CARMEL COLLEGE

Mala, Thrissurm, 680 732 Kerala

GREEN AUDIT REPORT 2019 – '20

NGFn

Nature's Green Guardians Foundation

Trivandrum 695 043

CARMEL COLLEGE

MALA, THRISSUR
680 732 KERALA

GREEN AUDIT REPORT 2019 – '20

Nature's Green Guardians Foundation
Trivandrum 695 043

Carmel College, Mala
Thrissur, PIN 680 732 Kerala
Green Audit Report 2019-'20

Contents

Carmel College, Mala, Thrissur
Profile

Carmel College, Mala, is an institution of higher education in Mala, Thrissur, Kerala. The college was established in 1981 by the Sisters of Congregation of Mother of Carmel (CMC), guided by their founders Saint Kuriakose Elias Chavara, and Rev. Fr. Leopold Beccaro. The college is affiliated to the University of Calicut and re-accredited by NAAC with A Grade.

The College currently has 1,574 girls (in 2019-'20) as students under the 28 programmes offered. The faculty strength is 106, supported by 37 non-teaching staff. Total campus population is 1,717 persons (which can be around 1,750 including the day visitors).

Carmel College in Mala has been established with the objectives of:

a. promoting the total development of the young woman in her uniqueness;
b. liberating her from economic dependency by inculcating in her a proper work culture;
c. instilling in her, a desire to attain excellence;
d. helping her to think in a clear, fearless, and independent manner;
e. equipping her to see and apply knowledge so as to find solutions to human problems;
f. making her conscious of her social obligations;
g. moulding her to be an agent of peace, harmony, and universal brotherhood;
h. sensitize her on the social, ethical, and cultural values; and
i. help radiate true light through love.

On the whole, the aim of setting up Carmel College in such a green and serene atmosphere is to uplift the weak and downtrodden sections of society, especially the rural women, so as to liberate them from the shackles of several unelaborated bondages.

Students are encouraged to join NSS, NCC, Socio-economic interventions, Eco-clubs, Sports and Games teams, and all other possible group activities, as well as for humanitarian campaigns and projects.

Rooftop Rainwater Harvesting, Biogas plant, and appropriate waste disposal steps, are implemented following a pragmatic practice of an 'environment and sustainability policy', for building excellence in education for the young women of the near-coastal rural outlying areas of Thrissur district.

Carmel College, Mala, Thrissur

Vision and Mission

Motto

Light and Love

The motto symbolizes the ideal for which the Mala Carmel college stands.
Blessed Virgin Mary, chosen by God to bring forth the light of the world, the morning star, from whom the benign rays emanates, is the college's source of light.
She presides over the college and bestows her light and shade on college's children.
The College in turn try to radiate this light kindled in hearts in the form of sincere love made manifest through self-less service to brethren irrespective of caste or creed.

Goal

To help young women in their pursuit of intellectual and professional excellence,
which will lead to the total formation of the human person
as much for their own enrichment as for the service of the society
and the nation in the spirit of Christ

Vision

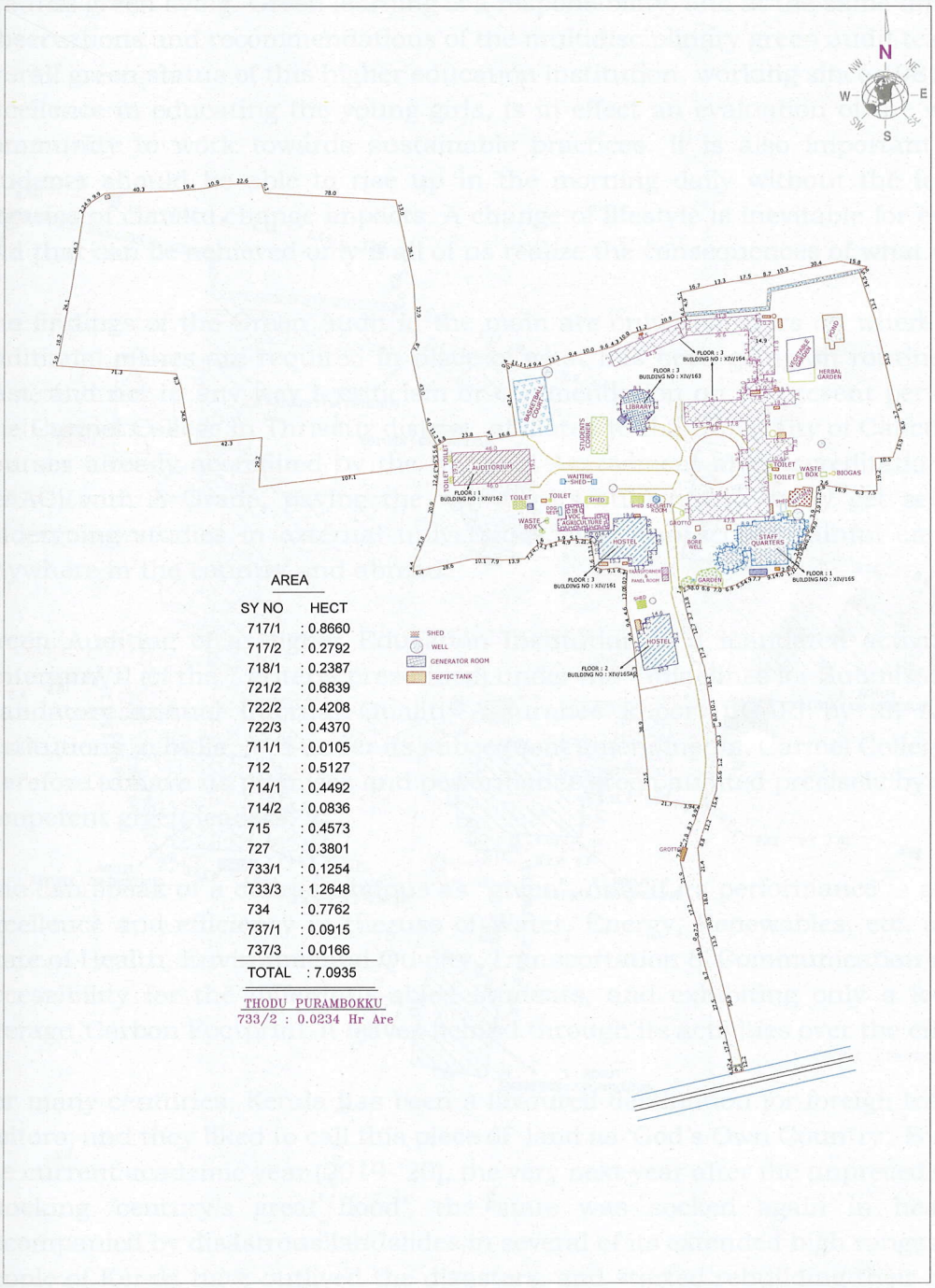
Uplift the weak and downtrodden sections of society, especially the rural woman
so as to liberate her from the shackles of bondage to
a new world of light and love

Mission

Dedicated to the cause of empowering rural women with knowledge,
inculcating in them the spirit of selfless love and compassion,
spreading peace in the society,
living in harmony with nature, and
illuminating the world to eternity.

Carmel College, Mala, Thrissur, Kerala

Layout of Buildings

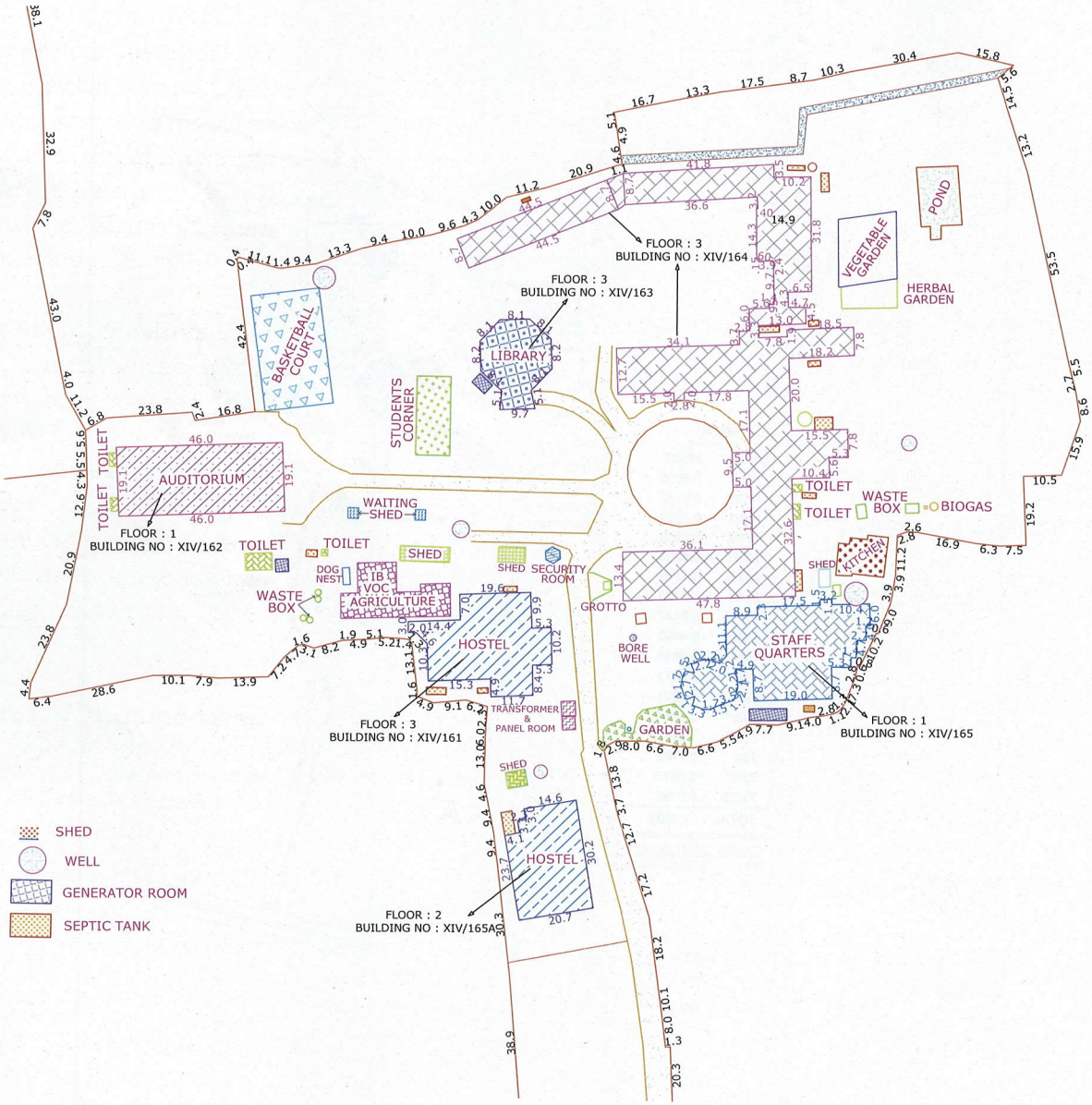


AREA

SY NO	HECT
717/1	: 0.8660
717/2	: 0.2792
718/1	: 0.2387
721/2	: 0.6839
722/2	: 0.4208
722/3	: 0.4370
711/1	: 0.0105
712	: 0.5127
714/1	: 0.4492
714/2	: 0.0836
715	: 0.4573
727	: 0.3801
733/1	: 0.1254
733/3	: 1.2648
734	: 0.7762
737/1	: 0.0915
737/3	: 0.0166
TOTAL	: 7.0935

THODU PURAMBOKKU
733/2 : 0.0234 Hr Are

Carmel, Mala: Activity Areas in Detail



Executive Summary

This Report of Green Audit of the campus of Carmel College, Mala, Thrissur district, Kerala, is prepared in a format that will be easily understood by the students, as they are the most important among the stakeholders of the institution. Their appreciation of the facts appraised in this report will go a long way in our Nation moving fast towards green living. Green learning is a responsibility, and at the same time a right. Observations and recommendations of the multidisciplinary green audit team on the overall green status of this higher education institution, working since 1981 towards excellence in educating the young girls, is in effect an evaluation of the will of the community to work towards sustainable practices. It is also important that the students should be able to rise up in the morning daily without the fear of the vagaries of climate change impacts. A change of lifestyle is inevitable for everybody, and that can be achieved only if all of us realize the consequences of what we do.

The findings of the Green Audit in the main are only indicators on where and why additional efforts are required in place of what has been going on routinely in the past, and not in any way a criticism or commendation on its present performance. The Carmel College in Thrissur district, affiliated to the University of Calicut, has its courses already accredited by the National Assessment and Accreditation Council (NAAC) with A Grade, paving the way for its students to easily get selected for undergoing studies in external universities, and also secure gainful employment anywhere in the country and abroad.

Green Auditing of a Higher Education Institution is a mandated activity as per Criterion VII (of the 7 criteria prescribed) under the 'Guidelines for Submission' of the mandatory annual Internal Quality Assurance Report (IQAR) by all Accredited Institutions in India, and under its subsequent amendments. Carmel College decided therefore to have its premises and performance green audited precisely by a team of competent green leaders.

