

## Assessing Municipal Solid Waste Management System in Quetta, Pakistan

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ARTICLE INFO	ABSTRACT
<p><b>Article type:</b> Research Article</p> <p><b>Received:</b> 2024/01/10</p> <p><b>Accepted:</b> 2024/02/27</p> <p><b>pp:</b> 99-112</p> <p><b>Keywords:</b> Municipal Solid Waste; Municipal Solid Waste Management; Waste Management Practices; Quetta; Balochistan; Pakistan.</p>	<p><b>Background:</b> Assessing municipal solid waste management systems is crucial for improving the quality of waste disposal services in urban areas.</p> <p><b>Objectives:</b> The main objective of this study is to assess the operational capacities and challenges of Metropolitan Corporation Quetta in managing municipal solid waste (MSW).</p> <p><b>Methodology:</b> Applying a mixed-method approach, this study used a case study research design. The primary data was collected through semi-structured interviews from the selected six key informants and official data on waste management services. The findings showed that MCQ's waste lifting capacity for 2020-21 and 2021-22 were 256523 tons and 259350 tons, respectively. The average daily waste lifting capacity in 2020-21 was 657.75 tons, while in 2021-22, it increased to 665.00 tons.</p> <p><b>Results:</b> The findings also revealed that the amount of waste generated in Quetta is estimated at 1500 tons a day, of which almost 50% is disposed of daily. MCQ has 231 vehicles for solid waste management. Of the total human resource capacity i.e., 2595, 1600 work on daily wages. MCQ needs more funds, machinery, and vehicles. The findings of the study concluded that the Metropolitan Corporation Quetta needs more operating capability due to inconsistent and insufficient funding availability, a lack of machinery and vehicles, and a shortage of human resources. The MCQ has successfully disposed of about half (50%) of all the waste generated daily.</p> <p><b>Conclusion:</b> This study suggests a dire need for enhancing the operational capability of MCQ through allocating sufficient finances, equipment and machinery, and adequate human resources for an improved and sustainable solid waste management system in Quetta.</p>



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### 1. INTRODUCTION

Municipal solid wastes (MSW) are unacceptable substances disposed of by human exercises. The waste includes solid, semi-solid, or liquid materials disposed of in family units and commercial and mechanical areas (Mukwana et al., 2014). MSW management refers to the systematic procedure of dealing with wastes that contain waste segregation and deposition at

source, primary accumulation, secondary stockpiling, and transportation (Chhabra et al., 2014). In the German Waste Demonstration of August 1993, waste was characterized as a convenient item that the owner had sidelined and as an orderly garbage transfer (Masud, 2013).

Municipal solid waste has different types based on the origin, nature, and composition of waste substances.

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According to Masud (2013), municipal solid wastes are classified as follows. Household wastes contain rubbish, lagging ingredients, kitchen waste, etc. - Produced after families, and this type of solid waste is non-hazardous. Agriculture solid waste comprises nutrition residues, animal compost, yield residues, grass, plants, and leaves. Insecticide containers and herbicides are not dangerous and biodegradable/ecological. These types of solid wastes are alarming to the human health. Commercial Includes electronics, timber, wire, metals, plastic bags, tin cans, garbage, etc. - Generated from business establishments, food and drink services, shops, or open marketplaces. Non-hazardous waste. The solid waste could contain chemicals, wood, metal, ceramic, or other components. Hazardous or non-hazardous. Institutional solid waste is produced by private or government institutions, offices, educational institutions, universities, religious institutions, entertainment fields, etc. Institutional wastes are non-hazardous in nature. Healthcare Solid Waste is a result of healthcare services, for example, health posts, health cores, and hospitals. Healthcare solid waste is sometimes hazardous and sometimes non-hazardous. Moreover, six (6) components of a successful solid waste management system (SWMS) exist. These include source reduction, reuse, recycling, composting (3 r + c), on-site storage, collection, transport and transfer, processing and disposal (Zeb, 2012).

Solid waste management in developing countries, particularly in low-income countries, has received less attention from academics and politicians than other urban environmental challenges and problems such as wastewater treatment and air pollution. However, improper handling and disposal of solid waste poses a serious problem, causing high morbidity and mortality in most cities (Zohoori & Ghani, 2017). According to global methane emissions, municipal solid waste landfills are a third major source of methane emission, the black Corban and other air toxins, and greenhouse gasses emitted from burning open garbage. However, cities face balancing solutions with social, political, environmental, and financial considerations (Verma et al., 2016). Global warming, its causes, effects, and prevention are some of the chief environmental concerns of the current situation. One controlled listed and suggested source is methane exposure to municipal solid waste land fillings MSWLFs (Frank & Tchobanoglous, 1994).

