7.1.6. Report on Energy Audit

2022-2023

ENERGY AUDIT REPORT

ENERGY AUDIT REPORT

GREEN ENCON SOLUTION GES

Prepared for

K.K.WAGH COLLEGE OF PHARMACY, Nashik

2022-2023

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ABBREVIATIONS

ABBREVIATIONS	EXPANSIONS
APFC	Automatic Power Factor Controller
BEE	Bureau of Energy Efficiency
DG	Diesel Generator
EE	Energy Efficiency
MD	Maximum Demand
MT	Metric Ton
MTOE	Metric Ton of Oil Equivalent
No.	Number
PF	Power Factor
SEC	Specific Energy Consumption
A	Ampere
AC	Alternating Current
Avg.	Average
KW	Kilowatts
KWh	Kilowatt hours
GES	GreenEnCon Solution

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PREFACE

K.K.WAGH COLLEGE OF PHARMACYis the acknowledged leader in education field. Today K.K.WAGH COLLEGE OF PHARMACY has established a strong presence in the education field. This audit was conducted to seek opportunities to improve the energy efficiency of the campus as well as promote the green energy practices in college campus. Reduction of energy consumption while maintaining or improving human comfort, health and safety were of primary concern. Beyond simply identifying the energy consumption pattern, this audit sought to identify the most energy efficient appliances. Moreover, some daily practices relating common appliances have been provided which may help reducing the energy consumption. The report accounts for the energy consumption patterns of the academic area, central facilities based on actual survey and detailed analysis during the audit. The work encompasses the area wise consumption traced using suitable equipments. The report compiles a list of possible actions to conserve and efficiently access the available scarce resources and their saving potential was also identified. We look forward towards optimization that the authorities, students and staff would follow the recommendations in the best possible way. The report is based on certain generalizations and approximations wherever necessary. The views expressed may not reflect the general opinion. They merely represent the opinion of the team guided by the interviews of consumers.

ACKNOWLEDGEMENTS

GES places on record its sincere thanks to K.K.WAGH COLLEGE OF PHARMACYfor vesting confidence in GES to carry out the Green Energy Audit. A Green energy audit study is a joint venture exercise of consultant and institute to account and contain energy usage without sacrificing the purpose of energy use. The contribution of K.K.WAGH COLLEGE OF PHARMACY team is equally important in this venture. Team of technical experts from M/s GreenEnCon Solution, Nasik appreciates the keen interest shown by the management of K.K.WAGH COLLEGE OF PHARMACY, Nasik for their kind co-operation , furnishing required data and hospitality offered during our visits.

Our special thanks to,

- Chairman- Mr. Sameer Balasaheb Wagh
- Principal – Dr. Dipak Dhanraj Patil
- Vice Principal – Dr. Rupali A Patil

We are also thankful to other members of the institute for their diligent involvement and co-operation.

EXECUTIVE SUMMARY

Greenencon Solution has conducted a "Green Audit" of K.K.Wagh College of Pharmacy for the academic year 2022-23. Green auditing is the process of identifying and determining whether institutions practices are eco-friendly and sustainable. The main objective to carry out green audit is to check green practices followed by college and to conduct a well formulated audit report to understand where we stand on a scale of environmental soundness.

Questionnaires prepared to conduct the green audit were based on the guidelines, rules, acts and formats set by Government of India, Ministry of Environment and Forest and Bureau of Energy Efficiency. Questionnaires were prepared for solid waste, energy, water, hazardous waste and e-waste. For audit purpose and suitability analysis of data the study area is grouped as administrative buildings, Seminar Hall, Laboratories, class rooms, Common rooms, Sick room, Computer centre & Language Lab. The audit was carried for solid waste, electricity and energy, water and wastewater, hazardous waste, air quality and green inventory including carbon sequestration and carbon foot prints. It also lists green initiatives taken by campus to save environmental resources. The "Green Audit" also gives a "Environmental Management Plan".

1. PREAMBLE

K. K. Wagh College of Pharmacy, Nashik (KKWCOP) has now flourished and expanded by including a D. Pharm course in the existing B. Pharmacy Course in the same building affiliated with Dr. Bababsaheb Ambedkar Technological University, Lonere.

The K. K. Wagh College of Pharmacy, Nashik started in 2017-18 with a current intake of 100 for the B. Pharmacy course. Over the years, K. K. Wagh College of Pharmacy, Nashik has grown in leaps and bounds providing a stimulating learning environment in Nasik by providing a sprawling campus and state-of-the-art infrastructure. K. K. Wagh College of Pharmacy, Nashik has students from many different areas across the state pursuing their education in pharmacy streams. This Institute is strategically located in the heart of the city and has a campus providing enlightening and inspiring, academic ambience. K. K. Wagh College of Pharmacy, Nashik is spearheaded by well-qualified, experienced, and dedicated staff.

1.1 ABOUT GREEN AUDIT

2 Energy auditing is the process of identifying and determining whether institutions practices are eco-friendly and sustainable. Traditionally, we are good and efficient users of natural resources. But over the period of time excess use of resources like energy, water, chemicals are become habitual for everyone especially, in common areas. Now, it is necessary to check whether our processes are consuming more than required resources? Whether we are handling waste carefully? Energy audit regulates all such practices and gives an efficient way of natural resource utilization. In the era of climate change and resource depletion it is necessary to verify the processes and convert it in to Energy and clean one. Energy audit provides an approach for it. It also increases overall consciousness among the people working in institution towards an environment.

2.1 OBJECTIVES

The objective of Energy Audit is to promote the idea of Energy Conservation in the Campus of K.K.W.C.O.P.. The purpose of the energy audit is to identify, quantify, describe and prioritize cost saving measures relating to energy use in the Departments and Institute Central Facilities.

The work eligible for Energy Audit Study should be directed towards Identification of areas of energy wastage and estimation of energy saving potential in Departments and Institute Central Facilities.

- Suggesting cost-effective measures to improve the efficiency of energy use.

• Estimation of implementation costs and payback periods for each recommer action.

• Documenting results & vital information generated through these activities.

•Identification of possible usages of co-generation, renewable sources of energy Solar Energy) and recommendations for implementation, wherever possible, with benefit analysis.

2.2 GOALS OF GREEN & ENERGY AUDIT

K.K.W.C.O.P. has conducted a green audit with specific goals as:

1. Identification and documentation of green practices.
2. Identify strength and weakness in green practices.
3. Conduct a survey to know the ground reality about green practices.
4. Analyze and suggest solution for problems identified from survey.
5. Assess facility of different types of waste management.
6. Increase environmental awareness throughout campus.
7. Identify and assess environmental risk.
8. Motivates staff for optimized sustainable use of available resources.
9. The long term goal of the environmental audit program is to collect baseline data of environmental parameters and resolve environmental issue before they becom problem.

2.3 SCOPE OF WORK

- To study electrical energy metering, Green practices, monitoring and control syster existing at site and to recommend a suitable system for future monitoring.
- To study monthly power factor, maximum demand, working hours, load factor etc. for th reference period along with monthly electricity Consumption and establish scope for MI control through load optimization of load factor and through detailed load managemen study.
- To recommend a specific rationalization/ optimization program based on measurement o DB power factors, existing capacitor system and its maintenance, automatic / manual controls required etc.
- To study water distribution system for improving efficiency of water use. The water used at bathrooms, toilets, laboratory, kitchen, garden, shower and other uses as well as leakages and over flow of water from overhead tanks is also been evaluated.

- To undertake detailed lighting study on all buildings with the help of Lux meter to identify lux level for each application.
- Based on the above to evaluate the possibility of replacing inefficient light with Energy efficient lighting system.

2. METHODOLOGY

The methodology adopted for this audit was a three step process comprising of:

1. Data Collection– In preliminary data collection phase, exhaustive data collection was performed using different tools such as observation, interviewing key persons, and measurements.

2. Data Analysis- Detailed analysis of data collected was done using Elektra. The database generated by Elektra was used for producing graphical representations.

3. Recommendation– On the basis of results of data analysis and observations, some steps for reducing power consumption without affecting the comfort and satisfaction were recommended along with their cost analysis.

2.1 Data Collection

The first module is related to the general information of the concerned department, which broadly includes name of the department, month and year, total number of students and employees, visitors of the department, average working days and office timings etc. The next module is related to the present consumption of resources like water, energy, or the handling of solid and hazardous waste. Maintaining records of the handling of solid and hazardous waste is much important in green audit.

For suggesting any corrective measures to reduce power consumption, it is first necessary to know the power consumption pattern in detail. For this, the exhaustive data collection exercise was performed at all the departments, academic centers, and other supporting entities such as library, institute hospital, computer centre etc.

Following steps were taken for data collection:

- The team went to each department, centre, etc.
- Information about the general electrical appliances was collected by observation and interviewing.
- The power consumption of appliances was measured using power analyzer in some cases

(such as fans) while in other cases, rated power was used (CFL for example).

- The details of usage of the appliances were collected by interviewing key persons e Warden (in case of hostels), caretaker (in case of departments) etc.
- Light intensity was measured using lux meters at the places where light intensity w either very low or very high.
- In case of Air Conditioning, insulation was checked by visual inspection.

2.2 Data Analysis

In data analysis, the data collected is processed to draw significant conclusions pinpoint loopholes and identify the areas to focus upon. Analysis of the po consumption observations obtained was used to obtain the power consumption patt and also to get the information about the points where electric power is wasted. Anal of the water consumption observations obtained was used to obtain the w consumption pattern and also identify the losses. This helped to identify the areas maximum water and energy saving potential

2.3 Recommendations

Energy as well as cost analysis of different areas were performed and recommenda were made based on the capital cost recovery time.

