Municipal Solid Waste Management in Makassar city, Indonesia

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1. Introduction

This paper an overview of existing waste management conditions in Makassar city, based on literature study and secondary data collection in Makassar city that has been conducted by the author. At the beginning described of Makassar city solid waste management in general then organization, operation and facility, community and private sector involvement, financing and ended with conclusion that contains summary of the current problem which is expected to be a municipalities reference to improve waste management of Makassar city.

2. Makassar city solid waste management

In most major cities in Indonesia, population increase has created poor environmental living conditions that significantly affect sanitary conditions. Of all these problems, the commonest in urban areas is currently the improper management of municipal solid waste (MSW), which is also a growing concern within those cities. Makassar is the capital of South Sulawesi provincial, one large province located on the center of the Republic of Indonesia. As one of metropolitan city in Indonesia (table.1), Makassar has 175,77 km^2 area which include 14 wards. Average growth rate 2.8% per year (2003-2006), average production waste 0.0029m3/capita/day in 2006 derived from 1,223,540 person and in 2009 year is has reached 1,272,349 people. Figure.1 shows the characteristics of solid waste which organic waste tends to decrease, otherwise increase of paper and plastic waste that be reused easily compare than other waste. In 2009, 59.4% of garbage in Makassar city derived from household particularly generated from the families who stay at standard house type (figure.2)

Table 1 Total area, population and solid waste generated metropolitan city in Indonesia

City	Area (km2)	Population				Waste Generated (m3/day)				(m3/person/day)
		2003	2004	2005	2006	2003	2004	2005	2006	2006
Jakarta Selatan	145.30	1,703,491	1,708,269	1,718,042	1,738,248	4,609	5,223	NA	5,663	0.0033
Jakarta Pusat	50.20	1,115,952	897,789	893,195	888,419	4,571	4,651	NA	5,280	0.0059
Medan	265.10	1,926,520	2,068,400	2,068,400	2,067,288	4,664	164	4,382	4,985	0.0024
Semarang	373.67	1,309,667	1,424,000	1,406,999	1,445,334	3,750	4,274	3,805	4,500	0.0031
Surabaya	374.36	2,599,352	2,599,796	2,740,490	2,809,679	6,700	6,700	6,234	2,610	0.0009
Palembang	102.47	1,418,796	1,500,872	1,520,199	1,369,239	NA	4,698	NA	8,700	0.0064
Jakarta Utara	137.00	1,435,207	1,176,307	1,182,749	1,257,952	4,580	4,180	NA	5,161	0.0041
Jakarta Timur	187.56	2,371,121	2,385,121	2,434,163	2,413,875	5,325	5,442	5,273	6,593	0.0027
Jakarta Barat	127.11	1,567,090	1,565,406	1,573,619	1,565,947	5,947	5,947	NA	5,500	0.0035
Makassar	175.77	1,130,384	1,160,011	1,179,024	1,223,540	3,748	3,580	3,546	3,582	0.0029
Depok	200.29	1,313,495	1,335,734	1,369,461	1,420,480	2,000	NA	NA	3,764	0.0026
Bandung	167.67	2,141,837	2,141,837	2,453,302	2,520,812	6,470	6,474	NA	7,500	0.0030
Tangerang	164.54	1,311,746	1,466,577	1,488,666	1,537,558	NA	3,298	NA	3,367	0.0022
Bekasi	210.49	NA	NA	1,914,316	2,066,913	NA	NA	NA	2,790	0.0013

Source : Environmental ministries Republic of Indonesia

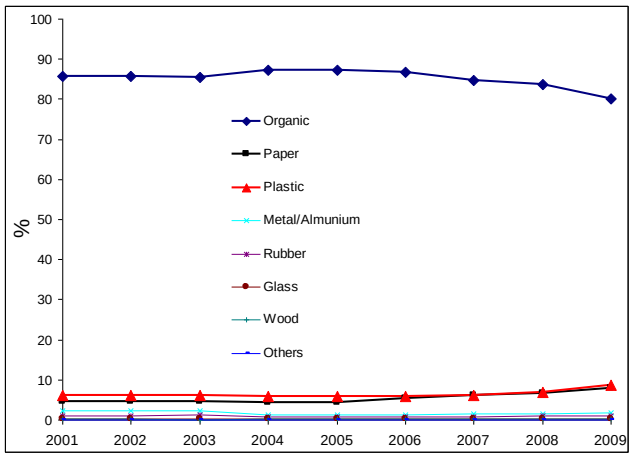


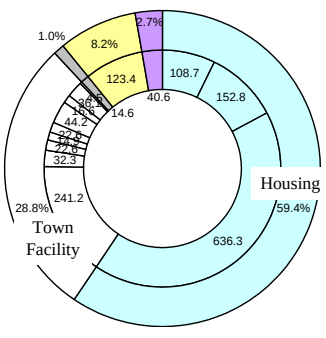
Fig.1 Makassar city solid waste characteristic
Source : Makassar city central bureau of statistics