One can speak of a college campus as "green", only if its performance is attuned to excellence and efficiency in the use of Water, Energy, Renewables, etc. and in its State of Health, Environmental Quality, Transportation & Communication as well as accessibility for the differently-abled students, and exhibiting only a lower than average 'Carbon Footprint' it leaves behind through its activities over the entire year.

For many centuries, Kerala has been a favoured destination for foreign traders and visitors, and they liked to call this piece of land as 'God's Own Country'. But, during the current academic year (2019-'20), the very next year after the unprecedented and shocking 'century's great flood', the state was socked again in heavy rains accompanied by disastrous landslides in several of its extended high ranges. Yet, the people of Kerala have outlived the disasters, and started rebuilding their homeland 'better and greener'. The youth here are now doubly convinced that they are required to join this 'building back better' as responsible future citizens. No curriculum of

studies in the past had covered the causes and remedies of the problems they had to face during the recent years.

Therefore, students need to master the methods of analysing such situations objectively and act jointly for solving them. Students also realise that Green Audit is the way to grapple with such scenarios. Green Audit is considered by NAAC as a useful tool to know how and where an institution is using the most of energy, water, and other resources. The audited education institution can thus plan for the needed changes to ensure sustainable use of resources. As environmental sustainability is an increasingly important issue for Kerala, the role of higher education institutions in helping to ensure ecological balance is emphasized more than ever.

The Green Audit process for Carmel College during 2019-'20 therefore, involved the getting together of environment conscious student groups in the form of Nature Club, Eco Club, and Green Guardians, and evaluating their own work for the year for areas other than their study subjects. An audit team with teachers and a team of experts who have practiced greening for years (including certified and accredited energy and environmental auditors and ecological administrators) through the Nature's Green Guardians Foundation (NGGFn) worked for its successful completion.

The results showed that, through the commitment of the management, teachers, and the students, for the maintenance of a healthy environment in Carmel College, Mala, Thrissur, the per capita carbon footprint during 2019-'20 is only at a very low level i.e., 0.079 T CO_2 eq., compared to the national average of 1.9 T CO_2eq [of 2020]. Deliberate efforts have been made to conserve the green resources, and even nurture them to grow further. The Audit has made a number of observations in the respective chapters on component audits, and under the section on Future Directions, to help the Management, the Staff and the Students in their plans for making the college premises greener than others in the district, and ultimately as the best in the State.

Prof. V K Damodaran
Chairman, NGGFn
Former (Founder) Director of S&T and Environment Department &
Former (Founder) Director of Energy Management Centre-Kerala
And Former Secretary to Govt. of Kerala (Ex-Officio)
International Energy & Environment Expert/ Ex-Consultant to UNIDO & UNEP
Trivandrum, 695 035. Dated: 03.08.2020

The Green Audit Team for Carmel College, Mala, Thrissur [2019 -'20]

Dr Licy A D, *Principal*
Dr Sr Kochuthressia K P, *Vice Principal*
Ms Linda P Joseph, *NAAC Coordinator*
Dr Sr Rini Raphael, *IQAC Coordinator*
Ms Riya Jose, *Faculty, Dept.*
Sr Jasmi Jose, *Administration Dept.*

V K Damodaran, *Chairman, NGGFn*
K Madhukrishnan, *CEO, Herbal Heritage Homes*
Sabu T, *Program Director, CED*
A M Narayanan, *Ex-Head, Energy Efficiency, EMC*
Hari Prabhakaran P S, *ISO 14001 Lead Auditor*
Ramkamal Manoj, *Managing Trustee, Chakshumathi*
Ranjini Damodaran, *Monitor, Accessibility & Gender issues*
C Jayaraman, *Editor, Energy Manager (International Journal)*

Carmel College, Mala
Environment and Sustainability Policy

The Carmel College, Mala, in a campus blanketed in greenery, expects every one of its stakeholders to uphold its policy to 'Stay Green', through their participation in the implementation of its well-perceived practices that are sustainable and nature conserving.

It is the prime intent of the Carmel College to, imbibe in its students and staff a sense of value and ecological consciousness, inculcate the spirit of enthusiastic participation in all its efforts to nurture the nature, and build an ecological team so that they may actively partake in the eco-friendly considerations and engagements promoted by the institution.

In particular:

1. Frame and implement policies and viable practices, in line with those of central and state governments, involving prevention of pollution and reduction of wastes that will ensure the sustainability of environment.
2. Communicate proactively with stakeholders on the institution's policy regarding environment and sustainable practices, so as to secure their wholehearted participation.
3. Act with practical measures to preserve the biodiversity in the campus.
4. Execute environment and energy initiatives systematically through green audit, energy audit, biodiversity audit, and such other assessment tools.
5. Implement energy conservation measures and expand the use of alternative sources of energy, including the installation and maintenance of solar panels, biogas plants, and energy efficient equipment.
6. Harvest rainwater effectively for storage and recharging of land and water bodies in the campus.
7. Ensure measures for minimizing and managing the proper disposal of all forms of wastes - solid, liquid and E-wastes.
8. Abide by the principle of 'Carmel Green Protocol' in the use of products and services.
9. Engineer all measures to maximize the utilization of renewable resources and minimize the use of hazardous substances.
10. Ensure observance of national and international days related to environment, and help foster environmental commitment among stakeholders through enlightening seminars, workshops, demonstrations and other deliberations.
11. Go paperless through substitution of electronic and other means in academic and administrative activities.
12. Restrict the use of motor vehicles within the campus.
13. Actualize all measures to recycle waste water, conserve water bodies, and protect wetlands within the campus.
14. Construct and maintain tanks and bunds, as needed, for ecological enrichment of the college campus.
15. Initiate and actualize community engagements for promotion and expansion of sustainable ecological niches, through extension activities and outreach programs involving the students, staff and the community.

Green Audit 2019 – '20: Procedures and Priorities

To impart higher education for the women of the predominantly rural area of Mala, in Thrissur, and lift them to a level of empowerment, the Carmel College was established in 1981. It has been working ever since towards excellence in teaching and learning, and making the campus greener than its surroundings. In order to identify and highlight the shade of green that this College has been able to elevate itself to, in addition to the green initiatives it had held always, during the academic year 2019-'20 Carmel decided to have a detailed green audit of the campus.

The college management and the PTA are committed to keep the premises as a "Green Campus", and is contributing towards environmental conservation and sustainable development. The college administration works on several facets of the philosophy behind "Green Campus" - including Water and Energy Conservation, Tree Plantation, Waste Management, Mapping of Biodiversity, Community Outreach, etc.

Towards Detailed Green Auditing

Maximizing performance efficiency through conservation and adopting a route of minimalist approach in all sectors of activities are the broad objectives of the management. This 'green auditing' is done for the period from 01 July 2019 to 30 June 2020, even though the COVID-19 pandemic disrupted the decades-old routines of teaching and learning towards the end of the academic year – i.e., from March 2020.

The stakeholders of this temple of learning are expected to ensure the following:

a) Enhancement and coordination among various activities of the institution with importance given to ecological considerations and resources conservation;
b) Institutionalizing all good practices initiated as part of accreditation;
c) Driving a strong decision-making approach on the basis of 'life cycle cost' analysis on institutional issues; and
d) Acceptance of a dynamic system for functional and lifestyle changes by the institution's stakeholders including the students.

The Green Audit for the year was organised with abundant precautions, and by informing and involving all stakeholders in the functioning of the college, including the PTA. The Procedures and Priorities followed are:

Procedures:

1. Apart from the efficient use of energy, leading to substantial reduction in carbon footprint of the institution, the scope of renewable energy integration is also aimed at for compensating for the unavoidable imprints.

2. The procedure for Green auditing adopted by the team is to collect basic data on the components of green audit, by the Green Guardians, refining them by the Faculty and Mentors, and showcase achievements - through photographs, where possible.
3. Set up feasible goals for the year ahead, and help to go up in steps.
4. In the end, convey the message to the community associated with the college, through its adopted villages, the students' homes etc. to bring about desirable changes in lifestyles, wherever possible.

Priorities:

While all the listed green audit components are equally important, priority for the current audit was set on:

1. Evaluating the compliance potential of the stakeholders
2. Examining in detail the reduction in carbon footprint possible in at least three major areas that emerge as the main emitters
3. Convincing the management on investment required, as well as the return on investment that is possible through 'Life Cycle Cost' analysis
4. Assessing the momentum gathered on student initiatives towards making the campus greener, a trend that is existing already in the institution.

Carmel College, Mala: Programmes during 2019-'20

I	Doctoral (Ph. D.) Programme
1	Ph. D. (Botany)
II	Post Graduate (PG) Programme
1	M A History
2	M A Sociology
3	M A English
4	M Sc Botany
5	M Sc Mathematics
6	M Sc Chemistry
7	M Com Commerce
8	M Com Commerce – 2
III a	Undergraduate Programmes – B Sc
1	B Sc Applied Physics
2	B Sc Mathematics
3	B Sc Botany
4	B Sc Chemistry
5	B Sc Zoology
III b	Under Graduate Programmes – B Com
1	B Com Computer Applications
2	B Com Finance
III c	Under Graduate Prog [BA, BBA, BCA, BVoc)
1	B BA Bachelor of Business Administration
2	B CA Bachelor of Computer Applications
3	B A Bachelor of Functional English
4	B A Bachelor of Sociology
5	B A Bachelor of History
6	B A Bachelor of Political Science
7	B Voc Bachelor of Software Development
8	B Voc Bachelor of Multimedia
9	B Voc Bachelor of Fashion Technology
10	B Voc Bachelor of Accounting and Taxation
11	B Voc Bachelor of Banking Financial Service and Insurance
12	B Voc Bachelor of Agriculture

Carmel Campus Population in AY: 2019-'20

Category	Male	Fem5ale	Total
Students	0	1,574	1,574
Teaching Staff	3	103	106
Non-teaching Staff	3	34	37
Total for the Year 2019-'20	**6**	**1,711**	**1,717**

Component Audits

1. Audit on Green Campus Initiatives

1.1. Campus Trespass Restrictions

Carmel College campus on the side of the Annamanada – Mala Pallippuram road, in Mala Panchayath of Thrissur district is accessible easily by road (better internal connectivity) from the Mala Private Buses Station, which is only 1.2 km away. Buses from different directions are available very frequently, and they all stop near the College gate. The nearest railway station is Chalakudy, at a distance of 13 km, though Thrissur (TCR) is an important and more popular station in the region.

The staff and students who arrive in own vehicles or by bus, use the main gate facing the College road. There are two other gates facing public road for entering and exiting the campus. The gates are guarded and entry is possible only after verification by the security staff. The students are in uniform, and the staff and students use photo ID tags to make it is easy for detecting any unlikely trespass. All outside vehicles will have to be parked at an assigned parking location. Nobody is allowed, particularly outsiders, to wander inside the campus or drive motor vehicles.

The Audit team could experience the strict restriction on entry and the careful attention on casual visitors, as proof of the security of the campus. At no occasion could any trespass, noisy conversation, or movement of vehicles along the normally quiet campus roads be seen.

Students of course, under normal conditions gather in groups under the several trees and mingle with their friends as well as relax in cool shade.

1.2. Use of Bicycles and EVs

The Carmel Mala campus being away from the highways and busy rail terminals, almost 90% percent of students prefer to use road transport (buses) that stop right in front of the college gate. Only 78 students from nearby homes walk to the college for their studies during the year; sixty-one students use 48 scooters in single or shared mode and arrive for their studies; and only less than 10, mostly staff, use own cars. Not many use bicycles. Kerala being of high population density, and since many roads are without continuous, wide enough, and obstacle free footpath or cycle tracks, it is unsafe to opt for walking or cycling. Only 172 occupants are there in the hostels. Within the campus, during working hours, staff and students walk the distance from building to building for change of activities, hostel to college, as well as between the places of activity. Electric vehicles (EVs) are yet not popular among the staff and students, but the situation is likely to change soon.

1.3. Pedestrian Friendly Pathways

The Carmel campus is a silent and serene community of knowledge seekers. Not much distance to go, in any direction to approach any department, or college office. The different blocks are in multi-storeyed buildings, and academic work go on undisturbed, even if guests and visitors, or students of other classes, happen to pass by. The walkways are broad enough for groups of students at the same time to move in both directions without any strain.

Main Block

The Audit found the campus as very safe, green, and hassle-free to move around, especially for the girls. Motor vehicle movements are not allowed within the campus.

1.4. Plastic Free Campus

The Carmel College has a clear policy, to shun all wastes and particularly, the use of plastics in any form, as the institution is in perfect alignment with the government 'green protocol'. Audit found that the students keep up their pledge of banishing plastics in letter and spirit. Avoidance of plastics is targeted for all activities including making of bouquets for invited guests. More than that, the students are very particular of carrying this culture into their own home surroundings, and being girls, they insist that their families also follow the same. Kerala Government has since 2016, restricted the use of plastics very strictly, and this initiative of students in eradicating plastic menace and combating climate change impacts, duly supporting the 'Rebuild Kerala' initiative of the Government (after August 2018) is actually going smooth.

Carmel girls send the message of freedom from plastic pollution even to the outside world through several cleaning campaigns over the year.