A number of research studies have explored the existing municipal solid waste (MSW) management practices in Pakistan. The majority of the studies have been conducted in the Punjab province of Pakistan. The thematic areas of these studies include household demand for solid waste (Altaf & Deshazo, 1996), household waste generation in Rawalpindi (Haider et

al., 2013), Household Solid Waste generation rate in Lahore (Hamid & Asghar, 2018), current solid waste management situation in urban areas of Pakistan (Mahar et al., 2007), the feasibility of MSW for energy generation (Korai et al., 2017), power generation from solid waste of Lahore (Ahmad et al., 2014), the use of solid wastes as an alternate energy source in Pakistan (Masood, 2013) management of hospital waste (Ali et al., 2016a, 2016b), health implications of hospital waste management practices in Gujrat (Nadeem, 2014), managing the health care solid waste in Punjab province (Ullah, 2010), public-private partnerships for solid waste management in Lahore (Nasreen & Zaidi, 2009). Other studies included environmental and economic implications of MSW compost in Punjab (Qazi & Akram, 2008), revisiting MSW management in Pakistan (Rahman, 2013), solid waste management in Punjab (Joeng & Kim, 2007), and the effects of open dumping on soil in Islamabad (Ali et al., 2014). Moreover, research studies have also explored the physio-chemical analysis of MSW in Gujranwala (Nadeem et al., 2016), willingness to pay the cost of waste management services in Islamabad (Anjum, 2013), recycling and disposal system for SWM (Ali et al., 2016a), practices and conditions of SWM in Bahawalpur (Mohsin et al., 2016), the environmental impacts of waste disposal (Ali et al., 2018), analysis and forecasting of MSW in Nankana City (Mahmood et al., 2018) and the effects of MSW on water contamination in Lahore (Muhammad & Zhonghua, 2014). In the case of Sindh province, several studies have explored the status of municipal solid waste management, such as integrating recycling and disposal systems for SWM in Karachi (Ali & Hasan, 2011), environmental impacts of MSW in Karachi (Shahid et al., 2014), evaluating the landfills-related activities in Karachi (Abbasi et al., 2015), solid waste management in Karachi (Karachi Master Plan, 2006), municipal solid waste composting and its assessment for reuse in plant production (Jilani, 2007).

In the context of Balochistan province, relatively fewer studies are conducted on assessing solid waste management (Government Innovation Lab, 2020; Gul, 2022; Malik et al., 2022; Mati). Similarly, Zafar et al. (2013) assessed the impacts of hospital waste management in Balochistan. To the best of the authors' knowledge, research has yet to be conducted on comprehensive solid waste management in Quetta, the largest city in the province. Therefore, this study aimed to assess the existing operational capacity and practices of Metropolitan Corporation Quetta (MCQ) in the collection and disposal of municipal solid waste (MSW) management and to identify the strengths and weaknesses of the MCQ in managing municipal solid waste from collection points to ultimate disposal.

## 2. METHODOLOGY

### 2.1. Study Design

This study employed a case study research design. Moreover, the mixed methods approach was used for a comprehensive analysis.

### 2.2. Study Area

Balochistan province has 36 districts. Quetta is the capital of Balochistan Province. Balochistan is primarily rural and has a poor socio-economic background (Ashraf, 2019; Rehman et al., 2019). It was selected purposely because it is the capital city, the most urbanized (Khan et al., 2020), and the most populous city of Balochistan. Quetta is located at 66o 57' 20" E, 30o 11' 39" N (Bazai & Panezai, 2020). According to the Pakistan Bureau of Statistics, the population of Quetta District is 2,269,473. With an annual growth rate of 2.27, the current population of Quetta for 2023 is estimated at 2,595,492 (Pakistan Bureau of Statistics, 2023). Large volumes of solid waste are produced by this enormous population, which needs to be continually disposed of. To the best

of the author's knowledge, no study has ever been conducted on assessing the MSW management system in Quetta City. Therefore, Quetta was selected as a case study to fill the gap in the body of knowledge.

### 2.3. Conceptual Framework

This study was intended to assess the operational capacity of municipal solid waste (MSW) management systems in Metropolitan Corporation Quetta (MCQ) areas. The study also seeks to measure the operational capacity of MCQ in terms of the vehicles and workshops, the strength of human resources, the availability of finances, waste collection capacity, and the ultimate waste disposal. The primary data was collected to assess the operational capacity. The assessment of the operational system of the metropolitan corporation would result in unveiling the existing capacities, the required capacities, and the main challenges MCQ faces. Lastly, this study has provided specific recommendations for Sustainable Municipal Solid Management (MSWM) in the provincial capital of Balochistan province.

