File Ref.No.84872/IQAC-SO/2021/Admn

UNIVERSITY OF CALICUT

Abstract

IQAC- Reports of the Committees constituted for conducting Environmental Audit, Carbon Foot Print ,Green Audit and Gender Audit -Approved for implementation - Orders issued.

IQAC

U.O.No. 4315/2022/Admn Dated, Calicut University.P.O, 15.02.2022

Read:-1.U.O.No. 7841/2021/Admn Dated, 10.08.2021.
2.U.O.No. 8036/2021/Admn Dated 13.08.2021.
3.Orders of the Hon'ble Vice-Chancellor in the file of even No. Dated 09-02-2022.

ORDER

1. As per paper read as (1) above, a Committee has been constituted for conducting Environmental Audit, Carbon Foot Print and Green Audit of University of Calicut with Prof. C C Harilal, Head, Dept. of Environmental Science, as its Convenor. Similarly, Smt. Layana Aanand, Assistant Professor, Centre for Women's Studies has been entrusted with the conduct of Gender Audit in the campus vide paper read as (2).

2. Prof. C C Harilal, Head, Dept. of Environmental Science, has submitted the Audit Reports on Environmental Audit, Carbon Foot Print and Green Audit of University of Calicut and Smt. Layana Aanand, Assistant Professor, Centre for Women's Studies, has submitted the Audit Report on Gender Audit in the University for approval and implementation.

3. Considering the matter in detail, the Hon'ble Vice Chancellor, vide paper read (3) above, has accorded sanction to approve and implement the following Audit Reports in the University of Calicut.

1.Environmental Audit Report

2.Report on Carbon Foot Print

3.Green Audit Report

4.Gender Audit Report

Orders are issued accordingly.

Sabu V.V

Assistant Registrar

To

1. Prof. C C Harilal, Head, Dept. of Environmental Science
2. Smt. Layana Aanand, Assistant Professor, Centre for Women's Studies

Copy to : PS to VC/PA to PC/P to R/SF/DF/FC

Forwarded / By Order

Section Officer

UNIVERSITY OF CALICUT

GREEN AUDIT REPORT
(2020-2021)

INTERNAL QUALITY ASSURANCE CELL
UNIVERSITY OF CALICUT
October 2021

UNIVERSITY OF CALICUT

GREEN AUDIT REPORT

2020-2021

INTERNAL QUALITY ASSURANCE CELL

UNIVERSITY OF CALICUT

GREEN AUDIT REPORT

CALICUT UNIVERSITY CAMPUS

(2020-2021)

Convener
Dr. C.C. Harilal
Professor
Division of Environmental Sciences
Department of Botany, University of Calicut
&
Coordinator, Department of Environmental Sciences,
University of Calicut

Committee members
Dr. Rathy. M.C. (Assistant Professor, Department of EVS)

Dr. T.R. Shanthi (Assistant Professor, Department of EVS) Mrs.

Ms. Shamili V.K. (Assistant Professor, Department of EVS)

Thanks to all the students of M.Sc. Environmental Sciences of the University of Calicut (2020 and 2021 admissions) for their help in data collection

This report has been prepared as per UO. No. 133086/IQAC-ASST1/2021/Admn (II), dated 12/08/2021, of the University of Calicut. The statements and conclusions drawn in the present report are the outcomes of an evaluation undertaken by the team for a specific purpose and in no way forms a policy / legal document of the University of Calicut or its authorities.

EXECUTIVE SUMMARY

The built-up area in the campus is 4.812% of its total geographic extent. The per capita green space allocation is 185.37 m^2, which is fairly higher than the WHO specifications (minimum) of 9 m^2 and Urban Green Space (UGS) requirements of 50 m^2 for sustainable living. All developmental activities within the campus requires serious considerations on its natural resources for ensuring sustainability.

The terrain of the campus is highly undulating and sloping, and is indicative of its proneness to higher erosion and thereby removal of fertile topsoil. Hence it is customary to construct erosion prevention structures in high erosion prone areas of the campus, which will also attribute to ground water recharge. Moderately higher temperature and wind velocity are attributing to higher evapo-transpiration from land surfaces. This points to the need for the development / maintenance of vegetation cover for soil conservation and in overcoming the drought situations.

The water resources management of the campus needs to be streamlined as 91% of its requirements are met from outside. Also, the per capita water utilization in a day is 322.9 litres, which is higher. There are quantitative and qualitative issues associated with the water resources at Parakkadavu region of Kadalundi river, especially during summer months. As the extent of anthropogenic pressures associated with this region are many, adequate number of estate staff needs to be employed in the region for the regular clearing of bushes, hideouts and other unwanted canopy. The area has to be fenced and a security staff needs to be employed for preventing waste disposal and other anthropogenic discharges at this region.

Most of the water resources within the campus are remaining unutilized or underutilized. As the quality confining to them are better, they can be utilized in laboratories, lavatories and for irrigation purposes. It is highly suggested to have a separate water distribution system in the campus, incorporating these water resources. This will reduce the usage of treated water for irrigation and other construction purposes. This will also reduce the cost of water treatment and ensures better treatment efficiency and subsequent quality of water meant for drinking purposes.

There has to be serious concerns on rain water harvesting, both roof top and run off, with in the campus. Considering the roof characteristics and ease of construction and maintenance of allied structures like capture, collection, treatment, storage and distribution facility, rooftop rain water harvesting is proposed at strategic locations in the campus (29693.5sq m of slope roof and 21061.15sq m of flat roof), with an anticipated annual yield of 142306902.8 litres. Also, considering the landscape features and rainfall pattern, check dams are proposed at 3 strategic locations of the campus.

Utilization of hydroelectric power by the University is higher with a per capita use of 541.28KWh per year. There has to be urgent measures to minimize the use of hydroelectric power with more solar power installations. Also, there is an urgent need for awareness among the campus community to reduce the usage of hydro power as conservation and effective utilization of such clean and green sources of energy are binding on every individual, which in turn reduces the pressure on polluting sources of energy on a national perspective.

The campus does not have any initiatives of green transport. For transportation within the campus alone, 13845.6 litres of diesel and 12,012.48 litres of petrol are used annually. The use of bicycles and the grouping up of vehicles can be promoted as sustainable solutions in this direction.

The magnitude (minimum) of solid waste generation in the campus is estimated to be 557.226 kg. with a per capita release of 0.112kg/ on a working day. The segregation of waste revealed higher

extent of food refuse (57%), followed by paper (30%), plastic (11%), glass (1%) and metallic substances (1%). The reduction in the extent of waste generation from 613.896 kg./day (2016) can be attributed to the Covid imposed semi lockdown situations.

The University campus is yet to have an effective waste management system. Though the implementation of Green Protocol in the campus in 2017 has help to reduce the magnitude of waste generation, especially plastic, lack of an effective system of waste collection, segregation, processing and management is putting offices and departments in trouble, which force them to adopt methods of their choice, which are mostly unscientific. A centralized facility for the collection of segregated wastes from the offices and departments by the University will overcome the burden of individual offices / departments from processing their wastes unscientifically. Adequate manpower and infrastructure (including vehicles) under a House Keeping Department can be arranged by the University in this regard. There can be a central waste processing unit in the campus with incineration, compost, biogas and recycling facilities set at strategic locations. Quarters and other residential areas are to be empowered to manage wastes, other than plastics, at their own areas using scientific means. There should also be efforts to manage the sewage generated by the hostels and canteens, scientifically.

Presently biomedical waste management is undertaken by the Health Sciences Department of the University. Similarly, management of e-waste is through the University Science Instrumentation Centre (USIC), which collects and dispose the waste to outside recognized agencies. The present system can be streamlined for better efficiency. However, with regard to chemical wastes, the University has to develop protocols for their effective disposal, apart from their collection and storage.

There is high extent of littering and waste disposal in this campus from outside. The local populace and commercial centres need to be informed of this matter through offices of local governance. Travelers are also involved in littering and waste disposal. Adequate sign boards and surveillance facility needs to be arranged by the University in this regard. There can have a greater number of properly functioning waste bins at strategic locations in the campus to control littering.

The area occupied by the buildings have increased from 4.405% to 4.812% over a period of 5 years. The vegetation cover (both dense and medium mixed type) has decreased to an extent of 0.534% over these years. The barren area also showed an increase of 1.240%. The area under Acacia plantation has decreased to an extent of 0.982%. As the built-up areas are likely to increase as part of various developmental initiatives in future, efforts are to be undertaken to bring more areas under vegetation cover. Presently barren lands contribute to 19.14% of the total area and are mostly attributed by exposed rocky and lateritic regions. More scientific approaches are required for the conversion of such areas, for which selection of species and method of planting needs to be standardized. It is equally important to control the expansion of invasive species like Acacia to conserve the growth of indigenous varieties. Acacia has recently been attributed with a wide range of ill effects, detrimental to both human health and ecology. They need to be replaced with healthy vegetation.

The carbon footprint of the entire campus for the year 2020 is estimated to be 2642.86 metric tonnes of CO2e. Also, the per capita carbon foot print is estimated to the 0.53 metric tonnes of CO2e. The present estimate is likely to attain higher values if the resource use of the people apart from office hours are worked out. The present carbon footprint per person in the campus is fairly less compared to the national average of 1.74 metric tons of CO_2 emissions per year (2020) and 15.52 metric tons of CO_2 emissions per year (2020) by the developed nations like the United States.

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OBJECTIVES OF THE GREEN AUDIT

The pace of socio-economic and infrastructure development at local, regional and global levels are contributing to several environmental impacts. It is becoming essential even for educational institutions to review their processes periodically for ensuring sustainability in the utilization of natural resources and managing waste materials effectively. The National Assessment and Accreditation Council (NAAC) has made it mandatory that all Higher Educational Institutions should evaluate their processes and activities and to prepare a Green Audit Report on a periodic time interval. Apart from this, it has turned to be part of Corporate Social Responsibility of all Higher Educational Institutions to ensure that their contribution to global warming is minimized through reduced Carbon Footprints. Therefore, the objective of the present green audit is to identify, quantify, describe and prioritize framework of Environment Sustainability in Calicut University Campus in compliance with the applicable regulations, policies and standards.

