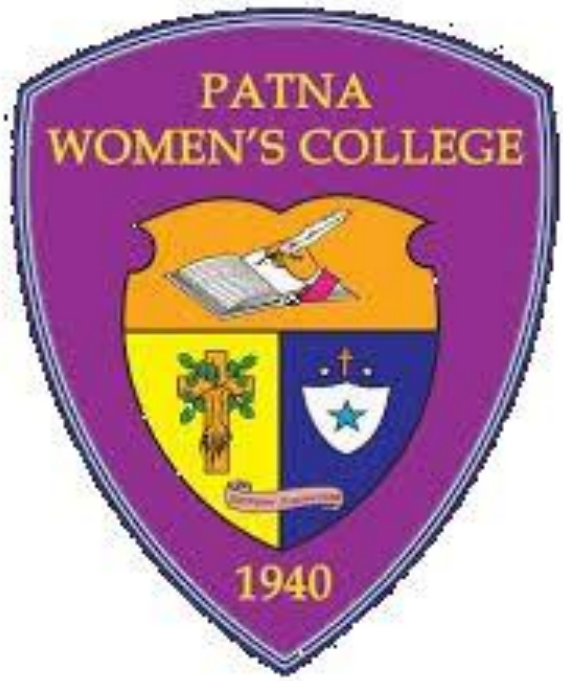
GREEN AUDIT REPORT
2021-22



(AUTONOMOUS)

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Abbreviations

PWC- Patna Women's College

UGC- University Grants Commission

NAAC- National Assessment and Accreditation Council

AQAR- Annual Quality Assurance Report

MRDA- Mentored Research Development Award

EC- Energy Conservation

BEE- Bureau of Energy Efficiency

GRIHA- Green Rating for Integrated Habitat Assessment

kWh- Kilowatt hour

ml/minute- Milliliter per minute

kg/month- Kilogram per month

RE- Renewable Energy

CPCB- Central Pollution Control Board

NBAP- National Biodiversity Action Plan

NEP- National Environmental Policy

WCG- Waste Crusaders Group

SHG- Self Help Group

DIY- Do It Yourself

ECO- Environment Conservation Outreach

GAV- Green Audit Volunteers

Chapter 1

Introduction

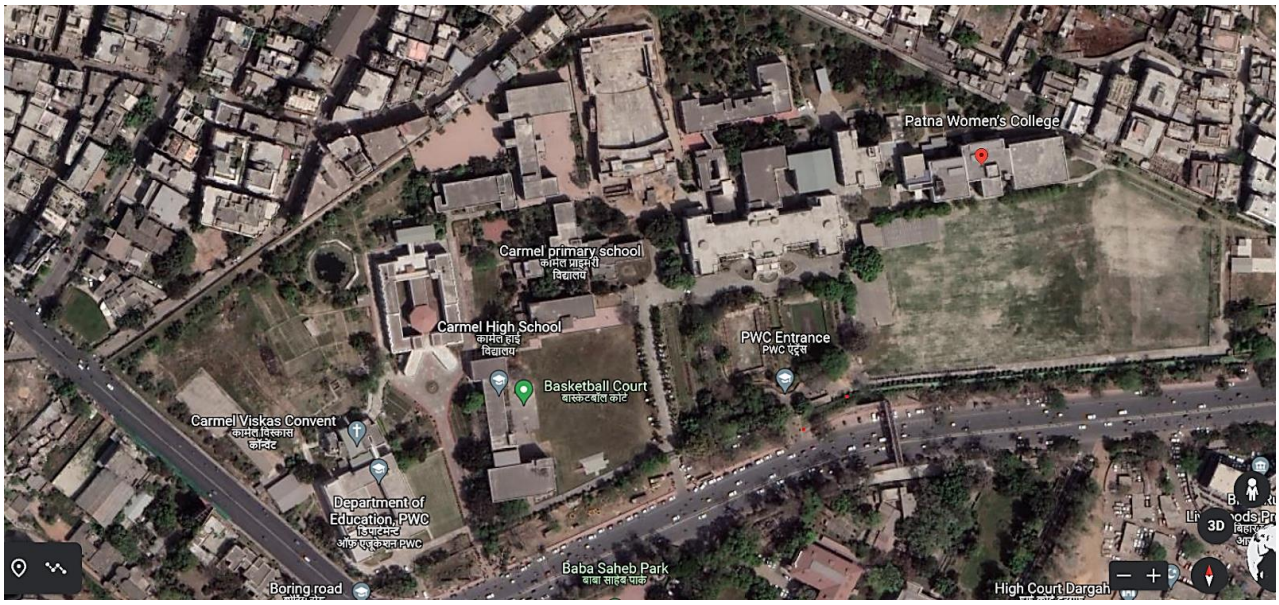
Picture 1.1: Patna Women's College campus
(Source: PWC administration)

Patna Women's College (PWC), founded in 1940 is the first institution of higher learning opened to cater to the educational needs of women in Bihar. It is run by the Catholic Religious Sisters of the Apostolic Carmel, an indigenous educational body founded in 1870. In the year 1952, the Government of Bihar gave a Special Status and it became a 'Constituent College' of Patna University. On 25.07.2007, the Government of Bihar officially declared PWC as a 'Religious Minority College'. The college, whose hallmark has always been Quality and Excellence, has been accredited by NAAC with 'A' grade for three consecutive cycles with CGPA 3.51/4 in 2010 and CGPA 3.58/4 in 2015. The college also has been accorded as 'College with Potential for Excellence (CPE)' status from UGC in three phases in 2004, 2010 and 2015. The University Grants Commission (UGC) has conferred Autonomous status to PWC in January 2018, which was further notified by the Parent University (Patna University) in July 2018.

PWC has achieved high ranking in the prestigious 'India Today- Mentored Research Development Award (MRDA) Survey 2021. The college has been ranked 31st in Arts and 39th in Science stream in the India. The college also been ranked 1st in Arts and 2nd in Science stream in Bihar, and 2nd (in both streams) in the Eastern region of the Country. Additionally, PWC has earned the prestigious 'Chancellor's Award- 2019-20' for Best Lady College in Bihar for their outstanding performance. Other than maintaining a high overall performance the college follows a holistic approach towards women empowerment, trying to share its views on education, empowerment, gender, and social issues.

Picture 1.2: Chancellor's Award 2019-2020 to PWC for Best Lady College
(Source: PWC administration)

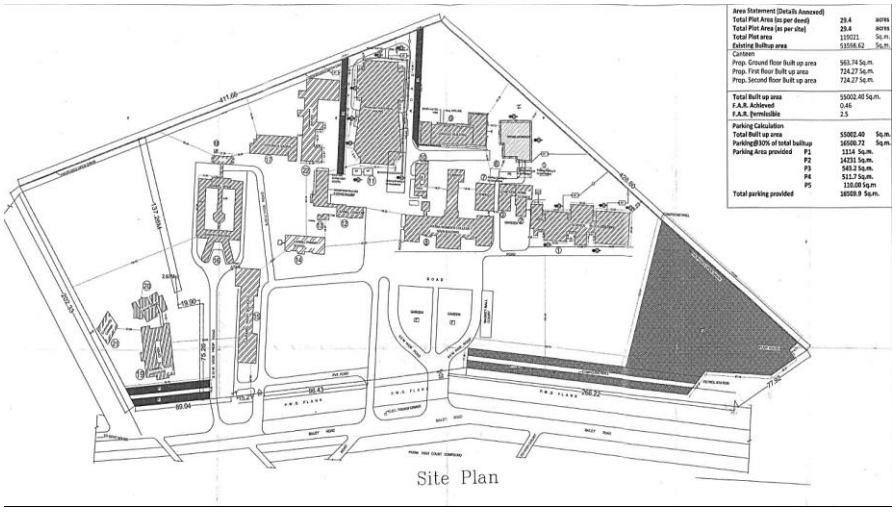
The college has 26 Undergraduate degree programmes in all the major streams like- Humanities, Sciences, Commerce and Management, and Education, along with 9 Post Graduate degree programmes and 4 Post Graduate Diploma programmes. More than 5000 students are enrolled in the campus during the current academic year pursuing different courses. The University also encourages cutting-edge research experiences in different science and technology disciplines. In addition, the college has always tried to compete with other colleges and universities of the state and country in terms of academic achievement, research and innovation, and placement records, which have been well reflected in its National Assessment and Accreditation Council (NAAC) assessments and Annual Quality Assurance Report (AQAR) report.



Picture 1.3: Aerial view of PWC
(Source: Google Earth Image)

Infrastructures at PWC

Main Building	R & D cell	Mother Veronica Excellence & Innovation Centre	Control Room
Science Block	IQAC office	Benedicta Memorial Study Hall	Audio Visual Studio
MCA Block	Control room (accounts)	Lucile Memorial Hall	Language Laboratory (Department of Communicative English)
BCA Block	General offices	Seminar Hall (Carmel Hall)	Creche and day care centre
Computer Science Block	Examination cell	Principal's Cottage (Residential quarters)	Basketball court/ College ground
B.Ed building	Vocational office	Computer Laboratories	Badminton Court
Community college	Central Library	GIS Laboratory (Department of Geography)	Digital display screens
Principal's chamber	Library (Department of Education)	Central Research Laboratories	Spacious classrooms



Picture 1.4: Site plan of PWC
(Source: PWC administration)

Vision

Rooted in the life, vision, and teachings of Jesus Christ and inspired by Mother Veronica, the foundress of the Apostolic Carmel, PWC strives to become a center of academic excellence in higher education, social responsibility, and empowerment of women.

Mission

PWC strives on its core mission as:

- To become a center of excellence in higher education for women in an atmosphere of autonomy.
- To excel in teaching-learning, research, and consultancy.
- To provide education that promotes capacity building and holistic development of a person.
- To offer subjects for competency building and motivate/animate a workforce imbibed with human values.
- To promote patriotism, communal harmony, and cultural integration to maintain a free and peaceful atmosphere on the campus.
- To train the students in creative arts, social service, critical thinking, and leadership in order to make an effective contribution to the creation of a new and value-based society.
- To create women leaders and to make them agents of social change.
- To develop skill-oriented and value-based courses, for the all-around development of individuals.
- To promote academic exchange and academia-industry interface.
- To form young women who are 'always wise' and who will dare to 'go ahead and conquer knowledge' through, competence, commitment, delicate conscience, and compassion.

Core Values

- Faith in God
- Honesty / Moral Uprightness
- Love and Forgiveness towards all
- Social Responsibility/ empowerment of the Marginalized
- Respect for Life and Creation
- Pursuit of Excellence
- Promotion of peace, harmony and brotherhood

Chapter 2

Green Audit

Background

Green Audit is a process of systematic identification, quantification, recording, reporting and analysis of components of environmental diversity of various establishments. It aims to analyze good or environmental practices within and outside of the concerned sites, which will have an impact on the eco-friendly ambience. Moreover, Green Audit is the most efficient ecological tool to solve such environmental problems. It is one of the initiatives for academic institutes to account for their energy, water resource use as well as wastewater, solid waste, E-waste, and hazardous waste generation. In the era of climate change and resource depletion, it is necessary to verify the processes and convert them into green and clean ones. Hence, green audit provides an approach for it, which increases the overall consciousness among the people working in an institution towards the environment. It could also be stated that institutional self-enquiry is a natural and necessary outgrowth of a quality educational institution. Thus, it is imperative that the college evaluate its own contributions toward a sustainable future. 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.

The National Assessment and Accreditation Council (NAAC) under its criteria VII has mandated educational institutes to perform a holistic green audit of the campus. NAAC accreditation process helps the institution identify its weaknesses, strengths, opportunities, and threats using a continuous evaluation process. It also introduces institutions to modern and innovative educational methods. Therefore, a green audit intends to upgrade the environmental conditions such as water, waste accounting, and energy, in and around the campus ensuring good and sustainable practices followed within the institution. Furthermore, it helps academic institutions to ensure responsive contributions towards the reduction of global warming through carbon footprint reduction measures.

Objectives

The Green Audit of an institution has played an important role in the self-assessment of the institutional level contributions towards mitigating the pressing environmental concerns. PWC has been putting efforts to keep environmental sustainability at the forefront since its inception stage. Therefore, the objective of green auditing of the PWC Patna campus is to document the non-scholastic efforts of the college.

Chapter 3

Methodology and Approach

PWC has been accredited by NAAC with 'A' grade for three consecutive cycles with CGPA 3.58/4. The college also has been accorded as 'College with Potential for Excellence'. To take the excellence further, the green audit has been carried out in three subsequent phases. At first, as part of the pre-audit survey, previous records, reports and studies were thoroughly reviewed, upon which the present status of resources, the ongoing practices and the management practices were thoroughly understood. Additionally, secondary literature on processes of green audit and reference documents like green audit reports of esteemed colleges were reviewed in order to devise and strategise the green audit process of PWC. The basic information gathered during the pre-audit process were collated with the NAAC criterias of evaluation which helped understand the necessity of conducting audit for four domains namely- water, waste, energy and biodiversity for understanding the environmental practices at PWC. Hence, the main objective of understanding the environmental practices was to highlight the existing best practices followed in the campus, and recommend innovative green solutions where there was scope for probing in sustainable, and effecient mechanisms. Thereafter the green audit survey was conducted for four different primary sectors – water, waste, energy, and biodiversity.

