

STUDY ON NEED FOR SUSTAINABLE DEVELOPMENT IN EDUCATIONAL INSTITUTIONS, AN ECOLOGICAL PERSPECTIVE – A CASE STUDY OF COLLEGE OF ENGINEERING – GUINDY, CHENNAI

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Abstract:

Sustainability has become the key word of developing world and it's evident in many issues, the growing economy is facing nowadays. Sustainability is the need of the hour for Indian economy to support our future generation with a cleaner, safer environment. Legal framework implemented by governing bodies such as Pollution control board is also supporting the implementation of sustainable development by new enforcements introduced then and there, but it is questionable about the effectiveness of this frameworks. Most of the enforcements are focusing to imply the sustainability in industries or equivalent organizations but not putting thrust on all polluting bodies, educational institutions are one among them. Recent growth in educational scenario in India had increased the number of educational institutions to a large extent, also increased the effect on environment by their activities. Growth of educational sector and the number of institutions catering various fields of education is needed for India but the growth should be optimized in a way such that it's sustainable and eco friendly. Various methods are developed recently to find out the exact problems associated with the environment, Geographical Information System (GIS) is one among them taking a big leap in the recent years in the area of environmental problem identification. This paper provides the details of the environmental impacts of educational institutions with case studies and also suggests a sustainable framework to make them environmental friendly by the use of (GIS).

Keywords: Sustainable development, GIS, optimization, framework, legislation

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INTRODUCTION

Ecology is being associated with the growth of any industry, organization or even a nation and it's not still a low key issue and its sustainability had become the buzz word of developing world and it's evident in many issues. Sustainable development is a pattern of resource use that aims to meet human needs while preserving the environment so that these needs can be met not only in the present, but in the indefinite future. The term was used by the Brundtland Commission which coined what has become the most often-quoted definition of sustainable development as development that "meets the needs of the present without compromising the ability of future generations to meet their own needs." As early as the 1970s "sustainability" was employed to describe an economy "in equilibrium with basic ecological support systems". Ecologists have pointed to the "limits of growth" and presented the alternative of a "steady state economy" in order to address environmental concerns (Van den Bergh & Nijkamp, 1991).

Sustainable development implies using renewable natural resources in a manner which does not eliminate or degrade them, or otherwise diminish their usefulness for future generations. It further implies using non-renewable (exhaustible) mineral resources in a manner which does not unnecessarily preclude easy access to them by future generations. Sustainable development also requires depleting non-renewable energy resources at a slow enough rate so as to ensure the high probability of an orderly society transition to renewable energy sources. Sustainable development ties together concern for the carrying capacity of natural systems with the social challenges facing humanity.

Sustainable development is defined as a pattern of social and structured economic transformations (i.e. development) which optimizes the economic and societal benefits available in the present, without jeopardizing the likely potential for similar benefits in the future. A primary goal of sustainable development is to achieve a reasonable and equitably distributed level of economic well-being that can be perpetuated continually for many human generations. The field of sustainable development can be conceptually divided into four general dimensions: social, economic, environmental and institutional. The first three dimensions address key principles of sustainability, while the final dimension addresses key institutional policy and capacity issues

A nation's growth starts from its educational institutions, where the ecology is thought as a prime factor of development associated with environment. Educational institutions nowadays are becoming more sensitive to environmental factors and more concepts were being introduced to make them eco friendly. To preserve the environment within the campus, there are various viewpoints that several Universities are

applying in order to tackle with their environmental problems such as promotion of the energy savings, recycle of waste, water reduction, etc. Eco-Campus is one such concepts or principles introduced to make the Universities environmentally sustainable.

Sustainable development in campuses

Eco-campus or Ecological Campus has its meaning in itself. The meaning of eco-campus has been expressed in its targets and objectives. By all means, eco-campus means "environmental sustainability within the school". School is a center for generating of education; moreover, it is also a research center where the students and teachers are attempting to develop the best strategy for achieving their purposes. Due to this reason, the development of eco-campus has been pointed out and established recently.

Eco-campus concept mainly focuses on the efficient uses of energy and water; minimize waste generation or pollution and also economic efficiency. Eco-campus focuses on the reduction of the University's contribution to emissions of green house gases, procure a cost effective and secure supply of energy, encourages and enhance staff and student energy issues, also promotes personal action, reduce the University's energy and water consumption, reduce wastes to landfill and integrate environmental considerations into all contracts and services considered to have significant environmental impacts.

