Institutional Solid Waste Management Practices: Case study of AgricultureUniversity in Kashmir

Abstract

This study was carried on solid waste management in Sher-Kashmir University ofAgricultural Science and Technology Kashmir. It is noted that the advantages inmanaging solid waste at institutional level such as university because of its unique characteristicsalsoinfluencesthewastemanagementneeds and strategies.Thispaperoutlinesfindingsfromayearlong study through surveys, field investigations,including on-site waste measurements and questionnaire on institutional solid waste management. It was discovered that the waste's content was primarily organic in content, suggesting astrong disposing potential in terms of organic manure or biogas production throughscientific digestion and composting.The study revealed that maximum contribution to organicwaste in the form of food waste was from messes of the hostels (53.32 T). That can bebiodegradable managed and properly disposed, hence make a significant change in the wastemanagementsystem.Hostelsalsogenerate17.77Tofplasticwasteannuallythatneedsprocessing through scientific recycling techniques on sustainable basis. The study found that scientific segregation of trash might significantly improve solid waste management at other universities with a comparable environment.

Introduction

1.1. Background

The undesired materials produced by human activity in residential, commercial, or industrial environments are referred to as solid waste. Solid waste does not have any economic value from the pointofviewoffirstowner. It can be divided into three categories. Its origin (household, industrial, commercial, construction, or institutional), contents (organic material, glass, metal, plastic paper, etc.), and hazard potential (toxic, non-toxic, combustible, radioactive, infectious, etc.) are all factors to consider.

Increasing population, unplanned urbanization, and changing lifestyles haveresulted in increased volumes of waste materials in India. By 2031, 125 million tonnes of trash are expected to have been generated, up from the current 64–72 million tonnes. (www.econstor.eu) Inappropriate waste managementresulting to heaps of untreated waste from Indiancitiesand towns liesformonthsandyearsatopen dumpsites has caused devastation to all sorts of life on the planet.

The globalwarmingbyGreenHouseGasemissions has also been attributed to the decompositionoforganicmatterintheairlessheapsofwasteatthedumpsites. In addition to thatgenerationof waste is also not handled effectively as well as scientifically, thatexacerbates the problem. Preferably, the city municipality development plan should be used to design and implement the infrastructure and collecting mechanisms for waste management, drainage, sewerage, and waste water treatment in a methodical and coordinated manner. Along with improving solid waste management practices in Indian cities and towns, management techniques for environmental and public health emergencies must also be improved.

The negative influence on the environment and human health is lessened or eliminated via solid waste management.In order for a municipality to manage trash successfully, several procedures must be followed.Theseincludemonitoring,collection,transport,processing,recyclinganddisposal. The amount of garbage produced varies mostly because of various lifestyles, which are inversely correlated with the socioeconomic status of the metropolitan population. Source reduction, recycling, storage, collection, transportation, processing, and disposal are all possible methods for managing solid waste. Examples of solid waste facilities include landfills,composting sites, transfer stations, incinerators, and processing facilities. Such facilities maybepubliclyor privatelyowned.(www.idahopublichealth.com)

There are several financial and technological constraints in developing countries that impede the solidwastemanagementespeciallyIndia (KassevaandMbuligwe,1999).Reduced trash creation can lessen the need for disposal facilities and reduce unlawful dumping by concentrating on management techniques at the source. (Tchobanoglous et al., 1993). It is further supported by the reality that discrete trash categories are simpler to manage than combined garbage types. This is due to the fact that in the latter scenario, extra time, effort, and money must be spent to separate the trash for resource recovery or merely for easy handling. The current mismanagement withrespect to solid waste management is to handle the waste wholesale. This can be partially due to the fact that waste management authorities do not address specific sources of garbage, which are numerous and hence challenging to handle separately. The exceptions to thisrule are institutions like colleges, universities, hospitals, schools, industries and large commercial premises like hotels.These generate large amounts of waste to justify individual management. .Because of the size of the institutions and the fact that they now manage their trash to a considerable degree on their own, it is deemed useful to examine solid waste management at the institutional level. Within the

framework of the major municipal solid waste management system, institutions can easily design their own miniature solid waste management systems.By putting such systems in place, institutions may include resource recovery and waste recycling more easily and effectively, which relieves pressure on solid waste disposal facilities and, in turn, the municipality as a whole. ThispaperpresentsfindingsoninstitutionalsolidwastemanagementinSher-KashmirUniversity of Agricultural Sciences and Technology Kashmir SKUAST(K). It highlights elements that can be improved upon and added to solid waste management generally. It advances the idea that municipal solid waste management may be enhanced through initiatives targeted at specific sources with an emphasis on trash minimization, segregation, and scientific disposal.