METHODS ADOPTED

Standard procedures enlisted for the conduct of Green Audit has been followed in this study. Some of the procedures adopted are:

Field surveys and data collection

The audit team has undertaken a detailed survey of the environmental attributes of the campus, with a view to evaluate various processes, collect data and to interpret them in accordance with the objectives. The audit team has undertaken detailed inventory on the demographic segmentation, land use pattern, water resources and management, energy consumption and use pattern, waste management practices, vegetation cover and the carbon budget associated with the campus.

Stake holder discussions

Inputs related to solid waste management, water resource utilization etc. were obtained from questionnaire surveys and group discussions. Discussions were held with the students, researchers, teachers, heads and branch officials, directors and statutory officers of the University. Discussions were also held with the representatives of engineering department, campus green committee, estate department, NSS, and the care takers of the Park and Botanical Garden. Inputs from such sources were interpreted for the development of strategic management plans.

Carbon foot print analysis

A detailed inventory on the demographic segmentation within the campus, nature and magnitude of power utilization by the campus community, magnitude of fuel utilization for cooking and power generation, fuel utilization for transportation etc. were assessed. They were then used for the estimation of the carbon footprint of the campus using online computational facility of the Carbon Footprint Ltd, Hampshire, UK (https://www.carbonfootprint.com/). The values were then interpreted.

AUDIT STAGES AND DATA SOURCES

Data concerning demographic segmentation of the campus were analyzed first. This was followed by an analysis on the geological and geographic features of the campus, together with an assessment of its land resource utilization, water resources utilization and vegetation characteristics. This is followed by a detailed inventory on energy utilization by various sectors and the waste disposal and management practices. The sources of data collection and the methods of evaluation are listed below:

Sl. No.	Nature and type of data	Source of data collection
1	Data concerning students, officials, teachers and other work forces associated with the campus	Administration wing
2	Inventory on the land resource utilization of the campus and estimation of canopy cover	Field surveys and analysis using Remote Sensing and GIS
3	Data on water supply to the campus and the share of its utilization	Engineering department and field level analysis
4	Inventory on the water resources within the campus and evaluation of its quality at source and distribution network	Field survey and laboratory level analysis following APHA (2000)
5	Data on waste and waste management	Departmental questionnaire survey on waste management practices, Field surveys, Waste collection and segregation, Quantification and characterization studies
6	Data on energy utilization, energy production from fossil fuels, use of renewable energy sources	Electrical Engineering Department
7	Data on fuel use for cooking and household purposes	Wardens of hostels, Canteen Managers, Surveys and field visits
8	Data on vehicular traffic within campus	Security Department, field level observations

AERIAL EXTENT, GEOGRAPHY AND CLIMATE

The area of the campus as per GPS survey is 2012869.80 square meters (497.388 Acres). The undulating terrain is mostly lateritic and is sloping to all directions. The magnitude of sloping is more towards the western (elevation: 57 – 73 m) and south western sides than the east (elevation: 95 – 119 m).

The climate experienced in the campus is mildly hot and humid with prominent rainy days during the monsoon season. March and April are the hottest and January and February are the coldest months. The maximum temperature of the region ranges from 28.9 to 36.2 ^{0}C and minimum from 17.0 to 23.4^{0}C. The wind is predominant from east as well as west during morning and evening hours. The wind speed ranges from 0.7-5.1 m/sec. with a mean value of 2.08m/sec. The relative humidity ranges from 84 to 94% during morning hours. The humidity is more during peak monsoon months, from June to September.

Rainfall data for a period of 6 years (2014 – 2019) indicate that the lowest precipitation was in 2016 (1533 mm) and the highest in 2018 (3658.5). Mean values of precipitation was lowest in January (0.853mm) and highest in July (629.2mm). Annual average rainfall was noted to be 2803.82 mm.

DEMOGRAPHIC SEGMENTATION

The number of people who are in various segments of the campus are listed below. The data obtained from various administrative departments were tabulated for this purpose.

Sl. No.	Sector	Number
1	Total no. of students in the campus undertaking graduate, post graduate, pre doctoral and doctoral studies (excluding students of distance education)	2596
2	Total number of office / administrative staff in the University (inclusive of contract employees)	1549
3	Total number of teaching staff in the University (inclusive of contract staff)	214
4	Total number of other labour force in the campus (including contract staff) working as CLR, gardeners etc.	146
5	Dependents of employees residing in the campus	450
	Total	4955

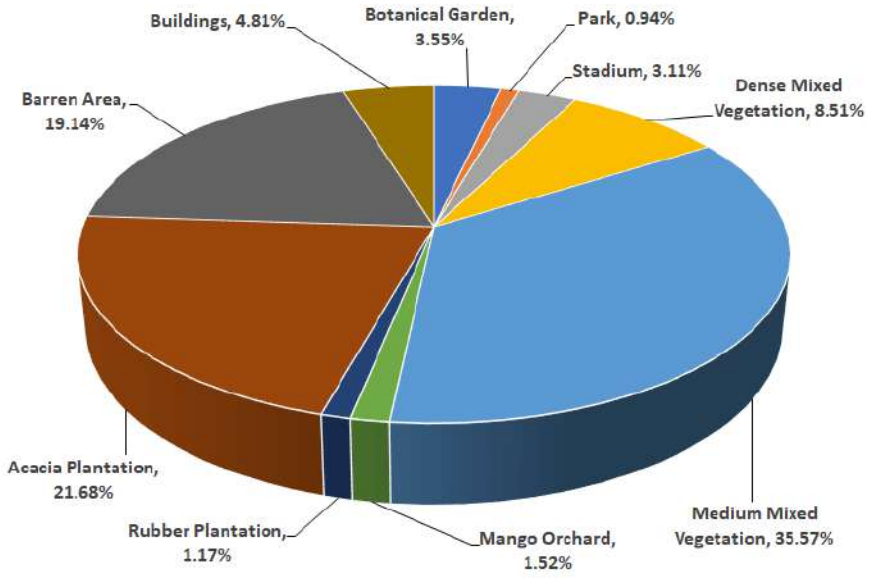
The campus is having a student strength of 2596, of which a sizable share are women. The total number of employees in the campus is 1899, of which 60.39% are men and 39.61% are women. The dependents of employees, who are residing in the campus is around 450.

LAND RESOURCE UTILIZAITON

Details of land resource utilization are inevitable for effective land management. Assessments were made using Aerial observations, field evaluations and GPS surveys. The consolidated table on land resource utilization is given below and its graphical representation in figure 1.

Sl. No.	Land use pattern	Area (sq. m.)	Area in Acres	% of total area
1	Botanical Garden	71492.796	17.6662546277	3.552
2	Park	18981.130	4.6903393693	0.943
3	Stadium	62607.965	15.4707650742	3.110
4	Dense MixedVegetation	171335.936	42.33803182431	8.512
5	Medium Mixed vegetation	715995.6515	176.92637859274	35.571
6	Mango Orchard	30511.755	7.53961885851	1.516
7	Rubber Plantation	23434.10755	5.7906940854853	1.165
8	Acacia Plantation	436392.835	107.8350179622	21.681
9	Barren Area	385258.085	95.19934605723	19.140
10	Buildings	96859.54203	23.934514082058	4.812
	Total extent	2012869.803	497.39096051405	100

Figure 1



Of the total area of 2012869.803 m^2, built-up area is coming to 4.8%. About 3.1% is occupied by the university stadium. Natural vegetation in the campus can be brought under two main types – Dense mixed and Medium mixed types. Dense vegetation cover 8.5% of the total land area. Dense vegetation includes a thick population of plants from all hierarchies – from herbs, shrubs to trees. But this vegetation is not uniform and is remaining fragmented due to geological / geographical reasons and land management practices. Majority of the land is occupied by the medium-mixed type of vegetation (35.5%). Botanical Garden (3.55%) and University Park (0.94%) are protected areas within the campus, which provides conservation to a wide range of plants and associated organisms.Plantations of mango varieties, rubber and Acacia are also seen in the campus. Mango orchard (1.51%) is surrounded by dense and medium vegetation on one side and an extensive cover of Acacia (21.68%) on the other. Rubber plantation contributes to 1.16% of the total land area. Apart from this, completely barren area is estimated to be 385258.085 sq. m. (95.19 acres), representing 19.14% area of the campus.

Auditing for Water Resources Management

Water is a prime natural resource and a basic human need. Its availability in specific quality and quantity are acting as key deliverables in socio-economic development and environmental sustenance. The existing water resources management in Calicut University campus has been assessed with respect to the demand, source, supply, infrastructure, use pattern and quality.

Details of intake facility, water treatment and distribution systems were collected from the Engineering Department. An inventory on the utilization of water by various sectors of the campus was carried out by assessing the recharge frequency of sumps and overhead tanks located at various buildings, offices and residential areas. The quality of water at source and in the distribution network was assessed using standard protocols (APHA, 2000). Water Quality Index of these sources were also worked out.

An inventory on the surface and ground water sources of the campus like ponds, wells and other water resources were undertaken. Their physical measurements were taken and their qualitative assessments were carried out with respect to standard protocols (APHA, 2000). An inventory on the water resources utilization pattern of the campus was prepared for suggesting management measures for their effective utilization.

The University of Calicut meets its requirement of water from Kadalundi river, approx. 10Km away from the campus. The water supply system comprises of an intake facility at Parakkadavu, booster facility at Chelari and a treatment facility in the Calicut University campus.

The water treatment facility in the campus (as per Engineering Department) comprises of a Rapid Sand Filter Bed, which has a daily capacity of 10-16 Lakhs Liters. In accordance with the requirements of water within the campus, every day, 10-16 Lakhs Liters of water are pumped from Kadalundi River. The collected water is then mixed with alum and limestone at a concentration depending on the turbidity of the raw water. The water is then passed through the sand bed for filtration and normally 80,000 liters of water is filtered in an hour. In order to confirm proper disinfection, filtered water is mixed with moderate levels of bleaching powder, which maintains chlorine concentration within a permissible limit. Treated water is collected in a base tank (4.5Lakhs Liter capacity) and pumped (using three 15 HP motors) to two overhead tanks (5 and 2.25 Lakhs Liters capacity each). Before distribution, the treated water is checked for various quality parameters.

