

Generation And Composition of Municipal Solid Waste in Karachi-Pakistan

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ABSTRACT

Mega city Karachi has its discrepancies in solid waste management. According to this study, Karachi city currently generates more than 20,000 ton per day (TPD) of municipal solid waste (MSW), 1.244Kg/c/d, and 7.464Kg/h/d. Only 50% of the waste reached at the land filled site that is 9216.468 t/d and the total capacity of both the landfill sites is 9500 t/d. The composition of MSW is also assessed in summer and winter 2019 to 2020 and it was found that MSW containing the waste in the following order: organic waste > plastic waste > paper waste > textile waste > tetra brick aseptic packaging waste > diapers > nappies. This study investigates the system of the current solid waste management in Karachi city according to collection, transportation, and disposal to MSW dumping site and pinpoint the weakness in every process along the way and includes observation and interviews to deal with actual scenario as well. A total 300 respondents were then interviewed using elaborated questionnaire. The results were appealing against the current strategies of civic agencies responsible for solid waste management, it is an effort to secure people from serious health effects. The future solid waste generation has been estimated till 2030 is to be 25669.193 tons/d based on growth rate of 2.53%. The research had concluded that recycling as well as process treatment is the best strategy to eliminate or reduce the volume of waste using state of the art techniques to secure the natural recourses.

Keywords: Municipal solid waste management; Generation; Composition; Waste Disposal Site; Municipalities

INTRODUCTION

Municipal solid waste (MSW) management is a highly neglected factor of environmental management in all low and most middle-income countries (Murtaza et al. 2000). Poorly managed waste streams are causing adverse environmental impacts and may result in health hazards (Misra et al. 2005).

Waste management is a civilization problem (Koladka and Malinowski 2015) and landfills have been widely applied due to several advantages, including simplicity, low investment, large handling capacity and low operating cost (Liet al. 2017). Some studies indicated that almost 95% of Municipal Solid Waste (MSW) was disposed of by landfilling worldwide (Ghoshet al. 2015). However, with the progress of urbanization and residential demands of higher living environmental quality, pollution of landfill sites has increasingly attracted attention in the world, because landfill contains a great deal of potential toxic compounds, some of which may threaten the safety of the surrounding environment. It is known that the impact of MSW landfills can cause pollution of all environmental components (Makarenko and Budak 2017).

Many cities in developing Asian countries face serious problems in managing solid wastes management. The annual waste generation increases in proportion with the rise in population and urbanization, and issues related to waste disposal have become challenging as more land is needed for the unlimited disposal of these solid wastes. Several major cities in developing Asian countries have reported problems with existing landfill sites (Indriset al. 2003; Nazeri Sallehet al. 2002).

Communities in developing countries turn to solid waste disposal methods that have proven to be vicious to human health and the environment, such as open dumping and burning or unregulated landfill sites because they feel they have no other way to manage their solid waste (Mwanthi. and Nyabola 1997; Goett 1998; Alavi Moghadam 2009; Narayana 2009; Khatibet al. 2015; Hilburn 2015).

The multicultural megacity Karachi has been considered 2nd largest Muslim city around the globe and facing various environmental issues including municipal solid waste management, it is an important issue, due to an increase in population density (Sabiret al. 2016; Sohoet al. 2021). The trend of urbanization has been rapidly increasing in Pakistan since the 1970s, with most of the population shifting to the mega city of the country from the rural regions, to seek better employment opportunities (Sharif & Raza 2016). Located on the southern coast, it is considered as the business hub of Pakistan. It is the largest city of Pakistan with 10% of the total residents of a country and producing over 10,000 tons of MSW per day (Abbasi et al. 2015). The several types of waste

generated include household, office, commercial and industrial, litter, parks, and garden waste (Jilani 2007). The purpose of this study is to point out the worst system of MSW in Karachi city and find out the exact amount of waste generation from the Karachi city and how much of the MSW reaches at the official landfill site as well as composition of the MSW fraction which is not yet found in the Karachi city. Solid waste management creates a huge challenge for local governments because of a steady rise in leftovers. Municipal solid waste management (MSWM) creates a big problem for local governments due to regular increase in leftovers. The study aims to gather latest data for generation and composition of Municipal solid waste in the mega city of Karachi.

MATERIAL AND METHODS

Study Area

Karachi is facing several issues regarding environment and health is which one of the alarming issues of municipal solid waste management (MSWM). Karachi Metropolitan Corporation (KMC) along with the District Municipal Councils (DMCs) remained responsible for the management of Municipal solid waste in the Karachi city. Initially, only DMC was responsible for managing the solid waste in these five zones. Now, this responsibility has been transferred to Sindh Solid Waste Management Board (SSWMB).

MSW Generation

For finding MSW generation in Karachi city gathered primary and secondary data. Secondary data of MSW generation in Karachi city from 2009 to 2020 (12 years) collected with the help of SSWMB. The two official landfill sites that is Jamchakro landfill site and Gondpass landfill site have a proper weighing bridge system. Therefore, the weight of MSW is calculated by using the following formula,

$$\text{Weight of MSW} = W_1 (\text{weight of Waste with truck}) - W_2 (\text{weight of truck})$$

Or,

$$W (\text{in ton}) = W_1 - W_2$$

The weight of the respective towns is noted on daily basis on landfill sites. By using this formula and the total amount of MSW reached at the landfill sites was estimated.

Determining The Amount of Waste

Secondly, according to the census 2017, the population of Karachi is 14.91 million and it increases with 2.53% annual growth rate and the size of house is about 6.45 people. Therefore, secondly the amount of generation ton per day (t/d), per capita per day (Kg/c/d) and per house per day (Kg/h/d) was calculated based on annual growth rate.

Survey Study

Thirdly, survey study is conducted through face-to-face interview of the respondent belonging to the resident in Karachi as quantity of data obtained by this method has been found to be the highest, comprehensive, and meaningful instead of telephonic and mail survey techniques. The total of three hundred (300) respondents were interviewed, who were selected using non-random sampling method. The questionnaire contains three sections having 22 questions in which one section was about household details regarding socio-economic data, second was household waste generation, composition, and disposal data and the third was MSW collection services.

Physical Composition of MSW

For the analysis of composition of MSW, sixty samples were collected during summer and winter season in 2019 to 2020 at source randomly from the lower, middle, and upper classes. All the sixty samples of 10 kg were segregated individually then weighed the individual fraction of the sorted items and documented. Secondly, the

nature of waste was checked, which would make it easy to understand the actual fraction of the waste discarded from the source point.

