

Study of the Solid Waste in IDPL Township and Ranipokhri Town of Uttarakhand

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Abstract

Solid waste (SW) is the unwanted or useless solid materials generated from human activities in residential, industrial or commercial areas. Any unwanted or discarded material from residential, commercial, industrial, mining and agricultural activities that causes environmental problems may be termed as solid waste.

In the developed countries, solid waste management (SWM) belongs to prominent thrust areas for pursuing research (Gupta *et.al.*, 1998) and economic and technological advancements have initiated responsiveness of stakeholders towards it (Kansal, A. 2002). High population growth rates, rapidly varying waste characterization and generation patterns, growing urbanization and industrialization in developing countries are the important reasons for paying attention towards SWM as more area is required to accommodate waste (Ramachandra, T.V. and Shruthi, B. 2007)

Solid waste needs to be characterized for source, generation rates, type of wastes produced and composition, in order to monitor, control and to improve prevailing waste management systems. All the important information related to sources, quantity and composition are very important for the design and operation of the functional elements related to waste management. The functional elements include waste generation, on-site handling and storage, collection, transfer and transport, processing and recovery, recycling and reuse, treatment and final disposal. The reliable estimates of SW generation are vital for effective waste management planning and help taking better financial, regulatory and institutional decisions. So, here we discuss about SW generation.

Keywords: Solid waste, Urbanization, Industrialization, Processing & recovery, & reuse

Recycling

Introduction

The Energy and Resources Institute has estimated that waste generation will exceed 260 million tonnes per year by 2047 more than six times the present level. Cities with 100,000 plus population contribute 72.5 per cent of the waste generated in the country as compared to other 3955 urban centres that produce only 27.5 per cent of the total at present.

Solid wastes are all the wastes arising from human and animal activities that are normally solid and are discarded as useless or unwanted. Generation of solid waste is not a new phenomenon. In the early days, before the advent of the industrial revolution, the major constituents of wastes were domestic sewage and agricultural residues, which were bio-degradable in nature. Since population was less and fallow land was in plenty, solid wastes could be conveniently disposed off in the countryside either on open ground or were placed in pits covered with layers of mud.

While the composition of solid waste is changing in India, due to increased use of packaging material and plastics by the urban population, no serious efforts are made to adapt latest methods and technologies of waste management, treatment and disposal. It is also a fact that a large portion of the municipal budget is allotted for solid waste management and most of it is spent on the wages of sanitation workers.

Composition and Characteristics of Indian Solid Waste

Following major categories of waste are generally found in SW of India:

- Biodegradable Waste: Food and kitchen waste, green waste (vegetables, flowers, leaves, fruits) and paper.
- Recyclable Material: Paper, glass, bottles, cans, metals, certain plastics, etc.
- Inert Waste Matter: C&D, dirt, debris.
- Composite waste: Waste clothing, tetra packs, waste plastics such as toys.
- Domestic Hazardous Waste (also called “household hazardous waste”) and toxic waste:
- Waste medicine, e-waste, paints, chemicals, light bulbs, fluorescent tubes, spray cans, fertilizer and pesticide containers, batteries, and shoe polish.

SW in India has approximate 40–60% compostable, 30–50% inert waste and 10% to 30% recyclable. Analysis carried out by NEERI reveals that in totality Indian waste consists of Nitrogen content (0.64 ± 0.8), Phosphorus (0.67 ± 0.15), Potassium (0.68 ± 0.15), and C/N ration (26 ± 5).