Water quality at Parakkadavu region

The quality of water adjoining the intake facility at Parakkadavu was assessed in the months of January and February, 2020. Surface water samples from the main stream (R1, R2, R3 and R4), its tributary (RT1, RT2, RT3 and RT4) and from selected locations of the treatment facility (P1, P2 and T1) were

assessed for various water quality parameters like pH, Conductivity, Resistivity, Salinity, Turbidity, TDS, Acidity, Alkalinity, Hardness, Chloride, DO, BOD, Phosphate, Sulphate, TPC and E coli, following standard methods. The analytical results were compared with the standard values (World Health Organization / Bureau of Indian Standards) determining potability. The sampling sites of the present study are depicted in figure 2 and the results of Water Quality Index in table 01. Also, the WQI of samples were compared with the standard WQI values (Table 02) of Brown et al., (1972).

Figure 2. Sampling sites of water quality assessment at Parakkadavu region of Kadalundi river

Table 01.
WQI of samples from Parakkadavu region

Sampling sites	Sampling 1 (January, 2020)	Sampling 2 (February, 2020)
R1	15.28	24.30
R2	19.22	46.70
R3	19.72	37.91
R4	17.91	29.47
RT1	25.10	66.99
RT2	15.17	44.68
RT3	42.49	70.94
RT4	19.73	36.69
P1	18.81	48.52
P2	19.72	29.14
T1	19.73	30.22
	21.17	42.32

Table 02. WQI developed by Brown et al., (1972)

Water Quality Index	Water Quality Status
0-25	Excellent
26-50	Good
51-75	Poor
76-100	Very poor
>100	Unfit for consumption

Water quality in the distribution system

As stated earlier, an average of 10 - 16 lakh liters of treated water are distributed within the campus, daily. The water released to the distribution system is stored in the tanks mounted in different blocks / buildings of the University. Hostels, especially the ladies' hostel and guest houses are maintained with

24-hour supply. Supply to all the other sectors is restricted in a way that it is made available during morning and evening hours.

The quality of treated water in the distribution system within the campus was assessed at various locations. Details of sampling locations (T1 – T7) and their quality index in the months of January and February (2020) are depicted in Table 03.

Table 03. WQI of samples in the distribution system in the months of January and February, 2020.

Sampling sites		Sampling 1 (January, 2020)	Sampling 2 (February, 2020)
T1	Administrative block	8.76	6.70
T2	Pareeksha bhavan	12.25	12.36
T3	Tagore nikethan	12.24	17.02
T4	Ladies hostel	22.71	15.83
T5	Men's hostel	12.25	17
T6	Staff quarters	15.75	12.48
T7	Treatment plant (after treatment)	12.26	8.92
Mean		13.74	12.90

Inventory on other water resources within the campus

Water resources like ponds, wells (dug wells and bore wells) and other water harvesting structures within the campus were identified through field surveys. Physical measurements of these water resources were taken. The quality of water has been assessed as per standard methods prescribed in APHA (2000). The list of water resources is depicted in Table 04 and their physical measurements in Table 05. The quality index of well water and pond water samples in the months of January and February (2020) are depicted in Tables 06.

Table 04: Details of water resources identified within the Campus

Sl. No.	ID No	Location Latitude	Location Longitude	Landmark	Remarks
Wells					
1	W1	N 11° 07.846'	E 75° 53.551	Inside cu LP school	Protected, used by school authorities for various purposes
2	W2	N 11° 08.429'	E 75° 53.203'	West of Ladies Hostel	Not Protected, water is not used
3	W3	N 11° 07.642'	E 75° 53.704'	Near teachers flat Kohinoor	Protected, water used for non-drinking purposes by local populace
4	W4	N 11° 07.894'	E 75° 53.591'	Front side of cu high school	Not protected, water is not used for any purpose
5	W5	N 11° 07.925'	E 75° 53.509'	Near men's hostel	Protected, used by printing press and for irrigation purposes
6	W6	N 11° 08.009'	E 7 5° 53.601'	Back side of seminarcomplex	Protected, water is occasionally used for irrigation purposes
7	W7	N 11° 08.078'	E 75° 53.468'	Inside botanical garden	Protected, water is used for irrigation purpose
8	W8	N 11° 08.085'	E 75° 53.455'	Inside botanical garden	Protected, water is used for irrigation purposes
9	W9	N 11° 07.93'	E 75° 53.373'	Inside botanical garden	Protected, water is used for irrigation purposes
10	W10	N 11° 08.038'	E 75° 53.468'	Inside botanical garden	Protected, water is not used
11	W11	N 11° 08.475'	E 75° 53.392'	North of stadium	Protected, water is used for irrigation and construction purposes

12	W12	N 11° 08.178’	E 75° 53.463’	Inside university park	Protected, water is used for irrigation purposes
13	W13	N 11° 08.193’	E 75° 53.156’	Inside mango orchard	No water
14	W14	N 11° 08.226’	E 75° 53.161’	Inside mango orchard	No water
15	W15	N 11° 07.760’	E 75° 53.440’	Near Rachana Nursery school	No water
16	W16	N 11° 07.905’	E 75° 53.573’	Inside CU High School	No water
17	W17	N 11° 08.554’	E 75° 53.660’	Near Chettiyarmad (NH)	Not protected, water is not used
18	W18	N 11° 08.193’	E 75° 53.819’	Near Police Station	No water
Bore wells					
1	B1	N 11°08.209’	E 75° 53.785’	Near Police Station	Has been sealed due to technical reasons
2	B2	N 11°07.727’	E 75° 53.755’	Opposite to Kohinoor ground	Has been sealed due to technical reasons
3	B3	N 11° 08.267’	E 75° 53.174’	Near Philosophy department	Has been sealed due to technical reasons
Ponds					
1	P1	N11°08.068’	E 75°53.462’	Inside botanical garden	Water in all season, used for irrigation, construction purposes
2	P2	N11°07.948’	E75°53.353’	Inside botanical garden	Water is not constantly present
3	P3	N11°08.183’	E 75° 53.459’	Inside University park	Water is not used
4	P4	N 11°08.011’	E 75°53.013’	Near villunniyal temple road	Water is used for irrigation.
5	P5	N 11 °7.050	E 75°53.023’	Pond near the stream in Skywalk	Water is used by nearby people.
6	P6	N 11°8.015	E 75°53.006’	Mango orchard	Protected, water is usedfor irrigational purposes.
7	P7	N 11 °08.227’	E 75° 53.777’	Near Police station	No water

Table 05. Physical measurements of water resources within the Campus

Sl No.	ID	Radius (Meter)	Total depth (Meter)	Depth to water front (Meter)	Collar height (Meter)	Depth of water Column (Meter)	Volume of water(m^3)
WELLS							
1	W1	1.4	14.26	11.46	0.92	2.8	17.23232
2	W2	1.26	14.09	12.43	0.93	1.66	8.275206
3	W3	1.13	7.7	6.2	0.71	1.5	6.014199
4	W4	1.17	11.72	10.02	0.82	1.7	7.307188
5	W5	1.62	15.85	12.45	0.77	3.4	28.01809
6	W6	1.5	14.07	10.2	0.74	3.87	27.34155
7	W7	1.65	7.39	5.27	1	2.12	18.12314
8	W8	2.8	7.5	5.4	1.14	2.1	51.69696
9	W9	1.6	10.5	7.94	0.86	2.56	20.5783
10	W10	3	3.36	2.5	0.23	0.86	24.3036
11	W11	1.76	8.22	5.7	0.9	2.52	24.51069
12	W12	1.14	12.03	9.38	0.58	2.65	10.81397
13	W13	-	-	-	-	-	-
14	W14	-	-	-	-	-	-
15	W15	-	-	-	-	-	-
16	W16	-	-	-	-	-	-
17	W17	2.35	8.02	6.02	0.5	2	34.6813
18	W18	-	-	-	-	-	-

PONDS							
Sl. No.	ID	Radius /Length/ Breadth (Meter)	Total depth (Meter)	Depth to water front (Meter)	Pitching height (Meter)	Depth of water column (Meter)	Volume ofwater (m^3)
1	P1	40.8X28.6	2.99	2.52	Nil	0.47	171.08
2	P2	44X37.14	3.59	2.28	Nil	1.31	2140.75
3	P3	2.76	1.31	0	Nil	1.31	7.839
4	P4	2.16	0.74	0.24	Nil	0.5	1.832
5	P5	3.98	1.3	0.67	Nil	0.63	7.839
6	P6	4.25	0.9	0.08	Nil	0.82	11.634
7	P7	27.8X26.4	6.73	5.63	Nil	1.1	13.200
*** BORE WELLS**							
1	B1	#	#	#	#	#	#
2	B2	#	#	#	#	#	#
3	B3	#	#	#	#	#	#

* not under operation; - not having water during the survey period # not been assessed

Table 06. WQI of samples from various water resources of the campus in the months of Januaryand February 2020.

Sampling site	January, 2020	February, 2020	Sampling site	January, 2020	February, 2020
Wells			Ponds		
W1	3.11	6.40	P1	11.13	27.42
W2	6.13	41.16	P2	7.20	34.26
W3	12.3	6.46	P3	11.16	48.47
W4	5.50	-	P4	6.12	10.13
W5	5.36	42.79	P5	9.78	30.67
W6	4.98	42.49	P6	20.19	37.65
W7	15.45	45.81	Mean	10.93	31.43
W8	5.13	34.27			
W9	8.61	30.84			
W10	23.09	23.22			
W11	9.01	34.57			
W12	5.08	8.98			
Mean	8.645	28.81			

Water resources utilization in the campus

Water resource utilization in the campus is given in figure 03. The daily use of water by various sections of the campus community are depicted in Table 07.

