

# GREEN AND ENVIRONMENTAL AUDIT REPORT

JANUARY to FEBRUARY 2021

Prepared for

**Padmashri Manibhai Desai Mahavidyalay, Uruli kanchan,  
Pune. 412202**

Prepared by

**Adya Environmental services, Baramati**

Submitted on 5<sup>th</sup> March 2021

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## Adya Environmental Services

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*We dare to walk thin green line*

Date: 5<sup>th</sup> March 2021

To,

Principal

Padmashri Manibhai Desai Mahavidyalaya,

Uruli Kanchan, Pune

412202

**Subject: Detailed Environmental and Green Audit at your College.**

Respected Sir,

Based on field visit, Environmental baseline data collection, field study and our discussion, we are pleased to submit herewith Combined Green and Environmental Audit Report. We are thankful for your timely help and contribution towards making this Report.

Thanks and regards,

Yours faithfully,

**Adya Environmental Services**

  
**Proprietor**

Rupali A More

## SUMMARY

If self-inquiry is a natural and necessary outgrowth of a quality education, it could also be stated that institutional self-inquiry is a natural and necessary outgrowth of a quality educational institution. Concern about global environmental degradation and resource depletion is a logical consequence of the scholarly research, teaching, and learning that takes place on campuses every day. Because universities & colleges are by nature inquisitive institutions, it is only natural for the colleges to examine itself. The current Green/Environmental audit represents the first stage in our effort to build environmental sustainability on the campus. Green Auditing is one contribution that attempts to prevent the destruction of the world in which we live. Stresses that it is everyone's responsibility- that of both individuals & organizations in which they operate.

Green auditing is a systematic, documented, periodic and objective process in assessing an organization's activities and services in relation to:

- Assessing compliance with relevant statutory and internal requirements.
- Facilitating management control of environmental practices
- Promoting good environmental management
- Maintaining credibility with the public
- Raising staff awareness & enforcing commitment to departmental environmental policy
- Exploring improvement opportunities

The audit was conducted by Adya Environmental services, with a team of PMDC faculty and students & gathered all the necessary information about baseline environment of the college. That covered soil quality, water quality assessment, biodiversity assessment of the campus. AES has also conducted Energy audit of the campus. Noise levels of the campus falls within the permissible limits given by CPCB. Water quality of the campus follows the parameters of potable water given by IS 10500:2012. Carbon sequestration and carbon emissions study is also performed. College has also planned to promote campus and local biodiversity through detailed action plan and awareness programmes. Along with future action plans College has already undertaken several steps like Rain water harvesting, composting, reduction of waste to move towards becoming environmentally sensitive & a more sustainable campus. Amid coronavirus Outbreak College was shut down in March 2020 and remains closed for one year. So the green audit report is based on past and current information.

**Adya Environmental Services**

  
**Proprietor**

## AUDITS 1. SOLID WASTE AUDIT

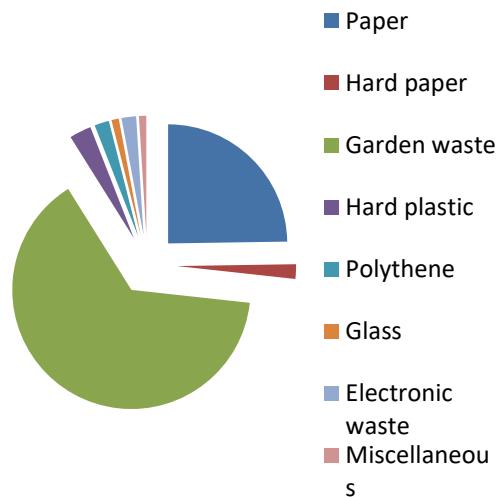
### INTRODUCTION

Urbanization and industrialization have resulted in increasing amounts of municipal, industrial and health care waste in the country. Central pollution control board (CPCB) has estimated current quantum of solid waste generation in India to the tune of 48 million tons per annum. Each year everyone in India throws away more than 0.4 tons of waste. Management of such high quantum of waste puts enormous pressure on solid waste management system. Throwing thing away is waste of natural resources and energy which have been used to make the product. Waste has to put somewhere. Most of it is sent to landfill sites or incinerated (burnt), using up land and releasing greenhouse gasses. On an average in India 12% of waste is recycled/composted, 79% is sent to landfill site and 9% is incinerated (burnt)

### SOLID WASTE GENERATION

#### VISUAL ANALYSIS OF MONTHLY SOLID WASTE GENERATION

Garden waste is the main contributor of campus solid waste by volume. Every week near about 6000 to 7000 gm of Garden waste is removed from college campus. Variation in Garden waste quantity is also found due to the seasonal variation. Paper waste also contributes a lot to the solid waste volume.



**Graphical analysis of Waste by volume (apprpx)**

As an educational institute, college's paper and hard paper waste like cardboard, paper covering, printing paper is also high. It accounts for near about 25% by volume. PMDC converts some quantity of its garden waste to manure by vermicomposting. Food waste is not included in visual analysis of solid waste for college building. College staff and students bring back their food waste (Tiffin waste) to their home. Tea cups

## SOLID WASTE ACCOUNTING BY WEIGHT

TABLE 1 WEEKLY WASTE OF OFFICES, CLASSROOMS & LIBRARY IN GM APX

Place	Paper	Hard paper	Polythene	Hard Plastic	Glass	Chalks	Biomass + other	E-waste
<b>Library</b>	70	100	4	35	10	NEG	NEG	20
<b>Main offic</b>	150	100	4	30	3	NEG	25	15
<b>Classrooms</b>	70	20	5	130	15	500	30	NEG
<b>Total</b>	190	150	6	105	17	300	25	14

TABLE 2 WEEKLY DPT WISE SOLID WASTE GENERATION OF COLLEGE IN GM APX

Department	Paper	Hard paper	Polythe	Har d	Glass	Chalks	Steel	Garde n	E - Waste
<b>Chemistry</b>	150	500	3	150	70	50	2	10	100
<b>Zoology</b>	35	30	2	50	20	40	2	10	50
<b>Botany</b>	20	30	2	40	20	50	2	1000	50
<b>Computer Science section</b>	100	50	2	70	10	40	2	10	100
<b>Geography</b>	50	30	1	20	10	40	5	10	10
<b>Others</b>	50	30	1	20	10	40	3	10	20
<b>Total</b>	405	670	11	350	140	260	16	1050	330

TABLE 2 WEEKLY SOLID WASTE OF NON-BUILT-UP OF COLLEGE CAMPUS APX (GM)

Place	Paper	Hard paper	Polythene	Hard Plastic	Glass	Chalks	Garden waste	E-waste
<b>Solid Waste of non built-up area</b>	100	100	2	200	5	NEG	4000 (depends on the season)	10

### TOTAL WEEKLY WASTE GENERATION OF CAMPUS

Here we can see that Garden waste is the main contributor of campus solid waste by weight. Paper comes after that. Hard Paper and Sanitary pads are the third and fourth main contributors. If we differentiate between degradable and biodegradable waste biodegradable waste shows a very large figure compare to Non – degradable waste (glass, electronic, waste, and plastic).

Weekly Biodegradable waste of college is 6-7 kg while non biodegradable waste of campus comparatively small and is approx 2 kg. But these are non-biodegradable substances and disturb natural processes. So College should take steps towards waste reduction, reuse and recycling to make its campus more Eco-friendly.

	Waste Type	Percentage
1	Paper	25 %
2	Hard paper	2 %
3	Garden waste	65 %
4	Hard plastic	3%
5	Polythene	2 %
6	Glass	1 %
7	Electronic waste	2%
8	Miscellaneous	1%

Table Visual analysis of Waste (apprx)

	Waste Type	Weight (gm)
1	Paper	505
2	Hard paper	770
3	Polythene	13
4	Hard Plastic	550
5	E – waste	340
6	Glass	145
7	Chalks	350
8	Garden waste	5050
9	Miscellaneous Organic waste	200
10	Sanitary pads	550

Table Waste by weight(apprx)

## KEY CONTRIBUTORS OF CAMPUS SOLID WASTE

### CHALK WASTE

Chalk waste is an important contributor of College's Solid waste. Chalk dust is also an allergic irritant for many students and teachers. Chalk is mostly made up of limestone or gypsum. It can be reused or recycled.



