



# Solid Waste Management Scenario of Raiganj Municipality, West Bengal, India

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## Abstract

Solid waste management is a significant aspect of urban services and environmental sustainability. In the past, enormous land masses made trash disposal easy, but today's growing population, changing lifestyle, technological advancements, and fast urbanization make it harder. Solid waste management is crucial for a healthy and vibrant society. In this paper, attempts have been made to analyze the solid waste management scenario of Raiganj municipality using geospatial technology in terms of solid waste generation, collection, transportation, and disposal. All necessary information was gathered from both primary and secondary sources. These included field research, interviews, and municipal data collection. Data were evaluated statistically and qualitatively using Arc GIS 10.2.1, Microsoft Office Excel, and Microsoft Office Publisher. The cartographic maps were used to analyze the data. The findings of this investigation show that

Raiganj's present waste management system cannot handle the growing number of urban residents. This city has growing challenges with solid waste collection, treatment, and disposal. The unavailability of scientific landfill sites hinders Raiganj's welfare. Solid waste management in the Raiganj Municipal area needed to be improved. The ramifications of prospective solutions for municipal solid waste (MSW) at the centralized and decentralized level must be emphasized via the conjunct initiative of different scientific treatment procedures. As a result, municipalities, in collaboration with the informal sector and commercial organizations, must concentrate on developing potential prospects to fulfill the long-term aim of municipal solid waste management (MSWM) sustainability for this municipality.

## Keywords

Solid waste • Solid waste management • Solid waste generation • Geospatial technology • Cartography

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## 22.1 Introduction

Man is a formal creature; every man has his duty toward society and nature. The Earth's extensive regeneration capacity is not satisfactory for

human beings (Patterson 2006). In the words of Mahatma Gandhi, “Earth has enough to satisfy every man’s need, but not every man’s greed.” For their selfish desire to improve their socio-economic well-being, they are destroying nature through deforestation, greenhouse gas emissions, and excessive use of chemical fertilizers, paving the way for irreversible environmental degradation. Among the various problems faced by the inhabitants of urban society, the problem of solid waste generation and management is one of the most crucial ones. Throughout the world, the problem of solid waste presents a wide variety of complex challenges daily (Singh and Gupta 2012). So, it has become an emergency to study and learn about the hazardous outcomes of solid waste and its management. First, it becomes necessary to understand “what is solid waste?”.

According to the World Health Organization (W.H.O.), any unwanted, useless, discarded material that is not a liquid or gas that arises out of man's activity that is not free flowing is called solid waste. Solid waste identification comprises organic and inorganic waste materials such as grass clippings, bottles, furniture, product packaging, kitchen refuse, appliances, paper, batteries, paint cans, which do not carry any value to the first user (Ramachandra 2006). In pure microeconomic terms, it is utterly “bad” or “nasty,” and nobody likes to consume it (Singh and Gupta 2012). These waste materials can have an unfavorable impact on public health and severe environmental consequences if not arranged or managed thoroughly (Alam and Ahmade 2013; Tariq 2012). As a result, the municipality or government authority and residents at their level must take precautions to manage solid waste and the resulting contamination (Vij and Aggarwai 2012). Solid waste management is used as a system for operating all garbage, waste collection, waste storage, waste transfer and transport, processing, recycling programs, and disposal of waste in a way that is in harmony with the best principles of human health, conservation, economics, and environmental considerations (Srivastava and Srivastava 2012). The literature survey has found that the disposal

problem is a vital issue of discussion among the researchers, but too few of them are vocal about the overall characteristics of solid waste management like collection, segregation, transportation, and disposal (Khanlaria et al. 2012; Prasad 2016; Roy 2017). However, solid waste management has become an imposing threat for every country (Dungdung and Gurjar 2012) because of the population explosion, rising economy, the boom in community living standards, rapid urbanization, etc. (Sharholy et al. 2008). However, it is one of the neglected areas of development in India (Dungdung and Gurjar 2012; Mohanty et al. 2021). In India, municipal solid waste management is going through a chronic phase due to poor collection, insufficient transportation, and unavailability of suitable facilities for disposal and treatment. However, the government has taken several initiatives in this regard (Dandabathula et al. 2019). Unscientific disposal negatively influences public health and all other components of the environment (Rana et al. 2015; Singh et al. 2012). This situation will change people's attitudes toward consumption (Sakai et al. 1996). India should embrace an out-and-out federal initiative to promote the concept of waste minimization, reuse, and recycling.

