



Parvatibai Chowgule College of Arts and Science  
Autonomous

Accredited by NAAC with Grade 'A' (CGPA Score 3.41 on a 4 Point Scale in 3rd cycle)  
Best affiliated College-Goa University Silver Jubilee Year Award

CHOWGULE  
TIGERS



## Report of the Green Audit

Conducted at Parvatibai Chowgule College of  
Arts and Science (Autonomous), Margao, Goa



By  
**Shubhankar Environmental Services, Ponda, Goa**  
(Nov-Dec 2018)

*Participatory Green Audit conducted at Parvatibai Chowgule College of Arts and Science  
(Autonomous), Margao, Goa*

## Acknowledgements

Shubhankar Environmental Services is thankful to the authorities of Parvatibai Chowgule College of Arts and Science for providing an opportunity to conduct a participatory Green Audit at the College.

We are thankful to Principal Shri Nandkumar Sawant who showed confidence in entrusting this task to us. Vice Principal Mrs Shaila Ghanti and Shri Vasant Hede (In-charge of Marketing/ Internships) played a pivotal role in the execution of the Audit and we wish to express our gratitude to them. All the Teacher co-ordinators for the three Green Audit Groups have ensured a good participation from students and our thanks are due to them.

Students who completed their Internship through this Green Audit were enthusiastic and we hope that the message of Environmental Conservation remains with them forever. We are also thankful to all the other Staff of the College including Shri Sameer Desai, Shree Joshi and all others who helped in getting information for this Audit.

We are thankful to all others who directly or indirectly contributed to this Audit. We attempted to deliver the best in this Audit Process and are hopeful that the recommendations given in this Audit Report shall be implemented to make the College Campus greener.

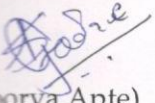
## Certificate

This is to certify that all the information given in this Report is to the best of our knowledge and errors, if any, are purely incidental.

The Green Audit Report is officially being submitted to the Management of Parvatibai Chowgule College of Arts and Science (Autonomous), Margao today.

Date: 25 / 02 / 2019

Submitted by:



(Apoorva Apte)

Proprietor, Shubhankar Environmental Services, Ponda

Acknowledged by on behalf of Parvatibai Chowgule College of Arts and Science:



(Dr. Nandkumar Sawant)  
Principal



(Dr. Shaila Ghanti)  
Vice Principal



## Executive Summary

Educational Institutions play a major role in grooming the future generations, especially with regards to topics of national and international importance. Environmental Conservation is a key topic and there is an urgent need to ensure that each one of us is aware of our roles and responsibilities towards conserving the Environment. Colleges can show the pathway for environmental action, through participatory activities on Campus such as Sustainable Waste Management, Energy Saving and Biodiversity Conservation. Policy level decisions such as creating a Green Campus Policy can help direct efforts and consistently to move towards a common mission of conserving the Environment and doing our bit.

The Green Audit conducted at Parvatibai Chowgule College of Arts and Science is a step towards sensitizing Students, taking stock of the status and finding ways for improving the health of different environmental parameters on Campus. During the Course of this participatory Audit, the aspects of Waste, Energy and Biodiversity have been studied in detail through series of planned hands-on activities. Recommendations based on the information collected by the groups appear in the Report. These can be readily taken up by the College in triggering a series of green initiatives in the years to come. This Audit Report is also envisaged to be a starting point for grooming green entrepreneurs on the Campus, who would definitely be a big asset to the College.



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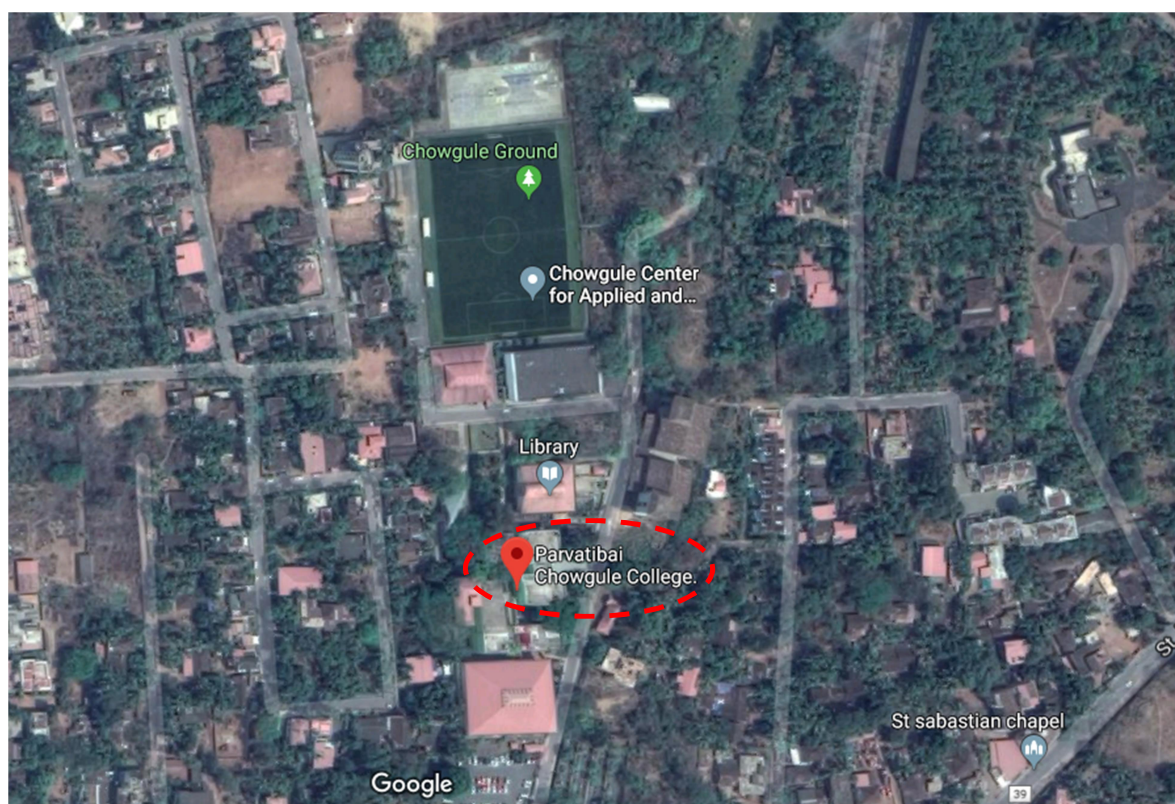
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## 1 Introduction

### 1.1 Background of the College

Parvatibai Chowgule College of Arts and Science, established in the year 1962, is one of the premier institutions in Goa.

A Google map of the College appears below:



1 Google map of the College (Accessed from Google Earth, November 2019)

Chowgule College offers courses in Bachelor of Arts, Bachelor of Science, Master of Arts in Geography, Hindi & Economics, Master of Science (Information Technology), (Biotechnology) streams and post-graduate diploma in Computer Application. It is the only institution in Goa, India to offer a Masters' degree (M.A.) in Child Psychology. It is also one of the very few colleges in Goa to offer Geology as a Bachelor of Science course.

The College campus is spread over an area of around 65000 sq.m. and is well connected by road.

The Chowgule College Library encompasses reading rooms, book stacks and special function areas such as visual room and multimedia resource centre.

The College Library has a collection of 57,794 items. It subscribes to 75 latest scientific as well as general journals. The specialist collection includes books, extensive reference materials, AV materials, rare photo collection etc. More than 2700 bound volumes are also available.

Chowgule Sports and Fitness Centre is located on a sprawling 5-acre property. The Centre has an indoor capacity of 35,000 sq. ft. which is equipped with sports and recreational fitness facilities.

In 2007, the campus inaugurated its exclusive Wi-Fi network, that promoted e-learning as well setting up online courses called Chowgules Learn Anytime Any Place (CLAAP), which helped students get course material online and have discussions in forums. *(Reference: Official Website of Chowgule College)*

In order to take a stock of the status of the Environmental initiatives taken by the College, Shubhankar Environmental Services was assigned with the task of carrying out a Green Audit of the College Campus and a detailed description of the same appears in the following Sections.

## **1.2 Need for the Green Audit**

A “Green Audit” basically means an assessment of an activity/ organization in terms of its impact on the environment.

A Green Audit thus enables an Organization to:

- Systematically document the existing status of various natural resources
- Take a stock of its performance with respect to Waste, Energy, Biodiversity, Water, etc.
- Find potential opportunities for conservation of energy, water, biodiversity, etc. and reducing/ better managing waste
- Prepare a Green Campus plan & design conservation programs
- Use the Audit Report as a Baseline to review Progress periodically
- Help raise awareness about environmental conservation among students and staff



In many Organizations there is no umbrella program which provides a complete picture of the status of the environment. Thus, the Green Audit proves to be a useful activity.

### **1.3 Scope of the Green Audit**

In the present Project, Shubhankar Environmental Services, Ponda was entrusted with the task of conducting the Green Audit, considering the following parameters:

- Waste
- Energy
- Biodiversity

The Audit was conceptualized to be completely participatory, with a team of Students working as per the guidelines and worksheets provided by M/s Shubhankar. Teacher co-ordinators worked closely with the Students and the Resource person to monitor and guide the Students in their work.

The above mentioned parameters were studied within the College Campus and this Report includes the findings of the same. Recommendations towards improving each of the parameters are also included, which the College Management could utilize for planning the future Green Activities.

### **1.4 Introduction to the Team**

The Green Audit was undertaken at the College from 10<sup>th</sup> – 19<sup>th</sup> November 2018. 23 students worked on the same. Details of the team from the College are given below. Overall Program Co-ordinator: Shri Vasant Hede, In-charge of Marketing/ Internships.

Department Co-ordinators:

<b>Sr. No.</b>	<b>Name of the Teacher Co-ordinator</b>	<b>Department</b>
1	Amisha Shiordker Pednekar	Botany
2	Yatin P. Desai	Physics
3	Dr. Nandini Vaz Fernandes	Zoology
4	Deepak Kumbhar	Geography

**Team 1: Energy Champions**

<b>Sr. No.</b>	<b>Name of the Student</b>	<b>Department</b>
1	Sindiya Faldesai	Physics
2	Ophra Gracias	Physics
3	Mayuri Gaad	Physics
4	Alex Colaco	Physics
5	Sheba Raichel	Physics
6	Joseph Pinto	Physics
7	Mayur Atvekar	Geology
8	Arthi Naik	Economics
9	Akshay Shiroadkar	Computer Science
10	Rahul Jiddi	Geography

**Team 2: Waste Management Champions**

<b>Sr. No.</b>	<b>Name of Student</b>	<b>Department</b>
1	Mueen Madhwani	Botany
2	Daksh Raikar	Botany
3	Mafren Riston Peixoto	Botany
4	Malaica Jacinta D'silva	Geography
5	Vedhangee Juvekar	Zoology
6	Rohan Naik	Geography

**Team 3: Biodiversity Champions**

<b>Sr. No.</b>	<b>Name of Student</b>	<b>Department</b>
1	Kartik Ramesh Redkar	Zoology
2	Marlon Cristiano De Sousa	Zoology
3	Shenya Greta Barbosa	Zoology
4	Daze Cardozo	Zoology
5	Uma Hari Pednekar	Zoology
6	Richa Ulhas Komarpant	Botany
7	Sunita Sharma	Botany
8	Jennis Simoes	Botany
9	Rajeshwari Ravindra Parab	Geography

The Students worked on this assignment as a part of their Internship hours.

## **2 Green Audit Process and Methodology**

### **2.1 The Process**

The following Process was followed for the Green Audit:

- Introductory Meetings with Principal Dr. Nandakumar Sawant and Vice-Principal Mrs Shaila Ghanti to fix up the scope of the Audit
- Finalization of the Audit schedule
- Formation of the Audit team (which included three groups viz. Energy, Waste and Biodiversity) including the Teacher co-ordinators
- Introductory meeting to brief the Team about the scope and Audit process; sharing of the required documents, worksheets, etc. In-depth discussion with the three groups w.r.t the corresponding Audit Tasks.
- Completion of the Audit Tasks as outlined in the Worksheets by the groups
- Compilation of all findings
- Combined Review Session to understand and share observations of the groups.
- Collection of supporting data, photos, maps, etc. as required
- Conduction of Community Outreach Program
- Preparation of Report and submission to the College Management
- Continuous updation of the Report as per new activities and findings on the Campus

### **2.2 Methodology**

The Methodology adopted for the Audit was participatory, since it was believed by M/s Shubhankar and the College Management that once ownership was taken by the Students, a lot of effort towards environmental conservation could be easily undertaken by the College. Such Student participation would also be crucial to ensure that the message was passed on to them effectively through hands-on activities. This would ensure a long-lasting impact and Students could act as Agents of Change in their future workplaces and drive environmental activities there. This Audit would also provide exposure to career opportunities in the field of environment by exposing students to different hands-on activities.

The Green Audit adopted the following methodology:

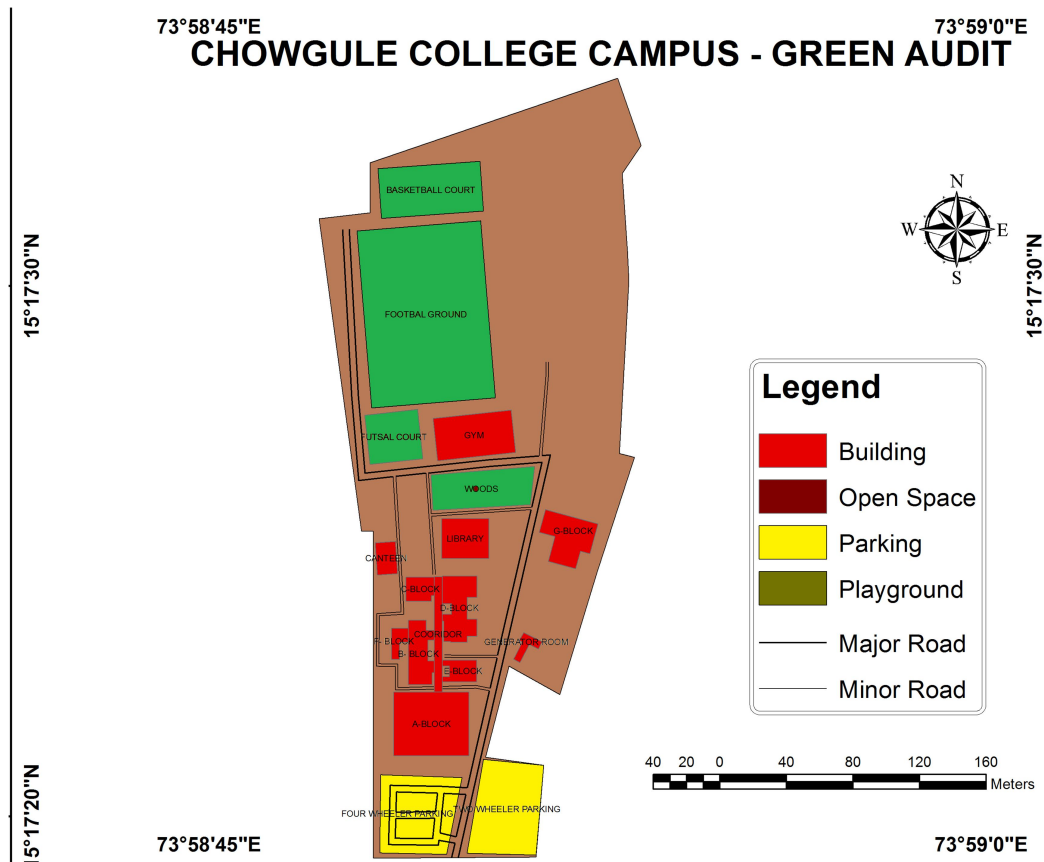
- Reading related literature and inspirational stories
- Analysis of secondary data such as Electricity Bills, etc.
- Actual Observation of various parameters/aspects

- On-field measurements as applicable
- Photo documentation and basic GIS mapping
- Semi-structured interviews and interactions with relevant stakeholders
- Compilation of findings

A Compilation of the various Green Initiatives taken by the College in the past was given as a ready reference to the Project Team. The Report appears at Annexure D. for reference. However, the facts reported in this Report are mainly as observed during the Course of this Green Audit.

With this background, this Green Audit Report shall now move ahead to explain the detailed observations around each of the three parameters: Waste, Energy and Biodiversity.

For the purpose of the Audit, the College Campus was divided into Sections as shown below:



The following Chapters shall describe the activities of the three Groups and analysis of the findings.

### 3 Waste Audit

The Waste Audit included the systematic study of waste from generation to disposal along with identification of opportunities for Reduce-Reuse-Recycle.

