ESTD: 1962
NAAC "A ++" Grade
CGPA 3.52

SHIVAJI UNIVERSITY, KOLHAPUR

Green Audit Report

Prepared by

Department of Environmental Science,

Shivaji University, Kolhapur- 416004

2021-22

ESTD: 1962
NAAC "A ++" Grade
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Certificate

This is to certify that the Department of Environmental Science, Shivaji University, Kolhapur has conducted detailed "Green Audit" of "Shivaji University, Kolhapur" during the academic year 2021-2022. The green audit was conducted in accordance with the applicable standards prescribed by the Indian Institute of Remote Sensing, Dehradoon, India, Ministry of Environment, Forest and Climate Change, New Delhi and Intergovernmental Panel on Climate Change (IPCC). The audit involves green inventory, carbon sequestration potential of the campus and awareness program, workshops conducted by the University for the Society. 'Environmental Management Plan', is also included in the report which can be followed to minimize environmental impacts. The performance of university was found to have very good quality with respect to sustainable Green Practices. Even though ample amount of work can be done in this area.

As the University has large area for the development, the opportunities of sustainable green practices and well consideration of suggested Environmental Management Plan can make the University role model to other institutions as well. In an opinion and to the best of our information and according to the information given to us, said green audit gives a true and fair view in conformity with environmental auditing principles accepted in India

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Abbreviations

SUK	Shivaji University Kolhapur
RO	Reverse Osmosis
Ft	Feet
CO_2	Carbon dioxide
O_2	Oxygen
POP	Plaster of Paris

Photo plates

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Green cover inventory of Shivaji University, Kolhapur

Year 2021-2022

The survey for the green cover inventory was conducted during January 2022 for compiling campus information. The Garden Department of Shivaji University, Kolhapur gave the information related to the entire campus. The Garden Department under the guidance of Hon. Vice Chancellor Dr. D.T. Shirke and Hon.Pro-Vice Chancellor Dr. P.S. Patil, Hon. Registrar Dr. V. N. Shinde has taken many initiatives to make this campus more diverse and rich by planting more endemic trees. The Centre for Climate Change and Sustainability Studies has taken initiatives to literate society about Climate Change and Sustainability Studies via lectures and workshops.

1. **The initiatives taken by the Garden Department are as follows:**

1.1 Plantation under Social Forestry at Synthetic track SUK:

Plantation done under Social forestry on SUK campus during 2020-2021 is in good conditions. It is observed that University authority has been taken lots of efforts to make campus green. The Samajik Vanikaran covers 10 hectares area on the campus behind Synthetic track, Shivaji University, Kolhapur. The plant tree species has planted on site are *Casia fistula* (Bahava), *Syzygium cumini* (Jambhul), *Tamarindus indica* (Chinch), *Pithecellobium dulce* (Vilayati Chinch), *Bambuseae* (Bamboo), *Pongamia pinnata* (Karnj), *Azadirachta indica* (Neem), *Bauhinia variegata* (Kanchan) and *Mangifera Indica* (Deshi Amba) etc. The site has also includes the shrub species as *Hibiscus rosa-sinensis* (Jaswand), *Cestrum nocturnum* (Ratrani), *Justicia adhatoda* (Adulsa) and *Acalypha indica* (Acalypha) etc. The Garden Department has taken an initiative to plant more native trees on the Social forestry site to attract native biodiversity around the campus.

Photo plate: 7.1 Social Forestry Plantation Site

1.2 Miyawaki Gardens:

On 19th June 2021, The Garden Department has established two Miyawaki Forest on the SUK campus. According to data and information provided by the Garden department these Miyawaki forest posses 958 trees with native species of trees. It is observed that, the trees planted in the area shows good condition and growth. The Miyawaki forests includes *Pongamia pinnata* (Karnj), *Azadirachta indica* (Neem), *Bauhinia variegata* (Kanchan) and *Mangifera Indica* (Deshi Amba) *Casia fistula* (Bahava), *Syzygium cumini* (Jambhul), *Tamarindus indica* (Chinch), *Pithecellobium dulce* (Vilayati Chinch), and *Bambuseae* (Bamboo), etc. The plantation is done for 2 plants per square meter to avoid competition between two trees as they required large area for their basal area such as *Pongamia pinnata* (Karnj), *Azadirachta indica* (Neem), *Syzygium cumini* (Jambhul), *Tamarindus indica* (Chinch), and *Pithecellobium dulce* (Vilayati Chinch), etc. This is a great initiative taken by the Garden Department under the guidance of Hon. Vice Chancellor Dr. D.T. Shirke and Hon.Pro-Vice Chancellor Dr. P.S. Patil and Hon. Registrar Dr. V. N. Shinde and Garden Superintendent Mr. Abhijit Jadhav. The Garden Department has well maintained these Miyawaki gardens. The Gardner and other people take care of this Miyawaki forest.

Photo plate: 7.2 Miyawaki forest plantation site

1.3 Chancellor's Coconut Garden:

Chancellor's Coconut garden was established in year 2018 by Garden Department SUK. The Chancellor's Coconut garden covers total area about 2.5 Acers on campus. The garden was established near Reverse Osmosis (RO) plant, Shivaji University,

Kolhapur. The garden posses total 265 coconuts trees. The garden is in good condition and well maintained.

Photo plate: 7.3 Chancellor's Coconut Garden site

2. Composting units at SUK nursery:

The Garden Department, SUK has taken an incentive to produce organic compost from plant litter. The compost includes only plant litter collected during the campus cleaning. Two composting units are established at SUK Nursery site. Each of unit has size 12ft X 3ft X 2ft. The plant litter will naturally degraded by degradation method. According to the information provided by Garden Department SUK, the plant will produce enough amount of compost per year as the composting unit run efficiently. The main objective of composting is to convert leaf litters into organic compost. This plant is working in good way and converting leaf litter into a compost as expected.

