</i>	Russell's Viper

In addition to the above, the campus has good diversity of butterflies and moths, dragonflies and damselflies, spiders and many other pollinators and plant pest insects.

Recommendations

- The butterfly garden has to be re-structured with sufficient host plants and proper care should be given.
- Since the location of the campus has proximity to the River Periyar, it is recommended to choose soil-binding native trees and shrubs where ever it is required replanting.
- Towards the riverine part of the campus, adequate care may be taken to preserve the ecological balance, particularly the erosion.
- Periodic monitoring and removal of alien and invasive species would enhance restoration of native and wetland species.
- Allow natural re-generation of the endemic and native species wherever it is possible.

- Members of Nature Clubs may be encouraged to contribute and update the birds, butterflies and other faunal check lists.
- Garden wastes out of trimming and disposal of excess seedlings should be done carefully to avoid further invasion into the natural areas.

Conclusion

Academic institutions, especially colleges and universities in India are known for their rich and diverse campus establishments. Most of these establishments are found to have supported the coexistence of natural landscapes in the form of plantations and gardens simultaneously with the built up areas. The institutions that located in urban areas with such natural as well as plantation landscapes have proven themselves to be the lungs of the surrounding areas. St Xavier's College for women is located in the heart of Aluva town with its diverse and rich biodiversity components; no doubt it contributes significantly to the ecological and environmental services to the town as well as to larger society.

CARBON AUDIT

Introduction

Academic institutions play a decisive and momentous role in helping society to meet the climate and environmental challenges proposed by international frameworks for achieving climate neutrality and thus environmental sustainability. Higher Education Institutions like colleges as organizations committed to education and research play a significant role in moulding responsible graduates involved in preserving sustainable development, and they themselves have to be an example for their students and staff as well as for society as a whole. For this reason, calculating, tracking, and reporting their own carbon footprint (CF) is a starting point from which to become sustainable organizations.

The term “carbon footprint” is defined by the IPCC Guidelines (2006) as “a representation of the effect on climate in terms of the total amount of greenhouse gases (GHG) that are produced, measured in units of CO₂e as a result of the activities of an organization”. It refers to the possible climatic impact (Global Warming) of the Greenhouse Gases (GHG) emitted directly or indirectly due to an organization’s activities. Carbon dioxide is one of the greenhouse gases (GHG) and the most significant contributing component to GHG, which is around 30%, followed by CH₄ and N₂O. The amount of GHG is denoted by carbon dioxide equivalent (CO₂- eq) or Global Warming Potential (GWP) which is a combination of a large GHG impact based on radiation power and the length of time GHG in the atmosphere.

CF is a convenient tool for exercising a greater degree of control over activities that impact the environment and also provides a baseline on which to gauge the effect of future mitigation efforts on-campus. Consequently, as organizations engaged in education, research and community services, they play an imperative role in sustainable development and the fight against climate change and hence should take a leading role in

the fight against climate change and thus in the calculation, monitoring, reporting, reduction or even offsetting of their CF. However, as a preliminary step for calculating the CF, it is necessary to understand the activities that contribute to climate change by assessing the emissions from the campus.

The disclosure of the carbon footprint of an educational institute is foreseeable to identify the source and sink of emissions and the best possible mitigation measures that can be adopted for carbon reduction. Furthermore, the valuation aids the establishment to recognize the carbon emanating hotspots on the camps in order to invent instantaneous mitigation actions to implement. Furthermore, the assessment of CF in an educational institution aid in the transformation of the campus to more eco-sustainable and assists to inculcate the inkling and attitude of environmental stewardship among the scholar community.

Significance of the study

The higher education sector is highly dynamic and subjected to unparalleled renovations and lodges a significant population. The activities of colleges necessitate various levels of changes right from resource utilisation to waste production and this drift is anticipated under most business-as-usual scenarios in the future.

Objectives

- To recognize the carbon emission sources and hotspots on the campus
- To evaluate the existing carbon sink and source status
- To calculate the carbon foot print of the campus
- To propose effectual measures for the carbon footprint reduction.

Methodology

The major sources and status of carbon emitters from primary and secondary sources were gathered through on the spot visits, individual consultations and deliberations, data gathering from official records, credentials and other dossiers. In this appraisal, the GHG protocol for the estimation of the total CO₂ emissions from sources that are owned or controlled directly by the campus, indirect emissions from electricity consumption, and other indirect emissions with three scope definitions.

Scope 1: Accounting of the direct emissions of GHGs from the campus-owned facilities.

Scope 2: Accounting of the indirect GHG emission from electricity consumption.

Scope 3: Accounting for other indirect GHG emissions (other than scope 2 emissions).

In order to calculate the CO₂ emission from the unit of activity data (e.g. kWh of electricity consumed, kg of fuel used), the values are multiplied by their respective conversion factors and expressed in terms of kg CO₂ equivalent (kgCO₂e). Emission factors adopted from national and international standards were utilized. The information provided by the institution is used for the carbon footprint calculation and henceforth missing information is omitted during the assessment.

Scope 1 - Identified carbon source and related GHG emission

Direct CO₂ emission sources: the direct points are constituted by the mobile and stationary combustion sources that are retained and operated by the institution and include vehicular combustion, and stationary combustion source like LPG cylinders (laboratories, canteens), furnaces, incinerators, etc. Emissions from refrigerators and air conditioners account for fugitive emissions. The identified direct emissions account for scope 1 of the inventory.

It is estimated that under Scope 1, the total annual equivalent CO₂ emission was recorded as 11.0773 TCO₂. The figures depict the percentage contribution of CO₂ from various fuel consumption in the campus. Maximum GHG emission is contributed by LPG consumption (6.0853 TCO₂) as considerable numbers of LPG cylinders are used in the canteen for cooking and related activities in hostels which account for a total of 55 % of the total CO₂ emission annually. Consumption of diesel accounted for a total annual equivalent of 4.992 TCO₂ since diesel is consumed for transportation and power generation purposes on the campus.

Table 1 Annual consumption of LPG and Diesel and equivalent CO₂ emission

Sl. No	Particulars	Annual consumption (kg)	Emission Factors with Unit	Annual Eqvt. CO ₂
1	LPG consumption	1963	0.0031 (TCO ₂ e/kg)	6.0853
2.	Diesel consumption	1560	0.0032 (TCO ₂ e/kg)	4.992
Total				11.0773

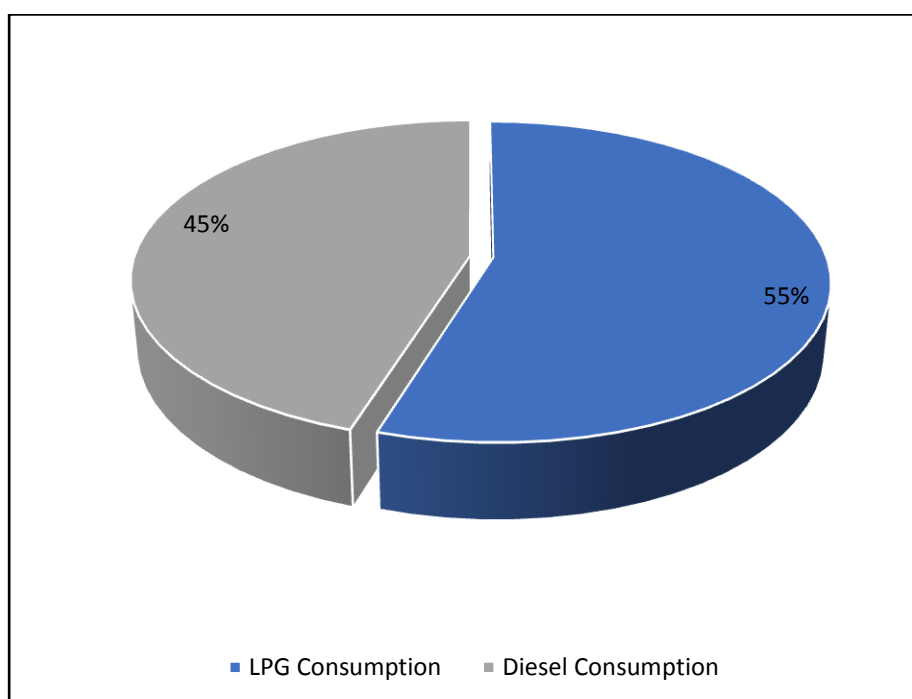


Fig. 1 LPG and Diesel Consumption

Scope 2 - Indirect CO₂ emission sources

The Scope 2 category of the CF survey reports the indirect emission source contributed by the purchased unit of electricity consumed during the concerned time period by the institution. CO₂ emission rates are noted as proportional to the consumed electricity by the college.

The total annual electrical energy consumption of the college is recorded as 77142 kWh and the emission estimated is 315.776 TCO₂ for the computing year. The emission factor considered for estimation specific for annual electricity consumption (kWh) is 0.00082 and the unit is TCO₂e/kWh.

Considering the trend of electricity utilization in various departments and sections on the campus, the emission status varied accordingly. The installation of solar power plants and biogas plants on the campus contributed to the substantial reduction of purchased electric

Scope 3 - Other Indirect CO₂ emission sources

The indirect CO₂ emission sources identified from outsourced activities like paper consumption, food and plastic waste generation in different blocks, and generation of the garden and other wastes fall in the operational boundary of scope 3 of this inventory.