It is estimated that the daily requirement of water for the University campus at Tenhipalam is about 10 – 16 lakh litres. Only 9% of the water requirement of the campus is met from water resources within the campus. Remaining 91% is met from Kadalundi river.

Figure 03. Water resources utilization in the campus

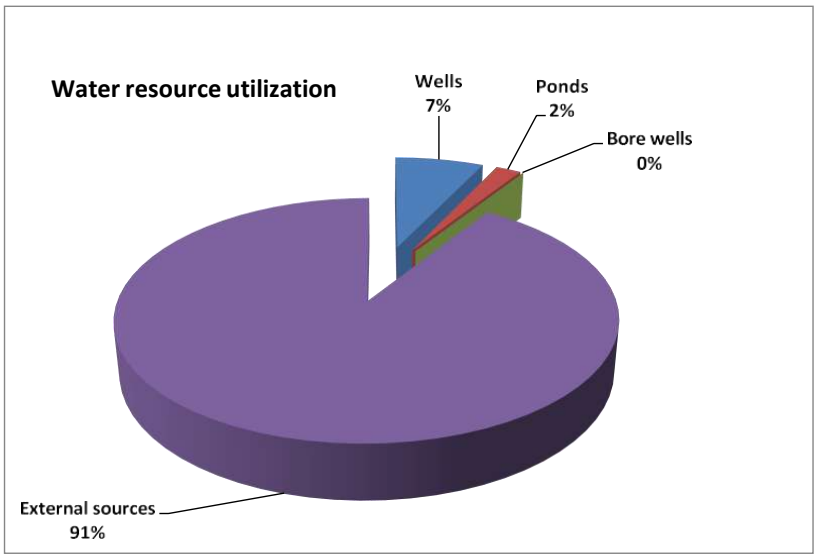


Table 07. Daily water consumption by different sectors of Calicut University campus

Sl. No.	Sector	Consumption of water (in Litres)
1	Hostels (Men's and Women's Hostels, Working Men's and Women's hostels)	539255
2	Quarters and Apartments (Flats, hostels and quarters of teachers and other office staff)	462996
3	Departments (All Science and Humanities departments)	342626
4	Administration and other Offices (Administration block, Pareeksha Bhavan, Tagore Niketan, Distance education etc.	123985
5	Gardening and Construction activities	112388
6	Others (canteen, auditorium, gymnasium, stadium, seminar complex etc.)	18750
Total		1600000

The major share of treated water within the campus is utilized by Hostels meant for students (~34%) and residential areas of teachers and administrative staff (~29%). This is followed by the Departments (~21%) and administrative offices (~8%). Approximately 7% of water is utilized for irrigation purposes and ~ 1% is utilized by the common facilities like canteens, seminar halls etc.

An assessment of the quality of water at the source (Parakkadavu) during early summer months (January and February) revealed that it is "Good" in terms of Water Quality Index. However, drastic deterioration in water quality was noticed with the progress of time from January to February. Microbial count represented by Total Coliforms and E. coli was higher in most of the sites studied. This is indicative of the poor quality of water during peak summer months (March – May). As Parakkadavu region experiences drastic decline in water table during peak summer months, the deterioration in water quality is certain. Also, the region is under terrific threat due to human intervention. People are making use of the premises of the intake well for open defecation and bathing. Few sewers adjoining this region are also causing threats to the water quality, especially during monsoon months.

The quality of treated water in the distribution system has been assessed at various locations within the campus. The quality, in accordance with WQI, was noted to be "Excellent". However, the microbial quality of water in the distribution system has to be examined in detail for ensuring infallible treatment efficiency.

An inventory of the water resources associated with Calicut University campus has been prepared in the early summer months. Their physical measurements were taken and quality parameters were assessed. Altogether 18 dug wells and 7 ponds are randomly located in the campus. In addition, 3 tube wells are also noticed, but are sealed by the authorities due to technical issues. 13 out of 18 wells and 6 out of 7 ponds contained water in varying levels during the months of January and February, 2020.

An assessment of the existing wells indicated an average water availability to the magnitude of 21.45 m^3 at a depth of 10.362 meters at ideal locations in the campus. A negative correlation (-0.2468) between the depth of well and the volume of water contained in it is noticed, which is indicative of the random availability of groundwater within the campus. The terrain characteristics also influence the same. As far as surface water sources like ponds concerned, a positive correlation (0.233922) has been noticed between depth of pond and volume of water contained in it. However, lesser extent of water contained in some of the major ponds are indicative of excess evaporation and inadequate recharge process associated with them.

The quality of both ground and surface water sources associated with the campus is nearer to potability limits and are falling in "Good' category as per WQI. However, water quality is found to deteriorate with the progress of summer. Most of the water resources within the campus are remaining unused or underutilized. It is noted that an inadequate quantity of water during summer seasons and lack of installed infrastructure for tapping water from these sources are acting as adverse factors in the effective utilization of these resources.

Auditing for energy utilization and management

The University of Calicut has undertaken Energy Audit separately for enhancing its ability in the energy sector. Energy conservation and sustainable utilization are also significant in an environmental perspective. It is an important aspect of sustainability and is linked with the carbon foot print of any community. Energy auditing deals with a set of protocols, which brings out strategic proposals to reduce consumption and enhance production from renewable sources and thereby reduces environmental degradation. Therefore, it is a mandatory exercise to be undertaken by every environmentally responsible institution on a specific time interval.

Utilization of Hydropower

For the present study, data concerning power utilization and power generation from renewable and non-renewable sources were obtained from the Engineering Department of the University. The hydroelectric power is utilized by almost all offices, laboratories and residential areas in the campus for regular activities. It is tabulated that the power consumption by the University in 2019 was 28,87,740 KWh and for 2020 was 24,76,360 KWh. The average utilization in a year is estimated to be 26,82,050 KWh. The monthly pattern of utilization in the year 2019 and 2020 are listed in Table 08.

Table 08. Power utilization by the campus

Sl. No	Months	Power utilization (KWh) 2019	Power utilization (KWh) 2020
1	January	229400	247820
2	February	208070	270420
3	March	227950	286030
4	April	272240	236640

5	May	231730	148420
6	June	262720	189920
7	July	232750	179000
8	August	249590	184150
9	September	230400	179560
10	October	199830	180540
11	November	254920	192730
12	December	288140	181130
	Total	28,87,740	24,76,360

Power from diesel generators

The Electrical Department is having two diesel generators of capacity 750KVA, which are operated on specific occasions. In 2019, the extent of fuel usage (Diesel) for its operation was 13000 litres and in 2020, it was 8400 litres. On an average, fuel usage is coming to 10700 litres in a year. Details are enclosed in the Table below.

Sl. No.	Month	Diesel usage (litres) 2019	Diesel usage (litres) 2020
1	January	800	4200
2	February	-	-
3	March	800	-
4	April	2200	-
5	May	-	800
6	June	3200	-
7	July	800	1600
8	August	2400	-
9	September	800	-
10	October	800	800
11	November	1200	-
12	December	-	1000
	Total	13000	8400
	Yearly average		10700

Utilization of solar energy

The University has an installed capacity of 255 KWp Solar Power Plants. They are installed at Digital wing (25KW), Men's hostel (25KW), Ladies hostel-1 (25KW) and 2 (25KW), CHMK library (25KW), AD Block 1 (25KW) and 2 (50KW) and Guest house 1 (25KW) and 2 (25KW) for meeting specific requirements. Apart from this, 57 LED Street lights (solar) are also installed.

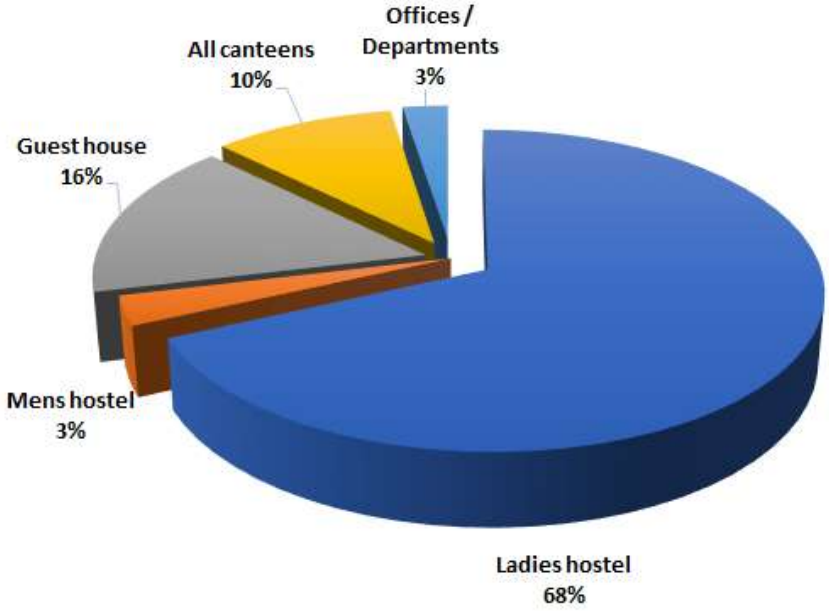
Fuel usage for cooking

LPG is mainly used in the campus for cooking and allied activities. Major utilization of LPG is by the ladies' hostel (270 home cylinders) and men's hostel (12 home cylinders) in a month. The guest house makes use of 40 cylinders (commercial) and 10 cylinders (home connection) in a month. All the canteens together make use of 30 cylinders (commercial) in a month. The use pattern of the major canteen near the student's trap has not been taken as it is remaining closed due to covid induced semi lockdown conditions. Around 10 cylinders (home connection) are used by all the other offices and departments within the campus. The residential areas are found to use approx. 160 cylinders in a month. Details are depicted in the Table below and its graphical representation in Figure 04.