3.1 Methodology

The information assembled after the pre-audit in the four domains of water, energy, waste and biodiversity helped in setting a baseline for the green audit. Moreover using the baseline information, the methodology for the green audit survey was developed based on national standards and protocols. Following standard protocols for each of the domains, sets of questionnaire and survey analysis tools were designed to meet the individual objectives for each sector. The survey methodologies for each domain has been elucidated below-

3.1.1 Energy Audit

The Energy Conservation (EC) Act, 2001, provides for the efficient use of energy and its conservation in India. The Government of India set up a Bureau of Energy Efficiency (BEE) under the provisions of the EC Act. The mission of the BEE is to assist in developing policies and strategies—with a thrust on self-regulation and market principles—within the overall framework of the EC Act with the primary objective of reducing the energy intensity of the Indian economy. Therefore, based on the BEE standards of energy efficiency relevant secondary data from different industries were collated through (i) performance audits and sectoral study reports, (ii) equipment manufacturing brands, (iii) sectoral experts, (iv) stakeholder consultations with industries and industry associations, and (vi) secondary sources such as relevant websites. Interactions with industry personnel and industry associations were carried out to understand key operating parameters in different utilities. Thereafter the survey framework for the energy audit was designed based on questionnaire survey and data analysis.

3.1.2 Water Audit

The main objective of the National Water Mission is "conservation of water, minimizing wastage and ensuring its more equitable distribution both across and within States through integrated water resources

development and management". Further, the Central Water Commission and Central Ground Water Board have formulated 'General Guidelines for Water Audit and Water Conservation'. Furthermore, the Board emphasizes all the State Governments for framing their own specific guidelines in line with the guiding framework.

The Central Water Commission states the following parameters for water audit for the purpose of a correct diagnosis of the problems faced in order to arrive at optimum solutions-

- Records of the amount of water earmarked.
- Record of the amount of water delivered.
- Record of amount of water loss.
- Measures to reduce water loss (through leakages and other unaccounted water losses)

Thereafter, the survey framework for the water audit of PWC was prepared following the standard protocol set by Central Water Commission.

3.1.3 Waste Audit

The Swachh Bharat initiatives have given impetus to waste management infrastructure in the country for different categories of wastes namely solid & plastic waste, e-waste, biomedical waste, industrial hazardous waste, construction and demolition waste. As per the Central Pollution Control Board (CPCB), waste management rules are notified to ensure safe handling , generation, processing, treatment, package, storage, transportation, use, reprocessing, collection, conversion, and offering for sale, destruction and disposal of different types of waste. In lieu of this, the CPCB has defined several rules and protocols based on the management of different categories of waste. Hence, following the management rules as per CPCB for each of the categories of waste, the survey framework for the waste audit was designed.

3.1.4 Biodiversity Audit

The National Biodiversity Action Plan (NBAP) draws from the principle of National Environment Policy (NEP), that human beings are at the centre of concerns for sustainable development and they are entitled to a healthy and productive life in harmony with nature. The NBAP identifies threats and constraints in biodiversity conservation taking into cognizance the existing legislations, implementation mechanisms, strategies, plans and programmes based on which the management mechanisms are designed. Hence, abiding by the biodiversity laws and management regimes, the protocol for conducting the biodiversity audit in the campus has been framed.

3.2 Approach

Based on the diversity of buildings and land cover, as representative sample, 24 buildings, and all open areas within the vicinity of the College campus were considered for the audit survey. The buildings were categorized into the type and usability purposes.

Post the preliminary observatory survey, four domains namely water, energy, waste, and biodiversity were found essential to be audited to ensure the environment sustainability of the campus. In the water sector, individual's consumption and losses/ wastage was evaluated. Whereas, in the waste sector, the type and amount of wastes generated was evaluated to understand the waste management load of the campus.

Furthermore, the energy sector audit helped in understanding the demand and supply pattern of the electricity, and through the biodiversity audit, the rich floral and faunal diversity that the campus was protecting was evaluated.

The survey audit was followed by a set of control measures/ recommendations in contrast maintaining the gaps or reducing the additional pressure from the College campus to maintain the sustainability of the progress in the final stage of the audit. The steps followed for this audit is as illustrated:

The audit is based upon on-site visits, secondary and primary surveys, and personal observations. Initially, based on data requirements, sets of questionnaires were prepared. The questionnaires were comprised of two groups of modules (Annexure). The first module was composed of information about the infrastructure, amenities, sources, and other services available for general operations of the college. The second module consisted of information about consumption (pattern of usage) of resources like water, energy, and the handling of different types of services within the campus. Personal observations during the survey highlighted the diversity of infrastructure and amenities in the campus. Hence, for the ease of compilation and analysis all the infrastructural facilities and support services within the campus were clubbed into three categories and coded as academic, residential, and commercial buildings. Thereafter the initial observations helped understanding various infrastructural facilities across the campus and likewise frame the questionnaires for conducting the audits:

a. Different types of electrical appliances used in the campus (Annexure)
b. Type of energy sources (eg: solar, electricity board)
c. Variety of taps and water outflow sources spread across the campus
d. Different waste disposal techniques used across the campus
e. The green and good practices followed in the campus like organic farming, plantation drives, green spaces or gardens with variety of trees and biodiversity across the campus, ponds recycling wastewater, signboards and cautionary messages indicating no wastage of water and electricity, no littering etc.
f. Attitude and behavior of students in terms of disposing garbage in proper locations, closing running taps, opening windows and using sunlight instead of turning on electrical lights, caring for the plants and animals in the campus, etc.

As part of the pre-audit, specific training and orientation were provided to the surveyors and faculty and administration staff who were part of the audit process. The stakeholders were oriented on the concept of green audit, the objective of conducting a green audit at PWC, the roles and responsibilities, the procedures of conducting the surveys of water, waste, energy and biodiversity sector and its compilation. In order to monitor the survey process and keep accountability of the surveyed data, a domain expert was chosen among the faculty members of PWC to guide volunteers during the survey process and share their observations and recommendations for the same. Post rigorous orientation and training, the surveyors conducted primary surveys from the four sectors in the campus. However, certain administrative constraints in the form of inaccessibility to some rooms and locations had cropped up during the survey, which pushed the survey process to be remolded and re-strategize in the form of a robust survey considering the maximum outcome of the findings. Thus, the data generated from the survey were further analyzed to identify the best practices and gaps in environmental sustainability at PWC.

Chapter 4

Findings

4.1 Pre-audit

In PWC, rounds of pre-audit meetings were conducted which consisted of collecting relevant documents directly from the college, gathering specific information related to the committees in the college, their responsibilities and activities, the infrastructural amenities, college rules and regulations etc. which are supporting environmental sustainability of the campus. At this stage itself, a formation of the green audit committee (figure 4.1) took place under the chairmanship of the college principal consisting of members from different departments, management staff and volunteers. This was followed by orientation and series of training to build the capacity of the committee members as well as the volunteers for the entire process of green audit.

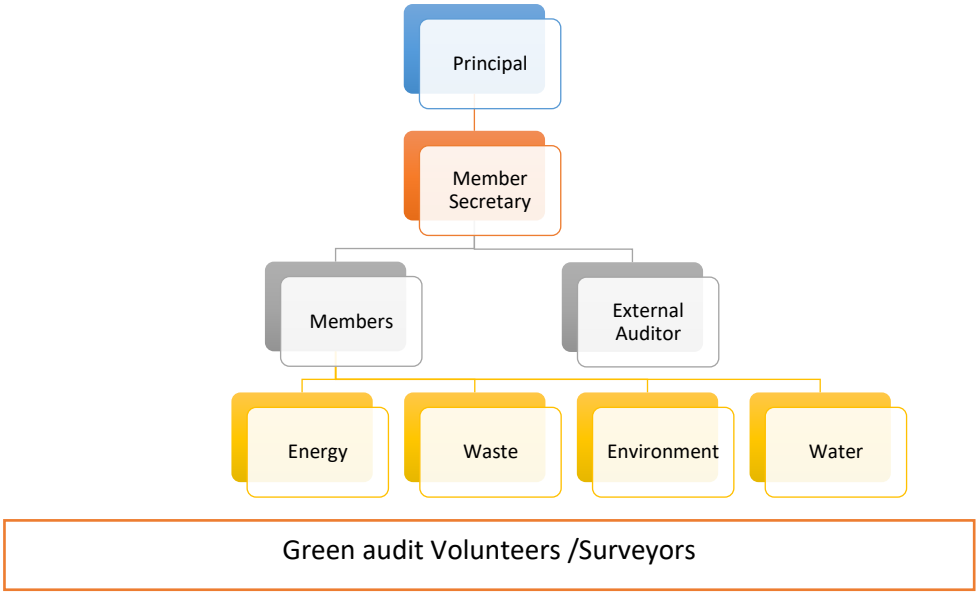


Figure 4.1: Green Audit Committee at PWC

In order to provide additional guidance to the survey volunteers, handouts stating the survey procedures, enlisted appliances and items to be identified, steps for numeric calculations, do's and don'ts, etc. were provided along with the questionnaire (Annexure).

(i) Preliminary survey and data collection

A preliminary survey was conducted to understand the baseline for the green audit report. As per the guidelines of the Ministry of Environment, Forest and Climate Change, New Delhi, Central Pollution Control Board and other statutory organizations primary level information was collected for sectors like waste, energy, water, and biodiversity within the campus. The questionnaires were divided into two groups of modules (Annexure). The first module comprised of the information regarding the college infrastructure, amenities, sources, and other services available for general operations of the college. The second module comprised of information on the consumption (pattern of usage) of resources like water, energy, and the handling of different types of services within the campus.

(ii) Preliminary observations

The PWC has a vast built up area comprising of various departments, administrative buildings, school buildings, teachers and staff quarters, convents, student hostels, guest houses, gymnasium, bank, ATM, and child care center. All these amenities have different kinds of infrastructures as per their requirement. All these buildings were visited by the surveyors and their present statuses were verified with the help of the survey questionnaires. In addition, personal observations were also made during the onsite visits to the campus. In order to simplify the outcomes of the survey, the amenities and infrastructure within the PWC were clubbed according to the similarities and differences. Therefore, for the ease of data compilation, the departments and support services were clubbed into three categories and were coded as academic, residential, and commercial buildings. The details of the buildings that have been coded are as follows:

Table 4.1: Details of the different buildings in the PWC campus

Academic Buildings	Residential Buildings	Commercial Buildings
Science Block	PWC hostel	Canteen-MCA Building
MCA Block	Avila Convent	Canteen- BCA building
BCA Block	Carmel Convent	Auditorium (under construction)
Main Building	Veronica Sadan	Bank
Carmel Primary School	Carmel Vikas	Gymnasium
Carmel High School	Convent building	ATM
Carmel Primary New Building		Auditorium (temporary)
B.Ed Building		
M.Ed building		
Community College		

4.2 Green-audit

Post pre-audit and training of the committee members and the volunteers, surveys with respect to the different domains of water, energy, waste and biodiversity were conducted in the college. All the surveys in the respective domains had a specific objective of identifying the good practices within the college campus and at the same time identifying the gaps where there is room for probing in green practices. Rounds of review and progress meetings followed the surveys between the committee members and the volunteers. Post the completion of the surveys, an interim report was submitted to the committee members and college management based on the analysis of the surveyed data. With respect to the decisions taken by the management authority, the committee members have the responsibility of planning suitable sustainable interventions and thereby ensuring the implementation of the physical and financial decisions.

(i) Data collection and analysis

As mentioned in the previous section, the data for the green audit was collected through a two way process of preliminary audit and survey by questionnaire during the green audit. The survey questionnaire was designed in a way to capture the minute details across all the sectors of water, waste, biodiversity and energy across the PWC campus. Based on the preliminary baseline obtained from the various departments and college administration, the questionnaire consisted of detailed information about the infrastructure, amenities, operative procedures and other services available for general operations of the college. However, after the

questionnaire design and development, the modules were tested and verified at the ground level with the help of a demo or preliminary green audit survey by the green audit volunteers. The questionnaires and survey procedures were also customized a little considering the ground level obstacles like accessibility and accountability. Thereafter, the survey procedure had begun, whereby the selected volunteers were engaged in data collection across the four domains of water, energy, waste and biodiversity. Next, the survey data from each domain (water, energy, waste and biodiversity) were tabulated in Excel spreadsheets. The tabulated data was further analyzed for desired outputs. Interpretation of the overall outcomes was made which incorporated all the primary and secondary data, references and correlation within different domains.

Table 4.2: Colors indicating the different buildings/blocks surveyed under each green audit survey

Sr. no	Audit Area	Audit Buildings	Audited Sectors		
			Water	Energy	Waste
1.	Academic buildings	Science Block	√	√	√
2		BCA block	√	√	√
3		MCA block	√	√	√
4		B.Ed block	√	√	√
5		M.Ed block	√	√	√
6		PWC Main building	√	√	√
7		Community college	√	√	√
8		Carmel High School	√	√	√
9		Carmel New Building	√	√	√
10		Carmel Convent (New +Old) building	√	√	√
11	Residential Buildings	Carmel Convent	√	√	√
12		Carmel Jwala	√	√	√
13		PWC hostel	√	√	√
14		Carmel Vikas	√	√	√
15		Avila Convent	√	√	√
16		Veronica Smriti Sadan	√	√	√
17		Carmel Vikas + Carmel Kunj	√		√
18	Commercial Buildings	College canteen	√		√
19		Monginis	√		√
20		BOB bank			√
21		BOB ATM			√
22		Gymnasium		√	
23		Canteen- BCA building	√		√
24		Canteen- MCA building	√		

4.2.1 Waste Audit

Waste management has emerged as a big challenge of the modern era, especially in urban contexts. Unscientific handling of waste (biodegradable waste, non-biodegradable waste, E-waste, Biomedical waste etc.) can create threats to public health and environmental safety. Thus, it becomes necessary to manage waste

efficiently. The purpose of this audit was to diagnose the prevailing waste disposal practices, management system, and most importantly, waste controlling policies (quantity, volume, type and current management practice of waste generation) in the PWC campus.