RESULT AND DISCUSSION

Current Status of MSW Generated in Karachi City

Karachi is divided into Six Zones or Districts (East, West, North, South, Central and Malir), eighteen (18) towns and 178 union councils. According to the SSWMB Karachi city generated around 12,000 tons/day of municipal solid waste and out of total 8,500 to 9000 tons / day of MSW reached at the official landfill sites. According to the Director Operations of SSWMB, Karachi has four main landfill sites in which two are official landfill sites (legal landfill site), that is Jamchakro, near Surjani towns and Gondpass, near Hub river road and two unofficial landfill site (illegal landfill site) that is Ibrahim Hyderi and Rehri Goth landfill sites, and out of twelve Garbage Transfer Stations (GTSs) only five Garbage Transfer Stations (05 GTS's) are operative that includes GTS-Imtiaz, EMB Cosway shift to Imtiaz (District East), Sharafi Goth (District Malir), Gutter Baghicha is temporary GTS in West from where the MSW shift to GTS Baldia / Kasba (District West) 100 quarters (District Korangi) and Dhobi Ghaath (District South) and four Garbage Transfer Stations (04 GTSs) out of total are planned to be scientific, where anaerobic digestion will be used to produce electricity very soon, but still not implemented. This mixed type of MSW is only dumped at the official landfill site without taking any type of proper planning, segregation, and treatment before disposal of landfill site. The continuous dumping of the waste at the official landfill site huge heap are formed about more than 12 feet height, these landfill sites are operational from 1986 till to date and in 35 years the condition of the landfill site has become worst for the human and environmental health. Out of the total amount of municipal solid waste 50% of the municipal solid waste (MSW) is dumped on the landfill sites and rest of 50% remain in the city dumped sites. The organic fraction which remained on every nook and corner caused naturally degrade, contaminate our resources, spreading unpleasant odor and cause diseases, and disturb the aesthetic beauty of the city and generate unhealthy environment.

Amount Of Municipal Solid Waste Generation in Karachi City According To SSWMB

In collaboration with SSWMB, the data was gathered from the towns dumped at the landfill that is Jamchakro landfill site and Gond pass landfill site, in the last twelve years (12 years). Among eighteen towns (18 towns) in Karachi city eleven towns like Gulshan, Gulberg, Gaddap, Korangi, Liaquatabad, Landhi, Malir, North Nazimabad, North Karachi, Shah Faisal, Bin Qasim towns dumped at the Jamchakro landfill site and four towns in which Baldia, Kemari, Lyari, and Orangi towns dumped at the Gond Pass landfill sites.

The rest of three towns such as Jamshed town, Saddar town, and S.I.T.E town dumped at both landfill sites because these towns possess greater UCs. This is given in the following table 1.

Table 1. Cumulative Weight of MSW Dumped at Jam Chakro and Gond Pass Landfill Site in Twelve Years, Karachi.

T W-A= TWJCL + TWGPL				T W- B =TWJCL + TWGPL						
YEARS	TWJCL (T#01T#11) Wt. (t/y)	TWGPL (T#12T#15) Wt. (t/y)	T W-A Wt. (t/y)	JAMCHAKRO LANDFILL SITE			GOND PASS LANDFILL SITE			T W-B Wt. (t/y)
				(T#16T#18) Wt. (t/y)	CDGK Wt. (t/y)	TWJCL Wt. (t/y)	(T#16T#18) Wt. (t/y)	CDGK Wt. (t/y)	TWGCL Wt. (t/y)	
2009	189,610	129,975	319,585	189,610	41,250	230,860	17,451	990	18,441	249,301
2010	188,000	127,514	315,514	198,430	41,500	239,930	15,200	1010	16,210	256,140
2011	198,819	133,550	332,369	199,210	49,460	248,670	18,937	850	19,787	268,457
2012	197,714	126,975	324,689	198,110	58,085	256,195	19,150	620	19,770	275,965
2013	198,201	132,960	331,161	198,280	57,460	255,740	16,950	1870	18,820	274,560
2014	198,311	124,800	323,111	197,260	40,460	237,720	16,000	1010	17,010	254,730
2015	199,501	129,770	329,271	199,720	48,990	248,710	18,800	750	19,550	268,260
2016	198,847	121,270	320,117	197,438	39,010	236,448	19,550	870	20,420	256,868
2017	197,250	130,250	327,500	198,236	21,010	219,246	18,950	440	19,390	238,636
2018	198,350	131,950	330,300	196,540	50,150	246,690	20,950	510	21,460	268,150
2019	198,510	132,550	331,060	196,670	41,250	237,920	21,550	770	22,320	260,240
2020	199,950	134,750	334,700	198,246	52,990	251,236	21,950	980	22,930	274,166
TCW(t/y)	2,363,063	1,556,314	3,919,377	2,367,750	541,615	2,909,365	225,438	10,670	236,108	3,145,473
Wt.t/d/t	539.512	355.322	894.834	540.582	-	664.238	51.469	-	53.905	718.143
Wt.t/d	5934.633	1421.291	7355.924	1621.746	123.656	1992.714	154.407	2.436	161.715	2154.43

Note: - TCW = Total Cumulative Amount, Wt. (t/y) = Weight ton per year, Wt. (t/d/t) = Weight ton per day per town
Wt. (t/d) = Weight ton per day, TWJCL = Total Weight Jamchakro Landfill Site, TWGPL = Total Weight
Gond Pass Landfill Site

It is observed that in the above table 1, The amount of MSW lifted from the eleven towns is about 539.512 t/d/t and is dumped at the Jamchakro landfill site as compared to the Gondpass landfill site that is about 355.322 t/d/t which is lifted from the four towns (T#12 to T#15). As well as the three town (T#16-T#18) dumped at both the landfill site in which 664.238 t/d/t dumped at Jamchakro landfill site and 53.905 t/d/t at the Gondpass landfill site. Because in these three towns possess higher union council and mostly union council are nearest to the Jamchakro landfill site than Gondpass landfill site. Therefore, a condition of the landfill site specially Jamchakro landfill site became worst because the MSW is only shift at the landfill and not handled scientifically. The total weight of MSW generate from the towns according to SSWMB reached at the landfill sites are given in the following Table 2.

Table 2. Total cumulative weight of msw dumped at landfill sites in twelve years.

YEARS	T W-A= TWJCL + TWGPL Wt. (t/y)	T W- B = TWJCL + TWGPL Wt. (t/y)	TOTAL WEIGHT DUMPED AT LANDFILL SITES TW-C= TW-A + TW-B Wt. (t/y)
2009	319,585	249,301	568,886
2010	315,514	256,140	571,654
2011	332,369	268,457	600,826
2012	324,689	275,965	600,654
2013	331,161	274,560	605,721
2014	323,111	254,730	577,841
2015	329,271	268,260	597,531
2016	320,117	256,868	576,985
2017	327,500	238,636	566,136
2018	330,300	268,150	598,450
2019	331,060	260,240	591,300
2020	334,700	274,166	608,866
TCW	3,919,377	3,145,473	7,064,850
Wt.t/d/t	894.834	718.144	1612.978
Wt.t/d	7355.924	2154.43	9510.354

Note: - TCW = Total Cumulative Amount, Wt. (t/y) = Weight ton per year, Wt. (t/d/t) = Weight ton per day per town
Wt. (t/d) = Weight ton per day, TWJCL = Total Weight Jamchakro Landfill Site, TWGPL = Total Weight
Gond Pass Landfill Site

The total cumulative amount reached at the landfill site observed during twelve years (12 years) is **7,064,850 t/y** and the weight ton per day is about **9510.354 t/d**. The total capacity of the landfill sites is **9, 500 TPD**, capacity of Jamchakro landfill site is **8,000 TPD** and the Gond Pass has **1,500 TPD**. Sindh Solid Waste Management Board (SSWMB) is going to develop the third landfill site, Dahbaji landfill sites that is about 3000 Acres, located thirty-five Km (35 Km) from Thatta and eighty-five (85 Km) from Karachi and situated at Mirpurkahs.