### GLASS, PAPER AND HARD PLASTIC

On an average 770g of hard plastic and plastic is weekly disposed of by campus. Approx 1300gm of paper and hard paper waste goes to dustbin every week. On an average 145gm of glass goes to waste. There should be a separate storage bin for these waste types. College staff reuses some of paper in for their daily office work. College gives remaining paper waste for reuse other vendors. For other waste separate storage bins should be provided for three categories of waste (at one place). And it should be given to waste recycler after possible reuse of waste. Currently Urali kanchan Grampanchayat collects this waste from College

### ORGANIC WASTE

Organic waste of this college mainly includes garden waste. Weekly on an average approx 6000gm of garden waste (depending on season) is removed from college premises plus other organic waste (other than gardening area) which further goes to vermicompost treatment. Garden maintenance is done once in two months. And this waste also goes to vermicompost unit..

Biological technique is most appropriate technique for organic and high-moisture wastes. It includes two main processing mechanisms – composting and anaerobic digestion/ bio-methanation. So PMDC recycle its waste through vermicomposting.



**Figure Vermicomposting Unit**



## USE AND THROW TYPE PENS


Nowadays many people use ‘use and throw’ type pens. Nobody goes to refill the pen with ink. This adds more plastic to our dustbin. Same picture can be found at this College campus. 98% of students of PMDC use ‘use and throw’ type pens. This adds near notable quantity of hard plastic to solid waste per year.

## ELECTRONIC WASTE

A college gives its E-waste to a vendor company.

## SANITARY PADS:

Menstrual Hygiene Management (MHM) is an integral part of the Swachh Bharat Mission Guidelines (SBM-G). The MHM Guideline (Dec 2015) is issued by the Ministry of Drinking Water and Sanitation to support all adolescent girls and women. It outlines what needs to be done by state governments, district administrations, engineers and technical experts in line departments; and school head teachers and teachers.

<b>Unsafe</b>  <b>Safe</b>	<b><i>Common practices</i></b>
	Throw them unwrapped into fields, rooftops, etc.
	Wrap them in paper/ plastic bag and throwing them outside
	Drying, wrap in paper/plastic bag and throw in dustbins (mostly non-rural)
	Bury them for de-composting
	Throw them in latrine / toilets
	Burn it (rural areas and peri-urban areas)
	Use small scale incinerators (community or school level)
Municipal waste management / burning in health clinics (more urban)	

As the usage of sanitary napkins is increasing, the amount of sanitary waste generated every day is also increasing. It is equally important to address the issue of efficient disposal of this infectious waste. Currently as we see, a major part of this waste is dumped into landfills leading to tremendous land pollution. Sanitary napkins are flushed down the toilet under the name of convenience. All the drains ultimately meet the rivers in the city and thus water pollution increases.

So if we see the chart of UNSAFE to SAFE practices i.e burning and use of small incinerators is comparatively safe option. Currently college is using small incinerator.

College has one more option to use one of two option to minimize environmental pollution. If college selects the burning option then it should be done at a distant place and under complete observation (till complete burning of the sanitary waste).

## RECOMMENDATIONS

PMDC College should improve its Waste Management Plan to achieve its goal of Carbon neutral campus.

## 2. WATER AUDIT

### INTRODUCTION

A water audit is a systematic review of a site that identifies the quantities and characteristics of all the water uses. The site may vary from a public water utility, facility (institutional or commercial properties like malls, office, schools etc.) or a household. The overall objective of conducting a water audit is to identify opportunities to make system or building water use more efficient.

#### **Current Water Status of Urali Kanchan region:**

According to government reports wells in Haveli tehsil are ranging in depth from 24.50 to 201.30 m bgl and the zones have been encountered in the depth range of 4.50 to 158.0 m bgl. The discharge of these wells varies from traces to 12.88 liters per second and static water level varies from 2.54 to 22.52 m bgl. Haveli tehsil falls in moderate rainfall intensity zone. The decadal rainfall average of the Urali Kanchan area is 897.67mm which is slightly higher than pune city. . It is observed that the concentration of high EC more than 3000 has been observed in isolated wells in Haveli tehsil.



**Figure: Main Water Source of PDMC College (locally known as ‘Manibhaichi vihir’)**

## WATER SUPPLY OF PMDC CAMPUS

The Primary source of PMDC potable and Non-potable wastewater is groundwater. The College receives its water from well located near PMDC campus itself. The college treats this well water before using it as potable water. College has filter located on terrace of the college.

The pipe from the well located in the campus is connected to an underground storage tank of capacity 70000 liters. The Underground water storage tank for storing well water is located within campus itself. This is Main storage tank of incoming well water.



**Figure: Water supply scheme of PMDC**

As per the daily pumping observations to overhead 50000 liter water tank, College daily uses about 12000 liters of water. Although on certain days there is a sudden jump & increase in the amount of water which is generally attribute to increase in certain water uses like different events, workshops etc. Gardening area has direct water supply from well located in the campus.

The current well which supplies to PMDC’s daily water requirement of potable and non potable uses is also a source of water for Uralic cancan Grampanchayat. It is located in campus premises and was drilled in 1972. Depth of this well is about 35 feet. College has constructed water tank of 70000 liter capacity to collect the well water. The submersible pump of 3 Horse Power (HP) was installed for pumping water to overhead 50000 liter water tank located on the terrace.



Figure: Bucket test

## WATER USAGE

PMDC building has three floors. To conduct a building water audit water consumption data for all the users were required to be monitored and recorded. Toilet water use including flushing and face/hand washing along with drinking was clubbed under personal water use. In order to collect primary data and to ensure accuracy, a brief telephonic survey of third year students was conducted.

Water users (2019-20)	Number
Students - Senior college	1085
Teaching – Regular Senior college	34
Teaching – on Contract Senior college	2
Non teaching– Regular	14
Non teaching – Contract	-
<b>Total</b>	<b>1135</b>

**Table 8 Total water users of the PMDC campus**

The total personal water use was calculated from flow rates, questionnaire and total water users (occupancy of the building). We measured the flow rates of taps and pumping lines

There are three drinking lines in college. In total there are 4 Toilet blocks in the building, which includes 1 for principle and 1 for students (2 for boys and 1 for girls ).Out of these one ladies toilet block is located on ground floor. All of these are provided with basins

	Use	Flow rate
<b>1</b>	Drinking	5 to 38s/liter
<b>2</b>	Toilet	13-18s/liter
<b>3</b>	Basin	10-12s/liter
<b>4</b>	Chemistry lab	5-7s/liter
<b>5</b>	Botany lab	15s/lire
<b>6</b>	Zoology lab	38 s/liter
<b>7</b>	Microbiology lab	5 s/liter

**WATER CONSUMPTION CALCULATION**

Total daily water Intake of water,  
is 9000 lit/day

\*Calculated from flow rate and daily water pumping operation to overhead tanks

**I. POTABLE WATER CONSUMPTION (DAILY)**

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College uses filtered well water for potable water use

**CALCULATION ON THE BASIS OF QUESTIONNAIRES AND FLOW RATES**

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i. Daily potable water consumption by staff and students:  $1135 \times 1.5 = 1702$  liters/day

**Total water use of drinking water is = 1702 liters/day**

**2. NON POTABLE WATER CONSUMPTION FROM CAMPUS WELL (DAILY)**

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College uses Well water directly for non potable water use

**CALCULATION ON THE BASIS OF QUESTIONNAIRES AND FLOW RATES**

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i. Water used for flushing by students  $1085 (2019-2020) \times 4$  liters = 4340 liters/day

ii. Water used for flushing by staff  $44 \times 4$  liters = 176 liters/day

iii. Water use for mopping of Main office area = Water per washing of wiper × Number

$$\text{of washing} = 200 \text{ liter} \times 1 = 200 \text{ liters/day}$$

iv. Water used for hand and face washing = Average time the tap left open × Number of times the hand and face washed) × Average flow rate of taps per second

$$= 10 \text{ seconds} \times 2 \text{ times} \times 0.1 = 2 \text{ liters per capita}$$

So, Total non potable water use by students and staff for hand and face washing = 2 liters × 1135 = 2270 liters.

