



Three “R” Concept in Waste Management for Sustainable Environment

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Article Info

Received:

14 March 2022

Accepted:

25 May 2022

Published:

1 August 2022

DOI:

[10.14710/jsp.2022.15520](https://doi.org/10.14710/jsp.2022.15520)

*Presented in the 7th
International (Visual)
Workshop on UI
Greenmetric World
University Rankings
(IWGM 2021)*

Abstract. The dawn of the 21st century has thrown several challenges to mankind. The most dangerous among the challenges is the maintenance of a sustainable environment. While anthropogenic activities are considered as the predominant cause for environmental pollution, the solution also lies with human beings only. Here comes the role of the Three “R” concept which has been widely adopted across the globe. The Three “R” concept talks about Reducing the waste, Reusing the waste, and Recycling the waste and products to the extent possible. Today, a developing country like India generates a huge amount of solid waste, sewage, electronic waste, and gaseous pollutants. When we adopt this Three “R” Concept, the ill effects of the pollution caused by these agents can be effectively mitigated. Indeed, the various pollution control bodies of the governments are vigorously propagating the Three “R” concept among the highly polluting industries to bring down the carbon emission to the sustainable level. Indeed, this is one of the United Nations Sustainable Development Goals (UNSDG). This new paradigm will

definitely yield the desired result in developing and maintaining a sustainable environment which ensures the availability of pristine natural resources for the generations to come. The Higher Educational Institutions (HEI) play an important role in sustainability promotion in society. Waste management is one of the challenges educational institutions have to face in accomplishing the sustainability goals. KARE adopts the Three “R” Concepts in managing the solid, liquid, biochemical, and e-waste resulting in the development of a sustainable and eco-friendly environment on the campus. This poster details the recycling of solid, liquid, biochemical, and e-waste on Kalasalingam University campus. The solid wastes generated are converted into wealth and reused in the form of Vermicompost which is eco-friendly, the liquid waste is reused after treatment, paper and e-waste are recycled or reused through vendors. Further, the bio-medical/biochemical wastes are disposed of as per the government norms.

Keyword:

Reduce, Reuse, Recycle, Sustainable Development Goals (SDG), Eco-friendly

1. Introduction

The 3R initiative aims to promote the ‘3Rs’ (Reduce, Reuse and Recycle). The principle of reducing waste, reusing, and recycling resources and products is called 3Rs. Reducing refers to choosing to use things with care to reduce the amount of waste generated. Reusing involves the repeated use of items or parts of items which still have usable aspects. Recycling means the use of waste itself as a resource. Recycling one tonne of paper saves 17 mature trees from cutting down, 7000 gallons of water, 3 cubic yards of landfill space, 2 barrels of oil and 4100 kilowatts of electricity^[1]. So, waste minimization can be achieved in an efficient way by focusing primarily on the 3Rs for a clean, pollution-free and sustainable environment. They also conserve natural resources, landfill space free, saves energy and reduces greenhouse gas emissions [1].

2. Reduce

Kalasalingam Academy of Research and Education (KARE) firmly implements one of the 3Rs namely reducing the sources to have a sustainable environment. The following technologies have been adopted in the KARE campus to reduce the usage of sources.

3. Paperless Office

One among the reducing the usage of sources is going paperless by way of implementing e-governance in Admission, Administration, Teaching & Learning and Finance. All the official communications are made electronically. Consumption and purchase of the paper by the University have seen a drastic decrease. Staff and administrators are encouraged to use less paper and communicate via emails, electronic documents, and cloud storage of records. The faculty members and staff adhere to double-side printing, thus making a big difference in reducing paper consumption and reducing the rubbish which needs to be treated. The office of Controller of Examinations plays a vital role in going paperless by recording and disseminating student examination timetables, declaration of

results and circulation of grade-sheets electronically. The faculty members and students use their respective online portal to enter question papers, attendance, and marks, whilst the student can check their respective marks and attendance in the portal thereby reducing paper waste. The Training and Placement Cell takes initiatives to maintain online methods to enroll students for Inplant Training and attend job interviews encouraging the system to depend less on the papers. The reduction in the usage of paper prevents deforestation for the manufacture of paper pulp. According to data from the Global Forest Research Assessment, nearly 80000 to 160000 trees are cut down each day around the world for the manufacture of paper. So less usage of paper results in the conservation of natural resources like trees and the environment. Waste management also brings health outcomes[2]. Thus KARE plays a significant role in the conservation of natural resources by way of going paperless office.