The Audit team could not find plastics strewn around anywhere in the campus during audit visits. Since there is a working policy for disposal or re-use of wastes, the personal plastic wastes generation is found to be nil. This is a good model. They also try to avoid using plastic body for ball point pens in their day to day class room writing. Attempts are made to create paper jacketed ball point pens for distribution among the newly admitted students.

1.5. Landscaping and Gardening

'Nurturing the Nature' is a motto, the Carmel students imbibe on being admitted to the college and on reading the environment policy to be followed in the campus. The college surroundings, the link roads and open areas, playgrounds, farm and gardens are all full of trees and plants of great variety. Many short walkways are left without blacktopping, mainly because the college wants rain water to be absorbed by the soil so as to help in the survival efforts of perennial trees and plants. Students realize these aims through their joint activities.

Open land is open for demonstrating what they preach

Nature Nurture

2. Audit on
Green Cover, Energy, Water & Environment

2.1. Green Cover (Biodiversity) Audit

The Carmel College in Mala has the benefit of being in an area where biodiversity could flourish even without any special care. The main stakeholders viz., the students however, are very much conscious of the need to create and maintain green surroundings for the entire campus with their efforts. Therefore, they have built up a number of islands of greenery within the Carmel campus. The management is also very particular about further steps for greening of the campus.

The Carmel College has a strong department of Botany, and with its support, trees in the campus are surveyed, and work on a biodiversity register is initiated, with their botanic name, common name, and the local name in vernacular entered - for all the students to know more about those plants. The College is collaborating with other institutions in the region for botanical exploration. This activity is proposed to be expanded. See also Table 2.1.1.

For the normal biodiversity survey, the bigger trees are measured at breast height and tree data entered in a register. This activity has been started with the students taking trial in their own homes first, with the support of other family members. Then they tried it with trees in the college campus. During 2019, as AGB (Above Ground Biomass), 578 trees under 73 species of girth above 10 cm are taken into record after survey by the Green Guardians/volunteers (See table 2.1.2.).

Discovery of New Species, Re-discovery, and New Reporting
Contribution by Dr Sinjumol Thomas of Botany Dept. (2017-'20)

SI No	Name	New Species/ New Report	Publication Date/Year
1	*Hedychium forrestii Diels*	New Report	Nov 2017
2	*Hedychium spicatum*	New Report	Nov 2017
3	*Impatiens josephia*	New species	19 Jan 2018
4	*Impatiens saulierea*	New species	19 Jan 2018
5	*Strobilanthes andersonii*	Rediscovery	Sept 2018
6	*Strobilanthes orbiculate*	New species	12 Sept 2018
7	*Begonia keralensis*	New species	Nov 2019
8	*Strobilanthes mullayanagiriensis*	New species	01 Feb 2019
9	*Strobilanthes bislei*	New species	01 Feb 2019
10	*Strobilanthes tricostata*	New species	01 Aug 2019
11	*Strobilanthes carmelensis*	New species	25 Oct 2019
12	*Impatiens periyarensis*	New species	09 Sept 2020
13	*Impatiens aliciae*	Rediscovery	09 Sept 2020
14	*Strobilanthes bourdillonii*	New species	18 Nov 2020
15	*Endopogon versicolor*	Reinstatement	01 Jan 2020
16	*Strobilanthes scopulicola*	New species	04 Mar 2020

Table 2.1.1: Involvement of Researchers from Carmel College, Mala

The next attractive task to attempt will be a faunal survey of the campus. It will be a difficult task.

Very patient waiting is required to spot or sight certain species of birds or burrowing animals. Sometimes, only in the early morning hours can a keen observer spot them. But, spotting them is a source of immense pleasure for the team members.

Unhurt and Untrodden 'greenscape' in Carmel campus >

Observations and Suggestions:

1. An attempt be made to plant a micro forest patch according to the Japanese technique (or the Miyawaki method of Afforestation) in a suitable patch. Through this, a high level of biodiversity could be developed. Even though initial cost is a bit high, Miyawaki forest does not require any care after the 3rd year. Fastest growth rate and self-sustenance are the notable merits of Miyawaki forests [Due to Prof. Akira Miyawaki, Emeritus Professor (aged 92) at the Yokohama State University, Japan].

Table 2.1.2.
Biodiversity – Flora in Carmel, Mala Campus

Sl No.	Vernacular name	Botanical name	Total No.	Girth Total
1	Plavu	*Artocarpus heterophyllus*	19	
2	Maavu	*Mangifera indica*	68	
3	Manja Vaaka	*Delonix regia*	1	
4	Sapota	*Manilkara zapota*	13	
5	Njaval	*Syszygium jambolanum*	3	
6	Rambutan	*Nephelium lappaceum*	7	
7	Thanni	*Terminalia bellirica*	1	
8	Mangostin	*Garcinia mangostana*	4	
9	Litchi	*Litchi chinensis*	1	
10	Diwi Diwi	*Libidibia coriaria*	3	
11	Arana	*Polyalthia Iongifolia*	62	
12	Poomaram	*Delonix regia*	3	
13	Kudampuli	*Garcinia gummi-gutta*	2	
14	Aami	*Prosopis cineraria*	1	
15	Vatta	*Macaranga peltate*	19	
16	Kasumavu	*Anacardium occidentale*	3	
17	Pappaya	*Carica papaya*	3	
18	Aryaveppu	*Azadirachta indica*	4	
19	Irimbanpuli	*Averrhoa bilimbi*	4	
20	Guava	*Psidium guajava*	10	
21	Loobikka	*Flacourtia jangomas*	3	
22	Kadachakka	*Artocarpus A Itil is*	19	
23	Kariveppu	*Murraya koenigii*	2	
24	Mahagani	*Swietenia macroph*	8	
25	Mathalam	*Punica Granatum*	1	
26	Silver tree	*Graviella Robusta*	1	
27	Badam	*Terminalia catappa*	3	
28	Ilanji	*Mimusops elengi*	2	
29	Bambloos naranga	*Citrus maxima*	4	
30	Moringa	*Moringa oleifera*	1	
31	Seethaphal tree	*Annona squamosa*	2	
32	Nelli tree	*Phyllanthus emblica*	8	
33	Athimaram	*Ficus racemose*	2	
34	Peanut tree	*Sterculia quadrifida*	1	
35	Arinellikka	*Phyllanthus acidus*	3	
36	Kasumanga Chamba	*Syzygium jambos*	1	

Table 2.1.2: Biodiversity – Flora in Carmel, Mala Campus (Contd...)

Sl No.	Vernacular name	Botanical name	Total No.	Girth Total
37	Chembakam	*Magnolia champaca*	1	
38	Ayini	*Artocarpus hirsutus*	1	
39	Pulimaram	*Tamarindus indica*	3	
40	Ung maram	*Vernicia fordii*	3	
41	Maruthu	*Terminalia paniculate*	9	
42	Kanikonna	*Cassia fistula*	2	
43	Bamboo tree	*Bambusabambos/ vulgaris*	1	
44	Accasia	*Vachellia nilotica*	4	
45	Choondapana	*Caryota urens*	1	
46	Gandhapala	*Wrightia tinctorial*	2	
47	Asokam	*Saraca asoca*	1	
48	Teak tree	*Tectona grandis*	20	
49	Pana maram	*Borassus flabel l i fer*	3	
50	Kattadi	*Casuarina equisetifolia*	1	
51	Rudraksha tree	*Elaeocarpus ganitrus*	1	
52	Churuli	*Diplazium esculentum*	4	
53	Thondi	*Sterculia balanghas*	1	
54	Marotti	*Hydnocarpus pentad ra*	1	
55	Aaval	*Holptelea integrifolia*	1	
56	Bodhi tree	*Ficus religiosa*	4	
57	Atha	*Annona reticulala*	3	
58	Jambakka	*Syzygium samarangensc*	6	
59	Jambakka	*Syzygium malaccense*	1	
60	Mandaram	*Bauhinia racemose*	1	
61	Neermaruthu	*Terminalia arjuna*	1	
62	Oarila	*Caesalpinia sappan*	1	
63	Manimaruthu	*Lagerstroemaia reginae*	1	
64	Pista	*Pistacia vera*	1	
65	Karuka	*Cynodon dactylon*	3	
66	Kunthirikkam	*Boswellia glabra*	2	
67	Sheemapuli	*Averrhoa bilimbi*	1	
68	Poomurukku	*Erythrina variegata (?)*	1	
69	Kalisu		17	
70	Kudampuli	*Garcinia gummigutta*	3	
71	Ambazham	*Spondias mombin*	1	
72	Coconut tree	*Cocos nucifera*	94	
73	Arecanut	*Areca catechu*	85	

New Species of flowering plant discovered: *Strobilanthes scopulicola*
Credit: 04 Mar 2020, Dr. Sinjumol Thomas, Botany Dept., Carmel-Mala

Observations & Suggestions Contd.

2. As Kerala is a fast urbanizing State in India, students may be encouraged to strengthen the nature conservation awareness programs with the local governments, and help them to build resiliency for our people against climate change.
3. In view of the existing greenery, the College may try to add attractive specialized gardens such as Butterfly garden, *Nakshatra Vanam,* etc. in addition to the Herbal garden and Fruit garden they have already built.
4. Girth measurement according to standard procedure (ABH) may be continued and the biodiversity (Flora) register entries completed during the coming two years.
5. In the biodiversity register, adding stamp size photographs of each species present in the campus, may be considered an attraction for the visiting school children.
6. Similar Biodiversity register for the Fauna in the campus also may be prepared, and the absence and presence of some species may be discussed by the students in the presence of their teachers. This could be a positive step to decide on what measures are required for improving the richness of biodiversity in the Carmel campus.

2.2.1. Energy Audit

Energy Audit is a very useful activity through which every student and every family will immediately appreciate the fact that, it is easy, at the same time profitable, to go for conservation - and also minimise the production of wastes. The major sources of carbon footprint (CF) – an indicator of ecological performance - in an educational institution, are electricity and other energy forms, transportation modes, as well as the wastes generated. During the current year's green audit, the data pertaining to electricity, transportation, and wastes were monitored to see how much 'conservation conscious' are the stakeholders in the Carmel campus in Mala.

Electrical energy consumption takes place during normal, peak, and off-peak times (for tariff purposes) differently in different areas within the campus. When electricity availed at 11 kV voltage level, the consumer is charged according to the 3 time of the day (TOD) rates. But, if the power supply is supplied in the campus at medium voltage (MV) – as the Carmel College case is seen – it will consist of monthly or bi-monthly billing for power at 415 Volt, 3 phase; and 240 Volt single phase connections extended to each building or a set of buildings directly by the KSEB Limited.

Cons. No. >	..522	..521	..911	Total	Fixed charge	Energy charge	Other charges	Charges Total Rs.
June 2019	866		19	885	3,360	7,794	809	11,963
July 2019	1,540		36	1,576	3,360	13,860	3,168	20,388
August 2019	1,852	2,060	41	3,953	6,526	31,088	4,640	42,254
September 2019	1,340		39	1,379	3,920	12,060	1,236	17,216
October 2019	2,292	2,033	38	4,363	6,800	34,861	3,545	45,206
November 2019	1,948		42	1,990	3,920	17,532	1,783	23,235
December 2019	2,676	2,815	37	5,528	3,920	43,789	4,438	52,147
January 2020	1,792		37	1,829	3,920	16,128	1,643	21,691
February 2020	2,162	2,068	39	4,269	5,360	33,934	3,453	42,747
March 2020	2,584		37	2,621	3,920	23,402	2,355	29,677
April 2020	978	1,038	DL	2,016	5,528	15,531	3,042	24,101
May 2020	978	930	DL	1,908	4,830	14,835	1,522	21,187
Total	**21,008**	**10,944**	**365**	**32,317**	**55,364**	**264,814**	**31,634**	**351,812**

Table 2.2.1: Data on Electrical Energy Consumption and Charges Paid

The energy charge is on an average, about Rs. 33,000 per month. The fixed charges are roughly 16% of it. As per data presented before the audit, consumption details to examine the possibility of shifting certain types of consumption to other times of the day, or to make other improvements are not available. Nor are power factor values for the consumption available. A College with large number of computers with UPS devices in the circuit, needs to be analysed more precisely through a detailed energy audit to find out the power quality aspects, as well as to examine whether the Power Purchase Agreement with the Utility company is due for revision. The extent of power failures and its frequency (the reliability aspect) is also to be examined. The College is advised to go for a detailed energy audit to optimise the power utilization and also to find the extent of renewable energy penetration possible in the campus.

Observations and Suggestions:

1. It is suggested that a detailed energy audit with electrical safety audit is done for the Carmel campus to evaluate the system and consider economic opportunities through efficiency enhancement, and at the same time to bring the carbon footprint to the minimum. Through newer technologies and products, the energy charges may be brought down considerably. Any investment needed can generally be recouped within a very short period.
2. The College may organize a Workshop on 'Electricity in Carmel' to learn new ways of efficient energy use, and examine the feasibility of shifting the 'duty time' of water pumping, etc. as also for making appropriate changes to maximize energy efficiency.

