



**KUVEMPU UNIVERSITY**

**Govt. of Karnataka, State Public University**

**Jnanasahyadri Campus, Shankaraghatta-577451, Shivamogga District, Karnataka**

**Supporting Documents pertaining to the following Metric:**

**7.1.6: Quality audits on environment and energy are regularly undertaken by the institution The institutional environment and energy initiatives are confirmed through the following**

- **Green audit / Environmental audit**
- **Energy audit.**
- **Clean and green campus recognitions/awards.**
- **Beyond the campus environmental promotion and sustainability activities.**



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Bengaluru-562130, Karnataka

## GREEN AUDIT CERTIFICATE

This certificate is issued to Kuvempu University, Jnanasahyadri Campus, Shankaraghatta - 577 451, Shivamogga District, Karnataka, for successful completion of Green cum Environment Audit of the University Campus for the year 2023-24, conducted by M/s Envipro Solutions Pvt. Ltd., Bangalore.

This Environment Audit included various Sectoral Audits in the sectors viz. Water, Energy, Waste cum Material & Resource Recovery, Air Quality, Noise Levels and Biodiversity. The University is certified to have done exceptionally well to conserve the environment and ensuring sustainable development for the assessment period till 15/12/2023.

Duration of Audit: Nov. 2022 to Dec. 2023

Date of Issue: 20<sup>th</sup> Dec. 2023

For M/s Envipro Solutions Pvt. Ltd.



Sri. M S Ashwath Narayan  
Managing Director



**KUVEMPU**  **UNIVERSITY**

**Jnanasahyadri Campus, Shankaraghatta  
Shivamogga-577 451, Karnataka**

**GREEN AUDIT REPORT**



**M/S ENVIPRO Solutions, Pvt., Ltd.,  
BANGALORE**

**2024**



ಪ್ರೊ. ಶರತ್ ಅನಂತಮೂರ್ತಿ, ಎಂ.ಎಸ್ಸಿ., ಎಂ.ಎಫ್., ಡಿ.ಫಿಲ್.ಡಿ.

ಕುಲಪತಿ

**Prof. Sharath Ananthamurthy**, M.Sc. M.S. Ph.D.

Vice Chancellor

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### FOREWORD

Universities can nowadays be regarded as 'small cities' due to their large sizes, population, and the various complex activities taking place in campuses. These can have some serious direct and indirect impacts on the environment. The environmental pollution and degradation caused by universities in the form of energy and material consumption via activities and operations in teaching and research, provision of support services and in residential areas can be considerably reduced by an effective choice of organizational and technical measures. Although many environmental protection measures can be seen at some universities, a more systematic and sustainable approach to reduce the negative impacts of those activities that result in making the campuses more sustainable, is generally lacking. Therefore, this study has been carried out to achieve campus sustainability that could remedy the limitations of the current environmental management practices in universities and ensure greater sustainability.

The Green Audit of Kuvempu University campus emphasizes air and water quality status, energy efficiency, water conservation methods, solid waste management, environment and green campus awareness and a rich biodiversity recorded in the forest region of the campus. Green Audit is a management policy to maintain the pristine purity and beauty of the university and to provide a congenial atmosphere for the academic and non-academic pursuits. The campus has well maintained greenery with natural forest area covered under the Bhadra Wild Life Sanctuary. Ecological balance is well maintained by conserving natural forest with wildlife habitat. Seminars, conferences and important environmental awareness activities have been conducted to promote environmental awareness among the students and surrounding local communities. An interesting observation is that the carbon sequestration potential is the highest in the campus due to the maintenance of rich vegetation and diversity of herbs, shrubs and canopy. Further solid waste generated in the campus is segregating and utilising the biodegradable waste for energy and compost production. Water conservation methods are adopted in the campus where spring action taps are fitted to minimize wastage of water. Awareness regarding the minimal consumption of energy is developed among staff and students. Minimal consumption of energy helps in energy conservation. Using CFL/LED bulbs reduces electricity consumption. Solar water heaters are installed in hostels as a source of renewable energy; and have reduced the use of electricity for water heating in hostels. Providing proper ventilation system in class rooms/labs reduces power consumption. The university has a rich green cover of natural forest in our campus which is scientifically listed. Every year, a World Environment Day and Wild Life Week as well as sustainable environmental practices are adopted to achieve the sustainable development goal.

As part of green campus initiatives, the Department of Environmental Science has commenced an Eco-Club. The Club has facilitated and promoted the use of bicycles in the campus to reduce the carbon load in the campus. In all these ways, Kuvempu University is proudly marching on in ushering in healthy environmental friendly practices towards meeting the sustainable development goals.



Vice-Chancellor



## **PREFACE**

Green Audit Report usually addresses the issues of energy and water resources management, solid and hazardous waste management, biodiversity, land use land cover, and healthy environment and ecosystem. Here, green refers to the sense 'environmentally sound or beneficial'. Although the environmental concern does play an important role in such audits, there is also an indirect outcome of the exercise i.e. "saving money". Under strict cost cutting regimes, savings on energy and water resources, waste management etc. has added a new dimension. The green audit has gone beyond the usual benefits of health, hygiene and safety.

Prof. J. Narayan, and his team, Department of Environmental Science, Kuvempu University has provided the logistics support by facilitating us in regard to the university's basic and essential data pertaining to the campus ecology and topography, resources and their management, available services etc. They have fully cooperated and monitored the auditing process and assisted the us in the preparation of 'Green Audit Report'.

The Green Audit Report is attempted to account the resource consumption pattern of university campus with an eye on the sustainable development. The Introduction Chapter deals with the scope of the Green Audit with Aims and Objectives as well as campus infrastructure. The Chapter-2 provides the detailed review of literature pertaining to institutional Green audit and its importance. Chapter-3 discussed the pre-audit stages and methodology for conducting Green audit in the campus. Chapter - 4 elaborates on land use systems, variation of on meteorological parameters, qualitative measurements, auditing for energy conservation and management. Chapter - 5 presents electricity audit details with records. Air quality assessment and noise monitoring values are also recorded. Chapter-6 represents the solid waste management in the university campus through calculating waste generation and future recycling opportunities, vermicomposting of leaf litter and other biodegradable wastes are also discussed. Water quality assessment and safe water supply to the consumers are discussed. It also projects the potential of roof top rain water harvesting along the university water requirement. Chapter-6 also discusses on Biodiversity supported in the campus area. Apart from the aesthetic looks, the trees on the campus can act as a potential sink for carbon sequestration. This aspect was brought forward in the form of carbon sequestration potential of trees in the university campus and portrayed in the Chapter -7 which describes about the details of carbon sequestration potential in the campus. In addition to this, carbon foot print in the campus is estimated and presented. Water quality and waste water management methods adopted in the campus is presented briefly. Finally best practices followed and environmental programs organized in the campus are mentioned. The last chapter is devoted to the outcomes of the green audit study of the campus. We would like to state that this report may not be a compliance study or guideline based approach. However, it does provide an insight and baseline information for further sustainable development goals in the coming years. Moreover, much still remains to be done. The University's Green Policy document serves as the basis for the Green Audit Report.



We greatly acknowledge the faculty members and the students from the various departments, Engineering Section and Estate Section for the support and assistance rendered by them during the preparation of audit report. Our profound thanks to Prof. Sharath Ananthamurthy, Hon'ble Vice-Chancellor, Kuvempu University, Shankaraghatta for providing us an opportunity to conduct Green Audit of Kuvempu University Campus from November 2022 to December 2023.

We acknowledge the logistics support rendered by Prof. J. Narayan, and his team Department of Environmental Science Kuvempu University.

**Sri M. S. Ashwath Narayan**  
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## Chapter 1

### 1.0 INTRODUCTION

Environmental pollution refers to the introduction of harmful substances to the environment which results in unfavorable alteration. The major types of environmental pollution are water pollution, air pollution, soil pollution, deforestation and hazardous gaseous emissions also leads to environmental pollution. During the last 50 years the world has witnessed severe rise in environmental pollution. Polluted air contains one or more hazardous substance, pollutant or contaminant that creates a hazard to general health [MC Michael et al 2007] the main pollutants found in air we breathe include particulate matter, PAHs, lead, ground level ozone, heavy metals, Sulphur dioxide, benzene, carbon monoxide and nitrogen dioxide (European Public Health Alliance, 2009).

Environment degradation and the depletion of natural resources induced by human activities have attracted steadily growing concern in the last decades such concern made consider the necessity for the planning authorities to count on sound information about the possible environmental consequences of development actions. One of the tools available to satisfy this need is represented by the procedure of EIA .this procedure involves the systematic identification and evaluation of the impacts on the environment .Its potential role in attaining sustainable development objectives was explicitly recognized during the 1992 earth summit held in Rio de janerio [United Nations ,1992].

Air pollution in cities cause a shortage lifespan for city dwellers, polluted wastes consists of industrial discharge effluent sewage water, rain water pollution [Ashraf et al 2011] and polluted by agriculture or households cause damage to human health or environment. Due to the increase in population along with increase in economic activities and rapid technological innovation, are leading to change in the natural ecosystem.The need for humans to understand, respond and alter their future impacts on the planet is essential. The current and future generations of students graduating from universities and institution will be faced with the challenge to re-think, re-design and re-create how humans utilize all the major natural resource based systems on earth,and also now a days high pollution causes drastic change in the environment, for reducing and proper management of the pollution environmental auditing is need of the hour.

Green auditing can be defined as systematic identification, quantification, recording, reporting and analysis of components of ecological diversity and expressing the same financial or social terms.Green audit is a tool which can be used to attain sustainable development and competative advantage. Green auditing is the corporate responsibility to bring out the truth about the statements made by the government and companies with regard to the effects of environment pollution. It reviews the measures taken to minimize and overcome pollution. The green audit is study of the effects of a company's activities and performance on the environment. It is widely known as Environment Audit. Green audit comprises of compliance of Environment Laws, auditing of environment cost and Environment Impact Assessment and Carbon Credit. Green audit is the process of assessing the environmental impact of organizations, project. The increasing awareness and the cost effectiveness of green auditing may prove its successive implementation.





The current environmental audit represents the next stage in the effort to build super sustainability. Sustainability has been defined in various ways in various contexts, but for this project, we defined sustainability through a whole-system framework within which a broad range of environmental resource use, technological and economic issues can be addressed. We defined sustainability as a means of living, working and behaving in a way that will sustain resources and the environmental integrity of local, regional and global ecosystems, without compromising the ability of future generations to meet their own needs. Environmental issues are becoming more complex multidimensional and interconnected and environmental sustainability by its very nature requires an integrated and systematic approach to decisions making, investments and management. Therefore, there is need for a professional and systematic environmental management approach to reducing the consumption of resources and negative impacts of the various campus operations and promoting campus sustainability.

The campus environmental audit is a common tool that many colleges and universities have employed in recent years. A campus environmental audit is both a summary and a report card for a campus and a way to evaluate where and how resources are being used. An environmental audit is also the first step in being able to quantify whether or not current and/or future environmental efforts are actually making a difference. As such, an environmental audit is the beginning of the sustainability planning process. The results can be used to quantify what kinds of impacts the campus community has on the environment and what steps the college can take to reduce these impacts. It is hoped that the results presented in this audit will serve as a guide for educating people on the current practices and resource use at kuvempu university for new innovation and initiatives.

### Objectives of the Green Audit

The important goal of an Environment audit is to promote the environment management and conservation for future generations. The reason for the environmental audit is to perceive, quantify, describe and prioritize the framework of environment sustainability in compliance with the applicable rules, regulations and requirements. In general, Environment audit can be achieved by creating awareness on the importance of safeguarding the environment among students, faculties and staff members, including public domain. An environmental audit programme is conventionally designed and implemented properly which can enhance an industry's environmental performance in a sustainable manner. It is useful to monitor the scale of optimum utilization of the resources and evaluating the company at National and International levels.

In recent times, the Green Audit of an institution has been becoming a paramount important for self-assessment of the institution which reflects the role of the institution in mitigating the present environmental problems. The University has been putting efforts to keep our environment clean since its inception. Therefore, the purpose of the present green audit is to identify, quantify, describe, and prioritize the framework of Environment Sustainability in compliance with the applicable regulations, policies, and standards. The main objectives of carrying out Green Audit are:



### **More efficient resource management**

1. To provide a basis for improved sustainability
2. To maintained green campus
3. To enable waste management through reduction of waste generation, solid- waste and water recycling
4. To create plastic free campus and evolve health consciousness among the stakeholders
5. Recognize the cost saving methods through waste minimizing and Managing
6. Point out the prevailing and forthcoming complications
7. Authenticate conformity with the implemented laws
8. Empower the organizations to frame a better environmental performance
9. Enhance the alertness for environmental guidelines and duties
10. Impart environmental education through systematic environmental Management approach and improving environmental standards
11. Financial savings through a reduction in resource use
12. Development of ownership, personal and social responsibility for the University and its environment

### **Qualitative and quantitative measurements of the Environmental Audit**

It covers both qualitative and quantitative measurements including physical observation of eco-friendly environment set-up. The qualitative and quantitative measurements such as achievement of environmental objectives and targets by implementing agency (Audited), appointment of Environmental Engineers and Agriculture Staff working for environment monitoring, Drinking water / RO water / Bore well water / Open well water / Pond water / Municipal or Corporation water facility to the stakeholders and periodical checking of drinking water quality through Physico-chemical properties analysis, Wastewater treatment facility, Hazardous and toxic material disposal facility, Solid waste management facility, Renewable energy utilization (Solar panel, wind mill, solar water heater, etc.), Air ventilation at Indoor / Outdoor auditorium, seminar / conference halls, classrooms, hostel, canteen, staff rooms, laboratories, restrooms, etc., Availability of Biogas plant, Rain harvesting system, water reservoirs, etc. Incinerator for napkin disposal use, Housekeeping, storage, areas, piping, plumping and etc. facility, Sign boards indicating plastic free campus, tobacco free campus, don't waste water, don't walk on the lawns, don't plug flowers, etc. The ratio of Environment sustainability courses (Environmental Science, Engineering, Technology, Management, Monitoring, Climate change, Global warming, etc.) to total courses / subjects to under graduate and post graduate course students including research scholars, Per capita water consumption per day and carbon footprint in the Organization campus due to an extensive use of vehicles, electricity usage and human population load are also analyzed during the environment audit. These qualitative and quantitative measurements are playing important role in environment sustainable development in the campus.



An account of a large number of Oxygen producing and Carbon-di-oxide absorbing plants planted in the Campus are taken into consideration to give pure atmosphere to the stakeholders. Establishment of different types of gardens in the campus, rainwater harvesting system, operation of water irrigation, drip and sprinkler irrigation methods may be adopted to improve the green campus. Bio fertilizers, organic and green manures, cow dung manures and farmyard manures may be used for the cultivation of plants which may be protected the environmental health that will not cause any air, water and soil pollution. The various Clubs, Forums, Cells, Associations and Student / Staff Chapters such as Eco club, Nature club, Science club, Fine Arts club, Flora and Fauna club, Youth Red Cross, NCC and NSS bodies may be involved in green campus as well as eco-friendly atmosphere initiatives, planning and efforts among stakeholders. Outreach programmes may be conducted for dissemination of natural resources management, environmental pollution studies, green and eco-friendly atmosphere pledge initiatives to rural, tribal and urban people across the country. Signing of MoU with Govt. and NGOs to ensure ecofriendly campus maintenance, conduct of awareness programs and cultural activities for environmental monitoring and ecosystem maintenance to the stakeholders.

Steps taken for organic, inorganic, toxic, e-waste, biomedical, food, sewage waste management, segregation of wastes and reuse methods, public transport, low-carbon emitting vehicles, battery operated vehicles, bicycles, biofuel use and control of car smokes and exhaust with respect to routine FC services, steps taken to take care of delighting, AC machine heat and carbon dioxide emission & carbon sequestration, Eco- friendly Refrigerants, instruments and materials use including Energy efficiency measures taken, Mosquitos, vectors and predators identified in the campus which are the root cause of various diseases spreading to students and impactful organization programs on climate change, global warming and environmental protection are taken into account while environment audit is carried out. In addition, academic credentials like taking up major and minor Projects, Dissertations, and Thesis work and Scholarly publications on environmental science and biological science carried out by students and staff members may be taken into account towards environment sustainability management. Best practices followed on green campus and eco-friendly set-up initiatives, planning and efforts in the Organization and recommendations for improvement are illustrated in the audit report as well.

### **Scope of Green Audit in Universities**

Now a days Universities and academic institutes with their various activities have some direct and indirect impacts on environment. The environmental pollution and degradation caused by universities need to be assessed and detail impact study is need of the hour. Therefore, in order to find out the overexploitation of resources the present study was carried out to assess the past and current environmental status of the study area

#### **1. Benefits of an Environmental Audit**

1. Environmental audit provides the following benefits to the Organization:
2. Discover various issues related to the environment in the Organization.
3. Compute the issues, identify and assess the impact of the issues.



4. Provide suggestions to minimize the issues found in the Organization. On conducting an Environmental audit, it provides the following results:
  5. Conservation of resources and reduction of raw materials.
  6. Minimizing wastes, control of pollution and reduction of costs.
  7. Improvement in working conditions and improvement in process efficiency.
  8. Corporate image and marketing opportunities.
  9. Concern about the environmental impact of the Organization.
  10. Development of ownership, personal and social responsibility for the College and its environment.
  11. Preparation of Environmental management plan and monitoring.
  12. Assessment of environmental input and risks to the ecosystem.
  13. Identifying areas of strength and weakness for improvements.
  14. Evaluation of pollution control status in the campus.
  15. Verification of compliance with environment laws.
  16. Assuring safety of plant, environment and human beings.
  17. Enhancement of loss prevention, manpower development and marketing.
  18. Budgeting for pollution control, waste prevention, reduction, recycling and reuse methods. Providing an opportunity for management to give credit for good environmental performance.
  19. As a whole environmental audit plays an important role in minimizing the environmental problem locally, regionally, nationally and internationally.
  20. Identification of various sources to generate wastes and types of wastes
  21. Types of degradable and non-degradable wastes in the campus.
- Setting up the target for reduction of wastes and source of waste generation without affecting the environmental health through pol

## **1.2 About the University**

Kuvempu University an affiliating University established in 1987. It is a State University recognized by UGC under 2(f) and 12(b). The University has been named after great Kannada writer Shri KUVEMPU and has achieved a distinctive academic profile and a cultural identity of its own. Interestingly, the features of its identity seem to have emerged out of the multifaceted personality of Kuvempu, the great doyen of Kannada literature, a Jnanapitha awardee and one among the most significant cultural figures of modern India.

Kuvempu University is a confluence of the local and the global; of the regional and the pan-Indian; of the sustenance provided by tradition and the dynamism provided by modernity; of a deep sense of commitment to the socially and culturally disadvantaged and an equally deep commitment to excellence. The emblem of the university has a mythical animal with the trunk of an elephant and the body of a swan. This mythical animal, called Gajahamsa is commonly found in the Vijayanagara and the Keladi sculpture and temple art. It symbolizes the integration of knowledge and wealth. The jurisdiction of the university spreads over the



districts of Shivamogga and Chikkamagaluru. It is a university with a distinctive academic profile, blending in itself commitment to rural ethos in modern spirit. The university offers under-graduate, post- graduate and Ph.D. programmes in a wide range of disciplines. It has 35 Post-graduate Departments in the Faculties of Arts, Commerce, Education, and Science and Technology. The University has its headquarters at Jnana Sahyadri campus. It sprawls over an area of 230 acres of a lush green, picturesque locale providing the right ambience for higher education. The main buildings of the university have been constructed on small hillocks, thus blending naturally with the landscape. The entire campus area is free from any form of pollution. The undisturbed and pleasant atmosphere on the campus makes it ideally suited for the pursuit of higher education and research.

Kuvempu University is an outstanding teaching and research university located on the edge of the Western Ghat’s serene environment. The University takes pride in its contributions to the betterment in dissemination of education and the commitment of its faculty to excellence in teaching, creativity works, scholarship, and research. We at the University work to foster a unique and encouraging culture with a commitment to the values of diversity and equity. Many Post Graduate departments of the university have been organizing campus interviews to help students to find placement. The university has now established a full-fledged Placement Cell in order to monitor placement services for the students.

The University with a motto of “holistic education for all” has been committed to undergraduate and postgraduate education since 1987. Our values are focused on discovery, creativity, excellence, integrity, and service to mankind, as well as holistic and inclusive completeness to address all such issues related to education and societal welfare.

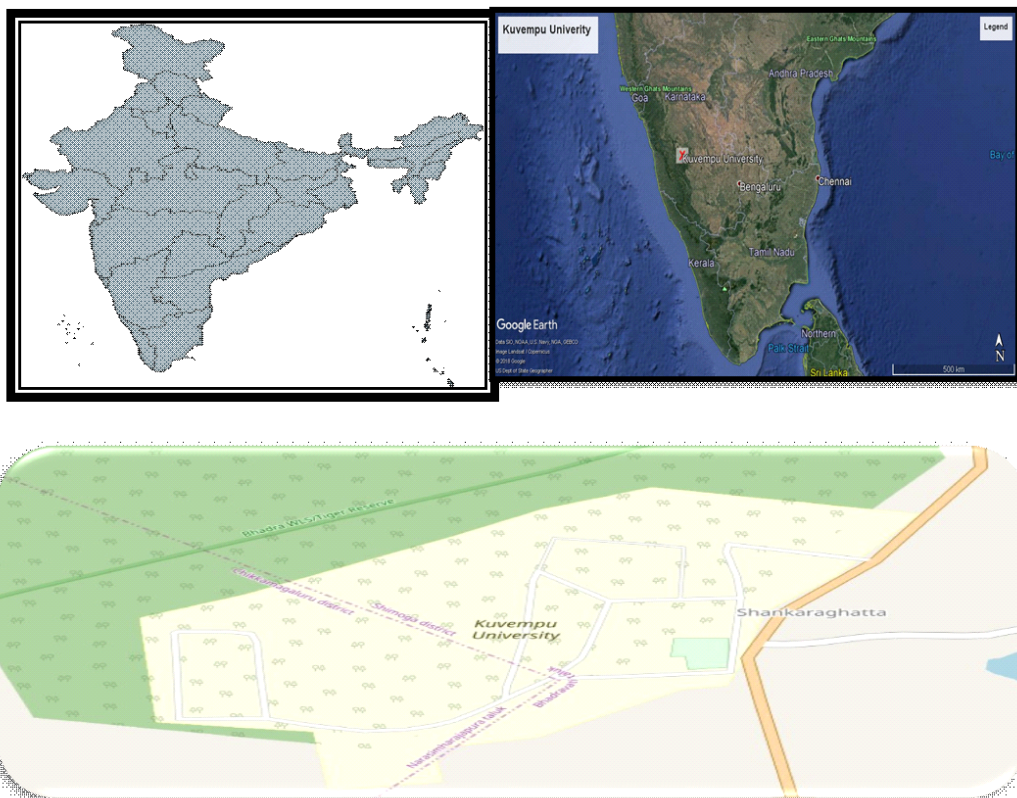


Fig 1.1 Location map





### **Geographical location:**

Kuvempu University is situated at Shankaraghatta very close to Bhadra reservoir, Lakkavally, Chickmagalur district. This is one of the affiliating type of university in Karnataka established in 1987. It is a university with distinctive academic profile and blending in itself to commitment to rural ethos and a modern spirit. Kuvempu university is located at the altitude of N-13o 44' 05.59" N and E- 75o 37' 52.35" and elevation of 661 meter 24 km South- East of Shimoga city and 4 km North of Bhadra Reservoir amidst the dry deciduous forest and is located on the edge of Bhadra Tiger Reserve.

The campus is on a sprawling 230 acre of rich forest land, surrounded by hilly region. The Average annual temperature recorded is 26°C. During summer months of March-May maximum temperature 38°C recorded in (2023) and the minimum temperature is during 16°C in the winter months of November-January. The average rainfall is about 1500mm received during the rainy season from June to the end of September. Major agricultural crops growing in this region includes Maize, Sugarcane , Paddy, Arecanut, Coconut , Zinger and Banana crops and vegetables for commercial and regular use purpose.

With a campus spread across 230 acres, the campus has a fine infrastructure and adequate state-of –the-art physical facilities which include administrative building, Department building containing classrooms, laboratories, staff cabins and restroom, central library, controller of examination building, hostels, auditorium, seminar halls, canteen, playground and other sports, games and gym facilities, bank, ATM, post office, hostel, and Estate section is responsible for taking care of housekeeping maintenance and overall of campus aesthetic maintenance. The University also provides hostel facility to boys and girls students in the campus itself. The buildings and other infrastructural facilities are well-maintained and are put to optimum use. The Institution is open to students of rural, urban and foreign students. The Institution has a well-defined decentralized and participatory organizational structure to coordinate the academic and administrative functions very effectively.

The dedication of the Management and the Administration section of the Kuvempu University, combined with providing excellent infrastructural and teaching facilities which helps to maintain high standards in curricular and co-curricular spheres to the stakeholders like students, staff members. It offers a well-established vision and mission coinciding with global standards to impart high quality of education to the students coming from rural background that lead to the challenges of an emerging India in a globalized world, by bringing in a positive difference in the socioeconomic- educational status of the state and the nation as a whole. The vision and mission are to provide internationally competent graduates and comparable quality higher education to the youth by focusing on imparting subject knowledge and skills and also molding the students with better conduct and character committed to the societal needs.

**Vision:** Kuvempu University shall strive to become an International Center of Excellence in teaching and research to provide high quality value-based education to all through various modes to meet the global challenges.

**Mission :** Foster creativity in teaching, learning and research to build a knowledge base and

promote quality initiative. Provide access to education to all. Develop human reso to meet the societal needs.

### Campus Infrastructure and layout

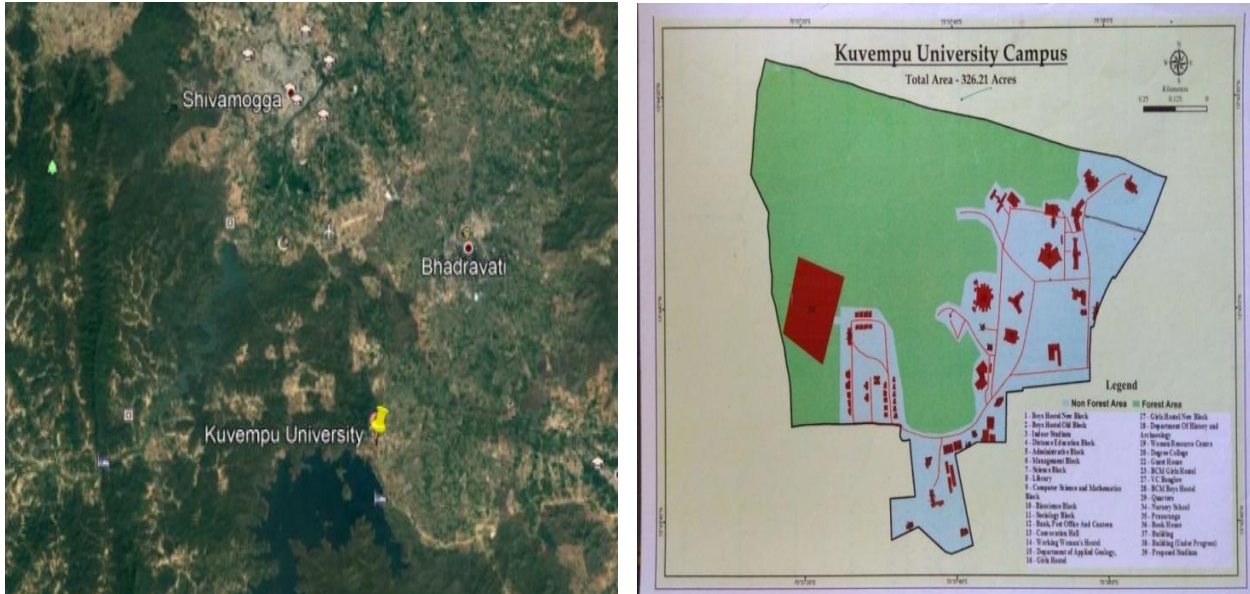


Fig 1.2 Campus Infrastructure and layout

### Landscape

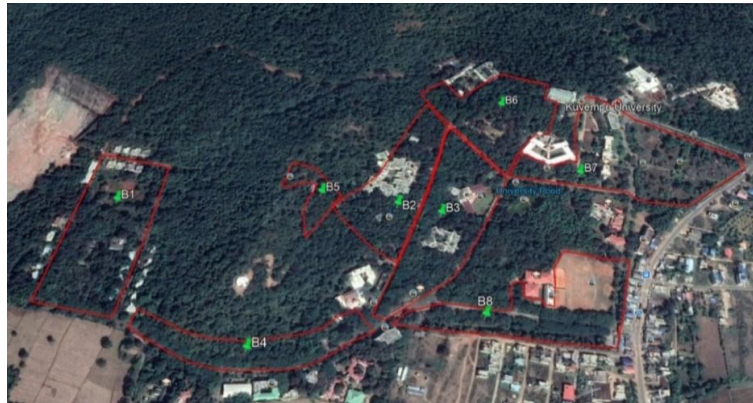
It sprawls over an area of 230 acres of a lush green, picturesque locale providing the right ambience for higher education. The main buildings of the university have been constructed on small hillocks, thus blending naturally with the landscape. The entire campus area is free from any form of pollution. The undisturbed and pleasant atmosphere on the campus makes it ideally suited for the pursuit of higher education and research.



Fig 1.3 Birds eye view of Kuvempu University



Fig 1.4 landscape of library pond



**Fig: 1.5** Locations of different blocks in the campus

Block	Name of the block	Latitude	Longitude
B1	Quarters Block	13 43'48.60"N	75 37'31.00"E
B2	Bioscience Block	13 43'55.53"N	75 37'45.10"E
B3	Library science Block	13 43'51.73"N	75 37'44.63"E
B4	Ladies hostel Block	13 43'48.55"N	75 37'36.17"E
B5	Temple Block	13 43'58.8"N	75 37'41.5"E
B6	Boys hostel Block	13 44'07.83"N	75 37'43.95"E
B7	MBA and Pampavana Block	13 44'09.31"N	75 37'54.80"E
B8	Chemistry Block	13 43'54.16"N	75 37'52.00"E

**Block 1:** Quarters block is the area situated in the Kuvempu University and this area is close to the Bhadra Wildlife Sanctuary which is surrounded the dry deciduous forest. This block that is surrounded by the roads and some of the buildings are constructed here and one of the pond is situated in this area which is located in the map. The vegetation is little bit disturbed in this block. **(Fig1.6)**



**Fig 1.6** Quarters block



**Block 2:** Bioscience Block is the area situated in the Kuvempu University and this area is close to the Bhadra Wildlife Sanctuary. It is surrounded by the road and buildings are situated and the vegetation is little high as per the data recorded, the vegetation is not that much disturbed here.

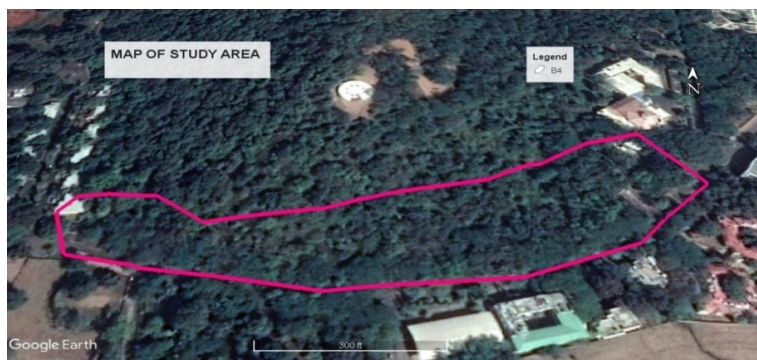


**Fig 1.7 Bioscience Block**

**Block 3:** Library science Block is the area situated in the Kuvempu University and this area is situated at the buffer zone Bhadra Wildlife Sanctuary. It is rich in the diversity as located in the map which is almost same compared to block 3 and this area is surrounded by the roads and some buildings.



**Fig 1.8 Library science Block**



**Fig 1.9 Ladies hostel Block**

**Block 5:** Temple Block is the area situated in the Kuvempu University area and this area is situated in high altitude place. The vegetation is high because it is an undisturbed area as the map indicates.



**Fig 1.10 Temple Block**

**Block 6:** Boys hostel Block is the area situated in the Kuvempu University area and in this vegetation is disturbed by cutting the trees for the construction of buildings. The vegetation is very thick in this area.



