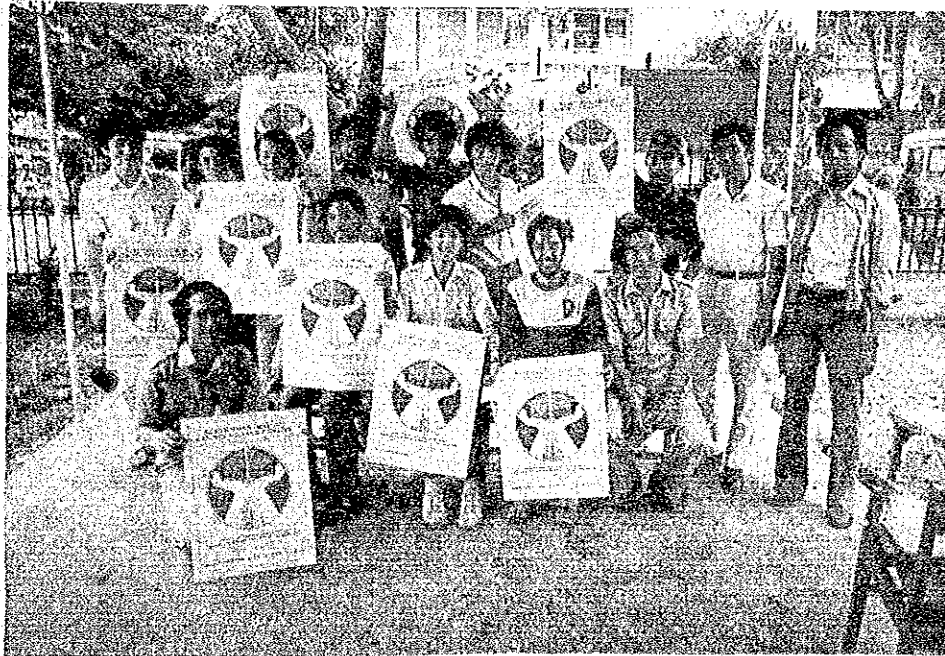


CHAPTER 3 EXAMINATION AND EVALUATION OF ALTERNATIVE SYSTEMS



CHAPTER 3 EXAMINATION AND EVALUATION OF ALTERNATIVE SYSTEMS

3.1 General

It will be necessary to establish the sub-systems shown in Fig. 3-1-1, as well as a comprehensive system to organically combine them, in order to achieve the future goal of solid waste management in Jakarta. In this Chapter, the alternative systems for the technical system in particular are examined and evaluated, and the basic directions of those sub-systems besides the technical system are also examined.

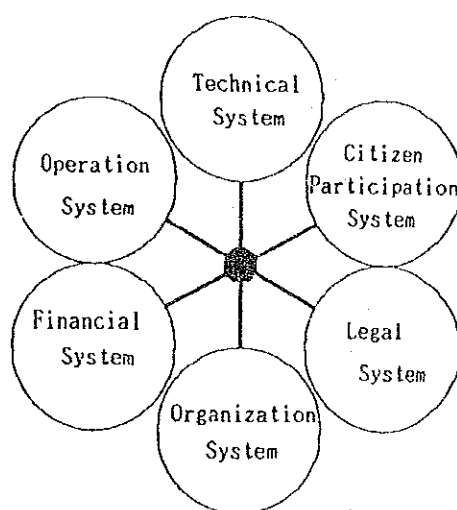


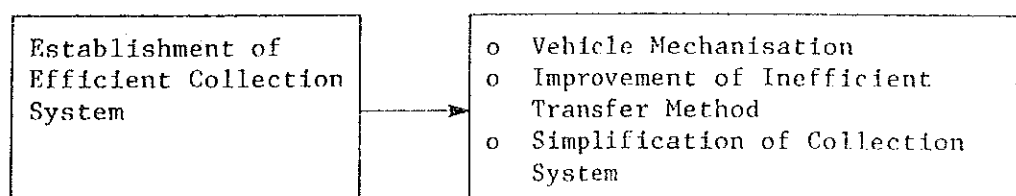
Fig. 3-1-1 Sub-systems in Solid Waste Management

3.2 Examination of Technical System

3.2.1 Collection

1) Required improvements

The required improvements of the collection system are summarised below.



2) Cost comparison between improved and current systems

Current collection systems are as shown in Fig. 3-2-1.

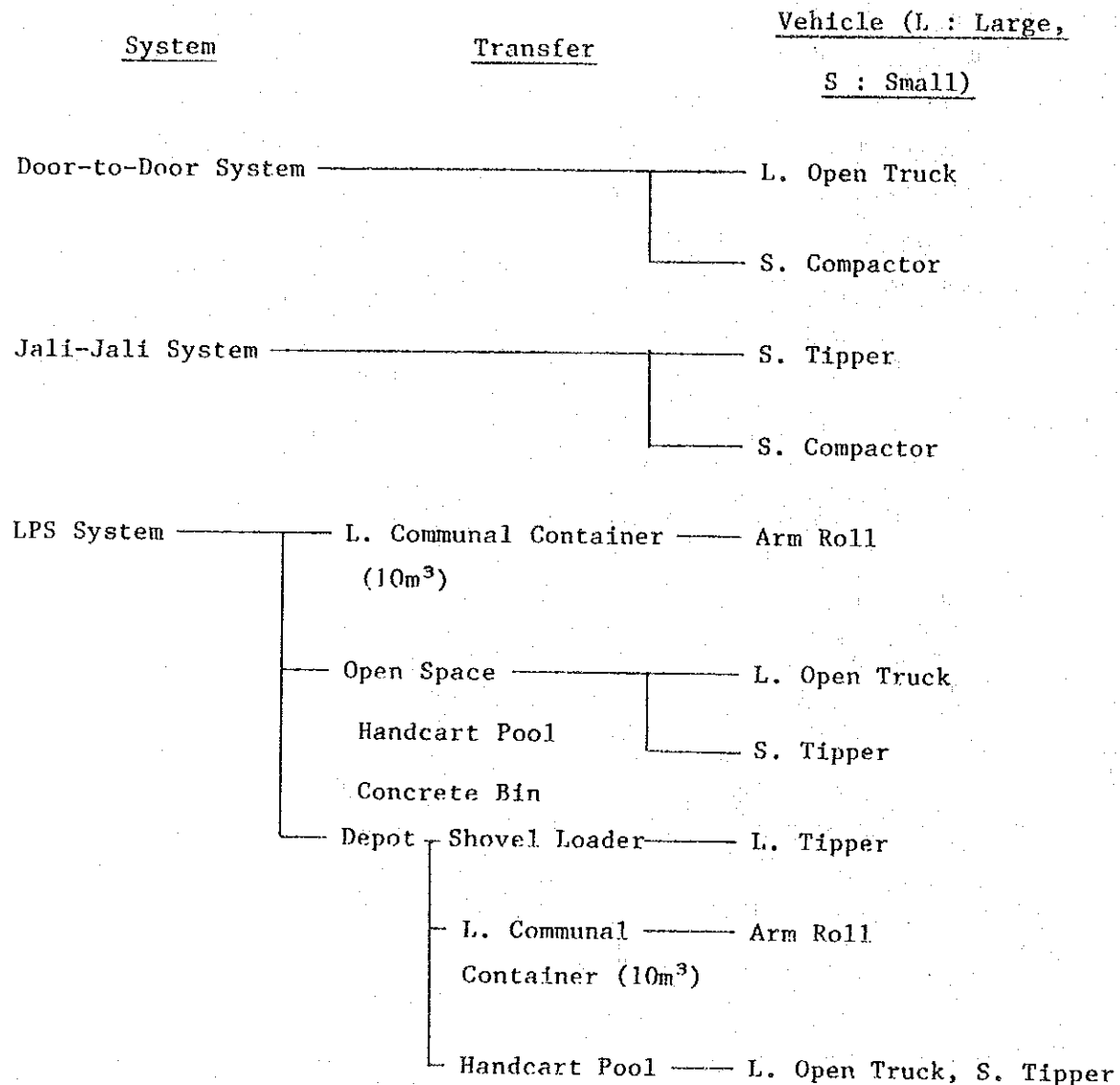


Fig. 3-2-1 Collection Systems

The collection cost of each system under the current conditions is given in Fig. 3-2-2.

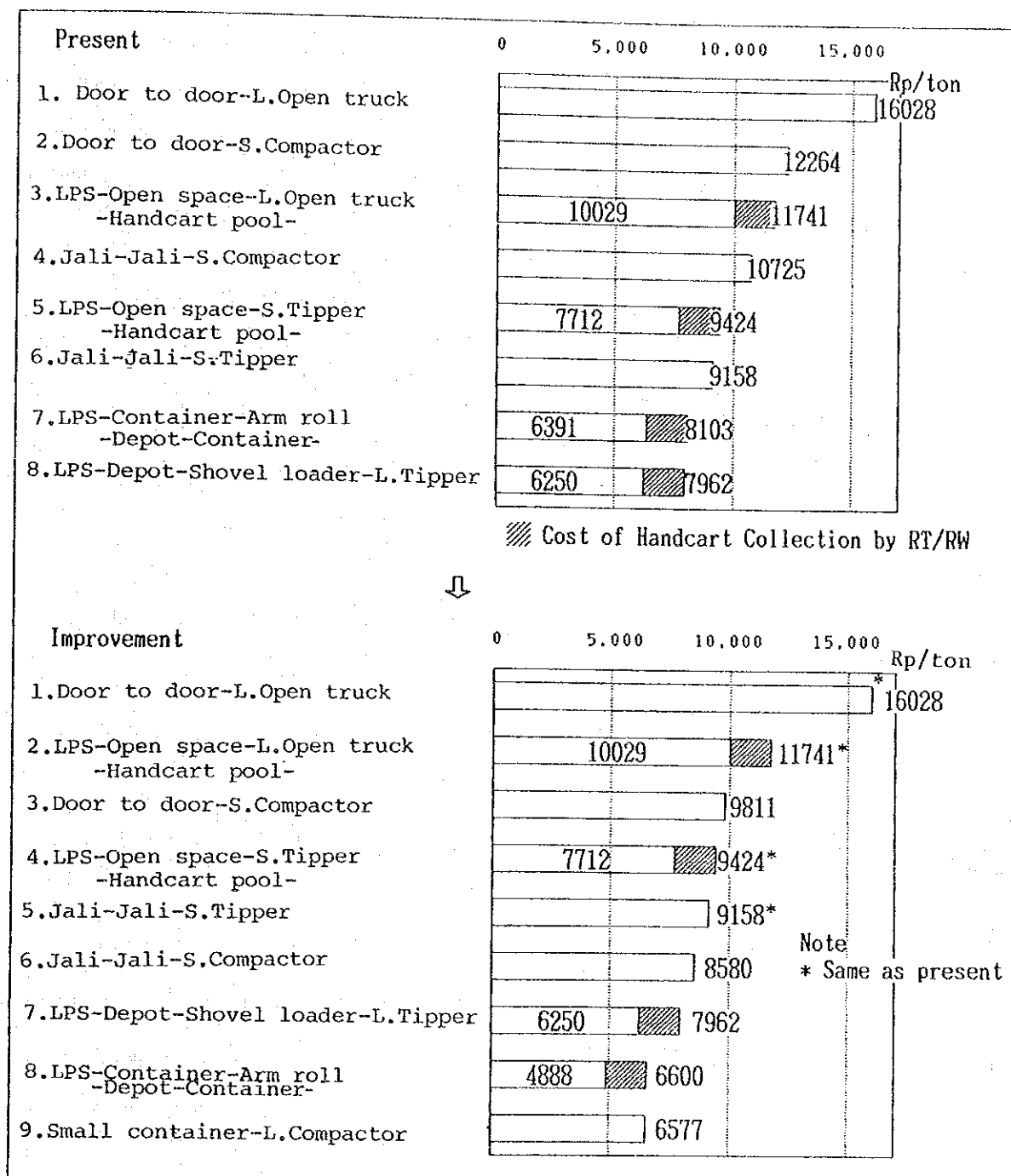


Fig. 3-2-2 Collection Cost

The current situation of vehicle trips is not efficient in the systems such as the door-to-door and LPS-open space systems. While these systems have little room for improvement in regard to the time required for collection and transportation, the other systems (excluding the LPS-shovel loader system) can be largely improved by the introduction of strong operational control. Table 3-2-1 shows the improved situation of vehicle trips by extending the small communal container system which is currently being introduced. When the target trips are satisfied, the collection cost will be as shown in Fig. 3-2-2.

Table 3-2-1 Current and Improved Number of Trips

System		Vehicle used	Current No. of trips	Improved No. of trips	
Door-to-Door System		L. Open Truck	1.3	-	
		S. Compactor	1.6	2.0	
Jali-Jali System		S. Tipper	1.6	-	
		S. Compactor	1.6	2.0	
S. Communal Container (1 m ³)		L. Compactor		2.5	
LPS	L. Communal Container (10 m ³)		Arm Roll	2.6	3.5
	Open Space, Handcart Pool, Concrete Bin		L. Open Truck	1.8	-
			S. Tipper	1.9	-
	Depot	Shovel Loader	L. Tipper	2.5	2.5
		Container (10 m ³)	Arm Roll	2.6	3.5
		Handcart Pool	Open Truck Tipper	1.8 1.9	- -

L: Large

S: Small

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The following points can be concluded from Fig. 3-2-2.

- a. The door-to-door system is very expensive.
- b. The LPS open system is also comparatively expensive.
- c. The Jali-Jali system is not really cheap.
- d. Those LPS systems with transfer equipment, such as the LPS-depot-container and LPS-depot-shovel loader systems, are cheap to run.
- e. The small container ($1m^3$) system is cheaper than the other systems.

3) Conditions for basic system

In deciding the future system, the service, appearance, sanitation and fee collection conditions should firstly be considered, in addition to the system's collection cost, and the physical conditions of the area should then be examined.

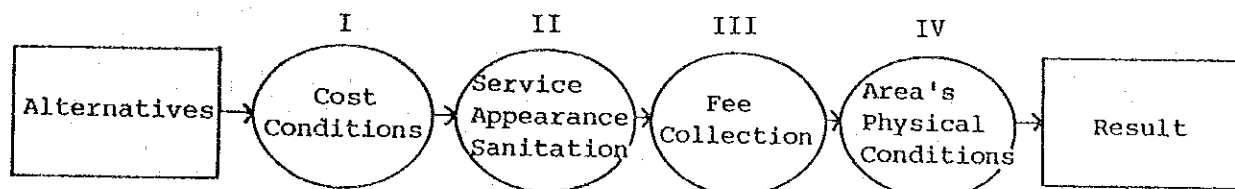


Table 3-2-2 shows the characteristics of each collection system and their appraisal. In principle, those systems whose cost conditions and service/appearance/sanitation conditions have been negatively appraised should not be adopted.

Of the existing systems, the LPS-handcart pool, open space and concrete bin systems should be replaced by other systems in view of cost and sanitation considerations.

While the LPS-container system is very much preferable in terms of cost, it is unsuitable due to the difficulty of securing enough space for the required number of containers to deal with the amount of waste in each area, and also due to the inevitable scattering of waste around container locations in Jakarta. In addition, the management of large communal containers ($6 - 10m^3$) by the community is difficult to sustain. In comparison, each RT/RW unit is expected

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to manage small communal containers of about 1 m³ (i.e. keep the container locations clean and tidy and obtain the residents' agreement for container locations). This point is verified by the collection experiment conducted in Cempaka Putih in August 1986.

Table 3-2-2 Comparison of Collection System

		I	II		III	IV	Ap- prais- al
		Cost	Ser- vice	Appear- ance/ sanita- tion	Fee collection	Physical conditions of area	
Door-to- Door	L. Open Truck	--	++	++	Direct collec- tion possible	Road conditions must allow direct access by vehicle to every household	x
	S. Compactor	-	++	++			x
Jali-Jali	S. Tipper	-/+	-/+	++		For areas where depots cannot be provided or where vehicles have no direct access	o
	S. Compactor	+	-/+	++			o
S. Container	L. Compactor	+	+	+		For areas where depots cannot be provided	o
LPS Container	Arm Roll	++	-/+	-	Direct collec- tion impossible unless hand- carts directly operated by Dinas. When RT/ RW is involved, handcarts operated by RT/ RW		x
LPS Open Space, Concrete Bin, LPS Depot - Handcart Pool	L. Open Truck	--	-/+	--			x
	S. Tipper	-	-/+	--			x
LPS Depot- Shovel Loader	L. Tipper	-/+	-/+	-/+		Where depots can be secured	o
LPS Depot- Container	Arm Roll	++	-/+	-/+			o

-- Very bad
- Bad
-/+ Fair
+ Good
++ Very good

x Not good
o Good

As the door-to-door system is very expensive to operate, it is unsuitable as the standard system to provide a solid waste collection service in Jakarta. Its adoption should be limited to those areas where an additional collection service to the ordinary service is required.

The Jali-Jali system is currently employed in those areas where handcart collection cannot be maintained and LPS space cannot be secured. This system may be suitable for those areas where the small communal container (1 m³) system cannot be applied.

The selection of the collection system should be based on the following order of priority. 1. LPS-depot-container system, 2. Small container system, 3. Jali-Jali system.

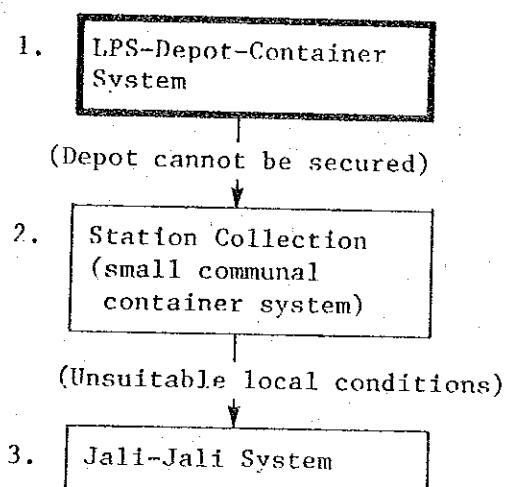


Fig. 3-2-3 Selection of Optimal Collection System

The LPS-depot-container system and the small communal container system are cheaper than the other systems even when the cost of handcart collection is included. The LPS-depot-container system will not necessarily be the cheapest, however, if the personnel cost increases.

4) Improvement effects

Given the same haulage conditions, the improved system structure shows the following effects in comparison to the current structure.

If the LPS-depot-container system is provided, mainly in the peripheral areas of Jakarta, it will possibly have a 50% share of the total amount of waste collected. The small communal container system (1 m^3), which will be introduced in Jakarta's central and commercial areas and those areas where depots cannot be secured, will be capable of handling some 15% of the total amount of waste collected. The share of the Jali-Jali system, which will be mainly introduced in the areas of Kampung, will be some 20% in consideration of the future income level of the residents. The door-to-door system, which can only be introduced in high income areas, will probably have a share of some 15% in view of the future ratio of the high income groups. Based on these conditions, solid waste collection in Jakarta will consist of a combination of the 4 systems shown in Fig. 3-2-4 compared to the situation at present where there is a number of different systems.

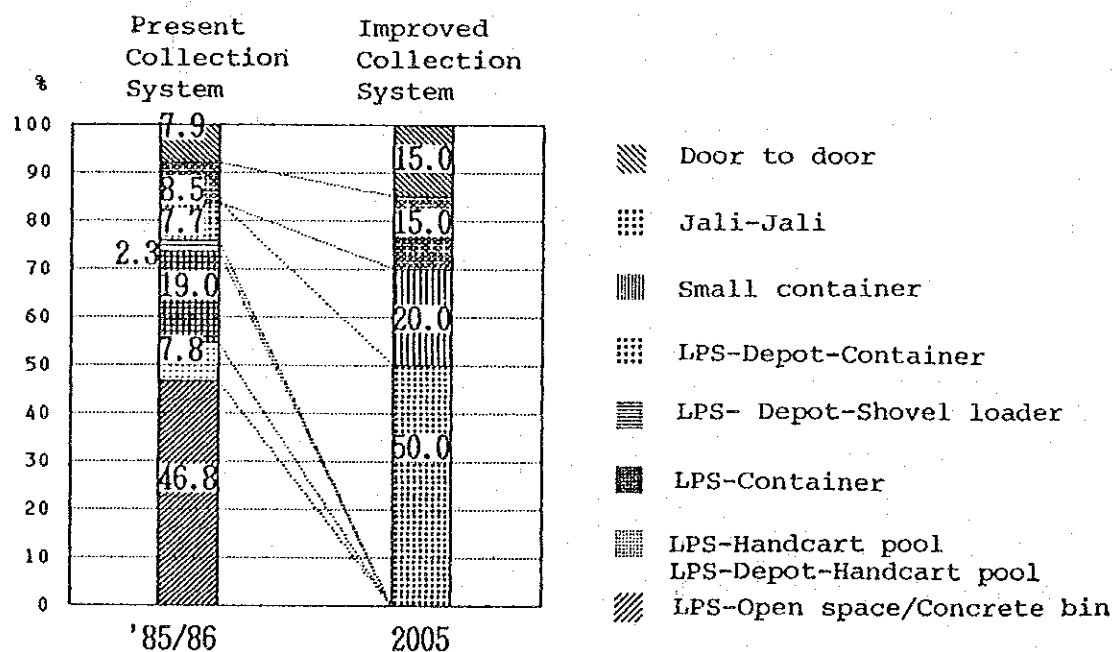


Fig. 3-2-4 Present and Improved Collection Systems

Fig. 3-2-5 shows the results of the trial cost calculation. When a comparison is made between the unchanged present structure in 2005 and the improved structure, the latter results in an annual operational saving of 8.2 billion Rp.

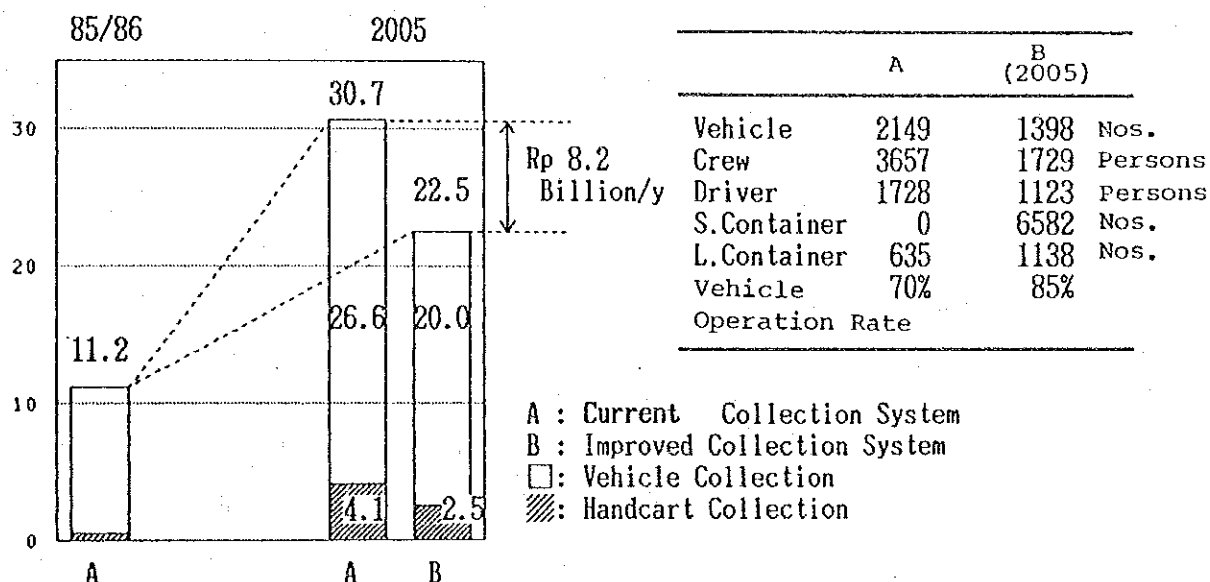


Fig. 3-2-5 Effect of Improved Collection System

5) Depots

Both the depot-shovel loader and depot container systems are promising depot systems. Fig. 3-2-6 shows the cost comparison of these 2 systems. However, since the depot-shovel loader system is the more expensive, the application of the depot-container system as the basic depot system is preferable.

The depot-shovel loader system has the following shortcomings in addition to its cost.

- In order for the advantages of the depot-shovel loader system to be felt, more than 30 t/day of solid waste is required.
Handcart workers would be obliged to haul the solid waste from distant locations to satisfy this requirement.
- The fast replacement of a broken shovel loader is difficult.

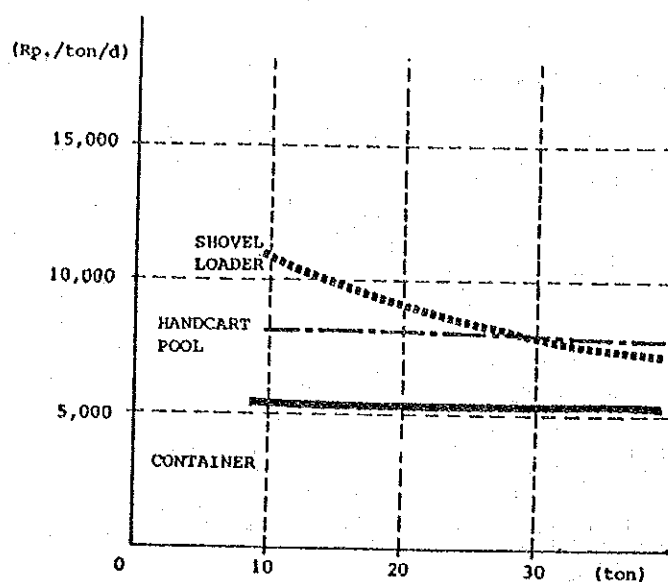


Fig. 3-2-6 Comparison of Collection Cost by Depot Systems

3.2.2 Haulage

1) Haulage system requirement

It will become increasingly difficult to secure disposal sites in Jakarta in the near future. Based on the present forecast, therefore, large disposal sites should be secured in Bekasi and Tangerang.

The distances between these disposal sites and each Wilayah are shown in Table 3-2-3. As the distance from collection areas to disposal sites is generally 10 - 15 km at present, the distance to the new disposal sites will be more than doubled.

Table 3-2-3 Distances to Disposal Sites

	(Unit: km)	
	Bekasi	Tangerang
Pusat	37	30
Utara	45	24
Barat	38	32
Selatan	32	34
Timur	28	38

With the establishment of new disposal sites at distant locations, a large increase in the cost of both collection and haulage is anticipated. Therefore, the requirement of the haulage system is given as follows.

The establishment of an efficient haulage system by the provision of transfer stations.

2) Examination of transfer stations

Although many types of transfer stations have been conceived of, as shown in Fig. 3-2-7, 3 systems, i.e. plane system, plane system with hopper and compactor container system, should be selected as the possible alternatives in view of the cost involved.

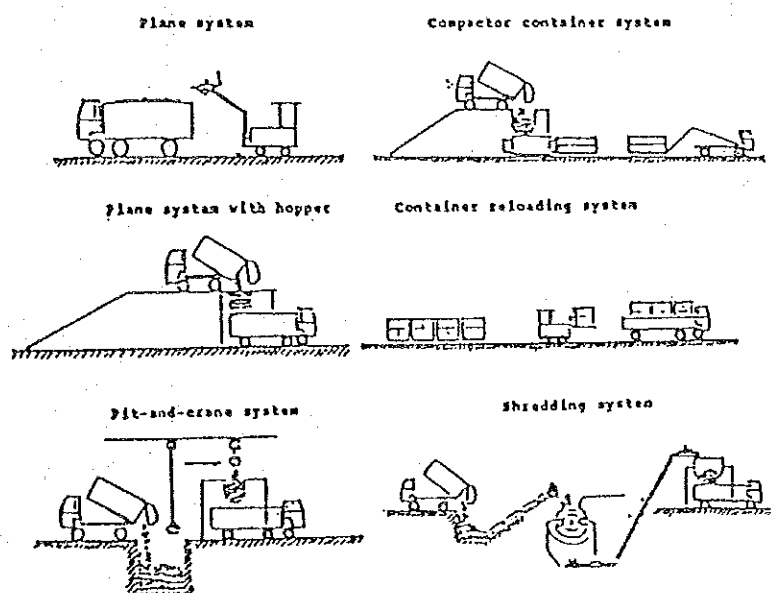


Fig. 3-2-7 Transfer Station Systems

(1) Transfer station cost

Assuming the haulage distance to a transfer station to be 25 km, the costs of each transfer station system for handling amounts of 200 t/day, 600 t/day and 2,000 t/day are as shown in Fig. 3-2-8.

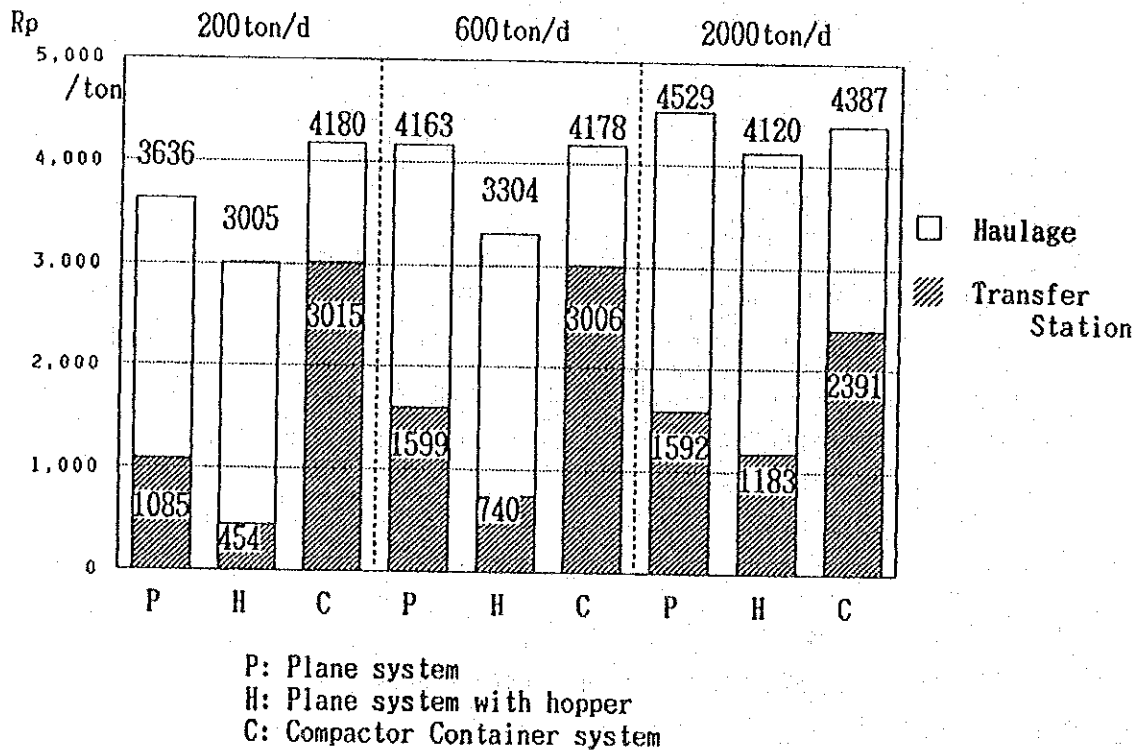


Fig. 3-2-8 Cost Comparison by Type of Transfer Station

As Fig. 3-2-8 shows, scale merits cannot be expected in the transfer station due to the requirements for environmental measures. If too much stress is placed on the cost aspect, the provision of a small and simple system is advantageous. In the case of large transfer station systems, the difference in the cost between the systems is minor.

(2) Land required for transfer stations

While there is little variation among the systems in the amount of land required for small transfer stations, the hopper system with a handling amount of some 2,000 t/day requires a larger amount of land.

Table 3-2-4 Area Requirement of Transfer Stations

	(m ²)		
	Plane system	Plane system with hopper	Compactor container
200 t/day	3,000	4,000	4,000
600 t/day	7,000	10,000	8,000
2,000 t/day	20,000	30,000	20,000

(3) Environmental conditions

When residential areas, etc. are located near a station, the plane with hopper system is unsuitable due to the possible scattering of the waste and odour carried by the wind. As the compactor system can deal with these possible problems, it is the most suitable system from the environmental perspective.

(4) Conclusion

In the case of a small transfer station dealing with some 200 t/day, the plane or hopper systems are the most suitable if no environmental problems are concerned. For a handling amount of some 600 t/day, however, the hopper system should be given priority. In the case of a handling amount of some 2,000 t/day, the compactor system is preferable due to the fact that its cost is only marginally more expensive than the hopper system and due to its superiority to the hopper system in view of environmental considerations and land acquisition.

3) Capacity of transfer station

The most significant factor in the decision of the transfer station size is availability of land acquisition. In addition, the area's future land use should be taken into account. These conditions should be given priority over the cost consideration.

The number of stations required for handling 2,000 t/day of solid waste (estimated solid waste generation in each Wilayah in 2005) and necessary land will vary depending on the station size, as shown in Table 3-2-5.

Table 3-2-5 Requirement for Total Site Area

Size	System	Number	ha/station	Area required
200 t/day	Plane System with Hopper	10	0.4	4 ha
600 t/day	Plane System with Hopper	3	1	3 ha
2,000 t/day	Compactor Container	1	2	2 ha

It is clear that a large-size station is preferable in terms of better land utilisation. While small stations are usually located within the subject collection areas, it would be extremely difficult to secure 10 sites in a Wilayah. In addition, the land cost would be very high even if possible sites could be found. In the light of land prices in Jakarta, the introduction of small transfer stations would involve a land purchase cost of two times more than that for a 2,000 t/day size transfer station.

