GREEN AUDIT REPORT 2020

ESTD 1964

BASELIUS COLLEGE
Kottayam

Prepared by

School of Environmental Sciences
Mahatma Gandhi University
Kottayam - 686560

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SCHOOL OF ENVIRONMENTAL SCIENCES

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16.12.2020

CERTIFICATE

Certify that Baselius College, Kottayam has scored 8.73/10 in the Green Audit conducted during 2019-2020.

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Director

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Kottayam

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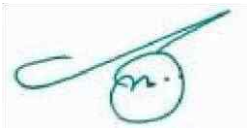
Executive Summary

Green campus is a concept implemented in many educational and research institutions all over the world. It will support them to be sustainable because of their mass resource utilization and waste discharge in to the environment. Waste minimization plans for the educational institute are now mandatory to maintain the cleanliness of the campus. To find out the environmental performance of the educational institutions and to analyze the possible solutions for converting the educational campus as the Green-campus the conduction of Green Auditing of Institution is essential. The green auditing of 'Baselius' College, Kottayam, enables to assess the life style, action and its impact on the environment. The audit was mainly focused on greening indicators like consumption of energy in terms of electricity and fossil fuel, quality of soil and water, vegetation, waste management practices and carbon foot print of the campus etc. Initially a questionnaire survey was conducted to know about the existing resources of the campus and resource consumption pattern of the students and staffs in the College. In order to assess the quality of water and soil, water and soil samples were collected from different locations of the college campus and analysed for its parameters. The Mobile Ambient Air Quality Monitoring System was used for assessing the ambient air quality. Collected data was grouped, tabulated and analysed. Finally, a report pertaining environmental management plan with strength, weakness and suggestion for the green campus are documented.

Dr. Mahesh Mohan

Co-ordinator, Green Audit



Dr. Baiju K. R.

Director

Chapter 1

INTRODUCTION

1.1 About College

Baselius College was established in the year 1964 by a galaxy of eminent men to fulfil the long-cherished dream of the Malankara Orthodox Christian Community to dedicate themselves to the service of God and man. This premier postgraduate institution that flourished from the precincts of the MD Seminary High School perpetuates the sacred memory of our heavenly patron His Holiness Baselios Geevarghese-II, the late lamented Catholicos of the East, who steered the destiny of the Orthodox Church with grace and vision for more than three decades. The College is situated at the heart of Kottayam town and is easily accessible by road, rail and water transport systems.

The College stands for academic excellence, development of skill and character formation so as to produce intellectually mature, morally upright, socially committed and spiritually inspired men and women. In pursuance of this goal, the College has set the following objectives:

- To develop the potentialities of young men and women and help all those engaged in the pursuit of Truth and Knowledge, keeping in view the intellectual, physical and spiritual values.
- To inculcate a sense of discipline, social responsibility and community service in the youth and also to bring home the dignity of manual labour.

- To provide society with the right kind of leadership through men and women trained in various spheres who are competent to tackle the problems in life and make them worthy citizens of our community and the country in general.
- To instil in the students a sense of national pride through appreciation of Indian traditions and cultures.
- To sensitise students to critique current socio-economic, political and cultural issues and to denounce all forms of oppression relating to class, caste and gender.
- To familiarise students with environmental issues, thus motivating them to promote ecological justice and sustainable development.
- To establish a link between the institution and policy makers through collaborative research leading to social development.

Vision

To be a premier temple of higher learning, imparting quality holistic education to all seekers, irrespective of caste, creed and gender.

Mission

To dispel the darkness of ignorance and elevate youngsters to the pedestal of wisdom by fostering spirituality, knowledge and skill, thereby empowering them to deal with real life situations and equipping them to build a fruitful future for themselves and the society at large.

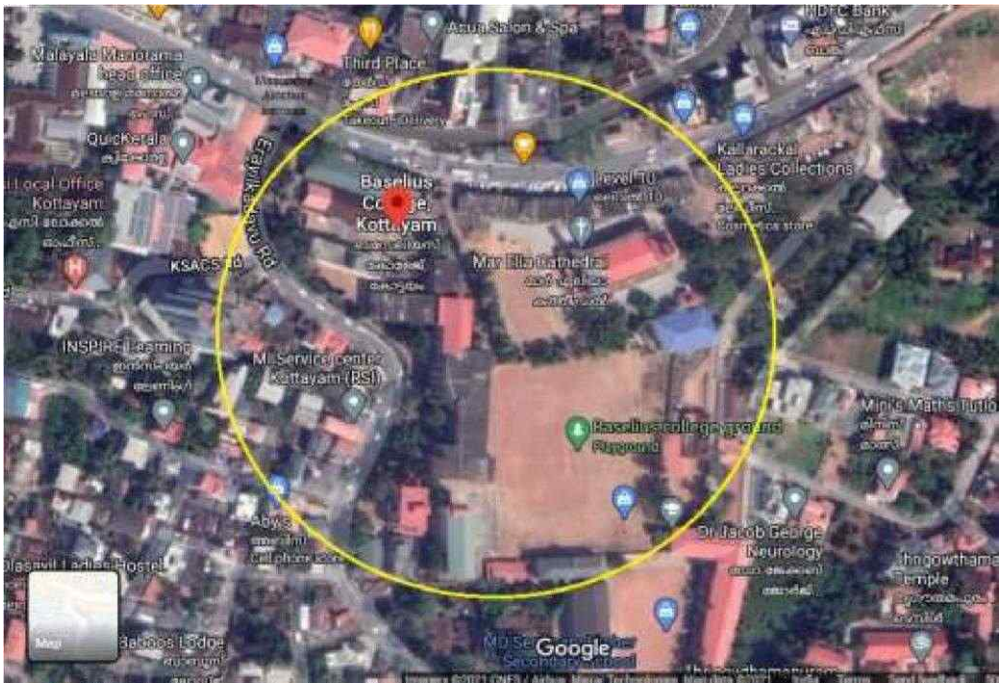


Fig. I Location of Baselius College

1.2 Programmes of study

The College offers the following programmes of study:

Table 1.1 Under Graduate Programmes (CBCS) Under Aided Stream

	CORE	**COMPLEMENTARIES**
1.	B.A. English	Language English & History& Literature
2.	B.A. Malayalam	Language & Literature Kerala Culture & Sanskrit
3.	B.A. Economics	Political Science & History
4.	B.A. Political Science	Economics & History

5.	B.Sc. Mathematics	Statistics & Physics
6.	B.Sc. Physics	Electronics & Maths
7.	B.Sc. Chemistry	Mathematics & Physics
8.	B.Sc. Botany	Chemistry & Zoology
9.	B.Sc. Zoology	Chemistry & Zoology
10.	B.Com (Model-I) Elective	Finance and Taxation
11.	BBA	

* English and additional language (Malayalam, Hindi, Syriac, Sanskrit- students may choose any one) are compulsory for all programmes/ students of B.A./B.Sc./B.Com.

