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UNIVERSITY OF MYSORE

(Estd.1916)

GREEN AUDIT REPORT

INTERNAL QUALITY ASSURANCE CELL
Manasagangothri
University of Mysore
Mysuru – 570 006

CONTENTS

UNIVERSITY OF MYSORE

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FOREWORD

I am happy to foreword this 'Green Audit Report- 2014-15 to 2018-19' of our University of Mysore. A Green Campus is a cleaner, safer, and healthier place to live and work. Green strategy refers to the adoption of new and innovative technology in the whole business process of Industries, which must be eco- friendly. Green technology uses new and innovative energy generation and conservation techniques in all parts of the world. Adopting green strategy by Universities is aimed at significantly reducing environmental risks, ecological scarcities and helps in ensuring human well-being as well as social equity within the campuses.

The United Nations reporting on the millennium development goals at a country level indicated a high level of energy consumption and limited energy resources in most of the developing countries. The report strongly recommends the imperative need to ration the use of energy resources in these countries and to implement energy conservation policies.

The University of Mysore has been concentrating to adopt the concepts of maintaining its all four campuses as Green Campuses only. The work done on this front is several years old. We have a very good green belt, gardens, lawns, clean environment, dust free roads, solar lights all around, energy efficient computer systems, electronic gadgets, and many more things added to green strategy. Though we followed everything in our normal campus life cycle, we wanted to place on record our initiatives and activities in the form of a policy framework so that our future generations will be continuing to adopt them with care and good practices.

I place it on record the effort of the intellectuals, who are involved in providing and compilation of this Mammoth work. I must congratulate IQAC Advisory Committee, Director- Prof. N.S. Harinaryana, Co-ordinator- Prof. K.N. Amruthesh and Dr. J. Lohith and a special mention of 'Green Audit Sub- Committee' Chairman- Prof. Basavaiah and his team for the completion of this 'Green Audit Report'.

I hope this 'Green Audit Report' will be helpful to all the concerned and will motivate to put green steps ahead in future.

G. Hemantha

Vice-Chancellor

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EDITORIAL...

The rapid urbanization and economic development at local, regional and global level has led to several environmental crisis like global warming, climate change, deforestation, urban smog and water pollution. On this background it becomes essential to adopt the system of the green campus for the institutes which will lead for sustainable development and at the same time reduce the emission of green house gases. A green audit can be a useful tool for any academic institution to determine how and where they are using the most energy or water or resources; the institution can then consider how to implement the changes and make savings. It can also be used to determine the type and volume of waste, which can be used for recycling project or to improve waste minimization plan. It can create health consciousness and promote environmental awareness, values and ethics. It provides staff and students better understanding of Green impact on campus. If self-enquiry is a natural and necessary outgrowth of quality education. As environmental sustainability is becoming an increasingly important issue for the nation, the role of higher educational institution in relation to environmental sustainability is more prevalent.

The national assessment and accreditation council (NAAC), New Delhi has made it mandatory that all higher educational institutions should submit an annual Green Audit Report. Moreover, it is part of Corporate Social Responsibility of the Higher Educational Institutions to ensure that they contribute towards the reduction of global warming through Carbon Foot Print reduction measures. Therefore, the purpose of present Green Audit of University of Mysore is to identify, quantify, describe and prioritize framework of environmental sustainability in compliance with the applicable regulations, policies and standards.

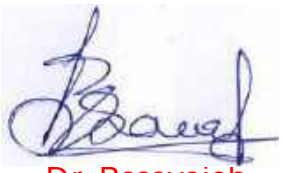
University of Mysore with its prestigious position among state Universities in strengthening Higher Education through sustainable development has already taken steps towards the Green Approach and adopted Green Campus Guidelines in the year 2014. It has taken green steps to reduce the Carbon Foot Print by using solar lights, energy efficient computer systems, electronic gadgets, solar electrical panels, rainwater harvesting, composting the plant litter and so on.

The responsibility of carrying out the scientific Green Audit of University of Mysore was given to 'Green Audit Team' constituted by the University under my chairmanship. During the audit focus was given to assess the consumption of electricity and waste water, disposal of wastes, composting and vermicomposting of leaf litter and to make inventory of flora and fauna to check how much CO2 sequestered and O2 is released.

I thank the Hon'ble Vice Chancellor for the encouragement with full support extended during the preparation of this Green Audit Report 2018-19. I also extend my sincere thanks to the Registrar, Director, IQAC, Deans of Faculties and other Officers of the University who were also given support to conduct this Green Audit. All Heads of Departments, Directors, Coordinators, In-Charge of Support Services of the University are acknowledged for their kind cooperation and support.

I must also thank all the members of Green Audit Committee and also the Faculty, Research scholars and Students who actively participated in this work.

I hope this report will be helpful for our University to practice and promote its Green Campus Policies.



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EXECUTIVE SUMMARY

The sub-committee constituted by the IQAC of University of Mysore, Mysuru conducted the 'Green Audit' of University of Mysore in the academic year 2018-19and the findings are presented in this report. Green Auditing is a process of systematic identification, quantification, recording, reporting and analysis of environmental components such as energy, water, waste and vegetation management of various establishments. It aims to analyze environmental practices within and outside of the concerned sites, which will have an impact on the eco-friendly ambience. This is the first attempt of University of Mysore to conduct green audit of its campuses. It was conducted by getting the data through questionnaires, interviews and verification of the documents. For proper analysis of data various buildings of Manasagangotri campus are grouped in to five blocks - all administrative and Service buildings (Block A), all Science and Technology departments (Block B), all Humanities, Arts and Commerce departments (Block C), all hostels (Block D) and all guest houses, canteens and quarters (Block E). The details of audit findings on energy, water, solid waste and biodiversity management, carbon foot prints of the campus and green initiatives taken by the university are presented in this report.

1. Energy Audit:

Energy audit is key to a systematic approach for decision making in the area of energy management. Energy sources utilized by the Manasagangotri campus include electricity, petrol, diesel, LPG and solar power. The annual actual power consumption of the entire university is around 23,50,959 kWh and the amount paid for electricity is Rs. 2,15,73,239/- for the year 2018-19. In the main campus of University of Mysore, among the major types of electricity consuming equipments/appliances the top six ranked items (AC's, Computers, Lab Equipments, Tube light & Incandescent bulbs, Ceiling Fans and Water Pumps) were found to consume 79.62% of total power consumption of the campus. If these major equipments/appliances are retrofitted or linked to solar panels, major saving of electricity could be achieved. The total power consumption at PG Center at Chamarajanagar was 13,943.26 kWh per annum (electricity bill amount Rs. 1,79,169/-) at PG centre Hemagangotri campus was 48,696.8 kWh per annum (electricity bill amounts to Rs. 4,25,354/-) at PG Center, PG centre Mandya was 75,472.6 kWh per annum (electricity bill amount Rs. 7,55,824). Based on the available data, the annual energy savings

through solarization for one year was approximately of 5,40,881 kWh and annual cost savings was of Rs. 36,77,991/-. The percentage of solar lighting existing in the campus is approximately 5%. If we retrofit the existing old equipments/appliances with energy efficient and environment friendly LED and solar based equipments/appliances (such as LED bulbs, Tubes, star rated fans, invertors, Air Conditioners, water pumps, etc.), there could be a drastic reduction of power consumption and also the cost saving potential with the worthy of saving of considerable amount towards energy expenses.

2. Water Audit

Water audit is qualitative and quantitative analyses of water supply and consumption to identify means of reducing, reusing and recycling of water. Manasagangotri campus, has got a total quantity of 7,79,963 liters of water per day through five sources. The major source of water is underground water lifted through bore wells contributing 67% of total water supply. Through 10 rain water harvesting facilities a total of 45,47,053 litre of water per annum is harvested (annual share is only 2.58%). The second major source of water is Kukkarahally lake which met 19.36% of water requirement. There are 19 bore wells, with nine mono-block submersible pumps and six surface pumps. A total quantity of 7,77,839 liters of water was found used for five major activities in the campus of which the domestic activities consumed nearly 69.12% water supplied, followed by gardening activity (19.41%). A total of 1,51,000 liters of water is pumped everyday for gardening purpose from four pumps installed on either side of the Kukkarahally Lake. In the administrative and service block 'Block-A', garden consumes the highest percentage of water (76.1%) followed by Urinals (9.64%). In 'Block-B' which includes Science and Technology departments, the laboratory and the garden consume the major quantity showing the percentage 39.12% and 23.47% respectively. The 'Block-C' which includes Humanities and Commerce and Law departments showed similar trend of water usage with Block-A consuming 33.09% and 32.54% of total water for garden and urinals respectively. Nine hostels of building Block-D consumed highest quantity of water (2,49,070 liters/day) among all the blocks. In this Block, the consumption of water for bathroom and washroom and cloth washing showed the 1stand 2nd rank with 38.14% and 19.27% consumption. In the campus, bathroom/washroom, toilets and urinals are the three major consumers of water showing 32.97%, 12.87% and 12.43% respectively. By overall, purpose wise use of water indicates that gardening,

bathroom/washroom and urinals consume more than 55% water in the campus of which garden shares 23.50%. In PG Center, Chamarajanagar, the total supply of water is 12,999 liters per day and urinals and washbasins consumed more than 58% of water supplied. In PG Center, Hassan, the daily supply of water is 12,789 liters per day. In this centre, unlike other centers, the highest percentage (23%) of water is consumed for the purpose of Kitchen of the hostel. In PG Center, Mandya, a total quantity of 21,665 liters of water supplied daily of which 23.83%, 16.05% and 14.3% of water used goes to kitchen, urinals, and bathrooms/washroom respectively.

3. Solid Waste Audit

Solid waste management is one of the basic parameters of environmental sustainability and hence managing our own waste is the responsibility of the every individual. The purpose of this audit is to find out the type, quantity and current management practices of soil waste generated in the campuses of University of Mysore. Among the biodegradable, non-biodegradable and hazardous wastes and also among the various types of major bio-degradable wastes, plant litter was found huge in quantity (12,50,000 kg/year) showing the lion share of 96.23%. Plant litter is dead plant material, such as leaves, bark, flowers, fruits, needles, and twigs that have fallen to the ground. In Manasagangotri campus, there are more than 20,000 tree populations which are generating more than 2500 MT of plant litter, 50% (1250 MT) of which could be collected easily. Realizing the importance of recycling leaf litter University of Mysore has started a novel program in 2010 to produce compost and vermin-compost from the leaf litter. The existing SWM unit of the campus is re-cycling only about 10-12% of this available leaf litter. In the last five years of under report, 1,14,757 kg of vermicompost, 3,991 kg of enriched vermicompost, 95,610 kg of Compost-grade I, 4679.5 kg of Compost-grade II, 2230 kg of enriched compost, 30 Liters of vermiwash and 27.1kg of earthworms has been produced in SWM unit and sold to the public. In addition, training, demonstration and teaching programs and also research activities are also undertaken in the SWM unit. Other biodegradable wastes such as wood, wooden, food, paper, and cloth (cotton) waste are being collected, segregated and disposed as per the guidelines of Mysore City Corporation. Among the non-biodegradable wastes, construction waste with 200 MT generated annually occupies the major share (96.95%). This includes demolished debris and disposed through to the land filing sites after extracting recyclable wastes from it. Other major types of non-biodegradable wastes are plastic, glass,

electronic, metal, rubber and chemicals. These wastes are generated in considerable quantities from various departments and offices in the campus. Paper waste is mainly sent for recycling purpose. Plastic, glass and metal waste will be sold to the authorized vendors for further processing. The hazardous wastes such as sewage sludge, medical waste, and lab waste are being disposed following the standard disposal protocols. There is a 'Bio-hazardous Safety Committee' to look after the safety measures for disposal of bio-hazardous wastes used in the laboratories.

4. Green Inventory and Biodiversity

Manasagangotri, the main campus of the University in Mysuru, is an embodiment of greenery. The sprawling 801.08 acres of campus has a balanced spread of plants and trees as green area in 697 acres of land (including water body of Kukkarahally Lake). So the green area totally accounts for 87% of its total land. As a part of total green area, around 71 acres is covered by horticulture gardens; parks in 13 acres, lawns in 42 acres, grassland and playground in 51 acres and the remaining 400 acres is a forest and horticulture tree area. Biodiversity in the Manasagangotri Campus is rich in biodiversity and encompasses diverse group of plants, animals. Manasagangotri campus harbors a great diversity of plant diversity. Preliminary report enlisted the occurrence of 397 plants species belonging to 96 angiosperm plant families. Among them, the families, Fabaceae and Euphorbiaceae are dominant and represented by large numbers of species which includes 19 and 18 species respectively. Similarly, the diversity of fauna in the campus is rich with large number of animals, birds, insects are inhabiting in the campus. The campus has hosted good number of invertebrate and vertebrate fauna. The invertebrates are represented by 323 species (66.6%) and vertebrates are represented by 167 species (33.4%). Moreover, the existed fauna was classified into different categories based on their status that accounts 12 major types. Further, based on animal species occurrence and abundance, recorded fauna was further grouped into common species (45.5%), very commonly occurring species (22.8%), rare species (18.8%), vulnerablespecies (2.4%) and endangered species (2.4%) which are recorded amidst Manasagangotri campus of University of Mysore. The Horticultural Division of University is actively participating in the Dasara Flower show by beautifying the heritage buildings (Crawford Hall, VC quarters, Administrative buildings, Kukkarahally Lake Bunds) and won several prizes ever year by the district administration. The university has the privilege of preserving the natural water body Kukkarahally Lake which is a good lung space for the city attracting more than 1000 morning and evening walkers. The university has created lot of infra-

structure for the benefit of general public in the Kukkarahally Lake. The greenery of the campus constitutes horticulture plants, ornamental plants, lawns and trees. The responsibility of developing and maintaining the greenery of the campus is with Horticulture division. It is maintaining 4501 horticultural plants/trees and also planted more than 20,000 saplings during the period under report. It has developed lawns and parks in front of every building. For this purpose, a sum of Rs. 2,02,80,452 has been spent by the University during 2014-2019. By auctioning of horticulture products and fishes from Kukkarahally Lake, the University has generated a sum of Rs. **71,76,151/-** in last five year (2014-2019). The air quality of the campus is appreciably good. Apart from the stake holders of the campus hundreds of morning and evening walkers from surrounding areas are enjoying the pleasure.

5. Carbon Foot Print:

The campus is in the heart of city and six kilometers away from bus stand and railway station. So, a large number (6684) of students commute through public transport. Comparatively, two wheelers are high in number. The electrical vehicles are only 0.57% in the campus. The University vehicles, generators and water pump motors consume around 289070 liters and have the total carbon footprint of 7,68,926 kg of CO_2e.It is estimated that there is a total of 353970 liters of petrol/diesel by the use of vehicles from all the stake holders of the university and showing the total carbon footprint of 941560 kg of CO_2e/year approximately. By recycling a total quantity of 829.757 MT of plant litter at SWM unit, a total quantity of 365.07 ton of CO_2 (annually 165 tons) emission is reduced. In addition, a total of 13.2 tons of CO_2 emission is reduced by the compost production activities of garden division and Department of Sericulture annually. Further another 4.4 tons of CO_2 emission is reduced with the production of 10 tons of compost annually at DOS in Sericulture science. Carbon Foot Print of 382 LPG cylinders used in the campus during 2018-19 is 8422kg of CO_{2e}.

A large number of green initiatives are undertaken in the campus. The green campus is a landmark in the city, with several hundreds of citizens choosing the Campus as a place for their morning and evening walks. I hope this report will help all the stake holders in promoting the green initiatives undertaken by the University and realizing their dream of developing Manasagangotri campus as the best Green Campus.

CHAPTER - I

INTRODUCTION

1.1: Green campus concept

A Green Campus is a place where environmental friendly practices and education combine to promote sustainable and eco-friendly practices in the campus. The green campus concept offers an institution the opportunity to take the lead in redefining its environmental culture and developing new paradigms by creating sustainable solutions to environmental, social and economic needs of the mankind.

Greening the campus is all about sweeping away wasteful inefficiencies and using conventional sources of energies for its daily power needs, correct disposal handling, purchase of environment friendly supplies and effective recycling program. Going green saves you from toxic products and environmental pollution. It is like detoxifying every day. As a result, you get more stamina, more energy, which eventually increase your productivity both at workplace and at home. The institute has to plan its Green Campus policy, work out the time bound strategies to implement **green campus** initiatives. Green campuses make a point to account for sustainable living when designing and operating their buildings. Many of their facilities incorporate natural lighting, improve air quality, and reduce energy and water use.

1.2: Need of Green Campus initiatives in universities

Universities have long been agents of change – catalysts for social and political action as well as centers of learning. They not only educate leaders, decision-makers and teachers and advance the boundaries of knowledge, but as major employers and consumers of goods and services they play a significant economic role nationally and globally. Given the ascribed role of Universities in society, and the prevailing environmental and sustainability challenges, Universities are coming under increasing pressure to engage with and respond to climate change and other sustainable development issues and the associated risks and opportunities.

They are expected to be the engines and innovation centers for sustainable development through teaching and learning, research and knowledge transfer. Critically, universities' educational role does not end with undergraduate and postgraduate learning; it extends to the

plethora of activities which support and extend the teaching and research core: campus management and operations; campus planning, design, construction and renovation; purchasing; transport; and engagement with the wider community. Awareness is also growing in the higher education sector that universities can teach and demonstrate the theory and practice of sustainability through taking action to understand and reduce the unsustainable impacts of their own activities.

1.3: Green Auditing and its Need

Green Auditing is a process of systematic identification, quantification, recording, reporting and analysis of components of **environmental** diversity of various establishments. It aims to analyze **environmental** practices within and outside of the concerned sites, which will have an impact on the eco-friendly ambience.

Green audit can be a useful tool for a university to determine how and where they are using the most energy or water or resources; the university can then consider how to implement changes and make savings. It can also be used to determine the type and volume of waste, which can be used for a recycling project or to improve waste minimization plan. It can create health consciousness and promote environmental awareness, values and ethics. It provides staff and students better understanding of Green impact on campus. If self enquiry is a natural and necessary outgrowth of a quality education, it could also be stated that institutional self enquiry is a natural and necessary outgrowth of a quality educational institution. Thus it is imperative that the university evaluate its own contributions toward a sustainable future. As environmental sustainability is becoming an increasingly important issue for the nation, the role of higher educational institutions in relation to environmental sustainability is more prevalent.

The rapid urbanization and economic development at local, regional and global level has led to several environmental and ecological crises. On this background it becomes essential to adopt the system of the Green Campus for the institutes which will lead for sustainable development and at the same time reduce a sizable amount of atmospheric carbon-di-oxide from the environment. The National Assessment and Accreditation Council, New Delhi (NAAC) has made it mandatory that all Higher Educational Institutions should submit an annual Green Audit Report. Moreover, it is part of Corporate Social Responsibility of the Higher Educational

Institutions to ensure that they contribute towards the reduction of global warming through Carbon Footprint reduction measures.

In recent time, 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. Many institutions undertake lot of good measures to resolve these problems but are not documented due to lack of green documentation awareness. All this non-scholastic efforts of the administrations play an important role in ensuring the green quotient of the campus is intact.

Therefore, the purpose of the present green audit is to identify, quantify, describe and prioritize framework of Environment Sustainability in compliance with the applicable regulations, policies and standards.

Promotion of Environmental Consciousness by the government through NAAC

In 2006, Government of India has declared the National Environment Policy 2006 and made green audit mandatory to each industry. It is recognized that the maintenance of the healthy environment is not the responsibility of the state alone. It is the responsibility of every citizen and thus a spirit of partnership is to be realized through the environment management of the country. The process of environmental audit was formalised by Supreme Audit Institution (SAI) according to the guidelines given in Manual of Standard Orders (MSO) issued by Authority of the Controller and Auditor General of India 2002.

Higher education institutes are trying to give solution for issues related to environment by using different evaluation methods such as Environmental Impact Assessment (EIA), Social Impact Assessment (SIA), Carbon Footprint Mapping, Green audit *etc*. National Assessment and Accreditation Council (NAAC) which is a self governing organization that assess the institutions performance with Grade according to the scores assigned at the time of accreditation of the institution has made Green Auditing mandatory procedure for educational institutes under its Criterion VII. The intention of green audit is to upgrade the environmental condition inside and around the institution. It is performed by considering environmental

parameters like water and wastewater accounting, energy conservation, waste management, vegetation management, air, noise monitoring, etc. for making the institution more eco-friendly.

Through this action of NAAC, educational institutions have adopted Green campus policy and practicing green actions and inculcating the good habit of caring natural resources in their students. Through Green Audit, higher educational institutions can ensure that they contribute towards the reduction of Global warming through Carbon Footprint reduction measures.

About University of Mysore

The University is located in Mysuru, the cultural centre of Karnataka. Mysuru was the capital of the Wadiyar dynasty. It is a city of palaces, temples, and gardens. Being a splendid tourist centre with historical monuments and unique architecture, it is famous for silk, sandalwood oil and artifacts of ivory and sandalwood. The city has salubrious climate throughout the year. It is about 140 kms south west of Bengaluru, the State capital, and is well connected by rail, road and air.

Vision

To aspire to become a world-class University by tapping human resources from all sections of society by offering them opportunities to learn across disciplines, and to build human capital, men and women of character and competence capable of being leaders of tomorrow and solving problems arising out of fast changing realities – global and local.

Mission

Built on a great legacy inherited from our founding fathers, our mission is to create an environment of stimulating intellectual dialogue across disciplines and harvest knowledge with a cutting-edge through high quality teaching, research, and extension activities leading to the generation of students who would provide leadership, vision and direction to society.

Goal

Our goal is to realize this vision by 2025. Our strategy is to develop innovative programmes in basic and emerging disciplines in a phased manner and to update them periodically so as to keep ourselves on track and on time. Our commitment is to involve the faculty and students in interactive learning environment both within and outside the University

through contextual and experiential programmes so that they would be builders of a worldwide-network of knowledge-sharing and excel in their performance with a winning edge in the wider context of globalization.

Motto

The motto of the University is well engraved on its emblem: (depicting the bird 'Gandabherunda' flanked on either side by lion-elephant Sharaba – a mythical creature believed to be stronger than lion and the elephant and the upholder of righteousness) that "Nothing is equal to knowledge" ("Na hi JnanenaSadrisham" - an excerpt from Rigveda) and "I always uphold the truth" (Satyamevoddaharamuaham). Thus the greatness of knowledge and the commitment to adhere to truth are the ideals, the University is pursuing all through its existence, and in its path of success.

Campus

The main campus named "Manasagangotri"– eternal flow of the mind – by the Poet-laureate 'Kuvempu', the former Vice-Chancellor, and the first 'Jnanapeetha' awardee, is located on 739 acres of picturesque land containing a sprawling Kukkarahalli lake surrounded by verdurous trees extending to an area of 261 acres.

In addition to the main campus, there are three campuses located in Tubinakere near Mandya, Hemagangotri near Hassan and at Chamarajanagara. The Tubinakere campus near Mandya is known as Sir M. Visvesvarayya Postgraduate Centre and is located on the Mysore-Bangalore highway at a distance of about 8 kms from Mandya. The Postgraduate Centre at Hemagangotri, Hassan is located near Kenchattahalli village on the Mangalore- Bangalore highway at a distance of about 10 kms from Hassan. Dr. B. R. Ambedkar Post-Graduate Centre of Mysore University is located at Chamarajanagar, the Southern most district Headquarters of Karnataka State.

There are 85 PG departments offering more than 150 postgraduate programmes with more than 1,20,000 UG, PG, M.Phil, and Ph.D. students. There are 228 affiliated colleges, 39 recognised research centers, 138 outreach centers, 8 training centers, 123 specialized programmes, 38 foreign collaborations and 131 national collaborations. Further, there are 11 PG departments with National Research Facilities, 15 Chairs, 13 DST-FIST, UGC-SAP funded

departments 13 supporting units. Enrollment of a large number of overseas students from around 50 countries reflects the international reputation of the University.

Green Campus Guidelines of UOM (2014-15)

The green campus guidelines established by the University of Mysore is the reflection of goals, objectives, scope and priorities of the organization related to environment sustenance. Environment Management System should declare 'Environment Policy of an Organization' and communicate it to all the concerns stakeholders. Environment Management System includes all stakeholders of an organization comprising top management to the functional team. Each of them has given a specific task of compliance within stipulated period.

The Pivots of the environmental guidelines of the University of Mysore are:

a) Solid waste management
b) Waste water management
c) Rain water harvesting
d) Optimum usage of solar energy

Objectives

These guidelines have been proposed with the following objectives:

- To increase the green cover in and around the campuses of the University of Mysore.
- To manage, collect and dispose all kinds of wastes including e-waste appropriately.
- To reduce generation and accumulation of hazardous waste and their management.
- To take initiatives and actions to reduce the consumption of plastic in the campus.
- To encourage paperless work culture and recycling/ reuse of paper.

Green Campus status can be achieved by making significant progress in cross campus community collaboration under one or a number of the following themes:

- Energy
- Water
- Waste
- Green Campus & Biodiversity

Every department or supportive units coming under the university will work with students, faculty and support staff to foster a culture of self-sustainability and make the entire campus environmental friendly. Save Energy will be the motto of every day's working in each department or center. Every unit of the university will purchase only energy star compliant computers and equipment's.

Energy Conservation Guidelines

Save Energy concepts will be adopted by every unit of the university with reference to the following aspects:

1. Activate power management features on your computer and monitor so that it will go into a low power "sleep" mode when you are not working on it.
2. Turn off your monitor when you leave your Table.
3. Activate power management features on your laser printer.
4. Whenever possible, shut down rather than logging off.
5. Turn off unnecessary lights and use daylight instead.
6. Avoid the use of decorative lighting.
7. Use LED or Compact Fluorescent bulbs.
8. Keep lights off in conference rooms, classrooms, lecture halls when they are not in use.
9. Use the fans only when they are needed.
10. Unplug appliances not plugged into power strips (like TVs, Refrigerators, ACs, tea/coffee pots, printers, faxes, chargers etc.)

Water Conservation Guidelines

A Major step towards the preservation of the intricate water table in the area of all the campuses and buildings was the establishment of rain water harvesting structures, under UPE and University Grants. Further, to minimize water use following guidelines will be adopted by every unit of the university with reference to the following aspects:

a) Repair the points of water leakage such as, supply and distribution lines, dripping taps and showers as quickly as possible.
b) Install appliances which reduce water loss at utility points.
c) Encourage use of recycled rainwater and grey water.

d) Reuse the water coming out from RO purification systems for washing clothes in hostels.
e) Adopt Rainwater harvesting and Waste water Management methods in all buildings, lawns and play grounds.
f) Water flow restrictors on bathroom faucets and showers, low water flow toilets and automated urinal flushers should be used to cut down campus water use.
g) Every department has to work in the direction of waste water management particularly in student's hostels.

