Green Audit Report

Jain Vishva Bharti Institute

(Deemed University)

Ladnun-341 306

Certificate by the Team of Independent Auditors

This is to certify that the Green Audit Report is based on the verification of the facts pertaining to Green Environmental Management of the Institution, during 1st April, 2018 to 31st July, 2019. Further, this is to place on record that the Questionnaire developed for the said Audit has been well responded by the Institution and responses have been authenticated by the Registrar.

We have complied with the ethical requirements of the Audit and have reported the findings/observations/remarks in objectivity, without any favour/bias/prejudice.

Members of the Audit Team, under the leadership of Prof.(Dr.) Nalin K. Shastree, Head, University Teaching Department of Environmental Sciences and Former Dean, Faculty of Science, Magadh University, Bodhgaya-824 234 put their signatures on this Certificate as under:

Prof.(Dr.) Nalin K. Shastree
Head, Univ. Teaching Dept. of Environmental Sciences,
Former Dean, Faculty of Science,
Magadh University, Bodhgaya
Leader of the Audit Team

Members of the Audit Team

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Dept. of Civil Eng.	Dept. of Mech.Eng.	Dept. of Elec.Eng.	Dept. of Elec. Eng.

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Jain Vishva Bharti Institute

(Deemed-to-be University)

Ladnun-341 306, Rajasthan

Greet Audit Report

The Green auditing of JVBI has been conducted for assessing environmental performance by way of conducting a systematic, documented, periodic, and objective review by entities of facility operations and practices related to meeting environmental wellbeing. Auditing has been used as a management tool comprising of a systematic, documented, periodic and objective evaluation of how well environmental organization, management and equipment are performing with the aim of safeguarding the environment and natural resources in its operations. The audit team has made a systematic examination of the interactions between any operation and its surroundings by including emissions to air; land and water; legal constraints; the effects on the neighbouring community; biodiversity dynamics, landscape and ecology and the public's perception about the University in the local area. It has contained a systematic and strategic approach to the organisation's activities and an objective assessment has been made on the basis of collected observations and evidences.

The JVBI has proactively developed the 'Green Campus' system for environmental conservation and sustainability. There are main three pillars i.e. minimized carbon foot print, positive impact on occupant health and performance and a commitment towards conservation and preservation of the environment and all students, teachers and non-teaching employees demonstrating environmental literacy. The goal is to reduce CO_2 emission, energy and water use, while creating atmosphere where students can learn and be healthy.

The 'Green Audit' has aimed to analyze environmental practices within and outside the University campus, which will have an impact on the eco-friendly ambience. It was initiated with the motive of inspecting the work conducted within the organizations, whose exercises can cause risk to the health of inhabitants and the environment. In addition, this report has also envisaged this exercise as a part of Corporate Social Responsibility of the University towards reduction of global warming through Carbon Footprint reduction measures.

Green audit has focused on exploring the possibilities of developing health consciousness and promoting environmental awareness, values and ethics. It also has kept an eye on the type and volume of waste, which can be used for a recycling project or to improve waste minimization plan and can provide staff and students a better understanding of Green impact on the campus.

OBJECTIVES:

- To map the Geographical Location of the university
- To document the floral and faunal diversity of the university campus
- To witness the meteorological parameters
- To estimate the Energy requirements of the institution
- To assess the Waste disposal system
- To understand dimensions of the ambient environmental condition of air, water and noise of the institution
- To introduce and aware students to real concerns of environment and necessity of its sustainability
- Aspects related to Water, Energy and Waste Management
- Landscaping and Greening the Campus by regular interventions

METHODOLOGY:

The audit methodology has included, preparation and filling up of questionnaire, physical inspection of the campus, observation and review of the documentation, interviewing key persons and data analysis, measurements and recommendations.

Audit exercise has focused on several facets of 'Green Campus' including Water Conservation, Tree Plantation, Waste Management, Paperless Work, Alternative Energy and Mapping of Biodiversity. With this in mind, information in the audit have been collected to evaluate the adequacy of the management control framework of environment sustainability as well as the degree to which the Departments are in compliance with the applicable regulations, policies and standards. It is expected to make an impact on student health and learning institutional operational costs and the environment. The criteria, methods and recommendations used in the audit were based on the identified risks.

The Audit Process:

- The audit questionnaire was informed to auditee.
- The auditee were informed of the date of the audit enabled them to adjust and become used to the concept.
- The audit scope was identified. The auditors were consulted when establishing the scope.
- The audit plan was designed in such a way that it accommodated changes based on information gathered during the audit and effective use of resources.
- Audit team and assignment of responsibility were established.
- The chosen working papers were collected. This facilitated the auditor's investigations on the sites.
- The background information on the facility including the facility' organization, layout and processes, and the relevant regulations and standards, were collected.
- The background information on the site's historical uses, and the location of soil and ground water contamination were collected.

Onsite Audit Activities

The onsite audit of JVBI included:

- The opening meeting is the first step between the audit team and auditee. In this meeting the purpose of audit, the procedure and the time schedule were discussed.
- Site inspection is the second step for onsite activity. In this step the audit team discovered matters which are important to the audit but which were not identified at the planning stage.
- Onsite phase of the audit developed a working understanding of how the facility manages the activities that influence the environment and how any EMS, if there is one, works.
- Assessed strengths and weaknesses of the auditee's management controls and risks associated with their failure were established.
- Gathering audit evidence i.e. collecting data and information using audit protocol.
- Communication with the staff of the auditee to obtain most information.
- Evaluation and validation of the audit evidence against the objectives established for the audit,
- An exit meeting to explain the audit findings.

Control Objective	Control(s)	Audit Observation
WATER MANAGEMENT	Repair sources of water leakage, such as dripping taps.	Regular checking and maintenance of pipelines are done to control water wastage.
	Minimize wastage of water and use of electricity during water filtration process, if used, such as Aquaguard filter.	Yes, the college has aquaguard filters installed in all departments.
	Use an efficient and hygienic water storage mechanism to minimize the loss of water during storage	The college has three (03) tube wells and a pond to ensure emergency water use other than the pump.
	Encourage to decrease excess water usage.	Though water is used nominal in the college, but to ensure a further minimal rate, placards and warnings are set up in the college premise.
	Install water recycling mechanism.	No such mechanism is adopted.
ENERGY MANAGEMENT	Appreciate that it is preferable to purchase electricity from a company that invests in new sources of renewable and carbon-neutral electricity	The college does not have any choice other than WBSEB for electric supply. The college also has 3 ecofriendly generators for the supply of emergency electricity to save our ecosystem.

ENERGY MANAGEMENT	Look in to the possibility of on-site micro-generation of renewable electricity.	The college is planning for increase in use of solar panels.
	Give preference to the most energy efficient and environmentally sound appliances available, this includes only using energy-saving light bulbs	The college is using LED lights as much as practicable.
	Encourage staff, students and conference guests to save energy through visible reminders, incentives and information to increase awareness. This particularly concerns turning off electrical appliances when not in use	Yes, the college has put several posters and reminder notes in classrooms and other relevant places to turn off electric appliances when not in use.
	Monitor and understand the importance of different sources of college energy consumption.	The college tries to put the main switch off when there is no need of electricity.
	Ensures that all electronic and electrical equipments, such as computers, are switched off when not in use and is generally configured in power saving mode when such option is available	It is practiced.
GREEN CAMPUS	Establish a Garden in the campus	College already has a well maintained garden.
	Encourage the faculties and students to plant trees in the garden.	The college celebrates "Bana Mahotsab", an annual tree plantation program in the campus where students and teachers plant trees in the campus.
	Minimize the use of fertilizers and pesticides in college grounds, opting for the use of vermin compost produced on site wherever possible	Moderate amounts of bio-fertilizers are used in the college.
	Ensure that all cleaning products used by college staff have a minimal detrimental impact on the environment, i.e. are biodegradable and non-toxic	Negligible amounts of washing liquids are used in the college and all the toilet cleaners are eco-friendly.
GREEN CAMPUS	Dispose the chemical waste generated from the laboratories in a	Non-toxic chemicals are included in Vidyasagar University practical

