

## INVESTIGATION ON QUANTITY OF MUNICIPAL SOLID WASTE TRANSPORTATION OF KHULNA CITY CORPORATION IN BANGLADESH

Md. Shofiqul Islam<sup>1</sup>, S. M. Moniruzzaman<sup>2</sup> and Sabok Mondal<sup>3</sup>

<sup>1</sup> Post-graduate Student, Department of Civil Engineering, Khulna University of Engineering & Technology, Bangladesh, e-mail: [ngdcshopon@gmail.com](mailto:ngdcshopon@gmail.com)

<sup>2</sup> Professor, Department of Civil Engineering, Khulna University of Engineering & Technology, Bangladesh, e-mail: [monir\\_ce92@yahoo.com](mailto:monir_ce92@yahoo.com)

<sup>3</sup> Post-graduate Student, Department of Civil Engineering, Khulna University of Engineering & Technology, Bangladesh, e-mail: [sabok.mondal@gmail.com](mailto:sabok.mondal@gmail.com)

### ABSTRACT

*In the modern world huge solid waste is generated by the cities; hence sustainable disposal of solid waste is a big challenge for most of the cities. Khulna, the third largest city of Bangladesh is not an exception. The aim of the study is to determine the amount of municipal solid waste transported by the Khulna city corporation (KCC). In order to recognize the present situation of transported municipal solid waste a number of field surveys have been conducted in Khulna city and questionnaire surveys have been carried out with the employees of KCC and non-government organizations involved with transportation. The study finds that KCC workers collect waste from 11 small hauled container points (SHCP) of capacity 3 ton each, 21 large hauled container points (LHCP) of capacity 5 ton each, 11 distinct collection routes (DCR) and 17 secondary disposal sites (SDS) at different locations in Khulna city. The study also finds that KCC workers transport waste about 374 ton/day from above mentioned sites and dump it to 3 final disposal sites. Besides that, from final dumping site 18.00 ton/day of solid waste are used for composting purposes in the city by a NGO. The quantity of transported waste at different SDS, LHCP and DCR in the wet season are about 25%, 26% and 22% respectively, which are higher than that of dry season because of a large amount of seasonal fruits in summer season. Conversely the total quantity of transported waste at SHCP in the wet season is about 8% lower than that of dry season because of the absence of the 2 container points. For this transportation and dumping purpose daily diesel consumption is 623.26 liter/day as fuel. In the wet season the daily diesel consumption is 10% greater than that of the dry season.*

**Keywords:** Municipal Solid Waste, Secondary Disposal Sites, Hauled Container Points, Waste Transportation, Landfill.

### 1. INTRODUCTION

The rising volume of municipal solid waste (MSW) generated, and the inclusion of harmful chemicals and additives in different waste fractions lead to waste management becoming one of the most prioritized problems for urban areas (Tulokhonova and Ulanova, 2013). Solid waste management of is one of the major environmental concerns in the most of the cities in the world (Demirbas, 2010). The first purpose of waste management is to protect human health as well as the environment from the uncontrolled dumping of waste and the second goal is to recover resources from the waste stream (European Commission, 2008).

In Khulna city. The total amount of solid waste generation is 450 ton/ day (Khulna City Corporation [KCC], 2017). The Khulna city corporation (KCC) authority is responsible for waste management in this city. Wastes are generally deposited in the community bins and secondary disposal sites (SDS) either by the dwellers themselves or community based organizations or non-government organizations (NGO) through their door to door collection system (Alamin and Hassan, 2013). The KCC staff generally does not collect waste from household. They collect waste from SDS and transport it to the final disposal sites in Rajbandh, about 7 km away from the main city (Moniruzzaman et al., 2011). For this

collection and transportation purpose the average distance driven by the collection trucks of KCC is about 2500 km/day (Islam et al., 2017). The existing trends in production, consumption and waste management have led to numerous emissions of heat-trapping greenhouse gases, ranging from carbon dioxide released during the extraction and production of new materials to methane from the decomposition of organic waste in landfills (Bari et al., 2012). Likewise uncontrolled disposal of solid waste without any waste treatment generates a countless potential for water pollution, public health problems, explosion and landslide.