**So, the total water use for flushing and washing = 4515 + 200 + 2270 = 6973 liters/day**

\* The daily water requirement for Science lab is not included here.

\* College fulfills its irrigation water demand directly from well water, so this use is not included.

## OVERALL WATER CONSUMPTION

Therefore based on the above recordings, monitoring and calculation, the total potable water consumption for PMDC College is 1693 lit/day and non potable water consumption is 6973 liters/day. Overall water consumption is 1702 + 6973 = 8675 liters per day. If gardening is excluded, then the per capita use for non potable water is around 6 liters day.

	Heads	Water use (in liters)
1	Average daily water supply, to the overhead tanks from the underground tank	8306
2	Total calculated water consumption from the water audit	8675
3	Difference between water consumption from overhead tanks and actual water use for various purposes	369

**Table Total water supply and use at PMDC College**

## DATA COMPARISON AND ANALYSIS

There is a little variation in the average amount of water that is pumped to the overhead tanks every day for various purposes and the average water consumption calculation. But this variation **may go wider** if we add laboratory water use into this (laboratory use is not covered in water audit). The average water supply (quantity) was based on time taken to overhead the tanks, flow rates and monitoring. The amount of water based on telephonic survey, flow rate and water users is 8675 liters per day while the daily water need to overhead all the tanks is 8306. The calculated water amount is 1.04 times greater than the amount of water which is used pumped in the tanks.

### THIS DIFFERENCE COULD BE ATTRIBUTED TO THE FOLLOWING FACTS

- The staff and students present per day in the college were assumed to be 100 % present. In real this percentage varies.
- The observations from questionnaire for personal water use were a representative observations and not a complete study.
- Along with this some staff and students living in nearby areas, they also don't use the college washrooms. Some of them bring drinking water from home.

## WASTE WATER GENERATION BY PMDC

Every building generates waste water amounting to almost 80% of total water consumed. The major source of PMDC waste water includes grey water from wash basins, lab basins, and black water from toilets. Out of that Black water of PMDC toilets goes sewer lines

### ESTIMATION OF WASTE WATER GENERATED BY PMDC

Waste water generated = 80% of water used

So, waste water generated by PMDC based on water audit

$$= 80\% \text{ of } 8675 \text{ liters per day} = \mathbf{6940 \text{ liters/day}}$$

Waste water generated by PMDC based on pumped quantity

$$= 80\% \text{ of } 8306 \text{ liter per day} = \mathbf{6644 \text{ liters/day}}$$



## THE KEY WATER CONSUMING AREAS

### SCIENCE LABS

Science Lab is the highest water demanding area of the campus. There are 4 labs which uses high amount of water. Water provided for these labs comes from the well of combined well water source. Out of these labs the water demand of chemistry lab is high due to number of students admitted to this subject and the type of practical's they perform. To arrive at total water use/loss of water from the basin taps by staff & students and to get the idea of water losses due to high pressure, flow rate was computed using the 500ml Beaker test by recording the time taken to fill the bottle, which was then used to compute flow at l/s.

**TOILETS:** Water consumption is more for flushing application in any building. College has single flushing system in Toilets

### IRRIGATION/WATERING OF CAMPUS PLANTS

Plants in the garden are watered in between 11am to 5pm in the evening to reduce evaporation losses.

## CONCLUSION AND RECOMMENDATIONS

1. The water meter should be installed for PMDC's senior college at the inlet of well water and This installation will give correct amount of well water used by PMDC's
2. The installation of water meter will give correct information about amount of wastewater produced by the college. Along with this characteristics of waste water will help to decide selection of treatment process. The use of best available waste water technique will improve the quality of treated water and it can be used for irrigation.
3. **LOW FLOW FLUSHING SYSTEMS** Water consumption is more for Flushing applications in any building. Use of more efficient water saving toilets having dual flush system can result in a saving of at least 50% of water. Dual flush systems can be installed in order to allow different volume of water for flushing liquids and solids. To facilitate efficient cleaning at low volume, it is possible to install suitable water closets.
4. **WATER TAPS** College taps works 5-40 seconds per liter. Use of low flow faucets along with other water saving devices such as auto control valves, pressure reducing devices, aerators wherever possible will minimize wastage of water.

### *Rain water harvesting*

*To overcome the problem of water logging along with the aim of water harvesting, PMDC College has designed Rainwater harvesting system in its campus. The college has sufficient surface area to adopt this system. For that PMDC preparing rainwater harvesting plan locating available catchments and identify location for siting the rainwater harvesting structures. We calculated the quantity of rain water available for harvesting & recharging With the help of built-up area, average rainfall of Haveli tehsil and paved area coefficient*

*So total rainwater available for harvesting and recharging,*

*= Avg rainfall of Urali Kanchan × built-up area of × Coeficient for impervious surface*

*= 0.9m × 1748 sq.m × 0.85 = 1337 qubic meter = 1337000 litre*

*Rain water collected from Rooftop of PMDC building goes to constructed recharge pit located within campus.*



Figure: Rain water harvesting unit

### 3. NOISE AUDIT

Actual noise monitoring is carried out with the help of sound level meter on various locations shown in figure. We have taken the samples within the free field. The comprehensive study was done inside the campus to calculate the noise level at various important locations such as class room areas, playground, parking area, library location and the data is interpreted for solutions.

Noise level readings (dB) was taken using noise meter

The readings were taken in certain period of interval and specific timings such as mornings, evenings, afternoon.

#### LOCATION OF PMDC



**Figure: location of PMDC**

## DISCUSSIONS

The location of PDMC is ideal location for educational institutes. This college is surrounded by green farms, vegetations and other educational institutes. They act as buffer zone to outside noise of crowdie places, roads and railway line.

In north PDMC is at a distance of about 110 meter from other educational complex and about 450meter from railway line. In south college is at a distance of about 200 meter from highway. Residential area starts at distance of 270meter in East. There are lush green agricultural fields in Eastward side of the college. In west PDMC is at a distance of near about 235m from residential area and about 300m from road. And in between this plantation acts as noise barrier to noise of road rush. The PDMC comes under 28 acre 'Mahatma Gandhi Sarvodaya Sangh' educational complex. Educational institutes itself are low noise producers. So College has got large buffer of silence zone.

Parking area of any educational institute is notable noise producer. But here in PDMC, vehicular parking is at a distant location from college building. Moreover this gap between parking area and college building is covered by three layer canopy of Trees. Areca palms forms highest canopy while Benjamin trees forms in the middle canopy. Shrubs of the other species forms lowest canopy.

Out of 10 average noise recordings at SITE I near college entrance. Almost all noise levels observations falls within standards, though it is near parking area of campus. The laid down noise monitoring standard for commercial zone is 50 dB (A) for a day time.

Site II is in the area of amphitheater of the college campus. 0 observation exceed the noise standard. 0 noise level recordings exceeds noise standard.

SITE III location is on the ground of the college. No observation exceeds the silence zone standard of CPCB.

We have taken the samples in free field where there are no reflected sound waves. So this clears that the Noise level decreases towards classroom areas.

## COMMENTS

- Silence is an important factor in education. PMDC campus is an ideal place for education as it follows the standards of CPCB.
- As per CPCB guidelines silence zone is referred as areas up to 100 meters around such

premises as hospitals, educational institutions and courts. The campus is at a wide distance from crowdie and noisy a r e a .

- The study of the PDMC surroundings shows that the massive plantation of trees like *Polyalthia longifolia*, *Hyophorbe lagenicauli*, *Dypsis lutescens*, *Alstonia scholaris*, *Ficus benamina* and hedge of *Bouganvella* Climber in campus do acoustic buffering of outside noise and acts as noise barriers for outside noise.

## 4. BIODIVERSITY AUDIT

### A TREE CENSUS AND INVENTORY

The present Tree census and inventory study was done to quantify, to create an inventory and to understand phyto-ecological structure of PMDC's Senior college and Gymkhana campus.