Following were the steps involved in this process:

- The capital cost involved in replacing an appliance and/or process was estimated.
- The energy saving by the move was calculated in terms of price of energy per year.
- These two costs were compared to calculate the capital cost recovery time wh defined as the total time by which the saving in energy bill balances the capita involved.
- If capital cost recovery time is less than the product life, the move can be supported.
- Some other recommendations were also made which are based on lighting intensi insulation, water leakage, solid waste etc.

3. ABOUT THE UNIT

K.K. Wagh college of Pharmacy, Nashik established in 2017-18 is approved by Pharmacy Council of India (PCI), State Government of Maharashtra and is affiliated to the Dr. Babasaheb Ambedkar Technological University Lonere, with an annual intake capacity of 100 seats for First Year B. Pharm and currently 472 students are studying under B.Pharmacy Course . Along with excellent academic inputs, we have trained our students for their soft skills also. Also, some of our students are attending internships in various companies and some of the final year projects are also sponsored by industries.

The methodology of present study is based on onsite visits, the personal observations and questionnaires survey tool. Initially, based on data requirement, sets of questionnaires were prepared. The surveyors then visited all the departments of the campus and the questionnaires were filled. The generated data is subsequently gathered and used for further analysis. From the outcome of the overall study, a final report is prepared.

4. ENERGY AUDIT

An energy audit is an analysis of a facility, indicating how and where that facility ca reduce energy consumption and save energy costs. Its insight to energy efficiency an conservation can lead to significant savings on the utility bill. Energy is one of the majo inputs for the economic development of any country. The fundamental goal of energ management is to produce goods and provide services with the least cost and leas environmental effect. The energy audit is key to a systematic approach for decisio making in the area of energy management. It attempt to balance the total energy input with its use, and serve to identify all the energy streams in a facility.

4.1. ELECTRICITY AUDIT

Energy resources utilized by all the departments, support services and th administrative buildings of K.K.W.C.O.P. campus include electricity. Major use of th energy is at office, class room and laboratories, for lighting and laboratories instruments K.K.W.C.O.P. has total sanctioned load of 495KW with 1 commercial Electricity meter Electricity is supplied to the K.K.W.C.O.P. campus by Maharashtra State Electricity Board

Table 1: Total Load Consumption of the Unit

Department	Total load (KW)	Energy consumed yearly (KWH)
LABORATORY	350	15112.24
CLASS ROOM	110	5309.2
BOY'S COMMON RROM	19	475.28
GIRL'S COMMON ROOM	8	570.96
LIBRARY	75	2305.7
COMP. CENTRE & LANGUAGE LAB	46	1948.48
SEMINAR HALL	61	1092
CORRIDOR	95	569.92
ADMIN OFFICE	0	0
HOD CABIN	0.716	927.16
EXAM OFFICE	12	455
MACHINE ROOM	77	1026.48
STORE ROOM	29	665.6
WATER PUMP	224.31	12310
MEETING HALL	70	791.44
CENTRAL INSTRUMENT ROOM	181	1026.5

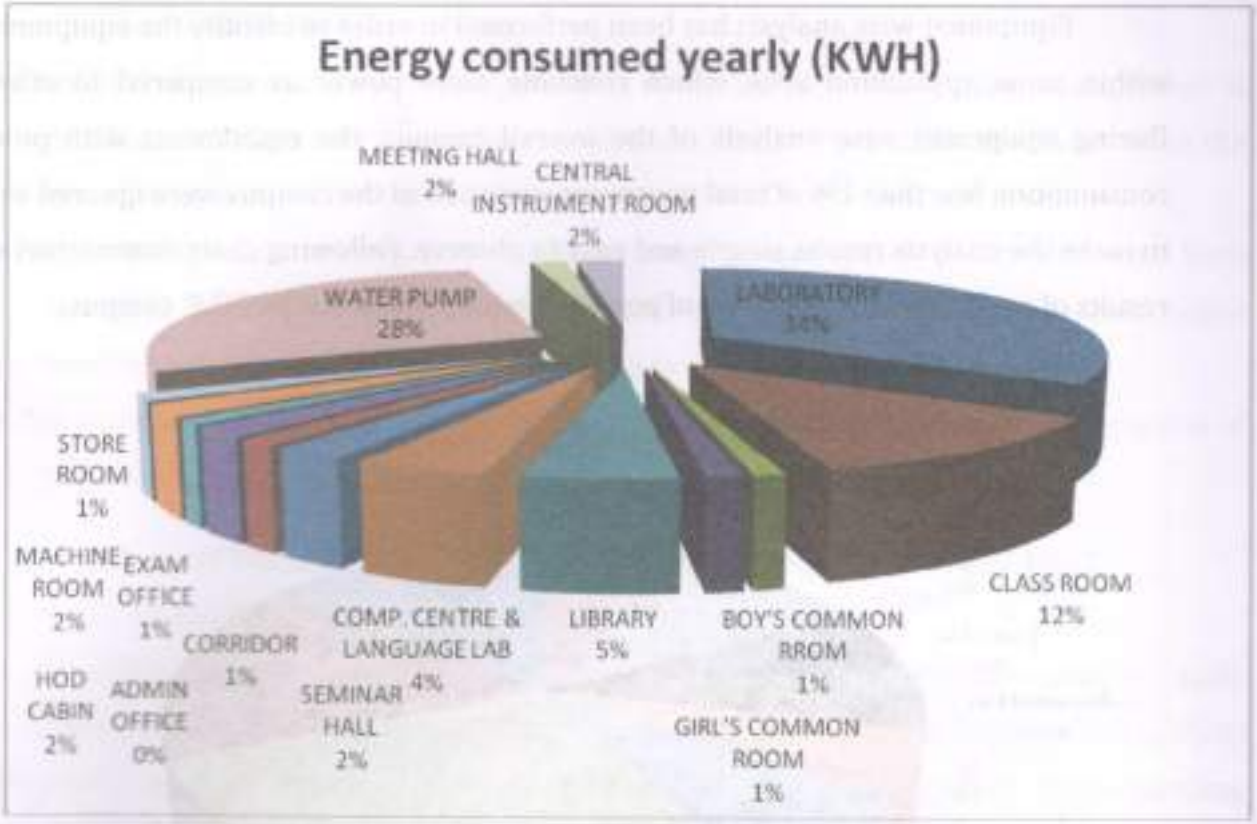

Fig.1: Total Load consumption of the campus

4.2. EQUIPMENT WISE ANALYSIS OF CAMPUS:

Table 2: Equipment wise Load of Campus

Sr. No	Euipment	Energy consumed yearly (KWH)
1	LED	4520.88
	TL	5366.4
2	Fans	8314.8
3	PRINTER	336.96
4	Computer	2077.92
5	Projector	1872
6	Cooler	20.8
7	TV	624
8	Wallmounted Fan	1216.8
9	Exaust Fan	1580.8
10	Ups	0
11	Scanner	234
12	200W Socket	2184
13	100 W Socket	3172
14	Water Pump	0
	TOTAL	**31521.36**

Equipment wise analysis has been performed in order to identify the equipments, within same application area, which consume more power as compared to others. During equipment wise analysis of the overall campus, the equipments with power consumption less than 1% of total power consumption of the campus were ignored so as to make the analysis results simple and easy to observe. Following chart summarizes the results of equipment wise analysis of power consumption of K.K.W.C.O.P. campus:

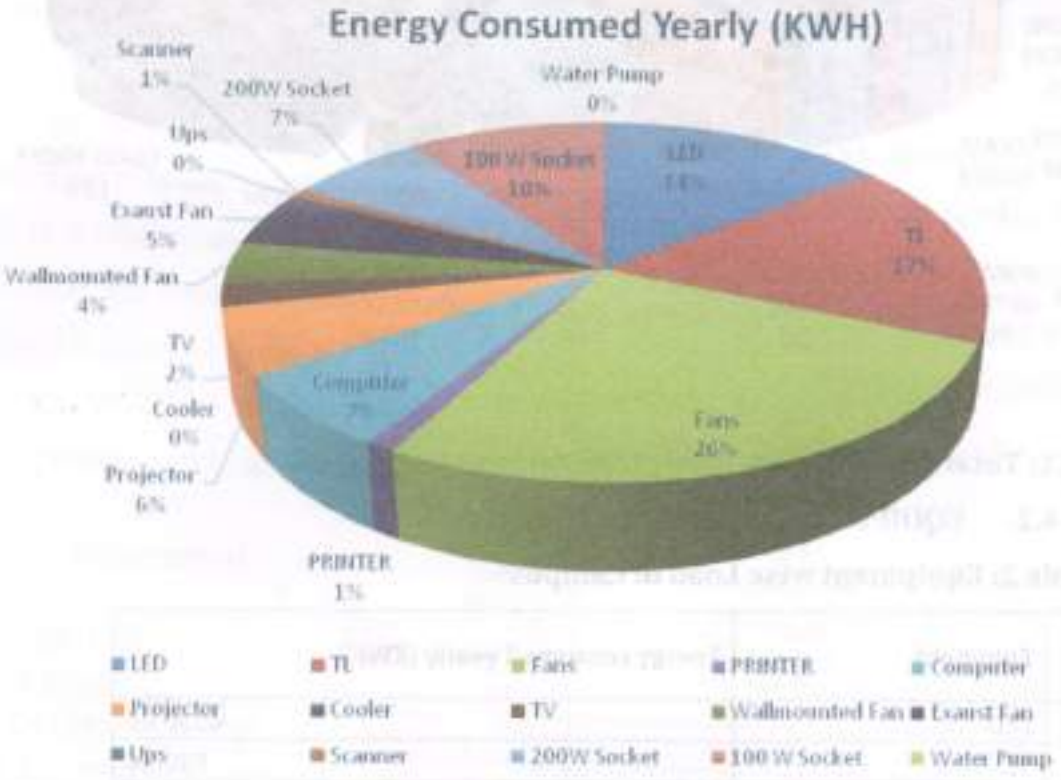

Fig.2.: Equipment wise energy consumed yearly chart

Computer consumes 7% of total power consumed. For lighting, dominant appliance is the conventional Ballast[Choke] tube light with 17% share and relatively efficient LED lamps have 14 % share. Fans have 26% share while wallmounted fan has 4% share in total power consumption..Computer has 7% share. Projector has 6% share of total power consumption.

