Table 2.2-13 Projection of Market Waste Composition (Rainy Season)

(Unit: wt.%)

Classification	1992		2000		2010		Moisture Content
	Content	Annual Growth	Expanded Share	Content	Expanded Share	Content	
	%	%	%	%	%	%	%
Recyclable							
Paper	5.14	+1	5.57	5.51	6.15	6.00	62.22
Plastics	2.75	+2	3.22	3.19	3.93	3.84	39.56
Metal	0.27	+1	0.29	0.29	0.32	0.31	5.27
Glass	0.20	+2	0.23	0.23	0.29	0.28	2.38
Sub total	8.36		9.31	9.22	10.69	10.43	-
Non-Recyclable							
Textile	0.27	±0	0.27	0.27	0.27	0.26	41.54
Wood/Grass	28.74	±0	28.74	28.45	28.74	28.05	75.71
Garbage	61.93	±0	61.93	61.32	61.93	60.44	78.69
Other Combustible	0.36	+1	0.39	0.39	0.43	0.42	9.07
Other Non Combustible	0.34	+1	0.37	0.37	0.41	0.40	5.78
Sub total	91.64		91.70	90.78	91.78	89.57	-
TOTAL	100		101.01	100	102.47	100	
Moisture Content	77.20		74.67		74.24		

Table 2.2-14 Projection of Market Waste Composition (Dry Season)

(Unit: wt.%)

Classification	1992		2000		2010		Moisture Content
	Content	Annual Growth	Expanded Share	Content	Expanded Share	Content	
	%	%	%	%	%	%	%
Recyclable							
Paper	2.86	+1	3.10	3.07	3.42	3.33	29.58
Plastics	2.62	+2	3.07	3.04	3.74	3.65	48.86
Metal	0.10	+1	0.11	0.11	0.12	0.12	4.69
Glass	0.03	+2	0.04	0.04	0.04	0.04	0.00
Sub total	5.61		6.32	6.26	7.32	7.14	-
Non-Recyclable							
Textile	0.37	±0	0.37	0.37	0.37	0.36	38.29
Wood/Grass	11.11	±0	11.11	10.99	11.11	10.83	58.64
Garbage	78.51	±0	78.51	77.66	78.51	76.54	74.20
Other Combustible	0.07	+1	0.08	0.08	0.08	0.08	10.19
Other Non Combustible	4.33	+1	4.69	4.64	5.18	5.05	5.10
Sub total	94.39		94.76	93.74	95.25	92.86	-
TOTAL	100		101.08	100	102.57	100	
Moisture Content	68.46		66.85		66.32		

Table 2.2-15 Projection of Street Waste Composition (Dry Season)

(Unit: wt.%)

Classification	1992		2000		2010		Moisture Content
	Content %	Annual Growth %	Expanded Share %	Content %	Expanded Share %	Content %	%
Recyclable							
Paper	9.11	+1	9.86	9.62	10.90	10.27	44.21
Plastics	4.33	+2	5.07	4.94	6.18	5.82	39.46
Metal	1.39	+1	1.51	1.47	1.66	1.56	7.71
Glass	0.37	+2	0.43	0.42	0.53	0.50	0.00
Sub total	15.20		16.87	16.45	19.27	18.15	-
Non-Recyclable							
Textile	0.09	±0	0.09	0.09	0.09	0.08	30.00
Wood/Grass	21.05	±0	21.05	20.53	21.05	19.83	53.68
Garbage	53.14	±0	53.14	51.82	53.14	50.08	62.59
Other Combustible	0.74	+1	0.80	0.78	0.89	0.84	6.25
Other Non Combustible	9.78	+1	10.59	10.33	11.70	11.02	5.12
Sub total	84.80		85.67	83.55	86.87	81.85	-
TOTAL	100		102.54	100	106.14	100	
Moisture Content	51.75		50.37		49.59		

b. Assumptions

In general, the waste composition changes in accordance with the economic growth showing the following tendency:

i Waste derives from the goods for basic human needs like foods and cloths shows low sensitivity to the economic growth

ii Waste derives from the other daily activities tends to increase in proportion to the economic growth

iii Due to the change of the composition the apparent specific weight becomes smaller, the moisture content also becomes lower on the other hand the calorific value becomes higher

iv Recyclable matters such as metal, glass, paper and plastics are liable to be affected by the condition of recycling market

Concerning the recycling market, the sales amount has been decreasing and the number of scavenger has also decreased through this decade. According to the Preliminary Report on Studies for Surabaya Water, Wastewater, Drainage and Solid Waste, the amount of recycled waste was 260 t/d in 1975 whereas the present amount is estimated at about 190 t/d. It means the sales amount has been decreased 1.8% per year in average. Further more the circumstances of recycling market is exposed to the two contrary winds: the market price of plastics is reported to be descending as the result of strict competition against

imported material and at the same time the local government is now promoting the policy to assist the scavengers to change their job into the others. therefore the waste amount will increase faster in proportion to the reduction of waste recovery activity.

Considering the circumstances of recycling market, the assumption is given as follows:

Assumption 1:
The unit generation amount of textile, wood/grass and garbage will be constant.

Assumption 2:
The unit generation amount of the other waste will be increased.

Assumption 3:
Among the recyclable wastes, plastics and glass will increase its share by 2% every year due to inactive situation of its recycling market and descending market price, referring to the assumption adopted in the study on Solid Waste Management System Improvement Project in Jakarta.

Assumption 4:
The other recyclable waste and the other non-recyclable waste except textile, wood/grass and garbage will increase its share by 1% every year because the growth rate is supposed to be smaller than plastics due to the lack of disadvantage in recycling market.
Assumption 5:
The moisture content of each component will not change even in future.

2) Calorific Value

The measurement of calorific value was conducted in this study for totally 13 samples (Rainy season 6, Dry season 7). Among these samples, there are 10 data which are related to the projection of future waste quality, namely the data of household waste, market waste and incinerator wastes are available for the basis of the projection. Table 2.2-16 and Fig. 2.2-5 present the results of the measurement of calorific value and moisture content.

According to these data, there seems to be an apparent relationship between calorific value and moisture content. The calorific value tends to decrease in inverse proportion to the moisture content. The approximate gradient of calorific value to moisture content can be seen at minus 50 kcal/kg per unit moisture change (1%).

Table 2.2-16 Correlation between Calorific Value and Moisture Content

Source	Rainy Season		Dry Season	
	Calorific Value (kcal/kg)	Moisture Content (%)	Calorific Value (kcal/kg)	Moisture Content (%)
Household Waste				
Darmo Permai	880	69.6	1,480	57.8
Sawahan	970	67.1	1,450	57.0
Tambak Sari	1,050	62.5	1,210	55.6
Market Waste				
Wonokromo	300	78.5	450	72.9
Incinerator	1,250	64.8	1,390	54.5

Considering this trend of calorific value appeared in the survey results, the future value is projected as shown in Table below.

The calorific value is projected in every case it will become higher, however, the market waste will still remain unsuitable for incineration even in 2010.

Table 2.2-17 *Projection of Calorific Value*

Source	1992		2000		2010	
	Moisture Content (%)	Calorific Value (kcal/kg)	Moisture Content (%)	Calorific Value (kcal/kg)	Moisture Content (%)	Calorific Value (kcal/kg)
Household Waste						
Rainy	66.1	1,020	65.5	1,050	64.8	1,090
Dry	54.7	1,290	53.4	1,360	52.3	1,410
Market Waste						
Rainy	77.2	300	74.7	430	74.2	450
Dry	68.5	450	66.9	530	66.3	560

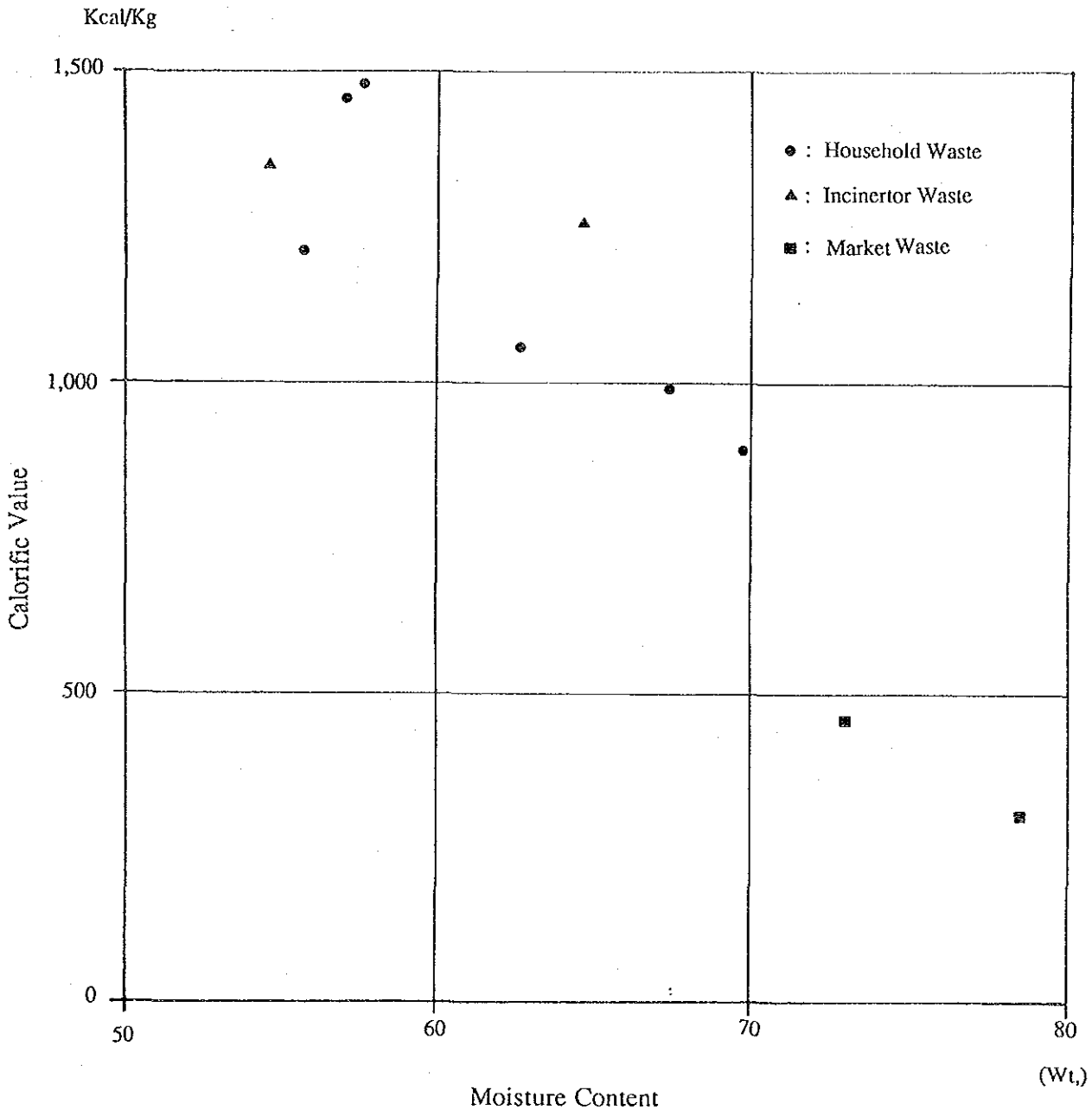


FIG. 2.2-5 CORRELATION BETWEEN CALORIFIC VALUE AND MOISTURE CONTENT

2.3 Laws and Regulations regarding SWM

2.3.1 List of Laws and Regulations related to Solid Waste Mansgement in Surabaya

There are about 18 valid laws and regulations that concern both directly and indirectly the solid waste management in Surabaya Municipality. The list of the laws and regulations by hierarchy order is as follows.

1) Provincial Level

a. Decree of East Java Governor No. 83/1987 concerning Environmental Cleanliness & Order Movement and Guiding Team in East Java.

b. Instruction of East Java Governor No. 11/1987 concerning Execution of Environmental Cleanliness & Order in the Regencies of East Java Province.

2) Regencial Level

a. Surabaya Municipal Regulation Level

(1) Surabaya Municipal Regulation No.4/1980 concerning Organization of Cleansing Department in Surabaya Municipality.

(2) Surabaya Municipal Regulation No. 6/1986 concerning Sanitary Management in Surabaya Municipality.

(3) Surabaya Municipal Regulation No. 2/1990 concerning First Amandment against the Surabaya Municipal Regulation No. 6/1986 on Sanitary Management in Surabaya Municipality.

b. Mayor's Decision Level

(1) Decision of Mayor of Surabaya Municipality No. 17/1987 concerning Determination on the Validity of Surabaya Municipal Regulation No. 6/1986.

(2) Decision of Mayor of Surabaya Municipality No. 23/1987 concerning Procedures of Executing Sanitary Retribution Charge Collection and Payment for Residents who are also subscribers of Water Supply Municipal Company in Surabaya Municipality.===> ***already revoked by Decision of Mayor of Surabaya Municipality No.77/1988.***

(3) Decision of Mayor of Surabaya Municipality No. 24/1987 concerning Procedures of Executing Sanitary Retribution Charge Collection and Payment for Residents who are non-subscribers of Water Supply Municipal Company in Surabaya Municipality.===> ***already revoked by Decision of Mayor of Surabaya Municipality No.77/1988.***

(4) Decision of Mayor of Surabaya Municipality No. 36/1987 concerning Coordination Team in Making Data, Collection and Supervision on the Execution of Sanitary Retribution Charge Collection for Residents who are non-subscribers of Water Supply Municipal Company in Surabaya Municipality.

(5) Decision of Mayor of Surabaya Municipality No. 37/1987 concerning Coordination Team in Making Data, Collection and Supervision on the Execution of Sanitary Retribution Charge Collection.for Residents who are subscribers of Water Supply Municipal Company in Surabaya Municipality.

(6) Decision of Mayor of Surabaya Municipality No. 78/1987 concerning Environmental Cleanliness & Order Movement and the Formation of its Executing Team in Surabaya Municipality.

(7) Decision of Mayor of Surabaya Municipality No. 199/1987 concerning Formation of Environmental Sanitary Task Unit in Surabaya Municipality.

(8) Decision of Mayor of Surabaya Municipality No. 251/1987 concerning Execution Guidelines on Sanitary Management in Surabaya Municipality.

(9) Decision of Mayor of Surabaya Municipality No. 122/1991 concerning Formation of Sanitary Enforcement Operational Team in Surabaya Municipality.

(10) Decision of Mayor of Surabaya Municipality No. 273/1991 concerning Execution Guidelines on Wet & Dry Wastes Separating Collection System in Surabaya Municipality.

(11) Decision of Mayor of Surabaya Municipality No. 77/1988 concerning Pocedures of Executing Sanitary Retribution Charge Collection & Payment for both Subscribers & Non-Subscribers of Water Supply Municipal Company in Surabaya Municipality

c. Mayor's Instruction Level

(1) Instruction of Mayor of Surabaya Municipality No. 16/1986 concerning Upgrading Effort on Environmental Sanitation in Surabaya Municipality.

(2) Instruction of Mayor of Surabaya Municipality No. 22/1988 concerning Sanction Execution on Surabaya Municipal Regulation No. 6/1986 in Surabaya Municipality.

(3) Instruction of Mayor of Surabaya Municipality No. 02/1987 concerning Execution on the Surabaya Municipal Regulation No. 6/1986.

3) Enforcement Operation Plan on City Sanitation in Surabaya Municipality Year 1988/1989.