Waste Management Guidelines:

Waste minimization is very important because, it makes good business sense to protect the environment and boost environmental performance. Waste minimization techniques focus on preventing wastes at source and recycling.

The University's guidelines on waste management include the following aspects:

a) Keep a stack of paper that has been printed on one side and use it for day to day rough paper works.
b) Use more readout material in soft form. Reduce the hard readout material. Use more of e-mail for officially communicating the information needed, online reading etc.
c) Minimize the use of synthetic fertilizers and pesticides in the campus area, opting for the use of compost produced on site wherever possible.
d) Reduce the practice of burning plastic and other materials that emit harmful gas on burning.
e) Ensure that all cleaning products used by students and staff have a minimal detrimental impact on the environment.
f) Use two types of bins separately for biodegradable and non-biodegradable wastes in the campus as well as in hostels.
g) Recycle electronics and batteries in e-waste recycling bins located around campus.
h) Dispose the chemical waste generated from the laboratories in a scientific manner.

Adoption of Waste Management methods

- To adopt methods for waste segregation.
- Take appropriate actions to reduce or recycle municipal waste inside the campus.
- To manage, collect and dispose e-waste appropriately
- To reduce hazardous waste and its management
- Actions taken to reduce consumption of plastic in the campus.
- To encourage paperless work culture and recycling/ reuse of paper.
- Display waste management instructions/alerts at prominent/relevant locations in the campus.
- Water Management adopting following measures in campus to reduce water consumption.
- Change of taps which are either more water efficient or sensor based taps.
- Use of recycled water for watering plants, trees etc. Display water management instructions/alerts at prominent/relevant locations in the campus.
- Suitable action taken to reduce greenhouse gas emissions due to energy Consumption.
- Use of energy efficient lamps/sensor based lamps where ever possible like corridors, toilets etc.
- Use of energy efficient equipments in laboratories/ classrooms/ canteens.

Green Campus Initiatives of the University of Mysore

1. Allocation of budget for green practices.
2. Solar panels for street lighting and water heating.
3. Bore well recharge pits.
4. MoU's for recycling, e-Waste, Solid wastes.
5. Establishing composting and Vermi composting unit.
6. Maintain Plant Clinic, Botanical and Cactus garden.
7. Sign boards to create awareness.
8. Making inventory of Flora and Fauna of the campuses.
9. Green Army certificates.
10. Effluent Treatment practices (ETP)
11. Conducting Energy audit report s and enact conservation practices.

12. Conducting Green audit and submit reports.
13. Carbon Sequestration audit report.

Corrective Measures:

The IQAC shall conduct all audits on the campuses and take necessary steps to inform the concerned to comply with the strategy and policy requirements, annually.

Land use analysis for green audit report: Area coverage (in acres) for four campuses of the University of Mysore, Mysuru is as shown isn the following table

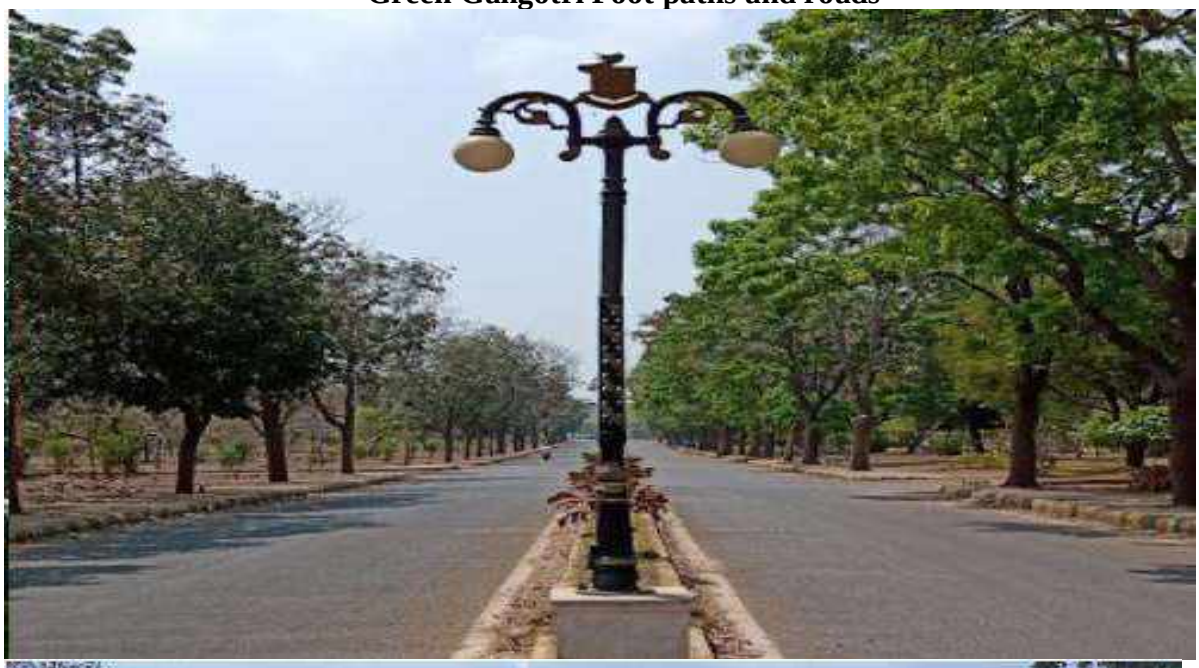
Land use analysis for green audit report: Area coverage (in acres) for four campuses of the University of Mysore, Mysuru

Sl. No.	Name of the Campus	Total area (acres)	Built up area (acres)	Road area (acres)	Green Area (Acres)						Total green area (acres)
					Garden (Horticulture)	Park	Lawn	Forest tree plantation area	Grass land and play ground	Water body (Kukkarralli lake)	
1	**Mysuru (Manasagangotri) Main campus**	801.08	64.02	40.00	71.0	13.0	42.0	400.00	51.00	120.0	697.0
2	**Dr. B. R. Ambedkar Center, Chamarajanagar**	54ac. 03 g	15 g (0.375 acres)	3acres 15 Gunta (3.375 acres)	-	-	0.50	38.50	11.25	-	50.25
3	**Hemagangotri campus, Hassan**	78ac.02g (78.05 acres)	10.5 gunta	24 gunta	2.0	-	-	40.00	35.14	-	77.14
4	**Sir M. Vishweshwarayya P. G. Center, Mandya**	95ac.16g	26 gunta	1 acre	-	05.0	02.0	38.00	48.75	-	93.75

Green area in Manasagangotri campus is 87% (including water body).
Green area in Manasagangotri campus is 72 % (excluding water body).
Water body of Kukkarahally lake is 15 %

Magnificent over view of Manasagangotri campus, UOM, Mysore, Mysore

Green Gangotri Foot paths and roads




"ನಿನಗೆ ನೀನೆ ದೀಪವಾಗು"

Crawford hall area (Maharaja &Yuvaraja colleges, Playground, Quarters)

CHAPTER – II

METHODOLOGY

University of Mysore has undergone three cycles of NAAC accreditation and is preparing itself for the fourth cycle of accreditation. The IQAC of the university is preparing the ground for the accreditation. This is the first attempt of preparing the Green Audit report of University of Mysore, Mysuru. Through a broad reference work and by studying some case studies clear idea of green auditing was obtained.

The audit process was carried out in three phases – Pre-audit, Audit and Post audit phases.

In the first phase, a pre-audit meeting was conducted and discussions were held on the sources of relevant data, methods of collection and analysis of data and the preparation of report. Separate teams were formed for the collection of data related to energy audit, water audit, waste management, biodiversity inventory, air & water quality of the campus. The team members according to the requirement, prepared sets of questionnaires based on the broad guidelines of statutory organizations. In the second phase, the surveyors, visited all the departments, offices, centers, hostels, canteens etc. with questionnaires and collected the data through interviews, expert opinion, surveys and enquiry and site visit observations. In the Third phase, the generated data was analyzed and final report is prepared in consultation with the authorities.

Collection of baseline data:

It is observed that a number of factors like climate, culture, food habits, work and working conditions, level and type of development, and physiology to determine the requirement of infrastructure facilities such as buildings, roads, energy, water etc.

Baseline data of each and every department/office/centre for green audit report preparation was collected by questionnaire survey method. In the first part of questionnaire the general information of the concerned department such as, total number of students and employees, visitors of the department, average working days and hours per day. In the next parts data (day/month/year wise) related to consumption of resources like water, energy, handling of wastes and inventory of flora and fauna of the campus and records related to maintenance of various details. The questionnaires include the questions on the following aspects.

For Energy audit:

Data on quantity of consumption of electricity, LPG, Petrol, diesel, firewood, *etc*., was collected from the departments/ offices/centers through questionnaires. Further, the amount paid for electricity, LPG cylinders, petrol, diesel etc in various offices was collected. Information on the number of CFL/incandescent/LED bulbs, fans, air conditioners, computers, photocopiers, TV etc. working in various buildings of the campuses along with the number of hours of usage per day and also the approximate consumption of electricity were collected.

Data on number of laboratory equipments and their usage hours/day in various science departments and their power consumption details were collected. From various hostels and canteens, the number of heaters, grinders etc. and their power consumption details were collected. Information on number of street lights and energy used by them per month was also collected. In addition, information on alternative energy sources/nonconventional energy sources employed and power consumption reduction measures taken in the campus was collected.

For Water audit:

The data on purposes of water use, sources of water, number of wells, number of motors used for pumping water from each well, the horse power of each motor, water storage facilities were collected. Further, information on the quantity of water pumped, used, wasted every day was collected. Information on number of water taps, bath rooms, toilet, urinals etc was collected. Information on consumption of water for various purposes was estimated through interactions with the stake holders. Further information on amount of water used per day for drinking, urinals, bath rooms, kitchen, laboratories, toilets and garden use was generated. Amount of water used in various laboratories, hostels for various purposes was collected. The data was collected on rain water harvesting units, water saving techniques adopted in the campuses. The students and staff were also asked to answer some questions to mention the ways which could reduce the amount of water used, reduce the wastage of water in the campus.

For Waste Management:

Approximate quantity of generation of various types of wastes in the campuses was collected through questionnaires and interviews. Information on adoption of methods of waste disposal, waste water treatment system, problems faced in waste management were collected.

Data and information **on** composting and vermicomposting activity, measures taken for collection and segregation wastes, number and type of dust bins in the campus was collected. Further questions were asked, to know the ideas of the inmates How to spread the message of recycling to others in the community.

Green Inventory and Biodiversity:

Information on the type of vegetation, total garden area, vegetation cover, botanical garden, medicinal plant garden, green house, glass house, agriculture garden, horticulture garden, inventory of flora and fauna of the campus, fishing activities in lake etc were collected through questionnaires. Further, number of trees with different type of canopies present in the campus was counted. Data on student activities in the garden, list of plants planted by students, published information on the flora and fauna of the campus, were collected. Questions were asked about the nature club in the campus, irrigation system, production of vegetables in the garden, awareness programmes conducted, ideas for further improvement of green cover of the campus.

Auditing for Carbon Footprint:

Information on total number of vehicles used (two wheelers, cars, tractors buses etc, average distance travelled and quantity of fuel and amount used by the stakeholders of the campus (per day)**,** number of persons using common (public) transportation (average distance travelled), average number of visitors with vehicles per day were collected. Further, number of generators used (hours per day), the amount of fuel used per day; number of LPG cylinders used in the canteen and the amount of fuel used per day and amount spent were collected. Further, suggestions were invited on the methods to reduce the quantity of use of fuel used by the student/teachers/non teaching staff of the university.

On site visit and observations:

University of Mysore has very vast built up area comprising of various department, administrative blocks, student hostels, guest houses, canteens, quarters which are having different kind of infrastructure. All these amenities have different kind of infrastructure as per their requirement. All these buildings were visited by the surveyors and the present condition is

checked with the help of questionnaires and review of documents. Personal observations were made by the audit teams.

Data computation and analysis:

The filled questionnaires of the survey from each group were tabulated as per the various aspects of auditing in excel spread sheets. For better understanding of the results averages and percentages of the activities were calculated. The tabulated data is then analyzed by the experts of the group and interpreted the overall outcomes of the survey. The interpreted data is presented in the report in a consolidated form. For the sake of convenience to present the data, the departments/offices/centers, hostels/guest houses, canteens quarters etc were grouped in different blocks based on their, water consumption and energy consumption pattern into five Building blocks (Building block A, B, C, D and E as given in the following table.

Table 2.1 Buildings of main campus of University of Mysore housing different departments

Sl. No.	Building Category (BC)	Buildings (Departments / offices housed in the building)	Population	Code
1	Administrative and support services	Crawford Hall, Library and Information Science, Engineering division /garden/NCC, Academic Staff College, Senate bhavan, Moulya Bhavana, BM Sri Auditorium, BIMS Auditorium, Amphi theater, Jayalakshmi Vilas palace, Health Centre (Manasagangotri), Prasaranga, Bank, Post office, Waste management center (Composting), Indoor stadium, Swimming pool .	Non teaching staff + visitors = 1050	**BC– A**
2	Science and Technology departments	Biochemistry, Biotechnology, Botany, Chemistry, Computer Science, Earth Science, Electronics, Environmental Science, Food Science and Nutrition, Genetics and Genomics, Geography, Human Development, IOE, Mathematics, Microbiology, Molecular Biology, Organic Chemistry, Physics, Psychology, Sericulture Science, Statistics, Zoology	Teachers + nonteaching staff + students = 2150	**BC– B**
3	Humanities, Social sciences, Commerce, Law departments	Ambedkar studies, Ancient History and Archaeology, Anthropology, Centre for Women Studies, Christianity, Commerce, Babu Jagjeevan Ram studies, Criminology, Economics and Cooperation, Education, EMMRC, English, Fine arts college, Gandhian studies, Hindi, History, IDS, Jainology and Prakrit, Journalism and Mass Communication, Kuvempu Institute of Kannada Studies, BIMS, NCHS, Oriental research institute, Peace and Conflict Resolution, Philosophy, Physical Education, Physical Education & Sports Science, Political Science, Public Administration, Sanskrit, School of Law, School of Planning & Architecture, Social Work, Sociology, Urdu.	Teachers + nonteaching staff + students = 3210	**BC – C**
4	Hostels	P.G. Boys Hostel B-1, MGM, P.G. Boys Hostel B-2, MGM, P.G. Boys Hostel B-3, MGM, P.G. Hostel, P.G. Ladies Hostel B-1, MGM, P.G. Ladies Hostel B-2, MGM, P.G. Ladies Hostel B-3, MGM, Physical Education Hostel, New Physical Education Ladies Hostel, Vishwamanava Int. Hostel, Working Women Hostel.	Nonteaching staff + students = 2400	**BC – D**
5	Guest houses, canteens and quarters	Manasa Guest House, DANIDA Guest House, International Guest House, Academic Staff College Guest House. Round Canteen, Downs Canteen. A few Quarters	Guests, students & residents = 1060	**BC – E**

Preparation of the report:

The Green audit committee analyzed the data and information collected by the various teams, discussed with the experts and advisors and prepared the report.

CHAPTER III

ENERGY AUDIT

Energy audit and its importance

An energy audit is an inspection survey and as analysis of energy flows for energy conservation in a building. It includes a process or system to reduce the amount of energy input into the system without negatively affecting the output. In an organization an energy audit is the first step in identifying opportunities to reduce energy expense and carbon footprint. Energy is one of the major inputs for the economic development of any country. The energy audit is key to a systematic approach for decision making in the area of energy management. It attempt to balance the total energy inputs with its use, and serve to identify all the energy streams in a facility.

Energy resources utilized by all the departments, support services and the administrative buildings of University of Mysore, Mysuru campus include electricity and liquid petroleum. Major use of the energy is at office, canteen, hostel and laboratories, for lighting, transportation, cooking and workshop instruments.

3.1: Electricity Audit:

Electricity is supplied to the University campus by Karnataka Power Transport Corporation Limited of State Electricity Board. There are eight High Tension (HT) power yards which supply the major electricity to the campus. The annual actual power consumption of the entire university is around **23,50,959** kW.

3.1.1: Electricity Audit of Manasagangotri Campus:

Building block wise consumption of electricity in the campus:

From the data collected on distribution and usage (consumption pattern) of electricity to various buildings, housing different departments and offices are grouped into five blocks (Block-A, Block-B, Block-C, Block-D & Block-E). The details of various departments and offices identified under different groups are listed in Table (xx) presented under methodology. The

electricity consumption pattern is presented as per the usage by allocating approximate quantity of electricity for various sectors listed in the following tables.

3.1.1.1: Electricity consumption in building Block A

The total electricity consumption by major electrical equipments in Building Block A is **4,13,606.3** kW/annum. More than 50% of the electricity is consumed by ACs **(29.45%)** and computers **(24.17%)** as there are **47** ACs and **1157** computers in various buildings of this block. Many officer rooms in this block are having ACs. Third major share **(15.03%)** of electricity is by tube lights and incandescent bulbs which are more in number in these buildings. Apart from these water pumps **(11.69%)** and ceiling fans **(11.62%)** are also consuming substantial quantity of electricity. The details of power consumption by various equipments provided in the buildings of this block are given in **Table 3.1.**

Table 3.1: Electricity consumption by major equipments in Building Block A

Sl. No.	Equipment	Number	kW/Annum	Percentage
1	AC	47	121824	29.45
2	Computer	1157	99964.8	24.17
3	Tube light + Incandescent bulb	1308	62156.2	15.03
4	Water pump	9	48340.8	11.69
5	Celling fan	742	48081.6	11.62
6	Printer	70	12096	2.92
7	CFL bulbs	429	6671.8	1.61
8	Projector	35	5685.1	1.37
9	Refrigerator	10	5400	1.31
10	Xerox Machine	4	1152	0.28
11	Scanner	50	576	0.14
12	TV	5	500	0.12
13	Others		1158	0.28
	Total	**3866**	**4,13,606.3**	**100.00**

3.1.1.2: Electricity consumption in building Block B

In Science and Technology Departments there are many laboratory equipments which are regularly used for research and practical purpose. The total number of major equipments is found to be 1342, which consumes a total of 308313.6 kW/annum. The second highest consumers of electricity in this block are air conditioners which are 77 in number. They are found to consume 266112

kW/h with 26.76 %. The next important consumers of electricity are refrigerators (218 Nos) and computers (660 Nos) which consumes 126440 kW/ annum (11.69%) and 114048 kW/annum (11.62%), respectively. The power consumption of tube lights and ceiling fans was found around 5% of the total consumption. The details of number of other equipments and their power consumption per annum are given in **Table 3.2.**

Table 3.2: Electricity consumption by major equipment's in Building Block B

Sl. No.	Equipment	Number	kW/Annum	Percentage
1	Lab Equipments	1342	308313.6	31.01
2	AC	77	266112	26.76
3	Refrigerator	218	126440	12.72
4	Computer	660	114048	11.47
5	Tube light + Incandescent bulb	680	53856	5.42
6	Ceiling Fan	725	50112	5.04
7	Water pump	4	25781.8	2.59
8	LCD Projector	90	20736	2.09
9	CFL bulbs	460	9538.6	0.96
10	Printer	68	11750.4	1.18
11	Xerox Machine	23	6624	0.67
12	Scanner	30	345.6	0.03
13	Others		720.9	0.07
Total		**4377**	**9,94,378.9**	**100.00**

3.1.1.3: Electricity consumption in building Block C

The block C includes Departments of Arts, Commerce and Law. In these buildings 11 major equipments/appliances are identified as major electricity consumers. In these departments the total power consumption is **2,74,154.9** kW/annum. The consumption of electricity of various equipments with their numbers are presented in **Table 3.3.** The data revealed that the computers which are 1070 in numbers consume 92448 kW/annum sharing 32.72 % of total electricity of the block. In this building also ACs which are 20 in number are the second major consumers of electricity. Tube lights and bulbs (790 Nos) as well as ceiling fans (553) consume around 13 % electricity. The electricity consumption of remaining seven equipments is found to be less as detailed in the table.

Table 3.3: Electricity consumption by major equipment's in Building Block C

Sl. No.	Equipment	Number	kW/Annum	Percentage
1	Computer	1070	92448.0	33.72
2	AC	20	51840.0	18.91
3	Tube light + Incandescent bulb	790	37540.8	13.69
4	Celling fan	553	35834.4	13.07
5	Projector	81	19735.5	7.20
6	Water pump	3	16113.6	5.88
7	CFL bulbs	394	6127.5	2.24
8	Refrigerator	11	5940.0	2.17
9	Printer	52	4492.8	1.64
10	Xerox Machine	18	2592.0	0.95
11	Scanner	7	40.3	0.01
12	Others		1450.0	0.53
Total		**2999**	**2,74,154.9**	**100.00**

3.1.1.4: Electricity consumption in building Block D

The 'D' building block includes ten hostels with 2300 inmates. The total electricity consumption of all these hostels is found around **3,71,396.4** kW/annum which is the highest among the various blocks. In these hostels ten major electricity consuming equipments are listed with their number, quantity of power consumption and percentage of power consumption in **Table 3.4**. Characteristically geysers which are 20 in number are found to consume electricity of 105000 kW/annum which amounts to 28.27%. The next type of equipments which consume more energy are tube lights and bulbs which are more in number (1164) showing the consumption of 92188.8 kW/annum (24.82 %). Ceiling fans which are 963 in number also consume 22.40 % of electricity. The water supplying six motor pumps are also consuming considerable amount of electricity of 14.17 %. The percentages of electricity consumption of remaining five types of equipments are ranging between 0.22 to 3.90. The details of electricity consumption of all the major equipments are tabulated in table 3.4.

Table 3.4: Electricity consumption by major equipment's in Building block D

Sl. No.	Equipment	Number	kW/Annum	Percentage
1	Geyser	70	105000	28.27
2	Tube light + Incandescent bulb	1164	92188.8	24.82
3	Ceiling Fan	963	83203.2	22.40
4	Water Pump	6	52637.8	14.17
5	Refrigerators	25	14500	3.90
6	Grinder	10	8100	2.18
7	Mixer grinder	10	5400	1.45
8	Computers	60	5184	1.40
9	CFL Bulbs	220	3421.4	0.92
10	LED TV	10	800	0.22
11	Others		961.2	0.26
Total		**2538**	**3,71,396.4**	**100.00**

3.1.1.5: Electricity consumption in building Block E

This block includes guest houses, canteens and quarters. There are 12 major types of equipments consuming the electricity ranging between 135.4 to 43200 kW/annum. In this block also geysers which are 20 in number consume maximum electricity (43200 kW/annum) with 27.12% of total consumption. Similar to the block D, in the block E also the second highest consumers of electricity are tube lights and bulbs which are totally 401 in numbers with consumption of 31759.2 kW/annum (19.94 %). The third, fourth and fifth highest consumers of electricity are ceiling fan, water pump and ACs, respectively. The details of number of equipments and their electricity consumption with percentage of consumption of all the equipments housed in these buildings are presented in **Table 3.5**.

Table 3.5: Electricity consumption by major equipment's in Building Block E

Sl. No.	Equipment	Number	kW/Annum	Percentage
1	Geyser	20	43200	27.12
2	Tube light + Incandescent bulb	401	31759.2	19.94
3	Ceiling Fan	240	23760	14.91
4	Water Pump	3	20679.1	12.98
5	AC	9	19440	12.20
6	Refrigerators	15	8700	5.46
7	CFL Bulbs	310	5892.5	3.70
8	LED TV	21	1785	1.12
9	Grinder	5	1716	1.08
10	Mixer grinder	5	924	0.58
11	Computers	10	792	0.50
12	Projector	2	135.4	0.08
13	Others		525.7	0.33
Total		**1041**	**1,59,308.9**	**100.00**

3.1.1.6: Overall Consumption of Electricity by all the equipments/appliances with rank

In this audit, by overall 16 major types of equipments consuming electricity are accounted. Depending upon their total power consumption they are ranked from I to XVI in **Table 3.6**. The data indicates that ACs which are 153 in number are most power consuming appliances ranking first with 20.75% of total electricity consumption of the campus. The second and third rank is found with computers (14.12 %) and lab equipments (13.93 %) respectively which consumes almost equal amount of electricity. The next highest consumer of electricity (IV rank) in the campus are tube lights + incandescent bulbs with 12.54% of total power consumption. The ceiling fans which are 3223 in number consume 10.89% of electricity and scored V rank. Water pumps (25) used for pumping water is also found to consume considerable amount of electricity and occupy the VI rank among the various types of electricity consuming equipments. Hence, it is observed that out of 16 types of electricity consuming equipments / appliances, the top six ranked items consumes 79.62% of total power consumption of the campus and the remaining 11 types consume only less than 20%. So, if these major appliances/equipments are retrofitted or adopted/linked to solar major saving of electricity and/or

money can be achieved. The least power consuming equipments (XVI rank) are scanners which are found 87 numbers and consuming 0.04 % of total electricity consumed in the campus.

Table 3.6: Overall Consumption of Electricity by all the equipments/appliances with rank

Sl. No	Equipments	Number of equipments in Building blocks					Total number	Total electricity consumption (kW/annum)	% of electricity consumption	Rank
		A	B	C	D	E				
1	ACs	47	77	20		09	153	459216	20.75	I
2	Ceiling fans	742	725	553	963	240	3223	240991.2	10.89	V
3	CFL bulbs	429	460	394	220	310	1813	31651.8	1.43	X
4	Computers	1157	660	1070	60	10	2957	312436.8	14.12	II
5	Geysers	-	-	-	70	20	90	148200	6.70	VIII
6	Grinders	-	-	-	10	05	15	9816	0.44	XIII
7	Lab equipments	-	1342	-	-	-	1342	308313.6	13.93	III
8	LED TV	05	-	-	10	21	36	3085	0.14	XV
9	Mixes grinder	-	-	-	10	05	15	6324	0.29	XIV
10	Printer	70	68	52	-	-	190	28339.2	1.28	XI
11	Projector	35	90	81	-	02	208	46292	2.09	IX
12	Refrigerator	10	218	11	25	15	279	160980	7.27	VII
13	Scanner	50	30	07	-	-	87	961.9	0.04	XVI
14	Tube lights and Incandescent bulbs	1308	680	790	1164	401	4343	277501	12.54	IV
15	Water pumps	09	04	03	06	03	25	163553.1	7.39	VI
16	Xerox Machine	04	23	18	-	-	45	10368	0.47	XII
17	Others							4815.8		
	Total							2212845	100	

3.1.2: Electricity consumption in Satellite Centers of University of Mysore

3.1.2.1: Dr. B. R. Ambedkar P G Center, Chamarajanagar

In this center, 10 types of electrical apparatus/appliances are identified for electricity auditing. The data on the number of each type of equipment, electricity consumed and percentage of electricity consumption are presented in **Table 3.7**. The data indicates that ceiling fans which are 50 in number consume maximum amount of electricity (2700 kW/annum) and sharing 19.36 % of total power consumed in the center. Only one water pump consumed the electricity almost equal to that of 50 ceiling fans presently operating in the center. It is also observed that tube lights + incandescent bulbs and geysers are in second and third place in the consumption of electricity. The minimum consumer of electricity is by the two Xerox machines present in the center.