The data on the waste sector from PWC was collected from all three user segments – academic buildings, residential buildings and commercial buildings. For waste audit, generated wastes were categorized into four categories – biodegradable, non-biodegradable, E-waste, hazardous, and others. The bio-degradable wastes included food wastes, canteen waste, wastes from classrooms, toilets, etc. Whereas the non-biodegradable wastes included the plastic scraps, tins and glass bottles etc. Hazardous waste in the campus accounted for the chemicals, acids, wastes from laboratories, etc and E- waste comprised of the discarded electronics or electrical appliances in the form of batteries, desktops, etc.

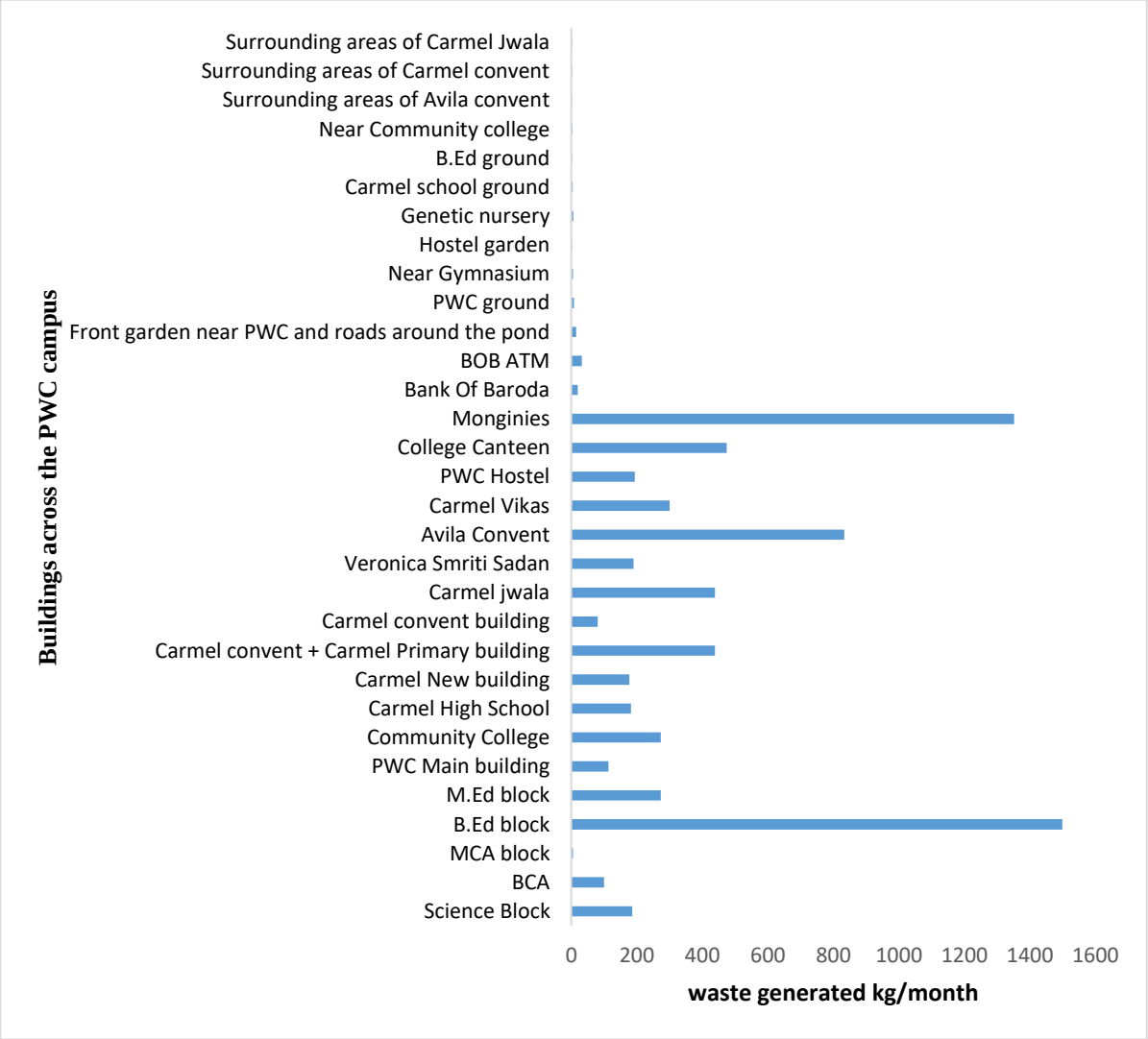


Figure 4.2: Total waste generated from the different sources across the different buildings at PWC

Key observations

It has been observed that almost every department/ building block generates some amount of waste. Wastes generally are collected in two different stages, one at door-to-door level and another at common building level.

As tabulated below, on an average, the B.Ed block accounted for the highest amount of total waste generated from the PWC campus of which the canteen in the building generated the maximum waste. This was followed by the Monginis canteen which generates the second highest amount of waste in the PWC campus. The waste generated from the monginis was a combination of waste like food particles, disposed thermocol plates, tetra packs, plastic bottles, paper wrappers, straws, paper tissues etc. Followed by this were the hostels and residential quarters within the campus. However, it was observed that the residential quarters surrounded by nurseries and gardens generated higher amounts of biodegradable wastes in the form of leaf litter, grasses, etc in comparison to the non-biodegradable waste. Therefore, on an average, various stakeholders generated 7215.836 kg of different types of total waste per month which is 0.2 kg more than the national average of per person waste generation.

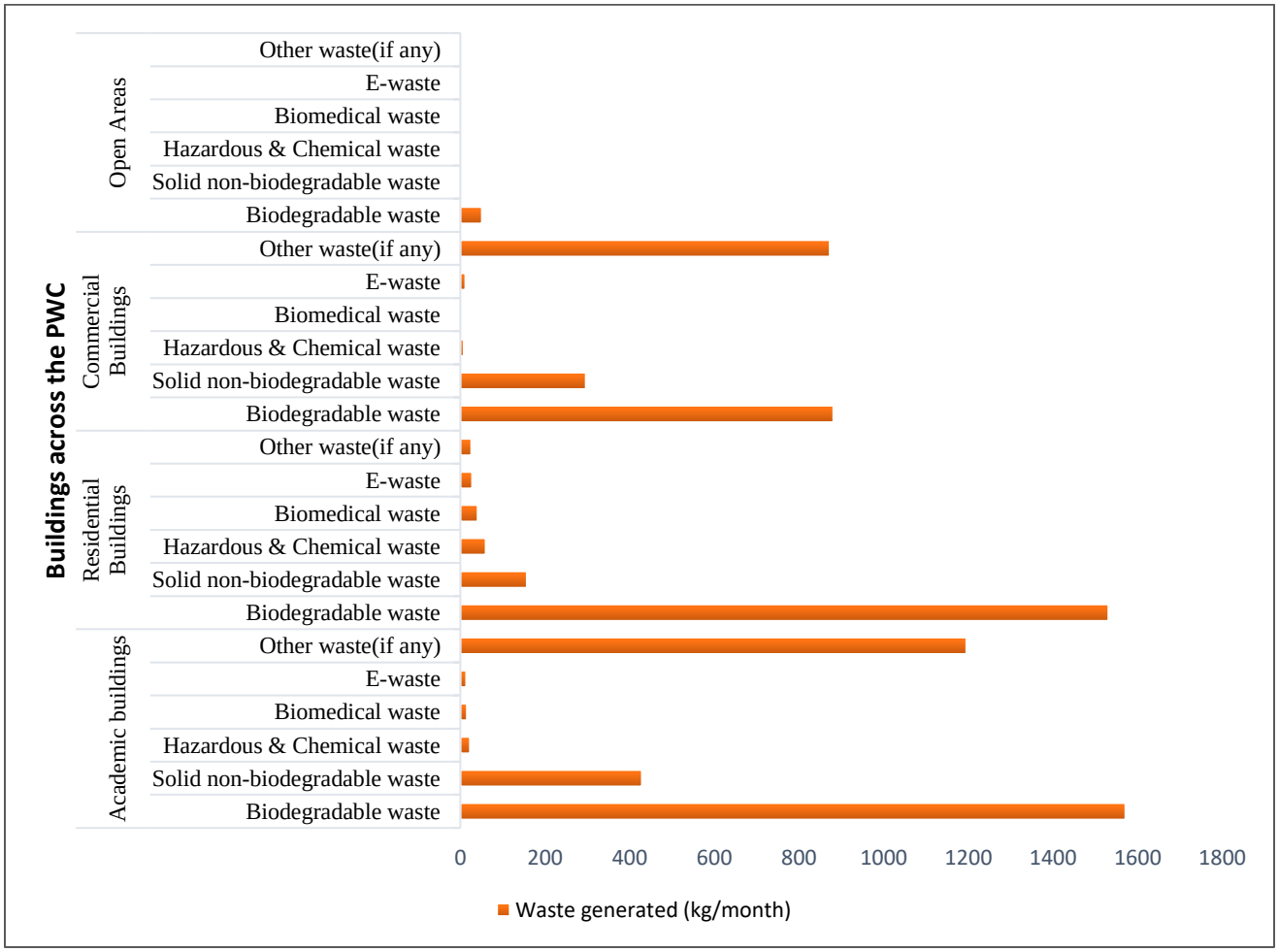


Figure 4.3: Types of waste generated across the different buildings at PWC

Management of solid waste is one of the areas where all stakeholders are more-or-less aware of the issues involved if left unattended. Moreover, every individual has appropriated their own set of solid waste management practices as per their convenience, requirements, and availability of resources. The waste audit survey revealed that 24 different buildings and departments of the college campus have a total of 350 indoor dustbins installed for solid-waste disposals. On an average, each building/department has roughly about 14-15 dustbins.

As shown in figure 4.3, the results from the survey data analysis reflect that the academic buildings generated more paper and glass waste across the different departments. That might be also the case of extensive usage of paper due administrative record keeping. However, glass waste is a periodical type of waste generated every month from laboratories, upon breakage of glasswares or instruments. Other wastes from the department comprised of plastic wrappers, thermocol, stationery items, etc which is of small quantity. Similarly, the residential buildings showcased domestic or household type of waste like bits of paper, plastic wrappers, old batteries, discarded masks and cloth pieces, shafts of hair, empty phenyl bottles, etc. However, the survey showcased the quantity of biodegradable wastes in the form of kitchen waste as well as fallen leaves and twigs in the gardens, generated from the open areas and near the residential blocks is more in comparison to the other types of wastes generated from that particular location.

It has been also observed that the city municipality collected 90 % of the accumulated solid waste every morning, excluding the biodegradable ones that are dumped in the pits for in-house composting. Additionally, out of the waste generated in the college campus approximately 900 kg (approximately 30 kg everyday) of waste is incinerated every month, which included biomedical wastes like sanitary napkins and other non-biodegradable wastes like plastic, thermocol plates, styrofoam, laboratory wastes like contaminated broken glass, beakers, pipette tips, scalpel blades, and other infectious wastes that pose a threat to health and environment. About 54 kg of E-waste is generated per month, consisting of broken light bulbs, tube lights, batteries, electronic gadgets like mobile phones, computer parts, and other common utility appliances, but their efficient disposal to private collectors makes the college efficient in managing E-waste. Likewise there are other waste management strategies which the PWC regulate within the campus (Fig 4.4)

Figure 4.4: Waste disposal practices followed by PWC

Though the college campus generated a high proportion of total waste, it has been observed that the college ensured proper management, whether in the form of composting, incineration, or segregated as municipal wastes. Such practices cut down the overall costs involved around waste management, and also avoided getting untreated. Even though there are no prescribed guidelines as such or training to the cleaning staff, the biodegradable waste generated from canteens and kitchens, which consisted of vegetable peels, and shredded paper wastes from the administrative blocks were effectively used for composting purposes.

Key Suggestion

(i) Waste as wealth

The process of conversion of waste to a product that can be put to primary use can be viewed as a process of generating wealth. Waste management that leads to generation of substances and products that can be put to.

Moveover, this mission will identify, develop, and deploy technologies to treat waste to generate energy, recycle materials, and extract worth,

- Vermi composting pit have been operative for consuming biodegradable waste collected from kitchen, canteen and administrative blocks. The composts are used as organic manure for the kitchen gardens and other green spaces within the campus
- The e-wastes and other solid waste like files, cartons, newspapers, etc. are partially segregated and sold off to scrap dealers.
- Incinerator (capacity of 10kg/hour) have been installed within the campus for ensuring safe disposal of biomedical and hazardous waste;
- Decomposition pit has been installed to manage the liter leaf wastes within the campus;
- Adequate deployment of cleaning staffs for door-to-door waste collection and disposal from sources to final stage without any mishandling and littering, i.e. timely disposal of municipal wastes, and other wastes management through incinerator, or composting;
- Sufficient waste collection bins and trash cans within the campus for easy disposal of wastes in a segregated manner.
- Adequate signage, posters, etc. were found affixed to aware students and other visitors about waste segregation and no littering across the campus;
- Constitution of Eco-task force to organize student led campaigns for reduce, reuse and recycle wastes on routine intervals.

