

Solid Waste Disposal Practices and its Consequences in Chittagong City Corporation, Bangladesh

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Abstract: This research focused on existing disposal and solid waste management (SWM) system, Chittagong for improving its inhabitant's environmental health and how peoples perceived solid waste management activities. A questionnaire survey was conducted among the inhabitants in Zamal Khan (Ward No. 21) and Lal Khan Bazar (Ward No. 14) residential areas to get their views regarding various issues related to solid waste management. In the study, 22% and 20% of respondents directly claimed solid waste miss management respectively. General characteristics of solid wastes indicated that kitchen borne vegetable wastes constituted the major portion (approx. 100%) of waste being disposed by households. More than 70% of wastes consisted of newspapers, old books, magazines and khata those were separated for selling. More than 45% of the respondents in both the areas stated that it was polluting their environment and about 22.5% of both areas rated the present waste management services as unsatisfactory. The main reasons for polluting environment by the solid waste were offensive odor from the waste disposed on the road (more than 85%) and waste is not properly removed (more than 65%). Most of the respondents identified environmental degradation (85.56%), presence of flies and mosquitoes (82.22%) and encroachment of roadway by waste (76.67%), clogging of sewer line with waste (51.11%), offensive odor (50%) and blockage of open drains with waste (46.67%). Flies and mosquitoes problem in Lal Khan Bazar respondent's area was high (about 83%) than Zamal Khan area (82%), but very severe in both the areas. It is necessary to fruitful management of the solid wastes for the good health of environment and people.

Key words: Solid Waste • Disposal • Management • People's Health • Chittagong City

INTRODUCTION

About 54% of the world population are living in city regions that are expected to increase up to 66% or more by 2050 and the world population estimated to add 2.5 billion people to urban population [1]. These huge populations producing millions of tons municipal solid waste day by day in the world. About 1.3 billion tons of solid waste produced per year which estimated to rise to 2.2 billion tons by 2025 [2]. As a result municipal solid waste is increasing in both quantity and composition across the globe [3, 4]. This solid waste is lying in the street that responsible for causing environmental degradation and ultimately posing a public health risk [5, 6]. Consequently, solid waste management (SWM)

become the greatest environmental health challenge since population continues to rise and consumption patterns change [7-9].

Solid waste disposal poses a greater problem when dumped in open places, water and polluted air if burnt [10]. Recently solid waste management (SWM) has become a massive challenge for developing countries of Asia and Africa [6,11]. Solid wastes related to public health risk and environmental pollution [12]. Researchers expressed serious concerns about improper waste treatment and disposal in these countries [13-18]. Solid waste collection and disposal systems are deteriorating [19]. In African regions, less than half of the solid waste is being collected while 95% of that amount is indiscriminately thrown away at various dumping sites

[20, 21]. Waste management in Ghana become a serious issue for successive governments, local authorities and international donors. Large investments have been made effective waste management in urban Ghana but no fruitful results [22]. Tanzania also facing great problems with solid waste management since 30-50% of waste being left uncollected in the urban area [23]. In the Bangladesh perspective, the unplanned and haphazard urbanization generate solid waste in massive quantities in the six major cities such as Dhaka, Rajshahi, Khulna, Chittagong, Barisal and Sylhet [24].

Bangladesh is a densely populated country and its population will be about 17 crores by 2020 [10, 25]. Solid wastes pose incredible environmental crises and social problems in city areas and make solid waste management a gigantic task. It's all about limited resources in handling solid wastes. Chittagong is the second-largest city known as a port city located in the southeast of Bangladesh, on the banks of the Karnaphuli River, which finally ends in the Bay of Bengal [26]. In 1995 the population of estimated as 1.98 million, increasing to 3.05 million in 2008 and this increasing pattern is continuing. About 0.41 kg/capita/day solid waste-producing and it will be around 0.6 kg/capita/day by 2025 [27]. In 2008 the average solid waste was 1705 tons per day and is currently about 1850 tons. About 1086 tons of solid waste was collected in 2008 whereas the present average is about 1160 tons. Around 80% MSW is considered as is compostable [26]. Chittagong City Corporation (CCC) is the only responsible authority for solid waste management in the city. The solid waste management work includes collecting the waste from communal bins and secondary disposal sites transfer them to the ultimate dumping site, management of disposal site street sweeping and drain cleaning, etc. The present study was carried out to know the current status of solid disposal practices and their consequences.