Table 3.7: Electricity consumption by major equipment's in Building

Sl. No.	Equipment	Number	kW/Annum	Percentage
1	Ceiling Fan	50	2700	19.36
2	Water Pump	1	2685.6	19.26
3	Tube light + Incandescent bulb	55	2178	15.62
4	Geyser	3	1800	12.91
5	Exhaust Fan	4	1208	8.66
6	Computer	20	1152	8.26
7	Projector	5	812.2	5.82
8	Printer	5	432	3.10
9	CFL Bulbs	30	388.8	2.79
10	Xerox Machine	2	288	2.07
11	Others		298.7	2.14
Total		**175**	**13943.26**	**100.00**

3.1.2.2: University Post Graduate Center, Hemagangotri Campus, Hassan

For the auditing of electricity consumption 14 major equipments are taken into account. The data on the amount and percentage of electricity consumption of all these equipments are presented in **Table 3.8**. The tube lights and incandescent bulbs which are 340 in number consume maximum amount of electricity (16156.8 kW/annum) sharing the 33.18 % of total consumption of electricity in the center. The second maximum of consumption of electricity was by 147 ceiling fans. The geysers which are five in number also found consumed 6000 kW/annum

of the electricity sharing 12.32 %. The remaining equipments are consuming comparatively less amount of electricity.

Table 3.8: Electricity consumption by major equipment in Hemagangotri campus

Sl. No.	Equipment	Number	kW/Annum	Percentage
1	Tube light + Incandescent bulb	340	16156.8	33.18
2	Ceiling Fan	147	12700.8	26.08
3	Geyser	5	6000	12.32
4	Water Pump	1	3222.7	6.62
5	Computer	25	2880	5.91
6	Printer	11	1900.8	3.90
7	Refrigerators	3	1740	3.57
8	Projector	10	1624.32	3.34
9	Exhaust Fan	2	1208	2.48
10	Xerox Machine	2	288	0.59
11	CFL Bulbs	8	207.4	0.43
12	Mixer Grinder	1	180	0.37
13	Oven	1	110	0.23
14	LED T V	1	99	0.20
15	Others		380	0.78
Total		**557**	**48697.8**	**100.00**

3.1.2.3: Sir. M. Vishweshwarayya P. G. Center, Mandya

Out of 11 types of major equipments accounted for their electricity consumption, tube light and incandescent bulbs and ceiling fans are found to consume 67.92% of total electricity consumption by the center similar to that of Hemagangotri campus. One water pump also consumed considerable amount of electricity 6445.4 kW/annum with 8.54 % of total consumption. The least amount of electricity consumption was with two LED TVs present in the campus. The details of electricity consumed and the percentage of consumption by all the equipments of the center are presented in **Table 3.9**.

Table 3.9: Electricity consumption by major equipment/appliances in Sir. M. Vishweshwarayya P. G. Center, Mandya

Sl.No.	Equipment	Number	kW/Annum	Percentage
1	Tube light + Incandescent bulb	425	26928	35.68
2	Celling fan	325	24336	32.24
3	Water pump	1	6445.4	8.54
4	Refrigerators	9	5850	7.75
5	Printer	15	3888	5.15
6	Computer	20	2880	3.82
7	Xerox Machine	3	1296	1.72
8	LCD Projector	5	1218.2	1.61
9	Oven	4	700	0.93
10	Sound system	1	440	0.58
11	LED T V	2	198	0.26
12	Others		1293	1.71
Total		**810**	**75472.6**	**100.00**

3.1.3: Overall consumption of electricity and amount paid in four centers of University of Mysore:

The data on total amount of electricity consumed and amount paid as electricity charges in four campuses of University of Mysore are presented in **Table 3.10**.

Table 3.10: Total energy consumption (kW/annum) and amount paid (Rs)

Sl. No.	Campuses	Electricity Consumed (kW/Annum)	Percentage of electricity consumed	Amount paid towards Electricity (Rs)	Amount paid per unit (Rs)
1	Manasagangotri Campus, Mysuru	22,12,845.4	94.13	2,02,12,892	9.13
2	Dr. B. R. Ambedkar Center, Chamarajanagar	13943.26	0.59	1,79,169	12.85
3	Hemagangotri campus, Hassan	48697.8	2.07	4,25,354	8.73
4	Sir. M. Vishweshwarayya P. G. Center, Mandya	75472.6	3.21	7,55,824	10.01
Grand total		**23,50,959**	**100**	**2,15,73,239**	**9.18**

The main campus of University of Mysore was found to consume **94.13 %** of electricity out of the total amount consumed by all the centers. Among the three sub centers the electricity consumption was found highest (3.21%) in Sir. M. Vishweshwarayya P. G. Center, Mandya and

least (0.59 %) in Dr. B. R. Ambedkar Center, Chamarajanagar. The analysis of amount paid per unit of electricity indicated that it is highest in Dr. B. R. Ambedkar Center, Chamarajanagar (Rs. 12.85) and least in Hemagangotri campus, Hassan (Rs.8.73).

3.2: FUEL AUDIT

Diesel/ petrol consumption:

By vehicles of University:

There are 11 cars, one mini bus, one tempo, two tractors and 1 tipper being used in the University for official purpose. The amount spent for diesel/ petrol for these official vehicles is **Rs. 2,04,51,000/-** at the rate of **Rs.75/liter** for petrol or diesel. The total consumption of the fuel is **2,72,680** liters during the auditing year.

Table Consumption of Diesel / petrol by generators, university vehicles and motors in Horticulture division

Sl. No	Department	No. of generators	Specifications	Consumption /month (Liters)	Consumption / year (Liters)
1	Moulya Bhavana	1	124 KV	40 lts	480
2	BIMS	2	82.5 KV 30 KV	48 12.5	576 150
3	International Students Hostel	1	125 KV	192	2304
4	Manasa Guest house	1	30 KV	120	1440
5	Printing Press	1	125 KV	10	120
6	Library	1	48 KV	40	480
7	Senate Bhavana	1	62.5 KV	10	120
8	Computer science	2	62.5 KVA	20	240
			62.5 KVA	20	240
9	Zoology	1	15 KV	11	132
10	Crawford hall	1	125 KVA	440	5280
	Total	**12**		**963.5**	**11562**
	Diesel/ petrol consumption by university vehicles				**2,72,680**
	Diesel/ petrol consumption at Horticulture division				4,828
Grand total					**289070**

By generators:

There are 12 generators installed at various departments of Manasagangotri Campus. The total consumption of diesel by these generators is 11562 liters during the year under report.

By motors of horticulture division:

Diesel /petrol is being used for water pumping motors (3 No's) and weed cutters (10 No's) of the division. The total annual consumption of these motors is 4828 liters.

Thus totally, 289070 liters of Diesel/petrol is consumed for the vehicles, generators and motors in the campus during 2018-19. The details of Diesel/petrol consumption are presented in **Table 3.11**.

LPG Consumption:

Number of LPG cylinders consumed by various hostels, canteens and departments are 382 in number.

Summary:

A brief summary of the actual consumption details of electrical appliances with saving potentials of the entire university are given as below;

1. We have **5163** number of ordinary incandescent and tube lights of 56W in our university with actual consumption of **3,22,764 kWh**. If retrofitted with 20W LED tubes, we can save an energy of **2,07,491 kWh** per year.
2. There are **3745** fans (75W) working in our university with actual consumption of **2,80,728 kWh**. If retrofitted with 30W power saving fans, we can save an energy of **1,68,437 kWh** per year.
3. There are **1851** CFL bulbs with 19W, with actual consumption of **32,248kWh**. These 19W CFL can be replaced with 12W LED lamps, which can save up to **11,881 kWh** per year.
4. We have **153** Air conditioners in our campus, with actual consumption of **4,59,216 kWh**. If replacing these old & inefficient split type AC with 5-star AC. The expected energy saving potential is **1,53,072 kWh** per year.
5. There are **3022** computers in our university, with actual consumption of **3,19,349 kWh**.
6. There are **28** water pumps, **52** Xerox machines, **228** projectors, **87** scanners, **221** Photocopiers and **98** geysers in our campus with actual total consumption of **2,53,709 kWh.**
7. We have **39** TV's, **292** numbers of refrigerators, with annual consumption of **171952 kWh**. Besides, there are **1342** major electrical equipments in different labs of the departments with annual consumption of **308314 kWh**, and **16** display boards were kept at different departments.

From the power consumption details retrieved from all PG Centers of University of Mysore, we infer that an approximate energy saving potential of **5,40,881kWh** per annum could be achieved based on recommendations given by energy audit committee.

Final remarks

Alternative energy initiatives:

Solar energy-based initiatives were conspicuously seen inside and outside the campus buildings. Mainly the street lights of our serene campus have been lighted by 500 solar lamps of 9W each. In comparison with street electric tube lights of 300 in numbers of 250 W, solar lighting has become more energy saving potential rather than existing old tube lights. Apart from solar lighting in the streets of the campus, some departments and hostels have been equipped with solar lights and heaters with respect to their demand potential. The clear picture of solar energy potential attributes would be recommended to the whole campus buildings. Maintenance of the solar lights is very cheap and cost-effective, unless the rooftops or the street lamps are uncovered by tree shades etc. Initiatives have been taken to procure 40 kW solar power generators and proposed to install them on each major departments of the campus.

Percentage of lighting:

The percentage of solar lighting existing in the campus is approximately being 5%. If retrofit the existing old existing Equipment/appliances with energy efficient and environment friendly by LED and Solar based Equipment/appliances (such as LED bulbs/Tubes, Star rated Fan, Inverter, Air Conditioners, water pumps etc). There could be a drastic reduction of power consumption and also the cost saving potential will be worthy of saving towards Crores of rupees (as evident based on our existing data). The percentage of Solar and LED lighting from the existing 5-10% potential can transform to approximately 40-50%.

Conservation Practices:

Solar and LED based usage practices are the more viable energy efficient and conservation systems that are profoundly implemented in the campus. More than 20% cost of power expenditures can be reduced by implementing the energy efficient systems. As of now, campus with this energy saving policy and implementation, the initial expenditures would cost little bit higher, but near future it will pay back with power savings and less expenditures.

High mast light systems in the campus are efficiently managed by using sensors to put on and off by themselves (Zero human control). Likewise, clock tower with radio station functions with a sensor. Such sensor systems could be implemented for lighting in the buildings and for the other avenues depending on the potentialities.

The annual actual power consumption of the entire university is around 23,50,959 kWh and power expenditure is of Rs. 2,15,73,239/-. Based on the above recommendations and available existing data, the annual energy savings for one year will be approximately of 5,40,881 kWh, and annual cost savings will be of Rs. 36,77,991/-. For 5 years, the approximate power saving potentials will be of 27,04,405 kWh and the cost savings of Rs. 1,83,89,954/-, respectively.

Solar panels in Physics department:

CHAPTER IV

WATER AUDIT

Water is a very valuables natural resource and the per capita availability of utilizable water is decreasing day by day due to ever rising standard of living of people, industrialization, urbanization and demand of fresh water is increasing day by day. The unabated discharge of industrial effluent in to the available water bodies is reducing the quality of sources of water continuously. Hence, the national mission on water conservation ('Jal Shakti Abhiyan') has appealed to all citizens to collectively address the problem of water shortage, by conserving every drop of water and suggested for conducting water audit for all sectors of water use. Water audit can be defined as a qualitative and quantitative analysis of water consumption to identify means of reducing, reusing and recycling of water. It helps to identify ways of conserving water by determining any inefficiency in the system of water distribution.

In water auditing availability of water from various sources, usage of water, recycling of water and usage of recycled water are accounted. Water is used for all activities which are carried out on campus from different water sources. This includes usage in all residential halls, academic and service buildings. Waste water is referred as the water which is transported off the campus. The waste water includes the used water from kitchen, bathrooms, washing of clothes, general dormitories, as well as waste water from research laboratories.

The standard norm for domestic water usage in India is 135 lcpd. It is reported that, consumption of water increases with wealth and house size and decreases if connection is shared by multiple people. It is also observed that a number of factors like climate, culture, food habits, work and working conditions, etc determine the requirement of water. The usage of water also depends on its availability and supply systems.

3.1: Sources of Water in Mysuru campus of University of Mysore:

For the campus, water is supplied from five sources, of which one is external source (Vani vilas water supply) and the remaining four are internal sources. A total quantity of **7,79,963** liters of water is obtained from these five sources. The major source of water is underground water lifted through bore wells which contributed **67.04 %** of total water supply. Kukkarahalli lake is second most important natural source, which is providing 19.36%

(**1,51,000** liters) of water requirement of the campus. The university also initiated rain water harvesting practice by installing **10** roof top Rainwater harvesting facilities in the campus which provide water@20,000 liters of water per day. The data related to sources, supply area, quantity per day in liters and percentages of contribution is presented in **Table 3.1**. Further a quantity of **34,664** (4.47%) liters of recycled water is made available for horticulture plots.

Table 3.1: Sources of water and their supply capacity

Sl.No.	Sources	Supply to	Quantity per day (liters)	Percentage
1	Bore Wells	Building blocks	**5,24,299**	67.22
2	Vani vilas Water supply	Hostels	50,000	6.41
3	Rain water harvesting	For the hostels and departments	20,000	2.56
4	Kukkarahally lake water	Gardening	1,51,000	19.36
6	Recycled water	Horticulture	34,664	4.44
	Total		**7,79,963**	**100**

3.1.1: Rain water harvesting

The data related to the rain water harvesting facilities with sumps having total storage capacity of **11,92,000** liter and harvesting annually (2017-18) a total of **45,47,053** liter of rain water are provided in **Table 3.2**.This facility contributes only **2.58%** of total water supplied in the campus. The details of water supplied from various sources are presented in tab- 3.2.

Table 3.2: Rain water harvesting facilities created in the campus

Rain water harvesting facilities			
Sl. No.	**Name of the building**	**Sump capacity (liters)**	**Collection /yr (liters)**
01	Humanities block	1,80,000	10,99,556
02	Library	2,16,000	9,59,324
03	Commerce & Mathematics	2,16,000	6,52,826
04	History & Geology	1,20,000	3,42,504
05	Earth Science	1,05,000	5,13,059
06	Ladies Hostel Block-1 & 2	50,000	1,44,210
07	School of Law	50,000	2,43,034
08	School of planning	50,000	1,97,340
09	Commercial Complex (SJCE Downs)	50,000	1,64,450
10	Engineering Division & Manasa Guest House	50,000	2,30,750
	Total	**11,92,000**	**45,47,053* 20,000 liters/day**

As a part of Green campus initiatives, the university also installed **10** roof top Rainwater harvesting facilities in the campus and harvesting 20,000 liters of water per day.

3.1.2: Bore wells and water supply pumps

There are 19 Bore wells with 19 Mono block submersible pumps of different capacities (HP) in the campus. In addition there are two open wells on east and west side of Kukkarahalli Lake with four surface pumps one each of 10 HP and 7.5 HP and two 5 HP capacity. The details of spots, number of hours of pumping per day, Yield of pump per hour and total quantity of water pumped per day of above said 25 water supply pumps are presented in **Table 3.3.**

Table 3.3: List of Bore wells and their yield

Sl. No.	Location: Two 10 HP motor; Two 7.5 HP motor; Remaining are 5 HP motors.	Quantity of water pumped / day (hrs.)	Pumpingcapacity l/ hr	Pumping/day (L)
1	Near Sericulture, MGM 7.5HP	12 hrs./day	6500	78000
2	Behind pump house, MGM	12 hrs./day	4333	51996
3	P.G.Gents hostel block -2	7hrs/day	4333	30331
4	P.G.Gents hostel block -1	6hrs/day	4333	25998
5	Working womens hostel, MGM	6hrs/day	4333	25998
6	School of plannig, MGM	5hrs/day	4333	21665
7	Printing press, MGM	5hrs/day	4333	21665
8	BIMS	7hrs/day	4333	30331
9	Ladies hostel P.G Block 1&2	7hrs/day	4333	30331
10	ladies hostel P.G Block 03	5hrs/day	4333	21665
11	Humanaties, MGM	6hrs/day	4333	30331
12	Senate Hall, MGM	4hrs/day	4333	17332
13	IOE, MGM	4hrs/day	4333	17332
14	New Building Law Department, MGM	4hrs/day	4333	17332
15	New Building Organic Chemistry	4hrs/day	4333	17332
16	Opp to Open Air Theatere, MGM	4hrs/day	4333	17332
17	Academic Staff college Guest House	5hrs/day	4333	21665
18	Guest House, MGM	5hrs/day	4333	21665
19	MoulyaBhavan, MGM	5hrs/day	4333	21665
Total				**519966**
23	Kukkarahally lake-1& 2 East bank (2 No), **7.5HP**	5*2=10hrs./day each motor (450L/min)	65000 **+20000**	151000 + 49000*
24	Kukkarahally lake-3 & 4 West Bank (2 No) **10 HP**	5*2=10hrs./day each motor	86000 **+29000**	
25	Garden-1 Horticulture office (1 No)	4 hrs./day	17332	34664 Recycled
26	Garden-2 Near Staff Qts. West (1 No)	4 hrs./day	17332	

Note: *average quantity of water for construction work in liters per day)

3.1.3: Kukkarahally Lake

Kukkarahally Lake is a natural water body is a boon to the campus. It is providing a substantial quantity (**19.47%**) of water required for the maintenance of vegetation in the campus and also recharging of bore wells operating in the campus as well as the surrounding bore wells. The water body in the lake is in area of around 100 acres. The engineering division of the university is properly maintaining its natural inlet (Poornaiah canal) and six diversion inlets at different sides of the lake for recharging the tank with rain water. The lake is a boon to the university campus without which the campus faces serious water scarcity.

Further, pisciculture is being practiced and encouraged in the lake and a revenue of Rs. 33,43,009 has been generated through auctioning of fishes during 2014–2019.

The 3KAR naval unit of NCC based in campus is using the lake for its training activities. Every year it is conducting sailing activities to train the cadets for All India Yachting Regetta Camp to be conducted at INS Chilka, Odisha and also boat pulling activity to train the cadets for Nausainik Camps to be conducted at Karwar and Goa.

Mummadi Krishnaraja Wodeyar (1794-1868) of the Mysore Dynasty (Kingdom Mysore) was responsible for getting the lake created in the year 1864. Sandy loam to clay loam from the dominant geological condition of the lake. The highest flood level in the lake is 755.73 m (2,479.4 ft).

3.1.4: Recycling of drainage water (Waste water management)

Entire waste water is going to the drainage. However, at two points (garden behind the quarters of west side of the campus and Northern side of old nursery),Horticulture division has made two simple recycling units in which the drainage water after sedimentation in tanks is diverted to the gardens.

3.2: Water consumption:

The quantity of water consumed (per day) for various activities of the campus are given in **Table 3.5.** It is observed that the major quantity (**5,37,675** liters) of water is used for domestic activities. Various domestic activities are identified and uses listed separately in subsequent

tables of different building blocks. The second highest requirement of water is for gardening (1,51,000 liters) purpose. The water obtained from recycling of waste water is used for horticulture (33,139 liters) purpose.

3.2.1: Water consumption for construction/development activities in the campus:

During the year under report there are four major construction activities for which the contractor has made his own arrangement for getting the water from the nearby bore wells. By taking temporary electricity connections for this facility the amount will be collected on nominal rates. The ground water exploited for these activities is 10 lakh liters. Apart from this 21 minor constructions works [repair and additional construction activities] took place by using water supply from regular bore wells. The approximate total quantity of water consumed for all the construction activities during 2018-19 is **12,52,500** lts.

3.4 Quantity of water consumed for construction works in the campus during 2018-19

2018-19		
Sl No	**Major Works (Water supply arranged by contractor on his own)**	**Approximate quantity of water consumed (Liters)**
1	Construction of Ladies hostel for Physical Education Department, University of Mysore, Mysore	4,00,000
2	Construction of Yoga hall for Physical Education Department, University of Mysore, Mysore	3,00,000
3	Construction of first floor (North Wing) for Nutrition Biology, Department of Studies in Food Science and Nutrition at MGM	2,00,000
4	Designing Rain water Harvesting System at Manasagangotri Campus, University of Mysore.	2,00,000
	Total (A)	**11,00,000**
	21 Minor Works (Water supplied through the University supply system) includes repair works, construction of store rooms, toilets, repair works at quarters, painting works and others undertaken at various buildings in the campus.	49,000
	Total (B)	**49,000**
	A + B	**11,49,000**

Table 3.5: The quantity of water consumption for various activities

Sl. No	Activities	Quantity (liters)	Percentage
1	Domestic activities	**537675**	69.12
2	Laboratory	**50000**	6.43
3	Gardening	**151000**	19.41
4	Horticulture	**34664**	4.46
5	Construction works	**4500**	0.58
	Total	**7,77,839**	100

The quantity of water required for domestic purpose is obtained mainly from bore wells and details of bore wells situated in various places of the campus and their capacities of their pumps, yield, and quantity of water pumped per day are listed in **Table 3.3.** The 19 bore wells supply a total quantity of 5,63,296 liters of water for the domestic and laboratory purpose in the campus.

A total quantity of 1,51,000 liters of water is pumped every day for gardening purpose from four pumps installed at two open wells on either side of the Kukkarahally Lake. In each of these two wells two motors are fixed which works alternatively for 5 hours a day. The pumped water is stored in two sumps of 50,000 liters capacity and used for gardens of various departments, guest house and hostel in the campus. The remaining 2 pumps of 5 HP each are also fixed for the open wells located at western side of the campus. These two pumps are supplying a quantity of 34,664 liters of recycled water for horticulture gardens.

3.2.2: Building block wise consumption of water in the campus:

From the data collected on distribution and usage (consumption pattern) of water to various buildings, housing different departments and offices are grouped into five blocks (Block-A, Block-B, Block-C, Block-D& Block-E). The details of various departments and offices identified under different groups are listed in table (xx) presented under methodology. The water consumption pattern is presented as per the usage, by allocating approximate quantity of water for various sectors listed in the following tables.

3.2.2.1: Water consumption at building block-A:

Administrative offices and supportive services wings are grouped under building block A and the total number of persons using the water in this block is around 1050. This population includes office staffs, students and visitors. In this block a total quantity of 98,548 liters of water used daily for seven purposes along with water loss during filling and water loss at discharge. The details of water utilized for various purposes with percentages are presented in **table 3.6**. It is observed that, among the various purposes, the highest quantity of water (75,000 liters) was used for gardening purpose which accounts to 76.11% of total usage in this block. The next highest usage is for urinals (9.64%) followed by wash basin (5.48%). The least quantity of water found used in bathrooms /wash rooms (1.07%). The quantity of water wasted at filling and discharge was found very minimum.

Table 3.6: Purpose wise use of water in building block - A.

Sl. No.	Purpose	Daily Use (liter)	Monthly (kL)	Yearly (ML)	Percentage
1	Garden	75000	1725.00	20.25	76.11
2	Urinals	9500	218.50	2.57	9.64
3	Wash basin	5400	124.20	1.46	5.48
4	Washing and house keeping	3600	82.80	0.97	3.65
5	Toilet	2400	55.20	0.65	2.44
6	Drinking	1188	27.32	0.32	1.21
7	Bathroom/ wash room	1050	24.15	0.28	1.07
8	Water loss during filling	210	4.83	0.06	0.21
9	Water loss at discharge	200	4.60	0.05	0.2
	Total	**98548**	**2266.60**	**26.61**	**100**

3.2.2.2: Water consumption at building block-B:

Building block B includes science and technology departments (22 numbers) with a total population of 2257. Students are the major users which accounts for 82.27% in this block. A total quantity of 1,27,810 liters of water used daily for different purposes including water for laboratory use (which is exclusive for block B). The details of water utilized for various purposes with percentages are presented in T**able 3.7**. It is observed that, among the various purposes, the highest quantity of water (50,000 liters) was used for laboratory purpose which accounts to 39.12% of total usage in this block. In this block also, the second highest usage is

for urinals which accounts for 15.65% followed by wash basin (7.04%). The least quantity of water found used in bathrooms /wash rooms (1.17%). The quantity of water wasted at filling and discharge was also found minimum in this block also.

Table 3.7: Purpose wise use of water in building Block - B.

Sl. No.	Purpose	Daily Use (liter)	Monthly	Yearly	Percentage
1	Laboratory	50000	1150.00	13.5	39.12
2	Garden	30000	690.00	8.1	23.47
3	Urinals	20000	460.00	5.4	15.65
4	washbasin	9000	207.00	2.43	7.04
5	Distillation unit	5000	115.00	1.35	3.91
6	Toilet	4800	110.40	1.3	3.76
7	Washing and house keeping	4600	105.80	1.24	3.6
8	Drinking	2500	57.50	0.68	1.96
9	Bathroom/wash room	1500	34.50	0.41	1.17
10	Water loss during filling	210	4.83	0.06	0.16
11	Water loss at discharge	200	4.60	0.05	0.16
	Total	**1,27,810**	**2,939.63**	**34.51**	**100**

3.2.2.3: Water consumption at building block-C:

The quantity of water consumed (**90,660 liters**) for various purposes in this block is least among the four blocks, though it houses more number of departments (**37 numbers**) with the highest population (**3131**) of all the blocks. The details of water utilized in block C for various purposes with percentages are presented in **table 3.8**. The water consumed for garden and urinals purpose was almost same with **33.09%** and **32.54%.** Since the total population as well as the students population was found highest in this block among the four blocks, the usage of water for urinals was found highest. The quantity of water wasted at filling and discharge was also found minimum in this block also.

Table 3.8: Purpose wise use of water in building block - C.

Sl. No.	Purpose	Daily Use (liter)	Monthly (23 Days, kL)	Yearly (270 Days, ML	Percentage
1	Garden	30000	690.00	8.1	33.09
2	Urinals	29500	678.50	7.97	32.54
3	washbasin	12600	289.80	3.4	13.9
4	Washing and house keeping	7200	165.60	1.94	7.94
5	Toilet	6000	138.00	1.62	6.62
6	Drinking	3750	86.25	1.01	4.14
7	Bathroom/wash room	1200	27.60	0.32	1.32
8	Water loss during filling	210	4.83	0.06	0.23
9	Water loss at discharge	200	4.60	0.05	0.22
	Total	**90,660**	**2,085.18**	**24.48**	**100**

3.2.2.4: Water consumption at building block-D:

This building block includes ten student hostels with a population of **2406**. The purposes as well as the quantity of water consumed (**2,49,070** liters) in this block was found highest among all the blocks as the students use more water for bathrooms, toilet and urinals. The details of water utilized in block D for various purposes with percentages are presented in **Table 3.9**. Among the various purposes, the usage of water for bathroom / washroom was found highest in quantity (95,000 liters) with 38.14%. The next activity which consumes more quantity (48,000 liters) of water is cloth washing (19.27%). The water consumed for Toilets, Kitchen and Urinals purposes was also found to be substantial quantity with 9.39%, 9.23%, and 8.95% respectively. In this block also the quantity of water wasted at filling and discharge was also found minimum.