With the assistance of the Geographic Information System (GIS), the current research is an exhaustive investigation that aims to analyze the current condition of waste production, sources, and composition and identify the reasons and challenges of municipal solid waste management in Raiganj municipality. In addition, the study intends to inspire academics, planners, and authorities to devise solutions congruent with the sustainable enhancement of the existing system.

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## 22.2 Materials and Methods

### 22.2.1 Study Area

Uttar Dinajpur is a predominantly agricultural district that is one of the least developed districts in West Bengal, India, with a high level of

illiteracy, rapid population growth, limited health care and livelihood access, and widespread rural poverty. There are four municipalities in Uttar Dinajpur, namely Raiganj, Kaliaganj, Dalkhola, and Islampur. Raiganj is the district town of Uttar Dinajpur and also one of the old municipalities. The substantial role of the municipality entails the maintenance of the cleanliness of the town, providing pollution-free urban areas and providing basic infrastructure like water supply, sanitation, and solid waste management, along with the facilities as per standards. I am a native resident of Uttar Dinajpur and am also a research scholar at Raiganj University. As a concerned citizen, the unscientific method adopted by the municipality to dispose of solid waste bothered my mind. The disposal site is located in ward no. 20 near the river Kulik, which has degraded the river's quality of water and the people who live near the disposal site are affected by several skin diseases. The Raiganj wildlife sanctuary is situated near the Raiganj municipality (around 5 km) and it's popularly known as the Kulik bird sanctuary because the river Kulik flows beside this sanctuary. Actually, the Kulik River is the heart-line of the Kulik bird sanctuary. If we don't take this matter seriously in the future, it might take an alarming shape. There has been a lack of infrastructure to manage solid waste in a proper way. This study attempts to explore the present solid waste management conditions of the study area and presents a conceptual analysis with the help of a Geographical Information System (GIS). Raiganj municipality is located in the south-western part of Uttar Dinajpur district. The absolute location of this municipality lies between  $88^{\circ}6'23.812''$  E to  $88^{\circ}9'5.932''$  E longitude and  $25^{\circ}38'27.102''$  N to  $25^{\circ}34'57.153''$  N latitude. The area of the municipality is  $10.75 \text{ km}^2$ , consisting of 25 wards (shown in Fig. 22.1), situated 425 km from the state capital Kolkata. The total population of the area is 183682. As a result of rapid growth, according to the 2011 census record, 96,565 are male and 87,092 are female. At present, the number of wards has been increased in Raiganj municipality, but proper maps are not available on the municipality website.

## 22.2.2 Materials

The method of this paper rests upon gathered data from the primary field and different secondary sources. These included preliminary field investigation, face-to-face interviews, and municipality data collection.