MATERIALS AND METHODS

Site Selection: In Chittagong Metropolitan City, there were 41 wards; it was not possible to investigate the feasibility of alternative options for each and every ward. So the final disposal site as the main sampling site for this investigation. This study was done from January 2000 to August 2000 for a period of 08 months.

Methods of Investigation: A questionnaire survey is conducted among the inhabitants near the dumping site to get their views regarding various issues related to final

disposal and alternative options for Chittagong. Due to lack of time each and, every ward in Chittagong Metropolitan City area was not possible to survey.

Discussions and Consultations with Organizations

Officials: Different offices are visited and officials are consulted to know their views and suggestions for the proper solid waste management system of Chittagong city. Different offices which are visited and consulted are World Health Organization (WHO), World Bank (WB), Asian Development Bank (ADB), Department of Environment (DoE), Chittagong City Corporation (CCC), German Cultural Centre (GCC), Chittagong Water and Sewerage Authority (CWASA), Local Government Engineering Department (LGED) and Public Health Engineering Department (PHED).

Data Analysis: Collected information and data were analyzed and literature was explored related to final disposal practice and what would be the alternative options for Chittagong.

Limitations of the Study: The study was based on primary information (interviews, observations, questionnaire survey and informal talks) and secondary information collected from various agencies. Detailed discussions on alternative options for solid waste management were drawn with the current practices of waste disposal of households and had been provided along with the identification of problems, efficiency and drawbacks of the present system.

RESULTS

Perceptions Regarding the Living Environment: Out of 50 respondents in Zamal Khan 22 (44%) and out of 40 in Lal Khan Bazar 16 (40%) have opinionated that the present solid waste management system was not properly managed. Among them, 22% and 20% of respondents directly claimed solid waste miss management respectively.

Opinions of Respondents about Present SWM System: More than 45% of the respondents in both the areas stated that solid waste polluting their environment and about 22.5% of both areas rated the present waste management services as unsatisfactory. Only 18% in Zamal Khan and only 27.5% in Lal Khan Bazar rated the waste management system as good; 24% and 32.5% as fair; and 38% and 15% rated as poor in both the areas respectively (Table 1).

Table 1: Perception of the respondents about the present SWM System operated by CCC

Name of the area	Zamal Khan		Lal Khan Bazar	
Total Household	-----50-----		-----40-----	
Rating	No.	%	NO.	%
Good	9	18	11	27.5
Fair	12	24	13	32.5
Poor	19	38	6	15
Unsatisfactory	10	20	10	25

Table 2: Reasons for pollution due to present SWM

Name of the area	Zamal Khan		Lal Khan Bazar	
Total Household	-----50-----		-----40-----	
Reasons	No.	%	NO.	%
Offensive odor from scattered solid waste all over the area due to lack of dustbin	43	86	36	90
Waste is not properly removed from the area	39	78	27	67.5
Waste is disposed on drains	12	24	6	15
Waste is scattered outside the bin	32	64	19	47.5
Waste is disposed on the road	41	82	26	65

Table 3: General characteristics of household waste

Name of the area	Zamal Khan		Lal Khan Bazar		Total	
Total Household	-----50-----		-----40-----		-----90-----	
Type of Items	No.	%	NO.	%	No.	%
Kitchen and Vegetable waste	50	100	40	100	90	100
Paper waste	9	18	8	20	17	18.89
Plastics	2	4	3	7.5	5	5.56
Glass (broken)	1	2	2	5	3	3.33
Metal/Tin	13	26	7	17.5	7	7.78

The main reasons for polluting environment by the solid waste were the offensive odor from the waste disposed on the road (more than 85%) and waste is not properly removed (more than 65%). In Zamal Khan, 24% and in Lal Khan Bazar 15% shared that waste had been disposed of on the drains in their areas; 64% and 47.5% in both the areas shared that waste had been disposed of scattered outside the bin; 82% and 65% in both the areas shared that waste had been disposed on roadside (Table 2).

Respondent's Priority to Different Services: When the householders were asked about priority wise problems of different services, more than 90% of them attached higher priority to solid waste management in their community, which suggested that there was an urgent need for improvement of the SWM system and there was a greater chance of community involvement and participation. They ranked their problems in their areas which were as: solid waste management system as the top, water management as second, electricity as third, recreation as fourth and gas management as fifth.