Table 2 Waste production and equivalent CO₂ emission

Sl. No	Particulars	Annual consumption(kg/yr)	Emission Factors with Unit (TCO ₂ e/kg)	Annual Eqvt. CO ₂
1	Food waste	3919	0.00063	2.47
2.	Paper waste	692	0.00056	0.387
3.	Plastic waste	193	0.00034	0.06562
Total				2.922

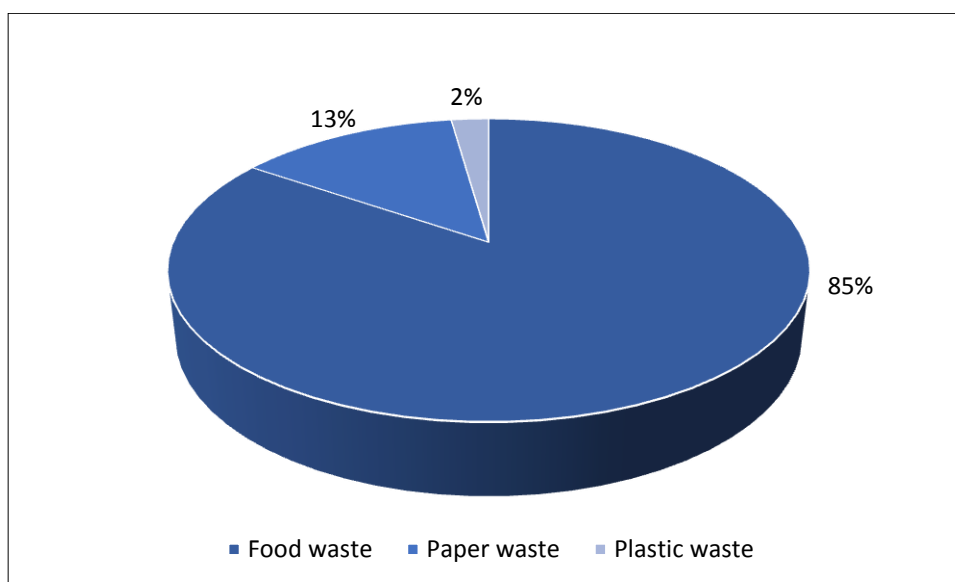


Fig. 2 Percentage distribution of Scope 3 emissions of different activities

Scope 3 accounts for a total emission of 2.922 TCO₂ on the campus. Thus considering the different categories the total emission on the campus was computed as 329.775 TCO₂ annually.

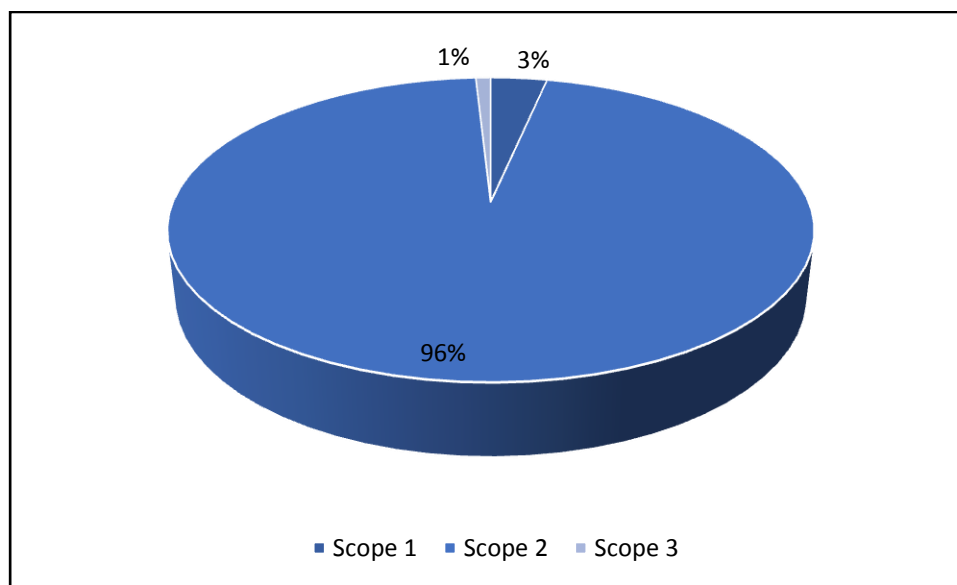


Fig. 3 Proportion of CO₂ emission from different scope

Carbon Sequestration or storage

Appraising the storage status and capacity of carbon in different compartments of the environment has due importance to the inclusion of carbon sinks in carbon emission inventories.

Moreover, the appraisal help to trim down the carbon footprint of a concerned institution by identifying the potential sinks thereby creating a possibility of sequestering more carbon into such vents. For St. Xaviers College for Women, Aluva such an exercise revealed the sincere endeavours the college has adopted to store carbon in order to achieve carbon sustainability.

Carbon sequestration is the method of incorporating atmospheric carbon into various components like plants, soils, and water. The resources or processes that incorporate atmospheric carbon are designated as carbon sinks owing to their capacity to incorporate, as opposed to emitting, GHG emissions, especially CO₂. Computation and assessment of carbon storage in various components of a system are quite intricate due

to difficulty in acquiring data, methodological complexity, and other types of uncertainties. A multitude of factors and indicators determine the carbon storage capacity of a system and the major variables are; geographic location, temperature, humidity, tree species dominance, soil types, litterfall, above-ground biomass, below-ground biomass, etc. In the present study, the application of remote sensing (RS) and Geographic Information System (GIS) possibilities were utilized for assessing the carbon sink of the campus.

Normalized Difference Vegetation Index (NDVI)

The Spectrally-based Normalized Difference Vegetation Index (NDVI) derived from RS platforms, is a common indicator used to monitor biophysical conditions and vegetation cover. NDVI computed using the following formula.

$$NDVI = (NIR - Red) / (NIR + Red).$$

Estimation of above-ground biomass

The above-ground biomass was estimated using doubled the value of Carbon.

The major carbon sinks of the campus identified are:

Campus Vegetation:

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. St. Xavier's college campus encompasses vegetation areas that included trees, shrubs, herbs, and grass types as reported under the biodiversity audit session in this report. The floral density of this campus is an indication of its carbon storage potential in terms of standing biomass (215.243 tons -T). Approximately 150 varieties of trees, shrubs, and other plants were identified from the campus, which acts as potential carbon sinks. Annual increment in carbon storage can be expected from this vegetation cover.

Carbon sequestration is the process involved in carbon capture and the long-term storage of atmospheric carbon dioxide. From the biomass carbon analysis using remote sensing, it is noted that the campus holds 215.243 T of standing biomass. The carbon storage capacity of the campus is estimated as 107.62 T which is equivalent to 394.70 TCO₂.

The presence of tree biomass on the campus results in the sequestration of atmospheric carbon in its biomass and it is assumed that one ton of carbon storage in a tree represents the removal of 3.67 tons of carbon from the atmosphere and the release of 2.67 tons of oxygen back into the atmosphere. From the observation, it can be interpreted that the vegetation cover of the campus and its associated area provides a better opportunity to sequester carbon and thus help in the substantial reduction of carbon dioxide emission into the atmosphere. Moreover, promoting more planting activities on the campus will help to increase the annual carbon storage of the campus thereby reducing the carbon footprint of the system can be achieved.

Best Practices

Installation of Solar Photo Voltaic (SPV) System

The institution has installed a solar power unit as they are much conscious of the need for energy conservation and emission reduction. It shares a fraction of the annual power requirement of the college. The institution hopes to extend further its pursuit of solar energy in the future. The college is planning for the wheel to grid solar system on the campus. Now the college is partially shifted to solar energy by establishing a solar panel of 3KV and solar water heaters. It is worth noting that the Physics Department of the College is fully operational under solar power. This has led to the considerable emission reduction derived from electricity usage.

Biogas plant installation

The campus has three biogas units, of which two are located in the convent and in the hostel. The implementation of a food waste-based biogas plant in the hostel helps to reduce the waste-derived emissions and also the production of energy to substitute LPG in the hostel. The generated gas from the biogas plant is used for cooking purposes. Biogas plants also provide a residue of organic waste after anaerobic digestion which has superior nutrient qualities and considerable environmental benefits by reducing GHG emissions.

Recommendations

Install biogas plant for waste disposal in other hostels

The use of firewood for cooking purpose was noted in the hostels, which can lead to intensive emissions. Hence it is recommended to construct biogas plants in potential areas for waste management and energy generation.

Utilizing the potential of the campus for Solar Photo Voltaic (SPV) System installation

It is recommended to install SPV systems to the full capacity to tap maximum solar energy so that energy sustainability and emission reduction can be achieved

Establish an emission Information Management System and green mottos for emission reduction target programs

It is encouraged to institute a carbon management task force in the campus to collect and archive data regarding the emission information for further referencing and management. It is also recommended to constitute an apt green motto suited for the college towards emission reduction.

Constitute a campus green policy

A robust green policy is inevitable for the campus to keep it green and environmentally sustainable. If the policy exists, it should be revitalized and strengthened by giving stress to emission reduction and the adoption of green substitutes. The policy should be well communicated in the campus.

Promote carbon neutral (Green events)

It should be made obligatory for every event held on the campus to be held under a low carbon emission profile. This can be executed with the help of the green crew of St. Xavier's. Moreover, It is appreciable to constitute a green fund from the savings made from sustainable initiatives and further use the amount for more green initiatives in the campus. It is recommended to place eco-boxes or caskets to collect suggestions and other green innovative ideas for the campus to embrace sustainability.

Campus reshaping or landscaping activities

Land restricting activities associated with infrastructure development are always a threat to the existing green patches and biodiversity of the campus. Hence it is inevitable to incorporate green landscape designs into the future construction plans of the campus. Moreover, design the landscape to use the minimum space to preserve the natural settings promoting wilderness, tranquillity, and calmness of the campus.

III

Green Initiatives and Outreach Programmes

Green Initiatives

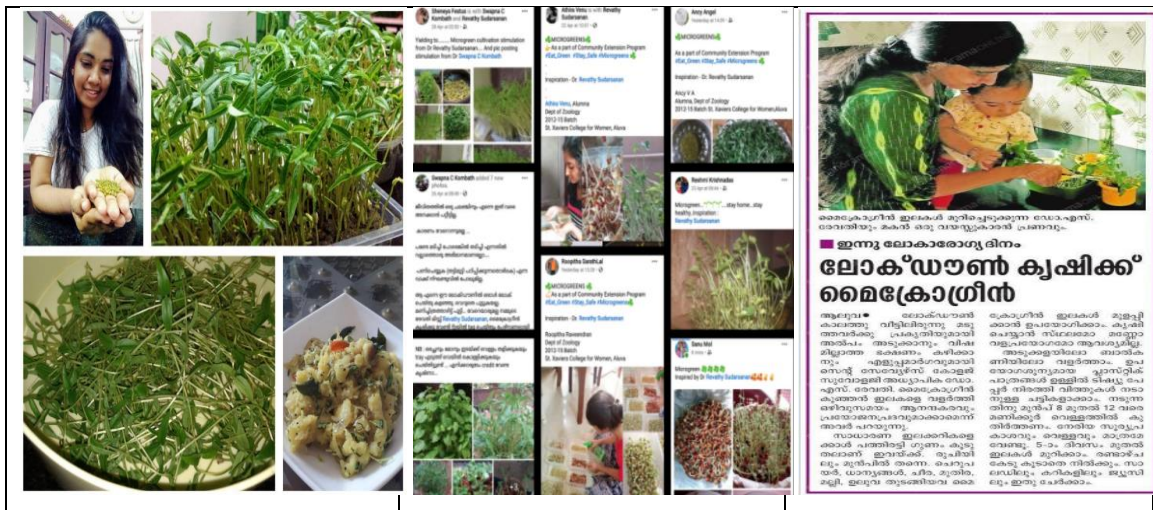
Green initiatives are a set of actions undertaken by the institution to curtail the negative environmental effects associated with the entire life cycle of its products or services. The concept of sustainability has drawn considerable attention in different areas of life, including education, and also has created several challenges for higher education institutions, especially in colleges. Educational establishments are responsible for a significant influence through their teaching, research, and operational activities at various levels. Environment sustainability performance of colleges can be improved by embedding effective initiatives which can be implemented through education, research, community involvement and campus operations.

