Assessment of Solid Waste Management Process in Rangpur City Corporation Area

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Authors' contributions

This work was carried out in collaboration between two authors. Author MFS collected the data, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author MZR designed the study and managed the literature searches. Both authors read and approved the final manuscript.

Original Research Article

ABSTRACT

Proper waste management process is very important for a healthy city environment. Recently, many city/urban areas have emerged in Bangladesh, where a considerable amount of solid wastes are produced daily. Rangpur City Corporation (RpCC) is a newly developed city in the northern part of Bangladesh having 33 wards. Among them, only 15 wards are practicing solid waste management process. These 15 wards cover the vital portion of RpCC. This paper intends to describe the solid waste management process and present scenario of different waste dumping points within the study area. The primary data has been directly collected from field survey along with GPS survey in order to assess and monitor the waste dumping points. Besides, secondary data/information were collected from books, journal, and websites. This study recommends that a detailed GIS database can be used to monitor and manage the solid waste of the city.

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1. INTRODUCTION

The city of Rangpur, in Bangladesh, has been considered as an ideal area due to its urban history and the presence of a wide variety in the typology of streets and public spaces [1]. The rural and neighboring people are drifting to the Rangpur city from periphery to meet the needs of growing demands [2,3]. As a newly developed city, it demands much attention to waste management to achieve healthy and sustainable city. It has been observed that the quick increase of various economic activities such as Urbanization and Industrialization attract people to change their residence from rural to urban and raising their living standard. The rising population generates large amounts of waste that create risk for both human health and the environment. Although waste is a threat to the environment and human health, it's not possible to avoid waste in our daily life, because waste is connected with human activities. Therefore proper management of waste is a great challenge to all over the world. The poor waste collection, storage and disposal cause problems for the management of solid waste, which involve subsequences such as population and environmental degradation [4]. So solid waste needs to be managed in order to protect the environment and human health and thus proper waste management is an essential part of sustainable urban development. In order to achieve the sustainable municipal solid waste system, economics, urban and Regional planning, social and environmental aspects need to be considered. In RpCC, solid waste management is an important issue to keep the city healthy. In addition, technological support is a vital issue for the well management of waste in RpCC. However, solid waste generation is lower in the developing county than the developed county in relation to per capita income owing to less purchasing and consumption rate [5]. Besides, solid waste needs to be managed in a way that reduces risks to the environment and to human health, which has implications for its storage, collection and proper disposal [6,7]. Due to insufficient financial ability, poor literacy rate, lack of awareness, growing the urban population, lack of urban planning and backdated technologies, solid waste management is difficult in developing countries than in developed countries. Now, Solid waste management system (in an urban area) has developed to ensure a healthier environment and sustainable development in the developing country [8]. A 'gap' exists between the daily generation and collection of solid waste, which leaves urban administration vulnerable to citizens' complaints. Available studies [9,10,11,12,13] show that, in spite of utilizing public resources, the city governments have apparently failed to provide satisfactory conservancy services to users [14]. So, solid waste management becomes more critical in the developing countries like Bangladesh. The problem of a growing urban population and production of urban solid waste in Bangladesh is not new but now this problem is becoming acuter. In 1995, the generated urban solid waste in Bangladesh was 0.49 kg/person/day, but this amount is predicted to increase to 0.60kg/person/day by 2025 [15]. In addition, the increase in the population of urban areas is an important cause of higher urban solid waste. To counter the negative impacts of solid waste mismanagement, Bangladeshi authorities have been developing and implementing policy guidelines on waste disposal and recycling since the 1990s [16]. Also, local and international non-government organizations (NGOs), as well as local community-based organizations (CBOs) formed by the residents of individual neighborhoods, are addressing the issue in a more "bottom–up" approach [17]. The study area, RpCC has total 0.797 million population (male 3,98,282 and female 9,98,274) and the total area is 206.76 square kilometer, so population density is 3871 per square kilometer [18]. Undoubtedly, this is one of the populous cities of the world. The highly dense population of RpCC produces a huge amount of solid waste each day and that has a large effect on the urban environment of Rangpur city. Even though many researches have been conducted based on waste management in the context of Asian countries including Bangladesh, it is still scanty for the study area. The major aspects of this study were to quantify and assess the solid waste dumping points and dustbins, calculate the amount of waste generation in different wards and to find some management approaches for a healthy city environment.