Photo plate: 7.4 Composting units at SUK Nursery

3. Carbon Sequestration potential of SUK campus:

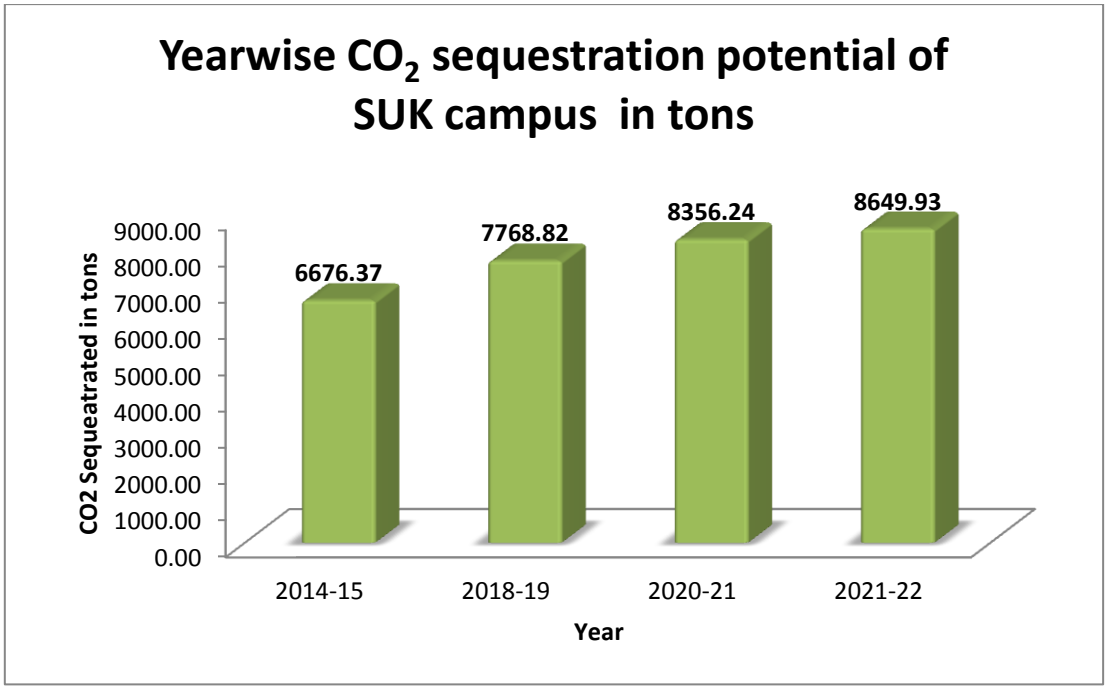
On Mother Earth, the predicted negative effects of global warming and climate change are already becoming a reality. Humans are made aware of the usefulness of plantations on terrestrial soil by the intensely hot summer days. Climate change is becoming somewhat tolerable for human life thanks to sustainability and developing healthy living and learning settings. A green campus improves environmental quality while increasing energy efficiency and resource conservation. Green campus recognizes and applauds the commitment of the campus community to long-term environmental improvement. Despite the building's relatively old design, it is highly environmentally friendly and incorporates sustainability. Natural lighting is utilized in many of their facilities, which improves the air quality and requires less water and energy.

The human race is no longer ignorant of the photosynthesis reaction. The human brain seizes the chance to consider the possibility of using photosynthesis to sequester excess carbon dioxide emissions. The plantation is a very inexpensive and practical method for storing carbon. The main GHG that contributes to climate change and global warming is carbon dioxide. The process of photosynthesis is how carbon dioxide is naturally captured and stored as carbon stock. As we transition from a regional to a global university, it is our responsibility as such institutions to address the concerns of the future and look for solutions. Government organizations, universities, national organizations, and international organizations have a social and environmental duty to take action. Government institutions, universities, national organizations, and international organizations have a social and environmental obligation to constructively address numerous global concerns at the local

level and to diffuse the information thus produced across society. Environmental problems like global warming and climate change must be handled effectively and scientifically. Since analytical infrastructure and skilled human resources are available in universities, it is our moral obligation to put these concepts into practice. The Department of Environmental Science at Shivaji University in Kolhapur has decided to count the number of trees on the SUK campus and calculate how much carbon dioxide they are now storing.

3.1 Carbon sequestration potential of Shivaji University campus:

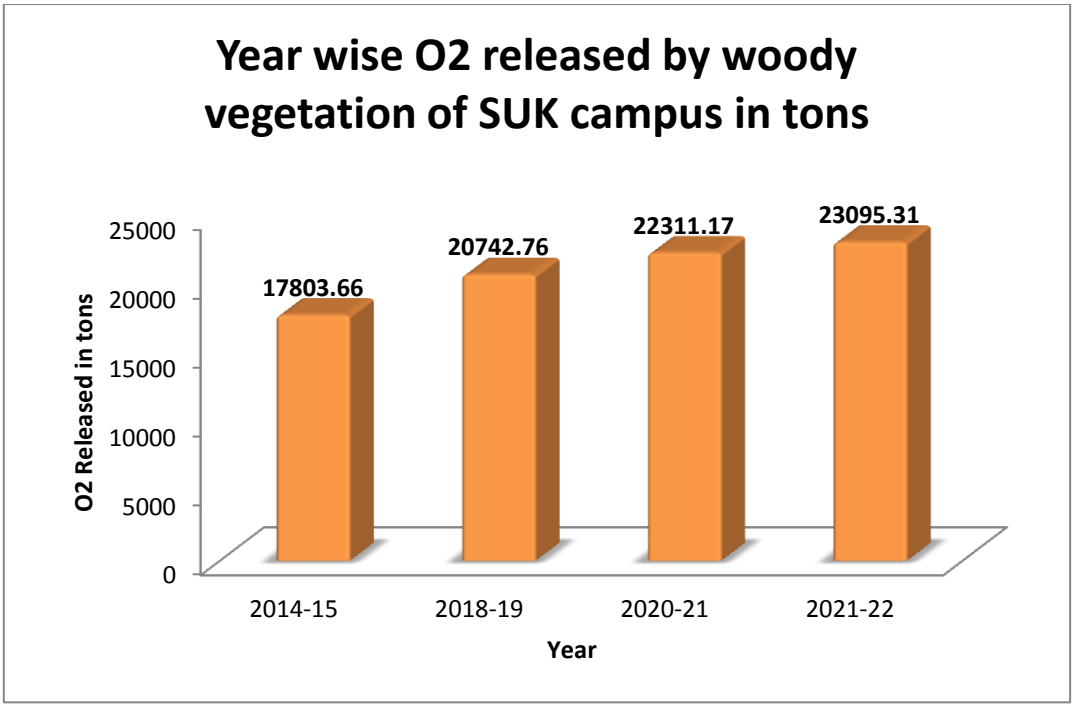
Carbon sequestration implies transfer of atmospheric CO_2 into other long lived global pools including oceanic, pedologic, biotic and geological strata to reduce the net rate of increase in atmospheric CO_2 (Lal, 2007). The terrestrial and atmospheric carbons are strongly interacting with each other. In the present study is the assessment of existing carbon stock stored in Shivaji University campus in the form of woody vegetation by enumerating every tree species. Overall 8,649.93 tons of CO_2 has been captured and stored by the woody plants present on the University campus during 2021-22.