Amount of Municipal Solid Waste Generated in Karachi City

Population of Karachi city increase rapidly and due to the mass migration from the different provinces for better standard of life, Karachi is facing several issues. Whereas management of Municipal Solid Waste (MMSW) become an alarming and hottest issue in Karachi and it is rising day by day. To assure better management of MSW, one need to find out the exact amount of generation of waste from the city. And it is also necessary to find out the amount of generation per person per day (Kg/c/d) as well as generation per house per day (Kg/h/d). In the previous table 1 and 2, with the help of SSWMB calculated the amount of MSW which is 50% reached at the landfill site that is **9258.169 t/d**.

According to population estimate the amount of MSW generated per day shown in the given table 3.

Table 3. MSW generated during twenty-one years in Karachi city.

YEARS	POPULATION IN KARACHI	MSW GENERATE IN KARACHI		
	In million	Wt. (t/d)	Wt. (Kg/c/d)	Wt. (Kg/h/d)
1972 ^a	3.515	1884.04	0.536	3.216
1973 ^E	3.618	1939.408	0.536	3.216
1974 ¹	3.724	2000	0.536	3.216
1998 ^b	9.269	5561.90	0.600	3.6
2001 ²	9.999	6000	0.600	3.6
2006 ³	11.329	6113	0.539	3.237
2007 ⁴	11.616	9000	0.774	4.648
2012 ⁵	13.162	10,000	0.759	4.554
2017 ^c	14.913	11319.33	0.759	4.554
2019 ⁶	15.67	12,000	0.765	4.59
2020 ^E	16.072	20,000	1.244	7.464
2021 ^E	16.479	20,434.58	1.244	7.464
2022 ^E	16.896	21019.121	1.244	7.464
2023 ^E	17.323	21550.807	1.244	7.464
2024 ^E	17.762	22095.928	1.244	7.464
2025 ^E	18.211	22654.857	1.244	7.464
2026 ^E	18.672	23228.025	1.244	7.464
2027 ^E	19.144	23815.635	1.244	7.464
2028 ^E	19.628	24418.169	1.244	7.464
2029 ^E	20.125	25035.880	1.244	7.464
2030 ^E	20.634	25669.193	1.244	7.464

Note: - Wt. (t/y) = Weight ton per year, Wt. (t/d) = Weight ton per day, Wt. (Kg/c/d) = kilogram per capita per day
Wt. (Kg/h/d) = Kilogram per house per day, a, b, and c = Population Census Organization, Federal Bureau of Statistic, 1 = Karachi Plan 1974-85, 2 = Mansoor Ali and Hassan, 2001, 3 = SWM, CDGK, 4 = Zaheer, 2007, 5 = Shahid. M, 2012, 6 = Muhammad, 2019, E = Estimated

According to the table 3, it is evident that generation of waste increases as population increases such as, in 1972 the population was **3.515 million** and the amount of waste ton per day was **1884.04 t/d**, and in 2017 population became increase as **14.913 million** and the amount of waste ton per day was about **11319.37 t/d**, and estimate the population based on 2.53 % growth rate will be reached to **20.634 million** in 2030 and the amount of waste should be generated about **25669.193 t/day**.

Estimation of Municipal Solid Waste Generation During 2019-2020 in Karachi City

During survey from the month of September to February, the amount of MSW was calculated which is dumped at the landfill site. The towns which dump the MSW at the Jamchakro landfill site is shown in the following Table 4 & 5.

Table 4. Weight of MSW dumped on Jam Chakro landfill site, Karachi.

Date	T# 01 Wt. (t/d)	T#02 Wt. (t/d)	T#03 Wt. (t/d)	T#04 Wt. (t/d)	T#05 Wt. (t/d)	T#06 Wt. (t/d)	TW Wt. (t/d)
02-September-19	650.10	615.10	515.21	645.21	680.22	508.10	3613.94
03-September-19	685.12	701.92	545.61	0	620.18	685.16	3237.99
04-September-19	630.21	665.16	645.62	690.61	650.42	596.31	3878.33
07-October-19	590.2	615.12	615.26	750.52	720.22	670.22	3961.54
08-October-19	650.71	655.83	720.19	640.21	610.12	645.30	3922.36
09-October-19	590.82	602.52	655.45	651.3	690.1	680.31	3870.5
11-November-19	561.53	515.92	620.42	685.24	650.61	710.40	3744.12
12-November-19	690.94	650.81	520.38	660.21	670.02	750.91	3943.27
13-November-19	781.42	510.1	595.22	650.53	720.12	602.21	3859.6

16-December-19	580.33	720.11	0	580.21	656.22	680.91	3217.78
17-December-19	595.12	650.22	660.44	690.3	715.29	750.82	4062.19
18-December-19	605.65	790.7	605.23	610.22	625.91	590.23	3827.94
20-January-20	750.22	780.5	610.82	630.33	590.21	560.43	3922.51
21-January-20	780.11	690.9	650.11	690.12	678.42	610.91	4100.57
22-January-20	600.1	670.91	620.82	620.21	615.44	690.46	3817.94
24-February-20	650.11	620.1	505.38	650.32	620.42	650.15	3696.48
25-February-20	690.22	615.12	520.28	610.42	690.63	590.55	3717.22
26-February-20	790.72	720.11	650.1	720.12	780.42	760.84	4422.31
TCW	11873.63	11791.15	10256.54	11176.08	11984.97	11734.22	68816.59
TAW (t/d)	659.64	655.06	569.80	620.89	665.83	651.90	3823.14

Note: - TW = Total Weight, TCW = Total Cumulative Amount, Wt. (t/d) = Weight ton per day, TAW = Total Average Weight, T# 01 = Gulshan Town, T# 02 = Gulberg Town, T# 03 = Gaddap Town, T# 04 = Korangi Town, T# 05 = Liaquatabad Town, T# 06 = Landhi Town.

Table 5. Weight of MSW dumped on Jam Chakro landfill site, Karachi.