200 t/day x 10 Stations	:	4ha x Rp.60,000/m ²	=	Rp. 2.4 x 10 ⁶
2,000 t/day x 1 Station	:	2ha x Rp.60,000/m ²	=	Rp.1.2 x 10 ⁶

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As described below, each Wilayah has its own characteristics with regards to available land for small transfer stations.

Pusat:	Extremely difficult to secure sites for small transfer stations in the area.
Utara:	Fairly possible to secure sites.
Barat:	Although available land is scarce around Kota, some stations could be located in the western sector where new development is expected in the future.
Selatan:	Relatively difficult to secure sites for small transfer stations in the eastern and western areas.
Timur:	While it would be difficult to secure sites for small transfer stations in Pulo Gadung and Matraman, there is a fair possibility of doing so in the eastern and southern sectors.

Given the above conditions of each Wilayah, the introduction of large transfer stations in Pusat and Selatan and of a combination of small- and medium-size transfer stations in Utara, Barat and Timur should be examined.

4) Effects of transfer haulage and transfer station development policy

Fig. 3-2-9 shows the comparison between the haulage cost using transfer stations and the cost of direct haulage to disposal sites. Based on this figure and the conditions for acquiring the necessary land for transfer stations, the following conclusion is reached for each Wilayah.

- a. The establishment of large transfer stations using the compactor system is expected to be effective for Pusat and Selatan.
- b. The establishment of small, simple types of transfer stations is recommended for Barat, Timur and Utara (where the advantages of a large station are not big enough to justify its introduction).

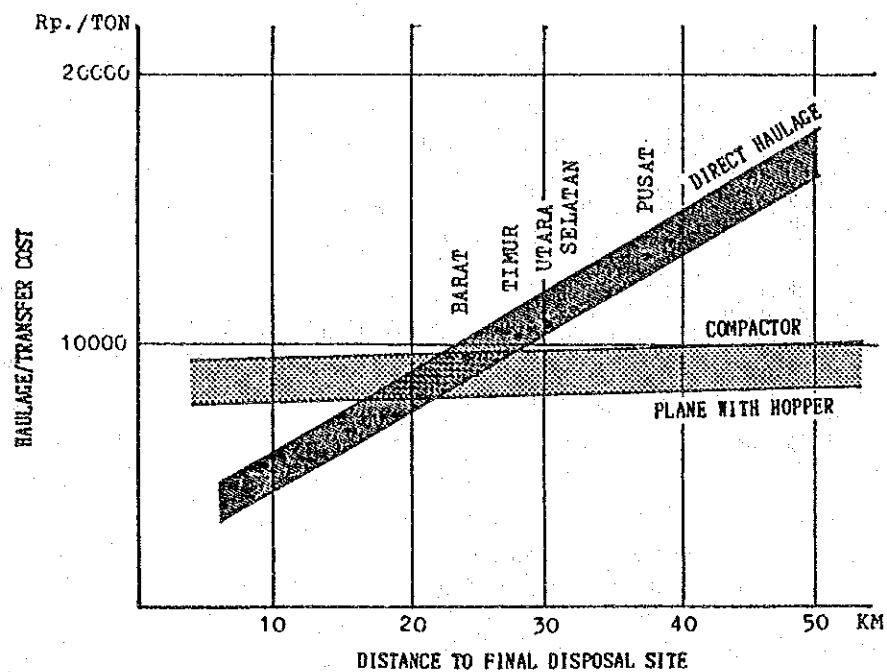


Fig. 3-2-9 Haulage/Transfer Cost of Transfer Station and Direct Haulage

5) Effects of transfer haulage

Fig. 3-2-10 compares with the transfer haulage cost based on the above development policy with direct haulage cost based on the current system of collection. An annual saving of Rp.7.6 billion per a year can be expected in the year 2005 by the introduction of transfer haulage.

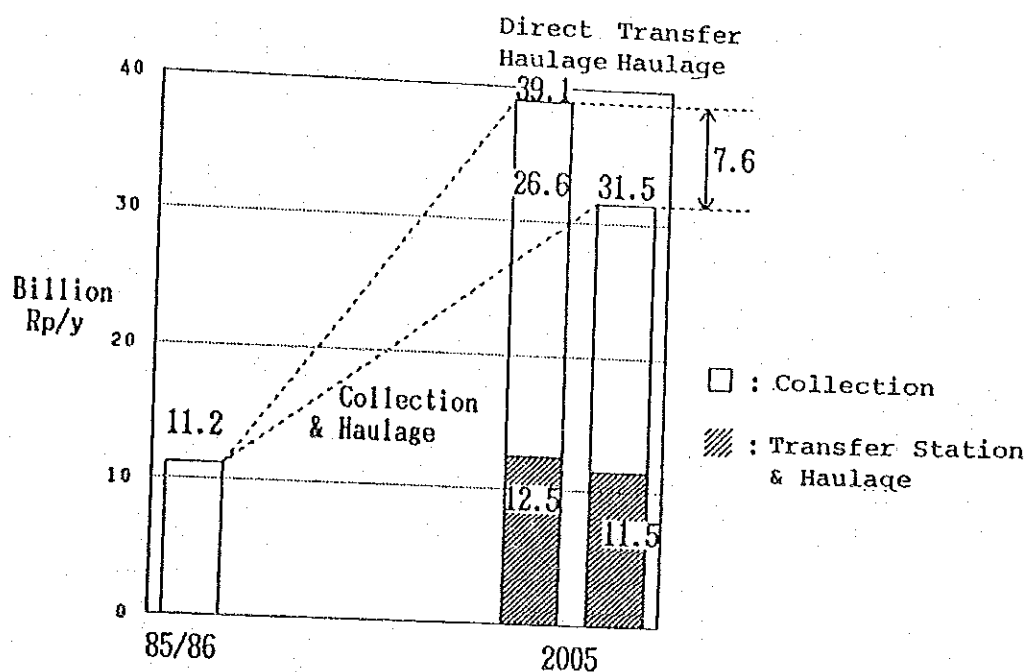


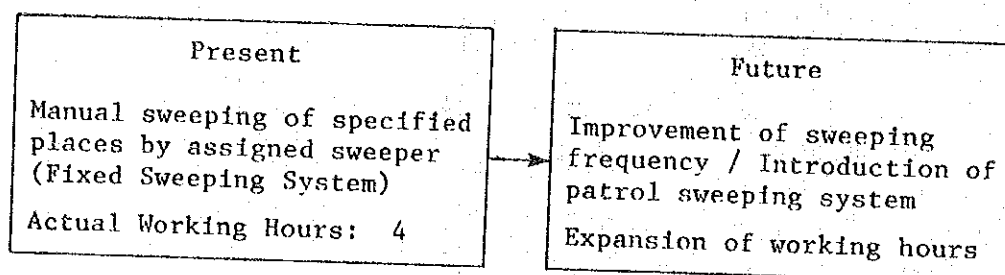
Fig. 3-2-10 Comparison of Cost for Direct Haulage and Transfer Haulage

3.2.3 Street Sweeping

1) Required street sweeping system improvements

Street sweeping is an important field of solid waste management. Its importance is underlined by the fact that some 40% of the total number of Dinas Kebersihan employees are allocated to this work. Despite the increasing demand for more sweepers in accordance with the increased length of streets requiring sweeping, new recruitment is, however, difficult owing to the city's financial position. Accordingly, the rationalisation of street sweeping must be conducted in view of the strong financial demand of other sectors in solid waste management in the future.

The current street sweeping system should be improved in the following manner.



2) Policy for selection of streets subject to sweeping

While the basic street sweeping principle is for the streets to be swept by the households facing them, there are streets where this principle cannot be applied. The public street sweeping service should be limited to those streets whose sweeping by ordinary households is too difficult.

The street sweeping policy by the types of streets is as follows.

Protocol Streets: Due to the existence of the median strip and the non-existence of houses on both sides, sweeping by residents cannot be expected. Accordingly, the entire length will be subject to public sweeping.

Economy Streets: Those sections where the enlistment of residents' help is difficult will be subject to public sweeping as in the case of Protocol streets. Those sections in busy areas will be especially served.

Other Streets: In principle, these should be swept by the neighbouring households. Those sections which apparently require the same treatment as streets in busy areas or Protocol streets, however, will be subject to public sweeping as exceptions.

The subject sweeping lengths are as follows.

	1985/86	2005	$\frac{2005}{1985/86}$
Protocol	445 km	892 km	2.0
Economy	196	569 1)	2.9
Others	112	237 2)	2.1
Total	753	1,698	2.25

- 1) 50% of the total length of Economy streets.
 2) 7.6% of the total length of other streets.

3) Sweeping frequency and patrol sweeping system

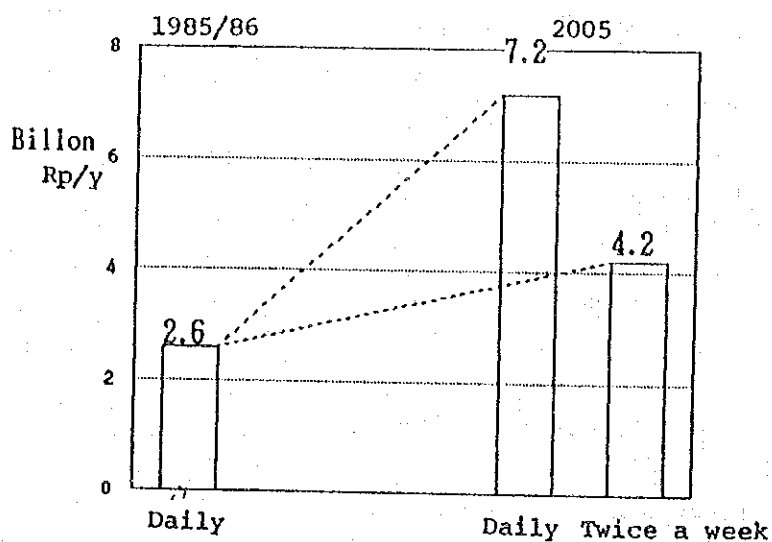
The possible collection frequencies are as diverse as follows.

- a. Several times a day
- b. Once a day
- c. Three times a week
- d. Twice a week
- e. Once a week
- f. Once every two weeks
- g. Once a month

Although the streets in busy areas are usually swept once a day, other streets are also usually subject to some sort of regular sweeping. The amount of solid waste in the streets of Jakarta is not large and mostly consists of sand and fallen leaves. The sanitation conditions and the beautiful appearance of the streets can, therefore, assumingly be maintained without daily sweeping. In addition, the improvement of the current inefficient haulage system for collected waste and of citizens' consciousness will contribute in this regard.

It is a difficult problem to decide the optimal collection frequency. If the cost of sweeping in the year 2005 is assumed to be somewhere between the current cost and the estimated cost of maintaining the current service in the year 2005, a twice weekly system may be the solution.

The annual costs of street sweeping services in those cases where the current service level is maintained and where twice a week system is employed are estimated below.



	1985/86	2005: Daily	2005: Twice a week
Sweepers	2,636	5,943	2,312
Mechanical Sweepers	7	23	23
Small Open Trucks	0	0	168
Drivers	7	23	191
Administrative Staff	-	418	251

Fig. 3-2-11 Prospects of Cost for Street Seeping

While the introduction of mechanical sweepers for Protocol streets with median strips is preferable, manual sweeping should be the basic method for other types of streets in view of the cost consideration.

The most realistic manual sweeping system would comprise a number of teams consisting of 7 members each, with each team being made up of 6 sweepers and 1 handcart operator. An open truck would be allocated to every 2 teams for the transportation of the collected waste, sweepers and equipment. These teams would then patrol specified areas on specified days of the week.

3.2.4 Treatment and Disposal

1) Current disposal situation and review policy

The daily generation of solid waste in Jakarta is 4,930 tons. When the reusable materials and waste that is self-disposed of is excluded from this figure, 4,150 t/day of waste remains to be disposed of. The amount of waste that is disposed of at the disposal sites of the Dinas Kebersihan, however, is only 2,160 t/day and the remaining 1,990 t/day is disposed of at the small disposal sites scattered around the city. The open dumping method is employed at every disposal site except Srenseng.

The amount of solid waste requiring disposal in Jakarta is expected to grow to 6,820 t/day in 1995 and to 9,290 t/day in 2005, thus it is clear to prepare an adequate treatment and disposal system.

As shown below, there are 5 methods for the treatment and disposal of solid waste. Here, these 5 methods are compared and their applicability in Jakarta is examined.

- a. Open dumping
- b. Sanitary landfill
- c. Sea reclamation
- d. Incinerating
- e. Composting

A large number of scavengers are engaged in the recovery of reusable materials at depots and disposal sites in Jakarta. However, the sorting and recovery system is not listed here as a treatment and disposal method because of the following reasons.

- a. The results of the analysis on the solid waste composition reveals that there is only a minor proportion of reusable materials which has little influence on the total amount for treatment and disposal.

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- b. The problem on sanitation is involved in the recovery of reusable materials from solid waste containing garbage. The recovery of reusable materials at the source of generation should be encouraged. The recovery of reusable materials after they were discharged requires new systems which have few sanitation problems, including separate collection. In view of the analysis results, however, the introduction of separate collection would only have a minor effect.
- c. The recovery of reusable materials by full mechanical sorting is not a firmly established technology for the treatment and disposal of waste.
- d. Picking up reusable material at disposal site is very dangerous and disturbs landfill operation.

2) Open dumping

(1) Outline

In comparison with the sanitary landfill method which employs measures for the conservation of the environment, including covering soil, disposal methods currently employed in Jakarta where the waste is simply dumped at the sites are collectively called open dumping.

The characteristics of open dumping are summarised as follows.

- a. As the conservation of the surrounding area's environment is neglected, the net cost of dumping is low.
- b. Bad odour, the scattering of waste and natural fires are unavoidable due to the lack of covering soil, thus resulting in the environmental pollution of the surrounding area.
- c. The waste amount disposed of is small due to the lack of sufficient compaction.
- d. As long as the open dumping method is employed, it is difficult to prevent the scattering of numerous small disposal sites in the city even if they are prohibited by regulations

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because the appearance of open dumping sites is similar to that of illegal dumping sites.

(2) Situation and cost of open dumping

Almost all Jakarta's dumping sites are located in low swamps. While the height of the dumped waste depends on the height of the neighbouring road, it is limited to generally 2 - 4 m in its height. In general, no covering soil is used at the time of disposal although final covering soil is later provided from nearby land.

The density of the waste at the dumping sites depends on the nature of the waste due to the compaction method and the dumping height. It is generally only 0.4 - 0.6 t/m³ in the cases where a bulldozer is used for spreading. As Jakarta's solid waste originally has a relatively high density, the dumping density is estimated to be fairly high with sufficient compaction. At an open dumping site where the waste is not sufficiently compacted and the height of the dumped waste is low, the disposal site cannot be used efficiently.

The cost of disposal by the open dumping method is made up of the waste levelling, site road construction, land acquisition and final covering, as shown in Table 3-2-6, and the total cost is Rp.2,000 per ton of waste except land cost and final covering cost.

Table 3-2-6 Open Dumping Disposal Costs

Item	Unit cost (Rp/t)
Levelling work	1,400
Site road	600
Sub total	2,000
Final cover	6,000
Land	6,000
Total	14,000

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The cost mostly depends on the last two items, i.e. the final covering and land costs. In general, the open dumping method is expensive due to low efficiency in its operation. In addition, a large area is required for disposal due to poor utilization of land.

(3) Evaluation of open dumping method

The open dumping method is currently employed in Jakarta and is considered to be an inexpensive method for the disposal of solid waste. It is clear, however, that its low cost is largely reliant on the following conditions which were examined previously.

- a. No land cost is involved. The land for a disposal site is either provided free of charge by the land owner or can be resold at a higher price than original price paid for it.
- b. No final covering soil cost is involved. The cost of the final covering soil is borne by the users when reclaimed land is used.

These two favourable conditions, however, have become increasingly lost in the process of urbanisation, as seen in the fact that the city authorities are now finding it difficult to secure new disposal sites. In addition, the open dumping method causes a number of problems in terms of environmental sanitation and the appearance of the surrounding areas. The open dumping method is, therefore, considered to be unsuitable for the disposal of solid waste.

To dispose of more waste at open dumping sites, the capacity should be increased on the basis of a higher compaction rate and an increasing waste height dumped, etc. However, the introduction of large and efficient disposal sites would require careful planning. In addition, large disposal sites would produce heavy pollution. All these considerations point out the necessity of a move towards the sanitary landfill method.

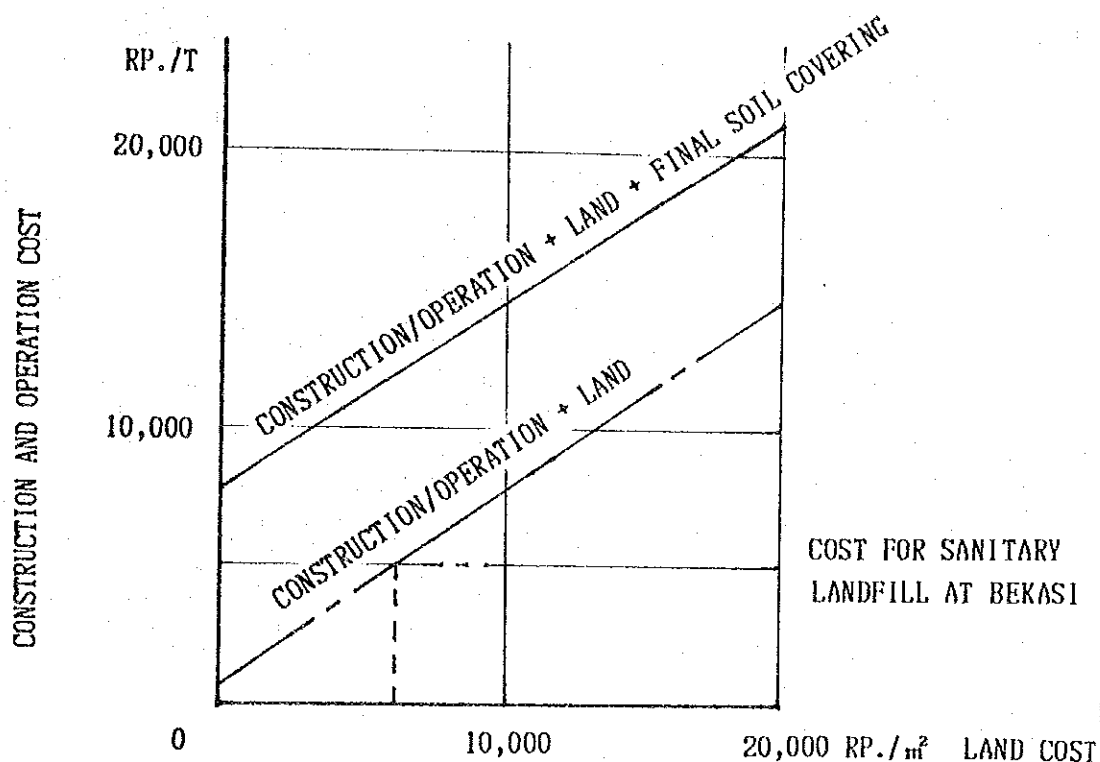


Fig. 3-2-12 Cost for Final Disposal

3) Sanitary landfill

(1) Outline

Environmental pollution due to bad odour, scattering waste, discharging leachate, damage to the scenic beauty, the generation of harmful insects and smoke due to natural fires is possible at any landfill disposal site. The sanitary landfill disposal method, however, applies measures to keep these adverse effects on the environment to a minimum. The major objectives of sanitary landfill are as follows.

- a. To prevent scattered waste, bad odour, natural fires, harmful insects and damage to the scenic beauty by the application of covering soil. This covering soil is also

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expected to reduce leachate by limiting the permeation of rainwater into the waste layer.

- b. To prevent the undesirable effects of leachate by conducting the collection, cut-off and/or the treatment of leachate whenever necessary.
- c. To achieve the maximum compaction of waste for efficient disposal.
- d. To prevent the undesirable disposal of hazardous materials by controlling and checking the amount and composition of waste and to secure useful data for the future.

The characteristics of sanitary landfill are as follows.

- a. Even in those cases where incineration or composting is employed, the disposal of the ash and residue is required at the final stage. Sanitary landfill is currently the most popular method of disposal.
- b. Sanitary landfill is usually the most economical method of disposal rather than incineration or composting.
- c. Disposal sites which have a large enough capacity must be secured for the disposal site.

(2) Facility outline

Table 3-2-7 gives the outline of the facilities at a sanitary landfill site.

Table 3-2-7 Outline of Sanitary Landfill Disposal Site

Item	Contents
1) Location	Jakarta, Bekasi and Tangerang
2) Area	30 ha Disposal site: 24 ha (400 m x 600 m) Facility site: 6 ha
3) Capacity	5,560,000 m ³ Solid waste: 4,560,000 m ³ (3,650,000 t) Covering soil: 1,000,000 m ³ (including final cover)
4) Height	Maximum: 30 m Average: 23.2 m
5) Major facilities	
o Embankment	Banking W = 10 m, H = 5 m, L = 1,000 m
o Leachate drainage	Compacting and laying of waste water drainage pipes
o Rainwater drainage	L = 2,000 m
o Leachate treatment	Capacity - Q = 900 m ³ /d
o Control facilities	Control building 1 unit Warehouse 1 unit Truck scale 1 unit
o Access road	W = 8 m, L = 2,000 m
o Fence	L = 2,000 m
6) Landfill method	Sandwich method
7) Covering soil	Collected on site
8) Construction cost	Rp.7,000 million (excluding land cost)

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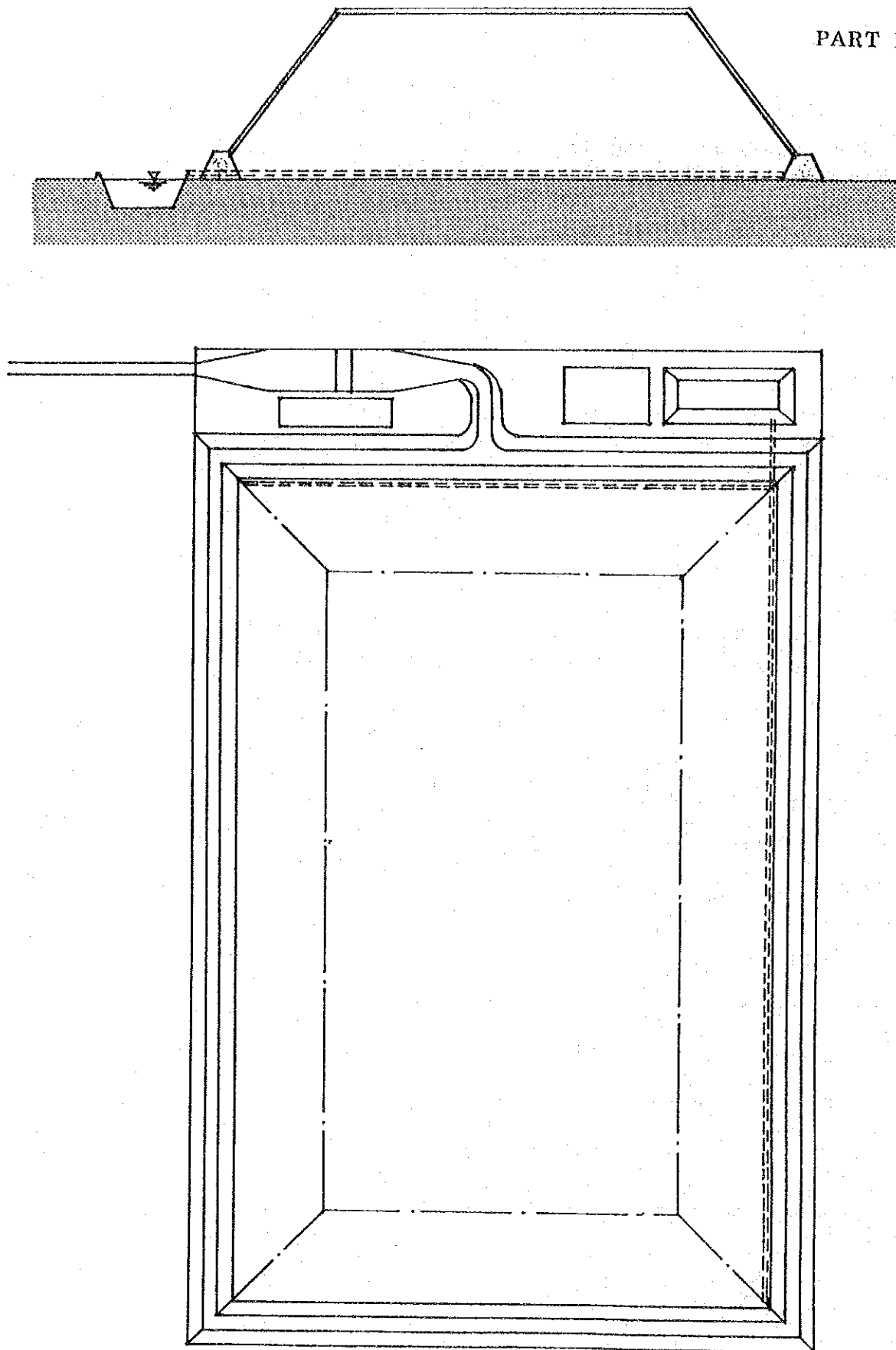


Fig. 3-2-13 Model of Sanitary Landfill

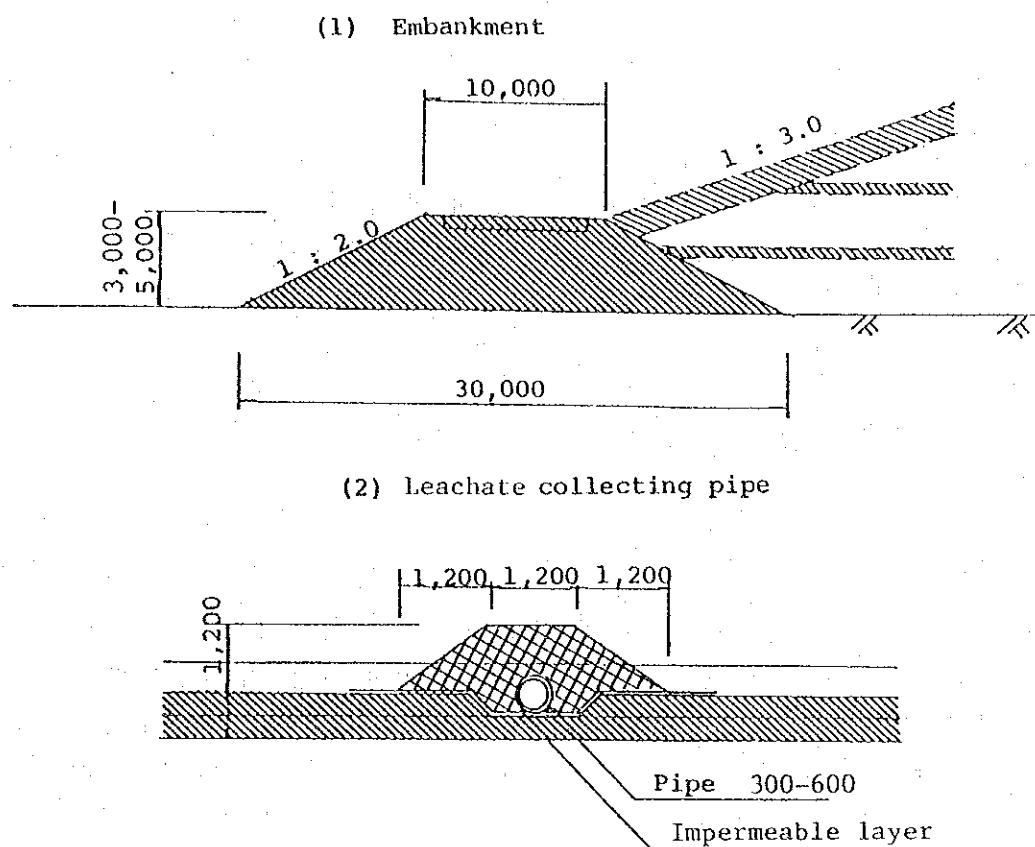


Fig. 3-2-14 Main Facility of Sanitary Landfill Site

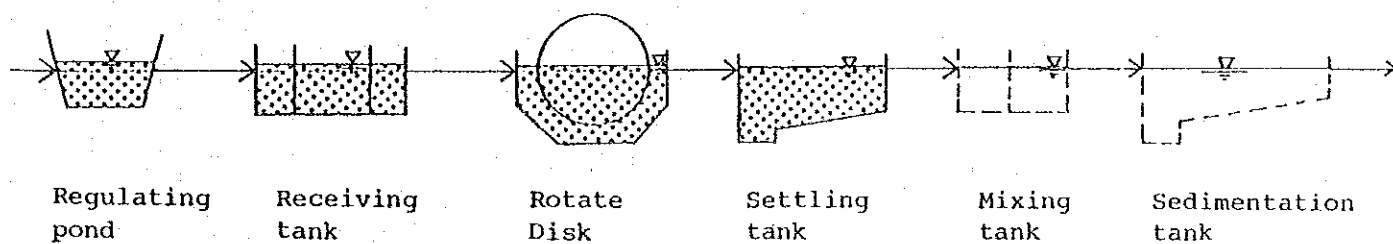


Fig. 3-2-15 Leachet Treatment Flow

(3) Disposal method

In the case of sanitary landfill, the waste is sufficiently compacted and 3 m thick waste is covered by 50 cm of soil. The waste should be compacted in each 50 cm thickness for sufficient compaction. Soil covering should be conducted each day to cover the daily dumped waste.

When the anticipated landfill formation is completed, a final covering of 1 m thick soil is applied.

Weight and quality checks are conducted at the landfill site to prevent the dumping of harmful waste and to control the disposal amount respectively.

Although a sanitary landfill pilot project is currently being conducted in Srenseng, the adequate collection of leachate and the sufficient compaction of the waste layer are difficult due to the poor workability of the site, in turn caused by the swamp location. In addition, no truck scale is installed.

Further examination of the sanitary landfill method in Jakarta is required. The use of swamps for sanitary landfill is rather expensive due to the difficulty of handling the covering soil and the poor workability for the bottom works.

Swamps are, however, advantageous for securing large disposal sites. In short, site selection plays a very important role in the introduction of sanitary landfill disposal.

The locational conditions for a sanitary landfill site are as follows.

- a. A large site should be secured. Although the required land size depends on the amount of waste to be disposed of, some 30 ha is necessary to deal with a quarter of the waste generated in Jakarta for a period of 10 years.
- b. The foundation of the site should allow for the preparation of the bottom works and the actual landfill work to be easily conducted.
- c. Handling of the covering soil should not be difficult.

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- d. The topography and foundation of the site should allow to be easily shielded from the nearby groundwater and surface water.
- e. Few houses should be located nearby.
- f. The site should have easy access and should not be too far from the collection areas.
- g. The discharge of leachate should not endanger the area's surface and ground water utilisation.

(4) Sanitary landfill cost

The cost of sanitary landfill widely varies depending on the conditions of the site. It must be particularly noted that the leachate treatment cost determined by the water utilisation in the neighbouring areas, covering soil cost determined by availability of site material and the land use efficiency determined by the disposal height largely affect the cost of sanitary landfill. The construction of a large disposal site to increase landfill height should, in principle, contribute to cost reduction.

Table 3-2-8 shows the sanitary landfill cost based on the previously described model.

The cost of sanitary landfill is Rp.3,600 per ton of waste and the total cost including the additional haulage cost of some Rp.4,000 per ton, is smallest among such waste treatment methods as sea reclamation, incineration and composting.

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Table 3-2-8 Cost of Sanitary Landfill

(Unit: Rp/t)		
Item	Unit cost	Remarks
Construction cost	1,920	
Operation cost	1,270	Including covering soil
Covering soil	-	
Land cost	410	5,000 Rp/m ²
Sub total	3,600	
Additional transportation cost	4,000	Distance 40 km
Sub total	4,000	
Total cost	7,600	

(5) Sanitary landfill

Sanitary landfill is the most economical method of waste disposal which maintains a sanitation and living environment. It should, therefore, be employed as the basic method for solid waste management in Jakarta. However, as sanitary landfill requires a large site, site acquisition is a precondition of its employment. Moreover, the selection of the site location should be carefully made because of largely affecting its disposal cost.

(6) Location of sanitary landfill disposal sites

As the availability of land is a large constraint, land acquisition is a preceding condition. The basic principles for locating the sites are, however, as described below.

a. Haulage distance

Comparing with the haulage cost for a distance of 20 km, the costs for distances of 40 km or 10 km change to some 145% or some 70% respectively. In terms of the unit disposal cost, the above percentages represent an increase of Rp.4,000 per ton or a decrease of Rp. 2,200 per ton respectively. As the haulage and disposal cost is affected by the haulage distance,

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the first priority should be given to the location of disposal sites.

b. Number of disposal sites

Realistically conceivable locations for sanitary landfill sites in Jakarta are in Bekasi and in Tangerang. In addition, sea reclamation is possible in the northeast of the city. As Bogor area located on the south of Jakarta acts as a source of Jakarta's groundwater, a landfill site in the area would require measures to provide adequate leachate treatment and measures to prevent groundwater pollution. The number of disposal sites and their respective haulage costs are calculated as follows.