A very few study has been found to assess the quantity of solid waste transportation to final dumping sites in Khulna city. The aim of the study are (i) to determine the quantity of transported MSW to landfill, (ii) seasonal variation of the quantity of MSW and, (iii) seasonal variation of the daily diesel consumption of the transportation truck.

## 2. METHODOLOGY

### 2.1 Data Collection Method

In order to achieve the objective of the study, the overall methodology being used is shown in Figure 1. Two types of data are mainly gathered to conduct this research. First one is primary data which have been collected by field survey, questionnaire survey, key informant interviews (KII) and focus group discussion (FGD). The second one is secondary data which have been gathered from different journal papers, reports, and online resources.

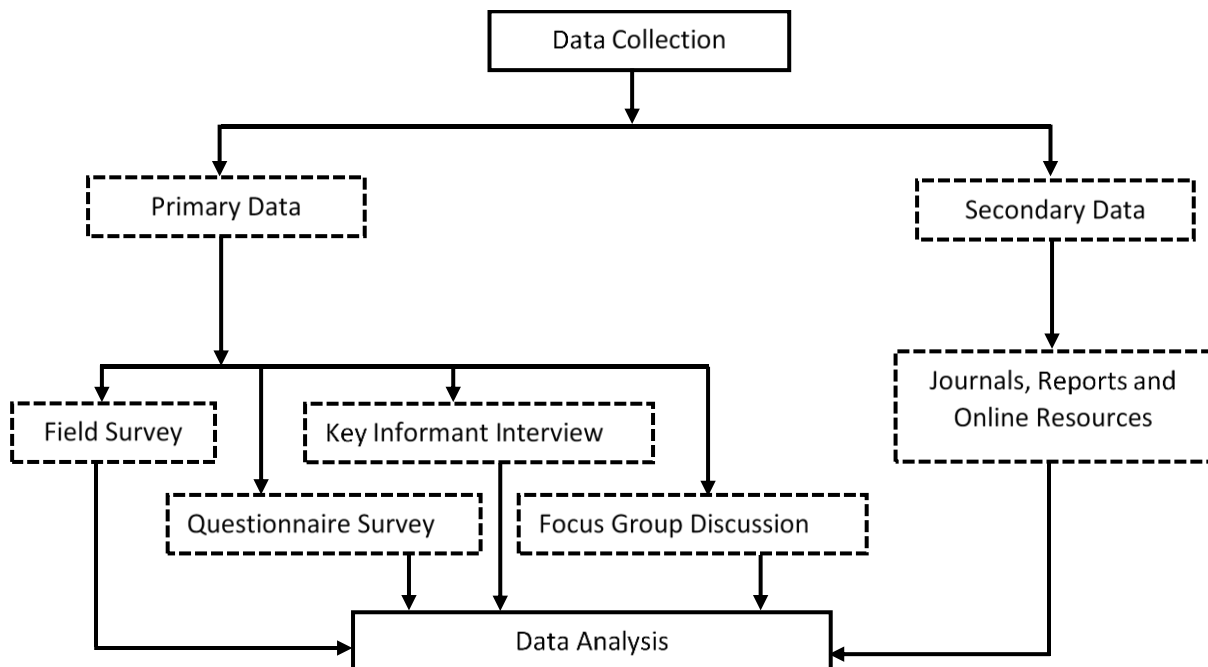


Figure 1: Flow diagram of the data collection

### 2.2 Selection of the Study Are

Khulna, the third largest city in Bangladesh, is located at the southwest of the country and is situated below the tropic of cancer, around the intersection of latitude 22.49° N and longitude 89.34° E. It is the second port entry in Bangladesh. The city has an estimated total area of 45.65 km<sup>2</sup>, the population of 1.5 million and the population density of 67,994 per km<sup>2</sup> (KCC, 2017). There is a separate department for the solid waste management in Khulna city corporation namely conservancy department. There are 31 wards throughout the city which

are selected for the survey area. The Location of study area in Khulna city of Bangladesh is shown in Figure 2.