Date	T# 07 Wt. (t/d)	T#08 Wt. (t/d)	T#09 Wt. (t/d)	T#10 Wt. (t/d)	T#11 Wt. (t/d)	TW Wt. (t/d)
02-September-19	780.22	581.62	472.11	525.13	470.20	2829.28
03-September-19	650.23	540.72	332.93	680.31	0	2204.19
04-September-19	690.21	360.21	461.21	580.31	465.12	2557.06
07-October-19	765.43	545.83	434.30	610.23	505.13	2860.92
08-October-19	601.43	501.34	390.12	660.24	0	2153.13
09-October-19	670.25	615.72	588.14	655.60	490.25	3019.96
11-November-19	610.77	605.92	410.55	620.11	470.23	2717.58
12-November-19	645.32	325.45	295.71	680.21	510.05	2456.74
13-November-19	750.29	344.21	414.10	0	543.19	2051.79
16-December-19	645.20	535.10	425.33	610.73	510.02	2726.38
17-December-19	665.10	655.11	355.91	790.51	0	2466.63
18-December-19	610.12	567.33	370.61	565.44	565.19	2678.69
20-January-20	530.22	621.81	520.10	745.24	555.21	2972.58
21-January-20	690.91	581.90	480.52	655.22	0	2408.55
22-January-20	525.22	214.10	315.74	610.44	565.0	2230.5
24-February-20	520.20	311.92	420.25	665.21	409.0	2326.58
25-February-20	565.12	425.11	375.28	610.44	445.16	2421.11
26-February-20	710.92	572.98	475.12	890.21	545.92	3195.15
TCW	11627.16	8906.38	7538.03	11155.58	7049.67	46276.82
TAW (t/d)	645.95	494.79	418.77	619.75	391.64	2570.93

Note: - TW = Total Weight, TCW = Total Cumulative Amount, Wt. (t/d) = Weight ton per day, TAW = Total Average

Weight, T# 07 = Malir Town, T# 08 = North Nazimabad Town, T# 09 = North Karachi Town, T# 10 = Shah Faisal Town, T# 11 = Bin Qasim Town

The eleven (11) towns dump total amount of MSW at the Jamchakro landfill site that is **6394.07 t/d**. The towns which touch with *goth*, *katchi abadies* and markets like Gulshan-e-Iqbal, Liaquatabad, Malir, Shah-Faisal, North-Nazimabad, North-Karachi, the industrial area like Korangi and Landhi generate high percentage of MSW than other towns. In the case of Liaquatabad, North-Karachi and Surjani towns are congested area and MSW is not properly collected from these areas, MSW found at the different MSW dumping site (*katchra kundi*), local sites and generally open burning at the street and MSW dumping site (*katchra kundi*) to reduce of waste by community members. Four towns such as Baldia town, Kemari town, Lyari town and Orangi town dumped at the

Gondpass landfill site due to the nearest distance as compared to Jamchakro landfill site, and these towns are indicated in the following table 6.

Table 6. Weight of MSW dumped on Gond Pass landfill site, Karachi.

Date	T# 12 Wt. (t/d)	T#13 Wt. (t/d)	T#14 Wt. (t/d)	T#15 Wt. (t/d)	TW Wt. (t/d)
02-September-19	336.12	145.20	215.61	142.29	839.22
03-September-19	350.53	120.33	0	150.27	621.13
04-September-19	350.20	94.27	205.24	190.31	840.02
07-October-19	365.94	105.10	210.52	120.20	801.76
08-October-19	412.92	40.24	0	250.11	703.27
09-October-19	506.49	50.23	210.27	205.26	972.25
11-November-19	280.22	55.22	216.95	175.23	727.62
12-November-19	295.11	67.21	210.21	145.29	717.82
13-November-19	280.23	42.30	245.29	180.31	748.13
16-December-19	380.25	0	310.24	205.22	895.71
17-December-19	345.20	35.27	460.21	110.24	950.92
18-December-19	390.12	50.24	410.10	170.20	1020.66
20-January-20	332.18	84.76	340.12	90.26	847.32
21-January-20	245.29	67.22	285.42	165.12	763.05
22-January-20	210.21	0	0	160.32	370.53
24-February-20	290.94	65.21	225.12	170.72	751.99
25-February-20	210.42	75.28	305.29	145.82	736.81
26-February-20	350.21	105.24	315.20	209.21	979.86
TCW	5932.58	1203.32	4165.79	2986.38	14288.07
TAW(t/d)	329.58	66.85	231.43	165.91	793.78

Note: - TW = Total Weight, TCW = Total Cumulative Amount, Wt. (t/d) = Weight ton per day, TAW = Total Average Weight, T# 12 = Baldia Town, T# 13 = Kemari Town, T# 14 = Layari Town, T# 15 = Orangi Town

Four towns dumped amount of waste at Gond Pass landfill site is **793.78t/d/t**. And the rest of three towns Jamshed town, Sadder town, and S.I.T.E town dump at both landfill sites. Therefore, most of the union councils are nearest from the one landfill site and some union council is nearest from the other landfill site. It is shown in table 7.

Table 7. Weight of MSW dumped on Jam Chakro and Gond Pass landfill site Karachi.

Date	T# 16 Wt. (t/d)		T#17 Wt. (t/d)		T#18 Wt. (t/d)		CDGK Wt.(t/d)		TW J.C Wt.(t/d)	TW G.P Wt.(t/d)	TW Wt.(t/d)
	J. C	G. P	J. C	G. P	J. C	G. P	J. C	G. P			
02-September-19	443.12	0	0	345.21	88.55	65.21	581.97	112.24	1113.64	522.66	1636.3
03-September-19	424.71	146.22	170.25	260.21	402.52	145.21	562.68	182.89	1560.16	734.53	2294.69
04-September-19	534.24	148.72	382.60	405.21	215.21	145.21	355.69	158.25	1487.74	857.39	2345.13
07-October-19	326.86	151.11	58.20	345.51	438.71	165.21	266.11	159.61	1089.88	821.44	1911.32
08-October-19	462.58	0	74.28	215.51	454.25	105.21	57.81	208.22	1048.92	528.94	1577.86
09-October-19	462.76	116.16	83.27	310.21	0	156.41	394.51	130.12	940.54	712.9	1653.44
11-November-19	414.26	0	185.27	345.51	493.56	278.31	369.48	133.27	1462.57	757.09	2219.66
12-	428.27	113.54	72.50	365.21	392.77	245.51	365.23	179.32	1258.77	903.58	2162.35

November-19											
13-November-19	426.76	0	113.44	245.21	376.54	266.46	245.58	269.23	1162.32	780.9	1943.22
16-December-19	427.55	135.61	69.93	305.51	501.69	278.51	214.26	385.91	1213.43	969.93	2183.36
17-December-19	484.16	0	0	415.31	245.39	256.71	122.21	118.21	851.76	790.23	1641.99
18-December-19	523.13	150.51	153.24	490.41	348.37	245.21	89.63	618.0	1114.37	1353.62	2467.99
20-January-20	582.36	164.21	245.43	380.61	489.29	0	55.28	0	1372.36	544.82	1917.18
21-January-20	528.12	0	100.44	360.21	456.75	0	83.42	0	1168.73	360.21	1528.94
22-January-20	447.88	198.21	67.71	345.21	621.57	145.51	42.38	0	1179.54	688.93	1868.47
24-February-20	565.21	46.21	0	475.41	365.21	156.31	546.21	215.24	1476.63	893.17	2369.8
25-February-20	516.91	0	0	380.90	346.21	145.21	522.11	282.89	1385.23	809	2194.23
26-February-20	665.21	121.21	54.21	415.51	342.51	156.51	565.21	278.65	1627.14	971.88	2599.02
TCW	8664.09	1205.59	1830.77	6406.87	6579.10	2956.71	5439.77	3432.05	22513.73	14001.22	36514.95
TAW (t/d)	481.33	66.97	101.70	355.93	365.50	164.21	302.20	190.66	1250.76	777.84	2028.60