	scientific manner	curriculum. Most of the waste generated is water-soluble and ultimately disposed through normal sewage system, diluted largely so biomagnifications is negligent.
WASTE MANAGEMENT	Make full use of all recycling facilities provided by Gram Panchayat and private suppliers, including glass, cans, white coloured and brown paper, batteries, print cartridges, cardboard and furniture.	No, the college doesnot have any such recycling device to carry on the procedure.
	waste, green waste and non-recycled collected from kitchens, gardens, offices and rooms.	compost plant that ensures proper treatment of all organic wastes.
	Recycle or safely dispose of dry wastes, computers and electrical appliances.	All dry wastes (paper, metal, glass, other dry waste, e-waste, etc.)are separated in different bins in the college and resell to the local vendor
	Provide sufficient, accessible and well-publicized collection points for recyclable waste, with responsibility for recycling clearly allocated	The college has set up separate bins to ensure proper segregation and collection of the various wastes. The responsibility of recyclable waste is however still not taken up the college.
	Make specific arrangements for events, such as community events, seminars and conferences in order to both arise consciousness among students and others and also to minimize the waste produced and maximize what is recycled/reused	The college organized several seminar and community program by the departments to ensure both consciousness and awareness among students and community members.
	Dispose all waste, whether solid or otherwise, in a scientific manner and ensure that it is not released directly to the environment	Yes, the college disposes all wastes, whether solid or otherwise, in a scientific manner and ensure that it is not released directly to the environment.

WASTE MANAGEMENT	To recycle and reuse of kitchen wastes (from canteen and hostels) and garden waste	Kitchen wastes and garden wastes commonly are recycled to form nutrient rich quality organic manure for agricultural purpose.
	Ensure use of eco-friendly transport option	About 90% of the students and teaching and non-teaching staffs of the college use bicycle as the main mode of transport. The college also encourages transport by bicycle to students.
	Promote environmental awareness as a part of course work in various curricular areas, independent research projects, and community service	UGC projects on sustainable development/ natural resources. Compulsory ENVS paper of 100 marks in the University Syllabus for all the students of all streams to develop Environmental Awareness (70 MCQ + 30 Project).
	Reduce the rate at which the College contributes to	College does not directly or indirectly
	the depletion and degradation of natural resources	participate in depletion and degradation of natural resources.
	Create awareness of environmental sustainability and takes actions to ensure environmental sustainability.	Seminars and awareness programmes are conducted periodically on nature and natural resources.
	Review architecture of existing buildings and reviews ways, in consultation with experts, to reduce usage of energy for such buildings, offering greatest efficiency for energy and water usage.	New constructions are in compliance with green standard.
	Conduct environmental awareness posters and seminars as a part of the programme.	Yes, the college places several posters and placards in the campus to ensure that environmental awareness is conducted. Also, seminars are organized on environmental theme in the college.

Carbon Footprint

Carbon footprint is historically defined as the total set of greenhouse gas emissions caused by an individual, event, organization or product, expressed as carbon dioxide equivalent.

Data collected from the following sources were taken into consideration to calculate carbon footprint emission and reduction. The floristic richness of the campus – total number of plants, trees, shrubs – was estimated. The impact of alternate green energy production and consumption to reduce fossil fuel-based energy was assessed, e.g. the number of CFL/ LED, tube lights and electronic chokes was counted. The Carbon Footprint Calculator was used to arrive at conclusions.

Carbon Footprint Calculator enabled the measurement of carbon emission by the Institution. Besides, by breaking down the value to key 'carbon drivers', the audit team could assess the magnitude of carbon footprint arising from various sources like high power-consuming incandescent bulbs vs. LED lights, solid waste management, etc.

Carbon Audit Tools and Analysis

The Carbon Audit tools and analysis methodology were developed collectively by the Green Audit Team and based on that the audit was conducted in three major thematic areas.

Flora and carbon footprint reduction

JVBI is spread in about 75 acres of land in the heart of the small city of Ladnun (District-Nagaur) in the State of Rajasthan. The details of the built-up area are as under:

Total Area	75 Acres
Total plinth area of Academic & Admin Blocks	2.53 lakhs Sq. Ft.
Total class rooms	56
Smart class rooms	20
Academic block	14
Administrative block	06
Education block	12
Constituent block	24

There are Eleven Gardens on the university campus; details of which are as under:

Garden No. 1: Sundar Vatika

Size : 275' x 187'
Bighan Bell - 58
Tikkum - 37
Kanher - 16
Neem - 01
Saresh - 01
Jaal-01
Grass - Full Area

Garden No. 2: Acharya Tulsi Smark

Size : 450' x 150'
Bighan Bell - 36
Tikkum - 06
Kanher - 18
Neem - 27
Saresh - 01
Karanj-09
Khajoor-01
Guddel-05
Pipal-02
Grass - Partly

Garden No. 3: Kamdhenu

Size : 454' x 211'
Bighan Bell - 19
Tikkum - 03
Kanher - 20
Neem - 46
Guddel-03
Gulmohar-01
Khejari-01
Safeda-01
Kandel-04
Grass - Partly

Garden No. 4: Aamla Garden

Size : 246' x 150'
Aamla Bell - 126
Neem - 02
Khejari-06
Peepal-04
Aadoo-01
Karanj-01

Garden No. 5(i) : Subham Samwad

Size : 182' x 48'
Neem - 12
Safeda-01
Kanher-01
Innari - Full Round

Garden No. 5(ii) : Subham Samwad

Size : 65' x 48'
Neem - 03
Saresh-01
Kanher-05
Gudhel-01
Innari - Full Round

Garden No. 5(iii) : Subham Samwad

Size : 65' x 48'

Neem - 10

Imali-01

Innari - Full Round

Garden No. 5(iv) : Subham Samwad

Size : 50' x 40'
Neem - 06
Saresh-01
Emali-01
Innari - Full Round

Garden No. 6 : Nehru Park

Size : 198´ x 115´
Neem - 31
Safeda-04
Saresh-03
Jall-01
Karanj-12
Kanher-17
Guddel-01
Khejari-01
Tikkam-01

Garden No. 7 : Chordia Garden

Size : 122´ x 109´
Neem - 04
Fikers-04
Bigganbelia-22
Tikam-01
Kanher-04
Grass-Full
Innari-Full

Garden No. 8 : Arham Vatika

Size : 136´ x 65´
Neem - 10
Ashoka-02
Fikers-01
Bigganbelia-04
Annar-01
Grass-Full
Innari-Full

Garden No. 9 : AKKM-B.Ed.

