Environmental and Green Audit Report

of

The People's Education Society's

Jamkhed Mahavidhyalaya,

Jamkhed, Dist. Ahmednagar

Auditing Agency –
Prathamesh Energy Solution,
A-302, Shiv Unnati Residency,
Kalepadal, Hadapsar
Pune- 411 028

Prathamesh Energy Solution

A-302, Shiv Unnati Residency, Kalepadal, Hadapsar
Pune 411028

Ref: EC/JMJ/22-23/06 Date: 20/02/2023

CERTIFICATE

This is to certify that we have conducted Environmental and Green Audit at **Jamkhed Mahavidhyalaya, Jamkhed,** in the Academic year 2022-23

. The College has adopted following Energy Efficient and green campus initiatives practices:

- Usage of Energy Efficient LED Fittings
- Maximum usage of Day Lighting
- Installation of 10 kWp Roof Top Solar PV Plant.
- Vermi-compost system
- Green Campus
- Rain water Harvesting system

We appreciate the support of Management, involvement of faculty members and students in the process of making the Campus Energy Efficient.

For,

Prathamesh Energy Solution,

IGBC

CII
Confederation of Indian Industry

The Indian Green Building Council

hereby certifies that

Vaijanath Narharirao Raibhole

has successfully demonstrated knowledge on the Green Building Design & Construction, Building Standards & Codes, IGBC Resources & Processes and Green Design Strategies & their Impacts, required to be awarded the title of

IGBC Accredited Professional

K S Venkatagiri
Executive Director
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V Suresh
Chairman
Indian Green Building Council

Gurmit Singh Arora
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200413

05 September 2020

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ACKNOWLEDGEMENT

We at Prathamesh Energy Solution, Pune, express our sincere gratitude to the management and Principal of Jamkhed Mahavidyalaya, Jamkhed for awarding us the assignment of Green audit of their College campus located at Jamkhed, Dist. Ahmednagar.

We are very much thankful to

- Prin. Dr. M. L. Dongare, Principal, Jamkhed Mahavidhyalaya, Jamkhed
- Dr. S. Y. Narke, Vice-Principal, Jamkhed Mahavidhyalaya, Jamkhed.
- Prof. S. N. Gadekar, Coordinator, IQAC, Jamkhed Mahavidhyalaya, Jamkhed.

for giving us opportunity to conduct detailed energy audit of the institute and provide all the required data and information promptly for the smooth conduction of detailed energy and green audit.

We are also thankful to various Head of Departments, IQAC team & other Staff members for helping us during the field measurements.

We are also thankful to all the technical staff and office staff for helping during the measurements at the electrical distribution center.

EXECUTIVE SUMMARY

After the Field measurements & analysis, we present herewith important observations made and various measures to reduce the Energy Consumption & mitigate the CO_2 emissions

1. Jamkhed Mahavidhyalaya, Jamkhed, consumes electrical Energy in majority used for various gadgets & office operations.

2. The various projects already implemented by the College are

- Installed solar roof top plant of capacity 10kWp. At present solar roof top is with net metering and it is meeting requirement electricity demand of college building.
- Usage of natural day lights and natural air circulation
- Usage of Natural Day light in corridors specifically
- Usage of LED lighting for Admin & outdoor lighting
- Fire extinguishers are installed and maintained for fire safety in the college campus.

3. Important Parameters: Electrical Energy:

Electricity is used for different purposes and at different sections in the college campus. The details of electricity distribution as mentioned below.

Sr. No.	Consumer No.	Electrical Meter No.	Location/Purpose	Payee
1	158010046982	055-X1021183	College building/building operation	Principal, Jamkhed Mahavidhyalaya

The important parameters of electrical consumption through solar roof top as per Consumer no. in the campus are mentioned as below.

Sr. No	Consumer No.	Parameter	Max	Min	Average
1	158010046982	Units consumed, kWh	949	0	387.91
		Total average units consumed per month, kWh			4655

4. Benchmark: In terms of Electrical Energy:

We now present important benchmarks in respect of Electrical Energy consumption as under.

No	Particulars	Value	Unit
1	Electrical Energy consumed	**0.14**	kWh/sq ft

6. Recommendations:

We present herewith various proposals to reduce the Electrical Energy demand.

No	Recommendation	Annual saving potential in kWh /Kg of LPG	Annual Saving Potential in MT of CO_2	Annual monetary gain, Rs.
1	Solar street lights	262.8 kWh	0.21	2628
2	Solar powered light for hoarding	-	-	-
3	Solar charging stations	-	-	-
	Total	262.8 kWh	0.21	2628

Notes & assumptions:

1. 1 Unit of Electrical Energy releases 0.8 Kg of CO_2 into atmosphere
2. 1 Kg of LPG releases 3 Kg of CO_2 into atmosphere
3. Daily working hours-10
4. Annual working Days-280
5. Average Rate of Electrical Energy- Rs 10 per kWh

ABBREVIATIONS

DP	:	Double Pole
CFL	:	Compact Fluorescent Lamp
EESL	:	Energy Efficiency Services Limited
F P	:	Feeder Pillar
MSEDCL	:	Maharashtra State Electricity Distribution Company Ltd.
MEDA	:	Maharashtra Energy Development Agency
MIDC	:	Maharashtra Industrial Development Corporation
V	:	Voltage
I	:	Current
kW	:	kilo-Watt
kVA	:	Apparent Power
kVAr	:	Reactive Power
P F	:	Power Factor
kWp	:	Kilo Watt peak