While these various measures are promoted synthetically and systematically, an "Environmental Management System" is introduced, in order to realize certainly the "Eco-campus" which considered environment, and clarifying the posture of a University to society. It aims at establishing the organization which may be evaluated objective. Most recently, the concept of cleaner production (CP) has entered the global environmental arena. Cleaner production fits within pollution prevention's broader commitment toward the prevention rather than the control of pollution.

Cleaner production means the continuous application of an integrated preventive environmental strategy to processes and products to reduce risks to humans and the environment. For production processes, cleaner production includes conserving raw materials and energy, eliminating toxic raw materials, and reducing the quantity and toxicity of all emissions and wastes before they leave a process.

Pollution prevention is an approach which can be adopted within all sectors, whether it is a small service operation or a large industrial complex. Cleaner production, on the other hand, directs activities toward production aspects. Unlike in the past when pollution was simply controlled, P2 and CP programs attempt to reduce and/or eliminate air, water, and land pollution. Therefore, the P2 and CP approaches benefit both the

environment and society. Economically, P2 and CP can actually reduce costs and in some cases, generate profit. Both approaches are practical and feasible, and can consequently contribute to a sustainable future (Devi, 2005).

Cleaner production, pollution prevention, etc. are all subsets of the concept of sustainable development, which states the basic problem that the other concepts attempt to address: There are limits to what the environment can tolerate, and society needs to ensure that development today does not cause environmental degradation that prevents development tomorrow. There are many issues here but the role of industry and industrial pollution is obvious. Industrial systems and individual companies will need to make changes in order to prevent future generations from being unable to meet their own needs. Sustainable development is thus the long-term goal of individual companies rather than a business practice.

Eco-campus approaches must be implemented step by step. First of all, data collection has to be conducted in order to find out what the status of the campus is. After collecting all information and data, the next step is determining of problematic areas and find out what the reasons are. Finally, proposing the way that can solve the issues, in order to achieve the sustainable development. Eco campus is a concept implemented in many Universities across the globe to make them sustainable because of their mass consumption of resources and creation of waste. Waste minimization plans inside the Universities for solid and wastewater is now mandatory to maintain the cleanliness inside the Universities. The number of Universities in the near future will be doubled and it is ripe time to emphasis the creation of Eco campuses and its implementation for making the Universities sustainable

Educational scenario in India

India with the second largest population in the world is now one of the fastest growing economies with a rapid growth in GDP. In the past few decades the need for trained people is rapidly increasing in the industrial and other fields to support our countries technological growth. This has lead to the establishment of more and more technological and educational institutions in India. India has a large number of Universities, colleges, and other institutions and the number is growing rapidly in the past few decades. In Tamilnadu itself more than 2000 educational institutions are now operating to cater to the needs of students from various areas of study.

Environmental problems associated with educational institutions

It is well known that educational institutions consume resources like water, electricity; forest product's and

generates wastes like many industries. Establishment and operating of Universities are not covered by any of the environmental laws in India (Devi, 2005).

As a result, the importance of making the Universities operate with self consciousness in the utility of resources inside the campus is least understood. Colleges and Universities that adopt the attractive but abstract goal of sustainability are intellectually honest only if they go on to devise operational approaches to meet that goal. Improved environmental performance is laudable, but may or may not be equivalent to sustainability. University performance can be definitely linked with sustainability: energy use, water use, use of land, purchase of products and treatment of them at the end of their useful lives, and emissions to air, water, and land. For each, a quantitative target can be defined and defended. Colleges and Universities that meet these targets can legitimately call themselves "sustainable".

Implying sustainable development in educational institutions

To study the possible ways to convert the campus into Eco campus and to apply the principles of sustainable utilization of resources the first step is to identify the resource utilization inside the campus by using various techniques or by conducting a detailed audit. The primary investigation can be done to check the usage of electricity, water consumption, solid waste generation, e waste generation, hazardous or bio medical waste generation (in medical colleges), noise level etc. A detailed audit can also be done inside the campus for a certain period which is decided according to the nature of institution and the results can be used to identify what is exactly going on inside the campus, what is the current usage pattern and the level of consumption. Electricity, water usage is to be given importance since both are commodities and the reduction in usage of these will ultimately increase the economical conditions. This can be accompanied by a survey among the students and staff members to check their general awareness about improving the environmental performance of the campus.