Size : 154 x 65´
Neem - 01
Kanher-07
Guddel-08
Bigganbelia-05
Tikkam-02
Aadoo-02
Gulmohar-02
Innari-Full

Garden No. 10: Garden on Entrance

Size : 230´ x 75´
Neem - 09
Guddel-02
Aadoo-01
Sheesham-03
Fikes-02
Aamla-01
Amrood-01
Kanher-15
Tikkam-03
Saresh-02
Jamun-01
Steppho-04
Neemboo-03

Garden No. 11 (i) : Near Main Gate

Size : 84´ x 52´
Neem - 06
Kanher-04
Innari

Garden No. 11 (ii) : Near Main Gate

Size : 84´ x 52´
Neem - 03
Kanher-10
Khejari-03
Innari

Garden No. 11 (iii) : Near Main Gate

Size : 84´ x 52´
Neem - 03
Tikam-01
Mor Pankhi-01
Kanher-02
Innari

Garden No. 11 (iv) : Near Main Gate

Size : 76´ x 57´
Neem - 02
Saresh-05
Tikam-02
Guddel-02
Kanher-02
Innari

In addition, there are avenue trees, shrubs and herbs spread all over the campus, which make the campus green. Altogether there are 125 families, 450 genera and 670 species of trees, shrubs, herbs (including potted plants) and climbers in the campus. Details of common trees are as follows:

Table-1 : List of Prominent Trees in the JVBI Campus

S.No	Name of the Plant Species	Number	Family	Common Name
1	Samania saman Merr	4	Fabaceae	Rain Tree
2	Caesalpinia pulcherrima	15	Fabaceae	Peacock Flower
3	Borassus flabellifer	1	Arecaceae	Tall Palm (wine palm)
4	Cassia fistula	4	Fabaceae	Golden Rain Tree
5	Tectona grandis	22	Lamiaceae	Teak
6	Gmelina arborea	1	Verbenaceae	Gomari
7	Mangifera indica	8	Anacardiaceae	Mango
8	Anacardium accidentale L.	2	Anacardiaceae	Kaju Badam
9	Mimusops elengi	40	Sapotaceae	Bakul
10	Cocos nucifera	10	Arecaceae	Coconut
11	Phoenix sylvestris	29	Arecaceae	Silver Date Palm
12	Ficus benghalensis	6	Moraceae	Banyan Tree
13	Azadirachta indica	15	Meliaceae	Neem
14	Calliandra haematocephala	2	Fabaceae	Powder puff flower tree
15	Eucalyptus sp.	1	Myrtaceae	Gums trees
16	Phyllanthus emblica	6	Phyllanthaceae	Amlakhi(Indian gooseberry
17	Artocarpus heterophyllus	6	Moraceae	Jackfruit
18	Areca catacheau	2	Arecaceae	Beetle nut
19	Zizyphus jujube	6	Rhamnaceae	Bogori(Chinese date)
20	Syzygium cumini	2	Myrtaceae	Jamun tree
21	Psidium guajava	1	Myrtaceae	guava
22	Albizia lebbek	8	Fabaceae	women's tongue tree
23	Terminalia chebula	2	Combretaceae	Xilikha(Haritaki)
24	Olea europaea	1	Oleaceae	Olive
25	Citrus maxima	1	Rutaceae	Pomello(Robab tenga)
26	Litchi chinensis	1	Sapindaceae	Litchi
27	Lagerstroeni speciosa	19	Lythraceae	Ajar Tree
28	Mesua ferrea	4	Calophyllaceae	Nahar
29	Grevillea robusta	5	Proteaceae	Silver Oak
30	Cycas revoluta	1	Cycadaceae	Japanese sago palm

31	Callistemon sp.	2	Myrtaceae	Bottle Brush Tree
32	Alstonia scholaris	6	Apocynaceae	Devil tree
33	Neolamarckia cadamba	2	Rubiaceae	Kadam
34	Michelia champaca	2	Magnoliaceae	Tetachapa
35	Averrhoa carambola	1	Oxalidaceae	Star fruit
36	Dalbergia sissoo	2	Fabaceae	sisu
37	Tamarindus indica	1	Fabaceae	Tamarind
38	Polyalthia longifolia	4	Annonaceae	Ashoka Tree
39	Delonix regia	14	Fabaceae	Krishnachura (Flame Tree)
40	Butea monosperma	6	Fabaceae	Bastard Teak
41	Terminalia arjuna	2	Combretaceae	Arjun
42	Aegle marmelos	1	Rutaceae	bael
43	Calotropis gigantea	1	Apocynaceae	Madar
44	Bombax ceiba	1	Malvaceae	Red cotton Tree
45	Sapthodea campanulata	4	Bignoniaceae	Fountain Tree
46	Cedrus atlantica	1	Pinaceae	Atlas
47	Jacaranda mimosifolia	1	Bignoniaceae	Fern Tree
48	Pterospermom acerifolium	1	Sterculiaceae	Hatipolia (Dinner-plate Tree)

165 species of trees, 109 species of shrubs, 306 species of herbs and 90 species of climbers (including creepers) have been observed.

About 560 to 700 fully grown trees shall be raised in 1 acre of land. This depends on the type of soil, the species/family of the tree and the spacing. However, with the normal spacing of 6 × 10 feet, the total number of trees shall be taken up as 600/acre. The audit team members have counted the number of plants: full-grown trees (above 10 years), semi-grown trees (below 10 years), shrubs and lawn (sq.ft. area).

The Table-2 illustrates these figures:

S.No.	Particulars of Flora	Number/area
1	Full-grown trees	957
2	Semi-grown trees	667
3	Bushes (including floriculture plants)	422
4	Lawn	60,000 sq.ft.

Most dominant on the campus is Peacock. In addition, some birds arrive as guests and enjoy the greenery. Details of faunal diversity have been presented in the Table-3:

FAUNAL GROUP	SCIENTIFIC NAMES
SPIDERS	Myrmachne orientalis (Family Salticidae); Nephila plipes (Family-Nephilidae); Heteropoda sp (Family-Sparassidae); Phintella vitatta (Family Salticidae)
MOTHS & BUTTERFLIES	Antheria assmensis;Bombyx mori;Philosamia ricini; Junonia atlites atlites; Commander (Moduza procris procris);Ethope himachala; Melanitis leda leda ; Paltoporia paraka paraka; Ypthima baldus ; Acraea terpsicore ; Elymnias hypermnestra undularis ; Mycalesis perseus blasius ; Tanaecia lepidea lepidae ;Euploea core core
OTHER INSECTS	Apis indica; Apis dorsata; Apis florae, Crocothemis erythraea (Scarlet dragonfly); Pantala flavescens (wandering glider)
AMPHIBIANS	Duttaphrynus melanostictus (Assian common toad), Leptobrachium smithi; Fejervarya pierrei; Hoplobatrachus tigerinus; Hylarana tytleri; Humerana humeralis; Hylarana leptoglossa; Polypedates leucomystax.
REPTILES	Calotes versicolor; Hemidactylus frenatus; Hemidactylus brookii; Hemidactylus platyurus; Hemidactylus flaviviridis; Gekko gecko; Eutropis multifasciata; H. Sphenomorphus maculates,Enhydris enhydris; Xenochrophis schnurrenbergeri; Xenochrophis cerasogaster; Rhabdophis subminiatus; Amphiesma stolatum; Chrysopelea ornate
BIRDS	Acridotheres tristis (Common myna); Streptopelia orientalis (Oriental Turtle Dove); Athene noctua (little owl); Pycnonotus cafer (Red-vented Bulbul)
MAMMALS	Macaca mulatta (The rhesus macaque); Sciurus carolinensis (Eastern gray squirrel); Pteropus giganteus (The Indian flying fox)

Tools Used to Measure Carbon Absorption:

Assumptions:

- Number of mature trees in 1 acre = 700
- Carbon absorption capacity of 700 trees is equivalent to carbon emitted by a speeding car for 26,000 miles
- 3. 26,000 miles = 41,843 km
- Average kilometres covered by a car per liter of fossil fuel is 20 km
- Total quantity of fossil fuel consumed by the car (41,843/20) = 2092 litres

- The carbon emitted by a car due to consumption of 1 litre of fossil fuel is 2.3 kg CO_2. At this rate the total quantity of carbon emitted by 2092 litres of petrol (2092 × 2.3 kg) = 4812 kg CO2 or 4.8 tonnes of CO_2. Therefore, the carbon absorption of one full-grown tree is 4812/700 = 6.8 kg CO_2.
- The footprint calculation is based on the standard unit of 1 litre fossil fuel = 2.3 kg CO_2
- Carbon absorption by flora in the Institution
- Carbon absorption capacity of one full-grown tree = 6.8 kg CO_2.
- Therefore, the carbon absorption capacity of 957 full-grown trees in the campus of the Institution (957 × 6.8 kg CO_2) = 6507.6 kg or 6.51 tonnes of CO_2.
- The carbon absorption capacity of 667 semi-grown trees is 50% of that of full-grown trees. Hence, the carbon absorption (667 × 3.4 kg CO_2) = 2,267.8 kg or
- 2.2 tones of CO_2.

