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

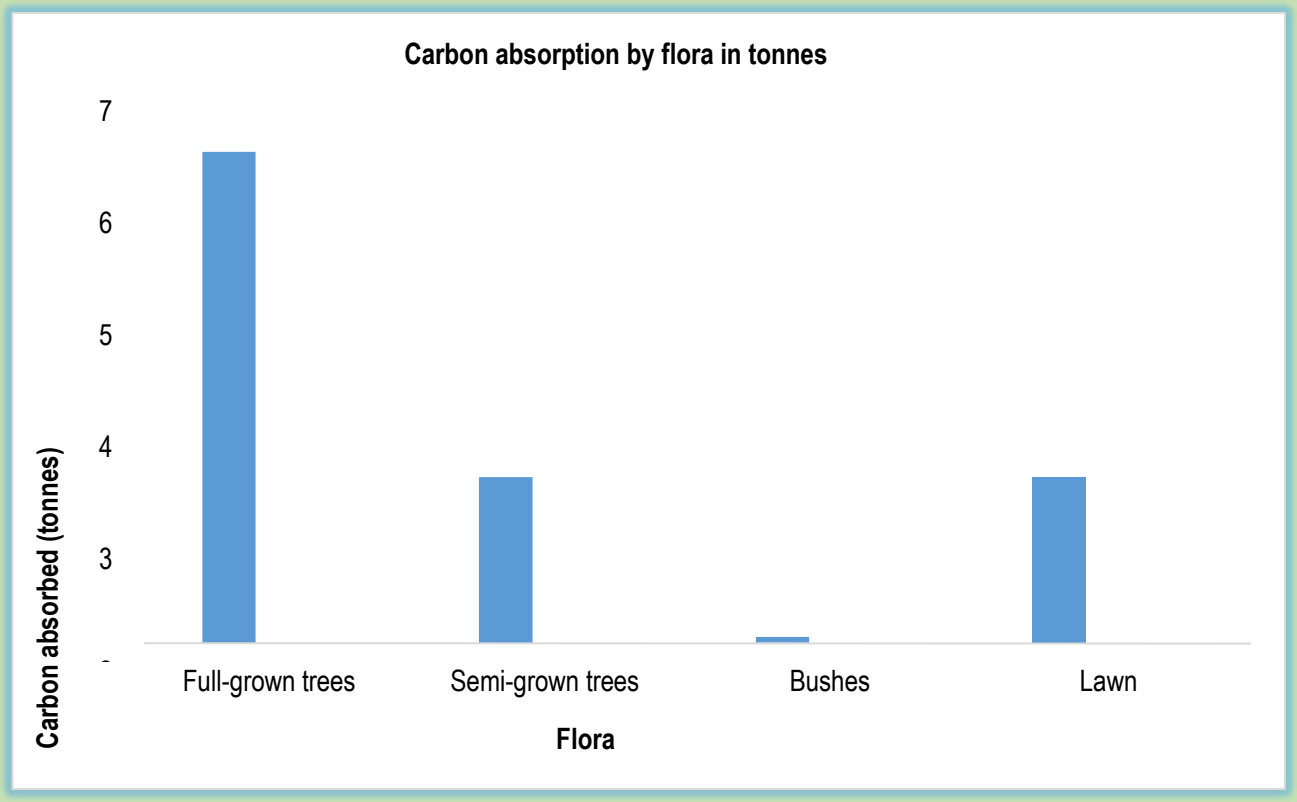
Criteria	Recommendation
Maximize the renewable flow energy to initiate healthy and continuous flow of energy	To set up solar panel in the college to ensure continuous renewable energy flow.
To channelize flow resource	To initiate rainwater harvesting by digging wells to accommodate rainwater flowing 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

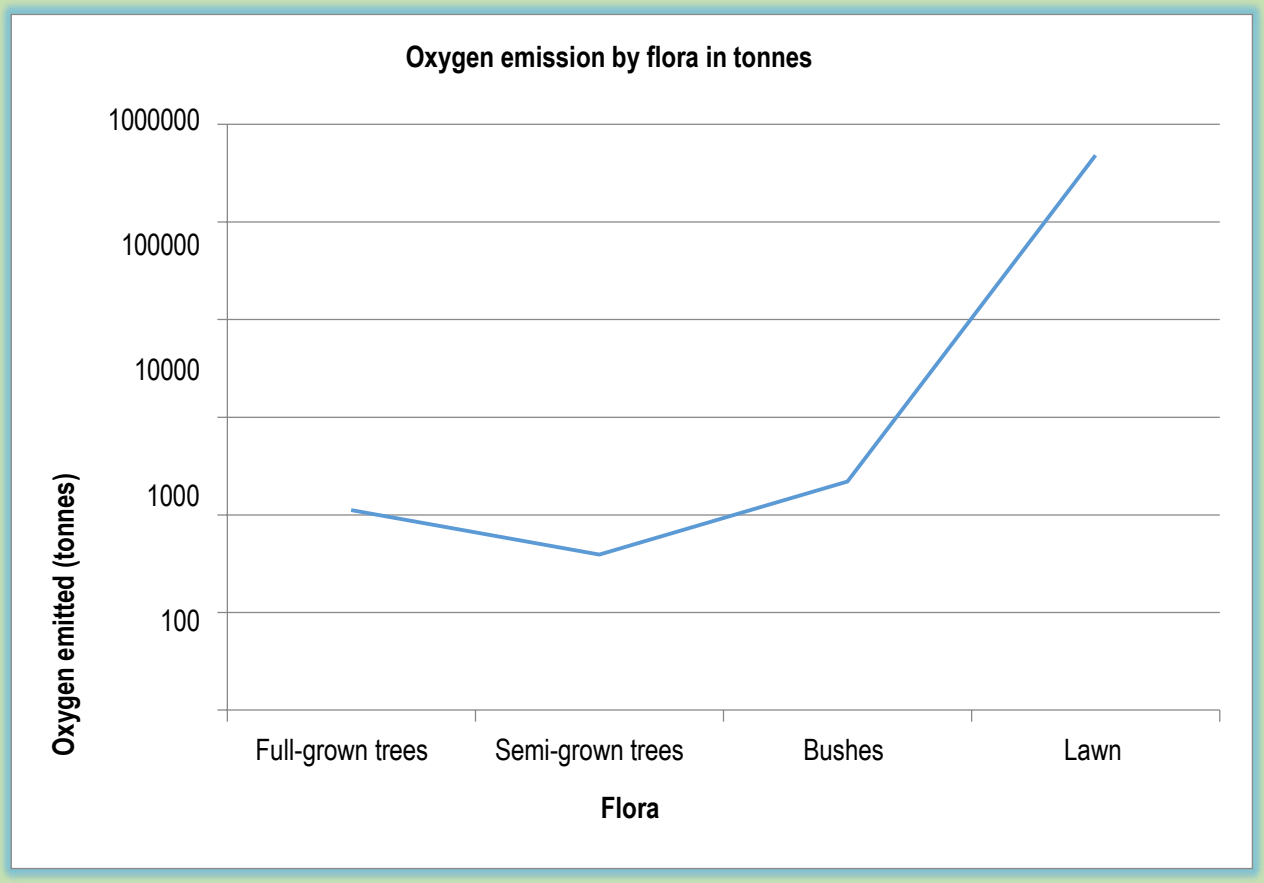
CARBON DIOXIDE ABSORPTION

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**



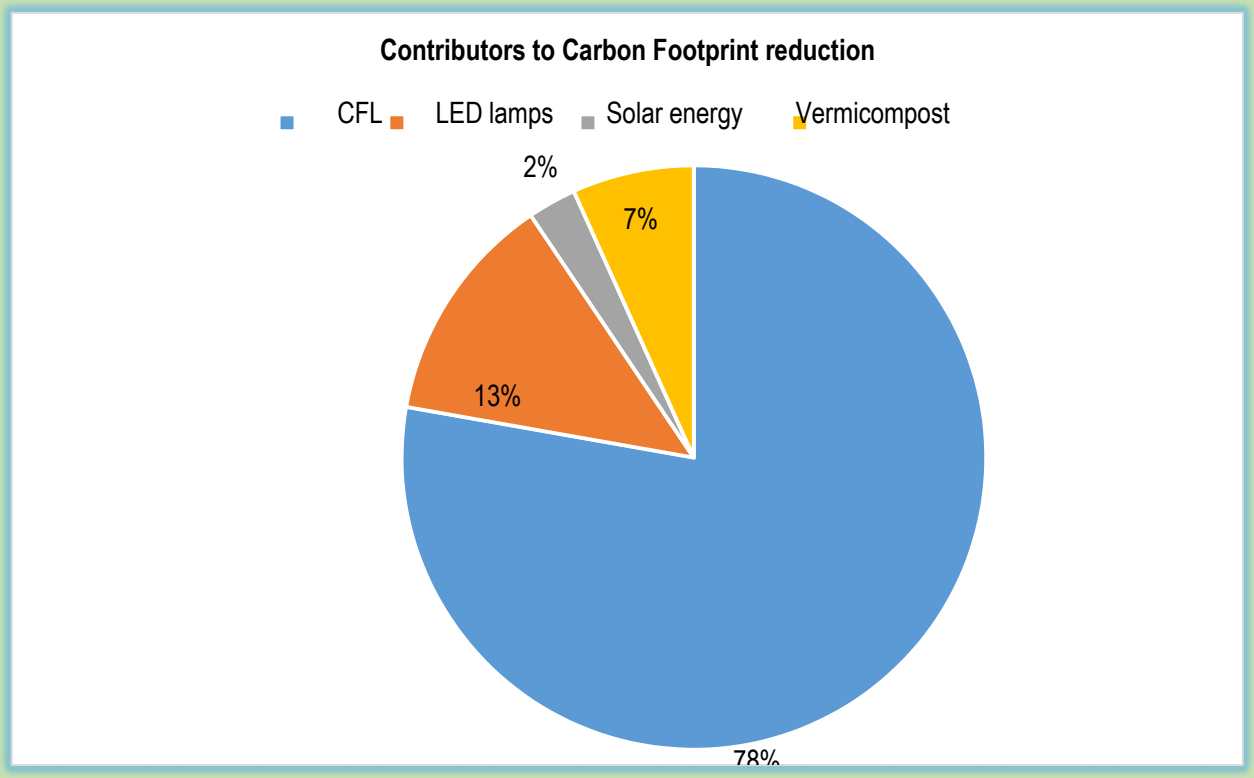
OXYGEN EMISSION BY FLORA

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)

Energy Audit Report

Jain Vishva Bharati Institute

(Deemed-to-be University)

Ladnun-341 306, Rajasthan

Certificate by the Team of Independent Auditors

This is to certify that the Energy Audit Report is based on the verification of the facts pertaining to Energy 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

Bharat Bhushan	Roshan K. Sinha	Rajeev Ranjan	Pritam K. Yadav
Dept. of Civil Eng.	Dept. of Mech.Eng.	Dept. of Elec.Eng.	Dept. of Elec. Eng.

R.P. Sharma Institute of Engineering & Technology, Patna

Audit Assistance

Rahul K. Sinha	Navneet Kumar
M.Sc. (Env.Sc.) Final Sem. Student	M.Sc. (Env.Sc.) 1st Sem. Student

ENERGY AUDIT REPORT

Introductory Observations

The Energy Audit exercise has identified energy as a crucial and balancing factor in the indices for sustainable development. It has considered that the heavy and unbalanced energy consumption may adversely affect energy price and economic growth and therefore, energy conservation methods need to get priority. Focus of this audit exercise has been to explore ways to optimize energy consumption per unit of product output and/or to lower operating costs.

The Energy Audit, which indeed is an on-going process has been effectuated as a part of a larger procedure to ensure long-term sustainable development and has comprised of the verification, monitoring and analysis of use of energy in the JVBI and this technical report is containing recommendations for improving energy efficiency including the cost benefit analysis and has proposed an action plan to reduce energy consumption. It has aimed at facilitating a systematic approach to the energy management in the university system by way of determining how and where energy is used and has tried to address the regime of the total energy input with its overall usage. It has taken into account all the energy streams in the university system and has quantified the use of energy according to its discrete functions with an aim to identify methods for energy savings. The Energy Auditing for a day has been worked out as the index of the consumption which normalizes the situation of Energy crisis by providing various schemes for conservation of energy. We focused our attention on energy management and optimization of energy efficiency of the systems, sub systems and equipment. The key to such performance evaluation lies in the sound knowledge of performance of equipment and system as a whole.

Opportunities have been viewed in the use of existing renewable energy technologies, with a special focus on solar energy so as to catalyze efforts at gaining energy efficiency and making possible the dissemination of latest technologies. Besides, this audit was undertaken in order to verify how effective these steps were, and also to identify loop holes, if any, in the existing practices, along with outlining measures for enhancing energy utilization. The recommendations of the study will become a basis for future schemes of better energy consumption and preservation throughout the organization.

Objectives of the Energy Audit

- To study the energy consumption pattern of the facilities on campus
- To identify the areas where potential for energy/cost saving exists
- To verify the steps adopted for energy management in the campus
- To spot the inefficient or inadequate practices, if any
- To improve the energy preserving measures and methods
- To identify potential energy saving opportunities
- To formulate feasible steps and measures to be adopted in the campus
- and prepare proposals for energy/cost saving along with investment and payback periods.

Methodology

The objective of Energy Audit is to balance the total energy inputs with its use and to identify the energy conservation opportunities in the stream. It has also focused attention to energy cost and cost involved in achieving higher performance with technical and financial analysis. The best alternative is selected on financial analysis basis. Energy audit has used data from various sources to look extensively at the existing energy consumption patterns and identify the areas for improvement, in addition to set reference points aiming at conservation of energy. An effort has been made to estimate energy savings and cost in order to account for the energy usage by of all major gadgets/equipment.

This step involved actual site measurement and field trials using various portable measurement instruments. It also involves input to output analysis to establish actual operating equipment efficiency and finding out losses in the system.

Identification and evaluation of Energy Conservation Opportunities has been effectuated by involving evaluation of energy conservation opportunities identified during the energy audit. It gives potential of energy saving and investment required to implement the proposed modifications with payback period. All recommendations for reducing losses in the system are backed with its cost benefit analysis.

About the Institution

Jain Vishva Bharati Institute (JVBI), a deemed to be the University is committed to provide highest quality of educational services to the utmost satisfaction of the students and give them an opportunity to cultivate an integrated personality blended with spirituality and moral values. University torch bearers have taken a responsibility for this investment to nurture the Next-Gen leaders with a vision to bridge the existing skill gap by way of providing not only the skilled personnel but also the human resources with values.

Details of the institutional infrastructure are as follows:

• 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

An assessment of energy usage in the JVBI Campus has been made, which is as follows:

- Electricity from MSEDCL
- High Speed Diesel (HSD)
- Electrical energy is used for various applications, like:
- Computers
- Lighting
- Air-Conditioning
- Fans
- Other Lab Equipment

Data Collection

For the purpose of this audit, audit groups for specific areas were formed. Data was collected through:

- Visual inspection and observation
- Verification/ Identification of energy consumption
- Quantification and segregation of data according to the following criteria:
  A. Energy consumption by end use
  B. Average energy use block-wise
  C. Consumption equipment-wise
  D. Rate of consumption month-wise
  E. Rate of consumption time-wise

The quantified data are presented below as figures and tables for easy reference. Figure-1 shows the energy consumption by end use.