For the purpose of the Audit, the College campus was divided into sections as follows:

Section No.	Name of Section	Nature (Indoor, Outdoor, Indoor + Outdoor, etc.)	App. total area (sq.m.)
1	Canteen	Indoor	772.47
2	Woods	Outdoor	1150
3	Parking Lot	Outdoor	5431.93
4	OIT / Library	Indoor	1509.53
5	A Block	Indoor	1891.72
6	B Block	Indoor	793.33
7	C Block	Indoor	238.44
8	D Block	Indoor	990.62
9	G Block	Indoor	992.16
10	Road	Outdoor	307m (Length)
11	Ground	Outdoor	11539
12	CS Dept	Indoor	304.74

Table 1: Sections for the Green Audit (Source: GIS Data provided by Geography Dept.)

Each section was assigned to a Student for the purpose of the Waste Audit.

#### 3.1 Solid Waste Generation

The Solid Waste Generation across various Sections was studied in the form of a checklist and some additional subjective criteria. The Students visited the section assigned to them and filled up the Worksheets. This helped in understanding the overall solid waste generation scenario within the College campus.

A sample worksheet for one of the Sections – Canteen – is given below for reference:

Format 1: Waste Generation Details					
Group Name: Waste Management					Date: 12/11/18
Name of Section Surveyed: <u>Canteen</u>					
Type of Waste	Sub-type	Waste Generation (Please tick mark wherever applicable, cross where not applicable)	Is the quantum of this type of waste generated usually constant or variable during the year? (Write Constant/Variable)	On an average how can you rate the Quantum of this kind of waste generated in this Section? (High/Medium/Low)	Mark the highest three types of waste generated in this Section (Give numbers 1,2 & 3)
<b>Paper</b>	Print paper	✓	Constant	Low	1
	Newspaper	X	X	X	X
	Cardboard	X	X	X	X
	Litmus Paper	X	X	X	X
	Filter Paper	X	X	X	X
	Old Answer Sheets	X	X	X	X
	Any other paper (pl. specify): _____	X	X	X	X
<b>Plastic</b>	PET Bottles	✓	Constant	High	1
	Hard Plastic	X	X	X	X
	Thin Plastic including wrappers, films, etc.	✓	Variable	Low	
	Plastic Bags	X	X	X	X
	Disposable plastic containers	✓	Variable	Low	3
	Any other type of plastic waste (pl. specify): Straws	✓	Constant	Medium	2



<b>Glass</b>	Beverage bottles	X	X	X	X
	Lab items	X	X	X	X
	Any other glass waste	X	X	X	X
<b>Other</b>	Aluminum foil	✓	Variable	Low	3
	Aluminum cans	✓	Constant	Medium	2
	Tetrapak	✓	Constant	High	1
	Thermocol	X	X	X	X
<b>Any other dry waste please specify</b>	-	-	-	-	-

Table 2: Waste Generation Form

This method was followed for all the Sections to get an overall understanding of the waste generated. Thereafter, all these Section-wise tables were compiled into a single sheet and the same appears next.

Format 2: Summary of Waste Generation in the Campus													
Group Name: <i>Waste Management</i>		Date: 15/11/18											
Type of	Sub-type	Section 1	Section 2	Section 3	Section 4	Section 5	Section 6	Section 7	Section 8	Section 9	Section 10	Section 11	Section 12
	<i>Specify name of Section here --&gt;</i>	Canteen	Woods	Parking Lot	Oil/Library	A Block	B Block	C block	D Block	G Block	Road	Ground	CS Dept.
Paper	Print paper	✓	✓	✓	✓	✓	✓	X	✓	✓	✓	X	✓
	Newspaper	X	✓	✓	✓	✓	X	X	✓	X	X	X	✓
	Cardboard	X	✓	✓	✓	✓	X	X	✓	✓	X	X	✓
	Litmus Paper	X	X	X	X	✓	X	X	X	X	X	X	X
	Filter Paper	X	X	X	X	✓	X	X	X	X	X	X	X
	Old Answer Sheets	X	X	✓	X	✓	✓	✓	✓	X	X	X	✓
	Any other paper (pl. specify):	X	✓	X	✓	✓	✓	✓	✓	✓	✓	X	✓
Plastic	PET Bottles	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	X
	Hard Plastic	X	X	✓	X	X	X	X	X	X	✓	X	X
	Thin Plastic including wrappers, films, etc.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	X
	Plastic Bags	X	✓	✓	✓	✓	X	X	X	✓	X	✓	X
	Disposable plastic containers	✓	X	✓	X	X	X	X	✓	X	✓	✓	X
	Any other type of plastic waste (pl. specify):	X	X	X	X	X	X	X	X	X	X	X	X
Glass	Beverage bottles	X	X	✓	✓	X	X	X	X	X	✓	X	X
	Lab items	X	X	X	✓	✓	✓	X	X	X	✓	X	X
	Any other glass waste	X	X	X	✓	X	X	X	X	X	X	X	✓
Other	Aluminum foil	✓	✓	✓	X	X	X	X	X	✓	X	X	X
	Aluminum cans	✓	✓	✓	X	✓	✓	✓	X	X	X	X	X
	Tetrapak	✓	✓	✓	✓	✓	✓	✓	X	✓	✓	✓	X
	Thermocol	X	✓	✓	X	✓	X	✓	X	✓	X	X	X
Wet Waste	Uncooked wet waste (peels, skins, etc.)	✓	X	✓	X	✓	X	X	X	X	X	X	X
	Food Waste	✓	✓	X	X	✓	X	X	X	✓	X	✓	X
	Leaves, garden waste	X	✓	✓	X	X	X	X	X	X	✓	✓	X
	Any other Wet Waste	X	✓	X	X	X	X	X	X	X	X	X	X
E-waste		X	X	X	✓	X	X	X	X	X	X	X	✓

Table 3: Summary of Waste Generation

Observations from the above Table are as follows:

1. Print paper, PET bottles, Thin plastic wrappers and tetrapak waste is generated in most of the Sections of the College. The number of sections in which these are reported to be generated are tabulated below:

Type of Waste	No. of Sections where it is generated
Print Paper	10
PET Bottles	11
Thin plastic wrappers	11
Tetrapak	10

Table 4: Type of Waste in different Sections

2. W.r.t the qualitative evaluation of the quantum of waste generated, it appears that tetrapak and PET bottles are generated in high volumes on the College campus.

Thus, the waste generation chart can help understand an overall picture of the waste generated within the campus and also help in planning the waste infrastructure and management.

Thereafter the different fractions of waste from the major waste-generating sections of the College were measured using a weighing balance. A table for the same is given next.

(A) Quantification of Waste generated during the Holidays

During Holidays	Quantity of waste generated (all in grams)												
Type of Waste	Section 1	Section 2	Section 3	Section 4	Section 5	Section 6	Section 7	Section 8	Section 9	Section 10	Section 11	Section 12	
Specify name of Section here -->	Canteen	Woods	Parking Lot	Oil/Library	A Block	B Block	C block	D Block	G Block	Road	Ground	CS Dept.	TOTAL
This waste has been generated approximately over how many days?	One day	One day	One day	One day	One day	One day	One day	One day	One day	One day	One day	One day	
Paper	34	376	0	30	54	12	75	50	0	0	20	0	651
Cardboard	0	0	0	0	0	0	46	0	0	0	0	0	46
PET Bottles	27	0	80	160	40	0	0	20	0	122	20	20	489
Tetrapak	22	0	0	0	62	0	80	8	0	60	70	0	302
Hard Plastic	0	0	0	0	0	0	0	0	0	0	0	0	0
Non-recyclable plastics and other waste (thermocool, all multilayered packaging like chips, biscuit packets, old footwear, old clothes, old bags, etc.)	0	0	0	0	0	0	0	0	0	0	0	0	0
Glass Waste	0	0	0	0	0	0	0	0	0	0	0		0
Aluminium foils/ cans	9	0	50	0	0	0	20	10	10	0	0	50	149
Wet Waste	10	0	0	0	0	0	0	0	0	0	0		10
Any other Waste (plastic)	5	10	20	0	0	0	0	1	1	0	0	10	47
Metal	0	114	0	0	0	0	0	0	0	268	0	0	382
												Grand Total	2076

Table 5: Waste Quantification during Holidays

(B) Quantification of Waste generated when the College is operational

During College operation		Quantity of waste generated (all in grams)											
Type of Waste	Section 1	Section 2	Section 3	Section 4	Section 5	Section 6	Section 7	Section 8	Section 9	Section 10	Section 11	Section 12	
Specify name of Section here -->	Canteen	Woods	Parking Lot	Oil/Library	A Block	B Block	C block	D Block	G Block	Road	Ground	CS Dept.	TOTAL
This waste has been generated approximately over how many days?	One day	One day	One day	One day	One day	One day	One day	One day	One day	One day	One day	One day	
Paper	75	1000	20	60	120	130	125	100	30	40	10	75	1785
Cardboard	50	50	16	170	170	20	20	50	0	20	0	20	586
PET Bottles	200	40	80	20	20	15	15	30	25	16	2000	12	2473
Tetrapak	100	45	20	10	65	25	30	0	25	10	80	12	422
Hard Plastic	50	60	15	0	20	0	0	0	0	5	0	0	150
Non-recyclable plastics and other waste (thermocool, all multilayered packaging like chips, biscuit packets, old footwear, old clothes, old bags, etc.)	10	55	10	0	0	0	0	0	0	0	0	0	75
Glass Waste	0	0	0	0	0	0	0	0	0	0	0	0	0
Aluminium foils/ cans	100	20	60	30	30	30	35	0	50	40	0	0	395
Wet Waste	500	10	60	0	25	0	0	0	0	0	0	0	595
Any other Waste (plastic)	10	12	0	0	0	0	0	0	0	0	0	0	22
Metal	0	0	0	150	0	0	0	0	0	0	0	0	150
												Grand Total	6653

Table 6: Waste Quantification during College operation

### **3.2 Study of Canteen Waste Generation**

For getting a better overview of the waste generated in the Canteen, a study report undertaken by First Year BSc Students of the College in the year 2018-19 was referred. A presentation about the same can be referred at Annexure B.

From the study, it can be seen that food waste measured in the Canteen was to the tune of 11 kg/day. Other wet waste like peels, etc. would be there in addition to this.

All this wet waste is presently being handed over to the Municipality in mostly mixed form.

It is highly recommended that this waste should be treated in-house to generate compost. A portable biogas could be another option worth exploring; the gas generated from wet waste can be used in the Canteen as a part-substitute for LPG Cylinders. Through interactions with the Canteen Manager, it was understood that the LPG consumption is as follows:

- When College is operational: Around 20 cylinders/month
- When College has holidays: Around 8 cylinders/month

At Rs 1400/cylinder (commercial 19 kg cylinders), the annual costs on LPG come to around Rs 2.85 lakh/year.

From an average 10 kg of wet waste per day, it is proposed to go for a 3 cu.m. biogas. Detailed proposals around this can be called separately by the College.

### **3.3 Solid Waste Segregation**

After studying the waste generation, the waste management infrastructure and the level of segregation was studied. The Table given next captures the same.



Table 7: No segregation of waste on College Campus

Thus the following is evident:

1. There is no/very limited amount of segregation of solid waste generated on the campus.
2. Mixed waste was observed to be present at the Canteen.
3. No labelling of bins for the type of waste to be deposited in the same has been reported for any of the bins, except those in the Parking Lot.
4. Other Waste management infrastructure reported is leaf composters & a vermi-composting bin.
5. In three locations (A, C and G Blocks), a shortfall in the number of Dustbins has been reported which would enable segregation.
6. There seems to be a need for setting up a recycling station to enable the College in starting a recycling program. The location of the Station should be in somewhere near the Canteen. This is because a very high volume of recyclables is generated in the Canteen and hence the Recycling Station should be easily accessible from there.



Section No.	Name of Section	Size of Dustbin* (10 l/ 20 l/ 50 l/ 1100 l, etc.)	No. of bins	Do the Dustbins have labels as to what kind of waste is to be put into them? (Yes/No/Some have)	Is the waste in the Dustbins usually segregated into dry and wet waste? (Yes/No/ Somewhat)	No. of days after which the dustbins are emptied (1/2 day, 1 day, 7 days, 15 days, No set frequency, etc.)	Do you usually see waste anywhere else in the Section other than the Dustbins? (Yes/No/ Sometimes)	Any other waste management infrastructure seen (e.g.: Composting unit/leaf composter/shredder, etc.)	Do you feel that more dustbins are required in this Section to ensure segregation into dry and wet waste?	Gap in the No. of Dustbins (Column J - Column D)	Any other Observations/ Remarks
A	B	C	D	E	F	G	H	I	J	K	L
1	Canteen	30	14	No	No	1	No	Vermi-composting bin	No	-	Recycling Of Paper
2	Woods	30	14	No	No	1	No	Yes	No	-	
3	Parking Lot	100	4	Yes	Yes	1	No	No	No	-	
4	Oil/Library	30	5	No	No	1	No	No	No	-	
5	A Block	50	37	No	No	1	No	No	No	-	
6	B Block	5	45	No	No	1	No	No	Yes	10	
7	C block	5	3	No	No	1	No	No	Yes	7	
8	D Block	5	46	No	No	1	No	No	No	-	
9	G Block	5	5	No	No	1	No	No	Yes	4	
10	Road	30	15	No	No	1	No	Leaf composters	No	-	
11	Ground	30	9	No	No	1	No	No	No	-	
12	CS Dept.	5	15	No	No	1	No	No	No	-	

**Table 8: Waste Management Infrastructure**

After the previous exercise where the segregation and quantification of dry waste was undertaken, the same data was used to extrapolate the generation of waste within the campus over a period of one month. Also, considering the recycling rates offered by a nearby authorized waste management agency, the amount of income possible to be generated from the College was roughly estimated. For this, waste generation during both, College holidays and when the College is operational have been considered.

(A) Estimation of income from sale of recyclables during the Holidays

Format 4b: Extrapolation and Value Estimation: DURING HOLIDAYS															
No.	Section	Paper & Cardboard		PET Bottles		Tetrapak		Hard Plastic		Glass Waste		Aluminium foils/ cans		Non-recyclable plastics and other waste	
		Measured (gms)	Est. (gm/month)	Measured (gms)	Est. (gm/month)	Measured (gms)	Est. (gm/month)	Measured (gms)	Est. (gm/month)	Measured (gms)	Est. (gm/month)	Measured (gms)	Est. (gm/month)	Measured (gms)	Est. (gm/month)
1	Section 1	34	850	27	675	22	550	0	0	0	0	9	225	0	0
2	Section 2	376	9400	0	0	0	0	0	0	0	0	0	0	0	0
3	Section 3	0	0	80	2000	0	0	0	0	0	0	50	1250	114	3420
4	Section 4	30	750	160	4000	0	0	0	0	0	0	0	0	0	0
5	Section 5	54	1350	40	1000	62	1550	0	0	0	0	0	0	0	0
6	Section 6	12	300	0	0	0	0	0	0	0	0	0	0	0	0
7	Section 7	121	3025	0	0	80	2000	0	0	0	0	20	500	0	0
8	Section 8	50	1250	20	500	8	200	0	0	0	0	10	250	0	0
9	Section 9	0	0	0	0	0	0	0	0	0	0	10	250	0	0
10	Section 10	0	0	122	3050	60	1500	0	0	0	0	0	0	268	8040
11	Section 11	20	500	20	500	70	1750	0	0	0	0	0	0	0	0
12	Section 12	0	0	20	500	0	0	0	0	0	0	50	1250	0	0
	TOTAL (gms)	697	17425	489	12225	302	7550	0	0	0	0	149	3725	382	11460
	TOTAL in Kg	0.697	17.425	0.489	12.225	0.302	7.55	0	0	0	0	0.149	3.725	0.382	11.46
Sale of Recyclables															
	Rate (Rs/kg)		2		15		3		7		1		40		TOTAL INCOME (Rs/month)
	Probable Income		34.85		183.38		22.65		0		0		149		389.88

Table 9: Estimated value generation from waste during Holidays

(B) Estimation of income from sale of recyclables when the College is operational:

Format 4b: Extrapolation and Value Estimation: DURING COLLEGE OPERATION															
No.	Section	Paper & Cardboard		PET Bottles		Tetrapak		Hard Plastic		Glass Waste		Aluminium foils/ cans		Non-recyclable plastics and other waste	
		Measured (gms)	Est. (gm/month)	Measured (gms)	Est. (gm/month)	Measured (gms)	Est. (gm/month)	Measured (gms)	Est. (gm/month)	Measured (gms)	Est. (gm/month)	Measured (gms)	Est. (gm/month)	Measured (gms)	Est. (gm/month)
1	Section 1	125	3125	200	5000	100	2500	50	1250	0	0	100	2500	10	250
2	Section 2	1050	26250	40	1000	45	1125	60	1500	0	0	20	500	55	1375
3	Section 3	36	900	80	2000	20	500	15	375	0	0	60	1500	10	250
4	Section 4	230	5750	20	500	10	250	0	0	0	0	30	750	0	0
5	Section 5	290	7250	20	500	65	1625	20	500	0	0	30	750	0	0
6	Section 6	150	3750	15	375	25	625	0	0	0	0	30	750	0	0
7	Section 7	145	3625	15	375	30	750	0	0	0	0	35	875	0	0
8	Section 8	150	3750	30	750	0	0	0	0	0	0	0	0	0	0
9	Section 9	30	750	25	625	25	625	0	0	0	0	50	1250	0	0
10	Section 10	60	1500	16	400	10	250	5	125	0	0	40	1000	0	0
11	Section 11	10	250	2000	50000	80	2000	0	0	0	0	0	0	0	0
12	Section 12	95	2375	12	300	12	300	0	0	0	0	0	0	0	0
	<b>TOTAL (gms)</b>	2371	59275	2473	61825	422	10550	150	3750	0	0	395	9875	75	1875
	<b>TOTAL in Kg</b>	2.371	59.275	2.473	61.825	0.422	10.55	0.15	3.75	0	0	0.395	9.875	0.075	1.875
<b>Sale of Recyclables</b>															
	<b>Rate (Rs/kg)</b>		2		15		3		7		1		40		<b>TOTAL INCOME (Rs/month)</b>
	<b>Probable Income</b>		118.55		927.375		31.65		26.25		0		395		<b>1498.825</b>

Table 10: Estimated value generation from waste during College operation



Figure 2: Measurement of waste

Thus, as per the preliminary calculations for waste quantification, the probable income from sale of recyclables (not considering the transport and other costs) shall be as follows:

	Holidays	College operation
Income from sale of recyclables	Rs 309/month	Rs 1500/month
No. of months	3	9
Income in the year	927 Rs/year	13500 Rs/year
<b>TOTAL</b>	<b>Rs 14,427/year</b>	

Table 11: Estimated Annual value generation from waste

### 3.4 Solid Waste Transportation and Disposal

#### 3.4.1 Waste Transportation

The waste transportation infrastructure on the campus was studied, since this is important to ensure that waste segregation is implemented from the point of generation to end disposal. The Table below was used to document the infrastructure.