St. Xavier's college has an extended and enduring association with nature which can be perceived from the activities and attitudes of the student and staff community of this college. The multitude of campus green initiatives pertaining to environmental protection and conservation have helped to transform the whole system towards sustainability through their curriculum, governance structure, research, and outreach activities. The major and notable green initiatives of the college are as follows.

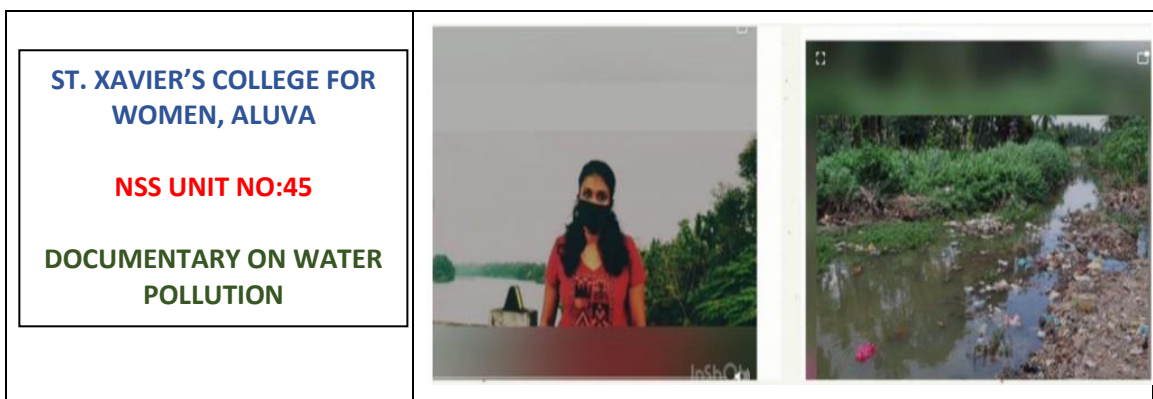
The College envisages establishing a culture of academia-meet-application through its venture of Xaverian Academic Dissemination and Practicing Tradition (XavADAPT) which is a practice of knowledge dissemination among students and society. The institution considers environment as an area of focus to be propagated and proliferated amongst students and society through the adoption of best practices at the academic and the societal level. The Academic Level accomplishes the activities in the institutional scenario, incorporating the participation of the student community. The Societal Level suffuses social responsibility in the students by ensuring their participation in the community linkage program.

Moreover, student associations and clubs of St. Xavier's College like **Bhoomitrasena**, and the National Service Scheme (NSS) play an ineffable role in the green scheme of the institution as well as the community. Staying in the forefront, these groups conduct and co-ordinate various activities in the campus and serve the institution and community so as to pave the way towards environmental sustainability.

1. **Academic Week** : The IQAC organized an Academic Week during August 11-15, 2021 espousing the motif of Environment under the specific theme '**Health @ Habitat**'. The program was conceived to ruminate on the issues of contemporary concern in an institutional setup by integrating 3 realms: Institutional, Department and, and Student. Each department organized expert lecture series (ORACLE) on the theme '*Health @ Habitat*' and was helpful for the students to internalize the key concepts and vital principles related to healthy environs and positive fitness. The main objective of the program was to sensitize the students more about the pandemic situation of COVID-19 and how important it is to ensure the health of the environment to ward off the pandemic.
2. **The interdepartmental student exchange program, INTERACT** was conducted online through Google Meet by the respective departments on July 12th, 2021 in which each department was twinned with another department in the college. This program was conducted to give an opportunity for the final year students to conduct lectures on topics related to the environment for the first- or second-year students in their twinned departments.
3. In order to engage the students in the ecological concerns, varied Green Initiatives were organized under the auspices of different departments and Cells as a part of Knowledge Dissemination and Practice in Society. However, the Pandemic situation restrained the prospects of social interaction and necessitated to venture into virtual possibilities. The activities initiated and implemented during the academic year 2021-22 were as follows:
 - **Microgreen Challenge**: The Institution's Innovation Council as part of the community extension program organized a microgreen challenge for a healthier tomorrow in association with the Department of Zoology and NSS Unit of the College.





- Documentary on Water Pollution:** The students prepared a documentary about water pollution. The documentary talked about the vital role water plays in our lives. The initiative was to create awareness on removing waterborne wastes from communities, industries, and so on while protecting the health of people and the environment





- Thanaloram- Cleaning Project:** To sensitize students on the need to keep the surroundings clean and healthy DURING 2021-22, the students were motivated to indulge in Thanaloram Cleaning Project. The united endeavours of the students made the resting place of the public clean and beautiful.

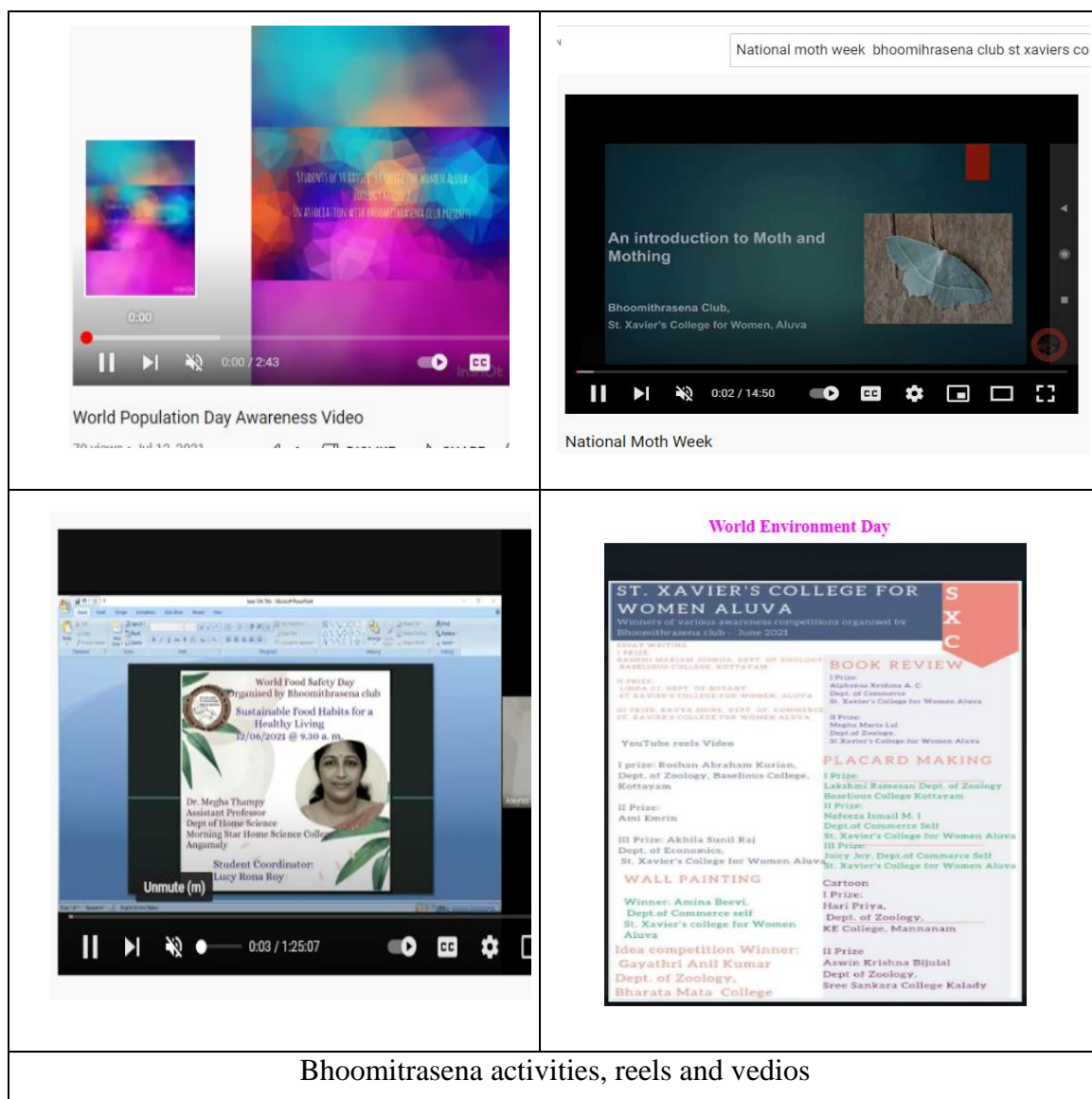
<div data-bbox="260 271 734 448" data-label="Image"> </div> <p data-bbox="432 342 852 425">ST.XAVIER'S COLLEGE FOR WOMEN, ALUVA</p> <p data-bbox="432 488 687 519">NSS UNIT NO:45</p> <p data-bbox="432 584 834 667">CLEANING THANALORAM PROJECT</p>	
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4. **World Environment Day** (5th June 2021) was celebrated pronouncing the academic year 2021-22 as the year of ecological restoration. The program mainly had the release of the logo for the campaign “**Nurture the Nature**” focusing on environmental protection activities, projects, surveys, and awareness sessions. Tree planting (approximately 2021 trees) for the year 2021-2022 and a webinar by Shri. Sujith Karun, district coordinator, Haritha Keralam on the topic “Measures and Methods to move towards Haritha Keralam” were the other major highlights of the day.
5. **Boomitrasena Club** of the college is an active group in the college responsible for conducting and organizing various programs and activities towards environmental protection, conservation, etc. As part of the environment day celebrations (05th June 2021), the club organized 6 inter-college competitions that include essay writing, youtube reels video, wall painting, idea competition, book review, placard making, and cartoon drawing related to various topics for students.

