

Solid Waste Management in The Town Of Darjeeling: Environmental Concern

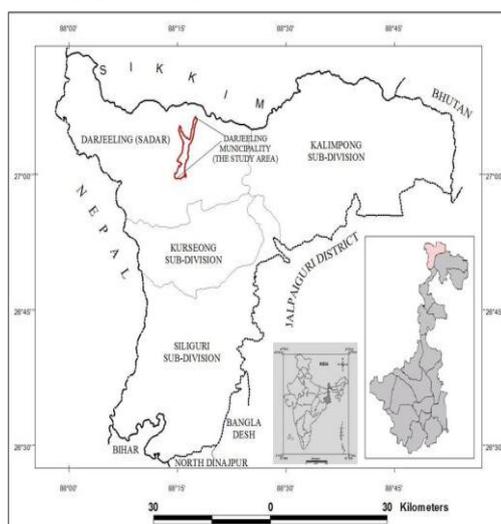
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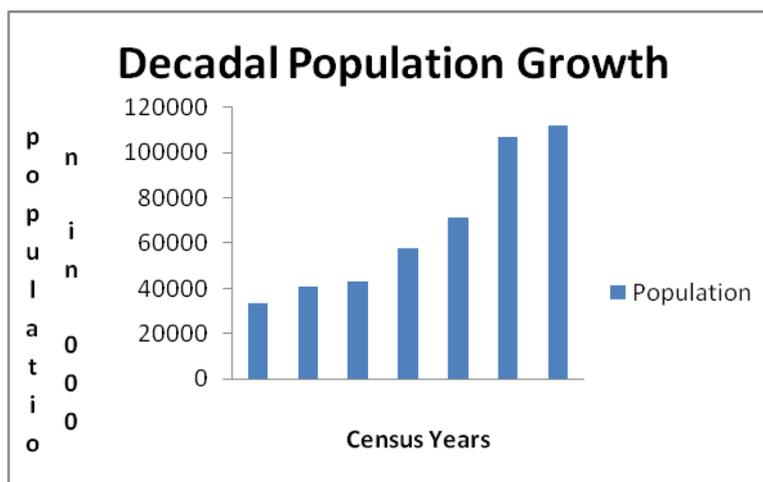
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ABSTRACT: *An area associated with urban features is bound to generate waste either degradable or non degradable. All around the world in every urban place this is a serious matter of concern. It has taken a serious turn in the towns of developing countries where the blindfold development in the cost of environmental degradation is taking place. The respective governments in the countries have implemented the laws regarding this but these laws sometimes conflicts with the development process and the former have to surrender in retrospect. There is little provision for solid waste management in these towns. In this case the metropolitan cities are bit lucky than the smaller towns. This article is about the solid waste management system in the town of Darjeeling, the health risks and environmental concerns and the solutions which the local government and the people can take into consideration. This article tries to relate to the environmental degradation an urban place faces and is facing with regard to the aggravating health problems of the people living near the dumping sites as well as the people living in the town itself. It also tries to study different problems of solid waste management in the town of Darjeeling.*

I. INTRODUCTION:

Darjeeling town is situated between 26°31' to 27°31' N and 87°59' to 88°53' E in the district of Darjeeling, West Bengal. It is one of the prided tourist town of West Bengal. Every year this town is visited by thousands of tourist from within the country as well as from foreign countries. The town of Darjeeling has 32 wards. It is a ridge, shaped liked English letter “Y” and the base resting Katapahar and Jalpahar while two arms diverge from the mall, one dripping suddenly to the North-East and ending in Lebong spur and the other arm running North-West passes through the St. Joseph’s College had finally ends in the valley near the Tukvar Tea Estate. Ever since this area was developed by British and left behind in the hands of the Indian government, the town has seen downfall in its infrastructural facilities. The popular mass movements for the demand of statehood have wrecked its image of “Queen of Hills”. The population of Darjeeling is increasing tremendously and the decadal growth rate in 2001 was 49.98%. During 90s there is massive influx of population from surrounding area as intra district migration for employment and educational and administrative facilities. The 49.98% clearly indicates the immense population growth which has lead to the congestion and space problem.





Among its 32 wards the solid waste management facilities are not equally distributed. The people of Darjeeling now has a tendency of throwing the garbage, waste into the nearby jhoras and upon the roads. The methodology applied here are:

- [1] Collection of articles and studies regarding Solid waste management
- [2] Inspection of the dumping sites and man to man conversation for collection of health related facts.
- [3] Data collection from the municipality of Darjeeling and Data analysis.