1.2. Backgroundtothecasestudy institutions

Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir is anagricultural university located in Shalimar, Srinagar, Jammu and Kashmir, India.[1] The university has numerous campuses, colleges, research centres, and extension centres spread out around the Kashmir Valley, with its main campus and Faculty of Horticulture located in Shalimar, Srinagar. In order to promote the state's agricultural industry, the Indian Council of Agricultural Research (ICAR) expert team proposed in 1979 that an agricultural university be established. The State Legislature passed the Sher-e-Kashmir University of Agricultural Sciences and Technology Establishment Act on March 31, 1982, the 33rd year of the Republic of India, and it went into effect on August 1, 1982, with jurisdiction over the entire State of Jammu and Kashmir and a main campus in Shalimar, Srinagar.(en.wikipedia.org)

1.3Wastemanagement

Waste has always been created as a result of human activity.However,Giusti(2009)reportedthat prior to people starting to live and manage trash in communities; waste creation and management were not a significant problem. Vergara&Tchobanoglous (2012) reported that as the world's population and spending power rise, more things are created to keep up with demand, which increases trash generation. Marchettini*etal*.(2007)pointedoutthat,thesehuman activity-related waste flows that were constant overwhelmed the ecosystem.Vergara&Tchobanoglous(2012)reportedpreventing the damaging effects of trash on the environment requires careful planning and management. As a result, Ghiani*et al*. (2014)added that, solid waste management needs to be properly organized in order to protect the environment..Beranek (1992) argues that today, having a good solid waste management system is just as crucial as having access to energy, airports, and highways..Basu (2009) pointed out that continued disposal of waste to landfills is unsustainable due to the growing volume of waste. Hence, Basu arguesthat the processing of waste is a necessary step needed to safeguard public health. Demirbas(2011) describes waste management is the process of gathering, transporting, and processing wastes before disposing of any leftover materials. Similarly, Tchobanoglous*et al*.(1993) Define solid waste management as the efficient control of the handling, storage, collection, conveyance, treatment, and disposal of waste in a way that protects the public and the environment.. Tchobanoglous*et al* (1993) added that, In order to manage garbage effectively on a daily basis, solid waste management makes use of expertise and information from many other fields, including law, finance, and administration. Demirbas (2011)suggested that themain reason formanagingwasteis to ensureasafe environment.

Waste managementisthe collection, transport, processing ordisposal,managingand monitoring of waste materials. Waste management is undertaken to reduce their effectonhumanhealthandenvironment.Wastemanagementisadistinctpractice.Allwastematerials , whether they are solid, liquid, gaseous or radioactive fall within the domain ofwaste management. It was observed in the campus, there is no proper waste managementsystem. These materials are thrown into the open area. Without employing adequate incineration processes, plastic items are burned in the open, which may result in a number of environmental and health difficulties. Additionally, piles of solid trash located across the campus create a nasty odour that affects people's health in a number of ways.

2. Materialsand methods

2.1. Materials

Survey was conducted from January to December during the year 2021. A weighing balance and plastic containers for gathering and measuring the waste were the tools used for waste measurement. There were also shovels and forks available for loading and sorting the trash, as well as gloves, boots, and facemasks for personal safety. The targetedtypesof solidwaste were:Food waste, Plasticwaste,Paper wasteand Metal waste.

2.2. Methods

2.2.1. Measurementsites

Measurements of wastes were carried out at student hostels, messes, residential quarters,canteen, fields, guest houses, faculty offices and health centre. The locations for the measurements were those that were thought to represent significant and frequent sources of garbage. This was in keeping with the requirement to collect a diverse range of trash sources and types from the institutions.

Student hostels: Four hostels of students at SKUAST (K) Shalimar Campus, were selected, representing 63% of all students' accommodation capacity. Additionally, the two halls accommodated waste from both male and female students.

Staff residentialsolid wastesources.Wastesampletakingat18residentialquarters.

2.2.1.1. Health facilities: The health centre and dispensaries cater for students, staff familiesandoutsiders.

2.2.1. Cafeterias. Cafeteriashadbeencommercializedandprivatized.Employees who are not academic personnel typically eat at a canteen.