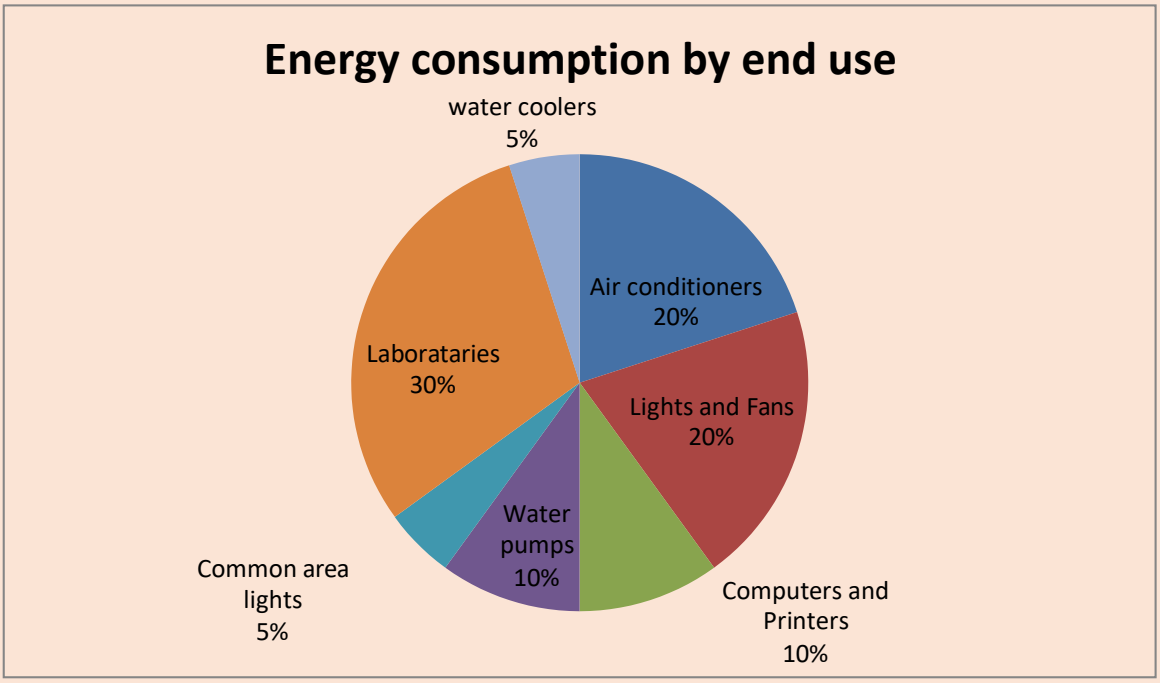


Figure-1: Energy Consumption by End Use

The consumption of energy block-wise is shown in Table-1:

Table-1: Average Use of Energy Block-wise

Blocks	Average day-time use on working Days (kwh)	Average use on Holidays (kwh)	Average night- time Use (kwh)
VC office	4.81	1.17	1.5
Academic Block	29.86	27.33	11.5
Ladies Hostel	3.45	4.5	2.5
Kalu Kanya Mahavidyalay	51.81	55.67	29
Administrative Offices	52.68	48.83	31.5
Library	72.90	61.5	34.05
Canteen	10.55	3.17	2.5
Boys Hostel	45.05	5.17	4
Guest House	16.36	14.17	2
Residential Complex 1	32.18	21.5	16
Residential complex 2	34.18	13.83	18.5

Figure-2: Shows the month-wise consumption rate of energy for the year 2018:

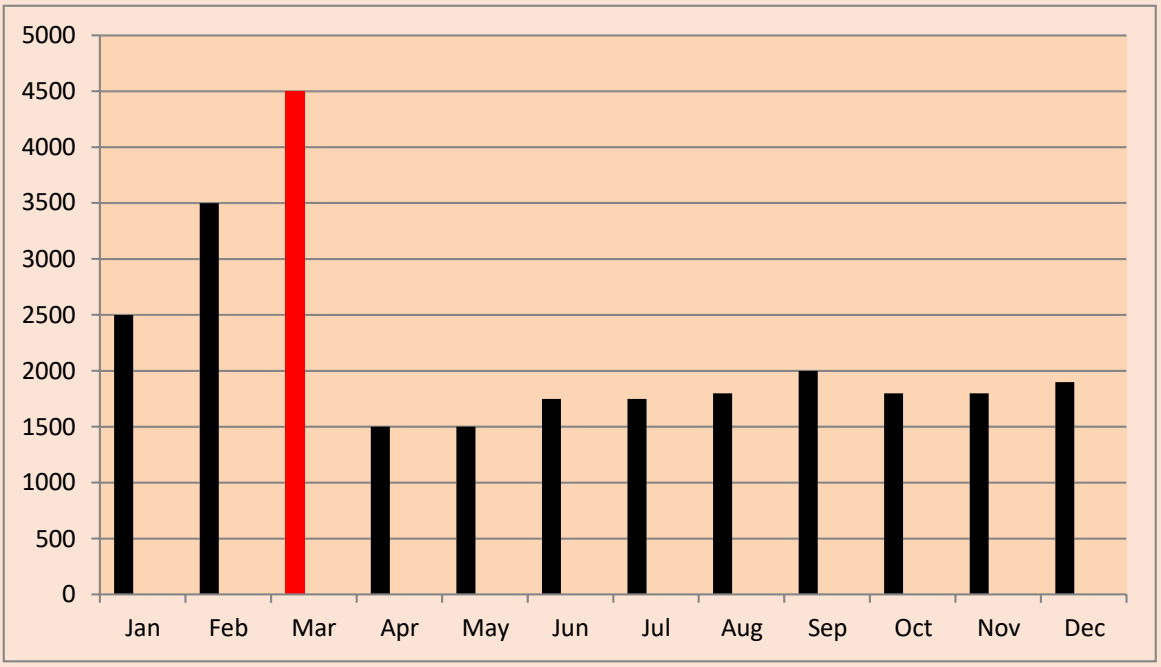


Figure-3: Energy Consumption for the Year 2018:

Figure-3: Shows the Time-wise Split-up of Energy Consumption on a Normal Working Day

Figure-3: Energy Consumption Per-Hour on a Working Day

Table-2: Study of Month-wise Maximum Demand Variation

Sr. No	Month	Maximum Demand (kVA/Month)
1	Aug-18	39
2	Sep-18	39
3	Oct-18	39
4	Nov-18	39
5	Dec-18	39
6	Jan-19	39
7	Feb-19	39
8	Mar-19	39
9	Apr-19	39
10	May-19	39
11	June-19	39
12	July-19	39
	Average	**39**

Table-3: Study of Month-wise Load Factor Variation:

Sr. No	Month	Load Factor
1	Aug-18	0.421
2	Sep-18	0.421
3	Oct-18	0.139
4	Nov-18	0.295
5	Dec-18	0.377
6	Jan-19	0.261
7	Feb-19	0.334
8	Mar-19	0.263
9	Apr-19	0.293
10	May-19	0.368
11	June-19	0.407
12	July-19	0.268
	Average	**0.3205**

Electrical Load factor has been measured as the utilization rate, or efficiency of electrical energy usage. It is the ratio of total energy (KWh) used in the billing period divided by the possible total energy used within the period, if used at the peak demand (KW) during the entire period. Thus,

Load Factor = KWh/ (KW/hours in the period/ number of days in the billing cycle),

If the load factor ratio is above 0.75 your electrical usage is reasonably efficient. If the load factor is below 0.5, you have periods of very high usage (demand) and a low utilization rate. Low load factor customers would benefit from a peak demand control system or from a Battery Energy Storage System to distribute electrical usage out over longer intervals of time and smooth the peaks.

Low load factors, such as, below 0.4 shall contribute significantly to the overall monthly electric bill in the form of demand charges. These demand charges are listed on the bill as coincident demand, facilities demand, and summer time related demand.

Study of Air Conditioners

In the facility for air conditioning there is no centralized system with AHU (air handling unit), but mostly split air conditioners are installed.

Load of ACs was as follow:

Item	Rated Power (kW)	Qty	Voltage	Current Amp	Actual Power
ACs	7	33	406	8.4	6.1

Observations and suggestions

1. Normal air conditioning temperature should be kept as high as possible. By thumb rule, increase in 3 degrees in indoor air temperatures can save 1% of electricity.
2. The ventilation in area can be provided with installation of natural ventilation. Natural ventilation will also minimize the requirement of exhaust fans.

Carbon-di-oxide Emission

It has been computed by taking into account of consumption of 1 Unit (1 kWh) of Electricity as equivalent to the CO_2 emission of 0.8 Kg or 0.8 Kg/kWh. In the following Table we present the total units consumed and CO_2 emitted as under:

Table 4: CO_2 Emission:

Month	kWh	CO_2 emitted in MT
Aug 18	11815	9.45
Sep-18	11815	9.45
Oct-18	3904	3.12
Nov-18	8284	6.63
Dec-18	10576	8.46
Jan-19	7332	5.87
Feb-19	9386	7.51
Feb-19	7374	5.90
Mar-19	8224	6.58
Apr-19	10324	8.26
May-19	11437	9.15
June-19	7512	6.01
July - 19	10335	8.36

Major Findings:

I. The laboratories record the highest consumption based on end use

II. The areas having high level of academic activities record the highest rate of consumption

III. Gadgets/Laboratory equipment show the highest rate of consumption equipment-wise

IV. Summer months shows the peak in consumption

V. The time slots in the Afternoon record the highest consumption on a normal working day.

VI. Identify the easiest areas of attention

Based on the physical observation and the analysis of data collected, certain areas have been identified as areas of attention:

- Old wiring cables in many parts of the campus leading to loss of energy
- Old water pipelines in several parts of the campus leading to waste of energy
- Use of incandescent bulbs in certain rooms
- Electric supply still depending on State Electricity Board, instead of solar panels
- Use of old equipment such as refrigerators in laboratories
- Uneven lighting facility – certain classrooms are under-illuminated, certain classes have more lights than required
- Estimate the Scope for Saving

The study could identify a large scope for saving energy in the campus, including:

- updating of technologies in laboratory equipment
- replacing old electrical cables and pipelines
- replacing incandescent bulbs with LEDs
- ensuring even lighting facilities in rooms
- use of Solar panels as a main source of lighting, especially common areas and grounds
- replacing old gadgets in laboratories

Immediate Areas of Improvement:

- ❖ Replacing incandescent bulbs with LEDs
- ❖ Repairing and updating laboratory equipment
- ❖ Encouraging students and staff to switch off electrical gadgets and turn off the water taps when not in use

Energy Conservation Proposals:

Providing Energy Saver Circuit to the Air Conditioners:

The energy saver circuits for the air conditioners, intelligently reduces the operating hours of the compressors either by timing or temperature difference logic without affecting the human comfort. This can save around 15% to 30% of the electricity depending on the weather conditions and temperature settings.

There are total 33 air conditioners. It is Recommended that the old air conditioners are being replaced with new energy efficient BEE STAR labeled (3 Star and above) air conditioners in a phased manner.

Considering the average compressor ON time = 5 h/day Power consumption by 2 TR compressor = 6.1 kW

Average daily consumption = 6.1 x 5 = 30.5 kWh/day/ air conditioner Yearly operating days = 100 days/year/ air conditioner

Yearly electricity consumption = 3050 kWh/year/ air conditioner

Considering a saving of 15%, total annual savings = 15% x 3050 = 457.5 kWh/year/ air conditioner
Cost of electricity = Rs. 8 / kWh

Yearly savings = 8 x 457.5 = Rs. 3660/ year/ air conditioner Total number of Air Conditioners = 33
Total yearly Saving = 33 x 3660/year = 1,20,780/year

Total Cost of each energy saver circuit = Rs. 4500 x 33 = Rs. 1,48,500

Replacing Fluorescent Tube Lights (FTL) with LED Tube Lights

The 36 W FTLs can be replaced with the LED tube lights 16 W. These changes can be made at the places where the life is higher. Usually minimum of 3 years warranty is given and approximate burning hours is 40 000. (15 years considering 8 hours per day running) Following calculations are done for the 8 hours working:

Power consumption by 36 W FTL with conventional choke = 40 W/ Tube Light Equivalent LED tube light = 16 W/ Tube Light
Savings in power = 24 W/ Tube Light

Yearly operating hours = 8 h/day x 300 = 2400 h/year/ Tube Light Yearly savings = 2400 x 24 W = 57.6 kWh/ year/Tube Light Average Cost of electricity = Rs. 8/ kWh
Saving= 57.6 kWh x 8 = Rs. 460.8 / year/ tube light

Approximate investment on single LED Tube lights = Rs. 2000 Number of Tube Lights to be replaced = 506

Total Yearly Saving = 506 x 460.8 = Rs. 2,32,760/year Total Investment = 506 x Rs. 2000 = Rs. 10,12,000

Providing Solar PV System for Part Load Operations during Day Time

There are mainly Lighting and Computer loads. Since, there is no separate lighting feeder; it becomes necessary to separate out the lighting feeder for those lights where they are used 6 to 8 hours in a day.

A 5 kW Solar PV is proposed for the Lighting load application with minimum Storage batteries. The power saved considering the 85% loading = 5 kW
Average Daily available hours = 6 h/day Electricity Saved = 6 x 5 = 30 kWh/day Yearly availability = 250 days/year

Yearly savings in electricity = 250 x 30 = 7500 kWh/year Monitory Savings = 7500 x 10 = Rs. 75000 / year Approximate cost of the solar system = Rs. 10.0 lac Subsidy from central government = Rs. 3.0 lac
Net cost = Rs. 7.0 lac

Proposal for enforcing Energy Efficiency Improvement measures: Table 5

Sr. No.	Recommendations	Annual Saving Potential (Rs.)	Estimated Investment (Rs)	Pay Back period (Months)	Remarks
1	Providing Energy Saver Circuit to the Air Conditioners	120780	148500	5 Months	Mid Term
2	Replacing Tube Lights (FTL) with LED Tube Lights	232760	1012000	54 Months	Long Term
3	Providing Solar PV system for part load operations during day time	75000	1000000	112 Months	Long Term
	TOTAL	**4,28,540**	**21,60,500**		

Table-6: Summarized Account of the Findings and Recommendations of the Audit

Findings	Recommendations
Most of the power consumption is used for lighting, electric fans, computers and water pumping	N. A.
The architectural design of buildings, with most of the rooms blessed with natural light and ventilation helps in reducing the number of lighting and ventilating equipment and gadgets.	New buildings, when constructed should follow the hanged patterns and assure more of natural light and flow of air passage to reduce loss of energy
The electrical wiring of many buildings was found to be old and inefficient	Replacement of old electrical cables with new ones
Poor plumbing lines leads to loss of water and subsequent loss of power resulting from over pumping	Replacement of old pipelines with new ones, and latest motors for pumping water.
There are a number of unused sockets and redundant power points causing power wastage.	The number of sockets should be assessed in objectivity and redesigning of placing electrical sockets with proper earthing connections should be ensured
There seem to be a lack of judicious use of power among students and staff. During the study, it was found that lights, fans and computers were kept on working mode in many rooms, without a single person present.	Students and staff should be motivated continuously to use energy judiciously. Posters and pamphlets should be distributed and notices about saving energy should be posted at major points of use.
Uneven distribution of lighting facilities. Certain classrooms were under-illuminated, while certain classrooms had more than sufficient lights.	Even lighting distribution system should be ensured.
Many Departments still use incandescent bulbs causing heavy power loss	Incandescent bulbs should be replaced with LEDs
Except for solar units entire power requirement is met from the RESB line.	More solar panels should be installed in key areas of the campus, and loads for common areas and grounds should be met from these.
AC, refrigerators and freezers used in many departments use obsolete technology and hence cause power loss.	Gadgets and equipment should be repaired and/or replaced with latest ones to save energy.
Power consumption is high in many locked buildings at night. This is probably due to locking the rooms without switching off gadgets.	Proper switching off of the gadgets and equipment should be ensured strictly.

Table 7 – A Bird's Eye-view of Cost and Returns of Recommended Actions

Action	Power units saved	Cost of implementation	Annual return	Period of return
Conversion of 200FTLinto LED	3000	1,00,000	18,000	5.5 years
Conversion of 600FTL chocks to electronic ballast	6000	1,20,000	36,000	3.3 years
Conversion of resistive regulator of 500fans into electronic regulator	5000	1,25,000	30,000	4 years
Providing solar water heater 500litres	4000	50,000	24,000	2 years
Replacing A/c and fridges by 5 star rating equipments	8000	2,00,000	48,000	4 years
Installation of Bio-gas plant 30Kg capacity	Equivalent to 90LPG cylinder 14.2Kg	60,000	72,000	10months
Energy saving settings for Computers	2500		15,000	
Replacing old 100desktop computers by Laptop	5000	3,00,000	30,000	
Providing 2KWSolar Panel with power units	3600	50,000	21,600	2.3 years

Conclusion

- A well-conceived electrical wiring plan for the campus is required, which would help to identify unused points of power and also in re-wiring the buildings
- Electric fans should be serviced and bearings replaced wherever necessary
- The scope for non-conventional energy should be increased.
- Installation of roof top solar panels should be made on certain locations like the top of library building, Kalu Kanya Mahavidyalay, Academic Block, which would cut the power bill substantially and may become a source of revenue generation over the period of time.
- Installation of a suitable Bio-gas plant to save energy used for heating water in Science laboratories.

- Rigorous training for both students and staff to inculcate awareness for the need of energy conservation. If everyone ensures switching off lights, fans and electrical gadgets that are not in use, roughly 10% to15% of energy saving is possible
- A master switch located at a prominent place which can be directly supervised by the HoD/supervising staff would help avoid power wastage in closed rooms.
- A healthy competition may be encouraged between departments by honoring those departments that produce higher savings by good practices. An element of weight-based on the above lines may be considered for allocation of funds.
- It is suggested that a permanent body under the chairmanship of a senior teacher may be established in the College for periodical review of energy usage and concurrent energy audit. Representatives of students, staff and PTA may be included in the body.