Significant contents of the respective regulation & decision are summarized as follows:

2.3.2 Outline of Significant Regulations and Decisions

1) Surabaya Municipal Regulation No. 4/1980 concerning "Organization of Cleansing Department in Surabaya Municipality"

The significant contents of this Regulation are described in the following sections 2.4.1 and 2.4.3.

2) Surabaya Municipal Regulation No.6/1986 concerning "Sanitary Management in Surabaya Municipality"

This Regulation regulates the responsibilities of Surabaya Municipal Government and the people in sanitary management, and the sanitary retribution charge as shown below.

Responsibilities of Surabaya Municipal Government:

- to keep clean the public roads/streets, spaces, and drainage,
- to arrange and determine temporal & final waste disposal sites,
- to haul wastes from temporal disposal sites to final ones, and
- to eliminate and utilize wastes with proper ways.

Responsibilities of the Residents:

- to keep clean pathways and individual drainage with the coordination of RT/RW;
- to keep clean buildings, yards, and the surroundings.

The Regulation also obliges entrepreneurs, industries, or workshops that generate hazardous wastes (solid, liquid, or gas) to have containers or tanks or filters in such a way that they will not pollute the environment. As there are also quite a few street vendors and hawkers in Surabaya, they are obliged to have their own waste containers for the waste they generate.

The Regulation also requires those who generate waste as much as 2.5 m^3 or more each day to haul the waste to final disposal sites by themselves unless they request Cleansing Department to do so.

According to the Regulation, it is forbidden to:

- burn wastes in the yards or other places that may cause fire or disturb the surroundings.
- discharge wastes into rivers, ditches, drains, public roads/streets, pathways, other public places.
- discharge glasses, chemical substances or other hazardous materials, feces, or bad smell wastes into improper places.

The Regulation requires the citizens to pay the sanitary retribution charge at stipulated rates:

Table 2.3-1 Tariff of Sanitary Retribution Charge by Municipal Government

No.	Type of Charge Payer	Monthly Tariff (Rp)
	A. *Residential/Commercial:*	
1	Housing A	1,000
2	Housing B	500
3	Small Industry	2,500
4	Large Industry	15,000
5	Small Enterprise	4,000
6	Big Enterprise:	
	a. Shop, Retailer, Wholesaler, Travel Bureau, Private Office, and the likes	5,000
	b. Restaurant	10,000
	c. Hotel	20,000
7	Foreign Diplomatic Office	5,000
8	Governmental Office	3,000
9	Particular Social Institution	500
10	General Social Institution	1,000
	B. *Market:*	
11	Municipal Market	1,000/m^3
12	Private Market, Shopping Center, Supermarket, Department Store	2,000/m^3

The Regulation also requires that the following retribution be paid:

- Rp 50.-/day upon street vendor/hawker.
- Rp 500.-/m^3 upon those who dispose waste directly to final disposal sites.

All revenues from the retribution charge will be the Local Original Revenue and shall go to the Municipal Treasury.

3) Surabaya Municipal Regulation No.2/1990 concerning "First Amendment against the Surabaya Municipal Regulation No.6/1986 on Sanitary Management in Surabaya Municipality"

This Regulation determines the following significant items:

a. Industries, factories, or workshops disposing hazardous wastes at final disposal sites should neutralize the wastes before hauling them to the disposal sites so that they will not cause pollution.

b. It is forbidden to:
   - excrete feces and urinate on streets, green lanes, parks and other public places.
   - discharge night soil into rivers, ditches, and other public places except to the final night soil disposal site prepared by the Municipal Government.

c. Those who dispose night soil to the night soil final disposal site shall pay the retribution charge as much as Rp 1,000.-/m^3.

d. Delay in the payment of the retribution charge is fined 10% from the charge.

4) Decision of Mayor of Surabaya Municipality No.251/1987 concerning "Execution Guidelines on Sanitary Management in Surabaya Municipality"

This Decision stipulates that every Assistant to the Mayor, Chief of District, and Chief of Sub-District assist the Mayor to make the sanitary management successful in their respective working area in the form of giving guidance, information, supervision, improving the people's participation and motivation, as well as making coordination among *the institutions concerned in sanitary management.*

In the Decision, responsibilities of relevant bodies are described as follows:

a. Assistants to the Mayor, with the following tasks:

   i. to assist the Mayor in the sanitary management.
   ii. to make coordination starting from the Chief of District level up to RT/RW level.
   iii. to make report periodically.

b. Chiefs of Districts assist the Mayor in the sanitary management and have the following tasks:

   i. to plan activities in sanitary management at district level in accord with the sanitary policies which have been determined.
   ii. to motivate the potency of the people in their respective working area to carry out voluntary cleaning at public places.
   iii. to activate Sub-Districts in order to raise up the motivation, self-support, and participation of the people in the sanitary management.
   iv. to give guidance and information to Sub-Districts in the sanitary management.
   v. to report periodically the result of sanitary management activities to the Mayor.

c. Chiefs of Sub-Districts assist Chiefs of Districts in the sanitary management and have the following tasks:

   i. to plan activities in sanitary management at sub-district level in accord with the sanitary policies which have been determined.
   ii. to activate RW in the sanitary management at RW level.
   iii. to give guidance and information to RW in the sanitary management.
   iv. to report periodically the result of sanitary management activities to their respective Chiefs of Districts.

d. Chiefs of RW assist their respective Chiefs of Sub-Districts in the sanitary management and have the following tasks:

   i. to plan activities in sanitary management at RW level in accord with the sanitary policies which have been determined.
   ii. to activate RT in the sanitary management.
   iii. to foster the motivation, self-support, and participation of the residents in sanitary management.
   iv. to give guidance and information to RT in the sanitary management.
   v. to coordinate voluntary cleaning done by RT.
   vi. to report periodically to their respective Chiefs of Sub-Districts.

e. Chiefs of RT assist their respective Chiefs of RW in the sanitary management and have the following tasks:

   i. to plan activities in sanitary management at RT level in accord with the sanitary policies which have been determined.

ii. to foster the motivation, self-support, and participation of the residents in sanitary management.
iii. to have their respective "yellow troop" collect waste from each household to temporal disposal sites continuously.
iv. to carry out voluntary cleaning at RT or RW level.
v. to report periodically to their respective Chiefs of RW.

The Decision No.251/1987 stipulates also the detailed responsibilities of Cleansing Department and its workers. They are summarized in Section 2.4.3.

5) Decision of Mayor of Surabaya Municipality No.77/1988

This Decision determines the following significant procedures:

a. Procedures of Executing Sanitary Retribution Charge Collection & Payment for Subscribers of Water Supply Municipal Company [PDAM]:

i. Sanitary Retribution Charge is imposed upon every subscriber of PDAM.
ii. Determination on the tariff of Retribution Charge is made every year by the Chief of Local Revenue Department.
iii. The claim on the Charge is made monthly by PDAM along with the claim on the Consumption Fee of Water Supply. The claim amount is written on the same bill of Water Supply Consumption.
iv. All the Charge obtained should be transferred by the PDAM to the Special Treasurer on the twentieth day of each month at the latest.

b. Procedures of Executing Sanitary Retribution Charge Collection & Payment for Non-Subscribers of Water Supply Municipal Company [PDAM]:

i. Sanitary Retribution Charge is also imposed upon everyone who has not become subscriber of PDAM.
ii. Every Chief of Sub-District is responsible for making data on non-subscribers of PDAM with the cooperation of RT/RW.
iii. Chief of Sub-District sends the result of data making to Chief of District.
iv. Chief of District sends the result to Local Revenue Department within 3 days after receiving.
v. Chief of Local Revenue Dept. will then determine the tariff of Retribution Charge for 1 year's period in a Tariff List.

vi. Based on the Tariff List, the Chief of Local Revenue Dept. will issue Sanitary Retribution Charge Assessment [SKRK] in three copies: one for Local Revenue Dept.; one for RT, and one for Charge Payer.

vii. In cooperation with RT/RW, Chief of Sub-District claims the Charge to every Charge Payer based on the SKRK.

viii. Every time the Chief of Sub-District receives the payment from a Charge Payer, he/she shall give the Charge Payer some fixed Sanitary Retribution stamp duty issued by the Special Treasurer as an official receipt.

ix. All the Charge obtained should be transferred by the Chief of Sub-District to the Special Treasurer on the twentieth day of each month at the latest.

c. Sanitary Retribution Charge obtained from both Subscribers and Non-Subscribers of PDAM:

All the Charge obtained every month is used to finance the execution of sanitary management after the following deduction:

Table 2.3-2 Deduction of Sanitary Retribution Charge through PDAM

Collection through PDAM	
5.00%	to PDAM as collection service fee
4.00%	to PDAM as administration fee
1.00%	to a Coordination Team formed by Mayor's Decision No.37/1987 [See: Appendix 4]
10.00%	**Total Deduction**

Table 2.3-3 Deduction of Sanitary Retribution Charge through Non-PDAM

Collection through Non-PDAM	
0.25%	to Assistants to the Mayor
1.00%	to Chiefs of Districts
4.00%	to Chiefs of Sub-Districts
5.75%	to RW
14.00%	to RT for supporting the sanitary infrastructures and facilities
3.00%	to Cleansing Dept.
1.00%	to Local Revenue Dept.
1.00%	to a Coordination Team formed by Mayor's Decision No.36/1987 [See: Appendix 4]
30.00%	**Total Deduction**

2.4 Organization and Responsibility of Cleansing Department

The organization and responsibility of Cleansing Department are stipulated by a municipal regulation, i.e. Surabaya Municipal Regulation No.4/1980 concerning "Organization of Cleansing Department in Surabaya Municipality".

2.4.1 Organization of Cleansing Department

The Headquarters of Cleansing Department comprises one division and five sections as shown below:

(1) **Administration Division:**
   i. Administrative Affairs Sub-Division
   ii. Personnel Affairs Sub-Division
   iii. Financial Affairs Sub-Division

(2) **Planning & Supervision Section:**
   i. Planning Sub-Section
   ii. Guiding Sub-Section
   iii. Supervision Sub-Section

(3) **Construction & Execution Section:**
   i. Inventory Sub-Section
   ii. Execution Sub-Section
   iii. Maintenance Sub-Section

(4) **Evaluation & Report Section:**
   i. Public Sanitary/Facility Sub-Section
   ii. Firm & Industry Sanitary Sub-Section
   iii. Sanitary Laboratory Sub-Section

(5) **Waste Disposal/MCK & Night Soil Section:**
   i. Waste Disposal & Recycling Sub-Section
   ii. MCK/Night Soil Sub-Section

(6) **Haulage Section:**
   i. Haulage Sub-Section
   ii. Vehicle Sub-Section
   iii. Vehicle Maintenance & Supervision Sub-Section.

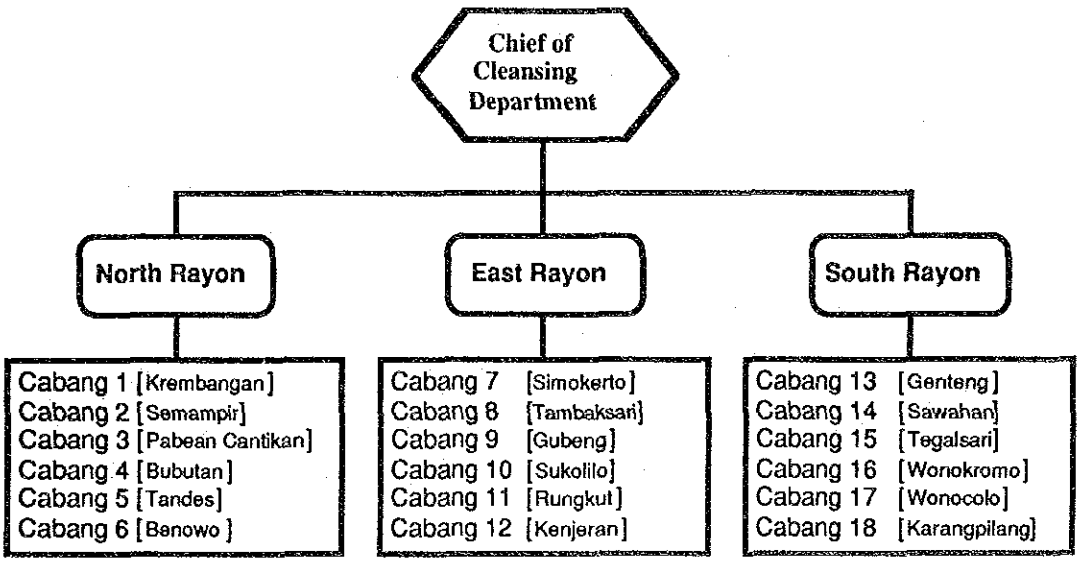
The organizational structure of Cleansing Department is shown in Fig 2.4-1

FIG. 2.4-1 ORGANIZATIONAL STRUCTURE OF CLEANSING CEPARTMENT

THE STUDY ON THE SOLID WASTE MANAGEMENT IMPROVEMENT FOR SURABAYA CITY

Besides the Headquarters, Cleansing Department has 3 (three) **Rayons** [working area of each Assistant to the Mayor], and each Rayon covers 6 (six) **Cabangs** [District] as shown in the chart below:

Fig. 2.4-2
Organizational Structure of Rayon & Cabang



Remarks: [ ] = name of District

Note: * Administratively, there are altogether 5 Rayons and 19 Districts in Surabaya Municipality. So, there is 1 District (in West Rayon) that has no Cabang, i.e. Lakarsantri District. Cabang 5 & 6 which are administratively included in West Rayon are, for the time being, still managed by North Rayon; while Cabang 4, 7, 13 & 15 which are administratively inside Central Rayon are still managed by North Rayon (i.e. Cabang 4), East Rayon (i.e. Cabang 7), and South Rayon (i.e. Cabang 13 & 15).

* Each Cabang consists of several Units at Kelurahan (Sub-District) level. In terms of sanitary management, there are altogether 58 Units in Surabaya City. Whereas, administratively Surabaya Municipality has 163 Sub-Districts in total. The existing 58 Units cover the sanitary management for the whole 163 Sub-Districts.

Since August 1991, Cleansing Department has started operating an incinerator. Nevertheless, so far Cleansing Department has neither divisions nor sections responsible for the operation and maintenance of the Incineration Plant. It is directly under the Chief of Cleansing Department.