Graph No: 7.1 Year wise CO_2 sequestration potential of SUK campus trees in tons

3.2 Oxygen released by SUK campus:

Woody vegetation in Shivaji University campus has released 23,095.31 tons of oxygen in their lifetime till date. Released oxygen is directly proportional to CO_2 in the ratio of 32/12. The oxygen released by woody trees present on campus is working as support system to people living in campus and surrounding. The university campus works as Oxygen Park in Kolhapur city.



Graph No: 7.2 Year wise O_2 released by woody vegetation of SUK campus in tons

3.3 Carbon sequestration potential of campus woody tree vegetation in future:

Plants sequester atmospheric carbon dioxide with natural process called photosynthesis. They absorb atmospheric CO_2 for their vegetative growth. Carbon sequestration by woody trees is the effective carbon offset methods recommended by many researchers for the minimization of carbon footprint and carbon emission. The Carbon offset by trees is the most widely used methodology used by institutions as well as many industries. Institutes and universities are usually having large campus which can be used for current as well as future carbon emission by planting more and more trees in their campus areas. Forests and woody trees are the biggest carbon pool on Earth, act as a major sources and sinks of carbon in nature. The woody vegetation of 13,473 trees is sequestering approximately 294 tons of CO_2 with the liberation of 783 tons of oxygen annually. The trees planted at Social forestry site will sequester 242 tons of CO_2 /annually while; Miyawaki forests and Chancellor's Coconut garden will sequester 21 tons of CO_2 and 5 tons of CO_2 /annually respectively. Overall, 269 tons of CO_2 will annually sequester by total 12,334 woody trees in future. The oxygen released by newly planted trees at Social forestry will be 647 tons of O_2 /annually, Miyawaki forests 55 tons of O_2 /annually and Coconut garden 15 tons of O_2 /annually respectively.

4 Fire mitigation plan for SUK campus

The SUK campus spans an enormous 853 acres and is home to a variety of woody trees, shrubs, and plants. There is a possibility of wildfires on the SUK campus due to the grassland and woodland that make up the campus. The campus's grassland will dry out considerably in the summer, providing fuel for nearby fires. On the SUK campus, there were no fire incidents at all during the years 2021–2022. By removing dry grass before summer, the SUK authorities have taken the initiative to reduce fire incidences on campus. As of right now, the university has taken some action to prevent these fire events on campus, including digging trenches in outlying regions to prevent the spread of surface fire on campus and building roads to get to fire extinguishers at the incident location. The campus is a carbon sink since it is covered in a vast area of lush green flora. On the other hand, these sudden events can also turn the campus into a source of carbon emissions. As a result, the campus must have a preventative and surface fire preparedness strategy.

5 Awareness Programs taken by the University:

5.1 Awareness Programs taken by the University through workshops and lectures:

A Centre for Climate Change and Sustainability Studies has been established by the university administration. Under the direction of Prof. (Dr.) Sachin S. Panhalkar, the Centre has organized a number of educational talks to raise awareness of a variety of environmental concerns. Dr. Anil Kulkarni gave a guest lecture on "Climate Change and Sustainable Development" on September 22, 2021, organized by the centre.

Photo plate: 7.5 Guest Lecture on "Climate Change and Sustainable Development" by Dr. Anil Kulkarni, IISC, Bangluru

Dr. Anil Kulkarni works as a senior scientist at the Indian Institute of Science, Bangaluru. He gave his expert talk on "Global warming and its impact on water resources". It is crucial to know the adverse impacts of climate change, and humans must be prepared for the worst impacts of climate change. The talk was organized in online mode, and students, faculties, and the common man have taken part in the talk.

The second lecture of this lecture series was given by Dr. Nandkumar Vadanere, former Principal Secretary of Water Resources, Department of Maharashtra, on September 25, 2021. The Kolhapur district, especially Kolhapur City, has experienced the worst impact of floods in the last five years. His talk was on "Dams, Floods, and Climate Change". Dr. Vadanere was the chief of the Vadanere Committee, which prepared the report on floods in Maharashtra state.

Photo plate: 7.6 Guest Lecture on "Dams, Flood and Climate Change" by Dr. Nandkumar Vadnere, Department of Water Resources, Maharashtra

Former Principal Secretary of the Water Resources Department of Maharashtra, Nand Kumar Vadanere, asserted here today that there is a need to create a separate flood disaster management department in the state. Dr. Vadanere said floods are an integral part of nature. Although it can't be stopped, its severity can definitely be minimized. He also added that the central and state governments are now seriously considering climate change policies in their decisions. This talk was also organized in online mode. Dr. Vadanere also answered the doubts of the attendees.

The third lecture of this series was given by Dr. Venkatesh Merwade on September 30, 2021. Dr. Merwade is working as a professor at Purdue University, America. He gave his talk on "Flood Planning in America and the Use of That Technology in India." Technology is now very advanced to keep pace with climate change. It is necessary to make information about climate change available to the public through various applications and make them aware of the possible dangers. Dr. Merwade gives information about rain gauge stations operated by the United States Geological Survey (USGS), the Federal Emergency Management Agency (FEMA), and the National Weather Service. Historical rainfall data and maps of the US can be obtained through these sources. Based on them, the National Weather Service has developed a National Hydrological Model for the entire United States, which enables near-real-time monitoring.

Photo plate: 7.7 Guest Lecture on "Flood Planning in America and use of that technology in India" by Dr. Venkatesh Merwade, Professor, Purdue University, US

Dr. Merwade said the parameters used for it play a more important role than the model that predicts the possibility of floods. Therefore, the storage and supply of accurate information are essential. Flood maps are static and cannot predict which areas will flood. To eliminate this defect, many parts of America have been scientifically studied by scientists. He also made a comparative review of one- and two-dimensional hydrodynamic models. He also discussed how these images respond to flood conditions and how capable they are of flood control. This lecture was organised in offline mode at Nilambari Hall, Department of Botany, SUK. A large number of scholars, college teachers, and research students from various universities in the country and abroad were present for this lecture.

The fourth lecture of this lecture series was on "Climate Change and Flood Planning" by Dr. Pradip Purandare, Senior Water Resource Expert. Dr. Purandare said

changes in water management and flood control will have to be made according to climate change. As the duration of the monsoon changes, the irrigation season and dam filling dates have to change.