Solid Waste Management: Solid Waste as defined under Resource Conservation and Recovery Act, is any solid, semi-solid, liquid or contained gaseous materials, discarded from industrial, commercial, mining or agricultural operations and from community activities. It includes garbage, construction debris, commercial refuse, sludge from water supply or waste treatment plants or air pollution control facilities and other discarded materials. It consists of all the waste in the solid or semi solid form and is either biodegradable, non-biodegradable or recyclable. Biodegradable or compostable waste comprises of organic waste which can be reduced or biodegraded into useful or less polluting products by action of micro organisms and animals like earthworms and final product is used as organic manure.

Waste management is the collection, transport, processing or disposal of waste materials, usually ones produced by human activity, in an effort to reduce their effect on human health or local aesthetics or amenity. Waste management practices differ for developed and developing nations, for urban and rural areas and for residential, industrial and commercial producers. Waste management for non-hazardous residential and institutional waste in metropolitan areas is usually the responsibility of local government authorities, while management for non-hazardous commercial and industrial waste is the responsibility of the generator.

The municipality is given the responsibility off the solid waste management in the town. Municipalities additionally address urban environment issues related to solid waste management. Public concern and sensitivity to environmental issues is driving this expanded agenda. These include:

- Health and environmental impacts of accumulated uncollected waste and clandestine disposal sites.
- Health and environmental impacts of solid waste facilities including transfer, composting and landfill facilities.
- Air emissions from waste collection and transfer vehicles.
- Special handling and disposal of hazardous wastes including healthcare and industrial hazardous waste.

Solid Waste management in Darjeeling Town:

Darjeeling lies in fragile ecology zone. In recent years it has seen an increase in the natural calamities as landslides during monsoon. Most of the section of the people are of view that this increase can be attributed to the population increase as well as the unconsolidated solid waste management system in the town. Thus it is an attempt to study the solid management system and give an insight to it. Generally in developing countries, the health-related underpinnings of solid waste management still need to be addressed. Even the minimal regulatory framework that exists in most of these countries for environmental protection and occupational health and safety is often not enforced. Large quantities of waste are uncollected; uncollected wastes clog drains and channels causing flooding, habitats for insect breeding and accumulate on open areas. Waste collection is by labour-intensive systems with little, if any, worker protection from direct contact and injury; waste disposal fills ravines and wetlands often near residential neighbourhoods and commonly is burned openly. In the towns of

developing countries, solid waste collectors lift heavier loads; often to higher loading positions and in traffic conditions with significantly more dust and diesel exhaust pollution. Waste pickers work informally at open dumps, typically living adjacent to the dumpsite in poor housing conditions, with minimal basic infrastructure for clean water and sanitation; and a significant portion of their number are children under 16 years old. Wastes sorting and recycling activities are typically conducted manually in micro and small-scale enterprises, with minimal washing and baling equipment and virtually no dust control or worker protection. Darjeeling is highly populated hill town where daily waste generation is 30 metric tonnes. This goes upto 50 metric tonnes in peak tourist seasons. In respect of Darjeeling Municipality that solid waste generation is @ 465 gm/cap/day. *(The following characteristics are observed after personal survey of different wards.)*

The main characteristics of municipal waste management are as follows:

- [1] **No Storage of solid waste at source.** Individual families, commercial establishments and institutions throw their solid waste in bins, streets, drains, *jhoras*(waterways, natural or reinforced), open spaces and near by water-bodies. This has resulted in dirty streets and clogged drains.
- [2] **Partial Segregation and Collection of Recyclable Waste.** Households keep aside newspapers, bottles and metal objects for sale to rag-pickers. They also pick recyclable material from waste thrown in the bins, street and *jhoras*. Some houses, at a distance from the town collect the vegetable waste and prepare manure to use for market gardening.
- [3] **Inefficient system of primary waste collection.** Waste is collected through street sweeping in certain parts of central Darjeeling, which is inefficient and irregular. The waste collected through street sweeping contains all types of waste and the tools used are inefficient(brooms,etc.). The secondary storage of waste collected in open spaces, masonry bins and iron bins is unhygienic and inefficient.
- [4] **Inefficient and irregular transportation of waste.** Waste is transported in the trucks (1.5 to 2 tonnes capacity) and jeeps. Multiple handling becomes necessary and contaminated waste is also handled manually. The transport system can handle only 20 to 25 metric tones of solid waste, thus creating a backlog.
- [5] **Unscientific Disposal of Waste.** The waste is manually dumped in the disposal site, above the Hindu Burial Ground and there is no scientific treatment of the waste dumped. Hospital, construction, toxic and industrial waste are also dumped in the same dumping site. There are people living within the vicinity of the chute and downstream. Besides the official „Dumping Chute“ communities dump their solid waste in their nearest waterways and streets.