* No additional language for BBA

Table 1.2. Post Graduate Programmes under Aided Stream (CSS)

Sl No	**COURSE**
1.	M.A. English Language & Literature
2.	M.A. Economics
3.	M.Sc Chemistry
4.	M.Sc. Physics
5.	M.Com. (Finance)

Table 1.3. Programmes under Self Financing Stream

UG PROGRAMME :	B.Com (Model –III Taxation)
PG PROGRAMME :	M.Com (Finance)

Table 1.4. The Student and Faculty Strength of the College

	Male	**Female**	**Total**	**Grand Total**
Students	623	1005	1628	**1628**
Teaching Staff (Permanent)	18	44	62	**80**

Guest Lectures	4	12	16	
FIP	2	0	2	
Non Teaching Staff	20	2	22	**49**
Management Staff	14	13	27	

Table 1.5. Physical Structure of the College

Departments	19
Laboratories	4
Conference halls	3
Libraries	1
Auditorium	1
Canteens	1

The College is located in about 9.5 acres of land. The built-up area of the College is 7.9 acres.

Chapter 2

PREAUDIT STAGE

2.1 Objectives of green audit

This green audit's main objectives are to assess the environmental quality and the management strategies in Baselius College, Kottayam. The specific goals are:

1. To evaluate the quality of the water and soil in the Baselius college campus
2. To monitor the energy consumption pattern of the College
3. To quantify the liquid and solid waste generation and management plans on the campus.
4. To assess the carbon footprint of the College
5. To assess whether the measures implemented by Baselius College have helped to reduce the Carbon Footprint.
6. To impart environment management plans to the College
7. Providing a database for corrective actions and plans.
8. To assess whether the Institution's extracurricular activities support the collection, recovery, reuse, and recycling of solid wastes.
9. To identify the gap areas and suggest recommendations to improve the Green Campus status of the Baselius College.

2.2 Target areas of green auditing

Green audit forms part of a resource management process. Although audits are individual events, the real value of green audits is that they are carried out at defined intervals, and their results can illustrate improvement or change over time. The Green-campus concept mainly focuses on efficient use of energy and water; minimize waste generation or pollution, and economic efficiency.

All these indicators are assessed in the process of “Green Auditing of this educational institute”. Green-campus focuses on reducing contribution to emissions and procuring a cost-effective and secure supply of energy. It encourages and enhances energy use conservation, promotes personal action, reduces the institute’s energy and water consumption, reduces waste to landfill, and integrates environmental considerations into all contracts and services considered

to have significant environmental impacts. Target areas included in this green auditing are water, energy, waste, green campus, and carbon footprint.

2.3 Auditing for Water Management

Water is a natural resource; all living organisms depend on water. While freely available in many natural environments, potable (drinkable) water is less readily available in human settlements. Groundwater depletion and water contamination are taking place at an alarming rate. Hence it is essential to examine the quality and usage of water in the College. Water auditing is conducted to evaluate facilities of raw water intake and determine the facilities for water treatment and reuse. The concerned auditor investigates the appropriate method that can be adopted and implemented to balance water demand and supply.

2.4 Auditing for Energy Management

Energy conservation is an essential aspect of campus sustainability linked with the carbon footprint of the campus. Energy auditing deals with the conservation and methods to reduce its consumption related to environmental degradation. It is therefore essential that any environmentally responsible institution examine its energy use practices.

2.5 Auditing for Waste Management

Human activities create waste, and it is the way these wastes are handled, stored, collected, and disposed of, which can pose risks to the environment and public health. Pollution from waste is aesthetically unpleasing and results in large amounts of litter in our communities which can cause health problems. Solid waste can be divided into three categories: biodegradable, non-biodegradable and hazardous waste. Bio-degradable wastes include food wastes, canteen waste, wastes from toilets, etc. Nonbiodegradable wastes include what is usually thrown away in homes and schools, such as plastic, tins, glass bottles, etc. Hazardous waste is likely to threaten health or the environment, like cleaning chemicals, acids, and petrol. Unscientific management of these wastes, such as dumping in pits or burning them, may cause the harmful discharge of contaminants into soil and water supplies and produce greenhouse gases contributing to global climate change, respectively. Particular attention should be given to the handling and management of hazardous waste generated in the College. Bio-degradable waste can be effectively utilized for energy generation purposes through anaerobic digestion or converted to fertilizer by composting technology. Non-biodegradable waste can be used through

recycling and reuse. Thus the minimization of solid waste is essential to a sustainable college. The auditor diagnoses the prevailing waste disposal policies and suggests the best way to combat the problems.

2.6 Auditing for Green Campus Management

Trees play an important ecological role within the urban environment and support improved public health and provide aesthetic benefits to cities. A single mature tree will absorb up to 48 pounds of carbon dioxide from the atmosphere and release it as oxygen in one year. The amount of oxygen released by the campus trees is right for the people on the campus. So while you are busy studying and working on earning those good grades, all the trees on campus are also working hard to make the air cleaner for you.

2.7 Auditing for Carbon Footprint

The burning of fossil fuels (such as petrol) impacts the environment through the emission of greenhouse gases into the atmosphere. The most common greenhouse gases are carbon dioxide, water vapour, methane, nitrous oxide, and ozone. Of all the greenhouse gases, carbon dioxide is the most prominent greenhouse gas, comprising 402 ppm of the Earth's atmosphere. The release of carbon dioxide gas into the Earth's atmosphere through human activities is commonly known as carbon emissions. Vehicular emission is the primary source of carbon emission on the campus; hence assessing the method of transportation practiced in the College is essential.