Sl. No.	Use sector	Type of connection	No. of cylinders used per month	Litres of LPG used per month###
1	Ladies hostel	Domestic LPG #	270	7514.64
2	Men's hostel	Domestic LPG	12	333.984
3	Guest house	Commercial LPG	40	1489.6
	Guest house	Domestic LPG	10	278.32
4	All canteens	Commercial LPG	30	1117.2
5	Offices / Departments	Domestic LPG	10	278.32
6	Residential areas	Domestic LPG	160	4453.12
	Total in a month			15465.18
	Total in a year			1,85,582.16

Domestic cylinder: 14.2 kg; ## Commercial cylinder: 19 kg; ### Assuming 1.0Kg LPG = 1.96 litres

Fig. 04. LPG utilization in the campus



Fuel usage for transportation

The type, fuel category and number of vehicles under use by various segments of the campus community have been worked out. The details of vehicles under use by the visitors to the campus were also tabulated. These were then used to assess the extent of fuel usage (both petrol and diesel) within the campus for transportation purposes. Details are given in the following Table.

	Type of vehicle	Number of vehicles on use / day	Type of fuel	Mileage of the vehicle	Daily fuel usage (in litre) per vehicle	Annual usage of fuel
I	Total number of vehicles of officers, students and other officials within the campus					
a	Heavy vehicles	01	Diesel	4.5km	0.864	248.832
b	Medium heavy vehicles	2	Diesel	17km	0.457	131.616
c	Light motor vehicles (Four wheelers)	241	Diesel	20 km	0.194	13,465.152
d	Two wheelers	430	Petrol	40km	0.097	12,012.48
e	Bicycles	0	-	-	-	-

II	Total number of vehicles of visitors to the University					
a	Four wheelers	60	Diesel	20km	0.194	3,352.32
b	Three wheelers	50	Diesel	30km	0.130	1872.0
c	Two wheelers	110	Petrol	40km	0.097	3,072.96
d	Bicycles	0	-	-	-	-

Days of activity: weekly 6 days; monthly 24 days Total distance covered within campus = 3.886 km

Auditing for waste management

Human activities, whether industrial or domestic, creates wastes, which may be of solid or liquid type. Among this, solid waste may fall within bio-degradable, non-biodegradable and hazardous types. The present study attempts to assess the magnitude of waste generation and methods of its management in the campus.

The data concerning solid waste management within the campus has been obtained through (1) Questionnaire survey (2) Collection, quantification and characterization of waste from strategic locations following CPHERI (1971) and (3) Field surveys.

Results concerning the questionnaire survey of the waste management practices in the campus are depicted in Table 09 and the magnitude of waste generation from various sectors of the campus in Table 10. Similarly, magnitude of segregation of waste, its present management practices and the percentage composition are depicted in figures 05 - 07, respectively.

Table 09. Survey results of waste management practices in the campus

Sl. No.	Name of the Department	Frequency of cleaning		Nature of collection		Segregation of	Biodegradable waste		Non – bio degradable waste					Existing waste management practices						
		Daily	Weekly	Waste bins	Others		Paper waste	Food waste	Plastic waste	Chemicals / Lab refuses	Sanitary Pads	E - waste	Medical waste	Open Dumping	Pit dumping	Open Burning	Pit burning	Landfills	Collected for cattle	Composting
1	Arabic	Y		Y		N	Y	Y	Y					Y		Y				
2	Biotechnology	Y		Y		N	Y	Y	Y	Y						Y				
3	Botany	Y		Y		Y	Y	Y	Y	Y							Y			
4	Chemistry	Y		Y		N	Y	Y	Y	Y						Y				
5	Center for women studies	Y		Y		N	Y	Y	Y					Y	Y	Y				
6	Computer Sciences	Y		Y		N	Y	Y	Y							Y				
7	Commerce and Management Studies	Y		Y		N	Y	Y	Y					Y			Y			
8	Education	Y		Y		N	Y	Y	Y							Y				
9	English	Y		Y		N	Y	Y	Y			Y				Y				

10	Hindi	Y		Y		N	Y	Y	Y			Y				Y			
11	History	Y		Y		N	Y	Y	Y			Y		Y					
12	Journalism and Mass communication	Y		Y		N	Y	Y	Y							Y			
13	Library and Information Sciences	Y		Y		N	Y	Y	Y			Y					Y		
14	Life long learning and Extension	Y		Y		N	Y	Y	Y						Y				
15	Life sciences	Y		Y		Y	Y	Y	Y	Y							Y	Y	
16	Malayalam and Kerala Studies	Y		Y		N	Y	Y	Y								Y		
17	Mathematics	Y		Y		N	Y	Y	Y			Y				Y			
18	Nanoscience and technology	Y		Y		N	Y	Y	Y	Y						Y			
19	Philosophy	Y		Y		N	Y	Y	N	Y				Y		Y			
20	Physics	Y		Y		N	Y	Y	Y	Y						Y			
21	Physical Education	Y		Y		N	Y	Y	Y			Y				Y			
22	Psychology	Y		Y		N	Y	Y	Y			Y			Y	Y			
23	Political Science	Y		Y		N	Y	Y	N					Y	Y		Y		
24	Russian and Comparative Literature	Y		Y		N	Y	Y	Y							Y			
25	Sanskrit	Y		Y		N	Y	Y	N							Y			
26	School of Folklore Studies	Y		Y		N	Y	Y	N					Y					
27	School of Distance education	Y		Y		N	Y	Y	Y								Y		
28	Statistics	Y		Y		N	Y	Y	Y							Y			
29	Zoology	Y		Y		N	Y	Y	Y	Y						Y			
30	CH library	Y		Y		N	Y	Y	N							Y			
31	Guest house	Y		Y		N	Y	Y	Y							Y			
32	Health centre	Y		Y		N	Y	Y	N				Y		Y		Y		
33	Publication and Printing	Y		Y		N	Y	Y	N					Y		Y		Y	
34	Canteen	Y		Y		N	Y	Y	Y							Y			Y
35	Hostels	Y		Y		N	Y	Y	Y		Y						Y		
36	Higher secondary school	Y		Y		N	Y	Y	Y								Y		
37	Rachana Nursery	Y		Y		N	Y	Y	Y							Y			
38	GMHSS Calicut University Campus	Y		Y		N	Y	Y	Y								Y		
39	Artecia Nursery	Y		Y		N	Y	Y	Y							Y			

40	Preeksha Bhavan	Y		Y		N	Y	Y	Y							Y			
41	Chair for Gandhian Studies		Y	Y		N	Y	Y	N						Y				
42	Guest house canteen	Y		Y		N	Y	Y	Y					Y		Y			
43	USIC	Y		Y		N	Y	Y	Y			Y			Y	Y		Y		
44	EMMRC	Y		Y		N	Y	Y	N						Y					
45	Tagore nikethan	Y		Y		N	Y	Y	Y							Y	Y			
46	AD Finance	Y		Y		N	Y	Y	Y							Y				
47	PLD	Y		Y		N	Y	Y	Y							Y				
48	Engineering Electrical	Y		Y		N	Y	Y	Y							Y				
49	Engineering wing	Y		Y		N	Y	Y	Y						Y					
50	Academic staff college	Y		Y		N	Y	Y	Y						Y					
51	Day care	Y		Y		N	Y	Y	N							Y				
52	Store I	Y		Y		N	Y	Y	Y											Y
53	Store II	Y		Y		N	Y	Y	Y							Y				
54	Garden	Y		Y		N	Y	Y	Y											Y

Figure 05. Segregation of waste

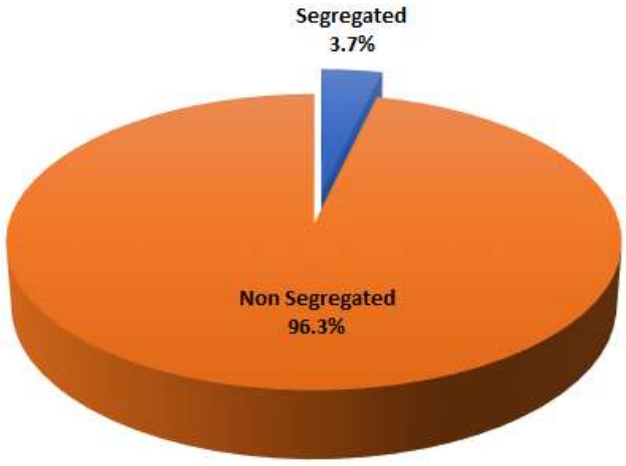


Figure 06. Solid waste management practices

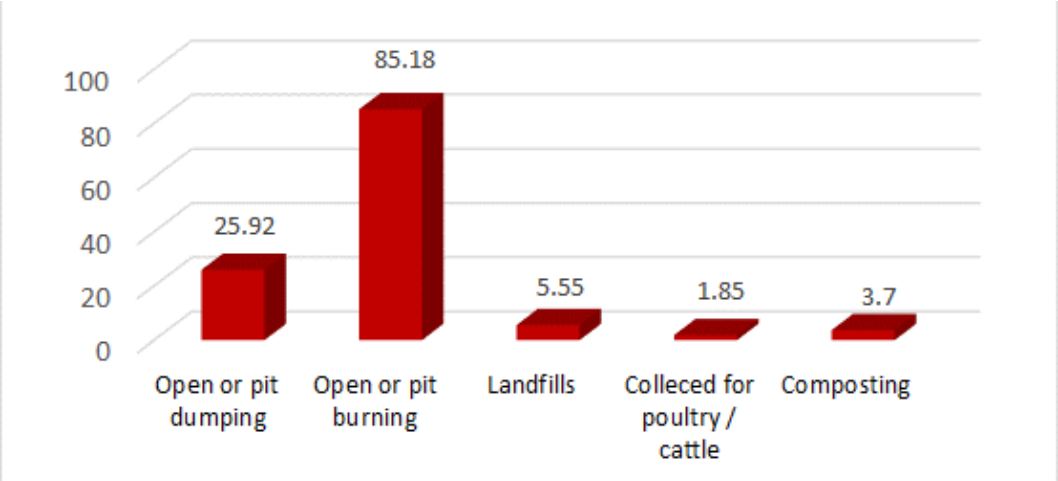
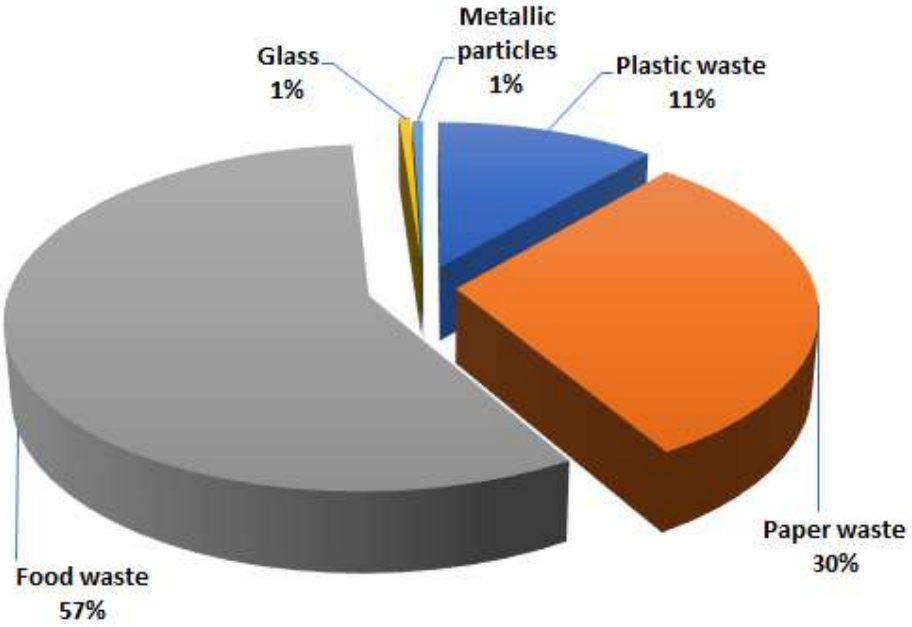