Case study

To study the above details a study was conducted at College of Engineering, Anna University, Guindy Campus in which all the areas including administrative locations, class rooms, residential areas, Sports facilities, canteen, library and recreational areas were studied in different audits. In the study area various environmental components were studied analyzed for improving the sustainability inside the campus and to reduce the resource utilization pattern inside the University. The studies conducted are:

- Electricity consumption pattern
- Water consumption pattern
- Noise Audit
- Social responsibility Studies.

The data collection is done for a period of 6 months and in various stages of the educational year to check the detailed usage pattern of various resources, the details studied are used for the analysis.

Energy audit

Energy audit primarily is focusing on having efficient campus electricity consumption. The actions that will have significant electricity savings, reduction in the power factor and also providing a more efficient refrigerating system, as well as water distribution was determined. The following actions was carried out, real time readings of electrical energy consumption was taken in energy meters installed inside the campus at various locations, refrigerated water system operation wherever necessary (Ductable split A/C's and other cooling units inside the campus) was studied for the emission of CFC's Lighting concepts in class rooms, laboratories, Computer rooms, Conference halls, Libraries, and other utility areas was be studied for the luminance and the comfort of the user by various methods and the techniques for lower power consumption was arrived by comparing it with literatures and brain storming session, i.e., substitution of lower power consumption methods instead of high power consumption techniques in all areas of the campus. Meter reading, campus electricity consumption details were utilized for the calculation.

Each selected buildings were monitored for their power consumption rate on three separate periods; (1) examination period, (2) weekend, and (3) semester break period and the results were identified. The details calculated after the energy audit were given in the **Table 1** from which the total energy consumption of Anna University per year is calculated.

With the studies conducted it was found that the power consumption of a University is as follows:

- Total electricity consumed per month (Average) = 103 198 kWh.
- Cost of electricity per month (Average) = 1 076 911.00 Indian Rupees (USD 4 120.00).

This detail excludes unaccounted energy utilized in the form of power generator usage and miscellaneous uses. The above tables clearly prove the way the energy is utilized inside the campus for its operations and the amount spend on each department.

With the collected information it's also evident that the major electricity usage is by air conditioners inside

Table 1. Summary of electricity bill

Sl. N.	Month	HT5 (kWh)	HT547 (kWh)	Total (kWh)
1	July	75 839	28 200	104 039
2	June	73 950	31 690	105 610
3	May	70 500	25 010	95 510
4	August	75 730	27 940	103 670
5	September	81 730	31 890	113 620
6	October	71 730	25 010	967.40
Total (Indian Rupees)				619 189

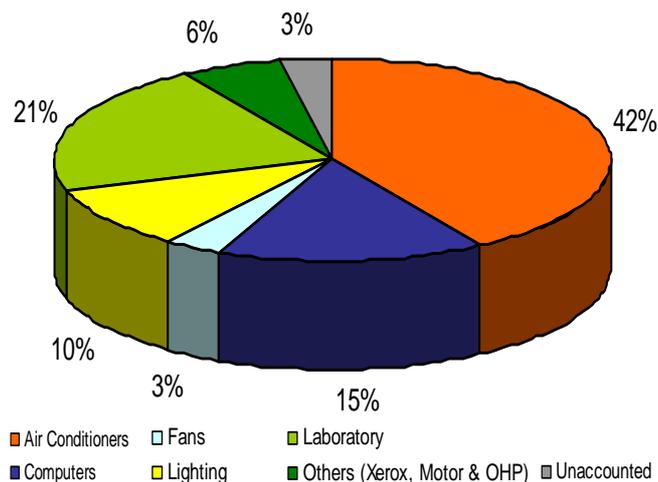


Fig. 1 Energy usage pattern inside a University.

the campus which is also the potential source of CFC emission, which is to be controlled to make the campus a Green campus. The usage pattern is given in **Fig. 1**.

It is advised to use the air conditioners more effectively and only in areas of necessity so that the power utilization is saved primarily for other major operations of the University. The amount spend on electricity is also to be reduced since its more than greater than amount spend on any other resources (Bailey, 1997). Special measures are to be provided to prevent energy loss and wastage, guidance for the students is to be given by authorities to use electricity effectively.