**Fig 1.11 Boys hostel Block**

**Block 7:** MBA and Pampavana Block is the area situated in the Kuvempu University and this block covers large area but the vegetation is too low when compared to other blocks because of the buildings situated here. This block majorly surrounded by the roads and also the garden.



**Fig 1.12 MBA and Pampavana Block**



**Block 8:** Chemistry Block is also one of the area situated in the Kuvempu University and this block covers larger area and it is surrounded by buildings as well as the playing ground as located on the map. This block contains some of medicinally usable plants.



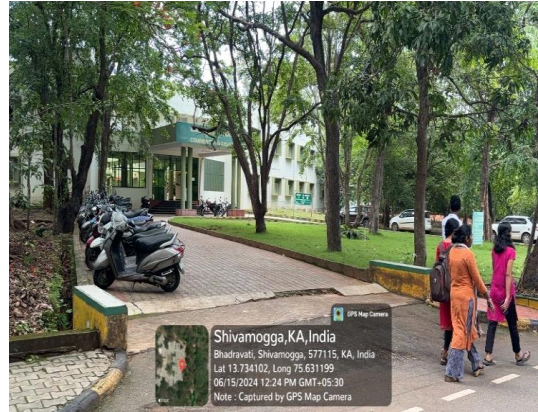
**Fig 1.13 Chemistry Block**

**Table 1.1: Schools and Departments in the University**

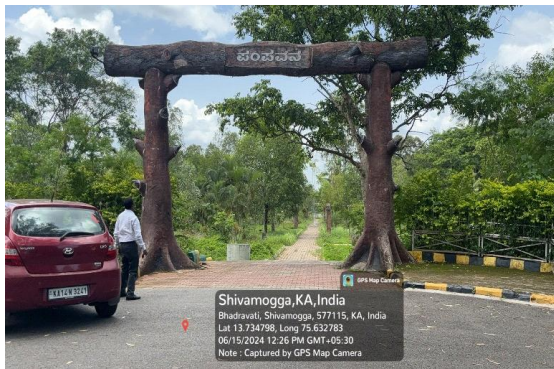
Name of schools of studies	Departments
School of Languages, Literature and Fine Arts Departments	Kannada, English, Hindi, Sanskrit & Urdu School
School of Social Science Departments	Sociology, History, Political Science, Economics, MSW, Journalism & Mass Communication
School of Business Departments	Commerce and management
School of Education	Education, M.Ed., M.P.Ed.
School of Bio Sciences	Botany, Zoology, Microbiology, Wildlife and Management, Biotechnology
School of Chemical Science Departments	Industrial Chemistry, Organic Chemistry, Pharmaceutical Chemistry, General Chemistry, Biochemistry, Food Technology
School of Earth resource and Environmental Science Departments	Earth Science & Resource Management, Geoinformatics, Environmental Science
School of Physical Science Departments	Physics, Electronics, Mathematics, Computer Science, MCA



Konanakunte pond



Management Block



Pampavana



Administrative block



Basava Bhavan - Auditorium

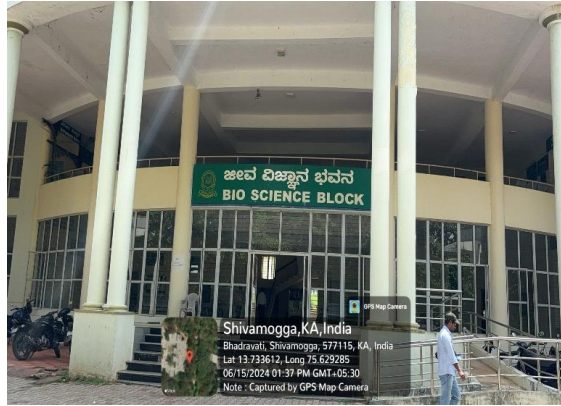


Languages Block





Chemical Sciences Block



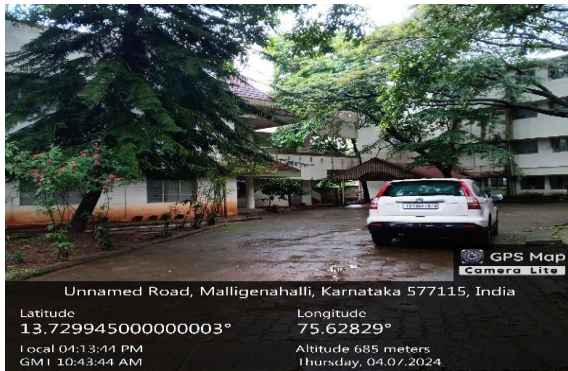
Biosciences Block



Kuvempu Statue with Greenery



Plant Nursery section-Ornamental plants

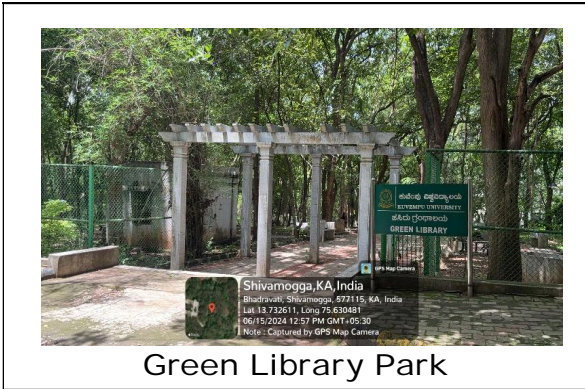


Earth Science Block

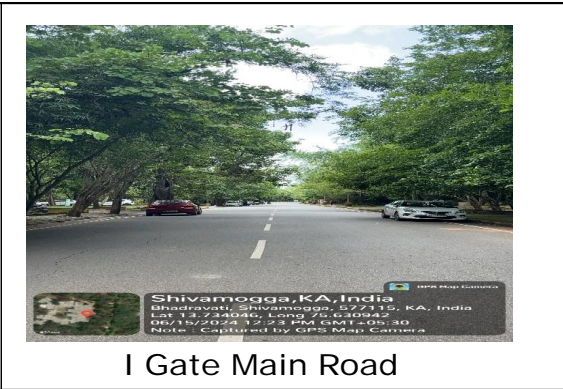


Mathematics and Computer Science Block





Green Library Park



I Gate Main Road



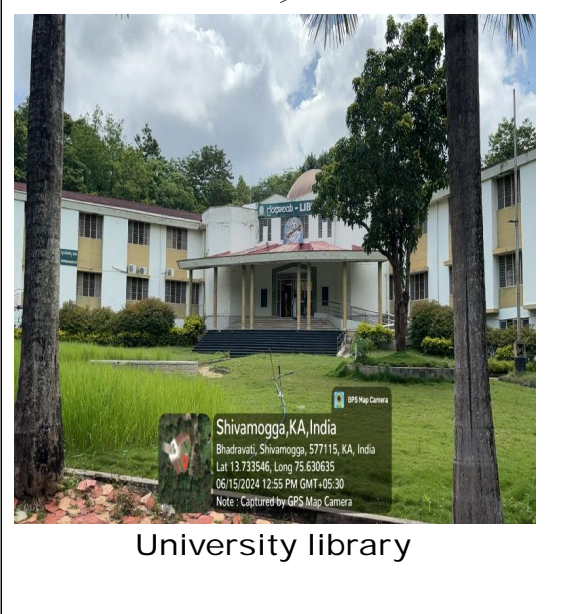
Giraffe Sculpture near Examination Block



Elephant Sculpture near Konana kunte Park



Social Sciences block



University library



**Table 1.2 : INFRASTRUCTURE DETAILS**

Sl No.	Type of Infrastructure	Details	Infrastructure Created				Total
			Shankaraghatta Campus	Sahyadri College campus, Shimoga	P G center Kadur	P G center Chickmagalur	
1	Total Area	Land Area in Acres	230	86	66	40	422
2	Administrative /Academic Buildings	No of Buildings	22	9	1		32
		Total Floor Area in Sqmts	71,987	24,414	1,889		98290
3	Hostels	No of Buildings	11	4	2		17
		Total Floor Area in Sqmts	29,504	10,651	3,000		43,155
4	Residential Quarters & Others	No of Buildings	35	3	1	1	40
		Total Floor Area in Sqmts	1,02,336	17,261	2,600	600	1,22,797
<b>TOTAL</b>			<b>2,03,827</b>	<b>52,326</b>	<b>7,489</b>	<b>600</b>	<b>2,64,242</b>
<b>AT KUVEMPU UNIVERSITY CAMPUS, SHANKARAGHATTA</b>							
	<b>Total Area</b>	930777.00 Sqm	230.00 Acres				
	<b>Builtup Area</b>	203827.00 Sqm	50.37Acres				
	<b>Forest Area Available</b>	<b>726950.00 Sqm</b>	<b>179.63 Acres</b>				

**Table 1.3: Academic / Administrative Buildings With Floor Area**

<b>INFRASTRUCTURE DETAILS AT KUVEMPU UNIVERSITY CAMPUS, SHANKARAGHATTA</b>			
<b>Sl. No</b>	<b>Name of the Building and Place</b>	<b>No of Floors</b>	<b>Floor Area (Sq. mtrs)</b>
1	Academic Block at Kuvempu University Campus, Shankaraghatta	G+2	9209
2	Prasaranga Building at Kuvempu University Campus, Shankaraghatta	GF	197
3	Museum Building at Kuvempu University Campus, Shankaraghatta	G+1	2080
4	Science Block at Kuvempu University Campus, Shankaraghatta	G+2	5612
5	Library Building at Kuvempu University Campus, Shankaraghatta	G+1	3062
6	Examination and Distance Education Council Building at KU Campus, Shankaraghatta	G+2	5421
7	Convocation Hall of size 20 x 41m at Kuvempu University Campus, Shankaraghatta	G	820
8	Kuvempu Shathamanotsava Bhavana at Kuvempu University Campus, Shankaraghatta	G+3	4776
9	Bio-Science Block at Kuvempu University Campus, Shankaraghatta	G+1	6785
10	Computer Faculty Building at Kuvempu University Campus, Shankaraghatta	G+1	2940
11	Earth Sceince Department at Kuvempu University Campus, Shankaraghatta	G+1	624
12	Rambhapuri College Building at Kuvempu University Campus, Shankaraghatta	G+2	1737
13	Pruthvi Bhavana at Kuvempu University Campus, Shankaraghatta	G+1	788
14	Student Utility Complex at Kuvempu University Campus, Shankaraghatta	G+2	2100
15	Nano Science Building at Kuvempu University Campus, Shankaraghatta	G+2	1208
16	Auditorium Building at Kuvempu University Campus, Shankaraghatta	B+G+1	5893
17	Karnataka Academy of Social Sciences and Humanities building at Kuvempu University Campus, Shankaraghatta	B+G+1	2920
18	Master of Business Administration block at Kuvempu University Campus, Shankaraghatta	G+1	5129
19	Social Science Building (Stage-1) at Kuvempu University Campus, Shankaraghatta		1360
20	Green Cafeteria at Kuvempu University Campus, Shankaraghatta		468
21	Seminar hall to the existing MBA block building at Kuvempu University Campus, Shankaraghatta		486
22	Open Air Theator at Kuvempu University Campus, Shankaraghatta		8372
<b>Total</b>			<b>71987</b>





**Table 1.4: Details of Buildings**

Sl. No	Name of the Building and Place	No of Floors	Floor Area (Sq. mtrs)
1	2	3	4
<b>II HOSTELS</b>			
1	Boys Hostel Block-I (old block) at Kuvempu University Campus, Shankaraghatta	G+2	3613
2	Water Treatment Plant at Kuvempu University Campus, Shankaraghatta	G+2	86
3	Ladies Hostel (old Block) A-Block, B-Block and Dining Block at Kuvempu University Campus, Shankaraghatta	G+1	7736
4	Working Women's Hostel at Kuvempu University campus, Shankaraghatta	G+3	2294
5	Ladies Gym Building at Kuvempu University campus, Shankaraghatta	G+1	576
6	Boys Hostel Block-II (new block) at Kuvempu University Campus, Shankaraghatta	G+2	5006
7	New Ladies Hostel Block at Kuvempu University campus, Shankaraghatta	G+3	4893
8	Indoor Stadium Building at Kuvempu University Campus, Shankaraghatta	G+3	3405
9	Extension of new Girls Hostel building at Kuvempu University Campus, Shankaraghatta	G + 1	693
10	Girls Hostel (Phase-I) at Kuvempu University Campus, Shankaraghatta		601
11	Girls Hostel (Phase-II) at Kuvempu University Campus, Shankaraghatta		601
<b>Total</b>			<b>29504</b>
<b>III RESIDENTIAL QUARTERS &amp; Others</b>			
1	C-Type Quarters at Kuvempu University Campus, Shankaraghatta (6 Nos)	G	1008
2	L-Type Quarters at Kuvempu University campus, Shankaraghatta (L-1 to L-11)	G	1650
3	M-Type Quarters at Kuvempu University Campus, Shankaraghatta (M-1 to M-8)	G	1380
4	A-Type Quarters at Kuvempu University Campus, Shankaraghatta (A1 -A12)	G+2	1800
5	Vice-Chancellor's Residence at Kuvempu University Campus, Shankaraghatta	G+1	441
6	Guest House For Kuvempu University, Shankaraghatta	G+2	1329
7	Type-II Residential Quarters for Professor's at KU Campus, Shankaraghatta (P1-P8)	G	1251
8	Type-III Quarters for Non-Teaching Staff at KUCampus, Shankaraghatta (6 Nos)	G+1	970
9	Non Teaching Staff Quarters II Block at KU Campus, Shankaraghatta (6 Nos)	G+1	970
10	C-Type Staff Quarters Block-I & Block-II at KU Campus, Shankaraghatta	G+2	1129
11	Lake View Guest House at KU Campus, Shankaraghatta	G+1	422
12	Gymnasium Building at Kuvempu University Campus, Shankaraghatta	GF	147
13	Telephone Exchange		
	A) Store Room	G	69.92
	B) Store Room	G	18.98

## Green Audit Report



Sl. No	Name of the Building and Place	No of Floors	Floor Area (Sq. mtrs)
1	2	3	4
14	Ladies Hostel (Old)		
	A) Guest Room	G	22.20
	B) Security Room	G	15.95
15	Airtel Tower	G	150.28
16	Water Tank		
	a) New Water Tank	G	89.00
17	Library Toilet Room	G	14.24
18	Boy's Hostel Generator Room	G	21.39
19	Boy's Hostel Store Room	G	18.48
20	Boy's Hostel Generator Room (Block-2)	G	14.80
21	Library Generator Room	G	30.10
22	New Nursery	G	55.90
23	SBI ATM (Near Distance Education)	G	15.30
24	Office Gate Security Room	G	17.60
25	History & Archaeology Block		
	a) Ladies Toilet	G	10.39
	b) Gents Toilet	G	10.39
26	Play Ground Near 1st Gate		
	a) Wash Room	G	27.01
	b) Store Room	G	17.39
27	Verniform Block	G	33.12
28	Verniform Block (Solid waste)	G	120.60
29	Vermiform Block (Store Room)	G	23.04
30	Bus Stand (Near Statue)	G	13.95
31	Security Room (Near 1st Gate)	G	14.40
32	Boy's Hostel Gym Building	G	220.00
33	Pampavana at KU Campus, Shankaraghatta	-	20211
34	Play Ground near I.C Block at KU Campus, Shankaraghatta	-	8496
35	Outdoor Stadium at Kuvempu University Campus, Shankaraghatta	-	24000
35	All Roads at KU Campus, Shankaraghatta	-	36088
<b>Total</b>			<b>102336</b>
<b>GRAND Total</b>			<b>203827</b>

**Table 1.5: Infrastructure Details at Sahyadri College Campus, Shimvamooga**

Sl. No	Name of the Building and Place	No of Floors	Built Area (Sq. mtrs)
1	2	3	4
<b>A</b>	<b>ACADEMIC/ADMINISTRATION BUILDINGS</b>		
1	Science College at Sahyadri College campus, Shimoga	B+G+1	7455
2	Diamond Jubilee Building at Sahyadri College campus, Shimoga	G+1	2259
3	Industrial Chemistry Lab at Sahyadri College campus, Shimoga	G	939
4	Sanskrit department at Sahyadri College campus, Shimoga	G	92
5	Library building at Sahyadri College campus, Shimoga	G+1	567
6	Arts College building at Sahyadri College campus, Shimoga	B+G+1	6271
7	MTA building at Sahyadri College campus, Shimoga	G+2	5177
8	City Office (Utility building) at Sahyadri College campus, Shimoga	B+G+1	1266
9	Sahyadri Science P.G. Block at Sahyadri College campus, Shimoga	G	388
<b>Total</b>			<b>24414</b>
<b>B</b>	<b>HOSTELS</b>		
1	Boys Hostel at Sahyadri College campus, Shimoga	G+1	2652
2	Ladies Hostel for Science college at Sahyadri College campus, Shimoga	G	2895
3	Ladies Hostel for Arts college at Sahyadri College campus, Shimoga	G	3500
4	New Boys Hostel at Sahyadri College campus, Shimoga	G+1	1604
<b>Total</b>			<b>10651</b>
<b>C</b>	<b>RESIDENTIAL QUARTERS &amp; Others</b>		
1	Canteen at Sahyadri College campus, Shimoga	G	407
2	Outdoor stadium at Sahyadri College campus, Shimoga	-	11354
3	Roads at at Sahyadri College campus, Shimoga	-	5500
<b>Total</b>			<b>17261</b>

**Table 1.6: Infrastructure Details at P.G. Center, Kadur**

Sl. No	Name of the Building and Place	No of Floors	Built Area (Sq. mtrs)
1	2	3	4
<b>a</b>	<b>ACADEMIC/ADMINISTRATION BUILDINGS</b>		
1	Administration Block at P.G. Center Kadur	G+1	1889
<b>Total</b>			<b>1889</b>
<b>b</b>	<b>HOSTELS</b>		
1	Ladies Hostel at P.G. Center Kadur	G	1500
2	Boys Hostel at P.G. Center Kadur	G	1500
<b>Total</b>			<b>3000</b>
<b>c</b>	<b>RESIDENTIAL QUARTERS &amp; Others</b>		
1	Teaching Staff Quarters (02 Nos) Block-1 at P.G. Center, Kadur	G	410
2	Roads at P.G. Center, Kadur	-	2190
<b>Total</b>			<b>2600</b>

**Table 1.7: Infrastructure details at P.G. Center, Chickmagalore**

Sl. No	Name of the Building and Place	No of Floors	Built Area (Sq. mtrs)
1	2	3	4
<b>a</b>	<b>ACADEMIC/ADMINISTRATION BUILDINGS</b>		
1	Administrative / College building at P.G. Center, Chickmagalore	G+1	600
<b>Total</b>			<b>600</b>

**Table 1.8: Employees and student strength recorded (2019-2023)**

Sl No	Year	Teaching staff	Non-teaching staff	Students	Total
1	2018-2019	103	330	PG-1820 PhD-254	2507
2	2019-2020	105	330	PG-1707 PhD-301	2443
3	2020-2021	104	326	PG-1490 PhD-312	2232
4	2021-2022	104	323	PG-1831 PhD-458	2716
5	2022-2023	104	326	PG-1244 PhD-238	1912





### List of Academic, Research and Administrative Sections

- 1. Library:** the library is housed in a modern and well-equipped building with excellent infrastructure facilities for reading, borrowing and references to the students, teachers and research and research scholars of all the departments. The library has kept a pace with modernization by introducing CD ROM data base and internet facilities. It is also anodal centre for INFONET, thus having access to resources sharing. The library has access to 10 thousand e-journals online under UGC-INFONET programme. It provides access to students beyond working hours .the library has more than one lakh books; more than 5400 back volumes of periodicals and subscribes to more than 300 current subject journals.

In the institute library, there are more than 70,000 books on different subjects. In addition to books, the library also has M.Ed. dissertations, Ph.D. theses, all of the institute’s internal publications, and several NCERT publications. The library uses open-source automation tools and is fully automated. Additionally, it makes use of an online public access catalog (OPAC).

**Table 1.9: Library Collection**

Details	Numbers
Back Volumes	6,165
Periodicals	120
Daily News Papers/ Magazines	12 Sets/40
e-books	3,000
e-journals	7,500

No. of Books in Library : 1,32,337

Number of News Paper : 12

Number of Magazines : 12

- 2. Hostels:** there are 4 hostels for PGstudents on the main campus -2 men’s hostels 2 women’s hostels. Besides, there is working women’s hostels on the campus providing accomaendation accomodation to students and research scholars the hostel for students belonging to backward classes and minorities [established near the main campus by the government of Karnataka] provides hostel facilities exclusively for the PG students of the university.
- 3. Language laboratory:** To train the student for English communication a fully computerized modern language lab has been established in the university.
- 4. Coaching for civil service examinations:** In order to motivate students to seek the administrative carriers and to equip them to face the examinations, the university organizers training for civil service and other comparative exams. The training includes counseling and essential skill development apart from academic guidance.
- 5. Directorate of student welfare:** Kuvempu University has maintained an excellent student friendly ambience and assigns top priority to student welfare. A directorate of student welfare has been established to plan and monitor student welfare activities.



6. **Sports:** The University has established a well-equipped indoor sports complex which has facilities for all indoor games including volley ball, basketball, gymnastics and modern multi gymnasium. It has 24 well-furnished dwelling rooms .inter- collegiate competitions in almost all games and sports are organized regularly, in which a large a large number of students from affiliated colleges participate
10. **National service scheme:** Kuvempu university NSS wing is recognized as one of the best in Karnataka state and has also received Indira Gandhi NSS national award for 2014- 2015 .The NSS wing organizes annual camps ,national camps and socially relevant programmes. It also coordinates the adult literacy programme in which student can participate actively.
11. **SC/ST and OBC cells:** the SC/ST and OBC cells have been established to provide special assistance to students belonging to schedule castes, schedule tribes and other backward communities. The cells monitor fellowships and scholarships to SC, ST and OBC researchers and P.G. students. These cells also organize remedial classes and coaching classes for the competitive examinations.
12. **Internal quality assurance (IQAC):** IQAC works towards improving the quality of teaching, research and administration.
13. **International student cell:** in order to facilitate the students from overseas in perceiving higher education and research in the university, international student cell has been established the cell, through the verification of documents, recommends enrolment.
14. **Employment information and Guidance Bureau;** the university employment information and guidance bureau was established in the university premises to cater to the educational and vocational guidance needs of the university student. The bureau runs directly under the guidance of a senior faculty member assisted by deputy chief who is appointed by the government of Karnataka. This office has separate library with 542 books on competitive examinations the bureau organizes free coaching classes and educational and vocational employment counseling services, provides continues assistance to the candidates in making educational and vocational plans, and creates awareness about employment and maintenance co-ordination with other agencies engaged in similar activities.
15. **Placement cell:** Many graduate departments of the university have been organizing campus interviews to help the students to find the placements the university has known established a fully-fledged placement cell in order to monitor placement service for the students.
16. **Student counseling center:** Kuvempu University introduced student counseling at different levels apart from the course counseling, there is also continuous expert counseling for students to help them to overcome their problem.
17. **Earn and learn scheme:** to supplement the financial needs of the students a unique and useful earn and learn scheme has been introduced. Selected students are assigned with some basic work and remuneration is paid to them.



18. **Health center:** The University has a health center with two Doctors assisted by necessary staff, trained laboratory technician supported with testing laboratory. It has the preliminary diagnostic facilities and online ECG with medical advices of narayana hrudalaya, Bangalore. Ambulance facilities is also available at the center. Separate Male and Female wards with well equipped preliminary facilities are provided.
19. **Campus network:** the university provides Wi-Fi internet facility for all students and employees of the university in the entire campus.
20. **Cafeteria:** There is a well-furnished canteen on the campus. Snacks and vegetarian food available to the students, employees and the visitors there is also branch of state bank of India in the campus.
21. The university develops its academic programs through the Schools of Studies. The Schools of Studies are academic bodies responsible for all academic and related administrative activities of the university. Each School has different departments which are the basic academic units responsible for the conceptualization, design, development and maintenance of the academic and professional programs. The existing Schools of Studies presented in Table-1.

#### Other Facilities

The Kuvempu also has a Pampavana park, Green Library park , Botanical garden and History and Archeology Museum , Rock specimens in Earth resource management, Plant Herbarium in Biotechnology It has two EDUSAT terminals, a branch of SBI Bank, Two Auditoriums , Mini conference attached to Library Building, and Health center with two resident doctors and emergency facilities with Ambulance facilities.

**Laboratories:** The institute offers courses in various aspects of science and education equipped with several laboratories for different subjects, apart from that it also has a state-of-the-art computer lab and English lab facilities for skill training.

**Table 1.10: Number of Laboratories in different Departments**

SI No	Departments	Labs
1	Botany	4
2	Zoology	5
3	Microbiology	4
4	Wildlife and management	2
5	Environmental Science	7
6	Biotechnology	7
7	Chemistry	6
8	Commerce and Management	1
9	Library Science	4
10	Biochemistry	4
11	Industrial Chemistry	6
12	Food Technology	1
13	Physics	5
14	Journalism and mass communication	1
15	Electronics	4
16	Geology	6
17	Computer Science	5



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### **Green Steps Taken by University**

Today, it's a noticeable fact that environmental science lessons are implemented beyond the classrooms and are practiced in our day-to-day lives. And leading from the front is our university campus. Everyone on campus has a part to play in green initiatives for improving our built environment and natural ecology. Along with educational and research activities University acknowledges the significance of an inspiring environment and puts in continuous efforts to build a Sustainable Campus. The University has successfully adopted and implemented best practices in the areas of sanitation, hygiene, waste management, water management, energy management, and greenery management. To instill the values of social, economic, and environmental responsibility and make a meaningful impact, the university takes the following action steps:

1. Maintaining virgin forest within the campus and implement sustainable maintenance
2. Promoting the use of a sustainable mode of transportation
3. Use of bicycles for commuting within the campus
4. Water conservation and rainwater harvesting for use on the campus
5. Developing a separate green Parks ,botanical garden, biodiversity conservation forest patches,
6. Combat biodegradable waste and improve the overall waste management system focused on recycling
7. Training and Production of vermin compost to enhance soil fertility physically, chemically, and biologically.
8. Raise awareness of plastic pollution
9. Promoting Susthira campus concept to mitigate plastic pollution





## Chapter-2

### **REVIEW OF LITERATURE**

In this chapter intensive review was done in the relevant areas subjected to environmental impact assessment, environmental auditing, energy management, solid waste reduction and recycling, environment assessment carried out in various companies and educational institutes. The summary of the work carried out by various authors are briefly discussed in detail.

The private and Government organizations should implement 'Green Audit' voluntarily because it is a tool which can be used to attain sustainable development & competitive advantage. The campus environmental audit helps for the establishment of a more sustainable direction for the university as well as on student's lives. Joshi Seema et.al (2014). The study pointed out that universities are by nature inquisitive institutions, it is only natural for the university to examine itself. Indeed, a university that promotes investigation of the world at large, and neglects to investigate itself in the process, misses a tremendous opportunity to teach its students by example. Thus it is imperative that the university evaluate its own contributions toward a sustainable future.

Campus Sustainability Assessment. The environmental assessment conducted by Concordia University The document is also highly "political" in nature, taking on many of the basic assumptions underlying common university practices, and examining social and economic issues in addition to environmental concerns. Davis, Jenn, et al. (2003). The increasing awareness and the cost effectiveness of green auditing may prove its successive implementation. Aaron S. Allen (1999).

Environmental audit is the only one of the model documents conducted by a professional environmental consulting firm rather than an internal team. The professional quality of the document is apparent, and there is a great attention to detail in areas dealing with campus facilities, especially energy. The audit lacks any discussion of the academic and administrative aspects of sustainability. Woodward and Curran. (2000).

The Central Energy Facility announced the eventual phase out of its coal-burning boiler and has greatly reduced the use of this undesired fuel by favoring cleaner-burning natural gas. Recycling levels increased substantially with the aid of new programs like University Housing's Solid Green as well as the purchase of 7,000 new recycling bins. And more other good practices leads to the aspects of sustainability Mike Pulley (2014).

Green audit is a holistic perspective of looking into the totality of the actions towards greening the university and is foremost reflected in its policies alongside the organization's profile, the curriculum being the core of the educative process as well as its environment-related programs and projects. Myrna nicol ogo (2015). Green means eco-friendly or not damaging the environment. This can acronymic ally is called as "Global Readiness in Ensuring Ecological Neutrality (GREEN)." The green audit practically involves energy conservation, use of renewable sources, rain water harvesting, efforts of carbon neutrality, plantation, hazardous waste management & E-waste management The concept of Green Audit, industries are using it as a management tool to evaluate the environmental standards; industries can



perform better and better for the sustainable development of the organization. The experiments on the nature by avoiding natural rules, this can be a one major reason behind that is green Audit. Krishna Murthy, Madhuri Pandit et al., (2015).

Office buildings have the potential to consume substantial amounts of energy and other resources. Inefficient business practices can lead to excess waste. The goal of an environmental audit is to identify these wasteful practices and suggest ways to improve. The role of an environmental auditor is to show participating offices the link between actions taken in the office and their effect on the environment. Although the consequences of inefficient offices may not be immediate or apparent, they are very real. The overuse of paper, such as only using only one side of a piece of paper, leads to deforestation and habitat degradation .This environmental audit is also an opportunity for employees to reflect on their own actions and find areas that could use improvement. Maxx hart and colleen connoly (2005).

Environment education is the process of recognizing values and classifying concepts in order to develop skills and attitudes necessary to understand and appreciate the inter relatedness among man, his culture and his surroundings. Establish Green, parliaments in schools and colleges to influence the policy makers at the higher level to ensure that development policies are green. Abraham Thomas (2013)

The main aim of the project was to catalogue the scope and scale of environmental and sustainability education at NUIG. The baseline information generated seeks to support the university's efforts to achieve Green Campus status and promote and potentially expand its 'green' course offerings in the future. Henrike Rau and Daniel Stewart (2015)

Green banking is comparatively a new concept. It is a paperless banking, which not only reduces the cost of banking activities but also helps in environment sustainability. It helps in reducing the use of paper, power and energy. The main objective of this paper is to know about the role of green banking in environment sustainability in Indian public sector banks and conduct a SWOC analysis about the banking sector regarding green banking activities. Omid Sharifi et al.,(2015)



## Chapter 3

### Pre-Audit Stage

#### 3.1 Goals of Green Audit

An environment that is clean and healthy promotes learning and is conducive to learning. Several initiatives are being made worldwide to address the problems with environmental education. A green audit is the most effective and sustainable method of handling environmental issues. It is a type of professional care that each person who is a component of an economic, financial, social, or environmental aspect is responsible for. Doing a green audit on college and institute campuses is essential because it raises students' awareness of the benefits of doing so for the environment and helps them develop into responsible citizens. As a result, green auditing is required at the institute and college levels.

#### Importance of Green Audit

1. To Improve Natural resource management
2. To provide the basis for improved sustainability
3. To create a green campus
4. Identify ways to reduce costs by managing and decreasing waste
5. To create a plastic-free campus and aesthetic environment: Recognize the cost-saving methods through waste minimizing and managing
6. Identify the current and upcoming complications: Verify compliance with the laws in effect.
7. Offer organizations the tools they need to design greater environmental performance: Enhance awareness of environmental obligations and guidelines
8. Promote environmental awareness by using a systematic approach to environmental management and raising environmental standards.
9. Setting benchmarks for environmental protection measures
10. Reducing resource usage to save cost
11. Developing social and personal responsibility for the institution and its surroundings
12. Improvement of institute profile
13. Evolving an environmental ethic and value systems in youngsters
14. Green auditing should become a vital tool in the management and monitoring of environmental and sustainable development activities of the university.

#### 3.2 Target Areas of Green Audit

A process for resource management includes a green audit. The actual value of green audits lies in the fact that they are conducted at predetermined intervals and that the results might show improvement or change over time, even though the fact that they are individual events. The eco-campus idea primarily emphasizes the effective use of water and energy to reduce waste production or pollution and maximize economic efficiency. All of these factors



are evaluated as part of the educational institution's green audit procedure. Eco-campus prioritizes the reduction of emissions, secures a cost-effective and reliable energy supply, promotes personal responsibility, increases energy efficiency, lowers institute consumption of water and energy, lessens waste sent to landfills, and incorporates environmental concerns into all agreements and services deemed to have a significant environmental impact. Water, energy, waste, air, and noise of the green campus are the focus areas of this green audit.