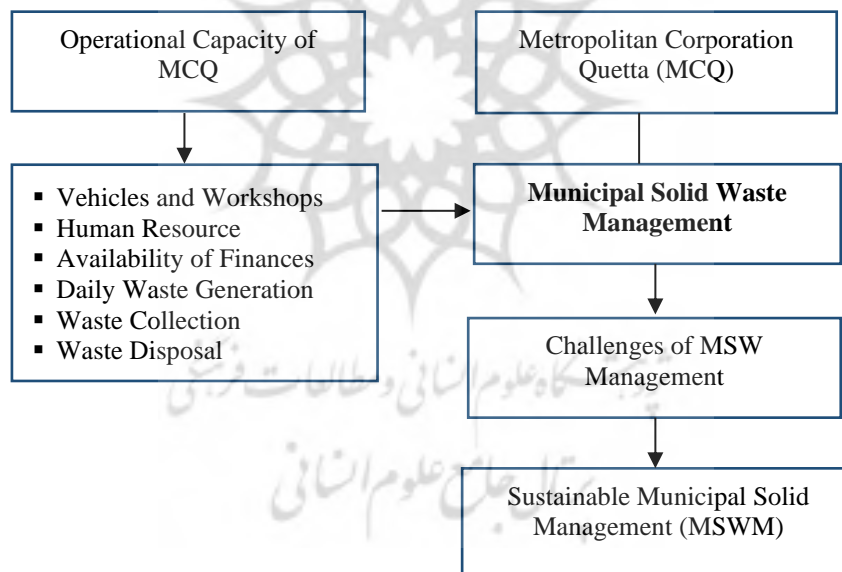


Figure 1 Conceptual Framework

### 2.4. Data Collection and Management

The primary data was collected on the existing operational capacity and practices of Metropolitan Corporation Quetta (MCQ) for collecting and disposing of municipal solid waste. The data on waste lifting capacity, expenditures incurred on waste collection and disposal, number of workshops, the number of vehicles and equipment, the number of total human resources responsible for waste management in the city, the waste management practices, and amount of municipal and medical waste were collected from

the accounts office of MCQ. A semi-structured interview schedule was used to collect data from the selected six (06) key informants (KIs) at MCQ. The key informants included the Chief Metropolitan Officer, Account Officer, Executive Engineer Technical-I, Executive Engineer Technical-II, In-charge Medical Waste Management, MCQ, and the Assistant at the MCQ. The data on other relevant aspects were collected from different sections of MCQ. The primary data were collected during the month of March 2023.

## 2.5. Data analysis methods

For the current study, both the quantitative and qualitative analyses were performed. Descriptive statistics were employed for quantitative analysis, whereas a thematic analysis technique was used for qualitative analysis. The responses on selected themes were processed and presented through qualitative statements. The selected themes were as follows: insufficient funding and financial crisis, insufficient vehicles and machinery, an unskilled labor force, throwing waste at unspecified points by the public, lack of well-equipped workshops, and lack of basic waste collection tools. Moreover, the pictorial assessment of existing conditions of waste management was conducted through pictures.

## 3. RESULTS

### 3.1. Waste Lifting Capacity of Municipal Solid Waste Management in Quetta

The findings in Table 1 show the waste lifting capacity of Municipal Corporation Quetta (MCQ) for the years

2020-21 and 2021-22. The waste lifting capacity is measured in terms of monthly and daily tonnage. From the table, we can see that the waste lifting capacity of MCQ has increased in 2021-22 compared to 2020-21. In 2020-21, the total waste lifting capacity was 256523 tons; in 2021-22, it increased to 259350 tons. The average waste lifting capacity per day in 2020-21 was 657.75 tons, while in 2021-22, it increased to 665.00 tons. This indicates a slight improvement in the waste-lifting capacity of MCQ in 2021-22. It is also worth noting that the waste lifting capacity in January 2022 was significantly higher than in any other month, with a monthly capacity of 26690 tons and a daily capacity of 889.67 tons. On the other hand, the waste lifting capacity in March 2022 was the lowest, with a monthly capacity of 19141 tons and a daily capacity of 638.03 tons. The "Others\*" category in the table represents waste lifting capacity for months not specified in the table, with a monthly capacity of 5273 tons and a daily capacity of 175.77 tons in 2020-21, and a monthly capacity of 4055 tons and a daily capacity of 135.17 tons in 2021-22.

**Table 1. Waste Lifting Capacity of Municipal Solid Waste (MSW) Management in Quetta**

S. No	Waste Lifting Capacity (2020-21)		Waste Lifting Capacity (2021-22)			
	Monthly (ton)	Daily (ton)	Monthly (ton)	Daily (ton)		
1	Jul-20	20525	684.17	Jul-21	21612	720.40
2	Aug-20	20535	684.50	Aug-21	20899	696.63
3	Sep-20	20218	673.93	Sep-21	21726	724.20
4	Oct-20	21371	712.37	Oct-21	21945	731.50
5	Nov-20	20500	683.33	Nov-21	20223	674.10
6	Dec-20	21243	708.10	Dec-21	19479	649.30
7	Jan-21	21297	709.90	Jan-22	26690	889.67
8	Feb-21	21222	707.40	Feb-22	23162	772.07
9	Mar-21	21203	706.77	Mar-22	19141	638.03
10	Apr-21	21507	716.90	Apr-22	20236	674.53
11	May-21	20129	670.97	May-22	21691	723.03
12	Jun-21	21500	716.67	Jun-22	18491	616.37
13	Others*	5273	175.77	Others*	4055	135.17
	Total Waste	256523	-		259350	-
	Daily Average	-	657.75		-	665.00

Source: (Metropolitan Corporation Quetta, 2023b)

### 3.2. Expenditures on Municipal Solid Waste Lifting in Quetta

The data in Table 2 shows the expenditure on waste disposal for two different years, 2020-21 and 2021-22, in Pakistan Rupees (PKR) by Metropolitan Corporation Quetta. The table shows the allocated amount for each month and the actual expenditure incurred. In 2020-21, the total allocated amount for waste disposal was PKR. 316,850,000, and the actual expenditure was PKR 152,658,065. This means the actual expenditure was less than the allocated PKR.