Table 10. Waste generation from various sections / Departments of the campus

Sl. No.	Blocks	Plastic waste	Paper waste	Food waste	Glass	Metallic wrappers	Total
1	Tagore Nikethan	1.3	7.62	3.5		1.345	13.765
2	School of Distance Education	0.5	2.3	0.5			3.3
3	Offices / Depts. in Chenakal including ASC	0.82	1.81	1.61			4.24
4	DCMS	0.15	2.15				2.3
5	Health centre	10.75	1.775		3.25		15.775
6	Engineering wing	0.25	1	0.25			1.5
7	Pareeksha Bhavan	1.675	23.49	0.75		0.055	25.97
8	Cafeteria (PB premises)	0.52	2.03	11.3			13.85
9	Administrative Block	0.15	2.65	2			4.8
10	Guest house	0.2	1				1.2
11	Guest house canteen	0.956	1.3	14.5			16.756
12	Canteen (students trap)	0.5	4.5	*42.115			47.115
13	Science Block	3.25		72.5			72.5
14	Language block	2.03					0
15	Humanities block	0.225	37.75	12.5		1.75	55.25
16	Working women's Hostel	0.75 @0.31	19.97	9			31
17	Ladies Hostel	13.5	14	*24.025			38.25
		@5.8					
18	Men's hostel	2.3		0.575			1.325
19	Teacher' Flat	0.8					0.31
20	CHMK Library	0.64	14	5.6			33.1
21	USIC	0.3		55			60.8
22	Store	2.16	7.8	15.7			25.8
23	EMMRC	0.15	1	21			22.8
24	Officer's quarters including teachers hostel	12.8	1.85				2.49
	Total	62.786	168.315	319.725	3.25	3.15	557.226

*Kitchen processing waste; @ Sanitary napkin
Quantification only from point sources; Values average of 3 working days collection;
Littered waste has not been quantified

Figure 8. Composition of waste



A physical assessment made in 2021 revealed that the total magnitude of solid waste generation in the campus on a working day is 557.226 kg. The segregation of waste revealed higher extent of food refuse (57%), followed by paper (30%), Plastic (11%), glass (1%) and metallic substances (1%). As compared to the previous environmental audit (2015 – 2016), waste generation in the campus has showed a declining trend from 613.896 kg. The implementation of green protocol in the year 2017 and the Covid induced semi-lockdown situations might have attributed to a reduction in the magnitude of waste generation.

A survey conducted in connection with the solid waste management (2021) revealed that the daily cleaning and collection of waste is undertaken by all offices and departments through dust / waste bins kept at strategic locations. The university does not have a centralized system of daily waste collection and processing. At present, the wastes which are collected and segregated at the offices and departments are handed over to Haritha Karma Sena at regular intervals for further processing. However, the lack of a centralized waste collection and processing system in the campus and lack of regularity in the collection and removal of wastes by external agencies is putting offices and departments in trouble, which force them to adopt methods of their choice, which are mostly unscientific. This is evident in the survey that only 3.7% of the offices / departments are segregating the waste for further processing. Nearly 26% of the departments / offices are subjecting their wastes for either open or pit dumping. Around 85% of the departments are openly burning their waste. Nearly 5.5% of the centres are putting the waste for landfilling and composting of waste is performed only at 2 centres, out of the 54 centres surveyed (3.7%).

Similarly, there are issues of other wastes like chemical wastes, biomedical wastes and electronic wastes. About 8 science departments are producing chemical wastes. The University at present is having only facility for the collection of chemical wastes, but has to develop protocols for its management. Electronic wastes are generated by almost all offices / departments and at present, University is having a system of collection and disposal of electronic waste through the University Science Instrumentation Center (USIC). The biomedical waste is associated only with the University Health Centre and is processed scientifically. Generation of liquid wastes, especially sewage is associated with canteens and guest houses. At present, they are being released openly, without any scientific means of treatment.

A survey on the field noticed careless disposal of solid wastes at various location of the campus. The travelers, local populace and small business venturers are found to dispose their wastes in

remote areas of the campus, which are having vehicular access. The gravity of such issues is more in Chettiyarmad and Kohinoor regions of the Campus.

Auditing for Green Campus Management

Attributions of soil and their overlying vegetation are to a great extent contributive to the economic as well as environmental sustenance of a region. Vegetation, in addition to attributing aesthetic beauty are contributive in protecting the soil from desiccation, maintains fertility, prevents erosion, supports associated biota, maintains micro climatic conditions by maintaining adequate albedo, provides oxygenation, maintains adequate humidity, provides food and feed stuff and fuel and also helps in carbon emission control.

The vegetation cover of the campus is estimated along with the studies on land use pattern. Areas having vegetation cover were surveyed using GPS / Google imageries and field observations. The vegetation types were assessed using Mehar Homji's system of classification. Thematic maps pertaining to vegetation cover was prepared using ARCGIS software. The extent of area occupied by various buildings, facilities and vegetation types are given in Table 11. Thematic map of vegetation in the campus is given in Figure 09 and the extent of barren area in Figure 10.

Table 11. Land use and vegetation type

Sl. No.	Land use pattern	Area (sq. m.)	Area in Acres	Percentage oftotal area
1	Botanical Garden	71492.796	17.6662546277	3.552
2	Park	18981.130	4.6903393693	0.943
3	Stadium	62607.965	15.4707650742	3.110
4	Dense Mixed Vegetation	171335.936	42.33803182431	8.512
5	Medium Mixed Vegetation	715995.6515	176.92637859274	35.571
6	Mango Orchard	30511.755	7.53961885851	1.516
7	Rubber Plantation	23434.10755	5.7906940854853	1.165
8	Acacia Plantation	436392.835	107.8350179622	21.681
9	Barren Area	385258.085	95.19934605723	19.140
10	Buildings	96859.54203	23.934514082058	4.812
	Total extent	2012869.803	497.39096051405	100

The results of the present study (2020-21) are compared with the Environmental Audit Report of the year of 2015-2016 to assess the magnitude of changes in land use over a period of 5 years.

A stated earlier, built-up area of the campus is 4.8% and the university stadium accounts for 3.1%. Natural vegetation within the campus can be brought under two main types – Dense mixed and Medium mixed types. Dense vegetation covers a total of 8.5% of the total land area. But this vegetation is not uniform and is remaining fragmented due to geological / geographical reasons and other land management practices. Majority of the land is occupied by the medium-mixed type of vegetation (35.5%). Botanical Garden (3.55%) and University Park (0.94%) are protected areas within the campus, which provides conservation to a wide range of plants and associated organisms. Plantations of mango varieties, rubber and Acacia are also seen in the campus. Mango orchard (1.51%) is surrounded by dense and medium vegetation on one side and an extensive cover of Acacia (21.68%) on the other.