CHAPTER-I
ENVIRONMENT AND GREEN AUDIT: INTRODUCTION

1.1 Objectives:

1. To Study tree plantation in college campus
2. To study Scope for usage of Renewable Energy
3. To study various measures for sustainable development

1.2 General Details of Jamkhed Mahavidhyalaya, Jamkhed:

No	Head	Particulars
1	Name of Institution	Jamkhed Mahavidhyalaya, Jamkhed
2	Address	Jamkhed, Dist. Ahmednagar
3	Year of Establishment	1984
4	Salient Features	Affiliated to Savitribai Phule Pune University
4	Courses offered	1. Bachelors of Arts, Commerce, Science and Business Administration (BBA CA) 2. Masters of Chemistry, History and Marathi
5	No of Students	1108
6	Total built up area	32400 Sq ft

CHAPTER-II
GREEN AUDIT FOR AY-2022-23

Jamkhed Mahavidhyalaya, Jamkhed is one of the leading higher educational Institutions of district Ahmednagar and affiliated to Savitribai Phule Pune University. It has been providing quality education to the students in various courses. The College is having beautiful green campus and a highly greenery maintenance college in Dist. Ahmednagar. The college has been accredited by National Assessment and Accreditation Council (NAAC), Bangalore.

We have prepared a green audit report after visiting the college campus by our team. This green audit report is based on the following major points.

1. Plantation in the campus
2. Carbon accounting
3. Use of Renewable energy options for saving the environment
4. Water audit
5. Rainwater Harvesting
6. Waste disposal
7. Green Initiatives in the campus
8. Suggestions and Recommendations

1. Plantation in the campus

Plantation is playing very important role in the green audit and helping to save environment from damage. The campus plantation is very diverse and well maintained.

The different species are cultivated to increase greenery of the campus. The species included Trees, Shrubs, Herbs, Climbers, ornamentals etc.

There are 121 trees present inside college campus. After a daylong survey and records about the plantation in the campus is prepared which is as per following table.

Sr.No.	Name	Quantity
1	*Alstoniascholaris*(L.) R.Br.(Saptaparni)	**16**
2	*Azadirachta indica*A.Juss.(Kadulimb)	**14**
3	*Bauhinia variegata*L.(Kanchan)	**11**
4	*Cycas revoluta*Thunb.(Sago palm)	**14**
5	*Dalbergia sissoo* Roxb. ex DC.(Shisam)	**13**
6	*Ficus benghalensis*L.(Wad)	**12**
7	*Ficus religiosa*L.(Pimpal)	**05**
8	*Magnolia champaca* (L.) Baill. ex Pierre(Chafa)	**08**
9	*Nyctanthes arbor-tristis*L.(Parijat)	**11**

10	*Pongamia pinnata* (L.) Pierre(Karanj)	**07**
11	*Others – specify randomly*	**10**

Photo-1: Greenery view of Jamkhed Mahavidhyalaya, Jamkhed

Photo-2: Greenery view of Jamkhed Mahavidhyalaya, Jamkhed

Photo-3: Tree plantation at Jamkhed Mahavidhyalaya, Jamkhed

1.1 Calculation of amount of co_2 sequestered in trees per year

The carbon sequestration potential of the plant species present in green belt has been estimated and suitable plant with maximum sequestration of CO_2 was recommended. Carbon sequestration is nothing but capturing atmospheric carbon dioxide or anthropogenic CO_2 from large scale stationary sources like cement industry before it is released to the atmosphere. Once captured, the CO_2 gas is put into long term storage. CO_2 sequestration in plants has the potential to significantly reduce the level of carbon that occurs in the atmosphere. Terrestrial or biologic sequestration means using plants to capture CO_2 from the atmosphere and then storing it as carbon in the stems and roots of the plants as well as in the soil. The green belts in industrial area acts as sink for capturing and storing carbon dioxide released from the industries. Assessment of carbon sequestration ability of trees for adopting in greenbelt of cement industries

The carbon dioxide sequestered in plant species are determined based on following method:

1. Determine the total (green) weight of the tree
2. Determine the dry weight of the tree
3. Determine the weight of carbon in the tree
4. Determine the weight of carbon dioxide sequestered in the tree
5. Determine the weight of CO_2 sequestered in the tree per year

1.2 Determination of Total (Green) Weight of the Tree

The algorithm to calculate the weight of a tree is:

For trees with D < 11: $W = 0.25D^2H$

For trees with D >= 11: $W = 0.15D^2H$

Where, W = Above-ground weight of the tree in pounds

D = Diameter of the trunk in inches

H = Height of the tree in feet

Depending on the species, the coefficient (e.g. 0.25) could change and the variables D^2 and H could be raised to exponents just above or below 1. However, these two equations could be seen as an "average" of all the species' equations. The root system weighs about 20% as much as the above-ground weight of the tree. Therefore, to determine the total green weight of the tree, multiply the above-ground weight of the tree by 120%.

1.3 Determination of Dry Weight of the Tree

Taking all species in into account, the average tree is 72.5% dry matter and 27.5% moisture. Therefore, to determine the dry weight of the tree, multiply the weight of the tree by 72.5%.