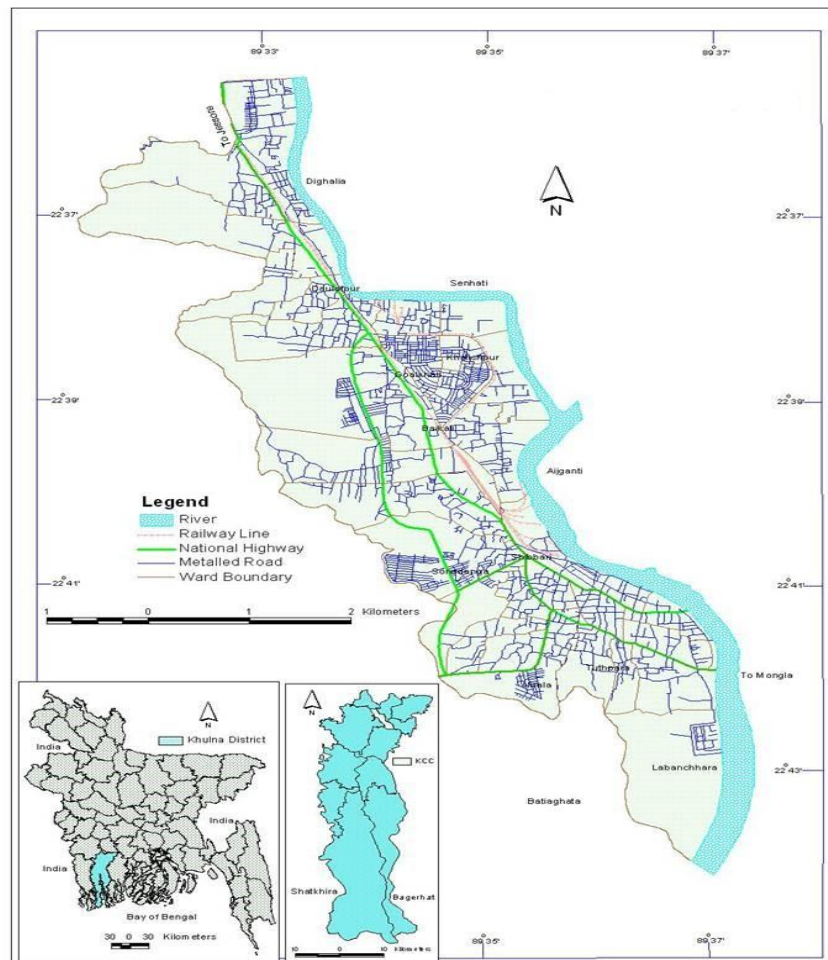


Figure 2: Location of study area in context of Bangladesh (Source: Map of Khulna, 2017)

### 2.3 Location and Number of Sites

The selected sites or transfer stations are final disposal sites (FDS) or landfills, secondary disposal sites (SDS), large hauled container points (LHCP), small hauled container points (SHCP) and distinct collection routes (DCR). In order to know the number of sites present throughout the city, questionnaire survey have been done to the drivers and helpers of waste collection truck. In this regards key informants interview and several meeting have been done to officers and relevant staff in KCC. Then the field survey have been performed throughout the city to find out the location of the sites. At the same time the location have been justified to the ward wise map of KCC.

### 2.4 Quantity of Transported Waste

With the aim of determination of the amount of transported solid waste, a series of field surveys have been conducted throughout the city. The field surveys have been conducted at each site of FDS, SDS, LHCP, SHCP and DCR. For the simplicity of research, the year is sub-divided into the two seasons i.e. dry season (October to March) and wet season (April to September). Moreover the amount of transported waste from each site of SDS, LHCP, SHCP and DCR have been recorded on throughout the entire November 2016 for the dry season and on throughout the entire July 2017 for the wet season.