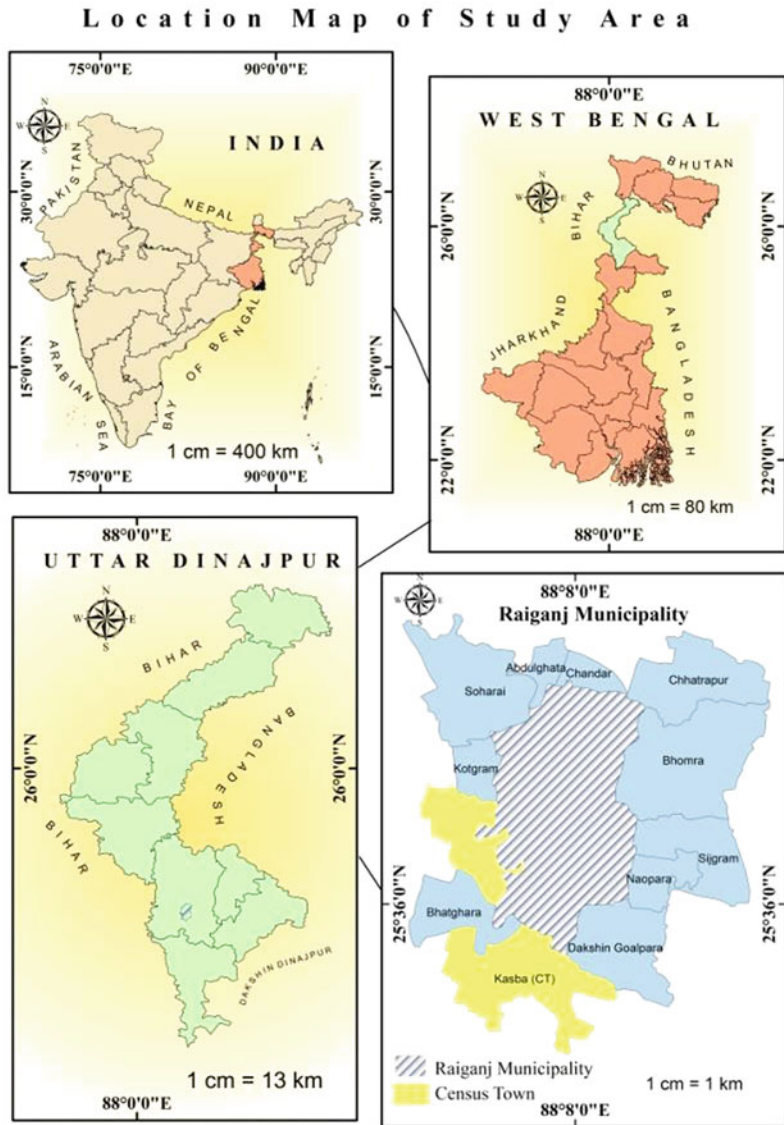
## 22.2.3 Methods

Data were analyzed both quantitatively and qualitatively using different softwares such as Arc GIS 10.2.1, Microsoft Office Excel, and Microsoft Office Publisher. A stepwise normative approach will be adopted to understand the solid waste management process of study area. The methodology of this study is a bifold system.

First step to study the existing situation analysis includes the pilot survey, information collection about waste management situation of the municipality, description of the factors which are influencing the solid waste generation of this area.

Second step is analysis of existing situation with the help of GIS technique comprised of result and discussion, finally the conclusion. To create maps in Arc GIS 10.2.1 software, spatial data and attribute data are entered into a database. Theses include ward map of Raiganj municipality, solid waste management related data like ward wise generation of solid waste, collection of waste and worker distribution for solid waste collection, etc. I have collected the ward map of this municipality from the municipality office. Registration and transformation were done to convert the collected ward map image into real-world image. After that I have used the digitization technique for R to V conversion (raster to vector). Necessary additional field was added in attribute table of these vector file. Different thematic mapping techniques like choropleth map and pie diagram have been incorporated with the help of this Arc GIS software. Choropleth map mainly shows the ward wise generation and collection of solid waste. Whereas, pie diagram reveals the ward wise

**Fig. 22.1** Location of the study area



worker distribution as well as the difference between collection and generation.

