WASTE MANAGEMENT & ENVIRONMENT IMPROVEMENT MEASURES TO ENSURE A SUSTAINABLE GREEN CAMPUS

Introduction

1. Waste is a by-product of human activities, and can be divided into several categories, such as hazardous waste, medical waste, solid waste, and specialized waste. Every kind of waste that is produced has the potential to have effects on both the environment and human health. Waste management has posed as a significant challenge because there are a growing variety of types of waste with the production of more and more disposable goods. There are many ways that waste can be managed, but the two most utilized management strategies are through sanitary landfills and incineration.

(a) **Landfills** are low areas of land that are built up with alternating layers of soil and garbage. Utilizing landfills is one of the oldest forms of waste disposal, and yet is still one of the most widely used methods for waste disposal and management.

(b) **Incineration** is the combustion of waste in a controlled facility. Incineration is used to manage all types of waste. Some incinerators capture energy from incineration and reuse it for other purposes. These are known as waste-to- energy incinerators. However, incinerators produce toxic ash that has been known to have adverse public health consequences in the communities surrounding waste incinerators.

What is zero waste?

2. The Zero Waste International Alliance created a definition in 2009 for zero waste that accurately describes the term:

"Zero waste is a goal that is ethical, economical, and efficient and visionary, to guide people in changing their lifestyles and practices to emulate sustainable natural cycles, where all discarded materials are designed to become resources for others to use. Zero waste means designing and managing products and processes to systematically avoid and eliminate the volume and toxicity of waste and materials, conserve and recover all resources, and not burn or bury them. Implementing Zero Waste will eliminate all discharges to land, water or air that are a threat to planetary, human, animal or plant health."

College students live extremely busy, multitasking-filled lives, and unfortunately, many don't take the time to think about the implications of throwing away something that is recyclable or compostable. They do it simply because it is more convenient. Waste is a by-product of humans' everyday lives. We invented the idea of waste, and now, the time has come where we must work to "de- invent" it. This is where student leaders come in!

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3. The following are the ten steps to achieve zero waste in any organization

(a) Source Separation

(b) Door-to-Door Collection

(c) Composting

(d) Recycling

(e) Reuse and Repair

(f) Waste Reduction Initiatives

(g) Economic Incentives

(h) Introduce Zero Waste Research

(i) Demand Better Industrial Design

(j) Respect

Source Separation

4. Source separation is an important process mainly because when sources are not separated correctly, or separated at all, waste is created. If someone throws something away that can be recycled, then it will end up in a landfill. If enough compostable organic matter ends up in the recycling, batches to be recycled will be considered "contaminated", and thrown away.

Source separation is a simple way to kick start waste reduction, because with proper resources and direction, waste can easily be diverted from a landfill.

Door to Door Collection

5. Making waste disposal public is a great way to keep people accountable for their actions. Something that has become increasingly popular internationally is door-to-door collection of waste and recyclables. There are many different strategies that can be used to utilize door-to-door collections for waste reduction on college campuses. One strategy is known as "The Italian Method", where there are different color-coded containers for different materials, and each day, one type of material is collected. Another option is "slow recycling" with curb sorting trucks. This method would allow students to be engaged in sorting materials with the help of the people who are staffing the trucks. The sorting trucks could rotate to centralized locations around campus at certain times each day, and students would have the opportunity to watch and learn how to properly sort their waste and recycling.

Composting

6. According to the U.N. Food and Agriculture Organization, one-third of all food is lost or wasted each year. At many colleges and universities, food waste contributes to a large portion of waste produced on campus each year. Composting organic waste—whether it be through composting food scraps in the dining services, and/ or using compostable utensils, cups, and plates—can significantly reduce the

amount of waste that is generated on a college campus. If possible, another way to reduce food waste is by feeding others with what you have left over. The Food Recovery Network, a student-led initiative should be started wherein student volunteers will collect leftover food from dining facilities, and deliver it to local shelters and soup kitchens. If you can't feed people with leftover food, you can feed the soil by composting. There are various approaches to composting on college campuses, and what will be most effective is dependent upon colleges' resources and waste management programs that are in place. Institutions can buy vessel systems to look after their own organic waste. Another option is to have centralized composting facilities or anaerobic digesters on campus, though these options are often more costly.