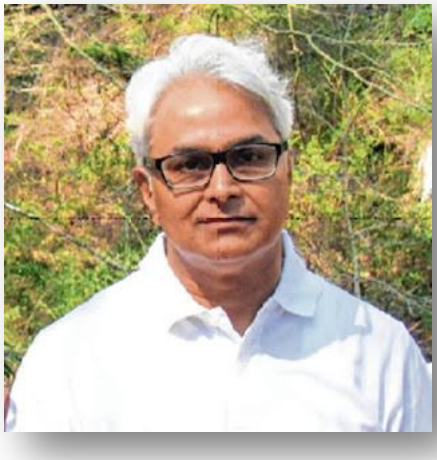


Photo plate: 7.8 Guest Lecture on " Climate Change and Flood Planning" By Dr. Pradip Purandare, Senior Water resource Expert.

He said that it is necessary to reserve some percentage of the storage capacity of the reservoirs of selected dams that are more vulnerable to floods. He also added that, to deal with the change, it is necessary to change the development process, and moving towards a 'low carbon economy' is the way to deal with climate change.

The fifth lecture of this series was on "Panchaganga Flood: Causes and Solution" by the Center Coordinator Prof. (Dr.) Sachin Panhalkar. Dr. Panhalkar said that using new technologies such as run-off models and flood models based on accurate rainfall information, the severity of floods can be reduced. A comparative analysis of the 2005 and 2019 floods in the Panchganga valley revealed that the intensity of the 2019 flood was greater. Only 12% of the Panchganga basin is a dam catchment, and we cannot control water coming from other areas. This causes flooding. He expressed the need to build a series of cascade dams to eliminate this problem.

Photo plate: 7.9 Guest Lecture on "Panchaganga Flood: Causes and Solutions" by Prof. (Dr.) Sachin Panhalkar, Center Coordinator, Climate Change and Sustainability Studies, Shivaji, University Kolhapur.

Prof. Panhalkar also mentioned that, As a result of climate change, Salwan and Ichalkaranji in the Panchganga basin experienced floods in 2019 when rainfall exceeded capacity (1040 mm and 84 cm, respectively). So it is important to study the nature of rainfall, its intensity, duration, and prone area.

Considering the "Ecofriendly Festivals" during the Ganesh Mohotsav, the Department of Environmental Science, Shivaji University, Kolhapur, has organized the "Seed Ganesha" workshop for the society on August 25, 2022. The Department of Environmental Science has organised the "Seed Ganesha" workshop to raise awareness of pollution caused by Ganesh idols made up of plaster of Paris (POP).

Photo plate: 7.10 Workshop on "Seed Ganesha" by Gaurav Kaingade, Terracotta Journey, Organised by Department of Environmental Science, Shivaji, University Kolhapur.

This year also, 50 students from various departments and 25 school students participated in this 'Seed' Ganesha murti-making workshop. Idols made of plaster of Paris or chemical dyes cause a lot of pollution in nature. To avoid that, Shadu idols were made with their own hands. After drying this Shadu Ganesha idol, seeds of various flowers were buried in it. This idol is installed at home. At the time of immersion, if it is immersed in a pot at home and water is poured over it, the idol becomes soil again, and the seeds buried in it take root in the pot. They transform into attractive flowers, and these flowers continue to delight us. This concept achieves the act of immersing the Ganesha idol made from the elements of nature back into nature without harming it and returning it to make nature bloom again.

A one-day management development programme on "Net Zero Emission: A Global Necessity" was organized at the University in association with Bank of India Adhyasan and Rajarambapu Institute of Technology, Islampur on 28th March, 2022. Pro-Vice Chancellor Dr. Patil said many terms like global warming, climate change, zero carbon," and net zero emission have created curiosity in the minds of common people and activists. In a real sense, some activists are doing a lot of work on this issue in society on their own to carry forward the work in this regard. The aim of bringing this topic to the fore by bringing together such different activists in society has been achieved through this workshop.

Photo plate: 7.11 Workshop on “Net Zero Emission: A Global Necessity” by Shivaji, University Kolhapur.

According to the discussion held at the Glasgow conference, Dr. Subhash Athalye, Dr. Experts Madhukar Bachulkar, and Colonel Shashikant Dalvi guided. If the citizens do not take this matter seriously, humans will have to face the serious consequences of global warming in the near future. Frequent cyclones, unseasonal rains, wet and dry droughts, and

water shortages will continue to occur, and the tone of the discussion is that humans are responsible for them.

5.2 Awareness program through newspaper articles:

Prof. (Dr.) V. N. Shinde, Honorable Registrar, Shivaji University, has written so many articles on global environmental issues. The university is continuously trying to spread awareness about concerning environmental issues through workshops, lecture series, and newspaper articles. Prof. Shinde has written blogs on issues such as sustainable development, plastic pollution, tree plantations, global warming, etc.

पुण्यनगरी

विज्ञानाच्या विश्वात

डॉ. वी.एन. शिंदे

शाश्वत विकास

युक्रेन आणि रशियातील युद्धाचा भडका उडाला. भारतापासून हजारो किलोमीटरवर युद्ध सुरू आहे. युद्धाचा फटका जगातील प्रत्येक देशाला प्रत्यक्ष किंवा अप्रत्यक्ष बसत असतो. युद्ध चांगले नाही, असे सर्वजण सांगत असतो. मात्र स्वार्थापोटी युद्ध, बहुतांश देश करत असतात. काही महिन्यापूर्वी 'इंटरगव्हर्मेंटल पॅनेल फॉर क्लायमेट चेंज'(IPCC) यांचा अहवाल आला. या अहवालाला गांभीर्याने घेत युनोने शाश्वत विकासासाठी विज्ञान आणि तंत्रज्ञान अशी भूमिका घेत, शाश्वत विकासासाठी मार्गदर्शक सूचना प्रसृत केल्या. त्यांना लक्षात घेऊन या वर्षी भारतात २८ फेब्रुवारीला राष्ट्रीय विज्ञान दिनासाठी 'शाश्वत विकासासाठी विज्ञान तंत्रज्ञान' अशी मध्यवर्ती संकल्पना जाहीर केली.