Table 3.9: Purpose wise use of water in building block - D.

Sl. No.	Purpose	Daily Use (liters)	Monthly Use (23 Days, kL)	Yearly (270 Days ML)	Percentage
1	Bathroom/Wash Room	95000	2185.00	25.65	38.14
2	Cloth Washing	48000	1104.00	12.96	19.27
3	Toilet	23400	538.20	6.32	9.39
4	Kitchen	23000	529.00	6.21	9.23
5	Urinals	22300	512.90	6.02	8.95
6	Wash Basin	18450	424.35	4.98	7.41
7	House Keeping	8000	184.00	2.16	3.21
8	Garden	8000	184.00	2.16	3.21
9	Drinking	2100	48.30	0.57	0.84
10	Water loss during filling	410	9.43	0.11	0.16
11	Water loss at discharge	410	9.43	0.11	0.16
	Total	**2,49,070**	**5,728.61**	**67.25**	**100**

3.2.2.5: Water consumption at building block-E:

This building block includes Guest Houses, Canteens, and Quarters with a population of **1060**. The purposes as well as the quantity of water consumed (**76,440** liters) in this block was found lowest among all the blocks. The details of water utilized in block-E for various purposes with percentages are presented in **Table 3.10**. Among the various purposes, the usage of water for bathroom / washroom was found highest in quantity (**25,200** liters) with 32.97%. The next activity which consumes more quantity (9,840 liters) of water is Toilet (12.87%). The water consumed for Urinals, Cloth Washing, and Garden purposes was also found to be substantial quantity with 12.43%, 11.77%, and 10.47% respectively. In this block also the quantity of water wasted at filling and discharge was also found minimum. The quantities of monthly and yearly consumption of water in this block are **229.32** KL and **20.64** ML respectively.

Table 3.10: Purpose wise use of water in building Block - E.

Sl. No.	Purpose	Daily Use (liters)	Monthly Use (kL) 23 days	Yearly Use (270 Days ML	Percentage
1	Bathroom/wash room	25200	579.60	6.80	**32.97**
2	Toilet	9840	226.32	2.66	**12.87**
3	Urinals	9500	218.50	2.57	**12.43**
4	Clothe washing	9000	207.00	2.43	**11.77**
5	Garden	8000	184.00	2.16	**10.47**
6	washbasin	5520	126.96	1.49	**7.22**
7	House keeping	5000	115.00	1.35	**6.54**
8	Kitchen	3000	69.00	0.81	**3.92**
9	Drinking	970	22.31	0.26	**1.27**
10	Water loss during filling	210	4.83	0.06	**0.27**
11	Water loss at discharge	200	4.60	0.05	**0.26**
	Total	**76440**	**1758.12**	**20.64**	**100**

3.2.2.6: Overall purpose - wise use of water in the University:

Here the quantity of water used daily and yearly for a total of 13 purposes of water usage in different blocks are summed up and presented in **Table 3.11** with percentages. Of the various purposes the water used for gardening was found highest amounting to 1,51,000 liters per day and 23.61%. The next highest consumption is at bathrooms/ wash rooms (18.72%). The water consumption for urinals was also found of substantial quantity (88,500 liters) with 13.84%. The overall usage for drinking purpose found to be least (1.64 %) among domestic usages. The water wastage was only 0.13 % in both the sites.

Table 3.11: Purpose wise consumption of water in campus of University of Mysore, Mysuru

Sl. No.	Purpose	Daily	Monthly (kL)	Yearly (ML)	Percentage
1	Garden	151000	3473	40.77	23.50
2	Bathroom/wash room	123950	2850.85	33.47	19.29
3	Urinals	90800	2088.4	24.52	14.13
4	Cloth washing	57000	1311	15.39	8.87
5	Washbasin	50970	1172.31	13.76	7.93
6	Laboratory	50000	1150	13.5	7.78
7	Toilet	46440	1068.12	12.54	7.23
8	Washing and house keeping	28400	653.2	7.67	4.42
9	Kitchen	26000	598	7.02	4.05
10	Drinking	10508	241.68	2.84	1.64
11	Distillation unit	5000	115	1.35	0.78
12	Water loss during filling	1250	28.75	0.34	0.19
13	Water loss at discharge	1210	27.83	0.33	0.19
	Total	642528	14778.1	173.48	100.00
	Construction works	-	-	1.15	
	Grand total and percentage				

3.3: Water Audit of satellite centers of University:

3.3.1: Dr. B. R. Ambedkar Center, Chamarajanagar:

This center is having around 520 persons. In this canter a quantity of 12,999 liters of water was suppliedto the various activities from a bore well with 5 HP motor which run 3 hrs daily. In this center water is used for 12 purposes. The details of usage of water are presented in **Table 3.12.**The data indicates that the main usage of water is for urinals which accounts for 4500 liters and 36.16%. The second most important is for wash basin which accounts for 23.2%. The loss of water is found marginal which accounts for only 0.32 %.

Table 3.12: Use of water in Dr. B. R. Ambedkar Center, Chamarajanagar

Sl. No.	Purpose	Daily	Monthly	Yearly	Percentage
1	Urinals	4500	103.50	1.22	35.16
2	Washbasin	2970	68.31	0.80	23.2
3	Bathroom/wash room	1400	32.20	0.38	10.94
4	Toilet	900	20.70	0.24	7.03
5	Clothe washing	900	20.70	0.24	7.03
6	Garden	500	11.50	0.14	3.91
7	Horticulture	500	11.50	0.14	3.91
8	Drinking	489	11.25	0.13	3.82
9	Kitchen	400	9.20	0.11	3.13
10	Washing and house keeping	200	4.60	0.05	1.56
11	Water loss during filling	20	0.46	0.005	0.16
12	Water loss at discharge	20	0.46	0.005	0.16
13	Laboratory	0	0	0	0
14	Distillation unit	0	0	0	0
	Total	**12,799**	**294.38**	**3.46**	

3.3.2: Hemagangotri P.G. Center, Hassan

In this center there are 425 persons. Here also one bore well with 5 HP motor running 3 hrs per day has supplied a total quantity of 12,999 liters of water. Unlike other centers the highest percentage (23.83%) of water is consumed for the kitchen of the hostel. The next major consumption (2020 liters) occupying 16.05%. Since there are students in the hostels, water for urinals, bathing, Cloth washing and toilet purposes take a share of 16.05%, 14.30%, 12.71% and 12.11% respectively. So a total of 12,589 liters of water per day was used in this center. The data on water usage is presented in **Table 3.13**.

Table 3.13: Use of water in Hemagangotri P.G. Center, Hassan:

Sl. No.	Purpose	Daily Use (liter)	Monthly	Yearly	Percentage
1	Kitchen	3000	69.00	0.81	23.83
2	Urinals	2020	46.46	0.54	16.05
3	Bathroom/wash room	1800	41.40	0.49	14.3
4	Clothe washing	1600	36.80	0.43	12.71
5	Toilet	1524	35.05	0.41	12.11
6	Washbasin	1020	23.46	0.28	8.1
7	Washing and house keeping	600	13.80	0.16	4.77
8	Drinking	385	8.86	0.10	3.06
9	Distillation unit	300	6.90	0.08	2.38
10	Garden	200	4.60	0.054	1.59
11	Laboratory	100	2.30	0.027	0.79
12	Water loss during filling	20	0.46	0.0054	0.16
13	Water loss at discharge	20	0.46	0.0054	0.16
14	Horticulture	0	0	0	0
	Total	**12589**	**289.55**	**3.40**	

3.3.3: Sir M. Vishweshwarayya P. G. Center, Mandya

Comparatively this is a big center with water consuming population of 593 numbers and it has got the supply of 21,665 liters of water daily from a bore well, with a 5HP motor running for 5 hrs. Among the purposes of water usage the major consumption is for urinals followed by bath rooms which accounts for 25.93% and 20.74 % respectively. The total daily consumption of water in this center is 21,210 liters. The consumption of detailsof a various purposes are presented in **Table 3.14.**

Table 3.1.4: Use of water in Sir. M. Vishweshwarayya P. G. Center, Mandya

Sl. No.	Purpose	Daily Use (liter)	Monthly	Yearly	Percentage
1	Urinals	5500	126.50	1.49	**25.93**
2	Bathroom/wash room	4400	101.20	1.19	**20.74**
3	Washbasin	3270	75.21	0.88	**15.42**
4	Clothe washing	1800	41.40	0.49	**8.49**
5	Toilet	1740	40.02	0.47	**8.2**
6	Kitchen	1100	25.30	0.30	**5.19**
7	Garden	1000	23.00	0.27	**4.71**
8	Horticulture	800	18.40	0.22	**3.77**
9	Washing and house keeping	600	13.80	0.16	**2.83**
10	Drinking	510	11.73	0.14	**2.4**
11	Distillation unit	300	6.90	0.08	**1.41**
12	Laboratory	150	3.45	0.04	**0.71**
13	Water loss during filling	20	0.46	0.0054	**0.09**
14	Water loss at discharge	20	0.46	0.0054	**0.09**
	Total	**21,210**	**487.83**	**5.73**	

A Major step towards the preservation of the intricate water table in the area of all the campuses and buildings was the establishment of rain water harvesting structures, under UPE and University Grants.

3.4: Overall observations and recommendations of water Audit

- The rate of ground water exploitation through bore wells is more in Manasagangotri campus which contribute 67 % of water supply of the campus. By proper management of water and proper utilization of Kukkarahally Lake water this may reduced.
- The second most important source of water supply is Kukkarahally Lake without which it is found difficult to irrigate the lawns and gardens which are developed in a big way during the last five years. Hence, proper measures for restoration, management and cleaning of Kukkarahally Lake should be taken by the University on priority basis.
- The rain water harvesting initiatives required further more attention as present harvesting meeting only 2.5 %. It should be further strengthened.
- Sewage water treatment plant may be established for recycling of waste water coming from the hostels as the present system of using untreated sewage water to the gardens is not correct.
- The wastage of water is more in the hostels because of lack of environmental consciousness on water use. So, awareness programmes should be conducted at regular intervals so that all stake holders participate in water management.
- Environment management system should take appropriate repair works of taps, urinals, wash rooms, and supply and distribution lines.

Rain Water Harvesting at Department of Commerce

Rain Water Harvesting at <u>Institute of Development Studies</u>

Rain Water Harvesting at Department of Library

Rain Water Harvesting at Department of Earth Science

Rain Water Harvesting at School of Law

Rain Water Harvesting at <u>School of Planning and Architecture</u>

Rain Water Harvesting at PG Ladies Hostel (2 Units)

Rain Water Harvesting at History & Geology

Rain Water Harvesting at Engineering Division & Manasa Guest House

Rain Water Harvesting at Commercial Complex (SJCE Downs)

CHAPTER - V

SOLID WASTE AUDIT

Waste is an unwanted and unusable material, discarded after its primary use during human activities in residential, industrial or commercial area. Waste management is the controlled generation, storage, collection, transport, processing, and disposal of wastes considering public health, conservation, economics, and environmental conditions. Poor management of solid waste leads to littering and thus unsanitary living conditions. Hence, the main objectives of solid waste management (SWM) are the maintenance of clean and hygienic conditions and reduction in the quantity of waste, which is disposed off in the sanitary landfill facility of the area after recovery of material and energy from it. As per the guidelines provided by the Ministry of Urban Development (MoUD), Government of India in the form of policies of SWM rule 2016 all gated society and campuses have been advised to develop the treatment and segregation of waste within their premise.

Solid waste management (SWM) is one of the basic parameters of environmental sustainability and hence managing our own waste is the responsibility of every individual. There is a constant increase in the waste generation especially in the larger cities due to lifestyle changes, use of packaging materials, *etc*. and management of waste has become a burning issue in current days. Higher education institute (HEI) campuses replicate a city's characteristics on a small level, producing similar environmental impacts. Since higher education campuses are like mini autonomous cities, they can act as a model for solid waste management (SWM) and enhance sustainable development. These campuses can demonstrate and influence the local neighborhoods to adopt and successfully implement sustainable practices. A dedicated SWM program on the campus will sensitize and build the consciousness of the campus occupants toward waste management; increase the productivity and performance of students and employees by providing clean and healthy workplace; influence the local community by creating a difference in the level of cleanliness between the campus and the local environment.

The purpose of this audit is to find out the type, quantity and current management practices of solid waste generated in the campuses of University of Mysore. This report will help the campus occupants to manage SW of the campus and proceed for green campus development.

5.1: An overview of generation of solid wastes annually in Manasagangotri Campus.

Based on the management strategy, various types of Solid Wastes generated in the Mysuru campus of University of Mysore are grouped into three main classes as biodegradable, non-biodegradable and hazardous wastes and their status of generation are presented in **Table 5.1.1**. Biodegradable wastes include Plant litter, Wood, Wooden, Food, Paper, Cloth (Cotton) wastes etc. which totally weigh 12,98,984 kgs and take the share of 85.50 percent. The wastes which are non-biodegradable are Construction waste, Plastic, Glass, Metal, Electronic, Rubber etc. which totally constitute 13.68 % with a total weight of 2,07,896 kg and 13.68 %. The hazardous wastes are medical wastes, laboratory wastes and sewage sludge which are very much less in quantity (12480 kg) and percentage (0.82%).

Table-5.1.1: Quantity of major types solid wastes generated annually in Mysuru campus

	Biodegradable waste		**Non-biodegradable waste**		**Hazardous Waste**	
	A		**B**		**C**	
Wastes	Plant litter, Wood Waste, Wooden waste, Food waste, Paper, Cloth (Cotton)		Construction waste, Plastic, Glass, Metal, Electronic, Rubber		Medical waste, Laboratory waste and Sewage sludge	
	Quantity kg/year	%	Quantity (Kg/ year)	%	Quantity (Kg/year)	%
Total	**12,98,984**	**85.50**	**2,07,896**	**13.68**	**12480**	**0.82**
Grand Total 15,19,360 kg /annum						

The quantity and percentage occurrence of various types of biodegradable wastes are presented in **Table 5.1.2**. Among biodegradable wastes generated, plant litter was found huge both in weight (1,250, 000) and volume taking the lion share of 96.23%. If we compare the quantity of remaining type of biodegradable wastes, it appears that they are negligible. Since, they are posing the real problem of management, the percentage of these after excluding the plant litter from the group is also presented in the said table. Further, the percentages of all these biodegradable wastes over the grand total of solid waste (**15,19,360kg**) are also included in the

said table. It is clear from the table that, next to plant litter, the wastes of wood generated by the trees and food wastes generated by the hostels of the campus constitute considerable quantity and percentages.

Table-5.1.2: Quantity and percentage of major biodegradable wastes generated annually.

Waste	Quantity kg/year	Including plant litter		Excluding plant litter		Percentage over grand total (A+B+C) 15,19,360kg /annum
		Total	%	Total	%	
Plant litter	1,250,000	12,98,984	96.23	48,984		**82.271**
Wood Waste	21600		1.66		44.10	**1.422**
Wooden waste	1740		0.13		3.55	**0.115**
Food waste	18504		1.42		37.78	**1.218**
Paper	6360		0.49		12.98	**0.419**
Cloth (Cotton)	780		0.07		1.59	**0.051**
Total	12,98,984		100		100	**85.500**

The data on the generation of various types of non-biodegradable wastes is presented in **Table 5.1.3.** Among the non-biodegradable wastes generated, construction debris is huge in quantity and comparatively the percentages of remaining types of this class of waste are less. Since, they are posing the real problem of management, the percentage of these after excluding the construction waste from the group is also presented in the said table. Further, the percentages of all these non-biodegradable wastes over the grand total of solid waste (**15,19,360kg**) are also compared in the said table.

Table-5.1.3: Quantity and percentage of major non biodegradable wastes generated annually.

Waste	Quantity kg/year	Including construction waste		Excluding construction waste		Percentage over grant total (A+B+C) 15,19,360 kg /annum
		Total	%	Total	%	
Construction waste	2,00,000	**2,07,896**	96.95	**7,896**		**13.16**
Plastic	1800		0.87		22.80	**0.12**
Glass	1656		0.80		20.97	**0.11**
Metal	2088		1.00		26.44	**0.13**
Electronic	732		0.35		9.27	**0.05**
Rubber	1620		0.78		20.52	**0.11**

Total	**2,07,896**		100		100	**13.68**

The hazardous wastes are very dangerous wastes and hence pose serious threats on the health of inhabitants. The quantum of generation of hazardous wastes is comparatively very less and totaling only 12,480 kgs with negligible percentage (0.12%).

The data on the generation of three types of hazardous wastes is presented in table 5.1.4. Among these wastes, sewage sludge is huge in quantity and comparatively the percentages of remaining types of this class of waste are very less. Since, they are posing very serious problem of management, the percentage of medical and lab waste after excluding the sewage sludge is also presented in the said table. Further, the percentages of all these hazardous wastes over the grand total of solid waste (**15,19,360kg**) are also compared which totally contribute only 0.82 %.

Table-5.1.4: Quantity and percentage of Hazardous Waste generated annually.

Waste	**Quantity kg/year**	**Including Sewage sludge**		**Excluding Sewage sludge**		**Percentage over grant total (A+B+C) 15,19,360 kg /annum**
		Total	**%**	**Total**	**%**	
Sewage sludge	12,000	**12,480**	96.15	**480**		**0.79**
Medical waste	360		2.88		75.00	**0.02**
Lab waste	120		0.97		25.00	**0.01**
Total	12,480		100		100	**0.82**

5.2: Generation and management of Solid wastes in the campus

The main types of solid wastes generated in the campus are biodegradable wastes (Plant litter, Wood Waste, Wooden waste, Food waste, Paper, Cloth/cotton), non-biodegradable (Construction waste, Plastic, Glass, Metal, Electronic, Rubber) and hazardous wastes (Medical waste, Laboratory waste and Sewage sludge).

5.2.1: Generation and management of biodegradable wastes

As stated above, bulk of biodegradable solid wastes generated in the campus is formed by plant litter. Plant litter is dead plant material, such as leaves, bark, flowers, fruits, needles, and twigs that have fallen to the ground. Plant litter is an instrumental factor in the ecosystem dynamics, is indicative of ecological productivity, and may be useful in predicting regional nutrient cycling and soil fertility.

5.2.1.1: Generation of Plant litter by the vegetation of the campus

The university campus at Mysuru has vast area with abundant tree population and other type of vegetation which are generating quite a large quantity of litter. It is estimated that there are more than 20,000 trees of different ages and growth conditions. Top 15 tree species contributing to the litter generation with large population in this campus are *Tectona grandis , Pongamia pinnata, Polyalthia longifolia, Peltaphorum ptorecarpum, Artocarpus heterophyllous, Azadirachta indica, Swetenia mahaghani, Syzygium cumini, Tamarindus indica, Leucaena leucocephala, Michaliachmapaka, Millingtonia hortensis, Delonix regia, Milletia ovalifolia, Spathodeacompanulata, Mangiferaindica, Ficus benghalensis.* The details of number of trees in each of these species identified under three canopy conditions (huge, good and moderate) are listed under biodiversity part of this report. It is estimated that, annually the trees with huge canopy having total population of 2,271 generate 1135.5 MT of litter @ 500 kg per plant/yr (range is 400 -2000 kg/yr per tree). Similarly, the tree population with good canopy (2228) and the tree population with moderate canopy (1,215) are generating 557.0 and 121.5 MT of litter respectively in a year. In addition there are a large number of small trees including old and recently (in last 5-6 years) planted ones. Hence,a total of **2,317** MT is being generated from these tree populations. A large percentage of this tree litter could be easily collected and managed through compost production.

In addition to the tree population, there are quite a large number of horticulture plants, bushes, creepers and herbs of gardens maintained in the campus and in and around Kukkarahally Lake generating around 183 MT of litter. By overall, 2500 MT of plant litter being generated from trees and other types of vegetation in the campus. This plant litter is creating hygienic problem in the avenues, parks, lawns, around the buildings, cultivated lands, and other places. Collection of entire quantity of this litter is not practically possible and feasible also. Out of 2500 MT of litter generated, 50% (1250MT) of this valuable plant litter could be collected easily by proper planning in different seasons annually. This biomass could be recycled by composting in the existing Solid Waste Management centre of the campus. The details of estimated quantity of litter generated by various types of trees and vegetation in the campus and quantity of litter could be easily collected are presented in the **Table- 5.2.1.1.**

Table-5.2.1.1: Estimation of Plant litter generated by the different types of vegetation

Sl. No.	Type of Vegetation	Number	Approximate quantity of Plant litter			
			Generated in a year		50% of plant litter generated (MT)	Remarks
			From each tree (kg)	Total from type of vegetation (MT)		
1	Trees with Huge Canopy	2,271	500	1135.5	**1250**	A total of 1250 MT of plant litter could collect easily by planning the collection in different seasons. This much of plant biomass could be recycled in to valuable 170 MT of compost/ vermicompost in the existing Solid Waste management centre of the campus
2	Trees with Good Canopy	2,228	250	557.0		
3	Trees with moderate Canopy	1,215	100	0121.5		
4	Small trees	10,060	050	0503.0		
	Total	**15,774**	**146.95**	**2317.0**		
5	Horticulture plants	10155		60		
6	Bushes – including bamboos (shrubs - including wild and floriculture plants)	-		40		
7	Herbs (including creepers - wild and garden plants)	-		20		
8	Lawn(Maintained in departments and administrative blocks)	-		13		
9	Grassland(Area of wild grasses with minimum maintenance)	-		20		
10	Aquatic plants(in water body of Kukkarahally lake)	-		30		
	Total			**2500**		

5.2.1.2: Program of "Biowaste management through composting and vermicomposting"

By understanding the importance of biowaste management in the campus, University of Mysore has taken the initiative and started a novel program entitled "Biowaste management through Composting and Vermicomposting" in Mysuru campus in the year 2010 under the coordinatorship of Dr. Basavaiah, Professor, Department of Studies in Sericulture. Dr. Basavaiahcoordinated the aforesaid program from 2010 to 2018. **Appreciating the activities of the program, Mysore City Corporation provided a three-wheeler Auto Tipper to transport the collected waste inside the campus.** In response to the assistance of the MCC, during 2011-12, practical training on composting techniques was given to a large number of trainees of Self-Help Groups identified and sent by the corporation under its JNURM scheme, in the university program. In recognition of the service, Mysore City Corporation assisted in the promotion of this

program in a big way, which is resulted in the development of a Solid Waste Management unit in the campus.

TRAINING PROGRAM forSELF HELP GROUPS of MCC

5.2.1.3: Solid Waste Management (SWM) unit in the campus

In appreciation with the activities of the programme "Biowaste management through composting and vermicomposting" and the training provided to its identified Self-Help Groups, Mysore City Corporation supported the university program by constructing a "**Solid Waste Management Unit**" in the campus during 2012-13. The unit is havingcomposting shed, storage shed, segregation shed, washing platform, parking shed, Office-cum-Tool room, Toilets for men and women. To make the unit functional, university has provided an underground sump with motor, two small storage tanks, all-round fencing to this unit power and water connection. Presently, this unit is working as 'Solid waste management centre' in the campus. This centre is functioning with the following objectives.

1. To demonstrate the commitment of the university to the public by recycling the biowastes generated in its campus by producing compost and vermiocompost.
2. To disseminate the knowledge and technique Soliwaste management through training, demonstration and teaching programmes.
3. To create the facilities to the students to undertake research and project works in the field of waste management, composting, vermicomposting of biowastes, organic/ natural farming etc.

5.2.1.4: Production and sale compost and vermicompost in the SWM unit

As a primary responsibility of the programme, various products viz., vermicompost, enriched vermicompost, compost, enriched vermicompost, Vermiwash and earthworms are produced by recycling the plant litter and sold to the public.

Table 5.2.1.4: Year-wise details of production, sale and balance of various products produced and sold in Biowaste management centre of University of Mysore, Manasagangotri, Mysuru.

Year		Vermicompost (kg)	Enriched Vermicompost (kg)	Compost grade-1 (kg)	Compost grade-2 (Cu.ft)	Enriched compost (kg)	Vermi wash (L)	Earth worm (kg)
Balance carried forward from 2013-14		**5100**	**200**	**6000**	**600**	**-**	**10**	**-**
2014-15	Production	23572	2792	18066	-	-	-	
	Sale	25972	1692	20766	495	-	10	11.7
	Balance	2700	1300	3300	105	-	-	-
2015-16	Production	18500	585	18050	153	-	04	
	Sale	19721	1561	19329	258	-	04	1.1
	Balance	1479	324	6021	-	-	-	-
2016-17	Production	9900	75	19395	300	2230	-	
	Sale	8654	399	13657	200	2230	-	0.8
	Balance	2725	nil	2759	100	Nil	-	-
2017-18	Production	3500	-	1000	-	-	30	
	Sale	5201	-	2070	-	-	30	0.25
	Balance	1024	-	689	100	-	nil	-
2018-19	Production	-	-	-	-	-	-	-
	Sale	-	-	-	-	-	-	-
	Balance	1024	nil	689	100	Nil	nil	-
Total	Production	1,15,781	3,991	97,299	4,779.5	2230	30	27.1
	Sale	1,14,757	3,991	95,610	4,679.5	2230	30	27.1
	Balance	1,024	nil	1689	100	Nil	nil	-

5.2.1.5: Plant litter recycled through composting and vermicomposting

A total quantity of 58924 kg of vermicompost and 51,195 kg of compost has been produced by recycling the plant litter generated in the campus. It is estimated that 8 kgs of plant litter after decomposition yields 1 kg of vermicompost and 7kgs of plant litter after decomposition yields 1 kg of compost. Using this measure, the total quantity of plant litter recycled is calculated and year wise data is presented in **Table5.2.1.5.**

Table-5.2.1.5: Quantity of plant litter recycled through composting and vermicomposting during 2014 to 2019 In SWM unit.

Year	Quantity of Vermicompost and Compost produced (kg)		Estimated Quantityof plant litter recycled (@ 8 kg for Vermicompost& 7 kg for compost production)
2014-15	Vermicompost	26,364	2,10,912
	Compost	18,066	1,26,462
2015-16	Vermicompost	19,085	1,52,680
	Compost	18,203	1,27,421
2016-17	Vermicompost	9,975	79,800
	Compost	12,926	90,482
2017-18	Vermicompost	3,500	28,000
	Compost	1000	7,000
2018-19	Vermicompost	-	-
	Compost	1000	7,000
Total	**Vermicompost**	**58924**	**8,29,757**
	Compost	**51195**	

The data clearly indicated that the Solid Waste Management centre has recycled an estimated total quantity of 8,29,757 kg of plant litter during 2014 -2019. On an average it has recycled 165.95 MT of Plant litter generated in the campus annually.