2.2.2. Other measurement places. Offices were among the additional locations for solid waste sampling and measurement.

2.2.3. Questionnaire surveys and interviews: Additionally, through questionnaire surveys and interviews, data and information on solid waste management practises at the university were gathered from the local municipality department officials, garbage collection crew, attendants, houses, and other relevant people.

2.2.4. Visualinspectionandfield investigations

To evaluate the aesthetic value of the research area and to lay the groundwork for assessing how study facts and numbers correlate with visual evidence on the ground, visual assessments and field investigations were conducted inside the institution. Additionally, the assessment and studies were carried out to assist in the selection of sampling and measuring points that would integrate theoretical conclusions with empirical data.In order to gain firsthand knowledge of how solid waste is actually managed at the institution under typical working circumstances, assessments and field investigations were also conducted.

2.2.5. On-sitewastesegregationandmeasurement

The following procedures were used to measure solid waste samples:

- Weight determination (Wb) ofemptybin usingtheweighingbalance;
- Filling the container with sample garbage while vigorously shaking it to prevent excessive blank spaces;
- Determinationofgrossweight(WT)of(bin)containerandwasteusingtheweighingbalance
- Determinationoftheinterval(ts)duringwhichthewastewasstoredandthenumberofpeople (p)who contributed to the waste generation.

Throughout the whole study period, the aforementioned approach was used to quantify samples of waste at various waste sources and on various sampling days.Thewaste

generationrates(WG)werecomputedusingtherelation:

$$W_G = = \frac{(WT - Wb)(kg)}{p(pe) \times ts(d)} (kg.pe^{-1}d^{-1})$$

Wherepeis population equivalent.

2.2.6. Statisticalanalysis

The data obtained in respect of various observations were analyzed statistically. Thesignificance of 'F' and 't' was tested at 5 per cent level of significance. The critical differencevalue was calculated when 'F' test was significant. SPSS software was used for statisticalanalysis.

3. RESULTSANDDISCUSSION:

3.1. Solidwastemanagementpractices

3.1.1. Current methods for managing solid waste

Types of wastes and sources of waste from the institution is shown in **Table 1.** Bins are used as the major means of on-site garbage storage, and rubbish from offices and living spaces is manually carried to disposal sites or centralized enclosures.

Table1:Sourcesandtypesofwastesfromdifferentinstitutionalsources

S.No	Source	Typeofwaste
1	Hostels	Paper,foodleftovers,foodpreparationwaste,clothes,plastics andsanitarywaste
2	Canteen	Bones,foodleftovers, foodpreparationwaste,ash,tins, bottles,wrappers andpaper
3	Residential quarters	Foodleftovers,foodpreparation waste,papers, ash, vegetables,clothesandplastics
4	Offices	Mainlypaper and plastic
5	Healthcentre	Bandages, cotton swabs, bottles, plastics, food scraps, food preparation trash, disposable syringes, and waste paper
6	Fields	Twigs,leavesandashes
7	Laboratories	Paper,plastics,discarded samplesandchemicals
8	Guesthouses	Foodwaste,plastics,sanitarywaste andothers

3.1.2. Segregationofwaste:

Wastes collected from different sites of the campus were segregated into four major typesviz:foodwaste/degradablewaste, plasticwaste,paperwaste andmetalwaste.

Table:2:Descriptionof the solid wastefromvarioussources:

Source	Descriptionof wastes(Kg)			
	Organic waste	Plasticwaste	Paperwaste	Metalwaste
Hostels	45452.81	17779.00	21636.75	0.18
Messes	53327.58	277.7	1215.38	1.22
Laboratories	843.56	168.32	108.15	0.04
Offices	9062.7	4276.03	4018.34	0.02
Residentialquarters	4385.22	1872.8	2220.3	0.36
Healthcentre	80.73	68.78	99.55	0.01
Canteen	3881.51	247.98	259.35	0.29
Guesthouses	249.15	296.77	237.9	0.16
Fields	69.99	31.65	1.711	0.02

3.1.2.1. Organicwaste:

Sources of organic waste in the form of food leftovers, food preparation waste, vegetableand fruit refuse and farm refuse are hostels, residential quarters, canteen, fields, farmer'shostel,guesthouses,facultyoffices,andfieldsetc.Totalorganicwastegeneratedwas11363 3.24 Kg during the year 2021 with maximum quantities collected in the months of Julyto October (12127.9, 11505.7, 11332.4 and 11496.9 Kg), because of higher presence ofstudents in those particular months. Maximum contribution to food waste was from messes ofthehostels.Fromthegraphsplottedindicatesthatorganicwastethatisbiodegradablecontribute most to the solid wastes in campus and its proper disposal could make a significantchangein thewaste management system.