### 3. RESULTS AND DISCUSSION

#### 3.1 Quantity of Transported MSW

The field survey reveals that there are 11 SHCP having capacity of 3 ton each, 27 large LHCP having capacity of 5 ton each, 12 DCR and 17 SDS at different locations in Khulna city. The study also finds that the amount of transported MSW by KCC is about 374 ton/day as shown in Table 1.

For the large quantity of transported waste, SDS is considered as the major sites. The field investigation yields that the quantity of transported waste from SDS, LHCP, SHCP and DCR to final dumping sites is found as 50% (183.75 ton/day), 26% (99.125 ton/day), 4 % (15.875 ton/day) and 20% (75.25 ton/day) respectively of total transported waste by KCC

Table 1: Summary of transported municipal solid waste by KCC in Khulna city

Name of the Sites (Number of Sites)	Daily Transported Waste (ton/day)		
	Dry Season (Oct-Mar)	Wet Season (Apr-Sep)	Average
Secondary Disposal Sites (17)	158.00	209.50	183.750
Large Hauled Container Points (27)	84.25	114.00	99.125
Small Hauled Container Points (11)	16.50	15.25	15.875
Distinct Collection Routes (12)	68.50	82.00	75.250
		Total	374.00

#### 3.2 Seasonal Variation of the Quantity of Transported Waste

The seasonal variation of the quantity of transported waste at different sites of SDS is presented in Figure 3. The total quantity of transported waste at different SDS in wet season is about 25% higher than that of dry season because of large amount of seasonal fruits in summer season. However, at Goalkhali Koborstan SDS, quantity of transported waste in wet season is less than that of dry season because of the addition of new large hauled container point. In wet season the maximum transported waste find at PTI Mor which is about 51.0 ton/day. In dry season there is no SDS at Zilla School and Sadar hospital but in wet season new SDS found and quantity of transported waste is recorded.