दिल्लीपासून युनोपर्यंत, शाश्वत विकास या संकल्पनेचा विचार करण्याची गरज का निर्माण झाली, हा महत्त्वाचा प्रश्न आहे. मानवाने आपले जीवन सुखासीन बनवण्यासाठी सुरुवातीपासून सुचतील ते मार्ग अवलंबले. पृथ्वीवरील असंख्य प्राणीमात्राप्रमाणे असणारा मानवही एक जीव. सुरुवातीला इतर प्राण्यांप्रमाणेच राहणारा, जगणारा, निसर्गातील एक घटक. पुढे आपल्या बुद्धीचा वापर करत निसर्गाच्या केंद्रस्थानी आला. गौतम बुद्धांसारख्या महामानवाने त्यावर असणारी जबाबदारी सांगितली. महात्मा गांधीनी 'भूमी, पाणी आणि हवा ही आपली जहागिरी नसून, पुढच्या पिढीला जशीच्या तशी सोपवण्याची जबाबदारी,' असे सांगितले. मात्र, यांचे ऐकणार कोण? स्वार्थापुढे ही शिकवण विसरली जाते आणि निसर्गावर अन्याय, अत्याचार करत कथित प्रगती केली जाते. युरोपियन लोकांनी भारतात आक्रमण करेपर्यंत परिस्थिती योग्य आणि निसर्गस्नेही होती. मात्र, पाश्चात्यांनी भारतीयांना मागास ठरवले. शिक्षण, आरोग्य, स्वच्छतेबाबत सर्वसामान्य जनता मागासही होती. मात्र, जगणे निसर्गस्नेही होते.

शिक्षण घेतलेल्या लोकांना पाश्चात्यांच्या जीवनशैलीमध्ये आधुनिकता दिसली आणि तीच त्यांच्यासाठी जगभर अनुकरणीय ठरली. चकचकीत, गुळगुळीत जीवनशैली आपलीही असावी, याचे स्वप्न प्रत्येकाला पडू लागले. यातून अहर्निष स्पर्धा सुरू झाली. या स्पर्धेचा वेग वाढत राहिला. अत्याधुनिक उपकरणे, वेगवान वाहने या सर्व गोष्टींसाठी ऊर्जा ही गरजेची. याचा परिणाम म्हणून राष्ट्राची प्रगती ही दरडोई ऊर्जेचा वापरावर ठरवली जाऊ लागली. हे परिमाण ठरताच ऊर्जा मिळवण्यासाठी अमर्याद प्रमाणात खनिज तेल आणि कोळशाचा वापर सुरू केला. निसर्गाचाच ठेवा उद्ध्वस्त करायला संपवायला सुरुवात केली. यातून प्रदूषण आणि तापमानवाढ अटळ बनली. हे साठे सर्वत्र नसल्याने ते ज्या राष्ट्रात ती राष्ट्रे महत्त्वाची ठरली. त्यांच्यावर वर्चस्व मिळवण्यासाठी स्पर्धा सुरू झाली. त्यासाठीच युद्धे सुरू आहेत. अशा पार्श्वभूमीवर शाश्वत विकासाचा जागर करण्याचे आवाहन सर्वांपुढे आहे. सुरू असलेल्या रशिया-युक्रेन युद्धात हजारो लिटर इंधन जाळले जात आहे. त्यातून दोन्ही बाजूंची हानीच होते. मालमत्तेचे नुकसान होते. दोन्ही राष्ट्रांशी कसलाही संबंध नसलेले अब्जावधी जीव मात्र याचे दुष्परिणाम सहन करत राहणार आहेत. जे प्रदूषण होत आहे, कचऱ्याचे ढिग तयार होत आहेत. इमारती पडल्यानंतर तयार होणारा कचरा असंख्य प्रश्न युद्ध निर्माण करतात. तरीही आम्ही प्रगती करत आहोत आणि शाश्वत विकासाची चर्चा करत आहोत. पूर्वजांनी केलेली नैसर्गिक संसाधनांची लूट थांबवायला हवी. उलट आपण ती वाढवत आहोत. आणखी वेगाने निसर्गाची हानीच करत आहोत.

युद्धाच्या पार्श्वभूमीवर या वर्षीच्या विज्ञान दिनाची संकल्पना आणखी विचार करायला भाग पाडते. वेगाने जाता यावे म्हणून रस्ते बांधायचे. रस्त्यासाठी डोंगर पोखरून भराव घालायचे. भराव घालताना पुराचा विचार न केल्याने पावसाळ्यात पूरपरिस्थिती बिकट होते. वेळ कमी लागावा म्हणून सहा-सहा मार्गिकांचे रस्ते तयार होतात. त्या रस्त्यावर पाळायचे नियम कोणीच पाळत नसल्याने पुन्हा परिस्थितीत काहीच बदल नाही. तेवढाच वेळ लागतो. वाहनांना इंधन जास्त लागते. टोलचा भुर्दंड आहेच. इकडे डोंगर सपाट केल्याने त्याचा पावसावर आणि पीकपाण्यावर अनिष्ट परिणाम स्वाभाविक. आपण विकासाच्या नावाखाली जे गुर्ते निर्माण करत आहोत ते कमी करणे महत्त्वाचे आहे. कोणताही प्रकल्प उभारताना भविष्यात होणाऱ्या परिणामांचा विचार करायला हवा. तो आज होताना दिसत नाही. हरित क्रांतीचा दुष्परिणाम आज पन्नास वर्षांनंतर दिसू लागले आहेत. अर्थात हरित क्रांती अपरिहार्यता होती. त्या काळात अन्नधान्याचे उत्पादन वाढले नसते तर यादवीची स्थिती अनेक राष्ट्रांनी अनुभवली असती. शाश्वत विकास म्हणजे विज्ञानातून निर्माण होणाऱ्या तंत्रज्ञानाचा अविचारी वापर नसून, निसर्गातील अन्य घटकांवर परिणाम न करता होणारा विकास. सुखासीन आयुष्यासाठी प्रकल्प उभारताना, याचा विचार व्हावलाच हवा.

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पुण्यनगरी

विज्ञानाच्या विश्वात

डॉ. वी.एन. शिंदे

रक्तातही प्लास्टिक..!

विसाव्या शतकाच्या सुरुवातीला जपानच्या एका भागामध्ये लोक लंगडत चालू लागले. सर्व प्रकारच्या वैद्यकीय चाचण्या झाल्या; मात्र लोकांच्या आजाराचे कारण सापडले नाही. त्यानंतर संशोधकांनी लोकांच्या आहाराचे पृथक्करण केले. त्यातून धक्कादायक माहिती समोर आली. ते लोक ज्या भागात राहात, त्या भागात इलेक्ट्रॉनिक उपकरणांचा कचरा टाकण्यात येत असे. त्यातील कॅडमियम पावसाच्या पाण्यावरोबर भातांच्या शेतात येत असे. ते भाताच्या पिकातून भातात आणि भातातून लोकांच्या पोटात जात असे. ते रक्तात उतरून लोकांचे सांधे दुखू लागत. सांधेदुखीमुळे ते लंगडत. आज ही घटना आठवण्याचे कारण म्हणजे नजीकच्या काळात पक्षाघाताचे रूग्ण वाढण्याची शक्यता संशोधकांनी व्यक्त केली आहे आणि याला कारण ठरतोय, प्लास्टिक.