### **Audit of Water Management**

Water is a natural resource that is essential to all living things. While freely accessible in many natural settings, potable water and quality is less easily accessible in many of the urban and rural areas. To supply potable water to everyone for the health is mandatory. Therefore, we must utilize water responsibly. We should stop leakage of water in our offices, residences and industries. Water pollution and aquifer depletion are occurring at completely unheard rates. So, it is crucial that any organization that cares about the environment evaluate its methods for using water resource management. Water auditing is necessary to assess the raw water intake facilities and identify facilities for water treatment and reuse as well as quality maintenance. The concerned auditor examines the appropriate approach that may be used to balance the supply and demand for water. Any institution that cares about the environment must therefore examine its water usage procedures.

### **Audit of Energy Management**

Although energy cannot be seen, we know it exists because we can observe its effects, such as heat, light, and power. Energy use, energy sources, energy monitoring, lighting, appliances, and automobiles are all included in this indication. Electricity use is undoubtedly a crucial component of campus sustainability, thus its inclusion in the assessment doesn't call for any justification. Energy auditing focuses on ways to conserve energy and reduce spending on using that could lead to environmental damage. So, it is crucial that any institution that cares about the environment evaluate its methods for using energy. Besides switch over to ecofriendly energy generation and usage is the responsibility of any institution in order to cut down greenhouse gases and limiting the climate change impact.

### **Audit for Waste Management**

Pollution from solid waste causes a lot of nuisance and health hazards to our communities, which can harm our well-being and it becomes unpleasant. Due to unscientific method of disposal and open dumping of plastic results effect of birds and other animals, plastic materials latter turned to micro plastic and Nano plastic in water and soil sources. Unscientific landfills could contain dangerous chemicals that seep into the ground and water systems and emit greenhouse gases that contribute to global warming.

Integrated waste management method is crucial. General wastes comprise items that are typically thrown out in households and schools, such as garbage, paper, cans, and glass bottles. Waste that poses a risk to human health and environment. Every organization need to undertake waste management process as per the solid waste management regulation. Moreover, solid waste frequently contains unused materials that may be recycled, repaired, or reused to provide better services. So, Universities must take action to reduce its solid





waste output. The auditor diagnoses the current waste disposal practices and makes recommendations for the most effective solutions to the issues. Therefore, it is crucial that any institution that cares about the environment analyze its waste management procedures.

### **Audit of Green Campus Management**

The loss of habitat, pollution, over-consumption, and invasive species are, unfortunately causes severe threats to biodiversity. The alarming rate of species extinction has an impact on both the delicate balance of nature and human quality of life. Without this diversity among living things, ecological systems and processes would fail, which would have negative effects on all types of life, including humans. Both newly planted and old trees reduce the atmospheric concentration of carbon dioxide. In addition to supporting better public health and enhancing cities' aesthetics, trees have a significant ecological impact. A single mature tree may remove as much as 48 pounds ( $4.535 \times 10^3$  tonnes) of carbon dioxide from the atmosphere in a year and release it as oxygen. One tree produces enough oxygen to meet human needs for one day. Hence, all the trees on campus are working hard to make the air better for us while you are busy studying and working to obtain those good scores. Trees can also improves one's mental health. Studies have shown that trees significantly lower stress, if a campus maintains rich forest and biodiversity that helps academic atmosphere and positive thinking.

The purpose of the audit was to ensure that the practices followed on the campus are by the Green Policy adopted by the University. The criteria, methods, and recommendations used in the audit were based on the identified risks. The methodology comprises preparing and filling out a questionnaire, physically inspecting the campus, watching and reviewing the document, interacting with the people who are responsible, analyzing the data, taking measurements, and making recommendations. The three-step methodology used for this audit consisted of:

1. Data Collection
2. Data Analysis
3. Recommendations and Management Plans

### **3.3 Data Collection**

1. In the preliminary data collection phase, exhaustive data collection was performed using different tools such as observation, survey communication with responsible persons, and measurements. The following steps were taken for data collection:
2. The team went to each department, center, Library, canteen, etc.
3. Data about the general information was collected by observation and interview.
4. Data Analysis and Recommendations
5. Based on data analysis findings and observation results, some recommendations for reducing electricity and water use were suggested. The proper management of waste was also recommended. For the sake of community health, fossil fuel use must be decreased. A questionnaire was used to examine the above target areas that are specific to the institution. Five categories of questionnaires were distributed which are given in pre-audit questionnaires.



6. Pre Audit Questionnaires
7. The major pre-audit questionnaires are based on the following topics:
8. Water
9. Energy
10. Waste
11. Green Campus
12. Other is Air, noise, and ecology (flora and fauna) of RIE.

### ***Questionnaires***

1. List the uses of water in the Institute.
2. What are the sources of water in the Institute?
3. How does your Institute store water?
4. If there is water wastage, specify why.
5. What are the uses of wastewater in the Institute?
6. What happens to the water used in your labs? Whether it gets mixed with groundwater?
7. The number of water coolers?
8. The number of water taps?
9. The number of bathrooms in staff rooms, common, hostels?
10. The number of toilets, and urinals?
11. Does your institute harvest rainwater?
12. Is there any water management plan in the institute?
13. Are there any water-saving techniques followed in your institutes? What are they?
14. List the usage of energy in the institute. (Electricity, electric stove, kettle, microwave, LPG, fire-wood, Petrol, diesel, and others).
15. Electricity bill
16. Is there a generator facility in the Institute?
17. How many CFL bulbs have the Institute installed?
18. How many tube lights and fans are installed in the Institute?
19. How many air conditioners are installed in the Institute?
20. How much electrical equipment including weighing balance is installed in the Institute? Mention the use (Hours used/day for how many days in a month)
21. How many TV, CCTV, and computers are there in the institute?
22. Which of the following are found near your Institute? Municipal dump yard, Garbage heap, Public convenience, Sewer line, Stagnant water, Open drainage, Industry – (Mention the type), Bus / Railway station, Market / Shopping complex / Public halls



23. Does your Institute generate any waste? (E-waste, Hazardous waste (toxic), Solid waste, Dry leaves, Canteen waste, Liquid waste, Glass, Unused equipment, Medical waste if any, Napkins,
24. Others (Specify)
25. Is there any waste treatment system in the Institute?
26. How is the waste generated in the Institute managed by composting, recycling, reusing, or other methods?
27. Do you use recycled paper in Institute?
28. Is there a garden in the Institute?
29. Do students spend time in the garden?
30. How can the wastage be prevented/stopped?
31. List the numbers of each plant species in the garden.
32. List the species planted by the students, with numbers.
33. Whether you have displayed the scientific names of the trees on the campus?
34. Is there any plantation on your campus? If yes specify the area and type of plantation.
35. Is there any medicinal garden in the Institute? If yes how much area?
36. Who is in charge of the gardens in your Institute?
37. Are you using any type of recycled water in your garden?
38. Do you have any composting pits in the institute?
39. What do you doing with the vegetables harvested?
40. Is there any botanical garden on your campus? If yes give details of campus flora.
41. Give the number and names of the medicinal plants on the campus of the institute.
42. Have any threatened plant species been planted/conserved?
43. What is the type of vegetation in the surrounding area of the Institute?
44. Is there any nature awareness program conducted on campus?
45. What is the involvement of students in green cover maintenance?
46. What is the total area of the campus under tree cover? Or under a tree canopy?
47. Total Number of vehicles used by the students of the institute.
48. Mention the usage of cycles, two-wheelers, and cars.
49. The number of persons using common transportation?
50. The number of visitors with vehicles per day?
51. The number of generators used per day (hours)? Give the amount of fuel used per day

## Chapter-4

### Kuvempu University Campus Audit Report

#### 4.1 Land Use System:

Kuvempu university campus is located very close to Bhadra wild life sanctuary Central Western Ghats region. The Geographical position of the study area is 13<sup>0</sup> 42<sup>1</sup> 22<sup>11</sup> N and 75<sup>0</sup> 30<sup>1</sup> 2<sup>11</sup> E with an Altitudinal range of 680m to 720m. The campus area is covered with dry deciduous forest of Bhadra Tiger reserve. It is situated 15 km south of Bhadravathi, 80 km northwest of Chikkamagaluru, 24 km south-east of Shimoga and 4 km north of Bhadra reservoir in Karnataka state. The total area of campus covers 230 acres with varied habitats from undulated hilly terrain to manmade wetlands. The average temperature ranges between 18 °C–36 °C and the relative humidity ranges between 60-75%. The study area receives an average rainfall of about 1435.64 -mm/year, highest in the month of June to August by South-west monsoon.

The university has a total of 230 hectares of land which was transferred from Department of Forests, Government of Karnataka for the purpose to start university with the development of various Offices/ Departments. It includes Academic/ Administrative building, computer lab, toilets, classroom, common room, canteen, roads, and also the area Vice Chancellor's Bungalow, Staff quarters and Physical Education Indoor stadium. The campus area also includes the parks, nursery and forest green cover etc (Table 4.1 & 4.2).

**Table 4.1: Total Campus Area, Building Spread Area, Vehicles and human population**

Sl No	Year	Teaching staff	Non-teaching staff	Students	Total
1	2018-2019	103	335	PG-2875 Ph.D-411	3724
2	2019-2020	100	324	PG-2658 Ph.D-343	3425
3	2020-2021	99	304	PG-2989 Ph.D-277	3669
4	2021-2022	92	281	PG-2878 Ph.D-261	3512
5	2022-2023	87	264	PG-3000 Ph.D-296	3647



**Table 4.2: Total Campus Area, Building Spread Area, Vehicles and human population**

S. No.	Details of Area	Total area
1.	Total Campus area	230 Acres
2.	Total Built up area	50.37Acres
9.	Forest vegetation	179.63 Acres
9.	Total number of Girl students	5124
10.	Total number of Boy students	2426
11.	Total number of Teaching Staff	217
12.	Total number of Non-teaching staff	193
13.	Total number of University Vehicles	34
14	Total number of Bicycles	30

**Meteorological information of campus**

Meteorology data such as temperature and rainfall data was collected at Meteorological station located at BRP near the campus. The data is incorporated to know the changes of temperature variation and rainfall measurement at KU campus area. In the campus meteorological station is located at pampavana in front of Kuvempu centenary building.

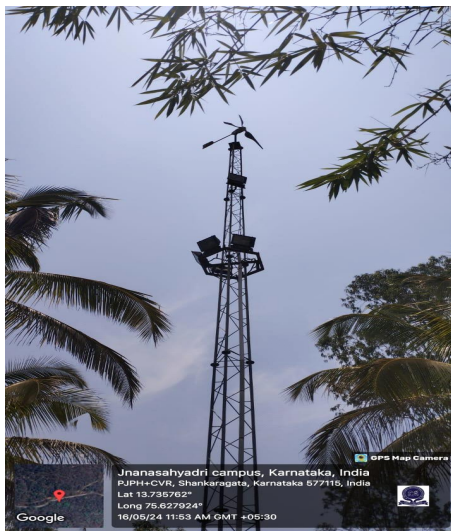


Fig 4.1  
Pampavana



Fig 4.2  
Fig BRP- Irrigation Department office



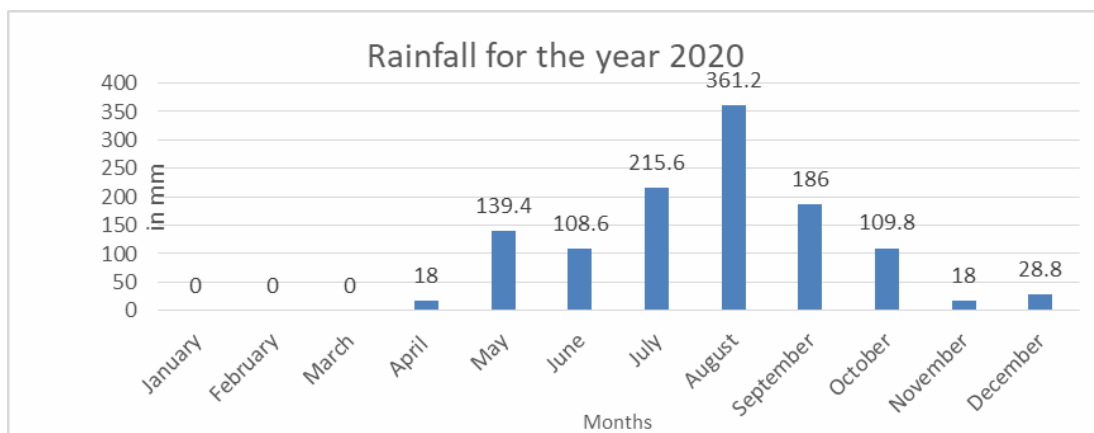
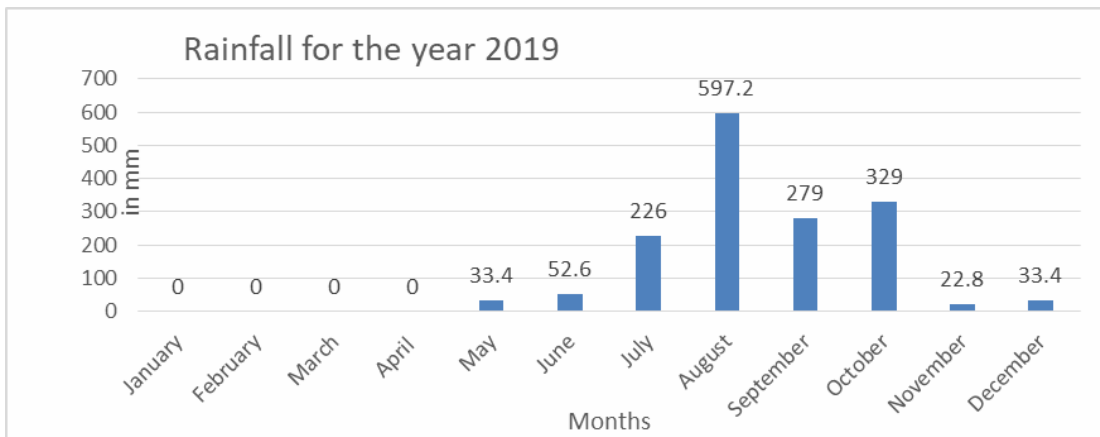
**(A) Climatic Parameters**

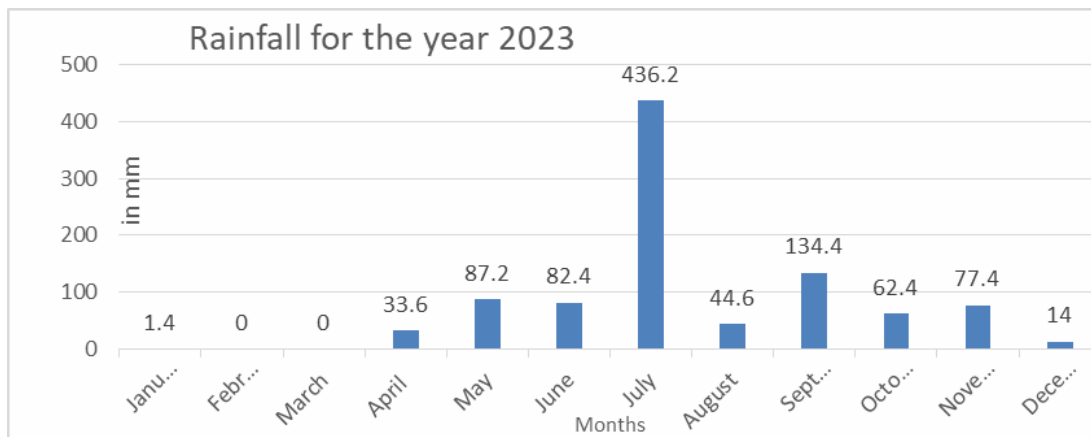
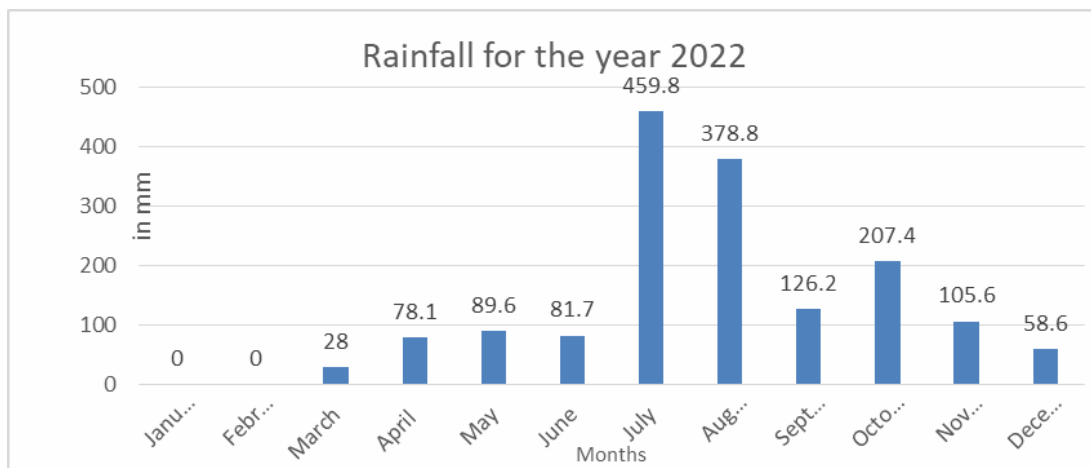
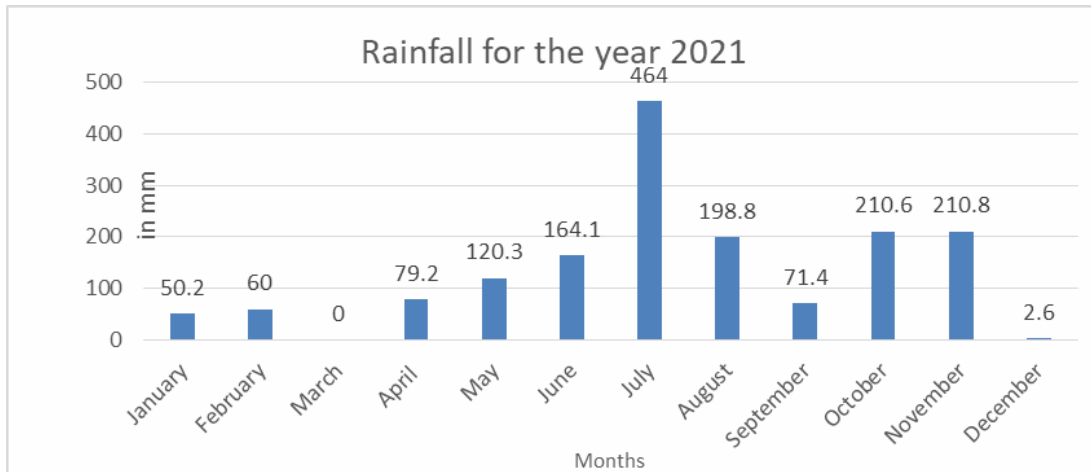
**i. Climate:** The Kuvempu University is located in the mid-western Ghat Region Karnataka also called Malnad region. There are three main seasons, the winter which is usually very slightly cold (December to March), the summer season, during which the temperature increases, thus, making the climatic conditions very warm (April to mid-May), and a rainy season with warm and humid conditions (mid-June to mid-September). The period between winter and summer can be recognized as autumn (October to November) and spring (February to March), respectively.

**Rainfall:** The rainfall occurs during the monsoon (June to mid of September, however, sometimes even at the end of September). The maximum rainfall occurs during June, July and August. Sometimes occasional rainfall occurs in the odd months also. The Seasonal the rainfall variation recorded from (2019-23) is presented in fig

**Temperature:** Temperature varies according to climatic conditions which tend to change drastically in the area. January and February are the slightly coldest months while May and June are the months of slightly moderate temperature. Generally, temperature remains high between March and May when it reaches close to mean maximum of 36.6 C. In rainy season it is slightly hot and humid.

**SEASONAL RAINFALL RECORDED (2019-2023)**





Academic credentials like taking up major and minor Projects, Student project work preparations of minor research dissertations, Thesis work and Scholarly publications on environmental science, Biological science technology and management domains carried out by students and staff members may be taken into account towards environment sustainability management. Best practices followed on green campus and eco-friendly set-up initiatives, planning and efforts in the Organization and recommendations for improvement are illustrated in the audit report as well.



In addition to this steps taken for organic, inorganic, toxic, e-waste, biomedical, food, sewage waste management, segregation of wastes and reuse methods, public transport, low-carbon emitting vehicles, battery operated vehicles, bicycles, bio fuel use and control of car smokes and exhaust with respect to routine FC services, steps taken to take care of day lighting, AC machine heat and carbon dioxide emission & carbon sequestration, Eco- friendly Refrigerants, instruments and materials use including Energy efficiency measures are taken,

**Table 4.3: Qualitative Measurements**

Sl. No	Requirements and checklists of the audit	Conformity		
		Yes	No	NA
1.	Have Internal Environment Audit procedures been Developed and implemented in the Organization?	✓		
2.	Have programmes for the achievement of environmental objectives and targets been established and implemented as on today?	✓		
3.	Have responsibilities been assigned for programmes at each appropriate function and level? (Environmental Staff working for environment monitoring in the campus)	✓		
4.	Are the following environmental aspects considered in sufficient detail?	✓		
5.	a. Drinking water / RO water / Bore well water to check quality of water through Physico-chemical properties analysis	✓		
6.	b. Wastewater treatment facility		✓	
7.	c. Hazardous and toxic material disposal facility		✓	
8.	d. Solid waste management facility	✓		
9.	e. Renewable energy utilization (Solar panel, windmill, solar water heater, etc.)	✓		
10.	f. Air ventilation at Indoor / Outdoor auditorium, seminar / conference halls, classrooms, hostel, canteen, staff rooms, laboratories, restrooms, etc.	✓		
11.	g. Acoustic proof in indoor auditorium, seminar / conference halls	✓		
12.	h. Availability of Biogas plant		✓	
13.	i. Rain harvesting system, water reservoirs, etc.	✓		
14.	j. Incinerator for napkin disposal use		✓	
15.	k. Housekeeping, storage, areas, piping, plumping and etc. in a proper way	✓		
16.	l. Sign boards indicating plastic free campus, tobacco free campus, don't waste water, don't walk on the lawns, don't plug flowers, etc.	✓		





Sl. No	Requirements and checklists of the audit	Conformity		
		Yes	No	NA
17	n. Per capita water consumption per day	✓		
18	Signing of MoU with Govt. and NGOs to ensure ecofriendly campus maintenance	✓		
19	Implementation of Government schemes (Swachh Bharath Abhiyan under Clean India Mission)	✓		
20	Functioning of Nature club, Eco club, Cell, Forum, Association, NCC, NSS bodies and Social Service League for students and staff members on environment conservation, pollution control and nature protection.	✓		
21	Conduction of awareness programmes and cultural activities for environmental monitoring and ecosystem maintenance to the stakeholders	✓		
22	Conduction of outreach programmes for dissemination of natural resources and environmental pollution	✓		
23	Implementation of composting pits, vermin-compost unit, recycling of kitchen wastes collected from hostels, canteens, and other places	✓		
24	Steps taken for organic, inorganic, toxic, e-waste, biomedical, food, sewage waste management, segregation of wastes and reuse methods		✓	
25	Public transport, low-carbon emitting vehicles, battery operated vehicles, bicycles, biofuel use and control of car smokes and exhaust with respect to routine FC services	✓		
26	Observation on the site preservation, soil erosion control and landscape management	✓		
27	Projects and Dissertation works and Scholarly publications on environmental science, engineering, technology and management carried out by students and staff members	✓		
28	Steps taken to take care of day lighting, AC machine heat and carbon dioxide emission & carbon sequestration*			✓
29	Eco-friendly Refrigerants, instruments and materials use including Energy efficiency measures taken *			✓
30	Mechanism of monitoring environmental parameters (Temperature, Relative humidity, Rainfall, Sunshine, Wind speed, dew point)*			✓



Sl. No	Requirements and checklists of the audit	Conformity		
		Yes	No	NA
31	Are all monitoring equipment appropriately maintained and calibrated?	✓		
32	Impactful Organization programmes on climate change, global warming, environmental protection, etc.	✓		
33	New initiatives to decrease private vehicles on campus to reduce carbon emission		✓	

\* Applicable for Industrial sectors

\*\* A minimum of 50% criteria should be attained

**Table 4.4: Requirements and checklists of the audit**

S.No	Requirements and checklists of the audit	Numbers / Percentage
<b>Quantitative Measurements</b>		
1.	Number of RO water Plant in the campus for drinking water	44
2.	Number of Borewell water and Open well water facility	05
3.	Number of Percolation Pond and Check Dam facility	2
4.	Number of Wastewater treatment facility	-
5.	Number of Solid waste management facility	2
6.	Number of Renewable energy utilization (Solar panel and solar water heater)	10
7.	Number of Rain harvesting system and water reservoirs	4
8.	The ratio of Environment sustainability courses (Environmental Science, Botany, Zoology, Biotechnology, Wildlife and Management, Earth Science , Microbiology, to total courses / subjects	80:10
9.	Functioning of, Eco club, Wild life forum, NSS, Eco-cycling, for nature protection and natural resources maintenance.	4
10.	Signing of MoU with Govt. and NGOs to ensure ecofriendly campus maintenance	1
11.	Implementation of Government schemes (Swachh Bharath Abhiyan under Clean India Mission) programmes conducted	1
12.	Number of composting pits and vermicompost unit for recycling of kitchen wastes and plant leaf litters degradation	2
13.	Per capita water consumption per day	153 lit/day
14.	Carbon footprint in the campus due to Electrical energy usage	1161.31m/t
15.	Carbon footprint in the campus due to Vehicles usage	109.5 m/t



### 4.3 Auditing for Energy Conservation and Management

Energy cannot be seen, but we know it is there because we can see its effects in the forms of heat, light and power. This indicator addresses energy consumption, energy sources, energy monitoring, lighting, appliances, and vehicles. Energy use is clearly an important aspect of campus sustainability and thus requires no explanation for its inclusion in the assessment (Ingle *et al.*, 2014). An old incandescent bulb uses approximately 60W to 100W while an energy efficient light emitting diode (LED) uses only less than 10 W. Energy auditing deal with the conservation and methods to reduce its consumption in terms of 1) Reducing the risk of energy scarcity, 2) Reducing the greenhouse gas emissions, 3) Renewables have overhead costs too and 4) Energy Management saves costs. An energy audit is a useful tool for developing and implementing comprehensive energy management plans of an Organization. The aim of an energy audit is to identify the energy efficiency, conservation and savings opportunities at the premises of the audit sites in a systematic manner. The audit process is carried out to review of energy saving opportunities and measures implemented in the audit sites and to identify the various energy conservation measures and saving opportunities. In addition, Implementation of alternative energy resources for energy saving opportunities and decision making in the field of energy management along with creating awareness among the stakeholders on energy conservation and utilization are being carried out. Kuvempu University has a substantial the energy conservation initiatives with very good savings opportunities. Energy efficient lighting schemes, awareness created among stakeholders and necessary power backups are being practiced by the institution. There are some best Practices followed on Energy Audit in the Organization like Transformers, Generators and UPS are protected properly with fencing and kept awareness boards on ‘Dangers’ and ‘Warnings’. It is observed that the most of places, sign board of ‘Switch ON’ and ‘Switch OFF’ are kept towards saving energy measures to the stakeholders. Electrical wires, switch boxes and stabilizers are properly covered without any damage which will cause any problems to the staff and student members. Adaptation of drip and sprinkler irrigation and solar street-lights in the campus to minimize the energy potential are well appreciated. Few recommendations, in addition, can further improve the energy savings of the Organization. This may lead to the prosperous future in context of Energy Efficiency Campus and thus sustainable environment and community development to the stakeholders in coming years to come.

#### Biogas plant facility at Kuvempu University Campus

A biogas plant is where biogas is produced by means of fermenting biomass using cow dung and plant waste products. This is done by developing methane-containing fuel that is usually present in energy crops like corn, or waste substances such as manure or food waste (Abanades *et al.*, 2021). The fermentation residue left over from the substrates at the end of the manner can be used as fertilizer. The biogas is produced by the micro- bacterial decomposition of the substrate in an oxygen-loose surrounding like below anaerobic situations. This is implemented by pumping the substrate into the fermenters. The substrate is stored beneath anaerobic situations and is periodically shifted *via* agitators to avoid the formation of surface scum and sinking layers. This also permits the biogas to rise greater



effortlessly (Miltner *et al.*, 2017). Installing biogas in educational institutions and industries help in the waste management process, as the wastes accumulated in canteen, hostels, mess and restaurants can be used for biogas plant, which in turn can be used for cooking. This fulfils two purposes simultaneously by energy saving and waste management. Kuvempu University is in the initial stage of establishing biogas plant in the campus.

#### **4.4 Energy consumption and saving practices**

The electricity audit is envisaged to make Kuvempu University campus energy efficient. Campus community uses a huge amount of energy and it is very obvious that in the campus waste quite a consumes less energy and the is bill is around in Rupees 1.21 cr and above per year. The amount is huge and naturally attracts attention as financial resources are being drained. Making Kuvempu university campus energy efficient will not only help it reduce its expenses but helps us in fulfilling our moral responsibility of saving the precious resource.

As per the Energy Conservation Act, 2001, Energy Audit is defined as “the verification, monitoring and analysis of use of energy including submission of technical report containing recommendations for improving energy efficiency with cost benefit analysis and an action plan to reduce energy consumption”.

#### **Methodology**

Energy audit conducted by electricity data using questionnaire method, data analysis and development of action plan for energy consumption. During the data collection and analysis care was taken to account for

1. The type of electrical appliances or device used in each section.
2. The level of awareness regarding energy conservation among the beneficiaries of university which include students, teachers, non-teaching employee and administration.

Electricity bills for the last five years were analyzed for the growth induced at different points of time. Temporal variation and trends were illustrated on a graph to decide whether electricity consumption increased or otherwise, during various seasons of the year.

#### **Energy consumption recorded in each building of Jnana Sahyadri campus of Kuvempu University.**

Electricity is supplied to the university campus by Karnataka State Electricity Board. Electricity is also generated in small quantity using wind energy and solar energy by University. Solar panel and wind fan is fixed at Pampavana near Examination building. Major use of the energy is at Centenary building.





Solar Street light with LED bulbs



Solar Street light with LED bulb



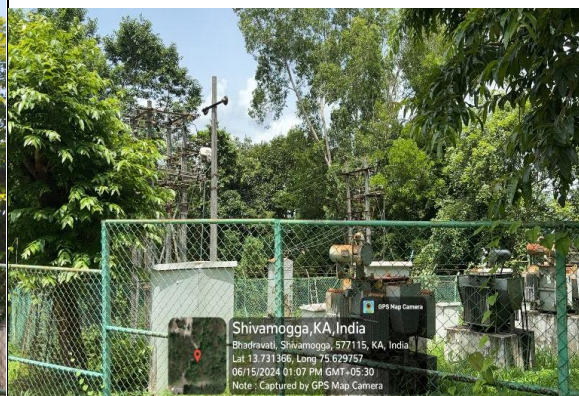
Solar water heaters using in university Hostels



Bio energy production unit maintained in University campus



Power transformer unit 1



Power transformer unit 2





eteorological station at Pampavana.