Note: - TW = Total Weight, TCW = Total Cumulative Amount, Wt. (t/d) = Weight ton per day, TAW = Total Average Weight, T# 16 = Jamshed Town, T# 17 = Saddar Town, T# 18 = S.I.T.E Town, CDGK= City District Government Karachi

Table 7 indicates that three towns like Jamshed town, S.I.T.E town and CDGK dumped high amount of MSW about **1250.76 t/d** at Jamchakro landfill site as compared to Gond Pass is about **777.84 t/d**, therefore, total amount of MSW of these three towns are **2028.60 t/d**. Jamshed town and S.I.T.E town possess higher union council and both touch with the big market along with the residential area around the towns also S.I.T.E town touch with the industrial zone, that's why these towns comparatively generate higher amount of MSW, and the total amount of MSW reached at the landfill site per day as shown in table 8.

Table 8. Weight Of MSW Dumped on Jam Chakro Landfill Site In 2019 And 2020.

Date	TW ((T#01-T#11) Wt. (t/d)	TW (T#12-T#15) Wt. (t/d)	TW (T#16-T#18 + CDGK) Wt.(t/d)	TOTAL MSW LANDFILLED
02-September-19	6443.22	839.22	1636.3	8918.74
03-September-19	5442.18	621.13	2294.69	8358
04-September-19	6435.39	840.02	2345.13	9620.54
07-October-19	6822.46	801.76	1911.32	9535.54
08-October-19	6075.49	703.27	1577.86	8356.62
09-October-19	6890.46	972.25	1653.44	9516.15
11-November-19	6461.7	727.62	2219.66	9408.98
12-November-19	6400.01	717.82	2162.35	9280.18
13-November-19	5911.39	748.13	1943.22	8602.74
16-December-19	5944.16	895.71	2183.36	9023.23
17-December-19	6528.82	950.92	1641.99	9121.73
18-December-19	6506.63	1020.66	2467.99	9995.28
20-January-20	6895.09	847.32	1917.18	9659.59
21-January-20	6509.12	763.05	1528.94	8801.11

22-January-20	6048.44	370.53	1868.47	8287.44
24-February-20	6023.06	751.99	2369.8	9144.85
25-February-20	6138.33	736.81	2194.23	9069.37
26-February-20	7617.46	979.86	2599.02	11196.34
TCW	115093.4	14288.07	36514.95	165896.4
TAW (t/d)	6394.07	793.78	2028.60	9216.468

Note: - TW = Total Weight, TCW = Total Cumulative Amount, Wt. (t/d) = Weight ton per day, TAW = Total Average Weight, T# 01 = Gulshan Town, T# 02 = Gulberg Town, T# 03 = Gaddap Town, T# 04 = Korangi Town, T# 05 = Liaquatabad Town, T# 06 = Landhi Town, T# 07 = Malir Town, T# 08 = North Nazimabad Town, T# 09 = North Karachi Town, T# 10 = Shah Faisal Town, T# 11 = Bin Qasim Town, T#12 = Baldia Town, T# 13 = Kemari Town, T# 14 = Layari Town, T# 15 = Orangi Town, T# 16 = Jamshed Town, T# 17 = Saddar Town, T# 18 = S.I.T.E Town, CDGK= City District Government Karachi.

In the above table 8, estimate the total amount of waste during 2019-2020 which is lifted from the towns and reached at both the landfill site from the mega city about **9216.468 t/d** and according to the data of SSWMB the amount of waste which is lifted from the towns and reached at landfilled sites was **9510.354 t/d**. This value is actual lifting the MSW from the towns that is showing 50% amount of MSW reached at the landfill site, because according to the population in Karachi city the amount of MSW generated from the city is **20,000 t/d** in 2020. The MSW that reached at the landfill site is 50% and 50% is not properly collected from the city and found in every nook and corner of the city.

In 2006, solid waste management department (CDGK) also estimated the actual amount of municipal solid waste lifting from the towns and dumped at the landfill site in Karachi city, this value is compared along with 2012 and the values during the survey in 02-September-2019 to 26-February-2020 is indicated in the following table 9.

Table 9. Comparison of msw generated in Karachi city in past fifteen years 2006 - 2020.

S.No.	Name of Towns	ACTUAL AMOUNT OF WASTE LIFTED IN FIFTEEN YEARS (t/d)		
		2006 ^a	2012 ^b	2020
01	Gulshan Town	318	444.48	659.64
02	Gulberg Town	330	307.84	655.06
03	Gaddap Town	320	146.25	569.80
04	Korangi Town	272	306.08	620.89
05	Liaquatabad Town	594	255.35	665.83
06	Landhi Town	324	406.01	651.90
07	Malir Town	270	229.01	645.95
08	North Nazimabad Town	336	406.60	494.79
09	North Karachi Town	280	338.04	418.77
10	Shah Faisal Town	105	241.13	619.75
11	Bin Qasim Town	27	0	391.64
12	Baldia Town	302	372.74	329.58
13	Kemari Town	180	92.43	66.85
14	Layari Town	300	360.63	231.43
15	Orangi Town	240	280.81	165.91
16	Jamshed Town	525	590.56	548.30
17	Saddar Town	454	340.14	457.63
18	S.I.T.E Town	153	323.08	529.71
	C.D.G. K	-	529.98	492.86
TCW (t/d)		5330	5971.16	9216.29

Note: - TW (t/d) = Total Weight ton per day, TCW = Total Cumulative Amount. 2006^a = SWM C.D.G.K2012 = Shahid M., et al, 2014.

The figure 8 compares the MSW generation rate from 2006 to 2020, the MSW generation rate is higher in 2020 as compared to the 2006 and 2012, whereas Liaquatabad, Gulshan, Gulberg, Landhi, Malir, Korangi and Shah Faisal comparatively generate higher amount of waste than other towns because they possess *goths*, suburbs, and big markets.

Composition Of MSW Generated in Karachi City In 2019-2020

In the Karachi city, three types of socio-economic classes are living, such as, lower, middle, and upper class. Composition of the waste was checked in the summer and winter season 2019 and 2020. The sample from the grocery market and vegetable markets were also taken for the assessment of MSW fraction. In table 09 the estimation of the average percentage in the summer and winter season is shown.

Table 10. Physical composition of MSW during 2019-2020.