4.3. LEVEL OF AWARENESS

- The level of awareness for energy conservation in top and middle management is excellent. It is felt necessary to make serious efforts to percolate the same up to the operating staff level and students.
- It is very important to record and monitor energy consumption department wise. Such recording and monitoring of energy consumption help in continuous performance monitoring of the equipments and attending to deviations , if any.
- The electrical personal regularly monitor and record current and power consumption of major equipments to assess their operating performance.

4.4. DETAILED TECHNICAL FEASIBILITY ASSESSMENT OF THE UNIT

4.4.1. ANALYSIS OF ELECTRICITY CONSUMPTION

Identifying where energy is used is useful because it identifies which areas the audit should focus on and raises awareness of energy use and cost. The results of the analysis can be used in the review of management structures and procedures for controlling energy use.

Analysis of energy use can be done by installing sub meters in different plant locations to pinpoint actual energy usage per area. This is a good source data for allocating energy use. The plant manager can also list all equipment used and the corresponding operating hours. With this information, spreadsheet can be created and charts useful for analysis may be generated.

Important Points to Consider When Collecting Load Data:

a. Usage– The usage of the equipments in terms of hours per day and days per year can be collected from key persons in s, departments etc. It is important to ensure the accuracy of this data because much of the potential for energy savings lies on wise allocation of the equipment's operating hours.

b. Actual power consumed– Actual power consumption is measured by Wattmeter or Power analyzer.

c. Supplementary Information – Some other supplementary information are also collected such as state of insulation in case of ACs or availability of natural light etc.

4.4.2. IDENTIFIED ENERGY CONSERVATION MEASURES IN THE UNIT

Based on the analysis of the power consumption data, certain steps have been recommended for improving energy efficiency of the campus. Complete cost analysis of implementation of recommended measures has been performed wherever necessary. Also, a number of general measures for energy efficiency have been listed. Described below are some important recommendations for better energy efficiency:

4.4.2.1. Replacing Conventional Ballast[Choke] FTLs with LED TL

Fig. 3. : Conventional Ballast FTL

Dominant light source at most places in the campus is traditional 40W FTLs with conventional Ballast[Choke] which consumes 20W in addition to the 40W. As per our data collection, the campus has in total 86 conventional Ballast[Choke] FTLs and no LED TL[Choke] FTLs. If these conventional Ballast[Choke]s are replaced by LED TL[Choke], 15-20W power can be saved per FTL. Cost Analysis of Replacing Conventional Ballast[Choke] FTL with LED TL[Choke] FTL.

Table 3: Energy Conservation in lighting system

A: Title of Recommendation	1. Replacement of Conventional ballast with Electronic ballast
B: Description of Existing System and its operation	The Existing system consist of 86 Fluorescent Tubes with conventional Ballast. The Max. working Hrs. are considered to be 6 Hrs. Total load of the lighting system is 6.9 KW. The total annual Energy consumption of the lighting system is 11174 KWH
C: Description of Proposed system and its operation	All the Conventional Ballast (86 Nos) are replaced with LED TL. Besides it arrange the Fluorescent TL with proper design as per the working area.
D: Energy Saving Calculations	
1. No of Ballast to be replaced	86
2. Avg power of conventional Ballast	40
3. Avg. power of Electronic Ballast	18
4. Power saved per FTL	(40-18)=22 W
5. Total Power saving	(86*22)/1000= 1.892 KW
6. Avg. use of FTL / year	(270*6)= 1620 Hrs
7. Total Energy saved / year	(1.892*270*6)= 3065.04 KWH
E: Cost Benefits	
1. Savings in Rs./ Year	**(3065.04*16)= Rs.49,040.64**
2. Investment	Rs. 18490
3. Payback period in Years	(18490 / 49040.04) =0.37Yrs

Hence, the capital cost recovery time for replacing all conventional Ballast[Choke] FTLs of the campus is around 0.37 years.

4.4.2.2. Revamping of Existing lighting system:

Fig. 4. : Existing Lighting System

Most of the buildings in K.K.W.C.O.P. campus are very old and so are the lighting syste
According to the data collected, there are a total of 86 TL . Most of the lighting syste
are not according to standards. A saving of 1540 units can be obtained by Revamping
existing lighting system.

Cost Analysis of **Revamping of Existing lighting system:**

- Total units consumed by existing lighting system = 9887 kWh
- Average units saved by revamping = 1540 kWh
- Saving in Rs. Per year = 1540*12 = Rs.18,480 /-
- Average Cost of Revamping = Rs. 9,900/-
- Capital Cost Recovery time = (9,900)/(18,480) = 0.53 yrs

Hence, the capital cost recovery time for **Revamping of Existing lighting system** of
campus is around 0.53 years.

4.4.2.3 Use of Motion Sensors in Corridors and Toilets:

Corridors and toilets have large potential of saving energy by use of automation tools. Motion sensors can be used there to automatically switch on the light when there is any movement and switch off the light when there is no movement. This can greatly reduce the total load in corridors and toilets.

Cost analysis of Installing Motion Sensors in a Typical Corridor:

- Average number of tube lights in a corridor = 10
- Average power of the tube lights = 40W
- Average number of motion sensors required = 10
- Average reduction in usage per day by motion sensor = 2 hrs
- Total energy saved in corridor per year = (10*40*2*365)/1000 = 292 kWh
- Saving in Rs. Per year = 292*7.11 = Rs. 2,076/-
- Cost of installation per motion sensor = Rs. 200
- Total cost of installing motion sensors in a corridor = 10*200 = Rs. 2,000/-
- Capital Cost Recovery Time = (2,000/2,076) = 0.96 yrs

Hence, the capital cost recovery time for installing motion sensors in corridors is 0.96 years.

Toilets are also having comparable capital cost recovery time. Hence, this is a highly recommended step to largely reduce the consumption in corridors and toilets.

4.4.2.4 Minimizing Repair Works in Fans:

During data collection, the repaired fans have been found to be consuming very high power as compared to the rated power. Fans repaired once and twice were consuming 16W and 43W more than the average consumption of new fans respectively. Thus, effort should be made to minimize the repairing of fans and also repair work should be supervised properly.

4.4.2.5. Use of Master Switch outside each Room:

Installation of a master switch outside a room can make it easy for a person to switch off all the appliances of a room in case someone forgets to switch off while leaving the room. This can help improving energy efficiency.

4.4.2.6 Reduce Contract Demand (CD) to 320 kVA from existing level of 400 kVA Install MD Controller so as to restrict MD Level at less than 320 kVA

Table 4: Reduced Contract Demand

Solution Description –

The working is done with existing values applied with HT VIII B Tariff for Y 2022-23.

Month	CD	65% CD	MD [kVA]	BD [kVA]	BD - MD [kVA]	Demand Rate	Add. BD Charges	
Apr-22	400	260	252	252	0	454	0	
May-22	400	260	278	278	0	454	0	
Jun-22	400	260	221	260	39	454	17706	
Jul-22	400	260	194	260	66	454	29964	
Aug-22	400	260	220	260	40	454	18160	
Sep-22	400	260	234	260	26	454	11804	
Oct-22	400	260	221	260	39	454	17706	
Nov-22	400	260	198	260	62	454	28148	
Dec-22	400	260	197	260	63	454	28602	
Jan-23	400	260	175	260	85	454	38590	
Feb-23	400	260	191	260	69	454	31326	
Mar-23	400	260	230	260	30	454	13620	
Summation	NAP	NAP	NAP	NAP	NAP	NAP	235626	
Minimum	400	260	175	252	0	454	0	
Average	400	260	217.58	260.83	43.25	454	19635.5	
Maximum	400	260	278	278	85	454	38590	

Month	New CD	65% of CD	New BD	New BD-MD	New Add. BD Charges	Saving in BD Charges
Apr-22	320	208	252	0	0	
May-22	320	208	278	0	0	
Jun-22	320	208	221	0	0	17
Jul-22	320	208	208	14	6356	23
Aug-22	320	208	220	0	0	18
Sep-22	320	208	234	0	0	11
Oct-22	320	208	221	0	0	17
Nov-22	320	208	208	10	4540	23
Dec-22	320	208	208	11	4994	23
Jan-23	320	208	208	33	14982	23
Feb-23	320	208	208	17	7718	23
Mar-23	320	208	230	0	0	13
Summation	NAP	NAP	NAP	NAP	38590	197
Minimum	320	208	208	0	0	
Average	320	208	225	7	3216	16
Maximum	320	208	278	33	14982	23

Saving - kWh/Year	Saving - Rs. Lacs/Year	Investment - Rs. Lacs	Simple Payback- Months
NAP	1.97	1	6

4.4.2.6 Improve the performance of APFC and maintain Unit PF (0.999 Lag) resulting into kVAh consumption almost equal to kWh