164,191,935. On average, the monthly allocated amount for waste disposal in 2020-21 was PKR. 26,404,167, and the average monthly expenditure was PKR. 11,742,929. This means the actual monthly spending was less than the allocated amount of PKR. 14,661,238 on average. Daily, the allocated amount for waste disposal in 2020-21 was PKR. 880,139, and the actual daily expenditure was PKR 391,431. This means the actual daily spending was less than the allocated amount of PKR. 488,708, on average. In 2021-22, the total allocated amount for waste disposal was PKR.

445,000,000, and the actual expenditure was PKR. 324,591,092. This means the actual spending was less than the allocated PKR. 120,408,908. The monthly allocated amount for waste disposal in 2021-22 was PKR. 37,083,333, and the average monthly expenditure was PKR. 24,968,546. This means the actual monthly spending was less than the allocated amount of PKR. 12,114,787 on average.

Daily, the allocated amount for waste disposal in 2021-22 was PKR. 1,236,111, and the actual daily expenditure was PKR. 832,285. This means the actual daily spending was less than the allocated PKR 403,826 on average. Notably, the "Others\*" category does not have allocated amounts but only shows the actual expenditure incurred.

**Table 2. Expenditures on Municipal Solid Waste Lifting in Quetta**

No	Expenditure on Waste Disposal (2020-21)			Expenditure on Waste Disposal (2021-22)		
	Months	Allocated Amount (In PKR)	Expenditure (In PKR)	Months	Allocated Amount (In PKR)	Expenditure (In PKR)
1	Jul-20	26404167	12214525	Jul-21	37083333	27048498
2	Aug-20	26404167	12218325	Aug-21	37083333	26156143
3	Sep-20	26404167	12029710	Sep-21	37083333	27191175
4	Oct-20	26404167	12715745	Oct-21	37083333	27465264
5	Nov-20	26404167	12197500	Nov-21	37083333	25310095
6	Dec-20	26404167	12639585	Dec-21	37083333	24378942
7	Jan-21	26404167	12671715	Jan-22	37083333	33403869
8	Feb-21	26404167	12627090	Feb-22	37083333	28988936
9	Mar-21	26404167	12615785	Mar-22	37083333	23955918
10	Apr-21	26404167	12796665	Apr-22	37083333	25326365
11	May-21	26404167	11976755	May-22	37083333	27147906
12	Jun-21	26404167	12792500	Jun-22	37083333	23142411
13	Others*	-	3162165	Others*	-	5075570
	Total	316850000	152658065	Total	445000000	324591092
	Monthly	26404167	11742929	Monthly	37083333	24968546
	Daily	880139	391431	Daily	1236111	832285

Source: (Metropolitan Corporation Quetta, 2023b)

Others\*= Need-based Special Campaign for Solid Waste Disposal; PKR= Pakistani Rupees

### 3.3. Amount of Waste Generated in Quetta Metropolitan Area

Several studies have documented the amount of waste generated in Quetta, including residential, commercial, urban, and municipal waste. The quantity of residential waste generated varies between 0.360 kg/capita/day (Gul, 2022) and 0.408 kg/capita/day (Government Innovation Lab, 2020). The average residential waste generated is 0.384 kg/capita/day. The quantity of

commercial waste generated is documented by only one study, which reports it to be 0.443 kg/capita/day (Gul, 2022). The quantity of urban waste generated is documented by one study, which reports it to be 0.720 kg/capita/day (Mati). The municipal waste generated varies between 0.378 kg/capita/day (Kaza et al., 2018) and the average waste quantity of 0.462 kg/capita/day. Overall, the average amount of waste generated in Quetta is 0.462 kg/capita/day. However, it is essential to note that the quantity of garbage generated may vary depending on the type.

**Table 3 Waste Generation Rate in Quetta Metropolitan Area**

No.	Type of Waste	Waste Generated (Kg/Capita/Day)	Location	References
1	Residential Waste	0.360	Quetta	(Gul, 2022)
2	Commercial Waste	0.443	Quetta	(Gul, 2022)
3	Residential Waste	0.408	Quetta	(Government Innovation Lab, 2020)
4	Urban Waste	0.720	Quetta	(Mati)
6	Urban Waste	0.430	Pakistan	(Kaza et al., 2018)
	<b>Average waste</b>	<b>0.462</b>		

Source: Authors Analysis

### 3.4. Vehicles and Machinery Used for Solid Waste Management in Quetta

The results in Table 4 present a list of vehicles and machinery used for solid waste management in Quetta and their respective operational capacities. The vehicles include a) vehicles for waste disposal and b). vehicles for waste collection; c). vehicles for sludge sucking; d). vehicles for road cleaning and sweeping; e). vehicles for waste loading; and f). vehicles for waste sorting. The vehicles for waste disposal are described as. 42 dump trucks or sweeping cabin trucks commute twice daily for waste disposal. These trucks have a waste-lifting capacity of 5 to 7.5 tons. Similarly, 35 compactor vehicles commute twice daily for waste disposal. These vehicles have a waste-lifting capacity of 3.5 to 4.5 tons. In addition, eight-arm roll trucks commute twice a day for waste disposal. These trucks have a waste-lifting capacity of 10 to 13 tons. Moreover, 19 multi-container trucks commute twice a day for waste disposal purposes. These trucks have a waste-lifting capacity of 3.5 to 5 tons.