2.1. Organization

Daily managerial and operation of makassar municipal waste currently handled by Makassar city of Sanitation and Fineness Department (Dinas Kebersihan dan Keindahan Kota Makassar, DKKM).
This department is responsible for waste management from collection of citizens to landfill management, maintenance facilities and infrastructure.
Number of employees this department are 909 person, consist of 128 permanent (government) employees, 7 of them working in the landfill and remain are non-permanent (part time). DKKM led by head of department who are assigned and responsible to the Makassar city mayor. In performing his duties, head of department aided by 4 head of sub-department and a secretary who oversees 3 activity fields.

2.2. Operation and Facility

Although solid waste in Makassar city had to be collected by DKKM to 89.1% in 2009, but existing condition not yet adopted integrated waste management system and monitoring the amount of waste flow that occurs has not been done, it has not research yet but about 80% of waste collected was taken straight to landfill. Figure.3 shows waste pattern services in Makassar city divided into 3 types : 1).Direct individual garbage service, applied in areas that easily accessible by garbage collector truck (vehicle) and usually located alongside major road, 2.)Indirect individual garbage service, applied to inaccessible areas by garbage collector truck (vehicles) and households that can afford private collectors to be taken their garbage to temporary shelters, 3.)Direct communal garbage service, usually applied to areas of poor households who must bring their own garbage to the



Source of waste	Waste Generated (ton/d)	%	
Exclusive house type	108.7		Housing
Middle house type	152.8	59.4%	
Standard house type	636.3		
Market	241.2		Town Facility
Commercial	32.3		
Office	22.6		
Education	14.9		
Transport Terminal	22.6	28.8%	
Seaport	44.2		
Hotel	16.6		
Hospital	36.1		
Religion facility	4.5		
Industrial area	14.6	1.0%	
Beach & River	123.4	8.2%	
Street, Park, etc	40.6	2.7%	
Total	1,511.4		

Fig.2 Makassar city waste generated
Source : Makassar city central bureau of statistics

temporary shelter as inability to pay the private collectors or a special location where the garbage collector truck (vehicle) does not operate.

Support facilities for waste management currently has 163 containers (can be carried by arm roll truck, 6m^3 cap.), 66 large-scale temporary shelter (permanent concrete, 10m^3 capacity) and 399 small type temporary shelter (permanent concrete, 3m^3 capacity) places spread over 14 wards in city.

Landfill of Makassar municipality, was in Tamangapa wards or sub district Mangala that adopt controlled landfill system, landfill covered with a soil layer every few days, there is leachate storage pond although not working properly, other supporting facilities are 3 units bulldozer, 1 unit excavator and 1 weigh bridges at the entrance gate, with area of 14.3 ha stand on land belong to makassar city government. Tamangapa landfill has originally designed capacity was 2,871.84 m^3/day, it location 0.5km from the nearest settlement/community, 14 km from the beach and city downtown, 30 km from airport. Based on initial calculations this landfill will be able to operate untill 2015. Currently there are number of 3R program supporting activities in Tamangapa landfill : 1.)Landfill mining, ORGI.Co (Australian company) by excavation garbage that has been buried for 5-10 years henceforth be converted into compost, established in 1999 with compost production capacity of 100-120 tons/day obtained from 666-800 tons/day garbage were excavated. Compost products used for forestry rehabilitation of mined activity and local agriculture with IDR.500.000(JPY 4,761)/ton price, 2.)CDM program plan for the construction of collection, monitoring and use of landfill gas (LFG) system to reduce methane emissions through combustion (on going feasibility study by world bank). 3.)Waste Reduction by scavengers who currently around 300 people, they collected the garbage that is still economic value and then sold to traders for recycling.