Table 5: Improve APFC panel

MONTH	KWH	KVAH	(KVAH-KWH)	Rs./KVAH	extra charges	present pf
Apr-22	79021	81818	2797	9.51	26599.47	0.965
May-22	86495	88808	2313	9.51	21996.63	0.973
Jun-22	75881	78549	2668	9.51	25372.68	0.966
Jul-22	65997	68142	2145	9.51	20398.95	0.968
Aug-22	69641	71487	1846	9.51	17555.46	0.974
Sep-22	76116	77931	1815	9.51	17260.65	0.976
Oct-22	65256	67672	2416	9.51	22976.16	0.964
Nov-22	68380	70153	1773	9.51	16861.23	0.974
Dec-22	70049	72056	2007	9.51	19086.57	0.972
Jan-23	62970	64239	1269	9.51	12068.19	0.98
Feb-23	64893	65981	1088	9.51	10346.88	0.983
Mar-23	78153	80085	1932	9.51	18373.32	0.975
Summation	862852	886921	24069	NAP	228896.19	NAP
Minimum	62970	64239	1088		10346.88	0.964
Average	71904.33	73910.08	2005.75		19074.6825	0.9725
Maximum	86495	88808	2797		26599.47	0.983

Month	New Expected PF	New Expected kVAh	New (kVAh - kWh)	Saving in Extra kVAh	Saving in Rs.
Apr-22	0.999	79100.10	79.10	2717.90	25847.23
May-22	0.999	86581.58	86.58	2226.42	21173.24
Jun-22	0.999	75956.96	75.96	2592.04	24650.33
Jul-22	0.999	66063.06	66.06	2078.94	19770.69
Aug-22	0.999	69710.71	69.71	1776.29	16892.51
Sep-22	0.999	76192.19	76.19	1738.81	16536.06
Oct-22	0.999	65321.32	65.32	2350.68	22354.95
Nov-22	0.999	68448.45	68.45	1704.55	16210.29
Dec-22	0.999	70119.12	70.12	1936.88	18419.74
Jan-23	0.999	63033.03	63.03	1205.97	11468.75
Feb-23	0.999	64957.96	64.96	1023.04	9729.13
Mar-23	0.999	78231.23	78.23	1853.77	17629.34

Summation	NAP	863715.72	863.72	23205.28	220682.25
Minimum	0.999	63033.03	63.03	1023.04	9729.13
Average	0.999	71976.31	71.98	1933.77	18390.19
Maximum	0.999	86581.58	86.58	2717.90	25847.23

Saving - kWh/Year	Saving - Rs. Lacs/Year	Investment - Rs. Lacs	Simple Payback- Months
NAP	2.21	2	10.85

4.7. SUMMARY OF ENERGY CONSERVATION OPTIONS & RECOMMENDATIONS:

Table64: Summary of Energy Conservation Measures

Sr. No	Energy Saving Recommendations	Annual Energy Savings(KWH)	Annual Cost Savings(Rs.)	Capital Investment(Rs.)	Simple Pay Period(Yrs.)
1	LED TL	3065.04	Rs. 49,040.064	Rs. 18,490.00	0.37
2	Revamping	1540	Rs. 18,480	Rs. 9,900.00	0.53
3	Automation	292	Rs. 4,672	Rs. 2,000	0.96
4	MD controller	-	Rs.1,97,036	Rs. 1,00,000	0.5
5	APFC	23,205	Rs. 2,20,682	Rs.2,00,000	0.90
Total		**28,102.04**	**Rs. 4,89,910**	**Rs. 3,30390**	**0.67**

5.SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1. Summary :

Green Audit is one of the important tool to check the balance of natural resources and its judicial use. Green auditing is the process of identifying and determining whether institutional

practices are eco-friendly and sustainable. It is a process of regular identification, quantification, documenting, reporting and monitoring of environmentally important components in a specified area. The main objective to carry out green audit is to check the green practices followed by institute and to conduct a well defined audit report to understand whether the institute is on the track of sustainable development. This is the first time to conduct green audit of college campus. After completing the audit procedure of College campus for green practices, there are following conclusions, recommendations which can be

followed by college in future for keeping campus environment friendly.

5.2. Conclusion:

Considering the fact that the organization is a well-established, long time run establishment with good reputation, there is significant scope for conserving energy and make the campus as self-sustained in it. The energy conservation initiatives taken up by the institution are substantial. Energy efficient lighting schemes, awareness created among stakeholders and necessary power backups are being practiced by the institution. There are some best Practices followed on Energy Audit in the Organization like Transformers, Generators and UPS are protected properly with fencing and kept awareness boards on 'Dangers' and 'Warnings'. It is observed that the most of places, sign board of 'Switch ON' and 'Switch OFF' are kept towards saving energy measures to the stakeholders. Electrical wires, switch boxes and stabilizers are properly covered without any damage which will cause any problems to the staff and student members. Adaptation of sprinkler irrigation in the campus to minimize the energy potential are well appreciated. Few recommendations, in addition, can further improve the energy savings of the Organization. This may lead to the prosperous future in context of Energy Efficiency Campus and thus sustainable environment and community development to the stakeholders in coming years to come.

5.3. Recommendations:

- The energy audit included suggestions for energy cost reduction, preventive maintenance and quality control activities, all of which are critical for utility operation in the audit sites.
- Procurement of equipment with energy efficiency (4-5 star rated equipment) during replacement may be considered.
- Sub meters in all the buildings for energy monitoring is recommended so that energy load required and energy consumption in each building may be noted.
- Optimal water usage and temperature settings may be used which are coming under automatic process towards energy savings.
- Continuous monitoring and analysis of energy consumption by dedicated team may be planned within the campus.
- Promoting ECON awareness and practice among the stakeholders may be conducted periodical through Association, Clubs, Forums and Chapters.
- Turn off electrical equipment when not in use
- Maintain appliances and replace old appliances in all laboratories.
- Use computers and electronic equipment in power saving mode.
- Installation of Biogas plant for hostel kitchen as well canteen.
- Automatic switches with occupancy sensors in common areas
- Monthly use of electricity in the College is very high which may be reduce to a greater extent by means of undertaking a periodical energy audit.
- There are fans of older generation and non-energy efficient which can be phase out by replacing with new energy efficient fans.
- Regular monitoring of equipment in all laboratories and immediate rectification of any problems.
- Value added / Non-formal / Certificate / Diploma course on 'Energy and Environment Management Audits' may be conducted for the benefit of students and research scholars to become a certified Lead Auditor.

5.4. Steps undertaken to amend the suggestions given in the previous Energy Audit Report

As per the previous Energy Audit report, the following steps were undertaken to amend the suggestions and recommendations. The last Energy Audit was conducted on 22.02.2022 by the M/s. Greenencon Solution, Nashik.

Table 7- Steps undertaken to amend the suggestions given in the previous Energy Audit Report

S .No	Suggestions made during the previous Energy Audit Report	Steps taken to amend the suggestions of the previous Energy Audit Report
1	Suggested to install Roof top solar power plants and Solar water heaters	In process & working with management
2	Suggested to protect all Transformer, Generators and UPS with fencing and keep the awareness boards and safety signs on 'Dangers' and 'Warnings, etc.	Transformer, Generators and UPS are protected properly with fencing and kept awareness boards and safety signs on 'Dangers' and 'Warnings for safety purpose and to draw the attention about safety intervention.
4	Advised to cover Electrical wires, switch boxes, inverters, and stabilizers not to cause any problem to the staff and student members	Electrical wires, switch boxes, inverters, and stabilizers are properly covered without any damage not to cause any problem to the staff and student members in the campus.
5	Advised to replace old generation computers and TVs with LED monitors and old incandescent (tungsten) bulbs with LED lights and install automatic street solar lights.	Replaced some of the old generation computers and TVs with LED monitors, most of the places, old incandescent (tungsten) bulb uses with LED lights and installed automatic street solar lights in the campus which indicated the positive indication on energy savings.
6	Use of motion sensors in corridors	In process

6.INSTRUMENT USED BY AUDIT TEAM

Table 8: Instruments used by Audit Team

SR.NO.	INSTRUMENT NAME	SPECIFICATIONS
1	Clamp-on Power meter	0-1200KW 0-600 V AC 0-600 V DC 0-400 A AC/DC
2	Power Analyzer	3 phase 4 wire Recording parameters- voltage current, frequency, Harmonics/ Inter harmonics up to 49th , THD of voltage, current with crest factor, Transients, voltage sag – swells, all power measurements, Inrush current, monitoring of events,etc.
3	Lux Meter	0-2,00,000 lux level
4	Infrared Thermometer	Non contact type Temp.= -30 to 550@C RH= 10 to 95 %

7.1.6 Report on Green Audit

2022-2023

GREEN AUDIT REPORT

GREEN AUDIT REPORT

GREEN ENCON SOLUTION GES

Prepared for

K.K.WAGH COLLEGE OF PHARMACY, Nashik

2022-2023

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

ABBREVIATIONS	EXPANSIONS
BEE	Bureau of Energy Efficiency
EE	Energy Efficiency
MT	Metric Ton
MTOE	Metric Ton of Oil Equivalent
No.	Number
GES	GreenEnCon Solution

DISCLAIMER

1. This Green Energy Audit Report [hereinafter referred to as Report], the business plan / financial projections, if any and its contents are confidential. Accordingly, report and its contents are on the basis that they will be held in complete confidence.
2. By accepting a copy of this report, the recipient agrees to keep its contents and any other information, which is disclosed to such recipient, confidential and shall not divulge, distribute or disseminate any information contained here , in part or in full , without the prior approval of GreenEnCon solution.
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Compiled / Prepared by

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BEE Certified (EA-21802)
Greenencon Solution

PREFACE

K.K.WAGH COLLEGE OF PHARMACYis the acknowledged leader in education field. Today K.K.WAGH COLLEGE OF PHARMACY has established a strong presence in the education field. This audit was conducted to seek opportunities to improve the energy efficiency of the campus as well as promote the green energy practices in college campus. Reduction of energy consumption while maintaining or improving human comfort, health and safety were of primary concern. Beyond simply identifying the energy consumption pattern, this audit sought to identify the most energy efficient appliances. Moreover, some daily practices relating common appliances have been provided which may help reducing the energy consumption. The report accounts for the energy consumption patterns of the academic area, central facilities based on actual survey and detailed analysis during the audit. The work encompasses the area wise consumption traced using suitable equipments. The report compiles a list of possible actions to conserve and efficiently access the available scarce resources and their saving potential was also identified. We look forward towards optimization that the authorities, students and staff would follow the recommendations in the best possible way. The report is based on certain generalizations and approximations wherever necessary. The views expressed may not reflect the general opinion. They merely represent the opinion of the team guided by the interviews of consumers.