5.2.1.6: Expenditure incurred and Revenue generated in SWM unit through recycled products of Plant litter

By selling the vermicompost enriched vermicompost, compost grade 1, compost grade 2, enriched compost, vermiwash and earthworms in the SWM unit, a total amount of Rs. 6,18,967/- has been generated. During this activities, a sum of Rs. 8,31,500/- has been spent for this SWM unit (**Table 5.2.1.6**). The cost-benefit analysis indicated that 74.43% of amount spent has been

realized in the form of valuable compost. At this stage, though the amount spent is high, but from the ecological point of view benefits overweighed the expenditure. The benefits are many, to quote a few, best way of recycling of the bio-resources, use of compost to farming, generation of employment and saving the serine environment of the campus. To add further, this unique SWM unit has given training to various self-help group personnel's, teachers, students and general public to create skill and awareness in general public.

Table-5.2.1.6: Expenditure incurred and Revenue generated in SWM unit through recycled products of Plant litter during 2014 to 2019.

Year	Expenditure incurred for recycling of Plant litter in SWM unit (Rs.)	Revenue generated by the sale of vermicompost and compost
2014-15	2,56,127	2,32,948
2015-16	3,11,286	2,00,761
2016-17	1,88,541	1,36,295
2017-18	75,546	48,963
2018-19	……	……..
Total	**8,31,500**	**6,18,967**

5.2.1.7: Project and Term works carried out in Solid waste management unit

Apart from getting the technical guidance and training on composting and vermicomposting techniques by many students and teachers of the university, students of M Sc. Sericulture, Botany and Zoology have conducted research on various aspects of Solid waste management unit and completed the following Project/Term works.

1. Efficacy of using silkworm bed refuse and pongamia flower waste in vermiculture. Carried out byJairaju P., M.Sc. IV semester of Sericulture.
2. Effect of vermiwash on mulberry *(Morus*sp.) and cocoon production in sericulture. Carried out by Sowmya, M.Sc. IV semester of Sericulture.
3. Evaluation of *anthelmintic* activity in leaves of mulberry cv. Victory-1 (*Morusalba* L.) with two species of earthworm. Carried out byDimeraMarak, M.Sc. IV semester of Sericulture.
4. Evaluation of *anthelmintic* activity in leaves of *Morusleavigata*Wall. Ex. Brandis with two species of earthworm. Carried out by Roopashree S. M.Sc. IV Semester of Sericulture.
5. Studies on the effect of mulberry leaf in combination with some vegetable wastes on the growth, reproduction and cast production of earthworm. Carried out byRoopa, B. C., II Semester of Sericulture.
6. Effect of foliar application of vermiwash supplemented with Poshan, A multinutrient formulation on yield and quality of mulberry (*Morus*sp.) leaves. Carried out by Anusha, G. D.,M.Sc. IV Semester of Sericulture.
7. Effect of one and two months old vermiwash as foliar nutrition on mulberry (*Morus sp.*) leaf quality and its impact on silkworm, *Bombyxmori* L. cocoon crop. Carried out by Chandini, A.C., M Sc. II Semester of Sericulture.
8. Efficacy of utilizing *Microcystis* algae scum and sludge of Kukkarahalli lake of Mysuru in composting and vermicomposting. Carried out by Udayashankar, K.P.,M.Sc. IV Semester of Botany.

9. Efficacy of spiking horse dung with selected dry and fresh biowastes for vermicompost production using the earthworm *Eudrilus eugineae* (Kinberg) Carried out byPriyanka, H. B. and Shruthi K. R., M.Sc. IV Semester of Zoology.


5.2.1.8: Support of SWM unit to Post Graduate Diploma in organic Horticulture course

In PG Department of Sericulture a **"Post Graduate Diploma in Organic Horticulture "** course was conducted for two years during 2015-16 and 2016-17. The SWM unit provided the facility for the practical training on composting and vermicomposting vermiwash production techniques, vermiculture and composting of farm wastes etc.

5.2.1.9: Demonstration of composting and vermicomposting techniques to visitors.

A large number of visitors including students from various colleges and schools, teachers, farmers and local residents who were interested in compost production and organic farming visited and obtained technical guidance on composting and vermicomposting techniques.

5.2.2: Additional activities of composting and vermicomposting

Apart from the recycling of biodegradable wastes in SWM unit, the horticulture division and department of sericulture are also producing compost for their in-house use.

5.2.2.1: Production of compost by Garden section and Sericulture department:

Horticulture division of the university has produced around 20 MT/ annum of compost by recycling the wastes generated in the garden and used for its horticulture gardens. Similarly, Department of sericulture has produced around 10 MT/annum of compost by recycling wastes generated from silkworm rearing bed and mulberry garden and applied for its mulberry garden.

5.2.2.2: Extension activities on Vermicomposting:

An external funded project has been implemented in the DOS in Environmental Science, on the popularization of Vermicomposting technology among the SC/ST laborers/ farmers of weaker sections by **Prof. Raju**, Environment Science. In this project, training was imparted and technical guidance on vermicomposting technology was givento the farmers in their places. It

helped the farmers to establish their own vermicompost units. The detailed project report is in the supporting documents.

5.2.3: Generation and management of biodegradable wastes (other than plant litter)

Bulk of the biodegradable solid waste generated in the campus was plant litter which is dealt in detail above. The remaining four types of biodegradable wastes *viz.* wood and wooden, food, paper and cloth (cotton)have also generated considerably quantity. The quantity and percentage of occurrence in a month of these three wastes in five building blocks of the campus are listed in **Table 5.2.3**.

Table- 5.2.3: Quantity (kg per month) of remaining (other than plant litter) biodegradable wastes generated

Wastes -quantity and percentage		Building block					Total waste	
		A	B	C	D	E	Kg/month	Kg/year
Wood		Generated from the trees of roads, garden, parks, bunds of lake					1800	21,600
Wooden	Quantity	45	30	35	25	10	145	1,740
	Percentage	31.03	20.69	24.14	17.24	6.90	100	
Food	Quantity	90	60	70	1000	325	1545	18,540
	Percentage	5.82	3.88	4.53	64.72	21.05	100	
Paper	Quantity	185	125	90	40	90	530	6,360
	Percentage	34.90	23.58	16.98	7.56	16.98	100	
Cloth (Cotton) waste	Quantity	10	15	10	20	10	65	780
	Percentage	15.38	23.08	15.38	30.78	15.38	100	

5.2.3.1: Wood waste

Among the four types of biodegradable wastes (excluding plant litter) wood waste is bulkier. It is generated mainly from the trees of roads, garden, parks, bunds of lake. A total quantity of 1800 kg/month (21600 kg/yr) of this waste is generated during 2018-19. High level of generation are cut trees (old and cleared), followed by Pruned tree branches and twigs and fallen branches of trees. These are collected and pooled by the Garden section. Disposed through auctioning to the fire wood vendors at regular intervals. Mulberry cut twigs are auctioned by the Department of Sericulture.

5.2.3.2: Wooden waste:

Wooden waste is the collection of broken and non-repairable furniture's and small packing materials of the campus. These constitute a quantity of 145 kg per month (1740 kg/yr). These include chairs, tables, almirahs, cabinets which are pooled at the Engineering division and auctioned to the vendors. The minor type of waste such as Package boxes, Chalk piece box, Match box, Rags etc., are being collected and handed over to the corporation vehicles.

5.2.3.3: Food waste:

Food wastesare generated mainly in hostels, canteens and guest houses. A quantity of 1545 kg of food waste is generated every month and constitutes 1.42 % of biodegradable wastes and 1.218 % of all types of wastes.Major food waste comprised of left over preparations in kitchen, dining table wastes and of kitchen. In addition, spoiled/ peels of vegetables and fruits also contribute to considerable percentage. These food wastes are pooled by the house keeping staff. Every day collection was carried by persons of surrounding areas to feed their cattle and pigs.

5.2.3.4: Paper waste:

Paper waste also an important type of biodegradable waste of high value. A total quantity of 530 kg/month and 6360 kg/year of paper waste is being generated in the campus. The major quantity of paper waste is constituted by Printing Paper, Newspaper, Magazines, Old answer scripts, Old books. Of these, one side printed paper is used for draft works in the offices. Answer sheets and confidential reports are sent for recycling after completion of their preservation period. Other major types of waste are pooled at the examination section, printing press and library and are auctioned by administrative branch of the University at regular intervals to the vendors who recycle them properly. A moderate quantity of paper waste is formed by old note books, writing pads, Files, File rappers, registers, calendars, Project works waste,postal covers,envelops, invitations etc at departments. These are collected by the house keeping staff and disposed to the vendors by the departments. The paper waste formed of tissue paper, hard card board sheets, Tea/Coffee cups, Water cups, paper plates for serving, Challans/ passbooks/ receipt books, package materials etc. are minor in volume though they are big in number. These

wastes are collected by the house keeping staff and send them to solid waste management unit of the University.

5.2.3.5: Cloth (Cotton) waste:

These are composed of old towels, napkins, bed covers, threads, muslin cloth, bags, and absorbent cotton etc...These are generated mainly in hostels. A minor quantity is also generated in offices and departments. The quantity and percentage of these waste is minimum among the other bio-degradable waste generated in the campus. These are collected by housekeeping staff and handed over to Corporation vehicles.

5.3: Management of non biodegradable wastes generated in the campus

Non biodegradable waste generated in the campus are construction waste, plastic, glass, electronic, metal, rubber, etc.Among these construction waste is bulkier.As stated above in the **Table 5.1.3**, this constitutes 96.95 %of non biodegradable waste generated in the campus and 13.16 % of overall production of solid wastegenerated in the campus.

This group of waste includes plastic, glass, electronic, metal and rubber etc. The quantity and percentage of generation of these wastes per month in various building blocks of the campus are presented in **Table 5.3.1**. The total quantity of these wastes is 658 kg/month and 7896 kg/annum. By overall the building block A and building block B generates more than 50 % of the waste in the campus. Among these wastes metal wastes are maximum in quantity (2088 kg/annum) and electronic wastes are minimum (732 kg/annum). The percentage of these wastes varies in quantity and percentage in different building blocks.

Table 5.3.1: Quantity and percentage of non biodegradable(excluding construction) waste generation

Waste		Building blocks					Total waste	
		A	B	C	D	E	kg/month	kg/year
Construction waste							**16666**	**2 Lakhs**
Plastic	Quantity	26	34	21	29	40	150	1800
	Percentage	17.33	22.67	14.00	19.33	26.67	100	
Glass	Quantity	24	49	19	28	18	138	1656
	Percentage	17.39	35.51	13.77	20.29	13.04	100	
Electronic	Quantity	12	17	16	9	7	61	732
	Percentage	19.67	27.87	26.23	14.75	11.48	100	
Metal	Quantity	60	41	17	26	30	174	2088
	Percentage	34.48	23.56	9.77	14.94	17.24	100	
Rubber	Quantity	50	30	20	25	10	135	1620
	Percentage	37.04	22.22	14.81	18.52	7.41	100	
Overall (Excluding construction waste)	Quantity	172.00	171	93	117	105	658.00	7896
	Percentage	26.14	25.99	14.13	17.78	15.96	100.00	

5.3.1: Construction waste:

A total quantity of 200 MT of construction waste is generated during 2018-19 in the campus. The waste generated at various construction sites are cleared by the Engineering division of the University. After the completion of demolition and construction, other re-cyclable waste if any will be extracted from the debris. The debris is sent to land filling sites in and around the campus by entrusting the responsibility to the respective contractor of the construction work.

5.3.2: Plastic waste:

Plastic waste is most problematic waste in the campus. This constitutes 150 kg/month and 1800 kg/year. Maximum quantity (40 kg) of plastic waste is generated in guest house, canteens

and quarters (building block E) followed by (34 kg) science departments (building block B). Minimum quantity of generation (21 kg/month) is found in Arts and commerce departments (building block C). The major items of the plastic wastes are chemical bottles, water bottles, broken chairs and tables, old batteries, shopping covers, vehicle parts etc., Chemical bottles accumulated in various laboratories are being disposed to the corporation vehicles at regular intervals. Plastic items of moderate quantity are juice bottles, medicine bottles, sanitary chemical bottles, milk packets, hand wash refills, etc.. The items of plastic waste of minor quantity are old cable, buckets, broom stick, dustbins, brush, poster/flex boards, switch boards, plastic files, storage boxes, are collected by the housekeeping staff in various departments and offices. They are pooled and auctioned to the vendors at solid waste management unit of the campus.

5.3.3: Glass waste:

Lab chemical bottles, bulbs, tube lights, medicine bottles, vehicle parts, window glasses are the important glass wastes. As stated in table 5.3.1, the total quantity of glass waste generated is 138 kg/month and 1656 kg/ annum. The major percentage (35.1%) of generation is recorded in science departments as they procure large number of chemical bottles and glass wares. Glass waste generation is least in guest house, canteens and quarters (building block E) which accounts for 18 kg/month (13.04 %). These wastes are being pooled by the administrative branch and auctioned to the vendors at regular intervals.

5.3.4: Electronic waste:

E-wastes are created mainly with old monitors, key boards, mouse, TVs etc., which constitutes 61 kg/month and 732 kg/year. More than 50% of e-waste is generated from building blocks B and C as they are using maximum number of computers. These major e-wastes will be disposed to the agencies on buy-back basis. Other e-wastes of minor volume and weight namely CDs, calculators, pen drive, ear phone, mobile charger, floppies, remotes, etc., are being collected by the house keeping staff and pooled in the Computer section of the University. They are auctioned to the vendors at regular intervals.

5.3.5: Metal waste:

Among the non biodegradable waste other than construction waste generated in the campus, metal wastes are found major in weight.Generation of, a total quantity of 174 kg/month and 2088 kg/annum of this waste is recorded in the campus. Among the various blocks maximum of 34.48 % (60 kg/month) is being generated in Administrative and service offices (building block A). The major quantity is contributed by iron rods, zinc sheets, aluminum partitions, iron window frames, lab equipments, and garden implements. These are pooled by the engineering division and auctioned to the vendors. Metal wastes of moderate quantity generated in the campus are oil tins, pipes and taps, vehicle parts, utensils, almeras, tube light frames, fans, geysers, etc., are also auctioned to the vendors. In addition minor quantity of metal wastes are generated in the offices and departments which includes knife, scissor, blades, clips, staplers, pins, punching machines, etc., are collected and send to the Corporation vehicles.

5.3.6: Rubberwaste:

Considerable quantity (135 kg/month and 1620 kg/annum) of rubber waste is being generated in the campus. The maximum quantity is generated by the building block A as this includes large number of office vehicles from which old tyres and tubes forms the major part of this waste. The major rubber wastes are being pooled by the engineering division and auctioned to the vendors. Minor level of rubber wastes are hand glows, slippers, shoes, purse etc., are collected and send to the Corporation vehicle.

5.3.7: Chemicalwaste:

Chemical waste generated in the campus is relatively less in quantity and are generated in the laboratories. Various types of chemical wastes such as laboratory chemicals, medicines etc., are pooled and burying in deep-well by the concerned departments.

5.4: Hazardous Wastes

This waste includes sewage sludge, medical waste and lab waste. University has its own committee to overview the usage of bio-hazardous materials. It has its own policy to be followed

by the university departments (exclusively Science Laboratories) for various experimental purposes (Teaching and Research). If any laboratory uses the bio-hazardous materials, they have to take prior permission and the method of disposal should followed as established by the committee.

5.4.1: Sewage sludge

Among the three hazardous wastes, the contribution of sewage sludge is huge (Approximately 12000 kg/year) with major percentage of around 96.15%. Major portion of the sewage of the campus is connected to sewage line of the city. But, the sewage water of the quarters on northern part of the campus is connected to the two sewage pool tanks located one at Coconut Garden behind University Quarters and another at Old Nursery (Sapota and Guava garden).

5.4.2: Medical waste

These are generated from two health centers of the campus. The major medical wastes are dressing materials, syringes, IV fluid bottles, drip sets, canuala, injection bottles etc. Nearly 30 kg of waste are generated per monthand 360 kg/year.The health centers have a MoU with Shree consultancy of Mysore to treat this medical waste; they will collect the waste every alternate day and took it to the treatment unit. Apart from this, small incinerators are installed in the ladies hostels to manage the napkins of hostels inmates.

5.4.3: Lab waste

Various science laboratories in the University campus are conducting various experiments ranging tissue culture, pathology, animal biotechnology, cancer cell lines and other routine laboratory works which generates a considerable quantity of chemical as well as other solid wastes. Science laboratories especially the labs working on human and plant pathogenic microbes are following the standard disposal protocols set by the international organizations. The best example for this is, killing of microbes after their application for teaching and research; they were killed before disposing them into the environment. Approximately, university campus

generates around 10 kg/month and 120 kg/year of hazardous waste. These wastes are managed by burying in deep-well by the concerned departments.

General Observations and Recommendations:

- We commonly observed that, in most of the departments, offices, administrative personals and by and large the students in the campus are not practicing the use of one side printed papers for writing and draft preparation which can reduce considerable quantity of paper waste generation. It is suggested to encourage the practice of using of one side printed paper for writing and draft printing by all concerned stake holders.
- Though, we routinely use the plastics and due to recommendation by the corporation to avoid plastic, we are using least quantity of plastic. Yet, we don't have an alternative for some sort of plastic wares. However, the quantity can be reduced with active participation of all the stake holders which will make the university plastic free zone. Reduction in usage of plastics directly enhances the environment quality and life therein. It is suggested not to use plastics and reduce as much as you can.
- We are in the digital era. All financial transactions of the University are made through e-payment gateways; it is well received by all the stakeholders. Each and every activity is becoming paperless. It is true and can be implemented in the campus. We can follow paperless activities in certain activities of the department and the university in large which can reduce the contribution of solid waste generation in the campus. We suggest all the stake holders to implement the paperless actions and support in curbing the solid waste generation.
- The university is having a novel approach of re-cycling the plant litter by establishing solid waste management unit in the campus and recycling only around 10% of the available plant litter. But the in the campus there is huge quantity of plant litters measuring around 1500kg of easily collectable plant litter. This much of plant litter can be recycled in the established solid waste management unit. So, it is suggested to make use of the available plant litter biomass for the production of valuable compost and/or Vermicompost. These activities definitely reduce the solid waste and the generated compost may be used for its own use to supplement to the plants in the University Campus.

- It is suggested to install biogas plants and supply to the canteens and Hostels.
- It is suggested to establish sewage treatment plants for the recycling of water.
- It is suggested to organize training and awareness programs in the campus to create awareness on reduction, re-use and re-cycle of solid waste.
- Collection bins to be installed at designated places and the solid waste collected at these bins should be segregated and arrange for disposal everyday to maintain the cleanliness.
- Bio-hazardous safety committee constituted by the University to look after the use and disposal of hazardous lab chemicals and other wastes to be strengthened to promote bio-hazardous waste management scientifically.
- Green Audit committee should be constituted to look after all the activities concerned with green campus.

CHAPTER - VI

GREEN COVER INVENTORY & BIODIVERSITY

Manasagangotri, the Main Campus of the University in Mysuru, is an embodiment of greenery. The sprawling 801.08 acres of campus has a balanced spread of plants and trees as green area in697 acres of land including water body of Kukkarahally Lake. So the green area totally accounts for 87% of its total land. As a part of total green area, around 71 acres is covered by horticulture gardens, parks in 13 acres, lawns in 42 acres, grassland and playground in 51 acres and the remaining 400 acres is a forest and horticulture tree area. The green campus is a landmark in the city, with several hundreds of citizens choosing the Campus as a place for their morning and evening walks.Biodiversity in the Manasagangotri Campus is rich in biodiversity and encompasses diverse group of plants, animals.

6.1: Horticulture Plantations

6.1.1: Fruit yielding plantations

There are horticultural plants in 71 acres which are of vivid nature with lot of potentiality of yielding regular revenue to the university. The major plantations of fruit yielding trees comprising Coconut, Sapota, Jack fruit, Jamboolana and others. In addition, as a major green initiative the horticulture division has planted 10,000 plants which include Jack fruit, Mango, Teak, Jamboolana, Beete, Honne, red sandalwood, Mahaghani, Tamarind, Neem and Others. The details of plantation of different crops are presented in **Table 6.1**.

Table 6.1: Details of horticultural (fruit bearing) plants in the campus

Sl. No.	Particulars	Number	New plantation
1	Jack Fruit	540	The horticulture division has also planted 10,000 plants which include Jack fruit, Mango, Teak, Jamboolana, Beete, Honne, red sandalwood, Mahaghani, Tamarind, Neem and Others.
2	Jamboolana	416	
3	Star fruit	05	
4	Bale Fruit	32	
5	Guava	379	
6	Custard apple	300	
7	Sapota	624	
8	Mango	400	
9	Tamarind	400	
10	Coconut	1405	

6.1.2: Revenue generation from horticulture plantations and fish culture.

The horticulture division regularly auctioning the horticulture products yields by its plantations. In addition it is also auctioning the dried up trees to the vendors. Through these activities the division has generated an amount of Rs. **38,33,142** during 2014 to 2019**.** Further, the division is also maintaining the Kukkarahally Lake. In the lake the fish culture activity is taken up by Fisheries Federation, Mysuru. By auctioning the fishes a total amount of Rs. **33,43,009** has been collected by the division. Year wise details of amount generatedby the above said activities is presented in **Table 6.4.**

Table 6.2: Year wise details of income generated from Horticulture division MGM, UOM

Sl. No.	Activity	Amount generated (Rs.)					
		2014-15	**2015-16**	**2016-17**	**2017-18**	**2018-19**	**Total**
1	Auctioning of Horticulture products	14,83,450	10,48,850	4,79,960	2,38,800	5,82,084	38,33,142
2	Auctioning of fishes	6,05,000	6,35,250	6,67,013	7,00,364	7,35,382	33,43,009
Total		**20,88,450**	**16,84,100**	**11,46,973**	**9,39,164**	**13,17,464**	**71,76,151**

6.1.3: Greening the campus

As a major initiative of green campus a lot of works on development of new ornamental gardens, adoption of drip irrigation system and new plantation of horticulture plants have been undertaken though out the campus and other P.G. campuses during 2014 to 2020. The details of expenditure incurred on various green initiative activities are presents in **Table 6.3**. The data revealed that a total amount of **Rs. 2,02,80,452**has been spent. This major initiative has yielded rich dividend to recognize the campus as a green campus.

6.3 Expenditure incurred on green initiatives by the University of Mysore during last five years

Sl. No.	Year	Activities	Expenditure
1	**2014-15**	New Ornamental Gardens at Centenary Hall, Yuvaraja's College, Maharaja's College, & Dr. B. R. Ambedkar Research Center	**34,40,861/-**
2	**2015-16**	New Ornamental Garden at IOE, Manasa Guest House, Open Air Theatre, Humanities Auditorium, UG Library, MGM, Women Hostels to IOE & Senate Hall, Prasaranga, Microbiology Department, Babu Jagjivan Ram Research and Extension Center, Hemagangotri, Hassan. Plants and Grass planted in the main gate to Senate Hall.	**1,05,00,211**
3	**2016-17**	New Ornamental Garden at UGCHRDC	**61,800/-**
4	**2017-18**	New drip irrigation system at Coconut farm near sericulture department, Farm Behind PG hostel, Farm near Pump House, & VC quarters. New Ornamental garden at Food Science, Moulya Bhavan, Genetics, Organic Chemistry, Molecular Biology, Applied Botany and Earth Science Department premises.	**43,90,986/-**
5	**2018-19**	Plantation of 400 Mango plants behind hostels, new ornamental plants at History department, new ornamental garden made at new museum downs shopping complex and school of design.	**18,86,594/-**

Lawn developed in front of newly established Moulya Bhavan (Evaluation Bhavan)

6.1.4: Participation in flower shows during Dasara festivities.

Horticulture division of the University has a pride of maintaining celeritous gardens throughout the year which is recognized by many agencies and nature lovers. Every year it is arranging the flower shows and vegetable plant shows on west side and east side Bunds of Kukkarahalli Lake and also decorating various heritage buildings. This effort of the division is recognized very well during flower shows and competitions during Dasara festivities as it is participating in the competitions and bagging good number of awards every year. The details of flower shows and the awards won by the division are listed in **Table 6.4**.

Table 6.4: Flower show organized and participated in Competition by University of Mysore (Horticulture Division) during DASARA Festivities

Sl. No.	Flower Show	Date	Place	Remarks
2014-15	University's 11th Flower Show	25-10-2014 to 05-11-2014	West Side and East Side Bunds of Kukkarahalli Lake	Bagged 14 First Place and 11 Second Place Prize/Awards = 25
2015-16	University's 12th Flower Show	09-10-2015 to 23-10-2015	West Side and East Side Bunds of Kukkarahalli Lake	Bagged 10 First Place and 16 Second, 5 Third Place Prize/Awards = 31
2016-17	University's 13th Flower Show	01-10-2016 to 24-10-2016	West Side and East Side Bunds of Kukkarahalli Lake	Bagged 14 First Place and 10 Second Prize/Awards = 24
2017-18	University's 14th Flower Show	21-09-2017 to 02-10-2017	West Side and East Side Bunds of Kukkarahalli Lake	Bagged 17 First Place and 7 Second Prize/Awards = 24
2018-19	University's 15th Flower Show	10-10-2018 to 21-10-2018	West Side and East Side Bunds of Kukkarahalli Lake	Bagged 1st Prize in Education Institutes Category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6.2: Bio-Diversity of the Campus

Plant diversity and estimation /population of trees were made by team of expert's (field taxonomist) from Department of Studies in Botany and on the similar line animal diversity which includes, invertebrates and vertebrates were documented by experts from Zoology department of University of Mysore. The detailed information is provided below.

6.2 Floristic Diversity in Manasagangotri Campus:

Mysore University harbors a great diversity of angiosperms. Detailed collection and identification with the help of trained botanist, students and Research Scholars of Botany department made an attempt to enlist the number of plants occurs in Manasagangotri Campus. The identification of the plants made based on morphological features and by referring the standard protocol as per the recommendations of International code of Nomenclature by involving the taxonomists. Survey was conducted periodically and available plants were photographed and detailed morphological features were recorded for the identification purpose.

The campus of Manasagangotri is bounded on the north by the Mysore-Hunsur road, on the east by Crawford Hall, on the south by Radhakrishnan Avenue (now popularly called as Bogadi road), and on the west by regional College of Education and JSS College of Engineering. Nearly, 50% of the area comprises the Kukkarahalli tank bed and again about one third of the tank bed is under water, the rest being water land covered by weeds, grasses, shrubs, bushes and other trees. The gardens, lawns and avenues account for a majority of plant species on the campus. Collections and identification of plants available in the campus was carried out with the help of trained and expert taxonomist and the detailed list was generated. So far, 397 plant species have been documented which spread over **96 families** in the campus of which Fabaceae and Euphorbiaceae are represented by large numbers of species which includes 19 and 18 species respectively. Recent names (accepted names) have been given as far as possible.