Waste collection



Waste dumped on the streets and jhorras



Unscientific disposal of solid waste

Solid Waste Composition: Darjeeling is a small town with no major industries. It does have few minor food processing small scale industries which are not capable of producing large chunk of waste. The waste generated is basically from the residential areas around the town. The town has few large hospitals generating bio-medical waste. Overall we have municipal solid waste and bio-medical solid waste.

II. MUNICIPAL SOLID WASTE:

Municipal Solid Waste consists of household wastes, market wastes, construction and demolition debris, sanitation residues, drain silt, waste from streets, etc. With rapid urbanization, rising population and change in lifestyle as well as food habits, the amount of MSW has been increasing rapidly. Moreover, its composition ratio is also changing. Over the last few years, the consumer market has grown rapidly leading to products being packed in cans, aluminium foils, plastics and other such non-biodegradable items that cause incalculable harm to the environment. However Municipal waste production is related to levels of industrialization and income status. The wards near the market area, housing number of hotels as well as residential places generate huge amount of solid waste. They also contribute in the liquid waste generation which has not been touched here. Though substantial amount of paper, rags, glass find ways to the refuse near its source, they are reclaimed enroot by rag pickers, before reaching the disposal point. The waste reaching the disposal point contains a large percentage of garbage and inorganic matter giving it a higher density low calorific value. The largest low moisture constituent of MSW is paper. Other low moisture combustible materials are plastics, textiles, rubber, leather and wood. These materials can be called “Dry Combustibles” in distinction to the “Wet Combustibles” of food, plant and other wastes, which contain 50-70% of water. “Non Combustibles” are metal, glasses and other inorganic compounds that have no heating value.

Bio-Medical Waste: The waste generating by the health care units are termed as bio-medical waste. . The town of Darjeeling has a government hospital and few private nursing homes, catering to the need of the town as well as the surrounding remote areas. These hospitals are the source of the bio-medical waste in this town. The hospital waste has always been considered potentially hazardous. The disposal of untreated bio-medical wastes poses an environmental and public health risk. It also presents an occupational health hazards to the health care personnel who handle these wastes at the point of generation, and those involved with their management i.e. segregation, storage, transport, treatment and disposal. The indiscriminate disposals of untreated wastes are the causes to spread the infectious diseases. It is imperative, therefore, to adopt appropriate system for the safe collection, storage, transport, treatment and disposal of the hospital wastes.

III. TYPES OF WASTE GENERATED:

Waste generation and composition from health care units depends upon a number of factors such as waste management methods, type of health care units, occupancy of healthcare unit, specialization of the healthcare unit, ratio of reusable items in use, availability of infrastructure and resources etc. The waste generated in the town are usually of low calorific value.

Types of Solid Waste

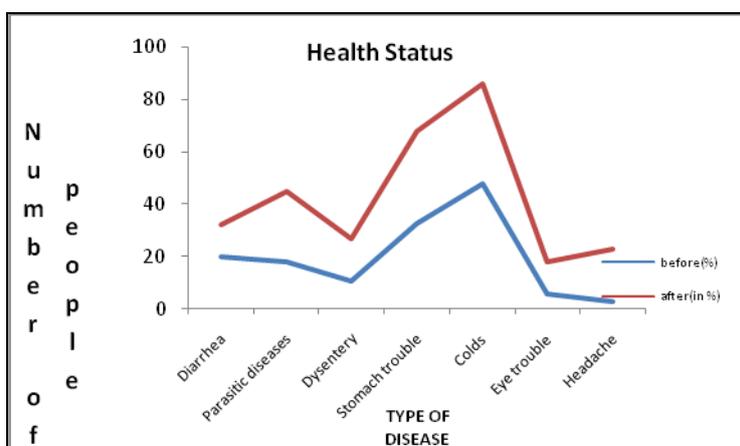
Types of waste	In(%)
Vegetable	20 to 65
Paper and carton	15 to 40
Plastic	2 to 13
Metal	1 to 5
Glass	1 to 10
Rubber, misc.	1 to 5
Fines (sand, ash, broken glass)	15 to 40
Other characteristics:	
Moisture	40 to 60
Density in trucks kg/m ³	170 to 330
Lower heating kcal/kg	1000 to 1500

Health Risks in Solid Waste management:

All activities in solid waste management involve risk, either to the worker directly involved, or to the nearby resident. Risks occur at every step in the process, from the point where residents handle wastes in the home for collection or recycling, to the point of ultimate disposal. For people working as dumpsite waste pickers, incomes are so low that many make insufficient money to meet daily subsistence needs—an issue which complicates the collection of occupation-related health data. Despite the income, more of the waste pickers interviewed reported that they experienced higher disease levels since becoming waste pickers, than they had before.