Surabaya Municipal Government purchased the incinerator from a private company named PT Unicomindo. Based on the contract between Surabaya Municipal Government and the said company, during the 9-year installment period, the company is responsible for the operation of the incinerator. The incinerator is operated 24 hours a day by 3-shift working hours, namely 06:00 - 14:00, 14:00 - 22:00, and 22:00 - 06:00. The organizational structure of the Incineration Plant is shown in Fig. 2.4-3

2.4.2 Manpower in Cleansing Department

1) Manpower by Sections

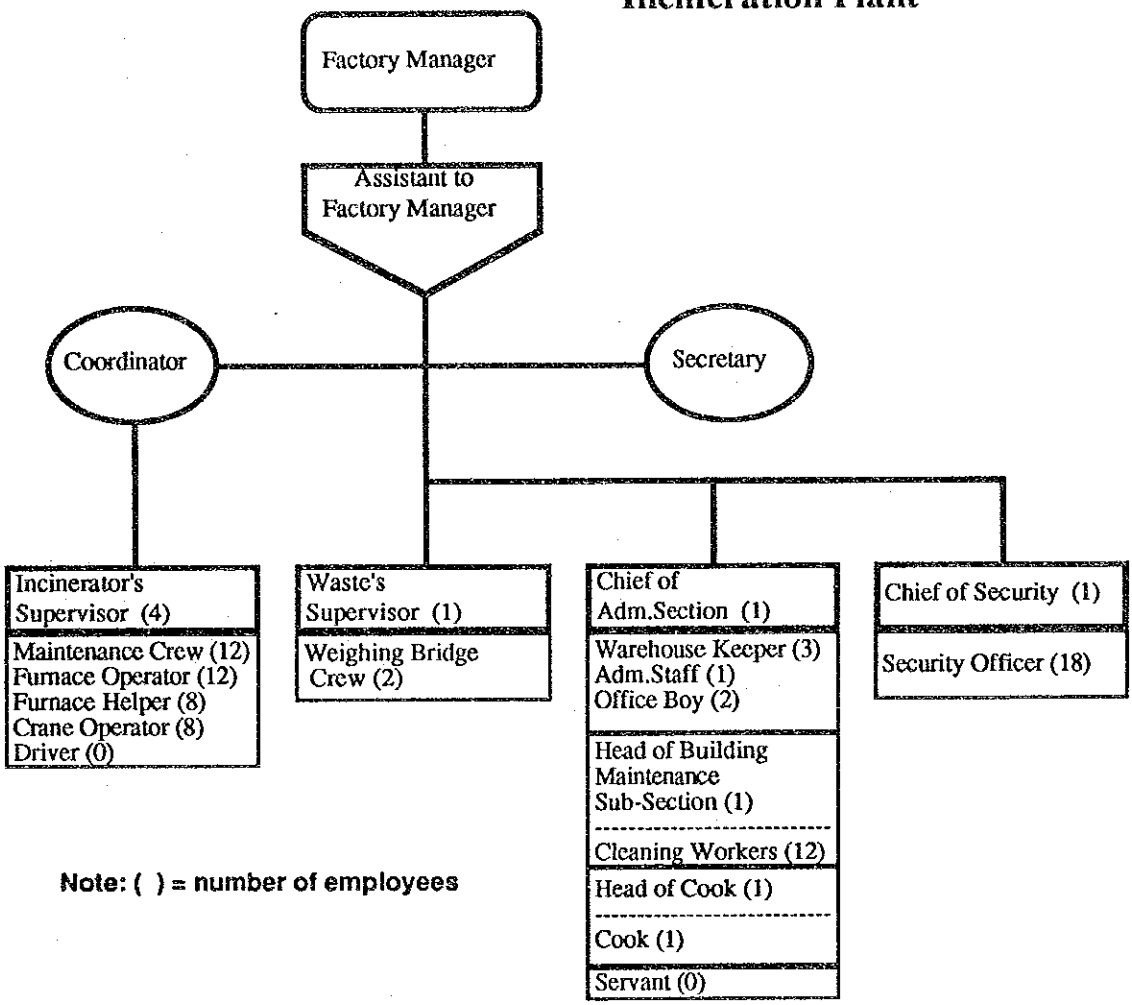
There are two categories of employees at Cleansing Department, namely permanent and temporary (daily-wage base) employees. The employees could be classified into 2 groups, i.e. those who work at the Headquarters of Cleansing Department (comprising 1 division and 5 sections) and those who work at Rayon (3 Rayons & 18 Cabangs).

The Cleansing Department has 1,722 employees, of which 1,037 are permanent employees and 685 are temporary workers (as street sweepers).

In order to cover the shortage of cleansing manpower in the field --both street sweepers and workers at open-dumping temporal disposal sites--, Cleansing Department also hires some private contractors in street sweeping (25 companies) and haulage from temporal disposal sites to final ones (5 companies). Number of field workers utilized by the private contractors is estimated at 404 (street sweepers) and 113 (haulage workers).

In addition, it is estimated that all RT/RW in Surabaya City employ about 10,500 workers as waste collectors.

Fig.2.4-3
Organizational Structure of Incineration Plant



Note: ( ) = number of employees

Table 2.4-1 Manpower Employed by Cleansing Department

Type of Employees	Nos.Manpower	
A. Permanent Employees		
(1)*Headquarters:*		
Administration Division	35	
Planning & Supervision Section	14	
Construction & Execution Section	14	
Evaluation & Report Section	16	
Waste Disposal/MCK&Night Soil Section	13	
Haulage Section	199	
Sub-Total (1)		291
(2)*Rayon:*		
North Rayon	238	
East Rayon	191	
South Rayon	267	
Non-Active Personnel	50	
Sub-Total (2)		746
Total (1) + (2)		1,037
B. Daily-Wage Base Employees		
Street Sweepers	685	685
Grand Total (A + B)	**1,722**	**1,722**

2) Manpower by Type of Service

The number of employees of Cleansing Department by type of service is shown below:

Table 2.4-2 Manpower by Type of Service

TYPE OF SERVICE	Nos.Manpower	
A. Office Work: 1) Headquarters	97	
2) 3 Rayons + 18 Cabangs	136	
Sub-Total (A)		233
B. Field Work:		
1) Haulage:		
a. Driver	69	
b. Assistant	32	
c. Car & Heavy Equipment Maintenance	35	
d. Depo/LPS Keeper	126	
Sub-Total 1)		262
2) Field Supervisor: a. Headquarters	28	
b. Rayon	21	
Sub-Total 2)		49
3) Final Disposal:		
a. Heavy Equipment Operator	16	
b. Site Recorder	14	
Sub-Total 3)		30
4) Street Sweeping #:		
a. Permanent Employee	375	
b. 'Daily-wage Base' Employee:		
i. Those who work also as permanent employees during day-time	[276]	
ii. Pure 'daily-wage base' worker	685	
Sub-Total 4)		1,060
5) Miscellaneous	38	
Sub-Total 5)		38
C. Non-Active Personnel	50	50
TOTAL	**1,722**	**1,722**

Remarks: # = total number of street sweepers in Surabaya City is estimated at 1,479 as follows:
a) of Cleansing Department = 1,075
b) of Private Contractors = 404

[276] = permanent workers of Cleansing Dept. that also work as 'daily-wage base' street sweepers. They are:
a) permanent street sweepers = 261
b) field supervisors from Rayon = 6
c) reserved field workers = 9

^ = drainage, grass mowing, waste collecting, and reserved field workers.

3) Manpower in the Incineration Plant

Number of manpower used in the Incineration Plant is altogether 92 personnel. Among this, 76 personnel are employed by PT Unicomindo; while the remaining (16 personnel) are employees of Cleansing Department.

Table 2.4-3 Manpower in the Incineration Plant

POSITION	Nos.Manpower
Factory Manager	1
Assistant to Factory Manager	1
Coordinator	1
Secretary	1 [1]
Waste's Supervisor	1
Chief of Adm.Section	1
Chief of Security	1
Incinerator's Supervisor	4
Head of Building Maintenance Sub-Section	1
Head of Cook	1
Incinerator's Maintenance Crew	12 [3]
Furnace Operator	12 [2]
Furnace Helper	8 [3]
Crane Operator	8 [3]
Weighing Bridge Crew	2
Warehouse Keeper	3
Administration Staff	1
Office Boy	2
Cleaning Worker	12
Cook	1
Security Officer	18 [4]
TOTAL	**92** [16]

Note: [ ] = number of employees belonging to Cleansing Department

2.4.3 Responsibility of Cleansing Department

The responsibilities of Cleansing Department, its division and sections defined by Surabaya Municipal Regulation No.4/1980 could be summarized as follows:

1) Responsibility of Cleansing Department

a. Carrying out waste collection, haulage, utilization, and elimination.
b. planning and constructing infrastructures, facilities, disposal sites for waste and night soil.
c. planning and providing sanitary equipment and heavy equipment for city cleaning development.
d. arranging and performing city cleaning and environmental pollution prevention.
e. providing guidance, guidelines, and information to the people in order that the people would participate in keeping the city clean and in environmental pollution prevention.
f. supervising the using of sanitary infrastructures and facilities.
g. cooperating with other institutions in performing the sanitary management and environmental pollution prevention.
h. formulating and planning technical policies in accord with policies determined by the Mayor.
i. securing and controlling the execution of main tasks in accord with policies determined by the Mayor.
j. carrying out other tasks given by the Chief of Cleansing Department.

2) Responsibility of Each Division and Section

a. Administration Division:

   i. to perform general administrative affairs, personnel affairs, financial affairs, and inventory affairs.
   ii. to perform protocol and business travelling affairs.
   iii. to carry out household affairs of the Department.
   iv. to do activities in upgrading the Governmental apparatus.
   v. to carry out other tasks assigned by the Chief.

b. Planning & Supervision Section:

   i. to make planning on sanitary activities.

ii. to make planning on sanitary infrastructures and facilities.
iii. to provide information and direct the people's participation.
iv. to control and supervise the execution of sanitary tasks.
v. to better the organization of Cleansing Department.
vi. to carry out other tasks assigned by the Chief of Cleansing Department.

c. Construction & Execution Section:

i. to determine new location and construct sanitary facilities including wastes disposal or utilization site and MCK buildings.
ii. to make inventory of construction materials and heavy equipment.
iii. to do maintenance on sanitary facilities, equipment, and buildings.
iv. to carry out supervision and control upon the construction of sanitary facilities and the inventory of sanitary equipment including heavy ones.
v. to carry out other tasks assigned by the Chief of Cleansing Department.

d. Evaluation & Report Section:

i. to make data on every aspect relating to city sanitation.
ii. to make evaluation on every operational activity in sanitary field.
iii. to make report on city sanitary activities.
iv. to analyze evaluated data as to make good sanitary management system.
v. to carry out other tasks assigned by the Chief of Cleansing Department.

e. Waste Disposal/MCK & Night Soil Section:

i. to haul waste from waste containers or other places to disposal sites.
ii. to carry out activities related to the maintenance of MCK and night soil disposal.
iii. to carry out other tasks assigned by the Chief of Cleansing Department.

f. Haulage Section:

i. to arrange everything required for the waste haulage.
ii. to arrange every needs related to hauling vehicles.
iii. to carry out technical supervision upon the operation of hauling vehicles.
iv. to arrange the maintenance of hauling vehicles.
v. to carry out other tasks assigned by the Chief of Cleansing Department.

3) Responsibility of Workers of Cleansing Department at Each Rayon & Cabang

The responsibilities of each Rayon and Cabang are stipulated in the Decision of Mayor of Surabaya Municipality No.251/1987 concerning "Execution Guidelines on the Sanitary Management in Surabaya Municipality".

a. Responsibility of Workers at Each Rayon

The above-mentioned Decision states that workers of Cleansing Department at each Rayon assist the Chief of Cleansing Department and have the following tasks:

i. to supervise the execution of waste collection and haulage on public roads/streets, public places, and drainage in their respective working area.
ii. to receive suggestion from the residents on the necessity of making temporal waste disposal site and convey the suggestion to the Chief of Cleansing Dept.
iii. to arrange and carry out city cleaning and environmental pollution prevention in their respective working area.
iv. to arrange and supervise the use of sanitary infrastructures and facilities.
v. to make coordination, give guidance and information to the people together with the Assistant to the Mayor in their respective working area.
vi. to lead, guide, coordinate, and supervise the activities of workers of Cleansing Dept. at district level in their respective working area.
vii. to report their activities periodically to the Chief of Cleansing Dept.

b. Responsibility of Workers at Each Cabang

According to the mentioned Decision, workers of Cleansing Dept. at each Cabang assist the workers of Cleansing Dept. at Rayon level and have the following tasks:

i. to supervise the execution of waste collection and haulage on public roads/streets, public places, and drainages in their respective working area.
ii. to receive suggestion from the residents on the necessity of making temporal waste disposal site and convey the suggestion to the Chief of Cleansing Dept. through Rayon.
iii. to arrange and carry out city cleaning and environmental pollution prevention in their respective working area.
iv. to arrange and supervise the using of sanitary infrastructures and facilities.

v. to lead, guide, coordinate, and supervise the activities of workers of Cleansing Dept. at sub-district level in their respective working area.
vi. to do monitoring and evaluation upon the execution of sanitary management together with the Chief of District in their respective working area.
vii. to report their activities periodically to the Chief of Cleansing Dept. through Rayon.

2.4.4 Problems related to Organization & Regulations

Judging from the organizational structure of Cleansing Department and the responsibilities of its division, sections, Rayons, and Cabangs based upon the fact as well as Surabaya Municipal Regulation No.4/1980, Decision of Mayor of Surabaya Municipality No.251/1987, and other related regulations, some problems related to the Organization and the Regulations are identified as follows:

1) Organizational Problems

a. Lack of Section Responsible for Final Disposal Plan

There are no sections responsible for final disposal plan which should perform the following activities:

i. acquisition of land for final disposal sites
ii. planning and design of final disposal systems in LPA

It is considered that planning on final disposal sites will increasingly be important in the future.

b. Poor Data Management

The management of data in the Department is not so effective although there is a section responsible for data evaluation and analysis. The current poor planning activity of the Department may be attributable to the poor data management.

c. Imbalance between Manpower and Workload

Based on the observation during the study period, it seems that most of the office staff at the Department do not have much workload. It may be assumed that there is no equilibrium in the manpower and workload.

2) Problems related to the Regulations

a. Deficiency in the Regulations

There are some deficiencies in the regulations as shown below:

e.g. 1: There are no regulations stipulating which section is responsible for waste disposal at final disposal sites. Neither are there stipulations concerning which section is directly responsible for the matters arising if final disposal sites bring about environmental pollution.

e.g.2: In the regulations related to sanitary management in Surabaya City, there are no articles regarding the using/hiring of and supervision upon private contractors for street sweeping and waste haulage to final disposal sites. Concerning the supervision upon the private contractors, in reality it is done by the Waste Disposal/MCK & Night Soil Section, instead of the Planning & Supervision Section.

b. Inconsistency between the Regulations and Execution

The following inconsistencies may be observed:

e.g.1: According to Surabaya Municipal Regulation No.4/1980 concerning "Organization of Cleansing Department in Surabaya Municipality", waste haulage from waste containers or other places (depo/LPS, public places) is the responsibility of the Waste Disposal/MCK & Night Soil Section; whereas, in reality it *is* the Haulage Section that takes such responsibility.

e.g.2: According to the same Regulation, the Construction & Execution Section is responsible for the determination on new location for disposal sites. However, in reality it seems that the Section is not requested to perform such responsibility.

e.g.3: According to the Regulation, the Planning & Supervision Section has the responsibility to propose improvement of the organization of Cleansing Department. Nevertheless, in reality this Section has never made such proposals.

e.g.4: According to the Regulation, the Evaluation & Report Section has the responsibility to propose improvements of sanitary management system after making analysis on evaluated data. However, it seems that such proposals have never been made.

e.g.5: According to the same Regulation, supervision/inspection upon sanitary tasks/activities is the responsibility of the Planning & Supervision Section; in reality, however, four Sections take part in such responsibility, i.e. Waste Disposal/MCK & Night Soil Section, Planning & Supervision Section, Evaluation & Report Section, and Haulage Section. This is concluded from the fact that each of those Sections assigns several staff respectively as field supervisors. And one more thing which is not less important is the fact that the responsibility for such supervision/inspection is formally taken by the Waste Disposal/MCK & Night Soil Section, instead of the Planning & Supervision Section.

e.g.6: According to Decision of Mayor of Surabaya Municipality No.273/1991 concerning "Execution Guidelines on Wet & Dry Wastes Separating Collection System in Surabaya Municipality", every citizen of Surabaya has the obligation to separate wet and dry wastes prior to discharge/collection. Wet waste should be discharged into waste containers with yellow color, while dry waste should be discharged into waste containers with blue color. Nevertheless, in reality, the waste separation is not done at the time of either discharge or collection.