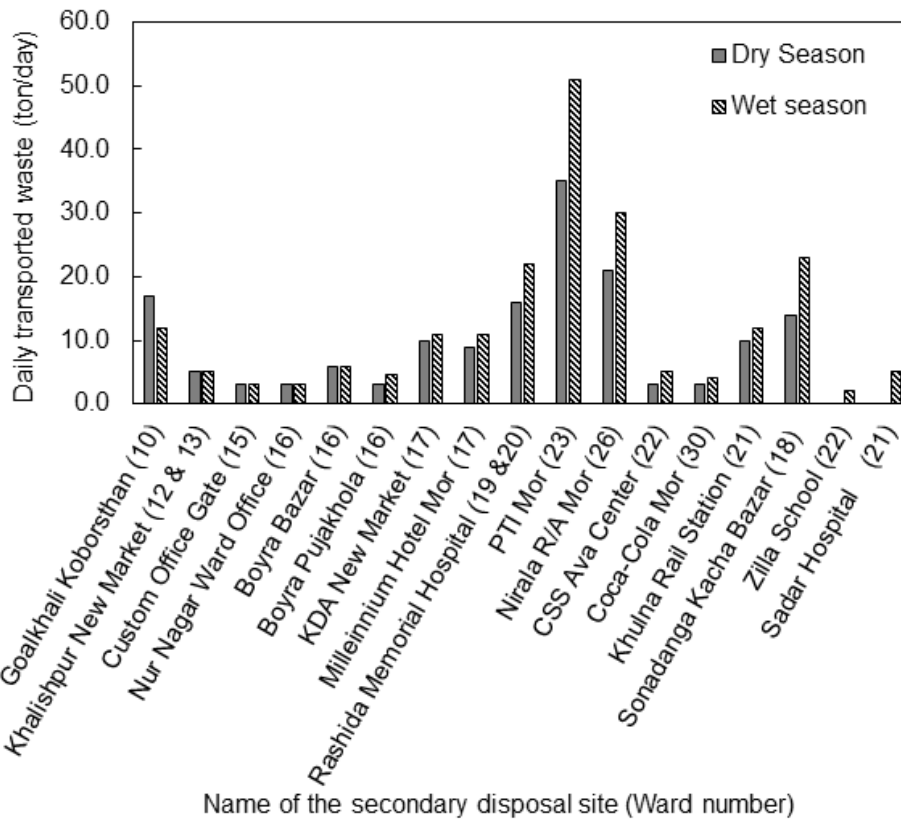


Figure 3: Seasonal variation of the quantity of waste transported waste at different SDS

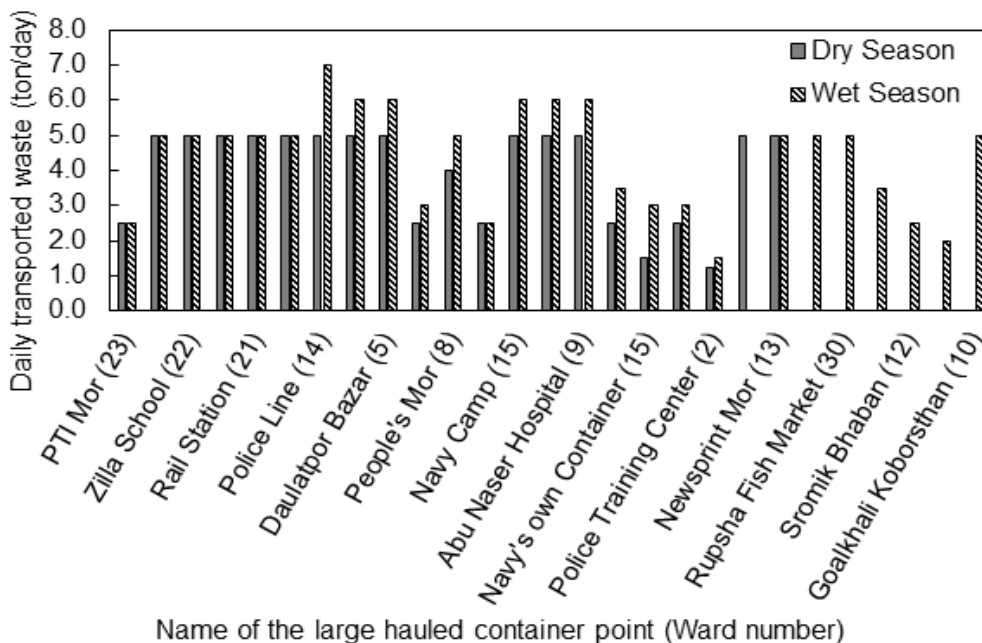


Figure 4: Seasonal variation of the quantity of waste transported by KCC at different LHCP

The seasonal variation of the quantity of transported waste at different sites of LHCP is presented in Figure 4. The total quantity of transported waste at LHCP in wet season is about 26% higher than that of dry season because of large amount of seasonal fruits in summer season. From the Figure it is found that there are 8 number of LHCP where amount of transported waste are same in both season because of the presence of SDS at the same location. Similarly there are 6 number of LHCP where quantity of transported waste is larger than the capacity of the container because the data are recorded on the basis of total

number of container emptied in a week. Especially in fruit season, the KCC staff transported waste at the early morning as well as evening in a day. In dry season there is no existence of LHCP at South central road, Rupsha fish market, Kulibagan, Sromik bhaban, Janata cinema hall and Goalkhali koborstan but in wet season new LHCP found and quantity of transported waste is recorded.