There are 4420 bushes of various species being raised in the gardens of the Institution. Carbon absorption of bush plants varies widely according to the species. Certain bushes absorb as high as 49,000 g CO2 per plant, whereas some others absorb as low as 150 g CO2 per plant. The per-plant carbon absorption was assumed to be 200 g in the light of information contained in literature and also in consultation with knowledge workers in the domain of environmental science. Based on this, the total carbon absorption of 4420 plants was calculated to be 4420 × 200 g = 8,84,000 g or 884 kg or 0.9 tonnes of CO2.
The University also maintains the lawns of the College. Buffalo variegated grass, Mexican grass and indigenous grass species have been raised and maintained in the lawn. The total area of the lawn is 60,000 sq.ft. The carbon absorption capacity of a 10-sq.ft. area of lawn is 1 g CO2. Hence, 60,000 sq.ft. of lawn absorbs 6,000 g or 6 kg CO2 per day. At this rate, the total carbon absorption per year (6 kg × 365) = 2,190 kg or 2.2 tonnes per year.

The grand total of carbon absorption by the flora in the campus of the JVBI is (1+ 2+ 3+ 4) = 10.99 or 11 tonnes.

This is the sink effect of the flora in the campus.

Tool used to measure oxygen emission by flora in the campus

The audit team has taken into consideration the observation of Arbor Day Foundation, which states that a mature leafy tree produces as much oxygen in a season as 10 people inhale in a year. A person breathes 7 or 8 litres of air per minute. Air is about 20% oxygen. But the exhaled air has about 15% oxygen, and hence the net consumption is about 5%. Therefore, a person uses about 550 litres of pure oxygen each day.

Calculation of Oxygen Emission by Flora

The number of litres in 1 kilogram depends on the density of the substance being measured. Litre is a unit of volume, and kilogram a unit of mass. Litres and kilograms are approximately equivalent when the substance measured has a density of close to 1 kilogram per litre.

On an average, one full-grown tree produces nearly 260 pounds or 117.6 kg of oxygen each year. Two mature trees can provide enough oxygen for a family of four.
Total oxygen emitted by 957 full-grown trees per year (117.6 kg × 957) = 1,12,543.2 kg or 112.543 tonnes.

Total oxygen emitted by semi-grown trees (58.8 kg × 667) = 39,219.6 kg or 39.2 tonnes (oxygen emission is 50% of that of the full-grown tree).
Total oxygen emitted by 4420 bushes is calculated based on the following oxygen-inhaling requirement per person per day. A normal human being requires 550 litres of oxygen per day. 400 bushes produce enough oxygen per day to enable a person to breathe adequate quantity of oxygen of 550 litres. Total quantum of oxygen produced by 400 plants per day is 550 litres of oxygen.

Taking 400 plants as one unit, the number of units of bushes in the campus (4420/400) = 11.

Total quantity of oxygen produced by 11 units is (11 × 550 litres) = 6050 litres of oxygen per day.

The annual production of oxygen at this rate (6050 × 365) = 22,08,250 litres or kg of oxygen, which is approximately 2208 tonnes of oxygen.

Lawn is an incredible oxygen-making machine. A 25-sq.ft. area will supply enough oxygen to support one person for a day. The total area of lawn in the campus is 6000 sq.ft. In units, the value has been assumed as (6000/25) = 240 units, which would produce (240 × 55 litres of oxygen) = 13,200 litres of oxygen per day. Total quantity of oxygen produced by the 6000 sq.ft. of lawn per year has been estimated as 13,200 litres/day × 365 = 48,18000 litres of oxygen.

Carbon Footprint Reduction Table Carbon Dioxide Absorption:

Sl. No.	Flora	Quantity of CO_2 (tones)
1.	957 full-grown trees	6.5
2.	667 semi-grown trees	2.2
3.	4420 bushes	0.9
4.	6000 sq.ft. of lawn	2.2
	Total	**11.8**

Oxygen Emission by Flora

Sl. No.	Flora	Quantity of O_2 (tonnes)
1	957 full-grown trees	112.5
2	667 semi-grown trees	39.2
3	4420 bushes	2208
4	60,000 sq.ft. of lawn	48,1,800
	Total	**4,84,159.7**

Energy-saving Measures and Carbon Footprint Reduction:

The Energy Audit Report of the College during the period 201has 8-19 revealed that the total consumption of electricity was 1,88,775 units. This includes air conditioners which consume about 20% of electricity.

One unit equals 1000 watts (1 kW hr). It requires 0.538 kg or approximately ½ kg of coal to produce 1 unit of electricity.

The total quantity of coal required to produce 1,88,775 units of electricity (1,88,775 × 0.538 kg coal) = 1,01,560.9 kg or 101.6 tonnes.

CO2 Emission by Coal : A Vital Information for Reference

One kilogram of coal emits 2.86 kg of CO2, thereby increasing the carbon footprint which in turn contributes to global warming.

Therefore, 101.6 tonnes of coal consumed indirectly by the Institution through consumption of 1,88,775 units of electricity led to the emission of (1,01,561 kg of coal × 2.86 kg CO2) 2,90,464.5 kg or 290.5 tonnes of CO2 into the atmosphere.

JVBI administration is conscious of this damage to the environment and has been implementing various programs/activities to reduce energy consumption on the one hand and increase green energy sources on the other.

They are replacing high energy-consuming lighting system with energy-efficient lighting systems and are planning of installing a 540-kW pilot solar PV power system through placing 10 solar panels.

Dimensions of Carbon reduction through the above measures

1. Installing Energy-efficient Lighting System

The Institution has reduced CO2 emissions indirectly by replacing high energy-consuming electric bulbs with energy-efficient CFL lighting systems. To understand the carbon emission reduction, it is appropriate to compare the units of electricity consumed between incandescent lamps and CFL.

The following table illustrates this:

S.No.	Contents	Value
1	Total no. of incandescent lamps used earlier	250
2	Average energy consumption by an incandescent lamp	60 W
3	Energy consumed by 250 lamps for 5 hr/day	75 kW hr or 75 units
4	Energy consumption of 250 lamps for 300 days/year	22,500 kW hr or 22,500 units
250 incandescent lamps are replaced with 250 CFL		
5	Energy consumed by 250 CFL for 5 hr/day	25 kW hr or 25 units
6	Energy consumption of 250 CFL for 300 days/year	7,500 kW hr or 7,500 units
7	Energy saved by CFL for 5 hr/day	50 kW hr
8	Energy saved by CFL for 300 days/year	15,000 kW hr or 15,000 units

Carbon Footprint Reduction Analysis

Incandescent bulb consumes 90 units of energy; 1 CFL bulb consumes 30 units of energy.

First, it is appropriate to analyse the carbon emission due to consumption of 22,500 units of electricity by 250 incandescent lamps per year. The standard tool of analysis employed in this Green Audit is coal equivalent of electricity.

0.538 kg of coal is required to produce 1 unit of electricity.
Total units of electricity consumed by 250 incandescent lamps = 22,500 units

Coal equivalent of 22,500 units (22,500 × 0.538 kg coal) = 12,105 kg or 12.1 tonnes.