Section No.	Specify name of Section here -->	Where all is the waste from this Section transported to?	How is the waste transported ? (Manually/trolley bin/ etc.) Also give no. of trolleys, etc. as applicable	Is there a larger bin/recycling station/pit/cage, etc. in the spot where the waste is transported to?	Is the Waste Transported separately (Dry & Wet) or mixed?	App. Distance to the place where the waste is transported	Assuming that segregation at source is taking place, is there presently a provision to transport the waste separately (dry and wet): Yes/ No	Are there any difficulties faced by the Housekeeping staff in transporting the waste?	How high are the chances of spillage of waste during transportation? (High/Low)
1	Canteen	Waste in the bin is directly dumped into the large bin in Parking Lot	Trolley Bins	Yes	No Mixed		No	No	Low, they use thick, Big, black bin bags for transport
2	Woods	Dry Leaves are thrown in Leaf pits	Manually	Yes	No Mixed		No	No	
3	Parking Lot		Manually	Yes	No Mixed		No	No	
4	Oil/Library		Trolley Bins	Yes	No Mixed		No	No	
5	A Block		Trolley Bins	Yes	No Mixed		No	No	
6	B Block		Manually	Yes	No Mixed		No	No	
7	C block		Manually	Yes	No Mixed		No	No	
8	D Block		Manually	Yes	No Mixed		No	No	
9	G Block		Manually	Yes	No Mixed		No	No	
10	Road		Trolley Bins & Manually	Yes	No Mixed		No	No	
11	Ground			Yes	No Mixed		No	No	
12	CS Dept.			Yes	No Mixed		No	No	

Table 12: Waste Transportation infrastructure

The observations are as follows:

- All the waste is transported in a mixed manner from all the Sections.
- Even if the housekeeping staff is instructed to transport the waste in a segregated way, there is no provision for such segregated transportation in the present trolley bins.



Figure 3: Trolley Bin with single compartment

### 3.4.2 Waste Disposal

The next and most important step in the waste management process is the final disposal of all solid waste. As the first step, the different waste disposal infrastructure present on the Campus was noted.



Figure 4: Dustbins for final storage of waste before handing over to Municipality

Thereafter, the mode of disposal of each type of waste was noted. Both these appear in the following tables.



Sr. No.	Description	Location	Is the location inside or outside the campus?	What kind of waste is disposed here? Note the types; e.g mixed paper, plastic, glass, etc.	Is the waste segregated or mixed?	Is waste being burnt? Or are there any signs that waste has been burnt previously?	Are there dogs/cows or other animals scavenging the waste?	Does anyone else (other than College) dump waste in this spot? (Yes/ No/ Don't know)	Any other Observations
1	Waste Storage Bins	Near Bike Parking	Inside	2 Bins are present one for plastic waste and other is for rest	One bin for plastic, other isn't segregated	No	No	No	Waste from these Bins is handed over to the Municipality
2	Leaf Pit	Behind ATM	Inside	Leaves only	Segregated	No	No	No	There Are other Leaf Pits also beside this in campus
3	Sonsodo (Waste Management Site of the Municipality)	Around 1.5 km from College Gate	Outside	Mixed	Mixed	No	No	College hands over to Municipality, who dumps the waste here	No
4	Vermi-composting Bin	Near Canteen	Inside	Wet Waste; but not used presently	NA	No	No	NA	The Bin can immediately be put to use for the uncooked food waste generated in the Canteen
5	Leaf Composters	Along Main Road inside the Campus	Inside	Leaves only	Segregated	No	No	No	No

**Table 13: Waste Disposal Infrastructure**

Type of Waste	Present Method of Disposal (E.g.: Picked up by Municipality, Dumped within Campus, Dumped outside Campus, Burnt, Shredded & sold, Given for Recycling, Composted, etc.)	Manner of Disposal (Mixed Wet + Dry/ Mixed Dry/ Segregated)	What is the recycling potential for this type of waste in the Campus? (High/Moderate/No potential)	How intense is the health and environment hazard of the present method of disposal of this type of waste? (High/Medium/Low)	What do you think is the most safe method of disposing this type of waste?	What all efforts will be required to ensure safest way of disposal? (Tick all applicable)					
						Additional Infrastructure	Additional housekeeping Staff	Students' participation	Training of Housekeeping staff	Typing up with Recycling Agency	Any other requirement
Paper	Municipality	Mixed	High	Low	Recycle			✓	X	✓	
Cardboard	Municipality	Mixed	High	Low	Recycle			✓	X	✓	
PET Bottles	Municipality	Mixed	High	Low	Recycle and reuse			✓	X	✓	
Tetrapak	Municipality	Mixed	High	Low	Recycle			✓	X	✓	
Hard Plastic	Municipality	Mixed	High	Low	Recycle			✓	X	✓	
Non-recyclable plastics and other waste	Municipality	Mixed	No Potential	Low	Waste Treatment plant			✓	X	X	
Glass Waste	Sent back to company	Mixed	No Potential	Low	Recycle			✓	X	✓	
Aluminium foils/cans	Municipality	Mixed	High	Low	Recycle			✓	X	✓	
Food Waste	Municipality	Mixed	Moderate	Low	Vermicompost			✓	✓	X	
Dry Leaves	Dumped inside	Mixed	Moderate	Low	Leaf Pits			X	✓	X	
E-waste	Dumped inside	Mixed	High	Medium	Recycle			X	✓	✓	

Table 14: Waste Disposal methods

### Observations:

- Leaf composting is being done on Campus and is a very good initiative
- Almost all the waste is disposed by handing it over in a mixed manner to the Municipality.
- There is a huge scope for setting up a Recycling program for around 85-90% of the waste and only the non-recyclable component should be handed over to the Municipality.
- Wet waste from the Canteen is handed over in a mixed form to the Municipality. The vermi-composting bin which is very well designed is lying idle right next to the Canteen. Hence, at least the uncooked wet waste could be easily vermin-composted in this bin. This will generate excellent quality vermi-compost which is the best form of manure for plants. This initiative should be immediately taken up.



Figure 5: Vermi-compost Bin present near canteen

### 3.5 3-R analysis

On this background, a brief 3-R analysis was done to understand the Reduce-Reuse-Recycle Opportunities for different types of waste.

Sr. no.	Type of Waste	Type of Opportunity (Reduce/ Reuse/ Recycle)	In which Sections this can be implemented?	Level of Impact of this initiative in overall safe waste management (High Impact/ Medium Impact/ Low Impact)	Stakeholders (Who all have to participate to make this happen)	Challenges (if any)	Suggested Priority of this opportunity (High/ Medium/ Low)
1	Paper	Recycle	A Block	High Impact	Students and Staff	Availability of recycling Facility, Segregation know-how for staff, Students & Attitude towards segregation	High
2	Plastic	Recycle / Reuse	Woods	Medium Impact	Students and Staff		High
3	Glass Bottles	Recycle	Canteen	High Impact	Students and Staff		Medium
4	Aluminium Cans	Recycle	Canteen	High Impact	Students and Staff		High

**Table 15: Identifying 3R opportunities**

### **3.6 Status of E-waste Management**

According to the E-waste Management Rules 2016, 'e-waste' means electrical and electronic equipment, whole or in part discarded as waste by the consumer or bulk consumer as well as rejects from manufacturing, refurbishment and repair processes.

Educational Institutions fall under the category of “bulk consumer” as per the Rules. The Rules state that the responsibilities of consumer or bulk consumer are as follows:

1. Consumers or bulk consumers of electrical and electronic equipment listed in Schedule I shall ensure that e-waste generated by them is channelized through collection centre or dealer of authorised producer or dismantler or recycler or through the designated take back service provider of the producer to authorised dismantler or recycler;
2. Bulk consumers of electrical and electronic equipment listed in Schedule I shall maintain records of e-waste generated by them in Form-2 and make such records available for scrutiny by the concerned State Pollution Control Board
3. Consumers or bulk consumers of electrical and electronic equipment listed in Schedule I shall ensure that such end-of-life electrical and electronic equipment are not admixed with e-waste containing radioactive material as covered under the provisions of the Atomic Energy Act, 1962 (33 of 1962) and rules made there under
4. Bulk consumers of electrical and electronic equipment listed in Schedule I shall file annual returns in Form-3, to the concerned State Pollution Control Board on

or before the 30th day of June following the financial year to which that return relates.

On this background, a quick survey of the E-waste on campus was conducted and for the purpose of this survey, Schedule I of the Rules was used. The same appears next.

Sr. No.	Categories of electrical and electronic equipment	Electrical and electronic equipment code
i.	Information technology and telecommunication equipment :	X
	Centralised data processing: Mainframes, Minicomputers	ITEW1 ✓
	Personal Computing: Personal Computers (Central Processing Unit with input and output devices)	ITEW2 ✓
	Personal Computing: Laptop Computers(Central Processing Unit with input and output devices)	ITEW3 ✓
	Personal Computing: Notebook Computers	ITEW4 X
	Personal Computing: Notepad Computers	ITEW5 X
	Printers including cartridges	ITEW6 ✓
	Copying equipment	ITEW7 ✓
	Electrical and electronic typewriters	ITEW8 ✓
	User terminals and systems	ITEW9 X
	Facsimile	ITEW10 X
	Telex	ITEW11 X
	Telephones	ITEW12 X
	Pay telephones	ITEW13 X
	Cordless telephones	ITEW14 ✓
	Cellular telephones	ITEW15 ✓
	Answering systems	ITEW16 X
ii.	Consumer electrical and electronics:	
	Television sets (including sets based on (Liquid Crystal Display and Light Emitting Diode technology)	CEEW1 ✓
	Refrigerator	CEEW2 X
	Washing Machine	CEEW3 X
	Air-conditioners excluding centralised air conditioning plants	CEEW4 X
	Fluorescent and other Mercury containing lamps	CEEW5 X

Table 16: Basic E-waste Inventory

- There is a stock of E-waste present on Campus that needs to be disposed.
- Presently, the College scraps the E-waste as per requirement. However, this is not done through an Agency authorized for handling E-waste.

- Thus, in order to comply with the E-waste management Rules so as to ensure safe disposal of E-waste, it is essential to immediately set up an E-waste Management initiative in the Campus. This should be done through authorized E-waste handlers only; and certificate of safe disposal should also be taken from the Recycler.
- Required Returns (Form 3) should be submitted to the State Pollution Control Board to ensure compliance against the E-waste Rules.

## 4 Energy Audit

As a part of the Green Audit, a walk-through Energy Audit of the College was conducted. The process for the same was as follows:

- Basic discussion and collection of preliminary information through
- Compilation of data from the Electricity Bills
- Preparation of detailed inventory list of various appliances in the premises
- Actual Measurement of few parameters
- Analysis based on the above to find out ENCON (Energy conservation) methods
- Estimation of the Solar PV potential of the College
- Report preparation

For the purpose of the Energy Audit, sections similar to the ones mentioned in Chapter 3 were used.

### 4.1 Overview of Energy Scenario of the College

To get an overview of the Energy scenario of the College, the first step was to understand what energy sources are used and for what purpose. The Table given next summarizes this:

Energy Source	Purposes for which it is used	Relative amount of utilization (Low/Medium/High)	Nature of utilization (Regular/Intermittent)
Electricity	Indoor lighting, outdoor lighting, cooling, ICT, heating, security, pumps, lab equipment, etc.	High	Regular
Diesel	College bus, DG Set	Medium	Intermittent
LPG	Lab burners, Canteen	Medium (Lab burners), High (Canteen)	Regular

Table 17: Energy sources and their Use

Thus, Electricity is the major energy source used on the Campus. The Energy Audit focussed on Electricity while carrying out the various activities.

## 4.2 Study of Energy Meters and Bills

The first step of the Audit was to study secondary data. An activity was carried out to identify the Electrical meters on the campus and their connected loads.

It was observed that while there is only one Main meter which is being used by the Electricity Department for billing, the College has installed sub-meters in a few locations for understanding individual electrical consumption of different areas.

Details of the said main meter are as follows:

Meter No.	Tariff Category	Sanctioned Load (kW/HP)	Loads from which areas are connected to this Meter?	Meter Location	Present Meter Status (Active/Not Working)
12042166	HTC	450	Entire College Load is connected	PARKING	ACTIVE

Table 18: Details of Main Meter

Details of the sub-meters are as follows:

Sr. No.	Loads from which areas are connected to this Meter?	Meter Location	Present Meter Status (Active/Not Working)
1	Football, Futsal, Multi-purpose Court	Near Futsal	Active
2	Canteen, Toilet Block	Near Canteen	Active
3	Full gym, Jacuzzi, Physiotherapy	Near Gym	Active
4	Entire G Block	In Basement of G-Block	Active

Table 19: Details of Sub-meters

The electricity bills of the College (Main Meter) were studied to find out trends in consumption of electricity. A table of the same appears next.