2.8 Methodology Adopted

The methodology adopted to conduct the Green Audit of the Institution had the following components

Onsite Visit

The Green Audit Team conducted field visits. The visit's key focus was on assessing the status of the green cover of the Institution, their waste management practices and energy conservation strategies, etc. The sample collection (water, soil) was carried out during the visits. The water samples from two open wells and two tap water sources were taken, and soil samples from three different campus places were collected. The sample collection, preservation, and analysis were done scientifically as prescribed by the standard procedures.

Focus Group Discussion

The Focus Group discussions were held with the nature club, bird club members, staff members, and the management, focusing on Green Audit's various aspects. The meeting was focused on identifying the attitudes and awareness towards environmental issues at the institutional and local levels. **Energy, waste management and Carbon footprint analysis Survey**

With the help of teachers and students, the audit team has assessed the energy consumption pattern and waste generation, disposal, and treatment facilities of the College. The monitoring was conducted with a detailed questionnaire survey method.

Survey forms

2.1 Water management

SL NO	PARAMETERS	Response	Remarks
1	Source of water		
2	No of Wells		
3	No of the motors used		
4	Horsepower – Motor		
5	Depth of well –Total		
6	Water level		
7	Number of water tanks		
8	Capacity of tank		
9	Quantity of water pumped every day		
10	Any water wastage/why?		
11	Water usage for gardening		
12	Wastewater sources		
13	Use of wastewater		
14	The faith of wastewater from labs		
15	Whether wastewater from labs mixed with groundwater		
16	Any treatment for lab water		
17	Whether any green chemistry method practiced in labs		
18	No of water coolers		
19	Is rainwater harvest available?		

20	No of units and amount of water harvested		
21	Any leaky taps		
22	Amount of water lost per day		
23	Any water management plan used?		
24	Any water-saving techniques followed?		
25	Are there any signs reminding peoples to turn off the water?		

2.2 Energy audit

Room No./name	**Electrical device/ items**	**Number**	**Power**	**usage time (hr/day)**

Item: Bulbs (CFL, incandescent, LED); A/c, fan, computer, instruments

2.3 Waste management

Approximate quantity of waste generated per day (in kg) *Office*

Approx	Biodegradable	Non - biodegradable	Hazardous	Others
<1Kg				
2-10Kg				
>10Kg				

Laboratories

Approx	**Biodegradable**	**Non - biodegradable**	**Hazardous**	**Others**
<1Kg				
2-10Kg				
>10Kg				

Canteen/kitchen

Approx	Biodegradable	Non - biodegradable	Hazardous	Others
<1Kg				
2-10Kg				
>10Kg				

The total strength of students, teachers, and Nonteaching staffs

No of Students		
No of Teachers		
No of Nonteaching staffs		
Gents		
Ladies		
Total		

How is the waste generated in the College managed?

A)Composting/ Vermicomposting	Yes/ No	Remark
B)Recycling		
C)Reusing		
D)Other ways		

Waste generated in the College?

E-waste	
Hazardous waste	
Solid waste	
Dry leaves	
Canteen waste	
Liquid waste	
Glass	
Unused equipment	
Napkins	

Others (specify)	

Do you use recycled paper in College?	
Any waste management methods used?	

2.4 Carbon footprint analysis

1.	The total number of vehicles used by the stakeholders of the College. (per day)	
2.	No of the cycles used	
3.	No of two-wheelers used (average distance traveled and quantity of fuel and amount used per day)	
4.	No of cars used (average distance traveled and quantity of fuel and amount used per day)	
5.	No of persons using public transportation	
6.	No of persons using college conveyance	
7.	Generators used per day	
8.	Amount of fuel used	
9.	Number of LPG cylinders used in canteen/labs	
10.	Use of any other fossil fuels in the College	
11.	Any suggestion to reduce the use of fuel	

Chapter 3

AUDIT STAGE

Green auditing in **Baselius College, Kottayam** began assessing the status of the green cover of the Institution followed by waste management practices and energy conservation strategies, etc. The team monitored different facilities at the College. Auditing determined types of appliances and utilities (lights, taps, toilets, fridges, etc.) and measured the usage per item. The audit identified the relevant consumption patterns (such as how often an appliance is used) and their impacts. The staff and learners were interviewed to get details of usage, frequency, or general characteristics of individual devices.

Data collection was done in the sectors such as Energy, Waste, Greening, Carbon footprint, and Water use. College records and documents were verified several times to clarify the data received through surveys and discussions. The environmental samples, including water, soil, and various campus locations, were collected and analyzed at the School of Environmental Sciences, Mahatma Gandhi University.

3.1 Student Clubs and Forums Involved

Nature Club, Bhoomithrasena Club, N.S.S, N.C.C, and Department level associations were involved in the green audit of the college.

3.2 Review of Documents and Records

The documents like admission registers, electricity and water charge remittance records, laboratory equipment registers, and office registers were examined and data were collected. Academic calendar, college magazines, annual report of the college and NAAC self-assessment reports, etc. were also verified as part of data collection.

3.3 Review of policies

The audit team discussed the environmental management aspect of the college with the management. They will modify/revise the green policies with respect to the green auditing.

3.4 Interviews

In order to collect information for green auditing interviewed office staff, Principal, teaching and non-teaching staff, students and other stakeholders of the college. Discussions were also made with the PTA office bearers to clarify doubts regarding certain points.

3.5 Site inspection

The audit team visited the College and its premises several times to gather information. Campus trees were counted and identified, Various gardens, play grounds, canteen, library, office rooms and parking grounds were also visited to collect data. Number and type of vehicles used by the stakeholders were counted and fuel consumption for each vehicle verified. Number of LPG cylinders used in labs, canteen and hostel kitchen were also counted. Site for air sampling was fixed. The audit team finalised the locations and sources for soil and water sampling.

Chapter 4

POST AUDIT STAGE

4.1 Ambient Air Quality Monitoring

Date: 27th November, 2019 to 25th December, 2019 Description of the Monitoring Site:

Baselius College established in 1964 situated in the heart of Kottayam. The college is ideal for sampling in traffic congested area and also for sensitive location due to its closeness to the city centre and to the District Hospital, Kottayam.

The School of Environmental Sciences, Mahatma Gandhi University, Kottayam conducted air quality monitoring at the premise of the institute during 27th November, 2019 to 25th December, 2019. Monitoring was done using the ambient air quality monitoring van (Fig. 4.1) to understand the status of air quality for various pollutants and also to identify the major pollutants in the area. As part of the Monitoring programme, air pollutants such as Particulate matters (PM_{10}, $PM_{2.5}$), SO_2, NO_2, O_3 and CO were analysed.