2.5 SWM Expenditures and Revenues

2.5.1 SWM Expenditures

1) SWM Expenditures and KMS Budget

Annual budget of the Cleansing Department in 1992/93 is approx. Rp 11.5 billion, of which Rp 7.8 billion is the routine budget, and Rp 3.7 billion is the development budget. The 1992/93 cleansing budget Rp 11.5 billion represents 10.2% of the budget of KMS (City of Surabaya). Table 2.5-1 shows both SWM and KMS expenditures, and the percentage of SWM budget relative to KMS expenditures since the fiscal year 1985/86.

Table 2.5-1. SWM and KMS Expenditures 1985/86 - 1992/93

Unit: Rp Billion

Fiscal year	SWM Expenditure			KMS Total Expenditures	Percentage of SWM Exp. to KMS Exp.
	Routine (A)	Development (B)	Total (C)=(A)+(B)	(D)	(E)=(C)/(D)
1985/86	2.1	0.2	2.3	31.7	7.4%
1986/87	2.2	0.2	2.4	36.7	6.5%
1987/88	2.7	0.6	3.3	50.4	6.5%
1988/89	3.6	0.5	4.1	59.8	6.9%
1989/90	3.9	3.5	7.4	62.1	12.0%
1990/91	4.2	3.8	8.0	74.7	10.7%
1991/92	7.3	3.9	11.2	99.4	11.3%
1992/93	7.8	3.7	11.5	112.7	10.2%

NOTES :

1. All the amounts for 1985/86 - 1990/91 are the actual expenditures, while 1991/92 and 1992/93 amounts are the budgeted amounts.
2. The KMS expenditures shown in the above table do not include the budget item "cash and calculation" as KMS has no control over this budget item, and this budget item just passes through KMS (Therefore revenue and expenditures of this item are identical always).

The percentage of SWM expenditures relative to KMS expenditures has jumped to 12% in 1989/90 from 6.9% in the preceding year due to the introduction of the incineration, and the commencement of KMS's repayment of the incineration plant to P.T. Unicomindo, a private contractor.

2) SWM Budget Details

Table 2.5-2 shows the details of the 1992/93 SWM budget.

Table 2.5-2. 1992/93 SWM Budget

A. Routine Budget

Unit: Rp

1.	All personnel expenditures	3,067,018,000	34%
2.	General equipment and material for mainly administrative use	218,538,000	3%
3.	Waste collection vehicles operation and maintenance	843,710,000	11%
4.	Depo/LPS improvement	65,000,000	1%
5.	Heavy equipment maintenance for final disposal	227,500,000	3%
6.	Incinerator operation	926,000,000	12%
7.	Payment to street sweeping contractors and temporary employees	1,750,000,000	22%
8.	Payment to waste haulage contractors	600,000,000	8%
9.	Law enforcement operation	120,000,000	1%
10.	Total of routine budget	7,841,260,000	100%

B. Development Budget

11.	Incineration	3,500,000,000	95%
	a. Repayment to P.T. Unicomindo	(3,336,359,500)	
	b. Payment to BPPT & ITS for consulting services	(120,000,000)	
	c. Other expenses	(43,660,500)	
12.	Depo/LPS Construction and Containers	100,000,000	3%
	a. Depo/LPS construction	(35,500,000)	
	b. New containers purchase	(60,000,000)	
	c. Other expenses	(4,500,000)	
13.	Construction of entrances and drain	75,000,000	2%
	a. Construction of entrance to the incinerator and drain to Keputih disposal site	(52,500,000)	
	b. Construction of entrance to Lakarsantri	(19,000,000)	
	c. Other expenses	(3,500,000)	
14.	Total of Development Budget	3,675,260,000	100%
15.	Grand Total (10 + 14)	11,516,260,000	

3) 1992/93 Budget by Type of Service

The table below shows the 1992/93 SWM budget by type of services. The incineration shares 45 %, street sweeping 25 %, haulage 21 %, final disposal 3%, and administration 6 %.

Table 2.5-3. 1992/93 SWM Budget by Type of Services

1. Incineration	
1.1 Repayment to P.T. Unicomindo	3,336,339,500
1.2 Operation (to be paid to Unicomindo)	926,000,000
1.3 Payment to BPPT & ITS for consulting service	120,000,000
1.4 Personnel Expenditures	40,000,000
1.5 Other expense	43,660,500
1.6 Total	4,466,000,000 (45 %)
2. Haulage	
2.1 Operation and maintenance (excluding personnel expenditures)	843,710,000
2.2 Payment to contractors	600,000,000
2.3 Depo/LPS improvement and construction	100,500,000
2.4 New container purchase	60,000,000
2.5 Other expense	4,500,000
2.6 Personnel expenditures	480,000,000
2.7 Total	2,153,210,000 (21 %)
3. Street sweeping	
3.1 Personnel expenditures	1,457,197,000
3.2 Payment to contractors	926,796,000
3.3 Equipment	87,618,000
3.4 Total	2,471,611000 (25 %)
4. Final Disposal	
4.1 Heavy equipment operation & maintenance	227,500,000
4.2 Personnel expenditures	17,742,000
4.3 Construction of entrance and drains	75,000,000
Total	320,242,000 (3%)
5. Administration	
5.1 Personnel expenditures	381,000,000
5.2 Equipment and materials for administrative use	130,920,000
5.3 Law enforcement operation	120,000,000
Total	631,920,000 (6 %)
6. Grand total	10,042,983,000 (100%)

Note: The personnel expenditures shown in the above table are those recorded at the end of the fiscal year 1991/1992. (1992/93 data are not available.)

2.5.2 Revenue of the Sanitary Retribution

1) Revenue Amount

The City of Surabaya (KMS) collected the retribution about Rp 4 billion in 1991/92, of which 15 % is paid as handling charges to the RT/RW, PDAM and other parties involved in the collection of the retribution. The net revenue is estimated at Rp 3.37 billion, which corresponds to about 30 % of the cleansing budget Rp 11.2 billion in 1991/92. Of the retribution of Rp 4 billion collected, 75% is paid by households, while the remaining 25% is paid by commercial, industrial establishments as well as markets, etc. Table 2.5-4 shows actual and target amounts of the retribution. Targets are decided by the Revenue Department of KMS.

Table 2.5-4. Retribution Collected and Handling Charges Paid to Involved Parties in 1991/92

Unit: Million Rupiah

	Through PDAM (A)	Through Non-PDAM (B)	Total (C)=(A)+(B)
1. Retribution Collected	2,498	1,477	3,975
2. Handling charges paid to involved parties	250 (10% of 2,498)	355 (26% of 1,477)	605 (15.2% of 3,975)
3. Net revenue to KMS (3-4)	2,248 (90%)	1,123 (74%)	3,370 84.8%)

2) Method of Collection (Collection Point)

There are two collection methods: one through PDAM (Municipal Water Authority), and the other through RT/RW. About 60% of the retribution is collected through PDAM, while the remaining 40 % is collected through PDAM.

3) Rate of Retribution and Number of Payers

There are about 400,000 payers of the retribution, of which 380,000 are households and the remaining 20,000 are business establishments as shown in the table below. The table shows the rates of the retribution. The current rates were decided in 1986, and implemented in 1987. No changes in the rates have been made since then.

The rates of retribution and number of payers are as shown below :

Table 2.5-5. Rates of Retribution and Number of Payers

Type of payers & (Rates of Retribution)	Number of Payers		
	Through PDAM (A)	Through RT/RW (B)	Total (C)=(A)+(B)
1. Household A (Rp 1,000/month)	65,388	0	65,388
2. Household B (Rp 500/month)	68,225	246,000	314,225
Sub-Total (Items 1 & 2)	133,613	246,000	379,613
3. Small Industry (Rp 2,500)	399	0	399
4. Big Industry (Rp 15,000)	424	0	424
5. Small Enterprise (Rp 4,000)	4,576	0	4,576
6. Big Enterprise			
a. Shop, Retailer, Travel Bureau, Private Office, and the likes (Rp 5,000)	7,669	0	7,669
b. Restaurant (Rp 10,000)	110	0	110
c. Hotel (Rp 20,000)	49	0	49
7. Foreign Diplomatic Office (Rp 5,000)	268	0	268
8. Governmental Office (Rp 3,000)	1,101	0	1,101
9. Particular Social Institute (Rp 500)	478	0	478
10. General Social Institute (Rp 1,000)	3,732	0	3,732
11. PDAM, DSAM & BPAM	0	0	0
12. Sea Port	0	0	0
13. Municipal Market (1,000/m^3)	42	0	42
14. Private Market, Shopping Center, Supermarket, Department Store (2,000/m^3)	19	0	19
Sub-total (Items 3 - 14)	40,145	0	18,918
Grand TOTAL	152,532	246,000	398,532

(As of March 1992)

NOTE : Definition of Household A, B
- Household A is the household facing a road with the width 6 m or wider.
- Household B is the household facing a road with the width less than 6 m.

2.5.3 Cost of Primary Collection by RT/RW

It is estimated that the annual cost of primary collection is about Rp 8.5 billion as shown below :

Table 2.5-6 Annual Cost of Primary Collection by RT/RW

	Unit Cost	Quantity	Total
1. Salary	Rp 624,000/worker	10,000 workers	6,240,000,000
2. Clothes, boots, gloves, etc.	Rp 100,250/worker	10,000 workers	1,002,500,000
3. Broom, etc.	Rp 51,700/worker	10,000 workers	570,000,000
4. Annual Depreciation of a handcart	Rp 246,500/cart	2,600 handcarts	640,000,000
5. O/M cost of a handcart	Rp 10,000/cart	2,600 handcarts	26,000,000
TOTAL			8,478,500,000

2.6 Collection and Haulage

2.6.1 General Description

In Surabaya, the waste collection (collection of waste from waste generation sources and transfer it to Depo/LPS) is mainly executed by the RW/RT, while the KMS is the main body responsible for the haulage of waste from Depo/LPS to LPA(final disposal sites) as illustrated in the figure below:

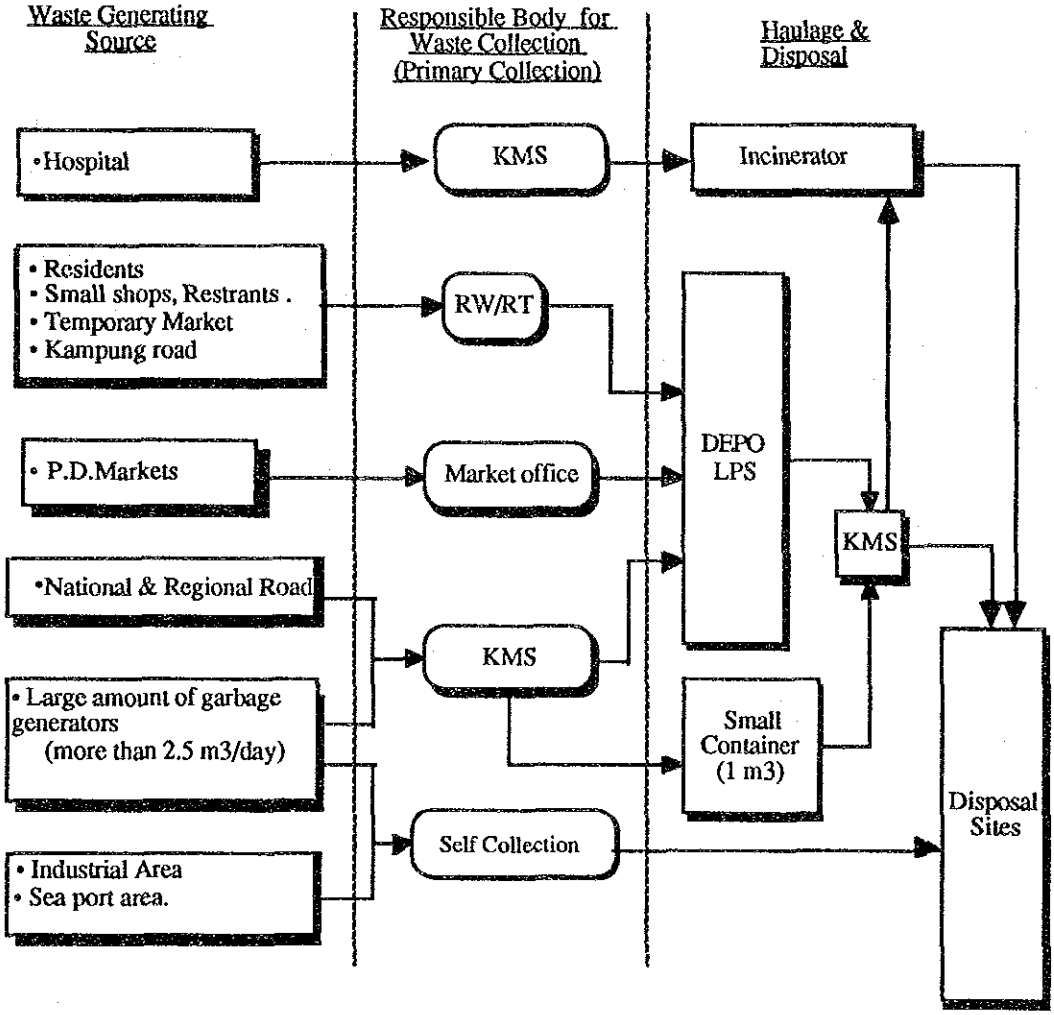


Fig. 2.6-1 Waste Flows and Responsible Bodies for Collection and Haulage

Collection Coverage in Terms of Waste Amount

It is estimated that the total waste amount either collected or recycled is 1,377 ton/day (total collection amount 1,197 ton/day + total recycling amount 180 ton/day). The sum of collection and recycling amount 1,377 ton/day is 85 % of the total waste generation amount in Surabaya (1,626 ton/day).

1. Collected by RT/RW and Haulaged by KMS	889 ton/day (55%)
2. Collected by RT/RW but disposed at unidentified places	171 ton/day (11%)
3. Collected and Hauled by generators	137 ton/day (8%)
4. Recycled by scavengers before LPA	180 ton/day (11%)
5. Total amount either collected or recycled (1+2+3+4)	1,377ton/day (85%)
6. Not collected	249 ton/day (15%)
7.Total (5+6)	1,626ton/day(100%)

The remaining 249 ton/day (15 % of the generation amount) remains uncollected. A portion of the uncollected waste is used to feed animals in open land, while the remaining waste is open dumped in the backyard of houses or sea shore.

Collection Coverage in Terms of Population

It is estimated that the waste collection service is provided for the population of 2,115,400 corresponding to 81% of the total population and 94% of the registered population of Surabaya in 1992.

On the other hand, those who receive both collection and haulage service correspond to 79% of the total population and 92% of the registered population.

The two percent difference (81%-79%) can be explained by the lack of depo/LPS. It is considered that the waste collected from those two-percent people are not hauled to proper places, but dumped at empty land by using Pasukan Kuning (Yellow Troop).

The existing system (where RT/RW collect waste from households and other sources and transfer it to depo/LPS, and KMS hauls the collected waste by arm-roll trucks) is very efficient.

2.6.2 Waste Collection

1) Historical Background of Community Participation

The system of RT (neighborhood unit) and RW (Community unit) was introduced by the Japanese military government during the World War II. This system, based upon Japanese "tonarigumi" model, was useful for the military government to convey orders and instructions from the top to the people at community level.