Number of disposal sites and haulage distances

Case	Location	Service area
1: 1 site	Bekasi	30 km radius
2: 2 sites	Bekasi/Tangerang	18 km radius
3: 4 sites	Bekasi/Tangerang/Bogor/ Sea reclamation	15 km radius

The haulage cost of Case ① is 12% more expensive than that of Case ②. In comparison, the cost of Case ③ is 8% less expensive than that of Case ②. (as shown in Fig 2-3-15). In short, even if 4 sites cannot be secured, 2 sites in east and west should be secured. Although the establishment of 4 sites is definitely the most desirable, the establishment of 2 sites is acceptable in view of the cost difference of less than 10%.

However, if the sites are acquired at the periphery of the city or outside the city, the haulage cost difference decreases to the order of 50% due to the shorter haulage distance involved, as described earlier. Consequently, the acquisition of sites within the city area should be pursued.

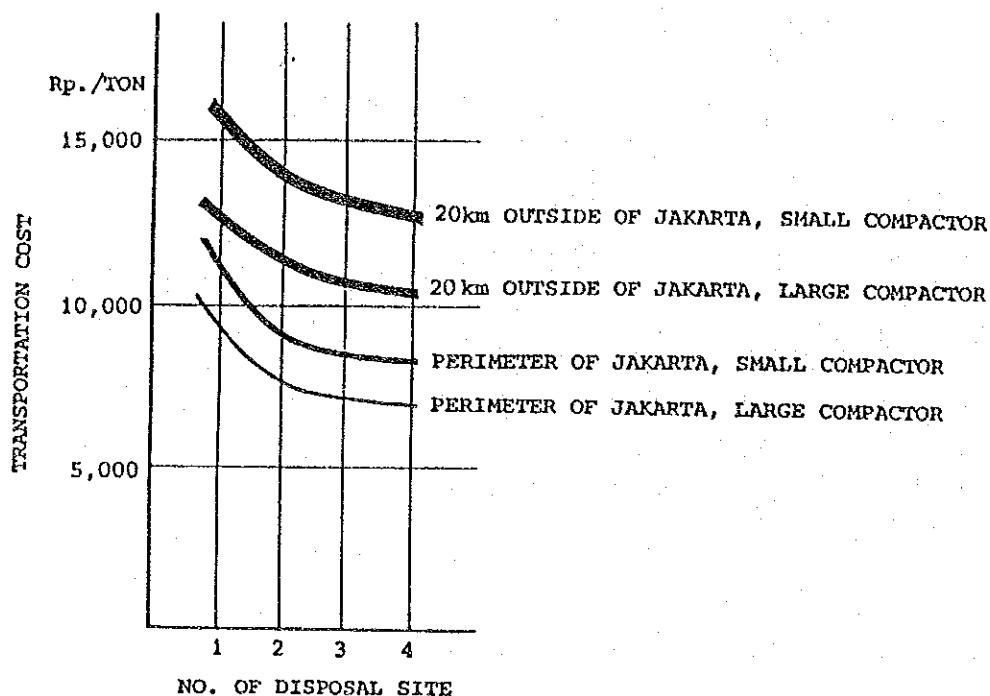


Fig. 3-2-16 Number of Disposal Sites and Transportation Cost

4) Sea reclamation

(1) Outline

Sea reclamation is conducted in large coastal cities, such as Tokyo, and is characterised by the following.

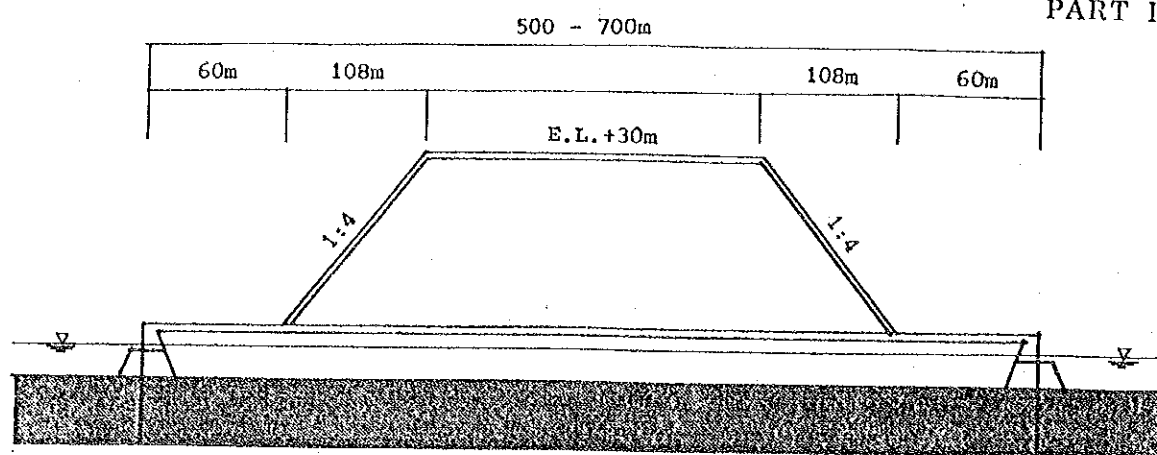
- The acquisition of the disposal site is easier than in the case of landfill.
- It offers new land at the end of the service period.
- A sea wall is required, of which the construction cost is very high.
- The leachate treatment is relatively easy due to the absence of groundwater for drinking and the limitation of water utilisation to fishing.

(2) Facility outline

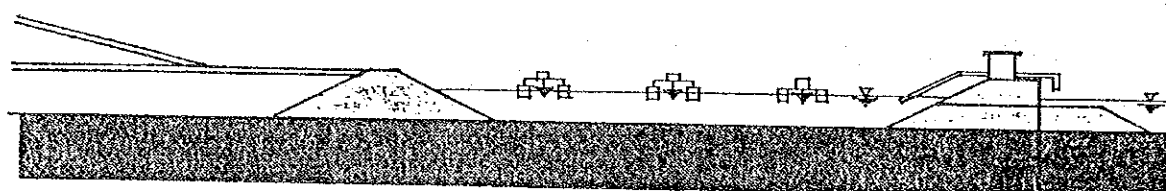
One candidate for a sea reclamation disposal site for Jakarta is the neighbouring area of Kel. Cilincing which is located to the northeast of Jakarta and where the construction of a timber port is planned. An outline of the possible sea reclamation in this area is given in Table 3-2-9.

Table 3-2-9 Outline of Sea Reclamation Disposal Site

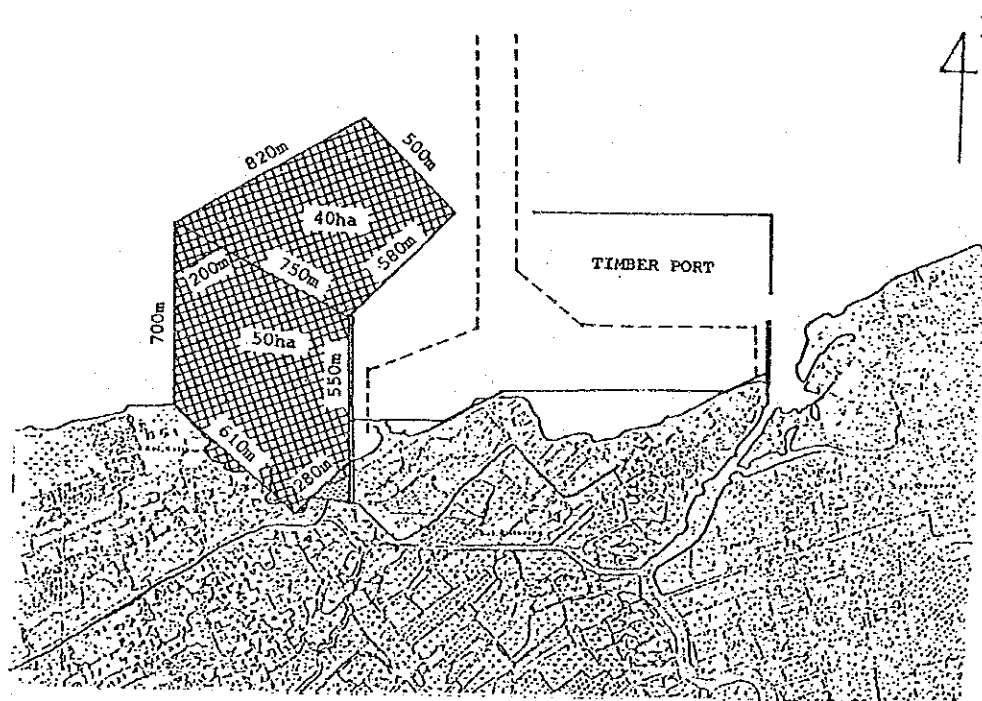
Item	Contents
1) Outline	
Location	Planned timber port location northeast of Jakarta
Area	90 ha
Disposal capacity	15,000,000 m ³ Waste: 12,300,000 m ³ (12,300,000 t) Covering soil: 2,700,000 m ³
Disposal height	30 m
2) Facility outline	
Sea wall	4,040 m
Access road	Use of existing roads
Waste water treatment facility	Aeration pond
Partition wall	950 m
3) Cost	Rp.100 billion (Rp.10,200/t)



CROSS SECTION



LEACHET TREATMENT POND



Plan

Fig. 3-2-17 Model of Sea Reclamation

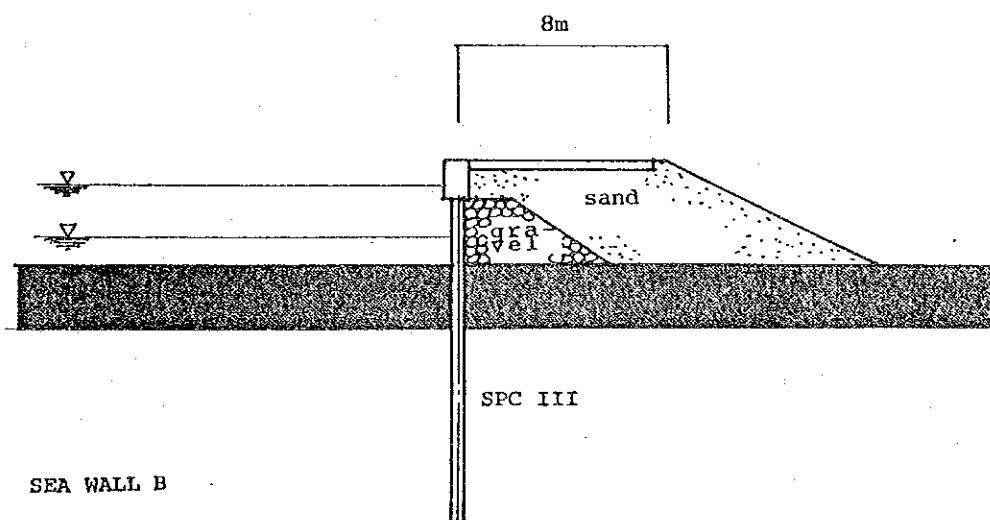
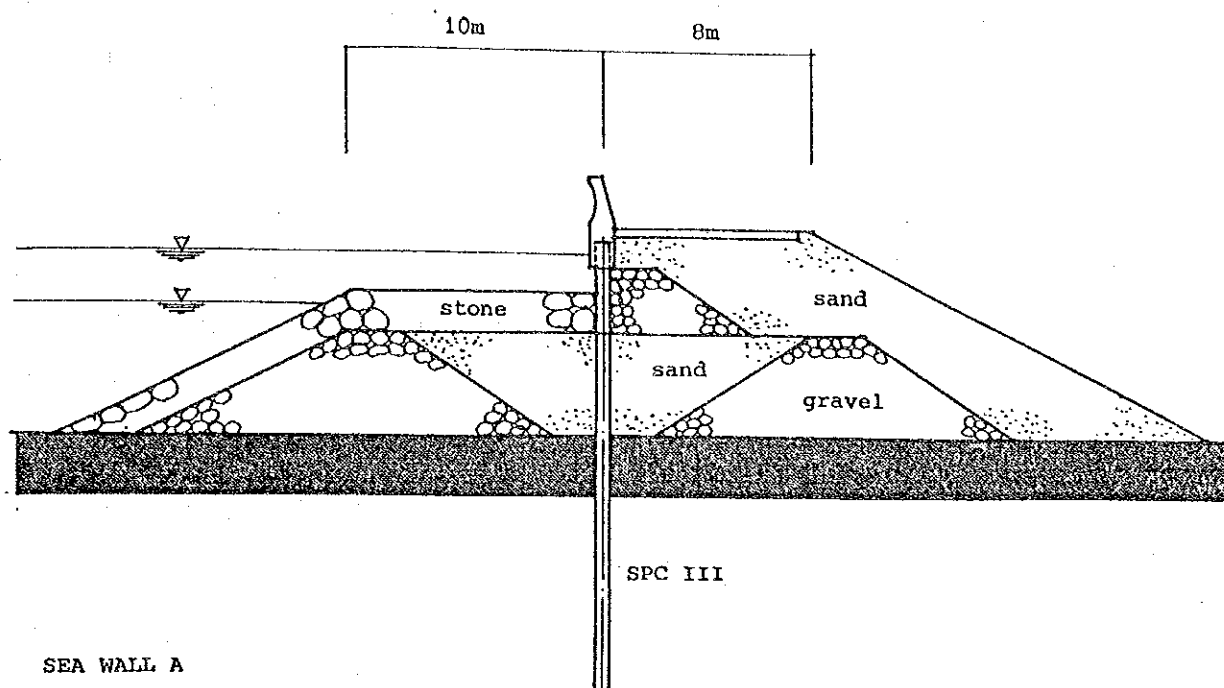


Fig. 3-2-18 Sea Wall

(3) Sea reclamation cost

As shown in Table 3-2-10, the sea reclamation cost is Rp.11,700/t which is 3.3 times higher than the cost of sanitary landfill. However, it is cheaper than incineration.

Table 3-2-10 Cost of Sea Reclamation

(Unit: Rp/t)		
Items	Unit cost	Remarks
Construction cost	10,200	
Operation cost	950	
Covering soil	550	Distance 20 km
Land cost	-	
Total	11,700	
Transportation cost	-4,000	Distance 20 km
Sub total	-4,000	
Comparison with sanitary landfill cost	7,700	Additional cost

(4) Evaluation of sea reclamation method

The cost of sea reclamation is high due to the construction cost of the sea wall. There is, therefore, no immediate need to introduce sea reclamation prior to landfill. However, with the requirement for a large disposal site in accordance with the increased amount of solid waste, a new disposal site may be required depending on whether or not additional sites can be secured in Bekasi and Tangerang. In conclusion, a possible sea reclamation site should be secured in the long-term perspective.

5) Incineration

(1) Outline

Incineration intends the stabilisation and reduction of the generated solid waste for disposal by burning the combustible materials of the solid waste. In the case of a large plant, the generated heat energy is also recovered. The characteristics of incineration are as follows.

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- a. If the low calorific value of the waste is over 800 Kcal/kg, the waste is capable of spontaneous combustion, making incineration possible.
- b. As a result of incineration, the weight of the waste is reduced to 15 - 20% and the volume is reduced to 5% of the original volume.
- c. All germs are killed due to the high temperature. The decaying content of the incinerated ash is less than that of the original waste.
- d. A number of large incineration plants, particularly in Japan and Europe, are conducting the recovery of the heat energy for power generation and other purposes.
- e. Although the disposal cost is high, this method should be given serious consideration for those cities where the landfill cost is high due to difficulties in acquiring a disposal site because of its distinctive reduction of the volume.
- f. The ash can be used as an intermediate covering for the final disposal site.

(2) Outline of incineration facilities

Fig. 3-2-18 shows the incineration system. The main facilities are the solid waste supply system, incinerator, ash discharger, gas cooling system, gas treatment system and air supply system. In addition, a power generation system, water treatment system and steam cooling system, etc. may be installed. It should be noted that the economy of power generation by solid waste incineration widely varies depending on the quality and quantity of the solid waste.

(3) Size and cost of incineration

It is estimated that Jakarta will generate 9,290 t/day of solid waste in the year 2005. While the location of an incineration plant should be determined taking into consideration its role as a

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transfer station and its advantages in reducing the waste volume, a large plant is desirable in order to reduce the operation cost. From the viewpoint of power generation, the plant should treat more than 500 t/day. The average haulage distance should be preferably 10 km or less in view of the efficient use of the collection vehicles. As the waste generation density in Jakarta is high, the average haulage distance for an incineration plant with a capacity of treating some 2,000 t/day is approximately 10 km, as in the case of transfer stations.

Apart from the incineration plant's operation cost, the ash haulage cost should be included in the incineration cost. In comparison, the income from power generation and the reductions in the haulage amount, final disposal amount and required soil for the final covering of the reduced waste volume contribute to the cost reduction. The resulting incineration cost is given in Table 3-2-12, showing the advantages of a large plant.

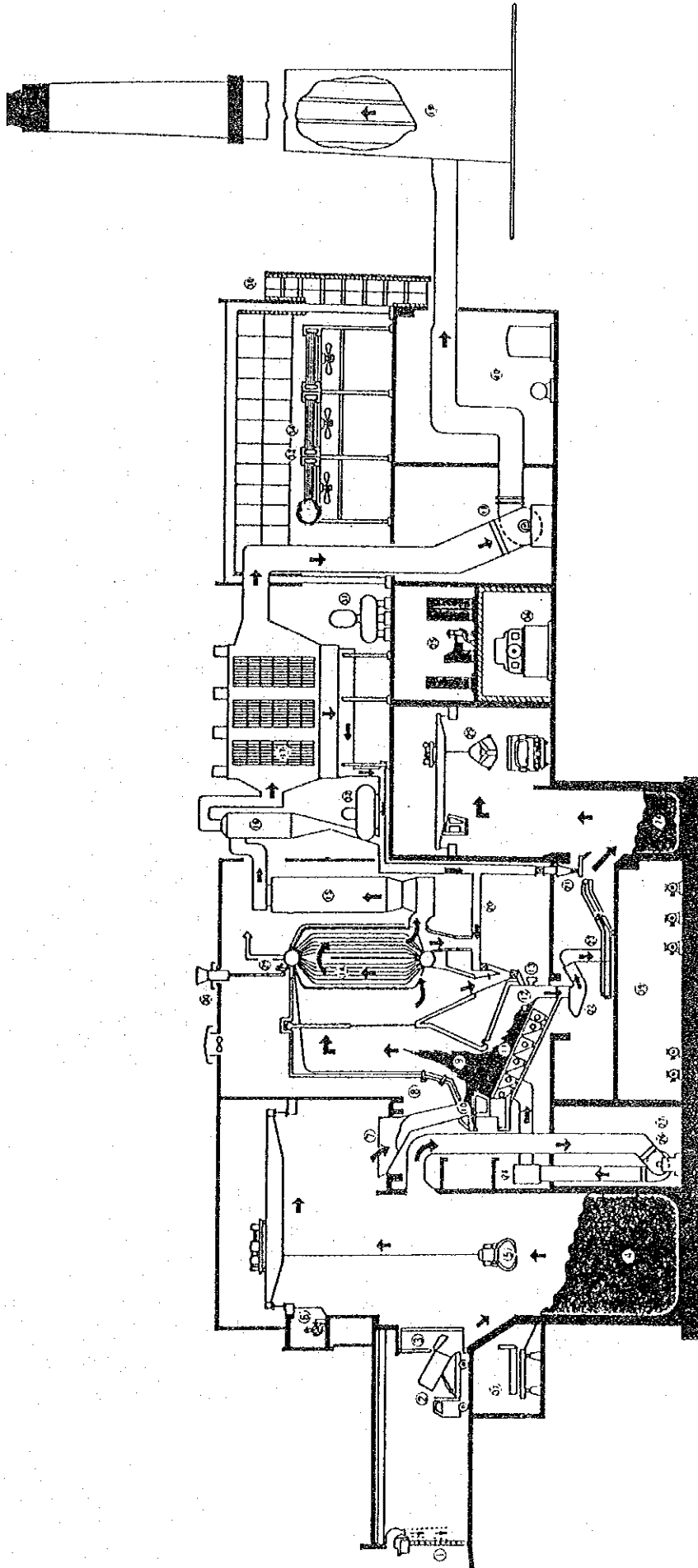


Fig. 3-2-19 Outline of Incineration Plant

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Table 3-2-11 Outline of Incineration Facilities

Item	Treatment capacity 1,500 t/d	Treatment capacity 600 t/d	Treatment capacity 100 t/d
1) Annual treatment amount	450,000 t	180,000 t	30,000 t
2) Plant area	6 ha	3 ha	1.5 ha
3) Annual ash amount	90,000 t	36,000 t	6,000 t
4) Operation method	24 hrs Continuous	24 hrs Continuous	24 hrs Continuous
5) Major facilities			
- Reception & supply system		Pit and Crane System	
- Incinerator	Stoker	Stoker	Stoker or fluidized
- Gas cooling system	Boiler	Boiler	Boiler or water jet
- Gas treatment system (HCl removal unit)	Electric dust collector	Electric dust collector	Electric dust collector
- Ash discharge system	Pit & crane	Pit & crane	Pit & crane
- Air supply system	Forced draft fan, induced draft fan, concentric stack	Same as left	Same as left
- Power generation	6,000 kW	2,500 kW	-
- Steam cooling system	Steam condensor	Steam condensor	Steam condensor
- Waste water treatment system	Biological treatment, coagulator	Same as left	Same as left
6) Construction cost	171 billion Rp	78 billion Rp	18 billion Rp

Table 3-2-12 Cost of Incineration

Capacity	(Unit: Rp/t)		
	1,500 t/d	600 t/d	100 t/d
Construction cost depreciation	19,700	22,300	29,700
Operation cost	10,900	12,100	16,600
Transportation of ash	700	700	700
Sub total	31,300	35,100	47,000
Revenue of electricity	-2,100	-1,600	-
Substitution for covering	-600	-600	-600
Sub total	-2,700	-2,200	-600
Total	28,600	32,900	46,400
Transportation cost saving	-4,000	-4,000	-4,000
Disposal cost saving	-3,600	-3,600	-3,600
Collection cost saving	-	-2,000	-2,000
Sub total	-7,600	-9,600	-9,600
Net cost of incinerator	21,000	23,300	36,800

(4) Evaluation of incineration method

The low calorific value of the solid waste should be 800 Kcal/kg or more for economical incineration. Existing analysis results on solid waste show the low calorific value of domestic waste to range from 700 Kcal/kg to 1,500 Kcal/kg with an average of 1,100 Kcal/kg. Therefore, the presence of a fairly large amount of waste with a calorific value of less than 800 Kcal/kg is expected.

Moreover, the composition of solid waste fluctuate with the seasons. In the rainy season in particular, the low calorific value of the waste is expected to be lower than usual due to mixture of fruit residue, etc.

In short, the introduction of an incineration system with a cost currently higher than that of sanitary landfill is questionable. As the low calorific value is expected to increase with the increased amount of paper and plastics in the waste, the analysis on the content of the waste should be continued for further examination.

6) Composting

(1) Outline

When waste with a high organic refuse content (paper can also be made into compost) is subject to the biological decomposition process (fermentation) under aerobic conditions at a temperature of 40 - 60°C, it will eventually become compost. This compost can be used as an organic fertilizer or soil conditioner for agricultural land or parks.

On the composting process at least, 30 - 60 days may be required. While the maintenance and control of this process appear simple, the difficulties in obtaining good quality compost lie with the requirements for the minimum inclusion of foreign matter and the maintenance of the fermentation conditions over a long period of time. The compost so obtained has to be used for landfill if there is no demand for it. As its volume reduction rate is not as high as that of incineration, composting should be regarded as an intermediate treatment method which should only be used based on the demand. The demand trend, therefore, should be continually watched and good quality compost should be produced.

Although Jakarta's current solid waste is suitable for composting in view of its large ratio of organic matter, the demand for compost is said to be only some 800 t/day which is 10% of Jakarta's generated solid waste amount. Therefore, composting should be regarded as an auxiliary intermediate treatment method.

When composting is intended to be introduced as the solid waste treatment method, the waste must be limited to that which is suitable for composting and the waste should be checked for any changes in composition.

(2) Outline of composting facilities

Table 3-2-13 gives the outline of composting facilities. The construction cost of a 200 t/day composting facility is approximately Rp.8 billion.

Table 3-2-13 Outline of Composting Facilities

Item	Contents
1) Disposal capacity	200 t/day
2) Annual disposal amount	60,000 t
3) Operation hours	16 hrs/day
4) Compost production	15,000 t/year
5) Rejected amount	18,000 t/year
6) Major facilities	
- Reception and supply system	Pit and crane
- Pre-treatment system	Selective shredding system
- Fermentation system	
- Maturing system	
- Post-treatment system	Vibrating filter
- Odour treatment system	
7) Construction cost	Rp.8 billion

(3) Composting cost

As shown in Table 3-2-14, the composting cost is Rp.14,100/t. When the income from sale of the compost is taken into account, the cost is Rp.11,600/t. Although composting is much more economical than the incineration method, it is still 3 times higher than the cost of the sanitary landfill disposal method.

Table 3-2-14 Cost of Composting

(Unit: Rp/t)		
Item	Unit cost	Remarks
Construction cost depreciation	6,600	
Operation cost	5,400	
Transportation cost of reject	1,200	Reject amount 30%
Disposal cost of reject	900	
Sub total	14,100	
Revenue from compost	-2,500	Compost production 25%
Sub total	-2,500	
Total	11,600	
Transportation cost saving	-4,000	
Disposal cost saving	-3,600	
Sub total	-7,600	
Net cost of composting	4,000	

(4) Evaluation of composting method

The composting method of waste disposal is only practical if a demand for the compost so produced exists. The demand for compost in Jakarta and its neighbouring areas is 76,000 t/year, which is equivalent to 800 t/day of solid waste, only 10% of the 9,290 t/day of solid waste generated in Jakarta.

Composting cannot be described as an economical method of waste disposal in view of the fact that its cost is 3.2 times higher than the cost of the sanitary landfill disposal method.

In 1963, the introduction of composting in Jakarta was planned and the necessary machinery was purchased. However, this machinery is still stored in the warehouse due to the lack of construction and operation funds for the composting facilities.

In conclusion, composting can play only a minor role in Jakarta's solid waste management and, therefore, should not be regarded as a major pillar.

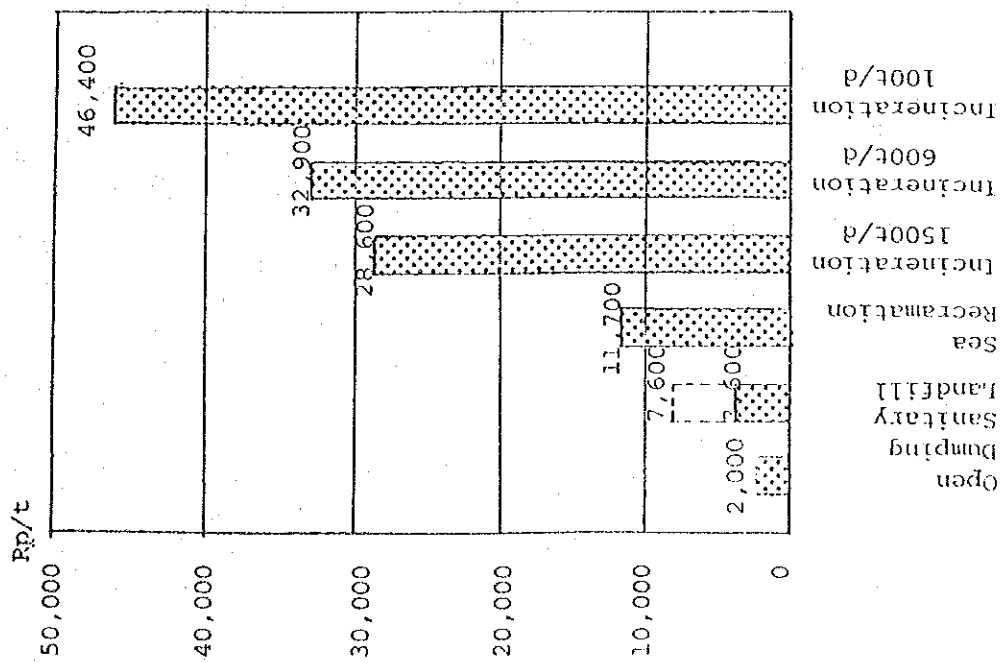


Fig.3-2-20 Unit Cost of Incineration

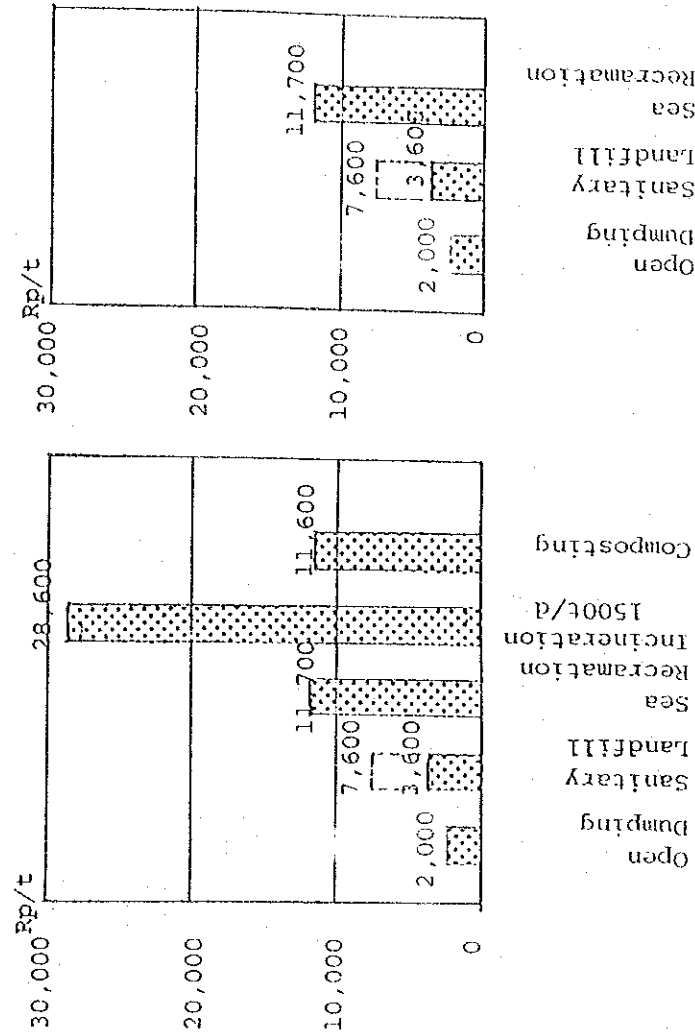


Fig. 3-2-21 Unit Cost of Composting

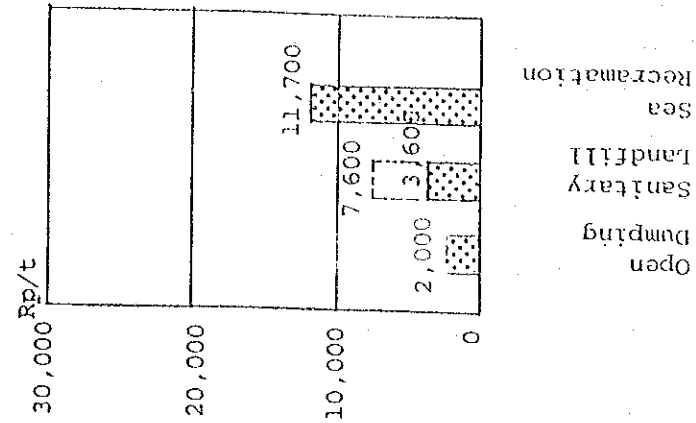


Fig. 3-2-22 Unit Cost of Sea Recreational

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3.3 Other Systems

The following systems which support the technical system should be firmly established in Jakarta for the efficient operation of the technical system.

- o Operation System
- o Citizen Participation System
- o Organisation System
- o Finance System
- o Legal System

3.3.1 Operation System

1) Collection

(1) Collection frequency

The collection frequency in Jakarta is as shown in Table 3-3-1.

Table 3-3-1 Collection Frequency

	1985/86	2005
Door-to-Door	Twice a week	Twice a week
Jali-Jali	Twice a week	Twice a week
Large LPS	Daily	Daily
Small LPS	Three times or twice a week	Daily or three times a week
Small Communal Container System (1 m ³)	---	Three times a week

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There are alternative plans which can either increase or decrease the current collection frequency. Although a reduced frequency would be more economical, it is in fact undesirable due to the requirement for large storage places and the reduced service contents. If the frequency is increased, the collection cost increases accordingly. For example, the change from collection twice a week to collection three times a week would result in a cost increase of some 10%. In view of the current tight financial situation, therefore, it is considered undesirable to increase the collection frequency.

In the case of the small communal container system (1 m³), collection of three times a week is desirable.

Table 3-3-2 Effects of Different Collection Frequencies on Small Communal Container System

	Container cost	Travelling distance
Daily	+	-
Three times a week	+/-	+/-
Twice a week	-	+
Once a week	--	+

Note: The effect of the container cost on the total cost is larger than that of the travelling distance.