1.4 Determine the weight of carbon in the tree

The average carbon content is generally 50% of the tree's total volume. Therefore, to determine the weight of carbon in the tree, multiply the dry weight of the tree by 50%.

Assessment of carbon sequestration ability of trees for adopting in greenbelt of cement industries

Determine the weight of carbon dioxide sequestered in the tree

CO_2 is composed of one molecule of Carbon and 2 molecules of Oxygen.

The atomic weight of Carbon is 12.001115.

The atomic weight of Oxygen is 15.9994.

The weight of CO_2 is C+2*O=43.999915.

The ratio of CO_2 to C is 43.999915/12.001115=3.6663.

Therefore, to determine the weight of carbon dioxide sequestered in the tree, multiply the weight of carbon in the tree by 3.6663

Determine the weight of CO_2 sequestered in the tree per year

Divided the weight of carbon dioxide sequestered in the tree by the age of the tree.

A total of eighteen different species of trees were enumerated on the campus. Total number of all the trees is 165.All these trees absorb about 416.34 kg carbon dioxide in one month. The most dominant species on the campus is *Peltophorum pterocarpum*, with a total of 84 trees. These trees carry about 66.2% of total absorption (275kg) while all other trees carry 33.8% of total carbon dioxide absorption (141kg). 11214 Sq.meter (2.77 Acre) area is covered under the trees. Total Campus area 18983 Sq . meter. Percentage of Green Area =59.07 %

2. Carbon Accounting

A Carbon Foot print is defined as the Total Greenhouse Gas emissions, emitted due to various activities.

In this we compute the emissions of Carbon-Di-Oxide, by usage of the various forms of Energy used by the College for performing its day to day activities. The college uses electrical energy for operating various electrical gadgets.

We herewith furnish the details of electrical Energy consumption consumer number wise as under

2.2.1 Month wise Consumption of Electrical Energy : 158010046982

Sr. No.	Month	Units Consumed, kWh
1	Dec-2022	533
2	Nov-2022	409
3	Oct-2022	949
4	Sep-2022	0
5	Aug-2022	393
6	July-2022	423
7	June-2022	309
8	May-2022	417
9	April-2022	319
10	March-2022	371
11	Feb-2022	251
12	Jan-2022	281
13	Total	4655
14	Average	387.91
15	Max	949
16	Min	0

2.2.2 Basis for computation of CO_2 Emissions:

The basis of Calculation for CO_2 emissions due to Electrical Energy are as under

- 1 Unit (kWh) of Electrical Energy releases **0.8 Kg of CO_2** into atmosphere

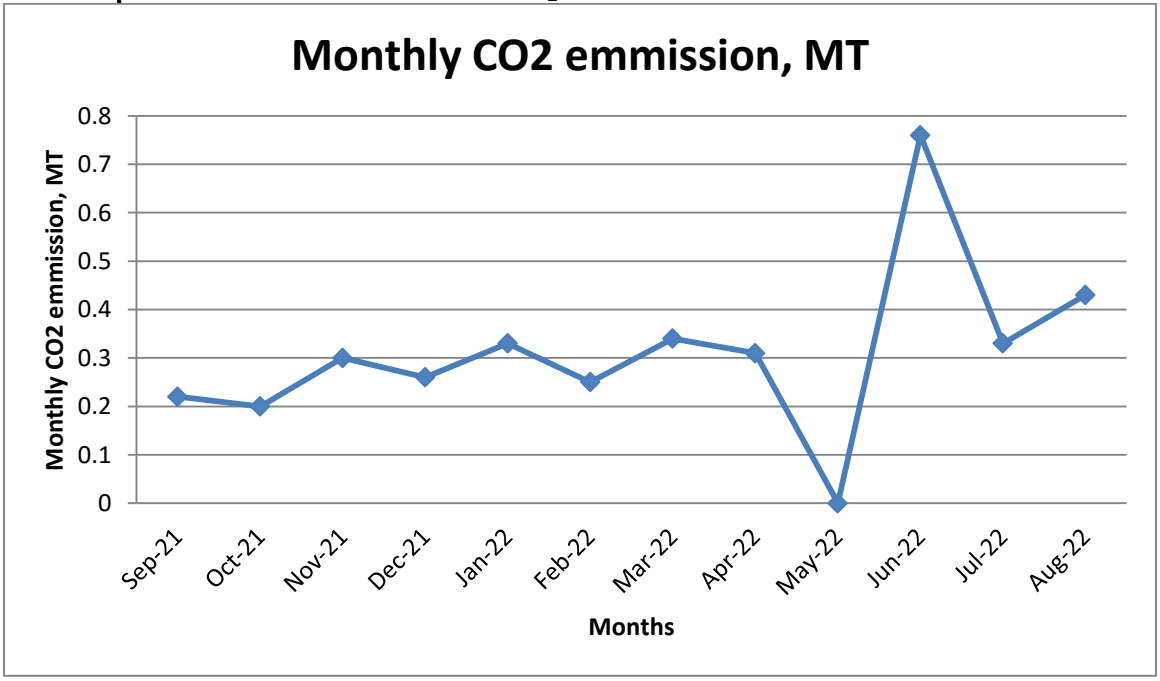
Based on the above Data we compute the CO_2 emissions which are being released in to the atmosphere by the College due to its Day to Day operations.