Coloured dustbins for segregating biodegradable and non-biodegradable waste at PWC

(ii) Waste Segregation

Ensuring waste segregation before disposal to the incinerator and Municipal Corporation dumping van. Introducing a concept of '**Waste Crusaders Group' (WCG)** comprising of cleaning staff who will be encouraged to responsibly dispose-of cum manage, especially the non-biodegradable wastes by earning money from the wastes. Thus, a system will evolve to achieve efficient waste segregation and disposal within the campus. This system can also be self-sustaining (like SHG model) where the incentives earned can be used as a resource by the WCG's financial needs.

(iii) Plastic Free Campus Policy

Encouraging the concept of plastic free zones in the campus by introducing zero plastic waste policy. In case a full ban on plastic is not possible, a partial ban may be introduced. This can be called No plastic Fridays, Zero Plastic/ Stylofoams etc. Zones.

Segregated waste disposalbins at PWC

(iv) No paper week

Being an academic institute, majority of the work is paper based, hence encouraging no paper week in the campus once in a month, whereby trying to substitute all the paperwork in digital media can cut down on a lot of paper waste that is generated from the campus.

(v) Sanitary Incinerator

As per the waste audit survey, the campus has only one incinerator installed which is sometimes unable to incinerate the extra amount of waste generated from the campus. Therefore installation of a separate

sanitary napkin incinerator at women's waiting rooms (and washrooms) can increase the efficiency of the waste disposal techniques.

(vi) DIY Weeks

Encouraging DIY philosophy as an extracurricular activity, focused around waste upcycling, and recycling which will help in managing single use plastic waste.

(vii) Collaboration and Cooperation

The waste audit survey report stated a huge volume of biodegradable and non-biodegradable waste that are unable to be managed properly due to its huge volume and lack of adequate technological setup. Hence, the college administration can collaborate with companies working on waste management as an alternative measure to manage the additional load of wastes, generated in the campus

Ensurinng plastic free campus/Zone

(viii) Coding Waste Bins

The audit processes showed that chemical/hazardous waste is disposed off randomly at every wash basin. Although there are existing protocols for safe handling of hazardous waste, but specific basins or counters can be marked within the campus (Example: in the chemical based laboratories) for safe disposal of hazardous waste.

(ix) Wastewater Treatment

Installation of sewage treatment plant within the campus for recycling and reusing the waste water in the campus for efficient water use and management.

(x) Training and Awareness Campaign

There can be time to time training cum awareness programs for students and staff members on plastic free campus, proper waste disposal and limiting the quantity of waste in the campus. Conducting campaigns on environmentally important days to raise awareness on zero plastic use, safe waste disposal, campus hygiene, sustainable water use management etc.

Faucet types in the common washroom

4.2.2 Water Audit

Water audit can be defined as a qualitative and quantitative analysis of water consumption to identify the means of reducing, reusing and recycling of water. Water Audit is nothing but an effective measure for minimizing losses, optimizing various uses and thus, enabling considerable conservation of water. Therefore, the objective of the water audit in PWC is to understand the total water consumption of water from the different water sources, the total use by the various water users in the campus and the leakages in the water system in the campus. Hence, a water audit is a technique or method which makes it possible to identify ways of conserving water by determining any inefficiencies in the system of water distribution. The measurement of water losses due to different uses in the system or any utility is essential to implement water conservation measures in such an establishment.

Key observations

The major source of water in the PWC campus is from the groundwater that is pumped out using borewells and water pumps. There are overhead tanks across the different buildings in the campus that are used for

storing the harnessed groundwater. There are 10 water storage tanks of an average capacity of 7000 litres which are refilled 3-4 times in a day. Hence, as per estimated, the total water pumped out for daily use is somewhere around 215000 liters. It has been observed that two-pond, 79200 m^3 of capacity helps in water seepage and recharge of the underground water table for the college campus.

The table shown below is water use in terms of total water discharge from the water sources in the campus and the losses in the form of leakages from the given sources.

Table 4.3: Total water discharge rate and leakages

	Buildings	Total water discharge (ml/minute)	Total leakage (ml/minute)	Total leak taps
Academic Building	Science Block	261748.38	186.9	16
	BCA	54603.6	692	3
	MCA block	56179.92	46	2
	B.Ed block	24102	0	0
	M.Ed block	28411.98	0	0
	PWC Main building	153034.26	0	0
	Community College	1250	0	0
	Carmel High School	68055.6	190	1
	Carmel New building	66345	0	0
	Community College	823.33	0	0
	Carmel convent + Carmel Primary building	164,519.34	0	0
Residential Building	Carmel convent building	66345	0	0
	Carmel jwala	473592	0	0
	Veronica Smriti Sadan	81337.02	0	0
	Avila Convent	167505	0	0
	Carmel Vikas	184728	0	0
Commercial Building	PWC Hostel	59514.84	0	0
	College Canteen	12300	32	1
	Monginies	0	0	0
	Bank Of Baroda	0	0	0
	BOB ATM	0	0	0
Open Areas	Garden between Science block	9000	0	0
	Garden attached to Science block	6480	0	0
	Garden infront of Science block	7800	24	1
	Garden infront of Monginis	6720	0	0
	Common basin (external) in Carmel High School	0	0	0
	Common taps near BCA building	3840	0	0
	Water pipe behind new primary block	10440	0	0
	External basin near Community college	2400	0	0
	External common washroom near B.Ed department	4500	0	0

The total water discharge is dependent on the number of water sources i.e. taps, pipes, jet sprays, showers etc. across the campus and the individual flow rate of the different sources. Hence as per the survey data of the water audit, among the academic buildings the Science block, PWC main block and the Carmel primary building showcases greater discharge rates implying that the average number of taps and water sources in these buildings is greater in comparison to the other buildings. The data also signifies that the average flow rate of the taps of these three buildings is higher than the rest of the water sources across the other buildings of the campus. Likewise, Carmel Jwala and Carmel Vikas exhibit high discharge rate among the residential buildings

in the campus. Similarly, the outside areas of the campus comprising of basin taps and pipes also showcases little amount of discharge in comparison to the other areas and buildings of the campus.

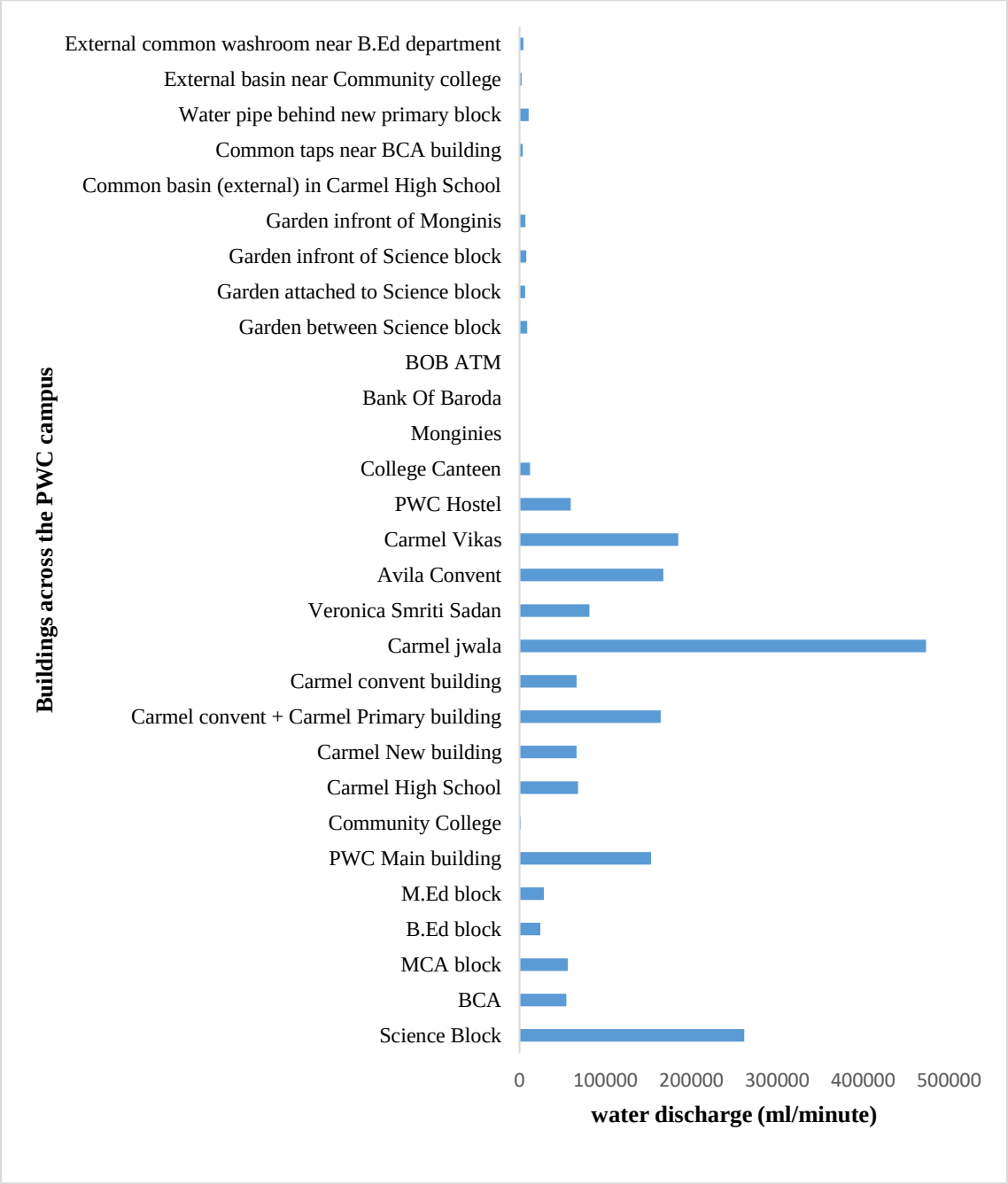


Figure 4.5: Discharge rates of different water sources of the different buildings across PWC

The water audit survey had also accounted for the total leakages in the water system of the PWC. As per the survey, the academic buildings like BCA block, Science block, MCA block and Carmel High School indicate some leakages in their water sources, which are the prime reasons for loss of unused water. Other than this, the college canteen and the garden in front of the science block also has a few taps that cause losses in the form of dripping of water from the taps even after closing it. Additionally, the per person water consumption in the

campus is roughly 20-22 litres per day on an average against the national average of 45 litres per day including the students, teaching faculty, administrative staff and the hostellers and residential quarters within the campus.

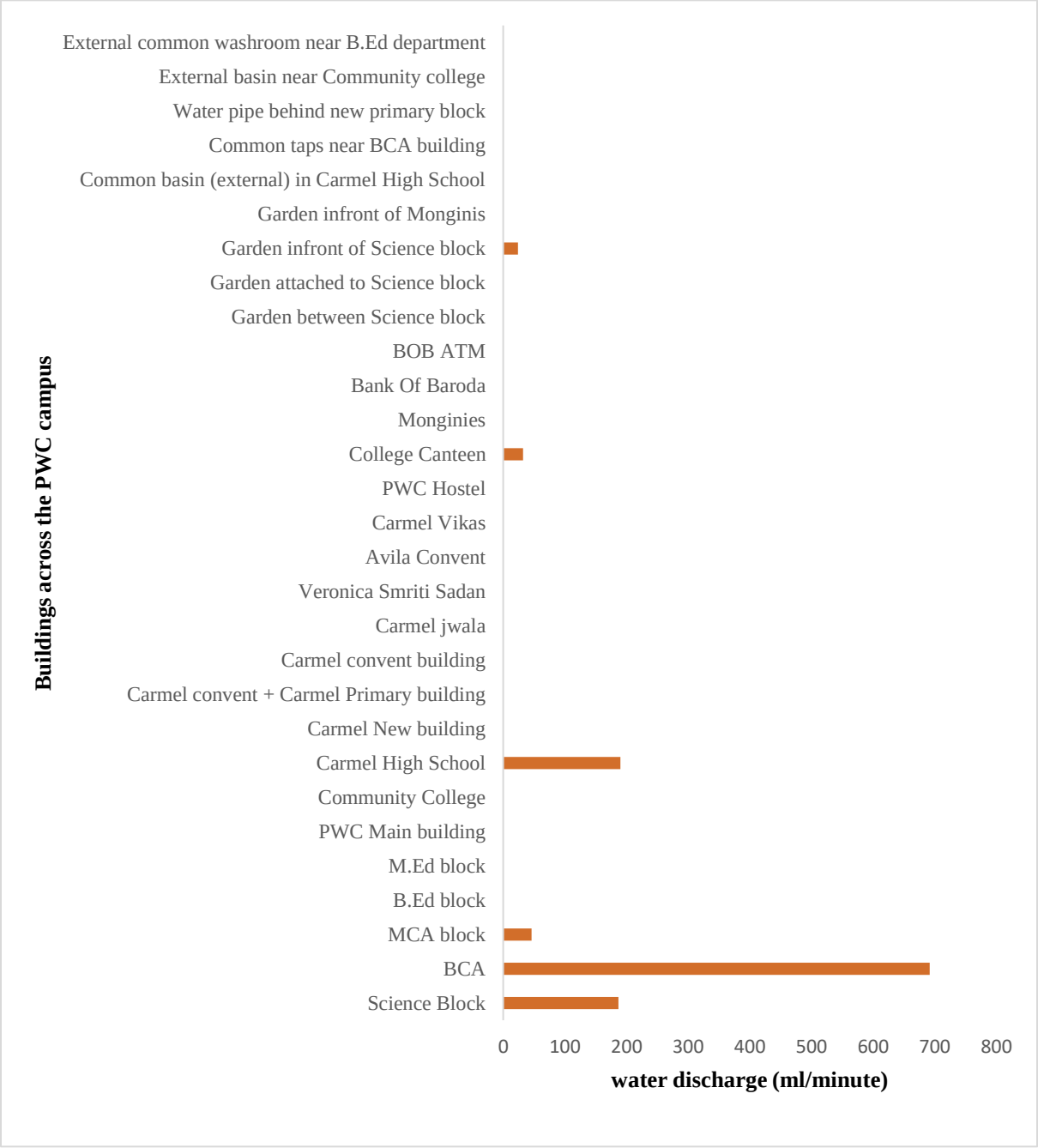


Figure 4.6: Leakage rates of different water sources of the different buildings across PWC

The figure 4.7 shows the total percentage of water consumed by all the building blocks of PWC. The graph shows toilets, wash basins, bathrooms and laboratories as the major sources of water consumption, while other uses are for garden, kitchen, and for drinking purposes.