Fig. 4.1 Mobile ambient air quality monitoring van

The mean daily concentration of PM_{10} is 33.77±17.89µg/m^3, $PM_{2.5}$ (42.66±16.73µg/m^3), SO_2 (6.53±1.21µg/m^3), NO_2 (21.61±7.57µg/m^3), CO (2.8±0.43µg/m^3) and O_3 (26.20±10.94µg/m^3). The National ambient air quality standard (NAAQS) for PM_{10} (60µg/m^3) has exceeded 5 times and $PM_{2.5}$ (40µg/m^3) exceeded 13 times during the study period (Fig. 4.3). Both PM_{10} and $PM_{2.5}$ has exceeded the WHO standard many times during the monitoring period. The average value for $PM_{2.5}$ in the study area is just above the NAAQS value, while PM_{10} is well below the NAAQS. The maximum concentration of PM_{10} observed on 5th December and for $PM_{2.5}$ it was on 25th December, 2019. The hourly average value for both PMs

has exceeded annual and 24 hr mean value prescribed by NAAQS (Fig. 4.4). Maximum concentration of PMs observed during morning and evening hours. The vehicular traffic may enhance the value for PMs in the area. The concentration of NO2 also shows a similar trend and implies the strong influence of vehicular traffic to the air quality depletion in the study area. The hourly concentration of O_3 shows that the concentration is maximum in the noon time with maximum peak during 02.00PM to 03.00PM. A gradual increase in the concentration of O_3 can be observed as the temperature increases and becomes almost zero during the night.

Table 4.1 shows the national ambient air quality index and corresponding health impacts. The Daily average concentration of Pollutants and corresponding Air Quality Index (AQI) is provided in Table 4.2. The AQI calculated shows that majority of the days are in satisfactory condition for air quality and only five days are reported to be in moderate condition. The moderate condition in air quality was reported during the Christmas days. It may be due to the increased vehicular movement during the festival period. The monitoring results show that PM_{10} and $PM_{2.5}$ are the major pollutants in the area followed by NO_2