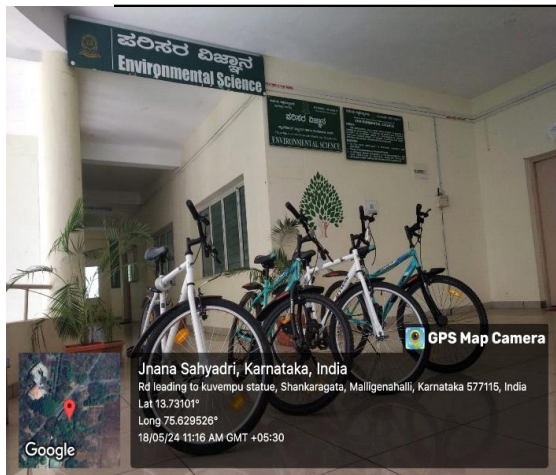
Wind energy unit at Pampavana



nergy units installed on campus buildings



Solar water heaters using in university Hostels



cles -Students and staff members using in the campus area



University staff Electric vehicle

#### 4.5 Air Quality assessment in the Kuvempu university campus environment:

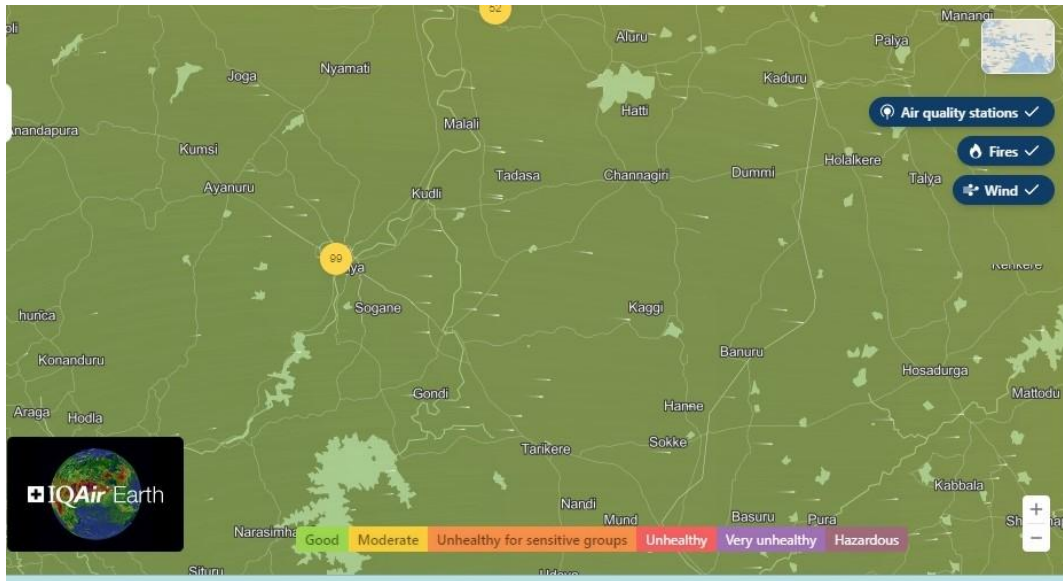


Fig 4.4

Air pollution is now a serious worldwide public health problem. Developmental activities like industrial expansion, mining exploration, transportation and constructional works etc. cause degradation and drastic changes in every component of environment. Air pollution has emerged in the past few decades as the most crucial problem to mankind]. Clean, pollution-free and hygienic living surroundings are essential as they are directly related to human health and better living standard of the country. Kuvempu university campus air quality shows good in the scale of environment . Dust free environment is witnessed in the campus. Due to rich in forest vegetation the campus air environment is free from particulate matter people in this campus breathe the air without any contaminants and they are very healthy.

#### Air quality index

Parameter	Status	Value
PM 2.5	Excellent	10 for 3 $\mu\text{g}/\text{m}^3$
NO 2	Excellent	8 for 4 $\mu\text{g}/\text{m}^3$
O 3	Excellent	8 for 24 $\mu\text{g}/\text{m}^3$
PM 10	Excellent	7 for 5 $\mu\text{g}/\text{m}^3$
CO	Excellent	1 for 97 $\mu\text{g}/\text{m}^3$
SO 2	Excellent	1 for 1 $\mu\text{g}/\text{m}^3$

Source: <https://www.accuweather.com/en/in/shankaraghatta/2856937/air-quality-index/2856937>



### Air Quality Scale

Air Quality Scale	micrograms per cubic metre
Excellent	0-19
Fair	20-49
Poor	50-99
Unhealthy	100-149
Very Unhealthy	150-249
Dangerous	250+

#### PM<sub>2.5</sub>

[Fine Particulate Matter](#) are inhalable pollutant particles with a diameter less than 2.5 micrometers that can enter the lungs and bloodstream, resulting in serious health issues. The most severe impacts are on the lungs and heart. Exposure can result in coughing or difficulty breathing, aggravated asthma, and the development of chronic respiratory disease.

#### PM<sub>10</sub>

[Particulate Matter](#) are inhalable pollutant particles with a diameter less than 10 micrometers. Particles that are larger than 2.5 micrometers can be deposited in airways, resulting in health issues. Exposure can result in eye and throat irritation, coughing or difficulty breathing, and aggravated asthma. More frequent and excessive exposure can result in more serious health effects.

#### O<sub>3</sub>

Ground-level [Ozone](#) can aggravate existing respiratory diseases and also lead to throat irritation, headaches, and chest pain.

#### NO<sub>2</sub>

Breathing in high levels of [Nitrogen Dioxide](#) increases the risk of respiratory problems. Coughing and difficulty breathing are common and more serious health issues such as respiratory infections can occur with longer exposure.

#### CO

Carbon Monoxide is a colorless and odorless gas and when inhaled at high levels can cause headache, nausea, dizziness, and vomiting. Repeated long-term exposure can lead to heart disease

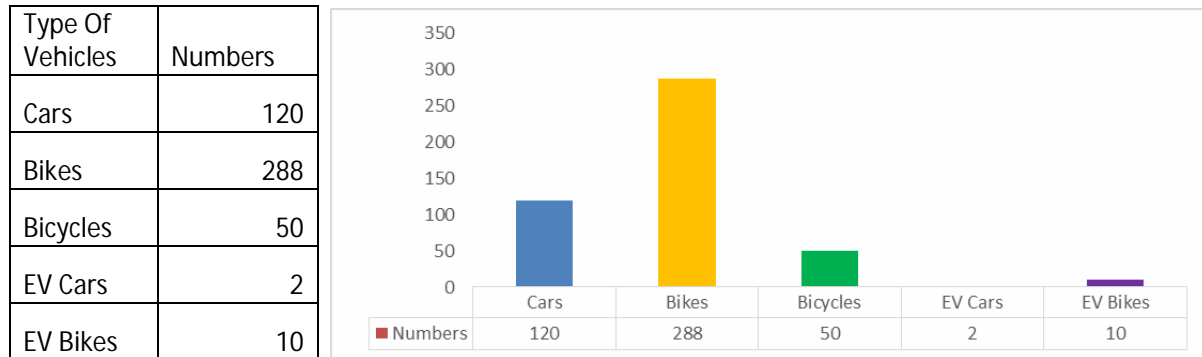
#### SO<sub>2</sub>

Exposure to Sulfur Dioxide can lead to throat and eye irritation and aggravate asthma as well as chronic bronchitis.



#### 4.6 Sources of noise pollution

**Fig 4.5 Vehicles used in the campus**



**Fig 4.5**

It was observed that there is no industrial as well as the sound generating activities near the university campus and it was revealed from that due to limited number of vehicles the chances of noise pollution seems to be quite below of standard limit. Moreover the two generators of the university are also sound proof. There is no other source of noise pollution in the campus.

**Table 4.14: Noise level recorded at different locations in the Kuvempu University campus**

Sl No	Sampling sites	Decibels (dB)
1	Bio Science Block	54.3
2	Examination section	67.2
3	Kannada Bharathi	45.2
4	Pampavana	51.8
5	Art Gallery	40
6	Engineering Section	50.2
7	Indore Stadium	43.7
8	Commerce and Management Building	58
9	Library	51.1
10	Green Library	44.7
11	Canteen	73
12	Guest house	40.7
13	Quarters	50.2
14	Shankaraghatta Main road	85.1
15	Chemical Science Block	46.5
16	Vice-Chancellor's Bungalow	42.8

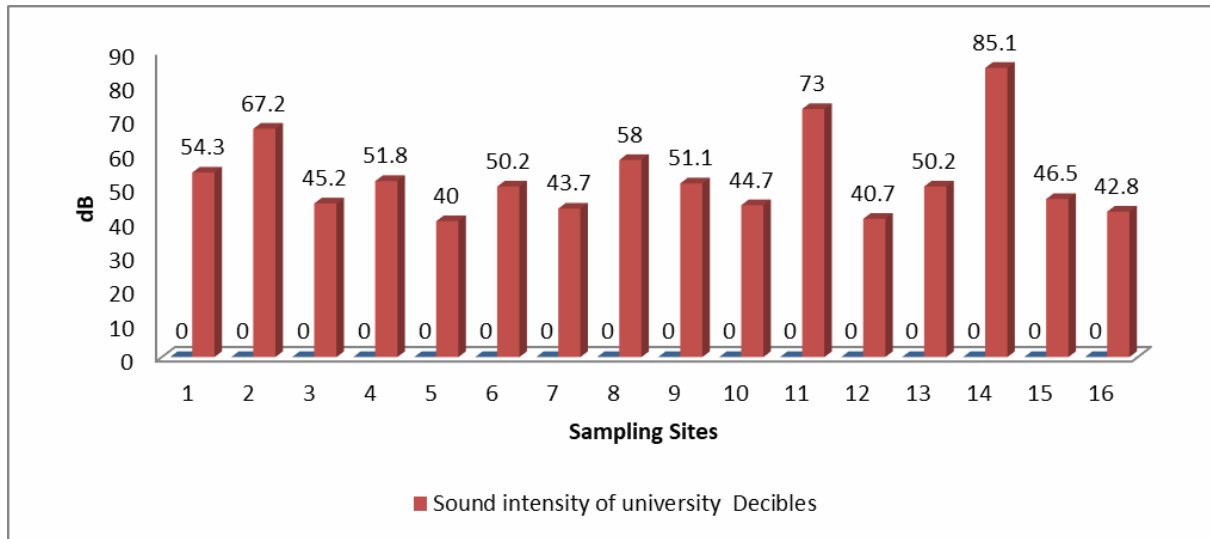


Fig 4.6

Table 4.15: Ambient Air Quality Standards In Respect of Noise

Area Code	Category of Area	Limits in dB (A) Leq	
		Day Time	Night Times
(A)	Industrial area	75	70
(B)	Commercial area	65	55
(C)	Residential area	55	45
(D)	Silence Zone	50	40

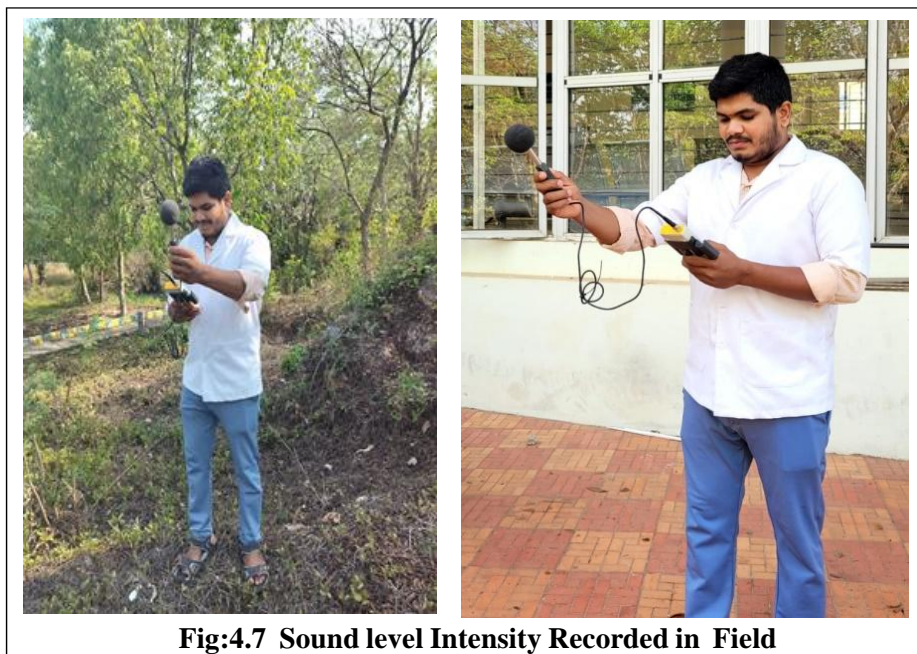


Fig:4.7 Sound level Intensity Recorded in Field



## Chapter-5 ELECTRICITY AUDIT

**Table 5.1: Energy consumption in various buildings of the Kuvempu University**

Sl. No	Name of the building	Maximum load (in watt)
1	School of physical science	301398
2	School of Earth science and allied Buildings	39208
3	MCA Block	80180
4	Bioscience Complex	287040
5	Arts Building	120031
6	Hostel	
	A) Boy's Hostel	69825
	B) Girl's Hostel	190553
7	Distance Education	178095
8	Library Section	78906
9	Physical Education	20801
10	Prasaranga	3993
11	Centenary Building	154898
12	MBA/commerce	62147
<b>Total</b>		<b>1587075</b>

**Table 5.2: Kuvempu University electricity bill paid (2018-2023)**

Month/ Year	BRP HT-2				BRP-8				Total Amount
	Present Reading Energy in Kwh	Past Reading Energy in Kwh	Unit Consumption	Amount Paid	Present Reading Energy in Kwh	Past Reading Energy in Kwh	Unit Consumption	Amount Paid	
April-2018.	5118.17	4914.4	122262	859431.00	186682	185706	9760	61390.00	920821.00
May-2018.	5334.87	5118.17	130020	985582.00	187710	186682	10280	75432.00	1061014.00
June-2018.	5534.41	5334.87	119724	974919.00	188638	187710	9280	74303.00	1049222.00
July-2018.	5683.87	5534.41	89676	767003.00	189445	188638	8070	62186.00	829189.00
August-2018.	5821.14	5683.87	82362	691214.00	190229	189445	7840	62061.00	753275.00
September-2018.	6016.09	5821.14	116970	989103.00	191244	190229	10150	79705.00	1068808.00
October-2018.	620242	6016.09	111798	933823.00	192225	191244	9810	77580.00	1011403.00
November-2018.	6397.53	620242	117066	974492.00	193215	192225	9900	78201.00	1052693.00
December-2018.	6573.26	6397.53	105438	886906.00	194124	193215	9090	71991.00	958897.00
January-2019.	6769.12	6573.26	117516	975275.00	195160	194124	10360	81334.00	1056609.00
February-2019.	6950.88	6769.12	109056	909353.00	196138	195160	9780	76861.00	986214.00
March-2019.	7149.93	6950.88	119430	986221.00	197124	196138	9860	77450.00	1063671.00

**Table 5.3: Kuvempu University electricity bill paid (2019-2020)**

Month/Year	BRP HT-2				BRP-8				Total Amount
	Present Reading Energy in Kwh	Past Reading Energy in Kwh	Unit Consumption	Amount Paid	Present Reading Energy in Kwh	Past Reading Energy in Kwh	Unit Consumption	Amount Paid	
April-2019.	7385.80	7149.93	141522	1053331.00	198253	197124	11290	76818.00	1130149.00
May-2019.	7607.24	7385.80	132864	1090098.00	199423	198253	11700	92310.00	1182408.00
June-2019.	7840.40	7607.24	139896	1142722.00	200633	199423	12090	97172.00	1239894.00
July-2019.	7995.42	7840.40	93012	879463.00	201580	200633	9470	83613.00	963076.00
August-2019.	8131.56	7995.42	81684	733605.00	202296	201580	7160	59871.00	793476.00
September-2019.	8310.81	8131.56	107550	932733.00	203305	202296	10090	83482.00	1016215.00
October-2019.	8502.23	8310.81	114852	1002982.00	204209	203305	9040	75573.00	1078555.00
November-2019.	8685.33	8502.23	109860	959093.00	747	2	11175	92234.00	1051327.00
December-2019.	8877.45	8685.33	115272	1002948.00	1536	747	11835	97456.00	1100404.00
January-2020.	9058.95	8877.45	108900	942797.00	2242	1536	10590	86664.00	1029461.00
February-2020.	9245.40	9058.95	111870	967833.00	2938	2242	10440	85431.00	1053264.00
May-2019.	9421.19	9245.40	105474	914696.00	3612	2938	10110	82782.00	997478.00

**Table 5.4: Kuvempu University electricity bill paid (2020-2021)**

Month/Year	BRP HT-2				BRP-8				Total Amount
	Present Reading Energy in Kwh	Past Reading Energy in Kwh	Unit Consumption	Amount Paid	Present Reading Energy in Kwh	Past Reading Energy in Kwh	Unit Consumption	Amount Paid	
April-2020.									
May-20	9685.58	9586.78	59280	1301468.00	4728	4295	6495	124484.00	1425952.00
June-2020.	9798.24	9685.58	67596	616014.00	5166	4728	6570	53936.00	669950.00
July-2020.	9910.02	9798.24	67068	618395.00	5639	5166	7095	58753.00	677148.00
August-2020.	10020.59	9910.02	66342	614523.00	6109.83	5639	7062	58457.00	672980.00
September-2020.	10131.58	10020.59	66594	617223.00	6613	6109.83	7547	62446.00	679669.00
October-2020.	10289.65	10131.58	94842	839393.00	7261	6613	9720	80195.00	919588.00
November-2020.	10410.77	10289.65	72672	666006.00	7803	7261	8130	67269.00	733275.00
December-2020.	10524.04	10410.77	67962	642871.00	8309	7803	7590	65412.00	708283.00
January-2021.	10659.67	10524.04	81378	747738.00	8994	8309	10275	87415.00	835153.00
February-2021.	10816.3	10659.67	93978	842109.00	9761	8994	11505	97294.00	939403.00
March-2021.	10971.95	10816.3	93390	831370.00	10532	9761	11565	97860.00	929230.00





**Table 5.5: Kuvempu university electricity bill paid (2021-2022)**

Month/ Year	BRP HT-2				BRP-8				Total Amount
	Present Reading Energy in Kwh	Past Reading Energy in Kwh	Unit Consumption	Amount Paid	Present Reading Energy in Kwh	Past Reading Energy in Kwh	Unit Consumption	Amount Paid	
Apr-21	11164.88	10971.95	115758	996637.00	11380	10532	12720	98790.00	1095427.00
May-21	11324.35	11164.88	95682	762463.00	12092	11380	10680	90355.00	852818.00
Jun-21	11417.76	11324.35	56046	541222.00	12537	12092	6675	57005.00	598227.00
Jul-21	11509.16	11417.76	54840	528428.00	13069	12537	7980	66055.00	594483.00
Aug-21	11622.74	11509.16	68148	633550.00	13697	13069	9420	77469.00	711019.00
Sep-21	11799.99	11622.74	106350	922428.00	14533	13697	12540	102178.00	1024606.00
Oct-21	11961.75	11799.99	97056	897217.00	15315	14533	11730	99484.00	996701.00
Nov-21	12109.92	11961.75	88902	828999.00	16071	15315	11340	99133.00	928132.00
Dec-21	12210.6	12109.92	60408	593891.00	16659	16071	8820	75493.00	669384.00
Jan-22	12335.44	12210.6	74904	711149.00	17459	16659	12000	102858.00	814007.00
Feb-22	12474.04	12335.44	83160	776461.00	18225	17459	11490	98514.00	874975.00
Mar-22	12619.14	12474.04	87060	804484.00	18989	18225	11460	98594.00	903078.00

**Table 5.6: Kuvempu university electricity bill paid (2022-2023)**

Month/ Year	BRP HT-2				BRP-8				Total Amount
	Present Reading Energy in Kwh	Past Reading Energy in Kwh	Unit Consumption	Amount Paid	Present Reading Energy in Kwh	Past Reading Energy in Kwh	Unit Consumption	Amount Paid	
Apr-22	12809.8	12919.14	114396	1021744.00	19864	18989	13125	104927.00	1126671.00
May-22	12987.12	12809.8	106392	891100.00	20510	19864	9690	84463.00	975563.00
Jun-22	13153.22	12987.12	99160	915337.00	21267	20510	11355	98291.00	1013628.00
Jul-22	13324.22	13153.22	102600	960276.00	22019	21267	11280	100035.00	1060311.00
Aug-22	13510.37	13324.22	111690	1046005.00	22843	22019	12360	109327.00	1155332.00
Sep-22	13669.45	13510.37	95448	912574.00	23537	22843	10410	92590.00	1005164.00
Oct-22	13847.81	13669.45	107016	1032689.00	24230	23537	10395	94943.00	1127632.00
Nov-22	13998.96	13847.81	90690	895980.00	24997	24230	11505	104698.00	1000678.00
Dec-22	14145.49	13998.96	87918	873766.00	25738	24997	11115	101390.00	975156.00
Jan-23	14264.83	14145.49	71604	688607.00	26478	25738	11100	94507.00	783114.00
Feb-23	14418.26	14264.83	92058	844588.00	27276	26478	11970	101629.00	946217.00
Mar-23	14568.69	14418.26	90258	855600.00	28033	27276	11355	100738.00	956338.00

**Table 5.7: Various electric appliance's electricity consumption in different departments of campus**

Sr. No.	Name of Building	Tube Light (1@40W)	Fans (1@100W)	PC (1@250W)	AC (1@2000W)	Projector (1@1000W)	Plug point (1@40W)
1	School of physical science	444	224	70	21	10	1250
2	School of Earth science and allied Buildings	102	46	15	08	04	240
3	MCA Block	204	109	134	14	07	805
4	Bioscience Complex	1126	302	59	23	10	1476
5	Arts Building	569	267	65	15	25	941
6	Hostel						
	A) Boy's Hostel	456	240	05	-	-	267
	B) Girl's Hostel	1070	545	07	-	-	694
7	Distance Education	471	197	104	29	04	1037
8	Library Section	341	139	89	32	03	542
9	Physical Education	125	63	04	01	03	100
10	Prasaranga	19	09	02	-	01	24
11	Centenary Building	489	149	65	17	02	688
12	MBA/commerce	379	156	15	05	15	511
	<b>Total</b>	<b>5795</b>	<b>2446</b>	<b>634</b>	<b>165</b>	<b>84</b>	<b>8575</b>

**Table 5.8: Expenditure of Five years electricity consumption**

Sr. No.	Name of Building	Tube Light (1@40W)	Fans (1@100W)	PC (1@250W)	AC (1@2000W)	Projector (1@1000W)	Plug point (1@40W)
1.	Physical Science	367	216	43	16	11	32
2.	Earth Science	98	42	30	7	5	34
3.	MCA Block	235	113	100	9	8	48
4.	Bioscience complexes	582	287	57	7	14	164
5.	Arts building	300	155	90	6	20	113
6.	Hostel	975	485	14	-	-	141
7.	Distance Education	508	261	126	30	9	297
8.	Library	307	143	68	26	4	172
9.	Physical Education and hostel	35	32	1	-	-	55
10.	Prasaranga	24	9	4	-	1	9
11.	Centenary building	395	143	54	21	1	198
12.	MBA and Commerce Block	224	105	30	-	11	26
		<b>4050</b>	<b>1991</b>	<b>617</b>	<b>122</b>	<b>84</b>	<b>1289</b>





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**Best practices following to reduce energy consumption**

1. Solar energy street lights
2. Replaced standard light bulbs with CFLs
3. Create awareness about energy loss
4. Sleep your computer when you are not use
5. Each and every employee should aware about the loss of energy resources and while going on they should turn of lights and fans
6. Try to use natural lights whenever possible
7. It is necessary to adapt solar energy system in the campus.

At present in Kuvempu University campus, facing severe power cut during all the seasons and days. In order to overcome the energy demand , it is necessary to think of renewable energy sources like wind mill and solar panels for self-sustenance and to cut the use of non-renewable energy sources.





## Chapter-6

### OBSERVATIONS OF THE ENVIRONMENT AUDIT

#### 6.1 Plastic use and their impact on the environment

The Ministry of Environment, Forest and Climate Change, Government of India has notified the Plastic Waste Management Rules, 2016. A Central Pollution Control Board report indicated that the total annual plastic waste generation in India at a humungous is around 3.3 million metric tonnes per year for which the data were collected from 60 major cities in India. The country generates around 26,000 tons of plastic waste a day out of which 60% of plastic produced is recycled. But the

Problem with plastic is that most of it isn't biodegradable. It doesn't rot, like paper or food, so instead it can hang around in the environment for hundreds of years. More than eight million tons of plastic enters the world's oceans each year and most of that escapes from land. It is observed that 96% of plastic wastes are collected and segregated by the respective urban bodies in which the recyclable plastic waste are sold to the recyclers and non-recyclable plastic waste are sent for co-incineration in cement plants. People should be asked to use reusable items and initiate models which allow up-cycling of waste items for better use. This will help reduce plastic waste from urban local bodies, as well as curb the value for waste. Among the citizens. Plastic waste management is very important, because plastic destroys food chains, only 9 percent of the total plastic waste in the world is recycled.

People use plastic bags and plastic ware items every day to hold objects like meals, clothes, grocery and stationary items, which can be bought from shops. Generally, the plastic items are non- degradable in nature that lead to soil pollution and affect the soil health significantly (Lazarevic *et al.*, 2010). Most of the plastic items are considered as solid waste. This has resulted in many damaging environmental effects inclusive of animal choking, pollution, blockage of channels, rivers and streams, and landscape disfigurement. According to the World Health Organization (WHO) report, plastic items take at least 400 years to decompose completely in the soil which illustrates the subsequent effects on the environment. Plastic pollutants form a basis for damage to humans, animals and flora through toxic pollution. It can take masses or even heaps of years for plastic to break down so the environmental harm is lengthy-lasting. It impacts all organisms in the food chain from tiny species to big ones. There is a need to reduce the plastic use to effectively limit plastic waste in the campus (Eriksson *et al.*, 2016).

Kuvempu University has taken sufficient attempts not to use plastics in the campus and displayed a slogan 'Plastic free campus' in places like canteen, hostel dining halls, seminar halls, corridors, etc. to the students, parents and public. The Kuvempu University Management insisted the people use eco-friendly bags made from organic materials like plant fibers which are easily decomposable in nature. These efforts are very much essential to keep the environment neat and clean to conserve nature.



## **6.2 Status of Solid waste management method in the campus**

Solid waste can be defined as an organic and an inorganic material produced by households, commercial, institutional and industrial activities that have lost their value with the first user and becomes unwanted. These unwanted materials are disposed of by human beings from their homes, industries, shops, offices and hospitals. If proper method is not adopted in disposing these materials, they pose various health problems. Hence, the designing of collection, storage, transportation and disposal of garbage and other solid waste is very much essential. For solid waste management envisages strong emphasis on information, education and communication (IEC) to increase people's awareness on sanitary practices, hygiene behaviours, health issues, leading to a healthy behaviour and better health condition in the campus. The main goal of Solid Waste Audit is to document the present status of waste generation in different places of the campus and management of this waste scientifically good enough to meet the hygiene conditions around the campus.

Swachh Bharath Abhiyan under Clean India Mission is the new initiative and a step towards sanitation, solid waste management and cleanliness to promote cleanliness across India. It is the country-wide campaign applied on a large scale in India for both the rural and urban places, producing needs for the bathrooms and providing hygienic atmosphere amongst the population by household member's was the main purpose of this. This scheme is implemented by the Educational Institutions covering Universities, Colleges and Schools, Government Departments, Companies and Public sectors across the country to give a safe pollution free environment, eliminate the open defecation, improve solid waste management and sanitation and refining drinking water quality to the stakeholders. The initiative is easily attainable by the support of Government employees, management representatives, staff members and students. The students of Kuvempu University conduct awareness programmes on cleanliness, alternative to plastics, solid waste management and sanitation and importance of environment to the rural people around Kuvempu University NSS units. They created awareness among the rural and urban people to keep the surroundings clean and hygiene. A sizable number of programmes and rallies are conducted periodically during the celebration of various events such as 'Independence Day', 'Republic Day', 'World Environmental and wild life week programmes.

Kuvempu University has well developed NSS, Swachh Bharath Abhiyan under Clean India Mission. These bodies are actively involved in tree planting programmes and cleaning the surrounding areas of tribal, rural and urban people across Shivamogga and Chickmagalur districts Kuvempu University organised number of activities to conserve the nature and created environmental awareness about the importance of environment both in rural and urban areas.

Awareness programmes on the green campus initiatives and dissemination of green motto and pledges are accounted in a sustainable manner. Its benefits and self-sustainability are being projected for wider centric on earth and Ecology conservation. Innovative practices that add up credentials in implementing the green campus which needs to be promoted in the awareness programme to the students and staff members including public domain (York and Rosa, 2003). Technology driven solutions initiated by the green campus organization are



periodically disseminated and documented successively for propagating the attitude of the green campus in wider masses.

Kuvempu University has taken sufficient attempts to disseminate the green campus motto and green pledge as well as awareness programmes such as ‘Don’t cut trees’, ‘Don’t use plastic bags’, ‘Don’t waste water’, ‘Plastic Free Zones’ and ‘Preserve the Natural Resources’ and etc. among the students and staff members in the campus.

Kuvempu University is a young and growing University. Nature has blessed the university campus with lush green surrounding and totally unpolluted environment. However, wherever human habitats exist, solid and liquid waste will definitely produce. Since the university large number of stake holders are using the products and generating various types of wastes. Therefore the case study is carried out by visiting each department and collected information about types of waste produced and quantity estimated.

### **Methodology**

An effective waste reduction program must be based on current and accurate information on the quantity and composition of the solid waste. Therefore, the first step in a “waste audit,” is a systematic procedure to review operations and waste generation. This is carried out by questionnaire methods as mentioned in the previous chapter. Performing the audit exercise will define the composition of waste discard by examining how material enters and exit our facility. However, today’s concern over solid waste generation and increasing costs of collection and disposal are good reasons to find out how to reduce waste, increase recycling and try to cut costs. An audit is the starting point that will enable our business to make informed decisions on how to allocate resources for waste reduction and recycling programs.

### **6.3 Solid Waste Management Practices**

Waste management has a common mandate that the “Producer Owns the Responsibility”. The community that generates waste should develop more responsibility in handling the waste with more care thus reducing negative impact on the environment. A study conducted in the University Campus had quantified a daily average of wastes 154kg/day in which Organic waste is about 68%, paper waste is about 17%, Plastic waste is about 7%, Glass waste is about 3%, Scrap waste is about 2% and other E-Waste is about 3%. The study revealed that the solid wastes needs to be professionally handled. The solid wastes are collected from different departments of Kuvempu University campus and segregated based on bio- degradable and non-degradable materials subsequently subjected for recycling and degradation processes like composting process also undertaken. Classification and types of the waste generated and management practices in Kuvempu University are recorded. Regarding the food wastes, a portion of food wastes is collected by local people for animal feeding. Vegetable and fruit wastes as well as food waste is used for bio-gas generation. Organic wastes like dry leaves, vegetable cuttings, etc. are sent for bio-composting.

**Table 6.1: Sources and types of solid waste generation and segregation.**

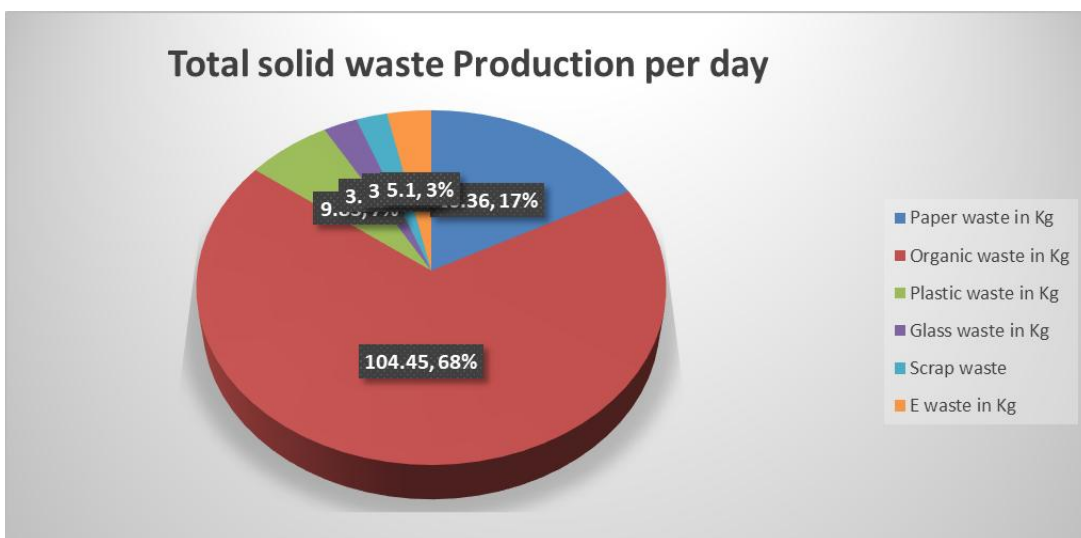
Sl. No.	Name of Building	Type of solid waste generate
1	Engineering Section	Paper Waste, Plastic Waste, E-waste
2	School of Physical science	Paper waste, Organic waste ,Plastic waste, Glass waste, Scrap waste, E-waste
3	School of Earth science	Paper waste, Organic waste, Plastic waste, Glass waste E-waste
4	MCA Block	Paper waste, Organic waste, Plastic waste, Glass waste Scrap waste, E-waste
5	Bio science complex	Paper waste, Organic waste, Plastic waste, Glass waste,
6	Arts Building	Paper waste, Organic waste, Plastic waste, E-waste.
7	Hostels	Paper waste, Organic waste, Plastic waste, Glass waste, Scrap waste, E-waste.
8	Exam block	Scrap waste, Paper waste, Organic waste, Plastic waste.
9	Centenary building	Paper waste, Plastic waste, Scrap waste, E-waste.
10	Commerce Management block	Paper waste, Organic waste, Plastic waste.
11	Prasaranga	Paper waste.
12	Library	Paper waste, Organic waste, Plastic waste.
13	Bank	Paper waste, Organic waste, E-waste.
14	Temple	Paper waste, Organic waste, Plastic waste,
15	SRM College	Paper waste, Organic waste, E-waste.
16	Academic Section	Paper, plastic, Organic waste,Scrap,
17	Kannada Bharati	Paper waste, Organic waste, Plastic waste,
18	Examination Section	Paper waste, Organic waste, Plastic waste,
19	Food Technology	Paper waste, Organic waste, Plastic waste, Glass waste.