	 <p>Bhoomithrasena club organises Revive with Nature- A refresher programme for students 27-31 May 2021</p> <p>Day 3- 29-05-2021 @ 10.30 a. m. Green Challenges to Conserve Nature</p> <p>Resource Person Dr. Saumi Mary M. Assistant Professor PG Department of English St. Xavier's College for Women, Aluva</p> <p>Student Coordinators: Neha Shajahan Anna Nivya</p>
NSS	Bhoomithrasena club

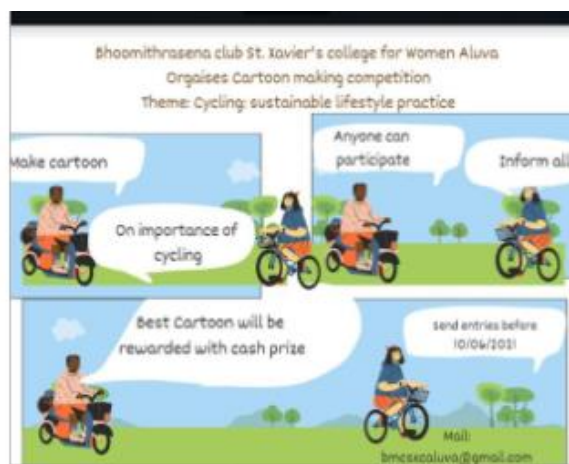
On the occasion of various important days (world population day, national month week, world ocean day, national conservation day, international ozone day, international day of clean air for blue skies) various awareness videos were created by Bhoomithrasena club in association with Department of Zoology.



Bhoomithrasena activities, reels and vedios

- College conducted a cartoon-making competition under the theme ‘cycling; sustainable lifestyle practices’ for creating awareness on sustainability.



7. On 17th August 2021, NSS volunteers made a handmade rain harvesting system at home to collect rain water as part of “Catch the Rain Campaign”.
8. Under the banner ‘Every Sunday as Dry Day’ cleanliness drives were carried out for 31 sundays for eradicating the mosquito-borne illness in the campus.

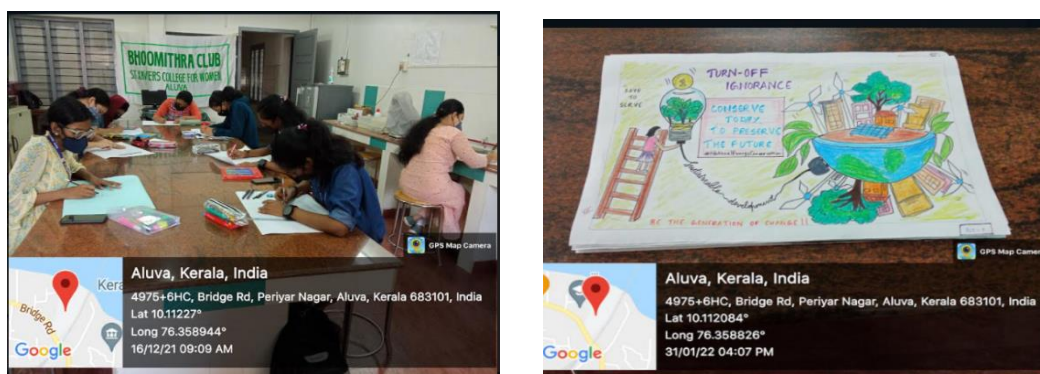


Cleanliness drive in the campus for eradicating the mosquito borne illness

9. To reduce the use of single-use plastic, paper bags were distributed to the vendors of Aluva Manappuram and nearby areas on 11th March 2022.

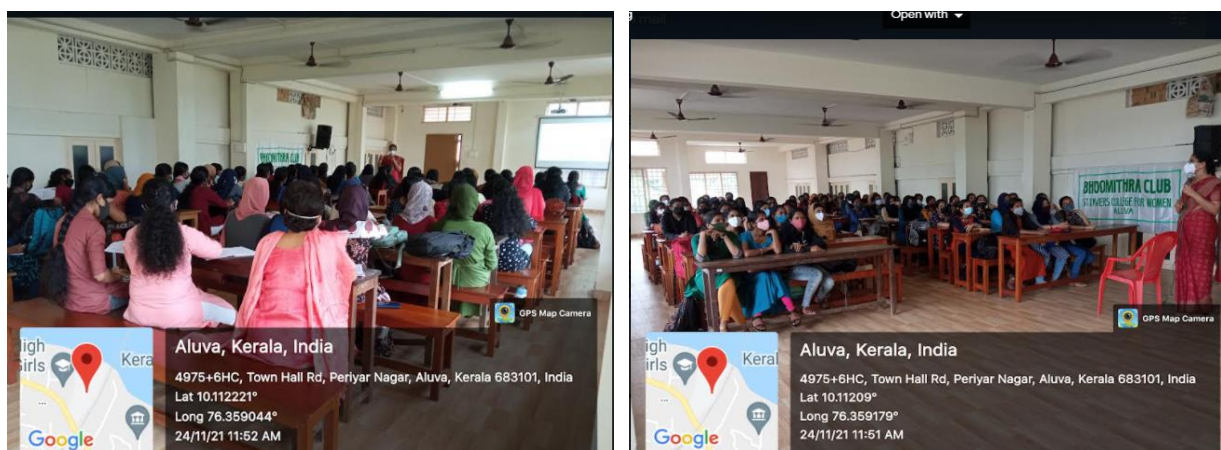


10. Marking the significance of world energy day, a poster designing competition was organized on the 16th of December 2021 in association with Energy & Environment conservation club.



World energy day poster designing competition

11. Highlighting the importance of 'energy management and conservation' an awareness talk was conducted in the campus (24/11/2021) in collaboration with the Energy & Environment conservation club.



Awareness talk on Energy management and conservation

12. Wildlife conservation week was observed with competitions focussing on the theme “an effort to save the wildlife and protect them”. Programs were organized to raise awareness to protect our wildlife.



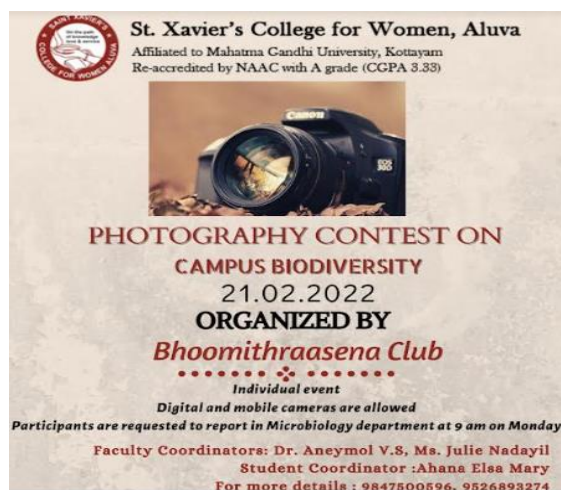
Wildlife conservation week

13. College carried out a nature study program at Mathrubhumi Arboretum, the 'Sitaraman vanam' Aluva for the club members on 14th December 2021. Shri. Chinnan Painadth was the keynote speaker for the program and led the sessions.



Nature study organized at Mathrubhumi Arboretum, the Sitaraman vanam

14. Photography competition related to campus biodiversity was organized at the college (21/02/2022) by the Bhoomothrasena.



15. “A ride for Ozone” a cycle rally challenge for India was one of the activities of ozone day (22nd September 2021) under which students cycled with posters highlighting the theme “ozone for life” to nearby areas of college and planted trees. In connection with this, ozone week was also observed in the college.
16. The NSS Unit No:45 of the St. Xavier’s college for women is highly indulged in conducting various functions from an environmental consciousness creation perspective and as a part of it, Mahotsav week was celebrated from 1-7th July 2021 to spread awareness of forest conservation and to save the environment. Inter-College competitions and screening of awareness videos were part of this event.
17. On 17th August 2021, NSS volunteers made a handmade rain harvesting system at home to collect rain water as part of “Catch the Rain Campaign”.
18. Distribution of handmade covers for safe keeping and disposal of used masks was another activity carried out by NSS volunteers on 11th August 2021.
19. Capacity Building Workshop “Mangroves: Natures Green Guardians” was organized in the college by NSS members on 14th August 2021 and Dr. Baby Divya, Assistant Professor in Zoology led the session.
20. On 15th August 2021, Independence Day was celebrated with great pride and honor supporting nations drive for awakening India – “Azadi Ka Amrut Mahotsav” (Initiative of the Government of India to celebrate and commemorate 75 years of

independence and the glorious history of its people, culture and achievements). Cleaning drives, preparation of paper flags, cycle rally, videos on different cultures of India, planting of trees were the activities conducted on this auspicious day.