Environmental Audit Report

Jain Vishva Bharti Institute

(Deemed University)

Ladnun-341 306

Certificate by the Team of Independent Auditors

This is to certify that the Environmental Audit Report is based on the verification of the facts pertaining to 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

Bharat Bhushan	Roshan K. Sinha	Rajeev Ranjan	Pritam K. Yadav
Dept. of Civil Eng.	Dept. of Mech.Eng.	Dept. of Elec.Eng.	Dept. of Elec. Eng.

R.P. Sharma Institute of Engineering & Technology, Patna

Audit Assistance

Rahul K. Sinha	Navneet Kumar
M.Sc. (Env.Sc.) Final Sem. Student	M.Sc. (Env.Sc.) 1st Sem. Student

The Environmental Audit Report: A Conceptual Background

The Environmental Audit Report of the JVBI addresses the environmental related matters and the basic philosophy and approach summarized by the broad definition adopted by the International Chambers of Commerce (ICC) in its publication of Environmental Auditing (1989). Accordingly, this third-party exercise has been taken into consideration the Environmental Audit as a management tool comprising a systematic, documented, periodic and objective evaluation of how well the University's management, human resources, men and machinery are performing with the aim of safeguarding the environment and natural resources. It shall focus on the Green Campus, Waste Management, Water Management, Air Pollution, Energy Management & Carbon Footprint etc.

A clean and healthy environment aids effective learning and provides a conducive learning environment. There are various efforts around the world to address environmental education issues. Environmental Management Systems (EMS), which is very popular in the industrial sector, has been a welcome initiative of the NAAC and the UGC. The third-party audit team has developed a compatible system by developing locally-applicable techniques. The team has envisaged a very simple indigenized system to monitor the environmental performance of the JVBI. It has come up with a series of questions, which have been answered on a regular basis. This innovative scheme is user-friendly and totally voluntary and has been aimed at helping the Institution to set environmental examples for the community and to educate young learners.

The present Environmental Audit Report is a snapshot in time, in which one can assess the campus performance in complying with applicable environmental laws and regulations. This shall hopefully become a helpful benchmark and pave a way to place some mechanism in place to continue the effort of monitoring environmental compliance.

This is very first environmental audit of the Institute, which has been aimed at the accreditation of the NAAC, which would highlight the institutional interventions towards environmental protection and increasing environmental awareness at local, regional and national front.

Audit criterion is environmental cognizance, waste minimization and management, biodiversity conservation, water conservation, energy conservation and environmental legislative compliance by the campus. A questionnaire has been used during audit. This audit report also contains observations and recommendations for improvement of environmental consciousness.

The expected outcomes of the eco-auditing system would be as under:

- Strengthening Environmental education through emphasizing systematic environmental management approach
- Improving environmental standards
- Benchmarking for environmental protection initiatives
- Reduction in consumption of resources
- Financial savings through a reduction in utilization of resources
- Curriculum enrichment through practical experience
- Development of ownership, personal and social responsibility for the Institute campus and its environment
- Enhancement of eco-friendly lifestyle on the Institute campus
- Developing an environmental ethic and value systems in young people

Ladnun : An Overview

Ladnun falls under the district Nagaur, which is located almost in the middle of the state of Rajasthan. It is 380 km west of Delhi and 225 km north-west of Jaipur. Its population is approx. 57,047 as of 2001 India census. It is situated 329 m high from the mean sea level. It's situated between 27° 39' 0" north latitude and 74° 23'-1" east longitude. It is a small city and local governance is managed through a municipality under Nagaur district.

Fig. 1: A. Map of Ladnun B. Ladnun Railway Station C. JVBI-Acharya Shree Tulsi Memorial

Fig. 2 Important Places of the City of Ladnun; A. Hanuman Dwar, Ladnun, B. Sukhashram Jain Mandir C. Karant Balaji Temple D. Digambar Jain Bada Mandir Postal Stamp and E. Mosque

It is also the tehsil headquarter and enjoys status of the subdivision. Ladnun Tehsil has 139 villages. There are 32 elected ward members in the Ladnun Municipality, in addition to one Panchayat Samiti, Tehsil and sub-division offices. Total Population (Census 2011) of the district is 3307743 including urban population of 637204 and rural population of 2670539.

The small town of Ladnun has gained its place on the map of the country being the headquarters of the famous 'Jain Vishva Bharati,' which has become a centre of spiritual learnings and knowledge under the leadership of Acharya Tulsi, a great Jain saint who was born here and who had propagated the philosophy of "ANUVRAT" and "Preksha Dhyan" in order to enlighten the people; irrespective of the cast and creed. On his inspiration, Jain Vishva Bharati Institute was established to start the schools of thoughts and the centres of spirituality and yogic purification.

This institution has been dedicated for Ahimsa and is a treasure of tranquility and indeed is an Fig. 3: Administrative Map of the District Nagaur depicting position of Ladnun

abode of humanity on earth. As a proud creation of Gandahipati Acharya Shree Tulsi., this institution is known as the place for evolution of the Preksha Meditation; a path of

Fig. 4: Preksha Meditation-the Central Idea

self- awakening and self- realization. It helps to connect the human body with the soul at its most profound level, enables a person to achieve a state of super consciousness and increased concentration. The process of meditation puts a person in touch with enlightenment, peace of mind and simple clarity.

Fig.5: Acharya Shree Tulsi; who dreamt to establish JVBI, along with Acharya Shree Mahaprajna and Acharya Shree Mahashraman

The city is heading towards spiritual tourist city. Famous Jain Vishva Bharati Institution (founded by Acharya Tulsi in 1970) situated here.

The Historical Legacy

Ladnun was earlier known as Chanderi Nagari. The city is heading towards spiritual tourist city. Glorified by the bards, the history of Ladnun finds mention even in the Mahabharata. The kingdom of Shisupal and after then Mohil Chauhan conquered it in the beginning of the 12th century BC. In 16th century AD king of Jodhpur, Maldev Rathore, annexed Ladnun and ruled before the merger of the states Ladnun was a part of erstwhile Jodhpur state. Ladnun has also witnessed the valour of Great Amarkot(Rathore) who challenged the mighty Mughal Empire.

Historical Monuments

Among the four famous dargahs of Ladnun, the most ancient one is that of the Dargah Umarshahpir, which has the inscription of the year Hizri 772.Thus, it was built before the year Hizri 772. The Jami mosque, the oldest of the fourteen known mosques, was originally built with monolithic beams and brackets on an Arab-type plan and consisting of a colonnade round a courtyard, in the Ghurid Of Khalji period, was restored during the period of Firoz Shah, nephew of Muhammad bin Tughluq.

Fig. 6: The historic image of Goddess Saraswati according to the Jain Tradition

The ancient Digambar Jain Bara mandir, situated in the heart of the city, has the idol of the deity Saraswati, one of the finest of that time. It has the inscription of the year 1229 AD. It has magnificent temple houses, several artistic and rare idols of Jain Tirthankaras, beautiful images, engraved pillars, rare pieces of art and old jaina dharma manuscripts. The Mool mandir, situated within it, is 10 feet deep inside the Earth and in its lowest floor, there is a beautiful idol of Lord Shantinath. On the crown of the Lord Shantinath an inscription clearly indicates that the temple was built on Ashad Sukla 8, Sanwat 1136. This shows that the temple is more than 1000 years old. In the second vedica chamber, there is an idol of second Thirthankar Bhagwan Ajitnathji. This idol is 74x60 cm in dimension and made of marble. An inscription on the idol is found of Baisak Sukla 13, Sanwat 1209. In front of Bhagwan Ajitnathji idol, there is also a marble door with two pillars. The two pillars are decorated with artistic jaina images. In the art gallery, there idols of Bhagwan Risbhadeva made of brown stone, and two idols of Bhagwan Parsavnath with nine headed serpents. A beautiful image of Bhagwan Neminath is also placed in the art gallery. Several other images made of metals, which had been found during excavation of the nearby areas of Ladnun have been placed in this art gallery. This temple is built and repaired several times but its magnificence, beauty, purity and calmness is preserved through ages.

Existing Infrastructure

Educational

The city is having more than 20 Educational Institutions out of which, one is the Deemed University, one is the Girls College and there are five Higher Secondary schools. Other schools are middle and primary schools. In addition, there are five secondary schools imparting education up to the high school.

Health Facilities

The details of health facilities are as follows:
Seth Ganpat Rai Saravagi Government Hospital, Mangalam Hospital, Raj Hospital, Teli Road, Jain Matra shisu Nursing Home, Station Road, M.N. Ghodavat Nursing Home, Didwana Road Aakash Hospital, Teli Road, Phoolchand Saravagi Government Ayurvedic Hospital, Sukhdev Netra Chikitsalya

Amenities

The city has one Post Office and three sub post office and four Nationalized Banks.

Electricity

The city is connected with electricity facilities. It has 33 kV and 132kV electric sub stations (G.S.) and one government electric supply office working under A.E.N. There remains high fluctuation in voltage supplied with 33kV & 132kV G.S., so due to increase in consumption of electricity, the present distribution of electricity supply system has become insufficient.

Connectivity through Roads

The roads are very narrow inside the city. It is connected with Sujangarh(12km) and Didwana(32km) By NH65 and Kishangarh-Hanumangarh Mega-highway.

Distance from Important Cities:
JAIPUR 220km, UDAIPUR 500km, BIKANER 200km, JODHPUR 240km, DELHI 400km

Buses Available from:
Jaipur, Ajmer, Bikaner, Kuchaman, Ahmedabad, Indore, Delhi.

Rail Network:
The Rail lines of Delhi-Rewari-Ratangarh-Degana-Jodhpur passes through Ladnun station.

Nearest Railway Station:
NAGAUR 97km, DEGANA 110km, KUCHAMAN CITY 98km, AJMER 180km, JAIPUR, 216km.

Nearest Airport:

- Indira Gandhi International Airport, Delhi 287km
- Jaipur Airport 168km
- Jodhpur Airport 203km
- Udaipur Airport 341km

Telecommunication
There is one Electronic Exchange with modern facilities.

Industries

Agricultural machinery, wooden camel cart, textile hand printing and dying industry, kutir udyog (papar, bari, sweet saffron, etc.) and khadi and handloom made blanket and shawl industry and building materials.

Agricultural Resources

Agriculture is the main occupation of a majority of the population of the Ladnun tehsil. Major crops include Bajra, wheat, jowar, til, barley and pulses are the major crops of Ladnun. Rabi crops are usually sown in November whereas Kharif crops are sown with the beginning of the first rains in July.

Climate

Ladnun has a dry climate with a hot summer. Sand storms are common in summer. The climate of the city is conspicuous by extreme dryness, large variations of temperature and highly variable rainfall. The mercury in the Barometer keeps on rising intensely from March till June. These are the hottest months. The maximum temperature recorded in the city is 47°C with 0°C as the lowest recorded temperature. The average temperature of the city remains 23.5°C. The winter season extends from mid-November till the beginning of March. Rainy season is of a short duration, which extends from July to mid-September. The average rainfall in the city is 36.16 cm & 51.5% humidity.

The district experiences arid to semi-arid type of climate. Mean annual rainfall (1971-2005) of the district is 410 mm whereas normal rainfall (1901-1970) is lower than average rainfall and placed at 363.1 mm. It is obvious that there is significant increase in rainfall during the last 30 years. The rainy days are limited to maximum 15 in a year. Almost 80% of the total annual rainfall is received during the southwest monsoon. The probability of occurrence of mean annual rainfall is 38%. Based on agriculture criteria, the district is prone to mild and normal type of droughts. Occurrence of severe and very severe type of drought is very rare. There is not much variation in aerial distribution of rainfall. However, the southern part of the district gets slightly more rainfall than northern part. The monsoon enters the district in the first week of July and withdraws by the middle of September. As the district lies in the desert area, extremes of heat in summer and cold in winter are the characteristics of the desert. Both day and night temperatures increase gradually and reach their maximum values in May and June respectively. The temperature varies from 46 degree in summer to 7 degree in winter. The winter season starts by middle of November and lasts till February. January is the coldest month with both mean maximum and minimum temperatures being lowest at 22.5° and 6.7° respectively. The minimum temperature sometimes drops down to below the freezing point of water and frost occurs. The diurnal variation in temperature during winter is as high as 16°C. Both maximum and minimum temperatures begin to rise rapidly from February onwards, reaching their respective maximum in late May or early June. The mean daily maximum temperature in May is 40.4°C and the mean daily minimum temperature is 25.7°C. Night temperatures in June are much higher than in May with mean daily minimum temperature of 27.9°C. Atmosphere is generally dry except

during the monsoon period. Humidity is the highest in August with mean daily relative humidity at 80%. The annual maximum potential evapotranspiration in the district is quite high and it is the highest (255.1 mm) in the month of May and the lowest (76.5 mm) in the month of December.

Geomorphology & Soil Type

The general topography of the area is fairly even. Slope of the area is fairly even. Slope of the land surface is towards west and elevation varies from 250 meter above msl in south to 640 m above msl in north. South-eastern part of the district comprises small scattered hillocks. The northern, north-western and north-eastern parts of the district are covered by sand dunes. The offshoots of Aravalli range are projected along the common boundary of Ajmer district and Metra, Nawa and Parbatsar tehsils of Nagaur district.

There is no river originating in the district. However, the river Luni which rises near Pushkar in Ajmer district, draining western slopes of the Aravalli, crosses the district in the southern part flowing for about 37 km in western direction. It is an ephemeral river and carries runoff that is generated in the upper reaches. Channel deposits of Luni facilitate percolation during rainstorm, thereby feeding the neighboring wells along its bank. Other nalas and streams are also ephemeral in nature which originate and die out in the district itself.

Soil Characteristics

Four types of soils have been reported in the district viz, clay, clay loam, sandy loam and sandy soil. The general texture of the soil in the area is sandy loam to clayey loam which is further classified into "Barani" or un-irrigated and "Chahi" or irrigated soil. A part of Nagaur tehsil and south-eastern part of Merta tehsil have deep sandy loam, while red loamy soil exists elsewhere in Metra tehsil except on the banks of river Luni. Light loamy soil occurs in Parbatsar tehsil away from hill ranges. A longitudinal belt from Didwana to Nawa extending up to Sambhar Lake has the characteristics of alkaline soil. Distribution of different types of soils is shown in table 2.

Table 1: Soil Types in Nagaur District

S. No.	Soil type	Area (hectare)	Block
1	Clay	22,840	Nagaur, Jayal, Merta, Riyan, Parbatsar
2	Clay loam	1,34,450	Nagaur, Kuchaman, Jayal, Riyan, Merta, Degana, Makarana, Ladnun, Parbatsar, Mundwa, Didwana.
3	Sandy loam	4,72,905	Makarana, Ladnun, Parbatsar, Mundwa, Didwana, Nagaur, Kuchaman, Jayal, Riyan, Merta, Degana.
4	Sandy	5,65,705	Nagaur, Khuchaman, Jayal, Riyan, Merta, Degana, Makarana, Ladnun, Parbatsar, Didwana.

Water

Ground water level at Ladnun is gradually going deep down and water contains salts, nitrates and fluorides beyond the permissible limits. The salinity levels fluctuates between less than 500 u/S/cm to as high as 32000 u/S/cm. The availability of water falls broadly in three categories; viz. fresh(32%), mixed(33%) and chloride type(35%). The high fluoride content has been reported to be beyond permissible levels; i.e. >1.5 mg/L and therefore has been found unsuitable for drinking. Nearly 64.3% well waters have been reported to contain fluoride content above to 1.5 mg/L. Nearly, 68% ground waters have nitrate concentration above 100 mg/L, which too is beyond the permissible limits. Despite of salinity problem, the city is characterized by low hardness in ground water. This is due to low percentage of calcium and magnesium in water. One government water supply office "Water works" works under a J.En. Drinking water is supplied to more than 80 villages and towns from Ladnun.

Systematic Hydrogeological survey in the district was initially carried out by GSI during 1964-65. Various studies including Systematic and Reappraisal Hydrogeological Surveys have been carried out in the district from time to time by Central Ground Water Board.