1 kg coal emits 2.86 kg CO2 into the atmosphere.

At this rate, 12,105 kg coal emits (12,105 × 2.86) = 34,620.3 kg or 34.6 tonnes of CO2.

The following are the CO2 reduction measures adopted in the Institution.

CFL

250 incandescent lamps which consume 7,500 units of electricity were replaced with 250 CFL. At this rate the coal equivalent (7,500 × 0.538 kg) = 4,035 kg or 4 tonnes.

CO2 emission by 4,035 kg coal (4,035 kg × 2.86) = 11,540 kg or 11.5 tonnes. Carbon emission reduction achieved through use of CFL bulbs (34.6 – 11.5) = 23.1 tonnes.

The positive impact of energy efficiency in this section on Carbon Footprint is
23.1 tonnes of CO2.

LED lamps in the campus

The Institution has installed 60 LED tube lights in the College campus. The power consumption and carbon footprint reduction are discussed below.

Computation details for energy consumption

A 100-W bulb left on for 10 hr consumes 100 × 10 = 1000 W hr, i.e. 1 kW hr, which is 1 unit. Similarly, a 10-W bulb left on for 100 hr leads to the consumption of 1 unit of electricity. The Institution procured 18-W bulbs numbering 60, which had been fixed in the renovated campus.

Average power consumption analysis

Assumption

On average, a bulb is on for 5 hours per day. The bulbs burn for 300 days a year. The remaining 65 days are considered holidays.

Based on the above information, the total units of power consumed by 60 LED bulbs for

1 year at the rate of 5 hours per day is

Watt rating of bulb × unit hour × quantity of bulbs × No. of days = Total units or kW hr.

18 W × 5 hr × 60 × 300 = 16,20,000 W, which is 1,620 units of electricity.

It is appropriate here to calculate the quantity of coal required to generate 1,620 units of electricity.

0.538 kg coal is required to produce 1 unit of electricity. Hence, the total quantity of coal required to produce 1,620 units of electricity is 1,620 ×0.538 kg =
871.56 kg.

Carbon reduction through this measure is based on the calculation that 1 kg coal emits 2.86 kg of CO2.

Hence CO2 emitted by 871.5 kg of coal (871.5 × 2.86) = 2,492.5 kg.

The real carbon reduction value can be assessed if the energy consumption of 60 LED lights is compared with that of 60 incandescent bulbs. One incandescent bulb consumes 90 units of electricity. Therefore, 60 bulbs consume 5,400 units.

But 60 LED bulbs consume only 1,620 units of electricity. Replacement value in favour of carbon emission is (5,400 – 1,620) = 3,780 units of electricity.

Coal required for generating 3,780 units of electricity (3,780 × 0.538 kg) = 2,033.6 kg.

Based on the calculation that 1 kg coal emits 2.86 kg CO2, the total quantity of CO2 emitted by 2,033.6 kg coal (2,033.6 × 2.86) = 5,816 kg or 5.8 tonnes.

Carbon footprint reduction through installation of 60 LED lamps per year is 5,816 kg or 5.8 tonnes of CO2.

Solar Energy

Solar energy is the most feasible and viable green energy available around the globe. Its viability is very high in tropical countries like India.

Ten solar panels, each measuring 4 × 3 ft, have been installed on the terrace of the college building where light intensity is very high. Each panel produces 180 W of electricity. However, the panels will function effectively only for about 10 months per year (300 days). Monsoon and clouds prevent sun’s rays for more than 2 months. At this

rate, the 10 panels produce electricity to the tune of 180 W × 10 × 300 days = 5,40,000 W, which is equivalent to 540 units of electricity per year. This solar power PV power system is connected to the college grid via a solar string inverter. The 540- kW power generated per year from this solar panel, the coal equivalent (540 × 0.538)
= 290 kg coal. The CO2 equivalent is 290 × 2.86 = 829 kg.

The following table illustrates the quantity of CO2 reduced through various measures

Sl. No.	Carbon Reduction Measures	CO_2 Reduction in Tonnes
1	CFL	23.1
2	LED lamps	3.8
3	Solar energy	0.8
	Total	**27.7**

II. Water Audit

Conservation of rain water through rainwater harvesting system is practised by the college management. The total open terrace area of the buildings amounts to 1,00,000 sq.ft.

Rainfall Calculator

A 10-sq.ft. area receives approximately 1 litre of water, if the rainfall is 1 mm. The average rainfall per year is 1,200 mm in the district. Hence, the total volume of water received on the 1,00,000 sq.ft. area of the terrace (1,200 mm × 1,00,000 sq.ft.) = 12,00,00,000 litres per year. If this is converted into metric tonnes, it is 1,20,000 metric tonnes.

At present the rain water is channelized through a PVC pipe drainage system to the ground water table directly. Only 10% of the water is channelized to the freshwater fish tank which houses 12 varieties of fish. The remaining water not only recharges the groundwater table but also provides adequate water to the flora in the campus during the summer season.

III. Solid Waste Management

Waste Management

The colour coded bins for different wastes are placed at different locations of the campus for collection of waste and its easy sorting at source.

Biodegradable wastes: The biodegradable wastes generated from mess kitchen, canteen and plant litters were collected and used for composting. The paper wastes especially the cardboards are generally sold to the recyclers. In order to reduce the paper consumption and paper waste generation the University follows double sided printing on papers for official purposes.

Hazardous waste: The biomedical wastes generated in the research laboratories were collected in biohazard bags in separate bins. This waste was collected regularly by Medicare Environment Management Agency. The different chemical bottles are labeled properly, grouped as per its hazardous nature, placed appropriately in the laboratories. The unused chemicals are kept with unbroken caps with great care. Chemical wastes and e- wastes are discarded following standard measures prescribed for safe disposal. All the science laboratories are installed with fire extinguishers for emergency.

Management of solid waste has been an important driver in Green Audit. Solid waste not properly managed leads to the degradation of the environment which, in turn, affects the flora and fauna. Keeping this in mind, the College has been strictly implementing scientific solid waste management to maintain the green status of the campus.

Small buckets numbering 120 have been kept in various places of the campus so that students shall deposit the solid waste in the buckets. Apart from that, three tanks with dimensions of 15 × 4 × 3 ft. have been constructed to collect compostable and non-compostable solid waste throughout the year. The volume of each tank is 80 litres. The quantity of compostable solid waste collected per year is 4,500 kg or 4.5 tonnes and that of non-compostable waste is 900 kg.

Apart from that the college canteen produces 5 kg of compostable and 2 kg of non-compostable waste per day. The 800 kg of vermicompost contributes to the reduction in carbon footprint if the coal equivalent to produce 800 kg of chemical- based fertilizer is calculated along with CO2 emission.

IV. Transport System

Emission of CO2 through transport system – both public and private – is very high in India as India is credited with the third rank in carbon emission in this regard. It is estimated that in India, 9% of the total carbon is emitted by the transport system.
The university owns two buses to bring girl students from the villages and small towns. There are three vehicles owned by the University and three faculty members also own their private cars. Other employees prefer public transport and also bicycles. Information on the usage of public transport and bicycles is as follows:

Public Transport used by the Staff Members			
S.No.	Name	From	By
1.	Miss Pragati Jain	Sujangarh	Bus
2.	Mrs Sunita Indoria	Sujangarh	Bus
3.	Dr Vikash Sharma	Sikar	Bus
4.	Miss Rajshree Sharma	Ratangarh	Train
5.	Sh. Madan Singh	Shyampura-Balsamand	Train
6.	Sh. Om Prakash	Sarothiya	Bus
7.	Sh. S.L. Mishra	Sujangarh	Bus
8.	Sh. Surja Ram	Kasumbi	Bus

Bicycle used by the Staff Members	
S.No.	Name
1.	Sh. Til Kumar
2.	Sh. Kishan Lal Tak
3.	Sh. Sunil Kumar Singh
4.	Sh. Chhatish Rai
5.	Sh. Dinesh Kumar Sharma
6.	Sh. Munna Lal
7.	Sh. Dil Raj Singh
8.	Sh. Bahadur Singh

Some members of the student community and teaching faculty members of the college are also using two wheelers driven by the energy of fossil fuels.