Name Of Fraction	HOUSEHOLD WASTE						COMMERCIAL WASTE			
	AP		AP		AP		AP		AP	
	L C		M C		U C		G. M		V.M	
	summer	winter	summer	winter	summer	winter	summer	winter	summer	winter
	2019-2020		2019-2020		2019-2020		2019-2020		2019-2020	
Food / Kitchen Waste	38.5	43.55	46.85	40.65	45	34.7	15.55	28.05	80	70.7
Green Waste			2.95	3.95	5	14.95	-			
Paper Waste	11.35	9.3	6	5.95	8	7.1	30		3.65	7.85
Broken Glass	5		3		4	3	9.15	8.5	-	
Metal Pieces			-		2.8	2	-		-	
Plastic	19.6	19.9	13.95	12.9	10	10.25	27.15	26.5	8.8	12.25
Wood			-		-				-	
Rags	4.55	4.05	2.95	7.3	-		11.45	15.05	-	
Diapers / Nappies	7.85	12.2	9	12.85	9.5	11.35	-		-	
Textile / Clothing	8.05	6.8	6.6	5.65	5	6.9	11.7	12.05	-	
Tetra Bricks	7.45	4.3	7.7	10.9	10.7	9.45	-		-	
Bones	-		-		-		-		-	
Rubber and Leathers	-		4		-		-		-	
Scrap Metal	-		1		-		-		-	
Cardboard	-		-		-		10	9.95	7.5	9.15

AP = Average Percentage

Summer (2019-2020) = May to July

Winter (2019-2020) = November to January

In the above table 09, it is observed that the Organic Waste > Plastic Waste>Paper Waste>Textile Waste > Diapers / Nappies >Tetra Bricks >Rags > Broken Glass >Rubber and Leather >Green Waste>Cardboard>Metal Piece > Scrap Metal. The organic waste is comparatively generated in higher percentage than plastic waste and paper waste from the household sector as compared to grocery markets. In the case of vegetable markets perished vegetables are discarded and damaged vegetable and fruit waste is sorted out by waste picker for cattle feed and the rest of waste remains there. Cardboard, metal piece and scrap metal not reached at the dumping site because this can be sorted out at the source point and by the waste picker for selling it against money. In the winter season food waste is comparatively generated in higher amount as compared to the summer season. The total average percentage of the MSW composition was compared in summer and winter season of 2019 and 2020, the variation among the fraction of MSW observed is given in the following table 10.

Table 11. Comparison average percentage of MSW fraction during 2019-2020 in Karachi City.

FRACTION	COMPOSITION OF MSW DURING 2019-2020					
	LC	MC	UC	GM	VN	T.A.P
	A.P % 2019-2020	A.P % 2019-2020	A.P % 2019-2020	A.P % 2019-2020	A.P % 2019-2020	% 2019-2020
Food / Kitchen Waste	41.025	43.75	39.85	21.8	75.35	44.35
Green Waste	-	3.45	9.975	-	-	6.71
Paper Waste	10.325	5.975	7.55	30	5.75	11.92
Broken Glass	5	3	3.5	8.825	-	5.08
Metal Pieces	-	-	2.4	-	-	2.40
Plastic	19.75	13.425	10.125	26.825	10.525	16.13
Wood	-	-	-	-	-	-
Rags	4.3	5.125	-	13.25	-	7.55
Diapers / Nappies	10.025	10.925	10.425	-	-	10.45
Textile / Clothing	7.425	6.125	5.95	11.875	-	7.84
Tetra Bricks	5.875	9.3	10.075	-	-	8.41
Bones	-	-	-	-	-	-
Rubber and Leathers	-	4	-	-	-	4.0
Scrap Metal	-	1	-	-	-	1.0
Cardboard	-	-	-	9.975	8.325	9.15

Note: - AP = Average Percentage, T.A.P = Total Average Percentage

Here, estimate the total average percentage of the physical composition of the MSW. Where, Organic Waste > Plastic Waste> Paper Waste> Diapers / Nappies > Cardboard > Textile Waste>Rags > Green Waste> Broken Glass > Rubber and Leather > Metal Piece > Scrap Metal. 50 % of the food waste is discarded from the city than plastic and paper waste. This waste generally not sorted out from the waste because these wastes have no value into the market and one has an interest for buying it. These wastes remain at the dumping site, cause bad odour, and spread disease in the city.

Some people (middle class and upper class) discard MSW without segregation and handover to waste picker or home servants which gutted and resell it to the agent. Waste pickers also collect the non-biodegradable items from the streets and installed dustbin by municipalities. In the following figure 01, the comparison of physical composition of MSW fraction is given during 2019 to 2020.

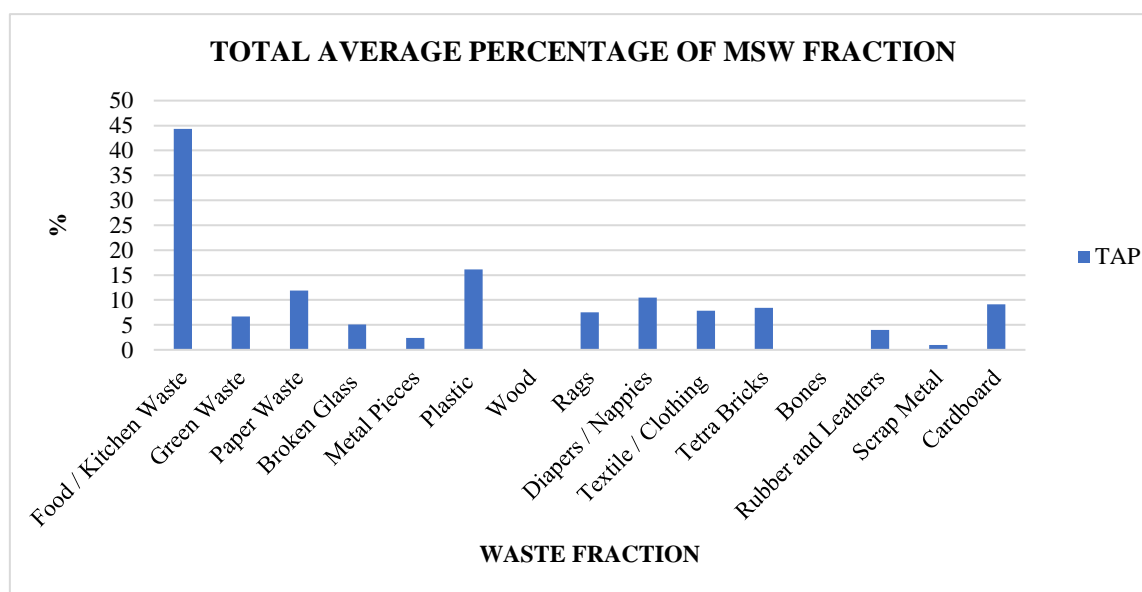


Figure 1. Comparison Of Physical Composition of MSW Generated During 2019 And 2020 in Karachi City.

In the above figure, total average percentage is showing organic waste is comparatively much higher in percentage than plastic and paper waste. Non-biodegradable waste separated out from the waste mostly at source and through waste picker from the streets, roads, and MSW dumping site (*katchra kundi*). Green waste is less than 5 % because mostly lower and middle class have no garden facilities, some middle class and upper class produce the green waste.