2.2.3 Month wise CO2 Emissions: 158010046982

Sr. No	Month	Electrical Energy consumed, kWh	CO_2 Emissions due to Electricity, MT
1	Aug-2022	**533**	**0.43**
2	July-2022	**409**	**0.33**
3	June-2022	**949**	**0.76**
4	May-2022	**0**	**0.00**
5	April-2022	**393**	**0.31**

6	March-2022	**423**	**0.34**
7	Feb-2022	**309**	**0.25**
8	Jan-2022	**417**	**0.33**
9	Dec-2021	**319**	**0.26**
10	Nov-2021	**371**	**0.30**
11	Oct-2021	**251**	**0.20**
12	Sep-2021	**281**	**0.22**
13	Total	**4655**	**3.72**
14	Average	**387.91**	**0.31**
15	Max	**949**	**0.76**
16	Min	**0**	**0.00**

2.2.4 Representation of Month wise CO_2 emissions:



2.2.5 Benchmarking:

Now we compute the CO2 emissions per sq ft basis as under:

No	Parameter	Value	Unit
1	CO2 emissions	3.72	MT/annum
2	College area	32400	Sq ft
3	**CO2 emissions/sq ft**	**0.11**	**Kg of CO_2/sq ft**

3. Usage of renewable energy at college campus:

3.1 Installation of 10 kWp Solar PV Power Plant:

Solar roof top power plant having capacity 10 kWp is installed at the college campus which meets the requirement of electricity demand of the Institute. The Solar roof top plant is successfully installed and it is in operation to meet the requirement of electricity of institute building. The existing solar roof top installed technical specifications and details are given below.

Technical Specifications:

Jamkhed Mahavidhyalaya, Jamkhed has installed solar roof top power plant. The brief specifications and details of the plant are mentioned below.

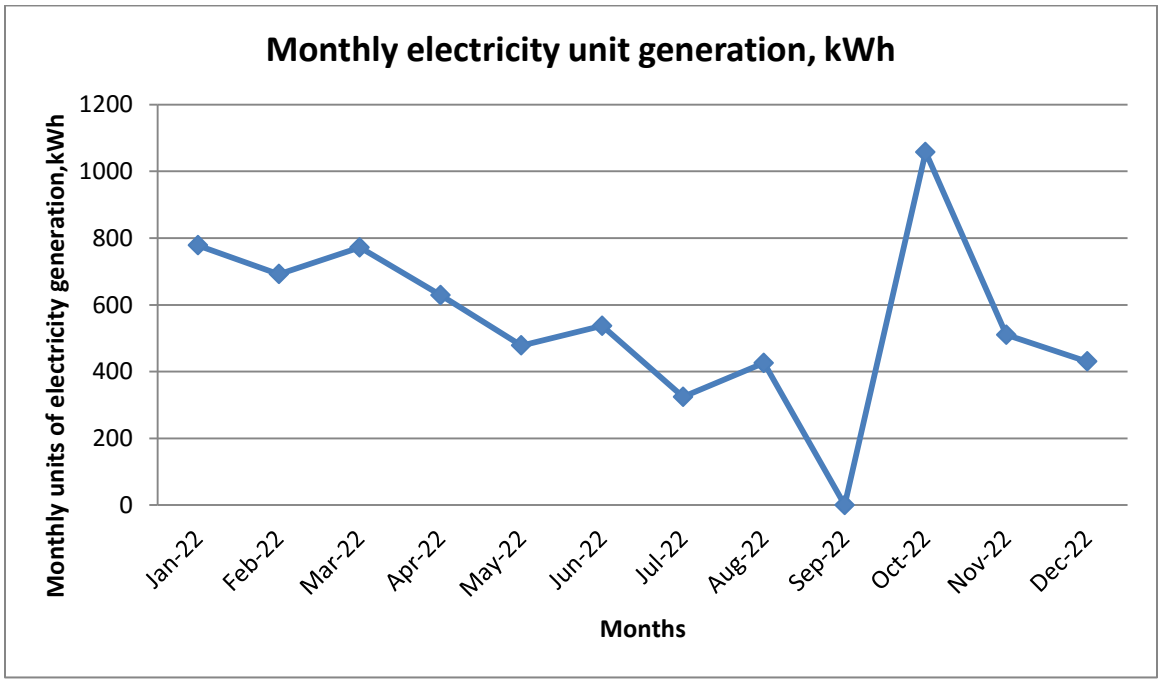
- **System Capacity:** 10 kW
- **PV Module: Model-** VikramSolar-ELDORA-VSP.72.330.03.04-330 Wp X31 nos.
- **Output:** 5.5 kWh/Sq.m/day (All output is under STC, 25°C)

Photo-4: 10 kW solar roof top on institute building roof.

The installed solar roof top in operation and its electricity generation from last 12 months is mentioned as below.

Sr. No.	Month	Units export	Units Import
1	Dec-2022	430	533
2	Nov-2022	510	409
3	Oct-2022	1058	949
4	Sep-2022	0	0
5	Aug-2022	426	393
6	July-2022	324	423
7	June-2022	537	309
8	May-2022	478	417
9	April-2022	629	319
10	March-2022	772	371
11	Feb-2022	692	251
12	Jan-2022	778	281
13	Total	6634	4655
14	Average	552.8333	387.91
15	Max	1058	949
16	Min	0	0

The graphical representation of electricity unit generation in last 12 months is as shown below.