Regarding vehicles for waste collection, there were 79 mini dumpers Suzuki that collect waste daily for door-

to-door collection. Additionally, five tractor trolleys collect waste daily for intra-city waste collection. Similarly, two Mazda trucks collect waste on a need basis for intra-city waste collection. Along with these, two dump trucks off-road collect waste daily for intra-city waste collection.

The vehicles for sludge sucking include sludge sucker, sludge sucker off-road, and Sewer Jetter. Two sludge suckers suck sludge on a need basis. Similarly, there is one sludge sucker off-road that sucks sludge on a need basis, and there is one Sewer Jetter that cleans sewerage on a need basis. The MCQ uses mechanical sweepers and tractor-mechanical sweepers to clean Quetta City roads. Two mechanical sweepers are used for road cleaning/sweeping purposes on a need basis. Similarly, five tractor mechanical sweepers are used for road cleaning/sweeping purposes on a need basis. The types of vehicles for waste loading include excavators (1), skid steer loaders (off the road) (4), front-end tractor loaders (1), heavy loaders (offloader) (1), skid steer loader (15) and heavy loaders (3) are used by MCQ daily in Quetta. Three bulldozers are used for waste sorting daily. In total, 231 vehicles and machinery are used for solid waste management in Quetta, Pakistan.

**Table 4. The Capacity of Vehicles and Machinery for Solid Waste Management in Quetta**

No	Types of Vehicles	No of Vehicles	Commuting Schedule	Purpose	Capacity (in tons)
<b>Vehicles for Waste Disposal</b>					
1.	Dump Trucks/ Sweeping Cabin Trucks	42	Twice a Day	Waste Disposal	5 to 7.5
2.	Compactors Vehicles	35	Twice a Day	Waste Disposal	3.5 to 4.5
3.	Arm Roll Trucks	08	Twice a Day	Waste Disposal	10 to 13
4.	Multi Container Trucks	19	Twice a Day	Waste Disposal	3.5 to 5
<b>Vehicles for Waste Collection</b>					
1.	Mini Dumpers Suzuki	79	Daily	Door-to-door Collection	
2.	Tractors Trolleys	05	Daily	Intra-city Waste Collection	
3.	Mazda Trucks	02	Need-based	Intra-city Waste Collection	
4.	Dump Trucks Off Road	02	Daily	Intra-city Waste Collection	
<b>Vehicles for Sludge Sucking</b>					
1.	Sludge Sucker	02	Need-based	Sludge Sucking	
2.	Sludge Sucker Off Road	01	Need-based	Sludge Sucking	
3.	Sewer Jetter	01	Need-based	Sewerage cleaner	
<b>Vehicles for Roads Cleaning/Sweeping</b>					
1.	Mechanical Sweepers	02	Need-based	Sweeping machine	
2.	Tractor Mechanical Sweepers	05	Need-based	Sweeping machine	
<b>Vehicles for Waste Loading</b>					
1.	Excavator	01	Daily	Waste Loading	
2.	Skid Steer Loader (Off-Road)	04	Daily	Waste Loading	
3.	Front End Tractor Loader	01	Daily	Waste Loading	
4.	Heavy Loaders (Off Loader)	01	Daily	Waste Loading	
5.	Skid Steer Loader	15	Daily	Waste Loading	
6.	Heavy Loaders	03	Daily	Waste Loading	
<b>Vehicles for Waste Sorting</b>					
1.	Bulldozers	03	Daily	Waste Sorting	
<b>Total Vehicles</b>		<b>231</b>			

Source: (Metropolitan Corporation Quetta, 2023b)

### 3.5. Medical Waste Collection in Quetta City

The Urban Basic Services (UBS) cell at the Metropolitan Corporation of Quetta (MCQ) was started in 2005 with the help of three groups: The Environmental Protection Agency (EPA) and the hospitals in Quetta, both public and private. The UBS cell aims to deal with the daily generation of hospital, medical, and hazardous waste in government, private hospitals, laboratories, polyclinics, and basic health units in Quetta city. The operational mechanism of the UBS cell incorporates collecting generated waste from all units of Quetta city with standardized medical waste collection measures and weighting measurements at the spot. Then, it transfers the daily collected medical wastes to the Bolan Medical College (BMC) Incineration Plant for further processing. According to an official of UBC Cell, this office has divided the medical waste-generating units of the Quetta Metropolitan Area into three categories, A, B, and C, based on monthly revenue collection. In this regard, UBS Cell collects revenues of PKR 4,15,000 every month. According to the official record, UBS Cell collects 600 kg to 700 kg daily from all generating units in the Quetta Metropolitan Area. The composition of collected medical wastes from all generating units contains 80% of general municipal solid waste. This means the administration of all units is not transparently delivering medically generated wastes to the UBC Cell. A city with a population of more than 2.2 million and the capital city of the province, with a large number of healthcare facilities, attracts more people to avail of healthcare services in Quetta. Therefore, the daily average of 600–700 kg of medical waste is not the amount generated at hospitals (Metropolitan Corporation Quetta, 2023b).