**Location** Latitude: 18.4897 N  
Longitude: 74.1369 E  
Average mean sea level: 551 meter..... PMDC college

### OBJECTIVES

1. To make an inventory of tree individuals and tree species in the campus.
2. To undertake phyto-ecological analysis with the help of
  - a. Species composition
  - b. Abundance, Relative abundance, density
  - c. Diameter class and height of the trees

### SAMPLING

Since the purpose of the study was to create a detailed inventory of Tree individuals and species, the "Census" was used as a sampling technique. In total, 4 acre of the campus was surveyed and each tree was counted. Within each plot all individual trees were identified, measured, and recorded. The diameters at breast height of the species were measured using a measuring tape.

### RESULTS

#### SPECIES COMPOSITION OF TREES

Species composition shows the different tree species found in the study area. A total of 44 species were recorded belonging to 21 families of trees and 42 genera. tree inventory shows the different plant species, their families found in the PMDC senior college campus. A total of 225 tree individuals (height above 3 meters) species were recorded in the study site.

Dominant families recorded in the study area according to descending order (based on number of species type in each family) are Moraceae (74), Arecaceae, Fabaceae (22), Apocynaceae (14), Annonaceae (11) and Bignoniaceae (7). All other families have less than 7 individuals

**ABUNDANCE** From the 21 families of trees recorded in the study sites, the Moraceae had the second highest number of species (72) which belongs to one genera followed by the Arecaceae with 3 species and 3 genera is highest in number of individuals. A total of 42 genera were recorded in the study site. *Ficus benjamina* (Moraceae) having 72 individuals was the most abundant Tree species. This was followed by the species *Dypsis lutescens* (Arecaceae) having 61 individuals, *Alstonia scholaris* (Apocynaceae), *Delonix regia* (fabaceae), *Cassia siamia* (fabaceae), *Caesalpinia pulcherrima*, *Polyalthia longifolia* (Annonaceae) and *Hyophorbe lagenicauli* having 12, 6, 5, 6, 11 and 15 individuals respectively. There were 20 species recorded in this site having only one individual. Out of which 16 species were native. The native species of this site having only one individual included *Phyllostachys aureosulcata*, *Mangifera indica*, *Ficus religiosa*, *Mimusops elengi*, *Tamarindus indica*, *Psidium guajava*, *Annona squamosa*, *Leucaena leucocephala*, *Ficus elastica*, *Sesbania bispinosa*, *Lawsonia inermis*, *Murraya koenigii*, *Vitex negundo*, *Punica granatum*, *Tactona grandi*, *Moringa oleifera*, *Bixa ordellana*, *Juglans regia*, *Sesbania grandiflora*, *Sesbania Formosa*.

#### RELATIVE ABUNDANCE OF TREES AND SMALL TREE (SHRUBS) SPECIES

Tree and shrub inventory shows the different species found in the study sites and their relative abundance. In this site, 225 individuals were sampled. The species with the highest number of individual was *Ficus benjamina* with a relative abundance of 32%. It was followed by *Areca lutescens* with relative abundance of 27.11%, *Hyophorbe lagenicauli*, *Alstonia scholaris*, *Polyalthia longifolia* with relative abundance of 6.6, 5.3 % and 4.8% respectively.



**Figure Side view of the College building showing vegetation**

## DISCUSSION

The canopy of the campus is characterized by mixed species i.e. evergreen as well as deciduous. The most dominant trees in this campus are *Ficus benjamina*, *Dyopsis lutescens*, *Polyalthia longifolia*, *Alstonia scholaris*, *Delonix regia*, *Cassia siamia* and *Caesalpinia pulcherrima*.

The Arecaceae were observed to be the most prevalent family. This may be due their massive plantation, good survival rate and adaptability. Along with this highest number Moraceae family individuals were recorded. This also attributes to massive plantation of those Arecaceae family species.

Out of first four abundant species of the campus three were native species while one is exotic to India. The four exotic species alone makes up 75.11 % of total tree number. So roughly we can say that more than 75% tree cover of the campus is under cultivation of native species and which is good sign for biodiversity of the study area and nearby area.

The campus does not contain tallest layer of vegetation. No emergent and canopy trees found. This site has more individuals of medium height (3m-10m). The higher number of individuals have diameter above 40 cm. This indicates that major plantation is taken place in recent years.

## CONCLUSION

1. Arecaceae is the dominant family and *Ficus benjamina* is the dominant species of this area.
2. It does not includes Trees of a rare, vulnerable or endangered species
3. This site does not contain tallest layer of vegetation
4. Large population of single species is one of the reasons for low value of evenness



## BIRD DIVERSITY

In nature birds occur in a variety of habitats – from deserts to the tropical rain forests; the short dry to the tall wet grasslands and on the alpine meadows in the high altitudes; from sea level to above 4000 meters above sea level; on rocks, cliffs in caves and mud banks; along fresh water estuaries, seas and shores. They also occur on man modified lands such as agricultural fields, airfields, along roadsides and hedgerows and gardens, among human habitations and dwellings.

PMDC College comes under habitat of man modified lands. 14 bird species were recorded from the campus.

### C DAY AND TIME OF BIRD CENSUS

Date 23<sup>rd</sup> Jan 2021, Time of the observations – 7.00 am to 10.30am

### D BEHAVIORAL OBSERVATIONS

- a) Communal roosting of Rose ringed parakeet (*Psittacula krameri*) was seen on tall trees of *Peltophorum pterocarpum* and *Polyalthia longifolia*
- b) Communal roosting of Red-whiskered bulbul (*Pycnonotus jocosus*)
- c) House Swifts (*Apus affinis*) do roosts on the top floors of College building.
- d) Roosting Blue rock pigeons (10-20 in numbers) were seen on college buildings.
- e) House sparrows were spotted early in the morning on shrubs near well area

Common Name	Scientific Name	College campus
Pariah Kite	<i>Milvus migrans</i>	1
Blue Rock Pigeon	<i>Columba livia</i>	8
Rose ringed Parakeet	<i>Psittacula krameri</i>	6
Indian Robin	<i>Copsychus fulicatus</i>	1
Purple Sunbird	<i>Cinnyris asiaticus</i>	4
Small Green Bee-eater	<i>Merops orientalis</i>	1
House Crow		4

	<i>Corvus splendens</i>	
Common Myna	<i>Acridotheres tristis</i>	5
Spotted munia	<i>Lonchura punctulata</i>	2

**Table List of birds reported at PMDC campus**

## METHODOLOGY

**Direct count method** was used to count the birds of campus.. The area was divided to record the number of birds in each part. The divisions were clearly demarcated by landmarks so they can be used subsequently for the same purpose. The observations included the species/common name of the bird, number of individuals observed.

## BUTTERFLY DIVERSITY

India hosts 1501 species of butterflies (Gaonkar 1996), of which peninsular India hosts 350 and the Western Ghats, 331. Remaining species are mostly forest dwellers and may not be found in the urban area. There is no literature available on Urali kanchan.



**Figure *Papilio polytes* enjoying nectar of PDMC campus shrub**

## OBSERVATIONS

<b>Common name</b>	<i>Scientific name</i>	<b>Family</b>	<b>Abundance</b>
<b>Tailed jay</b>	<i>Grapheme Agamemnon</i>	Papilionidae	Rare
<b>Common Mormon</b>	<i>Papilio polytes</i>	Papilionidae	Common
<b>Plain Tiger</b>	<i>Danaus chrysippus</i>	Nymphalidae	Common
<b>Great eggfly</b>	<i>Hyplolimnas bolina</i>	Nymphalidae	Common
<b>Common mime</b>	<i>Papilio clytia</i>	Papilionidae	Common
<b>Common grass yellow</b>	<i>Eurema hecabe</i>	Pieridae	Common
<b>Common mormon</b>	<i>Papilio polytes</i>	Papilionidae	Common

**Table Butterflies reported at PMDC college campus**

## MAMMAL DIVERSITY

As per the Champion and Seth's classification, the forest type of Urali Kanchan falls under the category 'Southern Tropical Thorn Forests'. As per the classification, the main tree species of these forests are *Acacia arabica* (Babul), *Acacia leucophloea* (Hiwar), *Ziziphus jujube* (Bor), *Butea monosperma* (Palas), and *Balanites roxburghii* (Hinganbet). These forests are also full of *Euphorbia* and *Cassia* scrub. Forest Survey of India, in its Atlas of Forest Types in India, has been described the Forest Types of the haveli tehsil as 'Dry Deciduous Scrub Forest' with shrubby growth of heights between 3 to 6 meters including some tree species. The forest area of tehsil is dominated by *Acacia* sp, with composition mainly comprising *Acacia catechu*, *Acacia nilotica*, *Azadirachta indica* and *Zizyphus jujube*. There is no scientific data on the tree and shrub density of the forest area in the tehsil, but on visual observation, it could be estimated to be 100 to 150 shrubs/trees per hectare.