2. MATERIALS AND METHODS

Rangpur is a divisional district among 8 districts of the northern part of Bangladesh. The study area (Fig. 1) shows that it is located in the central part of Northern Bangladesh and the geospatial importance of the study area is very high indeed. However, the methodology of this study describes the research strategy in different steps to get the expected results according to research objectives. This study uses both primary and
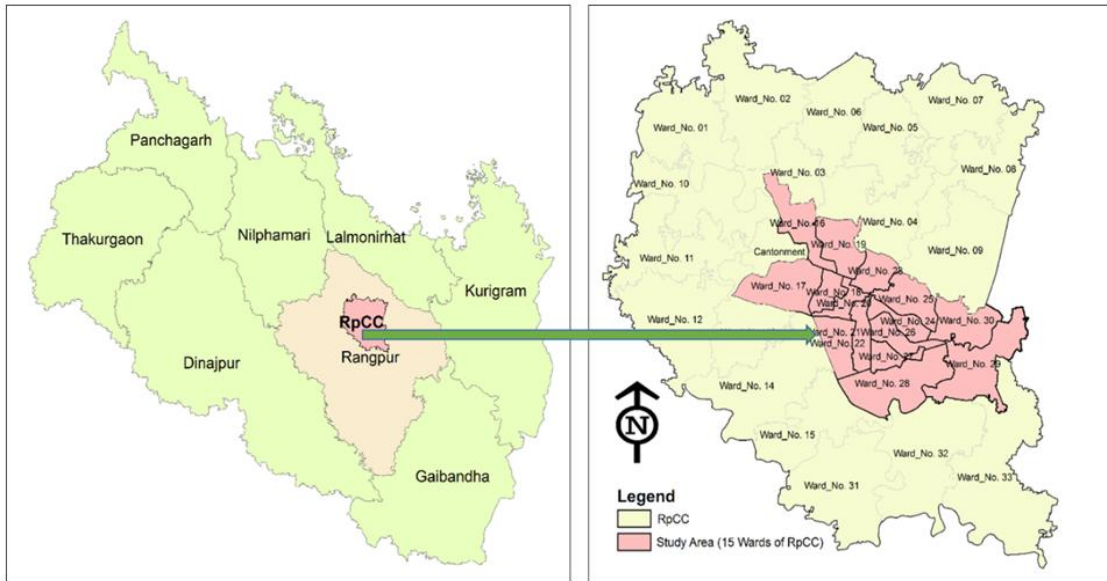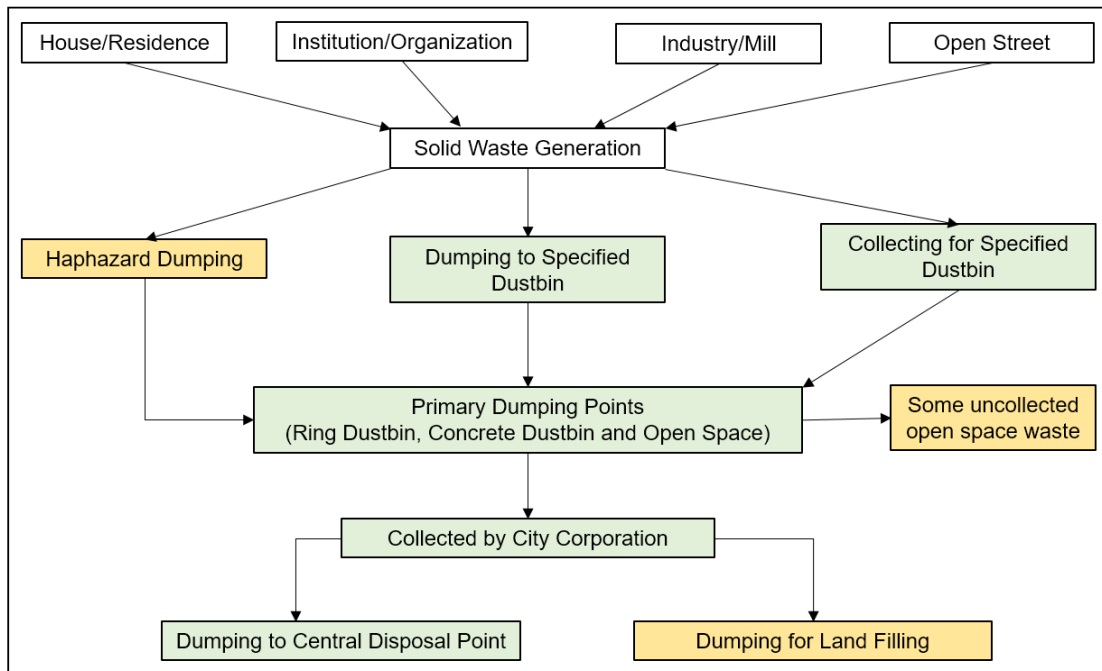
Fig. 1. Study area (15 wards of RpCC)