Table 6.2.1: List of Plants Species along with its family of Manasagangotri, Mysuru

	Plant Families with number of Species			
Sl. No.	**Number of Species**	**Families**	**Total No. of Families**	**Total No. of Species**
01	One	Acoraceae, Alangiaceae, Asparagaceae, Brassicaceae,Buddlejaceae, Caricaceae, Caryophyllaceae, Celastraceae, Clusiaceae, Cochlospermaceae, Colchicaceae, Cyperaceae, Dilleniaceae, Dipterocarpaceae, Ephedraceae, Erthroxylaceae, Goodeniaceae, Hernandiaceae, Magnoliaceae, Mimosaceae, Moringaceae, Musaceae, Nelumbonaceae, Oleaceae, Orchidaceae, Oxalidaceae, Pandanaceae, Papaveraceae, Passifloraceae, Plumbaginaceae, Pontederiaceae, Portulacaceae, Rhamnaceae, Salvadoraceae, Santalaceae,Scrophulariaceae, Simaraubaceae, Strelitziaceae, Symplocaceae, Typhaceae, Ulmaceae, Vitaceae, Zingiberaceae, Zygophyllaceae.	44	44
02	Two	Agavaceae, Araucariaceae, Arecaceae, Basellaceae, Bombacaceae, Cucurbitaceae, Gentianaceae, Lauraceae, Lecythidaceae, Loranthaceae, Malpighiaceae, Menispermiaceae, Thymelaeaceae, Violaceae, Viscaceae, Zamiaceae.	16	32
03	Three	Cupressaceae, Cycadaceae, Polygonaceae, Tiliaceae.	04	12
04	Four	Anacardiaceae, Boraginaceae, Capparaceae, Lythraceae, Molluginaceae, Sapindaceae, Sapotaceae, Sterculiaceae.	08	32
05	Five	Convolvulaceae, Myrtaceae,Verbenaceae.	03	15
06	Six	Annonaceae, Combretaceae, Nyctaginaceae.	03	18
07	Seven	Amaranthaceae, Caesalpiniaceae, Commelinaceae, Meliaceae, Solanaceae.	05	35
08	Eight	Bignoniaceae, Leguminosae.	02	16
09	Ten	Malvaceae, Rutaceae.	02	20
10	Eleven	Asteraceae.	01	11
11	Twelve	Lamiaceae.	01	12
12	Fourteen	Rubiaceae.	01	14
13	Fifteen	Moraceae.	01	15
14	Sixteen	Apocyanaceae, Poaceae.	02	32
15	Seventeen	Acanthaceae.	01	17
16	Twenty four	Euphorbiaceae.	01	24
17	Thirty eight	Fabaceae.	01	38
		Total	**96**	**387**

Table 6.2.2:List of plant species details documented from the Campus

Sl. No.	Botanical Name	Family
1.	*Abelmoschus moschatus*Medik.	Malvaceae
2.	*Abrusprecatorius*L.	Fabaceae
3.	*Abutilon indicum* (L.) Sweet	Malvaceae
4.	*Acacia auriculiformis*A.Cunn. ex Benth.	Fabaceae
5.	*Acacia farnesiana*(L.) Willd.	Fabaceae
6.	*Acacia leucophloea* (Roxb.) Willd.	Fabaceaea
7.	*Acacia nilotica* Delile	Fabaceaea
8.	*Acacia torta* Craib	Fabaceae
9.	*Acalypha hispida*Willd.	Euphorbiaceae
10.	*Acalypha indica* L.	Euphorbiaceae
11.	*Acalypha wilkesiana*Müll.Arg.	Euphorbiaceae
12.	*Achyranthes aspera* L.	Verbenaceae
13.	*Acorus calamus* L.	Acoraceae
14.	*Adhatodazeylanica*Medic.	Acanthaceae
15.	*Adina cordifolia* (Roxb.) Hook.f. &Benth.	Rubiaceae
16.	*Aegle marmelos* (L.) Corrêa	Rutaceae
17.	*Aeschynomene indica* Burm.f.	Fabacaeae
18.	*Agathis robusta* (C.Moore ex F.Muell.) F.M.Bailey	Araucariaceae
19.	*Agave Americana* L.	Agavaceae
20.	*Ailanthus excels* Roxb.	Simaraubaceae
21.	*Alangiumsalviifolium* (L.) Wangerin	Alangiaceae
22.	*Albizia lebbeck* (L.) Benth.	Fabaceae
23.	*Alternanthera ficoidea* (L.) P.Beauv.	Amaranthaceae
24.	*Alternanthera paronychioides* A.St.-Hil.	Amaranthaceae
25.	*Alternanthera philoxeroides* (Mart.) Griseb.	Amaranthaceae
26.	*Alternanthera sessilis* (L.) DC.	Amaranthaceae
27.	*Alysicarpus vaginalis* (L.) DC.	Leguminosae
28.	*Amaranthus spinosus*L.	Amaranthaceae
29.	*Anacardium occidentale* L.	Anacardiaceae
30.	*Andrographis echioides* Nees	Acanthaceae
31.	*Andrographis paniculata*(Burm.f.) Wall.	Acanthaceae
32.	*Andrographis serpyllifolia* (Vahl) Wight	Acanthaceae
33.	*Anisomeles indica* (L.) Kuntze	Lamiaceae
34.	*Anisomelesmalabarica* (L.) R.Br.	Lamiaceae
35.	*Annona muricata* L.	Annonaceae
36.	*Annona purpurea* Moc. &Sessé ex Dunal,	Annonaceae
37.	*Annona reticulate* L.	Annonaceae
38.	*Annona squamosa* L.	Annonaceae
39.	*Anogeissus latifolia* Wall.	Combretaceae
40.	Antigononleptopus Hook. &Arn.	Polygonaceae
41.	*Araucaria columnaris* Hook	Araucariaceae
42.	*Areca catechu* L.	Arecaceae
43.	*Argemone mexicana* L.	Papaveraceae
44.	*Argyreia cuneata* Ker Gawl.	Convolvulaceae
45.	*Artabotrysodoratissimus Blume. Fl*	Annonaceae
46.	*Artocarpus heterophyllus* Lam.	Moraceae
47.	*Artocarpus integrifolius*L.f.	Moraceae
48.	*Asclepias curassavica*L.	Apocynaceae

49.	*Asparagus racemosus*Willd.	Asparagaceae
50.	*Asystasiagangetica*(L.) T.Anderson	Acanthaceae
51.	*Averrhoa bilimbi* L.	Oxalidaceae
52.	*Azadirachta indica* A.Juss.	Meliaceae
53.	*Azimatetracantha*Lam.	Salvadoraceae
54.	*Barleria cristata* L.	Acanthaceae
55.	*Barleriaobtusa*Nees. Linnaea (*B. mysurensis*)	Acanthaceae
56.	*Barleriastrigosa*Willd	Acanthaceae
57.	*Basella alba* L.	Basellaceae
58.	*Basella rubra* L.	Basellaceae
59.	*Bassia latifolia* Roxb.	Sapotaceae
60.	*Boerhaviadiffusa* L.	Nyctaginaceae
61.	*Boerhaviaerecta*L.	Nyctaginaceae
62.	*Boerhaviarepanda* Kotschy	Nyctaginaceae
63.	*Bombax ceiba* L.	Bombacaceae
64.	*Bougainvillea spectabilis*Willd.	Nyctaginaceae
65.	*Brassica campestris* L.	Brassicaceae
66.	*Buchananialanzan*Spreng.	Anacardiaceae
67.	*Buddleja asiatica*Lour.	Buddlejaceae
68.	*Butea monosperma* (Lam.) Taub	Fabaceae
69.	*Caesalpinia coriaria*(Jack.) Willd.	Caesalpiniaceae
70.	*Caesalpinia pulcherrima* (L.) Sw.	Caesalpiniaceae
71.	*Calendula officinalis* L.	Asteraceae
72.	*Calliandrahaematocephala* Hassk.	Fabaceae
73.	*Callistemon lanceolatus*(Sm.) Sweet.	Myrtaceae
74.	*Calotropis gigantea* (L.) W.T.Aiton	Apocynaceae
75.	*Calotropis procera*(Aiton) W.T.Aiton	Apocynaceae
76.	*Canscoradiffusa* R.Br.	Gentianaceae
77.	*Canthium parviflorum*Bartl. Ex DC.	Rubiaceae
78.	*Capparis zeylanica* Roxb.	Capparaceae
79.	*Cardiospermum halicacabum* L.	Sapindaceae
80.	*Careya arborea* Roxb.	Lecythedaceae
81.	*Carica papaya* L.	Caricaceae
82.	*Carmona retusa* (Vahl) Masam	Boraginaceae
83.	*Cassia fistula* L.	Fabaceaea
84.	*Cassia hirsuta* L.	Caesalpiniaceae
85.	*Cassia mimosoides* L.	Leguminosae
86.	*Cassia occidentalis* L.	Caesalpiniaceae
87.	*Cassia siamea* Lam.	Caesalpiniaceae
88.	*Cassia spectabilis* DC.	Caesalpiniaceae
89.	*Cassia tora* L.	Fabaceaea
90.	*Catharanthus pusillus* G.Don	Apocynaceae
91.	*Catharanthus roseus* (L.) G.Don	Apocynaceae
92.	*Ceiba pentandra* (L.) Gaertn.	Bombacaceae
93.	*Celosia argentea* L.	Amaranthaceae
94.	*Celosia cristata* L.	Amaranthaceae
95.	*Centratherumanthelminticum* (l.) Gamble	Asteraceae
96.	*Chloris barbata* Sw.	Poaceae
97.	*Chromolaena odorata* (L.) R.M.King & H.Rob.	Asteraceae
98.	*Chrysopogonzanioides*(L.) Roberty	Poaceae
99.	*Cinnamomum zeylanicum* Blume	Lauraceae

100.	*Cissus quadrangularis* L.	Vitaceae
101.	*Citrus indica* Tanaka.	Rutaceae
102.	*Citrus maxima* (Burm.) Merr	Rutaceae
103.	*Citrus medica* f. *aurantifolia* (Christm.) M.Hiroe	Rutaceae
104.	*Clausenaanisata*(Willd.)Hook.f.	Rutaceae
105.	*Cleome gynandra* L. (*Gynandropsis pentaphylla* (L.) DC.)	Capparaceae
106.	*Cleome monophylla* L.	Capparaceae
107.	*Cleome viscosa* L.	Capparaceae
108.	*Clerodendruminerme* R. Br.	Lamiaceae
109.	*Coccinia indica* Wight &Arn	Cucurbitaceae
110.	*Cocculus hirsutus* (L.) Diels	Menispermaceae
111.	*Cochlospermumreligiosum*(L.) Alston	Cochlospermaceae
112.	*Cocos nucifera* L.	Arecaceae
113.	*Coleus amboinicus*Lour.	Lamiaceae
114.	*Coleus aromaticus*Benth.	Lamiaceae
115.	*Commelinabenghalensis*L.	Commelinaceae
116.	*Commelinaerecta* L.	Commelinaceae
117.	*Commelinaforskaolii* Vahl	Commelinaceae
118.	*Commelinaneurophylla*C.B.Clarke	Commelinaceae
119.	*Commelinaramulosa*(C.B.Clarke) H.Perrier	Commelinaceae
120.	*Commelina tuberosa*	Commelinaceae
121.	*Convolvulus pluricanthus*Choisy.	Convolvulaceae
122.	*Cordia subcordata* Lam.	Boraginaceae
123.	*Couroupitaguianensis*Aubl.	Lecythidaceae
124.	*Crossandrainfundibuliformis* (L.)Nees	Acanthaceae
125.	*Crossandranilotica*Oliv.	Acanthaceae
126.	*Crotalaria juncea* L.	Fabaceae
127.	*Crotalaria juncea* L.	Fabaceae
128.	*Crotalaria laburnifolia* L.	Fabaceaea
129.	*Crotalaria pallida*Aiton.	Fabaceae
130.	*rotalariaramosissima* Roxb.	Fabaceae
131.	*Crotalaria retusa* L.	Fabaceae
132.	*Crotalaria trifoliolata* Baker f.	Fabaceaea
133.	*Crotalaria verrucosa* L.	Fabaceaea
134.	*Croton bonplandianus* Baill.	Euphorbiaceae
135.	*Croton sparsiflorus*Morung	Euphorbiaceae
136.	*Cryptolepisbuchananii* Roem. & Schult.	Apocynaceae
137.	*Cupressus macrocarpa* Hartw	Cupressaceae
138.	*Cupressus sempervirens* L	Cupressaceae
139.	*Cycas beddomei* Dyer	Cycadaceae
140.	*Cycas circinalis* Roxb.	Cycadaceae
141.	*Cycas revolute*Thunb	Cycadaceae
142.	*Cymbopogon citrates*Stapf	Poaceae
143.	*Cynodondactylon* (L.)Pers	Poaceae
144.	*Cyperus rotundus*Hook.f.	Cyperaceae
145.	*Daemia extensa* (Jacq.) R. Br. ex Schult.	Apocynaceae
146.	*Dalbergia pinnata* Prain	Leguminosae
147.	*Dalbergia sissoo* Roxb	Leguminosae
148.	*Datura metel*L.	Solanaceae
149.	*Datura stramonium* L.	Solanaceae
150.	*Delonixelata* Gamble	Fabaceaea

151.	*Delonix regia* (Bojer)Ref.	Fabaceaea
152.	*Dendrophthoe falcata* Blume	Loranthaceae
153.	*Dendrophthoe trigona* (Wight & Arn.) Danser ex Santapau	Loranthaceae
154.	*Dentella repens* J.R.Forst. & G.Forst.	Rubiaceae
155.	*Desmodiumgangeticum* Blanco.	Fabaceaea
156.	*Dichrostachys cinerea* (L.) Wight & Arn.	Fabaceaea
157.	*Dilleniapentagyna*Roxb.	Dilleniaceae
158.	*Dodonaeaviscosa*Jacq.	Sapindaceae
159.	*Duranta repens* L.	Verbenaceae
160.	*Echinopsechinatus*Roxb.	Asteraceae
161.	*Eclipta alba*Hassk.	Asteraceae
162.	*Eichhornia crassipes*(Mart.) Solms.	Pontederiaceae
163.	*Elettaria cardamomum* (L.)Maton	Zingiberaceae
164.	*Eleusine coracana*Gaertn.	Poaceae
165.	*Eleusine indica* Gaertn.	Poaceae
166.	*Emblica officinalis* Gaertn.	Euphorbiaceae
167.	*Enicostema littorale* Blume	Gentianaceae
168.	*Enterolobium saman* (Jacq.) Prain	Fabaceae
169.	*Enterolobium saman (Jacq.) Prain*	Mimosaceae
170.	*Ephedra gerardiana* Wall	Ephedraceae
171.	*Erythrina suberosa*Roxb.	Leguminosae
172.	*Erythroxylummonogynum*Roxb.	Erthroxylaceae
173.	*Eucalyptus globules*Labill.	Myrtaceae
174.	*Eugenia jambolana* Lam.	Myrtaceae
175.	*Euphorbia antiquorum* L.	Euphorbiaceae
176.	*Euphorbia bojeri* Hook.	Euphorbiaceae
177.	*Euphorbia cotinifolia* Kunth	Euphorbiaceae
178.	*Euphorbia geniculata* Sessé & Moc	Euphorbiaceae
179.	*Euphorbia hirta* L.	Euphorbiaceae
180.	*Euphorbia microphylla* Lam.	Euphorbiaceae
181.	*Euphorbia pulcherrima* Willd. ex Klotzsch	Euphorbiaceae
182.	*Euphorbia tirukalli* L.	Euphorbiaceae
183.	*Fernandoaadenophylla* (Wall. ex G.Don) Steenis	Bignoniaceae
184.	*Feronia elephantum* Correa/ *Limoniaacidissima*L.	Rutaceae
185.	*Feronia limonia* Swingle	Rutaceae
186.	*Ficus benghalensis* L.	Moraceae
187.	*Ficus elastica* Roxb. ex Hornem.	Moraceae
188.	*Ficus hispida* L.	Moraceae
189.	*Ficus microcarpa* Blume	Moraceae
190.	*Ficus mysorensis* B.Heyne ex Roth	Moraceae
191.	*Ficus racemosa* Willd.	Moraceae
192.	*Ficus religiosa* L.	Moraceae
193.	*Filiciumdecipiens* Thwaites	Sapindaceae
194.	*Furcraea* Vent	Agavacaea
195.	*Garcinia indica* (Thouars) Choisy	Clusiaceae
196.	*Gardenia jasminoides* J.Ellis	Rubiaceae
197.	*Gloriosa superb* L.	Colchicaceae
198.	*Gmelina arborea* Roxb.	Lamiaceae
199.	*Gmelina asiatica* L.	Lamiaceae
200.	*Grewia tiliifolia* Vahl	Tiliaceae

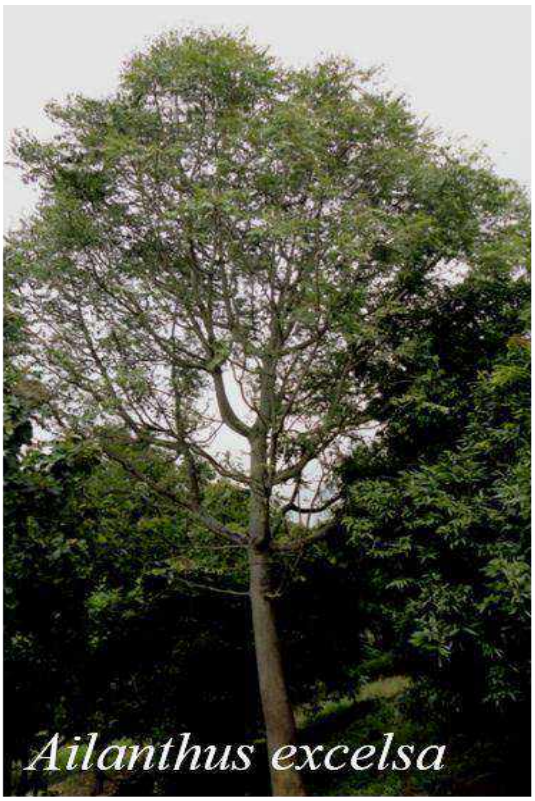
201.	*Guazuma tomentosa* Kunth	Sterculiaceae
202.	*Gyrinopswalla*Gaertn.	Thymelaeaceae
203.	*Gyrocarpus americanus* Jacq.	Hernandiaceae
204.	*Heteropogoncontortus* Beauv.	Poaceae
205.	*Hibiscus micranthus* L.f.	Malvaceae
206.	*Hibiscus rosa-sinensis* L.	Malvaceae
207.	*Hibiscus vitifolius* L.	Malvaceae
208.	*Hiptagemadablota* Gaertn.	Malpighiaceae
209.	*Holmskioldiasanguinea* Retz.	Lamiaceae
210.	*Holoptelea integrifolia* (Roxb.) Planch	Ulmaceae
211.	*Hybanthusenneaspermus* F.Muell.	Violaceae
212.	*Hygrophila auriculata* (Schumach.) Heine	Acanthaceae
213.	*Hymenodictyonexcelsum* Wall.	Rubiaceae
214.	*Indigofera enneaphylla* L.	Fabaceaea
215.	*Indigofera linnaei*Ali	Fabaceaea
216.	*Indigofera tinctoria* L.	Fabaceaea
217.	*Indigofera viscosa* Lam.	Leguminosae
218.	*Indigofera viscosa* Lam.	Fabaceaea
219.	*Ionidiumsuffruticosum*DC.	Violaceae
220.	*Ipomoea carnea* Jacq.	Convolvulaceae
221.	*Ixora chinensis* Lam.	Rubiaceae
222.	*Ixora coccinea* L.	Rubiaceae
223.	*Jatropha curcas* L.	Euphorbiaceae
224.	*Jatropha gossypifolia* L.	Euphorbiaceae
225.	*Justicia adhatoda* L.	Acanthaceae
226.	*Justicia betonica* L.	Acanthaceae
227.	*Justicia glauca* Rottler	Acanthaceae
228.	*usticiatranquebariensis* L.f.	Acanthaceae
229.	*Kigelia pinnata* (Jacq.) DC.	Bignoniaceae
230.	*Kydiacalycina*Roxb.	Malvaceae
231.	*Lagasceamollis* Cav.	Asteraceae
232.	*Lagerstroemia flos-reginae* Retz.	Lythraceae
233.	*Lagerstroemia speciosa* Pers.	Lythraceae
234.	*Lantana camara* L.	Verbenaceae
235.	*Lasiosiphoneriocephalus*Decne.	Thymelaeaceae
236.	*Lawsoniainermis* L.	Lythraceae
237.	*Leptadenia reticulata* (Retz.) Wight & Arn.	Apocynaceae
238.	*Leucas aspera* Link	Lamiaceae
239.	*Madhuca indica*J.F.Gmel.	Sapotaceae
240.	*Malpighia glabra* L.	Malpighiaceae
241.	*Malvastrumcoromandelianum*(L.) Garcke	Malvaceae
242.	*Malvaviscuspenduliflorus* DC.	Malvaceae
243.	*Mangifera indica* L.	Anacardiaceae
244.	*Manihot glaziovii* Müll.Arg.	Euphorbiaceae
245.	*Manilkara zapota* (L.) P.Royen	Sapotaceae
246.	*Markhamiaplatycalyx* Sprague	Bignoniaceae
247.	*Marsdeniavolubilis* Cooke	Apocynaceae
248.	*Maytenusemarginata* (Willd.) Ding Hou	Celastraceae
249.	*Medicago* L.Sp. Pl	Fabaceae
250.	*Melochiacorchorifolia* L.	Sterculiaceae
251.	*Merremia sp.*	Convolvulaceae
252.	*Merremia tridentata* (L.) Hallier f.	Convolvulaceae
253.	*Micheliachampaca* L.	Magnoliaceae

254.	*Micrargeriawightii* Benth.	Scrophulariaceae
255.	*Mimosa pudica* L.	Fabaceae
256.	*Mimusopselengi* Wight	Sapotaceae
257.	*Mirabilis jalapa* L.	Nyctaginaceae
258.	*Mirabilis viscosa* Cav.	Nyctaginaceae
259.	*Mollugocerviana* (L.) Ser.	Molluginaceae
260.	*Mollugolotoides* C.B.Clarke	Molluginaceae
261.	*Mollugooppositifolia* L.	Molluginaceae
262.	*Mollugo pentaphylla* L.	Molluginaceae
263.	*Momordica charantia* L.	Cucurbitaceae
264.	*Morindacitrifolia*L.	Rubiaceae
265.	*Morinda tinctoria* Noronha	Rubiaceae
266.	*Moringa oleifera* Lam.	Moringaceae
267.	*Muntingiacalabura*L.	Tiliaceae
268.	*Murrayakoenigii* (L.) Spreng.	Rutaceae
269.	*Musa paradisiaca* L.	Musaceae
270.	*Nelumbo nucifera* Gaertn.	Nelumbonaceae
271.	*Nerium indicum* Mill.	Apocyanaceae
272.	*Nerium oleander* L.	Apocyanaceae
273.	*Nyctanthes arbor-tristis* L.	Oleaceae
274.	*Oldenlandiacorymbosa*L.	Rubiaceae
275.	*Oldenlandia parviflora* Oliv.	Rubiaceae
276.	*Oroxylum indicum* Vent.	Bignoniaceae
277.	*Oryza sativa* L.	Poaceae
278.	*Pandanus amaryllifolius* Roxb.	Pandanaceae
279.	*Parthenium hysterophorus* L.	Asteraceae
280.	*Passiflora foetida* L.	Passifloraceae
281.	*Peltophoruminerme* (Roxb.) Naves	Caesalpiniaceae
282.	*Persea americana* Mill.	Lauraceae
283.	*Phyllanthus acidus*(L.) Skeels	Euphorbiaceae
284.	*Phyllanthus amarus* Schumach. & Thonn.	Euphorbiaceae
285.	*Phyllanthus emblica* L.	Euphorbiaceae
286.	*Phyllanthus maderaspatensis* L.	Euphorbiaceae
287.	*Phyllanthus myrtifolius* Moon	Euphorbiaceae
288.	*Phyllanthus narayanswamii* Gamble	Euphorbiaceae
289.	*Pithecellobium dulce* (Roxb.) Benth.	Fabaceae
290.	*Plumbagozeylanica*L.	Plumbaginaceae
291.	*Plumeria alba* hort. ex A.DC.	Apocynaceae
292.	*Polyalthia longifolia* (Sonn.) Hook.f. & Thomson	Annonaceae
293.	*Polycarpaeacorymbosa*(L.) Lam.	Caryophyllaceae
294.	*Polygonum barbatum* L.	Polygonaceae
295.	*Polygonum plebejum* subsp. *changii* (Kitag.) Vorosch.	Polygonaceae
296.	*Pongamia pinnata* (L.) Pierre	Fabaceaea
297.	*Psidium guajava* L.	Myrtaceae
298.	*Psychotriadalzellii*Hook.f.	Rubiaceae
299.	*Pterocarposmarsupius* St.-Lag.	Fabaceaea
300.	*Punica granatum* L.	Lythraceae
301.	*Rauvolfiatetraphylla* L.	Apocynaceae
302.	*Ravenalamadagascariensis* Adans.	Strelitziaceae
303.	*Ricinus communis* L.	Euphorbiaceae
304.	*Rungia repens* T.Anderson	Acanthaceae

305.	*Ruta graveolens* L	Rutaceae
306.	*Saccharum officinarum* L.	Poaceae
307.	*Santalum album* L.	Santalaceae
308.	*Sapinduslaurifolius* Vahl	Sapindaceae
309.	*Saracaasoca* (Roxb.) W.J.de Wilde	Fabaceaea
310.	*Saraca indica* L.	Fabaceaea
311.	*Sauropusandrogynus* Merr.	Euphorbiaceae
312.	*Scaevola taccada* (Gaertn.) Roxb.	Goodeniaceae
313.	*Schinusmolle* Hort.	Anacardiacaea
314.	*Sesbania grandiflora* (L.) Pers.	Fabaceae
315.	*Shorearoxburghi*G.Don	Dipterocarpaceae
316.	*Sida acuta* Burm.f.	Malvaceae
317.	*Sida cordifolia* L.	Malvaceae
318.	*Sidarhombifolia* L.	Malvaceae
319.	*Solanum erianthum* D.Don	Solanaceae
320.	*Solanum melongena* L.	Solanaceae
321.	*Solanum nigrum* L.	Solanaceae
322.	*Solanum parviflorum* Nocca	Solanaceae
323.	*Solanum sisymbriifolium* Lam.	Solanaceae
324.	*Soymidafebrifuga*Juss.	Meliaceae
325.	*Spathodeacampanulata* Buch.-Ham.	Bignoniaceae
326.	*Spathoglottisplicata* Griff.	Orchidaceae
327.	*Stachytarpheta indica* Vahl	Verbenaceae
328.	*Stachytarpitamutabilis*(Jacq.) Vahl	Verbenaceae
329.	*Stereospermumsuaveolens* DC.	Bignoniacaea
330.	*Stylosanthesmucronata* Willd.	Leguminosae
331.	*Swietenia mahaghoni*(L.) Jacq.	Meliaceae
332.	*Symplocoslaurina* Wall.	Symplocaceae
333.	*Synadeniumgrantii* Hook.f.	Euphorbiaceae
334.	*Synandrium sp.*	Apocynaceae
335.	*Synedrellanodiflora* Gaertn	Asteraceae
336.	*Syzygiumcumini* (L.) Skeels / *Syzygiumjambolanum* (Lam.) DC*)*	Myrtaceae
337.	*Tabebuia argentea* Britton	Bignoniaceae
338.	*Tagetes erecta*L.	Asteraceae
339.	*alinumcuneifolium* Willd.	Portulacaceae
340.	*Tamarindus indica* L.	Fabaceaea
341.	*Tarena asiatica* (L.) Alston.	Rubiaceae
342.	*Tecoma stans* Juss	Bignoniaceae
343.	*Tecoma stans* Juss	Bignoniaceae
344.	*Tectona grandis*L.f.	Lamiaceae
345.	*Terminalia arjuna* (Roxb. ex DC.) Wight & Arn.	Combretaceae
346.	*Terminalia bellirica* (Gaertn.) Roxb.	Combretaceae
347.	*Terminalia catappa* L.	Combretaceae
348.	*Terminalia chebula* Retz	Combretaceae
349.	*Terminalia paniculata* Roth	Combretaceae
350.	*Terminalia tomentosa* Wight & Arn	Combritaceae
351.	*Theobroma cacao* L.	Sterculiaceae
352.	*Thuja occidentalis* L	Cupressaceae
353.	*Thunbergia alata* Bojer ex Sims	Acanthaceae
354.	*Tinospora cordifolia* Miers	Menispermiaceae
355.	*Toddalia asiatica* (L.) Lam.	Rutaceae

356.	*Toona ciliata* M.Roem.	Meliaceae
357.	*Tradescantia pallida* (Rose) D.R.Hunt	Commelinaceae
358.	*Tragiainvolucrata* L.	Euphorbiaceae
359.	*Tribulus terrestris* L.	Zygophyllaceae
360.	*Trichodesma indicum* R.Br.	Boraginaceae
361.	*Trichodesma zeylanicum* (Burm.f.) R.Br.	Boraginaceae
362.	*Tridax procumbens* L.	Asteraceae
363.	*Triumfettarhomboidea* Jacq.	Tiliaceae
364.	*Tylophora indica* Merr.	Apocynaceae
365.	*Typha elephantina* Roxb.	Typhaceae
366.	*Urena lobata* L.	Malvaceae
367.	*Urena sinuata* Sw.	Malvaceae
368.	*Vernonia cinerea* (L.) Less	Asteraceae
369.	*Viscum nepalense* Spreng.	Viscaceae
370.	*Viscum orientale* Willd.	Viscaceae
371.	*Vitex negundo* L	Lamiaceae
372.	*Vitex trifolia* L.	Lamiaceae
373.	*Waltheria indica* L.	Sterculiaceae
374.	*Wrightia tinctoria* R.Br.	Apocyanaceae
375.	*Xeromphis spinosa* (Thunb.) Keay	Rubiaceae
376.	*Zamia furfuracea* L.f	Zamiaceae
377.	*Zamia integrifolia* L.f.	Zamiaceae
378.	*Zea mays* L	Poaceae
379.	*Ziziphus mauritiana* Lam	Rhamnaceae

Representatives of plant wealth recorded in the Manasagangotri Campus are presented below and their botanical names are appended in the image for identification.