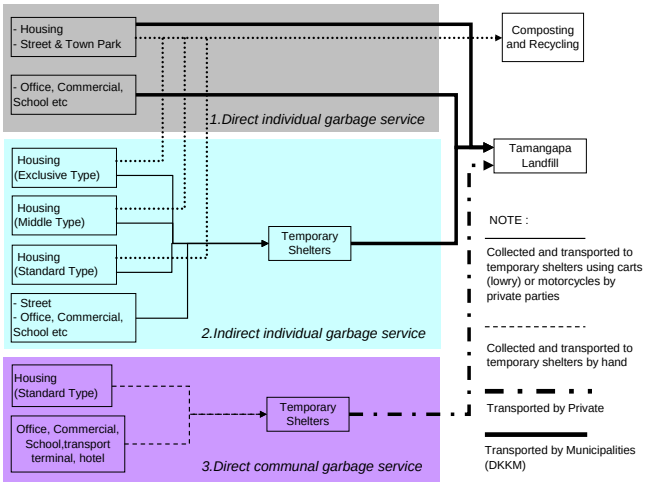


Fig.3 Solid waste flow and service pattern in Makassar city
Source : South sulawesi spatial and settlement department

Table 2 Makassar municipal solid waste cost

Year	O&M Cost (million rupiah)	Administration cost (million rupiah)	Capital expenditure (million rupiah)	Total cost (million rupiah)	Waste collected (tonnes/ year)	Waste collected (m3/year)	Cost/ tonnes (Rupiah)	Cost/ tonnes (JPY)	Cost/m3 (Rupiah)	Cost/m3 (JPY)
	A	B	C	D=A+B+C	E	F	G=D/E	H	I=D/F	J
2005	5,984	3,340	205	9,530	340,497	1,134,989	27,988	267	8,396	80
2006	9,069	1,959	526	11,554	345,064	1,150,214	33,482	319	10,045	96
2007	9,094	4,530	331	13,955	355,359	1,184,531	39,270	374	11,781	112
2008	10,298	3,986	14,519	28,802	363,014	1,210,048	79,342	756	23,803	227
2009	9,088	3,776	2,878	15,742	358,954	1,196,514	43,855	418	13,156	125

Source : Makassar city of Sanitation and Fineenes Department

2.3. Community and private sector involvement

The role of community and the private sector in waste management can be seen in some cases follows :

- Communities in several kelurahan (sub of ward) already implementing program 3 R, there are kelurahan : Kassi kassi, Barabaraya, Bungau Jaya, Tamua, Karang Anyar and Maccini Sombala. 3R program steps that was implemented .
- PD Pasar (local market management company) collecting garbage from each merchant on his territory. then garbage collected in containers provided by DKKM which then transport it to landfill.
- Panakukang Mas Real estate management perform garbage collection in their area, then transport it to a temporary dump for economic value waste segregation, then non economic waste transported to landfill by themselves.

2.4 Financing

Budget for waste management in the Makassar city mostly come from the government regular budget (APBD and APBN) 89% and 11% came from retribution collected through the community. Makassar city waste management costs in five years has increased by 57% from IDR.27,988 (JPY.267)/tonnes in 2005 to IDR.43,855 (JPY.418)/tonnes in 2009 (table.2). There are two types of retribution payment applied: 1.Retribution payment are collected every month through electricity bills, amount of payment is adjusted with the electricity used, 2. Direct payments to the collector, the amount of monthly bills based on Makassar city rules, are : Household IDR.2,000-7,000 (JPY13.3-46.7), Shop IDR.5,000-45,000 (JPY33.3-300), Restaurant IDR.35,000-225,000 (JPY233.3-1,500), Market IDR.2,500 (JPY16.7)/m^3 and Landfill gate fee IDR.1,000(JPY6.7)/m^3 however the retribution for a large waste source, such as hotels, shopping centers and supermarkets are determined through negotiations between business owners and government officials.

3. Conclusions

1. The increasing percentage of plastic and paper waste, opportunities to develop recycling industry thus reducing the amount of waste dumped in landfills and will indirectly extend landfill life time.
2. The amount of waste generated from the standard house type shows the largest source of household solid waste originated from low income communities. Solid waste financing should not depend on the waste management fees earned from households or housing.
3. There is no waste monitoring conducted by municipalities led to the amount of waste flow that occurs is exactly unknown. Needed more data and field survey. as material to develop Makassar waste management strategies
4. Makassar city waste management costs in five years has increased by 57% or 11% per year compare population growth rate 2.8% per year. needed alternative sources of financing and optimization at collection / transportation stage.