Fig. 2. Flow diagram of the waste management process in RpCC

secondary data/information. The primary data were collected directly from cleaners, conservancy department and community service providers of RpCC as well as from the open group discussion during last of 2016 to first of 2017. The secondary data/information was collected from different journal articles in order to meet the literature survey. To observe the real view of the dumping stations, GPS survey has been done. Later, the above data have been analyzed to understand the real pictures of waste management process within the study area. 'Fig. 2' spectacles the overall waste management approaches to RpCC.

3. RESULTS AND DISCUSSION

In RpCC, there are basically four key sources from where the solid waste is generated. They are- house/residence, institution/organization, industry/mill and open street. Though a big portion is dumped in dustbins, a large amount of waste is dumped haphazardly. Then, those were collected by the sweepers to the nearest dumping points. After that, those are collected by truck and dumped to central disposal point at Nachnia. The details about the overall process are discussed below in separate sections.

3.1 Organizational Aspects in RpCC

Solid waste collection and disposal from the city area is the responsibility of conservancy section of the RpCC. There are about 236 waste collecting points in this city, 7 katcha bazars (4 pucca and 3 katcha) and 140 hospitals and clinics for the urban dwellers. There are a city mayor and a chief executive officer to control all the executive orders. There are 573 people, directly and indirectly, working in this department to manage the waste of the city. Though there are some systematic processes for waste collection and disposal in the different ward, lack of manpower and technical instrument for waste collection and disposal hampers overall waste management process in RpCC.

3.2 Quantification of Waste in RpCC

Based on the field survey Table 1 represents the amount of waste produced every day in each ward. The amount of waste varies on the basis of the population density of the wards. The densely populated ward comparatively produces more waste than other wards. The amount of waste is calculated from the mean value of several days.

3.3 Density of Waste in RpCC

Waste density analyses were done at the household level and in markets (open dustbins). It is found that domestic waste generation rate for the middle-income group (0.243 kg/cap/day) is highest in comparison to other income groups. But the difference in waste generation rate between the high and middle-income group is very negligible. 'Table 2' shows the results. Waste density at residential areas varies from 302 kg/m3 to 325 kg/m3. Among the three residential income groups, the density of waste for the low-income group has been found as highest due to high population density. On the other hand, the density of market waste (569.44 and 583.33 kg/m3) has been found almost double to that of residential waste.