4. Usage of Solar Energy

Solar Energy is pollution-free and eco-friendly. It is a green source of energy for reducing the carbon footprint which is the need of the hour. It reduces electricity consumption also. KARE has a total solar capacity of 800.895 kW on the campus (refer Fig.1). More than 30% of the total electricity consumption is met from the solar power installed. Due to solar power generation, Per Capita Carbon Footprint Reduction is 0.0162 tCO₂ per year. By way of installation of solar power, the campus is free from carbon emission and it is pollution free. As per UN-SDG 7 (Affordable and Clean Energy) KARE is producing clean energy by way of solar power.



Figure. 1 Some of the solar panels installed on the campus

5. Energy Efficient Appliances

KARE has implemented the installation of energy-efficient appliances whenever replacement is done in all areas like lightings, air-conditioners, fans, and water-heaters thereby there is a total carbon saving of 18.576 tCO₂ per annum. As per the UN-SDG 13 (Climate Action), KARE saves energy thereby reducing global warming. The following are the energy-efficient appliances installed in the institution:

Number of LED bulbs (22 W) = 4000
 Number of Super Fans =1109
 Number of slim tube lights (28 W) = 900

A total number of 900 slim tube lights (fluorescent lamps) of 28W are installed in place of 40 W tube lights and 4000 numbers of 22 W LED lamps in place of 40 W tube lights are installed. As per the energy policy of KARE, higher energy-efficient air-conditioners, water heaters and brushless DC electric motor (BLDC) fans, are used while replacing the older ones.

6. Reuse

The Reuse policy is strictly adhered to at the Kalasalingam Academy of Research and Education. Several electronic items such as computers, printers, fax machines, fans, lights undergo a systematic checking mechanism to refurbish and/or repair the gadgets to increase their lifespan. A thorough procedure is followed for an electronic or electrical gadget to be discarded or rendered waste. The students are educated, encouraged, and rewarded through activities such as “art from waste” “food from waste” etc., to practice and adopt a culture of reusing before discarding. Materials such as aluminum, reusable plastic containers, cardboard/paper and iron materials are collected and disposed of to the vendor for recycling purposes (refer Fig.2 & Fig.3). This helps to minimize the pollution and landfill space[3].

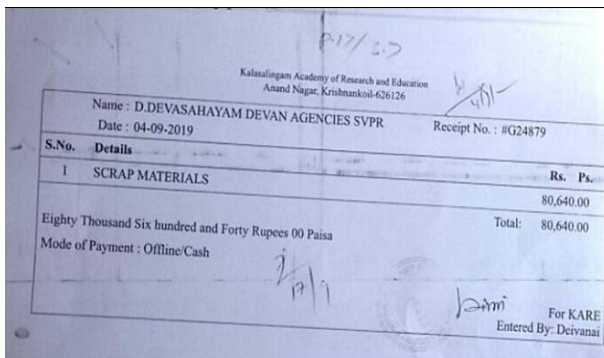


Figure 2. Inorganic Waste Disposal Scheme as per Sustainable Policy of KARE



Figure 3. Certificate of Appreciation for KARE on 100% of recycling of waste paper

7. Recycle

It is a process of collecting and processing the waste materials that would be thrown away as trash and converting them into new products. Recycling can benefit the community and the environment. The recycling process gives the following benefits

- Reduces the amount of waste sent to landfills and incinerators
- Helps to conserve the natural resources
- Prevents air and water pollution
- Keeps the environment clean
- Reduces the greenhouse effect

Solid & liquid wastes can be recycled and reused

8. Recycling of Solid Waste

KARE is located in a vast area of 163 acres. The solid wastes generated on the campus includes plant residues, vegetable waste from the hostel and canteen and wood materials. The following quantity of solid waste materials are produced within the campus.