Current Waste Disposal Place and Practice: Current waste disposal place and practice in Zamal Khan and Lal Khan Bazar areas were described by the following headings.

General Characteristics of Waste Disposed: General characteristics of solid wastes indicated that kitchen borne vegetable wastes constituted the major portion (approx.100%) of waste being disposed of by households. Other elements in Zamal Khan and Lal Khan Bazar wastes were paper, plastics, broken glass and metal/tin (Table 3).

The amounts of paper, plastics and broken glass were higher in the Lal Khan Bazar area; and metal/tin was comparatively greater in Zamal Khan area.

Items Separated before Disposal: When the householders were asked about the percentage of separated items it was shown that more than 70% of wastes consisted of newspapers, old books, magazines and khata those were separated for selling. From the scenario, it could be stated that items were separated for sale in both areas. The percentage of rubber and metal or tin items sold in

Table 4: Types of disposal place used by respondents

Name of the area	Zamal Khan		Lal Khan Bazar		Total	
Total Household	-----50-----		-----40-----		-----90-----	
Disposal place	No.	%	NO.	%	No.	%
Community bin	25	50	5	12.5	30	33.33
Roadside	12	24	22	55	34	37.78
In a vacant plot	9	18	6	15	15	16.67
In own house	3	6	5	12.5	8	8.89
Do not know where waste is disposed	1	2	2	5	3	3.33

Zamal Khan was less than Lal Khan Bazar, it was due to differences in income level as the percentage of tin food, or beverage items were mostly used in upper-income areas than low-income ones. It was cleared that about 23% of the households sell their separated items every two month's interval.

It was cleared that more than 85% of respondents in both areas sell their separated items to the hawkers. When the households were asked about any kind of separation of items before disposal more than 90% of respondents in both the areas answered that they separated certain items before disposal. Some respondents (more than 6%) were not serious about the selling of separated items or were not involved in separating the recyclable items.

Place of Disposal: It was evident from the investigation that 50% of respondents in Zamal Khan were disposing of their waste in community bins, while about 34% of respondents in Lal Khan Bazar area were disposing of their waste on roadside. The second highest place used by respondents for disposal of waste in Zamal Khan was roadside while in the Lal Khan Bazar area it was on community bins (30%). 18% respondents in Zamal Khan and 15% respondents in Lal Khan Bazar areas were disposing their waste in a vacant plot. About 6% respondents in Zamal Khan and about 12.5% respondents in Lal Khan Bazar areas were disposing their waste in vacant space of their own house (Table 4).

It was indicated that in an unplanned area, for example, Lal Khan Bazar only 12.5% were using community bin for disposal of their household wastes, whereas in Zamal Khan it was about 50%.

Persons Engaged for Disposing of Wastes and Frequency of Disposal: It was shown that in majority cases about 78% in Zamal Khan and 57.5% in Lal Khan Bazar areas' servants were involved for the disposal of wastes. There was no employee (sweeper) from CCC for collecting

household waste from house to house in Zamal Khan and Lal Khan Bazar areas. From the survey it was revealed that there were some private entrepreneurs (about 10%) in both the areas for collecting household wastes.

It was shown that 86% of respondents in Zamal Khan and 80% of respondents in Lal Khan Bazar areas preferred the daily disposal of waste. This was also indicated that the respondents in Lal Khan Bazar (7.5%) were not sincere enough in comparison to the Zamal Khan area i.e., they were disposing their wastes twice a week.

Materials Used for Disposal of Wastes: It was indicated that about 82% of respondents in Zamal Khan and 80% of respondents in Lal Khan Bazar areas used polythene bags for disposal of waste, while 6% in Zamal Khan and 7.5% in Lal Khan Bazar used small bucket for disposal of waste. This indicated that it would not be a problem if waste was collected from house to house (Since packed by polythene for handling).

Money Spent on Disposal of Waste: When respondents were asked specifically about their expenditure exclusively for disposal of waste 82% in Zamal Khan and about 83% in Lal Khan Bazar responded that they did not spend any money for disposal of waste, 18% respondents in Zamal Khan and about 17% respondents in Lal Khan Bazar were expending some money up to TK. 20 per month for this purpose.