Table 1. Ward wise quantity of waste generation in RpCC per day

Ward number	Number of waste collecting points	Amount of waste production approximately (Tons)/Day
Ward-16	12	0.87
Ward-17	07	0.80
Ward-18	11	0.98
Ward-19	30	2
Ward-20	22	1.5
Ward-21	21	1.3
Ward-22	19	1.24
Ward-23	16	1.12
Ward-24	22	1.5
Ward-25	15	1
Ward-26	14	0.98
Ward-27	15	0.99
Ward-28	12	0.82
Ward-29	08	0.50
Ward-30	12	0.86
Total= 15 Wards	Total points =236	Total= 16.46 tons.

Table 2. The density of waste in RpCC

Broad Category	Category of the area (based on economic activities	The average density of waste (kg/m^3)
	High-income area	302.94
Household	Middle-income area	315.17
	Low-income area	324.51
Markets	Rangpur Poura Bazar	583.33
	Railway Station Market	569.44

3.4 Waste Collecting Points in RpCC

3.4.1 Primary storage/collection points

In RpCC, all the wards do not have primary collection services. In the residential areas, mostly primary collection service providers collect waste from households or residential buildings. There are 236 dustbins or points in RpCC, where the waste are kept to collect by the primary collector. Fig. 3 shows the primary waste collecting point in RpCC.

There are 35 trolley vans and 35 Rickshaw vans are used in RpCC to collect the waste from the dustbins. RpCC owns 5 rickshaw vans given by UK-Aid and UNICEF which are not being used regularly. On the other hand, primary collection service providers are operating approximately 100 rickshaw vans covering 10 wards. And
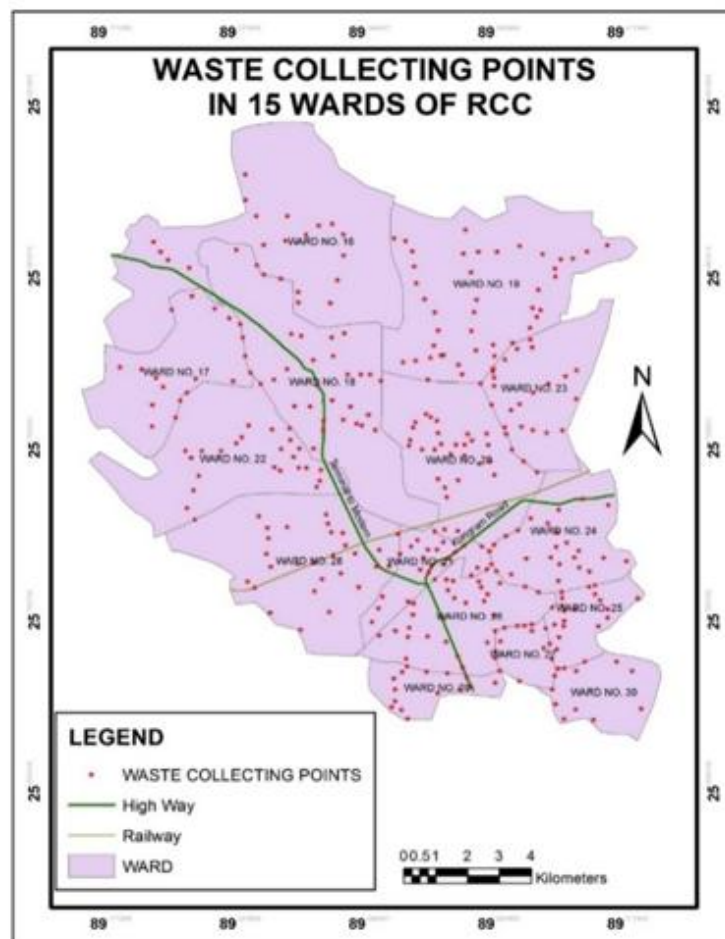

Fig. 3. Waste collecting points in RpCC

remaining 5 wards including 2, 11, 13, 14 do not have rickshaw van for waste collection. It is said by the municipality staffs that primary collection coverage is increasing gradually. However, based on interview and field observations, it was estimated that each rickshaw van has around 200-250 kg capacity. The domestic wastes are unloaded from rickshaw van to the dustbin locations and nearby low lands or open spaces. There is no uniform (e.g., apron, jacket, safety vest etc.) for primary waste collection workers. Primary waste collection time is 6 AM to 9 AM and secondary is 9 AM to 4 PM. The number of trips made by each rickshaw van varies from 2 to 3 as said by rickshaw van drivers.