Recycling

7. Recycling is a cyclical process that aims to divert items from the waste stream. It is also a process that is used to return material to another stage in its life cycle so it can be reused for new materials. Recycling programs are different on every college campus, but many campuses have one similarity: the programs are limited. If you ask a college student what can be recycled at their schools, some will most likely tell you aluminum, glass, paper, and plastic. Others will tell you that they do not really understand what can or cannot be recycled. Many people have no idea that many items, from carpets, to plastic film, to textiles, to electronics, can be recycled. Most of the materials that we interact with on a day-to-day basis are recyclable in some way.

Re-use and Repair

8. Reuse and repair is a high value step to take in efforts to reduce waste on college campuses. The more we are able to reuse and repair, the less we will have to produce, purchase, and, ultimately, waste. Reuse and repair efforts also provide opportunities for job creation. One simple option for campuses is to hold periodic "fix-it clinics", where students can bring any gadgets or electronics and learn from workers in the IT department how to repair their broken items. There are various ways for college campuses to promote reuse on campus, whether through education and outreach, or through programs and events on campus such as a free store, reuse sales, swap shop...you name it!

Waste Reduction Initiatives

9. Waste reduction is any action taken before waste is generated to reduce or prevent further generation of waste. College campuses often fall victim to choosing what is convenient over what is right for the environment, so many items that could be reused, repaired, or recycled are thrown away without much thought. Waste reduction initiatives on college campuses could turn this around by making it convenient for students to do the right thing, and eventually, make it a norm on a college campus to reuse, recycle, and recover as much as possible.

Economic Incentives

10. Using different incentives, such as economic incentives, are motivational factors that should be utilized in your campus waste reduction efforts. This step can be especially useful when you are proposing a new project to the administration at your college.

Making sure to explicitly outline the potential savings for your college is of critical importance. If more waste is diverted, less money will have to be spent on waste disposal, and thus, there will be more funding to start up new programs that can make the university money. For example, if you propose the introduction of selling recyclable items, this has the potential to create revenue for your college. Another economic incentive that could be developed on college campuses could take an entirely different approach by focusing on the students to be held accountable financially for their waste. For example, at the beginning of each year, students could choose the size of containers they want to use for trash, recycling, and composting on campus. The bigger the trashcan is, the more students have to pay on their room to dispose of this waste. This could incentivize the students to choose the cheaper (and more environmentally sound!) option so that they can save money

Industrial Design

11. One of the ultimate goals of many zero waste initiatives is to prevent packaging or product material that can't be reused, recycled, or repaired from being used in consumer and industrial production. A common approach to this is through Extended Producer Responsibility (EPR), which is an environmental policy approach where the producers' responsibility for a product is extended to the stage of a product's life cycle where the consumer no longer uses it. We can push to eliminate materials that cannot be reused or recycled by demanding better industrial design. Along these lines, we must make sure we understand the companies that we are working with. If a company claims to have sustainable practices, it is of extreme importance to research these companies, and dissect if the company is practicing what they preach.

Respect

12. Something that must be accomplished on the journey to zero waste is respect for waste management workers. These people work behind the scenes to deal with all of the waste we create, ensuring that reusable and recyclable materials are properly dealt with. They really do not get enough credit for the work they do, and making sure to appreciate the work they do is important.

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Recycling of some of the Solid waste material'

13. The average rates (0.5–0.99 kg per person per day) of waste generation are higher in India as compared to those (0.1–0.49 kg per person per day) in low-income countries worldwide and much lower than the developed economies (greater than

1.5 kg per day) of the world. However, there is a constant increase in the waste generation especially in the larger cities due to lifestyle changes, use of packaging materials, etc. Growth of urban population of 2.7 percent to 3.5 percent per annum will result in an increase of over five percent in a solid waste generation. As per the estimation of the Energy and Resource Institute (TERI), the waste generation exceeds 260 million tons per year by 2047, which is more than five times the current level in India. Cities with a population over 100,000 are the major contributors (72.5 percent) of total waste generated in the country as compared to the 3955 urban centers which produce about 17.5 percent. The per capita per day waste generation in urban cities have changed from an average of 0.5 kg to 1.5 kg

Textiles

14. There is a huge market for the recycling and reuse of textiles, because you can actually make money back on it! There are many companies that already exist that collect anything made out of textile materials, and will pay you per kg of items collected. Working with companies that have already been established is usually the easiest for a college campus, because they already have a system in place. Goonj is an example of a company that works with college campuses to collect and recycle textiles. They will drop off collection bins around campus, you can establish the frequency of collection times for them to come empty the bins, and you will get paid.