3.1.2.2. Plastic waste: Total plastic waste generated was 25 tonnes, maximum contribution toplastic waste was from residential quarters with 20-30 families living in the quarters**,** inaddition to that student hostels also serving as a major source of origin of the waste in theuniversity.Thedatacollectedshowedhigheramountofwastegeneratedinthemonthsof

July and August (2893.02 and 2960.35 Kg) respectively during the year 2021. This may beattributed to higher use of fluids by the inhabitants in these summer months contributing tohigher rates of plasticgeneration.

3.1.2.3. Paperwaste:

Total paper waste generated was 29 tonnes, maximum contribution to paper waste was fromhostelswith 200-300 students residingin this university eachyear.

3.1.2.4. Metalwaste:

Hostelmessesbeingthemainsourceofmetalwastebecauseofoveruseofcannedfoodpackedin metal tins in the hostelsin theseparticular months of winter.

ThereforetheannualaveragesolidwastegeneratedintheUniversitycampusis1136.32Qtls.Outofwhichthetotalquantityoffoodwastegeneratedis521.82Qtls,totalplasticwasteis 249.87Qtls,totalpaperwasteis294.48Qtls,totalmetalwasteis0.02Qtlsandfarmwasteis 70.11Qtls.

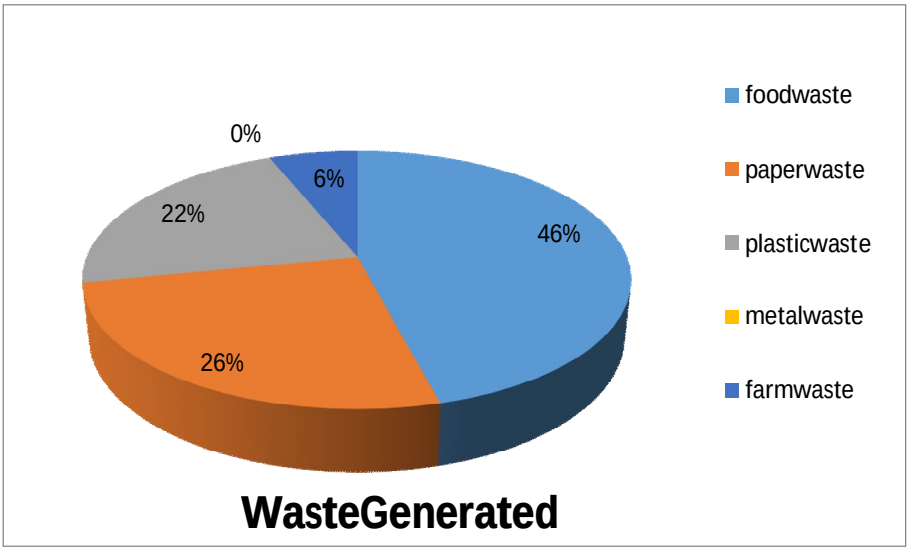


Fig.1TotalWastegenerated

Total waste generated from the institution was 111.482 tonnes. Out of this, 57.010 tonnes wasfood waste, 29.450 tonnes was paper waste, 25.019 tonnes was plastic waste and 0.0025tonnes was metal waste.The major sources of institutional wastes are hostels, residentialquarters, fields and canteen. The waste from these sources constitutes mainly organic wasteconstituents,includingfoodleftovers.This implies the possibility of using organic waste components, particularly meal leftovers and food preparation waste, as animal feed. The remaining organic waste may be treated for energy recovery through decomposition or composted.

Inthisregardsurveyswereconductedinhostels,offices,laboratories, hostel messes, canteen, fields, health centre, classrooms, parks and residentialquarters of SKUAST –K Shalimar Campus. Awareness programs were carried out within thecampus and colour coded bags were distributed among hostel students, residential quarters,laboratories, offices, canteen etc. Main focus in the awareness program was to segregate thewasteso that therewill beeffectivesolid waste management.