The mammals commonly seen on campus – Greater Bandicoot Rat (*Bandicota indica*), House Rat (*Rattus rattus*), Indian hare (*lepus nigricollis*), three striped squirrel.

## REPTILES OF THE CAMPUS

*Pheretima posthuma*, and earthworm of *Lumbricus* genus is found in the campus. Lizard of species *Hemidactylus frenatus* is found on the building walls of the campus. Rarely Oriental garden lizard can be seen on the trees of the campus. Asian snake-eyed skink (*Ablepharus pannonicus*) is found in the campus. These skinks are mostly spotted in the summer season at cooler places of the campus garden.

Once king cobra (*Naja naja*) was spotted in the campus area. Oriental rat snake (*ptyas mucosa*) is rarely found in the campus

## HONEY BEES OF THE CAMPUS

Bees and plants have co-existed since time immemorial. Bees depend for their food on plants; nectar provides them with carbohydrate, while pollen supplies protein. Most bees also depend on plants for shelter. In return, bees help with the vital process of plant reproduction. They cross-pollinate flowers, diversify the genetic background of seed, and help plant species reproduce and survive.

Bees need a clean and healthy environment. The existence of natural bee colonies is a good indicator of a healthy environment. Individual bees can also be useful in detecting air pollution. India can boast of being a centre of origin of the world's honeybee species. Out of the five honey-producing bee species, four have occurred in India since ancient times.



**Figure This Mint plant of Medicinal garden is attraction of dozens of honey bees**

Three types of Honey bees were listed in campus

**i) *Apis dorsata-the rock bee or giant bee***

This wild bee constructs single, huge, vertical wax comb exposed to light. The nest hangs on tall tree branches or towers, or underneath bridges or on rock cliffs. It contributes nearly 75% of total honey production of India. It migrates with the season to seek



**Apis dorsata**

ii) *Apis cerana-indica the Indian hive bee*

This hive bee constructs several vertical parallel combs in dark enclosures like hollows in tree trunks or in the ground. It is relatively stationary and can be kept in wooden hives for commercial production of honey and pollination services.



i) *Apis florea-the garden bee or little bee*

This wild bee constructs a single, small, vertical comb in bushes exposed to light. It produces small quantities of honey. It also migrates depending upon the availability of food



## BOTANICAL GARDEN

PDMC has beautiful, diverse, informative and well maintained botanical garden in its campus. In principle, its role is to maintain documented collections of living plants for the purposes of scientific research, conservation, display, and education. A botanical garden or botanic garden is a garden dedicated to the collection, cultivation, preservation and display of a wide range of plants labeled with their botanical names. It may contain specialist plant collections such as cacti and other succulent plants, herb gardens, plants from particular parts of the world, and so on; there may be greenhouses, shade houses, again with special collections such as tropical plants, alpine plants, or other exotic plants.

Botanical garden of PMDC inhabits 130 species of plants which includes Trees, shrubs, herbs. There is a separate section for seasonal plants. There are about 600 potted plants and about 978 planted plants. Most importantly this botanical garden has collection of almost 70 living plants. In total this garden inhabits 1778 individuals of plants.

This botanical garden has 8 sections: Medicinal plant section Seasonal Plant section, Angiosperm plant section, Cactus section, Herb section, Tree section, Shrub section, Climber section.



## MEDICINAL PLANTS SECTION

	Common name	Scientific name	No of Individuals
1	Wekhand	<i>Acorus calamus</i>	01
2	Shatavari	<i>Asparagus racemosus</i>	01
3	Brahmi	<i>Bacopa monnieri</i>	01
4	Mandukparni	<i>Centella asiatica</i>	01
5	Gokarna	<i>Clitoriaternatea</i>	01
6	Hadjodi/ Kandwel	<i>Cissus quadrangularis</i>	01
7	Gavtichaha	<i>Cymbopogon flexuosus</i>	01
8	Maka	<i>Eclipta alba</i>	01
9	Bedki/ Gudmar	<i>Gymnemasylvestre</i>	01
10	Adulsa	<i>Adhatodavasica</i>	01
11	Panfuti	<i>Bryophyllumsp</i>	01
12	Mehendi	<i>Lawsoniainermis</i>	01
13	Pudina	<i>Mentha piperita</i>	01
14	Japnis Mint	<i>Mentha spicata</i>	01
15	Lajalu	<i>Mimosa pudica</i>	01
16	Kadipatta	<i>Murrayakoenigii</i>	01
21	Anantmul	<i>Hemidesmus indicus</i>	01
23	Bakul	<i>Mimusopselengi</i>	01
24	Pandhri Kunti	<i>Murrayapaniculata</i>	01
25	Narkya / Amruta	<i>Mappiafoetida</i>	01
28	All spice	<i>Jamaica pimento</i>	01
29	Chitrak	<i>Plumbago zeylanica</i>	01



30	Ritha	<i>Sapinduslaurifolius</i>	01
31	Sitechaashok	<i>Saracaasoca</i>	01
32	Sabja	<i>Ocimumbasilicum</i>	01
33	VaijantiTulas	<i>Ocimumtenuiflorum</i>	01
34	Krushna Tulas	<i>Ocimumsp</i>	01
35	KapurTulas	<i>Ocimumsp</i>	01
36	Beetle	<i>Piper beetle</i>	01
37	LendiPimpli	<i>Piper longum</i>	01
38	Kali Miri	<i>Piper nigrum</i>	01
39	Satap	<i>Clerodendummultiflorum</i>	01
40	Somwel	<i>Saturejapilosa</i>	01
41	Gulwel	<i>Tinospora cordifolia</i>	01
42	Wala	<i>Chrysopogonzinzinoides</i>	01
43	Nirgudi	<i>Vitex negundo</i>	01
44	Ashwagandha	<i>Withaniasomnifera</i>	01
46	Takali	<i>Cassia tora</i>	01
47	Shivan	<i>Gmelina arborea</i>	01
48	Koshimb/Kusum	<i>Schleicheraoleosa</i>	01
50	Kajra/ Kuchala	<i>Strychnosnux-vomica</i>	01
51	Behada	<i>Terminalia bellerica</i>	01
52	Tetu/ Shonak	<i>Oroxylum Indicum</i>	01
53	Bhuiringni	<i>Solanum virginianum</i>	01
54	Padal / Patla	<i>Stereospermumsuaveolens</i>	01
55	Pitwan / Prishniparni	<i>Urariapicta</i>	01
56	Insulin	<i>CostusIgneus</i>	01
58	Khair	<i>Acacia catechu</i>	01
59	Ratangunj	<i>Adenantherapavonina</i>	01

60	Samudraashok	<i>Argyreia nervosa</i>	01
61	HirwaChapha	<i>Artabotrysodorattisimus</i>	01
63	Bamboo	<i>Dendrocalamussp</i>	01
64	Kanchan	<i>Bauhinia acuminata</i>	01
65	Palas	<i>Butea monosperma</i>	01
66	Oandhirui	<i>Calotropis gigantea</i>	01
67	Ratrani	<i>Cestrum nocturnum</i>	01
68	Hirda	<i>Terminalia chebula</i>	01
70	Odomos	<i>Citronella sp</i>	01
		Total	70