Ailanthus excelsa


Anthurium cv.


Antigonon leptopus


Aloe vera


Hamelia patens


Artabotrys odoratissimus


Impatiens Sp.


Holmskioldia sanginea


Crotalaria trifoliata


Dalbergia sissoo


Duranta repens


Emblica officinalis


Clitoria ternatea
Senna polyphylla
Commelina forskalaei


Bignonia magnifica


Careya arborea


Bismarckia nobilis

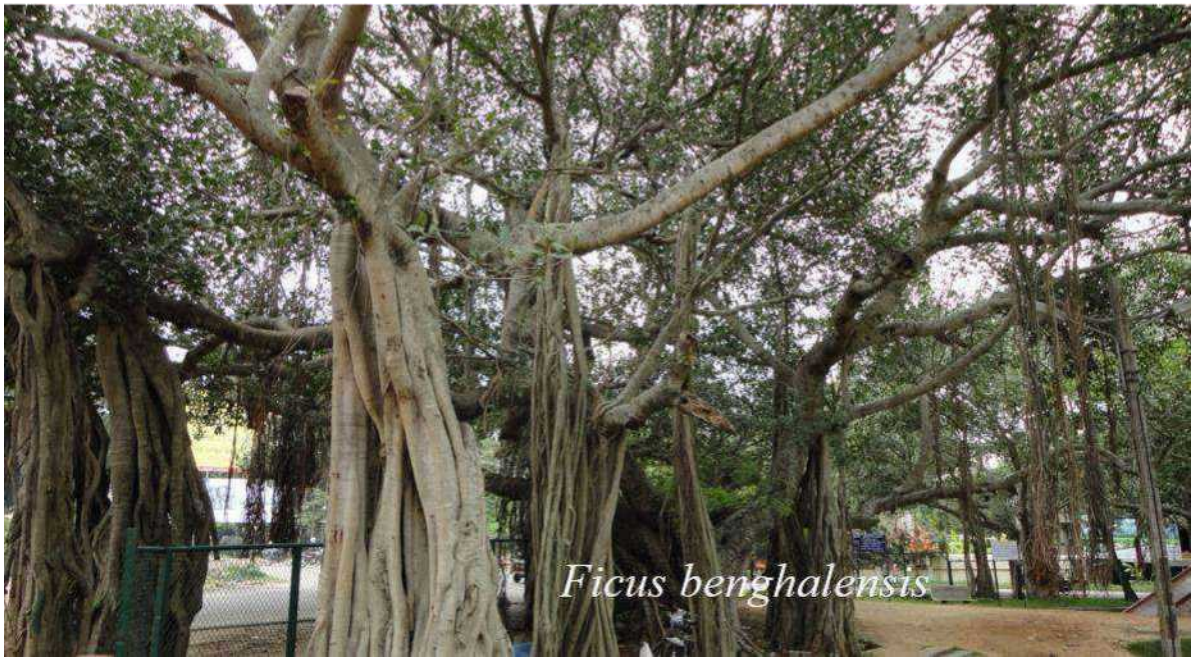

Allamanda blanchetii


Crinum difixum


Cycas revoluta


Euphorbia milli


Gloriosa superba


Ficus benghalensis


Ipomoea cairica


Kalanchoe pinnata


Lagascea mollis


Lantana camara


Leucaena leucocephala


Millingtonia hortensis


Hibiscus vitifolius

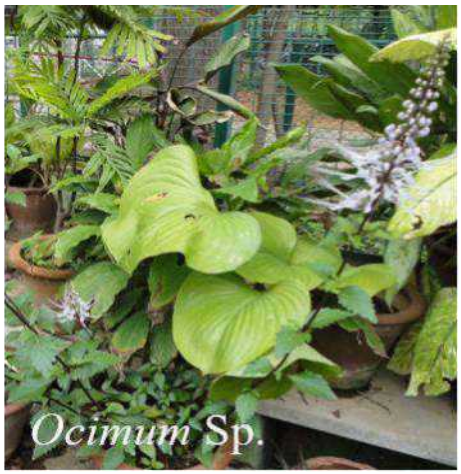

Markhamia platycalyx


Mimosa pudica


Morinda tinctoria


Muntingia calabura


Muehlenbeckia platycladus

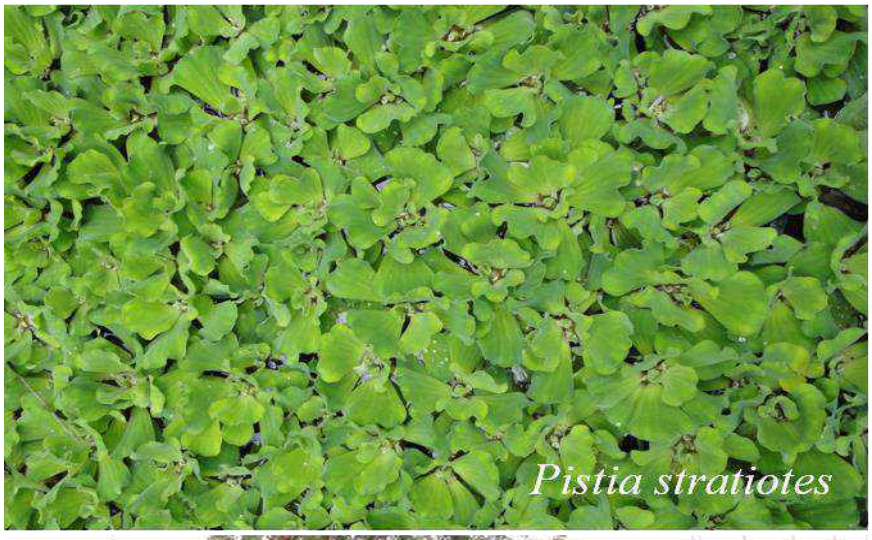

Ocimum Sp.


Parkia biglandulosa

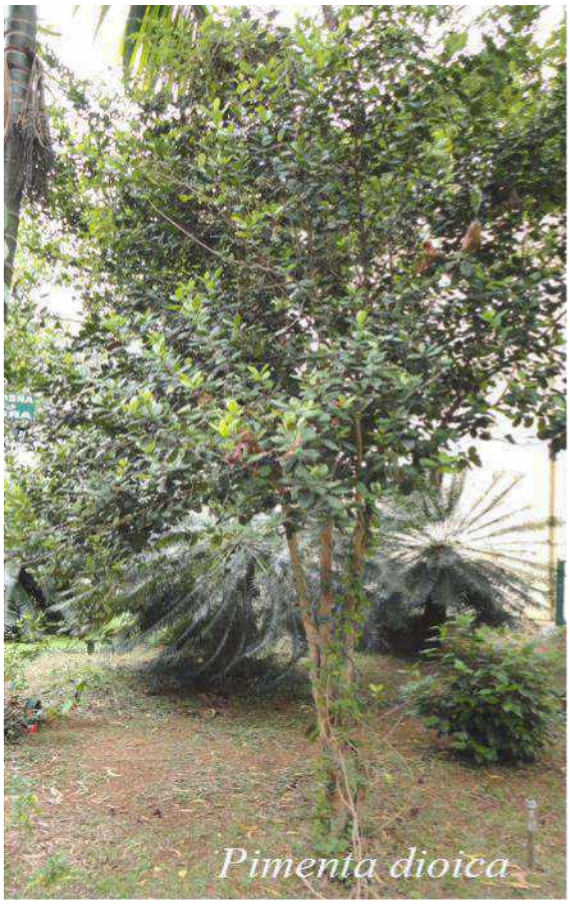

Pandanus fascicularis


Oxalis latifolia

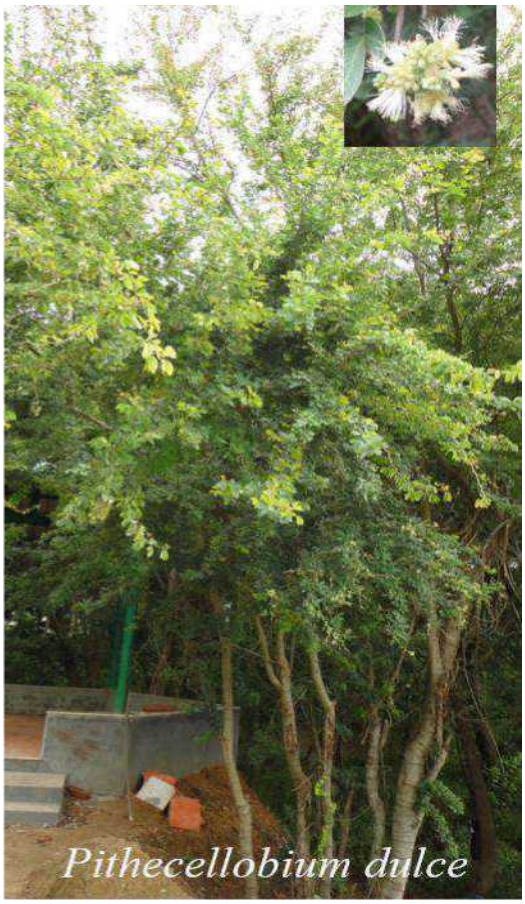

Passiflora foetida


Pistia stratiotes


Peltophorum pterocarpum



Pimenta dioica

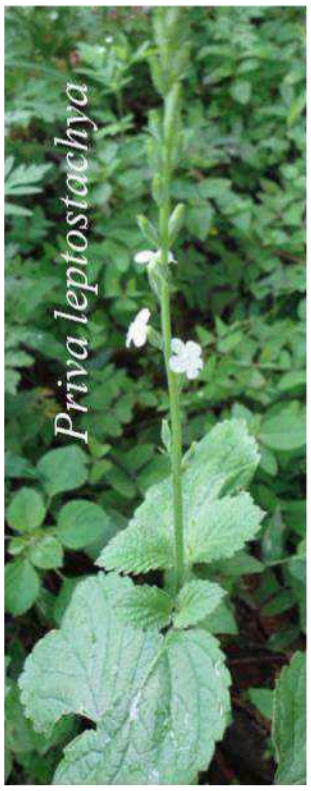


Pithecellobium dulce

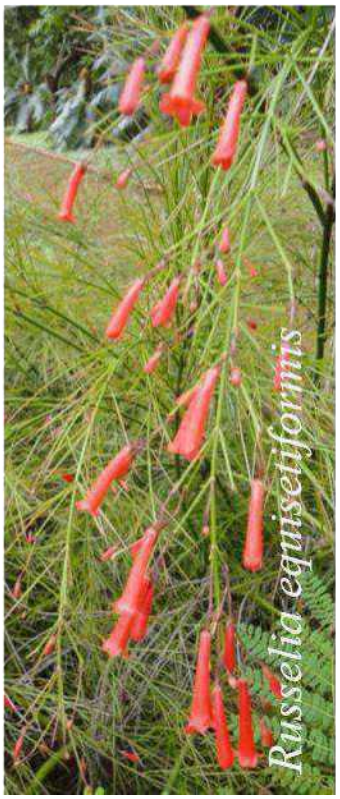
Polygala erioptera


Polygonum glabrum


Portulaca grandiflora


Priva leptostachya


Abelomoschus moschatus


Russelia equisetiformis

6.3 Major tree species and their population with canopy classes:

Tree population in the campus provides an aesthetic value and green cover appearance. We made an attempt to record the tree species which are in larger number and accounted for greener patch in the campus. A total of 45 tree species were recorded and which *Tectona grandis* tree is represented by large number (over 1000 populations are recorded) followed by *Pongamia pinnata, Polyalthia longifolia, Peltaphorumpterocarpus, Artocarpus heterophylla, Sweteniamahaghani, Acacia auriculiformis* are the other major tree species spreads across the green campus of Manasagangotri. Though, a large area is developed through introduction of horticulturally important plants (via establishment of lawn, avenues plantations, etc.). However, recently in the year 2018-19, a total of 2000 saplings of red sandal tree (*Pterocarpus santalinus*) were planted across the Manasagangotri campus which will be a great move to have greener cover in the coming years. These plantations / trees are adding biomass for enriching the soil fertility and also bio-waste management team collecting the large amount of litter which was further processed to generate compost materials for gardening purpose by the University.

Table 6.5: List of plant species present abundantly in the campus

Sl. No.	Plant species	Canopy			Number
		Huge	Good	Moderate	
1	*Tectona grandis*	350	172	405	**967**
2	*Pongamia pinnata*	283	70	59	**412**
3	*Polyalthia longifolia*	164	73	85	**322**
4	*Peltaphorumptorecarpum*	112	147	53	**312**
5	*Eucalyptus sp.*	124	87	47	**258**
6	*Artocarpus heterophyllous*	157	52	39	**248**
7	*Azadirachta indica*	112	71	54	**237**
8	*Sweteniamahaghani*	137	70	13	**220**
9	*Cocos nucifera*	10	152	56	**218**
10	*Syzygiumcumini*	58	127	30	**215**
11	*Tamarindus indica*	112	67	33	**212**
12	*Leucaena leucocephala*	82	94	21	**197**
13	*Phyllanthusemblica*	5	127	63	**195**
14	*Michaliachmapaka*	17	137	24	**178**
15	*Millingtonia hortensis*	94	37	24	**155**
16	*Santalum album*	0	10	105	**115**
17	*Delonix regia*	78	35	1	**114**
18	*Tabubiaaurea*	0	105	7	**112**
19	*Milletiaovalifolia*	72	30	10	**112**
20	*Spathodeacompanulata*	63	27	5	**95**
21	*Acacia auriculiformis*	0	63	29	**92**
22	*Mangiferaindica*	41	26	0	**67**

23	*Jacarandra indica*	12	53	0	**65**
24	*Terminaliacatappa*	11	47	6	**64**
25	*Peltaphoruminermae*	42	14	1	**57**
26	*Pithcellobium saman*	32	16	0	**48**
27	*Adenantherapavonina*	0	37	11	**48**
28	*Bauhinia purpurea*	3	32	6	**41**
29	*Tabubiarosea*	0	28	11	**39**
30	*Bamboo sp.*	35	3	0	**38**
31	*Tabubiapentaphylla*	13	24	0	**37**
32	*Terminaliaarjuna*	0	30	0	**30**
33	*Cordia obliqua*	0	30	0	**30**
34	*Grevillea robusta*	12	16	0	**28**
35	*Bauhinia variegata*	3	24	0	**27**
36	*Muntungiacalabura*	0	22	5	**27**
37	*Glyricidia sp.*	0	18	9	**27**
38	*Ficusreligiosa*	5	13	0	**18**
39	*Limoniaacidissima*	3	15	0	**18**
40	*Ficus benghalensis*	15	0	0	**15**
41	*Saracaasoka*	2	13	0	**15**
42	*Aracaria sp.*	2	10	1	**13**
43	*Bombax ceiba*	5	3	2	**10**
44	*Ficusracemosa*	2	1	0	**3**
45	*Couroupitaguianensis*	3	0	0	**3**
	Total	**2271**	**2228**	**1215**	**5754**

Note:

Criteria followed for classification of Trees based on Canopy as Trees with huge canopy; Trees with good canopy and Trees with Moderate canopy. The classification of Huge, Good and Moderate is based on the tree height and the area it covers/spreads and the quantity of litter it generates viz., a huge tree measured an height of more than **50** ft. and with a canopy cover of more than 20mts.; a good canopy tree measured an height in the range of **30 - 50**ft. and with a canopy cover of 10 – 15 mts.; and a moderate tree measured an height of less than **30** ft. and with a canopy cover of less than 10mts.

The above ground biomass generated was estimated with an approximate value determined by our studies. For a huge canopy tree, yearly 0.6 ton biomass was obtained with around 30% moisture. Similarly, for a good and moderate tree canopy, yearly 0.3, and 0.15 ton of biomass was generated respectively.

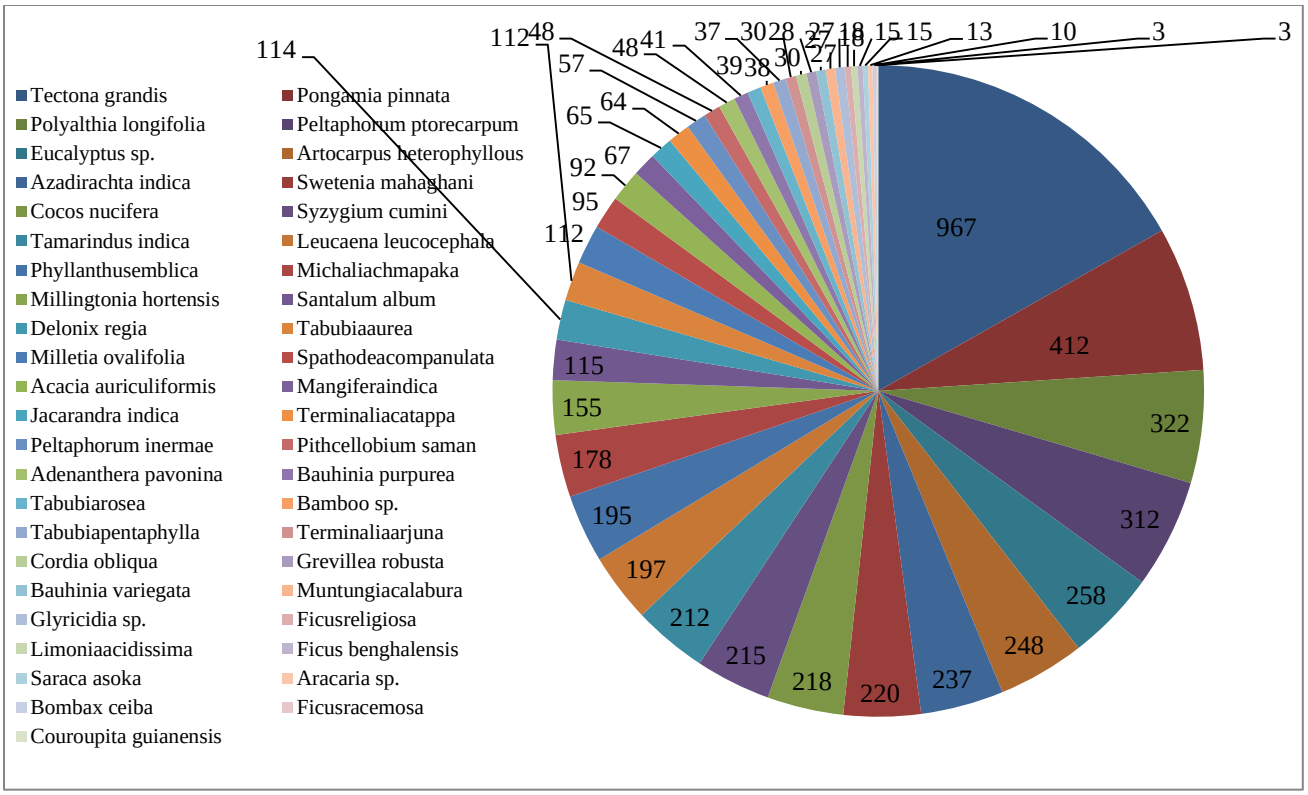


Figure: 6.2. Pie diagram showing abundance of tree species distributed from 45 species in the Manasagangotri Campus.

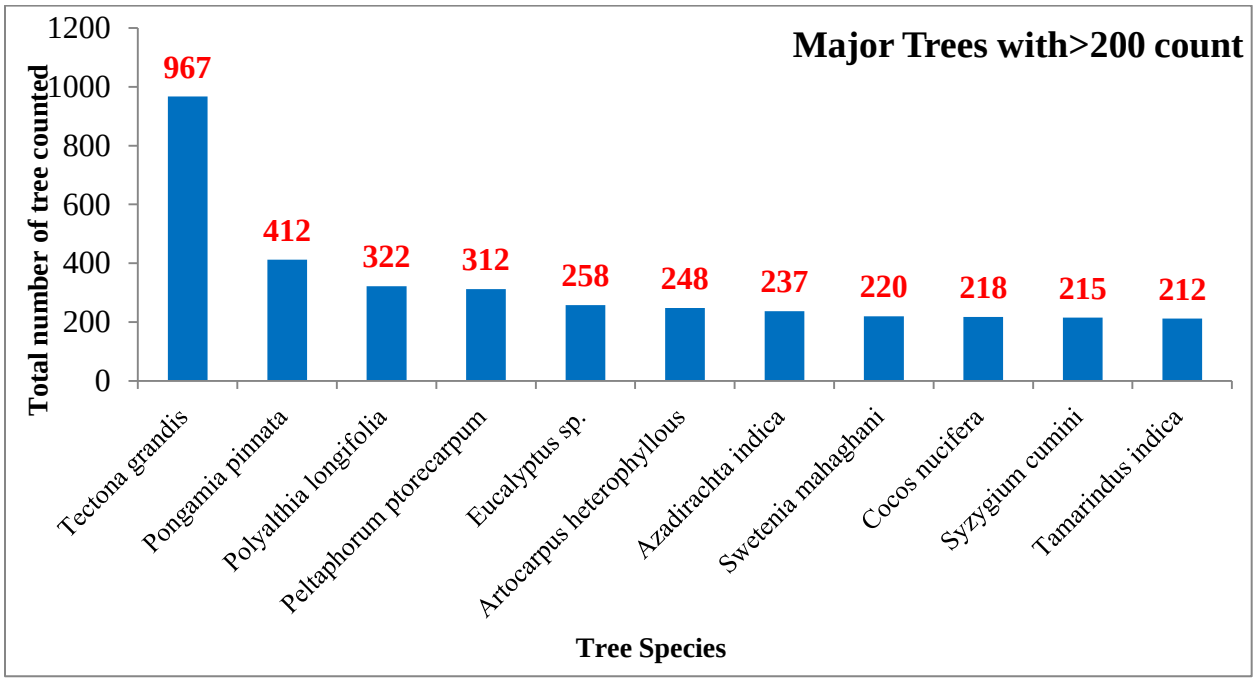


Figure: 6.1 Bar-graph representing the most dominant tree count recorded from Manasagangotri Campus

6.6 Botanical Garden and Plant Diversity:

Department of Studies in Botany is having a Botanical garden in which several plants were nurtured in their natural habitat and several other host plants were introduced for study purpose. The botanical garden was used by the students to explore the diversity and to learn the subject systematics by practical exposures. The botanical garden is having more than 180 plants (which includes herbs, shrubs, trees, medicinal plants). It is important to note that, *Cycas swamii* is an important cycad plant present in our botanical garden which is around more than 60 year old. A rare *Agathis alba* - a gymnospermous plant of an approximately 100 years old is available at Botanical garden of Botany Department. There are around 30 Cycas plants and there were several huge trees. Inside the botanical garden, there exists a net house with a large number of o4rchids collection collected by students of M.Sc. Botany collected during field excursion/botanical explorations undertaken as per their curricula were maintained in the net house.