3.4.2 Secondary collection points

The secondary collection points include dustbins and open dumping points. The open dumping points are numerous across the city but all the points or all the dustbins are not covered every day by the collection vehicles. Street sweeping waste and other wastes are accumulated at/in those points. The actual number of secondary collection points is difficult to count. Approximately there are 85 concrete dustbins across the city. Waste workers use baskets to manually load the vehicle from dustbins and open dumping spots. The total number of dustbins and dumping points are not enough for the proper management of the produced waste every day. The authority should find out the highly populated zones and set up more dustbin for waste collecting and management. The dense residential area especially the Medical More, the Jahaz Company More, the Lalbag Bazar, the Pyra Chattar etc. have higher population density. The authority must take more steps to collect and proper management of waste in Rangpur City Corporation. It has been found after observing crew behavior that the relationship between cleaner and driver is good though there are some communication and coordination gaps. This issue needs to be solved by proper supervision, monitoring and regular guidance by conservancy inspector or conservancy officer. On the other hand, cleaners take extra time to load the vehicle, and working pattern is very relaxed and they are found ignorant about the time efficiency of loading and collection work.

3.5 Analysis of the Waste Dumping Points in RpCC

There are 15 major wards in the RpCC, where the dumping points are available for the waste management.

3.5.1 Local name of waste collecting points of different ward RpCC

Table 3 shows ward wise local name of the waste collecting points along with produced waste.

Table 3. Local name of the dumping points

Ward number	Local name of the waste collecting points
Ward-16	Rangpur Medical College and Hospital (2 points), CO Bazar (3 points), Hazipara, School Para, Kellaband, BICIC Industrial Area, Uttar Kellaband, Medical-Pakar Matha, Dhap-Banani.
Ward-17	Pashari Para, Kotkipara, Ideal More, 2 Number Check Post, Dhap City Bazar, Central Bus Terminal Rangpur, Khalida Para.
Ward-18	Mobile dustbin in front of Judge Court, southern part of Karamotia Mosjid, Karanipara Chourasta, Karani Para, beside Jewel's shop, Tuhin`s shop and Kolpona mess, behind the Police Circle Office, Mistry para and beside Laki Decorator.
Ward-19	Dhap-Chickli Vata (4 Points), Bangladesh Bank Rangpur, Radha Ballab (4 Points), DC More (2 Points), Rangpur Govt. College (2 Points), Chapatla (3 Points), Islampur (4 Points), Rangpur Community Hospital, Diganta Hospital, Shagor Para (4 Points), Police Line (2 Points), Shuravi Uddan, Doctors Clinic.
Ward-20	Laxmi Cinema Hall, Engineer Para Water Tank, District Court, Ansar Club (2 Points), Lichu Bagan More, Palpara spot (3 Points), Amtola Mosjid More, Jamtola, Thatrir Matha, Mulatol (3 Points), Gurati Para (3 Points) and Montu Bania Road.
Ward-21	Khamar More, Santibag, Master Para, New Adorsha Para, Chartola More, Alomnagar, Ershad Nagar, Shenpara, Purbo Babu Kha, Dakshin Kamarpara and Sonali Bank More.