Types of Diseases

Disease	Before in(%)	After in(%)
• Diarrhea	20	32
• Parasitic diseases	18	45
• Dysentery	11	27
• Stomach trouble	33	68
• Colds	48	86
• Eye trouble	6	18
• Headache	3	23



Health risks from waste are caused by many factors, including:

- The nature of raw waste, its composition (e.g., toxic, allergenic and infectious substances), and its Components (e.g., gases, dusts, sharps);

- The nature of waste as it decomposes (e.g., gases, dusts, leakages, particle sizes) and their change in ability to cause a toxic, allergenic or infectious health response;
- The handling of waste (e.g., working in traffic, shovelling, lifting, equipment vibrations, accidents);
- The processing of wastes (e.g., odour, noise, vibration, accidents, air and water emissions, residuals, explosions, fires);
- The disposal of wastes (e.g., odour, noise, vibration, stability of waste piles, air and water emissions, explosions, fires).

Health studies in developing countries indicate that waste picking is high-risk work. The risk involves both occupational health risks to workers and environmental health risks to residents and workers. Because worker exposure times are shorter than resident exposure times, some risks may be less for workers than for residents. On the other hand, contaminant levels to which workers are exposed can be significantly higher than those that reach residents, thus leading to increased risks for workers over residents. Some of the results are highlighted below which are also prominent in the town of Darjeeling:

- The health risks associated with illegal dumping are significant. Areas used for open dumping are easily accessible to people, especially children, who are vulnerable to the physical (protruding nails or sharp edges) and chemical (harmful fluids or dust) hazards posed by wastes. A significant portion of the waste pickers found at open dumps are children and pregnant women. There have been incidents of children being suffocated to death when buried by the wasteslides. A 9 year old girl was choked to death and the body could not be retrieved even after 3 days of search operation in the dumping site in april 2011.
- Children are particularly vulnerable to toxins because they ingest more water, food, and air per unit of body weight; their metabolic pathways are less developed to detoxify and excrete toxins; and any disruption during their growth years can easily disrupt development of their organ, nervous, immune, endocrine and reproductive systems. (Landrigan, 1998)
- Poisoning and chemical burns resulting from contact with small amounts of hazardous, chemical waste mixed with general waste during collection & transportation.
- Burns and other injuries can occur resulting from occupational accidents and methane gas exposure at waste disposal sites
- Tuberculosis, bronchitis, asthma, pneumonia, dysentery, parasites, and malnutrition are the most commonly experienced diseases among waste pickers based on health studies of waste pickers.
- Waste pickers studied revealed a 40% had skin disease and 70% had upper respiratory ailments.
- During the course of one year, 40% had chronic cough, and 37% had jaundice. The average quarterly incidence of diarrhoea was 85%, of fever was 72%, of coughs and colds was 63%. Eye soreness or redness occurred quarterly in 15% and skin ulcers in 29%., with nearly all rates higher at the largest dump site than these averages.
- Among the surveyed waste pickers 80% had eye problems, 73% had respiratory ailments, 51% has gastrointestinal ailments, 40% had skin infections or allergies, and 22% had orthopaedic ailments. Most workers complained of eye burning, diminished vision, redness, itching, watering.

Health impacts of BMW

The hazardous component of health care waste may contain infectious agents, toxic and hazardous chemicals and pharmaceuticals, radioactive materials and sharps that can cause health hazards to hospital patients, healthcare workers and the general public at large.

Poor hospital waste management may cause the following diseases :

- Hepatitis B & C
- HIV positive
- Gastro-enteric infections
- Respiratory infections
- Blood stream infections
- Skin infections
- Radioactive toxicity
- Health problem associated with air and water pollution.

The growing number of HIV positive infected patients can prove the fact. The surveyed area near the dumping site revealed the higher rates of respiratory and gastro-enteric diseases. The children were affected by hepatitis B and skin diseases.