**FIGURE: MEDICINAL PLANT SECTION OF BOTANICAL GARDEN**

### TREES SECTION

	Common name	Scientific name	No of Individuals
1	Ashoka	<i>Polyalthia longifolia</i>	2
2	Jamun	<i>Syzygiumcumini</i>	1
3	Nilgiri	<i>Eucalyptus sp</i>	2
4	Cycas	<i>Cycas revolute</i>	2
5	Fan palm	<i>Washingtoniarobusta</i>	4
6	Coconut	<i>Cocus nucifera</i>	2
7	Golden Bamboo	<i>Phyllostachys aureosulcata</i>	1
8	Bottleneck Palm	<i>Hyophorbelagenicauli</i>	10
9	Amba	<i>Mangifera indica</i>	2
10	Pimpal	<i>Ficus religiosa</i>	24
11	Vad	<i>Ficus benghalensis</i>	2
12	Kadunimb	<i>Azadirachta indica</i>	2
13	Bakul	<i>Mimusopselengi</i>	2
14	Chinch	<i>Tamarindus indica</i>	1
15	Gulmohar	<i>Delonix regia</i>	4
16	Peru	<i>Psidium guajava</i>	2
17	Suru	<i>Casurina indica</i>	4
18	Jackfruit	<i>Artocarpus heterophyllus</i>	1
19	Areca Palm	<i>Dypsislutescens</i>	60
20	Kanchan	<i>Bauhinia acuminata</i>	3
21	Weeping fig	<i>Ficus benjamina</i>	2
22	Chiku	<i>Manilkara zapota</i>	1
23	Sonchafa	<i>Micheliachampaca</i>	1
24	Sitaphal	<i>Anonna squamosa</i>	1

25	Silver Oak	<i>Grevillea robusta</i>	1
26	Christmas tree	<i>Abies procera</i>	2
27	Katesavar	<i>Bambax ceiba</i>	1
28	White chafa	<i>Plumaria alba</i>	6
29	Apta	<i>Bauhinia racemosa</i>	2
30	Kashid	<i>Cassia siamia</i>	2
31	Parijat	<i>Nyctanthus arbor-tristis</i>	6
32	saptparni	<i>Alstoniascholaris</i>	4
33	Ficus	<i>Ficus sp</i>	60
34	Badam	<i>Terminalia catappa</i>	2
35	Subabhul	<i>Leucaena leucocephala</i>	1
36	Fish tail palm	<i>Caryotaurens</i>	12
37	Norfolk pine	<i>Araucaria heterophylla</i>	2
38	Bright eyes plant	<i>Catharanthus roseus</i>	2
39	Christ plant	<i>Euphorbia milli</i>	8
40	Blood leaf	<i>Alternanthera brassilian</i>	1
41	Purple false eranthemum	<i>Pseuderanthemumcarruthersii</i>	29
42	White jungle flame	<i>Ixora finlaysoniana</i>	9
43	Gum rockrose	<i>Cistus ladanifer</i>	20
44	Coral tree	<i>Erythrina lysistemon</i>	24
45	White frangipani	<i>Plumeriobtusa</i>	7
46	Umbrella plant	<i>Schefflera arboricola</i>	24
47	American evergreen	<i>Syngonium podophyllum</i>	29
48	Indian rubber plant	<i>Ficus elastic</i>	1
49	African milkbush	<i>Euphobi aumbellata</i>	11
51	Screwpine	<i>Pandanus tactorius</i>	55
		<b>Total</b>	<b>258</b>

*Campus inhabits 258 species of trees in total . Out of which 225 trees are above the height of 6 feet and are counted in tree census for phytoecological and carbon sequestration study. Some shrubs are scientifically considered as small trees. So those shrubs are also included in tree inventory of the campus.*



**FIGURE: TREE SECTION**

## SHRUB SECTION

	<b>Common name</b>	<b>Scientific name</b>	<b>No of Individuals</b>
1	Fine brush	<i>Callistemon citrinus</i>	06
2	Ixora	<i>Ixora sp.</i>	06
3	Kagadiphul	<i>Baugainvillia spp.</i>	10
4	Bottle brush	<i>Callistemon lanceolatus</i>	2
5	Duranta	<i>Duranta erecta</i>	50
6	Kanher	<i>Nerium oleander</i>	2
7	Hibiscus	<i>Hibiscus spp</i>	18
8	Jatropha	<i>Jatropha curcas</i>	10
9	Banana	<i>Musa paradistica</i>	5
10	Rose	<i>Rosa chinensis</i>	40
11	Adulsa	<i>Adhatodavasica</i>	2
12	Lemon	<i>Citrus lemon</i>	3
13	Golden Caparis	<i>Capparis spinosa</i>	10
14	Tulsi	<i>Ocimum sanctum</i>	50
15	Euphorbia	<i>Euphorbia sp.</i>	20
16	Dagdipala	<i>Tridax procumbens</i>	10
17	Karvand	<i>Carissa carandas</i>	2
18	Verbena	<i>Verbena sp</i>	40
19	Ghaypaat	<i>Agave sp</i>	5
20	Shatavari	<i>Asparagus racemosus</i>	10
21	Trema	<i>Trema orientalis</i>	5
22	Shankasur	<i>Caesalpinia pulcherrima</i>	4
23	Shevri	<i>Sesbania bispinosa</i>	3
24	Acalypha	<i>Acalypha wilkensiana</i>	10
25	Piwladhotra	<i>Argimone mexicana</i>	10

		<b>Total</b>	<b>333</b>
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**FIGURE: SHRUB SECTION OF THE BOTANICAL GARDEN**



**FIGURE: SHRUB SECTION OF THE BOTANICAL GARDEN**

### Introduction

Knowledge of chemical and physical properties of soils has been assessed to understand the capacity of campus soil to support existing green cover. The concept of soil quality includes assessment of soil properties of campus as they relate to ability of soil to function effectively as a component of a Plant health at PMDC campus. In present study soil quality was assessed to know the capacity of a soil to produce biomass. As front campus is physically locked due to fencing of cement wall, so movement from **outside – campus – outside** is significantly restricted.

### *Status of soil in Maharashtra*

The state of Maharashtra represents a mixed landscape with hill ranges, thick forest cover and coastline. The soils of Maharashtra are residual, derived from the underlying basalts. The land in the river basins of Godavari, Bhima, Krishna and Tapi has a deep layer of fertile black basalt soil rich in humus. The rest of the semi-dry plateau has a medium layer black regur soil which is clayey with high moisture retention capacity, rich in iron but poor in nitrogen and organic matter. The peaks of Sahayadri Mountains, the districts of Ratnagiri and the western regions of Kolhapur and Satara are composed of laterite soil. The Konkan coast has sandy loam soil. A variety of red soil and sandy soil is found in the Vidarbha region. Maharashtra's soils are highly deficient in nutrients when compared with the soils of other Indian states. They are lacking in Nitrogen (N), Phosphorous (P) and Potassium (K) and mainly because farmers in rain-fed areas use very little fertilizers. Further, excessive use of water for irrigation also leads to increasing salinity of soils.

### *Soil characteristics*

In order to assess the soil quality PMDC educational campus, a collective soil samples were taken from different sites. Soil samples between 0-20 cm depths were collected. Collected soil samples are analyzed by using water soluble extract of soil samples.



## Physical characteristics

Physical characteristics of soil are delineated through specific parameters, viz, particle size distribution in terms of percentage of sand, silt, clay is presented in table. It is observed that texture of original landscape of PMDC educational complex is Sandy Clay Loam.

The bulk density of soil sample in the campus area found to be  $1.1 \text{ gm/cm}^3$  which is suitable for plant growth. It is generally desirable to have soil with a low BD ( $<1.5 \text{ g/cm}^3$ ) (Hunt and Gilkes, 1992) for optimum movement of air and water through the soil. Soil porosity is a measure of air filled pore spaces and gives information about movement of gases, inherent moisture, and development of root system and strength of soil. Variation in soil porosity is presented in table. The porosity of soil sample is 54%, which shows moderate water holding capacity.