The current assessment of MSW composition in 2019-2020 is compared with the MSW fraction assessment in 2006 and 2014 in the figure 02.

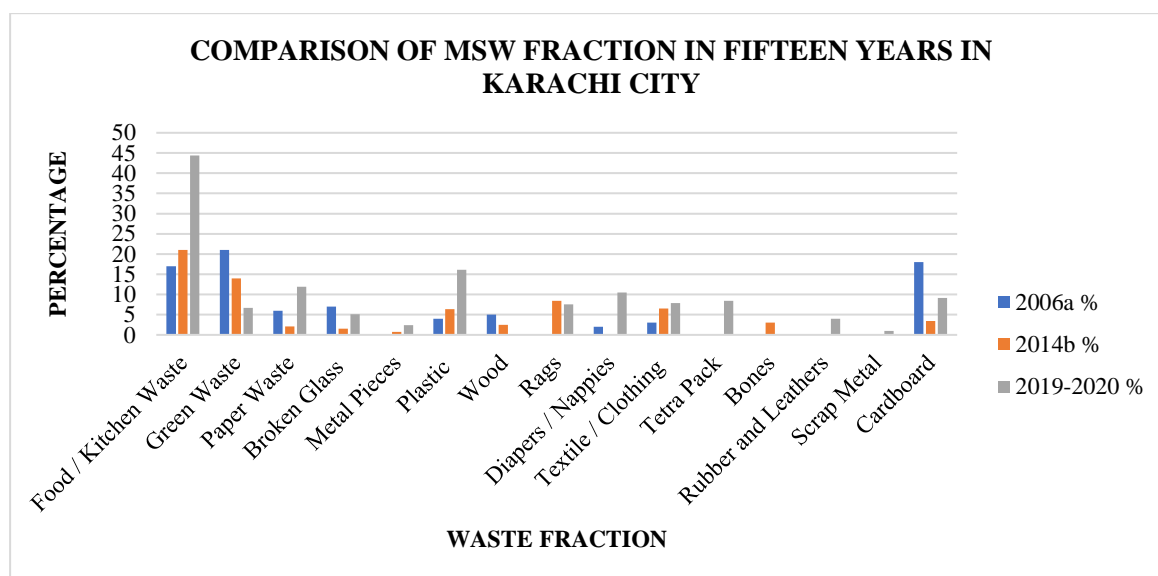


Figure 2. Comparison of physical composition of MSW generated during fifteen years in Karachi City.
Source: SWM CDGK (2006), TMA and solid waste department of relative city (2014)

In the above figure 02, It is observed that the entire fraction except green waste is higher in percentage in 2019-2020 in the order of food waste > plastic waste > cardboard > tetra pack > diapers and nappies > paper waste > textile and clothes > rags > broken glass > green waste > rubber and leather > metal piece > scrap metal. Food waste / kitchen waste (organic waste) comparatively increases in the above comparison among 2006 to 2020 as compared to the other fraction of waste. In 2020, the paper waste, plastic waste, diapers / nappies, textile / clothing, cardboard, and tetra brick is also in higher proportion than the previous years. Waste picker mostly Afghans are active in the collection and sorting of non-biodegradable waste including metal pieces, newspaper, breadcrumbs, damage plastic items, iron rod, plastic bags, plastic bottles, and these items are mostly sorted out and sold against money.

Public Perception Regarding Existing Condition Of MSW

A total of 300 personal face-to-face interviews were administered in 2020. In the survey three aspects of questions were covered, household details, household waste generation, composition, disposal and MSW collection service. The tables 12 and 13 indicate 130 respondents belonged to lower class, 90 respondents belonged to middle class and 80 respondents belonged to upper class (based on their monthly income). The mean age of the respondent was 35 to 40 years. Public participation is one of the most important indicators that reflect the environmental status, such as, people knowledge, personal consideration and behavior, public capacity, and the local people attitude towards sustainable society etc., all such information is useful for decision makers, environmentalists, educators, and business personnels in planning for social sustainable development.

Table 12. Summary of Questionnaire Regarding MSW Generation Composition and Disposal.

S.No.	QUESTION	POPULATION			% RESPONSE		
		L.C	M.C	U.C	L.C	M.C	U.C
		130	90	80	%	%	%
1	Priority concern about waste						
	1. MSW and look bad.	80	30	20	61.53	33.33	25.0
	2. Effect on human health.	40	40	30	30.76	44.44	37.5
	3. Effect on Environment.	10	20	30	7.69	22.22	37.5
2	Waste disposal in						
	1. Plastic bag	60	30	-	46.15	33.33	-
	2. Dust bin	10	50	70	7.69	55.55	87.5
	3. Direct disposal to dump	60	10	20	46.15	11.11	25.0
3	Weight of MSW generate per day.						
	1. ½ Kg	10	10	10	7.69	11.11	12.5
	2. 1 Kg	40	20	20	30.76	22.22	25.0
	3. 1.5 Kg	30	20	30	23.07	22.22	37.5
	4. 2 Kg	20	10	10	15.38	11.11	12.5
	5. Greater than 2 Kgs	30	30	20	23.07	33.33	25.0
4	Composition of discarded waste						
	1. Plastic, Paper, Tetra Pack, Clothes	90	40	20	69.23	44.44	25.0
	2. Plastic, Paper, Tetra Pack, Diapers, Clothes	40	20	10	30.76	22.22	12.5
	3. Plastic, Paper, Tetra Pack, Diapers, Clothes, Green waste	-	10	50	-	11.11	62.5
	4. Plastic, Paper, Tetra Pack, Diapers, Clothes, Metal, Can	-	-	-	-	-	-
	5. Plastic, Paper, Tetra Pack, Diapers, Clothes, Metal, Can, Bread crumb, Broken Glass	-	-	-	-	-	-
5	Segregate at your home						
	1. Yes	120	70	20	92.30	77.77	25.0
	2. No	10	20	60	7.69	22.22	75.0
6	Location of dustbin						
	1. Kitchen	60	50	30	46.15	55.55	37.50
	2. Backyard	50	30	50	38.46	33.33	62.50
	3. Outside home	20	10	-	15.38	11.11	-
7	Who dispose?						
	1. Servant	-	10	60	-	11.11	75
	2. Family Members	100	60	-	76.92	66.66	-
	3. Private Sweeper	20	10	10	15.38	11.11	12.5
	4. City Level Resource	10	10	10	7.69	11.11	12.5
8	Disposal time						
	1. Day time	30	50	70	23.07	55.55	87.50
	2. Nighttime	60	20	20	46.15	22.22	25.50
	3. Any time	40	20	-	30.76	22.22	-
9	Disposal frequency						
	1. Daily	80	60	50	61.53	66.66	62.50
	2. Every second day	20	20	30	15.38	22.22	37.50
	3. Every third day	-	-	-	-	-	-
	4. Random	30	10	-	23.07	11.11	-

L.C = Lower Class

M.C = Middle Class

U.C = Upper Class

Table 13. Summary of Questionary Regarding MSW Collection Service.