After the World War II, "Tonarigumi" system had remained in Indonesia as RK (Mutual Assistance Association in the Village). In 1965 it changed into RW/RT. People in RT/RW cooperate with neighbors in daily life. It seems that such cooperation among neighbors is essential to the economic and cultural life of the people, and to the preservation of the Indonesians' traditional value. RT/RW is also expected to help the government in implementing Government programs for development and solving social problems at local level.

The Municipal Regulation Pemda No. 6, issued by KMS in 1986, stipulates that one of the major roles of RT/RW is to keep the environment clean and sanitary although RT/RW used to partly collect waste even before the regulation was issued.

RT/RW employ waste collection workers called "Pasukan Kuning" (Yellow Troop). Salary of Pasukan Kuning is paid by each RT/RW, which collect waste collection fees from households, shops, offices, etc. that receive collection services. Waste collection fee rates are different according to RT/RW, and volume of waste collected.

As of April 1992, there are 1,224 RW and 7,711 RT in Surabaya. It is estimated that RW employs 6-10 collection workers. The total number of collection workers is estimated at about 10,500.

2) Waste Collection System

Pasukan Kuning collects waste from bins of each house and shop, and load it in a handcart. After finishing the waste collection, they go to Depo/LPS designated by RW/RT. The distance between the Depo/LPS and collection areas seems less than 1.5 km in most cases. Waste collection systems varies depending on waste generating sources as shown in the following sections.

a. Residential Area

(1) Responsibility for the Waste Collection

RT/RW collects waste from residential areas. A collection worker visit house to house to collect waste with a handcart. In some areas, two workers make a collection team.

(2) Collection Frequency

Collection frequency varies by area. Usually, waste is collected everyday in high income areas, three to four times a week in the middle income areas, and less frequent in low income areas.

(3) Waste Storage

Typical containers used by households for waste storage are as follows:

- Concrete bins placed in front of resident houses.
- Small containers made of tin, bamboo or wood
- Plastic bins.

Households in high income residential areas use mainly concrete bins, while tin, bamboo, wood containers are used in low income areas. Plastic bins have not yet widely utilized due to relatively high cost. However, users of plastic bins have been increasing in relatively high income areas.

Recently KMS has required each house to have two containers: yellow and blue ones. Wet waste is supposed be put in the yellow containers, and dry waste is to be put in the blue containers. However, most of houses do not separate their waste.

(4) Waste Collection Fee

Waste collection fee rates are decided by each RW/RT, based upon "Musyawarah" (meeting between RW/RT leaders and Pasukan Kuning). Salary of Pasukan Kuning is also decided in this meeting. According to interviews to some Pasukan Kuning and RW leaders, waste collection fee collected from each household ranges from Rp.300 to Rp.1,000 and Rp 1,150 Average (According to the JICA Household survey). The salary of Pasukan Kuning ranges from Rp.25,000 to Rp.75,000, median seems to be around Rp.50,000/month.

b. Commercial Area

(1) Responsibility for Waste Collection

According to the Municipal Regulation (Perda No.6 and No.2) the buildings which discharge waste 2.5 m^3 or more per day should collect their waste and transport by themselves or request the Cleansing Department to collect and haul waste. Big department stores, supermarkets employ collection and haulage contractors. Waste of small shops of which waste volume is less than 2.5 m^3 per day is collected by RT/RW.

(2) Collection Frequency

Waste is usually collected every day in commercial areas. If the volume of waste generated in a building is much, waste collectors visit the building more than once a day.

(3) Waste Storage

Tin containers are commonly utilized for waste storage in small shops. Waste discharged from hotels and department stores are usually separated into two: wet and dry ones. Dry waste such as papers, plastics, cartons, glasses are placed in storage bins and sold to some buyers. Wet waste is waste and is usually stored in plastic bins. In some hotels and department stores, wet waste discharged from their restaurants are stored in refrigerator rooms to prevent the smell.

(4) Waste Collection Fee

If waste is collected by RW/RT, the collection fee is decided by them. When hotels discharge irregularly large amount of waste, they are requested to pay extra collection fee.

c. Markets

(1) Responsibility for Waste Collection

Markets in Surabaya are classified into two types: those owned by PD Pasar (Market Authority) and the temporary markets. In the markets owned by PD Pasar, garbage discharged from each shop is collected and carried to the nearest Depo/LPS by the market workers. Waste of temporary markets are collected by RT/RW.

(2) Collection Frequency

Market workers collect waste discharged from each shop in the market two to three times a day.

(3) Waste Storage

Many shops have their own waste storage baskets, but some do not. Most of the waste are discharged from vegetables vendors. There are none or little waste discharged from fish, meat, and dry foods vendors. Waste collected by market workers are mostly open-dumped in the Depo/LPS that are usually located adjacent to a market because containers are not placed in such Depo/LPS.

(4) Waste Collection Fee

RT/RW decides the collection fees paid by the temporary markets. Waste collection fees from each shop in P.D. markets is determined as follows:

Table 2.6-1 Waste Collection Fees by Type of Shop in P.D Market

	Kinds of shop	Price
Group I	- Gold - Radio/Electronic tools - Motorcycle	Rp 50 / day
Group II	- Watch - Glasses - Bicycle - Spare park	Rp 50 / day
Group III	- Restaurant - Shoes - Meat - Bird - Rice	Rp 75 / day
Group IV	- Vegetable - Fruit - Salt for Cooking - Plastic	Rp 100 / day
Others	Temporary shops	Rp 125 / day

d. Road

See Section 2.7

e. Industry

(1) Responsibility for Waste Collection

In principle, those who generate solid waste 2.5 m^3 or more each day are obliged to collect and haul their waste to LPA by themselves. So called home industry which generate less than 2.5 m^3 per day, and has less than 10 employees are allowed to discharge their waste in the same manner as households do. Their waste is collected and hauled to Depo/LPS by RW/RT. According to the municipal regulations, it is the responsibility of waste generators to treat hazardous waste, and make it harmless.

(2) Collection Frequency

Enterprises responsible for collection and haulage of own waste have different frequency depending on the needs of respective enterprise. On the other hand, the collection done by RW/RT follows the schedule of each RW/RT/. The frequency of collection of waste from the home industry by RT/RW depends on the collection schedule of RT/RW.

(3) Waste Storage

Waste storage manner inside each industry is not specified by regulations.

(4) Waste Collection Fee

All the industries pay some fees to RT/RW that collect waste from generators to Depo/LPS according to the amount of volume. In addition, the waste generators have to pay the sanitary retribution to KMS. The amount of the retribution differ by waste amount and size of industries as shown below:

	Retribution
a. Industries that generate 2.5 m^3 or more waste each day:	Rp 500/ m^3
b. Industries that generate less than 2.5 m^3 each day:	
- Small Industries	Rp 2,500/month
- Large Industries	Rp 15,000/month

3) Collection Service Coverage by RT/RW

As is explained in Section 2.6.1, the sum of waste amount either collected or recycled is 1,377 ton/day, 85 % of the total waste generation amount in surabaya (1,626 ton/day). Of the sum of 1,377 ton/day, 1,197 is collected either by RT/RW (889 ton/day) or by generators (137 ton/day), the remaining 180 ton/day is recycled.

In terms of population, it is estimated that 81 % of the population receive waste collection service as shown in Table 2.6-2. and Fig.2.6-2. This estimation was made based upon the JICA Study that covered all the 163 Kelurahan.

Table 2.6-2 Waste Collection Service by Kecamatan (1992)

No	Kecamatan	Total Population estimated	Registered Population	Population served	Collection ratio in the total population	Collection ratio registered
		(A)	(B)	(C)	(D)=(C)/(A)	(E)=(C)/(B)
1	Genteng	74,400	70,600	70,600	95%	100%
2	Tegalsari	121,600	119,200	119,200	98%	100%
3	Bubutan	114,000	110,500	110,500	97%	100%
4	Simokerto	103,400	103,400	103,400	100%	100%
5	Krembangan	134,600	115,700	115,700	86%	100%
6	Semampir	167,000	151,200	151,200	91%	100%
7	Pabean Cantikan	93,400	91,400	91,400	98%	100%
8	Kenjeran	91,200	67,900	65,100	71%	96%
9	Tambaksari	196,600	183,700	171,100	87%	93%
10	Gubeng	159,400	145,300	145,300	91%	100%
11	Sukolilo	164,700	103,200	78,400	48%	76%
12	Rungkut	194,700	124,500	116,700	585	91%
13	Sawahan	211,200	198,000	198,000	94%	100%
14	Wonokromo	175,600	170,700	170,700	97%	100%
15	Wonocolo	151,000	114,300	114,300	76%	100%
16	Tandes	218,900	168,100	160,800	73%	96%
17	Benowo	38,400	32,100	8,600	22%	27%
18	Karang Pilang	151,100	115,300	109,700	73%	92%
19	Lakarsantri	61,900	57,100	17,700	29%	31%
	TOTAL	2,623,600	2,242,200	2,118,400	81%	94%

Note 1. The Study Team distributed a questionnaire to 163 Kelurahan, and visited each Kelurahan to collect answer sheets if they are not returned to the Team, or the answers were not clear.

Note 2. It should be noted that it is recorded that RT/RW provide collection services even if collected waste is dumped at non-designated places. Those who are not registered to RW/RT will not receive waste collection services because they do not pay collection fee to RW/RT.

Note 3. Data on collection service is indicated by the current registered population estimated, the total population of some Kelurahan estimated by the JICA population model is adjusted based upon the registered population. Such adjustments were made in some Kelurahan located in central area.

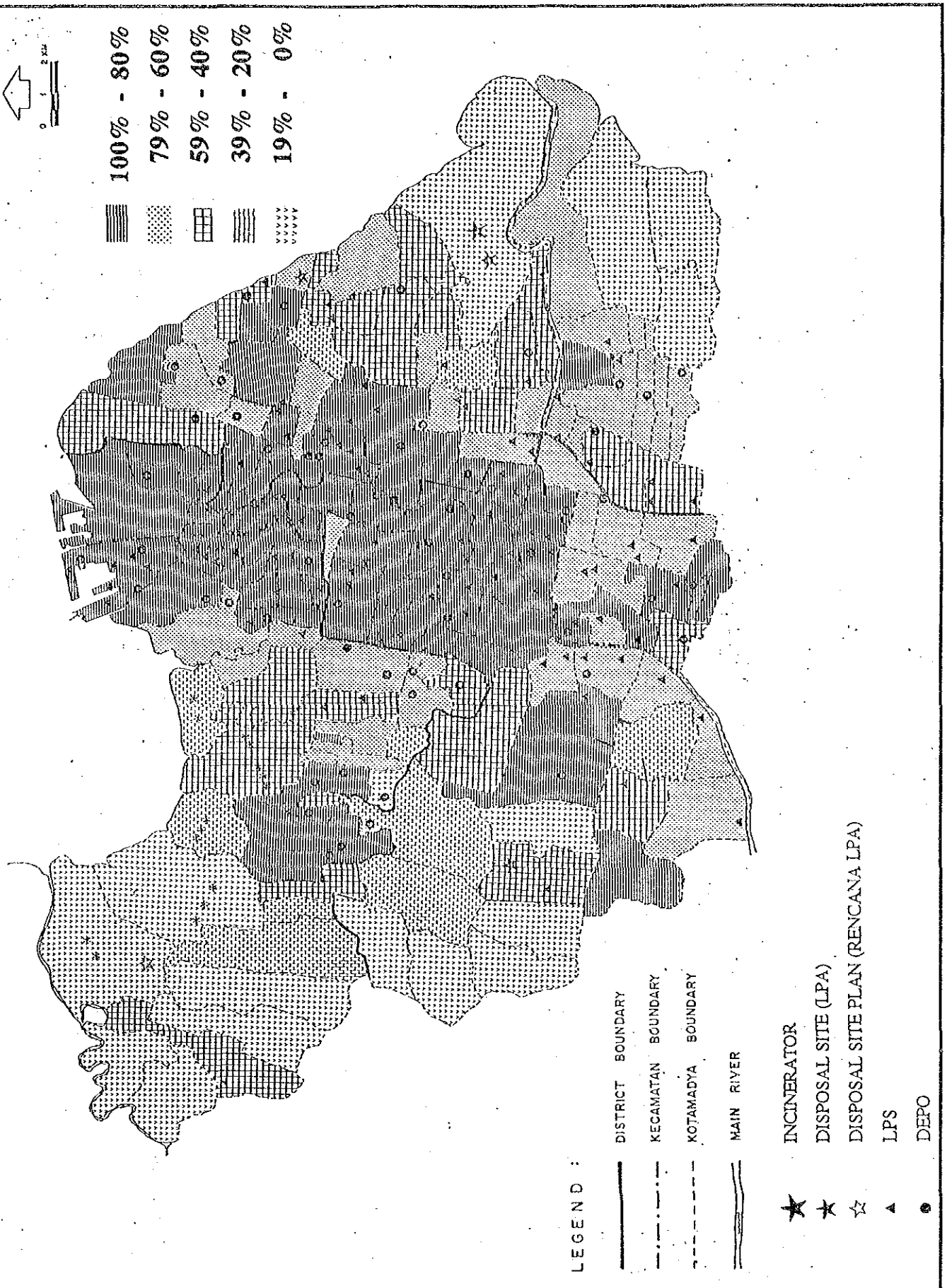


FIG. 2.6-2 WASTE COLLECTION SERVICE LEVEL BY KELURAHAN (1992)

THE STUDY ON THE SOLID WASTE MANAGEMENT IMPROVEMENT FOR SURABAYA CITY

4) Equipment

Major equipment used for waste collection are as follows.

- Handcart
- Brooms and Wood plates
- Yellow shirts, pants, boots and gloves

a. Handcart

Dimensions of some handcarts used for the collection are as follows:

-Length	1.5m - 1.8m
-Width	0.8m - 1.0m
-Height	0.8m - 1.3m
-Capacity	$1.1m^3$ - $2.6m^3$

In commercial areas, bigger handcarts tend to be utilized, and smaller ones are applied to collect street waste because bigger handcarts tend to disturb traffic. Weight of an empty handcart is 160 kg on average, and the weights with waste loaded range from 300 kg to 680 kg. A handcart is pulled by one or two collection workers.

b. Broom and Wood Plate

Bamboo-made brooms are used. Wood plates are used to collect waste swept, and put it into a handcart.

c. Yellow shirts and pants

Collection workers and street sweepers wear yellow shirts and trousers, which are considered very good in that 1) the workers with yellow uniform may be safer on the streets than those without them as the former can be easily recognized by drivers, and 2) the yellow uniforms give the workers the pride in their job. The uniforms are often donated by local firms located in the collection area.

5) Management System

Leaders of RT/RW are responsible for the recruit and management of collection workers. If waste is not collected for long time, residents complain to the RT leader. Then the RT leader takes an action to improve the situation.

6) Cost of Primary Collection

It is estimated that the annual cost of Primary Collection is about Rp 8.4 billion as shown in Table 2.6-3.

Table 2.6-3 Annual Cost of the Waste Collection Spent by Local Communities

	Unit Cost per Year	Quantity	Total
1. Salary	Rp 624,000/worker	10,000 workers	Rp 6,240,000,000
2. Clothes, boots, gloves, etc.	Rp 100,250/worker	10,000 workers	Rp 1,002,500,000
3. Broom, etc.	Rp 51,700/worker	10,000 workers	Rp 517,000,000
4. Annual Depre-ciation of a handcart	Rp 246,500/worker	2,600 handcarts	Rp 640,000,000
5. O/M cost of a handcar	Rp 10,000/cart	2,600 handcarts	Rp 26,000,000
TOTAL			Rp 8,425,500,000

7) Collection Efficiency

In order to grasp the efficiency of the waste collection, the time and motion study was executed in the following types of areas:.