Geological Framework

The geological set up of the district is presented by different sedimentary, igneous and metamorphic rocks belonging to Bhilwara Super Group, Delhi Super Group, Marwar Super Group, Palana Formation and Quaternary alluvium. A few outcrops of gneisses belonging to the Mangalwar Complex of the Bhilwara Supergroup are exposed north-east of Nawa. The Delhi Super Group includes Alwar, Ajabgarh/ Kumbhalgarh and Punagarh Group in descending order of antiquity. The rocks of Alwar Group are well exposed in the eastern part of the district and comprise of arkose, grit, conglomerate and schist. The overlying Ajabgarh/ Kumbhalgarh Group of rocks are exposed between Kerkeri and Bijathal. The Ajabgarh Group mainly consists of Quartzite with schist and marble. Kumbhalgarh comprises mica schist and marble. The overlying Punagarh Group of rocks (quartzite, slate phyllite, marble etc.) occur as isolated outcrops. The rocks of Bhilwara Super Group and Delhi Super Group are structurally isoclinal and recline fold which are exposed along south eastern margin (trend NE-SW) of the district adjacent to Ajmer district.
The rocks of Delhi Super Group have been intruded by Erinpura granite and Malani igneous suite. All these rocks are overlain by marine sedimentary sequence of the Marwar Super Group which is subdivided into Jodhpur, Bilara and Nagaur group representing arenaceous, calcareous and areno-argillaceous facies respectively. These rocks are overlain by sandstone and bentonite of the Palana formation. The Marwar Super Group of rocks have horizontal to gently inclined disposition of different beds, which are displaced by different faults. Palana and other Tertiary formations are showing same altitude.

Hydrogeology

Hydro geologically the whole district can be classified into three formations viz. consolidated formation, semi-consolidated formation and unconsolidated formation.

Consolidated Formations

The consolidated formations comprise of metamorphics like schists, gneisses, quartzites and phyllites of Precambrian age and limestone & sandstone of Marwar Super Group. Metamorphics are normally impervious except in the presence of a few weak planes, joints, weathered zones and kinks which contain moderate and limited quantity of ground water. These are basically phreatic aquifers and availability of ground water depends on good amount of precipitation. Such aquifers are mainly confined to eastern part of Riyan and Parbatsar blocks, central part of Makarana block, eastern part of Ladnun block and northern part of Didwana block.

Jodhpur sandstone mainly consists of medium to coarse grained sand, cemented with silica and ferruginous matrix. The sandstone is intercalated with siltstone and shale. The sandstone is hard, compact and forms medium aquifer. Wherever, ground water occurs, it mainly occupies either void space between the adjacent grains (primary porosity) and in the secondary porosity zones. Jodhpur sandstone, which mainly occurs in southwestern part of Mundwa block and central part of Ladnun block. Ground water in this formation occurs under semi-confined to unconfined condition. Thickness of sandstone varies from 100-250m.

Bilara limestone forms the most important and potential aquifer comprising limestone, dolomite and shale. The limestone is white to grey in colour, hard and compact, cherty and dolomitic in nature. However, it is cavernous at places and susceptible to solution activity which gives rise to high discharge in wells. This formation covers western and north-central parts of Nagaur block, central part of Mundwa block, west central & eastern parts of Jayal block and part of Ladnun block. Thickness of limestone varies from 100- 300 m.

Nagaur sandstone is coarse to fine grained, loosely cemented with gravel at basal part which acts as good aquifer and occupies mainly parts of Nagaur, Jayal, Mundwa and Merta blocks. The associated rocks are siltstone and shale. Its thickness varies from 140-240 m.

Semi-consolidated Formation. These include only Palana sandstone consisting of very coarse grained, gravelly sand with intercalations of clay with kankar and lignite. Ground water occurs under phreatic to confined condition and saturated thickness of 40 m constitutes a potential aquifer. This mainly occurs in parts of Merta, Mundwa and Jayal blocks. Its thickness varies from 100-250 m.

Unconsolidated Formation

Quaternary alluvium is the main aquifer which is comprised of unconsolidated to loosely consolidated fine to coarse grained sand having intercalations and intermixing with silt, clay with `kankar`. Ground water occurs under unconfined to semi-confined conditions, Quaternary alluvium covers parts of Riyan, Merta, Degana, Parbatsar, Makarana, Kuchaman, Didwana, Ladnun and Jayal blocks. Its thickness is limited to 200m.

A map depicting hydrogeological features is presented as Figure-7:

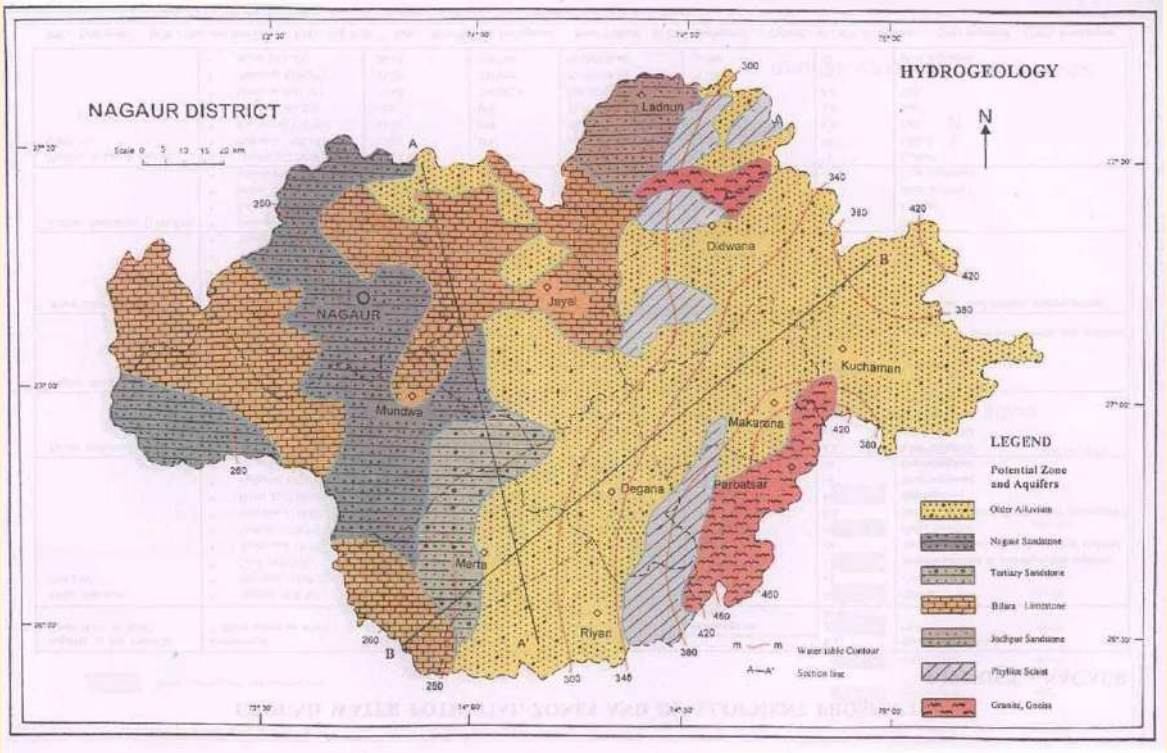


Fig.-7: Hydrogeology

Aquifer Parameters

The aquifer parameters of dug wells and tube wells have been studied from pumping tests. The yield of tube wells\ dug wells in metamorphic rocks like schists, gneisses, quartzites, phyllites and gneisses ranges from 5-20 m³\hr. The tube wells in Jodhpur sandstone give discharge in range of 12 to 32 m³\hr. Discharge\yield of tube wells in Bilara limestone varies from 5 to 40 m³\hr and that of Nagaur sandstone varies from 6.5 m³\hr to 36 m³\hr. The discharge of tube wells in Palana sandstone ranges from 5.0 m³\hr to 30 m³\hr and that of tube wells\dug wells in Quaternary alluvium varies from 12 m³\hr to 32 m³\hr. The deeper aquifers are being exploited extensively through low to medium duty tube wells.

Water Level Scenario

Central Ground Water Board periodically monitors ground water levels four times in a year during the months of January, May (Pre-monsoon), August and November (Post-monsoon). In Nagaur district water levels are monitored through a network of 89 observation wells (National Hydrograph Network Stations).

Depth to Water Level (2019)

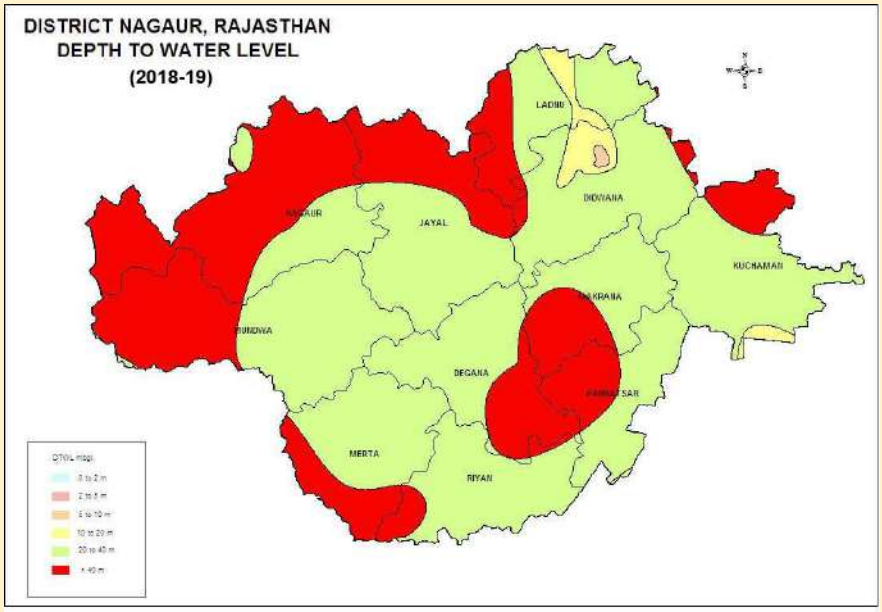
Depth to water level in the district varied from 5.00 to 68.46 mbgl and 4.97 to 68.06 mbgl during Pre-monsoon (May, 2019) and monsoon (July, 2019) periods respectively. Block-wise depth to water levels during Pre-monsoon and Post- monsoon and water level fluctuation between the two seasons are given in Table 3.

Table-2: Block wise details of depth to water level during May, 2019 and July, 2019 and water level fluctuation during May-July, 2019:

Block	Pre-monsoon water level in m bgl		Monsoon water level in m bgl		Water level fluctuation in m (Pre– Mn.)			
					Rise		Fall	
	Min	Max	Min	Max	Min	Max	Min	Max
Degana	5.00	36.74	5.34	45.22	0.90	1.05	-	-
Didwana	5.37	30.47	4.97	28.67	0.40	9.70	0.00	0.30
Jayal	37.06	51.43	37.36	51.53	-	-	0.10	0.30
Kuchaman	22.12	-	21.19	-	0.93	-	-	-
Ladnun	**19.87**	**-**	**25.62**	**28.47**	**-**	**-**	**8.60**	**-**
Merta	-	-	-	-	-	-	-	-
Mundwa	53.68	-	53.88	54.81	-	-	0.20	-
Nagaur	32.30	68.46	32.30	68.06	0.00	0.40	0.30	-
Parbatsar	-	-	-	-	-	-	-	-
Riyan	-	53.00	12.99	50.66	2.34	-	-	-
District	5.00	68.46	4.97	68.06	0.00	9.70	0.00	0.30

Fig.-8: Depth to Water Level

Depth to water level maps for Pre-monsoon 2018, Post Monsoon 2018 and Seasonal water level fluctuation (Pre & Monsoon, 2019) of district have been presented. During Pre-monsoon, the water levels in major part of the district varied in depth from 20 to 40 m. Deeper water levels (> 40 m) were observed in northwestern, northeastern, western, southwestern and central parts of the district. Shallow water levels (5 to 20 m) were observed in localized pockets in the northern part of the district.



During Post-monsoon season again, water levels in major part of the district varied from 20 to 40 m and deeper water levels (>40 m) were observed in northwestern, western, southwestern and northeastern parts and localized pockets in central part of the district. Water levels in the range of 5 to 20 m were observed in the southeastern part of the district.

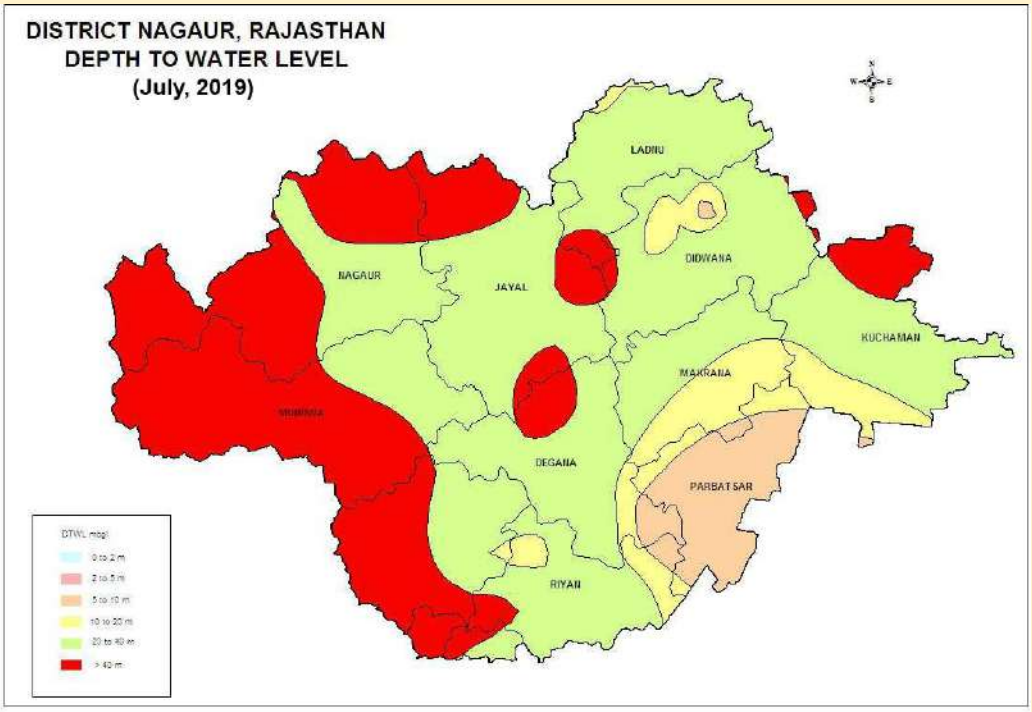


Figure-9: Depth to Water Level - Post-monsoon 2019 (July, 2019)

Seasonal water level fluctuation (May, 2019 – July, 2019):

Seasonal water level fluctuation map during Pre- and Post-monsoon season indicates rise in ground water levels in all the blocks except, parts of Mundwa, Nagaur, Jayal and Ladnun blocks. Major part of the district has registered rise in the range of 0-2 m. Decline of >4m has been observed in parts of Ladnun and Didwana blocks.

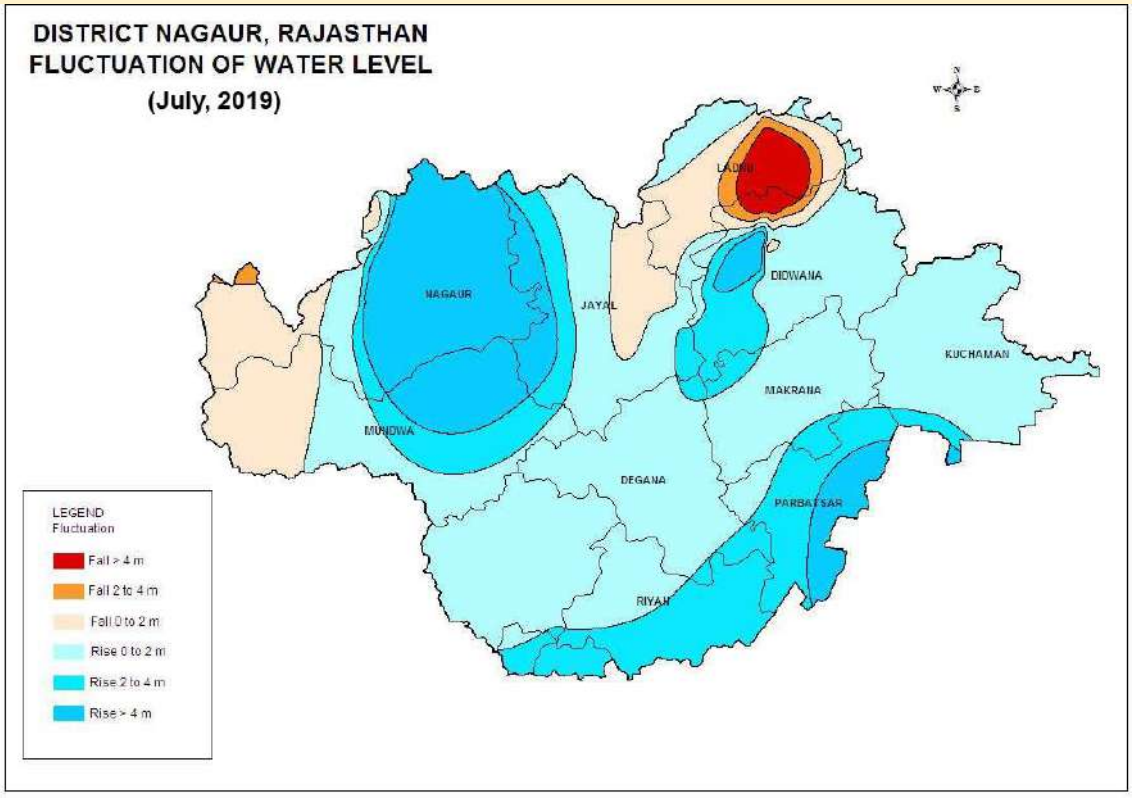


Figure 10: Seasonal water level fluctuation (Pre & Post-monsoon)

Water Level Trend

Water Level fluctuation Trend for Pre monsoon, 2002–2018 and Post monsoon, 2002 - 2018 reveal the declining trend of ground water levels in the range of 0 to 0.25 m/year has been observed in major part of the district except parts of Mundwa, Merta, Didwana, Parbatsar blocks, where rising trend in the range of 0 to 0.5 m/year in ground water levels has been noticed.