**Analysis of Electrical Bills for the period from April'17 to October'18:**

Meter No. 12042166

Tariff category: HTC

Sanctioned Load: 450 kVA

Avg. Power Factor: 0.92

Sr.No.	From (Date)	To (Date)	Period	Units Consumed	Total Bill Amount	Days billed	Units/day	Average cost of Electricity (Rs/kWh)	Meter Status	Billing Basis
1	01-Oct-18	01-Nov-18	Oct-18	49760	425792	31	1605.1	5.7	ok	actual
2	01-09-2018	01-10-2018	Sep-18	44180	380811	30	1472.6	5.7	ok	actual
3	01-08-2018	01-09-2018	Aug-18	47770	402168	31	1540.9	5.7	ok	actual
4	01-07-2018	01-08-2018	Jul-18	44030	376200	31	1420.3	5.7	ok	actual
5	01-06-2018	01-07-2018	Jun-18	32610	347646	30	1087.0	5.7	ok	actual
6	01-05-2018	01-06-2018	May-18	35390	366752	31	1141.6	5.7	ok	actual
7	01-04-2018	01-05-2018	Apr-18	44410	435142	30	1480.3	5.7	ok	actual
8	01-03-2018	01-04-2018	Mar-18	54880	504032	31	1770.3	5.7	ok	actual
9	01-02-2018	01-03-2018	Feb-18	35100	NA	28	1253.6	5.7	ok	actual
10	01-01-2018	01-02-2018	Jan-18	54400	NA	31	1754.8	5.7	ok	actual
11	01-12-2017	01-01-2018	Dec-17	36980	363898	31	1192.9	5.7	ok	actual
12	01-11-2017	01-12-2017	Nov-17	33840	340719	30	1128.0	5.7	ok	actual
13	01-10-2017	01-11-2017	Oct-17	47620	440629	31	1536.1	5.7	ok	actual
14	01-09-2017	01-10-2017	Sep-17	48250	NA	30	1608.3	5.7	ok	actual
15	01-08-2017	01-09-2017	Aug-17	44700	327761	31	1441.9	5.7	ok	actual
16	01-07-2017	01-08-2017	Jul-17	47190	338242	31	1522.2	5.7	ok	actual
17	01-06-2017	01-07-2017	Jun-17	41590	447996	30	1386.3	5.7	ok	actual
18	01-05-2017	01-06-2017	May-17	43040	460173	31	1388.3	5.7	ok	actual
19	01-04-2017	01-05-2017	Apr-17	46980	493574	30	1566.0	5.7	ok	actual

Table 20: Analysis of Electricity Bills



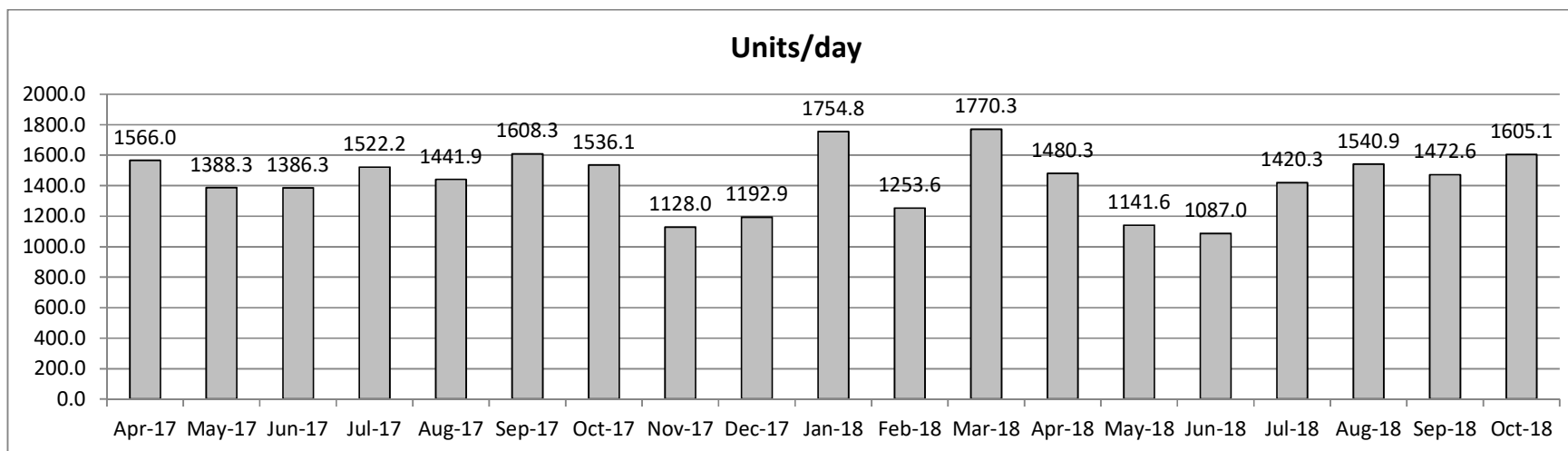


Figure 6: Units consumed per day

Observation of the maximum Demand recorded was made from the Electricity Bills and the same is given below:

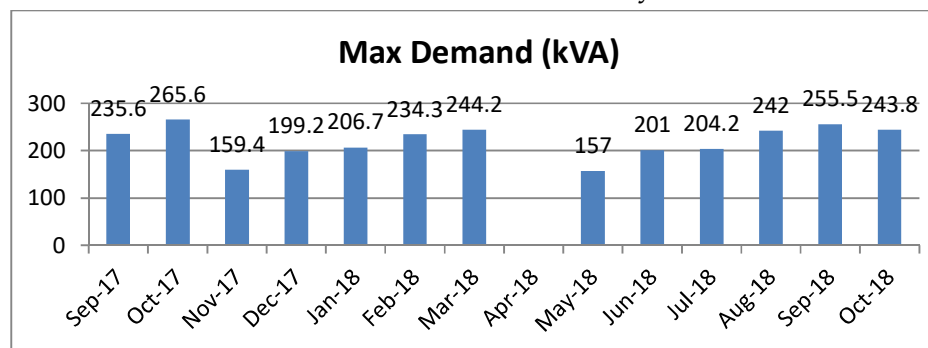


Figure 7: Trend of maximum demand

**Observations:**

1. The Meter has been working over the entire period from April 2017 to October 2018 (19 months) and the Billing Basis is “actual”.
2. The average consumption is 43827 kWh/month & average daily consumption is 1436 kWh.
3. The Sanctioned load for the College is 450 KVA. The Maximum Demand of the College noted between the period from Sep’17 to Oct’18 can be seen to be a maximum of 265.6 kVA in the month of Oct-17. The maximum demand recorded in 2018 is 255.5 kVA. This is around 57% of the Sanctioned Load.
4. Thus, there is substantial scope for reduction of the Sanctioned Load. Assuming the maximum recorded demand to be 256 kVA, if the maximum demand is to be kept around 85% of the Sanctioned Load, then the Sanctioned Load can be reduced to  $(256/0.85)$  300 kVA, instead of the present 450 kVA.
5. Reduction in the Sanctioned Load shall mean a reduction in the fixed charges per month @ Rs 250/kVA (Fixed charge levied by the Electricity Department). The College is presently paying an amount of close to Rs 95000/ month i.e. around Rs 11 lakhs per year as fixed charges. With the reduction of Sanctioned Load to 300 kVA, the saving per month shall be  $(450-300)*250 =$  Rs 37500/month. This amounts to a saving of Rs 4,50,000/- per year.
6. There is significant variation in the consumption of electricity across the months; with the consumption reducing in the months of November-December. Re-arranging the data differently,

Period	2017 Units/Day	2018 Units/day
Dec	1192.9	NA
Nov	1128.0	NA
Oct	1536.1	1605.1
Sep	1608.3	1472.6
Aug	1441.9	1540.9
Jul	1522.2	1420.3
Jun	1386.3	1087.0
May	1388.3	1141.6
Apr	1566.0	1480.3
Mar	NA	1770.3
Feb	NA	1253.6
Jan	NA	1754.8

7. The average monthly electricity cost is Rs 4,03,221/- (Rupees four lakh three thousand two hundred and twenty one). With this average figure, the average

annual electricity costs are Rs 4,03,221/- x 12 = Rs 48,38,652/- i.e. around Forty eight lakh rupees per year.

8. The Average Power Factor is 0.92. The Power factor was checked over the period of one year from the Bills, and it was found that the same has always been in the range of 0.92-0.93. There is scope for improvement in the power factor to make it as close to 1 as possible by using Capacitor Bank, etc. The improvement in power factor reduces the reactive component of the power and also can help bring in a financial benefit through the PF Incentive given by the Electricity Department.

The College also provided the Electricity Bills data over the past 5 years and the same is summarized below.

Month	Units Consumed (kWh)				
	FY 2013-14	FY 2014-15	FY 2015-16	FY 2016-17	FY 2017-18
Apr	55,540	61,380	60,910	30910	46980
May	52,400	50,580	49,070	40570	43040
Jun	49,860	55,690	57,510	40190	41590
Jul	63,270	57,690	66,000	53280	47190
Aug	65,560	57,510	62,680	59600	44700
Sep	58,450	62,880	48,600	48990	48250
Oct	58,850	57,940	58,000	46030	47220
Nov	55,190	50,660	47,470	35730	33840
Dec	47,450	45,040	52,150	39270	36980
Jan	65,090	50,400	49,730	46730	54400
Feb	55,010	52,240	51,130	48940	35100
Mar	59,130	55,320	62,750	57050	54880

Table 21: Electricity Bills for past 5 years

From the above table, the following graph is prepared for monthly average energy consumption for the year:

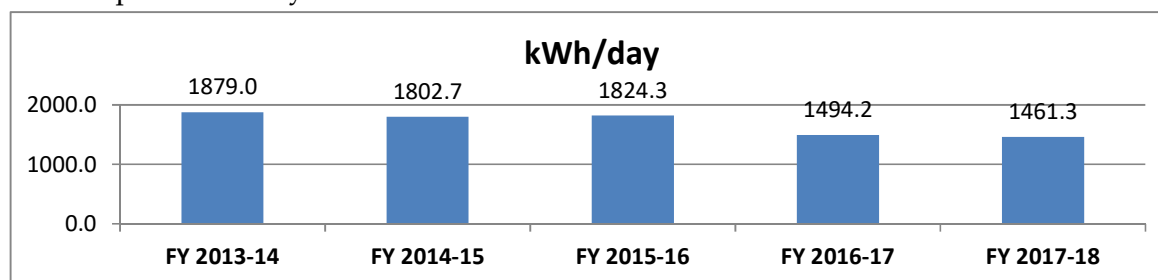


Figure 8: Monthly average energy consumption across years

Thus, it can be seen that the average daily consumption is reducing across the years, which is a positive sign. The reduction in the average daily consumption when

compared for FY 2013-14 and FY 2017-18 (period of four years) is 28%. When the costs of electricity are compared, the following graph comes up:

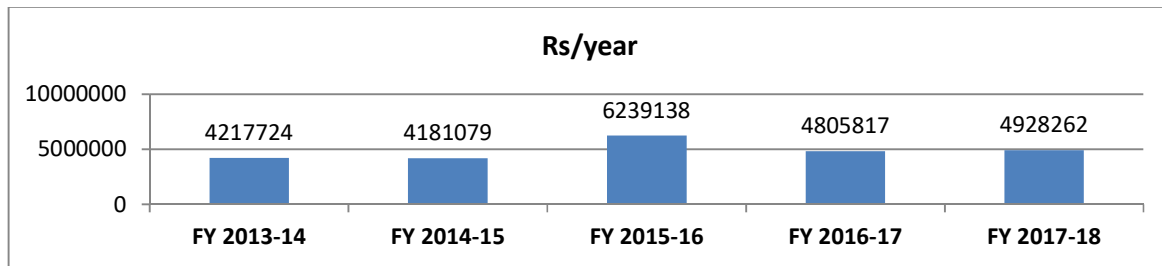


Figure 9: Annual Electricity Billing across years

From the graph it can be concluded that even though the actual consumption of electricity has reduced over the years, the total cost has increased owing to increase in tariff rates.

Thus, the total budget for Electricity costs over the past 5 years has been Rs 2,43,72,019/- i.e around Rs 2.4 crores. Thus, electricity costs have been significant for the College and this further indicates the need for a detailed Energy Audit.

### 4.3 Inventory of Electrical Loads

After studying the Electricity Bills, the next exercise was to make an inventory of all the connected loads. The entire College was divided into different Sections and the Energy Audit team created this detailed inventory of electrical loads. From the Inventory, the following can be observed:

The approximate distribution of Energy Consumption is as follows:

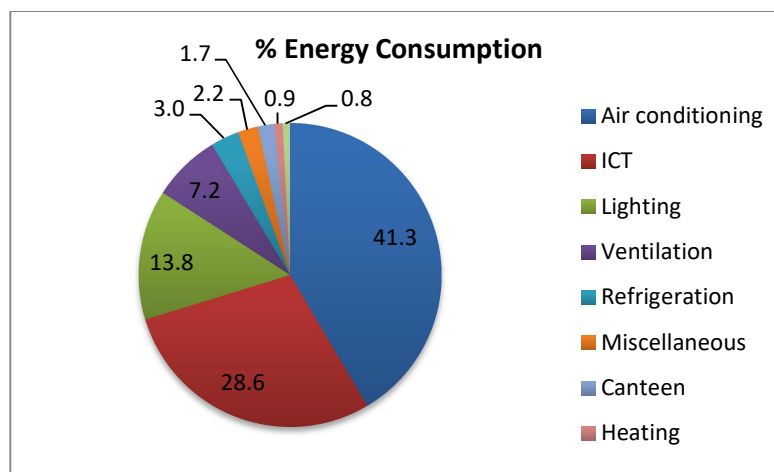


Figure 10: Pie-chart showing energy consumption pattern

Observations:

1. The topmost energy consumption areas are:
  - a. Air Conditioning: Nearly 80 ACs, out of which majority are Split ACs are present as indicated in the Inventory prepared by the Students.
  - b. ICT: This includes projectors, computers, telephones, printers, etc. and is the second highest energy consumption area.
  - c. Lighting: This includes mainly fluorescent tubelights and is the third largest energy consuming area
2. Fluorescent Tubelights are mostly present on the Campus, with minimal LED Lighting. The total proportion of LED lighting in the total lighting consumption is estimated to be less than 2% from the inventorization exercise.
3. Presently, the AC maintenance is mostly only when there is a problem. However, considering the huge component of air conditioning, it seems essential to set out a regular preventive program for AC maintenance.

#### **4.4 Solar PV potential Estimation Study**

A preliminary Solar Potential Estimation Study was carried out as a part of the Green Audit to find out the approximate solar PV potential of the College.

The methodology for the same was as follows:

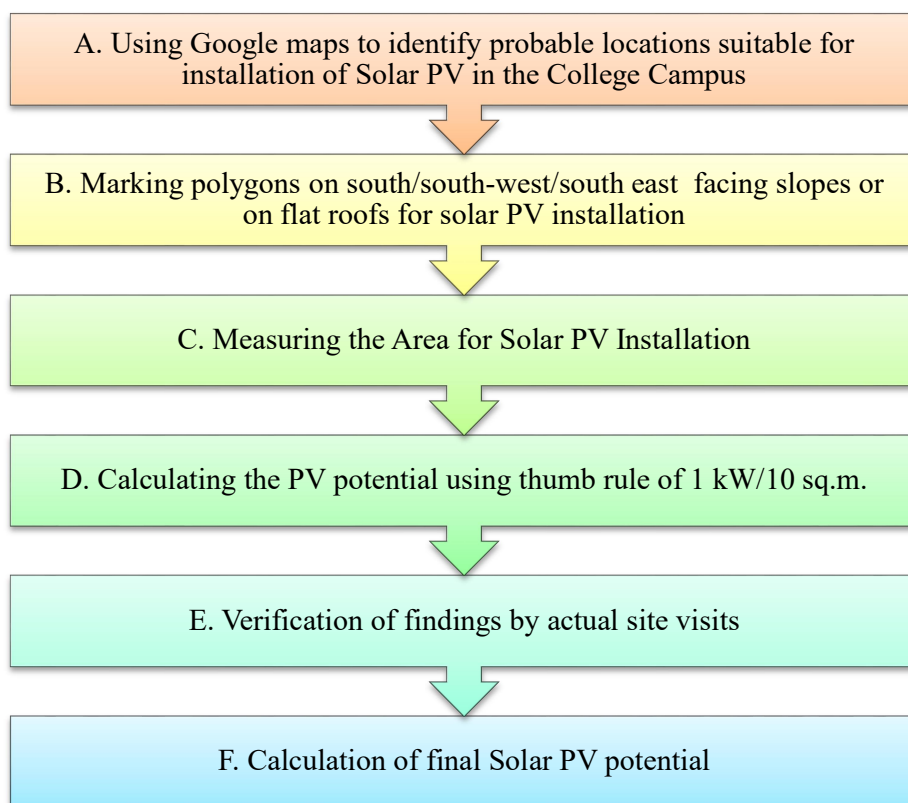


Figure 11: Methodology for Solar PV potential Estimation

This methodology has been adopted from the Report titled “Estimating the Rooftop Solar Potential of Greater Mumbai” published jointly by IIT Bombay, NCAOR, CUSE, IEEE Bombay Section, Observer Research Foundation and Bridge to India.

The detailed Report of this Estimation appears at Annexure A: Solar PV Potential estimation exercise.

From the Study, it can be concluded that the total Solar PV potential of the College is around 121 kW. Considering the average electricity costs as Rs 6.05/kWh, the payback period comes out to be lesser than 5 years.

## 5 Biodiversity Audit

The Campus of Chowgule College hosts a variety of flora and fauna. The purpose of the Biodiversity Audit was to systematically document the biodiversity within the College Campus and to find ways and means of preserving and enhancing the same.

The Biodiversity team for the Green Audit involved Students from Botany and Zoology backgrounds. Flora and Fauna on the College Campus were studied along with photo-documentation of the same. The College was divided into different Sections for the purpose of systematic documentation of Biodiversity. The Results given here are a compilation of all the Sections to represent biodiversity of the Campus as a whole.