S.NO	QUESTION	POPULATION			% RESPONSE		
		L.C	M.C	U.C	L.C	M.C	U.C
		130	90	80			
1	MSW collection services						
	1. Yes	80	40	20	61.53	44.44	25.0
	2. No	50	50	60	38.46	55.55	75.0
2	MSW collection frequency						
	1. Daily	60	30	40	46.15	33.33	50
	2. Every second	30	-	40	23.07	-	50
	3. Irregular day	-	40	-	-	44.44	-
	4. Do not know	40	20	-	30.76	22.22	-
3	Level of satisfaction						
	1. Yes	80	30	30	61.53	33.33	37.5
	2. No	50	60	50	38.46	66.66	62.5
4	Collection time						
	1. Morning	90	40	40	69.23	44.44	50.0
	2. Noon	-	20	30	-	22.22	37.5
	3. Afternoon	20	10	10	15.38	11.11	12.5
	4. Evening	20	20	-	15.38	22.22	-
5	Current collection mechanism						
	1. Donkey cart	70	-	-	53.84	-	-
	2. Wheelbarrow	20	40	10	15.38	44.44	12.5
	3. Cart	10	20	10	7.69	22.22	12.5
	4. Rikshaw	30	30	50	23.07	33.33	62.5
	5. Mini Truck	-	-	10	-	-	12.5
6	Preference for waste collection system						
	1. Door collection	90	60	40	69.23	46.15	50.0
	2. Disposal at centralized collection	40	30	30	30.76	23.07	37.5
	3. Kerbs ide collection	-	-	20	-	-	25.0
7	Problems related to waste disposal.						
	1. Waste lying around.	80	40	-	61.53	44.44	-
	2. No regular collection	20	30	60	15.38	33.33	75.0
	3. Diseases spread.	30	20	20	23.07	22.22	25.0

L.C = Lower Class

M.C = Middle Class

U.C = Upper Class

During survey the generation and composition of Municipal solid waste was estimated and the trend of disposal of waste among the local respondent was checked. It was seen that the rate of generation is between the 1.5 Kg and 2 Kg. also, some of the respondent said that the sometime the amount increased up to of 2 Kgs. Generally, the composition of plastic, paper, tetra bricks and clothes come from the residential areas

The one trend is similar among the three classes the valuable items segregate at home through family members, servant, private sweeper, or sanitary workers. The lower class generally place garbage at outside the home and generally into the plastic bags instead of dustbin than middle class and upper class. Middle class put their garbage into the kitchen than backyard and upper class put their waste in the backyard. The disposal time is into the daytime in the upper class and middle class than lower class because mostly the upper class itself disposes the waste and the waste collector comes in the mid-day and mostly lower class engaged their outside work than middle class and upper class.

Inadequate collection of the waste cause problems for the local residence as well as disturb the beauty of the city. Population of Karachi is increasing day by day and according to the census 2017 it increases at national level is 2.4 percent whereas growth in urban areas is 2.70 percent which is higher than the population growth rate in rural areas which is 2.23 percent. According to the survey people refer to the door-to-door collection of the garbage instead of alternative days. Municipal level the garbage is mostly collected in the noon time and mostly the lower class and the middle class engaged in job and leave the home in the early time for job. That's why their garbage collects in the second day or alternative day. The one thing is common derived through the survey that people said that local government does not take serious action and make proper planning for the collection, transportation, and disposal of the waste because most of the areas including *katchi abadies* is far from the center of the city and has a narrow street where the collection is too difficult. Mostly in the lower-class garbage is collected by means of donkey cart, wheelbarrow, and cart instead of that in the middle class mostly wheelbarrow and rikshaw is used. This inadequate collection not only disturbs the aesthetic beauty but also spread disease and damages our natural environment.

CONCLUSIONS

Karachi generates more than 20,000 tons per day of waste from its six districts. Developing countries are facing the increasing issue of solid waste management. In Karachi, Municipalities allot different sites as well as installed dustbins for dumping of Municipal solid waste, but they are all out of capacity and MSW comes out on the roads. The illegal dumping is one of the largest issues faced by the society, due to a lack of dumping sites which encourage illegal dumping habits among residents. Certain hazardous wastes, such as hospital waste is also dumped openly along with other wastes instead of being disposed in an appropriate way. This can lead to widespread diseases and epidemics in the city and is also harmful to the environment. Outdoor burning of MSW was observed in various areas which cause extreme level air pollution and environmental degradation. Due to the shortage of finance and improper management of solid waste, the outcome of solid waste management process becomes ineffective. The equipment and machinery for waste collection and disposal are insufficient in Karachi. Considering the huge population of Karachi, the number of dustbin bins allocated to a local area is too limited, most of which are not situated well to provide accessibility to the public. People do not throw their MSW in allocated points, because they do not find them convenient to access from their homes. Transportation for the collection of from the dumping sites is too infrequent and inappropriate, as the big trucks are exclusively capable of picking up trash from main roads and are unable to enter housing areas with narrow streets. Along with this, a major problem is that whenever any heavy machinery breaks down, it requires a long time to be repaired which causes disturbance in the MSW collection routine. The people have no awareness about the management of Municipal solid waste and their uses. Most households usually separately sell scraps like newspapers, plastic, and glass, but they are not aware about the most efficient ways of separating scrap and recyclable materials from other irreparable MSW, and as a result, they just throw them away together with the other waste. There is a low degree of social campaigning to create awareness among the people.

Recommendation

Alarming situation of municipal solid waste (MSW) is growing in Karachi, there is an immediate need for appropriate measures to be taken for the waste management throughout all districts of the city. Cleanliness can only be achieved if municipalities have a sufficient labor pool. There is a need to hire additional skilled persons to assist the municipalities in dealing with the growing waste situation in the city. Furthermore, the workforce must be competent enough in handling specialized heavy machinery and vehicles used for waste collection and disposal, such as auto rickshaw, trucks, and dumpers. To implement an integrated and systematic solid waste management policy, waste management procedures must be conducted by adopting the latest technology and engineering techniques. For this purpose, employees must be provided with training programs to aid in increasing their efficacy for the job. The dumpers that carry MSW are not covered which creates unbearable odors and can spread the diseases, hence, it should be ensured that all MSW collecting vehicles are covered. The study found that municipalities in Karachi share an opinion that there is a deficiency of funds and suitable

technique of waste management. Proper dumping sites must be allotted in every area with enough litter bins, so that residents dump their MSW only at the sites assigned for waste disposal. Two major problems that municipalities currently face are illegal dumping and open burning of MSW at various points around Karachi. These practices are severely harmful for the environment of the entire city as well as for the health and well-being of its residents. It is essential for municipalities to broadcast public service advertisements on television and other media to build awareness and encourage people to stop their current practices. The society must be educated and given the relevant information pertaining to the correct ways of dumping wastes at the nearest municipal dumping sites or bins in their areas. Solid waste management laws must be enforced, and people should be aware about the penalties, such as fines for breaking these laws. Such steps will be beneficial and valuable for the entire society in the long-term.

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