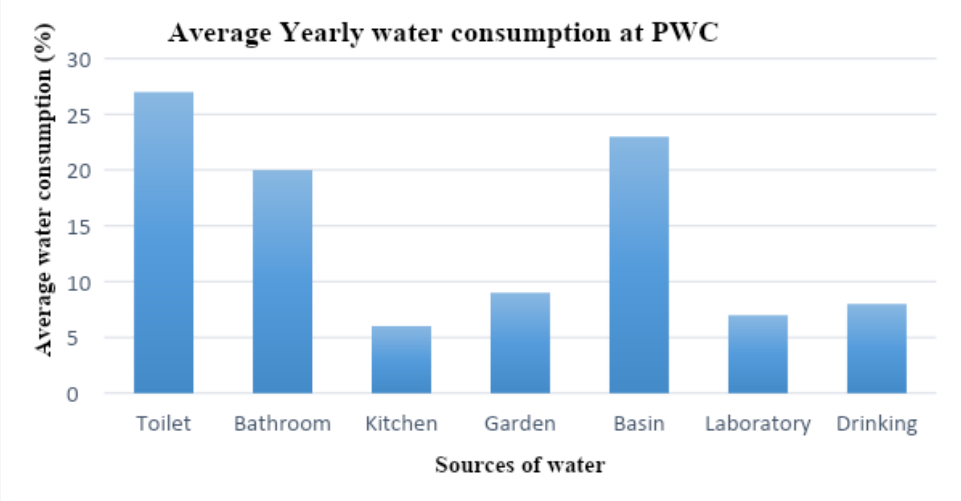


Figure 4.7: Trend of average yearly water consumption from the different sources across PWC

Key Suggestions

- **Monitoring System**

Ensuring a reporting mechanisms for the reporting of leaking faucets, running toilets, faulty hoses, or broken water fountains to appropriate authorities (example: maintenance staff) by cleaning and housekeeping staff

- **Repair or Replacement**

From the survey conducted under water audit, it was noted that there are couple of taps and water sources (i.e. 3 taps in BCA building, 14 taps in Science Block, 2 taps in MCA block, and one tap each in Carmel High school, college canteen, garden infront of science block and animal house) that require replacement inorder to minimize the losses and leakages. within the campus**.** Also**,** during the water audit survey, it was observed that majority of the sanitary fittings in the campus comprises backdated flushes. (Example: 10 litres flush box in the science block common washrooms) and sanitary fittings with water efficient technology like dual flush, water saving narrow nozzle taps, etc.

- **Water Saving Aerators**

Foam flow water aerator

During the water audit survey at PWC, the volunteers have observed taps/water sources with very high flow rates that are leading to uncontrolled water losses.Hence, installation of water saving aerators (example: foam like water outflow) in the faucets in kitchen, laboratories, gardens and in taps with high flow speed across the campus will increase the efficiency of water use and management in the campus. Installation of **drip irrigation, adjustable sprinklers in the garden** instead of taps or hand pumps can reduce upto 70 % of the water consumption for the garden and other outdoor pu

- **Rainwater Harvesting System**

Installation of rainwater water harvesting systems in the new buildings of the campus.

- **Awareness Campaign:**

Pamphlets and sign boards reading 'Do not waste water' , 'save water' attached in various locations across the campus. Routine awareness campaigns and drives conducted in the college on efficient water management.

4.2.3 Biodiversity Audit

The key element of this audit is the development of an evidence-based inventory of biodiversity within the campus to understand the requirements of priority species and provide guidelines for their conservation. Ecological requirements of priority species for conservation have been collated, and synthesized, integrating across numerous individual priority species to produce management guidance for multi-species assemblages. The objective of biodiversity audit is to identify the diversity of flora and fauna within the campus area, to observe ecosystem structures and functions along with regular biodiversity monitoring of the campus.

The biodiversity audit survey focused on the assessment of the present status of diversity in the form of plants, insects and birds from college campus and efforts made by the college authorities for nature conservation. The data related to protection and conservation of nature, plantation activities, awareness, eco-friendly development, etc. by the institution since the last two years has been assessed. The PWC campus, although located in the heart of the city, maintains its greenery. Findings from the survey have identified diversity of species of various genera and significance. Based on survey, the diversity of flora and fauna found in the campus are as illustrated:

Table 4.4: The diversity of canopy trees across the PWC campus

Sr. No.	Name of the tree	Carmel Vikas	PWC and Avila Convent	Carmel School and Carmel Convent	Carmel Jwala
1.	Ashok tree (*Saraca Asoca*)	9	90	35	2
2.	Kachnar (*Bauhinia variegata*)	2	9		0
3.	Neem (*Azadirachta indica*)	1	3	2	1
4.	Gulmohar (*Delonix regia*)	0	9		0
5.	Patli tree (*Stereospermumsuaveolens*)	0	5		0
6.	Amaltas (Cassia fistula)	1	4	1	0
7.	Rudraksha (*Elaeocarpus ganitrus*)	0	1		0
8.	Bottle brush (*Callistemon*)	2	1		
9.	Siris (*Albizia lebbeck*)	0	1		0
10.	Bay leaf tree (*Laurus nobilis*)	1	1		1

11.	Bogainvillea (*Bougainvillea glabra*)		52		
12.	American mahogany (*Swietenia mahagoni)*	22	0		
13.	Queen carp myrtle(*Lagerstroemia speciosa*)	0	5		
14.	Mahua (*Madhuca longifolia*)		1		
15.	Silver oak (*Grevillea robusta*)		1		
16.	Indian elm (*Holoptelea integrifolia*)		1		
17.	Jacaranda tree		1	2	

Table 4.5: The diversity of fruit bearing trees in the campus of PWC

Sr. No.	**Name of the tree**	**Carmel Vikas**	**PWC and Avila Convent**	**Carmel School and Carmel Convent**	**Carmel Jwala**
1.	Mango (*Mangifera indica)*	33	54	12	49
2.	Guava (*Psidium guajava*)	26	16	3	9
3.	Amla (*Phyllanthus emblica)*	2	6		6
4.	Papaya (*Carica papaya*)	12	8		0
5.	Mulberry (*Morus alba*)		2		0
6.	Drumstick (*Moringa oleifera*)	5	6		3
7.	Litchi (*Litchi chinensis*)	1	1		2
8.	Jamun (*Syzygiumcumini*)	1	3		2
9.	Anjeer (*Ficus carica*)	2	2		1
10.	Cashew (*Anacardium occidentale*)		1		
11.	Badam tree (*Prunus dulcis*)		1		
12.	Jackfruit (*Artocarpus heterophyllus*)	2	5	1	1
13.	Chikoo (*Manilkara zapota*)	1	13	3	3
14.	Bael (*Aegle marmelos*)	0	1	1	
15.	Hog Plum (*Spondias Mombin*)	1	0		2
16.	Tamarind (*Tamarindus indica*)	1	0		
17.	Pomelo (*Citrus maxima*)	2	2		1
18.	Peach (*Prunus persica*)	1	1		
19.	Custard apple (*Annona reticulata*)	4	3	3	
20.	Lime (*Citrus aurantiifolia*)	3	3		1

21.	Pomegranate (*Punica granatum*)	2	1		2
22.	Coconut (*Cocos nucifera*)	8	3	3	1
23.	Starfruit (*Averrhoa carambola*)		2		
24.	Banana (*Musa paradisiaca*)	8	2		10
25.	Water rose apple (*Syzygiumsamarangense*)	0	1		
26.	Sweet chestnut (*Castanea sativa*)	0	1		
27	Kadam/Burflower tree (Neolamarckia cadamba)	1	1		1
28	Bull's HeartWild sweetsop(Annona reticulata)		1	1	

Table 4.6: The diversity of bird, amphibians, reptiles and mammals species across PWC campus

S. No	Common name	Zoological name
	Birds	
1.	Little Grebe	*Tachybaptus ruficollis*
2.	Rock Dove	*Columbia livia*
3.	Eurasian Collared Dove	*Streptopelia decaocto*
4.	Spotted-necked Dove	*Streptopelia chinensis*
5.	Little Swift	*Apus affinis*
6.	Lesser Coucal	*Centropus bengalensis*
7.	Common Koel	*Eudynamys scolopaceus*
8.	Common Hawk Cuckoo	*Hierococcyx varius*
9.	White-breasted Waterhen	*Amaurornis phoenicurus*
10.	Indian Pond Heron	*Ardeola grayii*
11.	Cattle Egret	*Bubulcus ibis*
12.	Little Egret	*Egretta garzetta*
13.	Indian Cormorant	*Phalacrocorax fuscicollis*
14.	Shikra	*Accipiter badius*
15.	Black Kite	*Milvus migrans*
16.	Spotted Owlet	*Athene brama*
17.	Indian Grey Hornbill	*Ocyceros birostris*
18.	Common Hoopoe	*Upupa epops*
19.	Black-rumped Flameback	*Dinopium benghalense*
20.	Brown-headed Barbet	*Psilopogon zeylanicus*
21.	Coppersmith Barbet	*Psilopogon haemacephalus*
22.	Green Bee-eater	*Merops orientalis*
23.	Indian Roller	*Coracias benghalensis*
24.	White-throated Kingfisher	*Halcyon smyrnensis*
25.	Pied Kingfisher	*Ceryle rudis*
26.	Rose-ringed Parakeet	*Psittacula krameri*
27.	Indian Golden Oriole	*Oriolus kundoo*

28.	Black Drongo	*Dicrurus macrocercus*
29.	Rufous Treepie	*Dendrocitta vagabunda*
30.	House Crow	*Corvus splendens*
31.	Large-billed Crow	*Corvus macrorhynchos*
32.	Purple Sunbird	*Cinnyris asiaticus*
33.	House Sparrow	*Passer domesticus*
34.	Grey Wagtail	*Motacilla cinerea*
35.	White Wagtail	*Motacilla alba*
36.	Common Tailorbird	*Orthotomus sutorius*
37.	Red-vented Bulbul	*Pycnonotus cafer*
38.	Jungle Babbler	*Turdoides striata*
39.	Common Myna	*Acridotheres tristis*
40.	Indian Robin	*Saxicoloides fulicatus*
41.	Oriental Magpie Robin	*Copsychus saularis*
42.	Taiga Flycatcher	*Ficedula albicilla*
43.	Black Redstart	*Phoenicurus ochruros*
44.	Brown Rock Chat	*Oenanthe fusca*
Amphibians		
1.	Indian Green Frog	*Euphlyctis hexadactylus*
2.	Common Toad	*Bufo bufo*
3.	Indian Bullfrog	*Hoplobatrachus tigerinus*
Reptiles		
1.	Oriental Rat Snake	*Ptyas mucosa*
2.	Common Krait	*Bungarus caeruleus*
3.	Indian Garden Lizard	*Calotes versicolor*
Mammals		
1.	Indian Palm Squirrel	*Funambulus palmarum*
2.	Indian Grey Mongoose	*Urva edwardsii*

Key observations

The biodiversity audit of PWC is a continuous process and efforts of the faculty members, researchers, and the students to assess the living biota and its conservation that have been going on for many years. The college authority regularly takes up conservation practices so that anthropogenic impact on the biodiversity components and ecosystems are minimized. The scientific information and existing database are based on various studies as well as research work done by Zoology and Microbiology departments of the PWC. In addition to maintaining a database, different conservation practices have also been applied for a better and sustainable campus ecosystem.

It has been also observed that the college maintains its own nursery to cultivate various other useful medicinal plants and spices. This floral diversity provides a conducive ambience to wide faunal diversity present in the campus. This includes a rich diversity of insects including butterflies, ants, wasps, birds and mammals.