Figure 09. Vegetation map of the campus

Figure

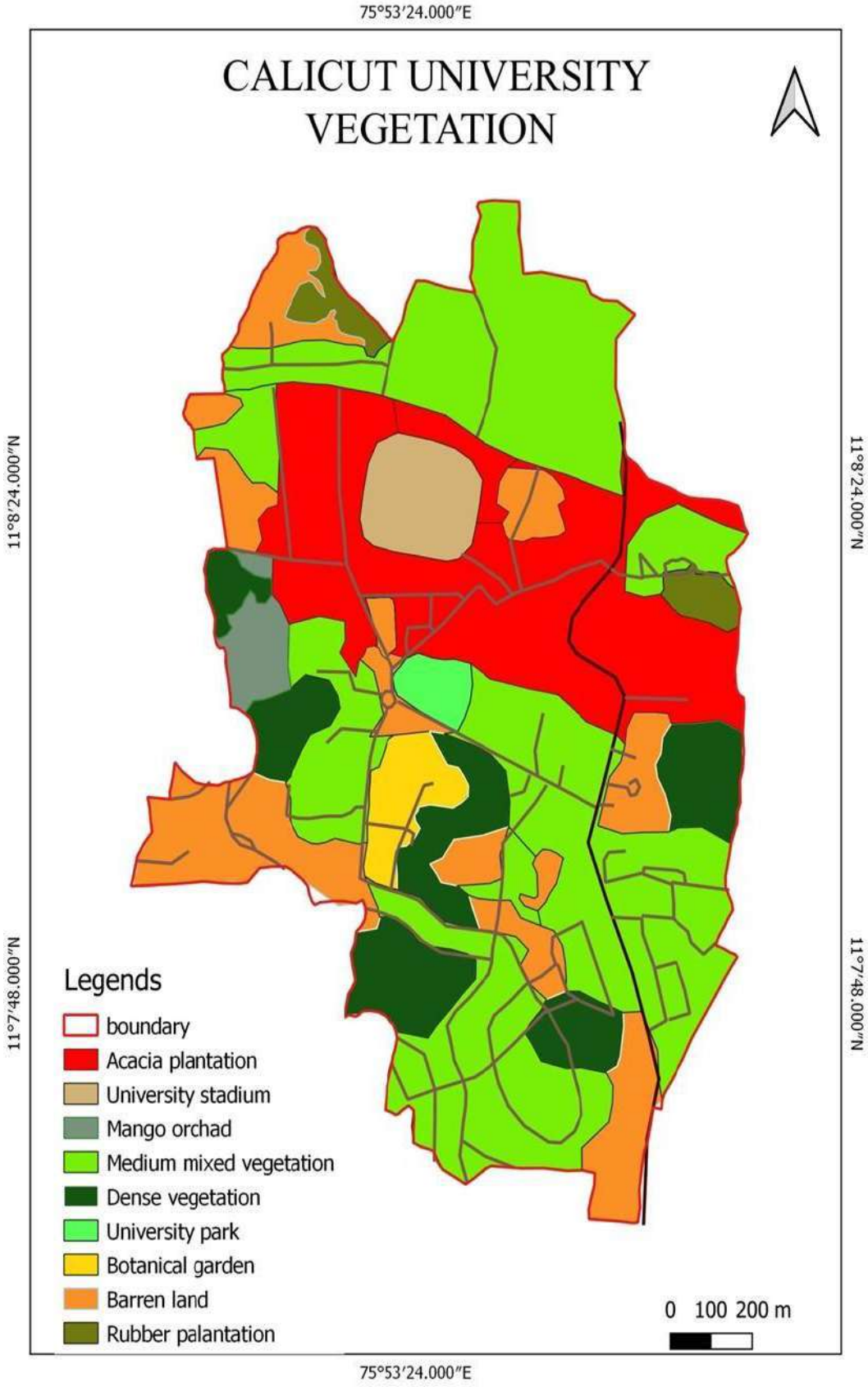
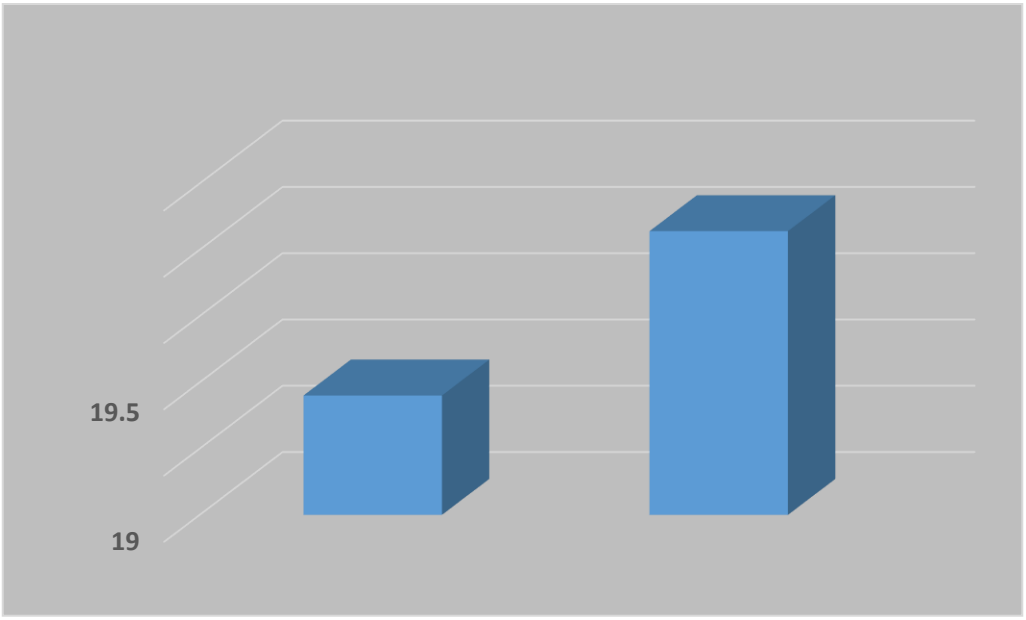


Fig. 10. Barren area (comparison)



Acacia forms a major environmental concern in the campus, owing to varied reasons and are to be replaced with native vegetation in the near future. Rubber plantation contributes to 1.16% of the total land area. Apart from this, completely barren area is estimated tobe 385258.085 sq. m. (95.19 acres), representing 19.14% area of the campus.

Auditing for Carbon Footprint

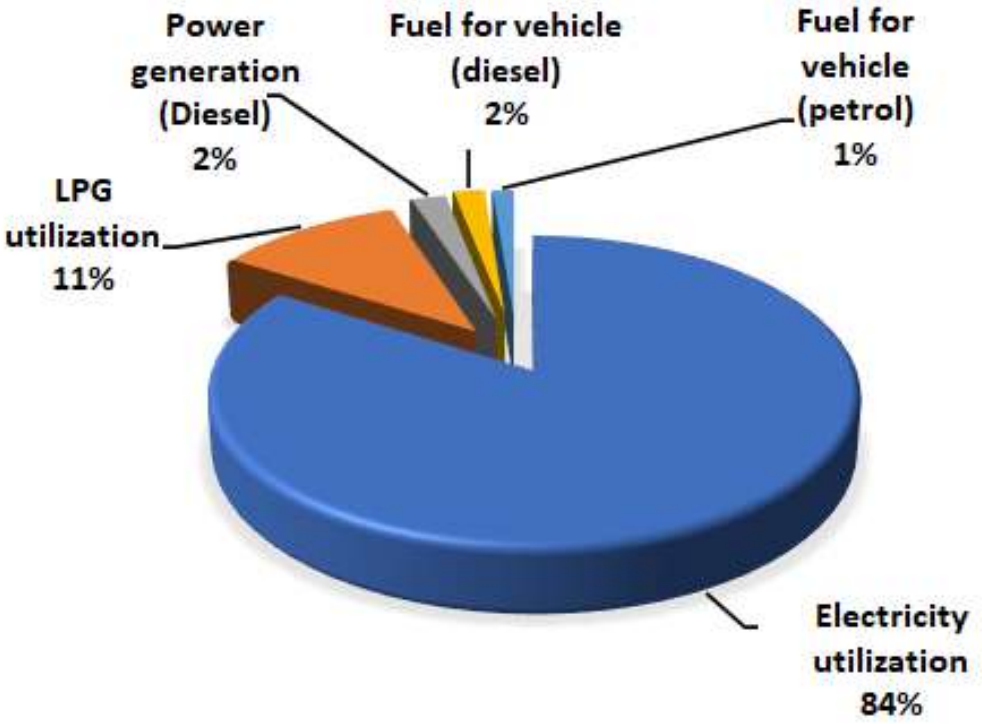
Energy utilization for various purposes is attributing to greenhouse gas emissions. Among various greenhouse gases, carbon dioxide is the prominent one as it is released through a wide range of activities. The release of carbon dioxide gas into the Earth's atmosphere through human activities is commonly known as carbon emissions. A carbon footprint is the total greenhouse gas emissions caused by an individual, event, organization, service, place or product, expressed as carbon dioxide equivalent (CO_2e)

Carbon footprint analysis of the campus has been undertaken with the online computational facility of Carbon Footprint Ltd, Hampshire, UK. (https://www.carbonfootprint.com/). The inputs used for the estimation of Carbon Footprint are listed below. The percentage share by various segments are given in Figure 11.

Sl. No	Activity	Unit	Magnitude
1	Total number of individuals who are stake holders / utilizing the resources of the campus (includes students, officials, teachers, other service providers who spend a minimum of 6 hours in the campus	Numbers	4955
2	Total electricity consumption in the campus for various official / academic / developmental activities	KWh	26,82,050
3	Fuel (diesel) utilization by power generators within the campus	litres	21400
4	LPG utilization by hostels, guest houses, canteens,	Litres	1,85,582.16

	offices, laboratories, departments and residential areas of officers and faculty members		
5	Fuel usage (diesel) within the campus by students, officials and teachers for transportation purposes	Litres	13845.60
6	Fuel usage (petrol) within the campus by students, officials and teachers for transportation purposes	Litres	12012.48
7	Fuel usage (diesel) within the campus by people visiting the campus	Litres	5224.32
8	Fuel usage (petrol) within the campus by people visiting the campus	Litres	3,072.96
9	Average distance travelled within the campus	Km	3.886

Figure 11. Percentage share by various segments



The above inputs were fed to the software for estimating the carbon foot print of the campus in general and the individual in particular. The results concerning carbon footprint is depicted in the following table.

Sl. No.	Activity	Carbon foot print (metric tonnes of CO2e)
1	Electricity utilization	2219.13
2	LPG utilization	288.97
3	Power generation (Diesel)	53.76
4	Fuel for vehicle (diesel)	47.91
5	Fuel for vehicle (petrol)	33.09
6	Carbon footprint of the Campus consequent to all activities	2642.86
7	Per capita carbon footprint of the campus	0.53

The carbon footprint of the entire campus for the year 2020 is estimated to be 2642.86 metric tonnes of CO2e. Also, the per capita carbon foot print is estimated to the 0.53 metric tonnes of CO2e. The present estimate is likely to attain higher values if the resource use of the people apart from office hours are worked out. The present carbon footprint per person in the campus is fairly less compared to the national average of 1.74 metric tons of CO_2 emissions per year (2020) and 15.52 metric tons of CO_2 emissions per year (2020) by each citizen of United States.