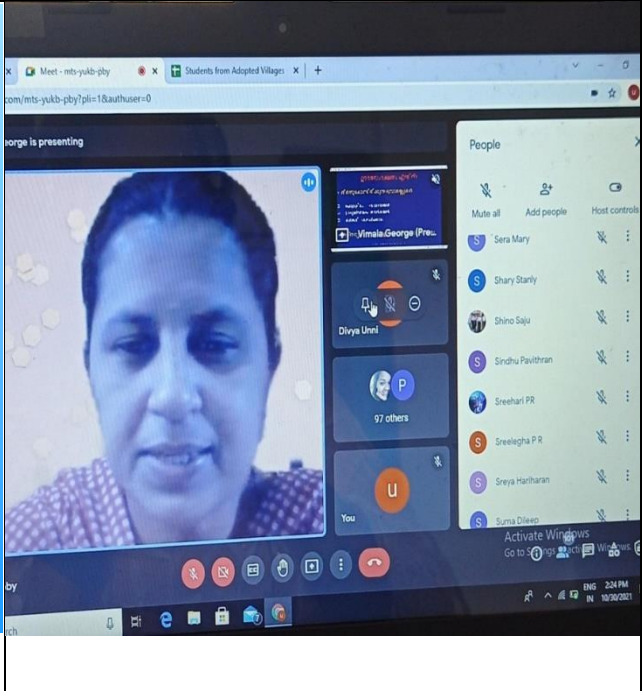


Cleaning drive of Butterfly garden

21. On Gandhi Jayanthi Day (2nd October 2021), NSS members cleaned the campus and nearby areas supporting the government initiative a for clean and green India under ‘Azadi ka Amrit Mahotsav’.
22. On 3rd November 2021, NSS volunteers made an effort in the Pokkali rice (unique saline tolerant rice variety) farming cultivation at Kaitharam, Cheriyaipilly, Ernakulam District.
23. NSS in association with Social Forestry Division, Kerala Forest Department, Ernakulam organized Nature Awareness Programme on 8th November 2021. Resource person Sri K N Unnikrishnan, IFS (DCF Rtd) led the session.
24. On Salim Ali's birth anniversary marked as National Bird Day in India (12th November 2021), a bird count program was organized on the campus. NSS volunteers, other students, and faculties participated in the event, and in connection with this a bird protection week was observed from 12th November to 19th November 2021.
25. A campaign called “Nurture the Nature” was organized in the college by NSS in association with Kochi Metro Rail Limited (KMRL) to offer free cycles to students and also conducted a cycle rally by students to promote pollution free campus “ride for better future” was also held from Aluva Metro Station to College.

26. On 13th December 2021, NSS members participated in the GO ELECTRIC campaign launched as part of the “Urjakiran” programme” sponsored by Government of Kerala GO Electric initiative. An awareness rally was conducted from college to Ashramam. A webinar by Dr. Sreeja, Assistant Professor in Physics, Al Ameen College Edathala and Urjakiran Trainer on the topic “ GO ELECTRIC was also scheduled as part of the program.
27. Distribution of paper bags to nearby houses of the camp area as a part of the going green initiative and plastic-free ward campaign was conducted on 24th December 2021.
28. In order to promote the go green campaign, cloth bags made by tribal people in Attapadi Tribal Colony were given to college students on 14th December 2021. The Bags were distributed among college students to promote the go green campaign.
29. An awareness rally against plastic usage and pollution of rivers was held from little flower school Panayikulam to Chirayam river Panayikulam on 25th December 2021 besides a survey on plastic usage and its disposal was conducted among houses in and around Chirayam River
30. As a part of the camp “*Prekrithiyodothu, Pusthakathooni, Karuthaloode* “e-waste collection drive at Panayikulam area was carried out. The programme also had an awareness campaign and survey on e-waste management on 26th December 2021.
31. An orientation class related to “Environment Consciousness for better future” by Shri. Chinnan Pandiyath, Social worker and Environmentalist was conducted as part of the camp on 27th December 2021.
32. E-waste collection drive and awareness, Setting of the garden in Little Flower School Panayikulam and cleaning its premises were activities organized on 28th December 2021.
33. Vegetable garden setting at Neercode Sahakarana Bank Ground, House construction initiated at Mupathadam, Sramadan cleaning drive in School, Release of Magazine “Sradha 2021” were also organized as a part of the camp on 28th December 2021.
34. As part of the Jal Jagran Abhiyan , a training session (26th February 2022) focusing youth was organized in the college in association with Nehru Yuva Kendra, Ernakulam.

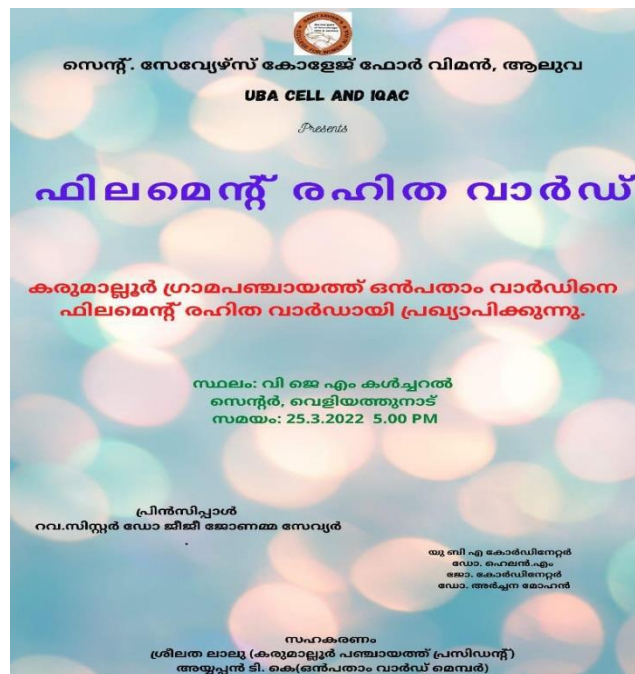
35. On 27th February 2022, The “Nanavu” project was officially started by planting banana sapling. The NSS members visited Kuttivanam or Harithavanam in Manapuram and Arboretum Mathrubhoomi Mathrukathottam, thotakatukara – artificially created forest as part of NSS minicamp.
36. On 5th March 2022, flash mob campaign to protect water resources was organized at three beaches of Ernakulam District (Munabam Beach, Cherai Beech and Kuzhupally beach). The programme was organized by NSS in association with Nehru Yuva Kendra.
37. UBA cell organized a webinar on energy conservation titled as “Oorjasamrakshanam nityajeevithathil” on 30th October 2021. Dr. Vimala George, Assistant professor in Department of physics of the college led the class.

 <p>ST. XAVIER'S COLLEGE FOR WOMEN, ALUVA യു ബി എ സെൽ സംഘടിപ്പിക്കുന്ന വെബിനാർ</p> <p>ഊർജസംരക്ഷണം നിത്യജീവിതത്തിൽ ഡോ. വിമല ജോർജ്ജ് അസിസ്റ്റന്റ് പ്രൊഫസർ സെന്റ് സേവ്യേഴ്സ് കോളേജ് ഫോർ വിമൻ, ആലുവ 30/10/2021 2.00 PM</p> <p>പ്രിൻസിപ്പാൾ റവ.ഡോ. സിസ്റ്റർ ശാലിനി</p> <p>യുബിഎ സെൽ കോർഡിനേറ്റർ ഡോ. ഹെലൻ എം ജോയിന്റ് കോർഡിനേറ്റർ ഡോ. അർച്ചന മോഹൻ</p> <p>സഹകരണം സുരേഷ് മുട്ടത്തിൽ (പഞ്ചായത്ത് പ്രസിഡന്റ്, കടുങ്ങല്ലൂർ) ശ്രീലത ലാലു(പഞ്ചായത്ത് പ്രസിഡന്റ്, കരുമാല്ലൂർ) ദിവ്യ ഉണ്ണികൃഷ്ണൻ (പഞ്ചായത്ത് പ്രസിഡന്റ്, ചേന്നമംഗലം) എം.പി ആന്റണി (പഞ്ചായത്ത് പ്രസിഡന്റ്, കാലടി) സുഹൈല ലത്തീഫ് (കരുമാല്ലൂർ സിഡിഎസ് ചെയർപേഴ്സൺ)</p>	
Webinar on energy conservation	

38. UBA cell and Malayalam department jointly organized a two day (10-03-2022 to 11-03-2022) training programme on manufacturing of herbal products. The programme had Mrs Anusha Martin, Kerala Sarvodaya Sangh as an expert who familiarized various activities (making of aloe vera gel, shampoo, hand wash and soap) for students for two days.



39. Zero Filament Drive was conducted by UBA cells with the support of IQAC at VJM Hall, Karumallur panchayath with the purpose of declaring the 9th ward of panchayath as Zero filament ward of the local body during 2022.



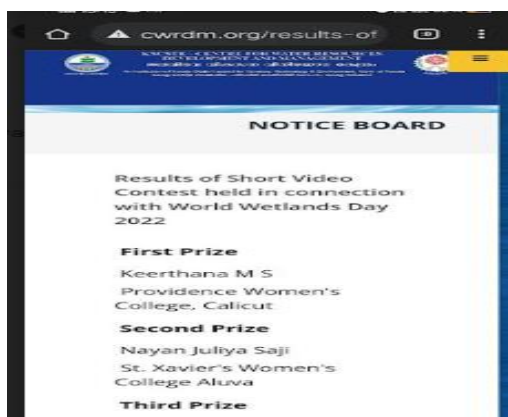
40. A documentary film on “life of animals and problems in their area” created by NSS Volunteers screened during the month of March 2022.
41. World forest day was celebrated on 3rd March 2022 in association with Kerala social forestry department by cleaning Aluva manapuram after shivarathri celebration. The function was inaugurated by Smt. Divya Sunilkumar, Counsellor with Smt. Sindhu, officer -Kerala social forestry department who presided over the programme and felicitation was done by Shri.M Jayamadhavan, Deputy Conservator of forest, Social Forest Division.
42. Digital book projecting nature in college titled as “life at college” prepared by first year students unveiled on March 2022.
43. World wetland day (2nd February 2022) was celebrated with the support from Kerala Social Forestry Department by organizing a webinar on the topic “wetlands- the importance and measures to conserve” by Dr. Bijoy Nandan (Dean, Faculty of Marine Science, CUSAT).
44. On 20th February 2022, first year students initiated cleaning drive in the campus.



45. NSS organized a three day camp “Mrithika” on 25th February 2022 and was inaugurated by Shri. Anwar Sadhath, MLA. The event also witnessed launching of agricultural project of NSS titled “Mrithika- Nanavau 2022”.

Moreover, various students and student associations had brought in laurels to the institution with regard to environmental literacy and knowledge initiatives.

- Students have won prizes in the short video making contest conducted by KSCSTE and Center for Water Resources Development and Management (CWRDM) in connection with World Wetland Day.



Nayan Julia Saji I B.Sc. Zoology Model II secured second prize in a short video making contest organized by KSCSTE-CWRDM

- On Nelson Mandela Day (18th July 2021), NSS Unit No. 45 of the college participated in a Quiz competition organized by United Nation (UN) to inspire individuals to take action for sustainable future.
- As a great recognition for the NSS unit of the college received the IMA excellence award on 8th September 2021.