As per the list provided by the Private Hospital Regulatory Board, Quetta District, there are a total of 46 private hospitals. Out of the total, 35 medical wastes are collected from 35 hospitals on a regular basis. It is pertinent to mention that medical waste is not collected from private pathological laboratories, polyclinics, and pharmacies.

### 3.6. Workshops for Solid Waste Management in Quetta

Currently, there are three workshops of the Metropolitan Corporation of Quetta in the metropolitan area, which are

located in Quarry Road, Sariab Road beneath Sariab flyover, and Satellite Town respectively. These workshops deal with the area-wide collection of municipal solid waste in Quetta. Moreover, these workshops are equipped with mechanical resources (Metropolitan Corporation Quetta, 2023b).

### 3.7. Human Resources for Solid Waste Management in Quetta

The data in Table 5 provides information about the human resources allocated for solid waste management in Quetta. The details are divided into different departments or cells, their respective designations, and the personnel allocated to each position. The Executive Team has two positions: one Executive Engineer and one Executive Engineer Technical. The Urban Basic Services Cell for Medical Waste has four positions: one Coordinator UBS Cell and three Social Organizers. The Sanitation department has the most significant positions, with 53 allocated personnel. This department includes one Sanitation Officer, two Chief Sanitary Inspectors, one Senior Clerk, 19 Sanitary Inspectors, and 30 Sanitary Supervisors. The Municipal Transport department has 55 allocated personnel, including one Transport Officer, two Assistants, one Senior Clerk, one Foreman, one Assistant Foreman, one Sub Engineer, two Mechanics, one Blacksmith, one Supervisor, 14 Cleaners, one Naib Qasid, one Auto Electrician, one Chowkidar, one Mechanical Engineer, two Hydraulic Engineers, two Sub Engineers, one Chief Sub Inspector, one Sub Inspector, two Senior Supervisors, and 16 Helpers. The Govt Colony has three allocated personnel, including one Sanitary Inspector and two Supervisors. The Field Staff (Permanent) department has 978 allocated personnel, including 76 Beldars, 715 Sweepers, 72 Sweepers (drainage), 113 Drivers, and 2 Beheshti. Finally, the Field Staff (Daily Wages) accounts for 1,600 allocated personnel, including Sweeper, Beldars, and Gangs. The total number of personnel allocated for solid waste management in Quetta is 2,695. Out of the total, the permanent staff is 1095 (40.6%), and the staff on daily wages accounts for 1600 (59.4%).

**Table 5. Human Resource for Solid Waste Management in Quetta**

Departments	Designations	Numbers
Executive Team	Executive Engineer	1
	Executive Engineer Technical	1
Urban Basic Services Cell (For Medical Waste)	Coordinator UBS Cell	1
	Social Organizers	3
	Sanitation Officer	1
Sanitation	Chief Sanitary Inspector	2
	Senior Clerk	1
	Sanitary Inspector	19
	Sanitary Supervisor	30
	<b>Sub-Total</b>	<b>59</b>

Departments	Designations	Numbers
Municipal Transport	Transport Officer	1
	Assistant	2
	Senior Clerk	1
	Foreman	1
	Assistant Foreman	1
	Sub Engineer	1
	Mechanic	2
	Blacksmith	1
	Supervisor	1
	Cleaner	14
	Naib Qasid	1
	Auto Electrician	1
	Chowkidar	1
	Mechanical Engineer	1
	Hydraulic Engineer	2
	Sub Engineer	2
	Chief Sub Inspector	1
	Sub Inspector	1
	Senior Supervisor	2
	Helpers	16
Chowkidar	2	
	<b>Sub-Total</b>	<b>55</b>
Govt. Colony	Sanitary Inspector	1
	Supervisor	2
	<b>Sub-Total</b>	<b>3</b>
Field Staff (Permanent)	Beldars	76
	Sweepers	715
	Sweeper(drainage)	72
	Drivers	113
	Beheshti	2
	<b>Sub-Total</b>	<b>978</b>
Field Staff (Daily Wages)	Sweepers, Beldars, and Gangs	1600
	<b>Grand Total</b>	<b>2695</b>

Source: (Metropolitan Corporation Quetta, 2023a)

### 3.8. Challenges of MCQ in Managing Solid Waste

The Metropolitan Corporation Quetta faces several challenges in managing municipal solid waste. The official highlighted the problems during face-to-face interviews as

#### i. Insufficient Funding and Financial Crisis

The major challenge faced by Metropolitan Corporation Quetta is the need for more funding to manage solid waste in the city. The MCQ officials highlighted this issue as follows;