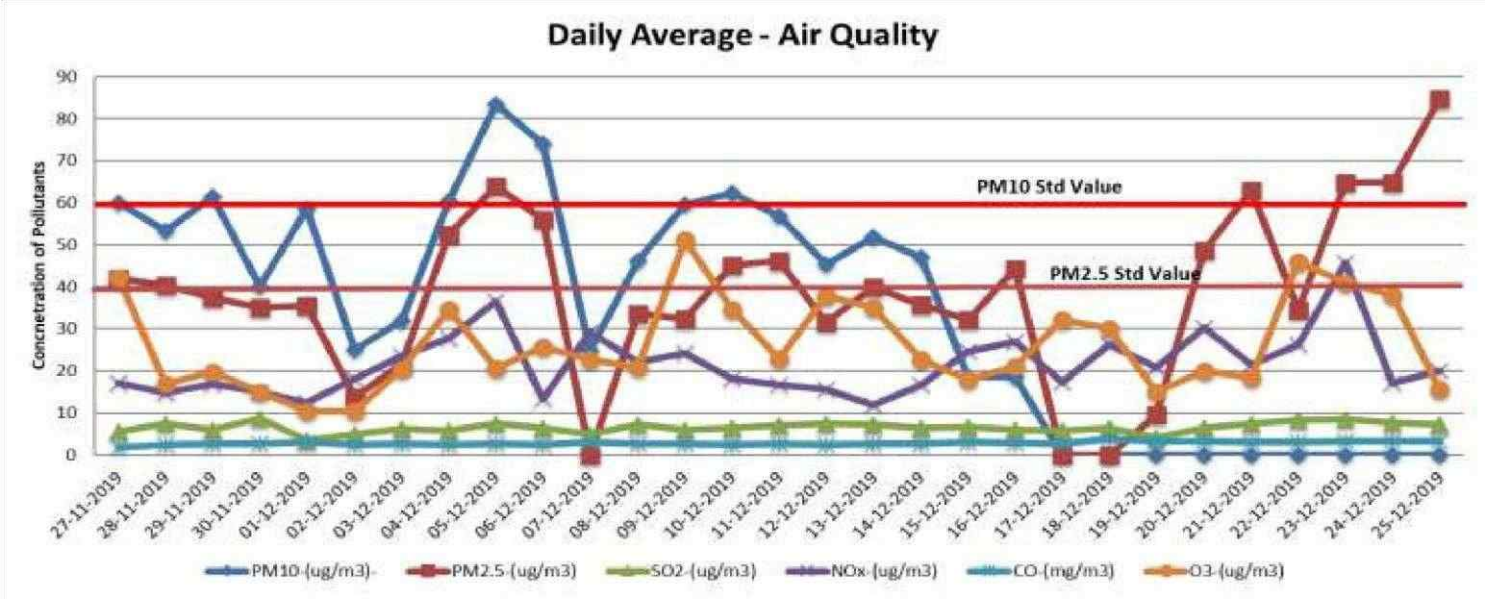


Fig. 4.3 Shows the Daily Average concentration of Air Pollutants

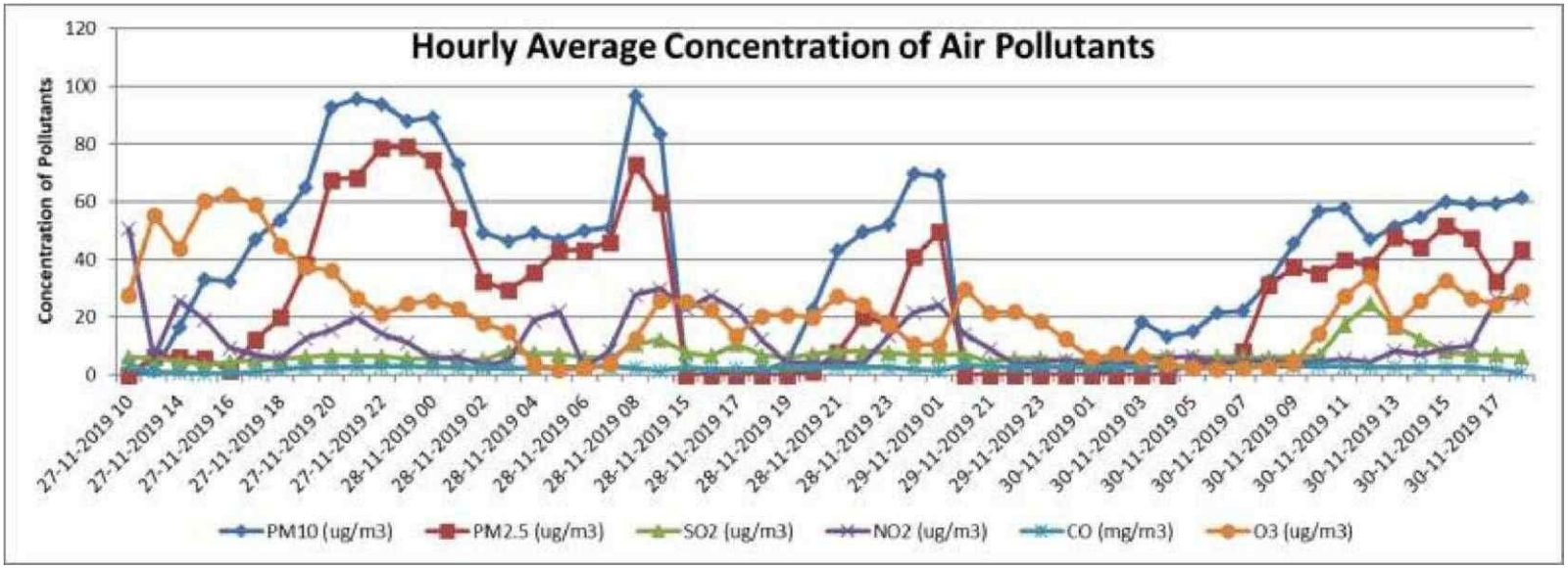


Fig. 4.4 Shows the Hourly Average concentration of Air Pollutants

Table 4.1. CPCB Ambient Air Quality Index and Associated Health Impacts

Good (0–50)	**Minimal Impact**
Satisfactory (51–100)	**Minor breathing discomfort to sensitive people**
Moderate (101–200)	**Breathing discomfort to the people with lung, heart disease, children and older adults**
Poor (201–300)	**Breathing discomfort to people on prolonged exposure**
Very Poor (301–400)	**Respiratory illness to the people on prolonged exposure**
Severe (>401)	**Respiratory effects even on healthy people**

Table 4.2. Pollutants Concentration and the AQI in the Baselius College Campus

Date	PM_{10}- ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	NOx ($\mu g/m^3$)	AQI
27-11-2019	60.03	41.95	5.56	17	**70**
28-11-2019	53.34	40.28	7.51	14.85	**67**
29-11-2019	61.44	37.36	6.01	16.87	**62**
30-11-2019	40.19	35.03	8.79	14.99	**58**
01-12-2019	58.49	35.43	3.57	12.39	**59**
02-12-2019	25.08	13.8	5.01	18.06	**57**
03-12-2019	31.96	21.77	6.13	23.67	**57**
04-12-2019	60.44	52.53	5.74	27.67	**88**
05-12-2019	83.48	63.99	7.54	36.58	**113**
06-12-2019	73.94	56.03	6.3	13.35	**93**

07-12-2019	24.8	ND	5.02	29.14	**57**
08-12-2019	46.09	33.65	7.3	22.2	**57**
09-12-2019	59.47	32.36	5.89	24.17	**59**
Date	**PM_{10}- ($\mu g/m^3$)**	**$PM_{2.5}$ ($\mu g/m^3$)**	**SO_2 ($\mu g/m^3$)**	**NOx ($\mu g/m^3$)**	**AQI**
10-12-2019	62.25	45.15	6.39	18.12	**75**
11-12-2019	56.82	46.15	7.08	16.63	**76**
12-12-2019	45.42	31.61	7.38	15.67	**57**
13-12-2019	51.74	39.91	7.15	11.87	**67**
14-12-2019	47.02	35.64	6.42	16.6	**59**
15-12-2019	18.6	32.24	6.51	24.65	**57**
16-12-2019	18.61	44.37	6.07	26.94	**74**
17-12-2019	ND	ND	5.83	17.23	**ND**
18-12-2019	ND	ND	6.39	26.19	**ND**
19-12-2019	ND	9.58	4.13	20.9	**25**
20-12-2019	ND	48.7	6.33	30.32	**81**
21-12-2019	ND	62.93	7.51	21.55	**110**
22-12-2019	ND	34.35	8.37	26.19	**57**
23-12-2019	ND	64.87	8.48	45.82	**116**
24-12-2019	ND	64.73	7.56	17.01	**116**
25-12-2019	ND	84.66	7.28	20.04	**182**

4.2 Water Quality assessment

The samples were collected, preserved, and transported to the lab and analyzed for various physio-chemical parameters. The details of water samples are as follows;

Table 4.3. Sampling locations

Sample	Area
I	Rainwater and Municipality water
II	Well water I- near Chem Laboratory
III	Municipality water
IV	Well water II - College ground

The harvested rainwater is directly pumping into the water tank and then feed to the purifier for usage.

The significant parameters analyzed include pH, Conductivity, Total Dissolved Salts (TDS), Salinity, Alkalinity, Total Hardness, and E.coli. The results are presented in Table 4.4. The results are comparable with the values of drinking water standards prescribed by different agencies.

Table 4.4 Water quality analysis results

SL No	Parameter	Sample I	Sample II	Sample III	Sample IV	Desirable limits as per IS - 10500-2012
1	pH	6.6	6.9	5.8	6.6	6.5-8.5
2	Conductivity	16.0	54	180	48	1476 µS
3	Total dissolved salts	18	64	52	240	500mg/L
4	Salinity	0.003	0.024	0.164	0.028	3ppt
5	Acidity	24	10	34	16	200mg/L as $CaCO_3$
6	Alkalinity	48.0	60.0	14	40.0	200 mg/L as $CaCO_3$
7	Chloride	0.08	0.094	0.462	0.049	250 mg/L as $CaCO_3$
8	Total hardness	20	46.0	138.0	50.0	300mg/ L as $CaCO_3$
9	E. Coli	absent	absent	absent	Absent	absent

All the water samples are within the permissible limit given by standard organisations.