Water audit

Water is biggest over head in any campus, process or operations and its essential for any business. A water audit can identify productive use and needless waste such as leaks prevention, reduced consumption, and money savings. A comprehensive water audit was done to uncover any costly inefficiency in the water distribution, utilization system that results in money literally pouring in drains. The water audit will eliminate the flaws in the unwanted utilization, wastage of water inside the University campus. The water audit was done on total water consumption, cost, consumption per capita, and other usage of water inside

the campus. A comprehensive waste water characterization was done or the available reliable data will be used for the calculations and analysis. This was done by calculating the following

- Real time water source finding – University water supply data was taken from the Estate office or from the different departments and the storage methods was analyzed.
- Trends of water usage for Gardening, Laboratory, Canteen, official purposes was calculated by taking real time reading with the departments of the University and with secondary data available in Estate office.
- Per capita water consumption for the University for the past one decade was arrived with the data calculated and secondary data.

Water Audit is done with the following method:

$$\text{Water Lost} = \text{Water supply} - \text{Wastewater discharge} \times \text{Wastewater discharge}$$

$$\text{Water Lost} = (\text{operational time of the pumps, h/d}) \times (\text{pumps' capacity, m}^3/\text{h})$$

Water usage pattern

To find out the usage of water for the university activities the detailed water audit was conducted and the flow of water from the starting point is analyzed. Anna University’s daily water consumption is found to be 0.8 million liters per day including hostels, gardening, canteen and other usages. The only source of water is corporation supply of 0.8 million liters per day provided as continues supply. The internal water sources like bore well are stopped temporarily and the main water supply is used all over the campus.

The incoming water is connected in the main sump and distributed to other sumps and over head tanks for distribution. The main water usage inside the campus is found to be hotels, canteens and main buildings owing to the number of dwellers and this accounts more than 65% of the total water usage. The water flow pattern inside the University is given in **Fig. 2**.

Water consumption details

Total in flow = 0.8 million litres per day.
 Water available at end point = 0.77 million litres per day.
 Net loss = 35 000.00 – 40 000.00 litres per day in the form of loss, wastage, unaccounted, etc.

This is evident from the readings taken from all over the campus for the water audit and in most of the areas of the University it’s found that the water usage is mostly unaccounted or wasted. The method of pumping

adapted now by the authorities is crude and there is no standard procedure for the pumping as of now. With this pattern of pumping it’s found that calculating the water usage requirements for each and every building or usage is difficult.

To eliminate this a standard method of pumping is to be adopted throughout the campus and the total water supply is to be exactly equal to the water need of the University campus since water is one of the prime resource which is to be effectively used. This indicates that there is a loss of approximately 15-20 % which is occurs owing to the crude operating procedures. It was found that effective usage of water inside the campus is the need of the hour, to achieve this both social and technological approach is to be followed to avoid wastage of water, effective point to point utilization. The major source of water inside the campus is found to be corporation water supply and saving water aims at economical point of view also.

The water intense buildings and areas were clearly demarked for easy identification, where the prime focus is to be implemented for the study noise pollution inside the campus. Universities are the places very unwanted noise is one of the important factors to be avoided to provide a quite atmosphere for studying. To analyze the present noise level inside the campus which will one of the most important factor to determine the aesthetic features of Anna University detailed Noise Audit was done throughout the campus at certain periods of time. Noise level readings (db) were taken using noise meter and the readings were tabulated in **Table 2**.