Table 1. Quantity of Solid Waste Generated

S.No.	Name of the waste material	Weight (kg/day)
1	Plant Residue	692
2	Vegetable Waste	290
3	Wood Materials	43
Total		1025

9. Vermicompost Unit

KARE is very particular in solid waste management by way of producing the nutrient-rich vermicompost, by way of recycling the solid waste generated on the campus (refer Fig.4). KARE generates more than 1 tonne of solid waste every day (refer Table 1). School of Agricultural Sciences, KARE has developed a vermicomposting technology to convert organic and food waste into nutrient-rich and eco-friendly manure (refer Fig.5). This vermicompost is used as organic manure and is used as an alternative to chemical fertilizer [4]. Each of the waste materials generated has a different decomposition rate in the environment. The microbial degradation of different solid waste materials takes place within 15-17 days. Microbes play a significant part in breaking down waste and producing fine powder suitable for uptake by earthworms. Bacterial consortia are used for decomposing the waste materials at a faster rate and then earthworms are used on the decomposed product to produce vermicompost [5]. The decomposed waste is used at the rate of 12 tonnes per month for the production of vermicompost after which 30 kg of earthworms used for the purpose are separated from the vermicompost for separate sale [6].

The output of vermicompost from the vermicompost unit is 140 tonnes (refer Fig.6). and the volume of earthworm produced is 0.5 tonnes annually. By way of selling the above products, the centre is able to generate revenue of INR 4.5 lakhs. The nutrient content of the vermicompost produced was analysed and found to be rich in nutrients. The centre is also offering consultation for establishing such a vermicompost production unit. The consultancy work yields a revenue of INR 1.0 lakh to this institution. The centre possesses promising facilities to take this technology forward into more versatile solid waste treatment methods. This technology is being propagated to the needy stakeholders in the nearby rural area by way of demonstration, exhibition and periodic training programmes.



Figure 4. Vermicompost unit on the campus



Figure 5. Our Agriculture students monitoring the Vermicompost pit regularly



Figure 6. Labelling for KARE – Vermicompost

10. Recycling of Liquid Waste

A new hi-tech Sewage Treatment Plant with a treatment capacity of 8 lakh litres per day has been installed on the campus to treat and recycle the wastewater generated from the hostels, academic blocks and staff quarters on the campus (refer Fig.7). Treatment of sewage water is carried out using rapid sand filters, activated charcoal, UV and chlorine disinfection (refer Fig.8). The treatment plant uses the advanced Sequential Batch Reactor technology against conventional Activated Sludge Process for efficient treatment confirming the norms of regulatory bodies. The wastewater is recycled and utilized effectively[7]. The sludge left after the treatment process is used as manure (refer Fig. 9). Using a dual pipeline system, the treated water is used for flushing urinals and in sprinklers to flourish the green

cover of the campus and irrigate vegetation like coconut groves (refer Fig.10).



Figure 7. Aeration Basin of Sewage Treatment Plant



Figure 8. Tertiary treatment of sewage water using rapid sand filter, activated charcoal, UV and Chlorine disinfection



Figure 9. Sediment left over after the treatment of sewage water



Figure 10. Dual Pipeline system for usage of recycled water

11. Biomedical and chemical waste management

The Biomedical and Chemical wastes generated in the Biotechnology and Chemistry Departments, Laboratories, Animal House, International Research Centre (IRC) are disposed of through an agency authorised by Government of India. This type of disposable mechanism helps to keep the environment safe and clean [8].

12. Conclusion

The 3Rs waste management is an ideal solution to the ever-increasing environmental, health and economic issues caused by increased wastage and pollution. Practicing the 3Rs of waste management conserves the environment and allows to reap the numerous benefits of going green. It is the responsibility of every institution to follow the

UN-SDGs to minimize global warming thus protecting the environment from climate change which is the need of the hour. By reducing waste, reusing, and recycling a clean, pollution-free, and sustainable environment can be created. KARE is very effective in implementing the 3Rs to have a clean and sustainable environment, thereby contributing to saving planet Earth from pollution and global warming. The message of the 3Rs is also spread through awareness programs in the nearby society.

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