## 22.3 Result and Discussion

### 22.3.1 MSW Generation of Study Area

The generation of MSW comprises household waste, market waste, sanitation residue, construction, demolition debris, etc. The amount of

MSW has been increasing rapidly due to changing lifestyles, rapid urbanization, and an increasing population. It can be said that solid waste is the inevitable upshot of human activity. The proposition can be asserted by citing a beautiful example. When we purchase articles from shops, the shopkeepers pack the goods in plastic, which is not destroyable and, more importantly, not biodegradable; we leave the plastic packet here and there. In this way, solid waste is generated. Raiganj generates approximately 97 MT of waste per day (per capita

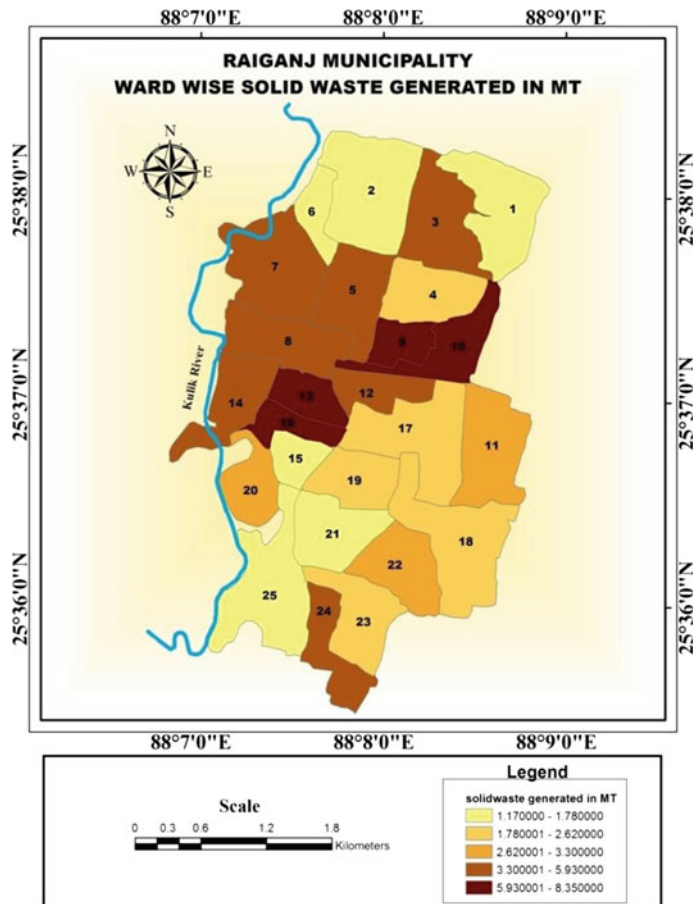
400 g) from various sources, with 51% biodegradable waste and 49% non-biodegradable waste. About 63% of trash comes from homes, and the other 37% comes from hotels, markets, farms, and other places. Domestic solid waste contains about 60% organic matter, and the remaining 40% is inert materials. The moisture that is contained in organic matter is about 50%. Market SW contains about 70% biodegradable matter, and 30% is non-biodegradable. It is assumed that agricultural waste contains about 100% biodegradable matter, neglecting the very few inert materials, and clinical waste contains about 100% non-biodegradable materials. Figure 22.2 represents the ward wise solid waste generated in MTPD. It has been shown that waste production varies from ward to ward. Most of the time, the inner wards produce more waste than the outer wards, and wards 9, 10, 13, and 16

are the most important ones for the Raiganj municipality. Commercial activities and many people living in these areas are primarily to blame.

### 22.3.2 Collection and Transportation

Solid waste management begins with the collection. Garbage is picked up from residences, business areas, and collection points. The success of any SWM system largely depends on the critical components of the collection, transportation, and disposal. The success of the effective solid waste management system, particularly the primary collection system, largely depends on the proper coordination between the dwellers, the generators, and the staff, the collectors.