### 5.1 Overview of the Campus w.r.t Biodiversity

Using GIS, the entire Campus was mapped with respect to different land use types and a summary of the same appears below:

Name	Area	Pattern
GYM	1209	Building
G-BLOCK	756	Building
LIBRARY	683	Building
B- BLOCK	521	Building
GENERATOR ROOM	115	Building
FUTSAL COURT	952	Building
E-BLOCK	240	Building
C-BLOCK	241	Building
COORIDOR	325	Building
D-BLOCK	689	Building
A-BLOCK	1739	Building
BASKETBALL COURT	1839	Playground
FOOTBAL GROUND	7954	Playground
FOUR WHEELER PARKING	2078	Parking
TWO WHEELER PARKING	2157	Parking
CANTEEN	239	Building
F- BLOCK	136	Building
WASHROOM	100	Building
CEMENTED SURFACE	337	Open Space
H-BLOCK	935	Building
WEATHER STATION	79	Open Space
<b>Total Area</b>	<b>23324</b>	
<b>Approximate Total Campus Area</b>	<b>65242</b>	

Table 22: Mapping of College w.r.t land use types (Source: GIS Data obtained from Geography Dept.)

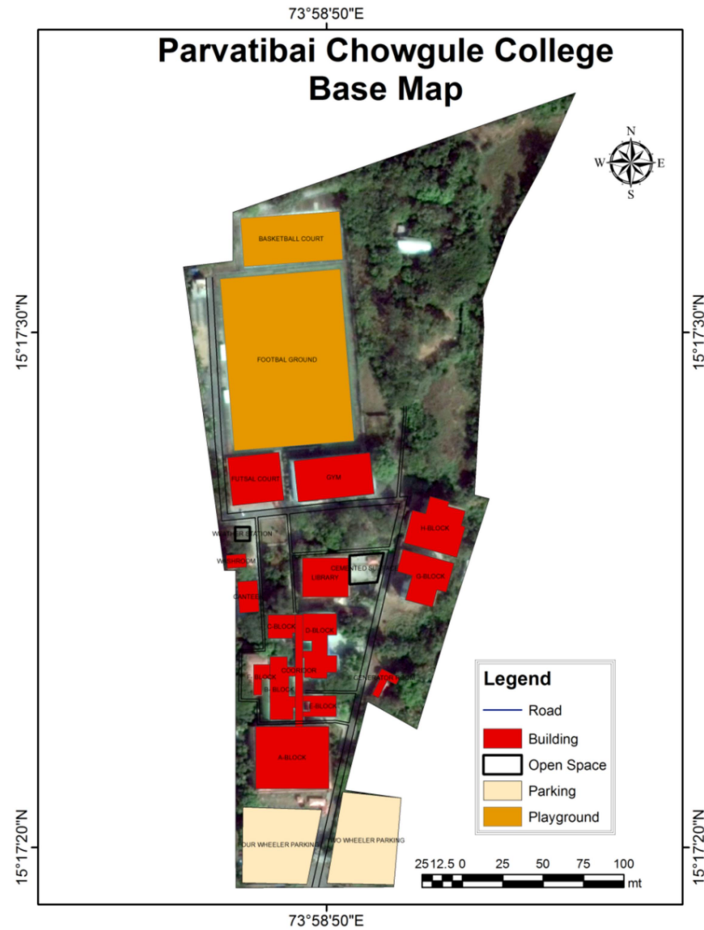


Figure 12: Base Map of College (Source: Geography Dept.)

Hence, the built-up area (including cemented area) of the College is around 36%. Discounting another 15% for the roads, the total green area of the College is around 49%. This includes the green space between the buildings, the woods and the forested area next to the basketball & football courts. This forested area was found to have a lot of biodiversity.

## 5.2 Over-time analysis

For this exercise, the timeline feature of Google Earth was used. Images of the College Campus over the years were retrieved from Google Earth to check any observable changes in the land use and biodiversity of the Campus. The images appear next.





Figure 13: Google Earth Image dated 18/12/2002

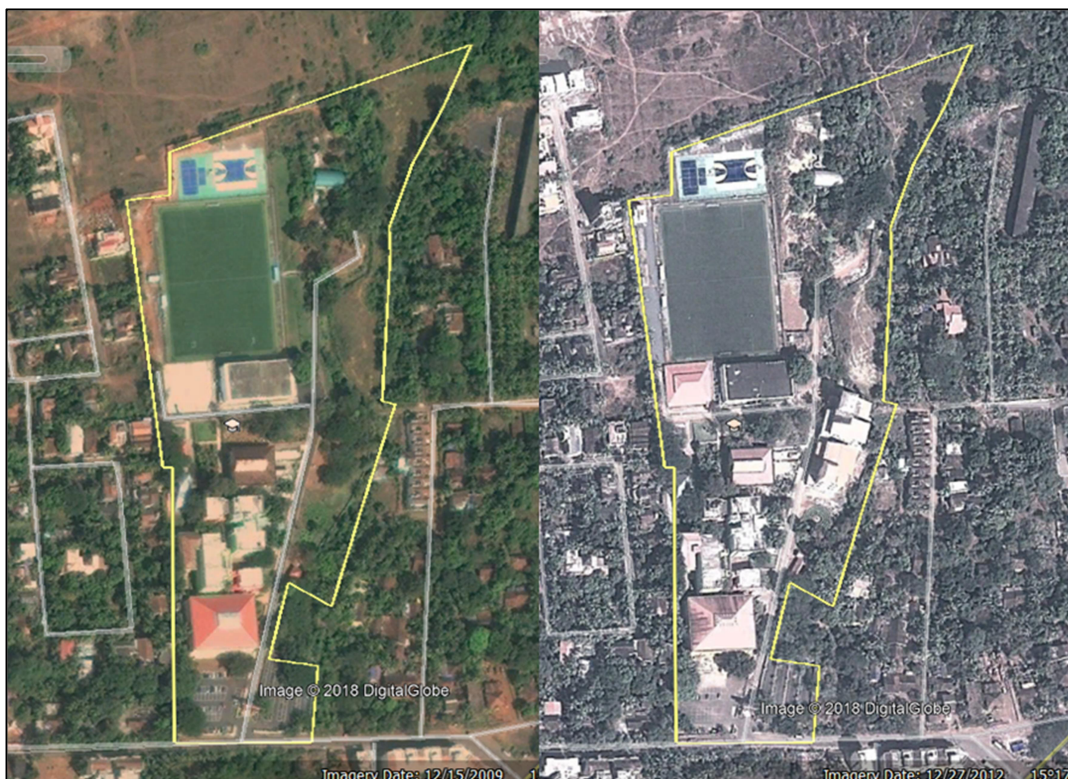


Figure 14: Google Earth Images dated 15/12/2009 and 27/12/2012



Figure 15: Google Earth Images dated 03/04/2015 and 10/03/2018

Thus, from the above images, it can be seen that over the years, the built-up area within the Campus boundary has increased substantially. However, it is evident that the green area has also increased, which is a positive fact with respect to biodiversity.

### 5.3 Detailed documentation of Biodiversity found in the College Campus

A documentation of species found on the Campus was undertaken and the Flora and Fauna reported to be present appears next.

#### 5.3.1 List of Flora

A list of Flora found on the Campus appears next:

FRUIT TREES		
Sr. No.	Scientific Name	Local Name
1	<i>Mangifera indica</i>	Mango
2	<i>Terminalia catappa</i>	Badam
3	<i>Psidium guajava</i>	Guava
4	<i>Cocus nucifera</i>	Coconut
5	<i>Carica papaya</i>	Papaya



6	<i>Artocarpus heretophyllus</i>	Jackfruit
7	<i>Carissa carandas</i>	Bengal currant, carandas plum and karanda
8	<i>Anacardium occidentale</i>	Cashew
9	<i>Murraya koenigii</i>	Curry leaves
10	<i>Tamarindus indica</i>	Tamarind
11	<i>Garcinia indica</i>	Kokum
12	<i>Musa sp.</i>	Banana
13	<i>Syzigium cumini</i>	Jamun, black plum
14	<i>Grewia microcos</i>	Chewra

#### MEDICINAL PLANTS

1	<i>Euphorbia hirta</i>	Asthma-plant
2	<i>Tradescantia spathacea</i>	moses in the cradle
3	<i>Hamelia patens</i>	fire bush
4	<i>Agave tequilana</i>	
5	<i>Tridax procumbens</i>	
6	<i>Hibiscus rosa sinensis</i>	Chinese hibiscus
7	<i>Ocimum tenuiflorum</i>	tulsi
8	<i>Ervetemia coronria</i>	Tagar
9	<i>Clitoria ternatea</i>	Gokarna
10	<i>Nerium oleander</i>	Kanher
11	<i>Anthurium andraeanum</i>	flamingo flower
12	<i>Aloe vera</i>	Aloe, Katkur
13	<i>Caesalpinia pulcherrima</i>	Shankasur/ Kum kum kesari
14	<i>Delonix regia</i>	Flame tree
15	<i>Rosa sp.</i>	Rose
16	<i>Ananas comosus</i>	Pineapple
17	<i>Hibiscus schizopetalus</i>	Japanese hibiscus
18	<i>Impatiens balsamina</i>	Garden balsam
19	<i>Catharanthus roseus</i>	Periwinkle
20	<i>Crossandra infundibuliformis</i>	Aboli
21	<i>Lantana camara var. aculeata</i>	
22	<i>Cosmos sulphureus</i>	Cosmos
23	<i>Cleome viscosa</i>	Asian spiderflower, tick weed
24	<i>Cassia tora</i>	Taykilo
25	<i>Boeharvia diffusa</i>	Punarnava
26	<i>Musa paradisiaca</i>	
27	<i>Bryophyllum pinatum</i>	Air plant/ Panfuti
28	<i>Costus Speriosus</i>	crape ginger
29	<i>Cynadon dactylon</i>	Hariyali
30	<i>Capsicum annum</i>	chilli
31	<i>Capsicum frutescens</i>	chilli
32	<i>Nyctanthes arbortristis</i>	Paarijat, night flowering jasmine
33	<i>Parthenium hysterophorus</i>	congress graas, carrot grass, etc.
34	<i>Chromolaena odorata</i>	Devil weed, siam weed

35	<i>Ficus begalensis</i>	Banyan
36	<i>Agave americana</i>	century plant
37	<i>Bougainvillea spectabilis</i>	Bougainvillea
38	<i>Mangifera indica</i>	Mango
39	<i>Terminalia catappa</i>	Badam
40	<i>Sygzium cumini</i>	Jamun, black plum
41	<i>Lantana montevidensis</i>	Trailing lantana
42	<i>Boehmeria nivea</i>	Ramie
43	<i>Lindernia crustacea</i>	Brittle false pimpernel
44	<i>Abelmoschus esculentus</i>	Okra, ladie's finger
45	<i>Elephantopus scaber</i>	Elephant foot
46	<i>Colocasia esculenta</i>	Taro, cocoyam, Green taro
47	<i>Peperomia pellucida</i>	Pepper elder, shining bush plant
48	<i>Murraya koenigii</i>	Curry tree
49	<i>Hamelia patens</i>	Firebush, hummingbird bush, scarlet bush, redhead
50	<i>Hedyotis corymbosa</i>	Parpat
51	<i>Samanea saman</i>	Monkey pod tree
52	<i>Piper nigrum</i>	Black pepper
53	<i>Akar Cempaka Hutan</i>	Golden-trumpet, Akar Cempaka Hutan
54	<i>Cinnamomum verum</i>	True cinnamon tree, Ceylon cinnamon tree
55	<i>Plumeria rubra</i>	Frangipani, red-jasmine, temple tree
56	<i>Stachytarpheta jamaicensis</i>	Blue porterweed, blue snake weed
57	<i>Alocasia cucullata</i>	Chinese Taro
58	<i>Ipomoea batatas</i>	Sweet Potato, Keledek
59	<i>Mallotus barbatus</i>	
60	<i>Calotropis gigantea</i>	crown flower
61	<i>Adiantum flabellulatum</i>	Fan-leaved Maidenhair
62	<i>Solanum nigrum</i>	European black nightshade
63	<i>Persicaria capitata</i>	Pink knotweed
64	<i>Emilia sonchifolia</i>	Lilac tasselflower, cupid's shaving brush
65	<i>Crassocephalum crepidioides</i>	Okinawa Spinach
66	<i>Momordica charantia</i>	Bitter melon, bitter apple, bitter gourd
67	<i>Cynodon dactylon</i>	Bermuda grass/ Durva
68	<i>Cassia fistula</i>	Bahava
69	<i>Merremia vitifolia</i>	
70	<i>Ixora coccinea</i>	Ixora
71	<i>Couroupita guianensis</i>	Kailashpati
72	<i>Physalis angulata</i>	Cutleaf Ground Cherry

#### TIMBER PLANTS

1	<i>Bambusa</i>	Bamboo
2	<i>Ficus bengalensis</i>	Banyan
3	<i>Casurina equistifolia</i>	fir tree
4	<i>Artocarpus heterophyllus</i>	Jackfruit

5	<i>Mengifera indica</i>	Mango
6	<i>Tamarindus indica</i>	Tamarind
7	<i>Tectona grandis</i>	Teak
8	<i>Polyalthia Longofolia</i>	False ashoka
9	<i>Saraca asoca</i>	Asoka
10	<i>Garcinia indica</i>	Kokum
11	<i>Samanea saman</i>	Monkey pod tree
12	<i>Eucalyptus sp</i>	Blue gum eucalyptus
13	<i>Ficus benghalensis</i>	Banyan
14	<i>Madhuca bourdillonii**</i>	

#### ORNAMENTAL PLANTS

1	<i>Duranta erecta</i>	Brazillian sky flower
2	<i>Sansevieria trifasciata</i>	Snake plant
3	<i>Hippeastrum puniceum</i>	
4	<i>Heliconia psittacorum x spathocircinata</i>	Heliconia golden torch
5	<i>Mimosa pudica</i>	Touch me not
6	<i>Caesalpinia pulcherrima</i>	Peacock flower
7	<i>Catharanthus roseus</i>	Periwinkle
8	<i>Cosmos sulphureus</i>	yellow cosmos
9	<i>Lantana montevidensis</i>	
10	<i>Jatropha integerrima</i>	Peregrina, Spicy Jatropha
11	<i>Solanum torvum</i>	Wild eggplant
12	<i>Plantago asiatica</i>	
13	<i>Hedyotis corymbosa</i>	Diamond flower/ Pittapapda/Poripat
14	<i>Ixora chinensis</i>	
15	<i>Mussaenda pubescens</i>	
16	<i>Caladium bicolor</i>	Fancy leaf caladium
17	<i>Plumeria rubra</i>	
18	<i>Sansevieria trifasciata</i>	
19	<i>Tradescantia spathacea</i>	Boat lily, moses in the cradle
20	<i>Cordyline fruticosa</i>	
21	<i>Allamanda cathartica</i>	
22	<i>Acalypha wilkesiana</i>	Copperleaf, Jacob's coat
23	<i>Lantana camara</i>	
24	<i>Crassula atropurpurea</i>	
25	<i>Syngonium podophyllum</i>	
26	<i>Solanum mammosum</i>	
27	<i>Euphorbia milii</i>	
28	<i>Alocasia macrorrhizos</i>	
29	<i>Adenium obesum</i>	
30	<i>Bougainvillea spectabilis</i>	Bougainvillea

31	<i>Geranium wilfordii</i>	
32	<i>Hibiscus rosasinensis</i>	
33	<i>Jasminum elongatum</i>	Jasmine
34	<i>Sinobambusa</i>	Chines temple bamboo
35	<i>Cycas revoluta</i>	Sago palm
36	<i>Tabernaemontana divaricata</i>	Crape jasmine
37	<i>Agave sisalana</i>	sisal
38	<i>Chrysalidocarpus lutescens</i>	Areca palm
39	<i>Savinia natans</i>	floating fern
40	<i>Costus Speriosus</i>	crape ginger
41	<i>Aphelandra crossandra</i>	Aboli
42	<i>Artabotrys hexapetalus</i>	Manorangini, Hari champa
43	<i>Ravenella madagascariensis</i>	Traveller's palm
44	<i>Elaeis guinensis</i>	African oil palm
45	<i>Delonix regia</i>	Gulmohar
46	<i>Schefflera heptaphylla</i>	English ivy tree
47	<i>Leucaena leucocephala</i>	Subabhul
48	<i>Casuarina equisetifolia</i>	Australian pine tree
49	<i>Caryota urens</i>	Solitary fishtail palm, toddy palm, wine palm, jaggery palm
50	<i>Couropita guianensis</i>	Cannon ball tree
51	<i>Syngonium podophyllum</i>	Goosefoot, African evergreen
52	<i>Asystasia gangetica</i>	Chinese violet, coromandel
53	<i>Sesbania cannabina</i>	Yellow Pea Bush, Sesbania Pea, Prickly Sesban
54	<i>Gliricidia sepium</i>	Quickstick
55	<i>Bauhinia variegata</i>	Purple orchid tree
56	<i>Peltophorum pterocarpum</i>	Copperwood/ yellow flamboyant/ yellow flame
57	<i>Aesculus chinensis</i>	Chinese horse chestnut
58	<i>Revenala madagascarrensis</i>	Travellers palm
59	<i>Michelia champaca</i>	Joy perfume tree
60	<i>Ficus alstissima</i>	Mountain fig
61	<i>Saraca asoka</i>	Ashoka
62	<i>Sanservieria s</i>	
63	<i>Hippeastrum puniceum</i>	Barbados lily
64	<i>Acalypha hispida</i>	Cats tail
65	<i>Bougainvillea glabra</i>	

#### WEEDS

1	<i>Sthagneticola caledulacea</i>	Wedelia
2	<i>Trema tomentosa</i>	Poison peach
3	<i>Mimosa pudica</i>	Touch me not
4	<i>Parthenium hysterophorus</i>	Congress graas, carrot grass, etc.