सर्वसामान्य निसर्गावर प्रेम करणाऱ्या नागरिकांपासून सर्वोच्च न्यायालयापर्यंत सर्वजण प्लास्टिकचा वापर थांबला पाहिजे असे म्हणतात. प्लास्टिकबंदीचे कायदे होतात. कडक अंमलबजावणीसाठी मोहीम राबवतात, तरीही प्लास्टिकचा वापर थांबत नाही, थांबवणे सोपेही नाही. १८५५ मध्ये अलेक्झांडर पार्क यांनी सर्वप्रथम प्लास्टिक शोधले. त्याचे नाव पार्कसाईन ठेवले. पुढे त्याला सेल्युलॉईड नाव मिळाले. प्लास्टिक कुजत नसल्याने निसर्गात तसेच राहते. त्याचे विघटन करण्याच्या पद्धती शोधण्यासाठी अनेक वर्षांपासून संशोधन सुरू आहे. मात्र, अद्याप कार्यक्षम पद्धती शोधता आलेली नाही. त्यामुळे ते निसर्गात तसेच पडलेले राहते. अलेक्झांडर पार्क आज हयात असते, तर त्यांनी निर्माण केलेल्या भस्मासूराचा त्यांना पश्चाताप झाला असता.

पार्क यांच्या प्लास्टिकच्या शोधानंतर अनेक संशोधकांनी वेगवेगळ्या प्रकारचे प्लास्टिक शोधले. १८९७ मध्ये डब्ल्यू क्रिशे यांनी दुधापासून प्लास्टिक बनवले. बेकलंड या संशोधकाने रेझिन्स शोधले. १९५२ मध्ये झिग्लरने पॉलिस्टर बनवले. पॉलिइथिलीन टेरेफ्थलेट (PETE)चा वापर सर्रास आणि मोठ्या प्रमाणात होतो. उच्च घनता पॉलिइथिलीन (HDPE)चा वापर दूध, फिनाईल, शांपू, डिटर्जंटच्या पॉकेटसाठी, पाईप बनवण्यासाठी होतो. पॉलिविनाईल क्लोराईड (PVC)चा वापर गाडग्यांचे भाग, पाईप, फळांसाठी क्रेट, स्टीकर्स इत्यादीसाठी होतो. निम्न घनता पॉलिथिलीन(LDPE)चा वापर पुडकाना वापरल्या जाणाऱ्या पिशव्यांसाठी होतो. पॉलिप्रोपिलीन (PP)चा वापर फर्निचर, खेळण्णी, दही इत्यादींसाठी होतो. पॉलिस्टिरीन (PS)चा उपयोग खेळण्णी, कॉफीचे कप, मजबूत पॅकिजिंगसाठी होतो. याखेरीजही अनेक प्रकार आहेत, ज्यांचा अक्रेलिक, नायलॉन, फायबर ग्लास, बॅटिल्स बनवण्यासाठी वापर होतो. त्यातील काहींचा पुनर्वापर करता येतो. मात्र, प्लास्टिकचा धोका आहे, तो मानवी निष्काळजीपणामुळे. स्वस्त मिळणाऱ्या प्लास्टिकचा अनिर्बंध वापर आणि पुनर्प्रक्रियेसाठी न पाठवता कोठेही टाकून देण्याचा वाईट परिणाम जीवसृष्टीवर होत आहे. गाय, म्हैस आणि इतर जनावरांच्या पोटात प्लास्टिक जाऊ लागले. ते न पचल्याने जनावरांचे जीवन धोक्यात आले. सहल, सफारीवर जाणारे जंगलातही प्लास्टिकचा कचरा फेकू लागले. याचा परिणाम एकूण जीवसृष्टीवर होऊ लागला.

वापरलेले प्लास्टिक स्वच्छ धुवून पुनर्प्रक्रियेसाठी करण्यासाठी उपलब्ध करून देणे गरजेचे असते. मात्र असे होत नाही. स्वस्त उत्पादन होत असल्याने पुनर्प्रक्रियेपेक्षा नव्या निर्मितीमध्ये उद्योजक व्यस्त असतात. लोकांनाही वापरलेले प्लास्टिक स्वच्छ धुण्याचे कष्ट नको असतात. त्यामुळे अन्न पदार्थांसाठी वापरलेल्या प्लास्टिकच्या पिशव्या, साहित्य तसेच फेकून दिले जाते. जनावरांचे खाद्य पुरेसे उपलब्ध नसल्याने आणि प्लास्टिकला अन्नपदार्थांचा दर्प असल्याने जनावरे ते खातात. ते त्यांच्या पोटात जाते; परिणामी त्याचा अंश जनावरांच्या पोटात उतरतो.

मानव थेट प्लास्टिक खात नाही, मात्र, प्लास्टिकचा वापर अनेक कारणांसाठी विशेषतः अन्न पदार्थांच्या पॅकिंगसाठी केला जात असल्याने प्लास्टिकचा अंश आपल्या पोटात जाऊ शकतो, याचे मानवाला भान राहिलेले नाही. कॉफी, चहा देण्यासाठी मोठ्या प्रमाणात प्लास्टिकचे कप वापरले जातात. शुद्ध पाणी म्हणून बाटलीतील पाणी वापरले जाते. हे पाणी असते मात्र प्लास्टिकच्या बाटल्यात. बाटल्यांचे क्रेट्स अनेक दुकानांच्या दारात सूर्यप्रकाशात ठेवले जातात. त्यामुळे बाटल्यातील प्लास्टिकचा अंश पाण्यात उतरतो, ते पाणी आपण शुद्ध पाणी म्हणून पितो. नुकत्याच झालेल्या संशोधनात संशोधकांच्या लक्षात असे आले की, जगातील ८० टक्के लोकांच्या रक्तात मायक्रोप्लास्टिकचे अंश आहेत. अन्न पॅकिंगसाठी वापरले जाणारे पॉलिस्टिरीन एक तृतीयांश लोकांच्या रक्तात आढळले. मायक्रोप्लास्टिक रक्तातून एका बाजूकडून दुसऱ्या बाजूकडे जाते. शरीराच्या एका भागात साठू शकते. यामुळे पक्षाघाताचा झटका येऊ शकतो. प्लास्टिकचे अंश हवेतही पसरतात, हवेतूनही मानवी शरीरात जातात. मायक्रोप्लास्टिक हिमालयाच्या शिखरापासून समुद्राच्या खोल तळापर्यंत मानवी कर्तृत्वाने पोहोचले आहे. आपण त्याचा अनिर्बंध वापर केल्याने ते आपल्या अस्तित्वावर उठले आहे. रक्तात हे कण आढळण्याचे गांभीर्य आता तरी ओळखायला हवे. प्लास्टिकचा वापर थांबायला हवा.