- High income areas
- Middle income areas
- Low income areas
- Commercial areas

Through the study, ten (10) sample round trips of collection vehicles were observed in total. The result of the time and motion study is shown in Table 2.6-4.

Collection activities differ by individual collector; some collectors are very eager to pick up recycling materials, while some other collectors are not. Some are very industrious. The total trip time in a collection area ranges from 35 minutes in the shortest to 107 minutes in the longest.

Table 2.6-4 The Result of Time and Motion Study for the Waste Collection

1	Date of Study	May 15	May 17	May 15	May 17	May 15	May 17	May 26	May 27	May 26	May 27
2	Characteristic of Area	High Income	High Income	Middle Income	Middle Income	Low Income	Low Income	Commercial	Commercial	Commercial	Commercial
3	Name of Depo/LPS	Manyar	Manyar	Kangean	Kangean	Kintamani	Kintamani	Pirngadi	Pirngadi	Pecindilan	Pecindilan
4	Handcart Capacity (m^3)	1.24	1.24	1.08	1.08	1.22	1.22	2.16	2.16	1.98	1.98
5	Waste Volume (m^3)	1.24	1.20	1.08	1.08	1.22	1.22	2.05	2.05	1.89	1.78
6	Net Load (t)	0.309	0.259	0.242	0.362	0.488	0.438	0.264	0.323	0.226	0.280
7	Waste density (t/m^3)	0.249	0.216	0.224	0.335	0.400	0.359	0.129	0.158	0.120	0.157
8	Number of House	61	34	45	38	47	29	80	76	72	71
9	Number of Concrete Bins	40	26	34	31	2	1	0	0	2	3
10	Number of Other Bins	21	8	0	2	43	28	77	76	49	56
11	Total Number of Bins (9)+(10)	61	34	34	33	45	29	77	76	51	59
12	Round Trip Time (13)+(18)	70.0	74.0	130.0	113.0	93.2	80.0	194.0	135.0	120.0	96.0
13	Total Time in Collection Area (1st bin to last bin)	59.5	35.5	73.0	70.0	55.0	35.0	107.0	103.0	104.0	76.0
14	Total Time Spent at Concrete Bins	21.0	14.5	35.5	32.5	4.0	0.5	0	0	4.0	2.5
15	Total Time Spent at Other Bins	8.0	4.5	0	1.5	46.0	21.0	42.7	53.3	53.0	40.0
16	Total Time Spent for Collection (14)+(15)	29.0	19.0	35.5	34.0	50.0	21.5	42.7	53.3	57.0	42.5
17	Total Walking Time at Collection Area	30.5	16.5	34.2	33.0	28.2	13.5	62.2	36.2	43.0	30.0
18	Total Time Spent for Neither Collection nor Walking	10.5	38.5	60.3	46.0	5.0	45.0	89.1	45.1	20.0	23.5
19	Mean Waste Pick-up Time (16)/(6)	93.9	73.4	146.7	93.9	102.5	49.1	161.7	165.0	252.2	151.8
20	Mean Pick-up Time per Concrete Bin	0.525	0.558	1.04	1.05	2.00	0.5	0	0	2.00	0.83
21	Mean Pick-up Time per Other Bin	0.381	0.563	0	0.75	1.10	0.75	0.55	0.70	1.08	0.71
22	Mean Pick-up Time per Bin	0.475	0.559	1.04	1.00	1.14	0.74	0.55	0.70	1.12	0.72
23	Mean Walking Time from Bin to Bin (17)/[(11)-1]	0.508	0.500	1.04	1.03	0.64	0.48	0.82	0.48	0.86	0.52

Mean collection time spent per bin is 30 seconds to 1 minute. However, in case of concrete bin, mean collection time tends to be longer than the average. Mean walking time from bin to bin is also 30 seconds to 1 minute.

In case of Kangean and Pirngadi, some workers have to spend a long time before being able to transfer waste from handcarts to containers placed in Depo/LPS when containers are full with waste, which often happens.

8) Major Issues

(1) There are some RW/RT which do not have waste collection services because there are many unused lands, and most of waste can be eaten by animals such as chicken and cat. It is considered that those area do not need waste collection. Rather it is good in view of resource recycling.

(2) It is considered that such unused lands where waste are eaten by animals will decrease in the future. Then, the people will increasingly demand for waste collection services.

(3) Use of concrete bins have some disadvantages, i.e., 1) it takes longer time for workers to collect waste from concrete bins than from other types of bins such as plastic or tin bins, and 2) concrete bins without covers serve as breeding beds for mice as mice eat waste dumped in the concrete bins.

2.6.3 Waste Haulage

1) Improvements in Recent Years

The city of Surabaya has made remarkable improvements on the solid waste management (SWM) over the past decade through the implementation of the Solid Waste Improvement Plan (SWIP), a component of the City Development Project (named Urban III and V), which commenced in 1980.

Before 1980 the Cleansing Department had used only flat-body trucks and open dump trucks. Some of these trucks were used instead of containers in certain areas, and some collected waste from households. The private sector involvement was much greater than the present.

In 1980 under the SWIP, the Cleansing Department changed the waste collection system to "container" system, by introducing 21 units of $6m^3$ containers in 1979 and 8 hydraulic container trucks in 1980. $10m^3$ hydraulic container trucks were introduced in 1982, $12m^3$ hydraulic container trucks in 1985 for the first time respectively.

In 1986 Rear End Loader (REL) compactor trucks were introduced for road side waste collection. In 1989, 3 mechanical road sweepers were imported from the United States.

With the containerization of depo and LPS (to provide large communal containers at Depo/LPS), the involvement of the private sector decreased sharply because the containerized haulage system requires expensive arm-roll trucks, while the contractors could not afford to purchase them. Therefore, the contractors' involvement has been limited to the waste haulage from Depo/LPS where waste is openly dumped without containers, and can be collected by open dump trucks, which the contractors can afford to purchase. Numbers of trucks and containers procured in the past are shown in Table 2.6-5.

Table 2.6-5 Procurement of Waste Vehicles and Containers in the Past

No	Truck & Container	1979	1980	1981	1982	1985	1986	1987	1988	1989	1991	Total
1	6 m3 Container truck		0 (8)	1 (10)	5 (10)	8 (15)			10 (10)	2 (2)		26 (55)
2	10 m3 Container truck				1 (3)	7 (7)		5 (5)				13 (15)
3	12 m3 Container truck					4 (4)						4 (4)
4	Dump Truck				2 (3)	1 (1)		1 (1)				4 (6)
5	Flat-body truck	0 (2)	0 (1)		2 (4)							2 (7)
6	10 m3 Rel compactor						10 (10)					10 (10)
7	6 m3 Rel compactor								5 (5)			5 (5)
8	Road Sweeper									3 (3)		3 (3)
	Sub-Total	0 (2)	0 (9)	1 (10)	10 (20)	20 (27)	10 (10)	6 (6)	15 (15)	5 (5)		67 (104)
9	0.6m3 Container								30 (30)	38 (39)		68 (69)
10	1m3 Container							0 (80)	29 (101)	339 (372)		368 (553)
11	6m3 Container	0 (21)	0 (6)	0 (55)	11 (39)	46 (46)	22 (22)		76 (76)	5 (5)	1 (1)	161 (271)
12	10m3 Container				5 (15)	21 (21)	42 (42)	5 (5)	7 (7)			80 (90)
13	12m3 Container					11 (16)				8 (8)		19 (24)
	Sub-Total	0 (21)	0 (6)	0 (55)	16 (54)	78 (83)	64 (64)	5 (85)	142 (214)	390 (424)	1 (1)	696 (1007)

Note: -Numbers without parentheses show those of operational trucks currently used.
-Numbers in parentheses show units purchased.

Source: The Cleansing Department

2) Waste Haulage Service Level

a. Waste Haulage in Terms of Waste Amount

It is estimated that KMS' haulage amount is 889 ton/day, and the amount of waste hauled by generators is 137 ton/day. The sum of waste haulage amount of both KMS and the generators is 1,026 ton/day, 63 % of the total waste generation amount in Surabaya, 1626 ton/day. Of the 1,626 ton/day of waste, 180 ton/day is recycled by scavengers, and 249 ton/day is not collected. The haulage amount 1,026 ton/day is 86 % of the total waste amount 1,197 ton/day collected by RT/RW and generators. [1,626 ton/day - (180 ton/day + 249 ton/day) = 1,197 ton/day]

The difference 171 ton/day between the collection amount (1,197 ton/day) and haulage amount (1,026 ton/day) is the waste collected but not hauled. This type of waste (171 ton/day) needs to be hauled in the future.

b. Waste Haulage in Terms of Population

Table 2.6-6 shows the waste haulage level by Kecamatan and Fig. 2.6-3 shows it by Kelurahan. The haulage service refers to KMS' waste haulage service from Depo and LPS to the final disposal sites.

The higher service level is found in the Central, the North, and the South areas where there are Depo/LPS. On the other hand, it is low in the Eastern and the Western part of Surabaya. As a whole it is estimated that 79% of the total population receive the haulage service.

The 79% haulage service level is lower than 81%, the level of collection service (waste collection from generators to Depo/LPS or other places). However, the 2% gap (81% - 79%) may be filled if containers are placed in the open space land where RW/RT is dumping after collection.

FIG. 2.6-3 WASTE HAULAGE SERVICE LEVEL BY KELURAHAN

THE STUDY ON THE SOLID WASTE MANAGEMENT IMPROVEMENT FOR SURABAYA CITY

Table 2.6-6 Waste Haulage Coverage by Kecamatan in 1992

No	Kecamatan	Total Population estimated	Registered Population	Population served with Haulage Service	Percentage to the total population	Percentage to the registered population
		(1)	(2)	(3)	(4)=(3)/(1)	(5)=(3)/(2)
1	Genteng	74,400	70,600	70,600	95%	100%
2	Tegalsari	121,600	119,200	119,200	98%	100%
3	Bubutan	114,000	110,500	110,500	97%	100%
4	Simokerto	103,400	103,400	103,400	100%	100%
5	Krembangan	134,600	115,700	115,700	86%	100%
6	Semampir	167,000	151,200	151,200	91%	100%
7	Pabean Cantikan	93,400	91,400	91,400	98%	100%
8	Kenjeran	91,200	67,900	57,500	63%	85%
9	Tambaksari	196,600	183,700	171,100	87%	93%
10	Gubeng	159,400	145,300	145,300	91%	100%
11	Sukolilo	164,700	103,200	76,700	47%	74%
12	Rungkut	194,700	124,500	110,600	57%	89%
13	Sawahan	211,200	198,000	198,000	94%	100%
14	Wonokromo	175,600	170,700	170,700	97%	100%
15	Wonocolo	151,000	114,300	107,800	71%	84%
16	Tandes	218,900	168,100	148,500	68%	88%
17	Benowo	38,400	32,100	4,100	11%	11%
18	Karang Pilang	151,100	115,300	109,700	73%	92%
19	Lakarsantri	61,900	57,100	95,000	15%	17%
	T O T A L	2,623,600	2,242,200	2,071,500	79%	92%

3) Equipment and Facility

a. Waste Collection Truck

KMS uses three(3) different types of waste collection vehicles according to the type of waste storage container and place. The most common type of vehicle is arm-roll container truck, which is used to haul large waste containers ($6m^3$, $10m^3$, and $12m^3$) from Depo/LPS. The second type of collection vehicle is rear end loader (REL) truck, which is

used to haul waste from small containers (0.6m^3 and 1.0 m^3) placed on road sides. The third type is open truck used to collect waste openly dumped at Depo/LPS.

The following table shows the number of waste trucks owned by the Cleansing Department and the five contractors used by KMS respectively. The private contractors possess the open trucks only, and collect waste from the Depo/LPS where containers are not placed.

Table 2.6-7 The Existing Waste Collection Trucks

(as of May 1992)

No	Types of Trucks	KMS			Private Contractors		
		Operational Unit	Ave. Amount of Haulage Waste (ton/trip)		Operational Unit	Ave. Amount of Haulage Waste (A) (ton/trip) (B)	
			(A)	(B)		(A)	(B)
1	Container truck 6m^3	26	2.09	1.78	-	-	-
2	Container truck 10m^3	13	3.67	2.65	-	-	-
3	Container truck 12m^3	4	3.96	2.44	-	-	-
4	REL Compactor 6m^3	5	1.76	1.14	-	-	-
5	REL Compactor 10m^3	10	3.15	2.75	-	-	-
6	Open truck 6m^3	7	2.36	1.54	-	-	-
7	Open truck 20 - 25m^3	-		-	19	5.87	5.86
8	Road Sweeper	3	2.57		-	-	-

Note : (A) : rainy season
(B) : dry season

Source: Data on operational units are from the Cleansing Department.
Average haulage amounts are estimated on the basis of field survey conducted by JICA

b. Waste Containers

KMS uses two types of waste containers: large ones (6m^3, 10m^3, and 12m^3) placed in Depo/LPS, and small ones(0.6 m^3, 1.0m^3) placed on the roadsides and some residential areas in the northeastern part of Surabaya where there is no Depo/LPS.

As of May 1992, there are 696 containers altogether. Waste stored in smaller containers is hauled by the compactor trucks, while the large containers with waste are hauled by arm-roll container trucks. The small containers are purchased not only by KMS but also by RW/RT and private firms.

The numbers of the existing containers are shown in Table 3.6-8. The average number of 0.6m^3 containers served by one 6 m^3 compactor truck is only 13.6 / day which is very small compared to 36.8 / day of 1.0m^3 containers served by one 10 m^3 compactor truck. A 12 m^3 compactor truck hauls 4.8 units of 12m^3 containers per day on average, which is less than the average number (6.2 unit) of the other types of containers (6m^3 and 10m^3) served by a compatible container truck.

Table 2.6-8 The Number of Containers Served by Trucks

Size	0.6 m^3	1.0 m^3	6 m^3	10 m^3	12 m^3	Total
No. of Container	68	368	161	80	19	696
No. of Trucks	5	10	26	13	4	58
No. of Container/Truck	13.6	36.8	6.2	6.2	4.8	---

The weights of a container by size are shown in Table 2.6-9. This means the Gross Vehicle Weight (GVW) is charged depending on a container hauled at Depo/LPS. These containers are manufactured by the local manufactures.

Table 2.6-9 The Weight of Container by Size

Type of Container	No. of Sample	Min ~ Average~Max
6 m^3 Container	4	660 kg ~ 860 kg ~ 960 kg
10 m^3 Container	3	890 kg ~ 1260 kg ~ 1580 kg
12 m^3 Container	3	980 kg ~ 1350 kg ~ 1540 kg

c. Depo/LPS

One of the superior aspects of the SWM of the KMS is that KMS has many Depo and LPS in Surabaya, which serve as small waste transfer stations. Depo/LPS are very important in view of the efficiency of waste haulage.

KMS has 55 Depo and 120 LPS in Surabaya, of which 2 Depo and 11 LPS have not operated as of May 1992. A newly constructed Depo has an area of 300 m^2. It has gates, office (kantor) and concrete floor. Ten trees were planted at the beginning of Depo construction but most of trees have been deteriorated due to waste leach ate and poor management. Fig 3.6-4 shows the typical design of a new Depo.