Classification of Solid Waste

SW can be classified into various heads as under:

- Garbage: Putrescible (decomposable) wastes from food, slaughter houses, canning, and freezing industries etc.
- Rubbish: Non-putrescible wastes, either combustible or non-combustible. Combustible wastes would include paper, wood, cloth, rubber, leather, and garden wastes. Non-combustibles would include metals, glass, ceramics, stones, dirt, masonry and some chemicals.
- Agricultural waste: Include crop residues, farm manure, fertilizer, pesticide, herbicides.
- Industrial waste: Fly ash, sewage, chemicals sludge, paints, toxic metals.
- Hazardous waste: Waste which adversely affect human, plant and animals. Ex- radioactive waste, toxic chemicals, flammable waste, explosives, waste from hospitals and research institutes.
- Pathological waste: Waste generated from pathological laboratories.
- Large Wastes: Demolition and construction rubble (pipes, plumber, masonry, brick, plastic, roofing and insulating material), automobiles, furniture, refrigerators and other home appliances, trees, tyres etc.
- Dead animals: Household pets, birds, rodents, zoo animals, etc. there are also anatomical and pathological wastes from hospitals.
- Sewage Treatment Process Solids: Screening, settled solids, sludge.
- Mining Waste: ‘Tailings’, slag heaps, culm piles at coal mines etc.

Review of Literature

Man in small numbers, can be tolerated as a parasite in the biosphere. When man's numbers and activities occupy a significant portion of the biosphere, the problem of waste assimilation, and even continued life, become paramount.

Bijilani (2005) studied the problems of pollution due to unclear solid wastes in cities.

Sharma (2015) in his study described the characteristic features of Indian solid waste management system.

Sundwar (2014) in his study focused on the intensity of the Hazardous Waste management problem.

Singh (2017) explored the possibilities of energy generation from solid wastes. In his study he has developed a decision support tool for management with the help of Geographic Information System (GIS). His study also consisted of analyzing the participation rates at household hazardous waste facilities, assisting haulers with routing collection vehicles, evaluating service levels of yard debris programmes, developing travel time models for transfer stations, inventorying of multifamily complexes and recycling levels, calculating recycling participation rates, distributing compost bins and evaluating, etc.

Sunil Kumar (2018) has made attempts to study solid waste management practices in Indian cities including Delhi. With regard to the problems faced by the households in disposing solid wastes in Chennai city

Sarika Kansal (2017) in her study dealt with the causes for the inefficient management and disposal of solid waste in the developing world. It was argued that India is still suffering from lack of effective, efficient and sustainable waste management system.

Anusha Kaushik's (2015) contribution on "Environmental Science and Engineering" provides the higher standards of living of ever increasing population has an increase in the quantity and variety of waste generation continues indiscriminately than very soon it would be beyond rectification management of solid waste management of solid waste has therefore, become very important in order to minimize the adverse effects.

Objectives

The following objectives were proposed for the present study:

- ✓ To identify sources of Solid Waste generation
- ✓ To identify Issues and Challenges of Solid waste

The Study Area

Virbhadrha is located at 30.07°N 78.28°E. It has an average elevation of 330 metres (1,083 feet). It is named after Virabhadra, an avatar created through the wrath of Shiva after the yachna of Daksha, at Kankhal. An ancient Shiva temple known as Virbhadrha Temple, dedicated to him, is situated within the town. Virbhadrha is famous for the first government pharmaceutical plant (producing Antibiotics), Indian Drugs and Pharmaceutical Limited (IDPL).

Rani Pokhri is a village situated in Doiwala Block of Dehradun district in Uttarakhand. Positioned in rural area of Dehradun district of Uttarakhand, it is one of the 75 villages of Doiwala Block of located in Rishikesh sub district in the state Uttarakhand in India. Total geographical area of Rani Pokhari village is 2 km² and it is the 27th biggest village by area in the sub district. Population density of the village is 2200 persons per km².

Methodology

IDPL, Virbhadrha is spread in an area of area of about 3 square kilometers. There are about 3500 residential apartments, which are categorized in blocks. At present there are 1700 families residing in the campus.

