Chapter 7
SUMMARY
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Guwahati is one of the large and densely populated cities in India and largest city in the northeast of India. As like as other cities of India, scientific sustainable Solid Waste Management (SWM) of the city is becoming essential which need to be addressed properly by considering environment and human health point of view. The Guwahati Municipal Corporation (GMC) is the only concerned authority to look after the Solid Waste Management (SWM) of the entire city. As of present practices, all the solid waste both biodegradable and non-biodegradable are collected together from the dust bins and other public places of different parts of the city and disposed in the vicinity of “Deepor Beel”, the lone “Ramsar Site” of Assam. Because of the deposition and leaching outs from the solid wastes, the internationally recognised wetland is now degrading day by day and some of the nearby areas are converting into wastelands. Moreover, there are severe shortcomings in the existing solid waste management practices in Guwahati city leading to different kinds of environmental as well as social problems. In the present context, solid waste menace in the city is a serious concern and its effective disposal and management are becoming most essential.

It has been observed that only source specific characterization and quantification can give a clear picture on the amount of different types of solid waste generated in the city which is very much essential for formulating a successful management plan of solid waste in the city. Therefore, an attempt has been made to study the source specific characterization and quantification of solid waste in Guwahati city. Some innovative steps under waste to wealth concept were also tried for sustainable solid waste management in the city.

7.1 Assessment of Solid Waste Generation

The study reveals that regular sources of solid waste are Households, Commercial areas, Market places, Hotels, Restaurants, Hospitals and Nursing Homes, Educational Institutes, Cinema Halls, Offices, Railway Stations, Bus Stands (long distance), Industries, Street Sweepings & Drain Cleanings and different ‘Other’ sources.
Besides these sources, there observed some major occasional sources of solid waste in the city. These occasional sources are festivals like ‘Bahag Bihu’, ‘Durga Puja’, ‘Kali Puja’ and ‘Idd’, and different fair like ‘Book fair’, ‘Trade fair’ and ‘Expo’.

The per capita generation of solid waste from Household works in the city was found to be 0.175 kg/day. The quantity of solid waste was the lowest in case of glass (0.84%), where as it was the highest in case of organic waste (73.93%). As per the analysis, total solid waste generated in the city from households was 180 tons/day. The average generation of solid waste from Commercial Establishments was estimated at 1.49 kg/unit/day. In case of commercial establishments also, the percentage contribution was the lowest in case of waste glass (1%), where as it was the highest in case of organic waste (41.93%). As per the analysis, total solid wastes generated by Commercial Establishments were 56.62 tons/day.

Vegetable, fruit, mutton, chicken and fish stalls, and commercial establishments like stationery, electrical, pharmaceuticals, general stores, grocery, PCO, tea stalls, etc. are the potential sources of solid waste in Markets of Guwahati. Accordingly, the average generation of solid waste from Vegetable/Fruit stalls were estimated at 12.00 kg/unit/day, from Mutton/Chicken stalls were estimated at 15.00 kg/unit/day, from Fish stalls were estimated at 2.00 kg/unit/day and from commercial establishments were estimated at 1.49 kg/unit/day. The total amount of solid wastes generated in the markets was 17 tons/day, out of which 83.8% was organic, 5.6% was paper and 6.1% was plastic. Glass, metals, rubbish and others collectively contributed 4.5% to the total solid waste generated in the markets of Guwahati.

The average generation of solid wastes from Hotels was estimated at 83.75 kg/unit/day, while the average generation of solid wastes from Restaurants was estimated at 16.50 kg/unit/day. Segregation of the waste generated from hotels and restaurants revealed that the percentage of plastic (3.25%) was the least, whereas the percentage of organic waste (81.5%) was the highest. Total solid wastes generated by hotels and restaurants were estimated at 2.68 tons/day and 9.40 tons/day respectively. Total solid waste generated by the Cinema Halls of the city was estimated as 0.65 tons/day with an average rate of generation of 43.33 kg/unit/day. Segregation of the
solid waste generated from the cinema halls revealed that the amount of paper waste was the lowest (3.25%), where as the amount of plastic waste was the highest (96.4%).

The average generations of solid waste from Educational Institutes and Offices in the city were found to be 0.153 kg/person/day and 0.05 kg/person/day respectively. The quantity of metal was found to be the minimum in the educational institutes (0.3%), while the quantity of other waste was observed to be the minimum in office waste (0.5%). Organic waste was found to be the maximum contributor both in educational institutes (57.8%) as well as in the offices (64.5%). As per the analysis, total solid waste generated from educational institutes and offices were 23 tons/day and 5.35 tons/day respectively.

On the average, every day per bed generation of non-biomedical solid waste from Hospitals and Nursing Homes in the city was found to be 1.035 kg/bed/day. This gives an estimate of total generation of non-biomedical solid waste from the hospitals and nursing homes of Guwahati as 4.81 tons/day of which the contributions of organic, paper, plastic, glass and other wastes were 2893 kg/day, 664 kg/day, 622 kg/day, 604 kg/day and 29 kg/day respectively.

The average generation of solid waste from Railway Stations and long distance Bus Stands of Guwahati were estimated at 800 kg/station/day and 363.33 kg/station/day, leading to the total generation of solid waste of 2.40 tons/day and 2.40 tons/day respectively. Highest contribution was from organic waste (51.35%) followed by plastic (28.4%) in case of railway station, while in case of bus stands the highest was from plastic (43.4%) followed by organic waste (35.2%).