ACKNOWLEDGEMENTS

GES places on record its sincere thanks to K.K.WAGH COLLEGE OF PHARMACYfor vesting confidence in GES to carry out the Green Energy Audit. A Green energy audit study is a joint venture exercise of consultant and institute to account and contain energy usage without sacrificing the purpose of energy use. The contribution of K.K.WAGH COLLEGE OF PHARMACY team is equally important in this venture. Team of technical experts from M/s GreenEnCon Solution, Nasik appreciates the keen interest shown by the management of K.K.WAGH COLLEGE OF PHARMACY, Nasik for their kind co-operation , furnishing required data and hospitality offered during our visits.

Our special thanks to,

- Chairman- Mr. Sameer Balasaheb Wagh
- Principal – Dr. Dipak Dhanraj Patil
- Vice Principal – Dr. Rupali A Patil

We are also thankful to other members of the institute for their diligent involvement and co-operation.

EXECUTIVE SUMMARY

Greenencon Solution has conducted a "Green Audit" of K.K.Wagh College of Pharmacy for the academic year 2022-23. Green auditing is the process of identifying and determining whether institutions practices are eco-friendly and sustainable. The main objective to carry out green audit is to check green practices followed by college and to conduct a well formulated audit report to understand where we stand on a scale of environmental soundness.

Questionnaires prepared to conduct the green audit were based on the guidelines, rules, acts and formats set by Government of India, Ministry of Environment and Forest and Bureau of Energy Efficiency. Questionnaires were prepared for solid waste, energy, water, hazardous waste and e-waste. For audit purpose and suitability analysis of data the study area is grouped as administrative buildings, Seminar Hall, Laboratories, class rooms, Common rooms, Sick room, Computer centre & Language Lab. The audit was carried for solid waste, electricity and energy, water and wastewater, hazardous waste, air quality and green inventory including carbon sequestration and carbon foot prints. It also lists green initiatives taken by campus to save environmental resources. The "Green Audit" also gives a "Environmental Management Plan".

1. PREAMBLE

K. K. Wagh College of Pharmacy, Nashik (KKWCOP) has now flourished and expanded by including a D. Pharm course in the existing B. Pharmacy Course in the same building affiliated with Dr. Bababsaheb Ambedkar Technological University, Lonere.

The K. K. Wagh College of Pharmacy, Nashik started in 2017-18 with a current intake of 100 for the B. Pharmacy course. Over the years, K. K. Wagh College of Pharmacy, Nashik has grown in leaps and bounds providing a stimulating learning environment in Nasik by providing a sprawling campus and state-of-the-art infrastructure. K. K. Wagh College of Pharmacy, Nashik has students from many different areas across the state pursuing their education in pharmacy streams. This Institute is strategically located in the heart of the city and has a campus providing enlightening and inspiring, academic ambience. K. K. Wagh College of Pharmacy, Nashik is spearheaded by well-qualified, experienced, and dedicated staff.

1.1 ABOUT GREEN AUDIT

The modernization and industrialization are the two important outputs of twentieth century which have made human life more luxurious and comfortable. Simultaneously, they are responsible for voracious use of natural resources, exploitation of forests and wildlife, producing massive solid waste, polluting the scarce and sacred water resources and finally making our mother Earth ugly and inhospitable. Today, people are getting more familiar to the global issues like global warming, greenhouse effect, ozone depletion and climate change etc. Now, it is considered as a final call by mother Earth to walk on the path of sustainable development. The time has come to wake up, unite and combat together for sustainable environment.

Considering the present environmental problems of pollution and excess use of natural resources, Hon. Prime Minister, Shri. Narendra Modiji has declared the Mission of Swachch Bharat Abhiyan. Also, Campus Grants Commission has mentioned "Green Campus, Clean Campus" mission mandatory for all higher educational institutes. As environmental sustainability is becoming an increasingly important issue for the nation, the role of higher educational institutions in relation to environmental sustainability is more prevalent. Green Audit is the most efficient ecological tool to solve such environmental problems. It is a process of regular identification, quantification, documenting, reporting and monitoring of environmentally important components in a

specified area. Through this process the regular environmental activities are monitored within and outside of the concerned sites which have direct and indirect impact on surroundings. Green audit can be one of the initiative for such institutes to account their energy, water resource use as well as wastewater, solid waste, E-waste, hazardous waste generation. Green Audit process can play an important role in promotion of environmental awareness and sensitization about resource use. It can create consciousness towards ecological values and ethics. Through green audit one can get direction about how to improve the condition of environment.

1.2 OBJECTIVES

The objective of Green Energy Audit is to promote the idea of Energy Conservation in the Campus of K.K.W.C.O.P.. The purpose of the energy audit is to identify, quantify, describe and prioritize cost saving measures relating to energy use in the Departments and Institute Central Facilities.

The work eligible for Energy Audit Study should be directed towards Identification of areas of energy wastage and estimation of energy saving potential in Departments and Institute Central Facilities.

- Suggesting cost-effective measures to improve the efficiency of energy use.
- Estimation of implementation costs and payback periods for each recommended action.
- Documenting results & vital information generated through these activities.
- Identification of possible usages of co-generation, renewable sources of energy (say Solar Energy) and recommendations for implementation, wherever possible, with cost benefit analysis.

1.3 GOALS OF GREEN AUDIT

K.K.W.C.O.P. has conducted a green audit with specific goals as:

1. Identification and documentation of green practices.
2. Identify strength and weakness in green practices.
3. Conduct a survey to know the ground reality about green practices.
4. Analyze and suggest solution for problems identified from survey.
5. Assess facility of different types of waste management.
6. Increase environmental awareness throughout campus.
7. Identify and assess environmental risk.
8. Motivates staff for optimized sustainable use of available resources.

9. The long term goal of the environmental audit program is to collect baseline data of environmental parameters and resolve environmental issue before they become problem.

1.4 SCOPE OF WORK

- Conduct a survey to know the ground reality about green practices.
- Analyze and suggest solution for problems identified from survey.
- Assess facility of different types of waste management.
- Increase environmental awareness throughout campus.
- Identify and assess environmental risk.
- Motivates staff for optimized sustainable use of available resourcesIdentify different green practices in college campus

2. METHODOLOGY

The methodology adopted for this audit was a three step process comprising of:

1. Data Collection– In preliminary data collection phase, exhaustive data collection was performed using different tools such as observation, interviewing key persons, and measurements.

2. Data Analysis- Detailed analysis of data collected was done using ms Excel report

3. Recommendation– On the basis of results of data analysis and observations, some steps for reducing power consumption without affecting the comfort and satisfaction were recommended along with their cost analysis.

2.1 Data Collection

The first module is related to the general information of the concerned department, which broadly includes name of the department, month and year, total number of students and employees, visitors of the department, average working days and office timings etc. The next module is related to the present consumption of resources like water, energy, or the handling of solid and hazardous waste. Maintaining records of the handling of solid and hazardous waste is much important in green audit.

For suggesting any corrective measures to reduce power consumption, it is first necessary to know the power consumption pattern in detail. For this, the exhaustive data collection exercise was performed at all the departments, academic centers, and other supporting entities such as library, institute hospital, computer centre etc.

Following steps were taken for data collection:

- The team went to each department, centre, etc.

- Information about the general electrical appliances was collected by observation a interviewing.
- The power consumption of appliances was measured using power analyzer in son cases

  (such as fans) while in other cases, rated power was used (CFL for example).
- The details of usage of the appliances were collected by interviewing key persons e.g Warden (in case of hostels), caretaker (in case of departments) etc.
- Light intensity was measured using lux meters at the places where light intensity was either very low or very high.
- In case of Air Conditioning, insulation was checked by visual inspection.

2.2 Data Analysis

In data analysis, the data collected is processed to draw significant conclusions to pinpoint loopholes and identify the areas to focus upon. Analysis of the existing green campus was used to obtain the green practices and also to get the information about the points where more focus is needed. Analysis of the water consumption observations obtained was used to obtain the water consumption pattern and also identify the losses. This helped to identify the areas with maximum water and energy saving potential

2.3 Recommendations

Energy as well as cost analysis of different areas were performed and recommendations were made based on the capital cost recovery time.

Following were the steps involved in this process:

- The capital cost involved green practices was estimated.
- If capital cost recovery time is less than the product life, the move can be supported.

3. ABOUT THE UNIT

K.K. Wagh college of Pharmacy, Nashik established in 2017-18 is approved by Pharmacy Council of India (PCI), State Government of Maharashtra and is affiliated to the Dr. Babasaheb Ambedkar Technological University Lonere, with an annual intake capacity of 100 seats for First Year B. Pharm and currently 472 students are studying under B.Pharmacy Course . Along with excellent academic inputs, we have trained our students for their soft skills also. Also, some of our students are attending internships in various companies and some of the final year projects are also sponsored by industries.