Herbal garden at PWC, maintained by ECO Task force

Interestingly, the PWC has an autonomous body called Environment Conservation Outreach (ECO) taskforce which consists of student volunteers involved in environmental education, protection and conservation awareness. The aim of this group is to inculcate in the students and the communities (rural and urban), an awareness of the environment, its problems and the needs for the protection of Mother Earth. Hence, this group conducts campaigns, awareness drives, and plantation drives on environmentally important days to promote a safe and environmentally sustainable environment for all. Moreover, the college campus has 6.56 acres of area or 22 per cent of the total area under green cover. It was evident that the campus, being located in between the concrete infrastructure, still possesses a significant amount of green cover, that not only makes the campus a carbon sink but also enhances the oxygen exchange within the campus.

Key Suggestions

- **Native seeds :**

  Though the biodiversity audit survey shows a variety of tree and floral diversity, encouraging the sowing of native seeds in the green spaces and promoting wildflower gardens in some patches in the campus can bring in greater diversity and make room for native species.

- **Green Roofing :**

  Transforming concrete roofs into garden spaces and growing indoor plants in the corridors or open spaces. A green roof absorbs rainwater by the water buffering in the plants, substrate and drainage layer. This delays the discharge of rainwater to the sewage system, purifies the rainwater, and water also evaporates through the plants. This all helps to stabilize the groundwater level, reduces the peak load on the sewage system and reduces the risk of flooding.

- **Permeable pavements :**

  Replacing concrete footpaths with permeable pavements or in the possible new areas of expansion. Permeable pavements help re-establish a more natural hydrologic balance and reduce runoff volume by trapping and slowly releasing precipitation into the ground instead of allowing it to flow into storm drains and out to receiving waters as effluent. This same process also reduces the peak rates of discharge by preventing large, fast pulses of precipitation through the stormwater system

4.2.4 Energy Audit

The energy audit is key to a systematic approach for decision making in the area of energy management. It attempts to balance the total energy inputs with its use, and to identify all the energy streams in a facility. The energy audit of PWC was conducted to understand the total energy consumption, the type of electrical appliance and electronics used and potential areas of energy saving using installation of modern technology and energy saving parameters.

Table 4.7: Total consumption of energy across the different buildings in the PWC campus

Type of Buildings	Buildings	kWh/month
Academic Building	Science Block	39185.26
	BCA	4617.984
	MCA block	5564.42
	B.Ed block	3833.048
	M.Ed block	3560.128
	PWC Main building	3369.24
	Community College	1682.652
	Carmel High School	2394.121
	Carmel New building	6784.88
	Carmel convent + Carmel Primary building	5321.06
Residential Building	Carmel convent building	842.738
	Carmel jwala	1038.279
	Veronica Smriti Sadan	10.244
	Avila Convent	1003.416
	Carmel Vikas	1166.007
Commercial Building	PWC Hostel	3369.24
	College Canteen	1322.39
	Monginies	3954.62
	Bank Of Baroda	3000
	BOB ATM	1100

Key observations

The average electricity consumption of each building in a year is 704 kWh. However the data on the average electricity consumption over a period of 5 years shows that the year 2021, recorded the highest amount of average energy consumption (704 kWh) in comparison to 2020 (436 kWh) and 2019 (536 kWh). It might be due to the global COVID surge and state lockdown. Moreover, from the survey of the energy audit, it can been seen that out of all the buildings within the college campus, the Science block has the highest amount of energy consumption (39185 kWh) which is due to the predominance of high energy consuming laboratory appliances (> 2000 Watt) as well as low energy saving (outdated) appliances present within the building. This is also due to a number of heavy appliances like air conditioners and laboratory instruments being non-star rated. Another reason for the high energy consumption in the science block is the presence of outdated wiring with higher resistance. On the other hand, the rest of the buildings in the campus mostly comprises of low (1

watt- 200 watt) to medium (200 watt- 1000 watt) energy consuming appliances like tubelights, fans, CCTV cameras, projector, refrigerator, television, alarm bell etc.

A general comparison between the different types of buildings in the campus shows that the academic buildings within the campus consume greater amounts of energy in comparison to the residential and commercial buildings. However, the wiring of the buildings with high resistance specifically in the science block of the academic buildings makes it the major energy consumption building across the PWC. One of the hypotheses formed is, other buildings/ blocks in the campus are consuming much lower amount energy in comparison to the science block because of their establishment in recent times. The science block being the oldest blocks in the campus (almost 30 years old) has little or no energy efficiency wirings and appliances. On the contrary the remaining buildings, for example the new building in the primary school are all built in the modern times with energy efficient technology and wirings. Moreover, the majority of the appliances fitted in the newly established buildings/blocks are energy efficient, consisting of appliances of star ratings and low energy unit consumption.

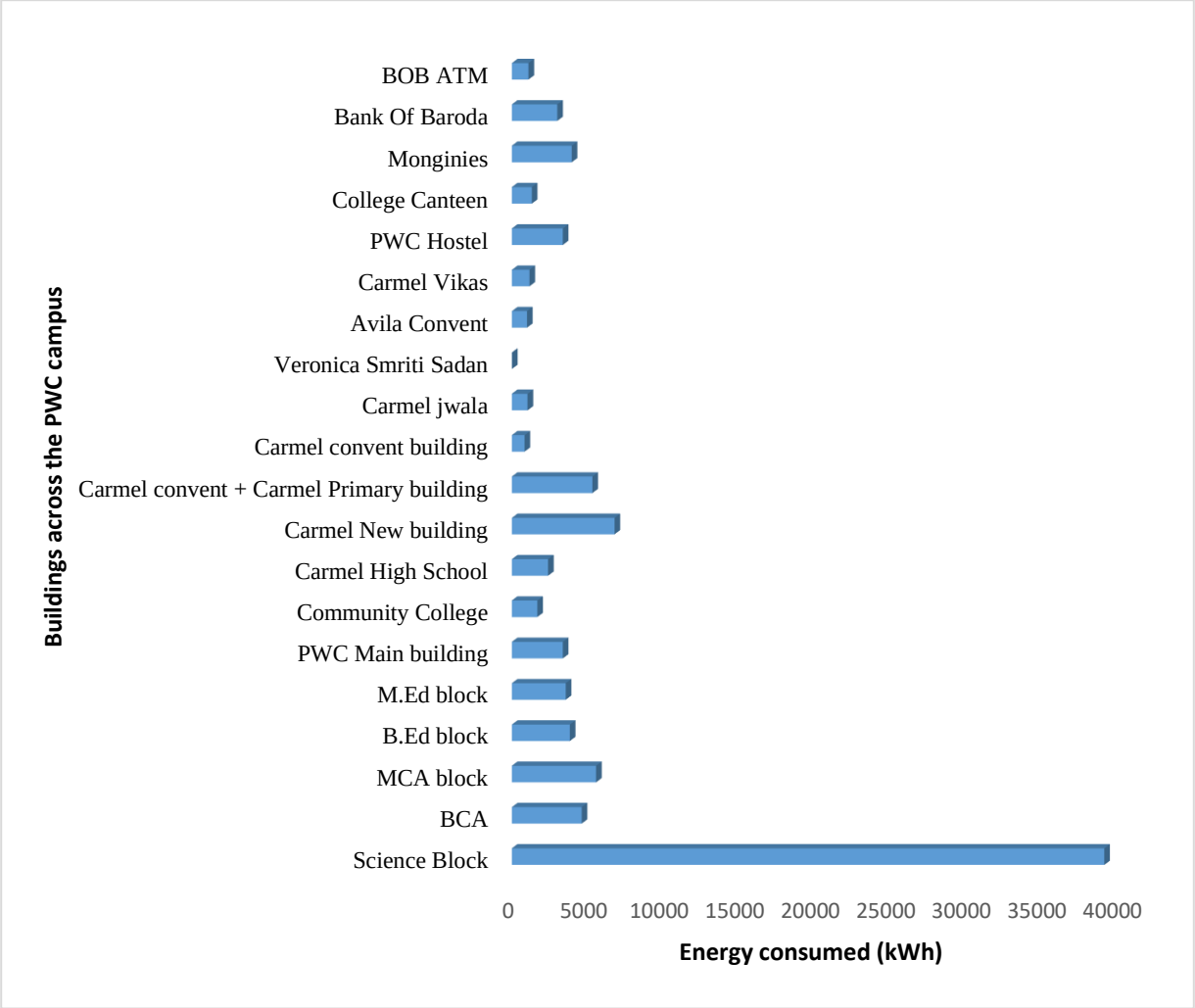


Figure 4.8: Total energy consumption of the different buildings across PWC campus

The energy resources utilized by all the departments, support services and the administrative buildings of PWC campus include electricity supplied by the Patna State Electricity Board and its major use is at the academic buildings, residential buildings and commercial buildings along with all the open areas of the campus. The

PWC has also installed a solar power system, with a capacity of 70 kWh per day covering 7000 sq ft in the two rooftops of Science block and B.Ed block. About 280 kWh at the rate of 7.40 INR is fed back to the grid every year. Majority of the street lights installed in the campus run on solar energy.

The observations from the energy audit survey also highlights a wider variety of energy-saving appliances and devices installed in buildings and rooms constructed less than 5 years ago, whereas the Science block, Main block and few other buildings dating back to 20-30 years have appliances like fans, lights, air conditioners, and other equipment without any energy efficiency.

Key Suggestions

- **Energy Efficient System**

  Substituting the outdated energy inefficient appliances with star rated or energy efficient appliances. For example: replacing the 30 year old fans (>80 watt) with low energy consuming fans (40 watt), and tube lights (36-40watt) with LED lights (9-15 watt). Policy-level decision has to be taken by the College administration to replace all fluorescent, CFL bulbs, sodium bulbs, with LED bulbs or other energy efficient solutions.

- **Rooftop Solar**

  Increasing rooftop solar power generation capacity may substantially reduce the dependency of the grid power. The left out buildings like main building, MCA and BCA block etc. seem to be potential sites of the system installation. Additionally, installation of a centralized solar water heating system in the residential buildings instead of electricity run geysers can cut down upto 60 % of the electricity consumption.

Solar panels installed on the science block roof of PWC

- **Natural Lighting**

  The PWC campus has many areas where lighting is not required at all times. Daylighting or natural lighting minimizes the amount of artificial light and reduces electricity and HVAC (heating, ventilation, and air conditioning) costs. Making use of natural light can save up to 75 percent of the energy used for lighting buildings and reduce cooling costs.

- **Replacing old and thick wirings with thinner high resistance wires** in the buildings that comprise of heavy appliances and consume loads of electrical energy. For example: the wiring of the Science block to be substituted with modern energy efficient wiring in order to bring down the existing energy load.

- **Awareness Campaign**

  Organizing workshops on energy conservation especially on the concept of energy efficient buildings, GRIHA code and others to educate students, faculty and staff from time to time

4.2.3 Review-audit

Review audit is the final step of the green audit process. Based on the gaps and loopholes found from the green audit, a set of recommendations and suggestions for improvements with respect to the environmental audit are made. Post implementation of plausible suggestions, this improvement can be assessed. The step by step process of the review audit has been given in figure 4.8.

The use of water is not limited to kitchens, bathrooms and gardens. On a daily basis, we contribute to the consumption of large quantities of water when buying various products, from the food we eat, paper and cotton to biofuel. This way, we indirectly affect water resources throughout the world. Therefore, by measuring water footprints of PWC, we can get a clear picture of how water is used in the day to day activities at the campus post the implementation of the recommendations during green audit. Hence, the review audit of all the parameters at PWC will be conducted post the implementation of recommendations after a stipulated time gap of two to three months.

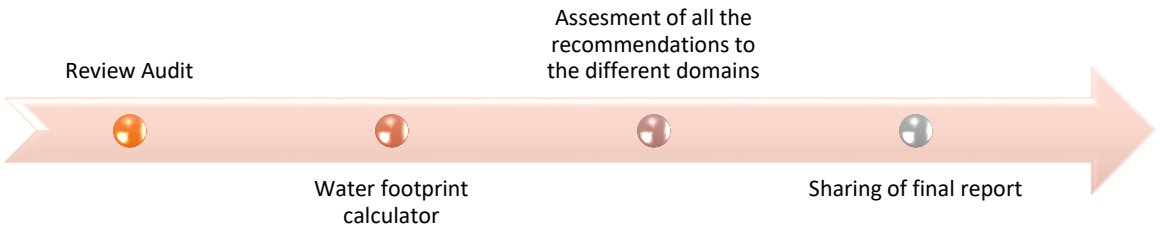
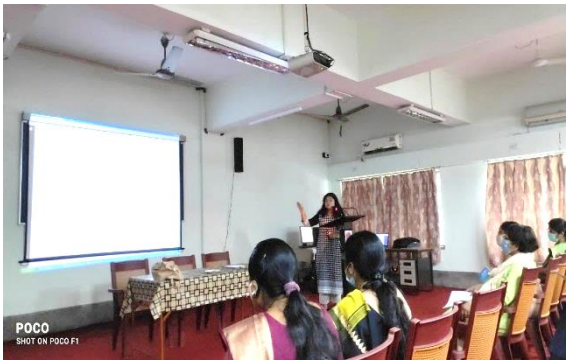


Figure 4.8: The processes of Review audit

ANNEXURES

1. Training and orientation on Green Audit

Orientation on the processes of green audit to Green audit committee members



Training and orientation on the processes of green audit volunteers

Progress review meeting- I with green audit committee members and volunteers

Progress review meeting- II with green audit committee

Progress review meeting- III, with green audit committee members

2. Water Audit (Key observations)

Faucet types in the common washroom

Leaked tap in the science block

Drinking water cooler in the science block

Awareness boards like 'save water' present in the campus

Volunteers of water audit survey

Demonstration of water audit survey to the green audit volunteers

3. Waste Audit (Key observations)

Waste compost pit at for recycling organic waste at PWC

Variety of wastes generated from the gardens in the open areas of PWC

Variety of wastes generated from the classrooms in the academic buildings

Variety of wastes collected in the dustbins outside academic buildings

Coloured dustbins for segregating biodegradable and non-biodegradable waste at PWC