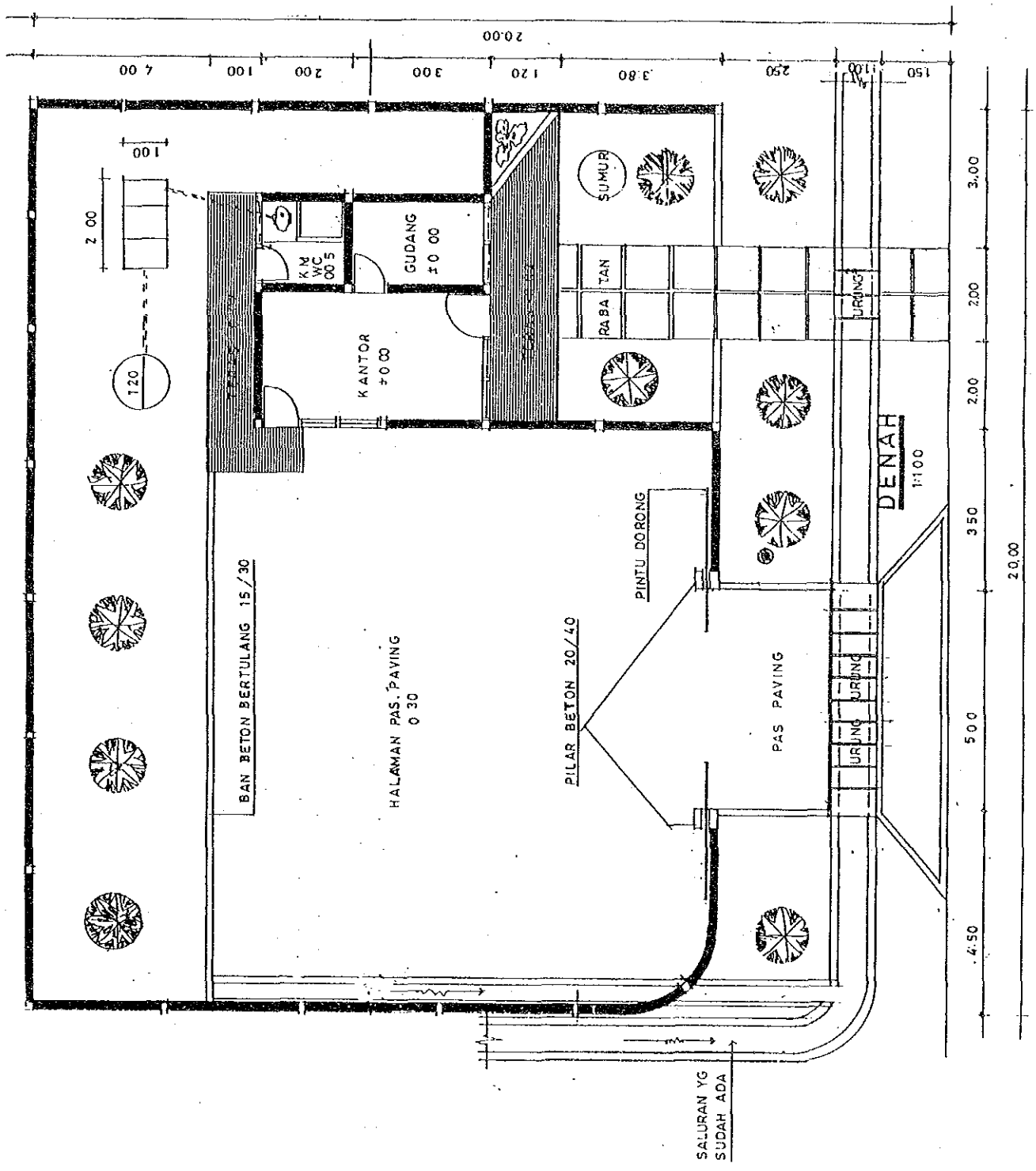


FIG. 2.6-4 TYPYCAL DESIGN OF NEW DEPO IN SURABAYA

THE STUDY ON THE SOLID WASTE MANAGEMENT IMPROVEMENT FOR SURABAYA CITY

The distinction between Depo and LPS is that the former is stationed with an officer, and usually has an office, wall, drainage and concrete floor, while the latter does not have an office and drainage. LPS is actually a part of roadside area. Five (5) LPS were recently closed due to the residents' complaints about bad smell and poor sanitary conditions.

d. Garage

The Cleansing Department has a place in Asemrowo that is used as a truck garage and as a maintenance workshop. This place is operated by the Haulage Section. An organization chart of the section is shown in Fig 2.6-5.

Haulage Section is responsible for both operation and maintenance of collection vehicles as well. Truck Operation sub-section of the Haulage Section is responsible for management of trucks' daily operation and supply of the fuel for truck.

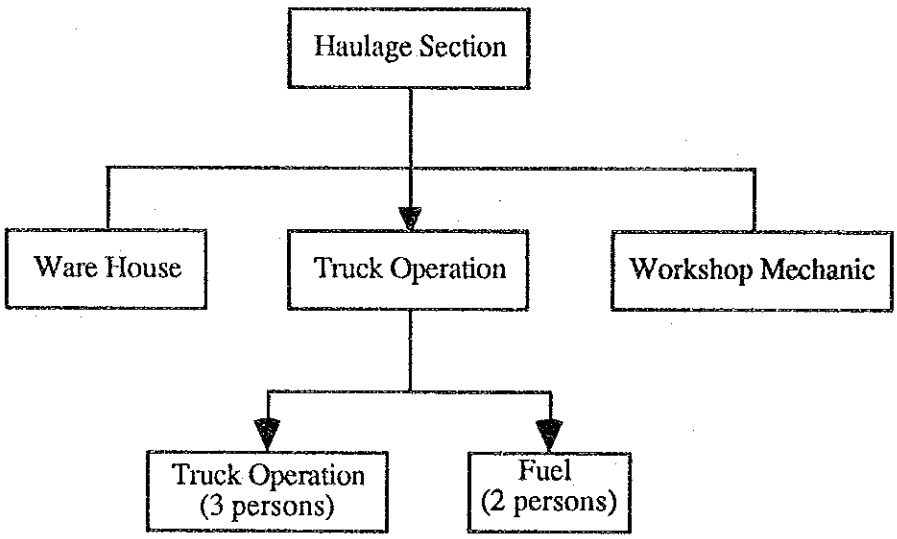


Fig 2.6-5 Organization of the Haulage Section

4) Operation Conditions of KMS Trucks

Table 3.6-10 shows that the operation conditions by the type of trucks based upon the vehicle operation record of April 1992.

The average vehicle operational rate 94% as shown in Column D is considered very high. However, it should be noted that there are some trucks which did not submit the vehicle operation records and their operation rates may be lower than those of the other trucks. The vehicle operation rate of compactor trucks is higher, especially $6m^3$ compactor is the highest (100%). The operation rate of container trucks is low, especially $6m^3$ container is the lowest (88.6%). The reasons for the high operation rate of compactor trucks are 1) the compactor trucks are relatively newer than the other type of trucks, 2) the average of daily running distance of compactor trucks is about 40 km while the container trucks is more than 120 km.

Table 2.6-10 Vehicle Operation Rate

Type of Truck	No of Truck	Total truck-days per month	Actual Operating truck-days per month	Operation rate
	(A)	(B)=(A)x30	(C)	(D)=(C)/(B)
$6m^3$ container truck	24	720	638	88.6%
$10m^3$ container truck	12	360	359	99.7%
$12m^3$ container truck	4	120	118	98.3%
$6m^3$ compactor truck	4	120	120	100%
$10m^3$ compactor truck	10	300	298	99.3%
Open Truck	7	210	188	89.5%
TOTAL	61	1,830	1,721	94%

Note: The above table does not include operation records of 2 units of $6m^3$ container trucks, 1 unite of $10m^3$ container truck and 1 unite of $6m^3$ REL tuck as the records were not available.

5) Haulage Trip

At present there are three LPA in Surabaya: Kenjeran and Keputih in the east, and Lakarsantri in the west. The destinations (LPA) of the waste haulage from each Depo/LPS are shown in Fig. 2.6-6. The haulage distance and time of the trips from Kecamatan to LPA surveyed by JICA Study Team are shown in Table 2.6-11.

It is estimated that the average one way trip distance is 11 km - 15 km. The longest trip is 24 km from Krembangan to Lakarsantri LPA. The average one way trip time is 30 minutes. The longest trip time is 75 minutes from Semanpir to Kenjeran LPA. The longest trip time is due to the traffic conditions. If a round trip traveling time take 1 hour, it is considered possible to make 6 to 7 trips per day in 8 hours working time including collection and disposal time.

Table 2.6-11 Haulage Time and Distance between LPA and the Center of Each Kecamatan

Kecamatan	Trip from Depo/LPS to Disposal Site (LPA)					
	Kenjeran		Lakarsantri		Keputih	
	Distance (km)	One way Trips time	Distance (km)	One way Trips time	Distance (km)	One way Trips time
1. Sukolilo	4	15 min	-	-	3	10 min
2. Kenjeran	5	16 min	-	-	10	27 min
3. Tambak Sari	7	25 min	-	-	15	32 min
4. Simokerto	7	18 min	-	-	11	25 min
5. Gubeng	13	30 min	-	-	7	14 min
6. Rungkut	15	33 min	-	-	11	30 min
7. Semampir	11	75 min	-	-	16	33 min
8. Pabean Cantikan	12	28 min	-	-	17	36 min
9. Wonocolo	17	38 min	-	-	14	26 min
10. Wonokromo	15	33 min	-	-	12	27 min
11. Tegalsari	14	30 min	-	-	10	20 min
12. Genteng	11	18 min	-	-	14	26 min
13. Sawahan	-	-	22	60 min	-	-
14. Bubutan	-	-	18	40 min	-	-
15. Krembangan	-	-	24	55 min	-	-
16. Tandes	-	-	17	40 min	-	-
17. Benowo	-	-	15	40 min	-	-
18. Lakarsantri	-	-	2	10 min	-	-
19. Karang Pilang	-	-	4	16 min	-	-
Average	10.9	29.9	14.6	37.3	11.7	25.5

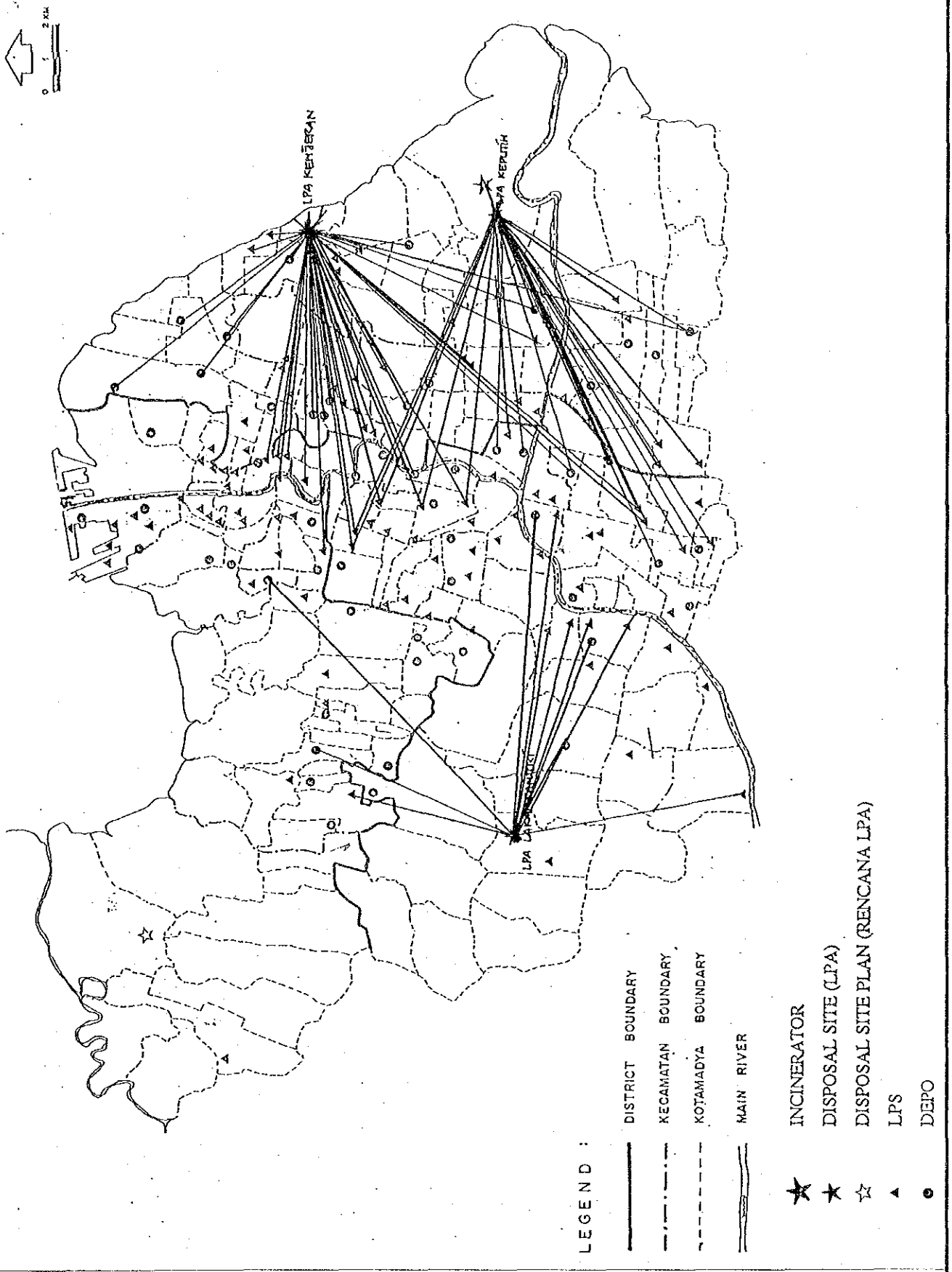


FIG. 2.6-6 DESTINATION(LPA) OF WASTE HAULAGE FROM EACH DEPO/LPS

THE STUDY ON THE SOLID WASTE MANAGEMENT IMPROVEMENT FOR SURABAYA CITY

6) Waste Haulage Amount

Based upon the JICA Study Team's field survey on both the rainy season (March March 21 - April 1) and the dry season (May 15 - May 23) the average daily amount of waste hauled in Surabaya is estimated at 889 ton.

a. Haulage by KMS

Amount of waste hauled by the type of truck is estimated as shown in Table 2.6-12. Among trucks, $6m^3$ container trucks, $10m^3$ container trucks and the contractors are the major waste collection system in Surabaya, which mark 80% of total waste hauled under the KMS responsibility.

In view of trip frequency per day, 6 m^3 container truck is the most frequent because the capacity of container ($6m^3$) cannot catch up with the increase of waste generated around Depo/LPS which $6m^3$ containers are placed.

Table 2.6-12 Estimated Amount of Waste Transported by the Trucks

Type of Truck	No of Truck	Average Weight	Trip frequency per day	Amount of waste per day (ton)	Amount of waste per year
	(1)	(2)	(3)	(4)=(1)*(2)*(3)	(5)=(4)*365
$6m^3$ container truck	26	1.63 t	5.8	246 (27.7%)	89,790
$10m^3$ container truck	13	3.16 t	4.7	193 (21.8%)	70,445
$12m^3$ container truck	4	3.20 t	4.3	55 (6.2%)	20,075
$6m^3$ compactor truck	5	1.45 t	2.1	15 (1.7%)	5,475
$10m^3$ compactor truck	10	3.45 t	2.5	86 (9.7%)	31,390
Open Truck	7	1.95 t	1.9	26 (2.9%)	9,490
Contractor's truck	19	5.64 t	2.5	268 (30.2%)	97,820
TOTAL	84	20.48 t	—	889 (100.0%)	324,485

b. Haulage by the Contractors

The daily waste hauled by the contractors is estimated at 268 ton based upon the JICA Team's field survey.