6.7 Medicinal Plant Garden:

Table 6.3: List of medicinal plant available in Manasagangotri campus

Sl. No.	Botanical name	Sl. No.	Botanical name
1	*Acorus calamus*	36	*Ficus religiosa*
2	*Adhatodavasica*	37	*Grevillea robusta*
3	*Aegle marmalos*	38	*Hemidesmus indicus*
6	*Aervalanata*	39	*Hibiscus rosa-sinensis*
5	*Albizia lebbeck*	40	*Indigofera tinctoria*
6	*Aloe vera*	41	*Ixora coccinea*
7	*Alpinia galanga*	42	*Ixora parviflora*
8	*Alstoniascholaris*	43	*Manihot esculenta*
9	*Alternanthera sessilis*	44	*Micheliachampaca*
10	*Andrographis peniculata*	45	*. Millingtonia hortensis*
11	*Artemisia pallens*	46	*Morindacitrifolia*
12	*Asparagus racemosus*	47	*Nyctanthesarbour-tristis*
13	*Azadirachta indica*	48	*Oscimum sanctum*
14	*Jasminum grandiflorum*	49	*Phyllanthus emblica*
15	*Bacopa monnieri*	50	*Phyllanthus niruri*
16	*Bambusa textilis*	51	*Piper longum*
17	*Bauhinia variegata*	52	*Plectranthusamboinicus*
18	*Boerhaviadiffusa*	53	*Plumeria alba*
19	*Bryophyllum sp.*	54	*Plumeria rubra*
20	*Calotropis procera*	55	*. Pongamia pinnata*
21	*Carissa carandas*	56	*Rauvolfia serpentine*
22	*Cascabelathevetia*	57	*Rheo tricolor*
23	*Ceiba pentandra*	58	*Russeliaequisetiformis*
24	*Centella asiatica*	59	*Santalam album*
25	*Cestrum nocturnum*	60	*Saracaasoca*
26	*Citrus medica*	61	*Sauropusandrogynus*
27	*Colocasia esculenta*	62	*Scaveola sericea*
28	*Costusigneus*	63	*Tabernaemontanadivaricata*
29	*Croton tiglium*	64	*Tamarindus indica*
30	*Curcuma longa*	65	*Tectona grandis*
31	*Cymbopogon citratus*	66	*Terminalia chebula*
32	*Cynodondactylon*	67	*Thespesia populnea*
33	*Elatteria cardamomum*	68	*Thuja occidentalis*
34	*Euphorbia tirucalli*	69	*Thunbergia grandiflora*
35	*Ficus benjamina*	70	

6.8 Animal diversity in Manasagangotri campus, Mysuru:

Manasagangotri campus has hosted good number of invertebrate and vertebrate fauna. The invertebrates are represented by 323 species (66.6%) and vertebrates are represented by 167 species (33.4%). Moreover, the existed fauna was classified into different categories based on their status that accounts 12 major types. Further, based on animal species occurrence and abundance, recorded fauna was further grouped into common species (45.5%), very commonly occurring specie (22.8%), rare species (18.8%), vulnerable species (2.4%) and endangered species (2.4%) which are recorded amidst Manasagangotri campus of University of Mysore.

Furthermore, the campus is known for different species such as local migrants (0.8%), local residents (21.4%) and seasonal migrants (1.0%). Interestingly, 22 species are aquatic forms, 276 species are terrestrial forms, 38 species are arboreal forms and 34 species are amphibious forms which constituted respectively 4.4, 55.2, 7.6 and 6.8%. Further, Manasagangotri campus is also known for nine vector species and five parasites. Thus, all these animal species have help develop very good local biodiversity and made the Manasagangotri campus unique in terms of good animal diversity in south India in general and in Karnataka in particular. The details of different animal species found in Manasagangotri campus are given in **Table 6.8.1**.

Table 6.8.1: List of Animal species belong to different groups (Phyla) and Fauna status in Manasagangotri, Mysuru

National Bird : Peacock (***Pavocristatus***) **State Bird** : Indian Roller (***Coracasbenghalensis***)								
Sl. No.	**Animal Phyla**	**No. of species**	**% Occurrence**		**Sl. No.**	**Status of Fauna**	**No. of species**	**% Occurrence**
1.	Protozoa	02	0.4		1.	Common species	76	45.5
2.	Coelenterata	02	0.4		2.	Very common species	38	22.8
3.	Platyhelminthes	03	0.6		3.	Rare species	30	18.8
4.	Aschelminthes	01	0.2		4.	Vulnerable species	04	2.4
5.	Annelida	02	0.4		5.	Threatened species	15	8.9
6.	Arthropoda				6.	Endangered species	04	2.4
	a. Crustacea	15	3.0		7.	Local residents	107	21.4
	b. Insecta	204	40.8		8.	Local migrants	04	0.8
	c. Myriopoda	04	0.8		9.	Seasonal migrants	05	1.0
	d. Arachnida	97	19.4		10.	Aquatic fauna	22	4.4
7.	Mollusca	03	0.6		11.	Terrestrial fauna	276	55.2
8.	Fishes	05	1.0		12.	Arboreal fauna	38	7.6
9.	Amphibia	06	1.2		13.	Amphibious fauna	34	6.8
10.	Reptilia	10	2.0		14.	Vector species	09	1.8
11.	Aves	125	25.0		15.	Parasites	05	1.0
12.	Mammalia	21	4.2			**Total**	**500**	**100.0**
Total		**500**	**100.0**					

Table6.8.2: Animal diversity in Manasagangotri, Mysuru

Invertebrates			
Sl. No.	**Name**	**No. of species**	**% Occurrence**
1.	Protozoan's	02	0.6
2.	Hydra	01	0.3
3.	Flat worms	03	0.9
4.	Round worms	01	0.3
5.	Earth worms	02	0.6
6.	Crustaceans	15	4.5
7.	Wingless insects	04	1.2
8.	Aquatic insects	06	1.8
9.	Dragon flies/Damselflies	04	1.2
10.	Grasshoppers	05	1.5
11.	Dipterans	37	11.1
12.	Mosquitoes	09	2.7
13.	Ants	31	9.3
14.	Honeybees	04	1.2
15.	Wasps	09	2.7
16.	Termites	02	0.6
17.	Butterflies/Moths	79	23.7
18.	Beetles	14	4.2
19.	Spiders	97	29.2
20.	Millipedes	02	0.6
21.	Centipedes	02	0.6
22.	Scorpion	01	0.3
23.	Snails	02	0.6
24.	Slugs	01	0.3
	Total	**333**	**100.0**

Vertebrates			
Sl. No.	**Name**	**No. of species**	**% Occurrence**
1.	Fishes	05	3.0
2.	Frogs	04	2.4
3.	Toads	02	1.2
4.	Lizards	03	1.8
5.	Snakes	06	3.6
6.	Crocodile	01	0.6
7.	Birds	125	74.8
8.	Rats/Bandicoots	03	1.8
9.	Cats	02	1.2
10	Bats	10	6.0
11.	Squirrel	01	0.6
12.	Mongoose	01	0.6
13.	Rabbit/hare	02	1.2
14.	Fox	01	0.6
15.	Monkey	01	0.6
	Total	**167**	**100.0**

Totally five hundred species of animals belongs to both invertebrate and vertebrates inhabiting in this campus. Greenery in the campus along with the flowering and fruiting plants are continuously available throughout the year. Hence nearly 204 species of insects spread in this campus witnessing the pollination. Apart from the insects, arachnids dominate the campus since, a rich diversity of arachnids represented in the campus. Among the Vertebrates the campus harbors the rich biodiversity of bird's population with 125 species. Several migratory birds visit Mysore especially to KukkarahalliLake attract many naturalist and bird watchers to the lake**.**

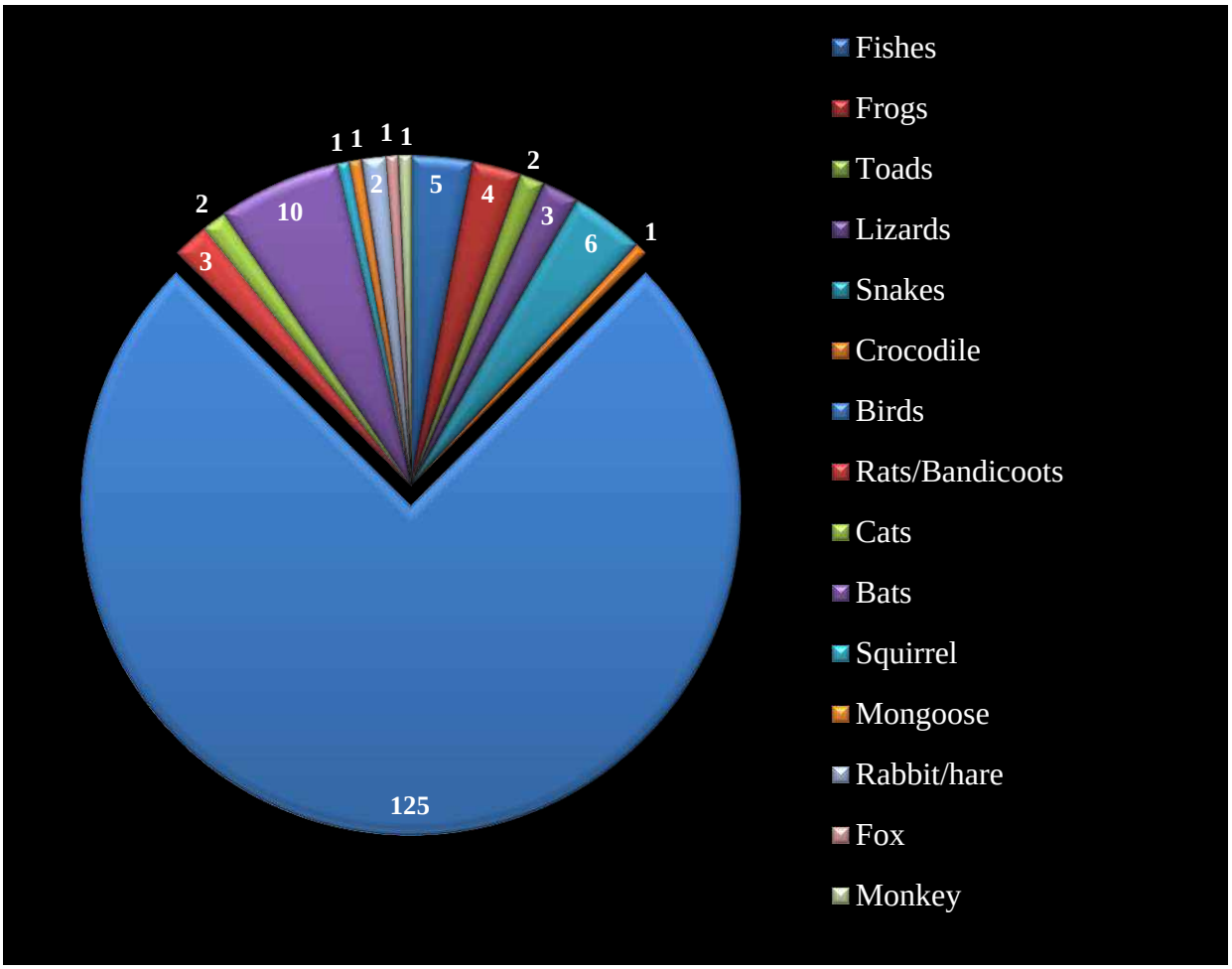
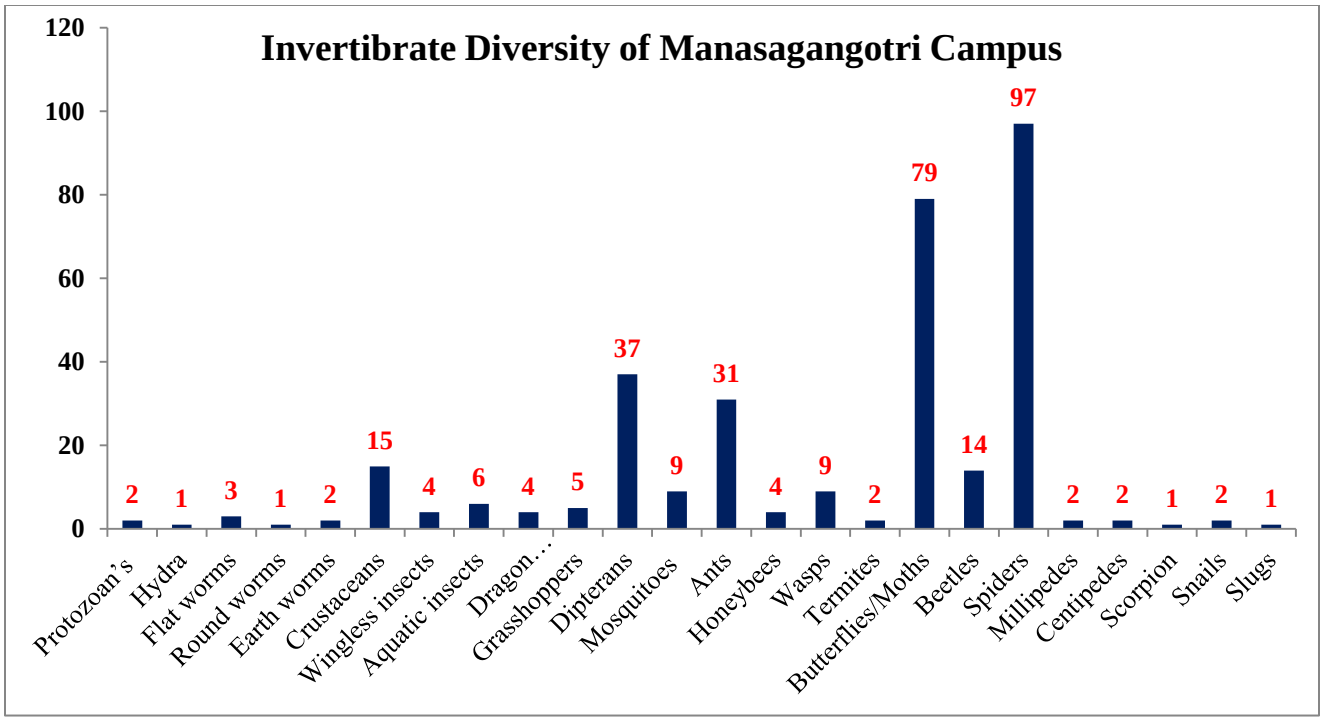


Figure 6.3: Pie diagram showing the diversity of Vertebrates from Manasagangotri Campus


Invertibrate Diversity of Manasagangotri Campus
120
100
80
60
40
20
0
2
1
3
1
2
15
4
6
4
5
37
9
31
4
9
2
79
14
97
2
2
1
2
1
Protozoan's
Hydra
Flat worms
Round worms
Earth worms
Crustaceans
Wingless insects
Aquatic insects
Dragon…
Grasshoppers
Dipterans
Mosquitoes
Ants
Honeybees
Wasps
Termites
Butterflies/Moths
Beetles
Spiders
Millipedes
Centipedes
Scorpion
Snails
Slugs

CHAPTER VII

AIR QUALITY OF MANASAGANGOTRI CAMPUS

The ambient air quality status of Manasagangotri campus was assessed in consultation with the Department of Studies in Environment Science and Karnataka State Pollution Control Board (KSPCB) for the years 2015-16, 2016-17, 2017-18 and 2018-19. According to the data, the level of SO_2 (4 µg/m^3) was highest in 2015. However, it remained fairly constant in the years 2016, 2017 and 2018 – 3, 2 and 1 µg/m^3 respectively. Similar trend was observed with NO_2 in the year 2015, 2016, 2017 and 2018-19 recorded the level of 11, 11,09 and 09 µg/m^3 respectively. Highest level of NO_2 was recorded in 2015 and considerably low in 2018-19. This may be explained due to the implementation of Bharat Stage IV emission standards and Euro VI standards and large no. trees planted during these years. Now all these trees are grown to the medium height giving a lush green sight to the area.SPM level recorded 08,06,05 and 02µg/m^3 in the years 2015, 2016, 2017 and 2018-19respectively. The similar trend has been observed for SPM also. Indian standards for annual $PM_{2.5}$ is 40 µg/m^3, PM_{10} is 60 µg/m^3 for residential, commercial and ecological sensitive areas. Standards for NO_2 is 40 µg/m^3 in residential area, commercial area and 30 µg/m^3 for ecological sensitive area and standards for SO_2 is 50 µg/m^3 for residential and commercial area and 20 µg/m^3 for ecological sensitive areas respectively. These standards are notified by Central Government of India. Our results shows that the NO2 SO2 and SPM levels are within the permissible limit.

Table 7.1: Annual average of ambient air parameters of Manasagangotri campus

	SO2	NO2	PM-10	PM2.5
2015	4	11	08	10
2016	3	09	06	09
2017	1	11	05	06
2018-19	1	09	02	04

(All Values in µg/m^3)

Reacting on the report, Prakash, Environment Officer, Karnataka State Pollution Control Board, have said that Manasagangotri campus enriched with green vegetation and no danger with regard to the pollution. He also added in an interview to "Star of Mysore" said that the air pollution levels in Mysuru are well within the permissible limits. Further, he said that the air

pollution levels conform to National Ambient Air Quality Standards. “Pollution control board has air pollution measuring units at K.R. Circle, considering the area’s density of vehicle population at any given point of time and at Royal Inn junction. We have been measuring pollution levels since the last 15 years and even the levels are digitally displayed at our office,” On the Green peace report, Prakash Environment Officer said that Green peace report failed to understand what parameters were used by it to include Mysuru in the list of polluted cities. “There are no dangerous materials nor is the situation alarming in and near Manasagangotri, campus he added.

Report:

- Overall the air pollution status of Manasagangotri is within the permissible limit.
- Manasagangotri campus is relatively possess a healthy ambient air quality as the movement of vehicles are restricted. A very good vegetative cover in the campus is helpful in natural carbon sequestration in the campus.
- Clean air clean environment concept of the campus has given room for attracting public to have a healthy walk in and around campus.

CHAPTER VIII

TRANSPORTATION AND CARBON FOOT PRINT

8.1. Transportation

The campus is in the heart of city and six kilometers away from bus stand and railway station. So, a large number (6684) of students use public transport. Comparatively, two wheelers are high in number as 20.21% of students/faculty/visitors use the two wheelers. The electrical vehicles are only 0.57% in the campus. Since, there is 'trin-trin 'bicycle standof MCC in the campus gate, the usage of bicycles is also of considerable percentage. The details of vehicles and number of users along with percent share are presented in **Table 8.1 and Figure 8.1.**

Table 8.1: Vehicles and number of users along with percent share in the Campus

Vehicles	No. of Users	Per cent
Car	380	4.08
Two Wheeler	1884	20.21
Electric Vehicles	53	0.57
BiCycles	323	3.46
Public Transport	6684	71.69
Total	**9324**	**100**

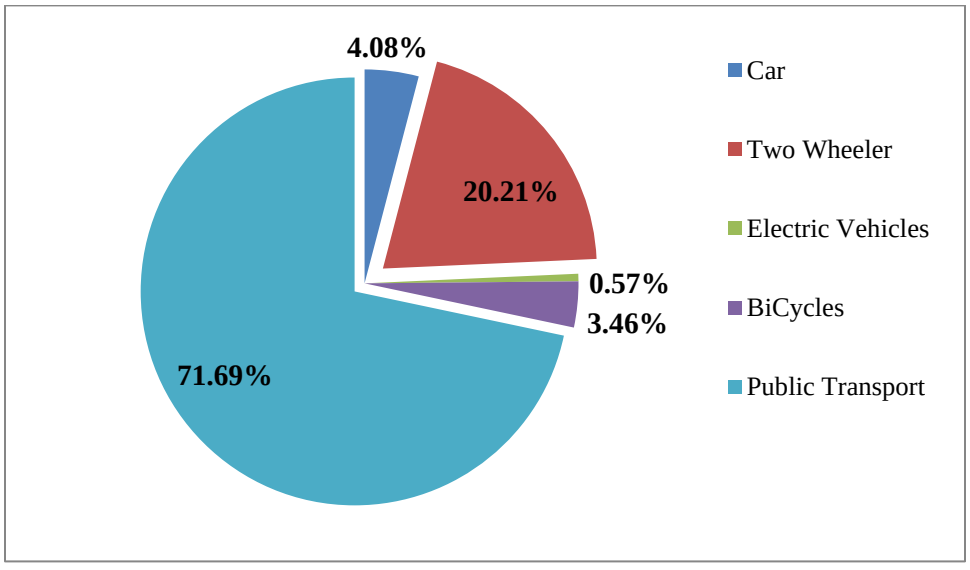


Figure 8.1: Pie Chart depicting the per cent distribution of vehicle usage in the Campus

8.2: Carbon foot print

Vehicle Foot Print:

The total consumption of diesel/petrol by the University Vehicles, generators and water pump motors is 289070 liters. SO the carbon foot print by the fuel consumption for aforesaid purpose is 7,68,926 kg of CO2e.

The number of vehicles used by the university stake holders (students, staff and visitors) – cars - 380; two wheelers – 1884; and a total of 6684 students are using the public transport. The daily fuel consumption of respective cars, two wheelers and students using public transport are 237, 502 and 572 liters per day respectively. Accordingly, a total of 353970 liters of fuel consumed yearly. So, the vehicle foot print of the university is 941560 kg of CO2e/year approximately. In case 'No vehicle day' is observed every week in the campus, a sum of 3,487kg of CO2e/day can be reduced and, in a year, (48 weeks of No Vehicle Day) 1,67,388kg of CO2e for 48 days.

Carbon Foot print of Plant Litter Re-cycling:

By recycling a total quantity of 829.757 Tons of plant litter at SWM unit, a total quantity of 365.07 ton of CO_2 emission is reduced. So annually 165 tons of CO_2 emission is reduced.

Similarly, 8.8 tons of CO_2 emission is reduced annually with the 20 tons compost produced by the garden division. Further another 4.4 tons of CO_2 emission is reduced with the production of 10 tons of compost annually at DOS in Sericulture science.

LPG Carbon Foot Print:

382 number of LPG cylinders are used in the campus during 2018-19. Each cylinder has 14.6 kg of fuel. A total of 8422kg of CO_2 is emitted from the LPG consumed.

CHAPTER IX

GREEN INITIATIVES OF UNIVERSITY OF MYSORE

1. Bio-hazardous safety committee constituted by the University to look after the use and disposal of hazardous lab chemicals and other wastes in the campus.
2. Small incinerators are installed in all the ladies hostels.
3. Good Solid waste management unit is established in the campus which is recycling a large quantity of plant litter.
4. One 4 wheeler auto-tipper is engaged for the collection of solid waste in the campus.
5. Solar water heaters are installed at hostels.
6. Solar lights for campus streets installed (>500numbers of 9 volt each). Approximately 5%.
7. A total of 10 Rainwater harvesting units have been established.
8. Four Ground water recharge units are established
9. Kukkarahally Lake restoration activities are going in a big way.
10. RO water units are installed at many places and departments of the campus.
11. New Gardens/lawns are developed at almost all buildingsand departments.
12. Drip irrigation systems are adopted in horticulture and sericulture gardens
13. Sprinklers are adopted for all the lawns established in the University Campus.
14. Swatch Gangotri Abhiyan – conducted every year for cleanliness drive in the campus.
15. Environmental Day is observed.
16. Installation of LED bulbs.
17. High mast light systems are installed and being managed efficiently managed by using sensors.
18. Clock tower with a radio station functions with a sensor.
19. Through Solar energy panels, university has generated and used 19440 kWh of electricity during 2018-19.
20. Installation of solar lights**.**

CHAPTER – X

SUMMARY & CONCLUSION

Green auditing is a process of regular identification, quantification, documenting, reporting and monitoring of environmentally important components of the institution. The Green audit committee constituted by the university has conducted 'Green Audit' of four campuses of University of Mysore in the academic year 2018-19.This is the first attempt of conducting the green audit in the university. After completing the audit procedure, for green practices, following conclusions, recommendations are made. These recommendations may be followed by the university in future for keeping the campuses environment friendly.

Conclusion:

1. There is ample scope for the exploitation of solar energy and hence more Number of solar panels have to be installed in the campus where ever possible on priority basis.
2. CFL and incandescent bulbs should be replaced with LED lamps and Tube Lights.
3. Old ACs and lab equipments are consuminghigh amount of electricity. They should be either replaced with energy efficient ones or monitor their proper usage.
4. Solar water pumps are also the major electricity consumers in the campus. Hence, solar pumps may install to save electricity.
5. Kukkarahalli Lake is the main water source serving the gardens and parks and also for recharging the bore wells of the campus. So it should be conserved on priority basis.
6. Rooftop rain water harvesting is highly beneficial and should be installed in all buildings.
7. Presently, only a small percentage of available plant litter being used efficiently for composting and vermicomposting in Solid waste management unit.
8. Solid management may develop as a model unit for SWM through which demonstration and training programmes on SWM, composting and vermicomposting may be conducted.
9. There is a big scope to utilize the organic matter generated at hostels and

canteens for biogas production.

10. The Green computing i.e. Online payment system, online circulars and examination procedures (SRPD) introduced in the university are helpful for reducing the use of papers and ultimately reducing carbon footprint.
11. Reducing the use of one time use plastic bottles, cups, folders, pens, bouquets, decorative items will be useful to solve the problem of plastic pollution to some extent.
12. Environment Management System (EMS) has to be made functional.
13. Old taps in toilets and bathrooms are consuming more water in the departments and hostels. They may be replaced with good one to save considerable amount of water.
14. "No Vehicle Day" has to be introduced in the to save the fuel and help for green and clean environment on the campus. The use of electrical cars to be increased.
15. The overall ambient air quality on the campus is good.
16. Segregation, handling and disposal of E-waste and biomedical waste are to be properly done as per rules in science laboratories.
17. Re-use of glass bottles for storage of chemicals should be encouraged or the bottles should be sent again to suppliers for reuse.
18. Green chemistry concepts to be adopted in all laboratories.
19. Waste water treatment plant should be installed on the western side of the campus.

Recommendations:

Following are some of the key recommendations for improving campus environment:

1. Installation of sensor based electrification items like fans, lights, etc. can save electricity.
2. The percentage of solarization has to be increased.
3. Regular checkups and maintenance of water supply pipelines, overhead tanks and leaking taps should be done by engineering division to reduce wastage of water.
4. In many science laboratories large amount of water goes waste to the drainage during the process of making distilled water and the system should developed to reuse this water for gardening and other purposes.
5. A system should be developed to ensure that the generated waste is measured,

monitored and recorded regularly.

6. The university should develop internal procedures to ensure its compliances with environmental legislation and responsibility should be fixed to carryout it in practice.
7. The plant litter should be reused or recycled to the maximum potential through solid waste management unit.
8. The biodegradable waste is generated in more amounts in hostels which should be properly utilized for biogas generation.
9. The number of rain water harvesting systems should be increased to harness the rain water to the maximum extent.
10. Richness of biodiversity should be preserved and documented continuously.
11. Labeling of trees and plants with their scientific names and common names to create awareness about the plant wealth in the campus.