2.2.1. Energy Efficiency Improvement

In any energy application area, the most attractive opportunity in the path of greening through energy management is the avoidance of incandescent bulbs and replacement of ordinary fluorescent tubes. The institution has reported completion of replacement of lamps with LED devices. Reduction in Carbon Footprint will arise due to electrical energy being saved by using LED lamps. Assuming 6 hrs per day of use, and 250 days in a year, the energy cost savings (at a cost of Rs. 5.00 per kWh) will be (36 W x 6 h x 250 d) divided by 1000 and multiplied by Rs. 5. That is, Rs. 270 in a year from one tube light alone. Such a tube can now be purchased at a cost of Rs. 250. That is 'money back' in even less than one year. Assuming a minimum of 5 years life for the tube, the net profit from each replaced tube is over Rs. 1,000 (4 times) for an investment of Rs. 250. Good quality tubes may last much longer than 5 years. It will be an illuminating exercise for the students to learn how much energy charges could the college save due to the use of better technology and compare it with the investment required and learn about the Life Cycle Cost approach. Students can very well plan to save on energy charges for their bfanilies.

Observations and suggestions for improvement of energy use pattern in the campus are as follows:

1. In the case of major equipment, the strategy of physical isolation – i.e., removing the plugs from the plug base (socket) – when not in use should be adopted, and this should be made known to the operators and other staff through noticeable stickers on or near such equipment in the laboratories and workshop. This will help first, in improving safety to the users and the equipment, and next in reducing what is called as 'Phantom load' (consumption of a small amount of energy, even while not using it, if remaining switched on).
2. Prepare a Maintenance schedule for switchboards and distribution boards, and exhibit them for all stakeholders to voluntarily follow them.
3. Arrange to keep Log Books for recording energy consumption, extent of power failures, and running of standby generator etc. (Format in Table 2.2.1.2). These shall be periodically inspected by a designated member of teaching staff.

4. Install Energy Meters for sub-units (different institutions, hostels, auditorium, laboratories, canteen etc.) for monitoring and managing the monthly energy consumption in those buildings/divisions.

2.2.2. Renewable Energy Use Audit

The natural calamities like Okhi & 2018 floods, and viral diseases like Nipa & H1N1 gave us a louder alarm on the grave consequences of the causes leading to climate change, resulting from excessive warming of the globe when compared to the situation at the time the industrialisation started (around 1850). The excessive Global Warming was undoubtedly on account of the trapped greenhouse gases in our atmosphere. And these gases, the major portion of it to the extent of 70-80% due to CO_2 are primarily owing to the increased use of fossil fuels for energy generation, for motive power, lighting, and for other industrial uses. Therefore, global warming can only be halted through reduced use of energy from fossil fuels such as coal, oil and natural gas. But limiting the energy use will go contrary to the efforts to develop and raise the wellbeing of the people. Yet, it is possible to improve our wellbeing through increased energy efficiency and increased generation of power and energy through non-fossil or renewable sources such as wind, sunshine, water, biomass, and the like.

Also, starting from 2011, the cost of Solar Photovoltaic lighting systems has been coming down, and it has almost reached a level where Solar PV projects can even be a business proposal. It is only natural that through its Green Campus Initiative, any education institution in India will be able to identify opportunities for developing locally feasible renewable energy (RE) sources, and for using them within its own premises, in view of the mounting climate change pressures.

	Type of RE	No. of Units	Size of Unit	Energy Output	% Total	Incurred Cost Rs.
1	Solar Energy (SPV)	12	3.6 kW	16 kWh (units) of electricity	6.4%	5,00,000
2	Biomass Energy (Biogas Plant)	2	Both of 1 m^3	Both produces 568 MJ/Month	40%	35,000
					50%	75,000

Table 2.2.2.1: Status of existing RE installations

Simple systems for converting slaughter-house wastes to energy thro' High Performance (2-stage) Biogas technology.

Can be turned to electricity as well. Storage in 3-ply balloons.

Photos from a small town nearby to Nairobi, Kenya, East Africa. Courtesy: UNIDO

Table 2.2.1.2

(Model Format): Record of Power Interruptions in the Campus

Time: (Hour & Minute); Generator or Solar source connected; Remarks

Date	Time failed	Time restored	Gen Start	Gen Stop	Remarks/ Reason

Observations and Suggestions:

1. With the specific objective of embracing increased use of renewable energy, and taking advantage of this window of opportunity, the proposal of Carmel college to go for a Roof Top Solar PV program exclusively for use within the campus and partly wipe off its energy-based carbon footprints, and bring down the energy bills considerably is endorsed.

1	Solar Panel (SPV System)	Cost Rs. 22,00,000	Annual Savings Exp. Rs. 6,42,400	27,000 kWh/yr (20 kW)	On the roof of Academic Block	To be used in the college itself.

2. As such, during the audit year, Carmel has used the renewable energy systems installed in a limited way in the most effective manner inside the campus.
3. The present capacity of the biogas digesters which are introduced are based on arbitrary factors. A detailed study on wet wastes and supplements available in the hostels and college academic area has to be conducted to find out the extractable quantity of biogas energy. In terms of application potential, the most judicious use of it either in the form of 'heat' as replacement to LPG, or as electricity, should be decided. Accordingly, a single (or two) large unit/s with 'high performance' features should be designed, waste feed channels, and multiple chambers should also be appropriately constructed to have a continuous stream of 'biogas' supply introduced.

2.2.3. Cooking Energy

In the Hostels and Canteen of all colleges, generally, cooking energy needs are met through the use of either Liquified Petroleum Gas (LPG), or firewood or combinations of both of these. LPG commercial type (19 kg) cylinders are used for most of cooking. However, to make use of the available biomass in the form of firewood is used for meeting rice cooking energy needs and a part of it is being purchased. The total firewood used this way in the two hostels come to about 18 to 20 Tonnes a year. If there is availability of large volume of dry biomass through local natural generation, the possibility of using 'biomass gasification' for making available a 'high heat' source may be explored. Other fuels that are used in the campus are shown in Table 2.2.3.1.

Other Fuels Used

1. LPG

No. and type of LPG Cylinders used during the year in different places							
(19 kg Cylinder) Canteen		(19 kg Cylinder) Hostel		(19 kg Cylinder) Laboratory		(specify) Other places	
Commercial	Domestic	Commercial	Domestic	Commercial	Domestic	Commercial	Domestic
0	0	48	0	0	0	0	0

2. Wood

Wood used/year in different places					
Canteen for cooking	kg	Hostel For cooking	kg	(specify) Place/Purpose	Kg
--	kg	19,000	kg	--	

3. Kerosene

Kerosene used/day in different places					
(specify) Place/Purpose	Litre	(specify) Place/Purpose	Litre	(specify) Place/Purpose	Litre
--		--		--	

4. Biogas

Biogas used/day in different places					
Canteen for Cooking	Cum	Hostel For Cooking	Cum	Heating Water Place/Purpose	Hours/ Cum
		2 Biogas plants	2 m^3		1 plant

Table 2.2.3.1.: Energy sourced from sources other than electricity

The College may attempt to maintain a Table of Connected loads in the campus, including in the hostel/s, for future audit - to critically assess the energy scene. [Sample below:]

SI.No:	Equipment	Unit	Number & Details
1	Ceiling fan	No:	
2.	LED Bulb	No:	
3.	Tube lamp	No:	
4	Motor (Water Pump)	No:	

2.3. Water Audit

Kerala state on the whole is 'Green' and 'God's Own'. Average annual rainfall for Kerala is 3000 mm. Adequate and uninterrupted water supply for drinking, personal use, agriculture, and animal husbandry is however, uncertain nowadays, in several districts of Kerala, especially in the northern. Water conservation is hence a major essential activity that should be pursued as part of greening initiatives in Kerala. But, on the ground, many people including good many students in several districts, cannot imagine the prospect of a water shortage even after several calamities have struck the State severely in the recent times.

Globally, The Alliance for Water Stewardship, Carbon Disclosure Project (CDP), Ceres, The Nature Conservancy, Water Footprint Network (WFN), World Resources Institute (WRI), WWF, and the Water Mandate Secretariat jointly conducted an exercise in 2013 to make the public familiarised with three terms: Water Scarcity, Water Stress, and Water Risk. Though these terms may sound similar, technically they are to be used to indicate different water availability situations.

"*Water Scarcity*" refers to the volumetric lack of water supply. This is generally calculated as a ratio of human water consumption to the available water supply in a given area. Water scarcity is an "*objective reality*" that can be measured with accuracy across regions and over a time scale.

"*Water Stress*" refers to the ability, or lack thereof, to meet human and ecological demands for water. Compared to scarcity, "*water stress*" is a broader concept. It considers several physical aspects related to water resources, including water scarcity, but also water quality, environmental flows, and the accessibility of water.

"*Water Risk*" refers to the probability of a difficult water-related event. Water risk is felt differently by any sector of society and the organizations or families within them. So, it is defined and interpreted differently, even when we experience the same degree of water scarcity or water stress. Many water-related conditions, such as water scarcity, pollution, poor governance, inadequate infrastructure, climate change, and others, create *risk* for many different sectors and organizations simultaneously.

We often hear of 'water stressed' regions where 'extra care' is required for discouraging the methods of wasteful water use by adults as well as children, farmers and others. As of 2019, according to World Resources Institute (WRI), the extremely high water-stress experiencing countries are - in order of their ranking - Qatar, Israel, Lebanon, Iran, Jordan, Libya, Kuwait, Saudi Arabia, Eritrea, UAE, San Marino, Bahrain, India (13th), Pakistan, Turkmenistan, Oman, and Botswana. It is in these 17 nations that nearly 1.7 billion (22%) of the world's population reside, with India housing the lion's share (1.37 billion or18%). *So, India is also at risk.*

The annoying conclusion is that these 17 countries could experience the biggest economic losses from climate-related water scarcity – up to 14% of GDP by 2050 - and as many as 3.5 billion people could experience water scarcity by 2025.

It is in this context that the 'water audit' of 2019-'20 of Carmel College, Mala, in Thrissur district, is assuming importance. The average annual rainfall in Thrissur district is 2500 mm (both SW and NE monsoon together), and the annual average temperature ranges from 23 to 36 deg. C.

The Carmel College campus in Mala of Thrissur, the higher education institution being audited, has 4 open wells, 2 bore wells (only one in use at present), and a few open ponds, and three water tanks (one in the hostel) of total storage capacity of 50,000 L (15,000+20,000+15,000) in use. The college has set up elaborate arrangements to tap rain water through roof top rain water harvesting in the hostel as well as the college buildings area. These are of 25,000 L capacity each. The harvest from the academic area is used mainly in the Chemistry laboratory. The hostel harvest is used in the hostel itself. There is also provision to re-charge the ponds in the campus. These speak of the water environment in the Carmel campus in Mala. The six electric pump motors of 5 x 1.5 HP and 1 x 2 HP operate for 1.5 hours a day to provide around 70,000 LPD of water for the campus community. The entire water requirements of the 172 students in the Carmel Women's hostel and the Carmel hostel, are served from the same OH tanks.

Water Conservation awareness to the public:
Students perform at Mala private bus station
One of several outreach programmes on 'sustainable living' demos

The campus community has no need to depend on municipal/panchayat water supply. The various functionalities for which this water is utilized is assessed by the student volunteers through surveys and sample measurements taken at user end. (see table 2.3.1.) Through repeated awareness and education programmes, attempts are made to bring down the water used per capita LPD. As the proportion of hostel mates are low in comparison to the college strength, net reduction in water use can occur only slowly.

As per the survey conducted to assess the quantum of water used for flushing, utensil washing, face washing, floor washing, bathing, cooking etc., the position during the current year is as given below in Table 2.3.1. [Separate water meters are not installed in the system to measure these. Therefore, the Student Green Guardians have collected data on water use as required for the green audit of the campus through representative surveys and user point measurements.]

Toilet flushing	: 15,000 LPD
Cooking	: 14,000 LPD
Utensils Wash	: 9,000 LPD
Floor Wash	: 4,000 LPD
Gardening	: 3,000 LPD
Loss thro' pipe break	: Nil
Loss- tap leaks	: Negligible
Other points	: 7,000 LPD
Bathing/Personal cleaning	: 18,000 LPD
Total	: 70,000 LPD

Table 2.3.2: Water use according to Students' Assessment

Note: The water conservation campaign have helped the institution to save around 10% of water. Fitted flush tanks have been of low volume flushing models.

Observations and Suggestions:

1) The total water use works out to about 70 LPD for residents in the campus, and 36 LPD for day users. These levels are satisfactory, as even according to UN norms, per capita water need comes only to 50 LPD. The highest supplied in India is in Kolkata and it is only 112 LPD (in 2019) per family. However, a bit more savings can be achieved.
2) The water quality, as proved by testing at regular intervals is acceptable.
3) There is no water problem in the campus either on quality or on quantity.
4) Conservation of water through effective rainwater harvesting is considered as a helpful activity, and Carmel College could easily tap a large quantity of water through this route, in view of the large harvestable area of roof surface of its buildings. The college green policy has already taken this view.
5) Audit suggests that it will be beneficial for the college to prepare a 'needs sheet' based on the various utilization zones, and also assess the current pumping efficiency and

look for an optimized internal water supply system. Student Green Guardians, Nature Club and Eco club members together can help in conducting the needs survey, and make the Carmel water management system (for the enlarged layout plan shown in p 9-10) a replicable one for other campuses.