5	<i>Lygodium palmatum</i>	American climbing fern
6	<i>Gomphrena celosioides</i>	Bachelor's Button, Prostrate Globe-Amara
7	<i>Passiflora foetida</i>	Bush passion fruit, marya-marya, wild water lemon
8	<i>Youngia japonica</i>	Oriental false hawksbeard
9	<i>Oxalis corniculata</i>	Creeping woodsorrel
10	<i>Hedyotis corymbosa</i>	Diamond flower
11	<i>Ricinus communis</i>	Castor bean, castor oil plant
12	<i>Avena fatua</i>	Common wild oat.
13	<i>Urena procumbens L.</i>	
14	<i>Eleusine indica</i>	Indian goosegrass, yard-grass, goosegrass, wiregrass, or crowfootgrass,
15	<i>Eragrostis ferruginea</i>	
16	<i>Cyperus eragrostis</i>	Nutgrass, chufa
17	<i>Panicum virgatum</i>	Switch grass
18	<i>Dactyloctenium aegyptium</i>	Egyptian crowfoot grass, durban crowfoot
19	<i>Setaria viridis</i>	Green foxtail, green bristlegrass, wild foxtail millet
20	<i>Alternanthera sessilis</i>	Sessile joyweed
21	<i>Synedrella nodiflora</i>	Nodeweed
22	<i>Galinsoga parviflora</i>	Quick Weed
<b>OTHER PLANTS</b>		
1	<i>Cratogeomys merriami</i>	
2	<i>Opuntia sp.</i>	

### 5.3.2 List of Fauna

A list of Fauna as observed on the College Campus appears next.

Sr. No.	Scientific Name	Local Name	Type
1	<i>Tetraponera rufonigra</i>	Arboreal bicoloured ant	Ant
2	<i>Camponotus radiatus</i>	Carpenter ant	Ant
3	<i>Apis</i>	Honey bee	Ant
4	<i>Oecophylla</i>	Weaver ant	Ant
5	<i>Anopholepis scolopaceus</i>	Yellow crazy ant	Ant
6	<i>Anopholepis gracilipes</i>	Yellow crazy ant	Ant
7	<i>Dicrurus leucophaeus</i>	Ashy drongo	Bird
8	<i>Eudynamis scolopaceus</i>	Asian koel	Bird
9	<i>Milvus migrans</i>	Black kite	Bird
10	<i>Dicrurus macrocercus</i>	Black drongo	Bird
11	<i>Cyornis rubeculoides</i>	Blue fly catcher	Bird
12	<i>Haliastur indus</i>	Brahminy kite	Bird
13	<i>Alcedo atthis</i>	Common kingfisher	Bird
14	<i>Acridotheres tristis</i>	Common myna	Bird

15	<i>Corvus splendens</i>	House crow	Bird
16	<i>Passer domestica</i>	House sparrow	Bird
17	<i>Saxicoloides fulicatus</i>	Indian robin female	Bird
18	<i>Psittacula krameri</i>	Indian parakeet	Bird
19	<i>Turdoides striata</i>	Jungle babbler	Bird
20	<i>Acridotheres fuscus</i>	Jungle myna	Bird
21	<i>Lonchura</i>	Munia	Bird
22	<i>Copsychus saularis</i>	Oriental magpie robin	Bird
23	<i>Pycnonotus cafer</i>	Red vented bulbul	Bird
24	<i>Pycnonotus jocosus</i>	Red whiskered bulbul	Bird
25	<i>Columba livia</i>	Rock pigeon	Bird
26	<i>Merops orientalis</i>	Small green bee eater	Bird
27	<i>Hirundinidae</i>	Swallow	Bird
28	<i>Orthotomus</i>	Tailor bird	Bird
29	<i>Megalaima viridis</i>	White cheeked barbet	Bird
30	<i>Lonchura striata</i>	White rumped munia	Bird
31	<i>Caleta caleta</i>	Angled pierrot	Butterfly
32	<i>papillio polymnestor</i>	Blue mormon	Butterfly
33	<i>Mycaliesis perseus</i>	Bush brown	Butterfly
34	<i>Neptis nata</i>	Clear sailer	Butterfly
35	<i>Euthalia aconthea</i>	Common baron	Butterfly
36	<i>Jamides celeno</i>	Common cerulean	Butterfly
37	<i>Jamides Celeno</i>	Common Creleam	Butterfly
38	<i>Euploea core</i>	Common crow	Butterfly
39	<i>Melanitis leda</i>	Common evening brown	Butterfly
40	<i>Cepora nerissa</i>	Common gull	Butterfly
41	<i>Acytolepis puspa</i>	Common hedge blue	Butterfly
42	<i>Castalius rosimon</i>	Common pierrot	Butterfly
43	<i>Pachliopta aristolochiae</i>	Common rose	Butterfly
44	<i>Neptis hylas</i>	Common sailor	Butterfly
45	<i>Melanitis phedima</i>	Dark evening brown	Butterfly
46	<i>Parantica aglea</i>	Glassy tiger	Butterfly
47	<i>Junonia atlites</i>	Gray pansy	Butterfly
48	<i>Tanaecia lepidea</i>	Grey count	Butterfly
49	<i>Pachliopta aristolochiae</i>	Indian common rose	Butterfly
50	<i>Talicauda nyseus</i>	Indian red pierrot	Butterfly
51	<i>Zizula hylax</i>	Indian tiny grass blue	Butterfly
52	<i>Delias eucharis</i>	Jezebel	Butterfly
53	<i>Junonia lemonias</i>	Lemon pansy	Butterfly
54	<i>Idea malabarica</i>	Malabar tree nymph	Butterfly
55	<i>Eurema andersani</i>	One spot grass yellow	Butterfly
56	<i>Euchrysops cnejus</i>	Oriental gram blue	Butterfly
57	<i>Leptocia nina</i>	Oriental psyche	Butterfly
58	<i>Danaus chrysippus</i>	Plain tiger	Butterfly
59	<i>Chilades pandava</i>	Plains cupid	Butterfly




60	<i>Graphium agamemnon</i>	Tailed jay	Butterfly
61	<i>Cirrochroa thais</i>	Tamil yeoman	Butterfly
62	<i>Acraea terpsicore</i>	Tawny coster	Butterfly
63	<i>Nacaduba kurava</i>	Transparent six line blue	Butterfly
64	<i>Danaus</i>	Tiger milkweed	Butterfly
65	<i>Diplacodes lefebvrii</i>	Black ground skimmer	Dragonfly
66	<i>Aeshna multicolor</i>	Blue darner	Dragonfly
67	<i>Aeshna multicolor</i>	Blue eyed darner	Dragonfly
68	<i>Diplacodes trivialis</i>	Blue percher dragonfly	Dragonfly
69	<i>Diplacodes nebulosa</i>	Charcoal-winged Percher	Dragonfly
70	<i>Orthetrum sabina</i>	Green marsh hawk	Dragonfly
71	<i>Diplacodes trivialis</i>	Ground skimmer	Dragonfly
72	<i>Brachydiplax sobrina</i>	Little blue marsh hawk	Dragonfly
73	<i>Neurothemis tullia</i>	Pied paddy skimmer	Dragonfly
74	<i>Brachydiplax sobrina</i>	Rufous blacked marsh hawk	Dragonfly
75	<i>Aethriamanta brevipennis</i>	Scarlet marsh hawk	Dragonfly
76	<i>Libellula luctuosa</i>	Widow skimmer	Dragonfly
77	<i>Bombus</i>	Bumble bee	Insect
78	<i>Caelifera</i>	Grasshopper	Insect
79	<i>Mantodea</i>	Green praying mantis	Insect
80	<i>Musca domestica</i>	Housefly	Insect
81	<i>Phereoca uterella</i>	Household casebearer	Insect
82	<i>Lygaeidae</i>	Milkweed bug	Insect
83	<i>Culicidae</i>	Mosquitoes	Insect
84	<i>Harpaphe haydeniana</i>	Yellow spotted millipede	Insect
85	<i>Melantis leda</i>	Evening brown	Insects
86	<i>Funambulus palmarum</i>	Indian palm squirrel	Mammal
87	<i>Hofmannophila pseudospretella</i>	Dark brown moth	Moth
88	<i>Plodia interpunctella</i>	Indianmeal moth	Moth
89	<i>Polia bombycina</i>	Pale shining brown	Moth
90	<i>Palithis asopialis</i>	Stealth bomber moth	Moth
91	<i>Calotes versicolor</i>	Garden lizard	Reptile
92	<i>Nephilia pilipes</i>	Giant wood spider	Spider
93	<i>Carrhotus viduus</i>	Jumping spider	Spider
94	<i>Lycosidae</i>	Wolf spider	Spider

#### 5.4 Observations


- It is important to note that an endangered species is present on the Campus. Details of the same appear next:

Name	<i>Madhuca bourdillonii</i>
------	-----------------------------

Geo-coordinates	15°17.4410'N, 73°58.8370'E	
Landmark	In the woods	
Photo		

## 5.5 Waterscape

An open well is present in the Campus as per the details given next:

Geo-coordinates	15°17.5190'N, 73°58.8700'E	
Landmark	Forested area next to the Football Court	
Photo		

## 6 Recommendations

### 6.1 Energy Conservation

- 1) **Sanctioned Load:** The sanctioned load is 450 kVA while the maximum recorded contract demand during the past 1 year has been 255 kVA i.e. just 57% of the sanctioned load. The College is paying around Rs 95000/- as fixed charges per month. Therefore, it is recommended that the Sanctioned load should be reduced to 300 kVA (so that maximum demand is 85% of the sanctioned load for some safe margin). This shall result in a saving of Rs 37,500/- per month i.e. Rs 4.5 lakhs/year.
- 2) **Solar PV:** The Solar PV potential of the College is 121 kW, which is around 60% of the College's electricity demand. Considering MNRE thumb rules for system costing, the payback comes to less than 5 years. It is highly recommended that the College puts up a Solar PV system.
- 3) **Replacing Fluorescent Tubelights with LED Tubelights:**
  - The College has 1300-odd fluorescent tubelights in various locations.
  - *Presently, the proportion of consumption by LED lamps is only around 2% of the total lighting consumption.*
  - This consumption can be reduced to half if these tubelights are replaced by LED Tubelights.
  - With a very rough estimation, the saving shall be 191 kWh/day i.e. around Rs 1160/day. Considering the cost of LED tubelight as Rs 450/piece (inclusive of replacement charges) and disposal cost of old fluorescent tubelights as Rs 15/piece, the total investment comes out to be around Rs 6.08 lakhs. Thus, the payback period is 20 months.
- 4) **Energy Conservation Program:** Considering the annual electricity costs of close to Rs 2.4 crores, it is essential for the College to take up a Program towards energy conservation, with awareness and novel ideas to ensure participation from staff and students.
- 5) **Labels/ Messages:** In order to reinforce the need to save energy, labels/messages should be put in strategic locations. Annexure C contains such sample stickers called "Enlabels" developed by Shubhankar Environmental Services.
- 6) **Monitoring:** The College has a significant amount of secondary data about the load profiles of different sub-meters which could be used for finding out high consuming areas and probable areas of energy saving. A small group including the Estate/Facility Management should be formed to regularly keep a track of the Energy Consumption in the College.

- 7) **Power Factor improvement:** The power factor of the College has been around 0.92 over the past one year. It is recommended that inputs be sought from an Electrical Contractor about probable improvements in Power Factor by installing suitable Capacitor Bank, etc. to understand the investment required and the pay back period.

## 6.2 Waste Management

- 1) **Waste Segregation:** There is an urgent need to start waste segregation on Campus since presently almost all the waste is given in a mixed manner to the Municipality. The first step towards this shall be to ensure that all the bins present on Campus are labelled appropriately, followed by a mass awareness program on the Campus for Management, housekeeping staff, Faculty and Students.
- 2) **Reducing and Refusing:** This is the first step in any waste management program, and there are a lot of avenues for reducing and refusing things from becoming waste, especially after single use. As pointed out in the Study conducted by the F.Y.BSc. Students (Refer Annexure B), initiatives such as minimizing use of disposables like straws, tissue papers, etc. should be strongly encouraged. One way of achieving this could include levying a small charge (of say, Re 1/straw) for the disposable so that the User thinks becoming using it. Similar Reduce and Refuse opportunities should be actively and continuously explored and implemented.
- 3) **Recycling Program:** There is a huge potential for setting up a Recycling Program for non-biodegradable waste such as tetra packs, PET bottles, Paper, Cardboard, Aluminium foils, etc. since this waste is generated in large volumes on the Campus. It is estimated that the Recycling Program can fetch an income of close to Rs 14,000/- per year from the sale of recyclables to authorized recycling Agencies. This shall also save around 1.4 Tons of dry waste going to the landfill per year.  
This initiative can be started through a Students start-up so that it is managed professionally and with ownership.
- 4) **E-Waste Management:** It is extremely essential for the College to ensure that all E-waste from the Campus is disposed only through Agencies authorized by the Goa State Pollution Control Board. It is recommended that an E-waste Management Program should be immediately started in the Campus to ensure safe disposal of E-waste and also compliance against the E-waste Management Rules 2016.

- 5) **Vermi-composting:** The vermi-compost bin near the Canteen which lies unused should be immediately put to use. It is estimated that this shall help saving around 250 kg of wet waste going to the landfill per month.

### 6.3 Biodiversity Conservation

- 1) **Butterfly Garden:** The butterfly garden area should be touched up and expanded.
- 2) **Greenhouse Area:** The area behind the football court is rich in biodiversity. At present, the Greenhouse which is present there is in a dilapidated condition. The same should be revived as a part of Internship/ Student Projects/ NCC/ Start-ups or any other way possible so that it is appropriately utilized.
- 3) **Biodiversity Register:** A biodiversity register of the College should be prepared. The College can take up this as a continuous activity with each new batch of Zoology/ Botany students so that all the biodiversity changes over the years are captured and also Students are exposed to the variety of flora and fauna on campus.
- 4) **Maintenance of Well:** The open well present near the Greenhouse area should be maintained regularly to free it from leaves and other litter.

### 6.4 Policy level Recommendations

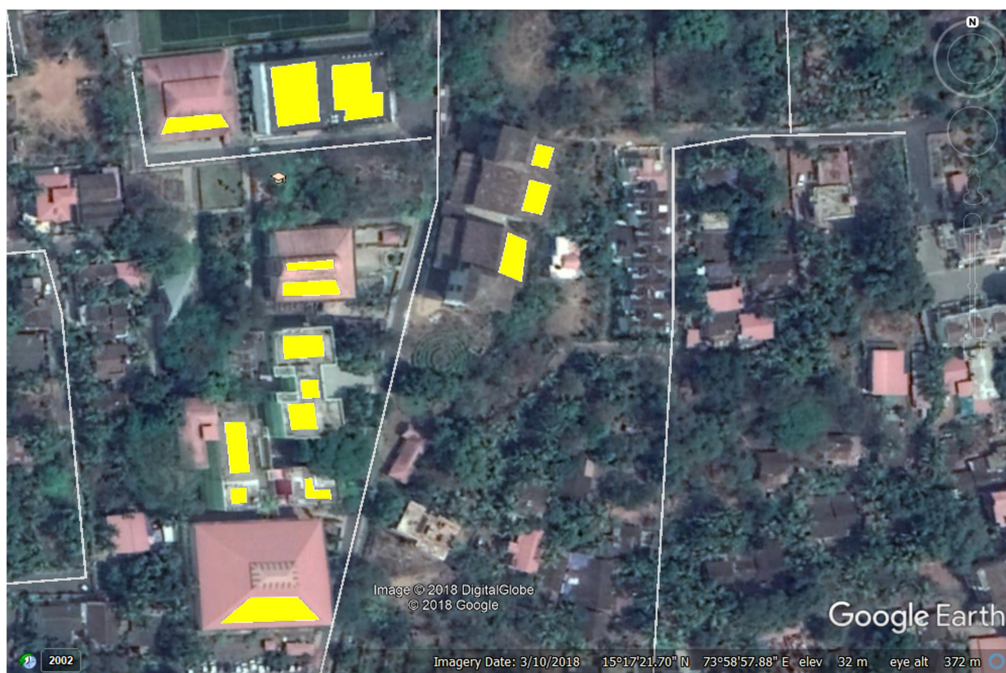
- 1) **Zero Waste Campus:** The College should chalk out a phase-wise plan to become a zero waste Campus, through active involvement of the Management, Faculty and Students.
- 2) **Environmental Policy:** It is recommended that the College formulates its own Environmental Policy (like other policies such as IT, Students Policy, etc.) which clearly provides practical guidelines from the Environmental perspective. This shall include a policy that all Events and Functions in the Campus shall be Green Events, the standard operating procedures for managing and monitoring environmental factors such as waste, water, energy, biodiversity, etc. in the College Campus. This should also include the sensitization of Students towards the subject of Environmental Conservation. This can also include structured tie-ups and Internships around these topics.