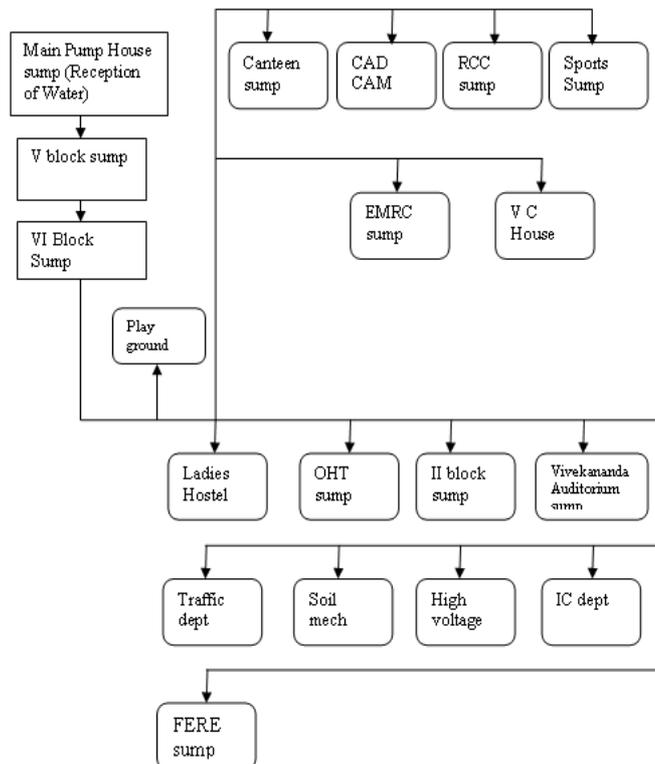


Fig. 2 Distribution of water inside the campus.

Table 2. Noise level inside the campus

Sl. No.	Location	Remarks	Noise level (db)
1	Class Room (Main Building)	Silent	53.7
2	Ladies Hostel Backside Near Boys Hostel	Slight noisy	54.3–55.0
3	Canteen Near Hostel	Location 1 Location 2 Location 3	48.2–56.2 67.2 66.9 59.6
4	Flight crossing (Low Flying) Near CES Building	Boeing type Emberar Wide Bodied Four Engine type	72.6 68.3 76.4 82.6
5	Flight Crossing	Boeing type Emberar	68.6 69.2
6	Vehicle Passing	Car Bike	67.2–67.8 63.0
7	Near Running Machine	Near Hall of Guinness Inside Workshop Normal labs	66.2 78.2 62.4
8	Near Garden	Normal time	49.0–54.2
9	Near Class rooms	Working time Second time	51.6–57.8 48.6–62.4
10	Inside Canteen Building	Afternoon	84.6–88.6
11	Main Building (Location1) (Location 2) (Location 3) (Location 4) (Location 6) (Location 7) (Location 8) (Location 9) (Location 10)	Near SBI Bank Left Side front Left Side rear Central Portion 1 Central Portion 2 Central Portion 3 Central Portion 4 Near Swimming Pool	82.4–85.0 48.1–53.6 46.0–48.3 52.0–53.6 45.2–47.6 46.2–47.8 58.4–60.1 58.6–61.4
12	Noisy Class room	Front side rear Main Building	56.0–59.4 78.6
13	Inside Office Room	Main Building	46.2–67.8
14	Near Road Side	Main entrance	84.8–89.2
15	Near Road side	Kotturpuram Side	82.8–88.0
16	Near Vice Chancellor Office	Location 1 Location 2 (Road Side) Generator Running	68.7–74.2 84.4–88.2 88.6
17	Near NCC Office	Lunch Time	58.6
18	Near Generator room	Location 1	87.8
19	Near Library	Afternoon	48.3–56.4
20	Near Hostel Wing	Location1	51.2–52.0

Noise audit

The noise pollution inside the campus will affect the serenity of the campus and will create distraction among the students which will directly affect the teaching learning process. The noise pollution is mainly due to the vehicular movement, anthropogenic sounds, laboratory works, operation of generator's, machineries etc.

The comprehensive study was done inside the campus to calculate the noise level at various important locations such as class rooms, pavements, laboratories, library location and the data will be interpreted for

solutions. Noise meter readings are taken at various locations and near the sound sources such as generators, class rooms, canteen blocks, vehicular movement areas, hostel blocks, main building, conference halls, etc.

The data available (secondary data) is utilized. The water intensive buildings and areas were also identified which will serve as an effective tool to identify the water wastage and the necessary areas of focus.

Noise level readings were taken both indoor and outdoor of the classrooms, verandah, main noise sources such as generators, canteen, road sides (vehicle traffic), front side entrance, side entrance of the campus, near hostel blocks. The readings were taken in certain period

of interval and specific timings such as mornings, evenings, afternoon, leave days, working days and specific readings were tabulated.

With the calculated readings in was clearly evident that Anna University campus is not much affected by the noise pollution but in certain areas standard measures are to be taken to bring down the noise level to ambient level. Areas such as Power house, Canteens, etc were to be isolated from the main utility areas such as class rooms, laboratories, library etc and special noise barricades are to be provided over the front side entrance or the wall height can be increased to a certain level so that the impact of noise is minimized.