**Fig. 22.2** Ward wise solid waste generation



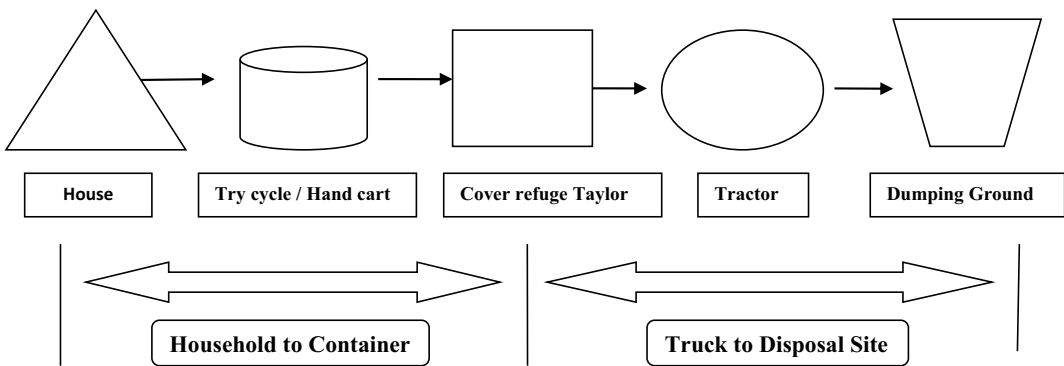
Raiganj municipality used a systematic method in the collection process (Fig. 22.3). Raiganj municipality collects waste from door to door daily except Sunday. The municipality pays for around 185 staff engaged in the collection process, and the municipality pays 112.018 lakh for 185 staff (as given in Table 22.1). Every morning, the collection staff blows the whistle, announcing his arrival at the place, and the people put their domestic waste into the handcart or tricycle of the staff (Tables 22.2 and 22.3).

According to Raiganj municipality, the door to door collection system serves about 60% of households without charges. It has been seen that the municipality collector plays a dominant role in the core area rather than the outer area. The NGO, namely Green Zen, the best NGO in North Bengal, executes the crucial task of

collection and disposal of biomedical waste. The NGO collects waste from the district hospital, five nursing homes, and 21 clinics. Waste is transferred to the transfer station from waste generating points through tractor tippers, tractor trailers, refuse collectors, dumper placers, and tricycles, along with hand carts. There is a lack of separate compartments or separate vehicles for biodegradable and non-biodegradable waste. There can be a massive discrepancy between the existing numbers of vehicles and the required ones (Figs. 22.4 and 22.5; Table 22.4).

### 22.3.3 Disposal of Waste

The disposal of waste is an essential aspect of the SWM process, as unscientific disposal of waste



**Fig. 22.3** Systematic model of collection system in RMC. *Source* Author creation

**Table 22.1** No of staff engaged in collection process

Type of workers	No. of staffs	Salaries and overheads (Rs. Lakh)
Door to door collectors	64	39.3578
Street sweepers	56	33.30275
Transportation personal	65	39.3578
<b>Total</b>	<b>185</b>	<b>112.01835</b>

*Source* Raiganj municipality office

**Table 22.2** Coverage of door to door collection system

Total no of wards	House to house collection		
	No of wards covered	Collection schedule (daily/alternative day)	Cost for collection
25	25	Daily	Nil

*Source* Based on municipality data



**Table 22.3** Ward wise distributions of workers, generation, and collection of SW

Ward No.	Solid waste generation in MT	Solid waste collection in MT	Workers engaged in collection		
			Door to door collector	Street sweeper	Transportation personal
1	1.54	1	1	1	2
2	5.59	4.3	3	2	2
3	2.37	1.37	2	1	2
4	1.75	1.1	1	1	2
5	4.57	2.44	3	3	2
6	1.78	1.07	1	1	2
7	5.2	3.33	3	2	2
8	5.16	4.12	3	3	2
9	6.58	4	5	4	2
10	8.35	6.55	8	6	4
11	2.85	2	1	4	2
12	5.61	4.4	3	6	4
13	8.01	7	7	6	4
14	5.14	4.42	3	2	2
15	1.57	0.97	1	1	2
16	7.07	6.8	6	5	2
17	2.62	1.55	1	3	2
18	2.48	1.95	1	3	2
19	2.27	1.76	1	1	2
20	3.19	2.91	2	1	2
21	1.17	0.9	1	1	2
22	3.3	2.3	2	2	2
23	2.19	1.12	1	2	2
24	5.93	3.21	3	2	2
25	1.23	0.9	1	2	2
Total	97.52	71.47	64	65	56