Problems Faced by Respondents during Waste Disposal: Householders were asked to identify the main problems they faced during waste disposal. It was revealed from the investigation that 92% respondents in Zamal Khan identified dustbin was not easily accessible and 86% identified there was no enough dustbin in the area, while in Lal Khan Bazar 85% of the respondents said that there was no enough dustbin in the area and about 78% of the respondents expressed that dustbin was not easily accessible (Table 5).

Table 5: Problem faced by respondents regarding waste disposal

Name of the area	Zamal Khan		Lal Khan Bazar		Total	
Total Household	-----50-----		-----40-----		-----90-----	
Problems	No.	%	NO.	%	No.	%
No enough dustbin in the area	43	86	34	85	77	85.56
Dustbin is not easily accessible	46	92	31	77.5	77	85.56
Dustbin is not in appropriate location	31	62	17	42.5	48	53.33
The dustbin is not in the way of walking	17	34	23	57.5	40	44.44
Offensive odor near the bin	2	4	9	22.5	11	12.22
Lack of manpower for waste disposal	12	24	16	40	28	31.11

Table 6: Problems due to improper disposal of waste in the respondent's area

Name of the area	Zamal Khan		Lal Khan Bazar		Total	
Total Household	-----50-----		-----40-----		-----90-----	
Problems	No.	%	NO.	%	No.	%
Blockage of open drains with waste	31	62	11	27.5	42	46.67
Clogging of sewer line with waste	27	54	19	47.5	46	51.11
Encroachment of roadways by the disposal of waste on roads	42	84	27	67.5	69	76.67
Offensive odor from waste	21	42	24	60	45	50
Presence of flies/mosquitoes due to indiscriminate disposal of waste in the area	41	82	33	82.5	74	82.22
Degradation of the environment due to indiscriminate disposal of waste in the area	46	92	31	77.5	77	85.56

Table 7: Knowledge of respondents about the disease spreading through solid waste

Name of the Area	Quality of knowledge					Total	Percentage				
	Very good	Good	Fair	Poor	No knowledge		Very good	Good	Fair	Poor	No knowledge
Zamal khan	Nil	2	6	31	11	50	Nil	4	12	62	22
Lal khan Bazar	Nil	1	5	22	12	40	Nil	2.5	12.5	55	50
Total	Nil	3	11	53	23	90	Nil	3.33	12.22	58.89	25.56

Note: Quality of knowledge

Problems identified by the respondents in the Zamal Khan area were not easy to access to dustbin, there were no enough dustbins, dustbin was not inappropriate location and dustbin was not in way of walking. While in Lal Khan Bazar, no available dustbin was ranked first and then dustbin was not easily accessible and dustbin was not in way of walking ranked 3rd and dustbin were not inappropriate locations was ranked 4th. These were reasons for disposing of waste on the roadside or a vacant plot in both the areas. Another problem identified by the respondents in both areas were offensive odor near the bins and lack of manpower for waste disposal.

Problems Due to Improper Disposal of Waste: Several problems were identified due to the improper disposal of waste by the respondents in their areas. It was shown that most of the respondents identified environmental degradation (85.56%), presence of flies and mosquitoes (82.22%) and encroachment of roadway by waste (76.67%), clogging of sewer line with waste (51.11%), offensive odor (50%) and blockage of open drains with waste (46.67%) (Table 6).

It was evident that flies and mosquitoes problem in Lal Khan Bazar respondent's area was high (about 83%) than the Zamal Khan area (82%) but very severe in both the areas.

Respondent's Knowledge about Disease and Disease Vectors:

It was identified from the investigation that the majority of the respondents in Zamal Khan and Lal Khan Bazar area had a fair knowledge about different disease vectors normally caused by solid waste mismanagement. It was also indicated that majority of the respondents had poor knowledge about disease that spread through or linked with solid waste pollution (Table 7). There was none in both the areas who can identify the five major names of diseases spread out through solid waste pollution. But it can be said from the survey that they had some idea about disease vectors.

Very Good: Can identify the four major names of disease vectors. **Good:** Can identify the three major names of disease vectors. **Fair:** Can identify two major names of disease vectors. **Poor:** Can identify one major name of the disease vector. **No knowledge:** Cannot identify the name of any diseases.