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MUMBAI
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विज्ञानाच्या विश्वात

डॉ. वी.एन. शिंदे

चला, झाडे लावू या!

या वर्षीचा मार्च महिना मागील १२१ वर्षांतील सर्वांत उष्ण महिना होता. विसाव्या शतकाच्या मध्यापासून 'जागतिक तापमानवाढ' शब्द ऐकायला येऊ लागला. एकविसाव्या शतकामध्ये 'इंटरगव्हर्मेंटल पॅनेल फॉर क्लायमेट चेंज'ने सादर केलेल्या अहवालानंतर, या चर्चेने चांगलाच जोर धरला. जागतिक तापमानवाढीचा परिणाम निसर्गाच्या अनियमतेत दिसणार, असे अहवाल सांगतो. वसुंधरेचे तापमान वाढल्यामुळे बर्फाचे पर्वत, नद्या, समुद्र वितळत आहेत. समुद्राच्या पाण्याची पातळी वाढत आहे. समुद्रकिनारी वसलेल्या गावांना, शहरांना, शेतीला धोका निर्माण झाला आहे. ब्रह्मपुत्रा नदी बंगालच्या उपसागराला मिळते, तेथील अनेक बेटे आज ओस पडली आहेत. काही तर समुद्राच्या पाण्याखाली गेली आहेत. विसाव्या शतकाच्या सुरुवातीस, विषुववृत्तीय भागातील किलिमांजिरो शिखरावर असणारे बर्फ आज २० टक्केही राहिलेले नाही. एकीकडे पूर आणि दुसरीकडे दुष्काळ, वारंवार अनुभवास मिळतो. मोठाला पावसाने जमिनीची धूप होऊन वाहून जाणारा गाळ समुद्राची खोली कमी करत आहे. कधीही वादळे न येणाऱ्या अरबी समुद्रात, वारंवार वादळे येत आहेत. हे सर्व जागतिक तापमानवाढीचे दुष्परिणाम आहेत. याचा अंतिम परिणाम म्हणजे वसुंधरा जीवसृष्टीसाठी योग्य राहणार नाही.

जागतिक तापमानवाढ होण्यामागे कार्बन वायूंचे, हरित वायूंचे वातावरणातील वाढते प्रमाण आणि ते कमी करणाऱ्या जंगलांचे घटते प्रमाण हे मुख्य कारण आहे. जगातील सर्व देशातील सुजाण नागरिक यावर विचार करत आहेत. हे रोखण्याचा प्रयत्न करत आहेत. मात्र, हे प्रयत्न तोकडे आहेत. केवळ काही नागरिकांच्या किंवा एखाद्या देशाच्या सरकारच्या प्रयत्नाने ही वसुंधरा वाचणार नाही. त्यासाठी शासन आणि जनता यांनी मनापासून प्रयत्न करायला हवेत. जे प्रयत्न होत आहेत, तेही योग्य आहेत, असे नाही. कार्बन वायू उत्सर्जनाचे प्रमाण कमी करण्यास कोणताही देश तयार नाही. त्यामुळे जंगल वाढवणे, हाच एक उपाय आहे. त्यासाठी जंगल वाढवण्याचे प्रयत्न होत आहेत. यात गवताळ प्रदेश आणि पानथळ जागांवरही वृक्ष लागवडीचे प्रयत्न होत आहेत, हे योग्य नाही. अशा भागाची एक वेगळी जैवसाखळी असते, ती आपल्या हस्तक्षेपाने नष्ट होत आहे. हे झाडे लावण्याच्या उत्साहात लक्षातच घेतले जात नाही. दुसरे म्हणजे जंगल लवकर वाढावे म्हणून झटपट वाढणारी झाडे लावली जातात. त्या झाडांचे स्थानिक जैवसाखळीतील स्थान लक्षात न घेता ग्लिरिसिडीया, आफ्रिकन ट्युलिप, बदाम इत्यादी झाडांची मोठ्या प्रमाणात लागवड होते. यातील काही झाडांची रोपे तर वन विभागामार्फतच पुरवली आणि लावली जातात. गुलमोहोरासारखा वृक्ष केवळ उन्हाळ्यात चांगला फुलतो म्हणून अनेकजण लावतात. एखाद्या वृक्षाचे महत्त्व सांगणारी माहिती कोणीतरी व्हॉटसॲप विद्यापीठात पसरवते आणि खातरजमा न करता लोक त्या झाडाची लागवड करतात. यातून तिरवे आच्छादन वाढते. मात्र, ते स्थानिक जैवसाखळीला उपयुक्त नसते. उलट आफ्रिकन ट्युलिपसारख्या झाडाची फुले तर स्थानिक मधमाशांसाठी विष असतात. त्यामुळे झाडे लावताना काळजीपूर्वक निवड करायला हवी. वसुंधरा वाचवायची तर पशू, पक्षी, किटक, जिवाणू, विषाणू सर्व काही जंगले पाहिजेत. या सर्वांच्या अन्नाचा मुख्य स्रोत वनस्पती असतो. मांसाहारी प्राणी, पक्षी ज्यांना खातात त्यांचे वाढ वनस्पतीवर होते. केवळ एकाच प्रकारची झाडे लावूनही स्थानिक जैवविविधता टिकणार नाही. त्यामुळे झाडे लावताना विविध स्थानिक वाण लावले पाहिजेत. अनेक स्थानिक झाडांची तर आजकाल रोपेही मिळत नाहीत. वड, उंबर, पिंपळ, पिंपरण, नांदुक की झाडे तर शक्य असेल तेथे लावावीत. मंदिराभोवती या झाडांबरोबर बेल, कदंब, चाफा, पारिजातक, शमी, आपटा, कांचन, कडुनिंब, चिंच ही झाडे योग्य. उद्यानामध्ये फुलझाडे लावावीत. मोठी फळे असणारे नारळ, आंबा अशी झाडे लावणे टाळावे. हलक्या फांद्या असणारी झाडे रस्त्याकडेला लावू नयेत. चिंच, कडुनिंब, शिरीष (रेन ट्री नव्हे), बहावा, करंज, वड, पिंपळ, शिसम, उंबर, पाखर इत्यादी झाडे लावणे योग्य. पक्ष्यांसाठी हिवर, बोर, बाभूळ, खैर अशी काटेरी झाडे महत्त्वाची असतात. ही झाडे हळू वाढत असली, तरी जैवविविधता टिकवून ठेवण्यासाठी महत्त्वाची असतात. आवळा, रक्तचंदन, कुसुंब, भेंडी, पांगरा, आकाशनिंब, महारूख, टेंभुर्णी, सिताफळ, रामफळ, कवठ, फणस, खैर, लिंबू, आंबा, शिंदी, धायडा, चाप, अर्जुन ही झाडेही महत्त्वाची आहेत. झाडाझुडपांच्या खुंटांचे, गवताळ भाग, पाणथळ जागांही महत्त्वाची असतात. वसुंधरा वाचवण्यासाठी झाडे तर लावावीच लागतील. विचारपूर्वक रोपांची निवड करायला हवी. तो जगवायला हवीत. केवळ झाडे लावणे महत्त्वाचे नाही, तर ती स्थानिक वाणांचीच लावायला हवीत.

