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Improper solid waste management and its impact on the environment: A case study of Jammu city

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Abstract
Solid waste management in the developing countries is a big challenge due to increasing generation of the waste. Solid waste management has become an issue of increasing global concern as urban populations continue to rise and consumption pattern change. Most developing and least developing countries are currently facing serious development challenges. Improper MSW disposal and management causes all types of pollution: air, soil and water. Indiscriminate dumping of waste contaminates surface and ground water supplies. In urban areas, MSW clogs drains, creating stagnant water for insect breeding and flood during rainy seasons. There is an emerging trend in encouraging the private sector to enter into solid waste management. Both public and private sector are active in management of solid waste in developing countries. Solid waste is spoiling the environmental condition in the developing countries. Negative impact of the solid waste Management on the environment can be seen everywhere in the developing countries. Most developing countries face many difficulties in relation to solid waste management, which has evolved into a number of issues with continuously increasing complexity due to limited resources and increasing quantity of solid waste. In India, due to inadequate funding and improper planning, the solid waste management scenario is becoming worse day by day. To highlight the main cause of improper solid waste management in developing countries, Jammu city is selected for the case study. It is investigated during the research that due to rapid growth in population, increase in the solid waste generation, lack in management and funds, lack of cooperation from the general public, the solid waste management system of Jammu city is not working properly.

Keywords: solid waste management, segregation, untreated, disposal

Introduction

Solid waste management scenario in developing countries

Around the world, waste generation rates are increasing. In twenty sixteen, the world's cities generated 2.01 billion tons of solid waste, amounting to a foot print of 0.74 kilograms per person / day. With urbanization and rapid growth of population annual waste generation is expected to increase by 70 percent.

In poor countries or low income countries, over 90 percent of the waste is often disposed of in unregulated dumps or openly burned and because of these practices there are serious health safety and environmental consequences. The waste which is poorly managed serves as a breeding ground for disease vectors, contributes to global climate change through methane generation and can even promote urban violence.

In developing countries, the problems which are associated with the management of solid waste are collection, transportation and disposal. In India due to unplanned management and development in cities, environmental and sanitary conditions are becoming worse. An improper solid waste management system may contribute to a worsening environmental degradation. Due to lack of awareness among the general public, lack of cooperation and lack of financial resources are the major cause of improper solid waste management.

Waste generation has increased massively around the world in recent decades, there are no signs of it slowing down. By the year twenty fifty, worldwide municipal solid waste is expected to have increased by seventy percent. This is because of factors such as population growth, urbanization and economic growth as well as consumers shopping habits.

Solid waste management in Jammu city (old city)

In the city of Jammu, improper and poor municipal waste management system is due to lack of public education, scientific techniques, machinery and legislation. The main aim of the study is to conduct a strength, weakness, opportunities and threats of the municipal solid waste management system in Jammu city and to propose an indicative solid waste management plan by analyzing both internal and external factors of (SWOT) strength, weaknesses, opportunities and threats. Jammu Municipal Corporation has been performing the task of upkeep and maintenance of civic amenities including solid waste management. Covering an area of 112km square, JMC comprises of 71 wards, 3 zones and 2 divisions for the execution of various activities at the field level. With a total budget of 1.7 million US$ for SWM and a staff of 1202, JMC proves to be inefficient in terms of technical, operational and financial expertise. The city of temple produces a whopping 350-400 MT(metric tons) of solid waste daily at a rate of 0.45 kg/cap/day, with contribution from domestic, industrial, commercial and street sweeping as 0.3, 0.03, 0.10 and 0.02 kg/cap/day respectively. The operational efficiency of Jammu Municipal Corporation is 50% and at present, only 18 wards have the facility of door to door collection of waste. The solid waste is being collected through the deployment of sweepers and sanitary crew. Beside door to door collection, these workers collect the solid waste from the streets with the help of wheel barrows and hand carts. Solid waste is being temporarily collected in containers from where it is transported with the help of collection vehicles and carried out to final disposal site. It was

observed during the field study that the collection bins, no. of containers and the collection vehicles are not sufficient to maintain the solid waste management system properly. The rag pickers collect only 20 MT of waste for recovery, recycling and reuse out of the total waste dumped by the municipality. The composition of the waste largely depends upon a wide range of factors like food structure, culture, lifestyle, climate, economic development and local landscaping. The solid waste generated in the city is mainly composed of the MSW with some proportion of hospital, industrial, commercial and demolition waste. The data which was collected from randomly selected from 25 houses shows that the municipal solid waste has the potential for reuse, recovery and recycle. Jammu city faces an acute problem of unscientific and indiscriminate disposal of garbage. Issues like lack of awareness and public participation towards scientific waste disposal have existed in the region. The current scenario calls for a decentralized low cost waste management system where a provision for recycling, material recovery, collection, transfer and disposal facilities has been made. A proposal has been made that at least two transfer station, each with a capacity of 800-ton-per-day, must be provided for all.

Source, composition and characteristics of municipal solid waste

Main source of solid waste generation are local residents, anaz mandi, restaurant, hospitals, vegetable markets, sweet shops, domestic and stray animals, residential and commercial establishments. The composition of waste largely depends on a wide range of factors like eating habits, lifestyle, climatic condition of the area economic development and local landscaping.