Sample	%sand	% silt	%clay	Texture	% OM <sup>1</sup>	CEC <sup>2</sup>	BD	Porosity <sup>3</sup>	pH
Native soil	30	20	50	Clayey soil	4	32	1.1	54	7.9

**Table Physico-chemical analysis of soil samples collected from Campus**

## Chemical characteristics

pH is an important parameter indicative of the alkaline or acidic nature of the soil. It greatly affects the microbial population as well as the solubility of metal ions and regulates nutrient availability. The pH of original soil of the campus is 7.9 and so is conducive for the growth of plants.

Cation exchange capacity (CEC) determines the storage capacity of nutrients as supplied to plant in exchangeable forms. CEC of the campus soil is 32 meq/100 in the study area is given in table. Very high level of CEC i.e. more than 40 meq/100 normally found in very heavy soils with a high clay content or soils with a high organic matter level. Nutrients can be bound very tightly to the soil particles and availability can be restricted.

### ***Fertility status of the soil***

Organic matter present in the soil influences its physical and chemical properties. It commonly accounts for as much as one third or more of the cation exchange capacity of the surface soils and is responsible for soil aggregates. Organic matter of the campus soil is 5%, which is good for landscaping and gardening and cultivation purpose..

### ***Recommendations and conclusions***

- Soil at different location of the campus is varying in texture and having mixture of native and exotic soil. So soil sample is selected from original landscape area of the campus. It shows that campus terrain has good fertility status and can be used for landscaping and gardening and cultivation.
- Though the campus soil has good quantity of Organic matter, improved quantity will help for better Plant growth.

## 8. Water Quality

### *Drinking water supply in PMDC College campus*

The Primary source of PMDC potable and Non-potable water is well water. The College receives its water from well located in the campus. The college treats this well water before using it as potable water. College has three water filter to filter

### *Water sampling and analysis*

Two drinking water samples were collected from campus premises to assess water quality. One sample was taken from direct well supply and other one was taken from filter. Water before filtration is also sampled to check the quality of non-potable water. This water is used for Laboratories, wash basins, toilets, mopping and irrigation of campus plants.

Source	Sample No.
Before filtration	D1
After filtration	D2

**Table Water samples of PMDC campus**

Collected water samples are immediately brought in Department of Chemistry for analysis.

Physical parameters such as pH, E.C., TDS, were determined at first in college. And others are determined by titrimetric methods.

Sample No.	pH	Total hardness	TDS	DO
<b>D1</b>	6.8	200	250	6.3
<b>D2</b>	7.2	50	55	6.5

**Table Physical parameters**

This table shows the results of physical parameters viz. pH, TH, TDS and DO are in the range of 6.8 -7.2, 50-200mg/l, 55-250mg/l, 6.3-6.5mg/l.

Physical parameters are within the permissible limits.

## ***Conclusion and Recommendations***

The drinking water (after filtration) quality i.e physical water quality parameters of the PMDC campus are found to be within the specifications for drinking water standards.

It is recommended to college that it should check inorganic parameters viz. Calcium, Sodium, Chlorides and Sulphates. The regular water quality analysis is needed to check the portability of drinking water.

The well water supply can be used directly for Gardening purpose.

## Carbon accounting A. Carbon Sequestration Potential

### *Introduction*

Increasing levels of carbon dioxide in the atmosphere are of growing concern globally and locally, and urban forests have a role to play in the battle against climate change. Urban forests can reduce atmospheric carbon directly and indirectly. As long as trees are growing, they remove CO<sub>2</sub> from the air in a process called carbon sequestration, transforming CO<sub>2</sub> into carbon and making use of it to build living matter - leaves, stems, trunk, roots, etc. The Biomass carbon sequestration potential was measured for PMDC campus.

### *Total biomass assessment*

The assessment of above ground and belowground biomass of PMDC campus was carried out within 15 acres.

$$\text{Biomass carbon} = (\text{aboveground biomass carbon} + \text{belowground biomass carbon})$$

**The total biomass has been summarised below in table**

Carbon pool	Estimated Quantity (Tones)
Aboveground Biomass	0.6
Belowground Biomass	0.2
Total Biomass	0.8
Total carbon	0.4

**Table Total biomass carbon sequestration in PMDC campus**

### *Conclusion*

Total 0.4 tons of carbon is locked in by the trees of PDMC campus

## B. Vehicular emissions

The emissions inventory is the foundation upon which the regulatory strategy can be formulated. There are many emission sources that contribute to the urban air pollution such as point sources, non-point or area sources, motor vehicles, non-road mobile and natural. Magnitude of contribution from each of the sources depends upon the individual emission rates and the activity level.

The on-road vehicle emission inventory can be summarized as the product of an emission rate (e.g., gram/km) and an associated vehicle activity (e.g., km/day).

The observations used in calculating vehicular emissions are visual observations of the past i.e 2019-2020. On an average 100-150 students were using bicycle transport. Around 100 two wheelers were used daily by PMDC students and staff. While 5-6 four wheelers were daily parked in the campus.

Based on the past vehicle observations and with the help of emission factors given for Indian vehicles total emissions by PMDC campus are calculated here.

Pollutants	Emissions Factor	Avg Number of Vehicle/day	Emissions (gm/km)	Average Travel (km)	Total Emissions per day
CO	1.4	100	140	15	2100
HC	0.7	100	70	15	1050
NO <sub>x</sub>	0.3	100	30	15	450
PM	0.05	100	5	15	75
CO <sub>2</sub>	33.83	100	3383	15	50745

**Table Total emissions by two wheelers**

If we consider CO<sub>2</sub> emissions only, we can see that 50745 gm/day of CO<sub>2</sub> is emitted by two wheelers of PMDC campus. So the CO<sub>2</sub> emitted by two wheelers per year is,

$$50745 * 185 = 9387825 \text{ gm/year} = 9.38 \text{ tones/year}$$

Pollutants	Emissions Factor	Avg Number of Vehicle day	Emissions (gm/km)	Average Travel (km)	Total Emissions per day
CO	4.3	5	21	15	315
HC	2.05	5	10.25	15	153.7
NOx	0.11	5	0.55	15	8.25
PM	0.08	5	0.4	15	6
CO2	72.50	5	362.5	15	5437.5

**Table Total emissions by Four wheelers**

Emission factors by four wheelers are higher than two wheelers. So the emissions per vehicles are also high as compared to two wheelers. If we consider CO2 emissions only, we can see that 10875gm of CO2 is emitted by two wheelers of PMDC campus. So the CO2 emitted by four wheelers per year is,

$$5437.5 * 240 = 1305000\text{gm/year} = \mathbf{1.305 \text{ tones/year}}$$

**Total Emissions by PMDC vehicles per year = 2W + 4W = 9.38 + 1.305 = 10.685 tones/year**

From above figure it can be analyzed that though the number of 4W are less as compared to 2W, they do major contribution in total CO2 emissions of the campus

### CARBON DIOXIDE EMISSIONS AND ITS ASSIMILATION BY CAMPUS TREES

In green audit college has also assessed carbon sequestration by campus trees. Study shows that 0.4 tones of carbon is sequestered by campus plants. And carbon flux shows that campus plants have capacity to absorb/sequester around 0.03 tons of carbon this year. This capacity gets increased by every year.

If we quantify CO2 flux to carbon dioxide,

$$0.4 \text{ tones of Carbon} = 362 \text{ kg of carbon}$$

To determine the amount of CO<sub>2</sub> that the trees removed from the atmosphere, we have to multiply the carbon value by 3.67. This value is the mass conversion factor for carbon to carbon dioxide.

362 kg of carbon \* 3.67 = 1328 kg of CO<sub>2</sub> = 1.328 tonnes CO<sub>2</sub> per year So it can be concluded that campus trees has capacity to assimilate 1.328 tonnes of CO<sub>2</sub> per year.

While the vehicular emissions study showed that total emissions of PMDC vehicles is 10.6 tonnes/year. This value is 8 times greater than Carbon dioxide assimilation capacity of campus trees.