For the present study the area was divided into five sites starting from the city gate 1 and ending with city gate 2, which more or less covers the complete IDPL campus. The sites were as follows:

- ✓ Site 1. IDPL City Gate 1
- ✓ Site 2. Haat Bazar
- ✓ Site 3. Near Lovely Store
- ✓ Site 4. Residential area D Block
- ✓ Site 5. IDPL City Gate 2

Sampling

A total of 40 general public, have been chosen as the respondents in Ranipokhri town for the purpose of the study. Questionnaire was distributed and data so obtained was recorded and analysed

Also for this study, the researcher has employed simple random sampling method. As per this technique, Ranipokhri Town was divided into five sites. 5 samples of 1 kg each were collected from each site after a gap of one week. Each site was visited four times during the study. Each sample of 1kg was segregated and individual waste was weighed and recorded. The average of 4 days data was used for deriving the results.

Types of waste	Site 1	Site 2	Site 3	Site 4	Site 5
Regular Biodegradable Waste	1.5kg (30%)	2.0 kg (40%)	1.75kg (35%)	1.25kg (25%)	0.5kg (10%)
<i>Food</i>	0.00	1.00	0.45	0.00	0.25
<i>Vegetables</i>	0.50	0.50	0.60	0.50	0.25
<i>Fruits</i>	0.50	0.50	0.50	0.40	0.00
<i>Beverages</i>	0.00	0.00	0.00	0.00	0.00
<i>Plant residues</i>	0.50	0.00	0.20	0.35	0.00
Biodegradable Waste	1.0kg (20%)	1.5kg (30%)	2.25kg (45%)	1.25kg (25%)	1.0kg (20%)
<i>Fruit seeds/shell</i>	0.25	0.50	0.50	0.00	0.50
<i>Paper</i>	0.50	0.75	1.25	1.25	0.50
<i>Clothes/rags</i>	0.25	0.25	0.50	0.05	0.00
<i>Wooden matter</i>	0.00	0.00	0.00	0.00	0.00
<i>Miscellaneous</i>	0.00	0.00	0.00	0.00	0.00
NBW Directly reusable	2.0kg (40%)	1.0kg (20%)	0.5kg (10%)	1.75kg (35%)	1.5kg (30%)
<i>Polythene</i>	1.50	1.00	0.50	1.50	1.50
<i>Tin</i>	0.25	0.00	0.00	0.00	0.00
<i>Glass (bottle)</i>	0.25	0.00	0.00	0.00	0.00
<i>Candle</i>	0.00	0.00	0.00	0.00	0.00
<i>Nylon cloth</i>	0.00	0.00	0.00	0.25	0.00
Decorative Reusable	0.00	0.25 kg(5%)	0.00	0.00	1.5kg (30%)
<i>Battery</i>	0.00	0.00	0.00	0.00	0.00
<i>Bones/eggshells</i>	0.00	0.25	0.00	0.00	0.00
<i>Paints</i>	0.00	0.00	0.00	0.00	0.00
<i>Hairs</i>	0.00	0.00	0.00	0.00	0.00
<i>Cold drink/ wrappers</i>	0.00	0.00	0.00	0.00	1.50
<i>Processed leather/ Mattress</i>	0.00	0.00	0.00	0.00	0.00
<i>Stone and bricks Ash and fine e</i>	0.00	0.00	0.00	0.00	0.00
Recyclable	0.5kg (10%)	0.25kg (5%)	0.5 kg (10%)	0.75 kg (15%)	0.5 kg (10%)
<i>Plastic</i>	0.50	0.25	0.50	0.75	0.50
<i>Rubber</i>	0.00	0.00	0.00	0.00	0.00
<i>Metal</i>	0.00	0.00	0.00	0.00	0.00
<i>Glass</i>	0.00	0.00	0.00	0.00	0.00
Needs safe disposal	0.00	0.00	0.00	0.00	0.00
<i>Medical waste</i>	0.00	0.00	0.00	0.00	0.00
Grand total	5.00 kg (100%)	5.00 kg (100%)	5.00 kg (100%)	5.00 kg (100%)	5.00 kg (100%)

Site 1. Market Area, Site 2. Residential Area, Site 3. Haat Bazaar, Site 4. Forest Area 5. School