**Table 6.2: Quantity of Solid waste generation in different departments.**

Sl No	Name of the Building	Paper waste in Kg	Organic waste in Kg	Plastic waste in Kg	Glass waste in Kg	Scrap waste	E waste in Kg	Total Solid waste generated /day in Kg
1	Engineering Section	0.25	0	0.15	0	0	0.05	0.45
2	School of Physical science	0.26	0.7	0.7	1	0.35	0.3	3.31
3	School of Earth science	0.5	0.1	0.5	0.6	0	0.2	1.9
4	MCA Block	1.5	0.2	0.35	0.1	0.5	0.7	3.35
5	Bio Science Complex	2.5	1.55	1.25	0.1	0	0	5.4
6	Arts Building	2.5	0.2	0.6	0	0	0.3	3.6
7	Hostels	8	95	4	2	2	3	114
	Exam block	0.2	1	0.2	0	0.1	0	1.5
9	Centenary building	3	0	0.3	0	0.3	0.25	3.85
10	Commerce Management block	1	0.1	0.25	0	0	0	1.35
11	Prasaranga	0.1	0	0	0	0	0	0.1
12	Library	0.175	0.05	0.2	0	0	0	0.425
13	Bank	2	0.5	0.2	0	0	0.1	2.8
14	Temple	0.3	0.3	0.35	0	0	0	0.95
15	SRM College	3	0.5	0.2	0	0	0.1	3.8
16	Academic Section	0.6	1	0.25	0	0.25	0.1	2.2
17	Kannada Bharati	0.15	0.1	0.05	0	0	0	0.3
18	Food Technology	0.125	2.15	0.08	0.12	0	0	2.475
19	<b>TOTAL</b>	<b>26.16</b>	<b>103.45</b>	<b>9.63</b>	<b>3.92</b>	<b>3.5</b>	<b>4.85</b>	<b>151.76</b>



**Fig 6.1 Solid waste Percentage in the campus.**

### Bio-degradable and Non-degradable waste materials Management Practice

For the purpose of segregation of waste (Organic, recyclable, non-recyclable and e- waste) at source and collecting the same in 'Waste Bins' are placed at designated locations in the Kuvempu University Campus viz. Students hostels, Staff quarters, Department Laboratories, Canteen, Foot court, Guest House and common places. Estate department in the campus with the guidance of Director is taking responsible for the collection, segregation and transportation of waste materials generated in the campus. Biodegradable wastes are converted into organic compost for its reuse







Figure: 6.2 Solid waste Segregation

#### 6.4 Vermicomposting, Organic and Green manures

Natural or eco-friendly methods should be used to grow plants vigorously in the campus which could reduce the environmental pollution. Use of biofertilizers, organic manures (cow dung, vermicompost and plant wastes and litters) and green manures to grow healthy plants in the medicinal plant garden, kitchen garden and terrace garden should be ensured to keep the campus organic. The plant waste such as fallen leaves, stems, fruits, nuts, seeds and other plant parts should be used to make green manures. A concrete or ground level green manure production unit and vermicomposting units will help to convert all the plant and animal based wastes into green/organic manures (Dominguez *et al.*, 2019). This will be a healthy way of solid litter waste management in the campus.

Minimal use of chemical fertilizers as part of integrated nutrient management system is acceptable but nil use of chemical fertilizers is highly appreciable and also helps to keep the campus more of an organic ecosystem. The soil, air, water and sunlight are the four major natural resources any campus gets. Proper use and conservation of these resources are mandatory in green campus audit sites. vermicompost are extensively used in Kuvempu University for nursery plants. These practices are very well appreciated because all the leaf litter and bio waste produced in the campus is recycled as a rich vermicompost.

Department of Environmental Sciences of Kuvempu University has established a Vermicomposting unit in which all the degradable items such as leaf litters, vegetable wastes obtained from University hostels and canteen along with farm yard manure and dried cow dung manure are used to produce vermicompost. The solid wastes are collected from different places of the University campus and segregated based on bio-degradable and non-degradable materials subsequently subjected for recycling and degradation processes like composting materials. Suitable bio inoculants may be used to degrade the solid wastes effectively in the composting unit.

The quantity of solid waste generation were carried out in each department stored waste is collected. The results of the survey reveals various that type solid wastes generated

are as follows; paper waste-17%, organic waste-68%., plastic waste-3%, glass waste-5%, E-waste-2%, scrap waste – 5%, The organic waste includes waste generated from the kitchen of boys and girls hostels, canteen and waste from the gardens surrounding various buildings. The same is used in generating vermicompost manure as “wealth from waste”. But at currently vermicomposting method is not working. But daily sweepers clean the each department and street collect the waste some of the waste like papers, leaf litters are waste are burned without any knowledge and other wastes are stored and send it to the solid waste collected vehicles finally all the collected solid waste are disposed. The organic waste production is high but not completely utilized it is one of the draw back. Improper solid waste management, worker not segregated the waste they are mixing both plastic and papers wastes simply dumping in the selected dumping site.

The response of the questionnaire indicated that 44% of the university departments / sections segregate the organic waste and 28% of the employees and students prefer reuse rather than recycling the waste. Above 30% of the various departments and sections in the university reuse the metal scrap and 40% of the metal scrap is segregate after its discard from use.



Fig 6.3



## 6.5 Biomedical Waste

The Ministry of Environment, Forest and Climate Change, Government of India has notified the Bio-Medical Waste Management Rules, 2016. As per the rules, bio- medical waste means any waste, which is generated during diagnosis, treatment or immunization of human beings or animals or research activities.

In Kuvempu University, Health centre generate biomedical waste and stored in respective color coded bins. Biomedical wastes are often incinerated to destroy pathogens and sharps efficiently. Autoclave methods are used to kill the infectious organisms by means of high heat, steam and pressure.



Fig 6.4

### Existing Solid waste management practices.

1. Collection and segregation of daily producing solid waste and transporting at processing site
2. Leaf litter waste collection and transportation by using vehicle
3. Onsite collection in each department by placing dust bins.
4. Dust bins are arranged in roadside and department wise for proper segregation and collection
5. Incineration unit is present near Health centre
6. Vermicompost unit and waste segregation constructed for composting of biodegradable waste.

### 6.6 Best management practices initiated

Kuvempu University has Adopted Susthira and Green campus program. The concept of this program mainly not to use plastics in the campus and displayed a slogan ‘Plastic free campus’ in places like canteen, hostel dining halls, seminar halls, corridors, etc. to the students, parents and public. The department of Environmental science insisted all the department to use Susthira vessels (Steel cups and Bottles) instead of plastic and other materials procured from other sources for routine programs conducting in the departments. On the other hand Eco-cycles initiated from the department of Environmental science that students can make use these cycles for moving around the campus. Besides we insisted surrounding people use eco-friendly bags made from organic materials like plant fibres which are easily decomposable in nature.



Fig 6.5

### 6.7 Water Quality Assessment

Water quality refers to the chemical, physical, biological, radiological characteristics of water. It is a measures of the condition of water relative to the requirements of one or more biotic species and or to any human need or purpose.

The safe portable water is absolutely essential for healthy living. Water quality plays important role for all living beings. The quality of surface water within a region is governed by both natural processes such as precipitation rate, weathering processes, soil erosion & anthropogenic effects such as urban, industrial & agricultural activities & the human exploitation of water resources (Jarvie et al.1998).



The water audit for the campus was conducted on the basis of available storage and consumption pattern. The consumption of water was estimated through random sample survey and user habits of both students and the employees. Various user were considered from personal hygiene to use in laboratories and gardens. The daily water requirement was calculated based upon inferential data derived through estimated use and daily average number of users. The averaged values for each type of use were obtained through survey based on questionnaire.

A water audit's an accounting of all the water in a water system resulting in a quantified understanding of the integrity of the water system and its operation. It is the first step in formulating an economically sound plan to address water shortage. Water audit is most effective tool for water management. With the help of water audit, we identify and quantify what steps can be taken to reduces water use and losses. Water audit and its analysis which can solve not only water related problem but also saves precious resources and public money. Water Audit is related to problems of shortage, leakages and losses. It provides a rational, scientific framework that categorizes all water use in your system. Just as business routine, bank prepares statement of debits and credits for their customers and provides a statement of money, which is flowing into and out of accounts. The water audit display how much quantity of water flows into and out of the distribution system and to the customer. Yet, as essential and routine as financial audit are to the world of commerce, water audit have been surprisingly uncommon in public water supply throughout the world.

#### **Water sources utilized:**

Students, staff and residential quarters use large quantity of water for various purposes, separate engineering section maintains the water supply. The main source of raw water drawing is from Bhadra reservoir.

#### **Water requirement and Availability**

Water is used to meet the following basic consumptive requirements

1. Drinking water supply
2. Laboratory use
3. Hostels and residences daily basic requirement
4. Construction
5. Gardening.

#### **Methodology**

Water Sample were collected at 5 selected sites and transported to the laboratory for further analysis All the physico-chemical parameters were analyzed The values were expressed in mg/L.

1. Physical parameters such as -Colour and Turbidity
2. Chemical parameters-PH, TDS, DO, BOD, Alkalinity, Total Harness, Calcium Hardness, Magnesium Hardness, Chloride, analysed following the standard procedure of APHA,(2017)

## RESULTS

Water consumption and quality assessment study was carried out for all the buildings of the university having water supply connection and storage facility. The daily water requirement was estimated and is presented in Table 1. These estimates are based on the user habits derived through questionnaire and sample survey.

The water requirement with reference to consumption of hostels was found to be maximum (70,000 Litres /day) which has the maximum number of users among all the other buildings. Although the Examination building and Rambhapuri Degree College of the University has fairly large number of users, the users are non-residents hence differ in their usage. Prasaraanga building has very less water requirement. The water storage based on the storage tank is found to be sufficient to the requirement for all the buildings in the campus. There is no dead storage. The important water source for campus is Bhadra river backwater. The water from channel stored in jack well. From this jack well using 35HP pump, water is lifted to water treatment sector. Daily two time's water is lifted from jack well. Then after treatment, water is supplied to all the buildings of the campus. The other water sources of campus are 5 bore wells and 1 well. Planning of water supply schedule based on daily requirement will ensure saving of electricity and water.

**Table 6.3: Daily Water usage and leakage recorded in the Jnanasahyadri campus of Kuvempu University**

Name of Building	Daily water supply (Litres)	Daily water usage approx. (Litres)	Daily water leakages overall Approx (Litres)
School of Physical Science	11100	8000	5000
School of Earth Science	3700	2000	
MCA Block	7400	7000	
Bioscience complexes	18500	15000	
Arts building	18500	14000	
Hostel	74000	70000	
Distance Education	18500	16000	
Library	7400	7000	
Physical education hostel(Indoor)	11100	10000	
Prasaranga	1850	1000	
Centenary building	18500	15000	
MBA/Commerce	11100	10500	
Garden	25900	25900	
Rambhapuri degree college	29600	25000	
Quarters	29600	29500	
Others	37000	37000	
	<b>323750</b>	<b>292900</b>	



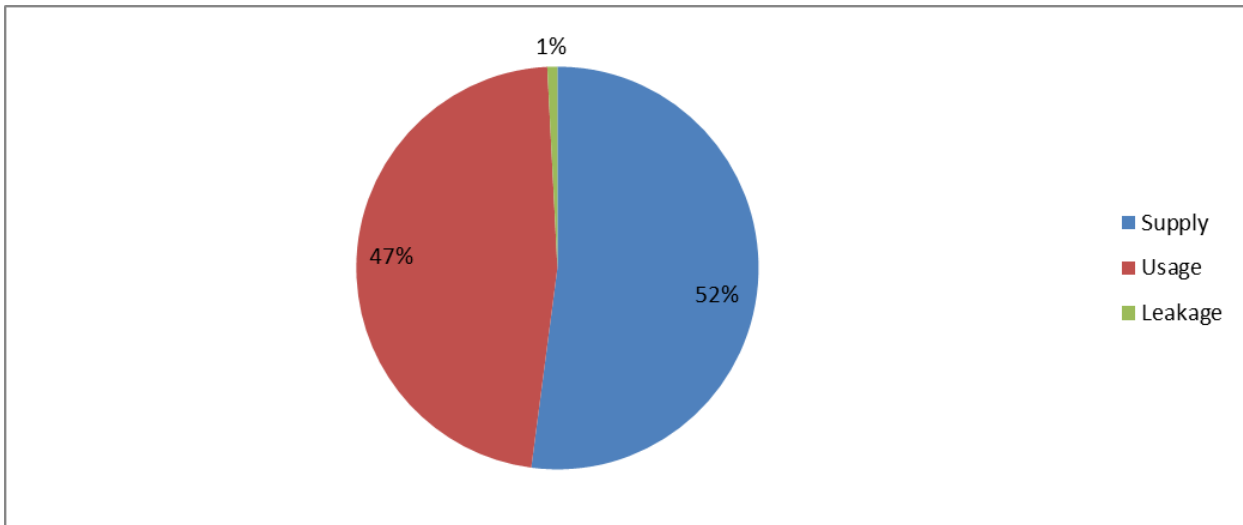


Fig 6.6

**Fig 6.6: Percentage of daily water supply, approximate usage and leakages**

In addition to drawing water supply from Bhadra river. Rain water harvesting system were adopted present water unit located behind the centenary building and second unit is near guest house. Tank capacity is around 2000 L and 10000 L respectively. The water collected is used for gardens in the campus.

**6.8 Water Treatment Unit**

In the campus area, treating raw water by conventional water treatment method (Fig3.8). Treatment methods involves primary and secondary treatment. The main objective of the treatment is to removal of contaminants from raw water to supply water that is pure enough for human consumption without any short term or long term risk of any adverse health effects. Substances that are removed during the process of drinking water treatment include suspended solids, bacteria, algae, viruses, fungi. The processes involved in removing the contaminants include physical processes such as settling and filtration, chemical processes such as disinfection and coagulation and biological processes such as slow sand filtration. Measures taken to ensure water quality not only relate to the treatment of the water, but to its conveyance and distribution after treatment. It is therefore common practice to keep residual disinfectants in the treated water to kill bacteriological contamination during distribution. Water pumped from jack well subjected to treatment and then from the water treatment department, treated water supply to the various buildings in the campus. Water stored in tanks and it is subjected to usage.

**Figure 6.7: water treatment chambers.**



**Aeration chamber**

**Sedimentation tank**

**Table 6.4 : Water samples collected at different sites in the campus.**

SI No.	Sample Stations	Sampling areas
1	S1	Drinking water treatment Unit
2	S2	University Canteen
3	S3	Chemical Sciences Block RO+UV Filter
4	S4	Tap Water
5	S5	University Boys PG Hostel

**Table 6.5: BIS Drinking water Quality Standards**

Sl. No.	Parameters	BIS Standard	
		Permissible Limit	Maximum Limit
1	pH	6.5 to 8.5	No Relaxation
2	TDS (mg/l)	500	2000
3	Hardness (as CaCO <sub>3</sub> ) (mg/l)	200	600
4	Alkalinity (as CaCO <sub>3</sub> ) (mg/l)	200	600
5	Magnesium	30	100
6	Calcium	75	200
7	Chloride (mg/l)	250	1000
8	Dissolved oxygen	6.5	8

**Fig:6.6 Physico-chemical Values Recorded in different water samples collected at different locations**

All parameters are in mg/L .except pH.

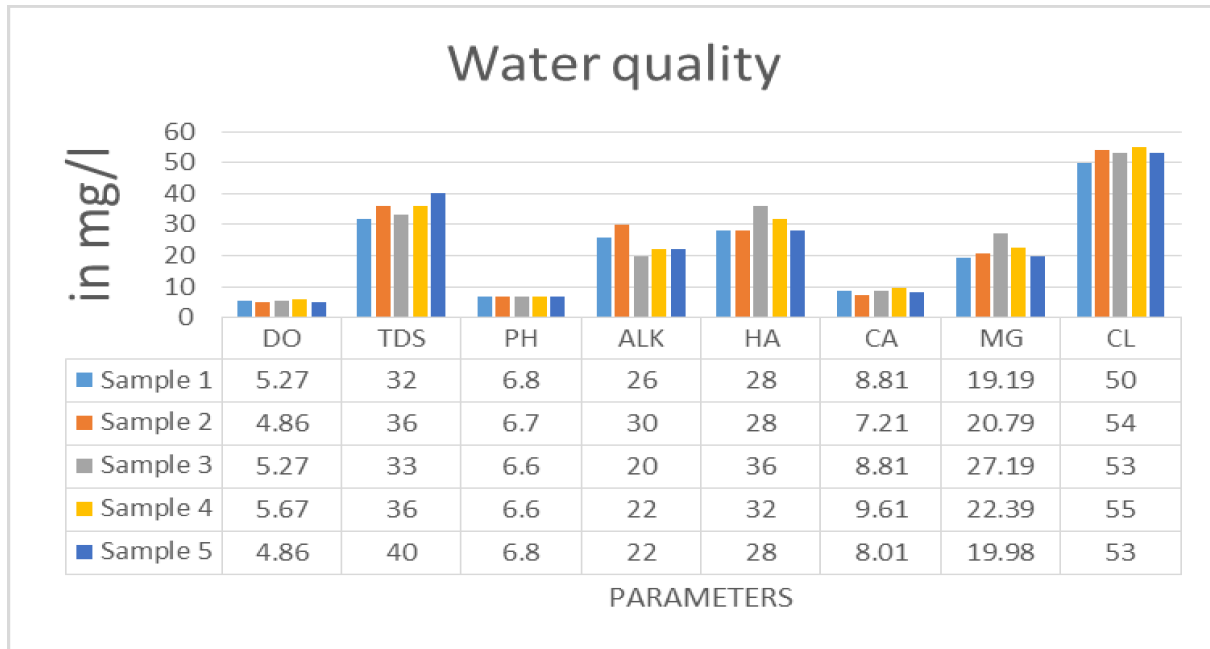


Fig 6.7

Water quality assessment was carried out by collecting water samples across the campus. The results of the study reveals that most of the physico-chemical parameters shows within the permissible limit compared with BIS standards. However during rainy season total dissolved solids may be slightly high due to run off of water reach to the riverine system. Which carries soil particles and it is difficult to remove in the treatment process. Slightly muddy colour may be observed during rainy season. Proper cleaning of overhead tanks and water stored tanks need to be properly maintained.

**Fig:6.8 Drinking water purifiers Installed at different Departments**





Water quality testing in the laboratory





## Chapter - 7

# BIODIVERSITY

### 7.1 INTRODUCTION

India being a mega diversity centre harbours 4,780 species of plants, 259 species of reptiles, 146 species of Amphibians, 528 species of birds and 140 species of mammals (Biodiversity Hotspots Western Ghats and Srilanka) recently with the increased consciousness for Biodiversity census and monitoring many new species are discovered or re-described. Biodiversity is important because species and ecosystem provide the basis of human civilization. Mankind is dependent on other species for the maintenance of the biosphere and the supply of basic necessities like food, shelter, clothing, medicines and so, on. Human being couldn't survive without the crucial services that are provided by nature including stabilizing, climate protecting watersheds. Cycling essential elements such as Carbon, Nitrogen and Sulphur, protecting nurseries and breeding grounds for harvested species (Indian Forester, 2000) [1]. Conserving for these ecological pressures, protection of individual species is very important. Biodiversity has ethical, social and economical value though values are different to quantify. The contribution of biodiversity to the gross domestic product of various countries is increasingly realized today by the policy maker and therefore its values are being recognized and taken into consideration during the planning process. The value of biodiversity cannot be assessed as how far it can be utilized in term's money or material for human beings. It has to be remembered that, like human being all other living organisms have the right to live and have to play a big role in providing stability to the entire biosphere. Before the inception of the University in this landscape, the area was a hilly slope with some vegetation. After establishment, considerable secondary vegetation many tree species was established. The predominating vegetation is typically dry deciduous with considerable similarities with the wildlife sanctuary.

### 7.2 Methodology

Plant diversity study was undertaken to check and document the floral diversity in the campus. Ten localities were chosen based on the abundance of trees, herbs and shrubs. In the present study quadrat method was used for analyzing the vegetation. Analytical characters were obtained by square type quadrat method. 10m×10m quadrates were placed in each locality and counted the number of trees, shrubs, herbs. The standard method was followed for quadrat study (Pandey et al., 2002 and Michael Kail et al., 1973).

Frequency, dominance and Abundance of plants were calculated using the standard formulae followed by Misra (1968). Botanical description was interpreted using International Plant Name Index (IPNI) list. Plants were identified using various district floras such as Flora of Shimoga (Ramaswamy et al., 2001), Flora of Hassan (Saldahna., 1976), Flora of Mysore (Raghavendra and Razi., 1981), Flora of Davanagere (Manjunatha et al., 2004), Flora of Chikmagalur (Yoganarasihman et al., 1982)



Formula

$$\text{Frequency} = F\% = \frac{\text{Number of quadrat in which plant present}}{\text{Total number of quadrat studied}}$$

$$\text{Dominance} = D = \frac{\text{Total number of individual}}{\text{Total number of quadrat studied}}$$

$$\text{Abundance} = A = \frac{\text{Total number of individual}}{\text{Number of quadrat in which plant present}}$$

Bird species diversity study was conducted in and around campus during early hours and evening hours of the day for several months with seasonal intervals. In each day the diversity was recorded along with morphological characteristics and Photographs.

Reptiles, amphibians were documented by direct sighting. They were recorded along with photographs and morphological characteristics for further identification.

Mammals were recorded by direct sighting. Their pug marks, dung were taken into consideration in the documentation study.

### **7.3 RESULTS**

In the study the results reveals that field observation data indicates that total of 69 species of plants belonging to 28 different families. Of trees, 17 species of shrubs, 12 sp. of herbs, 8 sp. of reptiles, 5 sp. of amphibians, 73 sp of birds, 20 sp. of insects, were recorded.

The plant diversity shows the following families namely Fabaceae, Malvaceae, Apocynaceae, Asteraceae, Combretaceae, are dominated. In these Fabaceae topped the list with 11 Genus which includes total of 14 species followed by Malvaceae with 5 genus consisting of 8 species. Among the recorded quadrat information, tree species dominated around the study area with dry deciduous habitat. Plants such as *Terminalia paniculata*, *Terminalia tomentosa*, *Xylocarpus* species are top canopy trees present in abundant number. In the ground layer *Stachytarpheta indica* (L.) Vahl similarly other species were also recorded in which some of them are woody and economically important plants. In addition to this, individual species were counted, *Terminalia paniculata* shows highest in number followed by *Santalum album* species, but the other species are sparsely distributed. Frequency, density and abundance of floral distribution were calculated, it shows 10-80% of frequency, density 0.1-4.8 and abundance of *Terminalia* species shows 48 and number of regeneration in the campus. Similarly herbs are more in number compared to shrubs climbers. Further abundance of trees, shrubs, herbs also recorded in the campus. Species distribution of insects, reptiles, birds and Mammals group were identified and table no 10 reveals the list. Insects were found to dominate. A large variety of insects including some of the spectacular *Butterflies* were documented during our study. However 9 species of reptiles and 12 species amphibians were recorded. Among reptiles, garden lizard, rock lizard and tree lizards are commonly distributed. Similarly tree frogs, toads are common in and around campus where as Bush frogs commonly seen during rainy seasons only. In the dry season they were almost inactive and prefer moist area near water bodies to reside and rarely encountered.



**Table 7.1: Species diversity, frequency, dominance and Abundance of individual species recorded.**

S.No	Plants Names	Family	F %	D	A
1	<i>Acacia auriculiformis</i> Benth.	Fabaceae	40	1.2	3.0
2	<i>Acacia pennata</i> (L.) Willd.	Fabaceae	40	1.0	2.5
3	<i>Asclepias curassavica</i> L.	Apocynaceae	40	4.4	11
4	<i>Albizia saman</i> (Jacq.) Merr.	Fabaceae	20	0.3	1.5
5	<i>Anogeissus latifolia</i> (Roxb. ex DC.) Wall. ex Bedd.	Combretaceae	80	2.8	3.55
6	<i>Bacopamonnieri</i> (L.) Wettst.	Plantaginaceae	80	3.4	4.25
7	<i>Bambusa bambos</i> (L.) Voss	Poaceae	10	0.1	1.0
8	<i>Bambusa vulgaris</i> Schrad.	Poaceae	30	0.7	2.33
9	<i>Bauhinia racemosa</i> Lam.	Fabaceae	20	0.5	2.5
10	<i>Bombax ceiba</i> L.	Malvaceae	20	0.5	2.5
11	<i>Butea monosperma</i> (Lam.) Taub.	Fabaceae	10	0.2	2.0
12	<i>Caesalpinia crista</i> L.	Fabaceae	30	0.5	1.66
13	<i>Careya arborea</i>	Lecythidaceae	70	2.0	2.8
14	<i>Cassia fistula</i> L.	Fabaceae	20	0.2	1.0
15	<i>Cardiospermum halicacabum</i> L.	Sapindaceae	10	0.1	1.0
16	<i>Chloris barbata</i> Sw.	Poaceae	40	1.6	4.0
17	<i>Chromolaena odorata</i> (L.) R.M. King & H. Rob.	Asteraceae	40	5.8	14.5
18	<i>Clerodendrum serratum</i> var. <i>dentatum</i> H. J. Lam	Lamiaceae	20	0.6	3.0
19	<i>Clerodendrum infortunatum</i> L.	Lamiaceae	20	0.6	3.0
20	<i>Canscora diffusa</i> (Vahl) R.Br. ex Roem. & Schult.	Gentianaceae	60	4.2	7.0
21	<i>Cyanotis cristata</i> (L.) D. Don	Commelinaceae	40	1.4	3.5
22	<i>Cyanthillium cinereum</i> (L.) H. Rob.	Asteraceae	80	5.4	6.75
23	<i>Dalbergia latifolia</i> Roxb.	Fabaceae	10	0.2	2.0
24	<i>Dalbergia sissoo</i> Roxb.	Fabaceae	10	0.1	1.0
25	<i>Dioscorea bulbifera</i> L.	Dioscoreaceae	40	1.4	3.5

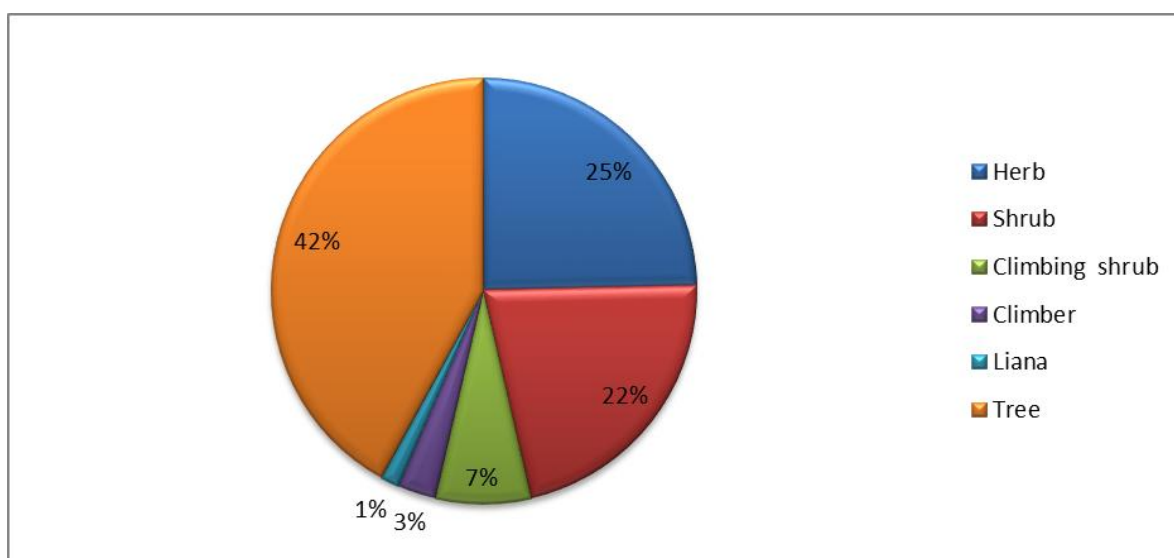
26	<i>Diospyros montana</i> Roxb.	Ebenaceae	50	1.2	2.44
27	<i>Elephantopus scaber</i> L.	Asteraceae	40	1.4	3.5
28	<i>Eucalyptus globules</i> Labill	Myrtaceae	10	2.0	20.0
29	<i>Ficus benghalensis</i> L.	Moraceae	20	0.3	1.5
30	<i>Ficus racemosa</i> L.	Moraceae	10	0.1	1.0
31	<i>Ficus arnottiana</i> (Miq.) Miq.	Moraceae	20	0.2	1.0
32	<i>Helicteres isora</i> L.	Malvaceae	40	2.0	5
33	<i>Hemidesmus indicus</i> (L.) R. Br. ex Schult.	Apocynaceae	20	0.2	1.0
34	<i>Holarrhenapubescens</i> Wall. ex G. Don	Apocynaceae	60	1.6	2.66
35	<i>Ipomoea carnea</i> Jacq.	Convolvulaceae	40	2.6	6.5
36	<i>Jasminum malabaricum</i> Wight	Oleaceae	60	2.4	4.0
37	<i>Lantana camara</i> var. <i>aculeata</i> (L.) Moldenke	Verbenaceae	20	2.0	10
38	<i>Mimosa pudica</i> L.	Fabaceae	60	8.2	13.6
39	<i>Mitragyna parvifolia</i> (Roxb.) Korth.	Rubiaceae	20	0.2	1.0
40	<i>Oroxylum indicum</i> (L.) Kurz	Bignoniaceae	60	3.2	5.33
41	<i>Oxalis corniculata</i> L.	Oxalidaceae	40	102	3.0
42	<i>Pentanema indicum</i> (L.) Ling	Asteraceae	60	3.4	5.6
43	<i>Phyllanthus amarus</i> Schumacher & Thonn.	Phyllanthaceae	40	7.6	19.0
44	<i>Phyllanthus emblica</i> L.	Phyllanthaceae	20	0.5	2.5
45	<i>Polygala arvensis</i> Willd.	Polygalaceae	80	5.8	7.25
46	<i>Pongamia pinnata</i> (L.) Pierre	Fabaceae	10	0.1	1.0
47	<i>Radermachera xylocarpa</i> (Roxb.) Roxb. ex K. Schum.	Bignoniaceae	10	0.2	2.0
48	<i>Santalum album</i> L.	Santalaceae	60	2.8	4.6
49	<i>Scoparia dulcis</i> L.	Plantaginaceae	30	0.5	1.66
50	<i>Semecarpus anacardium</i> L.f.	Anacardiaceae	30	0.5	1.66
51	<i>Sennasiamea</i> (Lam.) H.S. Irwin & Barneby.	Fabaceae	10	0.2	2
52	<i>Sennatoria</i> (L.) Roxb.	Fabaceae	40	3.0	7.5
53	<i>Sida acuta</i> Burm.f.	Malvaceae	40	3.0	7.5
54	<i>Sida cordata</i> (Burm.f.) Borssum	Malvaceae	40	9.4	23.5
55	<i>Sida cordifolia</i> L.	Malvaceae	20	2.6	13.0





56	<i>Sidarhombifolia</i> L.	Malvaceae	20	6.0	30.0
57	<i>Smilax zeylanica</i> L.	Smilacaceae	60	2.2	3.66
58	<i>Solanumrudepannum</i> Dunal	Solanaceae	20	0.4	2.0
59	<i>Spermacoearcticularis</i> L.f.	Rubiaceae	40	1.0	2.5
60	<i>Syzygiumcumini</i> (L.) Skeels	Myrtaceae	20	0.4	2.0
61	<i>Tecomastans</i> (L.) Juss. ex Kunth	Bignoniaceae	20	0.4	2.0
62	<i>Tectonagrandsis</i> L.f.	Lamiaceae	40	1.4	3.5
63	<i>Terminaliapaniculata</i> Roth	Combretaceae	80	4.8	6
64	<i>Terminaliatomentosa</i> Whight& Am.	Combretaceae	10	0.1	1
65	<i>Triumfettarhomboidea</i> Jacq.	Malvaceae	80	6.0	7.5
66	<i>Urenasinuata</i> L.	Malvaceae	60	2.0	3.3
67	<i>Vignaadenantha</i> (G.Mey.)Marechal& al.	Fabaceae	60	2.8	4.0
68	<i>Wrightiatinctoria</i> R.Br.	Apocynaceae	30	0.3	1.33
69	<i>Xyliaxylocarpa</i> (Roxb.) Taub.	Fabaceae	70	2.8	4.0

**Note:**F=Frequency, D=Density, A=Abundance, Do=Dominance



**Fig-7.1: - Habit distribution of flora recorded in the study area**

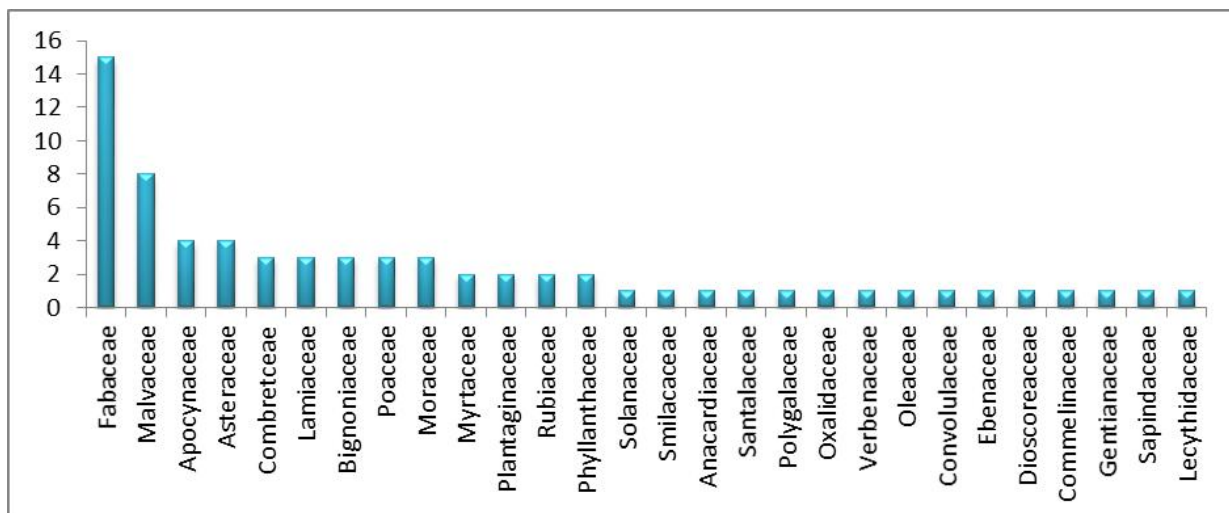


Fig-7.2:- Family wise distribution of flora recorded in the study area.