Outreach Programmes

The extension activities of St. Xavier's College touch every realm of society. The Societal Level extension and outreach activities suffuse social responsibility in the students by ensuring their participation in the community linkage programs so as to guard the human and environmental health and well-being. Moreover, in order to implant social responsibility, social accountability and civic liability, the college deems it mandatory for the students to participate in societal activities. Besides, the extension activities and initiatives provide exposure into the outside world through which the students can amass first-hand knowledge about the social-concerns and their possible remedies. Most of these activities focused towards caring the community from the pandemic situation of COVID-19 and also to inform them how important it is to ensure the health of the environment to

ward off the pandemic. The outreach activities concerning to COVID-19 crisis were organized so as to inform the society as a reminder of the intimate relationship between humans, animals and the environment. Apart from this, the palliative activities, women empowerment programmes etc portrays the societal commitment of the college management and the community. NSS is the major student organization at the forefront to modulate and organize the majority of these programs and the list of outreach activities conducted during 2021-22 is as follows:

1. NSS members distributed Covid Protocol awareness posters to nearby shops in Aluva on 18th August 2021 and asked them to paste in front of shops before onam shopping begins.
2. In a move to offer relief to widows and others affected by covid pandemic, NSS unit distributed various food items on the eve of onam under the campaign called “Annam” (11th August 2021). The event also witnessed the supply of clothes and distribution of food items to communities (both inside and outside the campus) in need. Interaction with communities was also included under the programme.
3. Arranged a dry week program to create awareness against monsoon disease from 15th – 25th June 2021. As part of the campaign titled awareness video on Zika virus was created by the NSS unit members.
4. A webinar related to the “Anemia Prevention Campaign” was conducted in the college in association with the Department of Women and Child Development, Government of Kerala, ICDS Vazhakulam (16th June 2021).
5. Recognizing the importance of Yoga and celebrating the significance of Yoga Day (21st June), the NSS unit observed yoga week from 19 - 23th June 2021. Besides, Yoga training program was also arranged and Mr Gopan JS, Trainer of Indian Yoga Team, Asian Yoga Referee, and Joint Secretary of Yoga Association Kerala led the session.
6. World Day against Drug Abuse (26th June 2021) was observed with an exhibition of posters that spread awareness about the global drug problem and elimination of drug misuse.
7. NSS unit hosted a webinar related to “Donate Blood - Save Lives” with Dr. M Vijayakumar, Blood Bank Medical Officer G.H Aluva as the keynote speaker for the program.

8. World Doctor's Day (1st July 2021) was observed to pay solemn tribute to the doctors who have sacrificed their lives due to covid -19 pandemic. NSS Volunteers prepared posters and conducted "Thank you card" making competitions to honour doctors that hold in our lives.
9. NSS volunteers of the college had a privilege to participate in a dance challenge "Donate blood, keep the pulse of the world alive" which signifies the glory of "blood donation" organized by the Ernakulam District Medical Office, the District Aids Control Unit and the National Health Mission in order to spread awareness about the importance of Blood Donation during this year
10. World Zoonosis Day (6th July 2021) that calls for the awareness about the infectious diseases that can transmit from the animals to humans was observed in the college. Quiz competition was the major highlight of the programme.
11. World Population Day (11th July 2021) was celebrated by conducting a quiz competition and awareness video presentation that spread awareness on various population issues.
12. A short film titled "Pukka" created by the NSS unit was screened on Anti-Drug day. The short film calls for the awareness about dangers of drugs mainly tobacco.
13. Webinar on "Road Safety" by Mr. Anoop Sai T, (Road safety trainer, Honda Safety Driving Education centre, Calicut) was conducted in the college. The programme mainly oriented about wearing helmet, seat belt, adjusting rear view mirror, and different road signs etc.
14. A part of New India@75 and International Youth Day, NSS in collaboration with Red Ribbon Club and KSACS conducted RRC level online quiz competition in the college on topic related with HIV/AIDS (18th August 2021) and voluntary blood donation.
15. NSS volunteers celebrated Onam with patients of Anwar Palliative Care Clinic Aluva and sponsored food on 21st August 2021.
16. NSS organized a function called "Adharam 2021" at Koduvazhanga SNLPS in association with Kerala Action Force, IMA Madhya Kerala and Sree Narayana Library Koduvazhanga on 25th August 2021. The programme consist of blood bank directory inauguration by P M Manah ,President Alagad Panchayat, 1000 person's willingness to hand over organ donation after death and finally distribution of education awards for SSLC and Plus Two 'A+ holders'

17. Under the “Annam” Project, NSS distributed various food items to widows of panayikulam at Chirayam Viswadeepthi School on 26th August 2021.
18. International Suicide Day (8th September 2021) was observed in association with IMA. Awareness class led by resource person Dr.AjithKumar, Psychartist.
19. “Santwanam” – 24 hours students’ active counseling group was formed in the institution. They were given training to handle and counsel affected persons in the college.
20. On 22nd September 2021, NSS unit had observed Anti Suicide Campaign with lighting the candles together in support to the programme.
21. Gender Sensitisation Campaign “Kanal 2021” organized by NSS unit in association with Mahila Shakthi Kendra Ernakulam and Women and Children Development, Ernakulam was held on 13th,14th and 15th September 2021.
22. Concerning with Covid pandemic, NSS in support with the Vigilance Cell arranged a programme (4th October 2021) to raise awareness among students for following COVID protocol and it also ensures that all students and teachers took vaccination. Posters and placards were pasted in classrooms in addition to awareness campaign through whatsapp groups and other social medias to students and teachers of the college.
23. A collection drive was organized from 23rd to 27th October 2021 for helping flood affected people in Koottickal Grama Panchayat, Kottayam District - as part of flood relief programme “oru kai sahayam”. Clothes, food items, sanitary items and others were collected from students, teachers and various residence associations as part of the flood relief program. These materials were handed over to people in Koottickal in association with Red Cross Society, Aluva.
24. In October 2021, Covid Vigilance Cell was also formed to create awareness and plan action and activities to prevent and protect against COVID pandemic Situation.
25. Covid Vaccination Drive (First Dose) was held in the campus on 3rd November 2021 in association with P S Mission Hospital, Maradu, Ernakulam on behalf of Covid Vigilance Cell.
26. Covid Vaccination Drive (Dose 2) was conducted in the college in association with P S Mission Hospital , Maradu on behalf of Covid Vigilance Cell on 16th November 2021.

27. Palliative care day (21st November 2021) was observed in association with Anwar Palliative Care Hospital, Aluva. NSS unit staged a skit highlighting the importance of various prevention measures that is to be taken for covid pandemic and its impact on cancer Patients.
28. NSS unit received an appreciation award from Anwar Memorial Pain and Palliative Care Society, Aluva for their services towards palliative care patients.
29. Road safety seminar was conducted in the college on 24th November 2021 in association with Kerala Motor Department.
30. NSS celebrated world AIDS prevention day by honoring many health workers for their selfless service during covid situation. A pledge was taken against AIDS and to consider and treat aids patients with great respect and care. World volunteer's day was also celebrated on this particular day (1st December 2021) by paying gratitude several volunteers who has rigorously worked in various fields and shown their selfless contribution.
31. The College in association with Kerala Action force conducted organ donation of 1000 patients to Sr.Shiny,vice president,District panchayat .
32. Christmas function was celebrated at Government Hospital, Aluva with 30 hemophilia patients and their parents on 18th December 2022. The festival ambience was created with various cultural programs, arranging different games and finally distribution of gifts to patients. Dr. Susmitha and Dr.Vijayakumar presided the function.
33. Door to door Covid awareness with special emphasizes on omicron was provided to residents at Panayikulam area. A survey on flood and Covid 19 were conducted at Panayikulam area on 24th December 2021,
34. On 14th, 15th and 16th January 2022, NSS members attended Covid Jagratha Training at IC4-Command Control Room, ICT Building Kaloor Metro Station.
35. NSS in collaboration with Social Justice Department, Ernakulum and Maintenance Tribunal Fort Kochi organized a webinar on the topic "*Mathapithakalum Muthirnapouranmarudeyum shemavum samrakshana niyamavum*" on 25th January 2022. Awareness class on "Dimensia" was also conducted on this particular date.
36. Two webinars related to topic "*Samoohika madhyamagalude dhurupayoogavum cyber chathikuzhikalum*" and "*arogyakaramaya bhakshana sheelagal*" were

- conducted on 11th February 2022 in association with District Health Department and AIDS control Department, Ernakulam
37. 102. Hair donation camp was held in the college on 4th March 2022 for helping cancer patients to prepare hair wigs. It is appreciable that 16 students and 1 Teacher of the college donated hair for this noble cause.
 38. Stress management webinar hosted by UBA cell was convened on 5th February 2022 with Rev. Dr. Sr. Ruby, Councilor of Prashanti Counseling Center, as the keynote speaker of the programme.
 39. An orientation and personality development class by Shri. Joby Thomas, President Kerala Action Force On 24th December 2021,
 40. NSS carried out various activities from 23 -29 th December 2021 as part of the special camp conducted with name given as SRADHA 2021
 41. A fest was organized to encourage entrepreneurial talents of students with food items, crafts and other items on 3rd December 2021.
 42. College distributed laptops to 10 students to help them during their online study programmes.
 43. NSS members performed a flash mob against dowry system at Edapally metro station in association with Kochi Metro Rail Limited (KMRL) on 26th November 2021.
 44. NSS unit no: 45 of the college brought another laurel to the institution by bagging the best NSS unit of Mahatma Gandhi University during the period 2020-2021. Smt. Jasmine Gonsalvez faculty member from the english department selected as the best NSS program officer and the certificate of appreciation was awarded to the volunteers Aleena Sabu and Namitha Mukesh. The award ceremony was held on 17th November 2021.
 45. Children's day (14th Novemeber 2021) was celebrated with the distribution of books to children in nearby houses of the college. Another programme titled “Sparsham” was also launched on the same day for the students who are affected by online teaching.
 46. Diwali (4th November 2021), was celebrated with great enthusiasm by lighting up the lamps on the night of that day for a better and peaceful nation.
 47. To inspire entrepreneurship talents among students and parents, NSS volunteers started an instagram page “ Auctio 2021” on 4th November 2021.