V. Environmental Sensitization

Environment has become a popular subject in the last three decades. Some of the problems faced by humankind directly or indirectly are due to ozone depletion, greenhouse effect, acid rain, global warming, air-water pollution and fossil fuel combustion. Chemicals and allied processes are the most important among these. Noticing the bad effects of chemicals and traditional energy sources on environment and human life, the Institution has been trying to find solutions for a better life. For this, creating awareness about environmental issues and the conservation of the ecosystem have become increasingly important in the life skill education in the University.

The rationale behind the environmental education has been focused on three factors:

- If people are aware of the need for and the ways of protecting the environment, they will act to preserve it,
- The student community should assume responsibility for educating others about the need for environmental protection and Environmental education can be

effective as a part of a college curriculum. Hence the Institution should prioritizes it.

- Methodology
- Fifty-two questions related to the environment had been fielded to the students and faculty members to assess their understanding of environment-related issues.
- The questions focused on four concerns:
- Whether they consider themselves eco-conscious?
- Do they consider the Institution to be eco-friendly?
- What do they think are the top priorities that should be tackled to improve the green campus status of the Institution?
- Whether the students and teachers who own vehicles are aware of the quantity of CO_2 emissions by their vehicles?

Of the 300 respondents, almost 80% were eco-conscious. But they were ignorant of the quantum of carbon emission at the national, state or at campus level. About 60% of them were not well informed of the simple carbon emission mitigation measures to be carried out in their homes.

Students who owned two wheelers were sensitized of the carbon emission by their vehicles and educated on this regard. They were also motivated to share their vehicles on alternative days with their peers. For example, 50% of the students who own two wheelers were advised to share their ride with their fellow students/neighbours.

All the respondents considered their Institution to be eco-friendly and were very conscious of the proactive role of the flora in their campus towards carbon absorption. They feel very much honoured that their Campus contributes, though very marginally, to the reduction of global warming.

Audit Observations

The overall observations, one makes while conducting green auditing of the university campus is that it qualifies to be labelled as a **Green Campus**. The geographical terrain and the vast area at the disposal of the Institution is a contributing factor to further green the campus.

- ❖ Conversion of the solid waste into compost is an impressive achievement and commitment to reduce Carbon Footprint.

- ❖ Other good practices include use of solar energy, water conservation, rain water harvesting etc.

- ❖ The university management and the faculty deserve appreciation for their efforts

to reduce Carbon Footprint through installation of various energy-efficient measures. One example is replacing incandescent and fluorescent bulbs with less energy- consuming CFL and LED bulbs.

Suggestions and Recommendations

There exists vast scope to improve the green campus status of the College through biodiversity promotion and tapping green energy sources.

More than 12 acres of land area is available to raise horticulture gardens, fruit- bearing trees and shade-giving trees. About 6,000 such trees and 15,000 plants may be raised in the Campus in the next 3 years. Through transplantation of branches from 8-year-old trees, 2,000 trees shall be raised in a year. Within a 6-month period, the Campus will get 2.5-year-old trees numbering 2,000.

Another 15,000 sq.ft. area of lawn shall be raised through the involvement of students from NSS or NCC to enhance oxygen emission by another 40%.

Compostable solid waste should be collected and deposited in solid waste collection tanks. These wastes shall be profitably converted into compost and applied to gardens and trees to reduce the application of chemical-based fertilizers and pesticides.

More solar panels shall be installed on top of the buildings to produce another 10,000 kW of electricity. To enhance solar power productivity, aluminium foil-based reflectors shall be installed on the eastern and western sides of the solar panel. Energy-efficient measures such as replacement of all incandescent bulbs with LED lamps, old electrical regulators of fans with energy-efficient electronic regulators, air-conditioning units with all-star rated systems need to be undertaken. Students should be trained as e-waste managers to manage e-waste. These e-managers shall be in constant touch with schools and other institutions through social media and inform them of the outdated computer systems that shall be used by them. They also should dispose of the less efficient, damaged and non-functioning e-wastes to the vendors. Biogas plants should be installed in the campus using solid waste and night soil generated from the Boys and Girls Hostel in the campus. The biogas shall be used by the Hostel Kitchen and College canteen. Water quality testing laboratory may be installed in one part of the laboratory to test the potability of the drinking water to ensure the students are free from water-borne diseases. All the water taps should be fitted with high-efficiency aerator taps to reduce wastage of water. The water taps with sensors may also be experimented. All toilets should be fitted with dual- flush water closets, which will reduce water consumption by 40%. Environment education is a part of the existing curriculum, which is a good sign. However, the same may also be imparted to all students through 1-hr life-skill classes once a week. This will create wide-level environment consciousness among the student community. They will be sensitized to encourage pillion riding with their peers or use

public transport instead of two wheelers. Moreover, they will also motivate their parents to replace all the incandescent or fluorescent bulbs with energy-efficient LED bulbs. The University may start a Diploma Course for Green Auditors, since it is now mandatory for all the educational institutions to conduct Green Auditing not only to discharge their Corporate Social Responsibility but also to retain their registration certificate. Since, in India, not many Green Auditors are available to green audit all the educational institutions, the proposed intervention would be socially useful. The need of the hour is to train at least 60 Green Auditors a year through a Diploma Course on Green Auditing. The duration of the course should be 6 months and in one course 30 students of the Institution should be enrolled and trained in all aspects of environment protection, which includes biodiversity promotion, carbon emission reduction measures, energy auditing, water auditing and individual responsibility to reduce carbon footprint. The Diploma Course may be got recognized by the MSME of the Govt. of India and the students who complete the course shall get government certificates that will help them to be professional Green Auditors.