Table 7.2: Epiphytes documented in the study area.

Sl. No	Common name	Botanical name	Status
1	Common Fox-Tail Orchid	<i>Rhynchostylisretusa</i> (L.) Blume	Rare
2	Common Parasite	<i>Viscum</i> sp	Common
3	Long-leaved Mistletoe	<i>Dendrophthoefalcata</i> (L.f.) Ettingsh.	Common

Table-7.3: Ground Orchid recorded in the study area.

Terrestrial Orchid			
S. No	Common name	Botanical name	Status
1	Plantain Habenaria	<i>Habenariaplantaginea</i> Lindl.	Rare



**Table 7.4: List of Bird species recorded in the study area**

Sl. No	Common Name	Scientific name	Status of bird	Ecological Status
1	Great Stone Plover	<i>Esacus magnirostris</i>	R	Common
2	Common Coot	<i>Fulica atra</i>	R	Common
3	Open billed Stork	<i>Anastocesoscitans</i>	M	Rare
4	White ibis	<i>Threskiornis oethiopia</i>	M	Rare
5	Red Wattled Lapwings	<i>Venellus indicus</i>	R	Common
6	White throated Kingfisher	<i>Halcyon smyrnensis</i>	R	Common
7	Common Hill Pigeon	<i>Columba rupestris</i>	R	Common
8	Little Green Beaeater	<i>Merops orientalis</i>	R	Rare
9	Grey Headed Hill Myna	<i>Sturnus malabaricus</i>	R	Rare
10	Forest Long homed Owl	<i>Bubo bengalensis</i>	R	Rare
11	Wood Pigeon	<i>Columba palumbus</i>	R	Common
12	Scarlet minivet	<i>Pericrocotus flammeus</i>	R	Common
13	Indian Paradise Fly -catcher	<i>Terpsiphona paradisi</i>	M	Rare
14	Asian Koel	<i>Eudynamis scolopacea</i>	R	Common
15	Short-toed Snake Eagle	<i>Circeus gallicus</i>	R	Common
16	Common House Sparrow	<i>Passer domesticus</i>	R	Common
17	Brahminy Myna	<i>Sternus pagodarum</i>	R	Common
18	Indian Peafowl	<i>Pavocristatus</i>	R	Common
19	Greater Racket Tailed Drongo	<i>Dicrurus paradiseus</i>	R	Common
20	Black Drongo	<i>Dicrurus macrocercus</i>	R	Common
21	Indian Golden Oriole	<i>Oriolus kundoo</i>	R	Common
22	Chestnut headed bee eater	<i>Merops leschenaulti</i>	R	Common
23	Malabar Grey Hornbill	<i>Ocyroceros griseus</i>	R	Rare
24	Indian Grey Hornbill	<i>Ocyroceros birostris</i>	R	Rare
25	Jerdon's Leaf Bird	<i>Chloropsis jerdoni</i>	R	Rare



Sl. No	Common Name	Scientific name	Status of bird	Ecological Status
26	Indian Roller	<i>Coracias benghalensis</i>	R	Common
27	Purple rumped sunbird	<i>Leptocomazeylonica</i>	R	Common
28	Greenish Warbler	<i>Phylloscopus trochiloides</i>	M	Rare
29	Orange Headed Thrush	<i>Geokichlacitrine</i>	R	Rare
30	Indian Pitta	<i>Pitta brachyuran</i>	R	Common
31	Red Wiskered Bulbul	<i>Pycnonotus jocosus</i>	R	Common
32	Red Vented Bulbul	<i>Pycnonotus cafer</i>	R	Common
33	Rufoustreepie	<i>Dendroci ttagabunda</i>	R	Common
34	Indian Robin	<i>Copsychus fulicatus</i>	R	Common
35	Yellow Wagtail	<i>Motacilla flava</i>	M	Rare
36	Common Myna	<i>Acridotheres tristis</i>	R	Common
37	Jungle Myna	<i>Acridotheres fuscus</i>	R	Common
38	House Crow	<i>Corvus splendens</i>	R	Common
39	Bronze Winged Jacana	<i>Metopidius indicus</i>	R	Common
40	Small Blue Kingfisher	<i>Alcedo atthis</i>	R	Common
41	Spotted Dove	<i>Spilopelia chinensis</i>	R	Common
42	White Cheeked Barbet	<i>Psilopogon viridis</i>	R	Common
43	Grey Jungle Fowl	<i>Gallus sonneratii</i>	R	Common
44	Amur falcon	<i>Falco amurensis</i>	M	Rare
45	Common tailor bird	<i>Orthotomus sutorius</i>	R	Common
46	Black headed oriole	<i>Oriolus larvatus</i>	M	Rare
47	Commaniora	<i>Aegithina tiphia</i>	R	Common
48	Ashy crowned sparrow lark	<i>Eremopterix griseus</i>	R	Rare
49	Common hawk cuckoo	<i>Cuculus canorus</i>	R	Rare
50	Tickell's blue fly catcher	<i>Cyomistickellia</i>	R	Common





Sl. No	Common Name	Scientific name	Status of bird	Ecological Status
51	Yellow billed babbler	<i>Turdoides affinis</i>	R	Common
52	Asian palm swift	<i>Cypsiurus balasiensis</i>	R	Common
53	Red rumped swallow	<i>Cecropis daurica</i>	R	Common
54	Paddy field pipit	<i>Anthus rufulus Malay</i>	R	Common
55	Jerdon's bushlark	<i>Mirafra affinis</i>	R	Common
56	White browed wagtail	<i>Motacillamaderaspatensis</i>	R	Common
57	Oriental magpie robin	<i>Copsychus saularis</i>	R	Common
58	Greater flame back woodpecker	<i>Chrysocolaptes guttacristatus</i>	R	Common
59	Jungle crow	<i>Corvus macrorhynchos</i>	R	Common
60	Black kite	<i>Milvus migrans</i>	R	Common
61	Black winged kite	<i>Elanus axillaris</i>	R	Rare
62	Spotted owlet	<i>Athene brama</i>	R	Rare
63	Yellow wattled lapwing	<i>Vanellus malabaricus</i>	R	Rare
64	White breasted wterhen	<i>Amaurornis phoenicurus</i>	R	Common
65	Grey headed swamphen	<i>Porphyriopoliocephalus</i>	R	Common
66	Brahminy kite	<i>Haliastur Indus</i>	R	Common
67	Indian Peafowl	<i>Pavocristatus</i>	R	Common
68	Jungle babbler	<i>Turdoides striata</i>	R	Rare
69	Purple sunbird	<i>Aethopygasiparaja</i>	R	Common
70	Orange miniwet	<i>Pericrocotus spesiosus</i>	R	Common
71	Rose ringed parakeet	<i>Psittaculakrameri</i>	R	Common
72	Great coucal	<i>Centropussinensis</i>	R	Common
73	Shikra	<i>Accipites badius</i>	R	Common

R: Resident, M: Migratory

**Table 7.6: List of Amphibians recorded.**

Sl. No.	Common Name	Scientific Name	Family
1	Commo Indian Toad	<i>Dattaphrynusmelanostictus</i>	Bufonidae
2	Fungoid Frog	<i>Indosylviranamalabarica</i>	Ranidae
3	Common Indian Tree Frog	<i>Polypedatesmaculatus</i>	Rhacophoridae
4	Bicoloured Frog	<i>Clinotarsuscurtipes</i>	Ranidae
5	Beddom's leaping frog	<i>Indiranabeddomii</i>	Ranixalidae
6	Common Indian Tree Frog	<i>Polypedates maculates</i>	Rhacophoridae
7	Indian bull frog	<i>Hoplobatrachustigerinus</i>	Dicroglossidae
8	Reddish burrowing frog	<i>Zakeranarufescens</i>	Dicroglossidae
9	Fungoid frog	<i>Indosylviranamalabarica</i>	Ranidae
10	Sri Lankan Painted frog	<i>Kaloulataprobatica</i>	Microhylidae
11	Ornate Narrow-mouthed frog	<i>Microhyla ornate</i>	Microhylidae
12	Marbled ramanella	<i>Ramanellamarmorata</i>	Microhylidae
13	Common skittering frog	<i>Euphlyctiscyanophlyctis</i>	Dicroglossidae
14	Amboli bush frog	<i>Pseudophilautusamboli</i>	Rhacophoridae
15	Knob-handed Bush Frog	<i>Raorchestestuberohumerus</i>	Rhacophoridae
16	Wrinkled zakerana	<i>Zakeranacaperata</i>	Dicroglossidae

**Table 7.7: List of Mammals recorded.**

Sl No	Common Name	Scientific name	Family	Sign
1	Spotted Deer	<i>Axis axis</i>	Cervidae	Direct Observation/ photography/scat
2	Indian Muntjack	<i>Muntiacusmuntjak</i>	Cervidae	Photography/ scat
3	Mouse Deer	<i>Moschiloaindica</i>	Tragulidae	Scat
4	Indian Sambar	<i>Rusa unicolor</i>	Cervidae	Direct Observation
5	Wild Boar	<i>Sus scrofa</i>	Suidae	Direct Observation
6	Black Napped Hare	<i>Lapusnigricollisnigricollis</i>	Leporidae	Scat/ Direct observation
7	Indian Giant Squirrel	<i>Ratufaindicaindica</i>	Sciuridae	Direct Observation



Sl No	Common Name	Scientific name	Family	Sign
8	Indian Giant Fruit Bat	<i>Pteropus giganteus</i>	Pteropodidae	Photograph
9	Three Stripe Squirrel	<i>Funambulus palmarum</i>	Sciuridae	Photograph
10	Bonnet Macaque	<i>Macaca radiate</i>	Cercopithecidae	Photograph
11	Small Indian Civet	<i>Viverricullaindica</i>	Viverridae	Direct Observation
12	Brown Palm Civet	<i>Paradoxurus jerdoni</i>	Viverridae	Direct Observation
13	Pygmy White Throated Shrew	<i>Suncusetruscus</i>	Soricidae	Road Kill
14	Indian Leopard	<i>Panthera pardus</i>	Felidae	Pug Mark
15	Bengal Tiger	<i>Panthera tigris tigris</i>	Felidae	Scat

**Table 7.8: List of Insect species recorded.**

Sl. No	Common name	Scientific name
1	South hawker	<i>Aeshnacyanea</i> Muller
2	Great Green Bushcricket	<i>Tettigoniaviridissima</i> Linnaeus
3	Praying Mantis	<i>Mantis religiosa</i> Linnaeus
4	House Cricket	<i>Achetadomestica</i> Linnaeus
5	American Cockroach	<i>Blattaorientalis</i> Linnaeus
6	The Common Brown Mantid	<i>Idolomantisdiabolica</i> Saussure
7	Mound Termites	<i>Bellicositermesnatalensis</i>
8	Odonto Termites	<i>Odontotermesbadius</i>
9	Tiger Beetles	<i>Cicindelaoctonotata</i> Wiedemann
10	Common Tiger Beetles	<i>Cicindela galeata</i>
11	The Spanish Fly	<i>Lyttaversicatoria</i> Linnaeus
12	A Tsetse Fly	<i>Glossinassp</i>
13	Common Earwig	<i>Forficulaauricularia</i> Linnaeus
14	Honey Bees	<i>Apis mellifera</i> Linnaeus



Sl. No	Common name	Scientific name
15	Common Honey Bees	<i>Apis dorsata</i> Fabricius
16	Masked hunter	<i>Reduvius personatus</i> Linnaeus
17	Bag Worm moth	<i>Psychidae</i> Species
18	Antlion	<i>Myrmeleo</i> sp
19	Red Wood Ant	<i>Formica rufa</i> Linnaeus
20	Common Wasp	<i>Vespula vulgaris</i> Linnaeus
21	Red Wasp	<i>Vespa rufa</i> Linnaeus
22	Short Horned Grasshopper	<i>Acridid</i> sp
23	Long Horned Grasshopper	<i>Tettigonid</i> sp
24	Common Centipedes	<i>Scutigera coleoptrata</i>
25	Common Millipedes	<i>Polyxenus lagurus</i>
26	Black Scorpions	<i>Chactopsis insignis</i>
27	Common Wasp [Mound]	<i>Campanatus sericines</i>
28	Common Mole Cricket	<i>Scapteriscus acletus</i>

Table 7.9: List of Butterfly species recorded.

Sl. No	Common Name	Scientific Names	Wing Span [mm]	Ecological Status
1	Blue Pansy	<i>Precis orithya</i>	40-60	Common
2	Common Leopard	<i>Phalanta phalantha</i>	50-60	Common
3	Common Sailor	<i>Neptis hylas</i>	50-60	Common
4	Lemon Pansy	<i>Precis lemonia</i>	50-60	Common
5	Grey Pansy	<i>Junonia atlites</i>	55-65	Common
6	Peacock Pansy	<i>Junonia almana</i>	50-60	Common
7	Tawny Coster	<i>Acraea terpsicore</i>	50-65	Common
8	Crimson Rose	<i>Pachliopta aristolochia</i>	90-110	Common

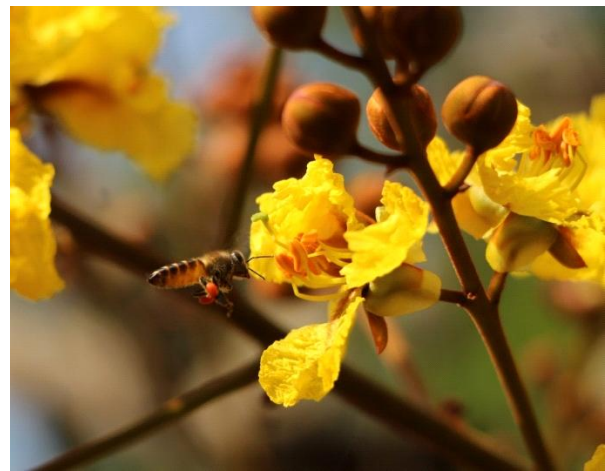




Sl. No	Common Name	Scientific Names	Wing Span [mm]	Ecological Status
9	Southern Birdwing	<i>Troidesminos</i>	140-190	Endemic
10	Tailed Jay	<i>Graphiumagamemnon</i>	85-100	Common
11	Common Crow	<i>Euploe core</i>	80-95	Rare
12	Blue Tiger	<i>Tirumalalimniacea</i>	90-100	Common
13	Striped Tiger	<i>Danausgenutia</i>	75-95	Common
14	Plain Tiger	<i>Danauschrysippus</i>	70-80	Common
15	Pea Blue	<i>Lampidesbeetius</i>	24-36	Common
16	Gram Blue	<i>Euchrysops snejus</i>	25-33	Very common
17	Common Pierrot	<i>Castalliusrosimon</i>	24-32	Rare
18	Common Grass Yellow	<i>Euremahecabe</i>	40-50	Very common
19	Common Emigrant	<i>CatopsillaPyranthe</i>	50-70	Common
20	Common Evening Brown	<i>Melanitiseda</i>	60-80	Rare
21	Grass Demon	<i>Udaspesfolus</i>	40-48	Very common



*Careya arborea* Roxb



*Peltophorum pterocarpum*



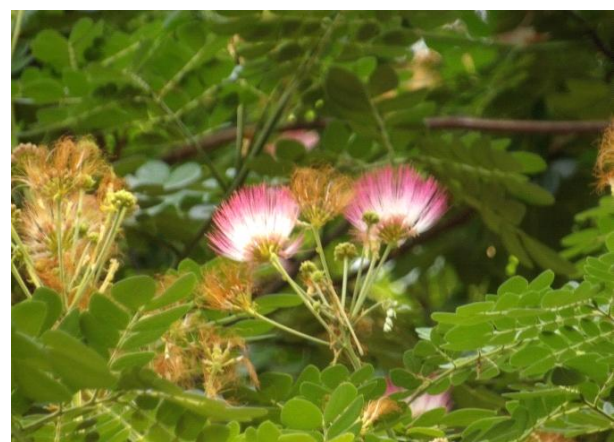
*Lagerstroemia lanceolata* Wall.



*Pongamia pinnata* (L.) Pierre



*Delonix regia* (Hook.) Raf.



*Albizia saman*



*Careya arborea* Roxb



*Delonix regia* (Hook.)Raf



*Radermachera xylocarpa*  
(Roxb.) Roxb. ex K.Schum



*Flacourtia indica* (Burm. f.) Merr.



*Gliricidia sepium* (Jacq.)Walp.



*Ficus benghalensis* L





*Saraca asoca* (Roxb.) Willd.



*Pongamia pinnata* (L.) Pierre



*Butea monosperma* (Lam.) Taubf



*Eucalyptus globulus* Labill.



*Artocarpus heterophyllus* Lam.




*Tamarindus indica* L.



**Birds observed in the campus**

		
Rufous treepie	Black hooded oriole	Red whiskered bulbul
		
Baya weaver	White throated kingfisher	Ashy prinia
		
Jungle babbler	Orange headed thrush	Orange minivet



		
Magpie robin	White cheeked barbet	Jordens leaf bird
		
Indian pitta	Blue caped rock thrush	Black hooded oriole
		
Indian Pond heron	spotted dove	Indian rock pigeon
		
Lesser yellowape	Malabar Pied hornbill	Ashy drongo



**Animals observed in the campus**



Spotted deer



Wild boar



Malabar giant squirrel



Bonnet macaque















Reptiles observed in the campus

		
Black headed snake	Green keelback	Banded kukri
		
Brown wine snake	Bronze Back Tree Snake	Spectacled cobra
		
Common Krait	Green Vine snake	Rat Snake
		
Russel's Viper	Wolf Snake	Indian garden lizard



**Amphibians observed in the campus**

		
Common cricket	Bicolored Malabar frog	Indian Burrowing frog
		
Red ant	Common sailor	Crimson rose
		
Locust	Tiger moth	Stink bug
		
Cicada	Huntsman spider	Oriental trunk spider



## Chapter –8

### Carbon sequestration

#### 8.1 INTRODUCTION

Global warming and associated climate change is negatively impacting humans and almost all ecosystems on the earth. The main cause of this change is rapid increase in greenhouse gases (GHG) especially CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O and their atmospheric concentration which has increased by 40%, 150% and 20% respectively, since 1750. Out of these GHG, CO<sub>2</sub> concentrations are increasing at the fastest observed decadal rate of change ( $2.0 \pm 0.1$  ppm y<sup>-1</sup> for 2002–2011) and is the largest single contributor to global warming (>70%) over 1750–2011. Reducing atmospheric concentration of CO<sub>2</sub> is the need of the hour for slowing down global warming and climate change. (Gupta & Bhatt, 2019).

The carbon dioxide level has been continuously increasing from a preindustrial period by 279 ppm through 393.84 ppm in 2012 to 395.15 ppm in August 2013 and the projected concentration of CO<sub>2</sub> in 2100 will range from 540 to 970 ppm and this will lead to increase in temperature by 1.8 to 4°C. A rise in the global mean temperature of 0.74°C has been recorded, and hence the climatologists are calling for an urgent action to curb global warming (Sundarapandian *et al.*, 2013).

The increasing carbon emission is of major concern, and addressed in Kyoto Protocol (Pragasan & Karthick, 2013) as the carbon content increases in the atmosphere it leads to cause global warming. The effects of global warming includes rise in temperature over land and sea surface, melting of glaciers and ice sheets, rise in sea level, ocean acidification, change in flowering and fruiting phenology of plants, shift in movement of fishes and animals. Further, new disastrous diseases have been outbreak due to global warming and climate change (Pragasan, 2016).

Carbon sequestration is a natural removal of carbon from atmosphere by plants and soil depositing it in the reservoir. It has also been defined as any of the several processes for removal of excess carbon dioxide (CO<sub>2</sub>) from atmosphere in an effort to moderate global warming. (Subramanian, *et al.*, 2017). It is the controlled disposal or storage of carbon compounds to prevent their release into the environment and it is sequestered by plants during photosynthesis process which is done by the leaves that helps in extracting the carbon from atmosphere. (Ramachandra *et al.*, 2013).

Carbon sequestration is the long term storage of carbon in oceans, soils, vegetation (especially forests) and ecological formations. Plants store carbon as long as they live, in terms of live biomass and here, trees perform important ecological function in sequestering carbon and reducing environmental pollution. Trees and their canopies provide a freezing effect on microclimate specifically by shading the ground surface and indirectly through transpiration. Global warming is undoubtedly one of the major environmental issues of this century. (Jithila *et al.*, 2018).

In the global carbon cycle, forests play an important role and in addition to that trees are also added and acting as carbon sink and source. During the process of photosynthesis,





CO<sub>2</sub> is converted into biomass, reducing carbon in the atmosphere and sequestering it in plant tissues above and below ground resulting in the growth of different parts. (Jithila *et al.*, 2018). As the CO<sub>2</sub> is taken by the leaves for the manufacture of food in the form of glucose, later on it gets converted to other forms of food materials i.e. starch, lignin, hemicellulose, amino acids, proteins etc, and is diverted to other tree components for storage. (Seema & Ramachandra, 2010). Carbon cycle described much attention is because carbon dioxide being the chief among the greenhouse gases, it has potential to influence the global climate pattern and it also has a relatively long residence time in the atmosphere. About 60% of the observed global climate change is attributable to this increasing carbon dioxide concentration in the atmosphere. (Kuimi & Jayakumar, 2012).

Carbon is found in all living organism and is the major building block for life on earth. Carbon exists in many forms, predominately as plant biomass, soil organic matter, and as the gas carbon dioxide (CO<sub>2</sub>) in the atmosphere and dissolved in sea water. There is a perpetual cycle of carbon being sequestered on the earth and emitted back into the atmosphere. It is argued that the accelerating accumulation of greenhouse gases, particularly carbon dioxide (CO<sub>2</sub>), in the atmosphere from human activities such as reducing amount of forest cover, increasing the amount and variety of chemicals released into the atmosphere, and intensive farming, is driving climate change. Some of these changes have decreased the capacity of the environment to support some life forms (Jaiswal *et al.*, 2014).

Biomass is the organic matter of trees and is the source of all other productivity in the forest and the biomass can be used to: (a) to determine energy fixation in forest, (b) to measure increment in forest yield, growth, or productivity and (c) assess changes in forest structure. (Devi & Yadava, 2015) and quantity of biomass in a forest determines the potential amount of the carbon that can be added to atmosphere or sequestered on the land with the intense focus on the increasing levels of atmospheric CO<sub>2</sub> and the potential for global climate change, there is an urgent need to assess the possibility of managing ecosystem to sequester and store carbon. (Borah *et al.*, 2013).

Carbon sequestration in growing forests is known to be a cost effective option for mitigation of global warming and global climatic change. India is sequestering more than 116 million tons of CO<sub>2</sub> per year which is equal to 32 million of carbon sequestration, contributes to reduce atmospheric carbon of the globe. (Marak & Khare, 2017). And this can be quantified to assess the magnitude and role of urban forests in relation to climate change. (Arya *et al.*, 2018). Although the extent and impact of increasing atmospheric CO<sub>2</sub> on climate change are unknown and relatively controversial, the Intergovernmental Panel on Climate Change (IPCC) reached an agreement in December, 1997, in Kyoto, Japan, to reduce greenhouse gas emissions. Under the Kyoto Protocol, the U.S. is requested to reduce net emissions of CO<sub>2</sub>, NH<sub>4</sub>, and N<sub>2</sub>O by 7 % below 1990 levels by 2008-2012. Sequestration of carbon could be counted as well as reductions in emissions (Williams *et al.*, 2000).

Developed countries can in turn count this reduction in the unit of CERs (certified emission reduction) against their defined targets. Unlike different other carbon credit generation activities, afforestation and reforestation (A/R) activity sequester CO<sub>2</sub> from atmosphere rather than reducing it at source. A/R is further important because it is generally



carried out through participatory approaches and results in upliftment of socioeconomic status of rural masses (Kale *et al.*, 2009).

In Nepal, forest and other wooded land together represent 44.74% of the total area of the country. The estimation of C-stock in this forest has recorded the highest. The present state of forest C-stock was only due to the introduction of community forestry in Nepal which started in the late 1970s, and has reversed the deforestation and forest degradation rates 9:10. Such forests act as a major source of C-sink storing about 20% of the total C-stock. (Bhatta *et al.*, 2018). Annual carbon sequestration is related to tree size and growth rates. According to the India State of Forest Report, 2017 total carbon stock in forests of India in 2017 is 7082 million tonnes. It has also reported that the annual increase in carbon stock is 19 million tons (Mishra & Prasad, 2018).

Managing land and vegetation to increase carbon storage can buy valuable time to address the ultimate challenge of reducing greenhouse gas emissions. (Nandini *et al.*, 2017). Anthropogenic activities, including combustion of fossil fuels and land-use change, contribute carbon dioxide (CO<sub>2</sub>) emissions to the global carbon (C) cycle. The atmospheric CO<sub>2</sub> reservoir is increasing annually (Wisniewskil *et al.*, 1993).

In the present climate change scenario, the international community is increasingly made aware of the fact that the alleviation of global warming cannot be achieved without the inclusion of forests in the mitigation plan. Reducing emissions from deforestation and forest degradation and enhancing forest carbon (REDD+) is a new initiative of the United Nations Framework Convention on Climate Change (UNFCCC). It is led by developing countries with rich forest cover and calls for economic incentives to reduce the emissions of greenhouse gases from deforestation and forest degradation in developing countries. (Padmakumar *et al.*, 2018).

The expanding level of CO<sub>2</sub> in the climate can be decreased by in two ways (i) controlling emissions and (ii) expanding capacity of carbon. The ecological point of view incorporates the expulsion of CO<sub>2</sub> from the environment, the change of soil quality and increment in biodiversity (Jaiswal *et al.*, 2018). Climate change due to increase in carbon emissions leads to great challenges for carbon mitigation strategies, besides socio-economic, biological problems and origin of new catastrophic diseases. (Pragasan, 2016).

Tropical forests play an important role in the global carbon (C) cycle and sequestering carbon dioxide to mitigate climate change. They are major sinks for atmospheric carbon, accounting for 50% of the above ground carbon in the vegetation (Hunter *et al.*, 2013). The increased emissions of greenhouse gases have negatively impact on the climate, through various ecological imbalances. Comparatively, Carbon dioxide is most potent green house gas. Perhaps, the only possible way to reduce the level of carbon dioxide in the atmosphere is to maintain rich plant diversity in forest area, agricultural fields, urban areas and vacant lands.

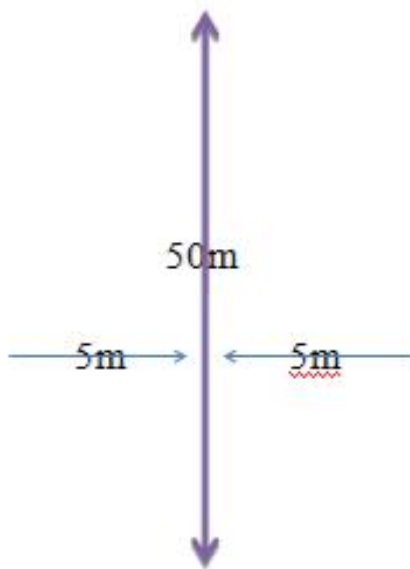
In recent years the role of urban trees and parks in reducing levels of carbon dioxide and other greenhouse gases in the atmosphere has been identified as an additional benefit. Urban trees can reduce the levels of atmospheric CO<sub>2</sub> through sequestration and reducing CO<sub>2</sub> emissions by conserving energy used for heating and cooling (Devi, 2017).



## 8.2 MATERIALS AND METHOD

Biomass estimation was carried out during summer season of 2019. A non-destructive method was followed on the basis of DBH (Diameter at breast height).

**Diameter at breast height (DBH):** The Line transect of 50m x 5m\*5m were used to record and locate the trees. Then DBH of each trees which are documented through line transect was measured using measuring tape (CRATER, 30m)



Above Ground Biomass (AGB), Below Ground Biomass (BGB) and Total Biomass (TB) of the different tree species were calculated using allometric equations developed by Brown *et al.*, (1989), MacDicken (1997), Takimoto *et al.*, (2008), Khan (2013) and Sundarapandian *et al.*, (2014) (Brown *et al.*, 1989; MacDicken, 1997; Takimoto *et al.*, 2008; Khan, 2013; Sundarapandian *et al.*, 2014).

## 8.3 RESULTS & DISCUSSIONS

A total of 5646 individuals of trees in study area were recorded during DBH measurements for Biomass (Total Carbon Stock) estimation. The trees in different areas of Kuvempu University campus show the total carbon stock of 1289.16 Mg·ha<sup>-1</sup>. Comparatively areas with diversified species of trees shows high amount of TCS. The major contributor (25%) of TCS in the study area is *Terminalia paniculata* Roth with 1455 individuals having 989.045 Mg·ha<sup>-1</sup> of TCS. The TCS of other dominant species *Annona reticulata* L, *Eucalyptus tereticornis* Sm., *Syzygium cumini* (L.) Skeels and *Santalum album* L. is 9.452 Mg·ha<sup>-1</sup>, 83.705 Mg·ha<sup>-1</sup>, 7.27 Mg·ha<sup>-1</sup> and 1.363 Mg·ha<sup>-1</sup> tons respectively but *Annona reticulata* L & *Eucalyptus tereticornis* Sm are the cultivated species which shows the importance of tree cultivation in mitigating carbon emissions. The wild species dominated the contribution to TCS with 1070.733 Mg·ha<sup>-1</sup> tons, whereas cultivated species shows 218.43 Mg·ha<sup>-1</sup> of TCS. The fast growing *Albizia saman* (Jacq.) Merr is cultivated as an avenue tree and contributed 2.802 Mg·ha<sup>-1</sup> tons of TCS with only 21 individuals. TCS recorded particularly in *Ficus benghalensis* L. is 1.042 Mg·ha<sup>-1</sup> tons with only 11 individuals because of the



higher DBH compared to other trees. The tree species below and above 150cm DBH contributes 4649.881 Mg·ha<sup>-1</sup> and 19.117 Mg·ha<sup>-1</sup> tons of TCS respectively.