7) Operation Hours

Based upon the vehicle operation record and the Study Team's observations, operation hours by type of truck are shown in Table 2.6-13. Operation hours start from the time of leaving the garage until the time of returning to the garage to stop the engine. KMS facility accepts that drivers and assistants do the side business such as transporting various materials and persons provided that they complete their responsibility.

Among 57 samples, 32 trucks or 56% operate for 7 - 9 hours on average, and 21 trucks or 37% operate 9 hours or more on average. 4 trucks or 7% operate less than 7 hours. It seems that the operation hours of the container trucks are longer than the other type of trucks. It should be noted that 8 units of $6m^3$ container trucks have already been used on 2 working shifts due to the lack of trucks.

Drivers and assistants work on Sunday and National holidays in principle, but take day-off irregularly when they feel tired or sick.

Table 2.6-13 Average Working Hours by Type of Trucks

Type of Truck	Sample No.	Average Working Hours		
		Less than 7	7 or more and less than 9	9 or more
$6m^3$ Container Truck	22	1	13	8
$10m^3$ Container Truck	12	0	6	6
$12m^3$ Container Truck	4	0	1	3
$6m^3$ Compactor Truck	4	0	4	0
$10m^3$ Compactor Truck	8	1	5	2
Open Truck	7	2	3	2
TOTAL	57	4	32	21

8) Waste Volume Monitoring and Vehicle Arrangements

There is an officer and some workers in each Depo. So in case of Depo, an officer is responsible to keep waste volume record and report to the branch office of the Cleansing Department (Cabang office). On the other hand, record keepers (Penjaga) in Cabang offices are responsible for keeping records of the daily waste volume in LPS. Records on

daily waste volume of Depo/LPS are arranged in Cabang offices, and reported to the Cleansing Department on the following day.

The Cleansing Department can know the waste collection situation of each Depo/LPS through the reports submitted by Cabang offices. If some waste of a Depo/LPS is not collected due to accidents of an assigned truck, the other truck will be sent to collect waste after finishing its work in the assigned area because there is no spare truck in the Cleansing Department. If the volume of waste has increased due to a population increase or emergence of new shops/restaurants, for example, but the Cleansing Department can not collect the increased waste, it requests private contractor to haul the waste.

Each waste collection vehicle is assigned with Depo/LPS from where waste should be hauled. Such assignment are decided by the head of Haulage Section. Appropriateness of Depo/LPS assignment is seldom reviewed. Open trucks are assigned with Depo/LPS where containers are not placed. Such places are mainly collected by the private contractors. $10m^3$ compactor trucks collect waste from 1 m^3 containers placed on roadside. $10m^3$ compactor trucks also collect hospital wastes for major hospitals by visiting hospitals one by one.

9) Manpower Used for Waste Haulage

Table 2.6-14 shows the present number of drivers and assistant. There are 69 drivers and 77 assistants in the Cleansing Department. It may be noted that more than 90% of the drivers have permanent status, while the assistants with permanent status of the drivers is only 42%.

Table 2.6-14 Number of Drivers and Assistants by Employment Status

	Permanent	Temporary	Total
Drivers	64	5	69
Assistants	32	45	77
Total	96	50	146

Table 2.6-15 shows the composition of workers by type of trucks. A container truck and a $6m^3$ compactor are operated by one driver and one assistant. A 10 m^3 compactor needs one driver and two assistants. The truck drivers and assistants come to the garage in Asemrowo before 7 o'clock morning gathering. After finishing the gathering, they leave for the designated Depo/LPS. An open truck is operated by one driver and 6 helpers who

are picked up at Rayon office, and load waste discharged at a open dumping site to the truck.

Table 2.6-15 Composition of Workers by Type of Trucks

	Driver	Assistants	Helpers	Total
$6m^3$ container Truck	1	1	0	2
$10m^3$ container Truck	1	1	0	2
$12m^3$ container Truck	1	1	0	2
$6m^3$ compactor Truck	1	1	0	2
$10m^3$ compactor Truck	1	2	0	3
Open Truck	1	0	6	7

10) Private Sector Involvement

At present, KMS uses five private contractors. They use open dump trucks to haul waste from the Depo/LPS where there are no containers. Since KMS has increased the number of containerized Depo/LPS and reduced the open-dumped Depo/LPS, the share of the contractors has decreased in recent years in terms of waste haulage amount because the contractors posses only open trucks. They can not purchase container trucks because no banks provide the contractors with loans due to the short period (3 months) of contracts between KMS and contractors.

The volume of waste hauled by the private contractors is shown in Table 2.6-16. The total contract waste haulage volume of the private contractors is 1,327 m^3/day in 1992/93. The volume of respective contractors are decided by KMS through the estimation of waste volume hauled by handcarts to the contract Depo or LPS. Based upon the JICA Study Team's field survey, the total haulage amount of the contractors is estimated at about 268 ton/day, which is about 30.2 % of the total waste hauled by KMS and its contractors.

In the Depo/ LPS where waste is open-dumped on the ground, the collectors load the waste into bamboo baskets and empty them in the truck. The waste are fully loaded on the body of truck and are covered by the sheet to prevent them from littering while traveling on the streets.

Table 2.6-16 Waste Amount Hauled by the Contractors

No	Contractors	Assigned Area		No of Truck	No of Worker including Driver	Average No of Worker per truck	Contract Waste Haulage Amount
		Kecamatan	Name of Depo /LPS				
1	C.V. Asri Karya	Rungkut Simokerto Wonocolo Wonokromo	T. Tengah K. Rungkut Ps Kapasan Simolawang Kebonsari Pagesangan Jambangan Ket. PLN Ket. Baru II Pasar Wonokromo Bendul Merisi Ngagel	5	35	7	374 m^3
2	C.V. Kurnia Pelita	Sawahan	K. Kuning Pasar Wonokitri Pasar Kupang Gunung Pasar Simo Katrungan Pasar Asem-Rowo	3	19	6.3	215 m^3
3	C.V. Tanjung Sarana	Tegalsari Sawahan Tandes	Dinoyo Ps. Kembang KedungAnyar Bukit Barisan Simomulyo	5	32	6.4	94 m^3
4	C.V. Karya Nyata	Gubeng Krembangan	Pasar Pucang Anom Pasar Bangunrejo Tanjungsadari	2	22	11	320 m^3
5	C.V. Tri Guna Jaya	Semampir P. Cantikan	Wonosari Tegal Kunti Ps Pabean Ps. Babaan Indrapura Pln Pesapen Pmp Karplen	4	28	7	324 m^3
	Total			19	136	7.2	1327 m^3

11) Efficiency Analysis

In order to evaluate the current collection system, the cost efficiency and operational efficiency are examined as follow:

a. Cost Efficiency

The unit costs of existing collection system are estimated as shown in Table 2.6-17. The unit cost spent for 1 ton waste by the type of truck is a very important indicator for KMS in the evaluation of the current collection system since the cost of waste collection vehicle is so expensive in Indonesia, about fifty (50) times more expensive than a worker's typical annual income.

The result of the unit Haulage costs efficiency are as follows:

The contractor (based upon contract price)	Rp	5,447/ton
A $10m^3$ Container Truck	Rp	9,129/ton
A Open Truck	Rp	9,459/ton
A $12m^3$ Container Truck	Rp	10,031/ton
A $6m^3$ Container Truck	Rp	10,370/ton
A $10m^3$ Compactor Truck	Rp	16,875/ton
A $6m^3$ Compactor Truck	Rp	34,900/ton

The contractors are the cheapest in all the haulage system. The contract price is about 60% of the cost of KMS' open trucks. Among KMS' trucks, the container trucks are more efficient than the compactor trucks. Among the container trucks, $10m^3$ container trucks is the most efficient. Comparing to $10m^3$ container and 12 m^3 container, it is considered $10m^3$ container is well-fitted to the sites placed. It means $12m^3$ containers are, so far, over capacity to collect waste at placed Depo/LPS. Thus, average waste amount hauled of $12m^3$ containers (5,019t/truck/year) is less than a $10m^3$ containers (5,419t/truck/year).

The annual waste amount hauled by a $6m^3$ compactor trucks is so small, only 1,095 ton/truck/year or 35% of a $10m^3$ compactor truck. The reason is the local design of compaction equipment of $6m^3$ compactor truck are so bad, and the number of containers for one $6m^3$ compactor may be not enough.

Table 2.6-17 Unit Cost Comparison by the Type of Truck

Type of Truck	Annual Depreciation of Truck	Annual Operation Cost	Annual Maintenance Cost	Others (Tax, Loan Payment, etc)	Cost of Container	Total Cost of System	Waste Amount hauled (ton/truck/year)	Unit Cost (Rp/ton)
	(1)	(2)	(3)	(4)	(5)	(6)=(1)+(2)+(3)+(4)+(5)	(7)	(8)=(6)/(17)
6m3 Container Truck	7,143,000	8,156,000	6,250,000	6,500,000	9,900,000	37,949,000	3,895	9,743
10m3 Container Truck	12,714,000	8,172,000	11,125,000	11,375,000	11,880,000	55,266,000	5,419	10,199
12m3 Container Truck	12,714,000	9,048,000	11,125,000	11,375,000	11,880,000	56,142,000	5,019	11,186
6m3 Compactor Truck	10,286,000	7,811,000	9,500,000	9,250,000	4,455,000	41,302,000	81,095	37,719
10m3 Compactor Truck	16,714,000	9,209,000	10,625,000	14,875,000	8,544,000	59,367,000	2,701	21,980
Open Truck	11,000,000	9,142,000	9,625,000	9,875,000	0	39,642,000	1,356	29,235
Private Contractor	Contract Price					28,042,000	47,223	3,882

Note: Personnel expenditure for officers at Depo is not included here.

The unit costs are analyzed by using the following assumptions and conditions.

(1) Annual Depreciation Cost of Collection Trucks

The chassis of $6m^3$ container trucks, $6m^3$ compactor truck and open truck is 7 gross vehicle weight (GVW) while that of the remaining trucks is 14 GVW. An open dump truck is equipped with 1 wheel loader. Durability of all truck is assumed as 10 years except an open truck is as 12 years. Annual Depriciation cost of each type of trucks is as follows:

Table 2.6-18 Annual Depriciation Cost of Each Type of Trucks

	Container Truck (6m3)	Container Truck (10m3)	Container Truck (12m3)	Compactor Truck (6m3)	Compactor Truck (10m3)	Open Truck
Chassis	32,000,000	59,300,000	59,300,000	32,000,000	59,300,000	32,000,000
Body	0	0	0	40,000,000	50,000,000	2,000,000
Equipment	18,000,000	22,000,000	22,000,000	0	0	5,000,000
Total Truck Cost	50,000,000	81,300,000	81,300,000	72,000,000	109,300,000	39,000,000
Annual Repreciation per truck	5,000,000	8,130,000	8,130,000	7,200,000	10,930,000	3,250,000

(2) Annual Operation Cost

Annual unit operation cost by the type of trucks is estimated as shown in Table 2.6-19 based upon the assumption i and ii.

Table 2.6-19 Annual Unit Operation Cost by the Type of Trucks

Type of Truck	Total Cost of Annual Fuel	No of Workers	Average monthly salary per Truck	Estimated Annual Salary per Truck	Annual Operation Cost
	(1)	(2)	(3)	(4)=(3)*12	(5)=(1)+(4)
$6m^3$ Container Truck	5,765,025	2	199,250	2,391,000	8,156,025
$10m^3$ Container Truck	5,956,825	2	184,583	2,215,000	8,171,825
$12m^3$ Container Truck	6,384,025	2	222,000	2,664,000	9,048,025
$6m^3$ Compactor Truck	4,355,475	2	288,000	3,456,000	7,811,475
$10m^3$ Compactor Truck	5,082,300	3	343,900	4,126,800	9,209,100
Open Truck	3,898,200	7	437,000	5,244,000	9,142,200

i. Cost of Light Oil and Engine Oil.

On the basis of vehicle operation record, the annual consumption of light oil and engine oil of each type of truck is estimated as shown in Table 2.6-20. The unit cost of light oil is Rp 300 / l and Engine oil Rp 2675 / l.

An open truck consumes the least fuel because the daily travel distance is shortest among the KMS trucks. Because a container truck's travel is longer than a compactor truck, annual fuel consumption of the container truck is much more than that of the compactor truck. The bigger the size of truck, the more the fuel consumption.

Table 2.6-20 Annual Consumption of Fuel by Type of Trucks

Type of Truck	Annual light oil consumption	Annual cost for light oil	Annual engine oil consumption	Annual cost for engine oil	Total cost for fuel
	(1)	(2) = (1)*300	(3)	(4) = (3)*2675	(5) = (2) + (3)
6 m^3 Container Truck	17,478	5,243,400	195	521,625	5,765,025
10 m^3 Container Truck	18,260	5,478,000	179	478,825	5,956,825
12 m^3 Container Truck	19,470	5,841,000	203	543,025	6,384,025
6 m^3 Compactor Truck	14,010	4,203,000	57	152,475	4,355,475
10 m^3 Compactor Truck	15,336	4,600,800	180	481,500	5,082,300
Open Truck	12,566	3,769,800	48	128,400	3,898,200

ii. Monthly Salary of Workers

The salary breakdown of the KMS workers is as follows:

- Basic salary according to the salary table
- A family allowance (10% of basic salary for wife, 2% for each child. Three children at max.)
- Rice (10 kg/family member, 50 kg at max.)
- Overtime allowance is Rp 6,000/month (Rp 200/day x 30 days)

The worker's salary is estimated by using average salary grade. A temporary workers receive, daily allowance of Rp 1,500 only (Rp 45,000/month).

Table 2.6-21 Estimated Worker's Salary Rates

Unit: Rupiah/month

	I a	I b	I c	I d	II a	II b	Temporary Worker
Basic Salary	78,000	90,800	98,000	105,200	133,300	149,000	45,000
Family Allowance (16%)	12,480	14,528	15,680	16,832	21,328	23,840	0
Overtime Allowance	6,000	6,000	6,000	6,000	6,000	6,000	6,000
Rice (Rp 700/kg)	35,000	35,000	35,000	35,000	35,000	35,000	0
Total	131,480	146,328	148,680	163,032	195,628	213,840	0
Estimated Salary	131,000	146,000	149,000	163,000	196,000	214,000	51,000

(3) Annual Maintenance Cost

It is assumed as 12.5% of vehicle purchase price, based upon the IUIDP report (1991).

(4) Others

10.5% of loan interest, annual road tax and annual insurance are included here.

(5) Cost of Container

The following items is included in the cost of the waste containers.

- Depreciation (life of the container is assumed as 5 years)
- Loan interest (10.5% of purchase cost)
- Maintenance (2.5% of purchase cost)

The number of containers served by trucks is assumed as follows:

Table 2.6-22 Estimated Number of Container by Type of Trucks

Type of Truck	$6m^3$,$10m^3$,$12m^3$ Container Truck	$6m^3$ Compactor Truck	$10m^3$ Compactor Truck
No of Container Served by a Truck per Day	6	27	28