संपर्क : ९६७३७८४४००


पुण्यनगरी

पाण्याचे प्रदूषण...

विज्ञानाच्या विश्वात

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पुण्यनगरी

दरडी का कोसळतात?

विज्ञानाच्या विश्वात

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Photo plate: 7.12 Newspaper articles by Prof. (Dr). V. N. Shinde, Registrar Shivaji, University Kolhapur.

6 The largest flora in the world is in the lead botanical garden of Shivaji University.

The century palm, a species of palm, blooms once in a lifetime of about 80 years, making it the largest and rarest bloom in the plant world. A palm of this species was also planted in the Lead Botanical Garden of Shivaji University 24 years ago, and this year the plant has blossomed. This is an opportunity for botanists and plant lovers to witness this rare sight. This information is provided by senior botanist Dr. Srirang Yadav,on September 1st 2022.

Photo plate: 7.13 the largest flora in the world is in the lead botanical garden of SUK.

In the year 1998, Century Palm at Sawantwadi came into bloom. That year, its seeds were collected and brought to Shivaji University. Their seedlings were produced in the lead botanical garden of the university's Department of Botany. They were planted in this garden. This year 2022, one of those palm trees has blossomed after almost 24 years. For the first time in Karveer Nagar, the historic bloom of the Century Palm has blossomed in the lead botanical garden of the Department of Botany. It is a feast for tree lovers.

7. Shivaji University Awarded the "District Green Champion Award"

Shivaji University has been awarded the 'Kolhapur District Green Champion' award for the year 2021–22. The competition was conducted through the Mahatma Gandhi National Rural Education Council under the Union Ministry of Higher Education. This information is provided by the Chairman of the Council. W. G. Prasanna Kumar has given it to the university administration through email.

The Swatch Campus Institutional Awards are presented every year by the Mahatma Gandhi National Rural Education Council of the Central Government. Under this, various educational institutes from district level to central level are selected based on the basic criteria of cleanliness and greenness of their premises and encouraged by awarding them. Shivaji University has participated in this competition for the first time this year and has won the first prize at the district level for its work in the field of water management and environmental conservation over the past few years. Major criteria for the award included water management, solar energy utilization, energy conservation activities, green space management, solid waste management, and land use and management.

Photo plate: 7.14 Water storage on Shivaji University, Kolhapur Campus.

Due to the water management campaign implemented by the university in the last few years, the campus has become self-sufficient in terms of water consumption. Every season, the university conserves around 31 crore litres of water.Also, 4 lakh litres of waste water are recycled every day and used in parks. The university is also gradually increasing its use of solar energy. Currently, 16 percent of the total electricity consumption is generated from solar energy. The university has planted trees extensively on its 853-acre area. There are more than 13 thousand trees of various species on the university premises. Due to this, this area is known as the lungs of Kolhapur city. Last year, the university planted 1,200 saplings. The university is implementing a project to develop the Miyawaki forest area. The university successfully manages an average of 575 kg of solid waste per day. Biomedical solid waste is also managed as per prescribed norms.Solid waste is also managed as per prescribed norms. The university is moving forward with the motto of green development for environmental conservation. It is on this strength that the university has achieved this success.

Photo plate: 7.15 Greenery on Shivaji University, Kolhapur Campus.

CONCLUSION AND MANAGEMENT PLAN

In the academic year 2021–22, Shivaji University, Kolhapur had a Green Audit by the Department of Environmental Science at Shivaji University, Kolhapur. The process of discovering and evaluating whether institutional policies are sustainable and environmentally friendly is known as "green audits." The major goal of the college's green audit is to examine the green practices that are being used in the institution and to carry out a well-planned audit to determine where we stand on a scale of environmental soundness.

- **Conclusions:**

The following are some findings from the team's green audit that can be used to improve the college campus and make it more environmentally friendly:

1. The institute has made attempts to keep the campus green.
2. Because the University site is older, there is higher carbon stock there.
3. The campus's tree biodiversity is particularly strong.

- **Recommendations:**

The primary recommendations for enhancing the campus environment are listed below.

1. It is possible to start drip irrigation for gardens and botanical gardens.
2. Events involving human-made fire should be avoided on campus.
3. In order to prevent fire occurrences on campus, fire lines should be getting ready.

❖ **ENVIRONMENT MANAGEMENT PLAN:**

We have created an Environment Management Plan (EMP) for the Shivaji University, Kolhapur by comprehending the dynamics of the current scenario of resource usage and current practises of green inventory. This strategy will not only outline the advantages, disadvantages, and solutions for maintaining a green and clean campus, but it will also prioritise the areas in which the University needs to make greater environmental improvements.

Environment Management Plan 2021-22

Sector	Strengths	Weakness	Suggestions	Priority
Tree Vegetation	• There is lots of space for plantation • 99 tree species on campus. • 13,473 total full grown trees on	• Fewer plantations on campus. • Plantation on campus of some	• Avoid monoculture, variety of species should be planted in campus area • Plantation on	Medium

	campus. • Lead Botanical Garden with endemic species of Western Ghats. • Plantation activity by University and all Departments. • University tree authority to look after campus garden and plantation.	exotic plants. • More growth of trees like Gliricidia.	slope areas of campus. • No permission to other organization for plantation. • Campus plantation plan to be prepared. • Guidance of Botany department for plantation activity.	