+ : Good
 +/- : Fair
 - : Bad
 -- : Very Bad

(2) Number of collection trips

The model schedule for each collection system is given in Fig. 3-3-1.

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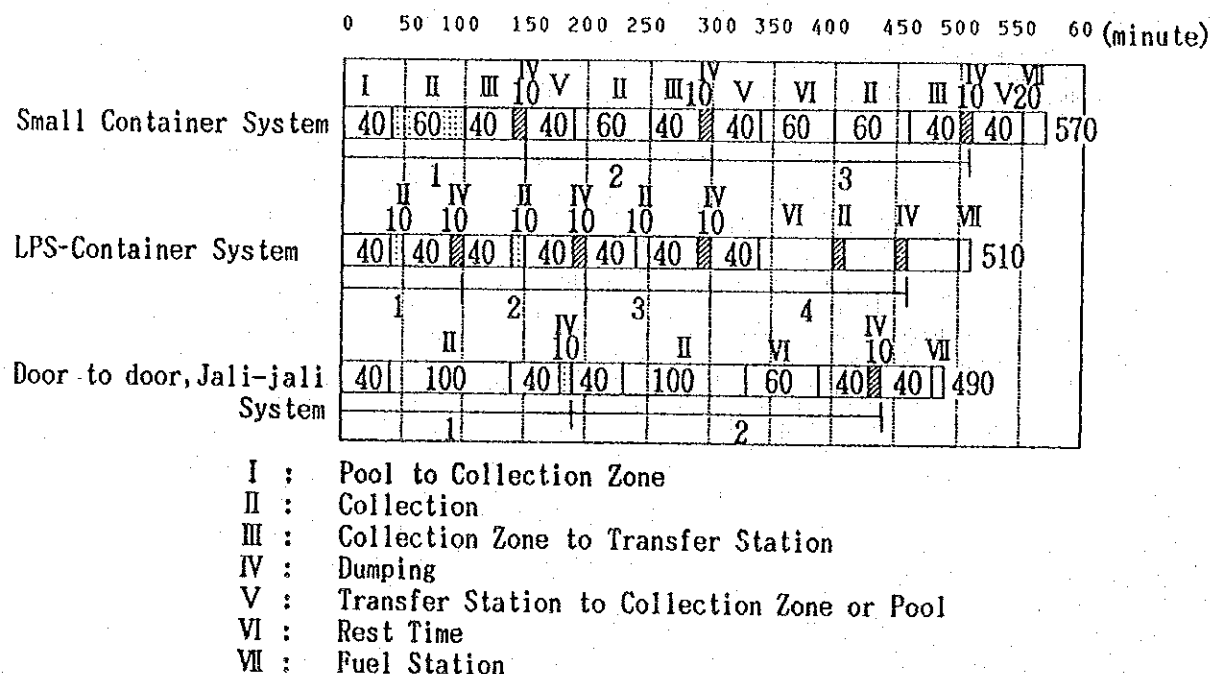


Fig. 3-3-1 Model Schedules for Collection Systems

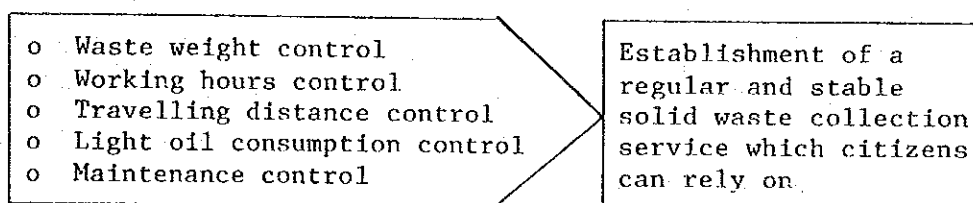
The small container and the LPS container systems may achieve 3 and 4 trips respectively depending on the locations of the containers. Therefore, in the case of the small container system, 2.5 trips are considered. Similarly, 3.5 trips are suggested for the LPS container system. In the case of the door-to-door and Jali-Jali systems, the saving in the haulage time will have only a minor effect on the total number of working hours due to the long period of time necessary for the actual collection work. Therefore, the maintenance of 2 trips a day should be considered as the objective for these systems. Based on the above considerations, the number of standard trips for each system is given in Table 3-3-3.

Table 3-3-3 Number of Standard Trips

LPS container system (10 m ³)	3.5 trips
Small container system (1 m ³)	2.5 trips
Jali-Jali system	2.0 trips
Door-to-door system	2.0 trips

(3) Operation control

The following controls are required for efficient operation.



(4) Maintenance

There are 3 possible maintenance systems which are described below. The most realistic of these is Plan 2: Reinforced sub-workshop of Suku Dinas Kebersihan and Dinas Kebersihan workshop for vehicle overhaul.

Plan 1. Present sub-workshop of Suku Dinas Kebersihan + Dinas Kebersihan workshop

Plan 2. Reinforced sub-workshop of Suku Dinas Kebersihan + Dinas Kebersihan workshop

Plan 3. All maintenance work is carried out by Dinas Kebersihan workshop

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The possible roles to be played by the sub-workshop and the main workshop are as follows.

Sub-workshop	Main workshop
<ul style="list-style-type: none"> o Daily check and maintenance o Regular check and maintenance o Emergency maintenance o Others 	<ul style="list-style-type: none"> o Overhaul of such components as truck chassis, etc. o Emergency maintenance which cannot be dealt with by the sub-workshop

2) Street sweeping

It is desirable to prepare a collection schedule which indicates the locations and times of collections.

3) Final disposal/transfer stations

It is desirable to provide the disposal sites with a reception gate where the solid waste can be weighed and the reception time recorded.

3.3.2 Citizen Participation System

1) Information system

The following information system should be established.

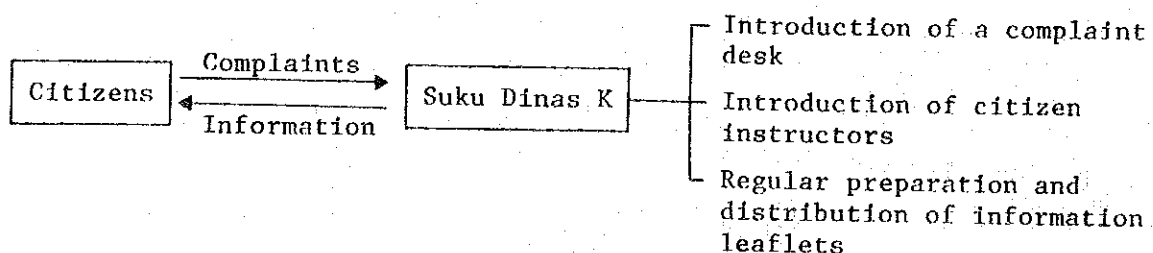


Fig. 3-3-2 Information System

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2) Solid waste collection by RT/RW

The following measures should be introduced for the continuation of handcart collection by the RT/RW.

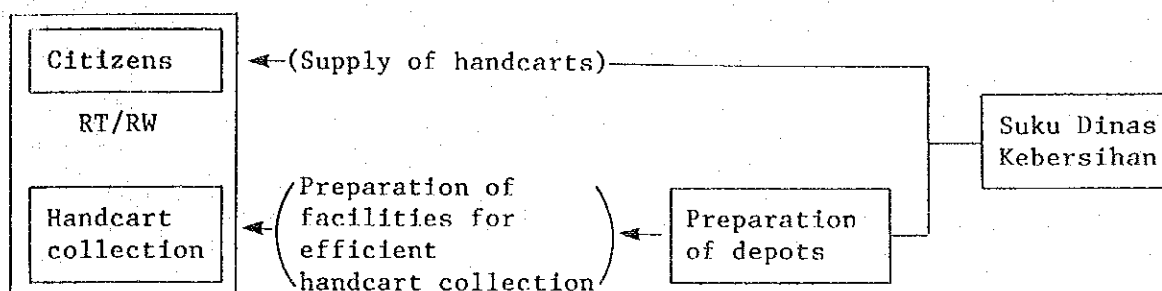


Fig. 3-3-3 Measures for Continued Handcart Collection

3) Community sweeping

It is desirable for a system to be set up whereby 2 - 4 voluntary sweeping days a year are allocated for the sweeping of minor streets and small drains in the community with all the community's residents participating in the sweeping on these days.

4) Recovery of reusable materials

It is desirable for a system to be introduced whereby the reusable materials are collected by the RT/RW's community activities. The income from the sale of these materials is used for community activities. The official collection and haulage cost could be reduced in this way.

5) Others

The use of containers (plastic bags and paper bags, etc.) for the discharge of waste and the payment of a collection fee should be promoted among the citizens.

3.3.3 Organization

The solid waste management system in Jakarta deploys the actual workforce to the Suku Dinas Kebersihan in each Wilayah and to the Seksi Kecamatans which are under the control of the Suku Dinas Kebersihans. As the basic wage of the Suku Dinas Kebersihan employees is paid by the Wilayah, the Dinas Kebersihan finds it difficult to adequately supervise and control the workforce. This situation should be changed by reinforcing the Dinas Kebersihan as the responsible body for solid waste management.

The following 2 points can be considered to be major fields for examination in terms of the organization.

- a. Whether solid waste management will continue to be carried out by the Dinas Kebersihan or a public corporation will be set up.
- b. Whether solid waste management in Jakarta will be carried out under centralized control or under decentralized control of districts will also be set up.

With regard to the first point, the general advantages and disadvantages of each method are given in Table 3-3-4. On this aspect, conclusions will not be hastily drawn in this study in view of the fact that the solid waste management system in Jakarta is still being consolidated and many efforts are currently being made to prepare a general framework for the management system. Instead, efforts to improve the productivity of the collection service and to secure sources of self-revenue will be made on the basis of the current organization with a view to achieving the same efficiency as that of a public corporation.

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Table 3-3-4 Advantages and Disadvantages of Dinas Kebersihan and Public Corporation

	Advantages	Disadvantages
Dinas Kebersihan	<p>Revenue is firmly established by the city budget.</p> <p>As recruitment is carried out by the city, only a minimum of employee education and training is required due to the relatively high educational standard of the applicants.</p> <p>Coordination with other departments is easy.</p> <p>Better public services can be provided.</p>	<p>Facility investment tends to be inflexible due to budget constraints, making the swift response to changes difficult.</p> <p>Efforts to collect fees do not lead directly to an increase in operators.</p> <p>Difficult to secure employees suitable for solid waste management (pay scale is determined by regulations).</p> <p>Difficult to maintain discipline.</p> <p>Service tends to be uniform and inflexible.</p>
Corporation	<p>Fee collection efforts should be strengthened as self-revenue sources are required.</p> <p>Easy to recruit and deploy employees suitable for solid waste management.</p> <p>Maintenance of discipline is easy as employees violating the regulations can be punished.</p> <p>Salary can be increased with productivity improvements.</p> <p>Timely investment in facilities and equipment is possible.</p> <p>Variety of services can be provided.</p>	<p>As revenue sources tend to be unstable, excessive services may result.</p> <p>Pay scale may be lowered if revenue sources are not secured.</p> <p>Less profitable public services tend to be less emphasised.</p> <p>As too much stress tends to be placed on short-term results, long-term efforts in terms of environmental policy may not be implemented.</p>

PART II

With regard to the second point, as the area's characteristics should be embodied in the solid waste management system, the establishment of an organization which is able to quickly respond to a changing local situation is desirable. However, as treatment and disposal face various constraints, including land acquisition, it is difficult to conduct those works in each Wilayah in an independent manner. In addition, the Dinas Kebersihan has traditionally been biased in the distribution of personnel, and has not provided adequate managerial and technical personnel for the Suku Dinas Kebersihans to give autonomous immediately. In this study, instead of separation of the organization, the improvement of the relative status of the Suku Dinas Kebersihans vis-à-vis the Dinas Kebersihan is aimed to strengthen the managerial (finance and personnel) and technical independence.

3.3.4 Fee collection method

The methods for collecting fees may be largely divided into direct collection and indirect collection. Indirect collection including existing method waste management fees are collected by collectors from households or business establishments. Indirect collection, collection of the waste management fee through some other systems such as tax systems or charge systems of public services, may be considered. In addition, various compromise system of the foregoing two collection methods may also be considered.

The current system is a combination of direct collection by Dinas Kebersihan and indirect collection by RT/RW and DISPENDA. However, fee collection by RT/RW has not yet been formally established and the rate of fee collection by DISPENDA is still low. In the case of direct collection, there are cases where fees are successfully collected from more than half of the households to be collected (for example, in Utara), so that it cannot be concluded that direct collection is totally unworkable. However, it is likely that direct fee collection will become increasingly difficult as the coverage expands from the middle income group to the lower income group, as in the case of Bandung.

PART II

The fee collectors' cost estimated on the basis of the number of premises, would amount to Rp.3.7 billion in 2005 in the case of direct collection. This is not a very large burden compared to the commission of 5% which is considered for indirect collection.

The largest problem of direct collection is that the collection rate would probably not be as high as expected due to lack of an effective method of punishment for those who do not pay.

In the case of indirect collection, the fees may be charged as a tax or collected as a surcharge on other public utilities. Of the two, the latter would seem more effective in the light of the established institutional system. Particularly when the service rates of electricity and of water supply in Jakarta and the level of the fee collection system are taken into consideration, collection of a surcharge on electric fee seems to be the best method by which fees may be collected from the largest number of beneficiaries.

In comparison, it would be impossible to increase fee collection by RT/RW by a large margin in view of its history and nature.

The advantages and disadvantages of direct collection and of indirect collection by RT/RW or as a surcharge on electric fee are as shown in Table 3-3-5.

Table 3-3-5 Comparison of 3 Fee Collection Methods

	Advantages	Disadvantages
Direct collection	<p>Possible to set up a fair charge which corresponds to the service.</p> <p>Fee collection efforts directly relate to the establishment of self-supporting financial resources.</p> <p>Residents' response to the collection service can be directly reflected to the authority.</p>	<p>Fee collection does not necessarily result in a reduction of waste generation but may cause illegal dumping.</p> <p>As fee collection is expensive, the necessary funds for its management may not be obtained.</p> <p>Excessive services may result in order to collect fees.</p> <p>An effective penalty for those who do not pay the fees is difficult to establish.</p>
Collection by RT/RWs	<p>Collection cost is lower than that of direct collection.</p> <p>The burden can be adjusted according to income levels, which is a characteristic of Indonesian society.</p>	<p>Due to interference by RT/RWs, there may be a gap between the collection target and the amount paid.</p> <p>Responsibility for fee collection tends to be blurred.</p>
Indirect collection	<p>Collection cost is low. Once established as an integrated system, the revenue will spontaneously increase with the growth of the electricity consumption.</p> <p>Self-supporting financial resources can be easily established.</p>	<p>This method does not necessarily satisfy the benefit principle (solid waste generation and electricity consumption do not always correspond).</p> <p>Difficult to set up a fee standard which corresponds to the service level.</p>

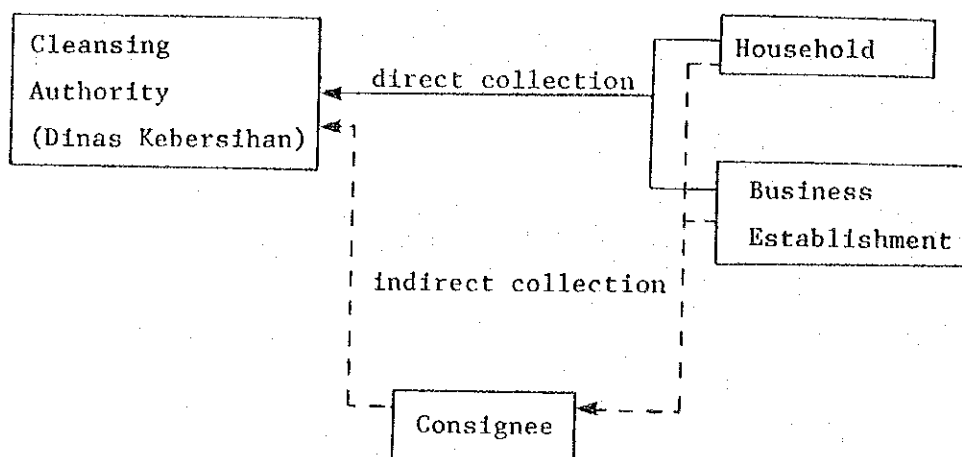
PART II

Regarding the addition of a surcharge on the public utilities charge, while there is no case of a surcharge being added to the electric rates in Indonesia's past, there is an instance of a surcharge being added to the water rates. There is no doubt that the implementation of a surcharge will give rise to various arguments and take time.

Particularly as the generated waste amount is not necessarily linked to the electric power consumption, a scheme that would assure an equity of burden would be necessary. Appropriating a certain ratio of individual household's electric rates to the waste management fund, though possible in theory, would be impossible in practice, at least in the foreseeable future. It would, therefore, be necessary to strictly control the data on beneficiaries and to make every effort to positively analyze waste generation by area and by enterprise in order to assure the equity, as in Bogor where the waste management fee is collected by adding a surcharge on the water supply rates.

Certain period will be required to actualize a foregoing idea as the government agencies responsible for electric power supply and solid waste management are different. Currently new fee collection system has been discussed between the PLN and DKI in this respect. It is necessary for DKI to quickly improve the present status of its waste management service which lacks reliability due to its informal fee collection and irregular service, and, to positively approach the PLN in order to actualize the a foregoing idea as soon as it has done.

Although problems will remain as stated above, a surcharge on electric rates as a source of funding would raise a substantial amount when the future growth of electricity consumption is taken into account. It is, therefore, extremely important that an organization and system is established at the earliest possible time for waste management fees to be indirectly collected as a surcharge on electric rates.



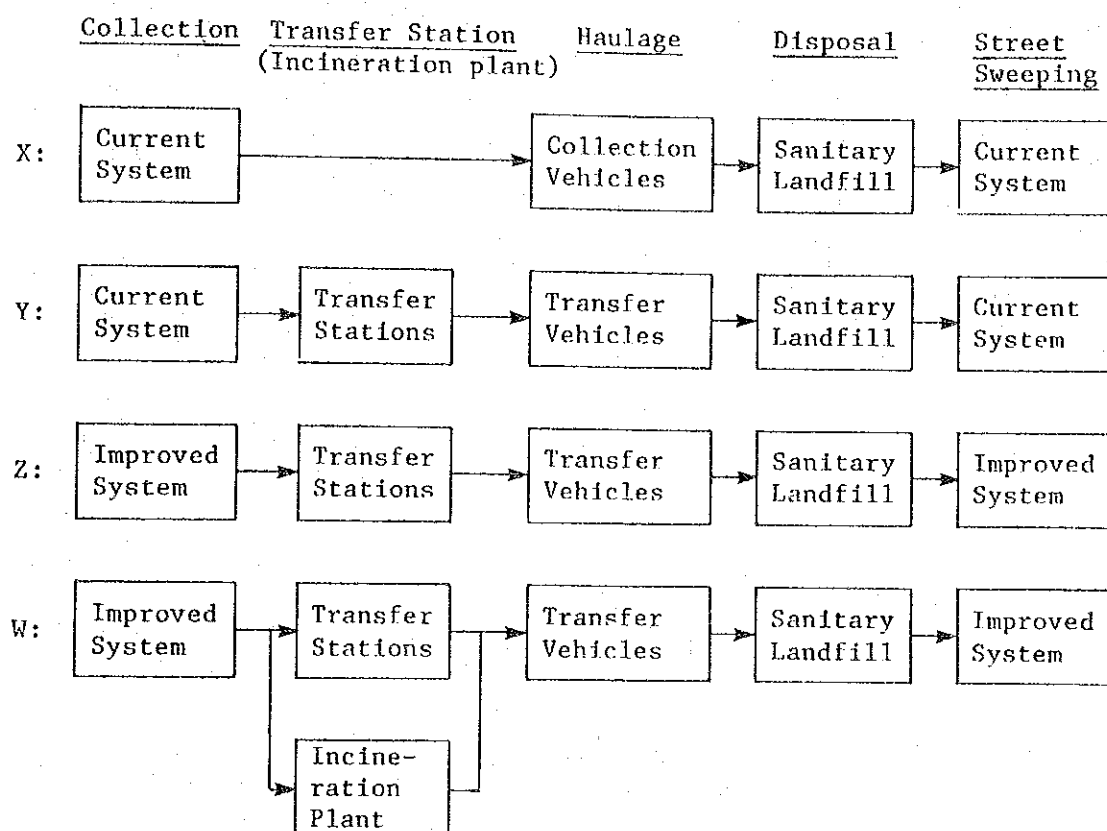
3.4 Evaluation of Alternatives

3.4.1 Alternatives

Based on the examination in 3.4.1 the possible combinations of the technical systems are given as follows for comparative examination.

- X: The present collection system is maintained and the collected waste is hauled directly to the sanitary landfill site located at a far distance. Street sweeping is conducted in the current manner.
- Y: The collected waste is transferred to the sanitary landfill site located at a far distance via the transfer stations. Street sweeping is conducted in the current manner.
- Z: The collection system is improved and the collected waste is transferred to the sanitary landfill site located at a far distance via the transfer stations. The street sweeping system is also improved.
- W: A large incineration plant is introduced in addition to the transfer stations in the case of Z above. The street sweeping system is also improved.

These systems are illustrated below.



Note: See 3.2.1, 3.2.2, 3.2.4 (3) and 3.2.4 (5) for the contents of the current and improved systems, transfer stations, incineration and landfill respectively.

Fig. 3-4-1 Planning of Alternative Systems

3.4.2 Details and Costs of Alternatives

(1) Details of alternatives

Table 3-4-1 shows the planning details for the 4 alternatives.

(2) Investment cost

Table 3-4-2 gives the calculation results of the investment cost for each alternative.

(3) Annual cost

Table 3-4-3 gives the annual cost for each alternative.

Table 3-4-1 Details of Alternatives

(1985)

	X	Y	Z	W
Collection				
Amount of Waste	7,970t/d	7,970t/d	7,970t/d	7,970t/d
Manpower				
Worker	5,518Nos.	3,657Nos.	1,729Nos.	1,729Nos.
Driver	2,545	1,728	1,123	1,123
Administration	562	374	284	284
Fuel Consumption	19,940 kℓ	13,540 kℓ	8,807 kℓ	8,807kℓ
Vehicle	3,165Nos.	2,149Nos.	1,448Nos.	1,448Nos.
Handcart	4,149	4,149	2,491	2,491
Handcart collector	4,149	4,149	2,491	2,491
L.Container	635	635	1,138	1,138
S.Container	0	0	6,582	6,582
Depot	90(62)	90(62)	162	162
Transfer Station				
Amount of Waste	0t/d	9,190t/d	9,190t/d	7,690t/d
Manpower				
Worker	0Nos.	81Nos.	81Nos.	78Nos.
Administration	0	161	161	163
Driver	0	461	461	474
Vehicle Tractor	0	34	34	17
Semi Trailer	0	85	85	43
Tipper	0	351	351	378
Fuel	0 kℓ	6,285 kℓ	6,285 kℓ	6,180kℓ
Electricity	0Mw	1,264 Mw	1,264 Mw	632 Mw
Disposal Site				
Amount of Waste	4,172,000t/y	4,172,000t/y	4,172,000t/y	3,722,000t/y
Manpower				
Worker	60Nos.	60Nos.	60Nos.	60Nos.
Driver	156	156	156	136
Administration	58	58	58	58
Fuel	3,142 kℓ	3,142 kℓ	3,142 kℓ	2,715 kℓ
Heavy Equipment	86Nos.	86Nos.	86Nos.	76Nos.
Incineration				
Amount of Waste	-	-	-	450,000t/y
Manpower	-	-	-	-
Worker	-	-	-	34Nos.
Technician	-	-	-	43
Administration	-	-	-	13
Vehicle	-	-	-	16
Ash	-	-	-	90,000t/y
Road				
Length	2,455km	2,455km	2,455km	2,455 km
Road Sweeper	23Nos.	23Nos.	23Nos.	23Nos.
Vehicle	0	0	168	168
Sweeper	5,943	5,943	2,312	2,312
Driver	230	230	191	191
Administration	418	418	251	251
Fee Collector	2,602Nos.	2,602Nos.	2,602Nos.	2,602Nos.
Staff				
Local	2,147Nos.	2,147Nos.	580Nos.	580Nos.
Central	1,307	1,307	228	228

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Table 3-4-2 Investment Cost (1985)

(Unit: 10⁴Rp)

	X	Y	Z	W
Investment				
1. Construction	94,492	141,122	158,754	306,192
(1) Transfer station				
Civil work	0	19,000	19,000	17,000
Equipment	0	23,790	23,790	12,120
Material	0	1,920	1,920	960
Sub total	0	46,630	46,630	30,080
(2) Disposal site				
Civil work	66,364	66,364	66,364	61,512
Equipment	28,080	28,080	28,080	25,920
Sub total	94,444	94,444	94,444	87,432
(3) Incineration				
Civil work	0	0	0	52,000
Equipment	0	0	0	119,000
Sub total	0	0	0	171,000
(4) Depot	48	48	280	280
(5) Workshop	0	0	17,400	17,400
2. Purchase of Vehicle etc.	148,750	133,846	119,848	115,029
(1) Collection				
Vehicle	129,948	68,884	68,884	66,884
(2) Transportation	0	26,353	26,353	21,884
Vehicle				
(3) Road Sweeper	4,140	4,140	4,140	4,140
(4) Heavy Equipment	11,537	11,537	11,537	10,034
(5) Vehicle for Ash	0	0	0	1,152
(6) Vehicle for Street waste	0	0	3,192	3,192
(7) Container (10m ³)	1,590	1,590	2,850	2,850
(8) S. Container (1 m ³)	0	0	1,970	1,970
(9) Handcart	1,535	1,535	922	922
3. Land Acquisition	20,133	33,883	36,914	39,264
(1) Transfer Station	0	13,750	13,750	12,500
(2) Disposal Site	19,500	19,500	19,500	19,500
(3) Incinerator	0	0	0	3,600
(4) Depot	633	633	3,664	3,664
1+2 Total	243,242	274,968	278,602	421,220
1+2+3 Total	263,375	308,851	315,516	460,484

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Table 3-4-3 Annual Cost

(Unit: 10⁶Rp)

	X	Y	Z	W
1. Operating Expenses and cost				
(1) Collection				
Depreciation	17,065	11,760	10,042	10,042
Manpower	10,517	7,042	4,024	4,024
Maintenance	7,505	5,147	4,200	4,200
Others	3,988	2,708	1,761	1,761
Sub total	39,075	26,657	20,027	20,027
(2) Transfer station				
Depreciation	0	5,713	5,713	4,182
Manpower	0	1,182	1,182	1,229
Maintenance	0	3,480	3,480	2,329
Others	0	1,097	1,097	1,034
Sub total	0	11,472	11,472	8,774
(3) Final disposal				
Depreciation	9,748	9,784	9,784	8,727
Manpower	447	447	447	411
Maintenance	1,367	1,367	1,367	1,239
Others	2,013	2,013	2,013	1,875
Sub total	13,575	13,611	13,611	12,252
(4) Intermediate treatment				
Depreciation	0	0	0	9,018
Manpower	0	0	0	152
Maintenance	0	0	0	3,136
Others				886
Sub total	0	0	0	13,192
(5) Fee Collection	2,498	2,498	2,498	2,498
(6) Street Sweeping				
Depreciation	532	532	746	746
Manpower	6,446	6,446	2,962	2,962
Maintenance	236	236	251	251
Others	21	21	230	230
Sub total	7,235	7,235	4,189	4,189
(7) Staff Cost	5,803	5,803	1,357	1,357
2. Expenses and cost of private sector	4,033	4,033	4,033	4,033
Handcart collection	4,091	4,091	2,456	2,456
3. Expense and cost of public sector				
Depreciation	27,345	27,789	26,285	32,715
Manpower	25,711	23,418	12,470	12,633
Maintenance	9,108	10,230	9,298	11,155
Others	6,022	5,839	5,101	5,785
Total	68,186	67,276	53,154	62,288
4. Cost of waste management				
Collection	39,075	26,657	20,027	20,027
Transportation	0	11,472	11,472	8,774
Final Disposal	13,575	13,611	13,611	12,252
Intermediate treatment	0	0	0	13,192
Street sweeping	7,235	7,235	4,189	4,189
Fee Collection	2,498	2,498	2,498	2,498
Staff	5,803	5,803	1,357	1,357
Total	68,186	67,276	53,154	62,288
Private Sector	8,124	8,124	6,489	6,489
Grand Total	76,310	75,400	59,643	68,412

3.4.3 Evaluation of Alternatives

Apart from the low cost, the following points should be noted in the appraisal of the alternative systems.

- a. Effect on Creation of Employment
- b. Effect of Investment
- c. Reduction of Final Disposal Amount

1) Financial evaluation

In terms of expenditure, the cost of alternatives Z is the lowest, followed by W, Y and X. This order in the expenditure does not change even when the depreciation cost is excluded. When the latter is excluded, however, the difference between alternatives Z and W becomes relatively small at Rp.2.7 billion.

Table 3-4-4 Financial Evaluation

	(Unit: 10 ⁹ Rp)			
	X	Y	Z	W
Investment amount	263.3	308.9	315.5	460.5
Expenditure				
Collection/haulage	39.1	38.7	31.5	28.8
Treatment (Incineration)	0	0	0	13.2
Disposal	13.6	13.6	13.6	12.3
Street sweeping	7.2	7.2	4.2	4.2
Others	8.3	8.4	3.9	3.8
Total	68.2	67.3	53.2	62.3
Expenditure excluding depreciation cost	40.8	39.5	26.3	29.0

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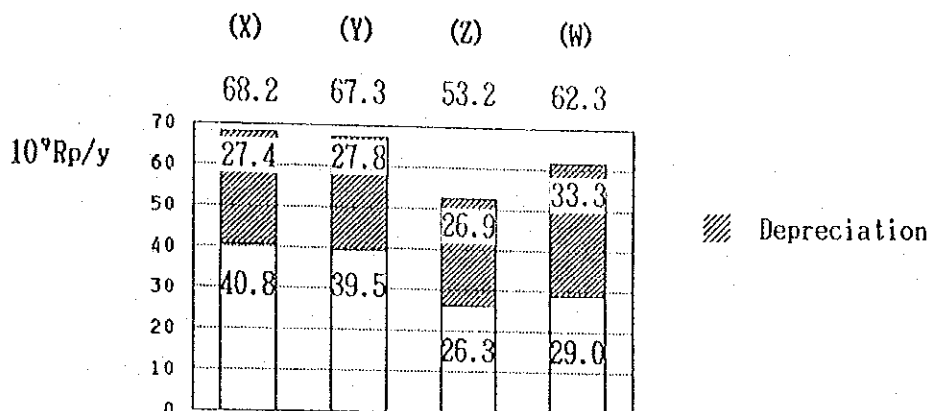


Fig. 3-4-2 Financial Evaluation

2) Investment

While alternative W appears to offer the largest spread effect in terms of the investment amount, the effect is in fact questionable in view of that the transfer facility and incineration plant costs account for 34% of the total investment and that a large part of these facilities and machinery may be imported.

3) Other considerations

Table 3-4-5 gives the required personnel, energy consumption and annual disposal amount of each alternative. Although alternative Y offers the best job creation effect, it is unrealistic because of the difficulty in securing an adequate workforce for solid waste management in the future.

Table 3-4-5 Comparison of Alternative Systems

	X	Y	Z	W
Personnel (persons)	18,618	19,107	10,278	10,360
Fuel (kl)	23,082	22,967	18,234	17,703
Electricity (MW)	-	1,264	1,264	632
Annual disposal amount (x 10 ⁶ ton)	4.2	4.2	4.2	3.7

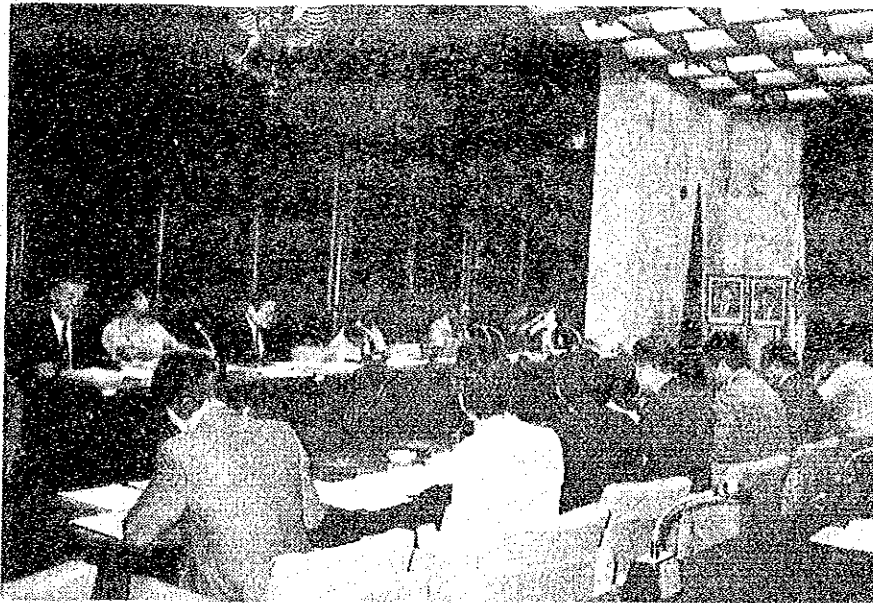
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In terms of the energy consumption, alternatives Z and W are superior to alternatives X and Y. In terms of the annual energy consumption, that of alternative X is 12% lower than that of the other alternatives. The reduction effect of alternative W on the amount of waste for final disposal is advantageous when the acquisition of disposal sites is difficult, resulting in an increased disposal cost in the future.