The solid waste generated in the city is mainly composed of the MSW with some proportion of hospital, industrial, construction and demolition waste. The composition analysis of the total MSW generated in the city indicates that the biodegradable fraction present in the total MSW is sixty percent and Non-Biodegradable fraction is 40 percent. A breakdown of the physical composition of MSW for the city of Jammu (old city) has also been shown in the similar study. It is observed from the composition analysis that organic waste in the form of vegetable, food and fruits has most considerable share in the MSW composition (40 percent) and has the maximum potential for composting, followed by inert waste, plastic, paper and textile. The findings are in accordance with those of Xiao *et al*., Visvanathan *et al*., Bandara *et al*. Yousaf and Rehman, who reported the solid waste composition in most of the Asian cities to be highly biodegradable and largely composed of organic fraction constituting mainly paper, leather, wood, rubber, plastic and textile. The chemical characteristics of MSW in Jammu city shows an increase in moisture contents. The reason behind this may be due to the presence of high proportion of unprocessed vegetable waste.

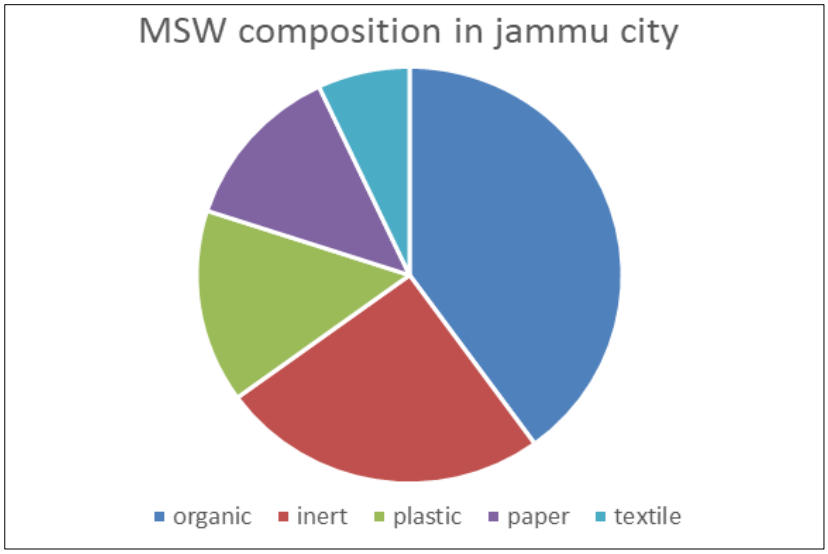

Fig 1: Physical and chemical characteristics of MSW in Jammu city

Table 1

Parameters	Value
Compostable%	40-45
Recyclable %	21.08
C/N Ratio	26.79
HCV (Kcal/kg)	1782
Average bulk density(Kg/m)	500
Moisture %	40

Generation and Disposal

Solid waste in and around the Jammu city is being dumped on roads, open plots, nook and street corners because the people of the area are not aware of the scientific waste management techniques. Waste segregation practice at the disposal stage has progressively deteriorated to an extent that the solid waste is now directly thrown into the waterbodies, a cattle menace also prevail in the region as the animals, mostly feed on the dumped domestic waste. These conditions have evolved due to lack of community bins, workforce, Transport and disposal site. There is no permanent landfill site to dump the solid waste as a result of this there is unscientific dumping of waste not only in the deep trenches created in the forest region around the city but also around the Tawi riverbed. The situation has led to the surface and groundwater pollution in the region. At present, JMC is having two temporary dumping sites situated at Bhagwati Nagar and Bhandurakh. About 350-400 MT of waste is daily disposed at the

dumping site through unsystematic and haphazardous dumping and about 20MT is collected by rag pickers and others for material recovery, recycling and reuse purposes. The Bhagwati Nagar dumping spreads across 60 kanals of land and is subjected to uncontrolled, continuous and haphazadous dumping of waste which has led to choking of Tawi riverbed. The deteriorated situation around the river bed has resulted in a direct intervention from the national green tribunal and the Jammu high court who have directed JMC to develop integrated waste management scheme for the city and clear out the catchment area of the river.

Table 2

Name of the province (J & K of UT)	Generation (TPD)	Collection (TPD)	Treated (TPD)	Total (TPD)
Jammu	692.16	673.40	79.19	1444.75
Kashmir	826.75	791.40	461.00	2079.00
Grand total	1518.91	1464.65	540.19	3523.75

Source: Annual report of municipal solid waste for the year 2019-2020

Methodology

To access the status of solid waste management in the city of Jammu (old city) a series of field survey were carried out. To get the response from the respondents separate questionnaire were designed for the staff of Jammu Municipal Corporation and for the general public. Various higher officials of the JMC were interviewed. The focus of the study was on impact of solid waste due to non-engineering and non-scientific disposal. It has been found that with the increase in the global population and the rising demand for food and other essential, there has been a rise in the amount of waste being generated daily by each household.