6) The bodily water needs of a person per day (drinking) are generally close to 2 LPD and with cooking etc. total needs may come to 16 LPD. However, other needs like bathing, washing and open-ended home needs are also to be accounted. Bureau of Indian Standards BIS 1172-1993 had set a per capita LPD of 100-150, which got revised in 1998 to 70 LPD per capita for India. With the newer flush tank capacities brought down considerably from the old 10 L/flush; recent installations like in Carmel college are in the water saving category.
7) The practice of re-using grey water for gardening as is done in many other colleges in Kerala, is acceptable and Carmel has already tried it for its fruit garden. Carmel students can very well plan for achieving self-sufficiency in its vegetable and fruits requirements. More than that, surpluses could be sold to neighboring families, branding them as "100% green".
8) Biotechnological means of using bacterial filtration and colour removal can recover waste water at very nominal cost. The Biotechnology students of Sahrdaya College of Engineering and Technology in Kodakara, in the same district, had evolved such a simple system as entry for a national Tech Top innovation contest, and won the first prize for it. The college green guardians can visit that college for seeing such innovations developed by their own sisters and brothers and use it in their community too.
9) Further, Carmel College, Mala, is advised to maintain a register for the recording of the periodical water quality tests as an abundant proof of quality assurance in the format indicated below:

(Model) Register for Water Quality Test

Date Sample taken	Tested by (Lab.)	Findings	Other reference

While College Chemistry laboratories may make very frequent routine checks, seasonal checks may be got done by any nearby Statutory Lab.

From Green to Greener

2.4. CGH – Clean, Green and Healthy – Audit

[Waste, Transportation, Health & Environmental Quality]

Colleges like Carmel, focus their attention on nurturing in the students, a healthy mind and an ethical attitude. Bodily health is not possible without a 'Healthy Planet Earth'. The health of Planet Earth, in turn is ensured only through a 'Clean, Green and Healthy' way of life by the people. Every citizen should therefore respect the laws of nature and try to lead a way of life in tune with the Nature. The Nature as we understand now is 4.5 billion years old, and the health of Nature - and its vicissitudes - have fed, as well as starved, millions of living organisms on and off, for long periods. The future citizens are, therefore, to be trained not to deviate too far from Nature's "limits of tolerance". Wasteful lifestyles create problems of wastes; pollution to the environment through transport vehicles; and in general results in the poor status of land, water, and air in terms of quality. The CGH audit is to ensure that the learning environment for the students is of the right type, and healthy; in other words 'Green'.

2.4.1. Waste Audit

As any other established higher education institution operating in Kerala, Carmel College, Mala, is continuing to dispose of its wastes in a conventional and hygienic manner. As the College has well-maintained hostels for accommodating outstation girl students, during the year 172 are in the two hostels, the nature and quantum of wastes are only of a limited pattern and quantum. There are differences in quantity of wastes generated between holidays and work days, as well as between seasons, as the lion share of students are day scholars. An average figure per person per day is however worked out by observing their activities through sample survey approach for a week by student volunteers, and inspecting the disposal area, quantifying the measured wastes, and then computing for the whole campus.

For Indian academic campuses, waste generation is calculated through empirical constants arrived at by research studies on waste generation, and these can be used as guidelines for arriving at GHG emissions from wastes. These are used in evaluating the green auditing data on wastes in the Carmel Campus as well. Summary of Data Sheets on Wastes with Auditors' Remarks is given in Table 2.4.1.1.

The wastes generated in the campus are minimised to the extent possible. What is to be processed systematically are collected and disposed of, through the local government approved channels. Wet wastes are directed from the sources itself, to reach the biogas digester plant. Energy is tapped from them as well, and fully utilised, saving on LPG charges. Garbage from activity areas and hostel rooms is another distributed source of wastes.

Sl. No.	Type of Waste Practice	Qty. kg/day	Type of Disposal	Remarks
1.	Food Waste by students & Staff	5.00	Biogas plant	Okay. Good system
2.	Food Waste: Canteen & Hostel	34.00	Biogas plant	Okay. Good system
3.	Paper Waste by Students & Staff	1.80	Sent for recycling	Okay. Good system
4.	Paper Waste Bulk: Canteen & Hostel	2.00	Panchayat Facility	Okay
5.	Water waste in kL	22.00	Gardening	Okay
6.	Plastic Waste – Individual	Nil	Nil	Good
7.	Plastic Waste – Bulk: Canteen + Hostel + Office	5.00	LSG Facility (Panchayat)	Okay
8.	Glass & other utensils: Canteen + Hostel + Office	0.02	LSG Facility	Okay
9.	Electronic Waste: Canteen + Office + Laboratories	0.05	LSG Facility	Okay

Notes: (i). *Carbon footprint calculations are in Chapter - 4; (ii). Being of small quantity, alternative solutions are not possible; (iii). Simple paper recycling, and converting them into useful or ornamental pieces are worthy examples.*

Table 2.4.1.1: Summary of Waste Audit in Carmel College, Mala

Adequate numbers of small garbage bins are provided in every room in the hostel, as well as in the academic area. Large enough waste receptacles are deployed prominently in open areas accessible by visitors too.

Observations and Suggestions:

1. Using waste paper for decorative use was tried in the past. Recently, a small-scale industry is collecting them and is converting them into reusable products. Local utilization, if attempted, cannot use the total volume. One way is to get paper pulp out of it, and to make handmade cards (with attractive colours and designs) and encourage the students to use them as Greeting Cards, Sign Boards during events, etc. Linking with entrepreneurial ventures having link with the management will be a better option for value added waste paper utilization.
2. Toilets are provided in all regions, well dispersed with running water 24x7. European and Indian toilet pans are provided – total 46. Majority is of European style – 35.
3. Being a Women's College, Napkins disposal facilities are important. Four napkin incinerators are provided, and they are directly linked to the napkin dropping facilities. The units are pollution free. However, newer arrangements for possible efficiency improvements may be explored.
4. Chemical wastes also originate from the laboratories on account of experiments and demonstration works being regularly carried out. The same sources produce glass wastes as well - on a limited scale. They are now disposed of safely. Though these are strictly not on a daily basis, the overall quantity is reduced to daily average to appreciate its impact on the nature. The system may be coordinated with other hazardous wastes and e-wastes disposal.

2.4.2. Transportation Environment Audit

For Colleges, reducing carbon footprint is a problem, as transportation and energy use related share will be the most prominent. Travel of students and employees to and from the campus has to be inexpensive and as comfortable as possible, for which public transport facilities like train and bus should be easily accessible. In the case of Carmel, the college is in Mala Panchayat, and buses are the most prominent option for daily commutation. The data on the number of people using public and private vehicles are collected by the student volunteers through a survey. Rest of the students and staff, other than scooter and car owning persons, use public transport vehicles for daily commutation. Students/ Staff coming in Own/Hired Vehicle:

1. Motor bike/scooter (single, shared) Per day
   a. No. of Motor bike/scooter : 48 (students + staff)
   b. No. of persons : 61
   c. Total km travelled/day (To and fro) : 15 km/2 wheeler
2. Auto Rickshaw
   a. No. of Auto Rickshaw used : Nil
   b. No. of Students :
   c. Total km travelled/day (one way) :
3. Own Car (single, shared)
   a. No. of Own cars : 9 (shared: 6)
   b. No. of persons : 22
   c. Total km travelled/day (To and fro) : 42 km to and fro/car
4. Shared Taxi Car
   a. No. of Taxi cars : Nil
   b. No. of Students & Visitors :
   c. Total km travelled/day (To and fro) :
5. Private Van/Mini Bus/Bus
   a. No. of Autos – material transport : Nil
   b. No. of Students :
   c. Total km travelled/day (To and fro) : 0
6. Public Transportation (Bus & Train)
   a. No. of students : 570 + 453; 27,780 km
   b. Total km travelled/day (To and fro) : <20 km + <90km (to & fro)
7. Students Cycling to College
   a. No. of students : 1
   b. Average km travelled by person/day : 1
8. Students Walking to College
   a. No. of Students : 78
   b. Average km travelled by person/day : 1.5 km/pax (to and fro)

Educational Institution Vehicles Operated during the Academic Year 2019-20

Car/Bus Nos.	Average No. of Persons per trip	Total distance travelled during the Year (km)	Fuel Consumed (Litre)
Car: 1	--	900 km	60 L
Bus: 0		--	Nil

The emission calculation is made based on available data from test running: 2.3 kg CO_2/litre (petrol); 2.68 kg CO_2/litre (diesel) [DEFRA 2016]

Table 2.4.2.1: Transportation data for Ansar College, Perumpilavu

The predominant mode of transportation for college students in Kerala is bus or train. In limited cases, they travel by bicycle or even may walk. Buses use diesel having heavy carbon footprint, in other words contribute to the generation of greenhouse gases (GHGs) generally referred to as carbon emissions (in the form of CO_2, Methane, Sulphur compounds, Nitrogen oxides etc.) and the total impacts are heavy. This has a direct bearing on the Global Warming and the consequent Climate Change (CC) effects. The purpose of Green Auditing is to make every stakeholder understand the extent of damage each person inflicts on earth and the atmosphere. Accurate assessment of such environmental damages is a time consuming exercise.

At the UN Framework Convention on Climate Change (UNFCCC-21) in December 2015, India too had committed to bring down our country's Carbon Foot Print on the global environment. Every Indian – be it a student, teacher, or parent, or anybody else not connected with it directly, should know how much burden each one is inflicting on the environment, and try to bring such impacts to 'near zero' through all possible remedial actions. 'Simple living' and 'Greener travel' generally help in keeping a low carbon footprint profile.

Emission of climate changing gases through transport system – both public and private – is very high in India, and India stands third in respect to GHG emitting resource utilization globally. India is also at the 6th place in the 'after industrialization accumulated emissions' [170 years starting from 1850]. But, if we take per capita emissions, India is not a heavy polluter – it stands at 10th position only, and the quantum is less than one-third of the world average. For assessing the carbon footprint due to transportation related to the functioning of the College, the following specific details were also gathered by student volunteers through the survey.

Sl. No.	Details: Type	No. of Vehicles	No. of Staff/ Students	Total km/day to & fro
1.	Motor bike/Scooter (Single/Shared)	48 (13 shared)	61	15 km/scooter
2.	Auto Rickshaw used	Nil		
3.	Own Car (Single/Shared)	3+6 shared	22	42 km/car
4.	Car - Visitors/Parents	Nil		
5.	Private Van/Mini Bus	Nil		
6.	Public Transport/Bus, Train	--	570+453	<10 km; <90 km
7.	Cycling to College	1	1	1
8.	Walking to College	--	78	1.5 km/pax
9.	Material Transport: Autos Canteen, Office etc/day	Nil		

Table 2.4.2.2: Summary of the Mode of Transportation for Students and Staff of College

The following additional assumptions are used for a rapid evaluation of the trend in transportation related carbon footprint:

1. Parents and occasional visitors generally use public transport; own car or taxi used only in a limited way.
2. Within the campus, students do walk regularly, and since all buildings are close to each other, inside the campus ordinarily there is no need to use vehicles.
3. Among the public transport (bus) users, there are private-bus or public-bus service users.
4. The management allows the hostellers to choose their own mode of travel for occasional family visits, as most of them are children of parents working abroad. This appears to be not a critical component of carbon footprint in the case of Carmel, Mala.

Observations & Suggestions:

1. Audit appreciate the accurate survey and detailed data gathering on the mode of commutation, with the name of user and registration number of the vehicles being used. This practice may be continued in the coming years also. However, the distance range of bus users may be re-classified into 2 or 3 ranges close to the clusters identified: [Within 10 km (221 pax.), <20 km (352), 20-25 km (99) & <88 km (354)].
2. The distance range of cars and scooters used by staff and students for commuting daily is studied with great precision. Vehicle sharing option is practiced by most of the two-wheeler users.
3. Awareness on the merit of using e-vehicles may be propagated more vigorously.
4. Every motor vehicle user should be reminded to plant additional tree/s within any greening exercise inside or outside the college campus, or at their own homes.

Circle of Yellow and Green

2.4.3. Health Audit

The main purpose of greening of educational campuses is to ensure that the students are able to live and learn in a healthy environment for contributing their best of physical and intellectual capabilities to the society.

The method adopted by NGGFn for assessing the physical well-being of the educational institution in Green Auditing is as follows:

1. Examine the prevalence of major 'sick leave' cases, if there are any;
2. Examine the first aid and medical facilities available for resident students and staff as well as for others during working hours;
3. Evaluate the atmospheric quality for adequacy, drainage systems for fast evacuation of liquids, and the extent of land pollution, if any in the campus; and
4. Assess the active involvement and achievements of students in arts, sports and games, especially in inter-collegiate and inter-university contests - as these are indications of their healthy mind and body.

Observations on these aspects in respect of Carmel College, Mala, for 2019-'20 are:

Sick leave: No major sick leave cases are reported. No wonder, Kerala is known for its low mortality and high morbidity status in comparison to the national health status in India. This is because most mothers are educated, and so even a minor headache is promptly taken care of at least at the nearest primary health centre, or a government or private clinic/hospital.