Ward number	Local name of the waste collecting points
Ward-22	Kamarpara Saw Mill (2 Points), Kamarpara Mondir, Kamarpara Pukur Par (2 Points), Mulatol Pakar Matha, Side of Shamim Chowdhory`s house, Babu Kha (3 Points), Side of ward commissioner`s house, Gurati Para-Terminal Road (3 Points), Goneshpur (3 Points) and Gurati Para Stand (3 Points).
Ward-23	City Bazar (2 Points), Islampur, Jummapara (4 Points), New Jummapara (3 Points), Karimia Madrasha, Polytechnic Institute, Rangpur Zoo, Rokeya School, Al-Hera School and Pashcim Jummapara.
Ward-24	Jahaz Company Shopping Complex, Mota Chowdhury Road, Arambag (2 Points), Press Club, Pintu Shaheber Goli, Mayorer Dustbin, Tati Para (2 Points), Muktarer Dustbin, Dalia Garage, Rana Shaheber Dustbin, Counselor Dustbin (3 Points), Konok Babur Dustbin, Fire Service (2 Points), Sumi Auto and Bairaagi Para (2 Points).
Ward-25	Agrani Bank, Customs Office, Vobsundori, Fire Service More, RpCC College & Bang Road, Shahi Para (2 Points), Mistry Para (2 Points), Shahi Ice-cream Factory, Shialer More, Technical School, Mosaddeker Bari and Shikhkha Ongon More.
Ward-26	Shapla Chattar, Nurpur Dustbin, Homeopathic College More, besides Anis Commissioner`s House, Nurpur Mosjid, Mohadebpur, Indramor, Robertson Road, Asha Office (2 Points), Tintola Mosjid (2 Points) and Navy camp (2 Points).
Ward-27	Chartola More, Post Office Gate, Station Platform, Sreenath Shop (2 Points), Kolahati Road (3 Points), Khamer More (3 Points), Shamoli More, Babu Para and Muslim Para.
Ward-28	Lalbag Bazer (2 Points), Chalk Bazar (2 Points), Asratpur (5 Points), Babu Para (2 Points) and Shajonpur.
Ward-29	Tajhat Jamindar Bari (2 Points), Mahiganj (2 Points), Kasaitola, Satmatha (2 Points) and Kanagatola.
Total= 15 Wards	Total points =236

3.6 Types of Dustbin Available in RpCC

Both concrete and ring dustbins are available in RpCC. Among all dustbins, 36% concrete dustbins and 64% ring dustbins are found in the RpCC (Fig. 4). There also some steel made dustbins were seen in different spots of the study area and those are totally temporary and not countable at all. Besides, there are many unspecified spots where the city dwellers dumping waste on regular basis (Fig. 5).
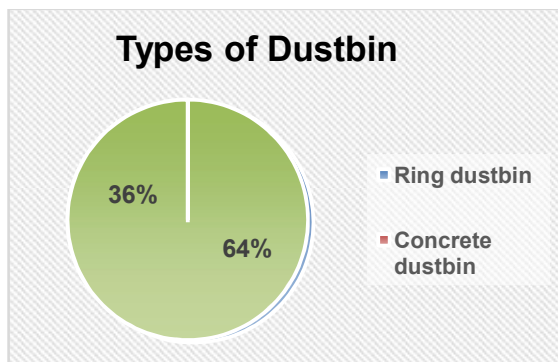
3.6.1 Scenario of concrete dustbin in RpCC

The dustbins which are built with the concrete materials are known as the concrete dustbin. These dustbins are used as permanent dumping points. The whole study (15 wards) contains only 85 concrete dustbins and these are used as the secondary waste disposal points. The primary waste collectors collect the waste and keep them in concrete dustbins. Further, these waste are transported to the final disposal site at Nasnia