The methodology of present study is based on onsite visits, the personal observations and questionnaires survey tool. Initially, based on data requirement, sets of questionnaires were prepared. The surveyors then visited all the departments of the campus and the questionnaires were filled. The generated data is subsequently gathered and used for further analysis. From the outcome of the overall study, a final report is prepared.

4. WATER AND WASTE WATER AUDIT

Water which is precious natural national resource available with fixed quantum. Tl availability of water is decreasing due to increasing population of nation, as per capi availability of utilizable water is going down. Due to ever rising standard of living people, industrialization, urbanization, demand of fresh water is increasing day by da The unabated discharge of industrial effluent in the available water bodies is reduci the quality of these ample sources of water continuously. Hence, the national mission c water conservation was declared by the then Hon. Prime Minister Narendra Modi as 'J Shakti Abhiyan' and appealed to all citizens to collectively address the problem of wat shortage, by conserving every drop of water and suggested for conducting water aud for all sectors of water use.

Water audit can be defined as a qualitative and quantitative analysis of wat consumption to identify means of reducing, reusing and recycling of water. Water Aud is nothing but an effective measure for minimizing losses, optimizing various uses an thus, enabling considerable conservation of water in irrigation sector, domestic, powe and industrial as well. A water audit is a technique or method which makes possible t identify ways of conserving water by determining any inefficiencies in the system c water distribution. The measurement of water losses due to different uses in the syster or any utility is essential to implement water conservation measures in such a establishment.

4.1 Importance of water Audit

It is observed that a number of factors like climate, culture, food habits, work an working conditions, level and type of development, and physiology to determine th requirement of water. The community which has a population between 20,000 t 1,00,000 requires 100 to 150 liters per person (capita) per day. The communities with population can consume over 1, 00,000 requires 150 to 200 liters person (capita) pe day. As per the standards provided by WHO Regional office for South East Asia School require 2 liters per student; 10-15 liters per student if water-flushed toilet Administration requires (Staff accommodation not included) 50 liters per person pe day, Staff accommodation requires 30 liters per person per day and for sanitatio purposes it depends on technology.

4.2. Water Audit

Water usage can be defined as water used for all activities which are carried out on campus from different water sources. This includes usage in all residential halls, academic buildings, on campus and on grounds. Wastewater is referred as the water which is transported off the campus. The wastewater includes sewerage, residence, hall water used in cooking, showering, clothes washing as well as wastewater from chemical and biological laboratories which ultimately going down in sink or drainage system.

4.3. Water Consumption in Campus

From the data collected for water audit of K.K.W.C.O.P. Campus, Nashik the water distribution and water consumption pattern is noticed as follows. The water is distributed and consumed in various sectors such as Bathroom, Toilet, Urinals, Garden, Drinking, Wash Basin, Laboratories, etc. It is recommended to install water meter at inlet of each sector to measure the water consumption.

4.4. Sustainable water Practices

K.K.W.C.O.P. Campus has adopted various sustainable water practices to conserve the water and also going to adopt new sustainable water practices.

4.4.1. Rainwater Harvesting

Fig. 1.: Rain Water Harvesting System

Rooftop Rain Water Harvesting is the technique through which rain water is captur from the roof catchments and stored in reservoirs. Harvested rain water can be stored in sub-surface ground water reservoir by adopting artificial recha techniques to meet the daily needs through storage in tanks. The Main Objective rooftop rain water harvesting is to make water available for future use. Capturing a storing rain water for use is particularly important in dry land, hilly, urban and coas areas. Rooftop Rain Water Harvesting is carried out at Main Administrative Building.

4.4.2. Water filtration Plant

Fig.2.: Water Softener Equipment

The Campus has boar well as a water resource and hence there is need of wate treatment for drinking purpose. K.K.W.C.O.P. has constructed Mini Water Treatmer plant in the campus at Administrative building.

4.4.3. Drip Irrigation and Sprinkler Irrigation

Fig.3.: Drip Irrigation System

K.K.W.C.O.P. has green campus surrounding the buildings. Efforts have been made on to bring part of land under cultivation of medicinal plants as well as other productive plants through various activities in college campus. Drip irrigation and sprinkler irrigation system have been installed at gardens which helps to save water and nutrients by allowing water to drip slowly to the roots of plants. The goal is to place water directly into the root zone and minimize evaporation to save water.

4.5. Recommendations

- Water meters should be installed at the entry of each sector to measure the water consumption.
- Non-teaching staff or peons in the concerned section should take responsibility of monitoring the overflow of water tanks.
- Large amount of water is wasted during the practical process in Science laboratories. Designs of small water recycle system helps to reuse of water.
- To produce 1 liter of wine required more than 860 liters of water. This figure is next to coffee. So it is very necessary to conserve the water.
- Pipes, overhead tanks and plumbing system should be maintained properly to reduce leakages and wastages of water.
- Use automation system for filling the overhead tank to avoid wastage of water flow.
- K.K.W.C.O.P. needs to arrange awareness program on water conservation by motivativating students and staff.

5.SOLID WASTE MANAGEMENT

Solid waste is the unwanted or useless solid material generated from the human activities in residential, industrial or commercial area. Solid waste management reduces or eliminates the adverse impact on the environment and human health. A number of processes are involved in efficiently managing waste for a organization. It is necessary to manage the solid waste properly to reduce the load on waste management system. Solid waste generation and its management is a burning issue in current days. The rate of generation of solid waste is very high and yet we do not have adequate technology to manage the generated waste. Unscientific handling of solid waste can create threats to public health and environmental safety issues. Thus, it is necessary to manage the solid waste properly to reduce the load on waste management system. The purpose of this audit is to find out the quantity, volume, type and current management practice of solid

waste generation in the K.K.W.C.O.P. campus. This report will help for further solid waste management and to go for green campus development.

5.1. Study of Solid Waste generation in College Campus

To create effective waste management plans, college first need to know the types of waste they produce. Below, we've compiled a list of various kinds of waste commonly generated in campus:

1. **E- Waste**

   Generation of e-waste is apparent in every educational institute. Especially, at the campus level where there are several equipments and instruments used for administrative as well as for scientific execution. Computers, Printers and Xerox machines are must for the administrative and research work. The wires required for the connectivity also gets included in the e-waste. More usage of these electronic as well as electrical materials generates huge amount of e-waste. Similarly, various scientific equipments and instruments get worn out with time. These too contribute to the e waste.

   E-waste include monitor, CPU, key board, electric wire, printer. Paperless work increase load on computer and therefore it is a need to reduce e-waste by repairing all these electric equipment . There is a need to reuse and recycling of electronic equipments and material .

2. **Chemical Waste**

   Campus Laboratories are the main source of chemical waste. The chemicals used for cleaning are also source of chemical waste. Most of these chemicals are hazardous and must undergo specific disposal process.

3. **Biological Waste**

   Biological waste from laboratories and campus such as sanitary napkins, Bandages Medicines, etc require special disposal system. They cannot be mixed with general waste. K.K.W.C.O.P. has special disposal machine for sanitary napkins.

Fig.4.: Sanitary Napkin Disposal Machine

4. **Plastic Waste**

   Generation of plastic waste is very low as compared to other waste. Only the source of plastic waste is Administrative building.

5.2. Recommendations

- Paper waste is generated by all departments. Especially, building Block A is using more one one side papers for printing and writing which is a good practices.
- Answer sheets, old bills and confidential reports are sent for shredding, pulping and recycling after completion of their preservation period.
- Campus has banned use plastic for any administrative as well as other purpose and therefore very less amount of plastic waste is generated in the Campus.
- Glass waste is generated from laboratory mainly in the form of bottles; Many times bottles are reused for storing of other chemicals and liquids.
- K.K.W.C.O.P. must form a dedicated team to gather data, analyze current practices and make recommendations for improvement.
- K.K.W.C.O.P. should find more reliable professional waste disposal facilities.
- K.K.W.C.O.P. should encourage the home made practices for compost from tree waste.

6.CARBON SEQUESTRATION AND GREEN COVER INVENTORY

Carbon is the basis of life on mother Earth. It is incorporated into the plants throu photosynthesis, consumed by animal species through the food, present in the form carbon dioxide (CO2) the atmosphere locked into the rocks as limestone a compressed into the different fossil fuels such as coal and oil. As CO2 level in t atmosphere continue to increase, most climate designs or project that the oceans of t world and trees will keep soaking up more than half CO2 .The plants on land and in t sea, taken up carbon by over many years increased the percentage discharged duri decay, and this increased carbon became locked away as fossil fuels beneath the surfa of the planet. The starting of the 21st century brought growing concern about glol warming, climate change, food security, poverty and population growth. In the 2 century more carbon has been released into the atmosphere than that has be absorbed. CO2 is a principle component causing global warming. Atmospheric carb dioxide levels have increased to 40 % from preindustrial levels to more than 390 pa per million CO2. On this background it is a need of time to cover the research are interrelated with climate change.

The "Carbon Sequestration and Green cover inventory" is a current status of tr cover

and vegetation carbon storage assessment of area under K.K.W.C.O.P. campus. In an e of climate change and global warming carbon emission, carbon footprints, carb sequestration, adaptations, mitigation are the keywords in academia.

6.1. Carbon Sequestration

Carbon sequestration is a process of converting atmospheric carbon i.e. CO2 in other sinks of carbon such as vegetation, soil, ocean etc. in various forms to mitig global warming audit is one of the important clauses of Kyoto Protocol.

6.1.1. Need of Study

While transforming ourselves, it is a responsibility of such campus to face the glol future challenges and try to find out possible solutions for them. It is a social a

environmental responsibility of Government Institutes, Universities, National and International Organizations to respond positively for various global issues at local level and should percolate the generated knowledge in to the society. Global warming and climate change are current environmental issues need to be addressed scientifically and efficiently. As Universities are provided with skilful human resource supported by analytical infrastructure, it is our duty to bring such ideas in practice. While understanding the call of time the K.K.W.C.O.P. has decided to enumerate the green cover of campus and quantify the carbon sequestration of existing tree population.