Environment pollution from BMW:

Apart from the above mentioned incidents, there are other environmental problems associated with untreated BMW generated from the healthcare units, which are as follows :

- Decomposing waste may generate foul odour inside hospital premises and surrounding area.
- Drains may be clogged with waste materials creating unhygienic environment within the surrounding hospital premises. This phenomenon may also help in breeding of mosquitoes/flies that might contribute to spreading of infectious diseases.
- Waste dump may attract stray animals and birds that might spread waste materials leading to unaesthetic and unhygienic environment.
- Indiscriminate disposal of pharmaceutical products (antibiotics and cytotoxic drugs) and discharge of untreated wastewater generated from the health care units could have disastrous ecological effects.
- Open dump of waste may decompose to produce leachate that might contaminate ground water.
- Uncontrolled and open burning of wastes can generate dioxins and furans, thus polluting the air.

Environment pollution from Solid Waste

Air pollution: Dust generated from on-site vehicle movements, and placement of waste and materials

Water pollution: Runoff from open dump sites containing chemicals may contaminate wells and surface water used as sources of drinking water open dumping can also impact proper drainage of runoff, making areas more susceptible to flooding when wastes block ravines, creeks, culverts, and drainage basins & also contamination of groundwater resources and surface water from leach ate emissions.

Soil Contamination : Permanent or temporary loss of productive land

Global Warming and Climate Change : In the town of Darjeeling the municipal solid waste is being dumped & burnt in the open space without understanding the adverse impacts on the environment. The waste in the dumping ground undergoes various anaerobic reactions produces offensive Green House gases such as CO₂, CH₄ etc. These gases are contributing potentially to certain environmental changes in the area.

Situation in Darjeeling: Darjeeling belongs to class I town and the waste generated can be brought down or controlled , had there been a proper solid waste management system. The town has a dumping site near the town which is open and the waste is dumped irrespective of its nature of degradation or decay. The foul smell from the open landfill creates health risks. The people are prone to the health risks due to the polluted air levels. The people are unaware of the health risks from air as there is provision for air quality measurement. The people tend to burn the waste which is not degradable, even in the dumping sites which releases toxic and carcinogenic gases. The dumping site is near a clustered site with the poor people living near it. These deprived class of people are the ones which are most affected by it. Apart from this health factors, the fragile area in due course of time has been prone to landslides. Earlier it was considered a natural phenomenon. But now, the unnecessary pile of non biodegradable plastics in the land is considered as a major contributing factor. Rotting waste lying about in streets and *jhoras* has created an unhealthy environment in Darjeeling. With the increasing fast moving consumer durables non-biodegradable packing material, one sees increasing packing material along with the rotting bio-degradable waste. The flies and street dog populations are shooting up. One has even started seeing mosquitoes in the Darjeeling town which was not seen even 10 years ago. The practice of dumping waste into waterways and streams might have been acceptable before the advent of mass non-biodegradable material, but today, plastic packing material, bottles are choking water ways which has contributed to landslides in Darjeeling.

Thus the lack of proper waste management is proving a health hazard in Darjeeling. The lack of segregation and combined dumping of waste in water ways and especially the dumping chute is polluting the water ways and resulting is serious health hazards to people living downstream. The pollution of the waterways is disturbing the ecology of the waterways by changing the composition of the water. Some of the chemicals promote the growth of certain life forms only, leading to change in the entire ecology. While, other chemicals are toxic to all life forms thus killing aquatic life. Ultimately, in both the cases, aquatic life gets killed. The infrastructure was not planned for the population today thus insufficient to handle the waste. The challenge with the changing consumption patterns and types of waste generated has not been taken into account and the existing waste management system has not adapted to this change. Dumping and Burning like in the yesteryears is highly unacceptable today. Thus the challenge of waste management is both of a societal behavioural change and an infrastructural one.

Present Situation: With the increase in population, the quantity of generated wastes increased at an alarming rate. With it came the non- biodegradable materials like plastics. As a result, to keep the environment healthy, from 1980, Vats at different locations, dustbins, handcarts etc. came into existence. But this system of vats was objected by people as existing vats created environmental nuisance. So, since 2007, the Municipality has started the new system of collecting waste from doorsteps and directly dumped in the land fill site. This has still not been possible to cover the whole of the Municipal Area but initiative has been taken to do so in the coming 5 years.