4) Comprehensive evaluation

Alternative Z proves to be the most economical. The results of the evaluation of other factors show no positive reason why another alternative with a higher disposal cost should be adopted. It is concluded, therefore, that alternative Z should be recommended as the technical alternative for solid waste management in Jakarta.

CHAPTER 4 CONCEPTUAL MASTER PLAN



CHAPTER 4 CONCEPTUAL MASTER PLAN

4.1 Preconditions and Goals of the Plan

4.1.1 Preconditions of the Plan

The preconditions of the Plan are as shown below.

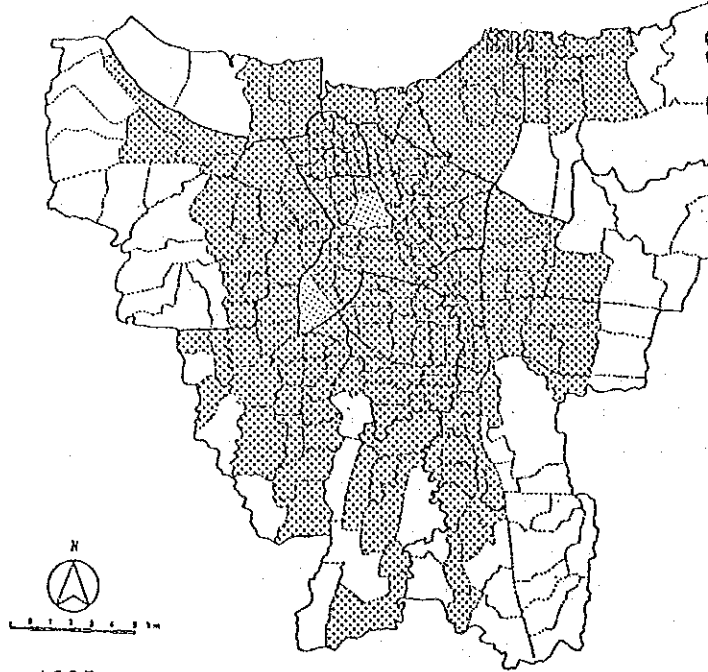
- a. Planned target year 2005
- b. Planned subject area Whole city of Jakarta
- c. Planned subject waste Ordinary domestic waste,
commercial waste, street waste,
market waste, park waste, industrial
waste (currently managed by the City)
and canal waste.
- d. Estimated waste amount

Table 4-1-1 Estimated Waste Amount

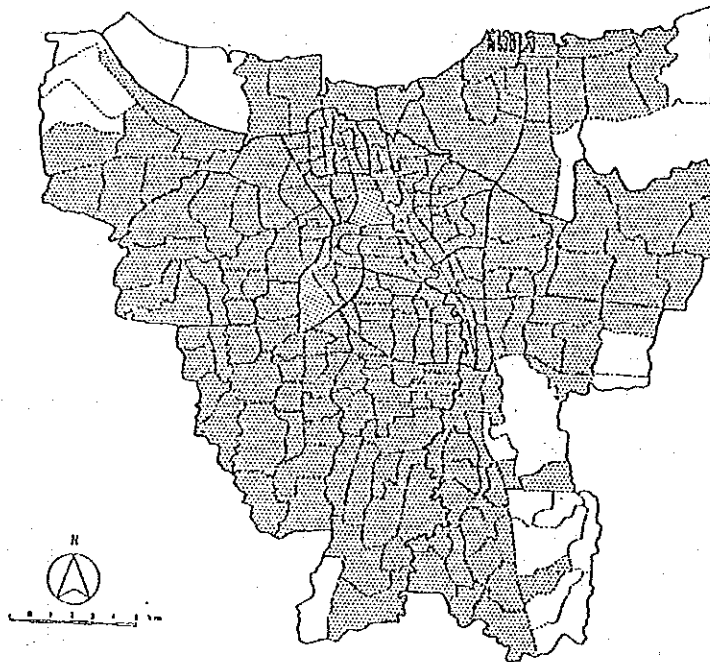
	Estimated generation	Planned collection	Planned transfer haulage	Planned disposal
Ordinary do- mestic waste	5,110t/d	5,100t/d	5,110t/d	5,110t/d
Commercial waste	1,790	1,790	1,790	1,790
Market waste	1,710	620	1,710	1,710
Industrial waste	1,510	450	580	580
Street waste	100	-	100	100
Total	10,220	7,970	9,290	9,290
Tangerang	1,260	0	0	1,260
Bekasi	880	0	0	880
Grand total	12,360	7,970	9,290	11,430

1986

PART II



1995



2005

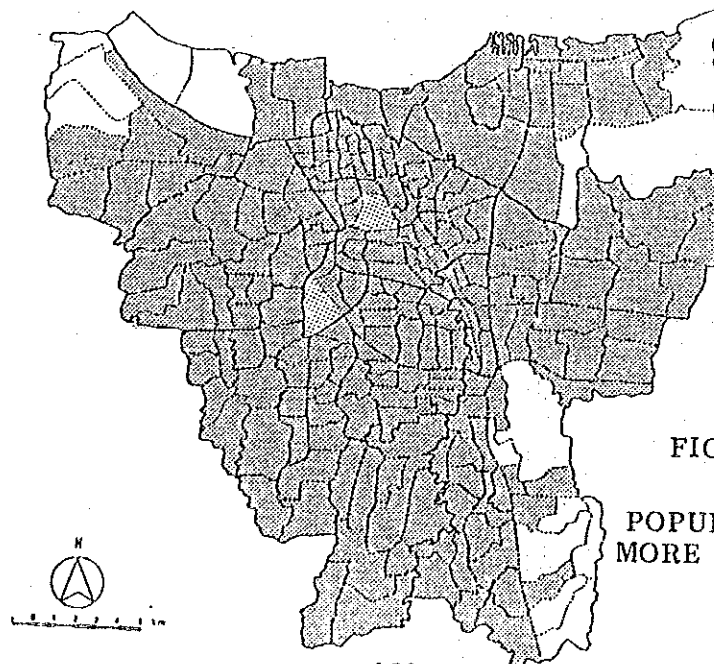


FIG.4-1-1

POPULATION DENSITY:
MORE THAN 5000 PERSONS/KM²

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Table 4-1-2 Estimated Composition of Waste

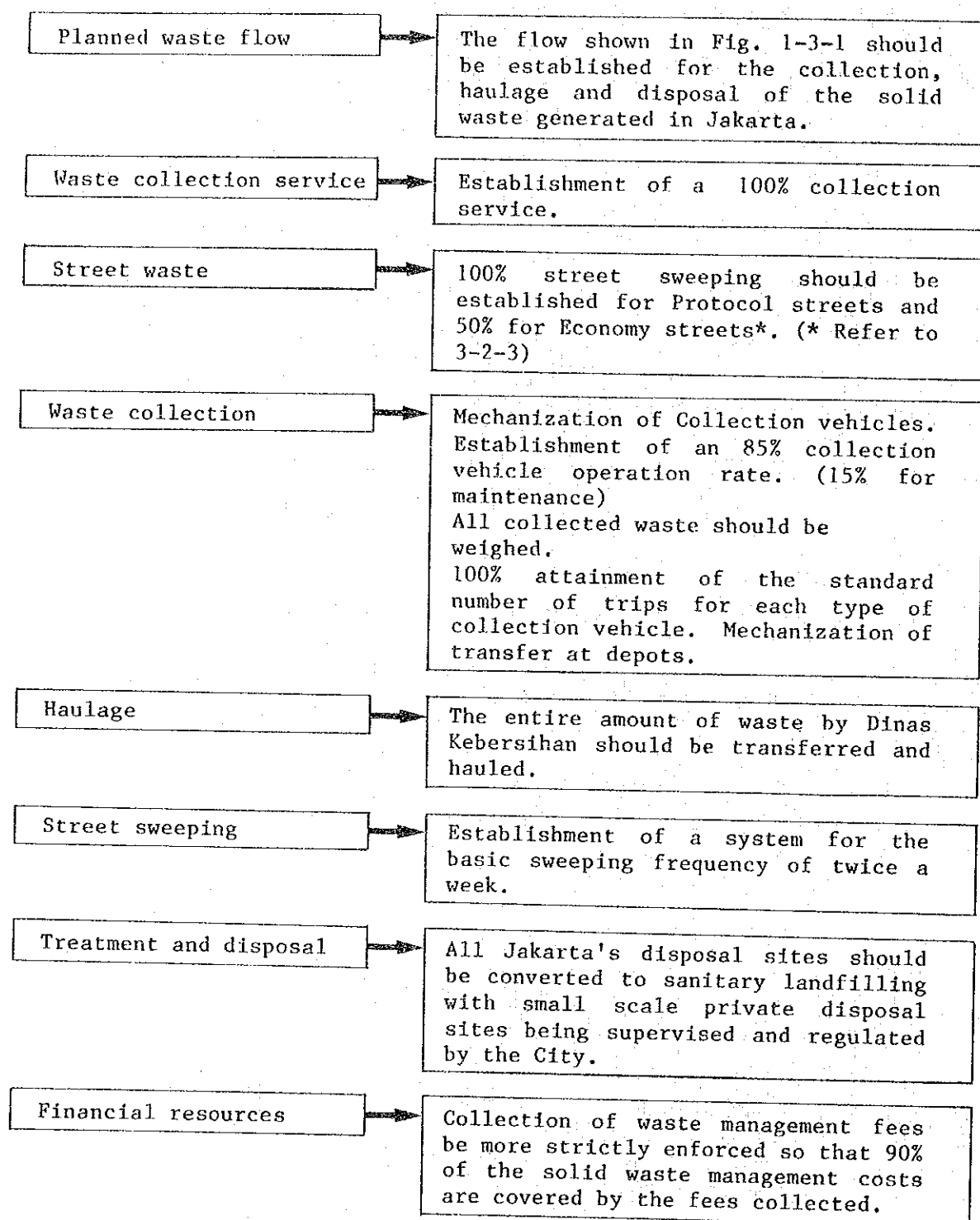
	Domestic waste %	Commercial waste %
Plastics	14	17
Paper	21	30
Textiles	5	3
Wood/Leaves	10	5
Garbage	19	21
Others	12	9
Sub total	81	85
Metal	7	7
Glass	6	7
Stones	6	1
Sub total	19	15
Total	100	100

4.1.2 Planning Targets

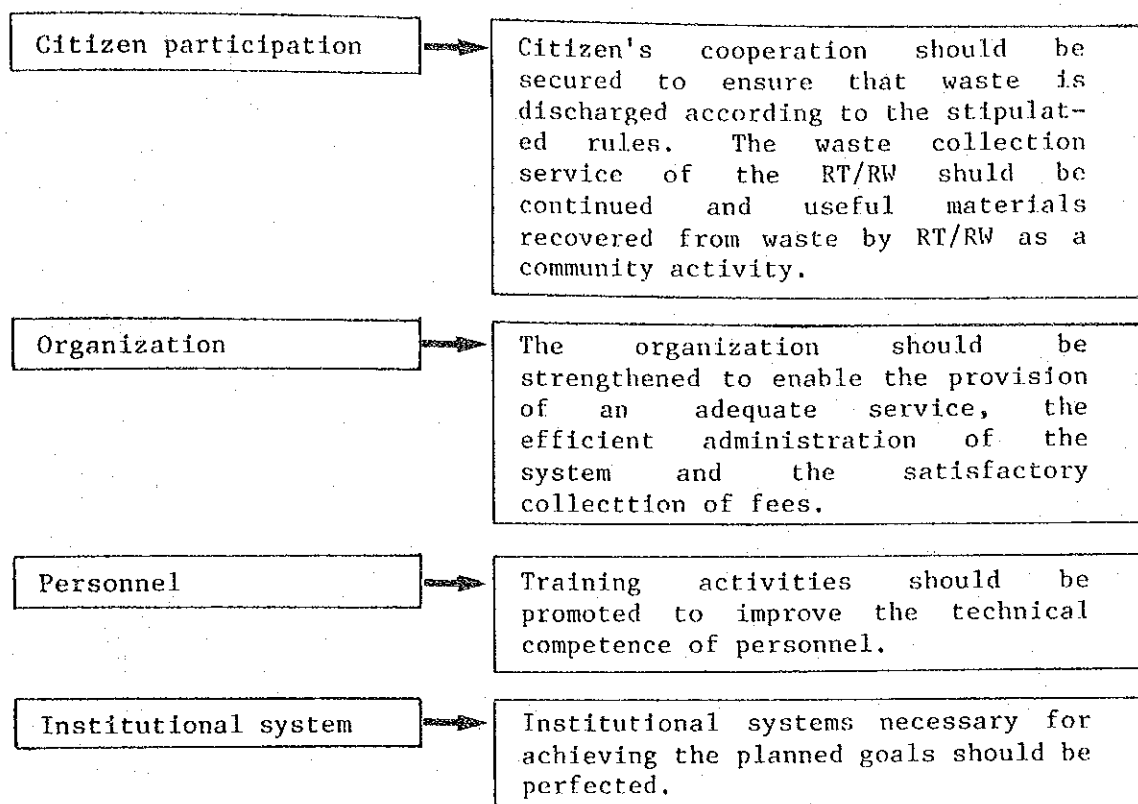
The planning flow shown in Fig. 1-3-1 should be established for the collection, haulage and disposal of the solid waste generated in Jakarta.

The specific planning targets for the year 2005 are as shown in Fig. 4-1-2 .

Fig. 4-1-2 Planning Goals (for the Year 2005)



PART II



4.2 Proposed Breakdown of Responsibility for Solid Waste Management

The solid waste collection, haulage, transfer and disposal activities should be carried out as follows by the parties involved.

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Table 4-2-1 Proposed Breakdown of Responsibility for Solid Waste Management

Source of Waste	Primary collection	Trans- portation	Transfer	Disposal
Domestic Waste	D.K. ————— D.K. ————— D.K. ————— D.K.			
	RT/RW ————— D.K. —————			
Market waste of Wilayah and Commercial Waste	D.K. ————— D.K. —————			
	RT/RW ————— D.K. ————— D.K. ————— D.K.			
	Private company ————— Private company —————			
Public Market Waste	P.D. Pasar Jaya ————— P.D. Pasar Jaya ————— D.K. ————— D.K.			
Industrial Waste	D.K. ————— D.K. ————— D.K. ————— D.K.			
	Each factory ————— Each factory —————			Each factory
	Private company ————— Private company —————			Private company
Canal Waste	Dinas PU ————— Dinas PU ————— D.K. ————— D.K.			
Micro-drainage Waste	RT/RW ————— D.K. ————— D.K. ————— D.K.			
Park/Garden Waste	Dinas . Pertamanan ————— Dinas Pertamanan ————— D.K. ————— D.K.			
Hospital Waste	Hospital ————— Hospital ————— Hospital			

D.K. = Dinas Kebersihan

The following policies apply to solid waste management and are given by the source of generation.

a. Domestic waste

With respect to domestic waste, the Dinas Kebersihan shall manage the whole operation from collection to disposal. In areas where handcart collection can and should desirably be maintained under the supervision of the Dinas Kebersihan, the Dinas Kebersihan shall back up the RW/RT's handcart collection.

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b. Commercial waste

As in the case of domestic waste, the Dinas Kebersihan shall manage the whole operation from the collection to disposal of commercial waste (including market waste with the exception of that generated by public markets). The self-hauling of waste or entrusting the operation to some private waste collector under the supervision of the Dinas Kebersihan is considered appropriate and this operation shall be approved. To prevent illegal dumping of waste, however, waste treatment and disposal shall not be approved at places other than those designated by the Dinas Kebersihan.

c. Public market waste

Collection of public market waste shall continue to be entrusted to the P.D. Pasar Jaya which is responsible for the administration of public market facilities, while such operations as transfer, haulage, treatment and disposal shall be undertaken by the Dinas Kebersihan.

d. Industrial waste

The Dinas Kebersihan shall continue to undertake the operation from collection to disposal of that industrial waste which cannot be distinguished from ordinary domestic or commercial waste and which is currently collected by the Dinas Kebersihan. In principle other industrial waste shall be disposed of by the generator of the waste or entrusted to private waste collectors with the proviso that proper treatment and disposal shall be maintained under the supervision of the Dinas Kebersihan. Among industrial waste, ordinary acceptable waste hauled to transfer stations by the generators will be treated and disposed of by the Dinas Kebersihan.

e. Canal waste and other waste

The handling and haulage of river and canal waste shall be left to the Dinas PU which is the administrator of rivers and canals, while the Dinas Kebersihan shall undertake transfer haulage, treatment and disposal of this waste.

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Cleaning and scooping of micro-ditch waste shall be carried out by the community RT/RW within the scope of its responsibility while the collection, treatment and disposal of this waste shall be undertaken by the Dinas Kebersihan.

The collection of garden waste shall be assigned to Dinas Pertamanan, the responsible administrator, while the treatment and disposal of this waste shall be undertaken by the Dinas Kebersihan.

Hospital waste, in principle, shall be disposed of by the hospitals generating the waste and not by the Dinas Kebersihan.

The Dinas Kebersihan shall continue to control and supervise the collection, haulage, treatment and disposal of waste which is generated in the city and shall approve the waste to be collected and disposed of by the facility administrators, citizens and private waste collectors under its supervision.

4.3 Collection and Haulage Plan

4.3.1 Division of Waste Collection

The Collection of wasteshall be divided into the following three categories according to the discharge characteristics at the respective generating sources.

- a. Ordinary collection Collection of domestic and commercial waste which is discharged in small amounts.
- b. Bulky waste collection ... Collection of bulky waste (trees, etc.) generated at irregular intervals from households and commercial installations.

PART II

- c. Special collection In the event of a large amount of waste being generated, special collection separated from ordinary collection shall be made.

4.3.2 Planned Amount of Waste to be Collected

The planned amount of waste to be collected by the Dinas Kebersihan is shown in Table 4-3-1.

Table 4-3-1 Planned Amount of Waste to be Collected

(Units t/day)				
	Ordinary collection	Bulky waste collection	Special collection	Total
1984				
Pusat	770			770
Utara	390			390
Barat	660			660
Selatan	550			550
Timur	580			580
Total	2950			2950
1995				
Pusat	660	50	400	1110
Utara	570	50	150	770
Barat	900	60	240	1210
Selatan	1070	110	230	1410
Timur	1010	100	260	1370
Total	4210	380	1280	5870
2005				
Pusat	810	60	570	1440
Utara	730	70	230	1030
Barat	1240	110	350	1700
Selatan	1410	140	350	1900
Timur	1400	130	370	1900
Total	5590	510	1870	7970

4.3.3. Level of Waste Collection Service

Waste discharge locations are stipulated to be as follows.

1) Ordinary collection

Waste discharge point : In principle, specified stations should be set up in each community. In areas where the door-to-door collection system is to be adopted, waste may be discharged in front of the door or gate.

Collection frequency

Door- to-door system	:	Twice a week
Jali-Jali system	:	Twice a week
Depot container system	:	Daily
Small container system	:	Three times a week

The collection frequency may be increased as necessary in shopping areas.

2) Bulky waste collection

Waste discharge point To be discharged at a specified waste station.

Collection frequency In principle, once a month

3) Special collection

Waste discharge point A waste accumulation and storage facility should be established at each applicable installation.

PART II

Collection frequency To be decided according to the waste discharge characteristics of each applicable installation.

4.3.4 Cooperation in Waste Discharge Management

The citizens' cooperation in regard to the proper discharge of waste should be sought in order to secure a sanitary and efficient working condition for waste collection.

1) Waste accumulation

Ordinary waste Placed in a plastic bin or some other airtight container in order to keep houses sanitary.

Bulky waste Stored together and kept until the specified collection day.

Special waste Kept in a container used exclusively for waste.

2) Waste discharge methods

Ordinary waste * Discharged on the specified day at the specified place.

Bulky waste * Discharged on the specified day at the specified place.
* Trees, etc. and such like should be bound with string prior to discharge.

Special waste * Discharged in a container.

4.3.5 Waste Collection System

The collection equipment should be mechanized for the establishment of an efficient collection system.

1) Policy for application of specific collection system

(1) Ordinary waste collection

The basic collection systems for ordinary waste collection are the Handcart - Depot-Container system and the Small Container system.

The choice of the system shall be in accordance with the criteria shown below.

Conditions of area

- Area A: Area in which a depot large enough to install large containers can be secured.
- Area B: Area in which a depot cannot be set up but where small containers can be regularly arranged on the roads.
- Area C: Area which does not satisfy the a foregoing conditions.
- Area D: Area in which special door-to door service is requested and vehicles have access to each home.

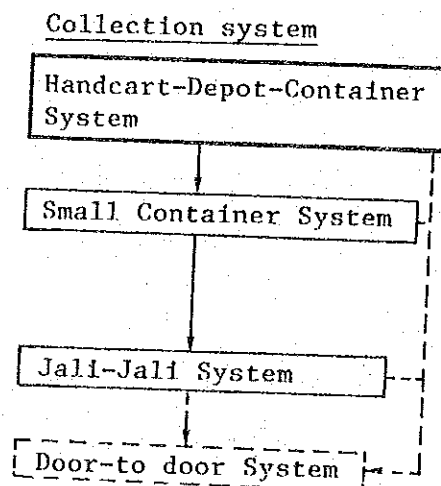
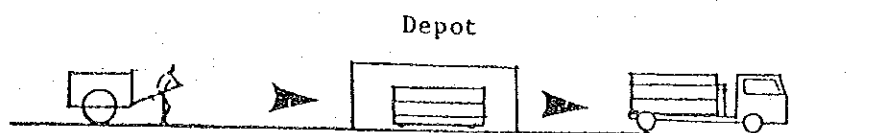


Fig. 4-3-1 Flow of Selection of Collection System

Area A Handcart - Container System



Area B Small Container System



Area C Jali-jali System



Area D Door to door System



Fig. 4-3-2 Collection Systems

LPS where large containers cannot be located should be completely abolished and small communal containers placed under the management of the RT/RW.

PART II

b. Bulky waste collection

For bulky waste collection, the following collection systems should be adopted for each area with the foregoing characteristics.

Area A : Collected by handcart and hauled by the container system.

Areas B, C and D: Collected from specified waste stations and hauled by small dump trucks.

c. Special collection

One of the following three systems should be adopted according to the discharge characteristics of each waste source.

1. Ordinary discharge : Small container-compactor vehicle system
2. Large-quantity : Door-to-door system
discharger Container - Arm-roll system

(2) Composition of applicable collection systems

Fig. 4-3-3 shows the respective share of each applicable collection system in the ordinary collection in Jakarta.

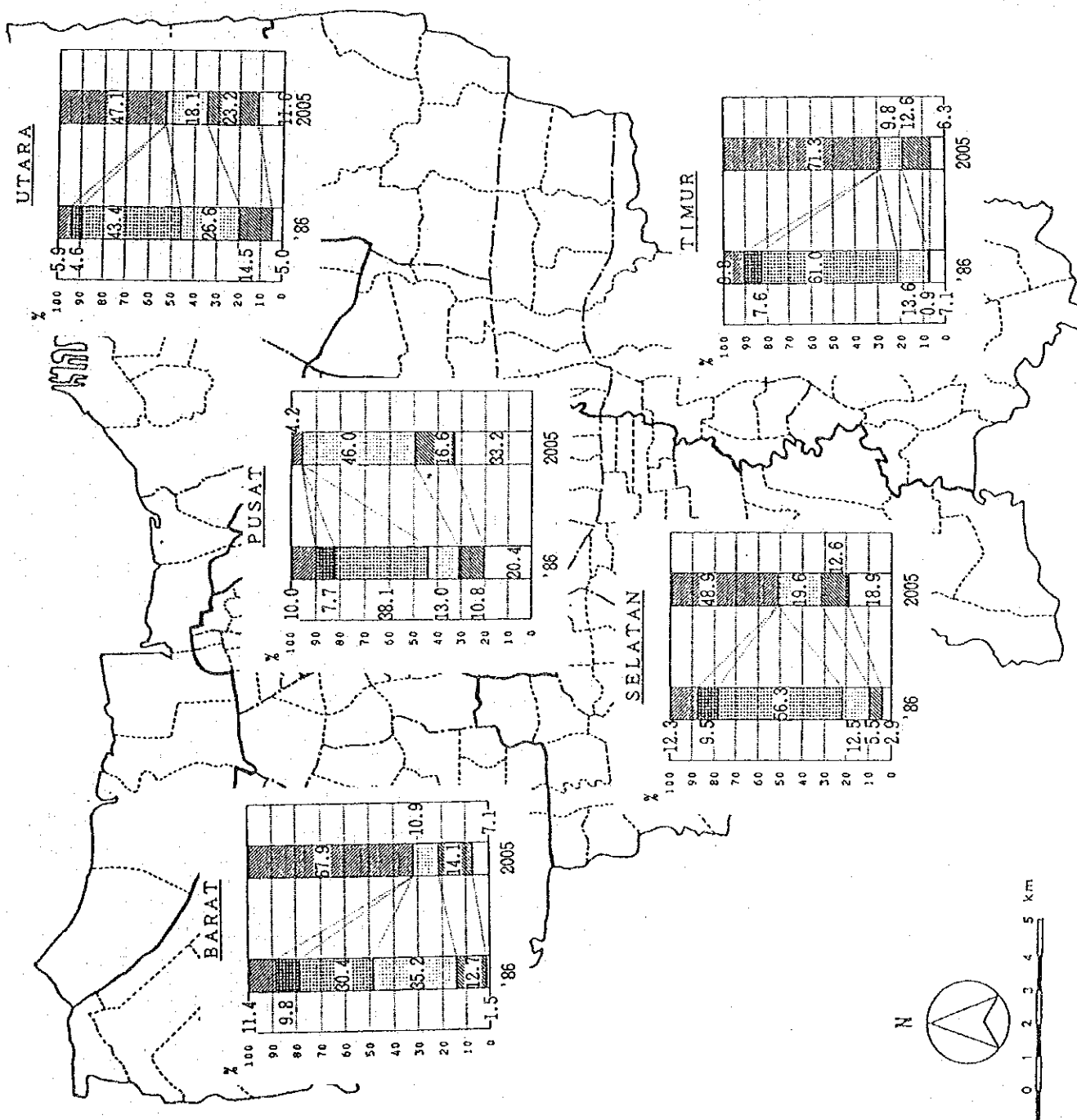
Since there are particularly many A Area's in Utara, Timur and Barat, depots should be mainly developed in the existing urban districts and future urban districts. As it is difficult to secure an adequate number of depots in Pusat and Selatan, the small container, Jali-Jali, and door-to-door systems shall be mainly adopted.

LEGEND

- LPS-Depot-Container
- LPS-Container
- LPS-Handcart pool
- LPS-Depot-Handcart pool
- LPS-Open space/Concrete bin
- Small container
- Jali-Jali
- Door to door

Fig. 4-3-3
Composition of
Collection Systems

Solid Waste Management System
Improvement Study
In The City Of Jakarta



PART II

4.3.6 Equipment Provision Plan

1) Collection equipment

The following equipment and vehicles should be provided for each collection system.

(1) Ordinary Collection

Handcart-Depot System	1 m ³ Handcart
	10 m ³ Communal Containers
	Large Arm-Roll Vehicle
Small Container System	1 m ³ Communal Container
	10 m ³ Compactor Vehicle
Jali-Jali System	4 m ³ Compactor Vehicle
Door-to-door System	4 m ³ or 10 m ³ Compactor Vehicle
Large amount of mass discharge ..	Large Container (10 m ³)
	Arm-Roll Vehicle

2) Depots

The following depots should be established according to the amount of waste handled.

Size of Depot	Standard Depot		
	18 tons/d	24 tons/d	30 tons/d
Container (10 m ³)	3 each	4 each	5 each
Required Area	300 m ²	380 m ²	410 m ²

PART II

The plan for an 18 t/d depot is shown in Fig. 4-3-4.

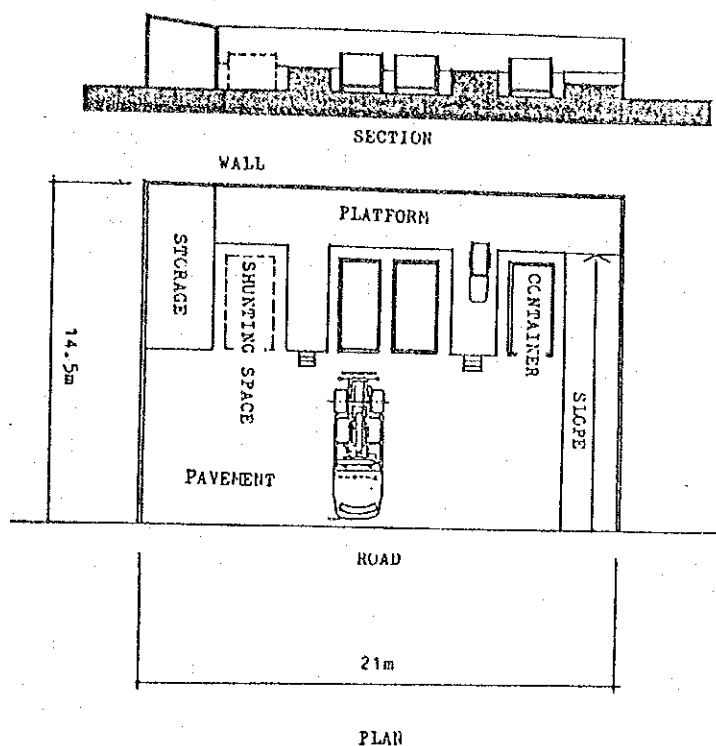


Fig. 4-3-4 Plan of Standard Depot

3) Equipment provision plan

Equipment which is considered necessary in the year 2005 is as shown in the Table 4-3-2.

Table 4-3-2 Equipment Provision Plan

(2005)

10 m ³ Communal Containers	1138
Large-Arm Rolls	574
1 m ³ Communal Containers	6582
10 m ³ Compactor Vehicles	176
4 m ³ Compactor Vehicles	648
6 m ³ Tippers	36
Handcarts	2491
Depots	162

PART II

4.3.7 Manpower Plan

Manpower shall be allocated as shown in the following table.

Table 4-3-3 Standard Personnel (persons)

	Drivers	No. in Crew
Ordinary Collection:		
Arm-Roll Vehicle	1	0
10 m ³ Compactor Vehicle (Small Container)	1	3
4 or 10 m ³ Compactor Vehicle (Door-to-Door)	1	4
4 m ³ Compactor Vehicle (Jali-Jali)	1	2
Bulky waste collection::		
4 m ³ Compactor Vehicle	1	3
Arm-Roll Vehicle	1	0
Special collection:		
Tipper	1	3

The total manpower required in 2005 is as follows.

Table 4-3-4 Manpower Plan

	(persons)	
	'85/86	2005
Drivers	775	1,123
Crew Members	1,424	1,729
Inspectors	562	284
Total	2,761	3,136

4.3.8 Operation Control Plan

- 1) Control of the number of trips by each type of collection vehicle

The standard number of trips for each type of vehicle is as follows.

Table 4-3-5 Standard Number of Trips

Collection System	Vehicle	No. of trips
Ordinary collection		
A. Door-to-door system	Small compactor	2 trips
B. Jali-jali system	Small compactor	2 trips
C. Small container system	Large compactor	2.5 trips
D. Depot container system	Arm roll	3.5 trips
Bulky waste collection		
	Arm roll	3.5 trips
	Large tipper	2 trips
Special collection		
	Large compactor	2.5 trips

2) Working hour control

A time schedule should be developed to enable each driver to control his working hours.

3) Waste measurement control

A truck scale should be provided at each transfer stations to control the amount of waste collected and hauled.

4) Mileage Control

Each collection vehicle's odometer should be maintained in good working condition to record the daily mileage.

5) Oil consumption control

Required amount of oil for each vehicle and the daily oil consumption should be recorded.

PART II

4.4 Transfer Haulage Plan

4.4.1. Haulage Distance

The average haulage distances from the Wilayahs to each of the two future disposal sites are as follows.

Table 4-4-1 Haulage Distances

	(km)	
	Bekasi	Tangerang
Pusat	37	30
Utara	38	32
Barat	43	24
Selatan	32	34
Timur	28	38

4.4.2 Estimated Haulage Amount

The waste to be hauled is as follows.

- * Domestic waste
- * Commercial waste
- * Industrial waste
- * Street waste

The planned amount of waste to be hauled is as follows.

Table 4-4-2 Amount of Waste to be Hauled

	(ton/d)
Pusat	1730
Utara	1250
Barat	1900
Selatan	2180
Timur	2130
Street Waste	100
Total	9290

4.4.3 Transfer Station Development Policy

- 1) Conditions for securing disposal sites and transfer station development policy

To prevent the initial investment burden from becoming too excessive, those Wilayahs in which disposal sites can be secured within their boundaries should, for the time being, try to prolong the life expectancy of these disposal sites. Other Wilayahs should be given priority in the development of transfer stations in view of the utilization of the remote disposal sites.