Effects of Haphazard Disposal of Domestic Waste:

Haphazard disposals of domestic wastes had already started creating adverse effects on the environment and surrounding areas. It was also creating strains on the municipal waste management system. Though the gaseous emissions from solid waste were not yet

Table 8: Water quality standard for water use

Parameters	For Recreation	For Laundry	For Bathing	For Survival of Aquatic Life
Temperature (0°)	-	-	-	85
pH	5.8-8.6	5.8-8.6	5.8-8.6	6.0-9.0
Color (mg/L)	<30-<50	<10-<15	<5-<15	-
Chloride (mg/L)	>300	>200	>200	250
Turbidity (PPM)	<5-<20	<10-<15	<5-<10	25
Suspended solid (mg/L)	<10	Very small	Very small	80
Dissolved Oxygen	-	-	-	>or= 5
BOD (mg/L)	<8-<10	-	-	<or= 5
COD (mg/L)	<20	-	-	-
Chromium (mg/L)	<1.4	<1.5	<0.05	0.03-0.05
Ammonia (mg/L)	<10-<20	<10	<0.5	0.5

Source: JICA [28] and Azad [29]

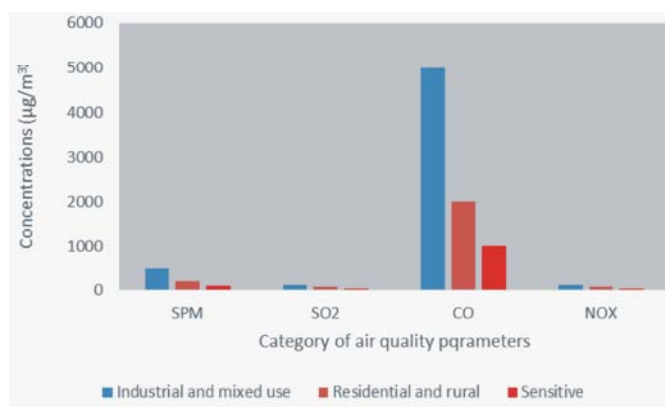


Fig. 1: Standards for ambient air quality (Source: Agarwal [31])

considered as a major problem, their future pollution potential cannot be neglected. Some of the effects of haphazard domestic waste's disposal were identified during the investigation.

Deterioration of Surface Water Quality: The water quality of the Karnafully river can be considered as the representative of surface water quality of the Chittagong area as the wastewater, leachate from solid waste and solids waste it selves were partially disposed in this river. The Karnafully River might be polluted by different polluting agents but solid waste was one of them. Due to lack of time the water parameters were not tested even though standard quality for use of water is given here for future research and comparison. The water quality standard is tabulated in Table 8.

Effects on Ambient Air Quality: The bad odorous smell, CH₄, H₂S, N₂ and CO₂ might be produced due to anaerobic decomposition of solid waste [30]. These gases polluted the ambient air undoubtedly (the standards for ambient air quality). The air quality standard is tabulated in Figure 1.

Effects on Groundwater Quality: Almost entire study areas were connected with the public water supply network provided by Chittagong WASA. During the field visit in the study area's water quality was observed and nothing objectionable was noticed. The respondents also did not mention any major complaints. But haphazard disposal of (domestic) solid waste and subsequent leachate formation might lead to groundwater contamination as the typical characteristics of leachate from the solid waste had tremendous pollution potential.

Drain Blockage and Disruption of Stormwater Conveyance: During the field visit, haphazard disposal of solid waste in the open drains was noticed. Besides, the respondents in Zamal Khan and Lal Khan Bazar areas identified drain blockage by haphazard disposal of solid waste as a major reason for water logging during the rainy season.

It was shown that about 90% of respondents of the study areas think that water logging after minor rains was due to the drain blockages by the disposal of solid waste in the Zamal Khan area (Table 9). About 64% of the respondents identified shortage of sewer lines in the areas

Table 9: Reasons for water logging

Name of the area	Zamal Khan		Lal Khan Bazar	
Total Household	-----50-----		-----40-----	
Reasons for water logging	No.	%	NO.	%
Drain blockage by haphazard dumping of solid waste	45	90	34	85
Filling up of ditches by the solid wastes	6	12	5	12.5
Shortage of sewer lines	32	64	28	70
Canal mouth blockage	7	14	9	22.5
Filling up of the low lands for housing	11	22	10	25

as the main reason. Besides filling up of ditches by the solid waste, canal blockage, filling up of the low lands for residences were also identified by the respondents as major causes of water logging in the study areas.