Table1. Observations from Site 1. Ranipokri Town

Types of waste	Site 1	Site	Site 3	Site 4	Site 5
Regular Biodegradable Waste	1.25kg(25%)	2.00kg(40%)	1.0kg(20%)	1.9kg(38%)	0.50kg(10%)
<i>Food</i>	0.00	0.85	0.50	0.00	0.00
<i>Vegetables</i>	0.50	0.65	0.30	0.50	0.00
<i>Fruits</i>	0.50	0.50	0.20	1.40	0.00
<i>Beverages</i>	0.00	0.00	0.00	0.00	0.00
<i>Plant residues Fine organic matter</i>	0.25	0.00	0.00	0.00	0.50
Biodegradable Waste	0.25kg(5%)	1.00kg(20%)	1.6kg(32%)	1.25kg(25%)	0.8kg(16%)
<i>Fruit seeds/shell</i>	0.25	0.20	0.00	0.50	0.00
<i>Paper</i>	0.00	0.80	1.40	0.75	0.40
<i>Clothes/rags</i>	0.00	0.00	0.20	0.00	0.40
<i>Wooden matter</i>	0.00	0.00	0.00	0.00	0.00
<i>Miscellaneous</i>	0.00	0.00	0.00	0.00	0.00
NBW Directly reusable Polythene	2.5kg (50%)	1.3kg(26%)	1.10kg(22%)	0.75kg(15%)	1.90kg(38%)
<i>Tin</i>	2.50	1.30	1.10	0.50	1.50
<i>Glass (bottle)</i>	0.00	0.00	0.00	0.00	0.00
<i>Candle</i>	0.00	0.00	0.00	0.00	0.40
<i>Nylon cloth</i>	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.25	0.00
NBW Reusable	0.00	0.40kg(8%)	0.50kg(10%)	0.15(3%)	1.3kg(26%)
<i>Battery</i>	0.00	0.00	0.00	0.00	0.00
<i>Bones/eggshells</i>	0.00	0.40	0.00	0.00	0.00
<i>Paints</i>	0.00	0.00	0.00	0.00	0.00
<i>Hairs</i>	0.00	0.00	0.20	0.15	0.00
<i>Cold drink/ wrappers</i>	0.00	0.00	0.30	0.00	1.30
<i>Processed leather/ Mattress</i>	0.00	0.00	0.00	0.00	0.00
<i>Stone and bricks Ash and fine earth</i>	0.00	0.00	0.00	0.00	0.00
Recyclable	0.50kg(10%)	0.30kg(6%)	0.80kg(16%)	0.75 kg(15%)	0.50kg(10%)
<i>Plastic</i>	0.50	0.30	0.80	0.75	0.50
<i>Rubber</i>	0.00	0.00	0.00	0.00	0.00
<i>Metal</i>	0.00	0.00	0.00	0.00	0.00
<i>Glass</i>	0.00	0.00	0.00	0.00	0.00
Needs Safe disposal	0.50kg(10%)	0.00	0.00	0.20(4%)	0.00
<i>Medical waste</i>	0.50	0.00	0.00	0.20	0.00
Grand total	5.00 kg (100%)	5.00 kg (100%)	5.00 kg (100%)	5.00 kg (100%)	5.00 kg (100%)

Table 2. Observations from Site 2. IDPL Township

Results and Conclusions

In site no.1 (IDPL City Gate No. 1), NBW was recorded the highest at 50% followed by RBW at 25%. With respect to site 2 (Haat Bazar), RBW recorded was 40%, followed by NBW, 26% and BW 20 %. Site 3 (Lovely Store and School) had the following values of BW 32%, RBW 20%, NBW 22% and RC 16 % respectively. RBW 38%, BW 25%, NBW and RC 15 % were recorded from Site No. 4(Residential Blocks) Site 5(IDPL City Gate No. 2) witnessed the values as NBW 38%, DR 26, BW 16%. The average of all the sites with respect to different types of waste stands at NBW 30%, RBW 27%, BW 20%, RC 11% and DR 9% and NSD 3%.