It is also true that most of the Colleges are not maintaining separate sick leave register for students. However, it is felt that the present day students are not as 'strong' as girls of the past. The reason appears to be that, the present girls are too 'figure-conscious', and therefore they eat less only. In addition, their fascination for fast-foods and addiction to mobile phones and social media use also tend to create health problems. Common cold and minor flu usually affect some of them at least for a few days every year, and these interrupt their undivided attention to lecture classes and laboratory practical. Notwithstanding these, Audit found that their participation in cultural and social activities are high. Carmel girls were very active in NCC, NSS and environment related activities during the audit year in addition to cultural and sports and games.

Sick Room: There is 'First-Aid' facility in the campus to give the students the needed immediate care. There is also separate sick room facility. There is arrangement for annual medical check-up for every student and it is organised every year.

Medical facilities: In addition, the Mala Govt. Hospital close by, opposite to the College, 650 m away, is having adequate facilities for attending to any treatment that may be needed for the students.

Those who need medical assistance according to other systems of medicine are free to have such consultation and treatment – for which facilities are available, for Homeopathy, the Ideal Homoepathy Clinic within 1.0 km; and for Ayurveda, the Kandamkulathy Ayurvedic Hospital in Valiyaparambu within 1.9 km are easily accessible for the Carmel College community. Transportation facilities are offered free for any emergency medical consultations for the students. Counselling facilities and Individual Mentoring facilities are also available for every student in Carmel.

Sports & Games facilities:

Even as a college for women, with about 90% of the students commuting daily between home and college, regular sports and games participation as well as contestant achievements by the students are very high. The table as well as photos given within this Section of this Report are proof that this emphasis in the College policy.

No:	Competition	Type	Students
	National		
1	Football	Team	Nikhila T
2	Ball Badminton	Team	Ronish R; Athulya K V
3	All India Inter Univ. Archery Championship, Bhubaneshwar, Odisha	Team	Jesna K J
4	All India Inter Univ. Ball Badminton tournament	Team	Suryalakshmi M P
5	South Zone Ball Badminton Championship, Mangalore		Menu Thomas
6	All India Inter Univ. Ball Badminton Championship, Bhilai, Chattisgarh	Team	Menu Thomas
7	Federation Cup Ball Badminton Championship, Andhra Pradesh	Team	Menu Thomas
8	Senior National Ball Badminton Championship	Individual	Menu Thomas
9	All India University Ball Badminton Championship	Team	Rosna Prince
	State		
1	Archery	Team	Deepthi R
2	Ball Badminton	Team	Lidya K X; Ronish R
3	State Senior Ball Badminton Intercollegiate Championship, TVM	Team	Rosna Prince
4	Calicut University Inter Zonal Foot ball	Team	Swathy Krishna S G Linsa Jacob Nisari K Ashiy Y M

Table 2.4.3.1 & 2: Participation of Carmel girls in National and State Sports Contests

No:	Competition	Type	Students
	University		
1	Taekwondo Korugi	Individual	Deepthi R; Mugdha N N
2	Archery	Individual	Sreelakshmi V
3	Archery	Team	Telmamol M J
4	Ball Badminton	Team	Christeena Joseph; Lidya K X; Mugdha N N; Sandra A M; Ronish R; Anitta Joy
5	Foot Ball	Team	Krishna Priya A T; Athulya K V; Anju A T K; Anjaly T
6	Intercollegiate Archery Championship, Pulpally, Wayanad	Individual Team	Jesna K J; Jesna K J
7	Calicut University Ball Badminton Inter Zonal	Team	Rosna Prince
8	Taekwondo	Individual	Shameema V

Table 2.4.3.3: Participation of Carmel girls in University level Sports Contests

Fitness Centre at Carmel College, Mala

Observations and Suggestions:

Having tried to offer all facilities for students to participate in several women's competitions in sports and games, to enable the girls to grow up healthy and emotionally strong, College may consider - in view of the vast land area available - the possibility of training the girls in brisk walking, bicycling, and other health giving, less strenuous sports and games. End result: All girls should participate in at least light sports item.

Medals of Honour for Carmel Girls

ദക്ഷിണ മേഖലാ ഫുട്ബോൾ: കാലിക്കറ്റ് റണ്ണേഴ്സ്അപ്

The names have gone all over the nation;
Fame has returned to hometown – Felicitation by the Media too
(picks from many)

2.4.4. Environmental Quality Overview

The environmental quality of Carmel College in Mala, which has no space constraints, and having the natural environment maintained well is in general, good. The Principal, members of teaching staff, students, and the Parent Teacher Association, as well as the responsive management is very much enthusiastic in conserving the nature, in sticking on to moderation in consumption, and in appropriately reusing and recycling materials wherever possible. This may be due to the following factors:

1. When it was decided to start the college in 1981, the ethical sights set were synonymous with environmentally sound surroundings which is conducive to the shaping of young women having exemplary character.
2. The college has from its beginning been very frugal in using electricity and the per capita consumption of energy is relatively low.
3. The same 'conservation of resources' concept has been followed in the case of water use as well. Available ground water sources are exploited at sustainable level and purchase of water supply from outside source is not resorted to. Rainwater harvesting is done enthusiastically. Opportunities to enhance these positives do exist.
4. The 2018 'Great Floods, and landslides and excess rains of 2019 in Kerala did not inconvenience the campus; instead, it could help those who were affected in multifarious ways utilizing the youth power and resources of the College.
5. On the whole, the Carmel Campus is seen to possess a good environmental quality conducive to serious learning by the young girls.

Look for Roots, Work on Nature Protection, and Reap Eco-Benefits

2.5. Audit on Societal Commitment, Outreach & Promoting Green

The students in higher education institutions should keep their eyes and ears keenly focused on problems faced by the people from time to time, and also envisage programmes and projects for solving them through the sustainable development route. In almost every country, efforts for economic development has been contributing to large scale decline in species diversity – pointing to a not too distant, dangerous, and fatal to the survivability of this planet itself.

The "Intergovernmental Science Policy Platform on Biodiversity and Ecosystem Services" (IPBES) – a committee similar to IPCC on Climate Change – had its 7th session in Paris in 2018 with 132 nations attending, and the findings of it in its 1500-page Report is more frightening than the IPCC Reports and its dire warnings.

IPBES studied 15,000 research papers and government reports that have come out during the past 50 years on the biodiversity status and has concluded that the global biomass with mammals have declined 82% over this period (rapid decline from 1970). Further, the natural ecosystems have declined by 47%, and the species threatened with extinction have reached 25%. 145 experts and 310 content authors from 50 countries had a three years' study on these aspects before coming out with this report.

In India, we have always believed in bringing out the best from our college students through outreach, social service, volunteering, and taking leadership roles. The IPBES Report (2018) actually underlines the focus of UGC and NAAC on assessing how best the higher education institutions are moulding the adolescent population into planners and leaders who would reverse the trend of suicidal slide into early doom of the living planet.

At Carmel, such commitments are met by the students through: 1) Activities under NSS, as well as NCC, and 2) by maintaining the campus in tune with the natural environment through eco-clubs and greening initiatives.

2.5.1. Expression of Societal Commitment

Carmel College has been doing good with social work, under the banner of National Service Scheme. College also encourages students to participate in activities of Nature Club, Eco club, Green Guardians Corps, Arts Club, etc. Community interaction programmes are also planned department-wise. Such activities are coordinated by one or more members of the staff and by active student volunteers.

NSS, NCC and Other Activities

Social Service activities include: Protection of the Elderly, Post-flood care of habitats etc., Blood Donation camp, Waste Management Training, Environment related activities, and Tree planting. The activities of 2019-'20, in spite of loss of study days due to natural calamities covered the following, but not limited to these only:

a. Zero Waste Campus
b. Green Guardians Club
c. Planting of Tree Saplings
d. Flood Relief
e. Jackfruit Day
f. World Environment Day
g. World Blood Donation Day
h. Annual Blood Donation Camp
i. Teachers' Day; Republic Day; Gandhi Jayanthi;
j. World Environment Day
k. Energy Conservation Day

In connection with the World Environment day on 5th June 2019, 400 tree saplings were distributed exclusively to the students for planting in any land they had access to. The day was also celebrated by holding a special campus cleaning drive, which got extended to the surrounding roads.

Carmel College, Mala in its adopted village, Kavanad, had a special tree plantation campaign during the year. In the college campus, one group of students cultivated a vegetable garden. In yet another adopted village, Snehagiri, 10 separate vegetable gardens were created for 10 different families. The work was done jointly with the villagers.

Realizing the great nutritional and medicinal value of jack fruit which used to be not so popular in public eating, a 'jack fruit day' was observed by the student volunteers. On this day, the Principal advised the eco-conscious students to carry jack tree saplings to their own homes from the college and plant them prominently in their own homesteads. 400 trees were thus planted.

2.5.3. Promoting Green Strategies

For promoting Green strategies, several clubs and academic departments of Carmel joined hands with experts from outside, as well as with their own Faculty and started weaving a canvas of green areas pertinent to the present-day life. Even though the campus is maintained plastic free through the adopted green policy, and meticulous student volunteering is present, a comprehensive plan to exploit the green resources hidden within the campus – with all its vulnerabilities as evidenced during the 2018 floods, is yet be made. These could be based on scientific studies.

Since the campus has highly promising vegetation and tree cover, the management can consider having a Biodiversity conservation plan and its further development through a strategic plan, drawn up in consultation with either KFRI in Thrissur district or with the State Biodiversity Board. The Kerala State Council for Science, Technology sand Environment will also assist in such an effort, as well as in coordinating the efforts of all the concerned agencies.

While such innovative programmes are added, the usual activities such as encouraging the students of schools in the locality by arranged visits, have also to be developed further. This will be highly helpful for the school children to get attuned to learn about nature as well as practice voluntary environmental protection activities.

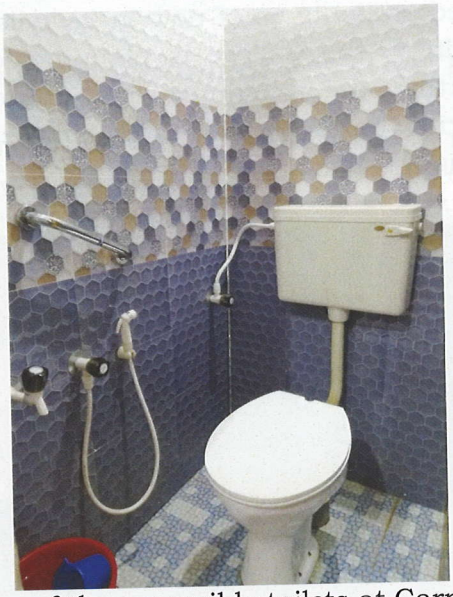
Green Skirt for the Carmel College, Mala

3. Audit on Accessibility and Gender Justice

3.1. Built Environment and Accessibility Audit

Carmel College, Mala, has during the Audit Year (2019-'20), a student strength of 1,574. Total campus strength is 1,717.

Accessibility: There are five differently-able students studying, in the college currently. Students or Staff with physical, mental or visual challenges have very special consideration in Carmel college campus. There are toilets with accessibility considerations taken into account provided for their use. These are accessible for parents and visitors, in case they need such a set up. NGGFn is planning to have an accessibility special audit by its expert to go during the coming year, once the COVID protocols are withdrawn.



One of the accessible toilets at Carmel

The buildings and their passage ways are well-built, with effortless transiting possible and the passage ways are well lit. However, certain buildings have multiple floors and the consultant is expected to advise on how to make optimal improvements, if in future such students seek admission for courses requiring the use of multiple floors. The differently-able visitors will find that the entire college campus is mostly level, and there is always extra care and consideration for them from the security guards. The main auditorium area has 5 toilets which meet with universal norms followed for public use. Carmel College with humanitarian considerations as its core concept, is envisioning expansion of such facilities required by *Divyangjan* stakeholders for the future.

Sl. No.	Type of DP	No.	Gender	Age	Course studying
1	Congenital Hemiparesis (55% disability)	1	F	20	BA Functional English
2	Cerebral Palsy	1	F	22	BA Political Science
3	Locomotor Disability	1	F	21	BCom CA
4	Locomotor Disability	1	F	19	BCom FA
5	Locomotor Disability	1	F	19	BCom CA
	Total	5			

Table 3.1.1: Differently-abled students studying in Carmel College, Mala in 2019-20

3.2. Audit on Signage and Guidance for *Divyangjan*

Differently-able persons – students and staff as well – can have the feeling of inclusiveness only if they are self-guided (of course with very exceptions) through easily understandable signage and guidance for locating and reaching the various venues, rest rooms, dining facilities, office and service areas. Carmel College has no visually challenged students as of now in its rolls, but even for the benefit of new entrants and visitors, the College is planning for proper signage and guidance implemented. Further, the assistance when needed, starts from the point of entry through the security guards and later through the Information Office, which is only 500 m from the main gate.

Ramps for independent self-navigated wheel chair entry at Carmel

Observations and Suggestions:

1. Wherever physical support is required, as well as equipment such as special wheelchairs, easy release of door locks and latches, etc. are to move independently, the toilets, ramps etc. should follow all the accessibility norms.