*Our monthly expenditures for solid waste are approximately 90-100 million PKR. However, the provincial government, released only 30 million. We add 20 million from our sources and make it 50 million. Still, we have a shortfall of approximately 40 million each month. Due to insufficient funding, the operations for solid waste disposal are disrupted (Account Officer, MCQ).*

*More funding is needed for the smooth management of solid waste in Quetta. The MCQ has not been able to pay its employees their salaries for the last three months. Due to this, they went on strike, and the solid waste was lying undisposed (Chief Metropolitan Officer, MCQ).*

*We have not even been able to provide pensions for the last three months to our retired employees due to the financial crisis (Account Officer, MCQ).*

#### ii. Insufficient Vehicles and Machinery

Insufficient vehicles and machinery have negatively affected solid waste management in the Quetta Metropolitan area. The officials responded as;

*We have insufficient vehicles for disposing of solid waste in Quetta. Due to this limitation, we have only been able to dispose of approximately 750 tons on a daily basis, which accounts for about 50% of the total daily*



generated waste (Executive Engineer Technical-II, MCQ).

**iii. Unskilled Labor Force**

The unskilled labor force is another significant challenge for solid waste management in Quetta. Since most of the workforce involved in waste-lifting is employed on daily wages, they lack the necessary training for their job. As a result, garbage lifting is not managed well. The issue was reported by the key informants as follows:

*We need more well-trained staff and labor to improve our operational efficiency. Most of our field staff is hired on daily wages for an unspecified time and need to be adequately trained for their job (Executive Engineer Technical-I, MCQ).*

*Our human resources department needs special training on the safe disposal of municipal solid waste (Chief Metropolitan Officer, MCQ).*

**iv. Throwing Waste at Unspecified Points by the Public**

The disposing of waste by the public at unspecified places causes a considerable challenge for the field staff of MCQ in Quetta. The officials responded as;

*The households dispose of their residential waste at undesignated points, such as open fields and along the roadsides, which makes its collection difficult for MCQ's field staff. (Executive Engineer Technical-I, MCQ)*

**v. Lack of Well-equipped Workshops**

The lack of well-equipped workshops causes operational delays in the solid waste management by MCQ in Quetta. The high-tier official of MCQ responded as follows;

*Our workshops need to be better equipped, so the general maintenance of our vehicles is delayed. This ultimately causes operational inefficiency in solid waste management. (Executive Engineer Technical-II, MCQ).*

**vi. Lack of Essential Waste Collection Tools**

The lack of essential waste collection tools causes operational delays in the solid waste management by MCQ in Quetta. The officials responded as;

*The waste collection tools are needed for waste disposal. The insufficient waste collection tools negatively affect the efficiency of the field staff of MCQ (Executive Engineer Technical-II, MCQ).*

**3.9. Municipal Solid Waste Management Practices in Quetta**

The waste management practices include generation, source reduction, reuse, collection, transport and transfer, segregation, and disposal and recycling. The findings showed that Quetta City generates approximately 1500 tons of waste per day. The MCQ uses compactors for the reduction of solid waste. MCQ has no mechanism for reusing the waste; however, private waste pickers use it for personal benefit. MCQ collects almost half, i.e., 750 tons of the waste daily. In some areas, door-to-door, whereas in other areas, waste is collected from specific sites and transported out of the city. Moreover, waste is not segregated at source and on a daily, twice a week and weekly basis (Table 6).

**Table 6. Municipal Solid Waste Management Practices in Quetta**

Waste Management	Practices
Generation	▪ Quetta City generates approximately 1500 tons of waste on a daily basis.
Source Reduction	▪ The solid waste is reduced through compactors within the selected points by MCQ in Quetta.
Reuse	▪ The private waste pickers collect the saleable item from the waste and use it for their own benefit.
Collection	▪ The MCQ collects approximately 750 tones daily in Quetta.
Transport and Transfer	▪ Waste is collected both door-to-door and at specific sites in the city and then transported regularly by MCQ vehicles.
Segregation	▪ Waste is not segregated at source by MCQ.
Disposal	▪ Waste is disposed of on a daily, twice a week and weekly basis by MCQ.
Recycling	▪ The eeeee ccynnng donnn'e exss.

Source: Primary Data, (2023)

### 3.10. Pictorial Assessment of the Waste Collection and Disposal



**Pic 1. Waste collected by MCQ vehicle**



**Pic 2. Waste lying on Sariab Road**



**Pic 3. Waste Lying near Jinnah Road**



**Pic 4. Waste lying on Inskumb Road**



**Pic 5. Waste laying near Akram Hospital**



**Pic 6. Waste collection point at Zarghoon Road**



**Pic 7. Waste collected at Sariab Road**



**Pic 8. Waste lying near Railway Colony**

## 4. DISCUSSION

Assessing municipal solid waste management is crucial for improving urban service delivery. This study comprehensively analyzes solid waste management in Quetta City. Quetta is the provincial capital of Balochistan province, with 2.5 million people. Due to accelerated urbanization, this city has seen enormous urban growth over the past three decades. The city has seen urban sprawl that has brought severe challenges to urban service delivery, particularly urban solid waste management (Bazai & Panezai, 2020). Thus, it is highly important to plan for delivering sustainable solid waste management services for growing population of provincial capital. For this, the capacity building of Metropolitan Corporation Quetta (MCQ) is essential.