48. National Unity Day (31st October 2021) was celebrated with various cultural programs showcasing essence of “national integration”. Besides this, Hockey tournament was also conducted in association physical education department.
49. On 13th October 2021, NSS conducted an Philately exhibition with Department of Postal India ,Aluva Division and an awareness session was organized.
50. Philately exhibition was held in the college on 13th October 2021 in collaboration with Department of Postal India, Aluva Division. Awareness session highlighting the importance of topic was also arranged as part of the event.
51. On 7th October 2021, an awareness class on Cyber Crime was conducted in the college in association with Cyber Cell, Kerala Police.
52. As part of National Voluntary Blood Donation Day (On 1st October 2021), NSS members participated in blood donation camp that was organized in association with Regional Blood Donation Center, District Hospital Aluva. NSS unit also received great acclaim for blood donation in association with Kerala Action Force from Regional Blood Donation Center.
53. NSS day was observed on 24th Septemeber 2021. The Principal raised the flag and pledge was taken on the same day to mark the occasion. In tune with this a weeklong programme called “Jagratha Varacharanam” was also organized to create awareness and protest against all social issues in current society.
54. Fit India Freedom Run 2.0 (Azadi ke Amruth Utsav) was conducted by the NSS unit on 23rd September 2021 in association with Youth Red Cross and Nehru Yuva Kendra , Aluva railway station
55. The NSS unit felicitated various rank holders who have shown their excellence in the field of agriculture, education and in society. The programme also had an interactive session with those honored persons to motivate NSS volunteers for the upliftment of society.
56. International webinar on ‘fostering women empowerment through holistic education” by Resource Person Dr.Gina B Alcoreza ,Partido State University , Camarines Sur Philippines was held on 4th September 2021.
57. National level online webinar on “Entrepreneurship Development Programme” was organized by the UBA cell on 4th December 2021.
58. Cyber Security Social Media Seminar was organized by NSS unit on 13th August 2021.

59. NSS Unit No: 45 of St. Xavier's College for Women, Aluva organized a Campaign *" I # CHEER FOR INDIA TOKYO 2021 "* to cheer up 'team India' for Tokyo Olympics 2021. As part of the campaign NSS volunteers shared a poster with their photo with a caption "I # Cheer for India Tokyo 2021" and also prepared a video to encourage the Indian players in the Olympics.
60. NSS volunteers remembered former president of India Dr APJ Abdul Kalam's on his 6th death anniversary (27th July 2021) by creating a tribunal video of Kalam sir and organized a campaign "give a book to a child ".
61. On Kargil Vijay Diwas (26th July 2021), NSS volunteers prepared a tribunal video to remember the heroes of the Indian army who lost their lives back in 1999 Kargil war. The event also honored our brave fighters of Indian armed force who ensured India's win over Pakistan in the warWorld Youth Skill Day (15th July 2021) was celebrated.
62. NSS Unit no: 45 celebrated Literacy Week from 8th -11th July 2021, by organizing various competitions.
63. The college (NSS unit) commemorated Vaikom Muhammed Basheer (famous writer of malayalam literature) day on 5th July 2021 by organizing reels contest by enacting the characters of Basheer's novels.
64. National reading day (19th June 2021) marked the release of "Mayilpeeli", a short story book by NSS volunteers. Other activities that dignified the occasion include distribution of reading books to students, screening of short video on book review for encouraging reading habits.
65. National Youth Day (Swami Vivekananda birthday) was celebrated with great joy and enthusiasm at the college on 12th January 2022 by performing various activities that include awareness rally, yoga, elocution competition, tree planting, distributing tree saplings, online essay writing, online poster making, online cultural programs, intercollegiate QUIZ competitions. The event also had a one day seminar on the "life of swami Vivekananda and his life principles" by Dr. Milon Franz, Professor, Department of English, St. Xavier's College, Aluva.
66. 86. On 13th January 2022, college had initiated a "Poshan Abhiyan Awareness Campaign" and familiarizing poshan tracker app among parents. NSS members also attended Covid Jagratha Training online, organized by DMO, Ernakulam, Government of Kerala on the same day.

67. A workshop on public transport in Greater Kochi was conducted in association with Kochi Metro Rail Ltd and Greater Kochi Development Forum (29th January 2022).
68. NSS in association with Aluva Municipality organized a seminar on Women Empowerment on 8th March 2022.

IV

SWOC ANALYSIS

SWOC analysis is a framework for identifying and analysing the strengths, weaknesses, opportunities, and challenges of an organization. It aids in the process of planning for improvement, competitiveness, and excellence.

SWOC analysis of an Environmental Audit in college can result in an efficient green strategy that can positively impact management decision-making procedures. It aids in the development of proper management initiatives, demands, and expectations in the pursuit of environmental sustainability.

SWOC analysis is currently being conducted for the domains under consideration in order to analyse existing gaps and identify resource and other potentials for St. Xavier's on its path to excellence. Furthermore, it enables consistent decision-making and management. This analysis is expected to aid in providing a stable framework for assessing the current situation and developing strategies available resources and technical competency.

The analysis revealed the institution's potential for developing a suitable eco-friendly campus. Based on the SWOC analysis, it is possible to create a green management plan that can be integrated into St. Xavier's broad range of prosperity. Based on the identified weaknesses and challenges, appropriate corrective actions can be taken. Thus, the analysis serves as a foundation for revising or updating the environmental policy. The SWOC analysis is expected to sharpen and increase the precision of Environmental Audit as a tool for moulding the path to environmental sustainability of the institution.

Domain	Strength	Weakness	Opportunity	Challenge
Energy	<ul style="list-style-type: none"> • Facility for tapping additional renewable energy in the form of solar power and biogas • Effective usage facility for existing power sources 	<ul style="list-style-type: none"> • Under-utilized facilities to tap solar power • Over dependence on non-renewable energy sources • Absence of consistent arrangement to appraise the campus carbon footprint 	<ul style="list-style-type: none"> • Potential for tapping additional renewable energy like solar power, and waste-derived biogas • Formulation of a campus team for monitoring of energy consumption, carbon accounting • Prospects of creating an effective campus energy management • Vision towards carbon footprint reduction • Green initiatives and best practices to conserve energy • Inclusion of technological competence in energy efficiency 	<ul style="list-style-type: none"> • Escalating energy demand • Infrastructure development • Carbon footprint analysis
Water	<ul style="list-style-type: none"> • Presence of surplus and perennial water resources including the Periyar river • Massive potential for rain water harvesting • Water storage facility • Self-sufficiency in water resource • Waste water recycling 	<ul style="list-style-type: none"> • Under-utilization of roof-top rainwater harvesting potential • Under-utilized water source (Well III) within the campus • Maintenance of water quality (bacterial quality) 	<ul style="list-style-type: none"> • Room for increased rain water harvesting • Renovation of existing water resources within the campus • Proper protection of water bodies from pathogens • Insist strict water quality management measures 	<ul style="list-style-type: none"> • Water quality management (Bacterial quality) • Escalating per capita water usage • Possible climate extremes

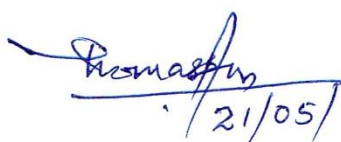
Waste	<ul style="list-style-type: none"> • Waste minimization through reuse, reduce and recycling • Plastic ban • Emphasis on digital platforms • E-waste handling • Biogas unit for treating food waste • Incinerator facility • Waste water treatment unit 	<ul style="list-style-type: none"> • Lack of green initiatives and policies • Absence of stringent waste management and disposal methods • Lack of periodic monitoring and quantification of waste 	<ul style="list-style-type: none"> • Biodegradable waste derived energy production potential • Waste to wealth programmes • Waste derived bio- fertiliser production • Green policies • Existence of institutional green policy • Buy back policy activation 	<ul style="list-style-type: none"> • Lack of awareness in proper assessment method • Augmented per capita resource consumption • Communication and awareness through IEC programmes
Carbon	<ul style="list-style-type: none"> • Natural carbon sinks like vegetation through conservation area and soil etc. • Provision for renewable energy usage • Effective waste management provisions 	<ul style="list-style-type: none"> • Lack of carbon emission appraisal • General apathy in maintaining the low carbon footprint 	<ul style="list-style-type: none"> • Prospect in renewable energy harvest facilities • Green initiatives to reduce emission • Carbon sequestration sink potential • Human resource and technical viability 	<ul style="list-style-type: none"> • Lack of proper assessment method • Data consistency and precision • Technological competence • Emergence as carbon neutral campus • Greenhouse gas emission documentation and carbon footprint accounting
Biodiversity	<ul style="list-style-type: none"> • Presence of different habitats including 	<ul style="list-style-type: none"> • Limitation of space in the campus naturally restricts 	<ul style="list-style-type: none"> • Green initiatives to foster rare and endemic species 	<ul style="list-style-type: none"> • Infrastructure development

	<p>riverine, garden, open areas etc.</p> <ul style="list-style-type: none"> • Indoor and outdoor garden initiatives • Extensive floral and faunal diversity • coexistence of natural landscapes in the form of plantations and gardens simultaneously with the built-up areas • Nature conservation attitude and consciousness • Erudition of belonging and concern towards nature and nurturing 	<p>the movement and flourishing of flora and fauna</p> <ul style="list-style-type: none"> • Untapped conservational potential 	<ul style="list-style-type: none"> • Restructuring of butterfly garden • Planting soil-binding native trees and shrubs • Adequate care to preserve the ecological balance, particularly the erosion. • Periodic monitoring and removal of alien and invasive species • Allow natural re-generation of the endemic and native species • Strengthening of Nature Clubs may be encouraged to contribute and update the birds, butterflies and other faunal check lists. 	<ul style="list-style-type: none"> • Resource consumption • General apathy in conservation • Lack of awareness and communication
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ENVIRONMENTAL AUDIT CERTIFICATE

The Environmental Audit enclosed herewith has been carried out as per the standard recognized procedures authorized for statutory requirements of environmental audits and governance of academic institutions. St. Xavier's College for Women, Aluva has been emerged out as a robust pioneering academic institution with specific vision and mission.