Water Management

Wells and Municipality water are the primary sources of the College's water. The College has two wells about 16 feet deep and 8 feet water level (Table 4.5). There are four motors of one horsepower each for pumping water to the three tanks of 30000 litre capacity. 35000 litre water is pumped every day to meet the requirements of the College. About 300 litres of water is spent daily on gardening. There are two coolers in the College. About 20,000 litre water is harvested through Rainwater harvesting. Water management is effectively done in the College, addressing various water wastage issues, waste water from labs and leaky taps, and adopting efficient water-saving strategies. Students are aware of the need for saving water through the signboards kept at various places in the College.

Table 4.5 Water management in campus

Sl No	**PARAMETERS**	**Response**	Remarks
1	Source of water	Well	
2	No of Wells	2	
3	No of the motors used	4	
4	Horsepower – Motor	1 HP- 4 nos.	
5	Depth of well –Total	16 ft - well no:1 8 ft- well no: 2	
6	Number of water tanks	3	
7	Capacity of tank	30000 L-3	
8	Quantity of water pumped every day	35000L	
9	Any water wastage? If yes, why?	Nil	
10	Water usage for gardening	300L/day	
11	Wastewater sources	Lab, canteen	
12	Use of wastewater	Nil	

Sl No	**PARAMETERS**	**Response**	Remarks
13	The fate of wastewater from labs	After neutralization, wastewater is kept in a large covered pit	
14	Any wastewater treatment for lab water	No	
15	Whether any green chemistry method practiced in labs	"Microscale analysis "is implemented for chemistry students	
16	Is rainwater harvest available?	Yes	
17	No of units and amount of water harvested		
18	Any leaky taps	Nil	
19	Amount of water lost per day	Nil	
20	Any water management plan used?	Water management audit conducted	
21	Any water-saving techniques followed?	Nil	
22	Are there any signs reminding peoples to turn off the water?	Yes	

Fig. 4.5 Rainwater harvesting tank

Soil Management

The samples were collected, preserved, and transported to the lab and analyzed for various physio-chemical parameters. The details of soil samples are as follows

Table 4.6 Soil sampling locations

Soil samples	Area
I	Near College canteen
II	Near College auditorium
III	College Chem lab-near butterfly garden
IV	College ground

Table 4.7 Soil analysis results

Parameters	Sample I	Sample II	Sample iii	Sample Iv
pH	7.2	5.4	7.1	7.0
Nitrogen (mg/100g)	1.2	1.2	0.98	1.3

Phosphorus (mg/100g)	0.15	0.75	0.12	0.73
Potassium (Kg/ha)	152.55	152.55	58.33	98.71
Organic carbon (OC) (%)	3.8	3.6	3.4	3.6

The soil samples were analysed to determine the parameters pH, NPK, and organic carbon. The soil productivity is determined primarily by organic matter, which constitutes less than 5% of the soil. OC content in the samples was ranged from 3.4% to 3.8%. Overall, the soil quality is good.

Energy Audit Report

Table 4.8 shows the energy consumption pattern of the College for a month. The one-month electricity bill amount is around Rs. 60,000/-.

Table 4.8 Energy Audit 2019-2020

Sl. No	***Item***	***Power Rating (W)***	***Number***	***Average Number of Days in Use per month***	***Average Hour per day Use***	***Total Consumed Power per month (kW)***
1.	*Fan*	*65*	*405*	*18*	*6*	*2843.1*
2.	*Exhaust Fan*	*40*	*5*	*18*	*7*	*25.2*
3.	*Tube Light*	*35*	*335*	*18*	*2*	*422.1*
4.	*CFL*	*9*	*84*	*18*	*3*	*40.8*
5.	*LED Bulb*	*9*	*156*	*18*	*6*	*151.6*
6.	*LED Tube*	*20*	*26*	*18*	*4*	*37.4*
7.	*AC*	*1500*	*14*	*18*	*2*	*756.0*
8.	*Photocopy Machine*	*1450*	*6*	*25*	*2*	*435.0*
9.	*LCD Projector*	*150*	*10*	*18*	*4*	*108.0*
10.	*Audio System (Auditorium)*	*4000*	*1*	*2*	*3*	*24.0*
11.	*Audio System (public address)*	*450*	*4*	*18*	*0.2*	*6.5*
	Audio System (Seminar hall)	*450*	*3*	*10*	*3*	*40.5*
12.	*Audio System (Portable)*	*80*	*3*	*2*	*1*	*0.5*
13.	*Computer (PC)*	*150*	*125*	*18*	*4*	*1350.0*
14.	*Laptop*	*50*	*15*	*18*	*2*	*27.0*
15.	*Printer*	*750*	*30*	*18*	*0.5*	*202.5*
16.	*Internet*	*40*	*3*	*30*	*24*	*86.4*
17.	*CCTV Recording Unit*	*130*	*1*	*30*	*24*	*93.6*
18.	*LED TV*	*120*	*1*	*25*	*8*	*24.0*
	LED TV	*150*	*1*	*18*	*1*	*2.7*
19.	*Refrigerator*		*3*	*30*	*24*	*135.0*
20.	*Freezer*		*2*	*30*	*24*	*150.0*

21.	*Oven*	*1250*	*5*	*10*	*2*	*125.0*
22.	*Furnace*	*4000*	*1*	*5*	*3*	*60.0*
23.	*Incubator*	*100*	*2*	*10*	*24*	*48.0*

Sl. No	***Item***	***Power Rating (W)***	***Number***	***Average Number of Days in Use per month***	***Average Hour per day Use***	***Total Consumed Power per month (kW)***
24.	*Boiler*	*1000*	*2*	*18*	*1*	*36.0*
25.	*Laminar Flow*	*150*	*1*	*18*	*1*	*2.7*
26.	*Induction Cooker*	*2000*	*1*	*18*	*1*	*36.0*
27.	*Water Bath*	*300*	*1*	*18*	*2*	*10.8*
28.	*Heater*	*150*	*4*	*18*	*3*	*32.4*
29.	*Shaker*	*50*	*1*	*18*	*3*	*2.7*
30.	*DC Power Supply/ eliminator*	*15*	*32*	*18*	*3*	*25.9*
31.	*Function Generator*	*10*	*12*	*18*	*3*	*6.5*
32.	*CRO*	*35*	*10*	*18*	*3*	*18.9*
33.	*Diode Laser*	*3*	*6*	*18*	*2*	*0.6*
34.	*Heating Mantle*	*120*	*3*	*18*	*3*	*19.4*
35.	*Four Probe Setup*	*50*	*2*	*18*	*2*	*3.6*
36.	*Digital Gaussmeter*	*20*	*2*	*18*	*3*	*2.2*
37.	*Hall Effect setup*	*15*	*1*	*18*	*3*	*0.8*
38.	*e/m Apparatus*	*25*	*1*	*18*	*3*	*1.4*
39.	*RF Oscillator*	*40*	*1*	*18*	*3*	*2.2*
40.	*Sodium Vapour Lamp*	*250*	*2*	*18*	*3*	*27.0*
41.	*Mercury Lamp*	*120*	*4*	*18*	*3*	*25.9*
42.	*Grinder*	*600*	*1*	*25*	*4*	*60.0*
43.	*Mixie*	*700*	*2*	*25*	*2*	*70.0*
44.	*Coffee Machine*	*2000*	*1*	*25*	*2*	*100.0*
45.	*Water Pump*	*750*	*2*	*30*	*2*	*90.0*