The average daily waste lifting capacity in 2020-21 was 657.75 tons. The total waste generated in Quetta is estimated to be more than 1500 tons daily. This shows that MCQ can lift almost half, i.e., 50%. These findings show that MCQ needs a 100% increase in its operation capacity to handle all the waste generated in the city. A study conducted in Punjab province, Pakistan, reports that in large cities of Pakistan, 80% of the generated waste is collected on a daily basis (Chaudhary et al., 2022). It is important to remember that the estimated capability of MCQ to lift trash is derived from outdated population numbers. The most recent census, conducted in 2023, shows that Quetta's population has grown to 2,595,492. (Pakistan Bureau of Statistics, 2023). Given the recent surge in Quetta's population, a major expansion of the MCQ's capacity of waste management is imperative.

The allocated expenditure on lifting the solid waste in Quetta was PKR. 37,083,333. However, the released amount was 24,968,546, 34% less than the allocated amount. The data shows that there has been a cut in MCQ's funds for solid waste management. This significant cut needs to be clarified for the smooth delivery of waste management services.

For solid waste management in Quetta, 231 vehicles and machines are available. The findings showed that insufficient vehicles and machinery had negatively affected the proper and timely disposal of solid waste management in the Quetta Metropolitan area. MCQ has been unable to collect the waste generated in Quetta City regularly. The review of published studies also showed that the average waste generation rate in the Quetta Metropolitan area is 0.463 kg per capita daily. The other published studies have also reported more or less similar findings. According to Gul (2022), residential waste (0.360 kg/capita/day) and commercial waste (0.443 kg/capita/day) are generated in Quetta, respectively. Similarly, Government Innovation Lab (2020) reports that 0.408 kg/capita/day is generated in Quetta.

However, a slightly higher ratio is reported by Mati , with urban waste to be 0.720 kg/capita/day.

The total human resources for solid waste management in Quetta is 2695. According to the 2023 Census, the total population of Quetta District is 25,95,492. Keeping the latest population statistics of Quetta, it can be found that one sanitary worker is available for 1000 persons in Quetta. Similar findings were reported by a study published in 2022, which reports that in Pakistan, almost all waste management companies have a ratio of one sanitary worker per 1000 population (Chaudhary et al., 2022).

The analysis of the waste management practices revealed that waste generation is more than waste collection; no waste reduction at source, no reuse, no segregation, and recycling are practiced in Quetta. Due to limited resources, waste is irregularly collected in different wards of the MCQ, i.e., on a daily, twice-a-week, and weekly basis, respectively. To reduce the negative impact of irregular waste collection on the environment and public health of dwellers, it is direly necessary to collect all waste regularly. For this, the operational capacity of the MCQ needs a significant enhancement.

## 5. CONCLUSION

This study aimed to assess the Metropolitan Corporation Quetta's current operational capacities and procedures for managing municipal solid waste (MSW) collection and disposal and to pinpoint the challenges and suggestions for the secure disposal of MSW. The findings showed that the municipal solid waste generated in Quetta is approximately 1500 tons daily. However, only 50% of the total generated waste is disposed of on a regular basis. The significant challenges faced by Metropolitan Corporation Quetta include insufficient funding for managing solid waste, financial crisis, insufficient vehicles and machinery, an unskilled labor force, throwing waste at unspecified points by the public, a lack of well-equipped workshops, and a lack of essential waste collection tools. The findings of the study concluded that the Metropolitan Corporation of Quetta's solid waste management system needs more operating capability due to a lack of machinery and vehicles, a shortage of human resources, and inconsistent and insufficient funding availability.

### 5.1. Suggestions for improving solid waste management in Quetta metropolitan area

The Metropolitan Corporation Quetta faces several challenges in managing municipal solid waste. These challenges include insufficient funding and financial crisis, insufficient vehicles and machinery, an unskilled labor force, throwing waste at unspecified points by the public, a lack of well-equipped workshops, and a lack of

essential waste collection tools. The findings of this study suggest that the revamping and restructuring of the Metropolitan Corporation Quetta is direly needed. The following recommendations are made by this study for a sustainable solid waste management system in Quetta:

- This study recommends that the provincial government should allocate sufficient financial and technical resources and ensure the timely provision of funding to the Metropolitan Corporation for improved solid waste management in the Quetta.
- This study recommends that a greater number of vehicles and supportive machinery should be added to the existing fleet of vehicles.
- It is direly needed to provide Metropolitan Corporation with sufficient human resources along with proper in-service training for efficient and secure solid waste management.
- This study suggests that awareness campaigns should be launched for civic education of the people in schools, colleges, universities, and religious institutions. Moreover, social media messages through the MCQ should be broadcast.
- This study recommends that the operational capacity of workshops should be enhanced through the provision of necessary technical services.
- This study recommends that the human resource of MCQ needs to be fully equipped with waste collection tools.

## DECLARATIONS

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