In site no.1 (Market Area), NBW was recorded the highest at 40% followed by RBW at 30%. With respect to site 2 (Households), RBW recorded was 40%, followed by BW, 30% and NBW 20 %. Site 3 (Haat Bazar) had the following values of BW 45%, RBW 35%, NBW 10% and RC 10 % respectively. NBW 35%, RBW and BW 25% and RC 15 % were recorded from Site No. 4(Forest Area) Site 5(Schools) witnessed the values as NBW and DR 30%, BW 20, RBW and RC 10%. The average of all the sites with respect to different types of waste stands at NBW 27%, RBW and BW 28%, RC 10% and DR 7% and NSD 0% respectively.

In the case of Ranipokhri, in site no.1 (Market Area), NBW was recorded the highest at 40 % of the population produced 1-2 kg of waste /day followed by 30% 2-4 kg. Maximum (40%) of the waste generated was NBD followed by BD and MIX. 95 % of the population were not satisfied with the current waste management practices, 80 % of the respondents were not satisfied with the discharge of duties by the municipal corporation. Only 28% of the respondents were happy with the services of garbage vans. As expected 78% of the respondents didn't segregate the waste at source. The waste collectors do not ask for segregated waste, opinion of 76% respondents. 96% admitted that there is a major issue of the waste management in the study area.68% reported that the condition of the dust bins is bad, in some areas the dustbins are in good shape and condition (12%). Maximum of the waste is generated by households (58%) followed by shops 32%.

The following sources of Solid waste generation were identified in both the study areas:

Source of Waste	General Practices to follow
Household Waste	<ul style="list-style-type: none"> ✓ Don't throw solid waste in the neighbourhood, on the streets, open spaces, and vacant lands, into the drains or water bodies. ✓ Keep food waste/biodegradable waste in a non-corrosive container with a cover (lid). ✓ Keep dry, recyclable waste in a bin or bag or a sack.
Shops, offices, Institutions, etc.	<ul style="list-style-type: none"> ✓ If situated in a commercial complex, put the waste in bins provided by the association. ✓ Keep dry and wet biodegradable waste separately.
Hotels & restaurants	<ul style="list-style-type: none"> ✓ Adopt In house composting and waste for 2000 Waste Disposal. ✓ Sell Non-biodegradable waste to end-user.
Vegetable & fruit markets	<ul style="list-style-type: none"> ✓ Provide large containers, which match with transportation system of the local body. ✓ Shop keepers not to dispose of the waste in front of their shops or open spaces. ✓ Waste shall be used for composting. ✓ Deposit the waste as and when generated into the large container placed in the market.
Meat & fish markets	<ul style="list-style-type: none"> ✓ Not to throw any waste in front of their shops or open spaces around. ✓ Use waste for composting.

Street	<ul style="list-style-type: none"> ✓ Not to throw any waste on the street.
Marriage halls, Community Halls	<ul style="list-style-type: none"> ✓ Not to throw any solid waste in their neighbourhood, on the streets, open spaces, and vacant lands, into the drains or water bodies. ✓ Provide a large container with lid, which may match with the transportation system of the local body and deposit all the waste generated in the premises in such containers.
Hospitals	<ul style="list-style-type: none"> ✓ Not to deposit construction waste or debris on the streets, footpaths, pavements, open spaces, water bodies etc. ✓ Store the waste within the premises or with permission of the authorities just outside the premises without obstructing the traffic preferably in a container if available through the local body or private contractors.

Table 3. Sources of Solid Waste generation in both the Sites

The following issues and challenges were observed in both the sites during the present study

Segregation at source

Waste segregation at source for example at household level is a critical issue for the sustainable management of SW. Considering its importance, the waste should be segregated into two categories: (a) biodegradable and (b) non-biodegradable according to the SW Management Rules 2000 notified by Ministry of Environment, Forest and Climate Change, Government of India.. According to new rules, waste should be segregated into three categories:

- ✓ Biodegradable
- ✓ Non-biodegradable and
- ✓ Domestic Hazardous Waste.