Negative impact of improper solid waste management on the environment, human health, animal and aquatic life.

It was observed during the study that due to improper waste management system in the city there are multiple negative impacts on the environment. An inefficient Municipal Solid Waste Management system may create serious negative environmental impacts like infectious diseases, land and water pollution, obstruction of drains and loss of biodiversity

1. Soil contamination
   Soil contamination is caused by improper waste removal and disposal. Some waste that end up in landfills excrete hazardous chemicals that leak into soil. When plastics bottles breakdown, they release DEHA, a carcinogen that effects our reproduction system, cause liver dysfunction and weight loss. Soil contamination does not only affect plant growth, it is unhealthy to humans and animals feeding on those plants. It is therefore important that we should prefer recycling. Electronic waste, papers, plastics and metals can be recycled at the local recycling center. Therefore we should sort the recyclable waste and bring them to recycling center, so that the bulk of waste can be removed from the landfills.
2. Air contamination
   Open burning and even the burning of papers and plastics in landfills emits the gas and chemicals that hurt the ozone layer. Waste that release dioxins are also dangerous and pose a health risk when they diffuse into air that we breathe. Finally landfill gas produced by decomposing wastes can be explosives and can harm nearby community.
3. Water contamination
   Hazardous waste in the environment leech into the ground and ultimately into the groundwater. This water is used for many thing, from watering the local fields to drinking. Streams and water bodies can get contaminated with the toxic liquid chemicals. Contaminated water is dangerous for human consumption and untreated sewage can threaten marine life that comes in contact with the contaminated water.
4. Causes extreme climate changes
   Decomposition of waste emits gases that rise to the atmosphere and trop heat. Greenhouse gases are the one of the major culprits behind the extreme weather changes that the world is experiencing. From extreme heat to strong storms and typhoons, we are experiencing and suffering the negative effects of greenhouse gases.
5. It is slowly killing the planet
   We only have one planet, and our careless handling of waste is harming it. Taking care of the environment is everyone's responsibility, for ourselves, for our planet and for our next generation.
6. Scavengers and stray animals invade the roadside garbage and litter the garbage over the large area causing much aesthetic damage to the atmosphere.
7. Organic solid wastes emits obnoxious odor on their decomposition and make the environment polluted.
8. Water and food contaminated through flies causes various diseases in human as dysentery, diarrhea and amoebic dysentery.
9. Various vectors like rats and insects invade refuse dumps and spread various diseases.
10. Rats dwelling with infectious solid waste may spread diseases like plague, salmonellosis, trichinosis, endemic typhus etc.
11. Water supply if gets contaminated with pathogens present in solid waste, may result in cholera, jaundice, hepatitis, gastro enteric diseases etc.
12. Chocking of drains and gully pits by the solid wastes results in water logging which facilitates breeding of mosquitoes and results in the spread of diseases like malaria and plague.
13. Dispersed solid waste from illegal open dumps often blocks the drains and sewers and ultimately these blockages are creating flooding and unhygienic conditions in the city which can be seen everywhere in the city.

Preventive measures for reduction of solid waste and its impacts on human and environment.

Solid waste management should be undertaken properly to ensure that it does not affect the environment. Proper segregation should be done at the household level and it should be ensured that all organic matter is kept aside for composting which is undoubtedly the best method. Organic waste can be composted and the used as a fertilizer. Following steps may be taken for the prevention of adverse impact of solid waste;

1. Generation of waste should be decreased.
2. Promoting the production of goods which generate minimum waste.

3. Promoting the use of plastic recycling identification codes and labels in order to make sorting and recycling of plastic packaging easier.
4. Awareness of producers, the public and people who work in the waste sector should be increased.
5. Municipalities should increase their level of service to the public regarding sorting of waste.
6. Legislation in the sector of waste should be improved.
7. Collection of waste should be safe, secure and performed in an environmentally sound manner.

Conclusion and recommendation

Present study is an attempt to interpret the solid waste management scenario in the city of temples. The disposal of untreated waste near the river Tawi must immediately be abandoned, as it is causing environmental complication in the region. The Govt. has taken initiative and has invited advisory services for MSW disposal through waste to energy means in public private partnership mode in order to review the MSW scenario in the region.

Following are the proposed solutions for each level of the waste management process;

1. Implementing separate door to door MSW collection. At present, only 25% municipal areas have door to door collection facility. Door to door collection of MSW should be executed with the help of battery operated tricycles, hand carts etc.
2. Segregation at source is another important step in the management of solid waste i.e executing waste segregation process at the household level. Separate bins should be provided for the collection of dry and wet waste in a phased manner.
3. Increasing the frequency of waste collection and discouraging manual handling of waste by persistent use of front end loaders and refuse collectors at waste collection spots.
4. Strict action should be taken like spot fining at commercial areas to restrain littering.
5. Exploring alternatives for new landfill site, where suitable arrangements lightening, fencing, bottom liner, weighbridge, leachate collection and gas venting are kept in provision.
6. Enforcing strict laws and regulations to prevent illegal dumping of MSW in deep trenches around the bank of river Tawi in order to control air and water pollution in this eco-sensitive region.

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