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SUGGESTIONS AND RECOMMENDATIONS

Geography, Climate and land resource utilization

The terrain of the campus is highly undulating and sloping, and is indicative of its proneness to higher erosion and thereby removal of fertile topsoil. Erosion is evidenced by the lateritic rocks exposed at various locations within the campus. Hence it is customary to construct erosion prevention structures in high erosion prone areas of the campus which will also contribute to ground water recharging.

Moderately higher temperature and wind velocity experienced in the region are indicative of the higher evaporation rate and resultant desiccation of water resources. It points to the need for the development / maintenance of adequate vegetation cover for soil conservation and in overcoming the drought situations.

The built-up area is coming to 4.812% area of the campus. The per capita green space allocation in the campus is 185.37 m^2, which is fairly higher than the recommendations of World Health Organization, which insist on a minimum of 9 m^2 of green space per individual with an ideal Urban Green Space (UGS) value of 50 m^2 per capita for a sustainable living. For maintaining the present share of green space, all future developmental activities within the campus requires serious planning and meticulous implementation.

Water resources

The water resource management within the campus needs to be streamlined as 91% of its requirements are met from outside. The water table at Parakkadavu region of Kadalundi river is retreating at an alarming rate, leading to severe shortages and quality issues in the summer months. The University has to think of alternative sources of water for meeting such shortages in the near future. A detailed study is warranted in this regard.

As the level of contaminants is increasing progressively with a decrease in water level during the summer months, effective treatment options need to be adopted by the University during this period. This has to be seriously dealt in the case of microbial contaminants in water. The extent of anthropogenic pressures associated with Parakkadavu region are many. The main among them are open defecation and bathing. Also, a tributary reaching the intake station and sewers associated with the region are potential threats to the microbial quality of water. An estate staff need to be employed in the region for regular clearing of bushes, hideouts and other unwanted canopy. The area needs to be fenced and a security staff need to be employed for preventing waste disposal and trespasses to the region.

The physico-chemical quality of treated water in the distribution system within the campus was noted to be Excellent in terms of WQI. However, the microbial quality of water in the distribution system has to be examined periodically for ensuring infallible treatment efficiency.

Most of the water resources within the campus are remaining unutilized or underutilized. As the quality confining to them are better, they can be utilized in laboratories, lavatories and for irrigation purposes. It is noted that ~ 1,12,388 litres of treated water (~7%) is used daily for gardening and construction purposes. Efforts need to be undertaken for increasing the use efficiency of local water resources and thereby reducing the demand of water from external sources.

The campus follows the trend of utilizing treated water for a wide range of purposes, other than for drinking. It is highly suggested to have a separate water distribution system in the campus for laboratories, lavatories and irrigation purposes. Such a supplementary distribution system can utilize the raw water (untreated) from Kadalundi and water from other sources within the campus. This will reduce the cost of water treatment and ensures better treatment efficiency for water meant for drinking purposes.

As 91% of the water requirements within the campus are met from outside, there has to be serious concerns on rain water harvesting (roof top and run off) with in the campus. Considering the roof characteristics and ease of construction and maintenance of allied structures like capture, collection, treatment, storage and distribution facility, rooftop rain water harvesting is proposed at strategic locations (29693.5sq m of slope roof and 21061.15sq m of flat roof), with an anticipated annual yield of 142306902.8 litres. The Engineering Department of the University may further work on the feasibility of construction and the expenditure involved.

The campus is slopping towards all the directions and the magnitude of sloping is more towards the west, south and north-east. Considering the topography and terrain characteristics, storage of runoff water using check dams is recommended at the following locations of the campus. The Engineering Department of the University of Calicut may further work on the feasibility of construction and the expenditure involved. Some of the suggested areas are listed below:

1. Check dam with overflow / regulator facility for capacity control in the western side of Ladies Hostel Complex and southern side of Deepthi centre ($11^{o}14'1.132"$N and $75^{o}88'5.569"$E), with a size of 75m x 50mx 3 m and storage capacity of 11250 m^3.
2. Pool with capacity control and overflow facility in the south western side of the Chemistry Department ($11^{o}13'5.406"$N and $75^{o}88'6.848"$E) with a size of 100m x 50mx3m and with a storage capacity of 15000m^3.
3. Check dam with the control / overflow facility in the northern side of Tenhipalm Police Station and in the south of working Men's Hostel, in the eastern side of NH66 or on a location west of Police Station and the national highway which receives runoff water from the University stadium ($11^{o}13'6.958"$N $75^{o}89'5.801"$E) with a size 100m x 50mx3m and a capacity of 15000m^3.

Energy management

The average utilization of hydroelectric power by the University in a year is estimated to be 26,82,050 KWh. The campus also utilizes two generators of capacity 750KVA., for which the fuel (diesel) usage in a year is 10700 litres. Nine solar panels are set in the campus with a total power generation of 255KWp. Apart from this, 57 LED Street lights (solar) are also installed. The use of LPG by various sectors of the campus was noted to be 1,85,582.16 litres.

The expenditure on hydroelectric power utilization by the University is higher and has to be minimized with more solar power installations. Also, there is urgent need for awareness among the campus community to reduce the usage of hydroelectric power as conservation and effective utilization of such clean and green sources of energy are binding on every individual, which in turn reduces the pressure on polluting sources of energy on a national perspective.

For transportation within the campus, usage of fossil fuels like diesel and petrol was noted to be 13845.6 litres and 12,012.48 litres, respectively. The campus does not have any initiatives of green transport. The use of bicycles and the grouping up of vehicles can be promoted as sustainable solutions in this direction.

Waste Management

The present survey (2021) estimated the total magnitude (minimum) of solid waste generation in the campus to a tune of 557.226 kg. on a working day. The segregation of waste revealed higher extent of food refuse (57%), followed by paper (30%), plastic (11%), glass (1%) and metallic substances (1%). The reduction in the extent of waste generation from 613.896 kg./day (2016) can be attributed to the Covid imposed semi lockdown situations. The higher extent of degradable organic components in waste is indicative of the effectiveness of its management with a recovery of manure, energy etc.

The implementation of Green Protocol in the campus in 2017 has help to reduce the magnitude of waste generation, especially of plastic, to a certain extent. Most of the departments are following green charter with a ban on flex banners and plastic carry bags and cups for social functions and academic programmes. However, lack of a centralized system of waste collection, segregation, processing and management is putting offices and departments in trouble, which force them to adopt methods of their choice, which in most cases are not falling within the scope of the green protocol. The following suggestions and recommendations are placed in this perspective.

Offices and departments are to adhere more to the policies of Green Protocol, implemented in the University. They should adopt to various practices of` least waste generation. Adequate awareness initiatives and action programmes can be undertaken by offices and departments in this regard. Adequate administrative and financial services are to be mobilized by the University in this regard.

A centralized system of waste collection, processing and management needs to be developed by the University. Presently the offices and departments are constrained to retain the non-degradable wastes (plastics and other materials) and to process the degradable wastes collected by them at their centres, due to space requirements and technical constraints. The services by *Haritha Karma Sena* are not adequate in this perspective. A centralized facility for the collection of segregated wastes from offices and departments by the University will overcome the burden of individual offices / departments from processing their wastes using unscientific methods. Adequate manpower and infrastructure (including vehicles) under a House Keeping Department can be arranged by the University in this regard. There can be a central waste processing units in the campus with incineration, compost, biogas and recycling facilities set at strategic locations. However, quarters and residential areas are to be insisted to manage household wastes, other than plastics by scientific mechanisms. There should also be efforts for the management of sewage generated by hostels and canteens. A detailed study is warranted in this direction.

Presently biomedical waste management is undertaken by the Health Sciences Department of the University. Similarly, management of e-waste is through the University Science Instrumentation

Centre (USIC), which collects and dispose the waste to outside recognized agencies. The present systems followed by them can be streamlined for better efficiency. However, with regard to chemical wastes, the University has to develop protocols for its effective disposal, apart from their collection and storage.

There is high extent of littering and waste disposal in this campus from outside. The local populace and commercial centres need to be informed of this matter through offices of local governance. Travelers are also involved in littering and waste disposal. Adequate sign boards and surveillance facility needs to be arranged by the University in this regard. There can have a greater number of properly functioning waste bins at strategic locations of the campus to control littering.

Green Campus

This audit survey assessed the land use pattern and vegetation cover of the campus for the year 2020-2021 and compared it with that of the earlier report of 2015 – 2016. The area occupied by the buildings have increased from 4.405% to 4.812% over a period of 5 years. The vegetation cover (both dense and medium mixed type) has decreased to an extent of 0.534% over these years. The barren area also showed an increase of 1.240%. The area under Acacia plantation has decreased to an extent of 0.982%. Considering these aspects, the followingrecommendations are made.

As the built-up areas are likely to increase as part of various developmental initiatives in future, efforts are to be undertaken to bring more areas under vegetation cover. Presently barren lands contribute to 19.14% of the total land area and are mostly attributed by exposed rocky and lateritic regions. More scientific approaches are required for the conversion of such areas, for which selection of species and method of planting needs to be standardized.

In addition to the efforts for the control of barren areas, there has to be serious efforts for the conversion of medium mixed vegetation to the dense type. This is possible with the introduction of selected tree species, which attributes more biomass and maintains biodiversity. It is equally important to control the expansion of invasive species like Acacia to conserve the growth of indigenous varieties. Acacia has recently been attributed with a wide range of ill effects,detrimental to both human health and ecology. They need to be replaced with healthy vegetation.

Maintenance of vegetation cover is more significant in the campus, as its topography is highly undulating and sloping towards all directions. Lack of a proper vegetation cover is likely to accelerate the erosion process, which in turn will take away the fertile topsoil, leaving the rocky terrain exposed.

Carbon budgeting

The carbon footprint of the entire campus for the year 2020 is estimated to be 2642.86 metric tonnes of CO2e. Also, the per capita carbon foot print is estimated to the 0.53 metric tonnes of CO2e. The present estimate is likely to attain higher values if the resource use of the people apart from office hours are worked out. The present carbon footprint per person in the campus is fairly less compared to the national average of 1.74 metric tons of CO_2 emissions per year (2020) and 15.52 metric tons of CO_2 emissions per year (2020) by every citizen of the United States.

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