In the recent past, the rise in the atmospheric concentration of carbon dioxide leading to global warming and climate change has attained immediate global concern. A few studies have been carried out so far prior to the urgent need for quantifying the forest carbon stock for better monitoring and management of the forest biomass carbon. Comparatively, carbon sequestration potential is higher in Kuvempu University than Bangalore University campus in southern India. The study of estimating carbon sequestration by trees in Bangalore University campus have come up with 200.931 tons/ha of carbon in 449.74 ha of campus area (Nandini *et al.*, 2017), where as in our study, the carbon stock is 987.9 tons/ha. The primary reason is the presence of undisturbed natural forest patch of Bhadra wildlife sanctuary with diverse tree vegetation along with planted fast growing avenue trees in the study area. The floristic diversity of Bhadra wildlife sanctuary (Krishnamurthy *et al.*, 2009 and 2010) as well as phenological studies (Nanda *et al.*, 2010; 2014) and campus floristic diversity are documented (Narayana *et al.*, 2017)

A study in Southern Western Ghats concluded that the dominant tree species in the study area have contributed 17% of carbon stock (Padmakumar *et al.*, 2018). In our study, the dominated *Terminalia paniculata* Roth contributed a total of 25% of carbon stock. This may be due to high number of individuals of dominant trees. If large number of dominant tree species is under matured (Low DBH), the less contribution to TCS, even though the species is dominant in the study area.

We found this from the present pilot study hence it makes sense that the varied carbon density among a few forest types or cultivated is mostly due to vegetation degradation rather than to the actual characteristics of the types. This may be attributed to the either temporary or permanent changes in structure, density (canopy closure, canopy quality, tree density, biomass density and fragmentation), and species composition, and may be due to deforestation. But to know the actual reason behind it we need some permanent plots not only to measure diversity of species like (mortality, natality and regeneration success) the carbon carrying capacity varies depending on the forest structure and type.

Forests are among the most productive terrestrial ecosystems and attractive for climate change mitigation (Nabuurs *et al.*, 2007). Exchange of C between forests and the atmosphere is being influenced by natural and anthropogenic disturbances. Understanding and quantifying the impacts of disturbances are prerequisites to selecting forest management options aimed at enhancing C sinks and reducing C sources, while maintaining other ecological, social, and economic benefits of the forest (Black, *et al.*, 2008) as disturbance was the primary mechanism that changes ecosystems from C sinks to sources based on Fluxnet synthesis (Baldocchi, 2008).

Greater development of the understory and small trees (dbhd<sup>></sup>30 cm) in forest is a very important component of aboveground biomass. Furthermore, these main groups will have great potential for sequestration in the future if the area is managed appropriately. As per the present study the above ground carbon storage of forest (4649.881 Mg·ha<sup>-1</sup>) which is higher than other forests in India (Ravindranath 2007). Compared to studies in neighbouring



countries, our results were fairly more to the natural forests in Indonesia (161.00–300.00 Mg·ha<sup>-1</sup>, Lasco 2002). Hence these kinds of carbon stock inventorying studies need long term observation for mitigation and policy interventions.

#### **8.4 CONCLUSION**

Carbon sequestration study is one of the most important area under discussion in recent years. It is also emerging as an essential method to understand the carbon induced climate change. Carbon capture and storage is one of the most effective and discussed methods of solving the global climate issue. However, there is no single feasible solution. In order to know the effects of climate change, the carbon capture and storage study is essential. In this connection, trees play a very important role in mitigating atmospheric carbon dioxide levels. So that there is no more carbon being released into the atmosphere within it effects to the global warming. Furthermore, organic methods of farming, afforestation are the most effective eco-friendly methods of restoring natural ecosystem that was existed before industrialization with less carbon load in the atmosphere.

The present study reveals that the university campus contains natural tree species diversity is rich with greater potential of carbon stock, as similar to the natural tropical dry forests. Additional research efforts are also needed to determine to what extent stand disturbance in the coming years and this base data will serve as major reference for future research in carbon density and diversity studies. Finally, the study concludes that diversified vegetation with higher DBH values indicate higher the load of carbon capture by removing atmospheric Carbon dioxide. Conservation of natural forest, as well as planting avenue trees can mitigate atmospheric carbon more potentially. Therefore, every institution can easily contribute to global CO<sub>2</sub> mitigation by planting diversified vegetations in their campus areas and even it supports biodiversity



## Chapter-09

### AIR ENVIRONMENT

#### 9.1 Auditing for Air Environment

Air pollution is basically the presence of foreign substances in air. Air pollution means the presence in the outdoor atmosphere of one or more contaminants, such as dust, -fumes, gas, mist, odor, smoke or vapor in quantities with characteristics and of durations such as to be injurious to human, plant, or animal life or to properly or which unreasonably interfere with the comfortable enjoyment of life and property". Engineers Joint Council (USA)

Since air pollution has been mainly caused due to rapid industrialization, some critics comment on air pollution as 'the price of industrialization. Air pollution caused by automobiles has been described as the 'disease of wealth'. Historians tell us that Los Angeles which in recent years has become a national symbol of comparison for excessive smog levels was known as the 'Valley of smokes' when the Spaniards first arrived there.

Increased air pollution causes greenhouse effect, acid rain, impaired health, reduced visibility, bring about vast economic losses and contribute to the general deterioration of both our cities and country side.

It is therefore a matter of great importance that engineers of all disciplines consciously incorporate in their designs sufficient constraints and safe guard to ensure that they do not contribute to atmospheric pollution. In addition, they must apply their ingenuity and problem solving abilities to eliminate air pollution where it exists and restoring the natural environment.

An inventory of air contaminants is a necessary first step towards control of air pollution. Air pollutants can be either natural or may be the result of various activities of man like industrial operations. The industrial contaminants can be either byproducts of external combustion like smoke, dust and sulphur oxides or byproducts of internal combustion like the reactions in petrol and diesel engines. Further, the emissions can be either primary pollutants or secondary pollutants. Vehicular transportation is the major cause for the air pollution. Most of the gases like carbon dioxide, sulphur dioxide etc., are released from the vehicular transportation.

Forest is the major sink for the most of the gases which is released from the industries and vehicular transportation.

**In the campus area** employees and students use two and four wheeler vehicles approximately 400-450 vehicles. In addition to this private and Government buses also move daily two times. Only during morning and evening hours heavy vehicles are passing inside the campus. Number of vehicles varied based on programs arranged in the campus. In the campus each building parking facilities is arranged an in the campus area they displayed board of speed limit 20 to 30 Km/h. During evening hours campus environment found to free from any noise. The noise level measures well within the standards. Similarly Air quality shows well within the standard limits.



### Recommendation

1. Burning of solid waste should be avoided and awareness to be given to the cleaning personnel's about the impacts of burning of solid wastes.
2. All the internal roads shall be asphalted to reduce dust emissions due to vehicular movement
3. Ambient air quality for SPM, RPM, SO<sub>2</sub>, NO<sub>x</sub>, CO and CO<sub>2</sub> shall be regularly monitored as per KSPCB norms



Fig 9.1: Parking shed near Arts Building



Fig 9.2: Barricade to control speed



Fig 9.3 direction Boards



**Fig: 9.4 Speed limit display Board**



**Fig. 9.5 : No parking Board**

### Public transport, Low emitting vehicles and Control of Car smokes

A smart method is to pick out public transportation as much as feasible without polluting the environment by way of driving a car or bike. It additionally often is cheaper, and it leaves much tear in personal automobile expenses. Public transportation cars together with buses reduce carbon emissions which greatly decreases the development of smog within the towns. This means that human beings have healthy air to respire. Comparing a bus travelling with seven people to one single person using a vehicle, it's been observed that buses are the most effective by producing 1/5 the quantity of carbon gas emissions compared to the findings of the car effects. This is a huge decrease in discharge of natural resources per person.

Public transportation is better for the surroundings which have been proven through research on emissions. Other than this, it also gives more benefits like less noise and traffic congestion. Whenever possible, try to take public transport in place of one's own vehicle. Fewer miles means approaching fewer emissions. University staff and students every day using their own vehicles (Cars and Bikes / Scooters) which accounted to be moderate in numbers. Some of the students and scholars are coming to the University using their own electric scooters and cars which is highly appreciated in view of making pollution free environment.

### Ventilation and Exhaust systems in Buildings

Ventilation is necessary in buildings to remove 'stale' air and replace it with 'fresh' air. This helps to moderate internal temperatures, reduce the accumulation of moisture, odours and other gases that can build up during occupied periods. In addition, it create air movement which improves the comfort of occupants. Mechanical (or 'forced') ventilation tends to be driven by exhaust fans to replace stable air with fresh air along with moderating the optimum temperature to the occupants. Natural ventilation is driven by 'natural' pressure differences from one part of the building to another. Internal partitions may block the air paths, hence the creation of draughts adjacent to openings for more flow of air circulation. Natural ventilation can be wind driven, or buoyancy driven. If air quality is poor, nature ventilation by means of





opening windows may be adopted to use in the building. It may also be useful to reduce the noise level to a greater extent. It is recorded that Kuvempu University has a large number of ventilators for effective air circulation.

## **9.2 Auditing for Carbon Footprint at Educational Institutions**

Carbon footprint means of measuring and recording the GHG emissions of an organization or building within a defined system boundary. The carbon footprint is also an important component of the Ecological Footprint, since it is one competing demand for biologically productive space. Carbon emissions from burning fossil fuel accumulate in the atmosphere if there is not enough bio capacity dedicated to absorb these emissions (Huang *et al.*, 2017). Commutation of stakeholders has an impact on the environment through the emission of greenhouse gases into the atmosphere consequent to burning of fossil fuels (such as petrol, diesel and kerosene). The most common greenhouse gases are carbon dioxide, water vapor, methane, nitrous oxide and ozone of all the greenhouse gases, carbon dioxide is the most prominent greenhouse gas, comprising 402 ppm of the Earth's atmosphere. The release of carbon dioxide gas into the Earth's atmosphere through human activities is commonly known as carbon emissions.

An important aspect of doing an audit is to be able to measure your impact so that we can determine better ways to manage the impact. In addition to the water, waste, energy and biodiversity audits we can also determine what our carbon footprint is, based on the amount of carbon emissions created. One aspect is to consider the distance and method travelled between home and organization every day. It undertakes the measure of bulk of carbon dioxide equivalents exhaled by the organization through which the carbon accounting is done (Sovacool and Brown, 2010). It is necessary to know how much the organization is contributing towards sustainable development. It is therefore essential that any environmentally responsible institution examine its carbon footprint.

The observation on carbon footprint due to electricity usage per year at Kuvempu University showed 1161.31 metric ton. It is calculated based on CO<sub>2</sub> emission from electricity per year in kWh/1000 units. The recorded value of carbon footprint due to car usage per year is 73 metric tons. The Carbon footprint due to Motorcycles usage per year is 109.5 metric tons which is derived based on the number of motorcycle entering into the University multiplied with the approximate travel distance of a vehicle each day inside campus (in kilometres). The overall results indicated that total carbon emission at Kuvempu University per year is 179.5 metric tons which is the sum of the carbon emission from electricity plus transportation (bus, car, motorcycle) per year. The carbon footprint

### **Calculation of Carbon Footprint per Year at Kuvempu University**

The Carbon footprint calculation can be conducted based on the stage of calculation as stated in [www.carbonfootprint.com](http://www.carbonfootprint.com), which is the sum of electricity usage per year and transportation (shuttle bus services and Car and Motorcycles) per year.



**a. Electricity usage per year**

The CO<sub>2</sub> emission from electricity  
= (electricity usage per year in kWh/1000) x 0.84  
= (1382514 kWh/1000) x 0.84  
= 1161.31 metric tons

*Notes:*

Electricity usage per year= 1161.31 kWh  
0.84 is the coefficient to convert kWh to metric tons.

**b. Transportation per year (Car)**

= (Number of cars entering the University x 2 x approximate travel distance of a vehicle each day inside campus only (in kilometers) x 365/100) x 0.02  
= [(100 x 2 x 7 x 365)/100] x 0.02  
= 73 metric tons

*Notes:*

365 is the number of working days per year is the coefficient to calculate the emission in metric tons per 100 km car

**c. Transportation per year (Motorcycles)**

= (Number of motorcycle entering the University x 2 x approximate travel distance of a vehicle each day inside campus only (in kilometres) x 365/100) x 0.01  
= [(300 x 2 x 5 x 365)/100] x 0.01  
= 109.5 metric tons

*Notes:*

365 is the number of working days per year. 0.01 is the coefficient to calculate the emission in metric tons per 100 km for motorcycles

**9.3 Auditing for Water Management at Kuvempu University campus**

Water is a natural resource which is an essential resource for all life in the planet. It is observed that on earth only three percent of it is fresh and two-thirds of the freshwater is locked up in ice caps and glaciers. Of the remaining one percent, a fifth is in remote, inaccessible areas and much seasonal rainfall in monsoonal deluges and floods cannot easily be used (Senior and Brightman, 2015). At present only about 0.08 percent of all the world's fresh water is exploited by mankind in ever increasing demand for sanitation, drinking, manufacturing, leisure and agriculture. All living matters depend on common thing (i.e) water. Water management is important since it helps determine future irrigation expectations. It is the management of water resources under set policies and regulations. Water, once an abundant natural resource, is becoming a more valuable commodity due to droughts and overuse. While freely available in many natural environments, in human settlements potable (drinkable) water is less readily available. We need to use water wisely to ensure that drinkable water is available for all, now and in the future. A small drip from a leaky tap can waste more



than 180 liters of water to a day that is a lot of water to waste - Enough to flush the toilet eight times! Aquifer depletion and water contamination are taking place at unprecedented rates in a sustainable manner.

## 9.4 Waste water Collection and Management at Kuvempu University Campus

### Water Management Activities

It is therefore essential that any environmentally responsible institution should examine its water use practices. Water auditing is conducted for the evaluation of facilities of raw water intake and determining the facilities for water treatment and reuse. The concerned auditor investigates the relevant method that can be adopted and implemented to balance the demand and supply of water (Senior and Brightman, 2015). Kuvempu University is taking enough attempt to manage wastewater that are coming out from various Department laboratories, hostels and canteens. In general, water management activities are very important in terms of conserving water and its resources for future generations which in turn useful to reduce the land contamination.

### Physical Appearance and Overall Ambience on Water Conservation Water Conservation

1. Adequacy of Water
2. Plumbing adequacy of water taps and Sanitary fixtures
3. Water Efficient Toilets
4. Dedicated Staff for Water Maintenance
5. Dedicated Staff for Water Inspection
6. Periodic mending and repairs of leaks in taps and pipes
7. Two levels of flushing in all the toilets
8. Planting indigenous variety of plants and less water requiring plants
9. Organising water conservation workshops to the faculty and students on the campus

### Rainwater Harvesting

1. Installation of rain gauge and rain recording system
2. Steps taken for implementing rainwater harvesting inside the campus
3. Digging rainwater harvesting pits on the campus
4. Educating on Water Harvesting through workshops/seminars



Fig 8.7



### **Renovation of Traditional and other Water Bodies/Tanks**

1. Groundwater recharge & Maintenance of water balance
2. Reuse and recharge structures & Preservation of water bodies
3. Watershed development & Biomass management
4. Land management & Water management

### **Other Interventions**

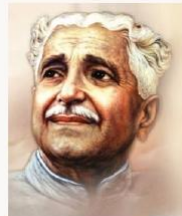
1. Technological and sociological interventions
2. Planning, Preparing and Reporting Mechanism
3. Appropriate display, publicity, sharing knowledge
4. Treating personnel/workers with respect and looking into their welfare
5. Adhering to Reporting Mechanisms
6. Designated Officer Monitoring and taking Corrective measures for Water Management

### **Leakages**

1. Leakage represents the largest share of wastage as well as unauthorized water use.
2. Each source meter needs to be reviewed for accuracy, either by reviewing available meter test results or retesting the meter.
3. System valves need to be checked periodically for malfunction. For instance, altitude control valves on storage tanks might be broken or set improperly, allowing the tank to overflow. These valves need periodic inspection, more so when there is observed leakage or overflow
4. Pressure relief valves which are set too low might cause spill when pressures reach the high range. These pressure relief valves need to be calibrated accordingly
5. When problems are discovered during routine inspections, possible water losses need to be estimated and corrective action can be taken up immediately.

### **9.5 Environmental Programmes Organized**

The Environmental Programmes promotes environmental management. Environmental Management always Initiatives awareness activities are conducted by the department of Environmental Science, Bio Science complex, Kuvempu University. Every year seminar, conference, workshops, environmental day to promote nature conservation and awareness. Every year June 5<sup>th</sup> environmental awareness programmes are conducted similarly drawing competition, essay writing are arranged with the theme of NATURE for school children, in order to know about the knowledge of wildlife, management, forest conservation etc.. These types of environmental programmes play a vital role in Universities to develop a sense of Environmental concern among the students. Along with the other programmes every year Environmental day programmes were organized by planting saplings around the campus. Other environmental concern activities such as Plastic Free Campus, Swacha Bharath Abhiyan, Wildlife lovers meet, National Seminars, Exhibitions, Medicinal Plant Garden, Vermi-composting and related awareness programs was regularly conducted.



**KUVEMPU UNIVERSITY**

Department of PG Studies and Research in Environmental Science  
Kuvempu University, Jnana Sahyadri, Shankaraghatta - 577 451

*One Day National Seminar on*  
**GREEN SOLUTIONS**  
*Exploring pollution management strategies*



**A REPORT**



**Prof. Yogendra K.**  
Chairman

**Faculty, Staff, Research Scholars  
& Students**





## WORLD ENVIRONMENT DAY - 2023



### Event Overview:

On June 5th, 2023, the Department of Environmental Science celebrated World Environment Day with dedication and commitment to environmental conservation. The event comprised various activities, including tree plantation and an exhibition showcasing zero-emission vehicles. Dignitaries and esteemed guests graced the occasion, emphasizing the importance of environmental protection and sustainable practices.

### Inauguration:

The inaugural ceremony was graced by distinguished guests, including the esteemed Chief Guest, Sri S. Rudregowda, Member of the Legislative Council and Industrialist from Shimoga, and Prof. B. P. Veerabhadrappe, the Vice-Chancellor, who presided over the proceedings. Prof. Geetha C, the Registrar, was also in attendance. Sri Srinath Nagaragadde and Sri M. Shankar, Former Municipal President of Shimoga and Environmental activist from Shimoga, added to the significance of the event with their presence. Prof. Yogendra K, Chairman, initiated the program with a preamble speech elucidating the significance and historical context of World Environment Day. Prof. Hina Kousar and Prof. S.V. Krishnamurthy warmly welcomed the delegates, and Dr. Basvarajappa S.H introduced the esteemed guests.

### Inaugural Address:

During the inauguration ceremony, Sri S. Rudregowda, a prominent Member of the Legislative Council and an esteemed Industrialist, delivered a compelling address emphasizing the critical importance of environmental protection for the well-being of future generations. He passionately advocated for the active engagement of young individuals in conservation endeavors, recognizing their pivotal role in shaping the future of our planet. Sri Rudregowda's impassioned plea resonated with the audience, inspiring a sense of responsibility towards safeguarding the environment for posterity.

Following Sri Rudregowda's stirring remarks, the Vice-Chancellor, in his presidential address, echoed similar sentiments, amplifying the urgency of adopting sustainable practices in our contemporary world. With a solemn tone, he emphasized the pressing need to embrace eco-friendly approaches, recognizing them as essential pathways towards ensuring a harmonious coexistence with nature. Drawing attention to the inherent value of nature's gifts, the Vice-Chancellor underscored the profound responsibility incumbent upon society to preserve and protect our environment for current and future generations.

### Special Lecture:

One of the standout moments of the event was the







special lecture delivered by Sri Srinath Nagaragadde, a highly respected educationist from Shimoga. His expertise and reputation lent significant weight to the topic he addressed, which explored the fascinating connection between social media and environmental conservation. He explained how social media, with its extensive reach and influence, can serve as a potent tool in the fight for environmental preservation. By harnessing the potential of digital platforms, individuals and organizations can amplify their voices and disseminate awareness about pressing environmental issues to a global audience.

Furthermore, Sri Srinath Nagaragadde elucidated various strategies and tactics that can be employed to effectively leverage social media for environmental advocacy. From crafting compelling content to engaging with online communities, he emphasized the importance of adopting innovative approaches to captivate and inspire action among digital audiences.

Additionally, the lecture underscored the role of social media in fostering environmental stewardship among individuals and communities. Sri Nagaragadde illustrated how online platforms can facilitate collaboration, knowledge sharing, and collective action, thereby empowering people to become proactive agents of change within their respective spheres of influence. Establishment of Gold medals:

As a token of appreciation for academic excellence and dedication to environmental causes, Sri M. Shankar, President of Hoysala Cooperative Society in Shimoga, made a generous contribution of Rs. One Lakh towards the establishment of a gold medal. This gold medal, named "PARISARA," will be presented annually at the convocation ceremony to the highest-achieving Postgraduate student in Environmental Science.

Additionally, Sri S. Rudregowda announced the creation of another gold medal to be awarded to the highest-achieving student. These initiatives serve to incentivize academic excellence and promote environmental awareness among students.

#### **End note:**

The celebration of World Environment Day 2023 was a resounding success, marked by insightful discussions, practical initiatives, and generous gestures of support. The event served as a reminder of our collective responsibility towards safeguarding the environment and inspired a renewed commitment to sustainable living. Prof. J. Narayana extended heartfelt gratitude to all participants, concluding the event on a note of optimism and determination.

The World Environment Day celebration underscored the department's commitment to environmental advocacy and sustainable development. It highlighted the importance of collective action and innovation in addressing pressing environmental challenges, leaving a lasting impact on all participants and stakeholders.







### **National Seminar on "Green Solutions: Exploring Pollution Management Strategies"**

The inaugural session of the National Seminar on "**Green Solutions: Exploring Pollution Management Strategies**" took place on **March 21, 2024**, at the Department of Environmental Science, Kuvempu University, Shankaraghatta. The seminar commenced with a resounding commitment to environmental protection and sustainability, bringing together experts, scientists, and stakeholders to address pressing environmental challenges facing the country.

Prof. Yogendra K, Chairman and organizer of the seminar, delivered the opening remarks, highlighting the critical need for innovative solutions to combat pollution and its detrimental impacts on public health and the environment. He emphasized the urgency of collective action to address pressing issues such as air pollution, water contamination, and waste management.

During the welcome address, Prof. Hina Kousar and Dr. S. H. Basavarajappa, Department of Environmental Science, introduced the distinguished speakers. Their introductions provided insight into the expertise and contributions of each speaker, setting the stage for the informative discussions to follow.

The seminar was inaugurated by **Prof. Sharat Ananthamurthy**, Hon'ble Vice-Chancellor, Kuvempu University, who highlighted India's commitment to reducing pollution and transitioning towards a greener economy. He praised the government's initiatives, including the National Clean Air Programme and the promotion of renewable energy and electric mobility, as significant steps towards achieving environmental sustainability. **Sri. A.L. Manjunath**, (Senior KAS officer) Registrar, Kuvempu University and **Prof. Gopinath S M.**, Registrar (Evaluation) were also present in the inaugural session of the seminar.

**Prof. E. T. Puttaiah**, Former Vice-Chancellor of Gulbarga University, provided valuable insights and expertise on pollution management and sustainable development as the keynote speaker. Distinguished speakers Prof. Sunil Nautiyal, Mr. Sujeetkumar Dongre, Dr. Sharathchandra, and Dr. Sunil Naik delivered invited lectures covering topics including renewable energy expansion, air quality improvement, waste management strategies, and measures to promote eco-friendly practices.

The seminar provided a platform for fruitful discussions and the exchange of ideas among **224** participants, including faculty members, research scholars, and students from diverse academic backgrounds. Their active engagement and contributions underscored the importance of collective efforts in addressing environmental challenges.



Additionally, the seminar witnessed a series of technical sessions focusing on diverse aspects of sustainability, particularly emphasizing waste management and renewable energies.

During the seminar, our Hon'ble Vice-Chancellor inaugurated two green initiatives – Susthira and Ecocycle, representing significant steps forward in the university's commitment to sustainability and environmental stewardship. These initiatives were launched in alignment with the Mission LiFe component of the Ministry of Environment, Forests, and Climate Change, Government of India program, highlighting the University's dedication to contributing meaningfully to national efforts aimed at combating climate change and promoting sustainable development.

## EcoCycle - Green Hub

*Your Path to Eco-Friendly Transportation and Sustainability*



EcoCycle-Green Hub promotes cycling as a sustainable mode of transportation on the Kuvempu University campus, aiming to create a more eco-friendly campus atmosphere. The initiative encourages cycling, thus reducing carbon footprint, improving air quality, promoting fitness, and building a healthier campus community. The bicycle service, provided free of cost with certain conditions, ensures accessibility for all, contributing to campus-wide sustainability efforts in line with Mission LiFe objectives.

## SUSTHIRA - A Green Campus LiFe Initiative

*Promoting Sustainability and Eco-Consciousness in Kuvempu University Campus*



At Department of PG Studies & Research in Environmental Science, we are committed to creating a campus environment that prioritizes sustainability and eco-consciousness. That's why we're excited to introduce SUSTHIRA, a Green Campus LiFe initiative aimed at promoting a greener, healthier, and more environmentally friendly campus.

Susthira promotes sustainability and eco-consciousness within the Kuvempu University campus by encouraging the use of eco-friendly, steel/glass coffee/tea/water cups and plates in various campus events. By saying '**NO**' to plastic cups and plates, SUSTHIRA contributes to reducing plastic waste and fostering a greener, healthier, and more environmentally friendly campus environment.

### **End Note :**

The National Seminar on "Green Solutions" not only facilitated discussions on pollution management strategies but also provided a platform for launching impactful green initiatives aimed at promoting sustainability and environmental consciousness within the university community. The successful implementation of these initiatives signifies the Kuvempu University's commitment to creating a more eco-friendly and sustainable campus for the benefit of present and future generations.



Concluding the program, Senior Professor Dr. J. Narayana offered closing remarks, summarizing the key points discussed throughout the seminar. His conclusion summed up the importance of what the seminar aimed to achieve and highlighted the importance of continued efforts towards environmental conservation and sustainability.



### GREEN RESOLUTIONS:



Based on the insights and discussions from the National Seminar on "**Green Solutions: Exploring Pollution Management Strategies**," we propose a set of green resolutions aimed at promoting sustainability and environmental consciousness within the Kuvempu University campus:

1. **Managing Waste:** Create a system to handle all the garbage produced at the university. This system will sort, recycle, and get rid of the waste in the best way possible. Implement a comprehensive solid waste management system to effectively segregate, recycle, and dispose of waste generated within the university premises. Encourage the adoption of sustainable waste management practices by introducing segregation of bio degradable and non-biodegradable wastes at source among students, faculty, staff members and campus residents.
2. **E-Waste Management:** Establish dedicated e-waste collection points on campus to collect and recycle electronic waste responsibly. Raise awareness among the university community about the hazards of improper e-waste disposal and promote the importance of recycling electronic gadgets.
3. **Solar Panels on University Office Buildings:** Install roof top solar panels on university office buildings under NET METERING concept with MESCOM so that we can generate revenue from solar energy. This initiative will not only lower carbon emissions but also lead to long-term cost savings on electricity bills and generate revenue also.
4. **Electric Vehicle (EV) Charging Stations:** Install stations on campus where people can charge electric vehicles (EVs). This will encourage students, faculty, residents, and visitors to use EVs, which are better for the environment. We can place these chargers in convenient spots, like near security areas by the main gates. We can do this by partnering with private companies by sharing the costs and profits.
5. **E-Vehicles for Campus:** Introduce electric vehicles for campus transportation, such as e-bikes or electric shuttles, to provide eco-friendly mobility options within the university premises. Replace conventional fuel-powered vehicles with electric alternatives to minimize air pollution and noise levels on campus.
6. **Solar Street Lights:** Replace traditional street lights with solar-powered LED street lights to illuminate walkways, pathways, and parking lots on campus. Solar street lights will not only reduce energy consumption but also enhance safety and security during nighttime.

7. **Less paper Office:** Promote paper shredding practices to securely dispose of confidential documents by providing paper shredder machine to all offices and encourage the transition towards a less paper office environment. Implement digital document management systems and online communication platforms to minimize paper usage and promote eco-friendly office practices.
8. **Rainwater Harvesting:** Implement rainwater harvesting systems to capture and store rainwater for landscaping and groundwater recharge purposes. Utilize harvested rainwater for non-potable purposes, such as flushing toilets, watering gardens, and cleaning outdoor spaces, to conserve freshwater resources.
9. **Development of Existing Green Library:** Enhance the sustainability features of the existing Green library opposite to University's main library next to Konanakatte by incorporating eco-friendly practices and modern technologies. Provide Wi-Fi connectivity throughout the Green library premises to facilitate digital learning and research activities for students and faculty members.
10. **Provision of E-Readers to Students:** Introduce e-readers as a sustainable alternative to traditional printed textbooks, allowing students to access academic resources in digital format. Provide e-reader devices or facilitate access to e-books through digital library platforms, promoting paperless reading and reducing the university's carbon footprint.

## Photo Gallery





# Photo Gallery





# Photo Gallery







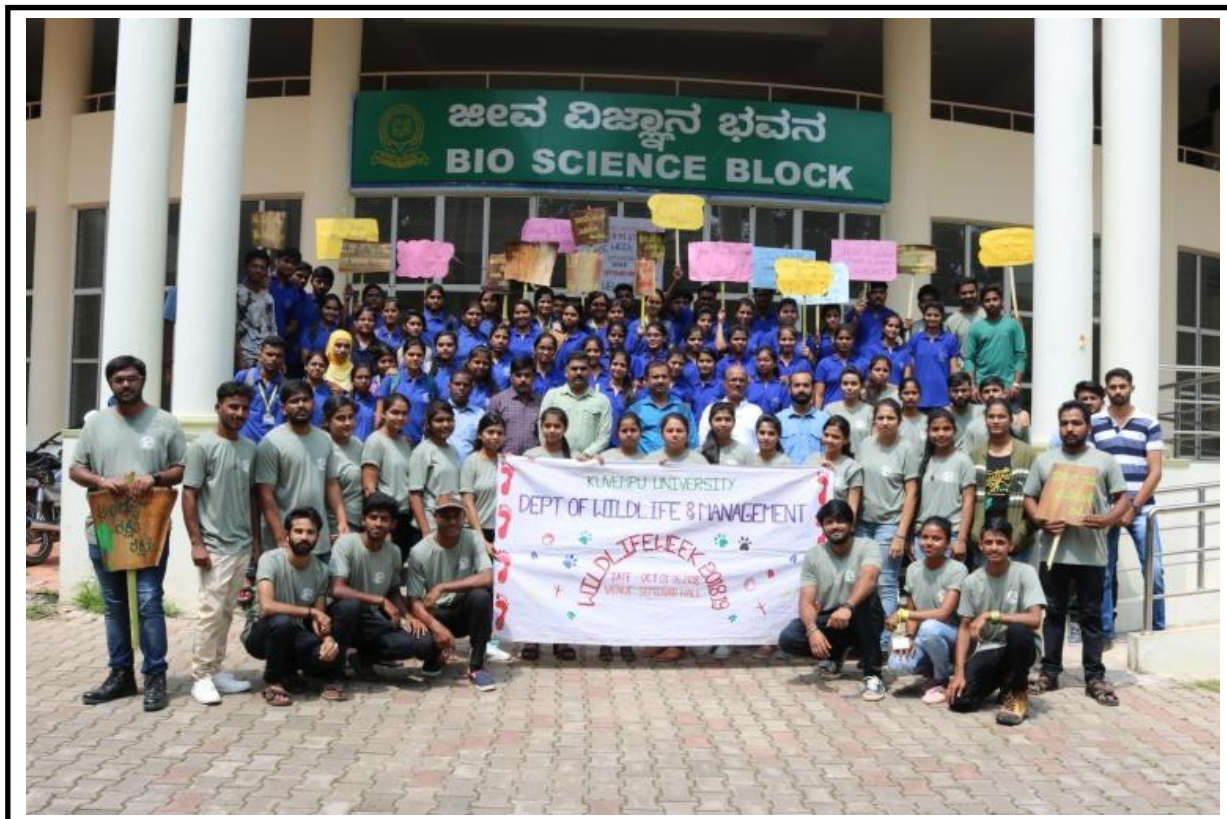






  
**KUVEMPU UNIVERSITY**  
Environmental Promotional Activities 2018

Department	Wildlife and Management
Activity conducted	Wildlife week celebration 1/10/2018 - 6/10/2018
Place of Conduct	Jnanasahyadri Campus, Kuvempu university
The outcome of the Programme	<ol style="list-style-type: none"><li>1. organized different activities related to wildlife conservation to commemorate this week.</li><li>2. The programme aimed at creating awareness among the youth to have a passionate heart for the biodiversity around them. During the celebration, several competitions for students were organized to raise consciousness in favour of wildlife preservation.</li><li>3. Wildlife march, Photography competition, Debate, Greeting card making, Exhibition, Rangoli, special lectures were organized.</li><li>4. Total 175 students were participated including Post graduate, graduate and School children's.</li><li>5. Students were actively participated in Special Lectures organized during the week related to wildlife conservation and management</li></ol>
Resource persons	<ol style="list-style-type: none"><li>1. Dr Jadegowda, M,</li><li>2. Mr. Rajesh Puttaswamai ah,</li><li>3. Dr Raghavendra, S,</li><li>4. Mr. Boss Madanna,</li><li>5. Mr. Satish</li></ol>





  
**KUVEMPU UNIVERSITY**  
**Environmental Promotional Activities 2019**

<b>Department</b>	<b>Environmental Science</b>
Activity conducted	Environmental Day 25-11-2019
Place of Conduct	Gram Panchayat Tavaraghatta, Conducted by Department Of Environmental Science Kuvempu University
The outcome of the Programme	<ol style="list-style-type: none"> <li>1. Organized Environmental Awareness Programmes to the public and students.</li> <li>2. The programme aimed at creating awareness among the youth to plastic awareness and Conservation of Environment.</li> <li>3. Conducted programmes like Essay Writing, Quiz and Drawing.</li> <li>4. Total 55 Post graduate, graduate students. were participated in Special Lectures organized related to Conservation of Environment.</li> </ol>
Faculty Attended	<ol style="list-style-type: none"> <li>1. Prof. J. Narayana</li> <li>2. Prof. S.V. Krishnamurthy</li> <li>3. Prof. Hina Kousar</li> <li>4. Dr. Basavarajappa</li> </ol>









ಶಿವಮೊಗ್ಗದ ಕುವೆಂಪು ವಿವಿಯಲ್ಲಿ ಪರಿಸರ ಸಂರಕ್ಷಣಾ ದಿನ, ಜನ ಜಾಗೃತಿ ಕಾರ್ಯಕ್ರಮ ನಡೆಯಿತು. ಕುಲಪತಿ ಪ್ರೊ. ಬಿ. ಪಿ. ವೀರಭದ್ರಪ್ಪ, ಸಂಸ್ಥೆ ಕವಿ ವಿವಿ ವಿಶ್ರಾಂತ ಕುಲಪತಿ ಪ್ರೊ. ಮಾಲ್ವೇಶ್ವರಂ ವೆಂಕಟೇಶ್, ಪ್ರೊ. ಜಯನಾರಾಯಣ, ಪ್ರೊ. ಕೃಷ್ಣಮೂರ್ತಿ ಇದ್ದರು.