46.	*Water Pump*	*1500*	*1*	*30*	*1*	*45.0*
				Total Monthly Power Consumption (kW)		***7815***

Waste management

Waste management is an important measure to convert a campus into ecofriendly that needs adequate attention. Different types of wastes are generated on a college campus; its collection and management are very challenging. The following data provide the details of the waste generated and the disposal method adopted by the College.

Table 4.9 Waste management

Types of Waste	Particulars	Disposal Methods
E-waste	Electrical and Electronic parts, Computers, Printers, UPS, etc.	Direct selling
Chemical waste	Laboratory waste	Neutralize with water
Wastewater	Urinals, washing, and bathrooms	Soak pits
Solid waste	Damaged furniture, Paper waste, paper plates, paper cups, etc	Reuse after maintenance, Energy conversion
Plastic waste	Plastic water bottles, Plastic containers, pens, Refill, etc.	Direct selling
Food waste	Classroom food waste and canteen food waste	Disposal in the food pit
Sanitary Napkin		Napkin incinerator
Glass waste	Broken glassware	Direct selling

To maintain the zero organic waste protocol throughout the campus, the College had taken the following measures. The food waste generated by the students and staff is taken by them to their own homes so that minimum waste is generated inside the campus. The organic waste generated in the

canteen and campus is also disposed of correctly in the food waste pit arranged on the campus. The chemicals from the laboratories are disposed of in a sealed tank and water to undergo neutralization with water.

Fig 4.6 Incineration unit in campus

Green Campus

Table 4.10 List of plants on the campus

Sl. No.	Common Name/ Local Name	Scientific Name	No. of Plants
1	Arali	*Nerium oleander*	1

2	Asoka Chethi	*Saraca asoca*	3
3	Breadfruit	*Artocarpus altilis*	1
4	Cananga Tree	*Cananga odorata*	1
5	Coconut	*Cocos nucifera*	2
6	Elenji	*Mimusops elengi*	15
7	Guava	*Psidium guajava*	3
8	Henna	*Lawsonia inermis*	1
9	Indian Almond	*Terminalia catappa*	1
10	Indian banyan	*Ficus benghalensis*	1
11	Indian Mast Tree	*Monoon longifolium*	22
12	Indian tulip tree	*Thespesia populnea*	1
13	Jackfruit Tree	*Artocarpus heterophyllus*	2
14	Kanikonna	*Cassia fistula*	1
15	Mahagony	*Swietenia mahagoni*	12
16	Malabar plum	*Syzygium cumini*	1
17	Mandarin Orange	*Citrus reticulata*	1
18	Mango Tree	*Mangifera indica,*	4
19	Neem	*Azadirachta indica*	1
20	Panineer chamba	*Syzygium jambosa*	1
21	Papaya	*Carica papaya*	1
22	Paradise-tree	*Simarouba glauca*	3
23	Pink Powderpuff	*Calliandra brevipes*	1
24	Podocarpus	*Podocarpus*	1

25	Purple Butterfly Tree	*Bauhinia purpurea*	1
Sl. No.	**Common Name/ Local Name**	**Scientific Name**	**No. of Plants**
26	Sappota	*Manilkara zapota*	3
27	Monkey puzzles	*Araucaria sp.*	2
28	Teak	*Tectona grandis*	8
29	Thuja	*Thuja occidentalis*	2
30	Vatta	*Macaranga peltata*	1

Fig 4.7

Routine Green Practices

Every year college celebrates World Environment Day, World Water Day, and Ozone Day on the campus. The main focus of these programs was to provide awareness to the students about the importance of the environment,

conservation, and sustainable use of environmental resources. The programs are conducted through seminars, poster presentations, quiz competition debates, etc.

Carbon Foot Print Analysis

The details of the carbon footprint analysis in the campus is as follows

Table 4.11. Carbon footprint analysis

1	Total number of vehicles used by the stakeholders of the College (per day)	150(Approximately)
2	No of the cycles used	Nil
3	No of two-wheelers used (average distance travelled and quantity of fuel and amount used per day)	Student-90, Teachers-09, Non-teaching staff-10, Visitors- 08
4	No of three-wheeler used (average distance travelled and quantity of fuel and amount used per day)	Auto: 1
5	No of cars used (average distance travelled and quantity of fuel and amount used per day)	Student-2, Teachers- 20, Non-teaching staff- 2, Visitors - 08
6	No of persons using public transportation	1468
7	No of persons using college conveyance	Nil
8	Number of generators used per day	2+1(Hostel)=3
9	Amount of fuel used	Rs.300 per month
10	Amount of Taxi/Auto charges and amount of Fuels (Approximately)for the transportation of office goods to the College per month	Rs.500
11	Number of LPG cylinders used in canteen/labs	7 (4 Labs + 3 Canteen)

12	Amount of Taxi/Auto charges and amount of Fuels (Approximately)for the transportation of Vegetables/other materials per month	Rs.500
13	Use of any other fossil fuels in the College	Nil
14	Any suggestion to reduce the use of fuel	Nil

Greenhouse gases, including carbon-containing gases carbon dioxide and methane, can be emitted through the burning of fossil fuels, roads, transportation, and other services. Atmospheric carbon dioxide levels, the most dangerous and prevalent greenhouse gas, are at the highest level ever recorded. The emission of carbon dioxide is caused mainly due to human activities. Vehicular emission is the primary source of carbon emission on the campus. The method of transportation that is practiced in the College is to be assessed carefully.