Electronics

15. In an age of rapidly advancing technology, electronic waste, also known as "e-waste", has become a growing problem in India. E Waste management Rules have been promulgated in India in 2016, they came into force from 01 Oct 2016. According to the Environmental Protection Act 1986, electronic waste is defined as "Waste electrical and electronic equipment that is dependent on electric currents in order to function (including all components, subassemblies and consumables which are part of the original equipment at the time of discarding)." E-waste can include consumer electronics, devices for offices, information and communication technologies, household appliances, lighting devices, power tools, and devices used for leisure. Many of the electronics labeled as "e-waste" are actually functional and can be sold for reuse, or can be broken down to recycle parts for other uses.

Plastic Film

16. Plastic film is a thin polyethylene plastic that is commonly used for wrappings, packaging, and commercial/retail bags. Plastic film is in many every day products, from Ziploc bags, to cellophane wrapping, to plastic bags. These plastic products, contrary to popular belief, cannot actually be accepted and recycled by most waste management programs. These products aren't collected with other recyclables in most collection programs because they can become too wet and dirty when mixed with other items. Plastic films can also jam machinery that sorts recyclables. Instead, there are various collection locations throughout the country where you can drop off your plastic film products to be recycled. The plastic film must be clean and dry in

order to be recycled.

Can't decide if a product is considered to be a recyclable plastic film product? Generally, if you pull the plastic product with your fingers, and it stretches, then it can be recycled. This is why plastic film is sometimes also referred to as "stretch film". However, products such as prewashed salad bags, frozen food bags, and degradable/compostable films or bags cannot be recycled because they contain additives in them that help extend the shelf life of the food, which, in turn, can contaminate other recycling products. When plastic film products are properly recycled, they can be processed into small plastic pellets, which can then be used to make a wide variety of new products, such as bags, containers, and piping. They can also be turned into composite lumber, which is a popular alternative to traditional wood lumber.

17. **Sustainability in waste management.** Solid waste has become a major environmental issue due to depleting natural resources and raising concerns of climate change. These factors have paved the way for sustainability in waste management for optimization and recovery of resource through integrated waste management system. Integrated solid waste management is a comprehensive waste prevention, recycling, composting and disposal program, developed after evaluation of local needs and conditions for selecting the appropriate waste management strategy. Wastes can be classified as biodegradable wastes (food waste, garden waste and paper), recyclable wastes (paper, glass, plastics, metals, etc.), inert wastes (construction and demolition wastes, dirt, rocks and debris, etc.) and hazardous wastes (e-waste, paints, chemicals, light bulbs, fluorescent tubes, spray cans, fertilizer, pesticide containers, etc.) Higher fraction of organic waste followed by recyclables (such as plastics, glass, metals, paper, etc.) in Indian scenario has the potential to provide multiple benefits. Benefits could be derived by managing solid waste, developed on basis of waste management hierarchy, i.e. prevention, recycling, recovery and disposal. Solid waste management has the potential to contribute substantially for the economic development of a country through the choice of technologies such as designed landfills for methane gas collection, energy recovery through incineration, pyrolysis, gasification and anaerobic digestion, manure production through composting of organic wastes and material recovery through recycling Countries like Poland, Malaysia, Italy and Ghana have been deriving benefits through power generation from wastes using technologies such as anaerobic digestion and designed landfills .

18. **Role of higher educational institutions/universities**. Environmental issues are quite complex and most of the problems are of anthropogenic origin, requiring an immediate attention of the citizens to address these issues. Environmental awareness can be propagated to the citizens by inculcating two aspects: perception of environmental problems and behavioral inclination to the problems. Higher educational institutions have a key role in this regard to develop a sustainable society. Universities are similar to small towns, requiring large amount of

resources and generating huge amount of waste. These universities offering courses in various specializations aimed at multi-disciplinary research are the best location to nurture the students regarding the need for sustainable development.

19. A sustainable university aims at adopting the framework for minimizing environmental, economic and societal concerns through actions such as resource conservation and The concept of sustainability in the campus can be propagated to the students through the initiatives such as construction of green buildings, developing green transportation facilities, planting vegetation, resource conservation, natural resource utilization, waste reduction, recycling and reuse. The work has suggested that sustainable waste management could be achieved through the development of infrastructure, service provision and behaviour change; considering the political, economic, social, technological, legal and environmental factors. Emanuel and Adams (2011) have examined the impact of sustainable programs and practices, implemented in the college campuses of Alabama and in Hawaii on the students. The survey results suggest that students were concerned about resource conservation and pollution, expressing their willingness to participate in sustainable practices.