ಶಿವಮೊಗ್ಗ: ಕುವೆಂಪು ವಿಶ್ವವಿದ್ಯಾಲಯದ ಪರಿಸರ ವಿಜ್ಞಾನ ವಿಭಾಗ ಲಾಪ್ತೀಯಿ ಬಹುತಾ ಸತ್ಯಾದದ ಪ್ರಯುಕ್ತ ಪರಿಸರ ಸಂರಕ್ಷಣಾ ದಿನ ಮತ್ತು ಜನ ಜಾಗೃತಿ ಕಾರ್ಯಕ್ರಮ ಆಯೋಜಿಸಿತ್ತು. ಕುಲಪತಿ ಪ್ರೊ. ಬಿ. ಪಿ. ವೀರಭದ್ರಪ್ಪ, ಸಂಸ್ಥೆ ಕವಿ ವಿವಿ ವಿಶ್ರಾಂತ ಕುಲಪತಿ ಪ್ರೊ. ಮಾಲ್ವೇಶ್ವರಂ ವೆಂಕಟೇಶ್, ಪ್ರೊ. ಜಯನಾರಾಯಣ, ಪ್ರೊ. ಎಸ್. ಎ. ಕೃಷ್ಣಮೂರ್ತಿ ಇದ್ದರು.

**ಕನ್ನಡಪ್ರಭ** Mon, 02 December 2019  
<https://kpepaper.asianetnews.cc>

**ಉದಯವಾಣಿ** Mon, 02 December 2019  
<https://epaper.udayavani.com/>

  
**KUVEMPU UNIVERSITY**  
 Environmental Promotional Activities 2019

Department	Environmental Science
Activity conducted	Environmental Day 18-06-2019
Place of Conduct	Spandana English medium school, Tammadihalli. Conducted by Department Of Environmental Science Kuvempu University
The outcome of the Programme	<ol style="list-style-type: none"> <li>1. Organized Environmental day And Conducted Plantation program, Drawing competition and Essay writing competition for students.</li> <li>2. The programme aimed at creating awareness among the Students to plastic awareness and Conservation of Environment.</li> <li>3. Total 35 students and teaching faculty of respective school were participated in Special Lectures organized related to Conservation of Environment.</li> </ol>
Faculty Attended	<ol style="list-style-type: none"> <li>1. Prof. S S Patil</li> <li>2. Prof. J. Narayana</li> <li>3. Prof. Yogendra K</li> <li>4. Prof. Hina Kousar</li> <li>5. Prof. Raja Naika</li> <li>6. Dr. S.H Basavarajappa</li> </ol>





  
**KUVEMPU UNIVERSITY**  
**Environmental Promotional Activities 2019**

Department	Wildlife and Management
Activity conducted	Wildlife week celebration and special lecture series 14.10.2019 to 19.10.2019
Place of Conduct	Jnanasahyadri Campus, Kuvempu university
The outcome of the Programme	<ol style="list-style-type: none"> <li>1. organized different activities related to wildlife conservation to commemorate this week.</li> <li>2. The programme aimed at creating awareness among the youth to have a passionate heart for the biodiversity around them. During the celebration, several competitions for students were organized to raise consciousness in favour of wildlife preservation.</li> <li>3. Wildlife march, Photography competition, Debate, Greeting card making, Exhibition, Rangoli, special lectures were organized .</li> <li>4. Total 150 students were participated including Post graduate, graduate and School children's.</li> <li>5. Students were actively participated in Special Lectures organized during the week related to wildlife conservation and management</li> </ol>
Resource persons	<ol style="list-style-type: none"> <li>1. Dr. Gururaja, K.V</li> <li>2. Sammilan Shetty</li> <li>3. Vinayak, S.G</li> <li>4. Sridhar Bhat</li> <li>5. Balachandra Hegde</li> </ol>







  
**KUVEMPU UNIVERSITY**  
Environmental Promotional Activities 2021

Department	Wildlife and Management
Activity conducted	World Wildlife day celebration-2021 and Special Lecture series 03.03.2021 to 5.03.2021
Place of Conduct	Jnanasahyadri Campus, Kuvempu university
The outcome of the Programme	<ol style="list-style-type: none"><li>1. organizes different activities related to wildlife conservation to commemorate World wildlife day</li><li>2. 85 Students were actively participated in Special Lectures organized during the programme related to world wildlife day 2021 theme, wildlife conservation and Snake diversity</li></ol>
Resource persons	<ol style="list-style-type: none"><li>1. Mr. Krupakar and Mr. Senani</li><li>2. Mr. S.S. Sunil</li><li>3. Mr. Nagaraj Bellur</li><li>4. Dr, K.N Ganeshaiyah</li></ol>



  
**KUVEMPU UNIVERSITY**  
 Environmental Promotional Activities 2022

Department	Wildlife and Management
Activity conducted	World Wildlife day celebration-2022 and Special Lecture series 29.3.2022-31.3.2022
Place of Conduct	Jnanasahyadri Campus, Kuvempu university
The outcome of the Programme	<ol style="list-style-type: none"> <li>1. Organized Special lecture series on worldwildlife day 2022 theme “Recovering keystone species for ecosystem restoration”</li> <li>2. The programme aimed at creating awareness among the youth to have a passionate heart for the biodiversity around them. During the celebration, several competitions for students were organized to raise consciousness in favour of wildli fe Management.</li> <li>3. 125 Students were actively participated in Special Lectures organized during the Programme related to “Recovering keystone species for ecosystem restoration”</li> </ol>
Resource persons	<ol style="list-style-type: none"> <li>1. Dr. Thammaiah, C.K</li> <li>2. Mr. Hithesh, N.D</li> <li>3. Dr Satyaprakash</li> <li>4. Dr. Jadegowda,</li> <li>5. Dr. Srinivasa, K.R</li> <li>6. Mr, C.K Chethan</li> <li>7. Dr. Harish Prakash</li> </ol>





  
**KUVEMPU UNIVERSITY**  
Environmental Promotional Activities 2023

Department	Wildlife and Management
Activity conducted	Wildlife week celebration and special lecture series 03.10.2023-07.10.2023
Place of Conduct	Jnanasahyadri Campus, Kuvempu university
The outcome of the Programme	<ol style="list-style-type: none"><li>1. Organized different activities related to wildlife conservation to commemorate this week.</li><li>2. The programme aimed at creating awareness among the youth to have a passionate heart for the biodiversity around them. During the celebration, several competitions for students were organized to raise consciousness in favour of wildlife preservation.</li><li>3. Wildlife march, Photography competition, Debate, Greeting card making, Exhibition, Rangoli, special lectures were organized .</li><li>4. Total 175 students were participated including Post graduate, graduate and School children's.</li><li>5. Students were actively participated in Special Lectures organized during the week related to wildlife conservation and management</li></ol>
Resource persons	<ol style="list-style-type: none"><li>1. Mr. Abhi Mandela,</li><li>2. Dr. Sachin sridhara</li><li>3. Sri. Rahul Aradhya, B.M</li><li>4. Mr. Sandeep Shetty</li><li>5. Mr. Uday Hegde</li></ol>





  
**KUVEMPU UNIVERSITY**  
 Environmental Promotional Activities 2023

Department	Environmental Science
Activity conducted	One Day Seminar on Environment and Health
Place of conduct	Department of Environmental Science
Outcome of the program	The resource persons delivered talk on common pollutants and its effects on health of the people and life in aquatic and terrestrial ecosystem
Teachers accompanied	Prof. Hina Kousar Prof. Yogendra.K Prof. J. Narayana Prof. S.V. Krishnamurthy Dr. Basavarajappa





  
KUVEMPU UNIVERSITY  
Environmental Promotional Activities 2019

<b>Department</b>	<b>Environmental Science</b>
<b>Activity conducted</b>	<b>One Day Seminar Environment and Health</b>
Place of conduct	Department of Environmental Science
Outcome of the program	The resource persons delivered talk on common pollutants and its effects on health of the people and life in aquatic and terrestrial ecosystem
Teachers accompanied	Prof. Hina Kousar Prof. Yogendra.K Prof. J. Narayana Prof. Dr. Basavarajappa

### 9.6 Conclusion

Kuvempu University is a well-established Institute in Karnataka, India in terms of academic activities, efforts are continuously made in providing an clean and green environment in the campus for the students, research scholars and staff members. The environmental management initiatives like creating solid waste management, rainwater harvesting system, Susthira (Plastic Waste management) and conservation of natural vegetation in the kuvempu University Campus without harming the environment. Kuvempu University has 'solid waste management and Vermicomposting facility to recycle the biodegradable solid wastes. The University has some Technology Missions related to Green Campus and Environment sustainability as well. A campus ecosystem is supported a rich biodiversity of flora and fauna which is making a sustainable environment and eco-friendly campus.

To conclude an environment audit report, the Kuvempu University is maintain an eco-friendly campus and providing benign atmosphere to the stakeholders and supports the nation as a whole in future generations by following sustainable development goal in the campus for future academic environment.

Green audit is inevitable in today's world. Issues of environment and natural resources and disasters are a daily routine. Each organization should make individual efforts to work for a better and prosperous future by ensuring economic, ecological and social growth of the country through the process of green auditing. Sustainability of the available and not explosion for the new by utilizing further natural resources is the need of the hour. Green audit ensures that to maintaining environment clean and proper management. This can be achieved only through proper implementation and timely control.

The electricity consumption in the Kuvempu University shows 84,2020 kilowatt. In order to minimize this and to increase energy efficiency in buildings use of solar power and wind power is essential. Except two units no such type of renewable energy units are planned.



Water consumption in the campus noticed around 2, 92,900 liters /day will be used and approximately 5000 liters of water leakage was noticed. Water quality assessment also carried out in different sampling points in the campus and found to be safe for drinking.

Total about 400-450 both two and four wheeler Vehicle move inside the main campus. But it may vary with special programs in the campus. It is necessary to provide bicycles to the members inside the campus

The quantity of Solid waste generation in the campus shows 150-200 kg/day which includes 56% of organic waste (biodegradable) and non-biodegradable waste includes paper-waste and scrap waste. Laboratory waste, Bio-medical waste generation in the university campus health center includes syringes, cotton, bandages, expired medicines. Interestingly there is no proper management for biomedical waste.

Department of Post graduate in research and teaching in Environmental Science was started in the year 1991-92. Since then the department faculty and research group working hard and it is well established with all the infrastructures. Large group of M.Sc and Ph.D scholars are placed in various administrative and teaching and research positions across India and world. The department also working for outreach activities to educate farmers, SHGs and public by motivating through environmental awareness programs.

This area also supported variety of wild animals because it is attached to Bhadra wildlife sanctuary area. The campus area also supported endemic and medicinal plants, it is every ones duty to maintain a healthy environment in the campus.

### **9.7 Steps undertaken to amend the suggestions given in the previous Green Audit Report**

As per the previous environment audit reports, the following steps were undertaken to amend the suggestions and recommendations.

<b>Sl. No</b>	<b>Suggestions made during the previous Eco Audit Report</b>	<b>Steps taken to amend the suggestions of the previous Eco Audit Report</b>
1.	Suggested to install roof top solar panels in the campus to save the energy demand in the campus.	Hon'ble Vice chancellor discussed with Engineering section for further planning to install roof top solar panels in the campus to save the energy demand in the campus.
2.	Suggested to ban use of plastics in the campus.	Department of Environmental science taken all the initiatives to ban use of plastics in the campus. However, Alternative arrangements also made that utensils from the department of ES can be used and return back.
3.	Rainwater water harvesting check dams can be constructed at appropriate places and restoration activities may be initiated to sustain the health of ponds and wetlands in the campus.	Initiatives taken to restore water bodies and small ponds in the campus area.





Sl. No.	Suggestions made during the previous Eco Audit Report	Steps taken to amend the suggestions of the previous Eco Audit Report
4.	Specific waste management plans should be adopted to manage solid waste in the campus, and use of plastic carry bags, thermo Cole cups/plates and flex boards should be banned inside the University. Further suggested for the management of hazardous wastes.	Segregation Unit was developed and the recycling waste is stored. Further the same scrap sent to recycling purpose.
5.	The public lights within the campus may be run with solar panels and the replacement of existing lights should be done with LED lamps. Energy auditing should be done with the help of Energy Management Centre (EMC).	Replaced LED lamps and solar lamps.
6.	Vehicle pooling should be promoted both among students and faculty and use of bicycles should be promoted as a green policy of university.	Faculty members from nearby areas pooled together and travelling 4to 5 members in one car alternatively
7	Considering water quality maintenance water purifiers facilities may be installed within the campus in order to ensure safe drinking water.	Water purifiers facilities installed within the campus for the supply of safe drinking water.
8	University departments can organize environmental related national and international days to aware students through environmental friendly activities	Most of the seminars organized based on environmental related national and international seminars, and awareness programs to the students

### 9.8 Recommendations:

1. Campus area is located in a natural forest area which supports rich flora and fauna. It is necessary to develop Kuvempu University campus wild life sanctuary unit for the research studies.
2. Existing energy saving practices need to be improved on the basis of environmental friendly energy sources. Therefore this study recommends to install roof top solar panels in the campus to save the energy demand in the campus.
3. Bird's diversity recorded highest in the campus it is due to rich forest area and diversity of species which helps to get fruit yielding, nesting habitat, Develop water resources points for wild life.
4. In every building Rainwater harvesting facilities need to be established to make use the rain water for domestic and gardening purpose. Rainwater water harvesting by developing check dams can be taken. Initiative.
5. Solid waste management by adopting 5R's (Reuse, Reduce, Recycle Refuse, Recover) concept is essential. Strictly ban plastic carry bags, thermo Cole cups/plates and flex boards inside the University. Bioenergy plant to be installed to generate energy from bio waste.



6. The wastes generated can be used for promoting organic farming activities within the campus and the products can be used in hostels and canteens, with a plan to ensure the availability of organic food in the canteen and hostels for future.
7. The public lights within the campus may be run with solar panels and the replacement of existing lights should be done with LED lamps. Energy auditing should be done with the help of Energy Management Centre (EMC).
8. Health and safety measures at work places and in campus is needful.
9. Vehicle pooling need to be promoted both among students and faculty and use of bicycles should be promoted as a green policy of university.

Administration should strictly issue the orders to follow the environmental management while conducting programs like welcome and farewell party celebrations as well as other programs both at departmental level and University functions.

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**KUVEMPU UNIVERSITY**

**Govt. of Karnataka, State Public University**

**Jnanasahyadri Campus, Shankaraghatta-577451, Shivamogga District, Karnataka**

**Supporting Documents pertaining to the following Metric:**

**7.1.6: Quality audits on environment and energy are regularly undertaken by the institution The institutional environment and energy initiatives are confirmed through the following**

- **Green audit / Environmental audit**
- **Energy audit.**
- **Clean and green campus recognitions/awards.**
- **Beyond the campus environmental promotion and sustainability activities.**



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Magadi Road, Bangalore North Taluk  
Bengaluru-562130, Karnataka

## GREEN AUDIT CERTIFICATE

This certificate is issued to Kuvempu University, Jnanasahyadri Campus, Shankaraghatta - 577 451, Shivamogga District, Karnataka, for successful completion of Green cum Environment Audit of the University Campus for the year 2023-24, conducted by M/s Envipro Solutions Pvt. Ltd., Bangalore.

This Environment Audit included various Sectoral Audits in the sectors viz. Water, Energy, Waste cum Material & Resource Recovery, Air Quality, Noise Levels and Biodiversity. The University is certified to have done exceptionally well to conserve the environment and ensuring sustainable development for the assessment period till 15/12/2023.

Duration of Audit: Nov. 2022 to Dec. 2023

Date of Issue: 20<sup>th</sup> Dec. 2023

For M/s Envipro Solutions Pvt. Ltd.



Sri. M S Ashwath Narayan  
Managing Director



# Vermicompost Training and Entrepreneurship





# Vermicompost Training certificates









Table.2 vermicompost and earthworms produced and income generated /harvest

Taluks	No. of vermicompost Units	Total VC harvested (tons)	Total income by VC (Rs.)	Total EW harvested (Kg)	Total income generated by EW (Rs.)
Shivamogga	10	16.20	62,300.00	86.00	13,125.00
Bhadravathi	09	19.60	62,700.00	101.00	12,100.00
Thirthahalli	04	6.70	28,075.00	35.00	4,350.00
Hosanagara	07	14.15	56,100.00	67.00	9,900.00
Shikaripura	08	18.10	59,400.00	95.00	14,375.00
Sagara	04	5.95	22,525.00	31.00	5,075.00
Soraba	05	10.30	44,050.00	53.00	8,375.00
<b>Total</b>	<b>47</b>	<b>91.00</b>	<b>3,35,150.00</b>	<b>468.00</b>	<b>67,300.00</b>

# Bioplate making Training and Entrepreneurship



Kuvempu Nagara, Bhadravathi Taluk



Dept. of Environmental Science , Kuvempu University



# Photographs Showing Areca Leaf Plate Productions







## Inaugural Functions





Photographs showing inaugural function of Areca Leaf plate machines.





# Waste Management





**KUVEMPU**



**UNIVERSITY**

**Department of PG Studies and Research in Biochemistry,  
Kuvempu University, Shankaraghatta -577 451**



**Mass rearing and release Trichogramma  
chilonis in the Sahyadri campus**

**Dr. P. Niranjana PhD.  
Associate Professor & Chairman.**

# Mass rearing of *T. chilonis* on *Corcyra* eggs

## Preparation of Trichocard



UV Killed *C. cephalonica* egg mass



Applying of Glue on Trichocard



Eggs were Pasted on Trichocard



Trichocard were cut into small strips



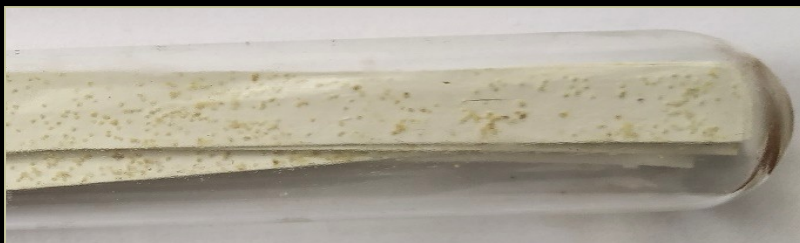
Adult *T. chilonis* were allowed to parasitize over night



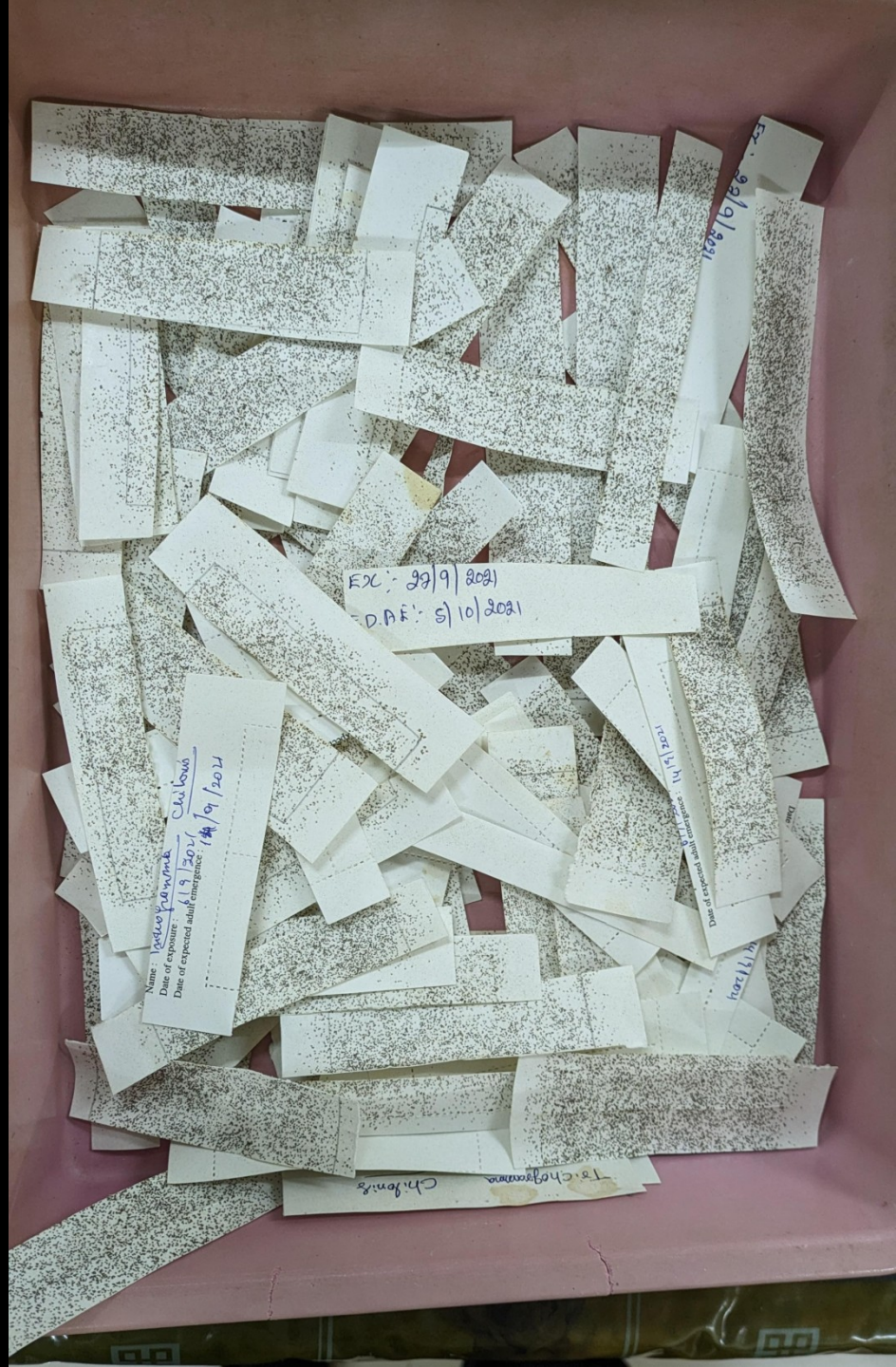
After parasitization adults were removed and incubated at  $26 \pm 1$  °C and observed for parasitization.



Emerged *T. chilonis* adults were fed with 10% honey









# Student batch- 2020-21

October 2021





October 2021





















**KUVEMPU**



**UNIVERSITY**

**Department of PG Studies and Research in Biochemistry,  
Kuvempu University, Shankaraghatta -577 451**



**Promotion of *Trichogramma chilonis* as  
Biocontrol agent:Field release**

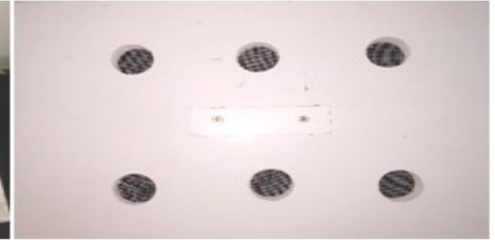
**Dr. P. Niranjana PhD.  
Associate Professor & Chairman.**

# Mass rearing of *Trichogramma chilonis*



## Components of Medium

2.5Kg Bajra  
2gm Dry yeast  
10gm Floured Ground nut  
0.5gm Ampicillin



**Corcyra Media**

**Corcyra Rearing box**



**Freshly laid *C. cephalonica* eggs obtained from NBAIR ICAR, Bengaluru.**

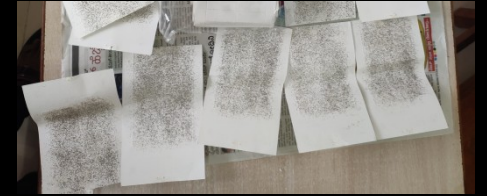


***C. cephalonica* eggs were added to media**



**Incubated in room temperature (25-30°C) for about 35-40 days**







# May/June 2022

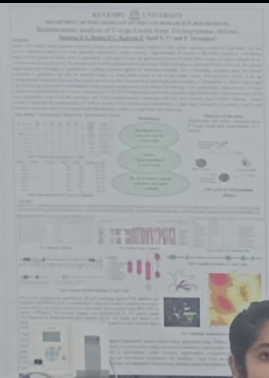




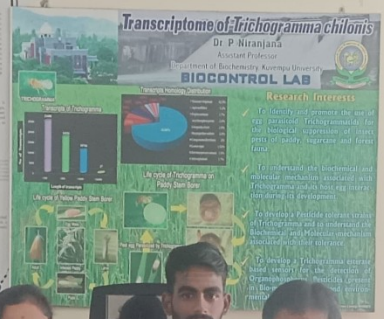
ಭಾ. ಕೃ. ಸಂ. ಸಂ.-ರಾಷ್ಟ್ರೀಯ ಕೃಷಿ ಕೀಟ ಸಂವಹನ ಬ್ಯೂರೋ  
भा.कृ.सं.प.-राष्ट्रीय कृषि कीट संसाधन ब्यूरो  
ICAR-NATIONAL BUREAU OF AGRICULTURAL INSECT RESOURCES  
( INDIAN COUNCIL OF AGRICULTURAL RESEARCH )  
HEBBAL, BENGALURU - 560 024



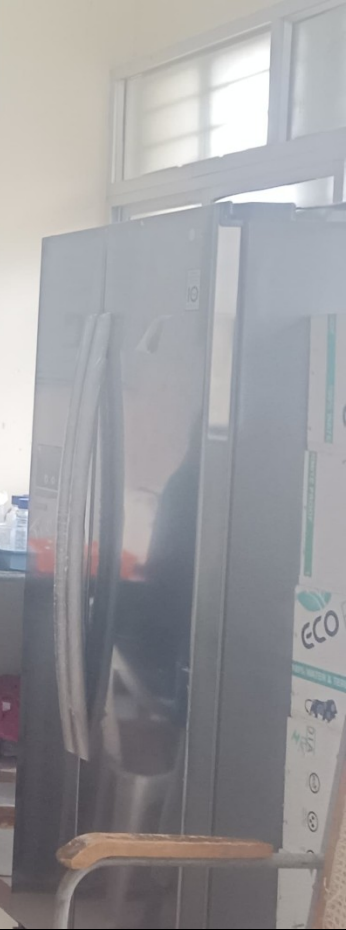




Scientific poster titled "Transcriptome of *Trichogramma chilonis*" by Dr. P. Niranjana, Assistant Professor, Department of Biochemistry, Kuvempu University, Shivamogga. The poster includes a list of authors and a detailed abstract of the research.



Scientific poster on the right wall, containing text and diagrams related to biological control and pest management.





























**KUVEMPU**



**UNIVERSITY**

**Department of PG Studies and Research in Biochemistry,  
Kuvempu University, Shankaraghatta -577 451**



**Industrial Training: Shriram Institute for  
Industrial Research bangalore**

**Dr. P. Niranjana PhD.  
Associate Professor & Chairman.**



# Shriram Institute For Industrial Research













TEST - 1



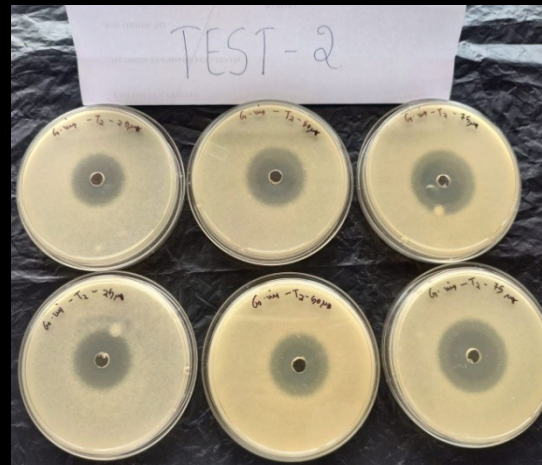


# Effect of *T.chilonis* AMP on superbug *Gliocladium virens* ATCC 9645



DMF

Bacitracin 50µg



Tested concentration

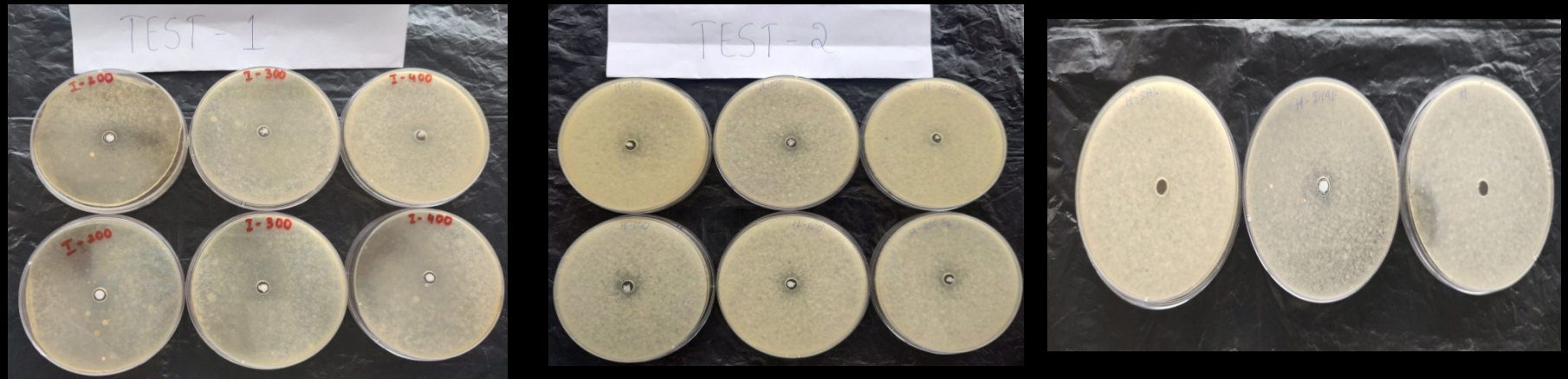
1.25 µg

2.50 µg

3.75 µg

Avg- inhibition 14 to 19mm

# Effect T.chilonis derived AMP 2



1. *Aspergillus niger*-ATCC 16404
2. *Aureobasidium pullulans* ATCC 9348
3. *Gliocladium virens* ATCC 9645

Derivative of .chilonis AMP- No inhibition