2. As a case in point, there shall not be doors or window leaves opening outward into the entry way of access, as it might hurt the entrant or obstruct seriously. A special workshop may be arranged during the next available opportunity on how others can contribute to an inclusive environment within a higher education institution. This could be educative on "Accessibility requirements" to the management, entire staff, and all students, if organized with a true accessibility specialist.
3. When accessibility rendered spots are not used regularly, sometimes cleaning staff and casual workers employed for small tasks may find it useful to make such open areas for stacking sparingly used tools and furniture. The Estates Officer of the college should inspect such spots in the campus with at least weekly regularity, and sign inspection slips/tags with compliance status recorded promptly.
4. Like having fire safety training, even if there has been no history of fire hazards in the past, accessibility training to all levels of employees in administration should be imparted every year to make the campus fully "divyanganjan-proof".

3.3. Audit on Introduction of Assistive Technologies

Carmel College has accessible software for access to the main library, appropriate screen readers are ready to be loaded, and it has requested for 'book share' membership to help the visually challenged readers, even if some of the potential users are 'print disabled' due to other reasons.

Observations & Suggestions:

1. For accessibility audit, accessibility/mobility training and for free assistive technology consultations, Carmel College can contact the Charitable Trust working in this area for the past 10 years, and having active R&D link with Assistech, IIT Delhi, and other national and international institutions, by name "Chakshumathi", Trivandrum 695 024 [e-mail: ramkamal@chakshumathi.com]. Contact: +91 79944 85311.

3.4 Focus on Environment in Outreach & Social Service

For healthy living, environment plays an important role. Students are made to understand that it provides all living beings with air, food, etc. It is correctly said that the difference between animals and humans is that "animals change themselves for the environment, but humans change the environment for themselves". Environment is just like our neighbourhood, its surrounding conditions influence us, and also modify growth and development.

3.5. Audit on Universal Information and Enquiry Systems

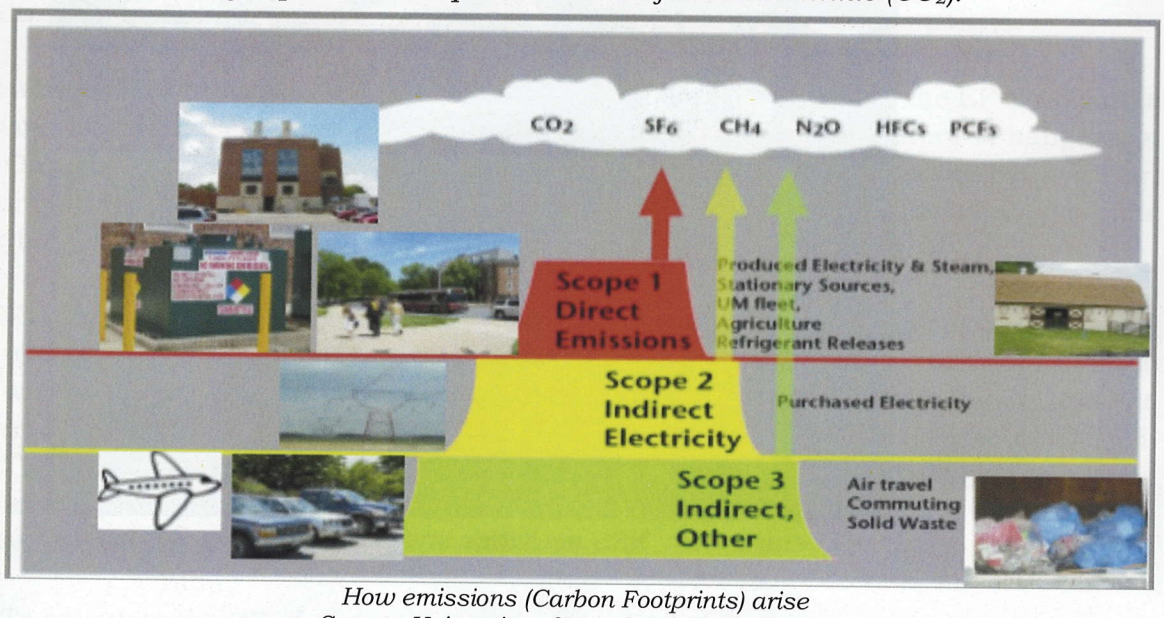
The present arrangement of first interception for any visitor, parent or student at the Carmel campus is the Information Centre, which can be directly accessed from the entrance road of 530 m length starting from the public road outside. The Information Centre in the Office Block of the College is easily accessible. With the present-day affinity to social media, the College has transferred several details required by prospective students and employees to the online platform and social media.

For increasing the number of accessible toilets, retrofits are also now available. College can source them from within India, for eg. from as near as Chennai.

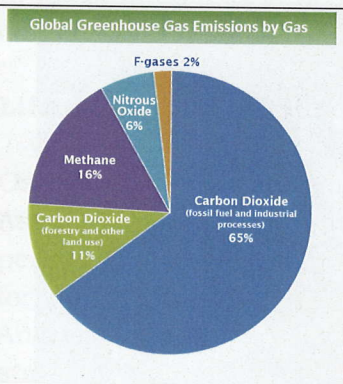
Building up strength through wise counsel

4. Carbon Footprint

Carbon Footprint is a measure of the total greenhouse gases emissions released into the atmosphere. This may result from either individual, organizational, or community based human activities. An acceptable definition is: *Carbon Footprint is the total amount of greenhouse gases produced directly and indirectly for supporting human activities, usually expressed in equivalent tons of Carbon dioxide (CO_2).*



How emissions (Carbon Footprints) arise
Source: University of Maryland Study Report



The most common greenhouse gases (GHGs) in our environment are carbon dioxide, water vapour, methane, nitrous oxide and ozone. Of all the greenhouse gases, carbon dioxide is the least harmful, but it is the most prominent GHG according to Intergovernmental Panel on Climate Change (IPCC), as it comprises 76% or more of all greenhouse gases, globally. The release of CO_2 into the earth's environment through human activities is commonly known as carbon emissions and its total impact is called 'carbon footprint' [*Source: IPCC 2014*].

The ability of earth to meet the excessive demands on resources of its population has been increasing day by day. This brings about adverse ecological impacts, which can be quantified as 'Ecological Footprints'. But, its computation is very complex and time consuming. The concept of 'Carbon Footprint' as a part of the 'Ecological Footprint' was put forward in 1990 by William E. Rees and Mathis Wackernagel.

Carbon Footprint (CF) by itself is not the complete measure of the damage to environment. The advantage of Carbon footprint approach is that it measures mainly

the emissions of gases that cause climate change, and therefore can be more accurately assessed than the ecological footprints.

Greening thro' NSS activities and Learning from Seniors

Farming by student teams – self-start; self-run

There are any number of popular software tools called 'CF calculator' for use by interested individuals and institutions for estimating the CF. Figures obtained from such tools are not very exact, but are good enough to have a comparison, or a picture of how large it is. This is in reality, more than sufficient to suggest the extent of remedy for the damages. Such software are freely available on the internet. Those who want to create awareness on the environmental problems are those who depend too much on it. The 'carbon footprint' assessment, in fact, was popularized worldwide in 2005 by British Petroleum (BP) company under one of their campaigns.

While the whole world believes now that CF is a simpler way than the EF to calculate and look at the extent of damages to environment that can happen or is happening, Christopher Weber of Carnegie Mellon University in USA, has come out with an important observation that the calculation of carbon footprints for many products that are in very common use, is certainly a "complex job".

Take for example, the smart mobile phones that has reached every nook and corner of this planet. The data required for calculating the carbon footprint of a smart phone will include CF on its: production, shipment, technology used to make it, and the number of hours we use it, as well as on what all functions of the device are utilized. Therefore, to accurately calculate the carbon footprint of a smart phone, we require too much time, energy, and resources. It is not worth the trouble and time to go for such detailed study on the CF.

To calculate the CF of an institution, industry, product, event, or service, we should first admit that it is a complex task, and the efforts towards the same should be commensurate with what we want to do with that result.

Life Cycle Assessment

One such tool for CF assessment, currently popular, is the LCA (Life Cycle Assessment) approach, which has as its base the entity's impact for the whole life period. The ISO (The International Organization for Standardization) has a standard for this in ISO 14040:2006 (with the framework for conducting an LCA study). Another method is through the Greenhouse Gas (GHG) Protocol and the set of standards it has for tracking GHG emissions.

The Carbon Footprint calculation of a college like Carmel College is to know whether or not the college activities are making excess demands on the ecology of the campus and its surroundings, and then to attempt 'remediation' through possible 'reductions in consumption' as well as 'expansion of carbon sinks' such as the greenery. The College is at liberty to choose either to go for remediation to bring the compensation to its correct level, or can try to attempt even 'excess' remediation. But, doing it either way should only be after roughly assessing the damages it is inflicting on the immediate environment. We should not be using a cannon for killing a fly.

The important stakeholders like students, staff, and the management can explore all means of reducing the 'consumption' that may result in higher emissions, increase the use of emission free energy forms, employ the 4R or 'reduce-reuse-recycle-refuse' strategy for waste management, and expand the GHG absorbing and sequestering technologies and greenery – to achieve a little more than what is 'essential' as per the findings. That will help the campus to grow greener than a 'Green Campus'.

Having noted that the tedious procedures involving continuous monitoring throughout the year to obtain a precise measure of potential damages to the environment is not warranted, this audit by NGGFn will employ only empirical measures that will quantify the ecological footprint to reasonable accuracy, and suggest simple remediation measures that will help neutralise the impacts completely. Also, take the positives even a little higher than that is required. As the major contributors of damaging impacts are the increased number of stakeholders, their nature of consumption, and the transportation modes requiring fossil fuels, the approach for this Green Audit is to use empirical constants on the quantities arrived at for the major contributors. Remediation is to depend on expanding the available positive factors.

Creating awareness to the entire campus community on these and getting them to contribute voluntarily will be an effortless change in lifestyle, on which the institution as a whole can feel contended and be proud of.

Data Obtained from Component Audits

Component Audits are in the foregoing Chapters: 1 to 3.

These component audit findings give us the following data:

1. The area covering the higher education institution/college
2. The total number of persons (students, teachers, other members of staff, visitors including parents and guests) involved in normal functioning of the institution
3. The number of people resident in the campus
4. The type and number of vehicles normally used for transportation
5. The forms and quantity of energy used in the campus and their origin
6. The amount of energy, water, food materials, stationeries etc. consumed
7. The amount of wastes including food waste and e-wastes
8. Amenities provided in the campus and their contribution to emissions

On the positive side:

1. The biodiversity in the campus and their potential to remediate emissions
2. The 'carbon positive' (renewable) energy generation within the campus
3. The amount of recycling/reuse of resources
4. The type of waste management resorted to
5. Water harvesting, water management, and waste reduction approaches

Assumptions:

The following assumptions based on well researched and globally accepted empirical procedures, are used for assessing the carbon footprint as well as for determining the remediation measures:

1. The coefficients taken are as per IPCC, International Energy Agency, India's BEE, or United Nations' FAO [in the case of food related ones] as well as from India specific studies by Research Institutions
2. The carbon emitted by a car while consuming 1 litre of petrol is taken as 2.3 kg CO_2, and of diesel as 2.68 kg CO_2
3. Average distance covered by a car per litre of petrol in cities at 10 km
4. The 'km run' by a bus as 4 km/L of diesel in towns and cities
5. For the 'per capita carbon footprint' calculation, a bus is assumed to carry 50 passengers with the kilometrage as at assumption 4
6. For an autorickshaw, the fuel need is assumed at 1 litre of fuel capable of getting 16 km of running on petrol
7. Two wheelers are expected to get 50 km/litre on Petrol
8. Carbon absorption capacity of one full-grown tree as 6.8 kg CO_2
9. Carbon absorption capacity of semi-grown trees as 50% of that of full grown
10. Carbon absorption of bush plants as varying widely according to the species. Certain bushes absorb as high as 49,000 g CO_2 per plant, whereas some others absorb as low as 150 g CO_2 per plant. As a general guide, the per-plant carbon absorption is assumed as 200 g CO_2
11. The carbon absorption capacity of a 10-sq.ft. area of lawn is 1 g CO_2 per day
12. A person uses about 550 litre of pure oxygen/day (Arbor Day Foundation)
13. Paper used is assumed to be of density 80 gsm (average)
14. Firewood is assumed to have not more than 10-20% moisture before burning
15. Contribution of Events & Festivals in the campus to CF is based on the no. of events, persons participating and extent of festivities with high emission levels

Carbon Footprint Assessment Required:

The following activity related carbon footprints are to be assessed in Table – 4.1 based on data available from component audits in the previous chapters.