During Post-monsoon period in the long term, major part of the district has registered declining trend in the range of 0 to 0.25 m/ year while the remaining part of the district has registered rising trend in water levels in the range of 0 to 0.25 m/ year. Increased ground water draft to meet the increased demand of agriculture and domestic sector is the main cause for declining trend of ground water levels.

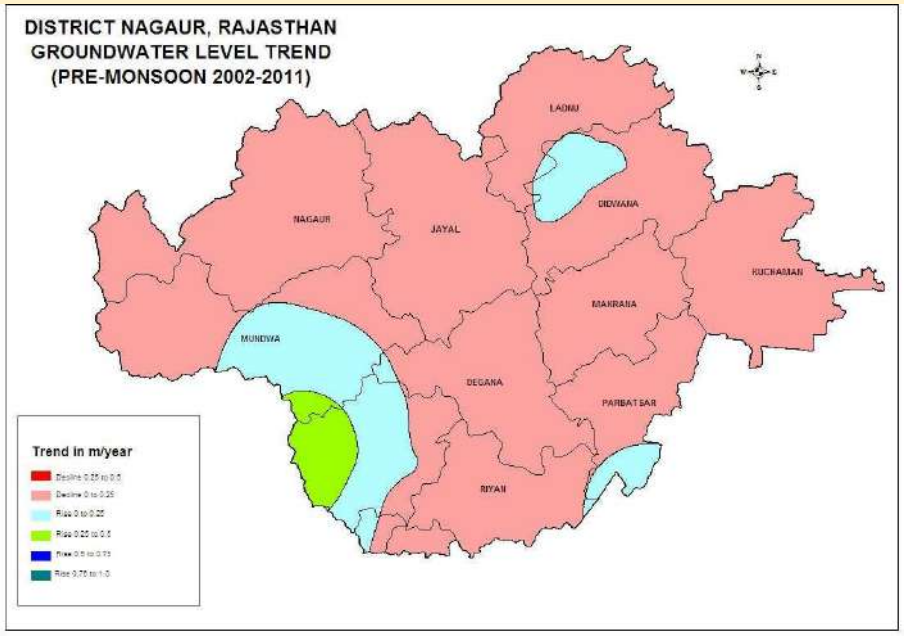


Figure 11: Water Level Trend

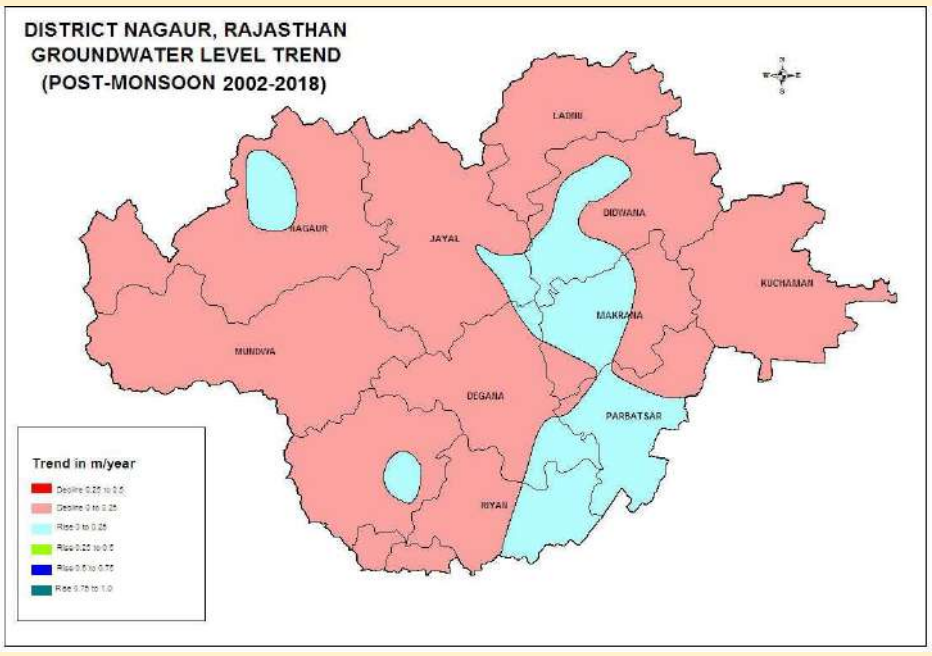


Figure 12: Water Level Trend (Post-monsoon, 2002 - 2018)

Ground Water Resources

Central Ground Water Board and Ground Water Department, Government of Rajasthan have jointly estimated the ground water resources of Nagaur district based on GEC-97 methodology. The same are presented in Table 4 below. Ground Water Resources estimation was carried out for 17718.25 sq. km. area out of which nil sq. km. is under command, 16378.50 sq. km. area is non-command. Ground Water Resources estimation was also carried out for 1339.75 sq. km. of saline area.

Table-3: Estimates of fresh ground water resources in Nagaur district (As on July, 2019):

Block	Type of area	Total annual replenishable resource (mcm)	Net annual ground water availability (mcm)	Annual ground water withdrawal for irrigation (mcm)	Annual groundwater withdrawal for domestic and other uses (mcm)	Annual ground water withdrawal for all uses (mcm)	Stage of ground water develop-ment (%)	Category
Degana (Excluding Saline)	NC	42.7205	38.4485	46.7125	14.9088	61.6213	160.27	OVER EXPLO.
Didwana (Excl. Saline)	NC	63.2149	56.8934	74.0685	18.1200	92.1885	162.04	OVER EXPLO.
Jayal (Excl. Saline)	NC	59.3985	53.4587	37.4225	19.9040	57.3265	107.24	OVER EXPLO.
Kuchaman (Excl. Saline)	NC	72.3797	65.9525	160.0143	16.2400	176.2543	267.24	OVER EXPLO.
Ladnun (Excl. Saline)	**NC**	**42.8697**	**38.5827**	**23.6406**	**11.8307**	**35.4714**	**91.94**	**CRITICAL**
Makrana (Excl. Saline)	NC	49.2807	44.3526	32.2364	14.9456	47.1820	106.38	OVER EXPLO.
Merta (Excl. Saline)	NC	50.7527	45.6774	120.8390	13.4400	134.2790	293.97	OVER EXPLO.
Mundwa (Excl. Saline)	NC	70.8171	63.7354	170.5655	29.9520	200.5175	314.61	OVER EXPLO.
Nagaur (Excl. Saline)	NC	55.8985	50.5966	24.7045	17.0560	41.7605	82.54	SEMICRITICAL
Parbatsar (Excl. Saline)	NC	38.4671	34.6204	42.0653	7.9083	49.9736	144.35	OVER EXPLO.
Riyan (Excl. Saline)	NC	58.3085	52.4776	61.4845	11.2704	72.7549	138.64	OVER EXPLO.
TOTAL OF DISTRICT (Excluding Saline)	NC	604.1080	544.7959	793.7536	175.5758	969.3294	177.93	
TOTAL OF SALINE		**54.9100**	**49.4189**	**8.3073**	**4.9440**	**13.2513**	**26.81**	

Stage of ground water development in the district as on 31.7.2019 is 177.93%, which indicates that the scope of ground water development is already exhausted. Nine blocks viz. Degana, Didwana, Jayal, Kuchaman, Makarana, Merta, Mundwa, Parbatsar and Riyan have been categorized as "Over-exploited".

Ladnun block has been categorized as "Critical" and Nagaur block as "Semi-critical. Stage of ground water development is even more than 300% in Mundwa block, above 250% in Kuchaman and Merta blocks, above 150% in Degana and Didwana blocks, above 125% in Riyan and Parbatsar blocks and above 100% in Makarana and Jayal blocks.

Ground Water Quality

A perusal of analytical results of water samples collected during May 2019 indicates that the quality of ground water in phreatic aquifer varies widely from saline to fresh. Electrical Conductivity (EC) ranges between 1380 to 16240 µS/ cm at 25◦C. It has been observed that by and large, EC conforms broadly with chloride concentration. In greater part of the area, it is within 5000 µS/cm at 25◦C. Higher values of EC have been observed in the west central part of the district and also in depressions in the vicinity of the saline lakes. The chloride content ranges from 50 to 5069 ppm in phreatic aquifer.

Fluoride in the ground water ranges between traces and 11.20 mg/l. Fluoride concentration in excess of maximum permissible limit of 1.5 mg/liter has been noticed in central and northeastern parts of the district.Nitrate concentration in ground water varies widely. Its concentration ranges between traces to as high as 1000 ppm.

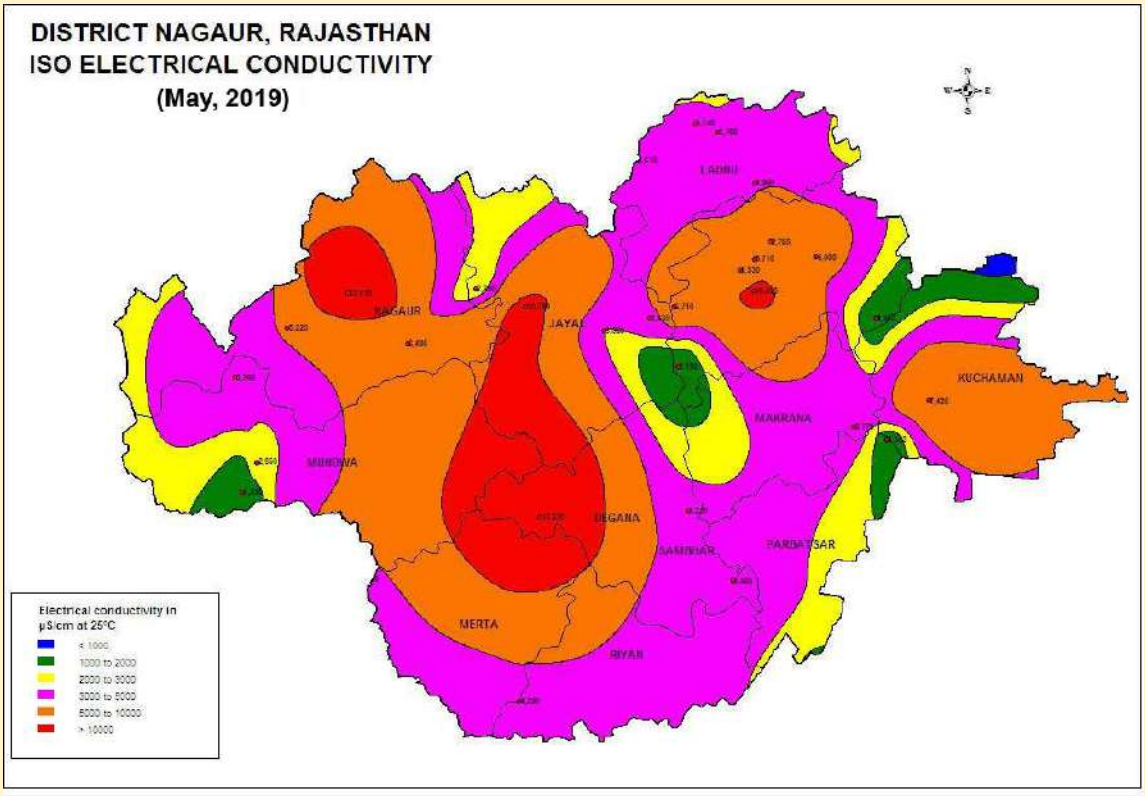


Figure-13: Map showing distribution of Electrical Conductivity in Nagaur District

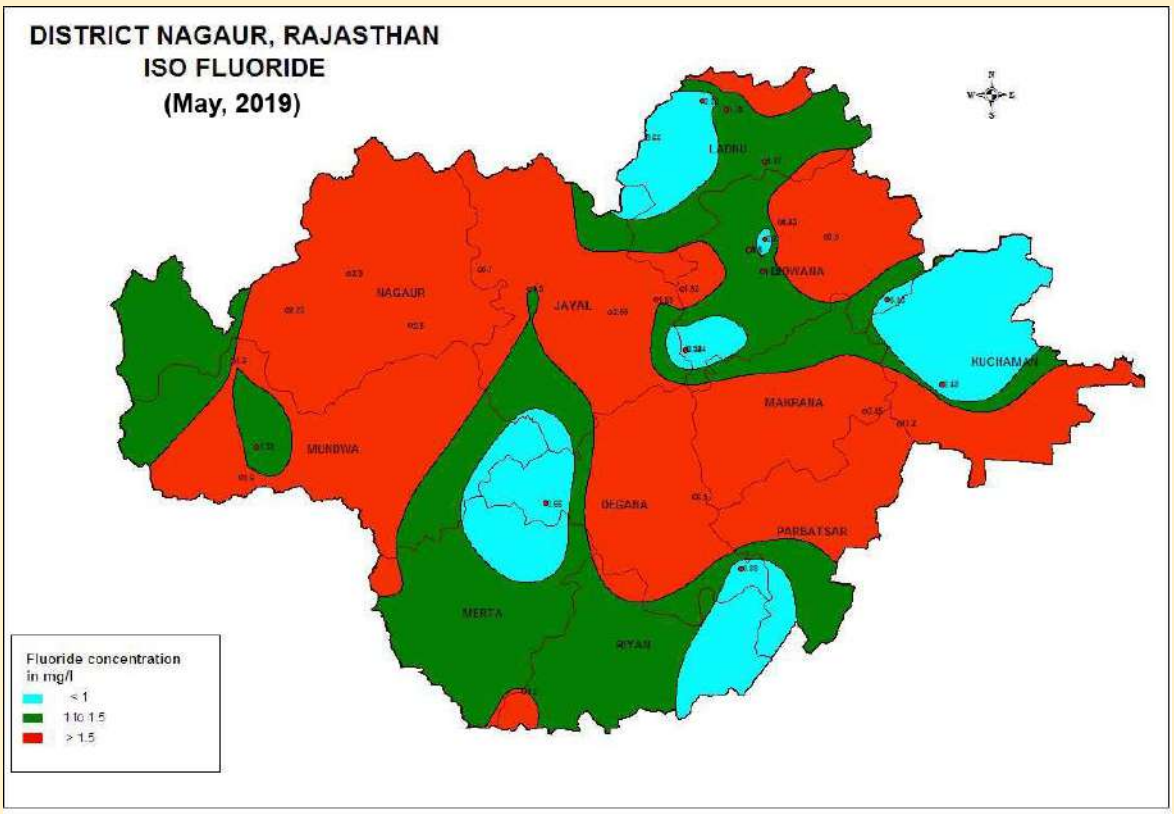


Figure-14: Map Showing Distribution of Fluoride in Nagaur District

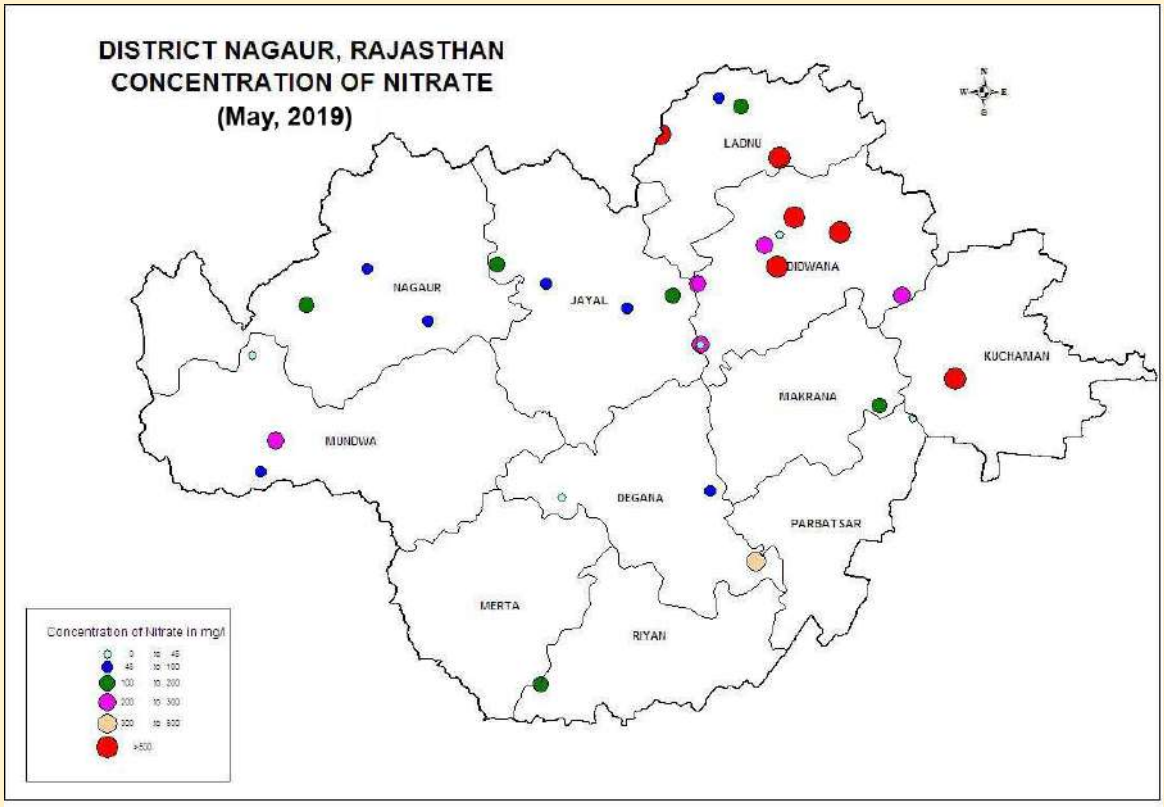


Figure-15: Map Showing Distribution of Nitrate in Nagaur District

The Iron concentration ranges between nil to 2.21 mg/l in the district. Iron concentration in excess of permissible limit of 1 mg/liter has been noticed in localized pockets in Nagaur, Mundwa and Didwana blocks.