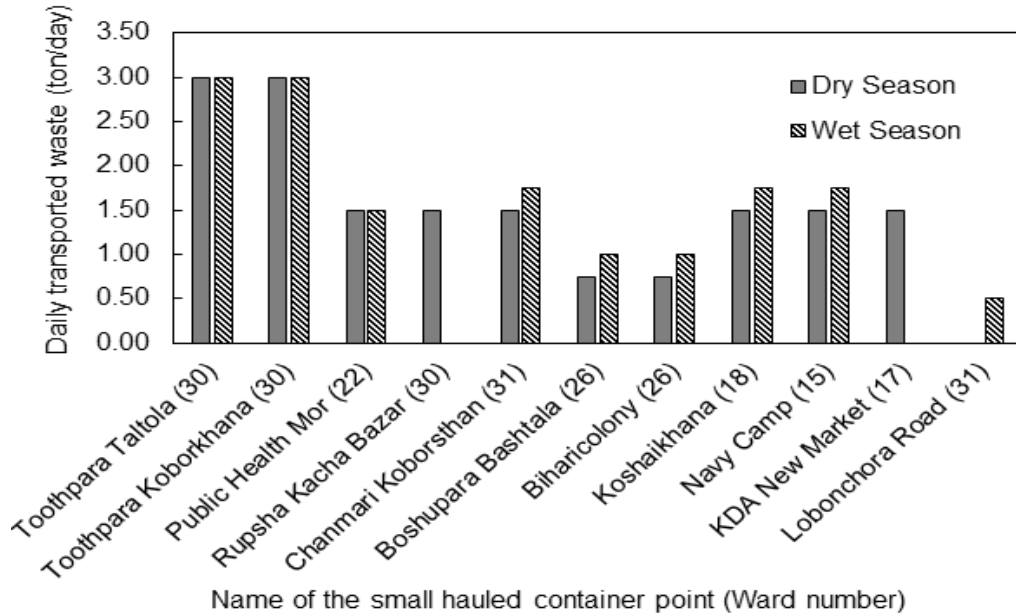


Figure 5: Seasonal variation of the quantity of waste transported by KCC at different SHCP

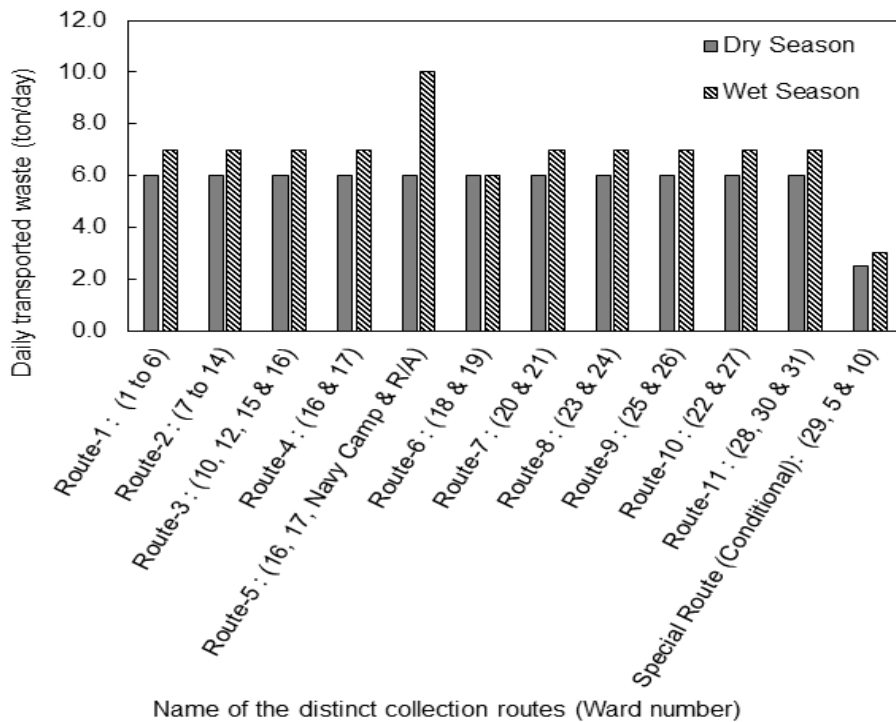


Figure 6: Seasonal variation of the quantity of waste transported by KCC at different DCR  
 The seasonal variation of the quantity of transported waste at different sites of SHCP is presented in Figure 5. The total quantity of transported waste at SHCP in wet season is about 8% lower than that of dry season because of the absent of the 2 container points.