Biomedical or hazardous waste generated from PWC campus

Old paper & files shacked up for discarding

Recycle waste used by fashion department

Housekeeping staff collecting waste from PWC campus

Waste collected from the canteen & Discarded in the incinerator

Demonstration of waste audit survey to the green audit volunteers

4. Energy Audit (Key observations)

Generator for power backup at PWC

Infrastructural amenities in computer lab at PWC

The street lights in the open areas of the campus run on solar energy

Electrical appliances installed in the laboratories in science block

Outdated high wattage electrical appliances in science block

Infrastructural amenities in classrooms at PWC

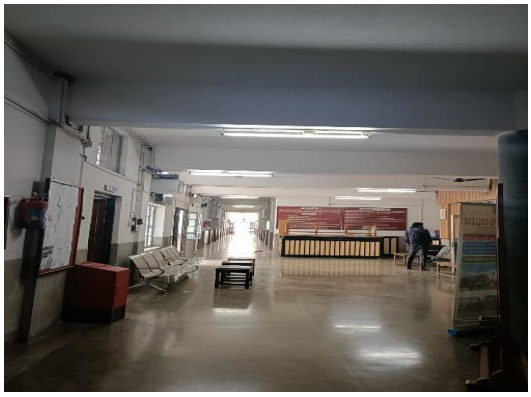
Demonstration of energy audit survey to the green audit volunteers

Solar panels installed on the science block roof of PWC

Star rated electrical appliances installed in the science block

Precautionary boards like 'save energy' present in PWC

Infrastructural amenities in science laboratory of PWC

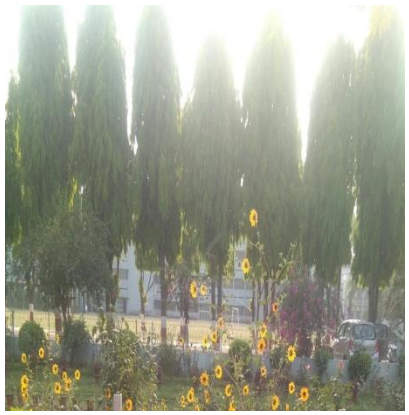


Ground floor corridor of science block at PWC

Volunteers of energy audit survey

5. Biodiversity Audit (Key observations)

Herbal garden at PWC, maintained by ECO Task force group



Flower tree found in PWC campus

Permeable pavements within the PWC campus

Green spaces at PWC

Two ponds at PWC, using recycled water

Incinerator installed in the PWC

Green beds present near every building in the campus

Canopy trees and green cover at PWC

6. Others (Key observations)

Entrance gate of PWC

Construction waste in PWC (Auditorium)

Precautionary boards like 'no parking' and 'no vehicles' present in PWC

Participation certificate to the green audit volunteers

Green Audit Orientation cum Training

Patna Women's College **Date:** 21.10.2021

Sl. no.	Name	Designation	Contact number	Signature
1	Dr. Sister M. Rashmi AC	Principal	9473027965	21.10.21
2.	Sister M. Jemeyae		9934295678	
3	Dr. Shakla Yasmin	Head, Dept of Zoology	9431879974	
4.	Dr. Sista M. Stuti AC.	Assistant Prof. Dept of Zoology	9771663667	
5.	Dr. Neetu	Assistant Professor Deptt of Zoology	9430964260	Neetu 21/10/21
6	Dr. PIYUSH Hr RAI	Assistant Professor Deptt of Botany	9472286987	21/10/21
7.	Dr. Urvashi Sinha	Asst. Prof. Deptt of Botany	7739729529	21/10/21
8.	Dr. Jaya Philip	Head, Dept of Microbiology	7544852759	21.10.21
9.	Mr. Rajeev Ranjan	Asst. Prof. Dept. of Zoology	8210054092	Rajm. 21/10/21
10.	Dr. Sumeet Ranjan	Asst. Prof. Deptt of Zoology	9472122900	21/10/21

Green Audit Orientation cum Training

Patna Women's College **Date:** 22.10.21

Sl. no.	Name	Department	Semester	Contact number	Signature
1.	Prof (Dr). Shakla Yasmin	Zoology		9431879974	Sh.
2.	Dr. Sister M. Stuti AC	Zoology		9771663667	
3.	Dr. Neetu	Zoology		9430964260	Neetu 22/10/21
4.	Mr. Rajeev Ranjan	Zoology		8210054092	Rajm 22/10/21
5.	Dr. Jaya Philip	Microbiology		7544852759	22.10.21
6.	Dr. Urvashi Sinha	Botany.		7739729529	22/10/21
7	Dr. PIYUSH KUMAR RAI	Botany		9472286987	22/10/2021
8.	Dr. Sumeet Ranjan	Zoology/CRL		9472122900	22/10/21
9.	Paden Lepcha	Geography			Paden Lepcha
10.	Ankita Kumari	Zoology (M.Sc)			Ankita
11.	Sakshi	Zoology (B.Sc, Sem IV)		7870547060	

Sl. no.	Name	Department	Semester	Contact number	Signature
12	Andrade Monica	Zoology (M.Sc.)	III	8459085192	Andrade Monica
13	Jacinta Marandi	Hindi	III		Jacinta Mardi
14	Tejamalai Jayashedi. T	History	III		
15	Anjali Priyadarshi	Zoology (B.Sc)	III	85211 73058	Anjali
16.	Anita Kumari	Zoology (B.Sc)	III	9473388378	
17.	Sunita Saren	B. Com (Commerce)	III	8521031727	
18.	Apurva	B.Sc (Zoology)	III	8825368177	Apurva
19.	Sneha Murmu	B.Sc (Zoology)	III	7870297121	Sneha Murmu
20.	Shivangee Muskan	B.Sc (Zoology)	III	8226898977	Shivangee
21	Priya Raj	BSC (Zoology)	III	9771648385	Priya Raj
22.	Khadija Imam	BSc. (ZOOLOGY)	III	7370048637	Khadija
23	Richa Prakash	B.Sc. (ZOOLOGY)	III	9798337131	Richa Prakash
24	NIHARIKA RAJ	B.Sc (ZOOLOGY)	I	8789952787	Adharika Raj

Sl. no.	Name	Department	Semester	Contact number	Signature
25	Ritu	B.Sc Zoology (Hons)	Ist	7726935059	Ritu
26.	Bhavya Kumari	B.Sc. Zoology (Hons)	IIIrd	7909070637	Bhavya
27.	Amisha Kumari	B.Sc. Zoology (Hons.)	I st	7541941141	Amisha Kumari
28.	Navishta Saba	B.Sc Zoology (Hons.)	I st	6202444456	Navishta Saba
29.	Sonal Choubey	B.Sc Zoology (Hons.)	III rd	9508170592	Sonal choubey
30.	Pooja Kumari	B.Sc Zoology (Hons.)	III rd	707303997 7	Pooja Kumari
31	Muskan	B.Sc Zoology (Hons)	III rd	9341800721	Muskan
32	Shambhavi Raj	B.Sc Zoology (Hons)	III rd	7250597084	Shambhavi Raj
33	Nisha Bharti	B.Sc Zoology (Hons)	III rd	9304661625	Bharti
34	Namrata Singh	BSc. Zoology (Hon)	III rd	8292258214	Namrata Singh
35	Jyoti Rani	BSc Zoology (Hon)	III rd	7903736987	Jyoti Rani
36.	Shreya Singh	B.Sc Zoology (Hon)	III rd	7903160384	Shreya Singh
37.	Prity kumari	B.Sc Zoology (Hon)	III rd	6206912886	Prity kumari

Sl. no.	Name	Department	Semester	Contact number	Signature
38	Roshni Kumari	Zoology	II nd	7544909675	Roshni Kumari
39	Bushra Ashraf	Botany	III rd	8757467081	Bushra
40.	Shambhavi Kashyap	Botany	III rd	6207437697	Shambhavi Kashyap
41	Shaina Bhagat	Botany	V th	9608700860	Shaina Bhagat
42	Divya Choudhury	Botany	III rd	8145266922	Divya
43	Lakshmi Kumari	Botany	V th	8789951047	Lakshmi Kumari
44.	Muskan Sinha	Botany	V th	7301340969	Muskan Sinha
45.	Ankita Karan	Botany	V th	8294098344	Ankita
46	Sheetal Puri	Botany	III rd	8507076729	Sheetal Puri
47.	Sadaf Azhar	Botany	III rd	9142574231	Sadaf Azhar
48.	Ramsha Imam	Microbiology	III rd	9708729157	Ramsha Imam
49.	Soumya Verma	Microbiology	III rd	9431871497	Soumya
50.	Sakshi Sinha	Microbiology	III rd	8544368024	Sakshi Sinha

Sl. no.	Name	Department	Semester	Contact number	Signature
51.	DEEP PRABHA	Microbiology dept.	IIIrd	9472902411	Deepprabha
52.	SHILPI KUMARI	Microbiology dept	III rd	6299234452	Shilpi
53.	SHREYA PRABHAKAR	Microbiology dept	III rd	8271947540	Shreya
54.	Kumari Surbhi	BOTANY dept	IIIrd	7004183107	Kumari Surbhi

PRE GREEN AUDIT SURVEY FORM
PATNA WOMEN'S COLLEGE

A. Basic Profile

Particulars	Response /Units
Campus area (acres)	
Built up area (acres	
Building layout	
Utility diagram	
Number of departments	
Number of hostels	
Number of rooms in a hostels	
Number of students living in hostels	
Number of canteens	
Number of commercial offices	
Number of students	
Number of teaching staff (M/F)	
Number of non-teaching staff (M/F)	
Number and type of buses used	
Number and type of cars used	
Number and type of two wheeler used	
Number of cycle used	
Number and type of other modes of transportation	
Average monthly expenses on maintenance of vehicles/electrical and electronics items	

a. Water Audit

Particulars	Response /Units
Sources of water (well/bore well/municial)	
Number of water pumps	
Capacity of overhead/underground water tank (in liters)	
Number of water coolers	
Number of water taps	
Number of bath rooms	

Number of toilet/urinals	
Number of water fountains	
Is there any waste water treatment facility	
Is there any rain water harvesting facility	

b. Energy Audit

Particulars	**Response /Units**
Sources of energy (grid/solar/wind/biogas)	
Average monthly electricity consumption (unit)	
Average monthly electricity bill (Rs.)	
Average monthly LPG cylinder consumption	
Average monthly consumption of petrol/diesel/others (liters)	
Is there any other sources of energy for cooking	
Number of generators	
Number of street lights in your college	

c. Biodiversity Audit

Particulars	**Response /Units**
Area under green cover (acres)	
Number of canopy trees	
Number of fruits trees	
Number of timber trees	
Number of lakes/ponds	

d. Waste Audit

Particulars	**Response /Units**
Type of waste generated	
Average monthly waste generation (Kg)	
Is there any waste treatment system in the college	
Is there any composting unit available? What is the capacity	

Is there any organic bio-composter installed in the campus, what is the capacity	
Is there any sewage treatment plant? What is the capacity (KLD)	
Is there any disposal facility for sanitary waste? What is the capacity	
Is there any waste recycling practice/facility	

GREEN AUDIT SURVEY FORM

SURVEY QUESTIONNAIRE FOR ENERGY AUDIT

(To be filled by domain experts)

PART –A

1. Electricity consumption over a period of 5 years

Year	Average Electricity consumption (kWh)/units consumed
2021	
2020	
2019	
2018	
2017	

2. i) Total Renewable Energy (RE) sources and utilization at Patna Women's College campus

RE sources	**Installation capacity (kWh/year)**	**Energy generated (kWh/year)**	**Power requirements met by RE (kWh/year)**
Ex. Solar			
Ex. Biogas			

ii) Is there a Feed-in-Tariff or equivalent system associated with the grid electricity connection? Yes/No

If yes-

Units of transferred to the grid (kWh/year)	Rate per tariff (INR)

SURVEY QUESTIONNAIRE FOR ENERGY AUDIT

Name of Surveyors- **Date and Time-**

PART – B

3. i) Energy Audit in Commercial Buildings

a. Building name/Department name:
b. Room number:
c. Size of the room (sq. ft.):
d. Number of doors in the room:
e. Number of windows in the room:
f. Rate the sun light in the room:

Un-Satisfactory/Average/Satisfactory

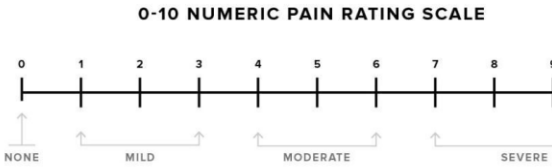
0-4 represents Un-satisfactory

4-6 represents Average

6-10 represents Satisfactory

g. Rate the cross ventilation (wind-flow) in the room:

Un-Satisfactory/Average/Satisfactory



Sr. no.	Name of electrical appliances used	Number	Energy unit (Watt/Liter/Kg/ton)	Star rating (If any)	Usage (hours/day)	Number of operating days in a week