Type of solid waste	Description	Sources
Food waste (Garbage)	Waste obtained as a result of preparation, cooking and serving of food. Market refuse, handling waste along with waste produced due to handling, storage and sale of food are included.	Household, restaurants, street food corners, etc.
Rubbish	It includes two types: (i) combustible (primarily organic)—paper, cardboard, cartons, wood, boxes, clothes, leather, bedding, grass, leaves, plastic, etc., and (ii) non-combustible (primarily inorganic)—metals, stones, bricks, glass, etc	Households, institutions and commercial facilities such as hotels, stores, markets, etc.
Ashes and residues	Waste obtained as fire residue from the cooking of food and heating of buildings, cinders, clinkers, etc	Household and small scale plants, etc.
Bulky waste	Auto parts, other large appliances, tires, stoves furniture, trees	Shops, households' etc
Street Waste	It includes dirt, leaves and animal droppings collected as a result of street sweepings.	Streets, sidewalks, vacant lots, etc
Dead Animals	It includes the dead bodies of dead animals such as cats, dogs, poultry, horses, cows, etc.	
Construction and demolition waste	The SW resulting from the construction industry such as lumber, rubble wires, etc.	Construction and demolition sites
Industrial waste and sludge	It includes SW from industrial processes and manufacturing operations	Factories, treatment plants
Hazardous	Hazardous waste includes pathological waste explosives, radioactive materials, etc.	hospitals, laboratories, institutions, chemical factories, etc.
Horticulture waste	horticultural activities such as tree trimmings, leaves, waste from gardens and orchards, etc.	Parks and gardens

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20. The waste generated in the campus includes wrappers, glass, metals, paper, plastics, etc. Old newspapers, used papers and journal files, workshop scrap etc. are given for recycling to external agencies. Glass, metals, plastic and other non-biodegradable wastes are given to external agencies where they are segregated and disposed/ recycled according to the nature of the waste. Leaf litter is allowed to decompose systematically over a period of time to be used as manure for the gardens in the institute. Excess leaf litter is disposed off into the compost pits created at various places in the campus. Apart from dry solid waste, the campus generates an average of 30 kgs of organic waste per day and 200 kgs of processed food waste per day from canteens and hostels which is also sent to compost pits.

LIQUID WASTE MANAGEMENT

21. Liquid Waste Management: The liquid wastes generated in the campus include Sewage, Laboratory, Laundry, hostel and canteen effluent waste. The above waste is treated through Sewage Treatment Plant (STP) setup in the institute with a capacity of 1000 KLD (Kilo Litres per Day) (900 KLD in old STP and 100KLD New STP). The entire treated water is used for watering the gardens and lawns maintained in the campus. The sludge settled in the STP is removed and is dried on drying beds and used as manure for the gardens. Therefore, the entire waste water generated in the campus is treated and reused. The laboratory waste water does not contain hazardous chemicals and periodical monitoring is done by the maintenance team. The wastewater entering the STP is tested for its characteristics like Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD), Total Suspended Solids (TSS), Total dissolved Solids (TDS), pH and Colour etc. on a timely basis. A proposal is pending with the management to utilize the recycled water for flushing of toilets. Excess recycled water, after watering the plants is left into an artificial pond for ground water recharge and also to maintain bio diversity. Two floating water pumps have been fitted in the pond for aeration water.

E-WASTE MANAGEMENT

22. Electronic goods are put to optimum use; the Major and minor repairs are taken adequate care by the IT team assigned to various colleges. IFHE undertakes periodical upgradation of all the desk top systems and the old systems are sold to the employees at a throw away price. During the pandemic period, all the computers sold to the staff/ outsourced staff have been gainfully utilized by the wards of the staff for online classes. The IFHE ensures that the E-waste does not end up in a landfill. Periodical certificate of re cycling of the Electronic waste is submitted to Telangana State Pollution Control Board UPS Batteries are recharged / repaired / exchanged by the suppliers. The waste compact discs and other disposable non-hazardous items are used by students for decoration during college fests as a creative means of showcasing the waste management practice that has been induced in the minds of the students.

Summary

23. The development of campus environmental management system in universities around the world is currently growing very fast. This is also related to the occurrence of Industrial Revolution 4.0, where technology plays a very important role. Improving services from various aspects becomes an important demand for the campus stakeholders, whether services related to the process of education, research and others.

24. "Understanding waste" is a major aspect to be undertaken before determining a policy for its handling. Understanding means we know where the waste comes from, why waste appears, what are the properties of the waste, what is the effect of waste both on environment and human, and so on. Given the enormous waste generated by humanity and its impact, the environmental management has become an international issue, not only politically and economically, but also educationally related.