Ground Water Quality in Deeper Aquifers

Ground water quality is brackish to saline from east of Merta to Degana and from Didwana to Nagaur via Jayal block in the central part of the district. In this big pocket covering about 6000 km2 area the E.C. of ground water is more than 5000 µS / cm at 25°C. There are three pockets namely around Nimri in Ladnun block, around Gotan in Merta block and in a longitudinal belt in the eastern part of the district where the E.C. of ground water is within 2000 µS /cm at 25°C.

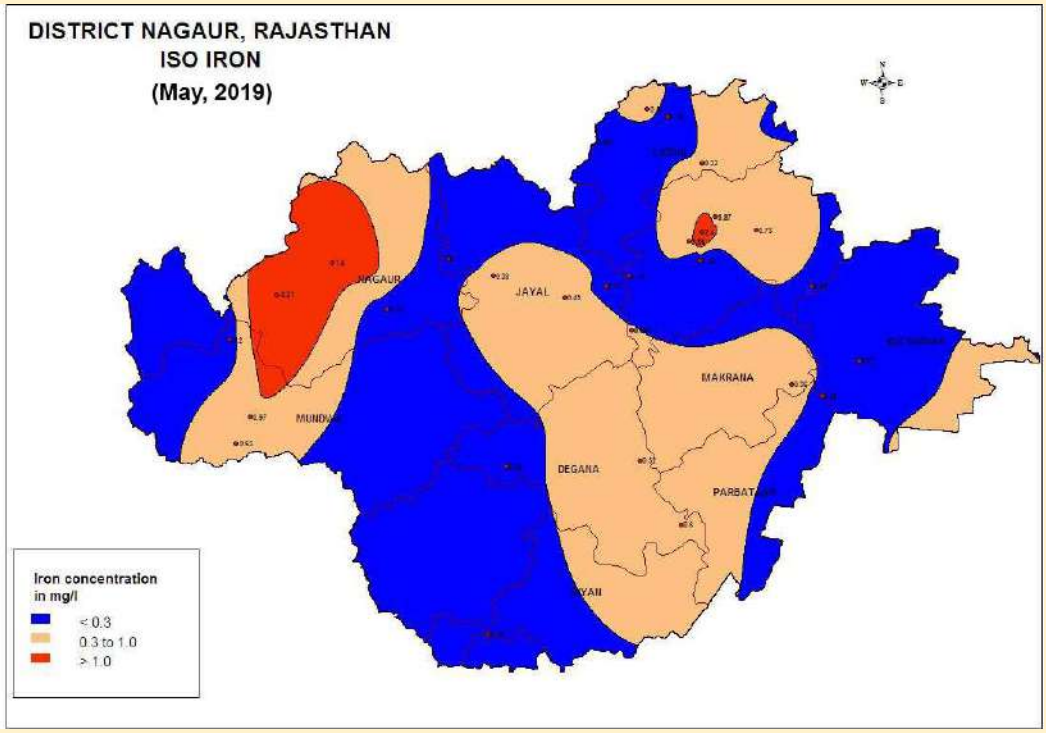


Fig. 16: Depiction of Iron Content

Ground water in the alluvium is in general better in quality than that found in the sandstones of Nagaur and Palana series. Ground water in Quaternary alluvium has T.D.S. less than 1000 ppm (E.C. less than 2000 micro mhos/ cm) only, whereas in the eastern part, the range of T.D.S is between 1000-3000 ppm. In the wells penetrating Tertiary sediments the T.D.S exceeds 3000 ppm.

The E.C. of ground water in the shallow aquifer of Nagaur and Palana sandstone varies from 900 to 6000 micro mhos/cm at 25°C. However, the quality of water deteriorates with depth. In a borehole of 421.20 m depth at Merta City, EC as high as 28496 µS/cm was observed. In tube wells of average depth of around 80 m tapping sandstones, the EC of ground water is around 2000 µS/cm. In tube wells tapping phyllites, schists and gneisses, quality of ground water is very poor.

The fluoride content in ground water of tube wells constructed at Kanwai (Didwana block) and Roru and As Ki Dhani (Ladnun block) was observed to be more than 3 ppm. The production well at Luniawas (Merta block) and Gorera (Nagaur block) also yielded water with more than 3 ppm fluoride.

Status of Ground Water Exploration

Status of ground water exploration as on 31.07.2019 in Nagaur district is furnished in Table-4.

Table-4: Status of exploratory wells drilled in Nagaur district

Type of borehole	Formation			Total
	Unconsolidated	Semi-consolidated	Consolidated	
EW	16	15	22	53
OW	-	19	-	19
SH	17	4	1	23
PZ	4	6	-	10

A total of 16 exploratory wells, 17 slim holes and 4 piezometers have been drilled in unconsolidated formation. Most of the exploratory wells drilled in alluvium have been drilled in the depth range of 32 to 275 meters with depth of well construction varying from 58 to 80m. Discharge of wells ranges from 220 lpm to 1513 lpm for drawdown up to 15 meters indicating potential of aquifer. Transmissivity value varies from 50 to 156 m2/day.

A total of 15 exploratory wells, 19 observation wells, 4 slim holes and 6 piezometers have been constructed in semi consolidated formation [Tertiary sandstone (Palana) and Nagaur Sandstone]. Depth of drilling varied from 49 to 443 m and depth of construction of wells varied from 49 to 257 m. Discharge of wells varied from 100 to 550 lpm with draw down varying from 1.14 to 4.05 m. Transmissivity of formation varies from 51 to 528 m2/day.

A total of 22 exploratory wells and 1 slim hole have been drilled in consolidated formation (Jodhpur sandstone, Bilara limestone of Marwar Super Group, quartzite, schist, limestone of Delhi Super Group and schist and gneisses of Bhilwara Super Group). The depth of bore wells ranges from 80 to 223.30 m. Discharge of wells varies from <50 lpm to 800 lpm.

Ground Water Related Issues & Problems

Major part of the district is covered by hard rock formations such as Jodhpur sandstone, Nagaur sandstone Bilara Limestone, Delhi Super Group metamorphics and granites. These have poor water yielding capacity except rocks of Marwar Super Group. Also, such areas suffer from water quality problem and in some of the areas ground water is highly saline. Villages located in such areas have the basic problem of scarcity of drinking water and the situation becomes very critical in summers and in drought years.

Another problem of concern in the district is that most of the potential zones have witnessed heavy ground water development causing lowering of water table and drying up of large number of shallow wells or reduction in their yields. Heavy decline of more than 15 m has been observed in Mundwa, Merta, Jayal and Kuchaman blocks during last 10 years.

Ground Water Management Strategy

Water Conservation and Artificial Recharge

Precious ground water resources have to be conserved for sustainable availability. Artificial recharge measures need to be implemented on large scale for augmenting ground water resources by roof top rain water harvesting, construction of sub surface barriers, anicuts and other suitable recharge structures at appropriate locations.

The Institutional Background

Jain Vishva Bharati Institute (JVBI) is committed to provide highest quality of educational services to the utmost satisfaction of the students and give them an opportunity to cultivate an integrated personality blended with spirituality and moral values. University torch bearers have taken a responsibility for this investment to nurture the Next-Gen leaders with a vision to bridge the existing skill gap by way of providing not only the skilled personnel but also the human resources with values.

University fosters a culture of Continuous Learning through its Directorate of Distance Learning to develop future innovative leaders of international repute, who are quick to learn & implement, understand changing customer needs, respect humanitarian values, are highly comfortable and creative with change and have the ability to revamp operations modestly.

The modern infrastructure and learner centric andragogy at JVBI extend full support to the learners and the University is focused to invest more in "Nurturing Future Leaders" to produce much more resourceful and productive employee respecting human values for each level in the organization, who can emerge as a "Green Graduates" or a "Tenured Senior Managers". To map the galloping pace of innovations blended with changing technology and HR systems. The University Administration is determined to inculcate Domain Specific Skills and Soft Skills to our emerging innovative leaders and make them future ready. University has focused to inculcate skills and behaviors for a good cultural fit along with right academic background. Salient features of its infrastructure are as follows:

• 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

The Institutional Legacy

JVBI was established with the inspiration of Gurudev Tulsi in Ladnun, Dist Nagaur, Rajasthan. In 1991, Government of India notified JVBI as Deemed-to-be University under Section 3 of University Grants Commission Act, 1956. The Institute continues to be housed in the common campus of its parent body organization Jain Vishva Bharati. Gurudev Shri Tulsi remained its first constitutional Anushasta (moral and spiritual guide) followed by Acharya Shri Mahaprajna as its second Anushasta. Acharya Mahashraman is its present Anushasta. The goal of the JVBI is has been clearly spelt out in the Preamble of its Constitution (Memorandum and Articles of Association) which reads as under:

"The Jain Vishva Bharati Institute is an endeavour in the direction of putting into practice, promote and propagate the high ideals of Anekant, Ahimsa, Tolerance and Peaceful Co-existence for the weal of the mankind. We, the members of the Jain Vishva Bharati, therefore resolve to constitute and establish the said University of Advanced Studies, Research & Training in Jainology in the context of comparative studies in Indology, World Religions, Ahimsa and World Peace."

Vision

The vision of the Jain Vishva Bharati Institute is to create a niche for itself in the field of higher education in the field of practice, promotion and propagation of the core Human Values and Ethics as enshrined in the Jain Traditions in particular and in respect of Anekant. It endeavors in the direction of putting into practice and to promote as well as to propagate Anekant (Non-absolutic outlook), Ahimsa (Non-violence), Tolerance, Peaceful Co-existence for the weal of mankind.

Mission

The mission of JVBI is to integrate modern science with the ancient wisdom of the great spiritual practitioners and visionary seers. The University seeks to interweave moral and spiritual norms and values with the materialistic and economic fibers of mankind to foster and develop universal human relationships for the peaceful co-existence of individuals, groups, communities, sects, races, religions and nations.

The first and foremost task of this University has been to develop an International Center of Jainological Studies and Research. It aims at imparting higher education and preparing scholars in this little-explored treasure of knowledge and conducting research in different Sciences hidden in Jain Agamas as well as to bring to light before the common masses and the international community by translating them from Prakrit into Hindi, English and other major languages of the world.

Objectives

Jain Vishva Bharati Institute is solely an educational institution dedicated to cultivate and practice high ideals of "Anekant" including tolerance and peaceful co-existence for the weal of the mankind at the global level as propagated by the Anushasta. The objectives for which the Institute is established are:

- To enable creation of institutions deemed to be university under the 'de novo' category devoted to unique and emerging areas of knowledge, not being pursued by conventional or existing institutions - particularly in specific areas of study and research preferably sponsored by the Government of a State / UT or the Central Government regarded as important for strategic needs of the country or for the preservation of our cultural heritage, so determined by a well laid-out process of wide consultation with the eminent peers of academic community with the prior approval of Central Government;
- However, it shall not be an Institution imparting education leading to conventional degrees only, without strong inter-disciplinary and innovative programmes with matching research capabilities, and should have achieved peer recognition and verifiable scholarly attainment and research output.
- to provide for research and for advancement of and dissemination of knowledge and extension activities in the Oriental Learning— Prakrit Language and Literature, Pali, Sanskrit, Apabhramsha, Jainology, Philosophy, Religion, Comparative Studies in Philosophy and World Religions, Astrology, Mantravidya, Avadhanvidya (Memonics), Yoga and Sadhana, Ayurveda, Naturopathy, Colour Therapy, Magnet Therapy, Epigraphy, Paleography, Jeevan Vigyan & Preksha Dhyan (Science of Living & Preksha Meditation) and the fundamental principles of Shramana Culture and such other related and ancilliary or supplementary subjects as may be permitted under the UGC regulations and /or guidelines and the higher education policies by the Government;
- to provide facilities for study and research & extension in discipline of Indian Yoga with special emphasis on spiritual discipline embedded in the Jain Agamas;
- to encourage students of higher education in critical study of the above - mentioned & related disciplines and to equip them with an analytical outlook to discover the elements of social sciences in the various disciplines;
- to edit the original works for a comparative and critical study of the aforesaid & related subjects;
- to prepare and publish reference books such as Dictionary and Encyclopedias on Prakrit Language and Literature, Jain Philosophy and Culture and related aspects; to provide for the teaching of other Indian and foreign languages and research in the context of the aim of the Institute;
- to give special emphasis on the synthesis of the spiritual heritage of the ancient Indian Shramana Culture with the modern scientific outlook in the field of education and research and inculcate amongst students the essential values and ideals of ancient Indian culture and civilization;

- to organize residential community of students and teachers for living together on patterns of ancient Indian Educational Centres and Ashramas;
- to establish courses of study, research & extension and to provide the instruction & extension in such branches of study as the Institute deems appropriate for the advancement of learning and dissemination of knowledge in such disciplines;
- to sanction and award financial assistance in the form of scholarships, stipends, awards, prizes, loans, etc. to students, scholars, researchers, spiritually devoted persons, social workers, and the institutions and to manage and arrange with cost or free for their boarding and lodging;
- to undertake suitable extension activities for the public welfare and social advancements;
- to disseminate the popular aspects of Prakrit and Jain learnings among the common people by holding meetings, conferences, seminars and discourses by inviting eminent scholars etc.;
- to supervise, control and regulate the discipline of the students of the Institute and to make arrangements for promoting their health, general welfare and cultural and corporate life.
- to establish laboratories as part of the Institute for the practice of Yoga, Meditation and Self-realization and to arrange for the training in these disciplines;
- to publish books, journals, monographs and periodicals and papers in furtherance of the objects of the Institute and to establish a library of CD's;
- to establish museum(s) and preserve rare manuscripts, letters, pictures, stone images, artistic works, and archaeological and historical exhibits;
- to build up and equip an up-to-date library of printed books, manuscripts, journals and periodicals relating to the abovementioned and related subjects and to establish reading rooms;
- to institute awards for outstanding contributions made by individuals or institutions for the promotion of and to the cause of global peace, propagation of Ahimsa, harmony and goodwill and in such other fields of national integration and in international understanding through literary, scientific or humanistic pursuits in accordance with Rules and Bye-laws adopted from time to time;
- to have well established, broad based and viable under-graduate, post-graduate and research programmes in several disciplines with firm inter-disciplinary orientation and linkages;
- The institution shall be a not-for-profit organization and shall not be engaged in commercialization of higher education, under-graduate, post-graduate and research programmes.

Provided, however, no object shall be pursued unless permissible under the rules of the UGC.