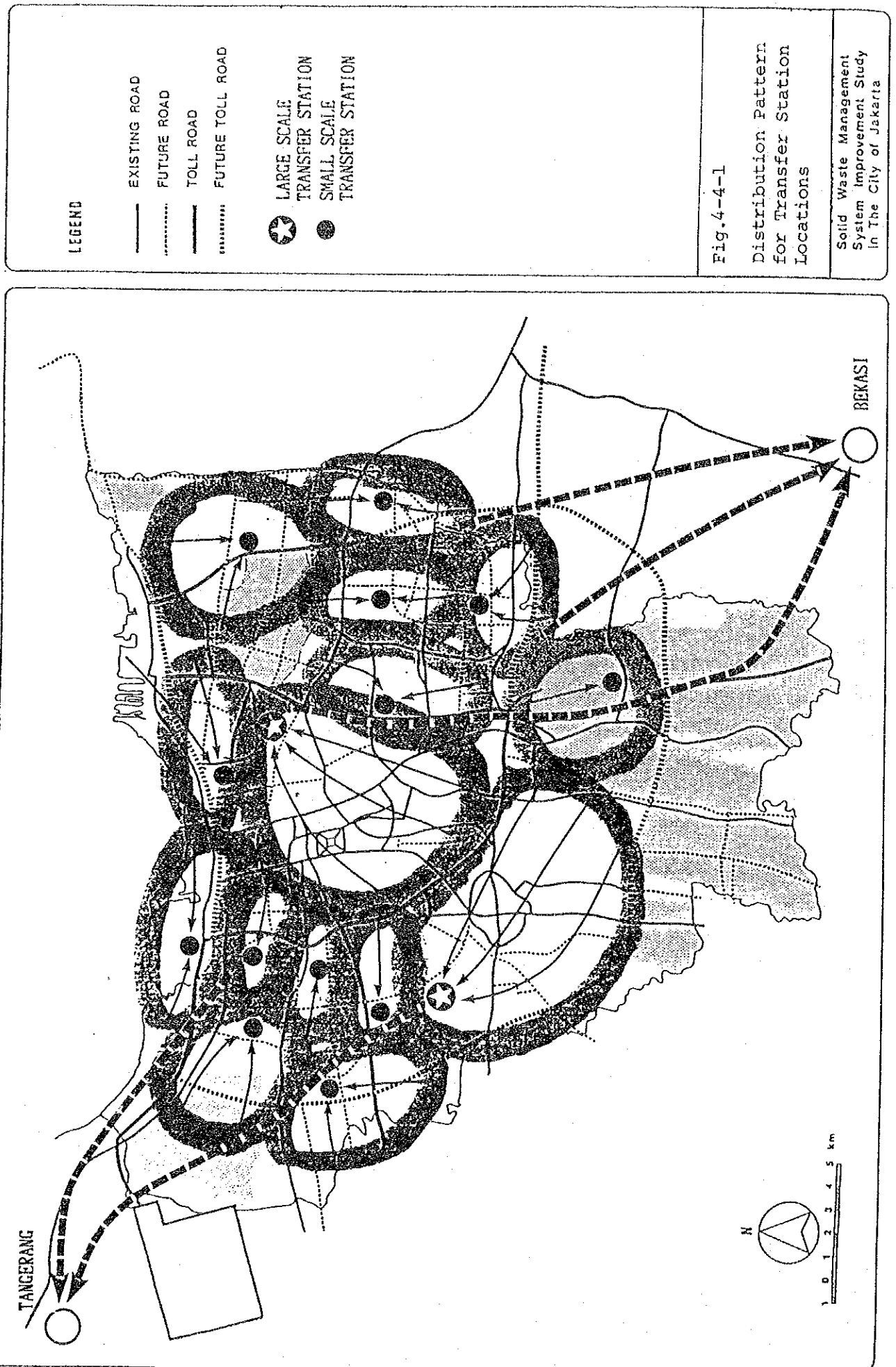
From the above viewpoint, Pusat should be given top priority in the development of transfer stations, followed by Selatan and Utara.

- 2) Selection of transfer system and station size and station distribution policy

In consideration of the site acquisition conditions, environmental conditions, degree of urgency, economics and prospects for the area's development, transfer stations should be developed for each Wilayah based on the following policy.

Pusat	One large size transfer station should be
Selatan		constructed within a 15km range of the center
		of the Wilayahs. In view of the environmental
		conditions surrounding the station, the
		transfer system should be the cp, compactor-
		container system.
Utara	Multiple small size transfer stations should be
Timur		constructed according to the Barat development
Barat		status of each locality and the schedule for
		the utilization of remote disposal sites. The
		transfer system should be the plane system with
		hopper.

An example of the distribution pattern of transfer station locations is shown in Fig. 4-4-1.



3) Policy for securing sites

Since a transfer station is considered to be a major important facility for cleansing, relatively large sites should be secured. The sites should be systematically secured in Utra, Barat and Timur with due consideration to the development of each locality in the long-term perspective.

4.4.4 Transfer Stations

Table 4-4-3 gives outline of the facilities.

Table 4-4-3 Planning Elements for Transfer Stations

Size	400 t/d	2000 t/d
No. of locations	13	2
Site area	0.75ha x 13	2ha x 2
No. of vehicles		
Tippers	27 x 13	0
Tractors	0	17 x 2
Semi-trailers	0	42 x 2
Administrative staff	11 x 13	9 x 2
Drivers	33 x 13	16 x 2
Workers	5 x 13	8 x 2
Total	637	66
Hoppers	3 each/location	5 each/location
Compactors	-	5 sets

Table 4-4-4 Outline of Transfer Stations

Planned treatment amount	400 t/d	2000 t/d
Site area	0.75 ha	2 ha
Dumping stages	3 (accomodating 1 collection vehicle each)	5 (accomodating 2 collection vehicles each)
Hopper size	3m wide x 2m deep	
Truck scale	30t x 1	30t x 2
Platform	5m high	7m high
Administration building	Floor area 100 m ²	Floor area 240 m ² x 1 bldg.
Roof	Slate	Slate
Compactors	-	5, capacity 550 m ³ /h, Ram pressure 3.8 kg/cm ²
Container		42 x 40 m ³ each Refuse packing 20t each
Tractors		24, 240 kw
Prime movers		3, 210 kw
Tippers	27 (10m ³)	

The types of transfer stations are as shown in Fig. 5-4-2. A schematic view of the facility layout and the system flow diagram of a compactor-container system transfer station are shown in Fig. 4-4-3 and Fig. 4-4-4 respectively.

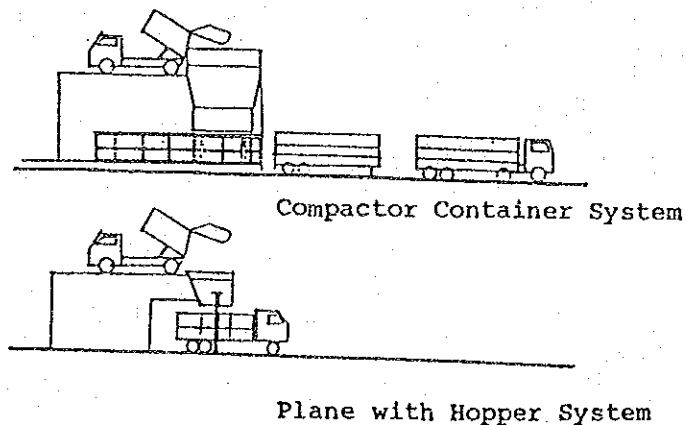


Fig. 4-4-2 Transfer Station Systems

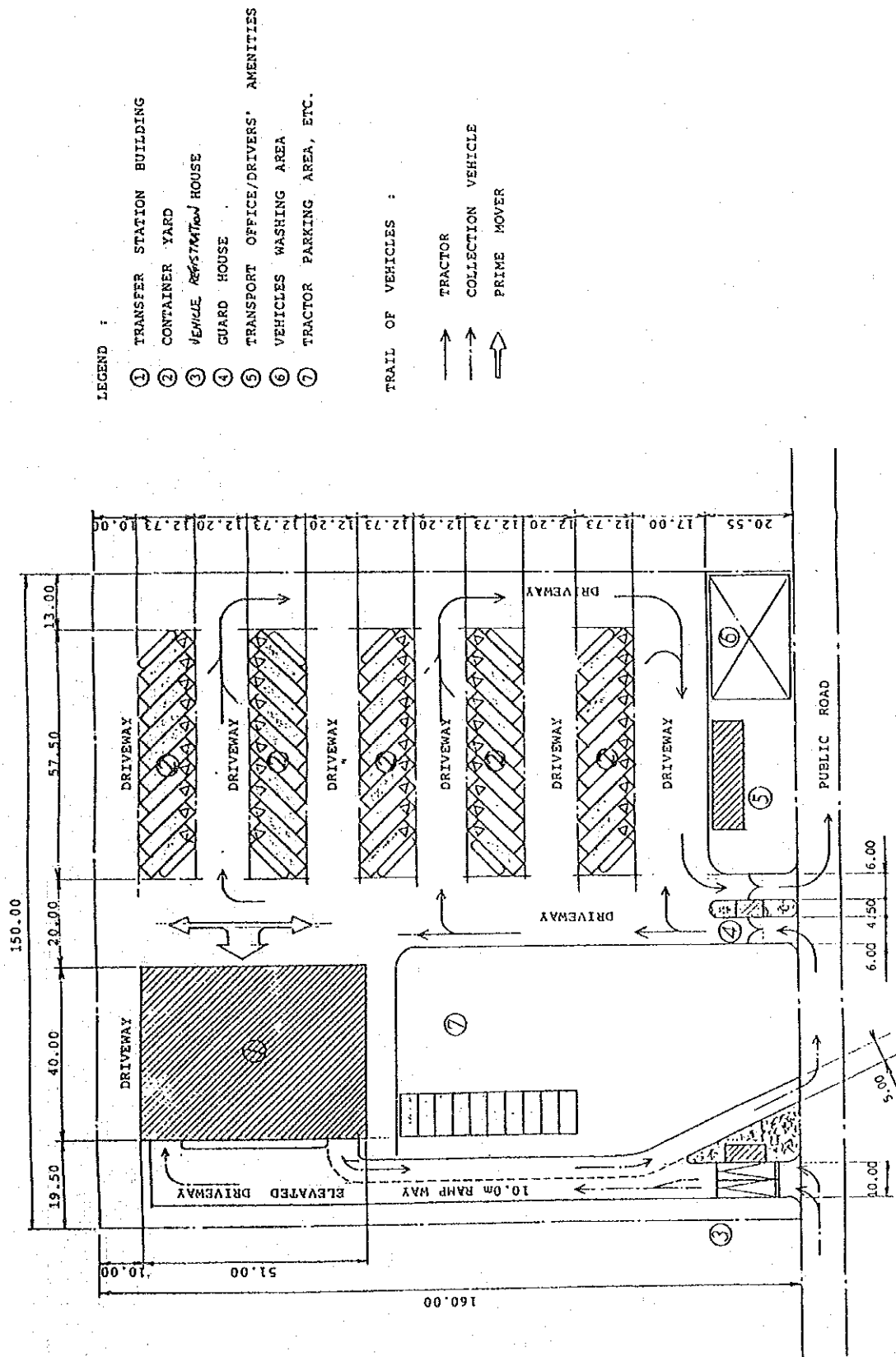


Fig. 4-4-3 Model Plan of Compactor Container System Transfer Station

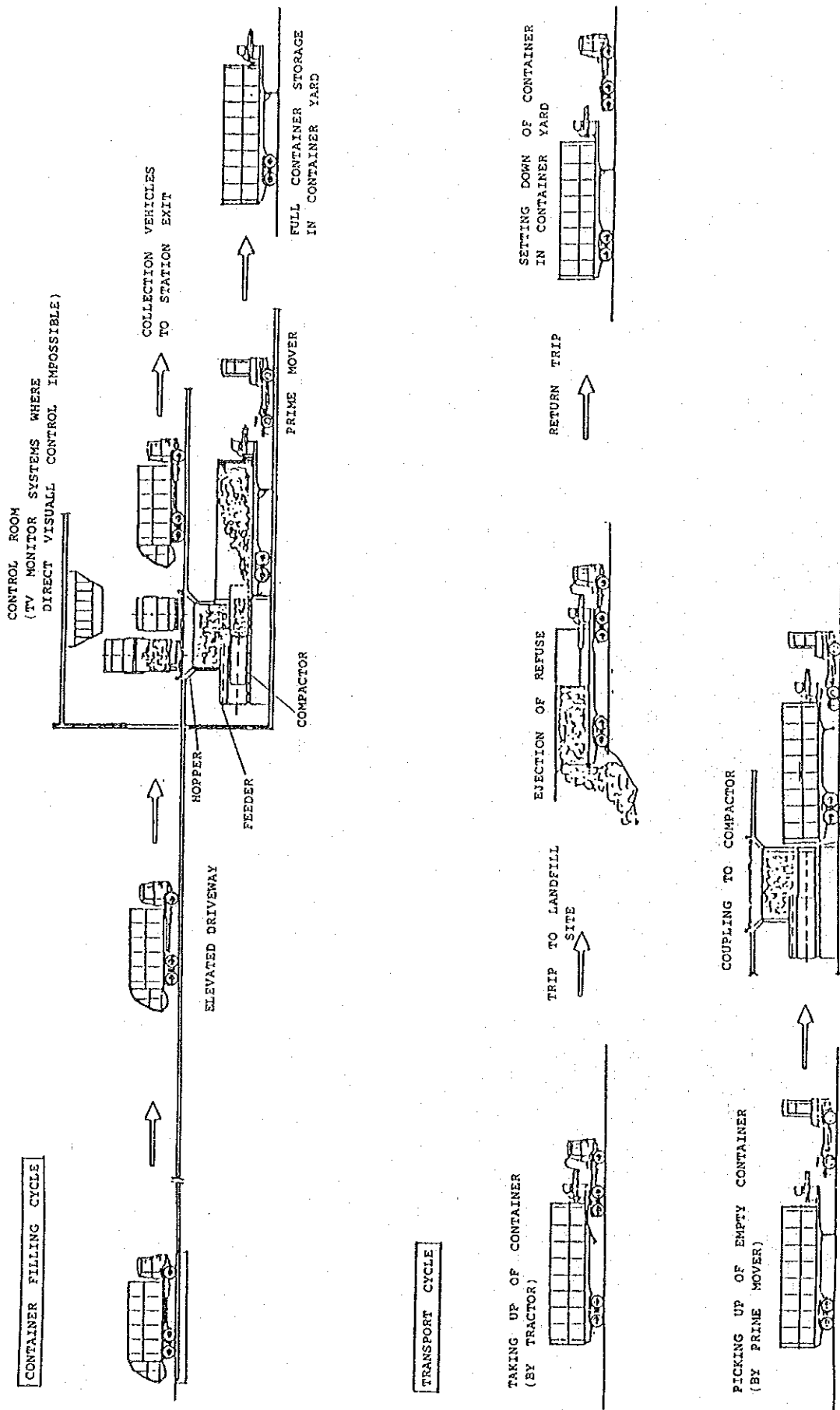


Fig. 4-4-4 Compactor Container System Flow

4.5 Street Sweeping Plan

4.5.1 Basic Policy of Street Sweeping

In principle, all households should be responsible for sweeping the street directly in front of them and pedestrians shall not be permitted to dump waste in the street. However, those streets which are difficult to keep clean by the above alone shall be subject to public sweeping.

4.5.2 Streets to be swept

Protocol Streets	As Protocol streets have a median strip and many places along them where there are no houses, the sweeping cannot be left to the inhabitants. These streets shall, therefore, be subject to public sweeping.
------------------	--

Economy Streets	Those streets whose sweeping cannot be left to the inhabitants shall be subject to public sweeping, as in the case of Protocol streets. Shopping areas in particular shall be subject to public sweeping.
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Other streets	While other streets shall be swept by households, some streets in shopping areas and those to be treated as Protocol streets shall be subject to public sweeping as exceptions.
---------------	---

The streets subject to public sweeping in the year 2005 are estimated to be as follows.

Table 4-5-1 Public Street Sweeping

	85/86	2005*	<u>2005</u> <u>85/86</u>
Protocol	445km	892km	2.0
Economy	196	569	2.9
Others	112	237	2.1
Total	753	1698	2.25

* In 2005, 50% of the total length of Economy streets and 7.6% of the total length of other streets.

4.5.3 Frequency of Street Sweeping

It will be necessary to establish a reasonable sweeping frequency commensurate with the City's financial capability as the cost of the continuation of the current daily sweeping system in the future would be too high. Basically, a sweeping frequency of twice a week should be established based on the premise that the waste dumped by citizens will decrease as they become more conscious of waste-management. Streets in shopping areas should, however, be swept at least once or twice every day.

4.5.4 Street Sweeping Methods

Manual sweeping and mechanical sweeping should be combined.

1) Manual sweeping

(1) Subjects

The subjects of manual sweeping should include the sidewalks of Protocol streets, and also Economy streets and other streets.

(2) Sweeping method

A length of 2,000m should be swept by one person early in the morning.

Teams should consist of six persons, one of which should collect street waste by handcart. A small open truck (2t loading capacity) should be provided to transport the equipment and collected street waste.

PART II

(3) Scheduled rotation sweeping system

The streets will be swept in rotation by the teams according to the schedule determined for each day of the week.

2) Mechanical sweeping

(1) Subjects

Protocol streets

(2) Sweeping method

Sweeping will be carried out at night. The total length to be swept per vehicle shall be basically 50 km/day.

4.5.5 Equipment and Manpower Plan

The following equipment and manpower will be required for street sweeping by the year 2005.

Table 4-5-2 Equipment and Manpower for Street Sweeping

(numbers)		
	Year 2005	Remarks
Manpower	2,312	
Drivers	191	
Management staff	250	
Total	2,753	
Handcarts	331	Small handcart
Open trucks	168	2 ton truck
Mechanical Sweeping cars	23	Vacuum type

4.5.6 Operation Control

1) Working hour control

A sweeping schedule for each day of the week and a time schedule should be established to control the working hours.

PART II

2) Others

The following measures should be taken.

- a. The provision of trash boxes on the streets of shopping areas to reduce the dumping of waste in the Streets.
- b. The determination of a community cleaning day to promote the cleaning of street waste in each community by the citizens.

4.6 Treatment and Disposal Plan

4.6.1 Locations of Disposal Sites

For final disposal, it is planned to construct large scale disposal sites at Bekasi and Tangerang for final disposal and the proposed locations of these disposal sites are as shown in Fig. 4-6-1.

The waste to be disposed of these sites is as follows.

- a. Waste collected by the Dinas Kebersihan (domestic waste, market waste, commercial waste and part of industrial waste)
- b. Directly hauled in waste (market waste, industrial waste, street waste and park waste)
- c. Waste from other cities (Bekasi and Tangerang)

Waste from the following areas shall be disposed of at the Bekasi and Tangerang disposal sites respectively.

Bekasi disposal site:	Waste from Jakarta Pusat, Jakarta Utara, Jakarta Timur and Bekasi
Tangerang disposal site:	Waste from Jakarta Barat, Jakarta Selatan and Tangerang

As it is desirable for the disposal sites to have a large capacity and be as close as possible to the areas from which the waste is collected, efforts must be made to secure the disposal sites within the city.

PART II

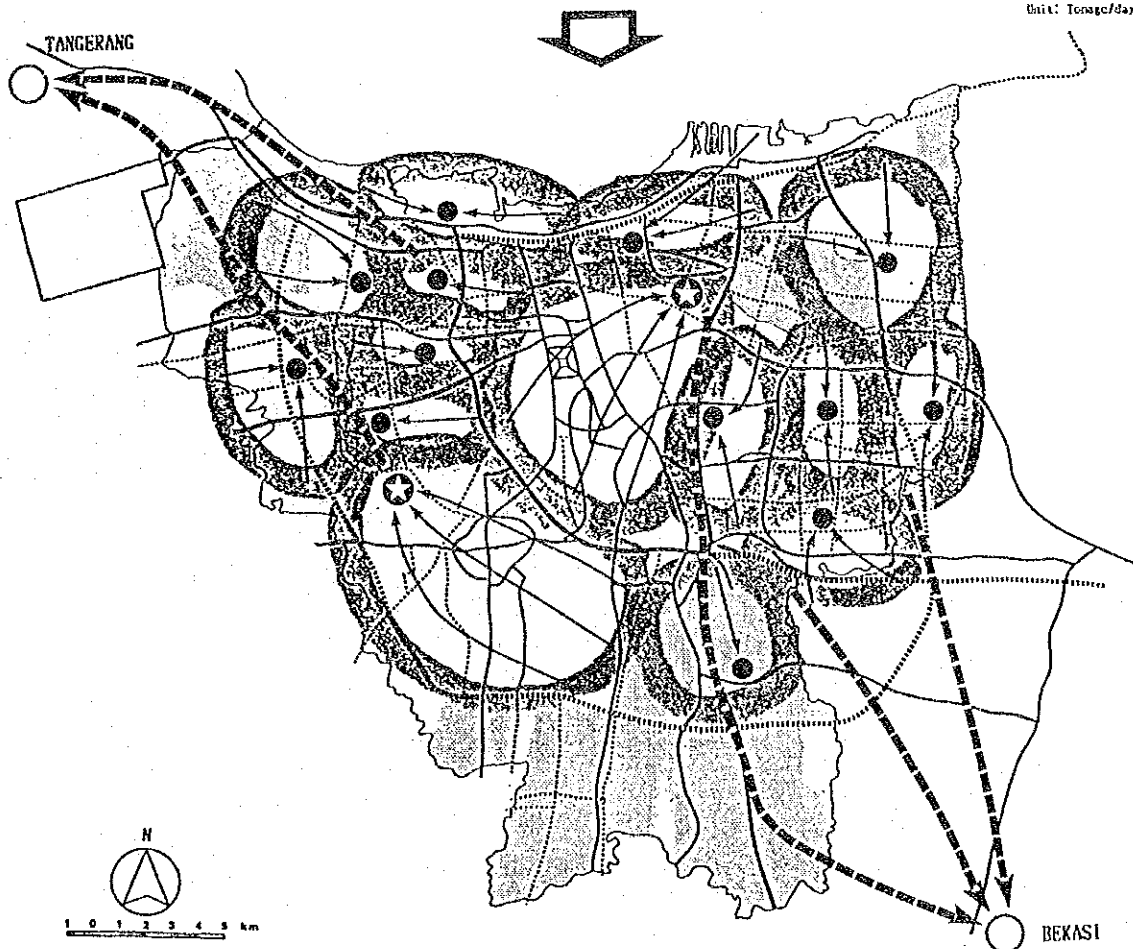
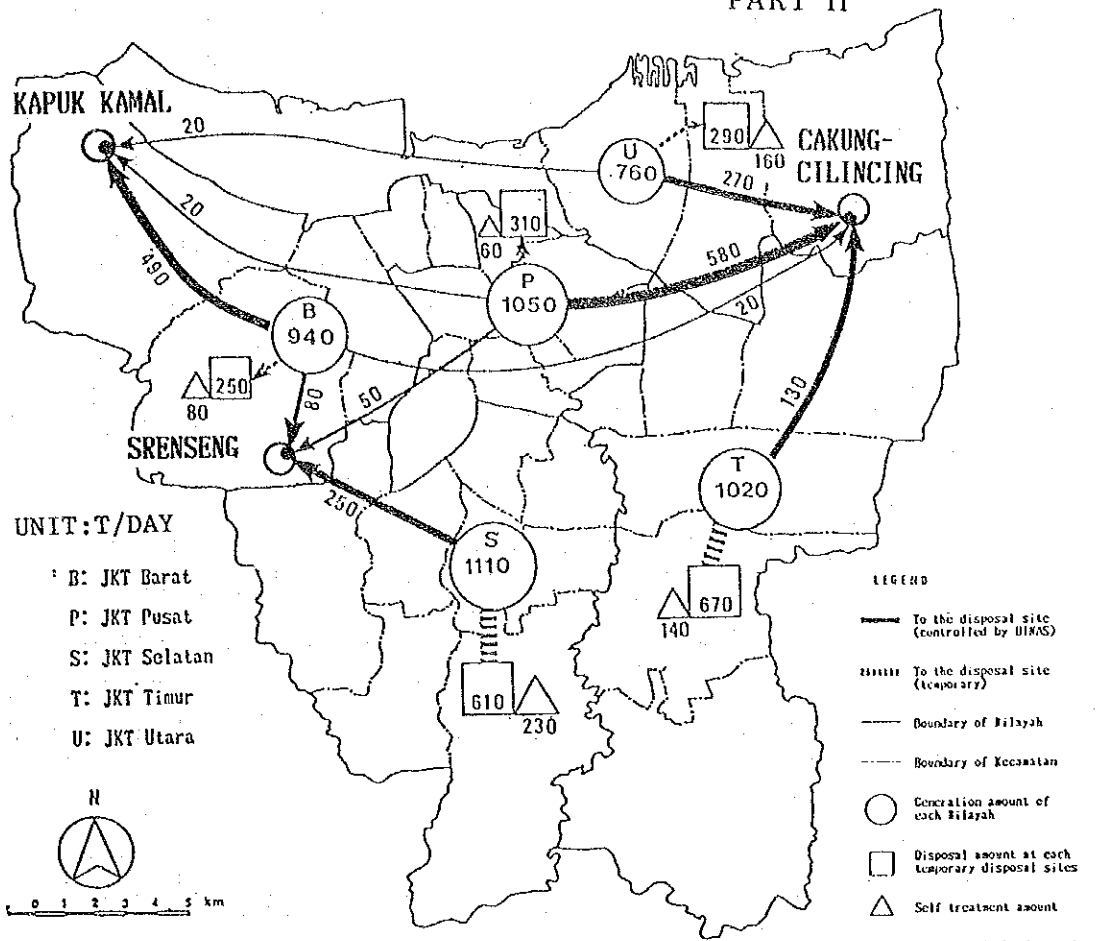


Fig.4-6-1 CHANGE OF FINAL DISPOSAL.

4.6.2 Planned Amount of Waste to be Disposed Of

The planned amount of waste to be disposed of is as shown in Table 4-6-1 and Fig. 4-6-2.

Table 4-6-1 Planned Amount of Waste to be Disposed Of (t/day)

Year	Bekasi Disposal Site	Tangerang Disposal Site	Disposal sites within the city	Total
1988	-	-	5,700	5,700
1990	3,430	-	2,730	6,160
1995	4,165	3,525	-	7,690
2000	4,960	4,320	-	9,280
2005	6,050	5,380	-	11,430

1 year = 365 days

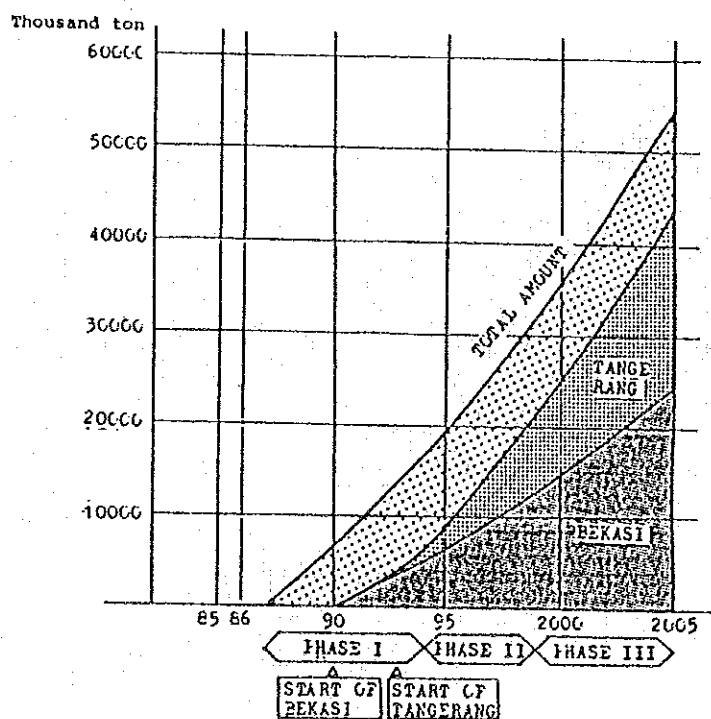


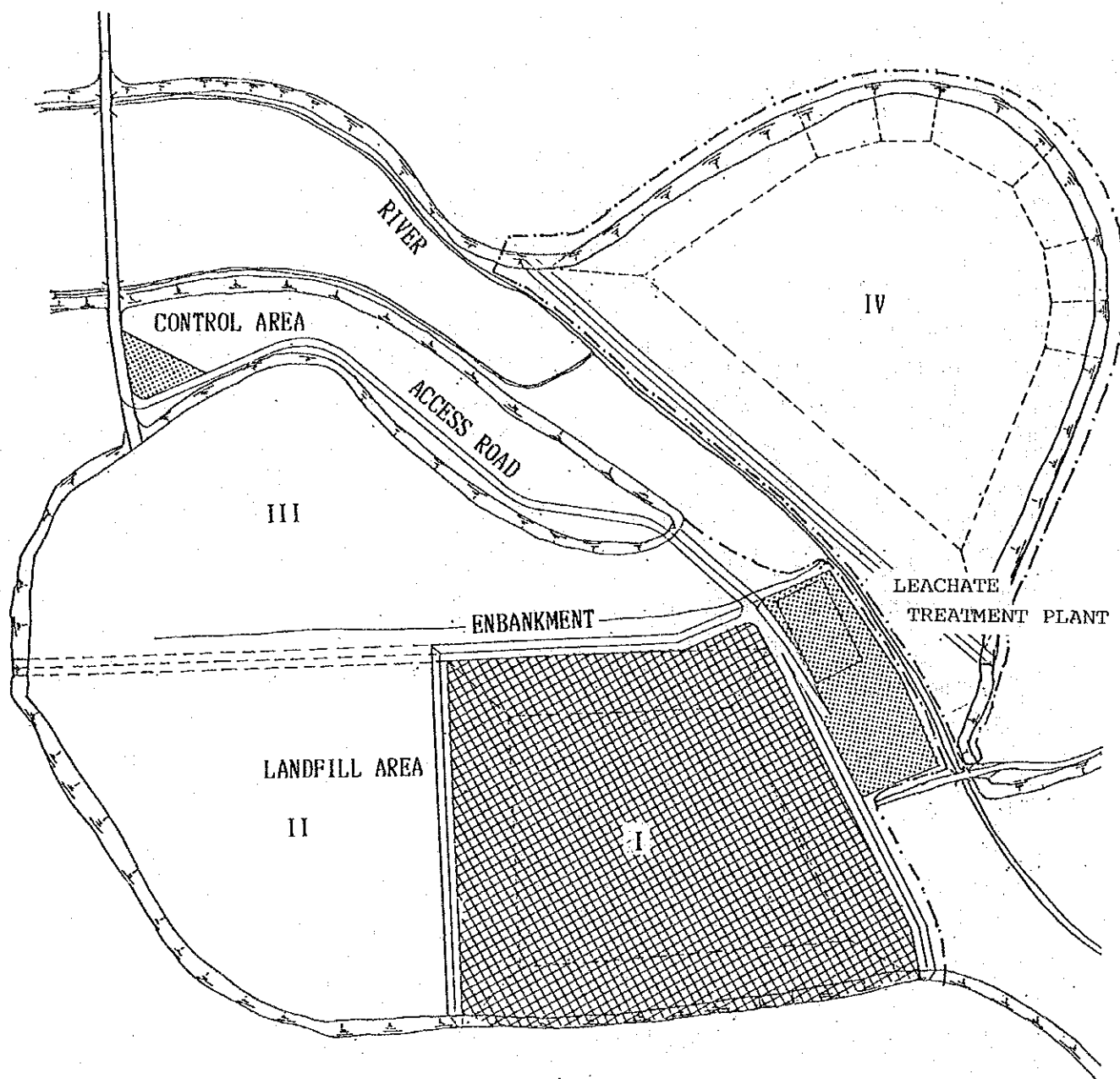
Fig. 4-6-2 Final Disposal Plan

4.6.3 Policy for the Development of Disposal Sites

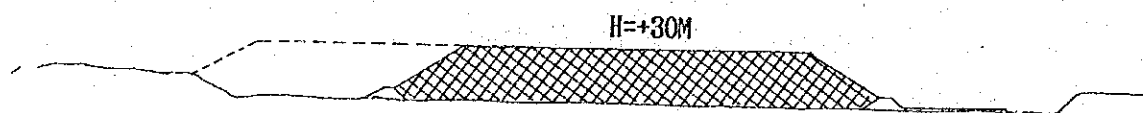
Considerable time will be required to develop the Bekasi and Tangerang disposal sites in view of not only their large scale but also their location at a distance of about 40km from the center of Jakarta. Because of this, the Bekasi Disposal Site shall be developed by 1990 and the Tangerang Disposal Site by 1993 and until then, waste shall be dealt with at the existing disposal sites. The cumulative amount of waste to be disposed of from 1988 until the time when the two new disposal sites become ready for operation is estimated to be approximately 1,000,000 tons, as shown in Fig. 4-6-2.

4.6.4 Outline of Facilities

The Bekasi and Tangerang disposal sites shall be developed as large scale disposal sites in a stepwise fashion and their facilities shall be as outlined in Table 4-6-2. The Bekasi Disposal Site is illustrated in Fig. 4-6-3.