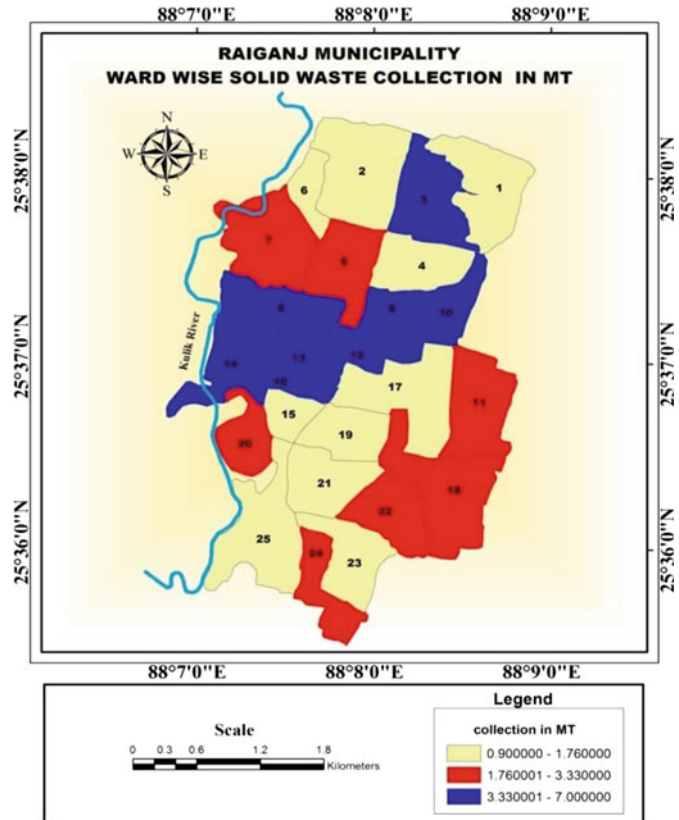
Source Based on municipality data

can cause irreparable damage to the environment, human health, and subsoil strata. Raiganj currently has one dumping ground covering approximately 7 acres of land near the River Kulik in Bander Ward No. 20, approximately 1.5 km from the town center. At present, the open dumping method is used in this area. The land is low lying, so it cannot contain much solid waste collected for dumping. The eastern side of the Kulik River is becoming increasingly filled with waste. As per requirements, the space is becoming confined.

## 22.4 Conclusion

The colossal amount of solid waste generated by human efforts, consciously or unconsciously, has now become a universal phenomenon, culminating in significant health-related issues for civilization. As the famous axiom goes, "Prevention is better than cure;" here, too, it is relevant in association with the prevention of these practices is superior to mitigating the toxicity of their pernicious effects on the living

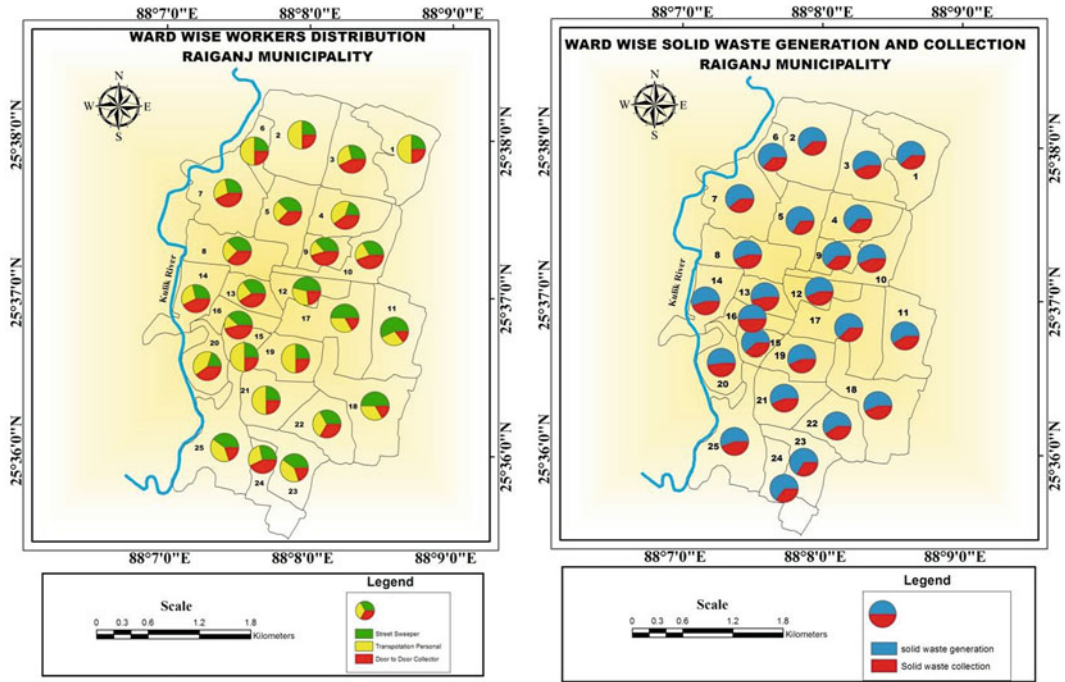
**Fig. 22.4** Ward wise collection of solid waste