Major Thrusts

- Non-absolute Outlook (*Anekanta*)
- Nonviolence (*Ahimsa*)
- Tolerance (*Sahishnuta*)
- Peaceful Co-existence
- Inclusiveness
- Creating a culture of understanding, communal harmony and social-services
- Indological Studies
- Platform of Inter-faith Dialogues
- Value-based Studies
- Synthesis of Ancient Indian Shraman Culture with the modern scientific outlook

Major Tasks

- Development of Oriental Studies
- Establishment of an International Centre of Jainology Studies and
- Research
- Provide a knowledge platform for the rural masses of backward region
- Enhance Women Empowerment
- Organization of integrated value-based courses

Core-Departments

- Department of Jainology and Comparative Religion & Philosophy
- Department of Prakrit and Sanskrit
- Department of Nonviolence and Peace
- Department of Yoga and Science of Living

Other Departments

- Department of Social Work
- Department of Education
- Department of English

Courses offered by the Constituent College

- B.A., B.Com., B.Sc.

Directorate of Distance Education

Programmes:

- M.A. in Jainology and Comparative Religion & Philosophy, Yoga and Science of Living, Hindi, English, Political Science, B.A. and B.Com.

Quality of Life Support Systems in the Institute Campus

Air Quality

AQI, the yardstick running from 0 to 500 for understanding the overall air quality was taken into consideration, as higher the AQI value, the greater shall be the level of air pollution and would be of the greater health concern.

- For each pollutant an AQI value of 100 generally corresponds to an ambient air concentration that equals the level of the short-term national ambient air quality standard for protection of public health. AQI values at or below 100 are generally thought of as satisfactory. When AQI values are above 100, air quality is unhealthy: at first for certain sensitive groups of people, then for everyone as AQI values get higher.
- The AQI has been divided into six categories. Each category corresponds to a different level of health concern. Each category also has a specific colour code. The colour code makes it easy for people to quickly determine whether air quality is reaching unhealthy levels in their communities.

AQI calculation

- Generally an AQI (Air Quality Index) number is calculated from 6 key pollutants. While this is true, the AQI formula itself does not use all 6 pollutants in one equation. Rather, each of the 6 pollutants has both a concentration and AQI value. The pollutant with the highest AQI level, or 'risk to health', is deemed the "main pollutant" and that pollutant's AQI determines the overall AQI number across all the included pollutants.
- AQI is calculated by using the following formula:
- Ip = [(Ihi-Ilow)/(BPhi-BPlow)] (Cp-BPlow)+Ilow,
- Where Ip is the index of the pollutant; Cp is the rounded concentration of pollutant p; BPhi is the breakpoint greater or equal to Cp; BPlow is the breakpoint less than or equal to Cp; Ihi is the AQI corresponding to BPhi; Ilow is the AQI corresponding to BPlow.
- While overall AQI is the highest AQI of the 6 main pollutants, for a majority of locations, the main pollutant in the air is PM2.5 most of the time, which is why we put primary importance on measuring this pollutant. Less frequently, during summer months in many locations the main pollutant may be Ozone, while in particularly sandy or dusty locations it may be PM10.
- There are six AQI categories, namely Good, Satisfactory, Moderately polluted, Poor, Very Poor, and Severe. The proposed AQI will consider eight pollutants (PM10, PM2.5, NO2, SO2, CO, O3, NH3, and Pb) for which short-term (up to 24-hourly averaging period) National Ambient Air Quality Standards are prescribed. Based on the measured ambient concentrations, corresponding standards and likely health impact, a sub-index is calculated for each of these pollutants. The worst sub-index reflects overall AQI. The AQI values and corresponding ambient concentrations (health breakpoints) as well as associated likely health impacts for the identified eight pollutants are as follows (Table 5):

Table-5 : AQI Category, Pollutants and Health Breakpoints								
AQI Category (Range)	**PM10 (24hr)**	**PM2.5 (24hr)**	**NO2 (24hr)**	**O3 (8hr)**	**CO (8hr)**	**SO2 (24hr)**	**NH3 (24hr)**	**Pb (24hr)**
Good (0-50)	0-50	0-30	0-40	0-50	0-1.0	0-40	0-200	0-0.5
Satisfactory (51-100)	51-100	31-60	41-80	51-100	1.1-2.0	41-80	201-400	0.5-1.0
Moderately polluted (101-200)	101-250	61-90	81-180	101-168	2.1-10	81-380	401-800	1.1-2.0
Poor (201-300)	251-350	91-120	181-280	169-208	10-17	381-800	801-1200	2.1-3.0
Very poor (301-400)	351-430	121-250	281-400	209-748	17-34	801-1600	1200-1800	3.1-3.5
Severe (401-500)	**430+**	**250+**	**400+**	**748+**	**34+**	**1600+**	**1800+**	**3.5+**

- AQI value for the JVBI Campus Ladnun as on 31st July 2019 was 45 and the same was Good.
- Main pollutant: PM10
- Temp.: 27°Cclear sky

NO2	9.18 µg/m³, AQI 11 Good
O3	25.95 µg/m³, AQI 25 Good
PM2.5	24.9 µg/m³, AQI 24 Good
SO2	6.33 µg/m³, AQI 6 Good
PM10	45.0 µg/m³, AQI 45 Good
CO	360.0 µg/m³, AQI 43 Average
Humidity	32.0 %
Barometric Pressure	1005.0 hPa
Wind Speed	8.12 m/s
Wind Direction	161.0 degrees

Water Quality Assessment

- Water samples were collected from five sampling stations and analysis was made by way of using the standard APHA methods. The sampling stations were as follows:
    - A – Administrative Block
    - B – Academic Block
    - C – Kalu Kanya Mahavidyalay
    - D – Hostels
    - E – Staff Quarters

Results have been presented as under:

Table-6: Determination of Iron Content

S.No.	Samples	Observed value (mg/ltr)	IS 10500:2012 Desirable limit (mg/ltr)	Remarks
1.	A	0.30	0.3 – 1	Within the limit.
2.	B	0.43	0.3 – 1	
3.	C	0.65	0.3 – 1	
4.	D	0.30	0.3 – 1	
5.	E	0.30	0.3 – 1	

Table-7: Determination of Turbidity

S.No.	Samples	Observed Value (N.T.U)	IS 10500:2012 Desirable Limit (N.T.U)	Remarks
1.	A	0	1 – 5	Below desirable Limit
2.	B	3	1 - 5	Within desirable Limit
3.	C	2	1 - 5	Within desirable limit
4.	D	0	1 - 5	Below desirable limit
5.	E	1	1 - 5	Within desirable limit

Table-8: Total Dissolved Solids

S.No.	Samples	Observed value (mg/ltr)	Desirable limit as per IS 10500:2012 (mg/ltr)	Remarks
1.	A	38	500 - 2000	Suitable for use
2.	B	38	500 - 2000	
3.	C	38	500 - 2000	
4.	D	38	500 - 2000	
5.	E	38	500 - 2000	

Table-9: Determination of Total Hardness

S.No.	Samples	Observed value (mg/ltr)	IS 10500:2012 Desirable limit (mg/ltr)	Remarks
1.	A	60	200 – 600	Below desirable limit
2.	B	76	200 - 600	Below desirable limit
3.	C	154	200 - 600	Below desirable limit
4.	D	232	200 - 600	Within desirable limit
5.	E	32	200 - 600	Below desirable limit

Table-10: Determination of Chloride Content

S.No.	Samples	Observed value (mg/ltr)	IS 10500:2012 Desirable limit (mg/ltr)	Remarks
1.	A	4	250 - 1000	Suitable for drinking
2.	B	6	250 - 1000	
3.	C	4	250 - 1000	
4.	D	8	250 – 1000	
5.	E	6	250 – 1000	

Table-11: Determination of Nitrate Content

S.No	Samples	Observed value (mg/ltr)	IS 10500:2012 Desirable limit (mg/ltr)	Remarks
1.	A	0	45	Nitrate content is nil.
2.	B	0	45	
3.	C	0	45	
4.	D	0	45	
5.	E	0	45	

Table-12: Determination of pH

S.No.	Samples	Observed value (pH)	IS 10500:2012 Desirable Limit (pH)	Remarks
1.	A	6.71	6.5 - 8.5	Suitable for Drinking
2.	B	5.64	6.5 - 8.5	Not suitable for Drinking
3.	C	5.35	6.5 - 8.5	Not suitable for Drinking
4.	D	6.79	6.5 - 8.5	Suitable for Drinking
5.	E	5.42	6.5 - 8.5	Not suitable for Drinking

Table-13: Determination of Fluoride Content

S.No.	Samples	Observed value (mg./ltr.)	IS 10500:2012 Desirable Limit (mg./ltr.)	Remarks
1.	A	1.30	1 – 1.5	Within desirable limit
2.	B	0.18	1 – 1.5	Below desirable limit
3.	C	1.28	1 – 1.5	Within desirable limit
4.	D	1.32	1 – 1.5	Within desirable limit
5.	E	1.30	1 – 1.5	Within desirable limit

Part B: Environmental Practices

B1. WATER MANAGEMENT

Sl. No	Department/Block	Wise use of water	Water leakage	Use of water	Rain Harvest	Use of water	Water quality	Water Use per day in liters	Water Storage	Water tank cleaning
1	Vice Chancellor's Office	√	√	√	√	√	√	50	√	√
2	Registrar's Office	√	√	√	√	√	√	40	√	√
3	Finance Branch	√	√	√	√	√	√	60	√	√
4	Establishment & other offices	√	√	√	√	√	√	50	√	√
5	Computer Centre & Server Maintenance Facility	√	√	√	√	√	√	70	√	√
6	Academic Block	√	√	√	√	√	√	100	√	√
7	Kalu Kanya Mahavidyalay	√	×	√	√	√	√	500	√	√
8	Boys Hostel	√	√	√	√	√	√	500	√	√
9	Girls Hostel	√	×	√	√	√	√	500	√	√
10	Guest House	√	×	√	√	√	√	200	√	√
11	Student's Canteen	√	×	√	√	√	√	500	√	√
12	Play Ground for Girls	√	×	√	×	√	√	50	√	√
13	Play Ground for Boys	√	√	√	×	√	√	100	√	√
14	Professor's Qrs.	√	√	√	√	√	√	1000	√	√
15	Teacher's Lodge	√	√	√	√	√	√	1000	√	√
16	Employees Qrs.	√	√	√	√	√	√	1000	√	√
17	Gardens	√	√	√	×	√	√	1000	√	√
18	Library	√	√	√	×	√	√	50	√	√

B2. WASTE MANAGEMENT

		a	B	c	d	e	f	g	i
Sl. No	Department/Block	Food/Organic waste/day	Non Plastic dry waste	Plastic, Thermocol/	Other (e-waste)	Manageement of Organic Waste	Management of Other Waste?	Waste dumping pit?	Waste Management Practices
1	Vice Chancellor's Office	L	√	√	√	-	-	√	√
2	Registrar's Office	L	√	√	√	√	×	√	√
3	Finance Branch	L	√	√	√	√	×	√	√
4	Establishment & other offices	L	√	√	√	×	×	√	×
5	Computer Centre & Server Maintenance Facility	√	√	√	√	×	×	√	×
6	Academic Block	√	√	×	×	×	×	√	√
7	Kalu Kanya Mahavidyalay	√	√	×	×	√	×	√	×
8	Boys Hostel	√	√	√	√	×	×	√	-
9	Girls Hostel	√	√		√	×	×	√	×
10	Guest House	√	√	√	×	×	×	×	×
11	Student's Canteen	H	√	×	×	×	×	√	√
12	Play Ground for Girls	Nil	√	√	Nil	-	-	√	×
13	Play Ground for Boys	Nil	Nil	Nil	Nil	√	√	√	√
14	Professor's Qrs.	H	√	√	×	×	×	√	×
15	Teacher's Lodge	H	√	×	√	√	√	×	×
16	Employees Qrs.	L	√	√		×	×	√	√
17	Gardens	Nil	Nil	Nil	×	×	×	√	√
18	Library	L	√	√	√	×	√	√	√

B3. ENERGY MANAGEMENT

Sl. No	Department /Block	No. of Tubes + Bulbs	No. of A/C	No. of LCD Projector	No. of Photocopier	Computers+ Printer	LEDs	Non-conventional (solar)	Star rating	Energy Management Practices
1	Vice Chancellor's Office	100	2	2	2	04	-	-	√	√
2	Registrar's Office	60	1	X	1	02	×	×	√	√
3	Finance Branch	80	1	X	1	10	×	×	√	√
4	Establishment & other offices	30	2	X	1	09	×	×	√	√
5	Computer Centre & Server Maintenance Facility	111	5	1	1	146	×	×	√	√
6	Academic Block	35	2	2	3	130	×	×	×	×
7	Kalu Kanya Mahavidyalay	1429	8	10	2	318	×	×	×	×
8	Boys Hostel	60	X	X	X	2	×	×	√	×
9	Girls Hostel	30	X	X	X	3	×	×	√	√
10	Guest House	25	6	X	X	X	×	×	×	×
11	Student's Canteen	20	X	X	X	X	×	×	×	-
12	Play Ground for Girls	10	X	X	X	X	×	×	√	×
13	Play Ground for Boys	10	X	X	X	X	×	×	√	√
14	Professor's Qrs.	500	3	X	X	10	×	×	×	-
15	Teacher's Lodge	400	2	X	X	08	×	×	×	×
16	Employees Qrs.	350	X	X	X	05	×	×	√	√
17	Gardens	10	X	X	X	X	×	×	×	√
18	Library	235	1	1	2	40	×	×	√	×

B4. LANDSCAPE/ENVIRONMENT

Sl. No	Department/Block	Over all Green cover	Garden	Indigenous Trees/Plants	Exotic Plants /Animals	Overall Biodiversity	Landscape Management Plan	Natural water bodies
1	Vice Chancellor's Office	G	√	√	√	√	√	√
2	Registrar's Office	G	√	√	√	√	√	√
3	Finance Branch	G	√	√	√	√	√	√
4	Establishment & other offices	G	√	×	×	√	×	-
5	Computer Centre & Server Maintenance Facility	A	×	√	×	×	×	×
6	Academic Block	A	×	×	×	A	×	×
7	Kalu Kanya Mahavidyalay	A	×	P	×	A	×	×
8	Boys Hostel	G	×	×	×	A	×	×
9	Girls Hostel	A	×	×	×	A	×	×
10	Guest House	A	×	×	×	×	×	×
11	Student's Canteen	A	×	P	×	A	×	×
12	Play Ground for Girls	G	×	A	Nil	√	Nil	Nil
13	Play Ground for Boys	G	√	G	√	G	√	×
14	Professor's Qrs.	G	√	G	×	A	×	×
15	Teacher's Lodge	G	√	G	×	A	×	×
16	Employees Qrs.	G	√	G	×	G	×	Nil
17	Gardens	G	√	√	×	√	√	×
18	Library	A	×	A	√	Avg	×	×
G-Good, A-Average, P-Poor								

B5. BUILT-UP ENVIRONMENT

		*a	b	c	d	e	*f	g	*h	*i	j
Sl. No	Department/Block	Building type	Area in Sq. ft	Eco-friendliness	Fire prevent.	Aesthetic	Serenity of	Ladies	Recreation	Provision for differently abled	Toilets; Men, women,
1	Vice Chancellor's Office	C*i		G	√	G	G	√	×	√	2
2	Registrar's Office	C		G	√	G	√	×	×	×	1
3	Finance Branch	C		√	×	√	G	√		×	5-common
4	Establishment & other offices	C		G	×	G	G	×	×	×	--
5	Computer Centre & Server Maintenance Facility	C		P	×	P	A	×	×	√	1
6	Academic Block	C*i		G	√	A	A	√	√	√	8
7	Kalu Kanya Mahavidyalay	C*i		G	×	A	A	√	√	√	10
8	Boys Hostel	C*i		A	×	A	A	x	√	√	3
9	Girls Hostel	C*i		G	√	G	G	√	√	×	3
10	Guest House	C		A	√	A	A	×	×	√	5
11	Student's Canteen	C*i		G	×	A	A	×	×	√	1
12	Play Ground for Girls	C		A	×	A	G	x	×		x
13	Play Ground for Boys	C		G	√	G	G	×	×	√	x
14	Professor's Qrs.	C		G	×	√	*f	×	×	×	10
15	Teacher's Lodge	C		-	×		-	×	×	√	10
16	Employees Qrs.	C		G	√	G	√	×	×	√	10
17	Gardens	G		√	Nil	Nil	√	x	×	√	X
18	Library	*a		P	×	A	A	√	×	√	4

G-Good, A-Average, P-Poor C-Concrete,

3)* a-Concrete with heritage look

*i- Ramp available.