Fig. 4. The Present scenario of dustbin in RpCC

Fig. 5. Unspecified waste dumping

Table 4. The using condition of a concrete dustbin in RpCC

Type of dustbin	Ward number	Number of concrete dustbin	Number of dustbin properly used	Number of dustbins not properly used
Concrete dustbin	Ward-16	3	2	1
	Ward-17	2	1	1
	Ward-18	4	3	1
	Ward-19	10	6	4
	Ward-20	8	6	2
	Ward-21	6	4	2
	Ward-22	9	7	2
	Ward-23	5	3	2
	Ward-24	10	7	3
	Ward-25	7	5	2
	Ward-26	4	3	1
	Ward-27	5	4	1
	Ward-28	6	4	2
	Ward-29	2	2	0
	Ward-30	4	3	1
	Total Ward=15	**Total=85**	**Total=59**	**Total=26**

Table 5. The present using condition of ring dustbin in RpCC

Type of dustbin	Ward number	Number of dustbins	Number of dustbin properly used	Number of dustbins not properly used
Ring dustbin	Ward-16	9	7	2
	Ward-17	5	4	1
	Ward-18	7	5	2
	Ward-19	20	16	4
	Ward-20	14	10	4
	Ward-21	15	12	3
	Ward-22	10	8	2
	Ward-23	11	9	2
	Ward-24	12	9	3
	Ward-25	8	6	2
	Ward-26	10	8	2
	Ward-27	10	9	1
	Ward-28	6	4	2
	Ward-29	6	6	0
	Ward-30	8	7	1
	Total Ward=15	Total Ring dustbin=151	Total=120	Total=31

Beel. All these dustbins are not properly used for the waste management (Table 4). Among these dustbins, only 59 dustbins are properly used.

3.6.2 Scenario of ring dustbin in RpCC

The dustbins which are built as ring-shaped with concrete materials are known as the ring dustbin. In RpCC, there are total 151 ring dustbins. Among them, 120 dustbins are properly used and 31 dustbins are not using properly (Table 5). The improper use of these dustbins totally depends on the unconsciousness of the dwellers of that area.

3.7 Disposal Point of Waste in RpCC

In RpCC, the central dumping station is located in Nachnia, Sathmatha, Rangpur (25.743612°N; 89.295220°E). It is situated beside a busy local road and as well as beside settlements (Fig. 6). Moreover, it is located the eastern most part of the city corporation which is not the best position at all. Actually, due the large aerial extent, RpCC

Fig. 6. Disposal point beside road and settlement

Fig. 7. Dumping beside the national and local roads

demands much dumping points in order to manage all the city wastes. Recently an organic fertilizer plant has been established by Forest Department (DoF) under the Ministry of Forest and Environment (MoEF), Peoples Republic of Bangladesh at Nachnia. It was funded by the Bangladesh Climate Change Trust, MoEF, and its operation is going on in a small scale by RpCC. It has seen that all the wastes are not properly collected and a big amount is dumping beside the national and local roads (Fig. 7). However, the wastes contain huge amount of plastic materials those were collected for private landfilling. As a result, these areas become unfit for gardening and others agricultural activities.

4. CONCLUSION

After evaluating the overall waste management scenario of RpCC it is found that the waste management process is not upgraded to the standard of a city corporation. Though the taxes are being paid by the city dwellers, all most 50% of the total area of RpCC are out of the waste management process. Even the total number of dustbin or primary waste collection point is not sufficient at all. Besides, most of them are not used properly due to the unconsciousness of the stakeholders. It is also observed that RpCC has no systematic monitoring system for waste management. In order to monitor the waste management scenario, Geographic Information System (GIS) can be used as an effective tool. A detailed database can be developed to monitor the condition of different waste dumping/collecting points using GIS tool and this tool also can suggest the potential dumping points as well as some more secondary/central dumping points. This study tried to locate the

dumping points using GPS device. This types of location/spatial data can be incorporated into other quantitative/qualitative data for proper monitoring and management. Developing and updating a complete GIS database on waste dumping points could be a new approach to waste management in the context of Bangladesh. Finally, to achieve a green and healthy city environment at RpCC, there are no alternatives rather than giving much priority to waste management and planning.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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