According to the green audit conducted inside the College, the total number of vehicles used by the stakeholders is approximately 150, including two, three, and four wheels. The others use public transportation systems. The main source of fuel used in the college canteen is firewood. LPG cylinder used is limited to seven in the canteen and lab. We try to be carbon neutral in every way we can.

SUGGESTIONS AND RECOMMENDATIONS

Water Management

The water sources are safe in terms of contamination. The food waste produced by students are collected and taken by persons from outside on daily basis. It helped in the management of organic waste in the campus.

The wells can be recharged with rainwater from the rooftops of the new buildings.

Rainwater for laboratory purposes – Construction of a 10000L rainwater harvesting tank can satisfy the laboratory's need, especially in distillation units where water is lost as coolant. The rainwater from the harvesting tank can be used as source water and a coolant for the distillation unit.
Rainwater can also be used as the source of drinking water. The coolant water can be recycled through a separate plumbing system.

The capacity of the distillation unit in the College is 1 L / hour. The amount of water used as a coolant for 1L of distilled water is 60L. Annually, the unit requires approximately 1500L of water as the coolant, and this much water can be saved with the construction of the harvesting tank.

The nature clubs and BMC club can arrange awareness programs for water and energy conservation. There should be proper monitoring of water consumption patterns on the campus.

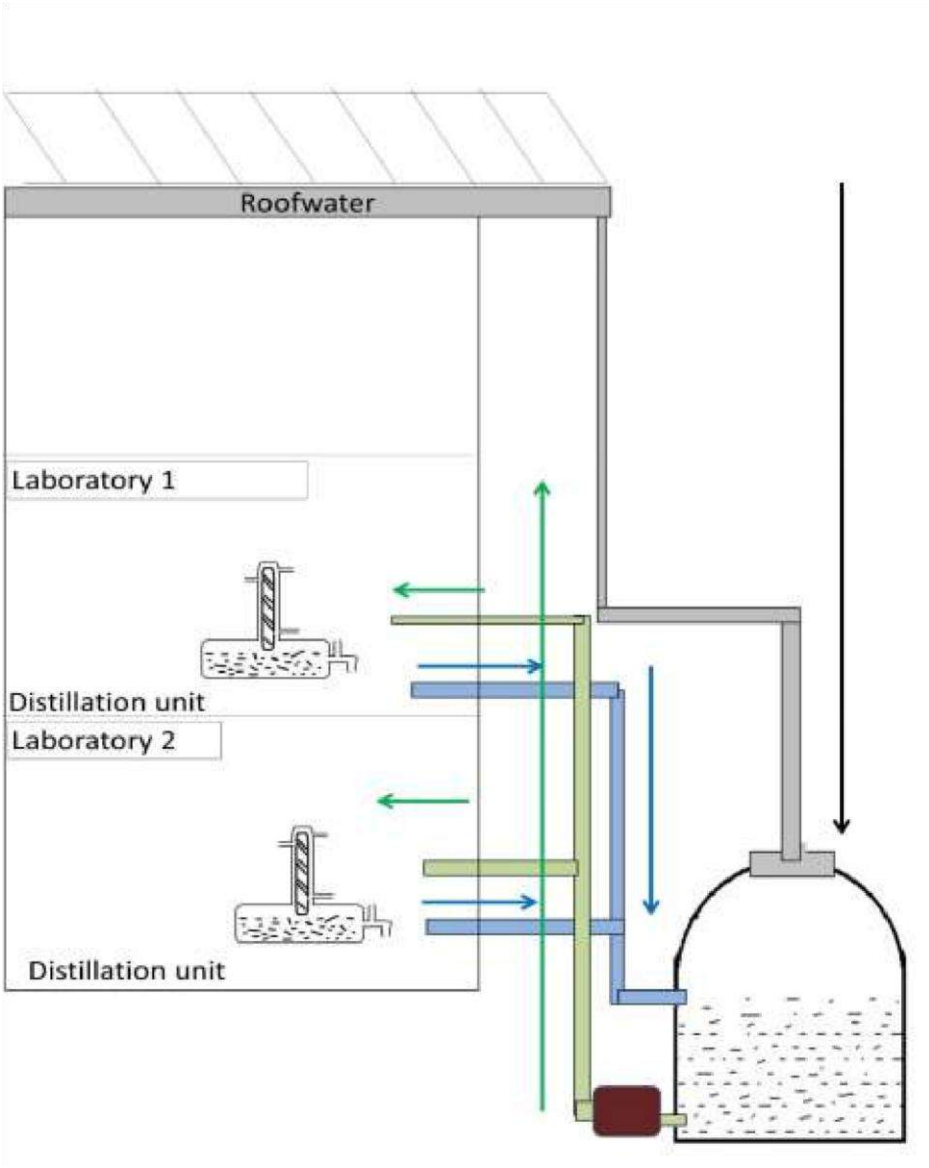


Fig. 4.12 Schematic diagram of water harvesting and its utilisation

Energy management

The energy audit recommends avoiding using more energy-consuming electrical appliances and replacing them with more environment-friendly and energy-efficient appliances (for example, five stars rated Air conditioner) in

the College. The potential of renewable energy sources has to be explored; for example, installation of solar panels for street lighting and office uses.

It is recommended to install the following solar-powered appliances on the campus;

Solar-powered street lights and LED display board

Solar powered office

Green Campus

In order to increase the carbon credit and greenery of the campus, it is recommended to plant more indigenous and evergreen/fruit trees inside the campus.

Waste Management

Try to avoid the use of plastic on the campus and encourage biodegradable materials as alternatives. Try to achieve the goal of a plastic-free campus.

Leaf litter from the campus can be effectively used for aerobic/ vermicomposting so that the composted material can also be used as good manure.

Recycle the paper waste instead of incinerating or burning.

General list of recommendation

- Indoor plants have to be kept in class rooms and long corridors.
- Planting trees in the campus is not possible due to space constraints. Hence the vertical garden will be a good practice for reducing the carbon footprint
- Green audit shall be conducted in specific intervals.
- Set up a collection centre for E-waste

- Solar panels shall be installed to generate electricity • More number of rain water harvesting tanks shall be installed.
- Follow green protocol in all the programmes.
- Conduct environmental awareness programmes for students regularly.

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