6.1.2. Objectives

- To study woody green cover of K.K.W.C.O.P. campus.
- To study species diversity of woody vegetation in the K.K.W.C.O.P. campus.
- To understand biomass and carbon stock accumulated by woody vegetation in the campus.
- To explore carbon sequestration potential of woody vegetation in the K.K.W.C.O.P. campus.
- To explore potential of woody vegetation of the campus as an oxygen source.
- To measure canopy cover of the trees on the K.K.W.C.O.P. campus.

6.1.3. Methodology

6.1.3.1. Study Area

KKWCOP College is situated at North-West side of Maharashtra at 20.012705 N and 73. 822161 E in the heart of Nashik City and it is at the altitude of 584m above sea level. KKWCOP campus covers an area of 8093 m^2 . Out of this 350 m^2 area is covered with plants.

Fig.5.: Aerial view of K.K.W.C.O.P.

6.1.3.2. Field Survey

Field Survey was carried out with the help of K.K.W.C.O.P. campus staff. Filed survey is done with the help of measuring tape, chalks, writing pad, etc. A tree with girth (circumference of tree) more than 10 cm at chest level and height more than 4 feet were considered as tree and taken for enumeration. Girth of each tree was measured with the help of tape and approximate height by visual method. Identification of tree species was done with the help of field guides, web source and with the help of expertise o K.K.W.C.O.P. campus.

6.1.3.3. Data Analysis

All the collected data was tabulated and analyzed with the help of MS- Exc spreadsheets and objected findings were extracted by using various factors given b Intergovernmental Panel on Climate Change (IPCC). All the tabulated data is analyzed b following standard formulae.

A. Measurement of circumference of the tree:

To estimate the biomass of the each individual tree species, non- destructive meth was used. The circumference Diameter at Breast Height (DBH) can be determined b measuring tree Girth at Breast Height (GBH), approximately at 1.3 meter from t ground. The Girth at Breast Height of trees having diameter which greater than centimeters were measured directly by measuring tape.

B. Height measurement:

Tree height is the important factor for the calculating tree biomass and evaluating tr life history. There are number of different methods which are used for the measureme of tree heights from the ground. For the present tree census, the height of individual tr is measured by visual method.

C. Above Ground Biomass (ABG) of tree:

The above ground biomass is the most abundant and visible pool of carbon in its all forms. The above ground biomass of tree includes branches, stem, fruit, whole shoot a flowers.

The specific wood density is used from the standard guidelines. By using the guideli the AGB of all the tree species were calculated.

D. Estimation of carbon:

Generally, in any plant species the 50 % of its biomass is considered as the carbon.

E. Determination of weight of carbon dioxide (CO_2) sequestrated in the tree:

Trees are the autotrophs, which make their own food by using photosynthesis. They took CO_2 and release O2 . The sequestrated CO2 is calculated by using the Carbon Sequestration Factor is used given by the standard guidelines by IPCC.

6.1.3.4.Canopy Cover

Canopy cover is measured by using standard guidelines. A canopy cover of tree is measured by tape using crown area cover. All the collected data was tabulated and analyzed with the help of MS- Excel spreadsheets. The crown cover areas of the trees were measured during the day time. The diameter of crown at its widest point (A) as well as the diameter of the crown perpendicular to its widest point (B) was measured in feets. The average diameter of the crown was calculated. Using the average diameter canopy cover area was estimated.

6.1.3.5. Findings

Total number of trees enumerated in K.K.W.C.O.P. campus:

The total 8093 m^2 area of KKWCOP Campus has 350 m^2 areas of plantation. Total 12 numbers of trees with 10 cm or more girth and height 4 ft or more have been numerated. Girth and height of every tree has been measured by using tailoring tape and chalks.

Fig.6.: Various Plants in KKWCOP campus

Total No. of tree species identified in KKWCOP campus:

There are total 40 tree species have been identified during the census. It shows rich plant diversity on campus.

6.1.3.6. Tree Species

The total tree species categorized into 4 groups

1) Vegetables
2) Fruits
3) Flowers
4) Medicinal

Table1: List of Plants- Medicinal Garden Plant List

Sr. No.	Common Name	Botanical Name
1.	Aralia	*Polysciasfruticosa*
2.	Adulsa	*Adhathodavasica*
3.	Shatavari	*Asparagus racemosus*
4.	Jaswand	*Hibisscusrosasinensis*
5.	Bibva	*Semecarpusanacardium*
6.	Arjuna	*Terminalia arjuna*
7.	Safed Musli	*Chlorophytumborviliamum*
8.	Sonchafa	*Acalphyaindica*
9.	Tejpan	*Laurus nobilis*
10.	Kadhipatta	*Murrayakoenigii*
11.	Amla	*Phyllanthusemblica*
12.	Vekhand	*Acoruscalamus*
13.	Ashwagandha	*Withaniasomnifera*
14.	Bakul	*Mimusopselengi*
15.	Sadafuli	*Vinca alba*
16.	Insulin	*ChamaecostusCuspidatus*
17.	Nagkeshar	*Mesuaferrea*
18.	Eucalyptus	*Eucalyptus globulus*
19.	Raktachandan	*Pterocapussantalinus*
20.	Henna	*Lawsoniainermis*
21.	Jambhul	*Syzygiumcumini*
22.	Black pepper	*Piper nigrum*
23.	Putranjiva	*PutranjivaRoxburghii*
24.	Coffee	*Coffeaarabica*
25.	Shevga	*Moringaoleifera*
26.	Tulas	*Ocimum sanctum*
27.	Datura	Datura stramonium
28.	Adulsa	*Adhathodavasica*
29.	Hadsandhi	*Cissusquadrangularis*
30.	Nirgudi	*Vitexnegundo*
31.	Chitrak	*Plumbagozeylanica*
32.	KasturiHalad	*Curcuma aromatica*
33.	Citronella	*Cymbopogennardus*
34.	Gulwel	*TinosporaCordifolia*
35.	Betel leaf	*Piper betle*
36.	Wala	*Chrysopogonzizanioides*
37.	Bramhi	*Bacopamonnieri*
38.	Shatavari	*Asparagus racemosus*
39.	Lendi pepper	*Piper longum*
40.	Aloe vera	*Aloe barbadensis Mill.*
41.	Behada	*Terminalia bellericaroxb.*
42.	Hirda	*Terminalia chebula*
43.	Lemon grass	*Cymbopogoncitratus*
44.	Bael	*Aegle marmelos*
45.	Ashoka	*Saracaindica*
46.	Nimb	*Azadirachtaindica*

47.	Rose	*Rosa* rubiginosa
48.	Kardali	*Canna indica*
49.	Lily	*Spathiphyllumcochlearispathum*

FLOWERS

Table 2: List of Flower Plants

SR.NO.	PLANT NAME	BOTONICAL NAME
1	Hibiscus	Hibiscus Rosa Sinensis
2	Adulsa	Justica Adhatoda
3	Lemon	Citrus Lemon
4	Brahmi	Bacopa Monnieri
5	Lotus	Nelumba Nucifera
6	Rose	Rosa
7	Chafa	Plumeria
8	Orchids	Orchidaceae
9	Marigold	Tagetes Erecta
10	Cape Jasmone	Gardenia Jasmonoids
11	Gerbera	Gerbera Jamesonii
12	Rose Periwinkle	Catrharanthus
13	Star Jasmine	Jasminum Pubescenes
14	Jasmine	Jasminum Sambac
15	Lily	Lilium
16	Desert Rose Bonsai	Adenium obesum
17	Nishigandha	Polianthes tuberosa

6.1.3.7. Total Biomass

In ecology, the mass of living biological organism in a given area or ecosystem at a given time is called as biomass. Biomass can refer to species biomass and community biomass. The species biomass is the mass of one or more species. The community biomass, which is the mass of all species in the community. It includes microorganisms, plants or animals. The mass can be defined as the average mass per unit area, or as the total mass in the community. K.K.W.C.O.P. has taken initiative for increase in biomass in the college campus.

6.1.3.8. Carbon Stock

The main carbon sink in tropical forest ecosystems includes the living biomass of trees, understory vegetation, dead mass of litter, woody debris and soil organic matter.

The carbon stored in the Above Ground Biomass (AGB) of trees is the largest pool and is directly impacted by deforestation and degradation. Trees and forests act as natural carbon stores, but this carbon is released when the trees are felled and the area deforested. The amount of carbon stored within an area of land varies according to the type of vegetation present in the campus.

6.1.3.9. Carbon Sequestration

Carbon sequestration is long-term storage of carbon dioxide or other forms of carbon to avoid climate change. It has been considered as a way to slow the atmospheric and marine accumulation of greenhouse gases, which are released by burning fossil fuels. Vegetation carbon pool having the potential of 560 Pg (Pg: Pentagram= billion ton) of carbon storage globally. In the current study the focus is given on the assessment of existing carbon stock stored in K.K.W.C.O.P. campus in the form of woody vegetation by enumerating every tree species.

6.1.3.10. Oxygen Release

Woody vegetation in K.K.W.C.O.P. campus has released ample tons of oxygen in their lifetime till date. Released oxygen is directly proportional to CO 2 sequestrate.Single tree supports oxygen demand of two people for their life. Thus, the trees in the K.K.W.C.O.P. campus are supporting many people on and around the campus.

6.2. Recommendations

To maintain green cover and carbon sequestration potential of Institute following precautionary measures have to be taken by every stake holder of the College.