3.2 Solar powered light for hoarding

Lighting solar systems are the fixed installations designed for domestic as well as small scale commercial application. The component of the solar lighting system includes solar PV module (solar cells), charge controller, solar battery and lighting system (lamps & fans). Modules are installed in the open on roof/terrace - exposed to sunlight and the charge controller and battery are kept inside a protected place in the house.

Figure-1: Solar powered light for Hoarding

This system comes with multiple benefits such as:

- **Economical:** Since the sun provides energy free of charge, 30% power savings on the electricity bill can be availed with longer back up lighting system at zero running cost.
- **Non-Polluting:** Powered by the sun's renewable energy, the system is energy neutral and an absolutely clean source of illumination. 1kWp solar installation reduces 1⁄2 ton of CO_2 (carbon dioxide) per annum.
- **No Maintenance:** The system has few moveable parts – reducing the risk of breakage. Once installed, it lasts for long time and requires little attention.

This system can be used to power the huge hoardings in the college campus.

Solar powered hoarding lighting system proposed will provide a better, faster, cheaper (and cleaner) alternative with solar. Since this product competes with diesel or conventional fuels, we needed to ensure we beat the cost of a diesel solution. In order to achieve that with solar, we consider the following system:

1. Highly Efficient Solar Panel

2. Charge Controllers with MPPT Technology – increases solar electricity production by up to 30% compared to conventional charge controllers

3. LED Projection Light – consumes 10-times less electricity compared to conventional bulbs, and has a 50,000 hour warranty.

Features:

- Auto on off
- 4 Days Battery Back Up
- Robust housing
- Weather proof

With this entire put together, we ended up with systems that provide 6 hours of lighting each night with 4 -lamp system to light up boards up to 15′x30′, and a 8-lamp system to light larger boards up to 20′x40′.More importantly, with these options, payback of the system will come around 2.5 years. This system provides a way to reduce the lightings costs, get rid of all the operational hassles of owning a diesel generator, plus brand benefits from being “green” with the use of renewable energy like solar powered light hoarding board.

3.3 Solar charging stations

Solar cell phone chargers use solar panels to charge cell phone batteries. They are an alternative to conventional electrical cell phone chargers and in some cases can be plugged into an electrical outlet. Solar mobile charger is a device which can charge mobile phones using solar radiation. Its major component is a compact solar panel. This solar panel traps solar energy and produces an output voltage. But, since the light radiations falling on the solar panel can vary, the output voltage becomes unstable. For charging a mobile phone, stable voltage is required. So, to make the output voltage stable and regulated, voltage regulator circuit along with the solar panel is used.

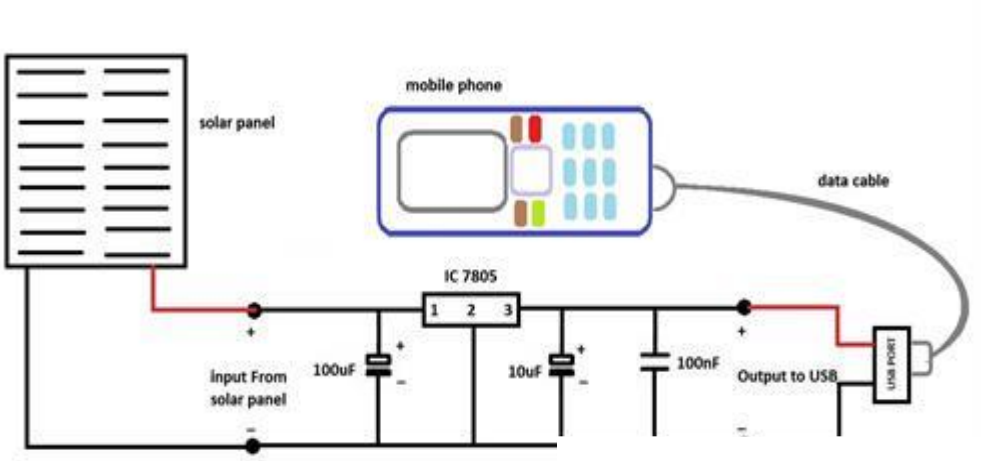


Figure-2: Solar charging Stations

Most of the mobile phones have computer connectivity via USB cable. USB port establishes 4 connection terminals. The connection terminals at the two extreme ends are the supply terminals. In a female USB connector (port via which we plug in USB devices to computer), these terminals carry 5V DC. When a mobile phone is connected to the USB port of a computer, it utilizes this 5V supply to recharge battery. This feature is used in a solar mobile charger. It converts and regulates solar energy to 5V DC and the output will be available through the female USB connector. To this connector, we can easily connect a mobile phone via data cable.

4. Water Audit

A water crisis is a very sensitive issue these days all over the world. Recently we are facing water crisis in major part of Maharashtra like Marathwada, Khandesh, Pachim Maharashtra and North Maharashtra. Jamkhed Mahavidhyalaya, Jamkhed has taken a good initiative for maintaining greenery in the campus and less concrete zone, it means that college campus is allowing the rainwater to absorb under the ground and maintain the underground water level.