*a- Concrete- 3 floors

*f—Clean air- good; Paint- Good; Spacious

B6. TRANSPORTATION

	Description	a	b	c	d	e
Sl. No	Department/Block	Dept. Vehicle No	Members with own vehicles	Members using public transportation (%)	Use of Bicycles?	Vehicle pooling?
1	Vice Chancellor's Office	1	1	5	2	-
2	Registrar's Office	3	Staff cars	04	1	×
3	Finance Branch	√	x	8	2	×
4	Establishment & other offices	×	x	9	1	×
5	Computer Centre & Server Maintenance Facility	×	2	6	×	×
6	Academic Block	×	7	25	3	×
7	Kalu Kanya Mahavidyalay	×	3	20	4	×
8	Boys Hostel	√	x	x	×	×
9	Girls Hostel	√	x	x	×	×
10	Guest House	×	x	<60	×	×
11	Student's Canteen	×	x	<85	×	×
12	Play Ground for Girls	×	x	80	×	×
13	Play Ground for Boys	×	x	83	×	√
14	Professor's Qrs.	×	6	90%	×	×
15	Teacher's Lodge	×	3	<90%	×	×
16	Employees Qrs.	×	8	90%	×	×
17	Gardens	×	3	80%	×	×
18	Library	×	x	50%	-	×

B7. GREEN AGENDA IN SYLLABUS

Sl. No	Department /Block	Environmental education in syllabus	Green Research	Green Clubs	Animal Experiments ?.	Ethics committee?	Extension related to Environment
1	Non violence and Peace	√	√	√	×	√	√
2	Prakrit	-	×	√	x	x	x
3	Jain Philosophy	×	√	√	x	√	x
4	Yoga & Science of Living	√	×	√	x	√	√
5	Social Work	×	×	√	×	×	√
6	Education	×	-	×	×	×	√
7	English	√	×	×	×	×	x
8	Undergraduate Studies	√	×	√	×	×	√

Summary Observations

Water management: As such, wise use of water is a general practice in University. Rainwater harvesting is in practice.

Waste management: Land filling is the general waste management strategy adopted by the University. Waste is segregated into biodegradable and non-biodegradable categories for which dustbins have been placed in sufficient numbers. The biodegradable waste is subjected for composting.

Energy management: In addition to a 100kW Grid of Rajasthan Electricity Power Corporation, Solar Panels have been installed at the roof-top of various buildings and also on roads for lighting the streets. The University has replaced the conventional lighting system with the modern LED lights and has reduced the consumption, which is significantly visible in the relevant data.

Landscape/environment: Gardens have been developed on the campus and fairly good type of biodiversity is viewed around the campus.

Transportation: Majority of the students in the campus rely on public transport, indicating lesser carbon foot print of the student community. A good number of students use bicycles also for commuting. Vehicle pooling has also been promoted among students and faculty. The faculty and non-teaching staff voluntarily do not use any motorized vehicle on the first day of the calendar month with a view to reduce the carbon emission.

Increase of Awareness through teaching-learning process: Environmental studies is being taught as a compulsory subject in all the academic programmes.

Water Quality: Sweet potable water is available and treated water is used for human consumption at large. Some people also use the water stored in the underground tanks. Presence of coliform bacteria was not found in the samples tested. Contamination with sewage has not been found.

Swachhata Mission : Swacchta Mission has exhibited its success and as a result use of plastic carry bags, thermocole cups/plates and flex boards have decreased substantially inside the University campus. For managing organic wastes, installation of biogas plant is under consideration. There exists a system for segregation of the hazardous wastes. Toilets have been installed in good number on the campus and also in the hostels.

Plantation of trees: Indigenous trees have been planted on the campus and there is a marked increase in the number of trees every year. The campus enjoys very good number of birds which find their nests on these trees. Number of peacocks has increased substantially.

Governance: The University has come forward in a major way to have a paper-less office, which has resulted substantially in lessening the consumption of paper. The human resources are optimizing the use of electricity in day-to-day discharge of activities.

Areas of Improvement: Some Suggestions

- Framing of an explicit Environment Policy and it's early adoption should be taken up on priority by the University.
- JVBI should regularly organize mass awareness campaigns to educate the stakeholders regarding conservation of water and need for adoption of rain water harvesting and artificial recharge measures.
- The University should also strive hard to conduct training programmes for capacity building of teachers/officers/employees.
- Use of water saving devices like sprinklers, drip irrigation, close field distribution channels etc. should be encouraged.
- Modern horticultural management techniques need to be adopted for effective and optimum utilization of the available water resources for gardening and landscaping. This can be achieved by maintaining irrigation through minimum pumping hours.
- Salt resistant plants should be encouraged for sowing.
- Traditional rainwater harvesting structures like 'Tankas' for roof top rain water storage should be more encouraged for meeting day to day requirements. This will help in reducing ground water withdrawal.
- Small check dams or earthen dams, at suitable sites, may be constructed to store rainwater. This will increase recharge to ground water which ultimately result in increase of yield of wells.

- Metering of Water from bore well and other sources in different uses are not available.
- Water Meter should be installed and maintain the inventory of water resource.
- Stack height should be as per government rules.
- Storage of chemicals like; paints, gums resins, oils, lubricants, acids etc. in designated place and safety/warning signs should be displayed.
- Internal inspection system should be developed for various equipment available in campus.
- Waste Management plan should be put more effectively in place.
- Environmental drills for response against spillage and leakage of chemicals in the campus.
- Plastic usage can be reduced in university campus.
- The monthly inventory of e-waste is required to be maintained in formats on regular basis.

CONCLUDING REMARKS

This audit involved extensive consultation with all the campus team, interactions with key personnel on wide range of issues related to Environmental aspects. The JVBI has taken a pro-active step to constitute an Environmental Committee for sustainable use of resources. An overall 30% of university campus has been dedicated for landscaping. The audit has identified several observations for making the campus premise more environment- friendly. The recommendations are also mentioned with observations for university campus team to initiate actions.

The audit team opines that the overall site is maintained well from environmental perspective. There is no negative observations but few things are important to initiate at an early date, which include maintenance of waste management records of hazardous waste, increase in rainwater harvesting and ground recharge facilities; enrichment of water balance cycle, periodic inspection of buildings; framing of an explicit environment policy, increase of alternative sources of energy; very specifically the solar energy and increase of composting facilities at campus.

APPENDIX: QUESTIONNAIRE

Jain Vishva Bharti Institute (Deemed University)
Ladnun, Rajasthan

ENVIRONMENTAL AUDIT -QUESTIONNAIRE

A. What is the total population of the Institute?

	Male	Female	Total
Students			
Teachers			
Non Teaching Staff			
Sub Total			
Approximate Number of Visitors (Per day)			50
What is the total number of working days of your campus in a year?			286

B. Where is the campus located?

The campus is Located in the heart of Ladnun under the District Nagaur (Rajasthan).

C. Which of the following are available in your institute?

Garden area	Available
Play ground	Available
Kitchen with non-smoking cooking facilities	Available
Toilets	Available
Garbage Or Waste Store Yard	Available
Laboratory	Available
Canteen	Available
Hostel Facility (numbers)	Available
Guest House	Available

D. Which of the following are located near your institute?

Municipal dump yard	Not in vicinity of institute
Garbage heap	No Garbage heaps
Public convenience	Yes , public convenience is available
Sewer line	No
Stagnant water	No stagnant water
Open drainage	No
Industry – (Mention the type)	No
Bus / Railway station	Yes; within 2 kms.
Market / Shopping complex / Public halls	Yes; within 1-2 kms.

E. WASTE MINIMIZATION AND RECYCLING

1.	Does your institute generate any waste? If so, what are they?	Yes, Solid waste, Canteen waste, paper, plastic, Horticulture Waste etc			
2.	What is the approximate amount of waste generated per day? (in Kilograms/month) (approx.)	Bio Degradable	Non-Biodegradable	Hazardous	others
		100kg	25kg	Limited	<1kg
3.	How is the waste generated in the institute managed? By Composting Recycling Reusing Others (specify)	Reuse of one side printed Paper for internal communication. Toilet water is discharged to sealed sumps. Domestic Waste is collected by the local Municipality. Dedicated Waste bins are provided at campus for biodegradable and non-biodegradable waste. Horticulture waste is composted.			
4.	Do you use recycled paper in institute?	Yes			
5.	Do you use reused paper in institute?	Yes			
6.	How would you spread the message of recycling to others in the community? Have you taken any initiatives? If yes, please specify.	Not done in locality for awareness of resource crunches.			
7.	Can you achieve zero garbage in your institute? If yes, how?	Not yet achieved. Possible through waste management plan.			

F. GREENING THE CAMPUS

8.	Is there a garden in your institute?	Yes, about 5000Sq. Meter area developed as Gardens.	
9.	Do students spend time in the garden?	2-4 Hours during winters	
10.	Total number of Plants in Campus	Plant type	Approx. number
		Trees	1180
		Ornamental	1020
11.	Dominant plants on the campus. (Trees, vegetables, herbs, etc.)	Ashoka, Ficus Religeosa, Boganvellia, Arjuna, Mango etc.	
12.	Is the university campus have any Horticulture Department	No But Gardeners have been appointed	
		Services of External Experts are also taken occasionally	
13.	Number of Tree Plantation Drives organized by School per annum. (If Any)	Yes, Two Tree Plantation Drives have been Organized every year during Monsoon. 150 trees and 50 shrubs planted during 2918-19.	
14.	Number of Trees Planted in Last Year.	100	
	Survival Rate	75%	
15.	Plant Distribution Program for Students and Community	Yes, Saplings are distributed to Students and visitors at various Occasions. Besides this landscape of some area in city are developed by Institute.	
16	Plant Ownership Program	Various Trees are Planted and owned by Visitors as well as students. The Name plates are also displayed near the plants.	

G. ENERGY

13.	List ten ways that you use energy in your institute. (Electricity, LPG, firewood, others). Using this list, try to think of ways that you could use less energy every day.	Electricity saves by use of CFL/LED bulbs for illumination, LPG is saved by use of Pressure cookers for cooking food. Alternate source of energy i.e. Solar Heater has been installed.
14.	Are there any energy saving methods employed in your institute? If yes, please specify. If no, suggest some	Yes, Renewable source of energy through solar plant (110 KW) in in commissioning phase. Massages are displayed at various locations to Aware the Peoples about Energy Savings. Use of Natural Lights and Natural Ventilation are promoted.

15.	How many CFL/LED bulbs has your institute installed?	95 % of Total Conventional bulbs are replaced by LED/CFL Lights.
16.	Are any alternative energy sources employed / installed in your institute? (photovoltaic cells for solar energy, windmill, energy efficient stoves, etc.,) Specify.	Yes, photovoltaic cells for solar energy, energy efficient stoves
17.	Do you run "switch off" drills at institute?	Yes
18.	Are your computers and other equipment's put on power-saving mode?	Yes, In Practice
19.	Does your machinery (TV, AC, Computer, weighing balance, printers, etc.) run on standby modes most of the time? If yes, how many hours?	No

H. WATER CONSERVATION

20.	List four uses of water in your institute	Basic use of water in campus: Drinking – 2000KL/month Gardening – STP treated water Kitchen and Toilets – 651KL/month Others – 1350 KL/month
21.	How does your institute store water? Are there any water saving techniques followed in your institute?	01# Overhead Water Tanks and 05# Underground Water tank installed for storage of water. Overflow of water is controlled by valves Which have been provided in water supply system.
22.	If there is water wastage, specify why and How can the wastage be prevented / stopped?	No
23.	Locate the point of entry of water and point of exit of waste water in your institute. Entry- Exit-	Entry- Water comes from two Submersible Pumps at campus Exit- From Water Drainage System to STP and ETP
24.	Write down four ways that could reduce the amount of water used in your institute	Basic Four ways: Closing the taps after usage Maintenance and monitoring of valves in supply system to avoid overflow, leakage and spillage. Water Conservation awareness for Students, Non-teaching employees and Teachers

25.	Record water use from the institute water meter for six months (record at the same time of each day). At the end of the period, compile a table to show how many litres of water have been used.	No, Water Meters not available for calculation of usage of total quantity only.
26.	Does your institute harvest rain water?	Yes. Modern rain water harvesting systems are available.
27.	Is there any water recycling System.	No

I. CLEAN AIR

28.	Are the Rooms in Campus are Well Ventilated?	Yes				
29.	Window Floor ratio of the Rooms	Very Good				
30.	What is the ownership of the vehicles used (Please Tick ▪ only one)		Yes			
			Operator-owned vehicles			
		▪	Universityl-owned vehicles			
			A combination of campus-owned and operator-owned vehicles			
31.	Provide details of University-owned motorized vehicles?	Buses	Cars	Vans	Other	Total
	No. of vehicles	4	11	02	09	26
	No. of vehicles more than five years old	--	--	02	02	--
	No. of Air conditioned vehicles	--	11	01	--	12
	PUC done	Yes	Yes	Yes	Yes	Yes
32.	Specify the type of fuel used by your school's vehicles:	Buses	Cars	Vans	Other	
	Diesel	All	03	01	--	
	Petrol	--	-08	01	--	
	CNG	--	--	--	--	
	LPG	--	--	--	--	
	Electric	--	--	--	1	
33.	Air Quality Monitoring Program (If Any)	Yes, Monitoring is being done by approved Laboratory				
34.	Students suffer from respiratory ailments? (IfAny)	No				
35.	Details of Genset	Yes, 4 Numbers of Kirlosker Silent DG Set The capacities of DG's are 125 KVA				

J. ANIMAL WELFARE

37	List the animals (wild and domestic) found on the campus (dogs, cats, squirrels, birds, insects, etc.)	Birds and Squirrels are commonly found in campus. Dominant bird is Peacock. A variety of birds species and other flora and fauna available, which are not harmful to human. Gardens are well protected and hunting is strictly prohibited.
36.	How many dogs in your area have undergone Animal Birth Control - Anti Rabies (ABC - AR)?	Not applicable since stray dogs are rare/
37.	Does your institute have a Biodiversity Programme?	Awareness programmes are run often by the Dept. of Education and Social Work.

J. ENVIRONMENTAL LEGISLATIVE COMPLIANCE

38.	Are you aware of any environmental Laws pertaining to different aspects of environmental management?	Yes
39.	Does your institute have any rules to protect the environment? List possible rules you could include.	No framed, but awareness activities are carried out.
40.	Dose Environmental Ambient Air Quality Monitoring conducted by the Institute?	Yes
41.	Dose Environmental Water and Wastewater Quality monitoring conducted by the Institute?	Yes
42.	Dose stack monitoring of DG sets conducted bythe Institute?	Yes
43.	Is any warning notice, letter issued by state government bodies?	No
44.	Dose any Hazardous waste generated by the Institute? If yes explain its category and disposal method	No
45.	Dose any Bio medical waste generated by the Institute? If yes explain its category and disposal method	No

K. GENERAL

46.	Are you aware of any environmental Laws pertaining to different aspects of environmental management?	Yes
47.	Does your institute have any rules to protect the environment? List possible rules you could include.	No
48.	Does housekeeping schedule in your campus?	Yes, under the Swatch Bharat movement
49.	Are students and faculties aware of environmental cleanliness ways? If Yes Explain	Yes, Periodically pollution reduction, plantation, energy conservation awareness programmes are organized campaigns carried out by institute
50.	Dose Important Days Like World Environment Day, Earth Day, and Ozone Day etc. eminent in Campus?	Yes
51.	Dose Institute participated in National and Local Environmental Protection Movement?	Yes, Swatch Bharat Abhiyan by students at campus.
52.	Dose Institute has any Recognition/certification for environment friendliness?	No
53.	Dose Institute using renewable energy?	Yes
54.	Dose Institution conducts a green/environmental audit of its campus?	No, This is first environmental audit done by institution
55.	Has the institution been audited / accredited by any other agency such as NABL, NABET, TQPM, NAAC etc.?	Yes. NAAC has accredited the University on three occasions in the past

L. BEST PRACTICES/INITIATIVES FOR ENVIRONMENT

A	Renewable Energy Solar water Heater (02 Numbers) at the campus.	
B	Biodiversity Conservation Flora and fauna consurvation	It is in schedule plan of Campus Environment committee
C	Tree Plantation Drives Two Drives Annually as well as Every Guest is honored by Tree Plantation at Campus.	Yes
d	Ground Water Recharge 5 units of Rain Water Harvesting System.	Yes
E	Pollution Reduction Personal Vehicles (Students) not allowed at campus	Reduction in Air Pollution through vehicular emission. Usage of public transport is encouraged.
F	E Waste Management	Old Computers Donated to Vimal Vidya Vihar and other Schools
G	Solid Waste Management Lifting of garbage from SGT campus on alternate day by Municipal Corporation.	Yes
H	Adoption of Village CSR	5 Villages have been adopted
I	Water Conservation	No
j	Corporate Resource Center (CRC)	JVBI Corporate Resource Center (CRC) is dedicated to nurturing future leaders