Vehicular traffic inside the campus is to be banned completely to preserve the noise pollutions inside the campus and the classrooms are to be provided with proper sound facilities such as noise absorbents inside the class rooms. When building new hostel blocks or class rooms special care is to be taken to locate them in an area where the noise level is minimum.

Social developmental perspective

Even though all the studies were done and many solutions were provided for the sustainable utilization of resources and the effective reduction in any waste generation, the concepts was perfectly shaped if the social element is also added into the project such as educating the students and staff for the same. In this paper the solution to improve the social awareness among the students and faculties of the campus was analyzed and a solution to improve the present scenario was given. For analyzing this area initially a brain storming session was done with other department heads, staffs, students, with a questionnaire focusing primarily on the issues related to social awareness creation for the staffs and the students. Also a questionnaire about the current awareness on environmental preservation is prepared, given to representative sample of students and staff members.

Social Impact analysis

Universities were not just bricks and mortar; it's made up of the people using the facilities inside the campus. The maintenance and the resource utilization inside the campus are directly in the hands of the students and staff using the University resources for day to day operations. Most of the resource utilization is by the student community for their study aids such as laboratories, library, classrooms, etc and they play a major role in saving the resource utilization inside the campus. It is found after discussing with the concerned

authorities that most of the students are unaware of the magnitude of resource utilization inside the campus for day to day operations and it's mandatory for the University authorities to inculcate knowledge among the student and staff community on the preservation and optimization of resources inside the university.

This starts with small posters inside the class rooms for saving electricity and water which are major resources wasted inside the campus, which may directly results in huge savings to the University authorities. Students should be made aware of the total amount of water and electricity usage inside the campus for the operations and they should be well known to the methods of savings it.

Posters and hand outs were prepared for distributing to the students to increase the awareness among them about the resource savings that can be done by them using simple methods such as switching off lights and fans while leaving, using water properly without wastage in laboratories, canteens, toilets , etc. It's also suggested to the University authorities to make some simple rules as mandatory for the students to form a team of students in all courses to improve the methods of resource usage while in the University.

This will be a major tool for resource optimization (Bailey, 1997) since the students will normally used to the conditions soon if it was practiced particularly in the hostel blocks students should be advised about saving electricity and water which are prime resources.

Using GIS for sustainable development

Geographical Information System (GIS) is a tool to look at data that has a location. A GIS transforms data into information by integrating different data sets, applying focused analysis and providing output, in such a way that it supports decision making. It is tool for managing spatial information. The key objective of a GIS is the analysis of complex relationships contained in a database.

These relationships, representing a multitude of geographic, descriptive and statistical data, must be readily accessible for a variety of queries and analyses. By exploring the spatial dimension, spatial analysis introduces a framework that can largely enhance decision making and problem solving.

Advantages of using GIS for environmental protection

GIS provides wider range of environmental protections applications such as:

- Disaster Management

- Forest Fires Management
- Managing Natural Resources
- Waste Water Management
- Oil Spills and its remedial actions
- Sea Water - Fresh water interface Studies
- Coal Mine Fires

Environmentally, GIS technology can help assess large quantities of environmental sampling data. Most environmental problems are defined by boundaries and most corrective actions are driven by the spatial distribution of contaminants. The efficiency and rapid decision-making achieved by using GIS is significant. Traditional environmental investigation techniques can also be enhanced using GIS. By using GIS inside the campus for identifying the various resources, their utilization it will be easy for the authorities to mark the areas of resource wastage and various measures of reducing them can be employed.

CONCLUSION

Each resource conservation measure should be given top priority inside the University campus and the proposal to conserve resources was to be implemented immediately. Universities being the one of the largest consumer of electricity, water and other consumables main focus are to be given to conserve these resources

and to optimize the utilization of resources inside the campus. By doing the same, Universities will become Eco-Campus, which will be an example for other industries to follow.

Noise level inside the campus is found not to be a main problem inside the campus even though it seems to be and is evident from the readings taken at various points inside the campus but it is suggested that the main source of noise such as generators, heavy equipments are to be isolated from main study areas such as class rooms, library. Energy being a main commodity is to be saved precisely inside the campus and its main utilization should be on core applications such as laboratory equipments, and other appliances. Air conditioners are consuming more energy and are to be replaced by cost effective solutions wherever viable. Awareness among the students and staff members of the University to conserve the resource utilization is to be improved considerably which will have direct impact over the resource conservation.

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