In addition to this as per the survey and site location following activities can be implemented for the conservation of water.

4.1 Water storage and consumption

Jamkhed Mahavidhyalaya, Jamkhe campus is having water supply from Jamkhed Nagarpalika and water reserve in the campus to mitigate the need of requirement water for various activities. The college campus has temporary water storage capacities in terms of overhead tanks on the Institute building. Water is temporarily stored in the campus for various activities. There is a provision of sparkler system to supply the water in garden to maintain greenery. The details of water storage in the campus as mentioned below.

Sr. No.	Building	Tank type	Capacity (Litres.)	No. of Tanks	Total Capacity (Litres.)	Remark
1.	Science	RCC Ground Floor	15000	1	15000	Working
		Syntax Tank	1000	3	3000	Working
2.	Gents Ladies Toilet Block	Syntax Tank	1000	1	1000	Working
3.	Staff Room	Syntax Tank	1000	1	1000	Working
4.	Exam & Library Toilet Block	Syntax Tank	1000	1	1000	Working
5.	Drinking Water Facility	Syntax Tank	1000	1	1000	Working
6.	Administrative Building	RCC Ground Floor	5000	1	5000	Working
		Syntax Tank	1000	1	1000	Working
7.	Canteen	Syntax Tank	1000	1	1000	Working
8.	Guest House	Syntax Tank	1000	1	1000	Working

4.2. Rain water harvesting

The system of rain water harvesting is an integral part of any educational institution. This system helps to conserve the rain water and also to use during the time of its desirable. This system helps the students to understand the basic concepts of rainwater harvesting system and their effective use in the real life.

Already Jamkhed Mahavidhyalaya, Jamkhed have ring wells and gray waste water from all the building taken through some specific path in these ring wells and used to charge under the ground to maintain the ground level water.

Photo-5: View of pipe for rain water collection from building

Advantages of rain water harvesting

(a) Promotes adequacy of underground water

(b) Mitigates the effect of drought

(c) Reduces soil erosion as surface run-off is reduced

(d) Decreases load on storm water disposal system

(e) Reduces flood hazards

(f) Improves ground water quality / decreases salinity

(by dilution)

(g) Prevents ingress of sea water in subsurface aquifers in coastal areas

(h) Improves ground water table, thus saving energy (to lift water)

(i) The cost of recharging subsurface aquifer is lower than surface reservoirs

(j) The subsurface aquifer also serves as storage and distribution system

(k) No land is wasted for storage purpose and no population displacement is involved

(l) Storing water underground is environment friendly

Rain water harvesting potential

The total amount of water that is received in the form of rainfall over an area is called the rain water endowment of that area. Out of this, the amount that can be effectively harvested is called rain water harvesting potential.

All the water which is falling over an area cannot be effectively harvested, due to various losses on account of evaporation, spillage etc. Because of these factors the quantity of rain water which can effectively be harvested is always less than the rain water endowment. The collection efficiency is mainly dependent on factors like runoff coefficient and first flush wastage etc. Runoff is the term applied to the water that flows away from catchments after falling on its surface in the form of rain.

Runoff depends upon the area and type of catchment over which it falls as well as surface features. Runoff can be generated from both paved and unpaved catchment areas. Paved surfaces have a greater capacity of retaining water on the surface and runoff from unpaved surface is less in comparison to paved surface. In all calculations for runoff estimation, runoff coefficient is used to account for losses due to spillage, leakage, infiltrations catchment surface wetting and evaporation, which will ultimately result into reduced runoff. Runoff coefficient for any catchment is the ratio of the volume of water that run off a surface to the total volume of rainfall on the surface. The runoff coefficient for various surfaces is given in following table.

Sr. No.	Type of catchment	Coefficient
1	**Roof Catchments**	
	Tiles	0.8-0.9
	Corrugated metal sheets	0.7-0.9
2	**Ground surface coverings**	
	Concrete	0.6-0.8
	Brick pavement	0.5-0.6

3	**Untreated ground catchments**	
	Soil on slopes less than 10%	0.0-0.3
	Rocky natural catchments	0.2-0.5

Based on the above factors, the water harvesting potential of site could be estimated using the following equation:

Rain Water harvesting potential = Amount of Rainfall x area of catchment x Runoff coefficient

Rain water harvesting methods

(a) Storing rain water for direct use

(b) Recharging ground water aquifers, from roof top run off

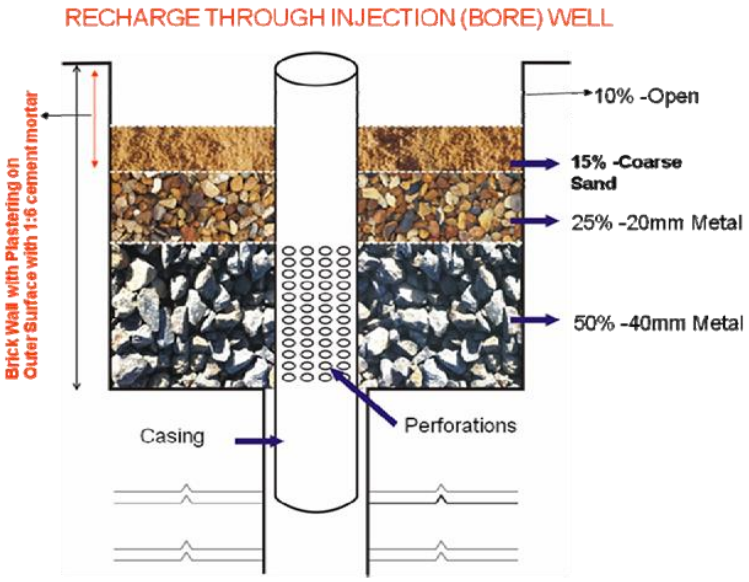
(c) Recharging ground water aquifers with runoff from ground area

According to the site of PICT College the method of recharging ground water aquifiers from roof top run off may be suitable.