## Annexure A: Solar PV Potential estimation exercise



Above is a Google Earth image of Chowgule College Campus. All the shade-free area from flat roofs as well as south, south-east, south-west facing sloping roofs are marked from the Campus in Google Earth using polygon tool and the same appears below.



The areas marked from the same are tabulated as below:

Sr. No.	Name of Building	Shape of Roof	Structure of Roof	Available area (sq.m.)	Generation potential (kW)
1	H Block	Sloping	Tiles	123.8	12.38
2	A Block	Sloping	Roofing Sheets	226	2.26
3	Auditorium Building	Slightly sloping	RCC Slab	40.1	4.01
4	B Block	Flat	RCC Slab	155.4	15.54
5	D Block	Flat	RCC Slab	231.7	23.17
6	Gym	Flat	RCC Slab	582	58.2
7	Library	Sloping + Curved	Tiles + RCC Slab	139.5	13.95
8	Futsal	Sloping	Roofing Sheets	107	10.7
9	G Block	Sloping	Tiles	108	10.8
				<b>TOTAL</b>	<b>151.01</b>

This was accompanied by an actual visit to the locations to find out some other factors like roof age, roof condition, access, etc. A tabulation of the same appears below.

Sr. No.	Name of Building	Roof Condition	Access	Shade-free area available (sq.m.)	Remarks
1	H Block	Not good	No access	NA	Not suitable
2	A Block	Good	No access	NA	Not suitable
3	Auditorium Building	Good	Limited access by ladder	72	Not feasible due to difficulty of access
4	B Block	Good	Staircase but access bit difficult	255	Access needs to be checked
5	D Block	Good	Staircase	265.5	
6	Gym	Good	No Access	582	Access can be easily created since building has only ground floor
7	Library	Good	No access	NA	Access needs to be checked
8	Futsal	Good	No access	107	Access can be easily created due to low height
9	G Block	Not good	No access	NA	Not suitable

Thus, total potential after site inspection:

- **Shade-free Area suitable for Solar PV installation = 1209.5 sq.m**
- **Hence, Total solar PV potential based on thumb rule (10sq.m./kW) = 121 kW**

- The average of the maximum demand as shown at Section 4.2 noted has been 219 kVA. At 0.92 P.F., this is  $[(121 \times 100) / (219 \times 0.92)]$  around 60% of the total electricity requirements of the College.
- Payback calculations

Parameter	Value	Unit
Solar PV System Size	121	kW
Sunshine	5.5	hours
Units generated	665.5	kWh/day
Average Electricity cost	6.05	Rs/kWh
Daily cost saving	4026.275	Rs/day
Monthly cost saving	120788.3	Rs/month
Thumb rule of MNRE for cost of Grid connected Solar PV system	55000	Rs/kW
Solar PV System cost (based on MNRE thumb rules)	6655000	Rs
Payback period	55.09	months
Payback period	4.59	years

The Solar PV system life is around 15-20 years. Hence, it is highly advisable to go for a Solar PV system in the College which shall meet around 60% of the electricity demand of the College.



## Annexure B: Presentation on “Wastage of food in college canteen and its management”

### Wastage of food in college canteen and its management

Study done by FYBSC students

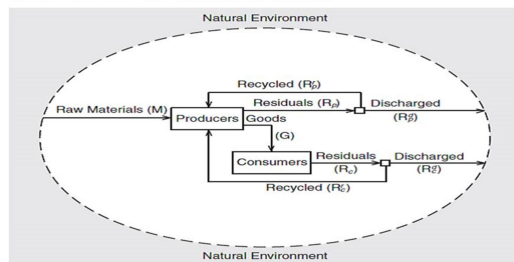
Class FYBSC, division B, Academic year 2018-19  
Continuous Assessment 1  
Case study 4

#### Objective:

Core of economics is scarcity of resources and multiplicity of wants. Based on the model taught in class of ‘Economic activity and problem of residual’ find out the solution to wastage of food in the canteen.

\*KAP

FIGURE 2.1 The Environment and the Economy



### Pointer questions

- Measure the food wasted per hour.( you can ask the canteen guy to drop all food in the bucket and weigh it using portable weighing scale). Approximate this for one day and accordingly. You can check this for peak and off peak hours
- Try to study if methods of cooking, serving and cutlery used are sustainable & environment friendly? alternatively using internet find out which are sustainable means of cooking( solar cookers, steam cooking)
- Try to suggest the feasible alternative means of cooking.
- Find out the disposal techniques used by the canteen.(producers & consumers waste)
- Alternatively develop a workable model for recycling of waste.
- Forward your suggestion to canteen owner and get his feedback.
- Suggest ways and means to reduce food wastage. Try to talk to your friends about this.
- Try talking to your friends about keeping their own plates in baskets after eating.
- Bring out the applicability of 4R: Reduce, Reuse, Refuse & recycle in this case. Concrete steps like displaying of posters is welcome( pictorial evidence)
- Forward the document to Principal

### Pre Case study spade work

- The final year BA economics students oriented the FYBSC students after distribution of case study.
- Objective:
  - To explain what is case study?
  - Applicability of model
  - Significance of four R's



## Food & other residuals

### Producer

- Used cooking oil
- Vegetable and fruits peels.

### Consumer

- Food left in the plates
- Used tissues and straws.
- Empty cans, bottles.

## Food residuals in canteen daily

Group 1	Group 2	Group 3
10 hours @ 20 kg food wasted	Peak & off peak hours	Peak & off peak hours
	8.30 to 11.30@ half to one kg per hour	9:00-10:00 am @ 1 kg per hour
	11.30 to 3.30@ 2 kg per hour	1:00-2:00 pm @ 2.2 kg per hour
	3.30 to 5.30 @ half kg per hour	3:00-4:00 pm @ 1.4 kg per hour
	Total wastage= 11 kg per day	Total wastage =11.4 kg day

## Food waste segregation

- Garbage bins: waste food is dumped in garbage bins.(segregated at source as dry & waste).
- Eventually find its way in municipality garbage.

## Recommendations: food wastage

- Food tray: getting away with food tray would mean one will carry only that much what fits in the hand.
- Juice dispenser:
- Buffet: at twice a week
- Smaller portions served.
- Awareness: posters, one to one talk.



### KAP findings

- Reason cited:
  - Break time:
  - Often they tend to misjudge the quantum of hunger .
  - Eat from friends tiffin's
  - Lunch thali had maximum wastage: salad not eaten, pickle waste)
  - Same dish tastes different on different days.
  - Food also gets over in the late afternoon, whatever is available is to be consumed.

### KAP findings

- 150 students interviewed.
- Almost all of them have knowledge of food not to be wasted.
- 100% students also exhibited positive attitude towards non wastage of food.
- 79% students agreed to be wasting food at any given point of time.

### Alternative methods of cooking

- Present cooking method traditional
- Steam cooking: healthy, less energy.
- Electrical frying machines( used cooking oil is major wastage ).

### Recycling

- Waste bins vs recycling bins:
- Recycling bins placement.
- Organic manure:
- Animal feed
- Kitchen garden

### Reducing

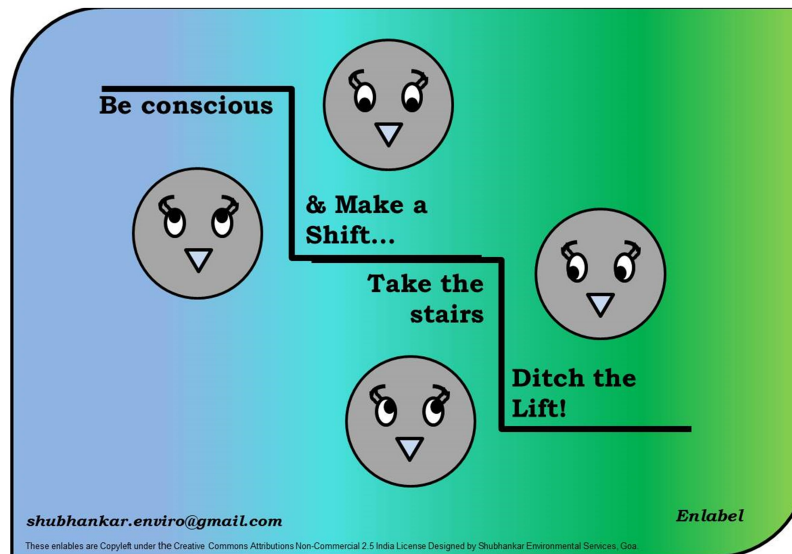
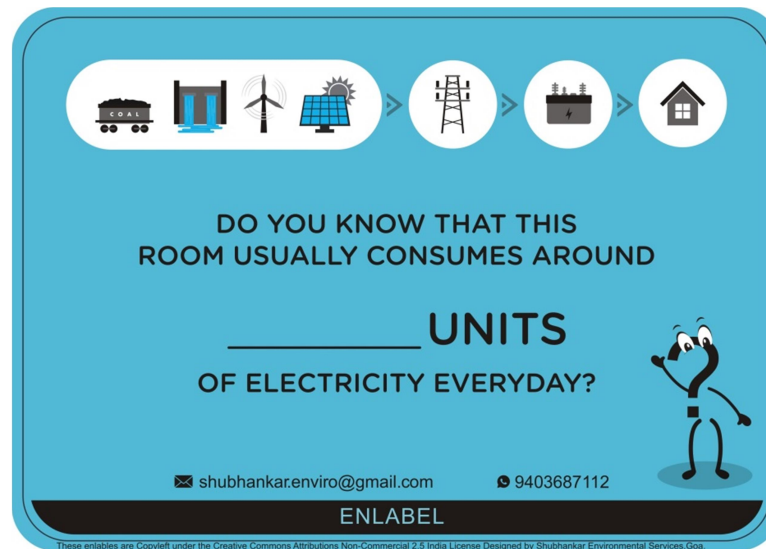
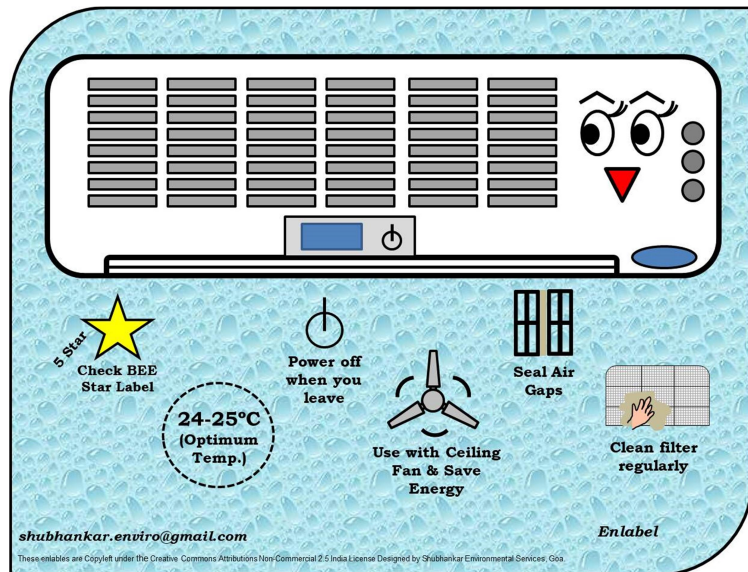
- Where possible reusable trays, cups, cutlery and plates in the canteen.
- Milk, juices and soft drinks should be used in bulk from dispensers rather than in individual cartons, bottles and cans.
- Instead of packed mineral bottles, students must be encouraged to drink water from purifiers. This helps reduce a lot of plastic generated from this product.
- consider reducing the size of portions served.

### Reusing & refusing

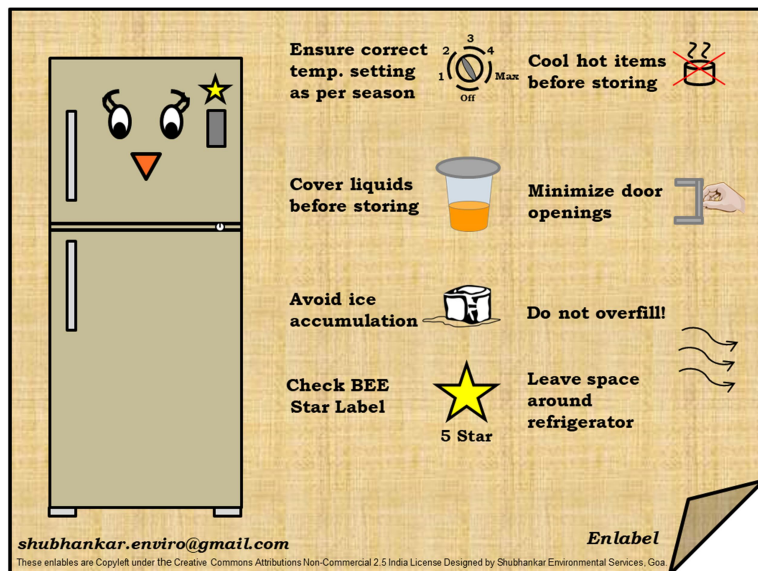
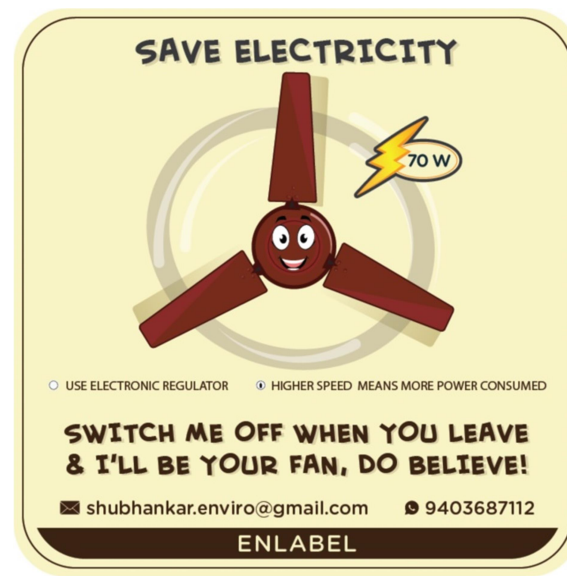
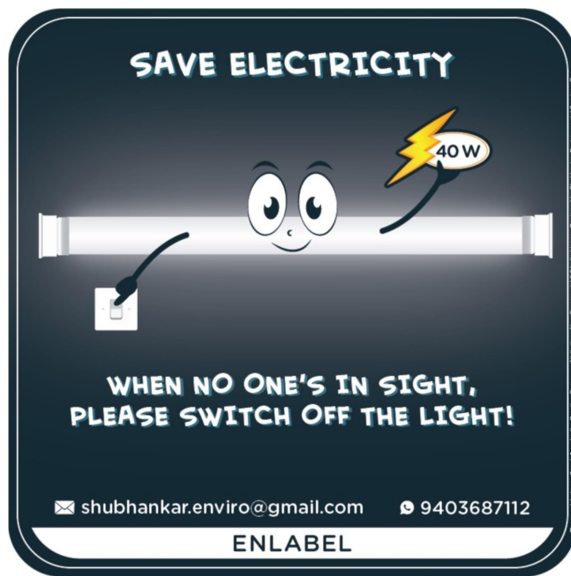
- Minimise use of straw, tissue paper.



## Annexure C: Enlabels (Stickers about Environmental Awareness)







## **Annexure D: Write-up on the Green Initiatives of the College – As reported by the College Management**

### **1) GREEN HOUSE:**

The college campus has a greenhouse/ shade house developed by the Botany Department. It is a structure enclosed by agro nets or any other woven material to allow required sunlight, moisture and air to pass through the gaps. It creates an appropriate micro climate conducive to the plant growth. Various practicals and activities related to the syllabus structures for all classes are carried out. This is under renovation to make provision for students to carry out research related projects on campus.

### **2) GROUND WATER RECHARGE AND RAINWATER HARVESTING INITIATIVES:**

Initiatives for ground water recharge and rainwater harvesting were taken up by college. The internal walkways within the campus are paved with pavers to allow rainwater to seep in and recharge the ground water. A patch of land of the college between 'A' block and Parking area has been laid with loose laterite stones to facilitate ground water recharge. Underground water tank in this area is also connected to water channels for rainwater harvesting. The artificial turf of football ground is laid in a manner with slight inclination in all directions to facilitate collection of rain surface water in the channels along the field. This water is further channelized to collect water at a particular pond.