DISCUSSION

The study present study revealed domestic and household activities in urban areas contribute to the high volumes of domestic wastes generation [32]. Haphazard dumping of wastes on the streets, gutters, holes and in nearby bushes create favorable breeding grounds for rodents and insects. These organisms are responsible for the spread of parasitic and zoonotic diseases [33]. Furthermore, Moreover, indiscriminate disposal off food debris play significant role to choked drains and blocked waterways. This blockage of drainage system increase the probability of flooding during the rainy season [34]. In the present study, the waste management system have been conducted and summarized accordingly. A structured questionnaire survey was conducted among the inhabitants in Zamal Khan and Lal Khan Bazar residential areas to get their views regarding various issues related to solid waste management. Due to lack of time, every ward in Chittagong City Corporation (CCC) area was not possible to survey. In the present study, most of the residents of the city corporation found to be not satisfied with the present management system. The management of solid waste in city areas are huge challenge for Bangladesh [35] and the people of Bangladesh are suffering from various disease due to environmental degradation [36]. Pollution potential of solid waste is very significant to cause health and sanitation problems. Leachate from the waste and producing disease vectors might cause severe health and sanitation problems. The majority of the respondents had poor knowledge about disease that spread out through solid waste pollution. During the dry season, the water of Karnafully River is used extensively for irrigation. It may cause various soil problems due to high levels of deposited

organic and inorganic solid and leachate ingredients. Besides, during dry season fisheries sector might be destroyed extensively. Strong and integrated cooperative actions should be taken to improve the existing solid waste management by the different stakeholdes e.g. government, NGOs, the media, the community leaders, municipalities, city corporations, concerned authorities, political leaders, the civil society, professional organizations and voluntary organizations [37]. Additional negative impacts of the dry season solid waste deposited include 1) Contamination of shallow tube wells that are used extensively in the area, 2) Insurability for livestock purposes, 3) Insurability for bathing and 4) Creation of aesthetic nuisance. During the survey the following problems were identified in solid waste management:

- The financial allocation for SWM in Chittagong is approximately Tk.42/= per person per year (the year 2000). A recent performance in the collection of local revenues namely those based on the annual rental value of property has been disappointing, as tax payers can easily manipulate the rental value. The present number of sweepers (1794), dustbins (1300) and trucks 90 and hand carts (503) are insufficient for the present need. With the present number of conservancy trucks only 700 tons of waste out of 1059 tons are collected whereas about 30% wastes (about 359 tons) remain uncollected, which acts as a breeding ground for mosquitoes, flies and other insects.
- Moreover, it helps in producing and spreading pathogenic microorganisms. The leachate from the degrading wastes can pollute the surface and groundwater.
- The present design of the communal bin is not satisfactory, as it is open and allows entry of rainwater which producing leachate, birds and other rodents spread the refuse and scavengers can easily scatter the wastes. As a result, unhygienic and unsanitary condition prevails around the bins.

- Wastes are dumping at Halishahar in low lying areas in an unsanitary manner, using crude dumping methods. It has been observed that no fencing is done at the disposal site. Roufabad landfill site is not designed to prevent contamination of surface and groundwater.
- It has been observed that cleaners, collection and disposal trucks are looked after by two different divisions within Chittagong City Corporation. As a result, there is fragmented responsibility and creates problems in the coordination of daily operations.
- There is a lack of law which does neither provide and penal provision for illegal disposal of wastes at any time or littering in the street.
- Continuous research is needed to update various pollution control standards. As SWM system is a complex task involving expertise from a number of individual fields such as engineering, planning, social science, economics, biological science, etc. The continuous research in these fields regarding various issues of SWM can help to develop the most efficient SWM for particular country. The universities, research organizations can play a vital role in this regard.
- General education regarding solid waste generation, their effects and ways and means of management of solid waste should be imparted at the secondary and higher secondary level and specialized education should be imparted at graduate levels.
- Besides, training regarding various issues of SWM to the conservancy workers, supervisors, inspectors and conservancy officers and special training to the personnel of pollution control agencies may be helpful in this regard.

CONCLUSION

From the above findings, it can be reported that the solid waste management system in the Chittagong City Corporation (Lal Khan and Zamal Khan area) is not up to the mark. The consequences of this poor management are the air and water pollution. City dwellers are sufferings from various health problems. To overcome this drawback along with government different stakeholder should come forward. People of the city should be aware and grow responsible mentality to help the local government rather blaming the system.

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