However, source segregation is not practiced at all in the existing scenario. In general, people (residents) are not aware of the importance of waste segregation and their participation is nil.

Collection efficiency

Poor SW collection efficiency is another challenging issue. There should be 100% door-to-collection to improve the overall collection efficiency. There could be multiple factors for poor collection efficiency. Inadequate infrastructure (shortage of community bins and vehicles, and poor roads) and poor management (un-optimized route, improper bin collection systems and schedule) are the critical factors affecting collection efficiency. In IDPL, community bins are not enough to cover the entire township. Moreover, the bins are not located with proper planning, which results in unequal distance of community bins.

Disposal of waste

This is the most neglected area of SW management in both the area as about 90% of the SW is disposed unscientifically to open dumping sites. The current waste disposal is unsound as un-segregated waste is dumped in to the open dumping site. Moreover, the dumping site is not scientifically managed.. Open dumping at land is prone to flooding during rain and it could be the major source of surface water contamination. There is a high risk of ground water contamination via leach ate percolation in open dumping site.

Some of the recommendations based on this study are as follows.

- ✓ Initiate steps for scientific and organized waste management this includes putting in place the necessary measures to collect, transport, and dispose of or treat solid waste.
- ✓ Develop a new policy based on a renewed understanding of the residing population
- ✓ Enforce the existing waste legislation and promote education and awareness among the people toward solid-waste issues and adverse health impacts.
- ✓ Develop a common waste-management infrastructure.
- ✓ Introduce incentives and emphasize efforts that promote reuse and recycling.

The key findings from the study are presented as under:

Waste Segregation: As per the existing practices only dry recyclables like, newspaper, glass bottles, plastic bottles and metal scrap are separated out from the waste stream at waste generation level; approximately 30-40% of the waste generators segregates high value dry recyclables and sell it to the scrap dealer or Kabariwala for monetary benefits. Other than the separation of high value dry recyclables from generator, segregation at source does not happen.

Waste as a Resource: Awareness about converting waste to resource is very less amongst the generator, thus efforts to segregate the waste at source is not made. Efforts in this direction if made will yield significant results.

Waste Disposal: No efforts are made to recover the resources from the waste. No compost is produced from the organic waste. They adopt the old practice of waste collection, handling and disposal at unidentified and unscientific dumpsites. Such practices could be termed as illegal waste management practices and need immediate attention, before it becomes hazardous for the surrounding flora and fauna.

Waste Collection: Door to door waste collection service is provided only at a few places, with the help of NGOs. Whereas, in most of the places the waste is routed directly to community bins or dumped in adjoining empty lands or nalas (drains). The collection and storage system within the study area were also found inadequate to receive and store the waste in a proper manner. It is witnessed that either the receptacles are very old (discarded one), small sized or placed at very far place, that travelling to that point will be too much time consuming. The dhalos (waste receptacles) for waste collection in most of the cases provide free access to birds, flies and animals, since they are broken or do not have the provision for a gate.

Satisfaction Level: The unhygienic and un-aesthetic surroundings with deteriorating health and environmental conditions have put the public satisfaction level to a minimum. The poor waste management infrastructure and administrative setup too has worsened the situation further.

User fee, willingness to pay and make attitudinal change: The good part of the above situations is that people who are looking for a change are willing to provide a monetary contribution to the collectors in form of user fee, provided the collectors approaches the society/ community and provides them with improved and reliable waste management solutions. The old mindset that waste is only the responsibility of the municipality has also now slowly started to change. But still many people are not accepting it as their own responsibility to safely store and get it disposed through legalized means. Activities targeting in bringing vast attitudinal change towards waste management will help to certain extent.

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