Criteria-centric Recommendations

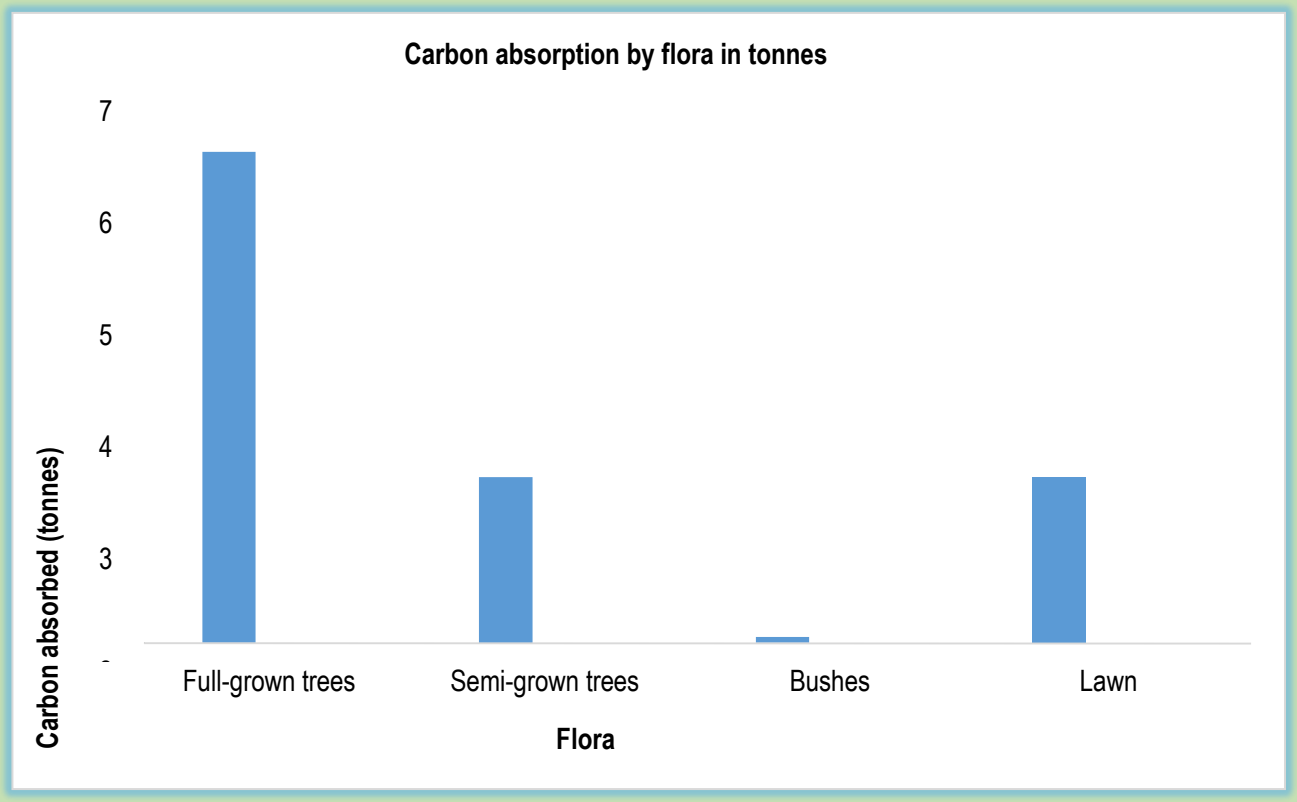
Criteria	Recommendation
Maximize the renewable flow energy to initiate healthy and continuous flow of energy	To set up solar panel in the college to ensure continuous renewable energy flow.
To channelize flow resource	To initiate rainwater harvesting by digging wells to accommodate rainwater flowing through the roof tops.
Maximize the proportion of waste that recycle & minimize the quantity of non- recyclable refuse	Implement a mechanism to recycle plastic waste in a scientific manner. To implement measures to recycle dry wastes
Reduce energy consumption, especially of energy derived from fossil fuels	All the areas of the campus should be under the preview of solar renewable power control. Also, switch off drills are to be set up in the campus to ensure all the electric devices to be in power off measure.
Minimize the use of chemical pollutants	The chemical pollutants from the chemical laboratories are water soluble. So, it is recommended that this water is recycled properly.

ANNEXURE-I

Abstract of Green Audit of JVBI for the Period 2018–19

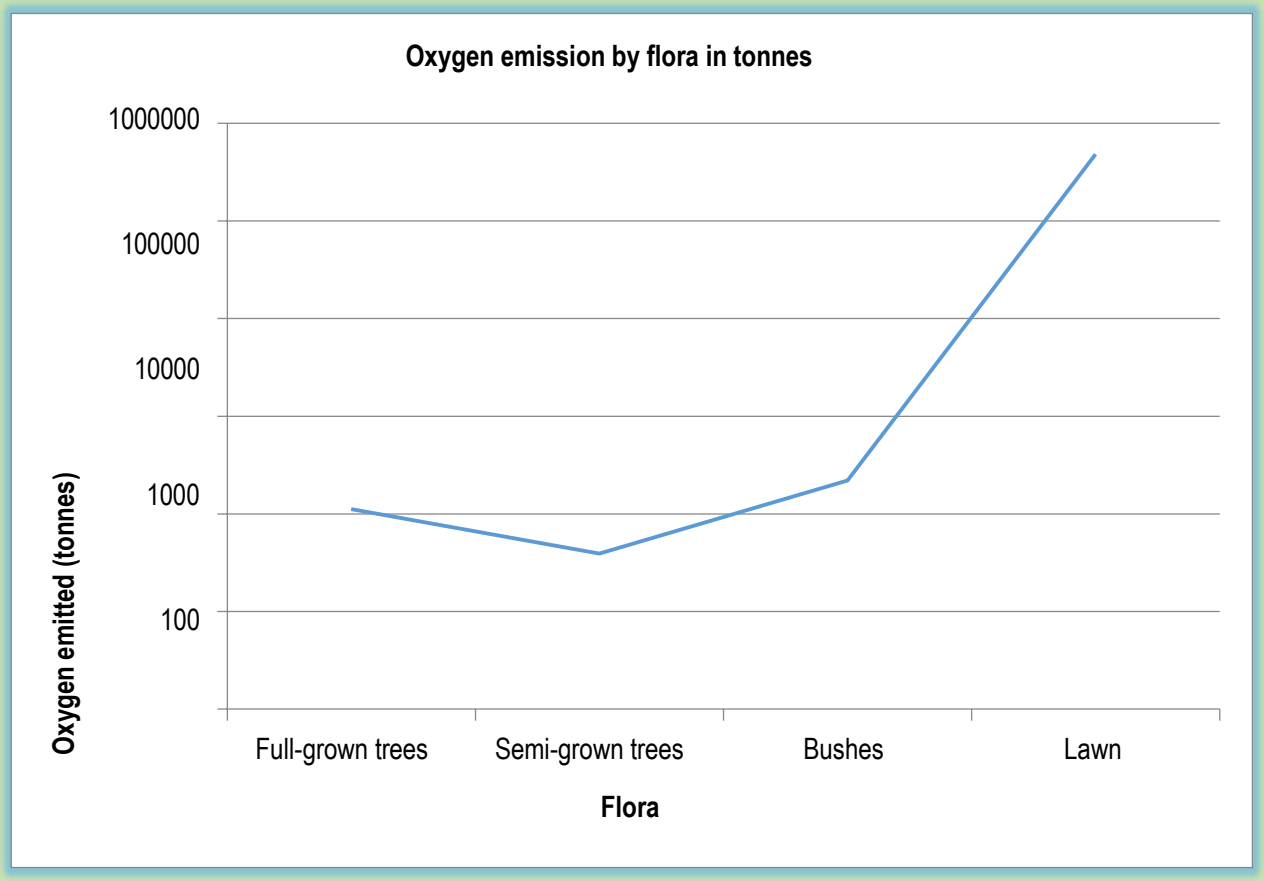
CARBON DIOXIDE ABSORPTION

S.No.	Types of trees/bush	Quantity of CO2 (tonnes)
1	957 Full-grown trees	6.5
2.	667 Semi-grown trees	2.2
3	442 Bushes	0.09
4	6000 sq.ft. of lawn	2.2
	Total	**11**