Recharging ground water aquifers from roof top run off

Rain water that is collected on the roof top of the building may be diverted by drain pipes to a filtration tank (for bore well, through settlement tank) from which it flows into

the recharge well, as shown in following Figure. The recharge well should preferably be shallower than the water table. This method of rain water harvesting is preferable in the areas where the rainfall occurs only for a short period in a year and water table is at a shallow depth. The schematic diagram of recharging water aquifers from roof top run off is as follows.



5. Waste disposal

The present Prime Minister of India, Shri Narendra Modiji launched " Swach Bharat Abhiyan" (Clean India Mission), on 2nd October, 2014. In this mission, the proper use of dustbins is one of the major priorities. For the successful implementation of this mission collective mass effort is necessary. The higher education institutions like Jamkhed Mahavidhyalaya, Jamkhed need to

play a major role in this regard to keep their campus neat and clean. Proper use of dustbins is not only the solution for the generating garbage in the college campus. Now days, its proper treatment should be given a major priority.

Characteristic and Disposal Practices of Solid Wastes Waste Management

Sr. No.	Waste Category	Method of disposal
1	Solid waste from trees droppings and lawn	Vermi Composting Organic Manure
2	Canteen waste	Vermi Composting Organic Manure
3	Plastic waste	Through Authorized recycler after segregation
4	Solid Waste from Lab	Solid Waste from Lab
5	Chemical waste generated in chemistry and zoology lab	The college is need to have a very good practice to use dilute chemicals for the experimentation in these labs. These dilute chemicals can be further diluted and disposed in the pit near the lab.
6	E-waste and defective items from computer and electronics lab	The institution has to decide to contact approved E- waste management and Disposal facility in order to dispose E-waste in scientific manner.
7	Sanitary Napkins	The institution have to take a very good initiative to install sanitary napkin disposal machine at the different location in the college campus. It is suggested to install vending machine along with incinerators at required locations in the college campus.

Photo-6: Collection and segregation of waste

5.1 Vermiculture Composting Culture

Vermicomposting is basically a managed process of worms digesting organic matter to transform the material into a beneficial soil amendment. The institute has been started vermi culture composting culture in house on 10 Sq. meter land. The main purpose of this is to reduce disposable waste in the college campus and after complete process of vermi composting it is used as manure for plantation and greenery in the campus. It is also used for the demonstration and awareness in farmers to implement organic farming and its importance.

The main benefits of the process are to reduce the waste in the environment and utilized for some useful purpose and also it is cost savings process.

The earthworms being voracious eaters consume the biodegradable matter and give out a part of the matter as excreta or vermi-castings. The vermi-casting containing nutrient is rich manure for the plants. Vermicompost, apart from supplying nutrients and growth enhancing hormones to

plants, improves the soil structure leading to increase in water and nutrient holding capacities of soil. Fruits, flowers and vegetables and other plant products grown using vermicompost are reported to have better keeping quality. A growing number of individuals and institutions are taking interest in the production of vermicompost utilizing earthworm activity. As the operational cost of production of this compost works out to less than ` Rs. 2.0/Kg., it is quite profitable to sell the compost even at Rs. 4.00 to 4.50/Kg.

Photo-7: View of available Vermi beds in college campus

Process:

The process of composting crop residues / agri wastes using earthworms comprise spreading the agricultural wastes and cow dung in gradually built up shallow layers. The pits are kept shallow to avoid heat built-up that could kill earthworms. To enable earthworms to transform the material relatively faster a temperature of around 30^0C is maintained. The final product generated by this process is called vermicompost which essentially consist of the casts made by

earthworms eating the raw organic materials. The process consists of constructing brick lined beds generally of 0.9 to 1.5 m width and 0.25 to 0.3 m height are constructed inside a shed open from all sides. For commercial production, the beds can be prepared with 15 m length, 1.5 m width and 0.6 m height spread equally below and above the ground. While the length of the beds can be made as per convenience, the width and height cannot be increased as an increased width affects the ease of operation and an increased height on conversion rate due to heat built up.

Cow dung and farm waste can be placed in layers to make a heap of about 0.6 to 0.9 m height. Earthworms are introduced in between the layers @ 350 worms per m3 of bed volume that weighs nearly 1 Kg. The beds are maintained at about 40-50% moisture content and a temperature of 20–30^0 C by sprinkling water over the beds. When the commercial scale production is aimed at, in addition to the cost of production, considerable amount has to be invested initially on capital items. The capital cost may work out to about Rs. 5000 to 6000 for every tonne of vermicompost production capacity. The high unit capital cost is due to the fact that large units require considerable expenditure on preparation of vermi beds, shed to provide shelter to these beds and machinery. However these expenditures are incurred only once.