- Plantation of endemic species like *Acasia catechu, Alstonia scolaris, Butea monosperma, Azadirachta indica* etc. will be helpful for conservation of native biodiversity.
- The plantation of tree species like *Acacia nilotica subsp. indica, Albizia lebbeck, Azadirachta indica, Citrus aurantium* works as green belt which can maintain the ecological balance in the environment as well as act as sink for the harmful gases and improve air quality.
- Plantation activity should be taken yearly to increase the green cover on the campus.
- Avoid plantation of exotic species like *Gliricidia sepium* which is fast growing species with less ecological values.

6.3. Carbon Footprints

In today's world one of the biggest issues faced by all of us is global warming. Global warming refers to an increase in average global temperature of mother Earth. The main cause of global warming is increase in the concentration of greenhouse gases (GHGs) in the atmosphere due to anthropogenic activities and their level is determined with the help of global warming potential (GWP) and expressed as Carbon Footprint (CF). Carbon Footprint is another phenomenon used for GHGs or carbon dioxide emission in terms of CO2 equivalents. There are various definitions of carbon footprint are in literature. But the most recognized definition given by Wiedmann "the Carbon footprint is the measure of carbon dioxide emissions directly or indirectly caused by an activity or accumulated over the life stages of a product." In other words, "A carbon footprint is the total greenhouse gas (GHG) emissions caused directly and indirectly by an individual, organization, event or product." As the K.K.W.C.O.P. considered as institutional organization, the various energy resources like electricity, fuels, Liquefied petroleum gas (LPG) are used. It is necessary to calculate the carbon footprint of the Institute to upgrading the Clean Developmental Mechanism (CDM) in various processes. All the data from the various sources were collected from all the sectors where energy resources are used. The collected data is calculated by using standard emission factors.

6.3.1. Electricity Carbon Footprint

In the College campus, electricity is used for various purposes like residential, office use and in the laboratories. The total electricity used in the institute is 7,51,264 Kwh/annum which (approximately) liberates 2,78,719 kg of CO2 per year. **Vehicle Footprint**

The vehicles are the source of CO2 and other greenhouse gases. The number of vehicles passed through the campus daily, which emits the CO2 in the atmosphere which add tons of CO2 as vehicle footprint. Burning 1 Ltr of Gasoline produces 2.3 Kg of CO2.

6.3.2. Paper Footprint

The papers are used in the institution for various purposes like exam answer sheets, circulars, notices, office work etc. The papers are responsible for the emission of CO2. In the College campus various departments follows paperless methods of communication to reduce the footprint by use of papers. The various sections on the campus save 2000

papers per years. The paperless work reduces approximately 100 kg of CO2 approximately.

6.4. Reducing the Carbon Footprints

- Installation of solar panels or solar energy generation devices should be enhanced to reduce the electricity footprint of the campus. Terrace of each building can be utilized to produce electricity from solar modules.
- The Green computing or E- work is helping the organization to reduce footprint very effectively.
- The solar energy based street lamps on campus will reduce carbon footprint.
- The awareness should be made among the faculty, students and other employees regarding

  Clean Development Mechanism (CDM) to reduce the consumption of electricity and natural resources.

7.GREEN INITIATIVES BY COLLEGE

KKWCOP college is situated at North-West side of Maharashtra at 20.013175620996442 N, 73.82213376136573 E in the heart of Nashik City and it is at the altitude of 584m above sea level. KKWCOP campus covers an area of 8093 m^2 Out of this 350m^2 area is covered with plants. The college aims to protect and conserve its biodiversity, fresh and clean ambience through many initiatives.

7.1. Carbon Sequestration on the college campus

KKWCOP campus has 120 trees on the campus and therefore, college campus is considered as a carbon sink for carbon sequestration. This woody vegetation helps in sequestrating tons of CO2 with the liberation of oxygen annually. Thus, the campus is working as a good carbon sink and a productive oxygen park.

Fig.7. Tree Plantation Activity in college Campus

7.2. Plantation and Nurturing program

The College on its campus takes many plantation drives. Every year on 5th June i.e. World Environment Day, the college takes Plantation activity. The garden department looks after tree plantation activities. The trees are watered by drip irrigation system to conserve the water. Students of various departments make the plantation and nurturing programmes successful.

Fig.8. Tree Plantation Activity outside Campus

7.3. Green Computing practices

Being an academic institution, papers are used for various purposes like exam answer sheets, circulars, notices, office work , for document printing and Xeroxing. Since the trees are cut for paper manufacturing, the sequestration of carbon is reduced increasing carbon foot print. To cut down the carbon footprint, the institute administration and various departments follows paperless methods of communication by using emails. Through such practices, it was estimated that overall 2000 papers per years were saved during the routine work. The paperless work was helpful in reducing approximately 100 kg of CO_2 .

7.4. Plastic free Campus

The KKWCOP has banned use of plastic on the campus and campus of college is "Plastic free campus". In all functions, workshops and conferences, the plastic mineral water bottles, tea cups, straws, bouquets and gifts with plastic covering, decorations and unwanted plastic use is strictly avoided. Instead of mineral water bottles, the drinking water is made available through traditional water pots or steel water.

7.5. Water purification Plant

The institute has installed an advanced water purification system. Through this every person in the institute department, Guest house, Hostels, etc. get benefitted by the pure drinking water. This has reduced waterborne diseases on the campus.

7.6. Rain water Harvesting

Rooftop Rain Water Harvesting is the technique through which rain water is captured from the roof catchments and stored in reservoirs. Harvested rain water can be stored in sub-surface ground water reservoir by adopting artificial recharge techniques to meet the daily needs through storage in tanks. The Main Objective of rooftop rain water harvesting is to make water available for future use. Capturing and storing rain water for use is particularly important in dry land, hilly, urban and coastal areas. Rooftop Rain Water Harvesting is carried out at Main Administrative Building.

7.7. Vermicompost Processing

Vermicomposting is an Eco-biotechnological process, and joint action of earthworm and microbes for the conversion of organic waste into nutrient-enriched vermicompost products. The various earthworm species such as red worms, tiger worms, and red wigglers are responsible for consuming organic waste such as flower waste, agricultural waste, animal waste, sewage sludge, etc. During the vermicomposting process, the digestive process of the earthworm is used as vermicompost. Under favorable temperature < 28°C, moisture content (60–80%) and suitable aerobic condition the earthworms ingest organic waste such as vegetable waste, flower waste, kitchen waste or industrial sludge and excrete a humus-like substance.

This process helps to convert into important nutrients of plants such as nitrogen, calcium, phosphorous, potassium present in the organic waste material and convert through joint action of earthworm and microbes which are highly soluble and useful for the plants than those in the parent organic substrate.

Fig.9. Vermicompost Processing

8.SUMMARY, CONCLUSION AND RECOMMENDATIONS

Summary :

Green Audit is one of the important tool to check the balance of natural resources and its judicial use. Green auditing is the process of identifying and determining whether institutional

practices are eco-friendly and sustainable. It is a process of regular identification, quantification, documenting, reporting and monitoring of environmentally important components in a specified area. The main objective to carry out green audit is to check the green practices followed by institute and to conduct a well defined audit report to understand whether the institute is on the track of sustainable development. This is the first time to conduct green audit of college campus. After completing the audit procedure of College campus for green practices, there are following conclusions, recommendations which can be

followed by college in future for keeping campus environment friendly.

Conclusion:

From the green audit following are some of the conclusions which can be taken for improvement in the campus.

1. Institute takes efforts to dispose majority waste by proper methods. The Green computing i.e. Online payment system, online circulars and examination procedures are helpful for reducing the use of papers and ultimately reducing carbon footprint.
2. Reducing the use of one time use plastic bottles, cups, folders, pens, bouquets, decorative items will be useful to solve the problem of plastic pollution to some extent.
3. Biodegradable waste is used efficiently for composting and vermicomposting. There is a scope to utilize the organic matter for biogas generation or manure production.
4. Installation of solar panels provides ample amount of electricity. Such solar modules should be installed wherever possible in the campus.
5. Use of LED lamps and Tube Lights is minimum and is to be encouraged.
6. Rain water Harvesting in the campus proved to be one of the best watershed management program for making the institute self reliant in water.
7. Toilets and bathrooms are consuming more water in the departments. The replacement of old taps can be beneficial for solving this issue
8. RO drinking water has solved the major problem of safe drinking water in all departments.

9. No Vehicle Day" proves to be one of the good practice to save the fuel and help for green and clean environment on the campus.
10. The overall ambient air quality on the campus is good while some air quality issues may arise due to developmental activities on the campus should be addressed.
11. The sound levels on the campus is good except due to some transportation and construction activities.

Recommendations:

Following are some of the key recommendation for improving campus environment:

- A Solar Rooftop system should be installed at the earliest to reduce the carbon footprint and indirectly saving the money of college.
- An environmental policy document has to be prepared with all the recommendations and current practice carried by campus.
- A frequent visit should be conducted to ensure that the generated waste is measured, monitored and recorded regularly and information should be made available to administration.
- The College should develop internal procedures to ensure its compliances with environmental legislation and responsibility should be fixed to carry out it in practice.
- The solid waste should be reused or recycled at maximum possible places.
- Reuse of glass bottles for storage of chemicals should be encouraged or the bottles should be sent to again suppliers for reuse.
- Electrification of street lights by solar power should be encouraged.
- Installation of sensor based electrification items like fans, lights, etc. can save electricity.
- Installation of solar panels and rain water harvesting system to every terrace of building will be useful in conserving the natural resources.
- Regular checkups and maintenance of pipes, overhead tanks and plumbing system should be done to reduce overflow, leakages and corrosions.

GREEN ENCO GES ★ GRATION