### **3) BOTANICAL GARDEN:** the campus also harbours a botanical garden. In the Botanical garden basic experiments are carried out. There are various species of plants such as ornamentals, hydrophytes, xerophytes, pteridophytes, etc in the garden. Also, there is a small pond at one corner of the garden, where hydrophytes are grown. Certain economically important plants are also maintained in the garden such as, Banana, Teak, etc.

### **4) AUTOMATIC WEATHER STATION (AWS):** The Indian Space Research Organization (ISRO) has sponsored an indigenous Automatic Weather Station (AWS) to Parvatibai Chowgule College of Arts and Science, in year 2008, for monitoring and observing the weather changes in and around Salcete Taluka. Every weather station is given a number, and the number of the station here, is ISRO 429. The AWS consists of 6 sensors, namely, Thermometer, Anemometer,



Wind vane, Hygrometer, Barometer, Spectrometer and a Rain Gauge. The weather station automatically measures atmospheric pressure, air temperature, rainfall, humidity, wind speed, wind direction and solar radiation. The sensors are mounted on a three-meter tower with solar panel and Global Positioning System (GPS). The AWS records data for every one hour and transmit it via INSAT-3A and KALPANA-1 satellites. The collected data is used for teaching and learning at graduate and postgraduate climatology courses. According to ISRO, the processed information from AWSs will have huge potential for civilian use. Local farmers could be tipped-off about local climatic conditions and availability of ground water among other factors. Information about the direction of wind and its speed will help the health department to take effective preventive measures.

- 5) Butterfly Garden:** Butterfly garden initiated by Zoology department is designed to encourage butterfly diversity in the campus. Presence of more than 43 species of butterflies on our campus is an indication that the Chowgule college campus is clean and healthy. The butterfly garden has different host plants planted in it which include both adult and larval feeding plants. The garden also has shelter providing trees and shrubs, water and substitute for nectar. It also has a board displaying the different species of butterflies found on the campus. Relevance of Butterfly garden in ensuring clean environment is multi-fold. Besides being pollinators of many plants, they also serve as important part of the food chain. The most important feature is that Butterflies serve as an 'Ecosystem barometer' which that tells us about the health of our environment. These creatures are sensitive to changes in climate, the presence of harmful chemicals, pollution in the air and water, and any other changes in the environment.



**BUTTERFLY GARDEN OF CHOWGULE COLLEGE**

- 6) **Vermicomposting Unit:** The Vermicomposting unit of department of Zoology, takes care of bio-degradation of organic waste from college canteen. The unit was installed in the college in 2009. The compost produced by vermicomposting was sold in the tigers coop since 2014. Compost provides many essential nutrients for plant growth and will therefore served as important substitute for fertilizer. It improves the texture of both clay soils and sandy soils, making either type rich, moisture retentive, and loamy. Thus this initiative will ensure reduction in garbage volume, improve soil aeration and drainage and help us to reduce drastically the use of chemical fertilizers. The department also plans to expand the section of composting to cater to the requirement of compost for the plants on campus.
- 7) **Leaf litter waste management:** To facilitate biodegradation of leaf litter, metal mesh Bins are placed at multiple points. Besides garbage bins for dry (leaf

litter) and wet waste are placed at various points on the campus. The college also has a crude compost pit dug by the NSS unit to degrade the organic material, such as leaves, grass clippings, and kitchen waste produced on campus.

**8) Bird Houses on campus:** In order to encourage avifaunal biodiversity on the campus, 20 birdhouses were installed in various regions of the campus.

**9) Green Initiatives to Save Paper:** Being an educational institute, there is a lot of paper waste generated. The initiatives taken by college to reduce paper usage on campus are:

- a) **E-Governance:** All correspondences are replaced with e-correspondences to reduce paper wastage.
  - Replacement of paper-correspondences by E-correspondences.
  - Assignments online.
  - Notices – emails / websites.
- b) **Paper recycling:** The old papers to be disposed off are collected from faculty and administrative offices and pooled at a central point to be disposed off for 'Recycling'. The paper is segregated and collected for recycling by paper recycling company 'BAVISH'.

**10) Swatch Bharat Campaign:** Swatch Bharat Campaign was initiated in 2017 for sensitising students on environmental cleanliness. Every year the students take an oath/Pledge to maintain cleanliness on campus and the environment at large. On 2<sup>nd</sup> October mass cleaning initiatives are carried out on the campus.

**11) Dustbins:** The campus has 44 dustbins placed at multiple locations of the campus both indoors as well as outdoors. This initiative was taken to make campus litter free.

**12) E-Waste collection:** E waste generated on the campus is accumulated at a specific point during E-Waste collection drive for further disposal.

**13) Biodiversity Documentation:** The department of Botany and Zoology had initiated process of documenting floral and faunal diversity respectively. All the trees on campus are labelled and list of plants, herbs and shrubs are listed by students. The insect and avian diversity is recorded for past five years as part of the curriculum. This activity is carried out by zoology students. 68 species of Nonchordates and 89 species of vertebrates are recorded in the campus. 51 species of lepidopterans and odonates are recorded which includes Atlas moth (largest moth) and southern birdwing (largest butterfly). 69 species of birds are recorded on the campus over period of 05 years and the college also participates in the annual bird festival 'Global Backyard Bird Count' where list of birds on campus are recorded on E-Bird global site. Other fauna reported are amphibians, snakes, monitor lizards, langoor and macrochiroptera (flying foxes).

#### FAUNA OF CHOWGULE COLLEGE

NONCHORDATE DIVERSITY		
	<i>Common Name</i>	<i>Scientific Name</i>
<b>BUTTERFLIES AND MOTHS</b>		
1.	Common Fivering	<i>Ypthima baldus</i>
2.	Three-Spot Grass Yellow(Dry Season Form)	<i>Eurema blanda</i>
3.	Golden Angle	<i>Caprona ransonnetti</i>
4.	Blue Tiger Butterfly	<i>Tirumala limniace</i>
5.	Common Jessebelle Butterfly	<i>Delias eucharis</i>
6.	Zebra Blue	<i>Leptotes plinius</i>
7.	Painted Lady	<i>Vanessa cardui</i>
8.	Common Emigrants Butterfly	<i>Catopsilia pomona</i>
9.	Grey Count Butterfly	<i>Tanaecia lepidea</i>
10.	Common Small Flat	<i>Sarangesa dasahara</i>
11.	Common Awl	<i>Hasora badra</i>

12.	Oriental Plain cupid	<i>Chilades pandava</i>
13.	Common Wanderer	<i>Pareronia hippia</i>
14.	Small Grass Yellow	<i>Eurema brigitta</i>
15.	One spot Grass Yellow	<i>Eurema andersonii</i>
16.	Common Rose	<i>Pachliopta aristolochiae</i>
17.	Oriental tailed jay	<i>Graphium agamemnon</i>
18.	Blue Mormon	<i>Papilio polymnestor</i>
19.	Common mormon	<i>Papilio polytes</i>
20.	Indian Painted Jezebel	<i>Delias hyparete indica</i>
21.	Oriental Psyche	<i>Leptosia nina</i>
22.	Common Quaker	<i>Neopithecops zalmora</i>
23.	Banded Pierrot	<i>Discolampa ethion</i>
24.	Red Pierrot	<i>Talica nyseus</i>
25.	Common Pierrot	<i>Castalius rosimon</i>
26.	Grass Jewel	<i>Freyeria putli</i>
27.	Pale grass blue	<i>Pseudozizeeria maha</i>
28.	Common Cerulean	<i>Jamides celeno celen</i>
29.	Common Crow	<i>Euploea core</i>
30.	Common Evening Brown	<i>Melanitis leda</i>
31.	Plain Bush Brown	<i>Telinga malsarida</i>
32.	Tawny Coaster Butterfly	<i>Acraea terpsicore</i>
33.	Common Sailor	<i>Neptis hylas</i>
34.	Common leopard	<i>Phalanta phalanta</i>
35.	Lemon Pansy	<i>Junonia lemonias lemonias</i>
36.	Grey Pansy Butterfly	<i>Junonia atlites</i>
37.	Peacock Pansy	<i>Junonia almana</i>
38.	Great eggfly	<i>Hypolimnas bolina</i>

39.	Glassy Tiger	<i>Parantica aglea</i>
40.	Oriental Gram Blue	<i>Euchrysops cnejus cnejus</i>
41.	Common Palmfly	<i>Elymnias hypermnestra</i>
42.	Grass demon	<i>Udaspes folus</i>
43.	Indian Bush hopper	<i>Ampittia dioscorides</i>
44.	Atlas moth	
<b><i>Dragon Flies And Damsel Flies</i></b>		
45.	Pied Paddy Skimmer	<i>Neurothemis tullia</i>
46.	Marsh Skimmer	<i>Orthetrum luzonicum</i>
47.	Long-Legged Marsh Glider	<i>Trithemis pallidinervis</i>
48.	Crimson Marsh Glider	<i>Trithemis aurora</i>
49.	Globe Skimmer	<i>Pantala flavescens</i>
50.	Black Tailed Skimmer	<i>Orthetrum cancellatum</i>
51.	Common Blue Damsel Fly	<i>'Pseudagrion microcephalum</i>
<b><i>Other invertebrates</i></b>		
52.	Common Housefly	<i>Musca domestica</i>
53.	Fruit Flies	<i>Drosophila sps</i>
54.	Honey Bees	<i>Apis sps</i>
55.	Potter Wasps	<i>Rhynchium brunneum.</i>
56.	Asian Weaver Ant	<i>Oecophylla smaragdina</i>
57.	Black Ants	<i>Camponotus compressus</i>
58.	Cockroach	<i>Periplaneta americana</i>
59.	Grashopper	<i>Diabolocatantops sps</i>
60.	Long-Horned Grasshopper	<i>Ruspolia nitidula</i>
61.	Conehead Grasshopper	<i>Neoconocephalus sps</i>
62.	Praying Mantis	<i>Hierodula membranacea</i>
63.	Stick Insect	<i>Carausius morosus</i>

64.	Spider	<i>Plexippus petersi</i>
65.	Common home Spider	<i>Crossopriza sps.</i>
66.	Black And Yellow Garden Spider	Argiope sps.
67.	Giant Wood Spider	<i>Nephila sps</i>
68.	Garden cross spider	<i>Araneus diadematus</i>

VERTEBRATE DIVERSITY OF CHOWGULE COLLEGE		
Sr. No	Name	Scientific name
<b>BIRD DIVERSITY</b>		
1.	Cattle egret	<i>Bubulcus ibis</i>
2.	Black kite	<i>Milvus migrans</i>
3.	Brahminy kite	<i>Haliastur indus</i>
4.	Crested Serpent Eagle	<i>Spilornis cheela</i>
5.	Indian peafowl	<i>Pavo cristatus</i>
6.	White breasted waterhen	<i>Amaurornis phoenicurus</i>
7.	Blue rock Pigeon	<i>Columba livia</i>
8.	Spotted dove	<i>Streptopelia chinensis</i>
9.	Rose ringed parakeet	<i>Psittacula krameri</i>
10.	Pied Crested cuckoo	<i>Clamator jacobinus</i>
11.	Asian Koel	<i>Eudynamys scolopacea</i>
12.	Small Green billed Malkoha	<i>Phaenicophaeus viridirostris</i>
13.	Crow pheasant	<i>Centropus sinensis</i>
14.	Barn owl	<i>Tyto alba</i>
15.	House swift	<i>Apus affinis</i>
16.	Asian Palm swift	<i>Cypsiurus balasiensis</i>

17.	Lesser Pied kingfisher	<i>Ceryle rudis</i>
18.	Small blue kingfisher	<i>Alcedo atthis</i>
19.	White breasted kingfisher	<i>Halcyon smyrnensis</i>
20.	Blue tailed bee eater	<i>Merops philippinus</i>
21.	Small bee eater	<i>Merops orientalis</i>
22.	Chestnut headed bee eater	<i>Merops leschenaultia</i>
23.	Indian roller	<i>Coracias benghalensis</i>
24.	Common Hoopoe	<i>Upupa epops</i>
25.	White-cheeked Barbet	<i>Psilopogon viridis</i>
26.	Coppersmith barbet	<i>Psilopogon haemacephalus</i>
27.	Rufous woodpecker	<i>Celeus brachyurus</i>
28.	Indian pitta	<i>Pitta brachyuran</i>
29.	Common swallow	<i>Hirundo rustica</i>
30.	Wire tailed swallow	<i>Hirundo smithii</i>
31.	Yellow wagtail	<i>Motacilla flava</i>
32.	White wagtail	<i>Motacilla alba</i>
33.	Paddyfield pipit	<i>Anthus rufulus</i>
34.	White-browed Bulbul	<i>Pycnonotus luteolus</i>
35.	Red whiskered bulbul	<i>Pycnonotus jacusus</i>
36.	Red vented bulbul	<i>Pycnonotus cafer</i>
37.	Common iora	<i>Aegithina tiphia</i>
38.	Eurasian Golden oriole	<i>Oriolus oriolus</i>
39.	Black headed oriole	<i>Oriolus xanthornus</i>
40.	Black drongo	<i>Dicrurus macrocercus</i>
41.	Ashy drongo	<i>Dicrurus leucophaeus</i>
42.	Greater racket tailed drongo	<i>Dicrurus paradiseus</i>



43.	Indian tree pie	<i>Dendrocitta leucogaster</i>
44.	House crow	<i>Corvus splendens</i>
45.	Jungle crow	<i>Corvus macrorhynchos</i>
46.	Baya weaver	<i>Ploceus philippinus</i>
47.	Common myna	<i>Acriditheres tristis</i>
48.	Jungle myna	<i>Acridotheres fuscus</i>
49.	House sparrow	<i>Passer domesticus</i>
50.	Jungle babbler	<i>Turdoides striatus</i>
51.	Common babbler	<i>Turdoides caudatus</i>
52.	Indian robin	<i>Saxicoloides fulicata</i>
53.	Oriental magpie robin	<i>Copsychus saularis</i>
54.	White rumped shama	<i>Copsychus malabaricus</i>
55.	Ashy prinia	<i>Prinia socialis</i>
56.	Plain prinia	<i>Prinia inornata</i>
57.	Purple sunbird	<i>Nectarinia asiatica</i>
58.	Black headed munia	<i>Lonchura malacca</i>
59.	Common tailorbird	<i>Orthotomus sutorius</i>
60.	Asian paradise flycatcher	<i>Terpsiphone paradisi</i>
61.	White throated fantail flycatcher	<i>Rhipidura albicollis</i>
62.	Black lored yellow tit	<i>Parus xanthogenys</i>
63.	Lotens sunbird	<i>Nectarinia lotenia</i>
64.	Purple rumped sunbird	<i>Nectarinia zeylonica</i>
65.	White rumped munia	<i>Lonchura striata</i>
66.	Tickell's Blue Flycatcher	<i>Cyornis tickelliae</i>
67.	Greater Coucal	<i>Centropus sinensis</i>
68.	Common Kingfisher	<i>Alcedo atthis</i>

69.	Scaly-breasted Munia	<i>Lonchura punctulata</i>
	<b>AMPHIBIANS (03)</b>	
70.	Martins bush frog	<i>Pseudophilautus sps</i>
71.	Asian tree frog	<i>Hyla sps</i>
72.	Common Indian toad	<i>Duttaphrynus melanostictus</i>
	<b>REPTILES (09)</b>	
73.	Russell's viper	<i>Daboia russelli</i>
74.	Green whip snake	<i>Ahaetulla nasuta</i>
75.	Common ratsnake	<i>Ptyas mucosus</i>
76.	Garden lizard (Topy))	<i>Calotes diversicolor</i>
77.	Monitor lizard (Saap)	<i>Varanus sp.</i>
78.	Skink (Levan shilli)	<i>Mabuya sp.</i>
79.	Crocodile	<i>Crocodylus porosus</i>
80.	Indian Rat snake	<i>Ptyas mucosa</i>
81.	Common bronze-backed tree snake	<i>Dendrelaphis tristis</i>
	<b>MAMMALS (08)</b>	
82.	Mongoose	<i>Herpestes auropunctatus</i>
83.	Grey langur	<i>Semnopithecus entellus</i>
84.	Dog	<i>Canis lupus familiaris</i>
85.	Cat	<i>Felis domesticus</i>
86.	Bandicoot	<i>Bandicota sps.</i>
87.	Indian Palm Squirrel	<i>Funambulus palmarum</i>
88.	Golden Jackal	<i>Canis aureus</i>
89.	Indian flying fox	<i>Pteropus giganteus</i>