system and environment. However, to achieve a sustainable solution to this problem, a proper waste management system and significant public awareness are highly instrumental. Waste management is a multifaceted system that deals with its treatment and disposal; it is a holistic approach with a wide range of complementary activities that integrate reduction of waste generation, collection, segregation, and proper transportation to its corresponding recycling hub. Through this analysis, we can conclude that the selected study area suffers from different disposal-related problems in this present study. The surrounding area's inhabitants face various problems due to unscientific landfilling in low-lying areas near the river Kulik. As per field survey data, the economic condition of the people and the generation rate of solid waste are entwined in this area. The wards inhabited by high-income groups of people generate more

garbage than those of people with low incomes. The commonly observed findings in this area are (1) the waste collection frequency is less in comparison with the amount of waste generated in the municipality; (2) there is a lack of workforce, trained staff, modern machinery, and equipment; (3) there are no facilities for implementing recycling processes; (4) lack of private participation or involvement of community-based organizations; (5) insufficient fund allocation to process and dumping is a challenging problem in this area; (6) a few of the wards face water logging problems such as wards 1, 2, 17, etc.; (7) there is no separation of solid waste such as plastic, food waste, metal, and so on; (8) lack of public awareness about the need for solid waste segregation; and (9) lack of proper dumping facilities in this area is also a significant problem. The dumping site is near the river Kulik, degrading the river's health and





**Fig. 22.5** Ward wise distributions, generations, and collection of solid waste

**Table 22.4** Total no and type of vehicles used in Raiganj municipality

Type of vehicles	Existing numbers	Actually require/proposed	Avg. no of tips per day
Tractor tipper	2	3	1
Tractor trailer	20	35	1
Refuse collector	4	60	2
Dumper placers	10	12	1
Try cycle	35	55	2
Hand carts	20	100	2

surrounding environment. Adopting centralized and decentralized strategies to facilitate solid waste management at various sources could be workable for tangible sustainability in the municipal solid waste management (MSWM) system. Also, the optimum involvement of organized informal waste management sectors, along with dedicated ventures from private and government agencies, can be an effective tool to combat the MSWM challenges and put forth good scopes for the future of this municipality. If we take some initiatives, it can minimize the impact of solid waste. These steps are

- Generation of municipal solid waste should be decreased.
- 4R (reduce, recycle, recovery and reduced) of solid waste management should be introduced in every part of municipality. Increase the people awareness about 4R.
- Municipalities should increase their level of service as well as the number of staffs to provide the good service to the public.
- People participation as well as awareness program regarding hazardous waste is essential.
- Collection of hazardous waste at collection points shall be safe and secure. Promotion of

the use of less hazardous alternatives. Segregation of solid waste is very essential in collecting points.

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