Fig.2:AwarenessprogramatShalimar campus

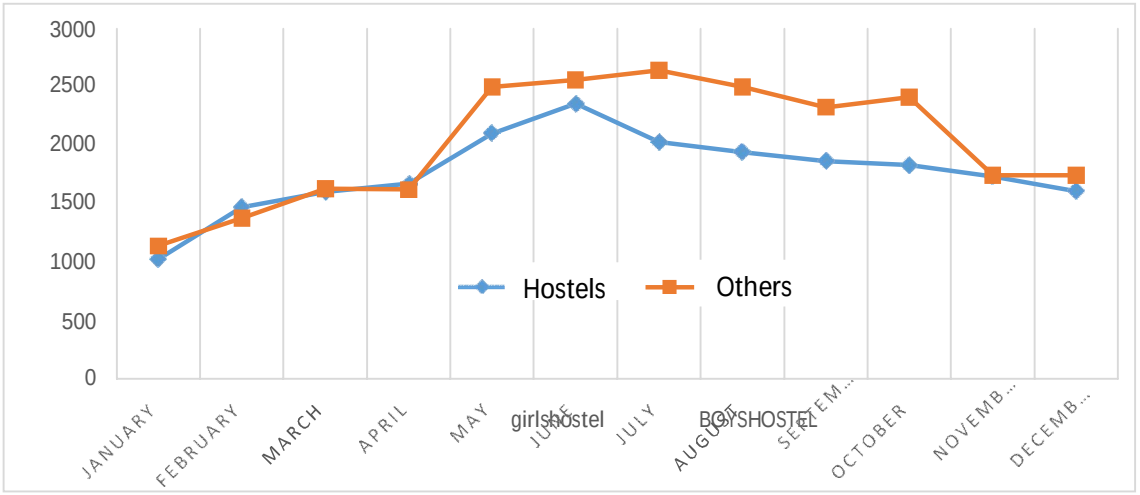
Fig.3:Distributionof colourcodeddustbinsandbags

3.1.3. Resourcerecoveryandrecyclingofwaste

Food waste from hostels and canteen, is reused as animal feed (for dogs) by lecturers andother staff ofthe institutions aswellas non-staff individuals. Plastic bags and paperswerealso collected for reuse but to a smaller extent and by low cadre scavengers. Aluminum foodand drink cans can be collected for sale. Wastepaper can be sold to various people forrecycling within and outside the institution. It goes without saying that source separation of waste is crucial for the resource recovery plan outlined above to succeed. This is because mixed wastes require post-generation sorting, which is cumbersome and frequently ineffective, making them unsuitable for recycling.

It is wise to note that the potential for resource recovery mentioned above is difficult to realise because it depends on a variety of circumstances. For instance, the organic waste component's moisture content will need to be changed before composting. This can be accomplished by drying the trash directly or by mixing it with other similarly dry wastes. The waste also needs to be separated, ideally at the source. Sensitization of the affected populations is necessary for effective waste segregation at the source.

Fig:4:Wastegenerated(kg) fromHostels andothersiteinthe Campus



Conclusion

Wastes are universally acknowledged to be a direct result of human interaction and activity. However, it appears that there are different viewpoints on what constitutes a waste. The objectiveof the project was to analyses the effectiveness of the current waste management systems inSKUAST-K Shalimar campus. Solid waste management refers to all activities pertaining tothecontrol,collection,transportation,processinganddisposalofwaste.Developingthesolution of solid waste management it requires significant cooperation.Periodic waste stream assessments will be necessary to pinpoint successful practises and areas that need improvement as management programmes are put into practise.

The paper has revealed that solid waste is not managed effectively as well as scientifically. This is despite the potential for improvement on account of the institutions being single entity and under one authority that can be easily managed. It is necessary to adapt storage and segregation procedures to stop dumping wastes carelessly on public lands, which increases the risk of pollution. A single gated campus like a university is relatively simple to govern because it is under one management authority and is subject to a number of tight rules and regulations, therefore there is room for improvement. Disposing of material by way of the use of organic waste as animal feed into compost or biogas production has been found to be potentially and environmentally feasible. Resource recovery presents a potential waste reduction of between 70 and 90%. Per capita waste generation rates have been determined as 0.33 kg cap−1 per day. It may be possible to implement and enforce a code of scientific waste handling practise with regard to waste management at the institutional level, which has the ability to improve the current subpar solid waste management practises. Additionally, the possibility for better solid waste management is increased by the relative higher levels of education among inhabitants and students of faculty.The implementation of the excellent waste handling practise code is necessary for the improvement that is intended to take place. Additionally, provisions that are now inadequate or ineffective must be made, including money, knowledge, equipment, manpower, and facilities. Furthermore, there is a requirement for community enlightenment on essential topics because the proposed solid waste management practises demand for some behavioural modifications.

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