The college has provided the mandatory information required for assessment that significantly assisted in deriving the audit conclusions. The data provided have been thoroughly assessed and clarified with the documents maintained by the college. The institution gave wholehearted support for physical inspection and consultations. There was periodic interaction with the college authorities, selected faculty and administrative staff members as well as students. The audit process has been set to guarantee that practices and derived standards will be followed by the academic and administrative community of St. Xavier's College. The capability and the work custom of the institution, undoubtedly provides strength for the implementation towards the much sought environmental cause. The sustainable approach towards resource utilization (water and energy), waste management, biodiversity conservation, and the best practices are admirable. The Environmental Audit of the college represented a substantial improvement in the resource utilisation, waste reduction, water usage, biodiversity conservation, carbon emission reduction and also in the implementation of green initiatives and outreach programmes compared to the previous survey. It is also found that the pollution status (environment quality) is highly appreciable and the quality indicator values are notably within the national standards. The healthy practices and initiatives taken up by the College help to preserve its green status, as a perfect academic model of environmental sustainability and stewardship.


21/05/2022

Director

Advanced Centre of Environmental Studies and
Sustainable Development (ACESSD)
Mahatma Gandhi University
Kottayam, Kerala.



Annexures

Energy Audit

1. Electrical energy consumption

Energy sources and consumption profile

Energy consumption profile	
Annual Electrical consumption (W or kwh) Annual Electrical consumption (Total units)	
Annual diesel consumption (Vehicles)	
Annual diesel consumption (DG set)	
Annual Petrol consumption (Vehicles)	
Annual LPG consumption No of cylinders required / year 14.2 Kg 19 Kg	

Particulars	Average cost / unit (Rs.)
Electrical (cost / unit)	
Diesel (cost/liter) DG set+Vehicles	
Petrol (cost/liter)	
LPG (cost/cylinder) 14.2 Kg 19 Kg	

2. Monthly electricity amount/ consumption details (2021-22)

Sl No	Month	Energy consumption (kWh)	Total units	Total amount paid
1	March (2021)			
2	April			
3	May			
4	June			
5	July			
6	August			
7	September			
8	October			
9	November			
10	December			
11	January (2022)			
12	February (2022)			

3. Annual/Monthly specific energy consumption per person – No. of person (building wise)

Sl No	Main Blocks in college campus	No of pupil	Annual/Monthly specific energy consumption
1	Jesus Block,		
2	Mount Block,		
3	St. Joseph Block		
4	St.Xaviers Convent		
5	St.Annes Hostel		
6	B.Voc and Communicative		
7	Other buildings etc (if any please add additionally		
8			

Sl No	Main Blocks in college campus	No of floors	Total area of the Block
1	Jesus Block,		
2	Mount Block,		
3	St. Joseph Block		
4	St.Xaviers Convent		
5	St.Annes Hostel		
6	B.Voc and Communicative		
7	Other buildings etc (if any please add additionally		
8			

4. Details regarding energy efficient appliances –

5 star home appliances (Number) –

Fridge

AC

Washing Machine

TV

Other electronic appliances etc. (if any add separately)

4 star home appliances (Number) –

Fridge

AC

Washing Machine

TV

Other electronic appliances etc. (if any add separately)

3 Star home appliances (Number) –

Fridge

AC

Washing Machine

TV

Other electronic appliances etc. (if any add separately)

2 Star home appliances (Number) –

Fridge

AC

Washing Machine

TV

Other electronic appliances etc. (if any add separately)

< 2 Star appliances (Number) –

Fridge

AC

Washing Machine

TV

Other electronic appliances etc. (if any add separately)

Number of LED screens/monitors –

TV –

Computer -

Number of LCD screens/monitors –

TV –

Computer -

Number of CRT screens/monitors -

TV –

Computer -

5. Lights details: No of LED, CFL, Incandescent lamps

Number of LED lamps -

Number of CFL lamps -

Number of Incandescent lamps -

6. Building wise energy consumption

Jesus Block, Mount Block, St. Joseph Block, St.Xaviers Convent St.Annes Hostel, B.Voc and Communicative, Other buildings etc (if any please add additionally).

Model data sheet is given below and fill the details in that respective format with respect to each block. Excel sheet with respect to each block is also acceptable.....

Jesus Block

Sl. No	Equipment	Number	Consumption/year (kWh)

7. Number of Vehicles

Diesel -

Petrol -

8. Number of Vehicles with respect to Bharat stage emission standards (BSES)

BS VI -

BS IV -

BS III -

BS II -

BS I -

9. Renewable energy avenues of the campus

a.Solar

Installation date

Its capacity

How much energy generating

Its usage

Is it is on grid / off grid connection

Photographs

b. Biogas plant

No of plants

Capacity

Amount of waste feed in this unit?

Amount of energy generation

For what purposes this energy is used

Photographs

10. Specify the lights installed in ground/streets or outside areas (outside the buildings)

Type of lights (High mast LED,CFL, Incandescent or sodium lamps etc.) -

Their Number -

Annual Power consumption -

11. Specify the motor pumps used for pumping the water for various purposes (agriculture, gardening, storage tanks etc.)

Type -

Number -

Horse Power -

Annual Power consumption –

Water audit

Sector wise use of water in building block

SL No.	Sector	Total Daily Use (L)	Approx. number of people used
1	Bathroom		
2	Toilet		
3	Kitchen		
4	Garden		
5	Urinals		
6	Dining area		
7	Guest room		
8	Laboratory		
9	Teacher's room		
10	Other wash area		
11	Water cooler		
12	Water purifier		
13	Office		
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			

Total capacity of Water Reservoirs on campus in Liter

[illegible]

Water tank: storage capacity and usage pattern

[illegible]

Rainwater harvesting system

Location of the tank	Target buildings of the tank	Capacity (L)	Date of commission	Average amount of water usage (Litres/day)

Sewage treatment plant

Location of the sewage treatment plant	Type	Capacity (L)	Date of commission	Sources of waste water	Average amount of water treated (Litres/day)	Average

Total loss of water per day due to leakage of water

No. of leaking taps	
Quantity of water loss through leaking taps	

Details of main outlets

[illegible]

Waste audit

Name of the College:

Period of data collection:

Total number of working days in the College:

Total number of people (average) working/residing in the College on working days:

Date of survey:

1. Overall waste usage (working days)

[illegible]

2. Waste Disposal strategies

Sl No	Categories of Waste		Particulars	Types of Disposal
1	Paper Waste		A4 Paper (Print out papers), Newspapers, Paper plates & cups etc..	
2	Plastic Waste		Pen, Refill, Plastic water bottles and other plastic containers, wrappers etc	
3	Glass waste		Broken glass wares from buildings	
4	Damaged Furniture		Furniture from different buildings	
5	Food waste		,	
6	Construction & Demolition Waste			
7	E-waste		Computers, Printers, other electronic gadgets	
8	Hazardous waste		Batteries,-normal batteries, ups/inverter batteries, mobile phone batteries, solar batteries, CFL lamps	
9	Bio medical waste		Gloves, masks, expired medicines, napkins, needles	
10	Liquid waste		Waste water from bathrooms, toilets, labs, other wash areas	
11	Other waste	1.Sandals 2. Clothes Etc.		

3. Waste treatment units

Sl. No	Waste treatment units/ specify number	Specify the location	Specify the building from waste is collected & used in the treatment units	Total quantity treated (Kg/day)	Approximate quantity of gas generated in Volume per day/month basis (specify accordingly)	Any other related information regarding biogas
1	Biogas 1 2 3 4					
Sl. No	Waste treatment units	Specify the location	Specify the building from waste is collected & used in the treatment units	Total quantity treated (Kg/day)	Organic manure produced from vermi compost used for farming and horticulture. (Kg/month or Kg/year – specify accordingly)	Any other related information including the name of earthworms used for vermi composting
2	Vermi compost 1 2 3 4					
Sl. No	Waste treatment units	Specify the location	Specify the building from waste is collected & used in the treatment units	Total quantity treated (Kg/day)	Quantity of ash produced (Kg/day)	Any other related information (eg. disposal of ash, types of waste used)

3	Incinerator 1 2 3 4					
Sl. No	Waste treatment units	Specify the location	Specify the building from waste is collected & used in the treatment units	Total quantity treated (Kg/day)	Quantity of fish harvested (kg/year)	Any other related information including the name of fishes used for farming
4	Fish farming 1 2 3 4					
4	Aerobic waste treatment unit	Specify the location	Specify the building from waste is collected & used in the treatment units	Total quantity treated (Kg/day)	Quantity of organic manure produced (kg/year)	Any other related information (eg. sale of manure, usage of manure etc.)
	1 2 3 4					
5	Any other waste treatment unit, specify if any	Specify the location	Specify the building from waste is collected & used in the treatment units	Total quantity treated (Kg/day)	Quantity of manure produced (kg/year)	Any other related information

4. Whether compost pits are available, if yes, provide the details given below

What type of waste used for preparing compost pits:

Number of compost pits and their approximate size (area or volume):

Approximate quantity of waste used for creating compost pits (per days basis or others):

Usage of treated compost:

5. Whether sewage treatment plant is installed, if yes provide the details given below

Sl. No	Number of sewage treatment plants, Specify accordingly	Specify sources of waste water (labs, bathrooms, toilets, wash areas etc.)	Total quantity of waste water generated (per day)	Total quantity of water treated (per day)	Usage of treated water
	1				
	2				
	3				
	4				

6. Any other disposal strategies adopted for treating the waste water in the campus, (particularly waste water from the labs):

7. Details of waste management programmes conducted (within the campus or outside) during the period

8. Details of the waste management committee established in the department/block during the period (mention its activities also)

9. Specify if any material collection facilities (MCF) or material recovery facility (MRF) is established in the campus is established in the campus, provide details.

10. Awards or any other recognitions obtained related to waste management

Biodiversity audit

Floral Diversity of the Campus (Trees & Medicinal plants)					
Sl. No.	Scientific name	Malayalam Name	English Name	No.	Trees (T)/ Medicinal Plants (MP)

Faunal Diversity of the Campus			
Sl. No.	Scientific name	Malayalam Name	English Name

Butterfly Diversity of the Campus			
Sl. No.	Scientific name	Malayalam Name	English Name

Odonate Diversity of the Campus			
Sl. No.	Scientific name	Malayalam Name	English Name