1. Carbon Footprint due to energy use
   a) Electricity use including for water pumping, water purification and waste water treatment
   b) Use of Fossil fuels like Diesel, Petrol, LPG etc.
   c) Use of Firewood

2. Carbon Footprint due to production of Wastes
   a) Food Waste
   b) Paper use & Paper waste
   c) Waste water
   d) Other wastes (e-wastes, hazardous wastes etc., if any)

3. Carbon Footprint due to Transportation needs
   a) Day scholars commuting between home and college
   b) Staff & Students – weekly/quarterly travel to home and back
   c) Use of Cars & Taxis by Staff, Parents, Management and others
   d) Autorickshaws (3-wheelers) hired
   e) Bikes and Scooters (2 wheelers) – Students and Staff

4. Carbon Foot print due to Events and Festivals within the campus

Remediation Available and/or Created:

1. Due to increased use of renewable energy (RE)
   a) Solar PV electricity
   b) Solar Hot Water
   c) Wind energy
   d) Biogas
   e) Micro Hydro Power & Other

2. Due to energy efficiency improvement
   a) Replacement of old tube lights
   b) Replacement of incandescent bulbs & CFLs
   c) Replacement of Fans/Pump Motors etc.
   d) Up-grading of UPS network
   e) Phantom load reduction
   f) Other means

3. Due to waste reduction, recycling and waste to energy projects
   a) Waste Reduction
   b) Recycling
   c) Waste to Energy

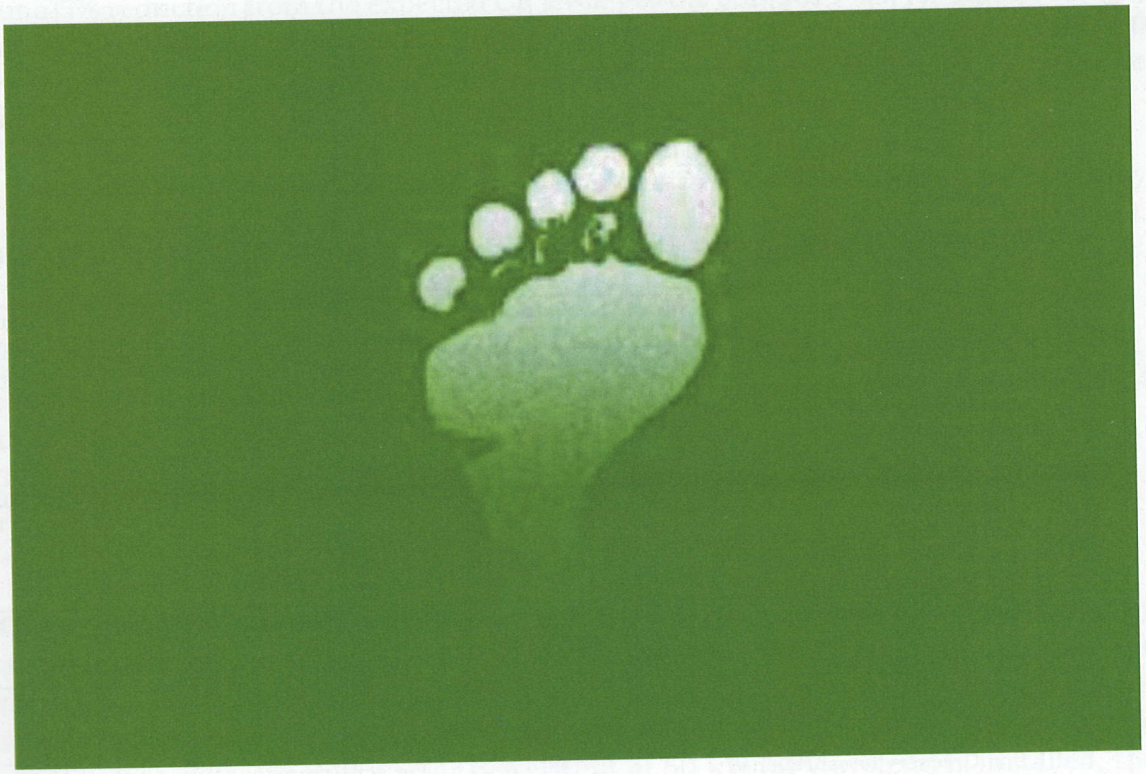
4. Due to innovations in transportation
   a) Sharing of Vehicles
   b) Adopting Means of low CF travel options
   c) Others like introduction of electric vehicles/Solar autos, boats etc.

5. Due to biologic means
   a) Conservation of existing greenery
   b) Tree plantation (new) & Biodiversity conservation
   c) Gardening, including lawns and hedges

6. Due to 'Outreach' for Promotion of Green Living

The CF calculated by the above consideration has to be brought into a Balance Sheet. Having assessed the maximum carbon footprint in terms of Ton of CO_2 equivalent, the next step is to assess the remediation available and see how far it will compensate for the damages to the environment.

The uncompensated part
will indicate the
Carbon Footprint.



Carbon Footprint Calculation for Carmel College, Mala, Thrissur for 2019-'20

Sl. No:	Source	Rate	Quantity x Days/year	Total Quantity	Annual Eqvt. CO_2
1.a	Electricity use	0.82 $kgCO_2$/kWh (India in 2018)	6.15 MWh/m x 12	73.8 MWh	60.5 T CO_2
1.b	Fossil fuel use	2.68 $kgCO_2eq$/kg 2.30 $kgCO_2eq$/kg	LPG (180 kg)		16.1 T CO_2
1.c	Firewood	1.65-1.8$kgCO_2eq$/kg	8kg x 365	3.0 T	0.5 T CO_2
2.a	Food waste	1.9 $kgCO_2eq$/kg	39 kg x 250	9.8 T	18.6 T CO_2
2.b	Paper waste	1.725$kgCO_2eq$/kg	3.8 kg x 250*	1.0 T	1.7 T CO_2
2.c	Water waste	0.298$kgCO_2eq$/kL	22 kLx250	5,500 kL	1.6 T CO_2
2.d	Plastic/Other	6.0$kgCO_2eq$/kg	5.0 kgx250	1250 kg	7.5 T CO_2
3.a	Bus/Train: Staff, Students daily travel	2.68 $kgCO_2eq$/L	[250x15]+[840x90] x250/(4x50)	9,450 L	25.3 T CO_2
3.b	Student weekly trips	2.68 $kgCO_2eq$/L	--	LS	10.0 T CO_2
3.c	Cars, Taxis	2.30 $kgCO_2eq$/L	{9x25 + 5x 33}x250/10	1,000 L	2.3 T CO_2
3.d	Auto rickshaws	2.30 $kgCO_2eq$/L	--	--	--
3.e	Two wheelers	2.30 $kgCO_2eq$/L	120x40x250/50	6,095 L	14.0 T CO_2
4	Events, Festivals	Approx.	1000x4x1.2	4,800 kg	11.0 T CO_2
5	Construction	Lump sum	--	Nil	0.0 T CO_2
	Total				**169.1 TCO_2**

**No. of activity days in a year assumed at 250.*

Table 4.1: Calculation of Carbon Footprint Source-wise

Remediation for Carbon Footprint – Carmel College, Mala for 2019 – '20

Sl. No:	Source	Rate	Quantity x Days/year	Total Quantity	Annual Eqvt. Saved CO_2
1	1.a. Solar PV electricity	0.82 $kgCO_2$/kWh	3.6 kW x12x365	15.8 MWh	13.0 T CO_2
	1.b. Solar Hot Water		Nil	--	--
	1.c. Wind energy	--	Nil	--	--
	1.d. Biogas	1.34$kgCO_2$/kg	365 x 3 x 3	3.3	4.4 T CO_2
	1.e. Micro Hydro Power, other	--	None		--
2	2.a. Replacing old tube lights		Limited	--	0.5 T CO_2
	2.b. Replacing bulbs & CFLs		"	--	1.5 T CO_2
	2.c. Replacing Fans, Motors		None	--	--
	2.d. UPS Upgrading		None	--	--
	2.e. Reduce Phantom load		Not done	--	--
3	3.a. Waste Reduction	0.26 $kgCO_2$/kL	20.0 kL/day	7,300 kL	1.9 T CO_2
	3.b. Recycling		Limited	--	--
	3.c. Waste to Energy		No other	--	--
4	4.a. Sharing of vehicles		Limited	--	--
	4.b. Low footprint options		Yes, small	--	--
	4.c. Electric/Solar vehicles		Only 2 scooters	--	--
5	5.a. Greenery forest retained	Nil	Per acre/yr.	--	--
	5.b. Tree planting, Biodiversity	22kg/yr	Limited	--	--
	5.c. Gardens, Lawns etc. (per acre)	2200 kg	LS	2.0 acre	4.4 T CO_2
6	6.Walking & bicycle use (174+14)	2.68 kg/L Avoided	79x4x250/50x4	395 kg	1.0 T CO_2
7	7. Outreach activities	22 kg/yr	600 trees	50%	6.0 T CO_2
	Total				**32.7 T CO_2**

Table 4.2: Remediation for Carbon Footprints: available/created

The International Organization for Standardization (ISO) also provides some general standards for

- *Greenhouse gas emissions at Organization level (ISO 14064 - 1) and*
- *Greenhouse gas emissions at project level (ISO 14064 – 2)*
- *Specifications to validate and verify relevant accountings are documented in (ISO 14064 - 3)*

Carmel College, Mala, Thrissur - Carbon Footprint Analysis and Evaluation

The actual per capita carbon footprint for the Carmel College, Mala, Thrissur, Kerala, is 98 kg (0.098 Ton) of CO_2 equivalent [169.1 Ton/1717 persons] *(See Table 4.1),* and a part of it (19% of it) is compensated by remedial routes adopted by the college. The net carbon footprint during 2019-'20 is thus [169.1 – 32.7 = 136.4 T CO_2 equivalent]. Therefore, effective CF for the year is 136.4/1717 or 0.079 T or 79 kg of CO_2 per capita. According to the Economic Survey of Govt. of India, the per capita emission for an Indian is 1.9 Ton $CO_{2\ eq.}$ per annum in 2020. It was projected to reach 2.0 – 2.5 T of CO_2 by 2020, and to 3.0 – 3.5 T of CO_2 by 2030 as per evaluation in 2010. In the year 2018, the actual assessed PC CF for India is 1.94 T. Our efforts for greening has luckily brought about a 5% reduction from the expected CF level. ***For the year 2019-'20, for Carmel College, Mala, Thrissur, Kerala, the Carbon Footprint per capita at 0.079 T CO_2 equivalent, is very well below levels obtaining in many other higher education institutions.*** *This* is achieved only due to the vigorous Green initiatives of its students who are the main stakeholders.

The whole CF can be wiped out by having a 50 kW solar PV roof top installation (by joining government roof top SPV scheme) and also improving the energy efficiency level.

The campus can be treated as of 'low carbon footprint' institution, with potential to achieve net-zero level.

CF Balance

The remediation gap between the assessed footprint and available remediation is 136.4 Ton CO_2 eq. for 2019-'20.

On a closer look, the major contributors are:

1. Use of Purchased Electricity (60.5 T)
2. Bus Transportation required for the students (35.3 T)

The College may consider the remediation options more seriously. Being a predominantly rural area, use of scooters/bikes are low, several students arrive walking, and the distance for the bus users is comparatively low. The campus has a high greenery content and it is further viable for development. Renewable energy development like solar roof top can make a difference. If a solar power unit of 50 kW (SPV system) is installed, the college will become carbon neutral. By that instead of a consumer status, College will become a 'Prosumer'. Electricity bill will be Nil or EBL will pay to the college for the excess power supplied to them. For the forthcoming academic year, the college can actually analyse the options available with the Life Cycle Cost approach.

Carmel Girls' Foot print – Up for celebration

5. Future Directions

The Internal Quality Assurance Cell of the educational institution can turn the observations and recommendations in this report into action points after an internal discussion according to the factors indicated as guidelines

Strengths and Weaknesses:

- Human resources : Staff, students, PTA, nearby NGOs, public
- Physical resources : Location, land, building, equipment
- Financial : Grants, projects funding, fees, and other sources
- Activities and processes : Green Protocol, programs, services rendered
- Past experiences : Learning tools, Reputation of the institution

Opportunities and Threats:

- Future trends : What is in the horizon or what is expected shortly
- The economy : Own, local, national, or other
- Funding sources : Own, donors, governments, subsidies and incentives
- Demographics : Change of players – students + staff joining & leaving
- Physical environment : Sensitivities related to locality, public & political
- Legislation : Change in government policies, rules &regulations

Points for Consideration: The college management should be given a strategic plan for making the campus greener than before and simultaneously for creating awareness among the students on the need for a determined local effort to bring down all the negatively weighing factors. For this,

- Decide on the directions that will be most effective to proceed with
- Assess possibilities and limitations for the intended change
- Identify barriers that will limit the objectives
- Find out new solutions to the problems in sight
- Re-look at plans to navigate the students and staff to get the best results

As both the internal and external environments are liable to change from time to time, it is necessary to review the scenario again - just before the implementation.

Future Directions and Search for New Opportunities are indicated in the respective chapters. The main thrust appears to be:

1. To increase the remediation by investing in roof top solar PV which is expected to give attractive returns perennially.
2. Conduct a more detailed energy audit for the entire campus
3. Prepare a detailed bio-diversity register for the campus
4. Conduct a survey of transportation needs and how they are met, to be of help to prepare a sustainable commutation policy through the most modern approaches, with the possibility of increased presence of Electric Vehicles.

CARMEL COLLEGE

Mala, Thrissurm, 680 732 Kerala

GREEN AUDIT REPORT 2019 – '20

Nature's Green Guardians Foundation
Trivandrum 695 043