PLAN



CROSS SECTION

Fig.4-6-3 BEKASI DISPOSAL SITE

Table 4-6-2 Outline of Disposal Sites

		Bekasi	Tangerang
Site area	ha	100ha	100ha
Landfill height	m	30m	30m
Mean landfill height	m	23.2m	23.2m
Disposal capacity			
Waste		19.0 million m ³	19.0 million m ³
Covering soil		4.2 million m ³	4.2 million m ³
Total		23.2 million m ³	23.2 million m ³
Daily disposal amount			
1985	t/d	3965 t/d	3725 t/d
2005	t/d	5120 t/d	4070 t/d
Major facilities			
		- Landfill area	- Landfill area
		- Bank	- Bank
		- Drainage	- Drainage
		- Leachate Treatment Plant	- Leachate Treatment Plant
		- Control room	- Control room
		- Truck scale	- Truck scale
Equipment			
		- Bulldozer	- Bulldozer
		- Backhoe	- Backhoe
		- Dump Truck	- Dump Truck
		- Tank Truck	- Tank Truck
		- Passenger car	- Passenger car
		Total 86 units	Total 86 units

4.6.5 Facilities Plan

1) Landfill method and procurement of soil cover

The "sandwich method" of covering every three meter thick waste layer with a 50 cm thick soil layer will be adopted. The final soil covering shall be 1 m thick in consideration of the growth of trees. Nearby soil will be used for covering at the Bekasi Disposal Site soil cover shall be purchased from outside sources at the Tangerang Disposal Site.

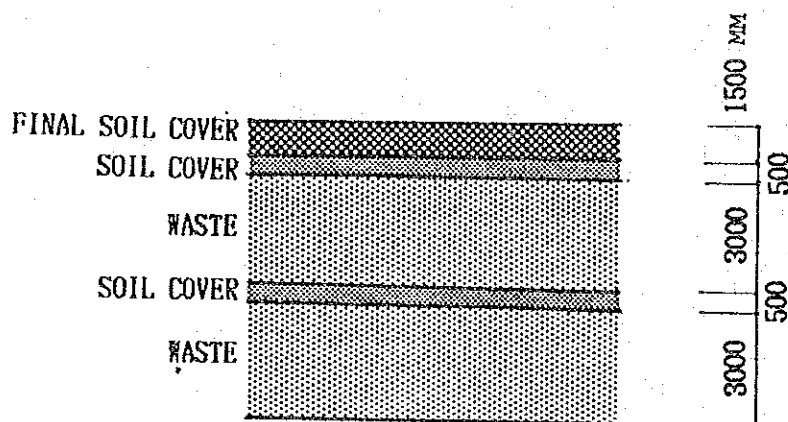
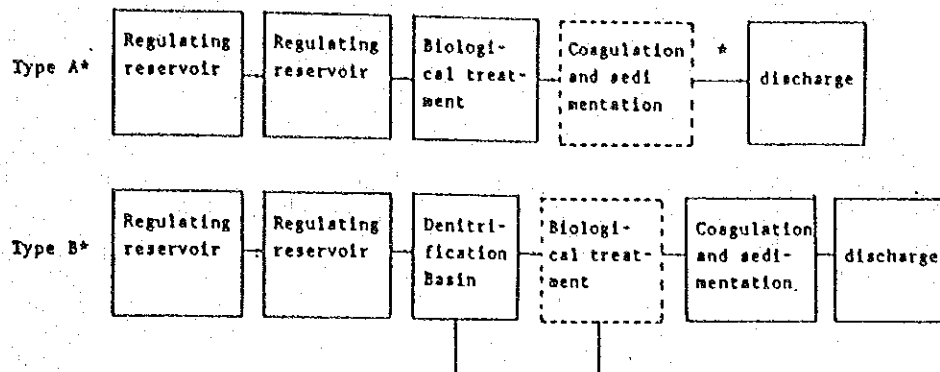


Fig. 4-6-4 Section of Sanitary Landfill

2) Treatment of leachate

Since water is used for agricultural purposes in the neighborhood and downstream of both the Bekasi and Tangerang Disposal Sites, leachate from the sites shall be treated. It is desirable that denitrification be included in the treatment process. However, in view of financial constraints, the decision shall be made with due regard to the timing of construction. The basic treatment flow is as shown in Fig. 4-6-5.

Fig. 4-6-5 Flow of Treatment



* The selection of Type A or Type B as well as coagulation and sedimentation shall be studied prior to implementation

Judgement on the danger of groundwater pollution must be made after investigation of the geological conditions and the utilization status of the groundwater in the neighborhood of both disposal sites. It is however, safer, to take this possibility into account. In view of the above, the quality of groundwater in the vicinity of the disposal sites should at least be monitored.

3) Utilization of reclaimed land

The thickness of the filled waste shall be approx. 30 m in view of reclaiming land for effective use. For this reason, the filled up areas would have to be left standing for a period of 10 to 20 years before they can be utilized. In view of the characteristics of the land thus reclaimed, its use for parks or recreation areas will be considered.

An example of filled up disposal sites being used for parks is given in Fig. 4-6-6.



TSURUMI GARDEN OF OSAKA CITY IN JAPAN

Fig.4-6-6 EXAMPLE OF THE ULTIMATE USE OF THE COMPLETED SITE

PART II

4.6.6 Organization and manpower for administration of disposal sites

The disposal site carries out waste reception control, waste disposal operation, soil covering operation, operation and maintenance of the leachate treatment plant and maintenance of equipment. To administer all these functions, an organization of the kind suggested in Fig. 4-6-7 should be established. The necessary manpower required by the year 2005 is 157 persons at Bekasi and 117 persons at the Tangerang Disposal Sites, totalling 274 persons.

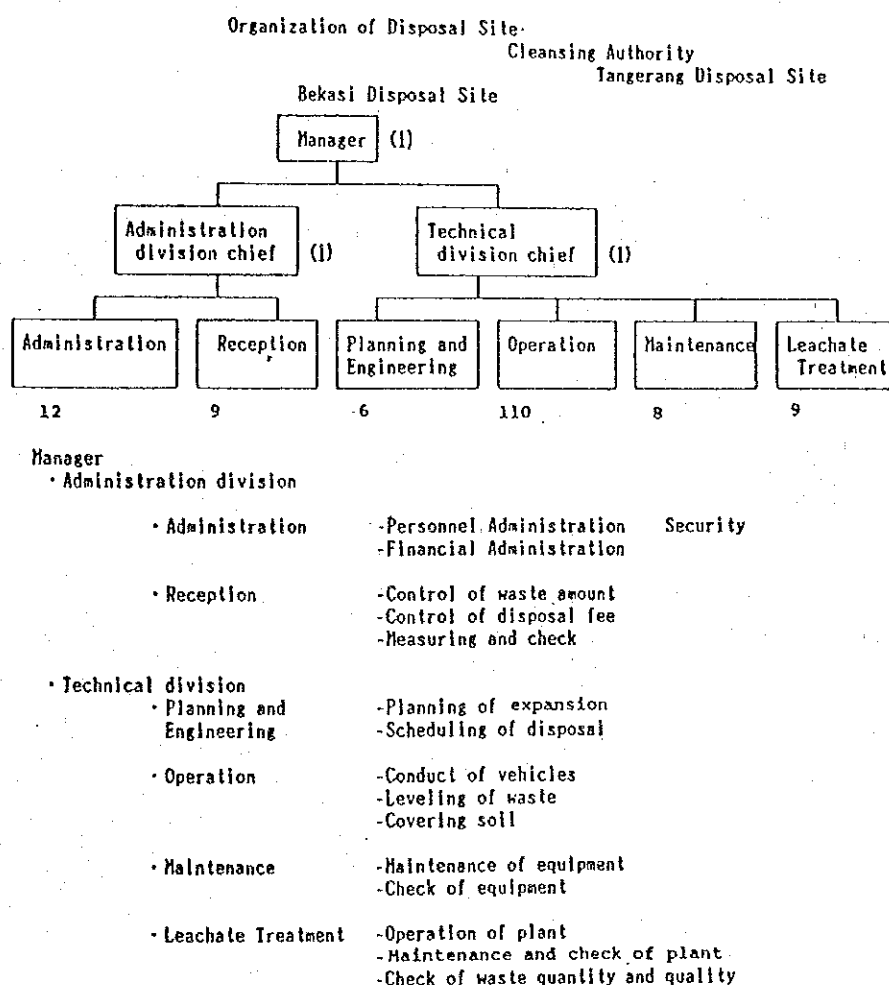


Fig.4-6-7 Organization of Disposal Site

PART II

4.7 Maintenance Plan

4.7.1 Workshop Improvement Policy

The maintenance work at the sub-workshops of each of the five Suku Dinas Kebersihans shall be upgraded and the maintenance work at the main workshop of the Dinas Kebersihan shall also be strengthened in view of conducting whatever work cannot be dealt with at the formes.

4.7.2 Sub-workshop Improvement Plan

1) Functional role

Sub-workshops shall primarily conduct preventive maintenance.

a. Daily checking and repair

Performed by drivers at the motor pool before commencing work. If there is any anomaly or malfunction, the equipment shall be repaired at the sub-workshop.

b. Periodical checking and maintenance

Equipment shall be checked and maintained at the sub-workshop at intervals of 50, 150, 300 and 600 working days.

c. Emergency maintenance

Sub-workshops shall mainly carry out emergency maintenance, such as the replacing of faulty components. If the work is beyond the capability of the sub-workshop, the repair work shall be passed to the main workshop.

d. Others

Sub-workshops shall carry out cleaning, painting and welding in conjunction with periodical maintenance and emergency maintenance.

PART II

2) Personnel

The following personnel shall be assigned to each sub-workshop to attend about 300 motor vehicles.

Table 4-7-1 Personnel for Sub-Workshop

Chassis	22
Component repair (light repair)	6
Engine/power train component	3
Tyre repair	4
Welding/machining	2
Painting	6
Office staff	5
<hr/>	
Total	48

3) Provision of equipment

Each sub-workshop shall be divided into a chassis repair area, a unit repair area and a tool room and shall be provided with the necessary equipment.

4.7.3 Main Workshop Improvement Plan

1) Functional role

The main workshop shall perform maintenance work centering on the overhaul of truck chassis and each component. The main workshop shall also undertake whatever emergency repairs are beyond the capability of the sub-workshops. The general content of the work is described below.

- a. Truck chassis overhaul (overhaul capacity 16 vehicles per month)
- b. Emergency repair (repair capacity: 32 vehicles per month)
- c. Component overhaul (overhaul capacity: 25 units each per month)

* Engine: overhaul, regeneration and testing

* Radiator: repair and testing

PART II

- * Fuel injection pump: overhaul and testing
- * Power train components: overhaul and testing
(transmission, clutch)
- * Front and rear axles and suspension: overhaul and testing
- * Hydraulic and steering components: overhaul and testing
- * Electric components: overhaul and testing of starter, generator
- * Tyre: overhaul, partial repair and regeneration
- * Brake: overhaul
- * Battery: Charging, repair

PART II

2) Personnel

The following personnel shall be assigned.

Tabel 4-7-2 Personnel

Chassis repair group	36
Engine repair group	18
Radiator group	2
Fuel injection pump group	2
Engine performance testing group	2
Power train component group	4
Hydraulic component group	4
Electric component group	4
Tyre group	4
Brake group	2
Welding and fabrication group	8
Machine shop group	4
Painting group	3
Automobile inspection group	4
Tool room/parts warehouse	8
Staff	24
Total	120

3) Provision of equipment

Equipment enabling the maintenance of 1,500 to 2,000 motor vehicles shall be provided.

4) Others

An maintenance company shall be employed for maintenance of heavy equipment other than daily and periodical checking and reconditioning.

4.8 Organization Plan

4.8.1 Division of Responsibility for Solid Waste Management

The ultimate responsibility for solid waste management rests with the municipality that is DKI Jakarta, but the Dinas Kebersihan is responsible for the day to day running of operations.

The foregoing shall not be construed as excluding collection and haulage by RT/RW and/or private waste collectors, however, in view of the environmental policy, these private activities shall be placed under the guidance and supervision of the Dinas Kebersihan.

Regarding market, canal, and park waste, administrators of each respective facility shall be responsible for collection while the Dinas Kebersihan shall be responsible for treatment and disposal of this waste.

The transfer stations, treatment and disposal facilities shall be administered by the Dinas Kebersihan. The present small scale disposal sites will presumably cease to exist in 2005 due to the limitations on land use but special waste, such as industrial waste and hospital waste, shall be treated and disposed by the dischargers.

4.8.2 Major Functions and Priority Targets

The following may be listed as the necessary major functions of the Dinas Kebersihan for the execution of solid waste management befitting Jakarta's status as an international city.

- a. Formulation of a long-term plan for solid waste management
- b. Periodical collection
- c. Sanitation of treatment and disposal
- d. Construction of facilities
- e. Collection of fees
- f. Education of inhabitants and guidance of RT/RW

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- g. Approval, guidance, and supervision of private waste collectors
- h. Operation and management system
- i. Technological development

The aim of the organization is to carry out the above functions efficiently. The basic target in planning the organization is to alter the organizational form to one which responds to the each local problems and to enhance managerial and technological independence (including financially and also with regard to personnel administration).

The organization plan should be established according to the following four points which may be considered priorities.

- a. Implementation of periodical collection
- b. Implementation of sanitary treatment and disposal
- c. Securing of necessary financial resources
- d. Prohibition of tips

4.8.3 Organizational Structure

The proposed organizational structure is as shown in Fig. 5-8-1 (consisting of 9 divisions and 38 sections).

The fundamental difference between the old and new organizational structures lies in the separation of the Suku Dinas Kebersihans from the Wilayahs, making each of them responsible for cleansing their own areas.

The Dinas Kebersihan's staff divisions are grouped into two headquarter staff divisions, supporting the respective operating divisions.

Furthermore, since numerical control and data processing is anticipated to become significant in the future, it will be necessary to establish dealing with these.

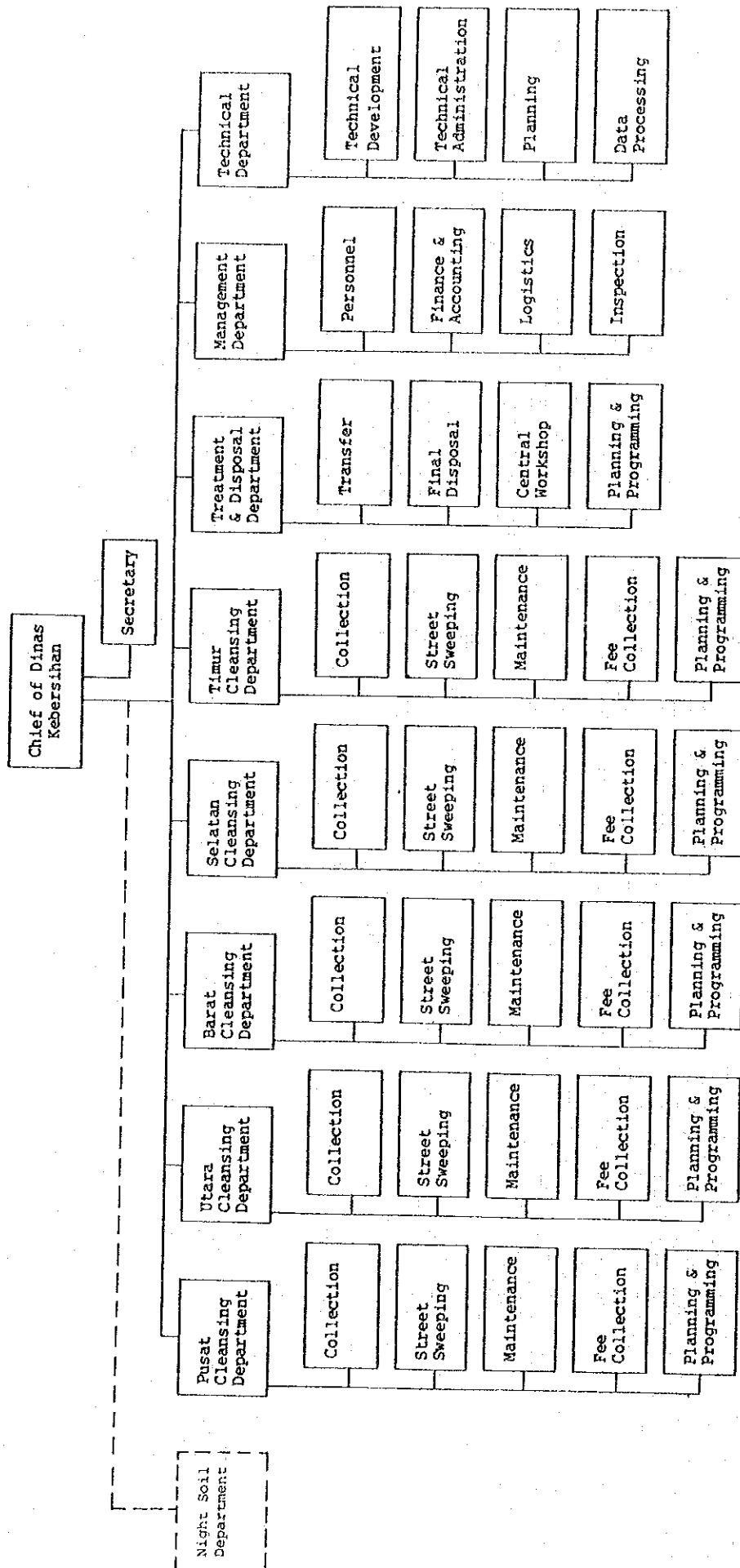


Fig. 4-8-1 Organization Chart

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The major functions to be performed by each section are shown in Fig. 4-8-2.

4.8.4 Manpower Plan

It is estimated that the manpower size in the year 2005 will total 10,278 persons, about 1.5 times the current manpower. The planned assignment of the manpower in 2005 is as shown in Fig. 4-8-3. The manpower of the operating divisions is very much increased reflecting the increased waste amount. The number of fee collectors is also increased when fees will be collected directly from inhabitants.

The manpower of the administrative is, however, greatly reduced.

4.8.5 Organizational Improvement Process

It is desirable that the organizational form will be changed prior to commencing the improvement of collection activities.

The number of personnel shall be increased in a stepwise fashion for each stage of the collection service improvement program. The manpower expansion program which is in accordance with the stage plan discussed later, is as shown in Table 4-8-1.

In regard to fee collection, about 20% of the fee collectors required by 2005 shall be secured in advance in all Wilayahs so that the best results may be attained by the collection systems at least for the time being.

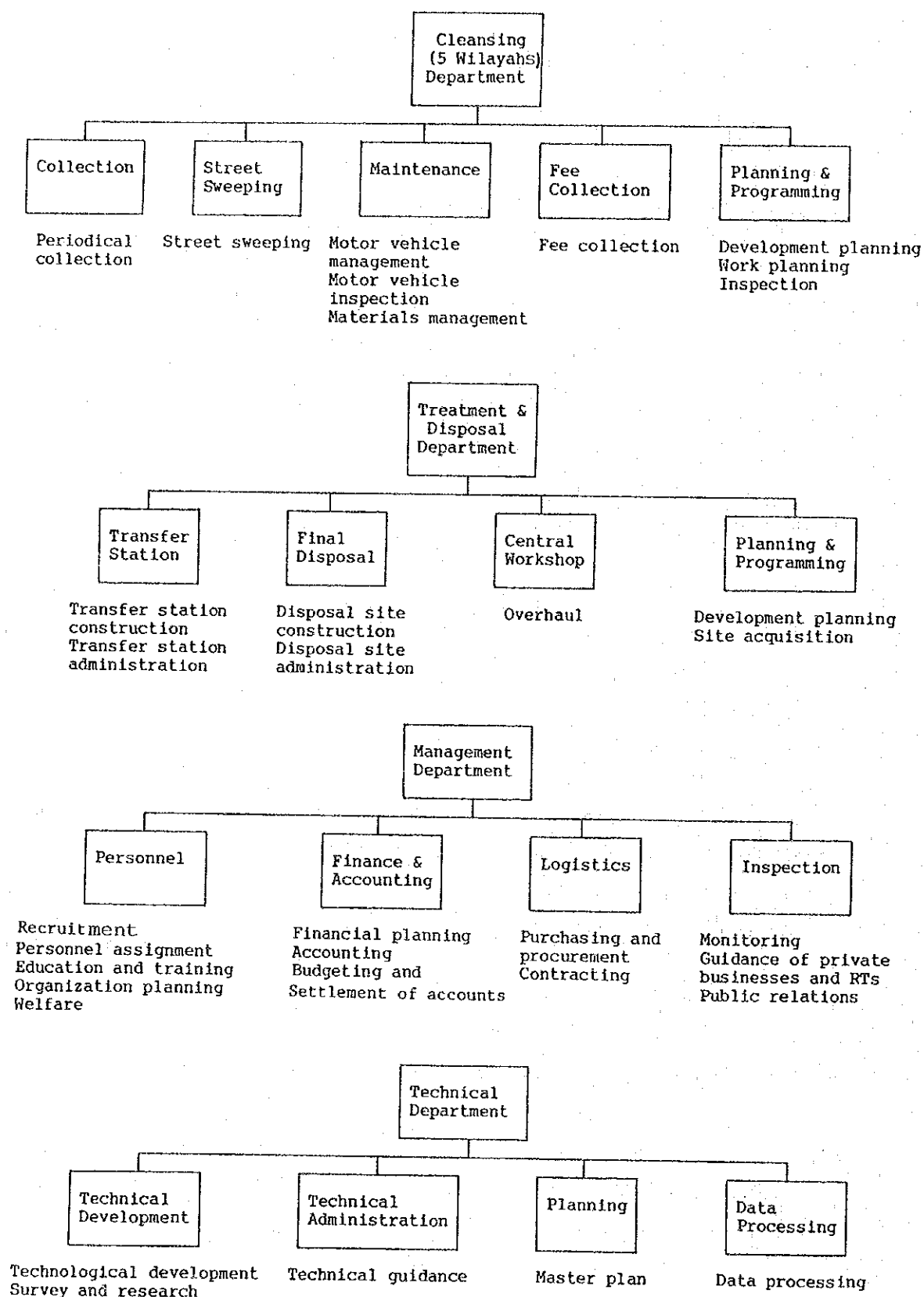


Fig. 4-8-2 Major Functions

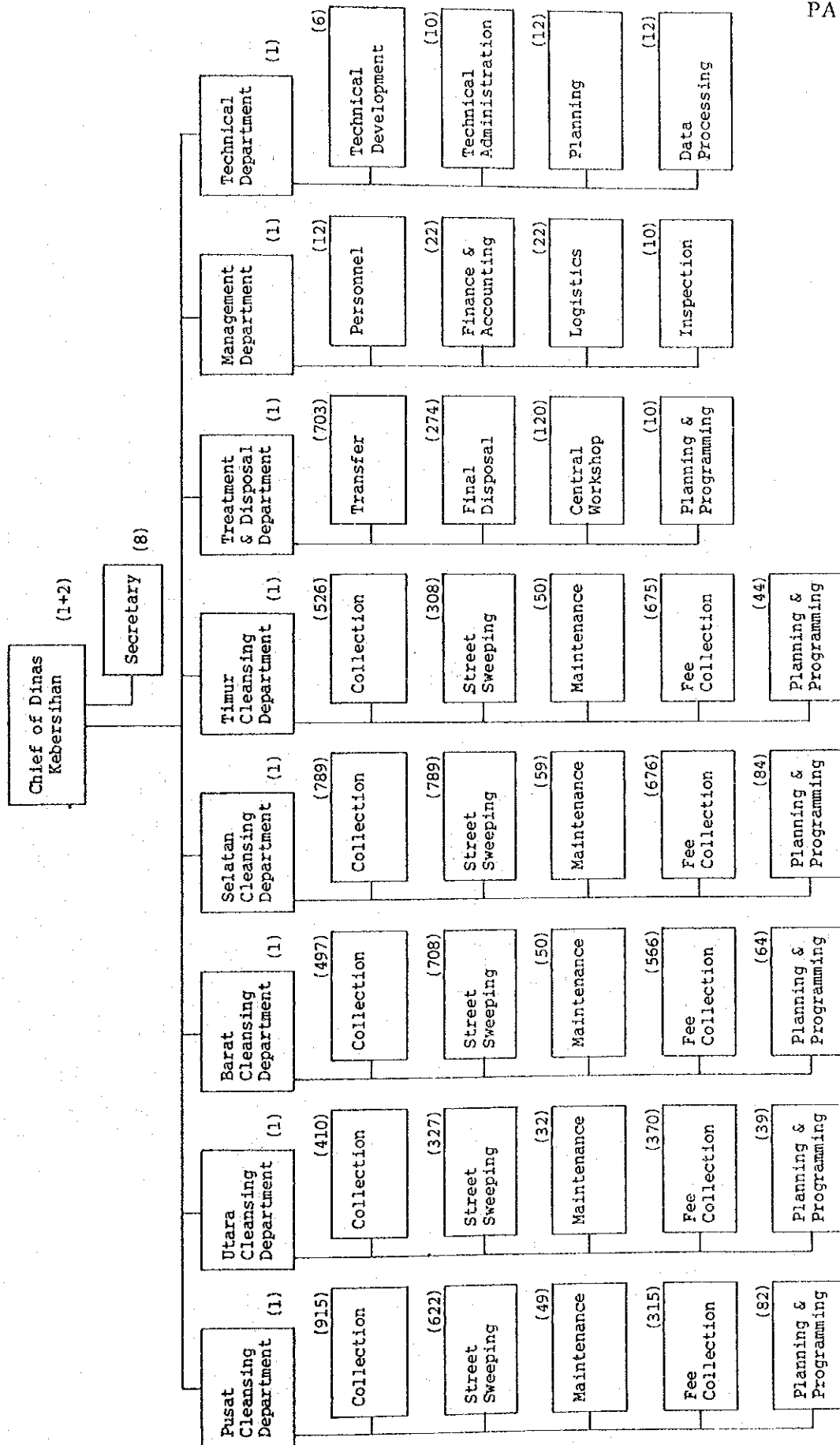


Fig. 4-8-3 Planned Assignment of Manpower in the year 2005

Table 4-8-1 Manpower Schedule

	(persons)			
	1990	1995	2000	2005
Chief Staff	991	700	410	119
Operation Staff	687	712	465	584
Inspectors	363	511	472	536
Drivers & Operators	923	1,334	1,612	1,931
Crews	1,562	1,932	1,507	1,729
Workers	36	72	102	141
Sweepers	2,529	3,007	1,976	2,312
Mechanics	240	268	296	324
Fee Collectors	792	1,680	2,385	2,602
Chiefs & Secretaries	11	11	11	11
Pusat Cleansing	1,485	1,666	1,823	1,984
Utara	823	899	1,035	1,179
Barat	1,613	2,523	1,654	1,886
Selatan	1,465	1,854	2,119	2,398
Timur	1,344	2,037	1,457	1,604
Treatment & Disposal	402	537	727	1,108
Managment	588	413	239	67
Technical	392	276	160	41
Total	8,123	10,216	9,225	10,278

4.8.6 Welfare

It is necessary to prohibit the acceptance of tips in order to modernize cleansing activities. This, however, cannot be accomplished merely by the use of discipline and it will be necessary to improve the wage level by incorporating special allowances, etc. in the wage system and to make the job more attractive by reducing the working hours, providing shower facilities and improving welfare conditions in general.

4.9 Financial Plan

4.9.1 Financial Requirement

Accumulative total investment of Rp.456 billion is necessary up to 2005 in order to implement the Conceptual Master Plan, as shown in Table 4-9-1, of which, Rp.263 billion is required for the solid waste management improvement project, including the improvement of waste collection services in the entire city of Jakarta, construction of transfer stations, adoption of sanitary landfill as well as street sweeping improvement and development of workshops.

On the other hand, however, operation and maintenance expenses required to conduct solid waste management activities will increase annually, as shown in Table 4-9-2, and will approach Rp.26 billion by 2005. They will reach to Rp.50 billion including depreciation and Rp.63 billion with interest repayment.

The characteristics of solid waste management are that it periodically requires additional investment and replacement investment due to the increased amount waste to be disposed of in accordance with population growth and the short life expectancy of vehicles and other equipment which is only seven years. This additional and/or replacement investment is necessary regardless of the improvement project. Here, however, the replacement investment required prior to launching of the improvement project and the additional and/or replacement investment required after improvement of the collection system have been included, totalling an investment requirement of Rp.197 billion by 2005. This trend is expected to continue even after 2005 and the same amount of Rp.197 billion will be required between 2006-2014.

The population that will benefit in each phase and the capital investment and operating cost per capita are given in Table 4-9-3.