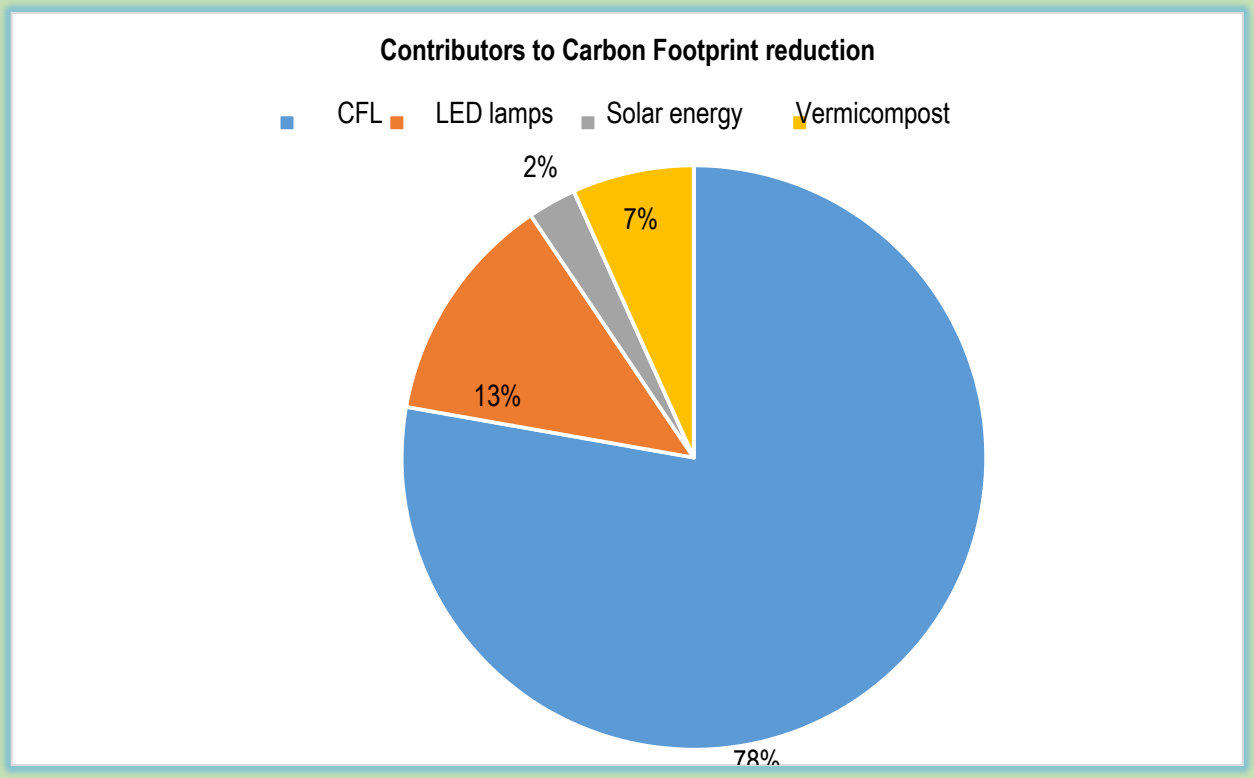
OXYGEN EMISSION BY FLORA

S.No.	Type of trees/plants	Oxygen (tonnes)
1	957 Full-grown trees	112.5
2	667 Semi-grown trees	39.2
3	442 Bushes	220.8
4	6000 sq.ft. of lawn	4,81,800
	Total	**4,82,172.5**



CARBON FOOTPRINT REDUCTION MEASURES

S.No.	Source	CO2 reduction (tonnes)
1	CFL	23.1
2	LED lamps	3.8
3	Solar energy	0.8
4	Solid waste management (vermicompost)	2
	Total	**29.7**



ANNEXURE-II

Solar Panels

Compost Tanks

Pond

Annexure-III: Some Important Flora

Abelmoschus Esculentus (Family: Malvaceae)

Acacia auriculiformis (Family: Mimosaceae)

Guazuma Ulmifolia (Family: Sterculiaceae)

Aloe Succotrina (Family: Liliaceae)

Amorphophallus paeoniifolius (Family: Araceae)

Anacardium occidentale (Family: Anacardiaceae)

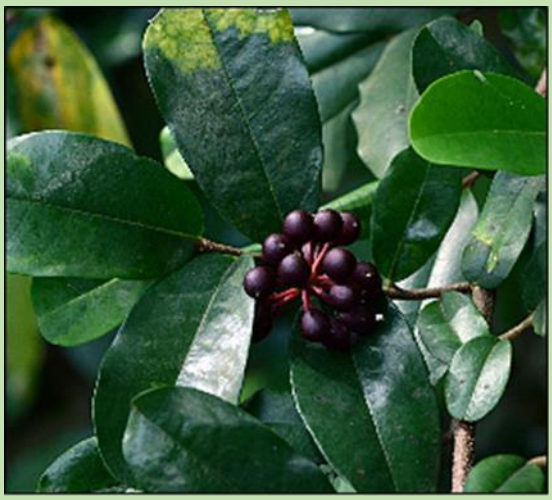
Coffea Arabica (Family: Rubiaceae)

Corypha Umbraculifera (Family: Arecaceae)

Cupressus Sempervirens (Family: Cupressaceae)

Dendrocalamus hamiltonii (Family: Poaceae)

Cycas circinalis (Family: Cycadaceae)

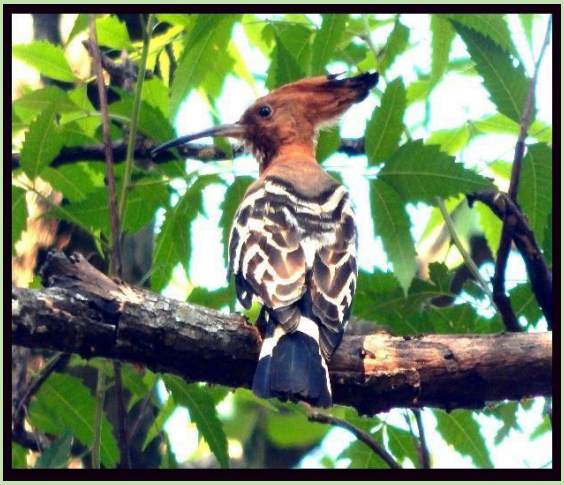


Polyalthia suberosa (Family: Annonaceae)

FAUNA

Terpsiphone Paradisi (Family: Monarchidae)

Merops philippinus (Family: Meropidae)



Upupa Marginata (Family: Upupidae)

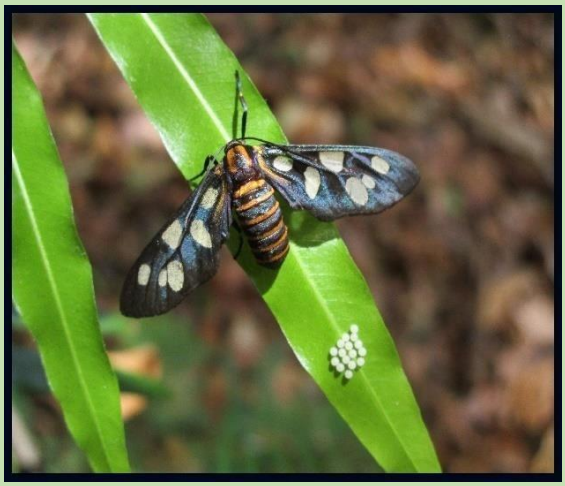
Castalius Rosimon (Family: Lycaenidae)

Oxytate Striatipes (Family: Thomisidae)

Poekilocerus Pictus (Family: Pyrgomorphidae)

Calotes Versicolor (Family: Agamidae)

Orthetrum Sabina (Family: Libellulidae)



Arctia Caja (Family: Erebidae)

Syntomeida Epilais (Family: Arctiidae)

Helix Pomatia (Family: Helicidae)

Indotyphlops Braminus (Family: Typhlopidae)

Apis Dorsata (Photographed by Rishi Das)

Commander (Moduza procris procris)

Myrmachne Orientalis

Heteropoda sp

Striped Tiger (Danaus Genutia)

Blue Tiger (Triumala Limniace)

Junonia Atlites Atlites (Grey Pansy)

Crocothemis Erythraea (Scarlet Dragonfly)

Pantala Flavescens (Wandering Glider)

Eastern Garden Lizard (Calotes Versicolor)

Little Owl (Athene Noctua)

Red-vented Bulbul (Pycnonotus Cafer)

Oriental Turtle Dove (Streptopelia Orientalis)

Acridotheres Tristis (Common Myna)

Macaca Mulatta (The Rhesus Macaque)

Peacock (Pavo Cristatus)