Major sources of solid waste in the study area are the domestic, commercial and institutional sectors. The Municipal Authority has provided 182 numbers of roadside vats for collection of Solid Wastes. During field investigations and sample survey carried out it has been observed that the people prefer to throw solid wastes on the sides of the roads, inside the surface drains, in the allies and rear side ditches where the dust bins or vats are not located within the reach of the people. Accumulated solid wastes are collected manually from the dumps and transported to the solid waste dumping chute with the help of tractor-trailers. There are altogether 3 numbers of tractor-trailers and 40 numbers of wheel barrows. The dumping chute (made of R.C.C) is located below the cemetery near the jail. There are about 91 vats which are not approachable by the tractor-trailers. The refuse from these vats are collected either by head load or by wheel barrows and dumped into nearby approachable roadside vats. Presently, about 50 tons of solid wastes are generated daily, out of which only 62 % is disposed off daily.

Deficiencies in the system:

The overall picture of solid waste management in the municipal towns is not quite satisfactory and needs to be improved in order to achieve proper environmental sanitation. The basic short-comings and problems associated with solid waste management in Darjeeling municipal town are as follows.

- Population explosion, uncontrolled urbanization, slum area proliferation.
- Socio-Economic crisis (huge external debt, economic austerities, prolonged recession, high rate of inflation, high rate of unemployment, social disorder etc.)
- Accelerated and uncontrolled generation of municipal wastes and industrial hazardous wastes.
- Negligence and lack of interest for an effective solid waste management plan.
- Insufficient public education and limited community participation.
- In appropriate design of primary handcarts and collection vehicles causing multiple handling of waste and environmental problems.
- The small and medium municipalities are lacking considerably in the servicing and workshop facilities for the mechanical transport fleet.
- The location of disposal grounds and their sizes are not decided on the basis of optimum haulage and rotational transformation routing.
- Disposal of solid waste by land filling method is not generally carried out in a proper sanitary method.
- Regular analysis and monitoring of solid waste characteristics are not done and presence of toxic and hazardous materials cannot be ruled out.

Recommendations:

Darjeeling should no longer roll her waste down the hill as she has being doing all these years. This is because of the increase in the waste that is generated and also the change in the type of waste. The unscientific as well and insufficient waste management system is leading to health hazards to the people of Darjeeling as well as people living downstream. The untreated waste is a threat to the fragile ecology of Darjeeling and its downstream. Most diseases have exposure pathways. Most injuries have contact pathways. Interrupting the pathways can reduce risks. In solid waste management this can be achieved by making waste technologies more contained, reducing contaminant emissions, changing working methods, use of protective clothing, and keeping the public and residents a safe distance away from operations. For example, risk of respiratory infection or allergic response to organic dusts can be greatly reduced if transfer stations, composting and recycling process systems are enclosed or ventilated and if workers wear respiratory masks. Thus it is imperative that the waste management system of Darjeeling is improved with utmost urgency. Some of the recommendations are given below.

- [1] Three 'R's of solid waste management i.e. reduce, reuse and recycle must be adopted by all urban centres. This will help in reducing the quantum of solid waste that the local governments have to deal with.
- [2] Efficiency of waste collection must be improved in the town by bringing about the necessary changes in the design of equipment used by sanitary staff, manpower management and planning.

- [3] Transportation fleet needs to be maintained well and needs to be modernised to improve collection and transportation efficiency.
- [4] Crude/ open dumping of waste must be completely discouraged by encouraging controlled tipping.
- [5] Identification of usable landfill sites should be done. In order to reduce the quantity of waste that goes to landfill sites, waste treatment such as neighbourhood composting and recycling of waste must be encouraged.
- [6] Separate collection of hospital waste must be ensured in every city and incinerators must be installed to deal with this waste. Landfill sites should apportion an area for the disposal of hazardous waste from hospitals.
- [7] Private sector participation must continue to be encouraged in this sector to achieve efficiency of operations and cost reduction. However, monitoring of privatised activities should be improved in order to provide better quality of services to the people.
- [8] Plans to improve cost recovery from this service must be made by every local government. New sources of revenue generation must be thought of.
- [9] People's participation must be encouraged to keep cities clean and NGOs must be used to do IEC work in communities.

IV. CONCLUSION:

The town is under severe pressure of population increase which consequently leads to increased waste generation. The Municipality has to tighten its grip in order to keep the town clean and healthy. The improper waste management may affect its physical as well as cultural features, hitting hard on its tourism industry which is ghastly losing its impact upon the visitors to the neighbouring state of Sikkim.

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