From the figure it is clear that the seasonal variation of transported waste at different container points is insignificant.

In Figure 5, the total quantity of transported waste at different DCR in wet season is about 22% higher than that of dry season. In wet season the maximum transported waste found at Route-5 which is 10.0 ton/day.

### 3.4 Daily Diesel Consumption of the Transportation Truck

Table 2 represent the daily diesel consumption of transportation truck. The total diesel consumption of transportation truck is of 227489 liter/year. Hence the daily diesel consumption is found as 623.26 liter/ day.

Table 2: Daily diesel consumption of transportation Trucks

Name of the month	Name of the season	Monthly diesel consumption (liter/month)	Daily diesel consumption (liter/day)
April-2016	Wet Season	21857	623.26
May-2016		20250	
June-2016		25493	
July-2016		22176	
August-2016		18161	
September -2016		17825	
October-16	Dry Season	17760	
November-16		19671	
December-16		17496	
January-17		14624	
February-17		14973	
March-17		17203	
<b>Total</b>		<b>227489</b>	

Figure 7 represent the seasonal variation of diesel consumption. The daily diesel consumption in the wet season and dry season are 689.11 liter/ day and 557.41 liter/ day. From Figure, in wet season the daily diesel consumption is 10% greater than that of the dry season because of greater amount of waste due to seasonal fruits.

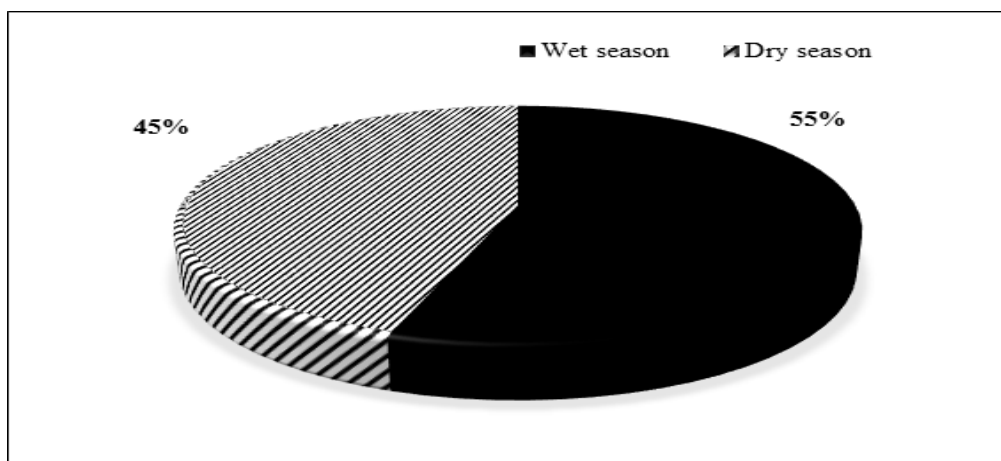


Figure 7: Seasonal variation of diesel consumption of the transportation Trucks.

#### 4. CONCLUSIONS

The main conclusions drawn from the present study are as follows:

- The amount of transported MSW is 374 ton/day.
- The quantity of transported waste at different SDS, LHCP and DCR in the wet season are about 25%, 26% and 22% respectively higher than that of dry season. Conversely the total quantity of transported waste at SHCP in the wet season is about 8% lower than that of dry season.
- In the wet season the daily diesel consumption is 10% greater than that of the dry season.

#### ACKNOWLEDGEMENTS

We wish to express our deepest thanks to Executive Engineer and Sub-assistant Engineer of conservancy the department of Khulna City Corporation for providing data and information, assistance rendered and interest in this study.

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