** Add whatever appliances or electrically operated devices observed in the room

4. i) Energy audit in Residential buildings

a. Building name:
b. Room number:
c. Size of the room (sq. ft.):
d. Number of doors in the room:
e. Number of windows in the room:
f. Rate the sun light in the room:
Un-Satisfactory/Average/Satisfactory

0-4 represents Un-satisfactory

4-6 represents Average

6-10 represents Satisfactory

g. Rate the cross ventilation (wind-flow) in the room:
Un-Satisfactory/Average/Satisfactory

Sr. no.	Name of electrical appliances used	Number	Energy unit (Watt/Liter/Kg/ton)	Star rating (If any)	Usage (hours/day)	Number of operating days in a week

5. i) Energy audit in Other Areas of the campus

a. Building/Area name: Ex. College entrance
b. Built-up area-
c. Room number (if any)
d. Size of the room (sq. ft.):
e. Number of doors in the room:
f. Number of windows in the room:
g. Rate the sun light in the room:
Un-Satisfactory/Average/Satisfactory

0-4 represents Un-satisfactory

4-6 represents Average

6-10 represents Satisfactory

h. Rate the cross ventilation (wind-flow) in the room:
Un-Satisfactory/Average/Satisfactory

Sr. no.	Names of electronic appliances used	Energy unit (Watt/Litre/Kg)	Star rating (If any)	Usage (hours/day)	Number of operating days in a week

Reference of Electrical and Electronic Appliances

Energy consumption (in Watts)		Energy consumption by volume (litres /kg/ton)
Tube lights	Wi-Fi router	Water filter
LED Tube light	Sound system	Water purifier
CFL bulb	Induction	Water cooler
LED bulb	Power generator	Microwave
Incandescent light bulbs	Inverter	Refrigerator
Focus lamp	Geyser	Washing machine
Halogen	Electric kettle	Air conditioner
Ceiling Fan	Electric heater	
Table fan	Water heater	
Exhaust fan	Immersion rod	
Air conditioner	Iron	
Air cooler	Mixer grinder	
Computer	Coffee machine	
Battery-powered projector	Vacuum cleaner	
LED projector	Digital clock	
DLP projector	Electric bell	
Laser projector		
CCTV (mention camera model and DVR if any)		
Photocopy machine		
Printer		
FAX machine		
Smart board		
Paper shredder		
Television		

SURVEY QUESTIONNAIRE FOR WASTE AUDIT

(To be filled by domain experts)

PART- A

1. Waste segregation at college

Sr. no.	Types	Yes/No	Sources of segregation	Sources of disposal

2. How much amount is spent monthly on waste disposal?
3. Waste management processes and their capacities

Sr. no.	Waste Management Processes	Capacity (kg/tonnes)	Quantity of Waste managed (kg/tonnes) monthly	By-product use

SURVEY QUESTIONNAIRE FOR WASTE AUDIT

Name of Surveyors- **Date and Time-**

PART- B

4. I) Waste audit at different Commercial Buildings

Name of the building/department: No. of rooms in the building:
No. of washrooms in the building: No. of kitchen/canteen rooms:

Sr. no.	Source of waste generation	Biodegradable waste generated (kg) per day	No. of days biodegradable waste generated in a week	Solid non-biodegradable waste+ Hazardous & chemical waste + Biomedical waste+ E-waste+ Other wastes generated (kg/litre) per week	Waste disposal technique	Types of wastes observed

5. I) Waste audit at different residential buildings

Name of the building/hostel:
No. of rooms in the building:

No. of washrooms in the building:
No. of kitchen/canteen rooms:

Sr. no.	Source of waste generation	Biodegradable waste generated (kg) per day	No. of days biodegradable waste generated in a week	Solid non-biodegradable waste+ Hazardous & chemical waste + Biomedical waste+ E-waste+ Other wastes generated (kg/litre) per week	Waste disposal technique	Types observed

6. I) Waste audit at other areas of the campus

Sr. no.	Source of waste generation	Solid non-biodegradable waste+ Biodegradable waste+ Hazardous & chemical waste + Biomedical waste+ E-waste+ Other wastes generated (kg/litre) per week	Waste disposal technique	Type of wastes observed

SURVEY QUESTIONNAIRE FOR WASTE AUDIT

(To be filled by domain experts)

PART-A

Sources of water	Capacity of water storage tank	How many times water tank refilled in a day

1. **Water conservation practices (if any). If yes, (also attach some photographs)**

Sr. no.	Name the techniques or conservation practices followed in the campus

Survey Questionnaires on Water Audit

Names of the Surveyors- **Date and Time:**

PART-B

2. **(a) Water usage in residential and academic buildings**

Name of the building:
Floor no.:
Number of water users in the building:

Sr. no.	Water outflow	Faucet Count	Avg. rate of discharge (ml/minute)	Average no. of Uses	Average duration of use (minute)	Average quantity per use (litre)
1.	Toilet					
2.	Bathroom					
3.	Kitchen					
4.	Washing machine					
5.	Dishwasher					
6.	Drinking / RO					
7.	Others (if any, please specify)					

2. (a) Water use of Commercial buildings

Sr. no.	Water outflow	Faucet Count	Avg. rate of discharge (ml/minute)	Average no. of Uses	Average duration of use (minute)	Average quantity per use (litre)
1	Toilet					
2	Bathroom					
3	Kitchen					

4	Washing machine					
5	Dishwasher					
6	Drinking / RO					
7	Others (if any, please specify)					
1	Toilet					
2	Bathroom					
3	Kitchen					
4	Washing machine					
5	Dishwasher					
6	Drinking / RO					
7	Others (if any, please specify)					

(b) Water losses of Commercial buildings

i. Name of the building

Sr. no.	Source of leakage	Location of the leakage	Rate of leakage (ml/minute)

2. (a) Water use of Other areas/ buildings

Name of the Area- Average number of water users-	**Sr. no.**	**Water outflow**	**Count**	**Rate of Discharge (ml/minute)**	**No. of uses**	**Average duration of use (minute)**	**Average quantity per use (litre)**
	1	**Taps**					
	2.	**Sprinkler**					
	3.	**Drip**					
	4.	**Fountain**					
	5.	**Others**					

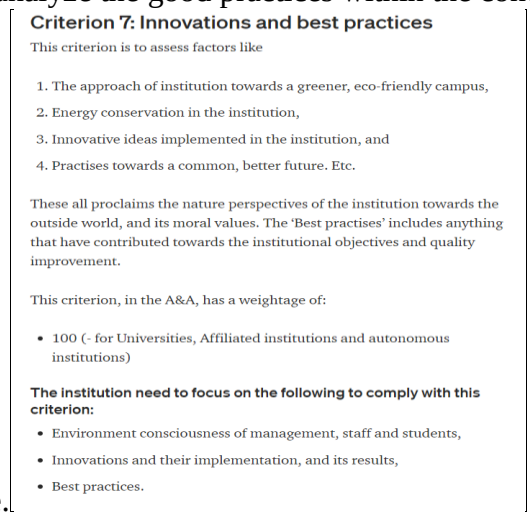
(b) Water losses in other areas/buildings

Sr. no.	**Source of leakage**	**Location of the leakage**	**Rate of leakage (ml/minute)**

Manual provided to Green Audit Volunteers

Green Audit

It is a process of systematic identification, quantification, recording, reporting and analysis of components of environmental diversity of various establishments. It aims to analyze the good practices within the concerned sites, which will have an impact on the eco-friendly ambience.



Criterion 7: Innovations and best practices

This criterion is to assess factors like

1. The approach of institution towards a greener, eco-friendly campus,
2. Energy conservation in the institution,
3. Innovative ideas implemented in the institution, and
4. Practises towards a common, better future. Etc.

These all proclaims the nature perspectives of the institution towards the outside world, and its moral values. The 'Best practises' includes anything that have contributed towards the institutional objectives and quality improvement.

This criterion, in the A&A, has a weightage of:

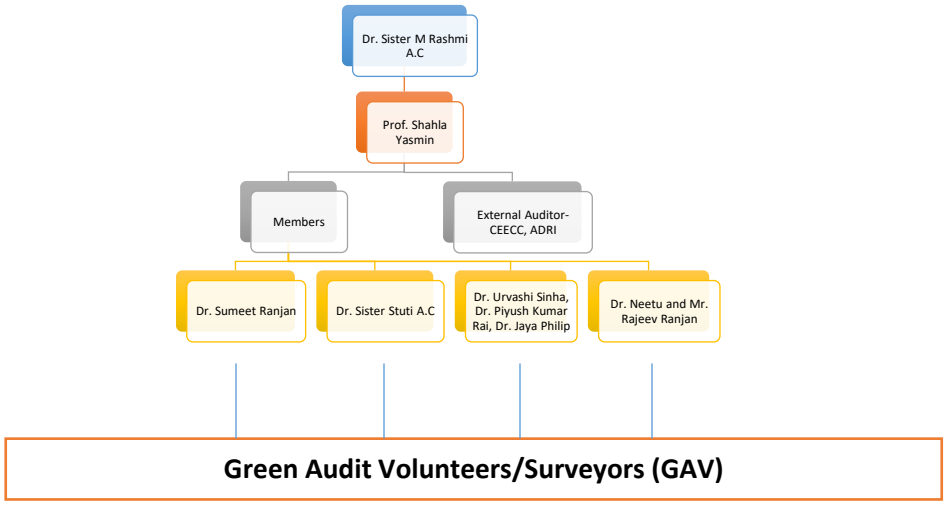
- 100 (- for Universities, Affiliated institutions and autonomous institutions)

The institution need to focus on the following to comply with this criterion:

- Environment consciousness of management, staff and students,
- Innovations and their implementation, and its results,
- Best practices.

- The **National Assessment and Accreditation Council (NAAC),** a government council is responsible to conduct assessments for accreditation of higher educational institutions. **The Green Audit is assigned to criteria 7 of the NAAC evaluation**. The evaluation of the institute's environmental infrastructure includes components like **energy conservation, waste management, water conservation, green campus initiatives** etc.

The Green Audit Committee, Patna Women's College



Things to keep with Volunteers while conducting Survey

1. Survey sheets as per the sectoral audits conducted
2. Pencil, Pen, Eraser and necessary stationary
3. Stopwatch
4. Calculator
5. Testubes and beaker (water audit)
6. Gloves (waste audit)

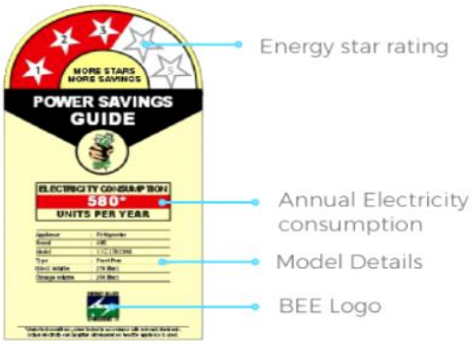
**** COVID precautions of wearing a mask and social distancing should be strictly followed.**

Do's and Don'ts while Green Audit Survey

- All the GAV's should strictly adhere to the discipline and guidelines of the college
- GAV should immediately consult the domain expert (committee member) in case of any confusion or problem
- The GAV should put down their observations exactly without any further analysis or assumptions
- The GAV should write their observations of the audit on the sheets clearly without any scribbling. If there is any unclear handwriting, it can be asked to be redone
- The GAV should keep all the data collection sheets neat and tidy. If sheets are found torn or untidy, it can be asked to be redone
- The GAV's should keep capturing needful pictures (ex: awareness posters, notices) while conducting the survey

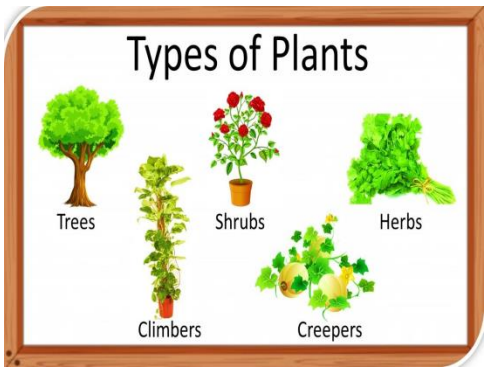
Roles and Responsibilities

References for Energy Audit



References for Waste Audit

References for Biodiversity Audit



Steps to calculate the Average rate of water discharge/flow-

1. Take a 500ml, 1000 ml and 5000 ml measuring cylinder/beaker having graduations on the sides.
2. Clean the measuring cylinder with tap water.
3. Keep ready with the stopwatch and reset it.
4. Keep the opening of measuring cylinder under the water flow and start the stopwatch measuring the water flow for a minute.
5. Take the water level reading by coinciding meniscus by taking care of your eyes are at the same level of the water surface.

6. Note down the reading in liter per minute flow rate and repeat the procedure for all the other water taps/faucets in the room.
7.
8. Add all the flow rates and divide by the total number of taps/faucets in the room. This is the final average flow rate, which has to be put down in the survey table in mililiters.

Steps to calculate the Rate of water leakage

1. Take a 100ml, 500ml, and 1000ml measuring cylinder/beaker having graduations on the sides.
2. Clean the measuring cylinder with tap water.
3. Keep ready with the stopwatch and reset it.
4. Keep the opening of measuring cylinder under the tap/faucet and start the stopwatch measuring the drops of water leaked for a minute.
5. Take the water level reading by coinciding meniscus by taking care of your eyes are at the same level of the water surface.
6. Note down the reading in milliliter per minute on the survey table, which is the final rate of leakage.

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