The average generation of solid waste from Industries in the city was found to be 14 kg/unit/day. Classification of the waste revealed that the highest amount was metal waste (60%) followed by other wastes (15%). The total generation of solid waste from Industries was 3.50 tons/day. Total amount of solid waste generated from Street Sweepings and Drain Cleansings was found to be 48 tons/day which was mostly other type of waste (70%). The average generation of solid waste from Other Sources were estimated at 15.45 tons/day out of which 44.19% was organic waste. Solid waste generation from the Occasional Sources was estimated at 19.75 tons/day most of which are of organic type of waste (59.4%).
On the basis of the above estimates of solid waste generation from different sources, the total generation of solid waste in the city was estimated at 390 tons/day. Accordingly, Per Capita Generation of Solid Waste was estimated at 379 gm/cap/day. The contributions of solid waste from different sources were estimated as 46.20% from household, 18.89% from commercial establishments and markets, 12.31% from street sweeping & drain cleaning, 7.27% from educational institutions & offices, 3.27% from hotels, restaurants and cinema halls, 1.23% from hospitals & nursing homes, 0.90% from railway & bus stations, 0.90% from industries, 5.07% from occasional sources and 3.96% from other sources. Characterisation of waste revealed that the different types of waste are as follows – Organic→57.4%, Paper→18.2%, Plastic→5.6%, Glass→2.6%, Metal→2.2%, Rubbish→2.8% and Others→11.3%.

### 7.2 Present System of Waste Disposal in Guwahati

Though the Guwahati Municipal Corporation is the only authority of solid waste management for Guwahati City, presently entire responsibility of solid waste management of Guwahati City is vested to Guwahati Waste Management Company Private Limited (GWMCPL) which is a joint venture of Guwahati Municipal Corporation and Ramky Enviro Engineers, Hyderabad under PPP (Public Private Partnership) model. Presently GWMCPL is conducting primary collection, secondary collection, road sweeping and drain cleaning, production of compost and sanitary land filling activities. Apart from that Guwahati Municipal Corporation is rendering the following additional service where and when necessary.

- Cleaning of drains and road sweeping, and transportation of these solid wastes to the land field site at West Bora Gaon.
- Cleaning of rubbish and dead animals along with 'other’ solid waste.

### 7.3 Rag pickers Activities

It has been estimated that there are 5,000 Rag Pickers in Guwahati city, who are surviving on collection of recyclable solid waste. At the present scenario, only the rag pickers are segregating the non-biodegradable solid waste from the biodegradable solid waste. Rag pickers are also collecting some amount of papers and cloths. It was observed that most of the light weight recyclable plastics like carry bags and pouches...
7.4 **Innovative components for sustainable Solid Waste Management**

From the characterization and quantification study of different sources of solid waste, it was revealed that organic waste is the maximum (57.42%). Amount of plastic waste was found to be comparatively less (5.61%), but due to its huge volume and mixing with the biodegradable solid waste, different problems are occurring. To reduce these problems, source segregation is the first step of solid waste management. Therefore, special kinds of litterbins were designed and developed specifically for source segregation of plastic waste. Experiments were also made to produce fuel from both recyclable and non-recyclable plastics by applying heat through an electric heater. However, further investigation is required in this line.

In the last 30 years back, there was a common trend among the citizens of Guwahati to utilize the day to day generating biodegradable solid waste for producing compost within the campus. But day by day the trend is becoming obsolete due to the lack of space and mixing of plastics in the biodegradable solid waste. Therefore, investigation was made on backyard Vermicomposting for the reduction of segregated biodegradable solid waste at source within a limited space. This effort on household level management of biodegradable waste was encouraging and resulted odour free hygienic environment with the benefits of ‘Vermiwash’ and the compost which can be used as organic fertiliser. ‘Vermiwash’ is rich in nutrients and have pest resistance potency. This concept will also definitely develop the concept of producing household level organic manure and organic farming to generate individual interest for sustainable management activities. Community level Vermicomposting was also suggested.

Present problems of solid waste management are chiefly created by the ‘light plastic’, like plastic carry bag, pouch packs of biscuits, tea-leafs, spices and others. People usually use and throw these plastics as there is no waste value. For reuse of these waste plastics, experimentally introduced plastic craft for making of varieties household utensils like garlands, chair-back, table-top, table-mat etc. was found to be supported by the people. Moreover, for source collection of segregated recyclable non-biodegradable solid waste like plastic carry bags, pet bottle, glass bottle etc., introduction of ‘waste...
value’ by giving benefits of ginger and garlic in exchange of the segregated waste found to be accepted by the housewives. The idea of offering ginger and garlic is to attract the house wife and the theme is “take home your kitchen spice from household waste”.

Design and operation of appropriate solid waste management systems are necessary for ensuring good sanitation and clean environment. Where, community should realize the necessity of solid waste management and at the same time there should some economical benefit for the sustainability of cleanliness activity. After thorough investigation and practical experience, following environment friendly practices for SWM are suggested for Guwahati City in which solid waste can be utilized as resource at maximum level.

**Option A. Household level Solid Waste Management**

1. Source segregation
2. Backyard Composting and Vermicomposting
3. Household level plastic craft
4. Source collection of non-biodegradable solid waste
5. Recycling of non biodegradable solid waste

**Option B. Community Based Solid Waste Management**

1. Source segregation
2. Source collection of biodegradable solid waste
3. Community Composting and Vermicomposting
4. Source collection of non-biodegradable solid waste
5. Recycling of non biodegradable solid waste