**Figure: Satellite image showing vehicular parking area of the campus**



## CONCLUSION AND RECOMMENDATIONS

Total 0.4 tons of carbon is locked by the campus trees of PDMC. Carbon flux calculations show that carbon sequestration capacity of trees will get increased by their age.

The Value of CO<sub>2</sub> emissions of PMDC campus vehicles is 8 times greater than carbon dioxide assimilation capacity of campus trees. Plantation is needed to assimilate the CO<sub>2</sub> emissions. As well as reduction in the use of four wheelers and two wheelers by college staff and students and can also do major impact on CO<sub>2</sub> reduction. Though the number of four wheelers are less as compared to two wheelers, they have significant contribution in total CO<sub>2</sub> emissions of the campus

PMDC staff and students must use public transport. Use of Bicycle is an eco-friendly transport option to lower the CO<sub>2</sub> emissions of campus. College is thinking of starting activities like 'No vehicle day' (at least once in a month).

**Adya Environmental Services**



**Proprietor**



# ENERGY AUDIT REPORT OF

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SANCHALIT

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## Energy Audit

### ***ENERGY SCENE***

Primary source of energy at PMDC is electricity. Electricity is used for all electrical appliances like lighting, fan, pumps, computer and lab instruments. Also water is used for drinking, domestic & gardening purpose.

### ***ENERGY: SOURCES & UTILIZATION***

Primary energy / natural resources utilized at the service center are electricity & water. These sources are consumed for the generation of motive power and water for drinking, washing & domestic usage, gardening respectively. The source of electrical power for the service center is from MSEDCL grid

### ***Objectives***

- Collect historical data to analyze background activities
- Collect & analyze monthly billing data & energy consumption data for the period of one year.
- Review on billing demand, load factor, etc. and suggest method to reduce maximum demand

### ***Monthly Electricity Consumption of College building***

<b>Sr. No.</b>	<b>Months</b>	<b>Contract Demand (kVA)</b>	<b>Billed Demand (kVA)</b>	<b>Units Consumed (kWh)</b>	<b>Total Bill, (Rs.)</b>	<b>Rs./kWh</b>
1	Apr 2020	28	11	1095	25646.54	23.42
2	Mar 2020	28	11	1059	27731.15	26.18
3	Feb 2020	28	11	1053	27272.38	25.89
4	Jan2020	28	11	1227	30234.59	24.65
5	Dec2019	28	11	1222	29986.56	24.53
6	Nov 2019	28	11	1503	30431.62	20.24
7	Oct 2019	28	11	1766	37810.09	21.41

8	Sept 2019	28	11	1651	34634.99	20.97
9	Aug2019	28	11	1486	33414.30	22.48
10	July 2019	28	11	1010	25748.44	25.49
11	June 2019	28	11	970	25083.56	25.85
12	May 2019	28	11	1370	31988.40	23.34

*Electricity bill analysis*

Sr. No.	Parameter	Value	Unit
1	Contract Demand	28	kVA
2	Average recorded Maximum demand	17	kVA
3	Avg. Unit Consumption (Electricity bill)	1284	Units/Month
4	Avg. Unit Consumption (Electricity bill)	33.63	Units/day
5	Avg. Unit Consumption (Electricity audit)	29	Units/day

Average monthly MSEDCL unit's consumption is 1284 units and average monthly consumption by shown by electricity bill is about 1.1 times higher than the Electricity audit.

***WATER***

For water quantification there is no any metering system available at building section.

Water flow meter has to be installed at all major water line for recording consumption of water.

***LEVEL OF AWARENESS***

College should organize different training programs for general awareness. Trainings on energy conservation are not found on records. It should be ensured that everyone knows the operating energy conservation parameters

The electricity bill consists of following parts

- Demand charges
- Unit charges
- Time of Day Charges
- Other charges, which cannot be controlled

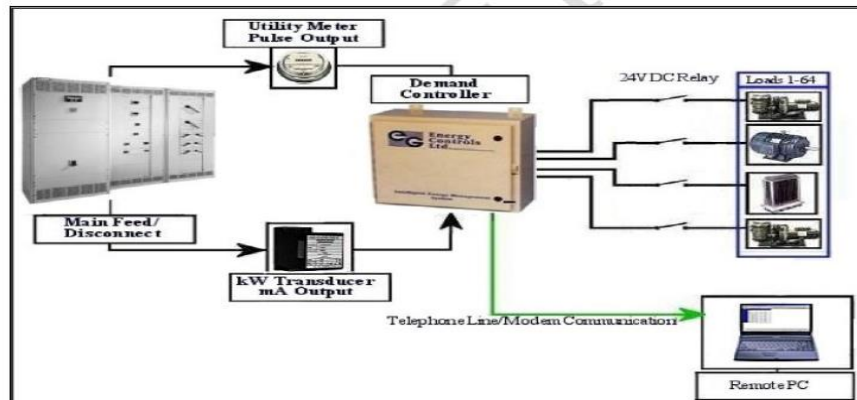
- Load factor is an indicator to assess if the billed maximum demand charges can be reduced. The monthly load factor is calculated as follows:

Load Factor =	Actual units consumed
	Maximum demand X No of hours per month X Average power Factor

Maximum demand should be monitored regularly so as to reduce non-critical loads when set maximum demand is reached. And also need to reduce contract demand in such way that to avoid excess demand charge by considering future load.

### ***Maximum Demand Controller***

- High-tension (HT) consumers have to pay a maximum demand charge in addition to the usual charge for the number of units consumed. This charge is usually based on the highest amount of power used during some period (say 30 minutes) during the metering month.
- The maximum demand charge often represents a large proportion of the total bill and may be based on only one isolated 30 minute episode of high power use. Considerable savings can be realized by monitoring power use and turning off or reducing non-essential loads during such periods of high power use.



### ***Power Factor Incentive & Penalty***

- Whenever the average power factor over a billing cycle or a month, whichever is lower, of a High Tension consumer is below 90%, Penal charges shall be levied to the consumer at the rate of 2 % (two %) of the amount of monthly energy bill (excluding of Demand Charges, FOCA, Electricity Duty and Regulatory Liability Charge etc.) for first 1 % (one percentage

point) fall in the power factor below 90%, beyond which the penal charges shall be levied at the rate of 1 % (one %) for each percentage point fall in the power factor below 89%. Such penalty will however not be applicable to Railways for Power Factor up to 72%.

- Whenever the average power factor is more than 0.95, an incentive will be given to High Tension industrial (HTP-I, HTP-II & HT- SEASONAL), and HTP-III & HTP-IV consumers, irrespective of status of TOD meter installation.
- The said incentive will be at the rate of 1% of the amount of the monthly energy bill (excluding Regulatory Liability Charges, Demand Charges, FOCA, Electricity Duty) for every 1% improvement in the average power factor above 0.95.
- For power factor of 0.99, the effective incentive will amount to 5% reduction in the energy bill and for unity power factor; the effective incentive will amount to 7% reduction in the energy bill.
- Power factor will be computed, by the method of kWh / KVAh & rounded off to two decimal points as per the existing practice.

### **RECOMMENDATIONS**

1. Average daily Unit use as per Electricity bill is 1.1 % higher than use calculated from Energy audit. This difference could be attributed to the following fact.
  - i) There may be a chance of Electricity wastage. To minimize this wastage, College should conduct awareness programmes about energy saving.
2. Electricity bill analysis shows that college is paying more penal charges due to improper maintenance of power factor. Maintenance of proper PF factor will not only minimize the electricity bill but will also add incentives to the bill.
3. College should minimize its contract demand to cut down unnecessary payment towards high contract demand.
4. College should do water pumping in the hours of 4am to 6 am OR 10pm to 12pm to minimize its unit charges.
5. College should go for Non conventional sources of Energy.

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- Make an energy-savings plan and allow all staff to contribute to it. When they see their ideas are put in an action plan, it will motivate them to closely follow the action plan and laid out procedures to help reduce energy consumption.
- Hold energy-saving contests. Encourage employees to honestly and accurately track their energy-usage in the workplace, and award employees who have provenly reduced their consumption.
- Ensure all staff and students are taught about new energy-saving equipment, sensors, and practices. Only with accurate and proper knowledge can staff really