Under the operational cost, transportation of raw materials as also the finished product are the key activities. When the source organic wastes and dung are away from the production facility and the finished product requires transportation to far off places before being marketed, the operational cost would increase. However, in most of the cases, the activity is viable and bankable. Following are the items required to be considered while setting up a unit for production of vermi-compost.

Components of a Commercial Unit

Commercial units have to be developed based on availability of cow dung locally. If some big dairy is functioning then such unit will be an associated activity. Commercial units must not be designed based on imported cow dung.

1. Sheds

For a vermi-composting unit, whether small or big, this is an essential item and is required for securing the vermi beds. They could be of attached roof supported by bamboo rafters or steel trusses. Locally available roofing materials or HDPE sheet may also be used in roofing to keep the capital investment at reasonably lower level. If the size is so chosen as to prevent wetting of beds due to rain on a windy day, they could be open sheds. While designing the sheds adequate room/pathways has to be left around the beds for easy movement of the labourers attending to the filling and harvesting the beds.

2. Vermi-beds

Normally the beds have 0.3 to 0.6 m height depending on the provision for drainage of excess water. Care should be taken to make the bed with uniform height over the entire width to avoid low production owing to low bed volumes. The bed width should not be more than 1.5 m to allow easy access to the centre of the bed.

3. Fencing and Roads/Paths

The site area needs development for construction of structures and development of roads and pathways for easy movement of hand-drawn trolleys/wheel barrows for conveying the raw material and the finished products to and from the vermi-sheds. The entire area has to be fenced to prevent trespass by animals and other unwanted elements. These could be estimated

based on the length of the periphery of the farm and the length and type of roads/paths required. The costs on fencing and formation of roads should be kept low as these investments are essential for a production unit, yet would not lead to increase in production.

4. Water Supply System

As the beds have to be kept moist always with about 50% moisture content, there is a need to plan for a water source, lifting mechanism and a system of conveying and applying the water to the vermi-beds. Drippers with round the clock flow arrangement would be quite handy for continuous supply and saving on water. Such a water supply system requires considerable initial investment. However, it reduces the operational cost on hand watering and proves economical in the long run. The cost of these items would depend on the capacity of the unit and the type of water supply chosen.

5. Transportation

For any vermi-composting unit transport arrangement is a must. When the source of raw material is away from the production unit, an off-site transport becomes major item of investment. A large sized unit with about 1000 tonnes per annum capacity may require a three tonne capacity mini-truck. With small units particularly with the availability of raw material near the site, expending on transport facility may become infructuous. On-site transport facilities like manually drawn trolleys to convey raw material and finished products between the storage point and the vermi-compost sheds could also be included in the project cost.

Design calculations

The size of the bed can selected as per the space available and convenient to the customer. Brick lined beds generally of 0.9 to 1.5 m width and 0.25 to 0.3 m height are constructed inside a shed open from all sides. On the basis of site survey and suitability of operation lets consider following dimensions for the bed. Generally, earthworms are introduced in between the layers @ 350 worms per m3 of bed volume that weighs nearly 1 Kg.

L= 3 m

W = 1.5 m

H = 0.6 m

Volume of the bed = 2.7 m^3

$$Input = \frac{15\,kg\ of\ organic residue}{m3 \times 15\,days} = \frac{1\,kg\ of\ organic residue}{m3 \times 1\,day}$$

It means for 2.7 m^3, 270 kg of organic residue is required. Therefor for a month approximately 8100 kg (8.1 Ton) of organic residue is required.

The financial viability on the basis of available data of the vermicompost system is shown below.

Sr. No.	Particulars	Expenditure Cost (Rs.)
1	Bed construction	Already available 10,000/-
2	Fencing including roof	5000/-

3	Water Dripper	3000/-
4	Electrical connections	1000/-
5	Earthworms	1000/-
6	Salary & wages	20000/-
7	Sale of Vermicompost (@ Rs.100 /kg at 30% conversion)	121500/-
	Net Benefit	**81500/-**

Chapter III
SUGGESTIONS AND RECOMMENDATIONS

Following are the suggestions and actions on the basis of green and environmental audit are suggested to implement in the campus on the basis of funds availability and institute preferences.

Green Audit: Environment conservation opportunities:

- Plants/Trees in the college campus may be designated with botanical name and specific number on the basis of year of plantation. There will be brick arrangement at the bottom to supply water to the plant.
- Water management system must be in place. Reduction in water consumption by addressing leakages of taps and other miscellaneous utilities. Installation of flow meters which will help in reduction of water consumption. TOD can be implemented for pumping application.
- Rainwater harvesting pipe which collects rain water from respective building may have filter before supply to the ring well.
- Provide required nos. of dustbins at respective locations in the college campus. There should be separate dustbins for biodegradable waste and plastic waste respectively.
- Vermi-culture composting plant in the college campus should be in operation and the organic compost from the same will be either utilized for the plants/trees and maintaining greenery in the college campus or sell for organic farming.
- It is suggested to display Energy conservation slogans boards in the college campus and classroom to make awareness about importance of energy saving.