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Talbe 4-9-1 Investment Plan

(unit: Rp.billion)

	Phase I (1989-1995)		Phase II	Phase III	Total
	1989-1992	1993-1995	1996-2000	2001-2005	
Projects					
Collection Improvement	Pusat	Around of	Other		
Transfer Station	Large 1No.	Pusat Large 1 Small 1	area Small 10 Bekasi 2nd	Small 3 Bekasi 3rd	
Final Disposal Site	Bekasi 1st	Tangerang 1st	2nd	3rd	
<hr/>					
Collection Improvement					
-Investment					
Vehicle	10.6	26.8	25.0		62.4
Depot	0.7	3.1	3.2		7.0
Container					
-Replacement & Supplement					
Existing System	25.3	1.1			26.4
Proposed System		0.7	17.8	80.0	98.5
<hr/>					
Transfer Station					
-Investment					
Land Aquisition	1.2	1.9	5.1	0.9	9.1
Construction	3.0	4.5	10.0	3.0	20.5
Mechanical Equipment	12.7	14.2	0.3		27.2
Transfer Vehicle	4.9	7.1	10.5	2.3	24.8
-Replacement					
Transfer Vehicle			5.6	21.7	27.3
<hr/>					
Final Disposal Site					
-Investment					
Land Aquisition	3.0	3.0	6.0	9.0	21.0
Construction	7.8	8.8	12.6	16.5	45.7
Facility	2.9	2.9	2.8	2.8	11.4
Heavy Equipment	4.7	3.4			8.1
-Replacement					
Heavy Equipment			9.8	16.7	26.5
<hr/>					
Street Sweeping					
-Investment					
Mechanical Sweeper	0.9	1.6	1.6		4.1
Open Truck	0.7	1.3	1.1		3.1
-Replacement					
Vehicle			1.6	7.2	8.8
<hr/>					
Work Shop					
-Investment					
Construction	1.0	1.9	1.9	2.2	7.0
Mechanical Tool	2.4	2.9	2.9	3.2	11.4
-Replacement					
Mechanical Tool				5.3	5.3
<hr/>					
Total	81.8	85.2	117.8	170.8	455.6
<hr/>					
Investment for the Project	56.5	83.4	83.0	39.9	262.2
Investment for Replacement	25.3	1.8	34.8	130.9	192.8

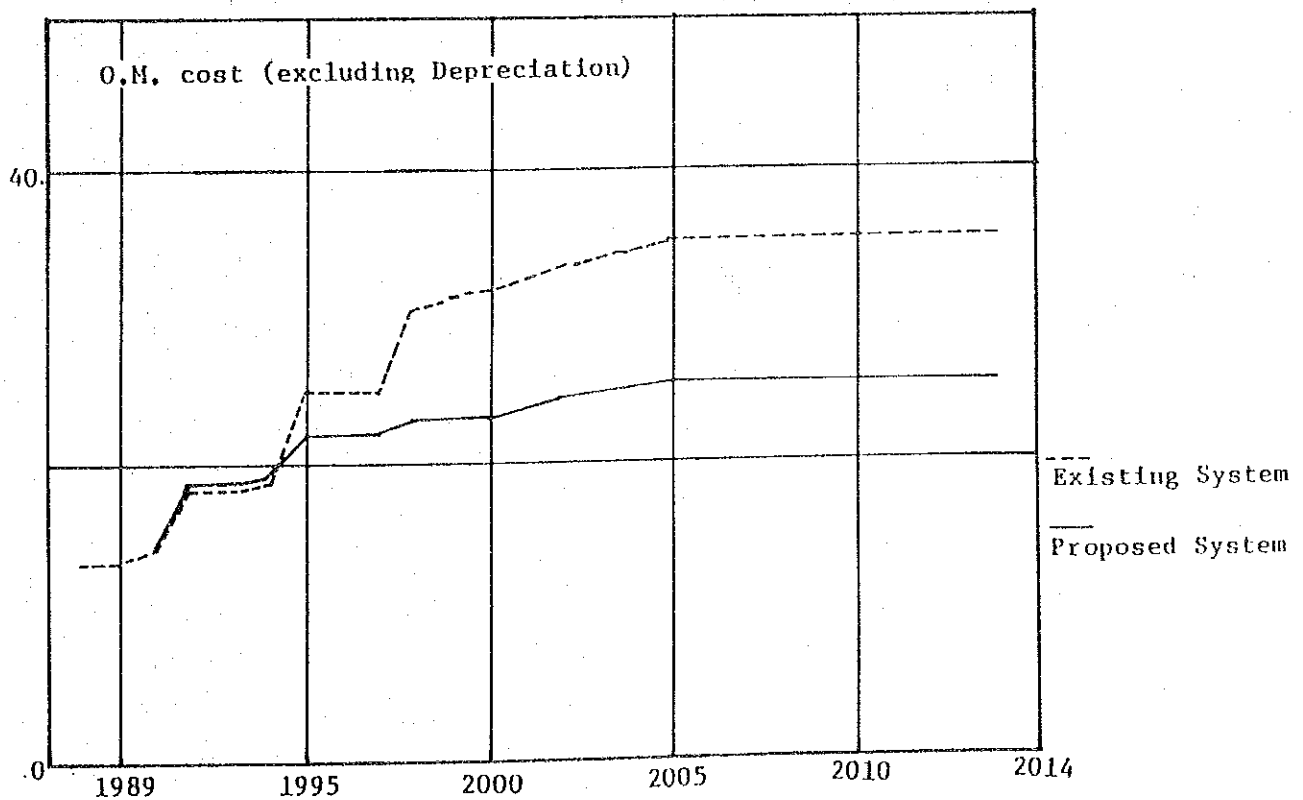
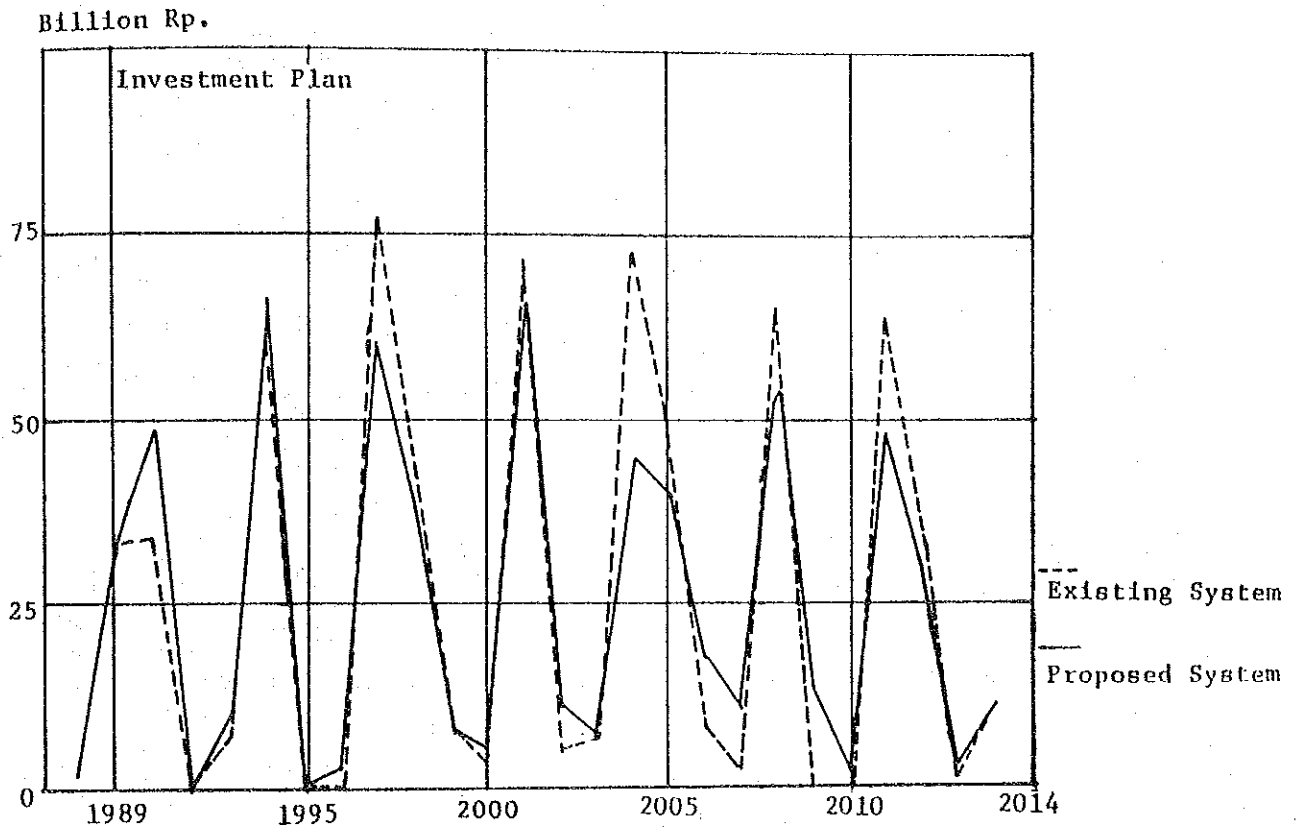


Fig. 4-9-1 Comparison between Existing System & Proposed System

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In any event, these financial requirements are far too large compared to the current financial scale. The current state of solid waste management, however, is merely the collection of waste and its dumping at vacant lots and its treatment or disposal in a sanitary way is not included. An indispensable precondition, therefore, is waste disposal by the sanitary landfill method instead of the conventional method of open dumping in view of the environmental conditions of DKI Jakarta. Another unavoidable precondition is the location of the final disposal sites at more distant places in view of the land use condition in DKI Jakarta.

If the current system of collection and transportation is continued (hereinafter referred to as continuation of the existing system) with considering the foregoing two factors, a total investment amount of Rp.476 billion will be necessary by 2005. This investment amount will not differ much from that proposed in the Master Plan. During the subsequent 2006 - 2014 period, however, an additional/replacement investment of Rp.204 billion will be necessary.

The amount of investment up to 2014 is initially larger for the proposed system than for the continuation of the existing system because the proposed system calls for advance investment for the transfer station, as can be seen in Fig. 4-9-1. As continuation of the existing system will require additional/replacement investment for collection vehicles in the latter half of the period, the proposed system will effectively will result in a larger saving in the investment amount as much as Rp.1 billion on average per year. As far as the annual cost of operation and maintenance is concerned, Rp.35 billion will be necessary in 2005 (Rp.62 billion including depreciation) for the continuation of the existing system, which is a financial requirement as much as 1.24 times that of the proposed system.

Furthermore, construction of a transfer station will reduce the haulage distance of the collection vehicle and improve the efficiency of waste collection, through the adoption of a rational collection system.

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In other words, the reduction of cycle times makes possible two or three trips in a day from only one trip of collection vehicle. It would reduce number of collection vehicles and financial burden also.

If these savings in the collection cost are considered to be benefits, the economic advantage of constructing a transfer station would be very large despite of large initial investment. (The EIRR for the construction of a transfer station exceeds 6.3%, which is reasonable enough for a BHN type of project such as solid waste management.)

In addition, for considering the long term financial requirements, it was assumed that the waste amount to be disposed of and the revenue and expenditure after 2005 would be the same as the 2005. The financial requirements for the years upto 2014 were studied in consideration of the repayment period on overseas loans.

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Table 4-9-2 Operation Cost of Conceptual Master Plan

(unit: Rp. billion)

	1990	1995	2000	2005
Annual Cost				
Depreciation	6.1	17.9	21.9	23.8
O. & M. Cost				
Personnel Cost	10.1	12.2	11.4	12.4
Maintenance Cost	2.6	6.6	7.8	8.4
Fuel & Others	1.2	3.3	4.4	5.1
Sub Total	13.9	22.1	23.6	25.9
Interest*	0.0	6.3	10.3	13.3
Total	20.0	46.3	55.8	63.0

* Interest Rate: Foreign Loan 4%
Local Loan 5%

Table 4-9-3 Population served and Cost per Capita

	Phase I-A (-1992)	Phase I-b (-1995)	Phase II (-2000)	Phase III (-2005)
Area	Pusat	Pusat + around area	Whole city	Whole city
Population(No.1,000)	8,928	9,950	10,874	12,000
Population service & beneficiaries	1,397	6,745	10,974	12,000
Pusat	1,397	1,401	1,404	1,409
Utara, Selatan	-	5,344	5,958	6,573
Barat, Timur	-	-	3,612	4,018
Investment for the Project (Rp. billion)	56.5	83.4	83.0	39.9
per capita (Rp. thousand)	40.4	20.7	20.3	21.9
Incremental Inv. per capita	40.4	15.6	19.6	38.9
Investment for Replacement (Rp. billion)	25.3	1.8	34.8	130.9
Operation cost for the Project (Billion Rp.)				
Excluding depreciation	11.0	18.3	23.6	25.9
Including depreciation	16.6	32.8	45.5	49.7
per Capita (Thousand Rp.)				
Excluding depreciation	7.8	2.7	2.2	2.2
Including depreciation	11.9	4.9	4.1	4.1

4.9.2 Establishment of Targets

As long as solid waste management is an indispensable service for urban life and aims at the maintenance of an environmental standard befitting an international city, it is expected that the source of revenue should be secured for the expenses required. As city services tend to expand easily, however, it is important that beneficiaries clearly understand that they must pay for their share of the service, and a rational and low-cost waste collection and disposal system should be established.

In particular, if the administration intends to convert the Dinas Kebersihan into a public corporation (Cleansing Authority) in the future, the establishment of an autonomous revenue source is necessary. In other words, it must be made clear to all that the cost necessary for solid waste management is to be financed by all households and enterprises (regardless of whether they are public or private) who discharge waste.

It is believed that the administration will aim at a 100% self-financing rate for 2005. In consideration of the fact that the current rate of actual fee collection is extremely low and that a preparatory period will be necessary to change the tariff structure, however, it is important that a minimum attainable level of self-financing up to 1995 should be established as a target of the financing plan.

The level at which the cost of operation and maintenance can be self-financed by the fees collected in 1995 will be aimed. As the target tariff schedule and fee collection rate described later show, this target is attainable with reasonable effort. If efforts are concentrated in collecting fees for special services, such as door-to-door collection and the special collection, it might even be possible to collect fees in an amount over and above the target.

Planned targets

	Self-financing rate	Fee collection rate
1992	24%	30%
1995	30%	45%
2000	96%	90%
2005	100%	90%

In contrast to the above, the target of fee collection rates for the year 2000 and thereafter are considerably higher than Indonesia's actual tax collection performance in the past. However, these targets must definitely be attained if the outstanding balance of loans is to be reduced in the future even with periodical additional/replacement investment. In this sense too, the development of a fee collection system which can establish autonomous revenue sources by 1995 is an important target.

In any event, the following secondary targets must be established in order to attain the foregoing basic targets.

- a. Formulation of a rational and low-cost solid waste collection and disposal plan
- b. Disclosure and termination of informal money flow
- c. Establishment of a tariff schedule commensurate to the services provided and establishment of fee collection system
- d. Improvement of fee collection efficiency

Regarding a. above, it will be necessary to adopt the rolling system of reviewing and adjusting the plan, which will be based on the proposed Master Plan coping with the improvements of service and the changes in operating environment in every few years. For this purpose, an attempt shall be made to induce a thoroughgoing numerical control system and the necessary information processing system. It will also be important to enforce a thoroughgoing system of operation control.

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Informal money flow in b. above is the cause of the current service irregularity and must be terminated at once. To do so, it will be necessary to prohibit workers from collecting the fees and to gradually shift to the system of collecting fees from households and enterprises to collection through bank transfer. In this sense, a change of system to collect waste management fees by adding a surcharge on electric bill is necessary.

At the same time, it will be necessary to make solid waste management an attractive by raising the wage level and improving the working conditions.

Regarding c. above, the amount of solid waste by each form of service and the respective costs and the actual amount of fees collected must be periodically analyzed. In addition, a system whereby citizens' complaints can be reported, such as complaints concerning irregular service, must be established in order to be well-informed.

Regarding d. above, banks should be positively utilized, and the first three points should be improved so that a shift to a surcharge on the electric bill for fee collection can be made at the earliest possible time.

4.9.3 Composition of Financial Resources

Financial resources in 2005 should be composed in proportion to the waste amount collected and disposed of based on the principle that waste dischargers pay their share of the cost of waste management.

Burden on households

The expenses incurred in the collection and disposal of waste discharged from households should be covered by the fees collected from the inhabitants.

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Burden on enterprises

The expenses incurred in the collection and disposal of waste discharged from shops and factories, etc. should be covered by the fees collected from enterprises. This also includes the amount of commercial waste mixed with the domestic waste collected by other than the door-to-door service.

Public burden

The expenses incurred in the collection and disposal of waste discharged from public establishments, as well as wastes collected from streets, rivers, canals and parks, shall be paid by the respective responsible administrative body. In other words, the expenses shall be appropriated from tax revenues.

The respective amount to be borne by each of the above-mentioned, based on the waste amount and waste management cost estimated for 2005, is as shown in Table 4-9-4. The proportional ratios are roughly as follows.

Burden on households	55%
Burden on enterprises	35%
Public burden	10%

The expenses here include additional (supplementary)/replacement investment costs.

Table 4-9-4 Estimated Burden in 2005

	Collection	Transfer Station	Treatment & Disposal	Street Sweeping	Total	Burden
	(10 ⁶ Rp)	(10 ⁶ Rp)	(10 ⁶ Rp)	(10 ⁶ Rp)	(10 ⁶ Rp)	Rp/ton
Households	13,844	6,804	8,143		28,791	15,500
Markets	1,680	825	987		3,492	15,500
P.D.Pasar	-	1,451	1,737		3,188	8,000
Commercial	4,850	2,384	2,853		10,087	15,500
Industry	1,219	599	718		2,536	15,500
Industry (Self-Transfer)	-	173	207		380	8,000
Streets	-	133	30	4,517	4,680	128,200
Total	21,593	12,369	14,675	4,517	53,154	

Financial resources in the years prior to 2005, however, pose a problem. Solid waste management is an activity for which the municipality is certainly responsible but the financial condition of DKI Jakarta does not warrant optimism. The financial condition for the next few years in particular appears quite stringent.

In this plan, therefore, the DKI's financial burden for the operation and maintenance will be gradually reduced as follows in relation to the aforementioned rate of autonomous financial sources.

Upto and including 1995	Rp.15 billion
1996 - 2000	Rp.10 billion
2001 and after	Rp. 5 billion

In regard to the investment cost, it will be difficult to simply incorporate in the fee structure as a burden to be shared by all dischargers. The necessary funds, therefore, should be secured from the budget appropriated by the DKI and by foreign and local loans. The loans will be switched over to the dischargers when the collection rate improves.

4.9.4 Cost Bearing Capacity of Inhabitants and Method for Establishing Financial Resources

(1) Cost bearing capacity of inhabitants

The results of the survey on public utility charges currently paid by Jakarta's citizens show that the burden on the low income group is relatively low based on the spirit of Gotong Royong, but that they pay around 0.4% of their income for solid waste management.

On the other hand, the results of the survey on citizens' willingness to pay for the waste collection service revealed that the high income group is prepared to pay Rp. 3,000 or more per month while the middle income group and even the low income group are prepared to pay Rp.1,000 and Rp.500 respectively.

Based on these findings and many interviews and discussions, it is estimated that citizens are able to pay waste management fees within 1% of their respective incomes. The tariff schedule will, therefore, have to contain the fees within 1% of the income of each group. Of course enterprises will be also called upon to pay their share.

Expenses incurred in solid waste management are as shown in the foregoing Table 4-9-4 and if these expenses plus interest and other expenses are all to be covered by the collected fees, a tariff schedule such as shown in Table 4-9-5 will be necessary.

Fees in the first stage is same as the present level. Although there are some opinion that these fees can be a little higher in the light of the citizens' willingness to pay, in consideration of the time required for the system to take root, this tariff schedule assumes raising the fees in two stages by 2005, with even the final fee containing the basic charge

Table 4-9-5 Tariff Tables

	Step 1 1992-1995	Step 2 1996-1999	Step3 2000-
1) Basic fee			
Households (Rp./month)			
- high income	2,000	2,400	3,000
- middle income	700	840	1,050
- low income	300	330	330
Business establishments (Rp./month)	6,000	7,200	9,000
2) Special fee			
households & shops (Rp./month)	2,000	2,400	3,000 door-to-door service
business establishments (Rp./ton)	20,000	24,000	30,000 large amount dischargers
3) Tipping fee (Rp./ton)			
-at transfer station	10,000	12,000	15,000
-at landfill site	5,000	6,000	7,500

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within 1% of the mean income. Even with a small burden of this level, it is difficult to expect a 100% collection rate in view of the actual state of public charge collection (including tax collection) in Indonesia. Particularly since the current total amount of fees collected for waste management is low, rapid rise in the collection rate seems difficult. On the other hand, considering that Bogor was able to increase its collection amount by three to six times its previous level by adding the waste management fee to water charges, it may be possible even for Jakarta to increase the amount by a few times of the current level, if the level of fees added is not very high. Considering this point, the following collection rates are assumed for each income groups in estimating the revenue from fees.

High income group	95%
Middle income group	80%
Low income group	50%

The revenue from fees estimated based on the above conditions is as shown in Table 4-9-6.

The potential amount of basic fees collectable from enterprises was calculated under the severe condition that the number of enterprises from which basic fees may be collected will remain the same until 2005, although the number of enterprises is anticipated to increase as economic activities advance. In contrast, the number of those from whom special fees may be collected is assumed to gradually increase as the solid waste management system improves. In the case of the door-to-door service for the high income group, it is assumed that this service will not cover the entire high income group.

It is assumed that these potential fees, estimated pessimistically, will be collected as per the planned fee collection rates indicated previously.

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Table 4-9-6 Fee Collection Estimate (Potential)

(Unit: Rp. million)

	1992	1995	1998	2000	2005
Basic Fee Collection					
Households (1,000)					
High income (95%)	(277)	(366)	(459)	(538)	(742)
	6648	8064	13219	19368	26712
Middle income (80%)	(750)	(840)	(916)	(964)	(1090)
	6300	7056	9233	12146	13734
Low income (50%)	(335)	(338)	(341)	(341)	(348)
	1206	1217	1350	1350	1387
Enterprises (1,000)	(26)	(26)	(26)	(26)	(26)
	1872	1872	2246	2808	2808
Subtotal	16026	18209	26048	35672	44641
Special Fee Collection					
Households (1000 Nos.)	(141)	(244)	(303)	(326)	(390)
Door to door	3384	5856	8726	11736	14040
Enterprises (ton/day)					
Large amount	(950)	(1035)	(1180)	(1275)	(1515)
Dischargers	6935	7756	10337	13961	16589
Accepted at T/S	(186)	(580)	(982)	(1050)	(1220)
	677	2117	4301	5749	6680
Subtotal	10996	15729	23364	31446	37309
Total	27022	33938	49407	67118	81950

The numbers in brackets show the numbers of each item.

As Fig. 4-9-2 shows, it is assumed that the ratio of collection to total potential collectable fees will be raised stepwise from 30% in 1992 to 45% in 1995 and further to 90% by 1999.

The collection target for 1995 is Rp.15 billion (Rp. 1,530 per capita per year) which represents the total amount of fees collected from an estimated service population of 9.8 million, including commercial waste dischargers. Compared to the 1985/1986 result of Rp. 880 per capita in Bogor, a per capita burden of Rp. 1,530 per year may be considered an amount that can be easily borne when the scale and future economic growth in Jakarta are taken into account.

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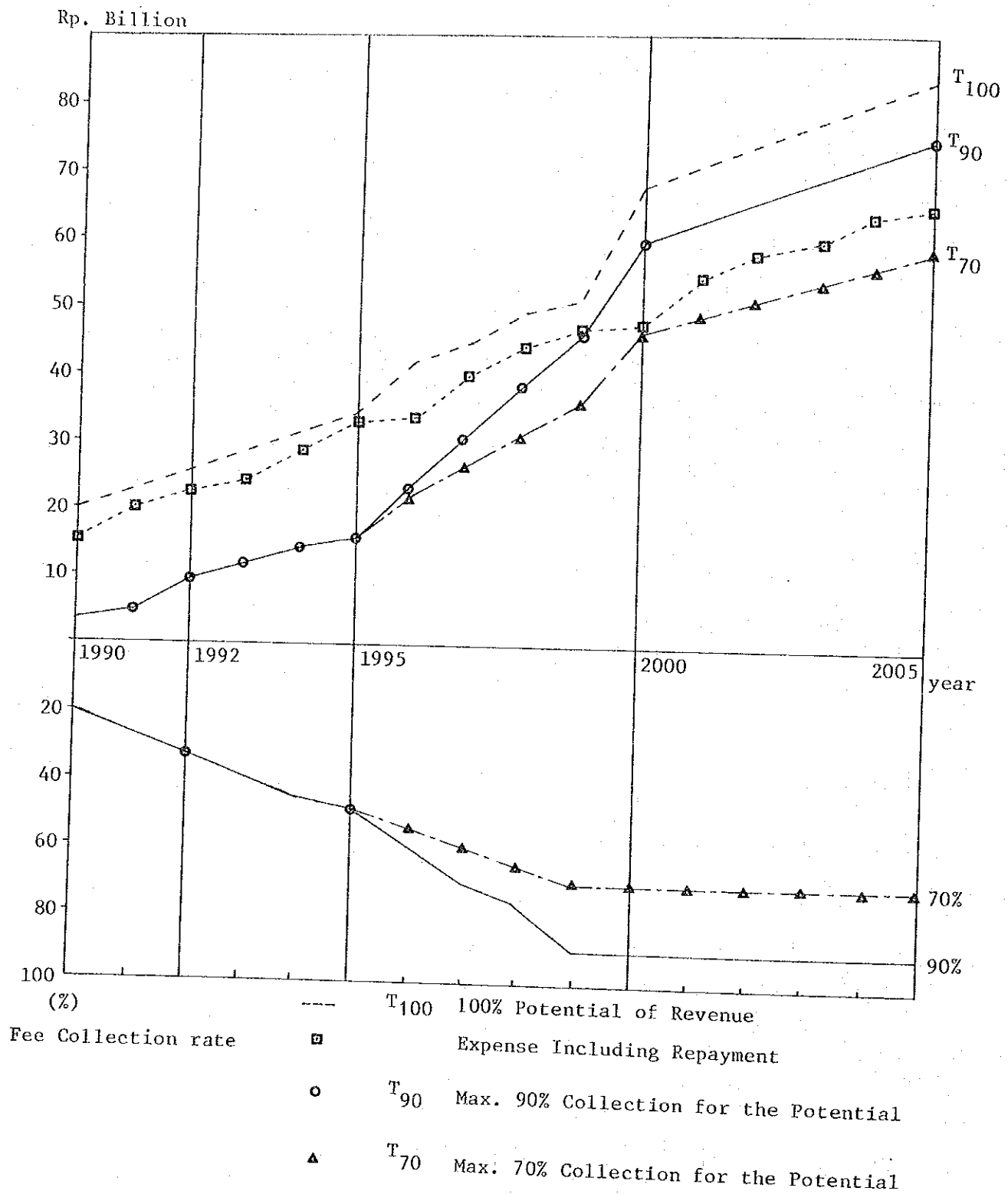


Fig. 4-9-2 Plan for Fee Collection

(2) Establishment of Financial Source

For the establishment of an independent financial source, the complete trust of inhabitants and enterprises in the solid waste service must be obtained thorough implementation of regular collections, as already described in section 4.9.2 "Establishment of Targets". The service contents should be simultaneously cleared so that they can be linked to a fee system. To be more precise, the solid waste collection from LPS is the basic service for the Dinas Kebersihan while the door-to-door and large amount collection services are required as additional (special) services. Tipping fees will be collected in the case of enterprises or other bodies transporting their own solid waste to a transfer station or a disposal site.

As of 1987, the fee collection rate has not increased up to its target and fee regulation for each type of collection service have not been clearly established. In addition, the process through the RW/RT has also made the real cash flow status unclear. Therefore, it is important that the RW/RT is not commissioned to collect fees when the new fee collection system is introduced. This does not mean the withdrawal of the RW/RT's security and cleaning assignments in their respective communities but simply means that their activities must be separated from the fee collection system. It is, then, desirable that the waste management fee be added as a surcharge on the electricity bill at the earliest possible time.

(3) Fee Collection System

The basic fee will be decided based on household incomes and the business sizes and types of enterprises and will be collected from all households and enterprises. The introduction of the proposed surcharge on the electricity bill will make it possible to collect fees from all households, excepting those not receiving the electricity service. Detail of collection methods will be further examined during the

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following detailed design stage. A system that the electricity charge and the waste management fee are shown on the same bill, as in the case of Bogor where the waste management fee is added as a surcharge to the water bill, is one idea. The total amount will then be paid through the bank.

With regard to the special fees for door-to-door collection and special collection, fee collection from individual beneficiaries can be introduced for more convenience. However, when the collection method of a surcharge on the electricity bill is introduced, the method of combined collection will also apply, as in the case of the basic fee.

As far as the door-to-door service is concerned, however, the service directly provided by the Dinas Kebersihan will be the subject of fee collection. While the similar service provided by the RW/RT as part of the community services will be subject to the respective community, the service corresponding to the waste flow from LPS to transfer station or to final disposal site should, in principle, be charged at an amount equivalent to the basic fee, and guidance and supervision will be required to prevent the introduction of an exorbitant fee by RW/RT. In this regard, the consciousness of inhabitants should also be strengthened.

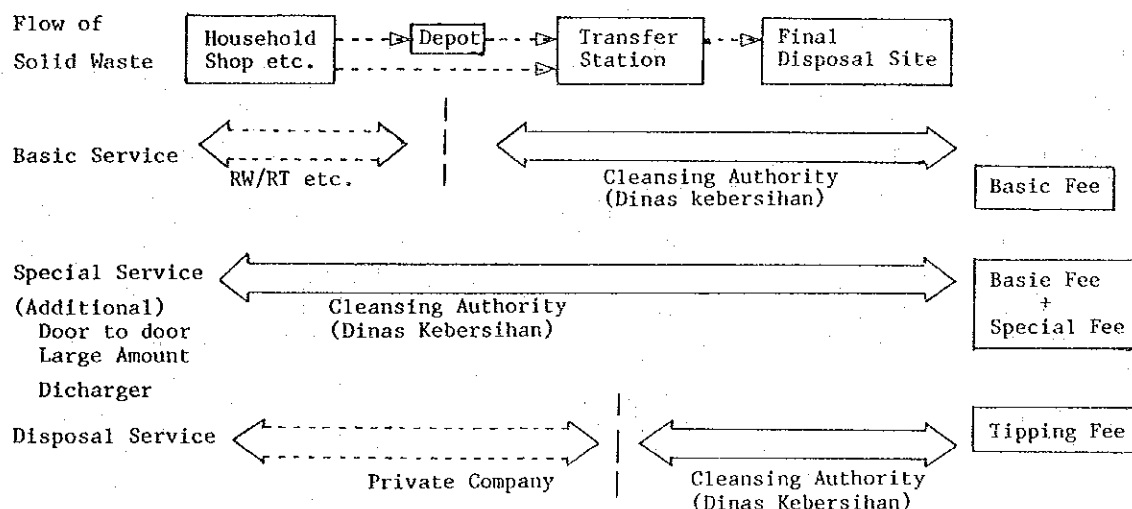
In the case of the tipping fee collection, it is basically desirable for a disposal permit to be issued in advance and the fee charged on the electricity bill. However, direct collection may be made at transfer station and final disposal site for irregular demands.

While the work assignment of each department of the Dinas Kebersihan is also subject to examination in the detailed design study, the general framework is as follows.

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The actual situation of the door-to-door service and the collection service for large amount dischargers will be reported monthly by the Seksi Kecamatan to the Suku Dinas Kebersihan. The fee collection results will also be reported monthly by the PLN or banks. The Suku Dinas Kebersihan will compare the solid waste collection results and the payment results, then issue reminders bills for the following month. The Retribution Section of the Dinas Kebersihan will be responsible for the collection of bills from each Suku Dinas Kebersihan, the request for PLN to collect fees and the payment of commission to PLN and banks based on the amounts collected by them.

a. Principle of Solid waste services and fees



b. Proposed Fee Collection System

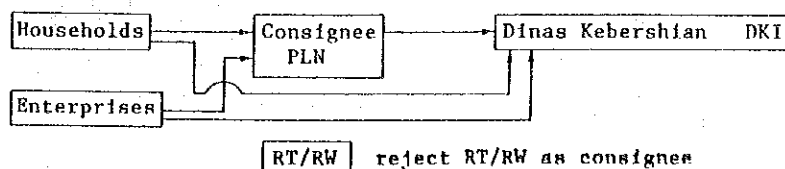


Fig. 4-9-3 Proposed Fee Collection System

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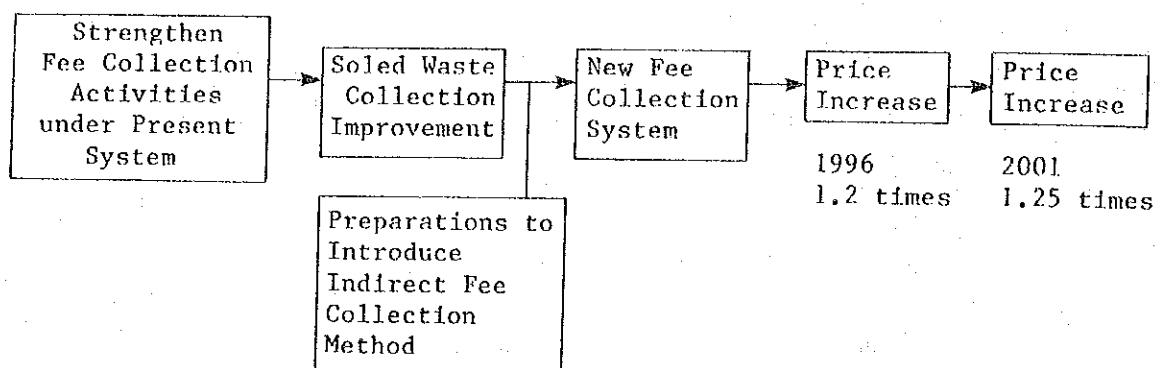


Fig.4-9-4 Steps of Fee Collection System Improvement

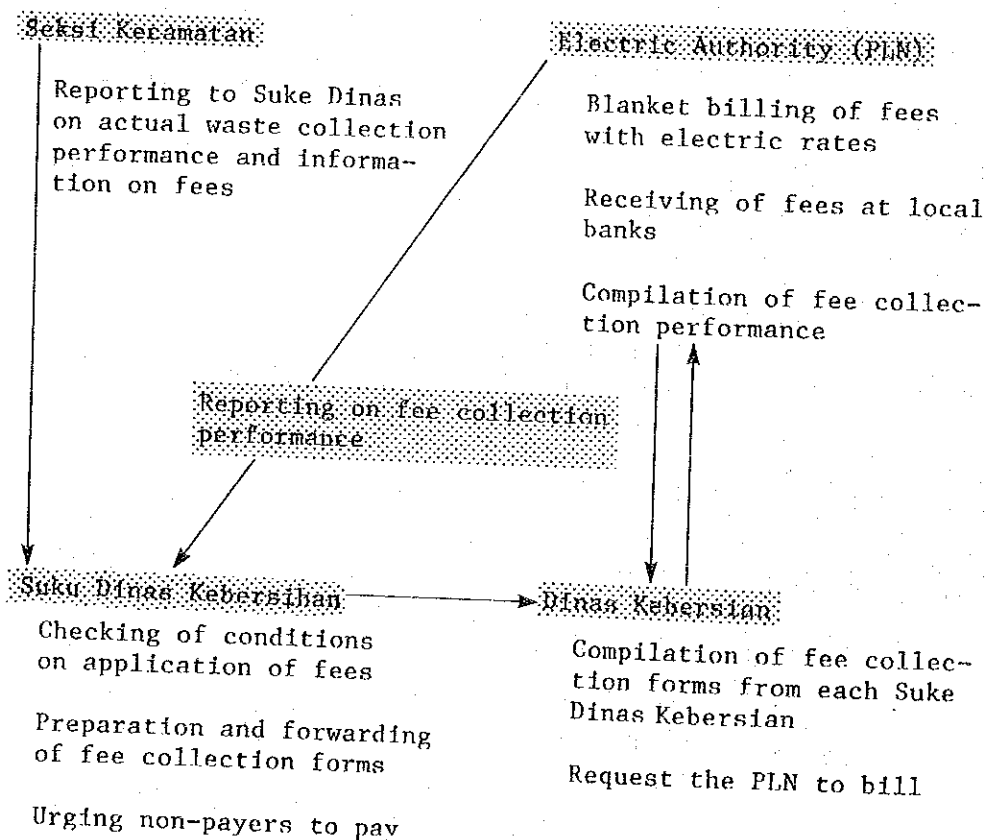


Fig.4-9-5 Framework of New Fee Collection System

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4.9.5 Financial Plan

The following may be listed as factors with a large effect on the success of the financial plan to be developed for the Conceptual Master Plan.

- a. Investment amount
- b. Fee collection rate
- c. Loan conditions

Of the above, the investment amount will affect not only the demand for funds but also depreciation and all other operation and maintenance expenses. Here, a comparative study of the proposed system and the existing system is made. While the total debt will rapidly decrease in and after the year 2000 and an internal reserve will become possible in the year 2010 onwards in the proposed system, it will be almost level in the existing system (refer to Fig.4-9-6).

The effect of the different investment amount will be mainly felt on the total debt amount in 2005 and at the time when the overall balance will be in the black (refer to Table 4-9-7).

Table 4-9-7 Sensitive analysis - effect of investment amount

	Total Debt in 2005 Rp. billion	Year surplus expected
10% cost-down	reserve 195	1998
5% cost-down	157	1999
5% cost-up	50	2000
10% cost-up	1	2000

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A comparative study of the fee collection rates was also made by assuming collection rates of 90%, 80% and 70% against the potential collectable amount. The results show that the total debt rapidly decreases and internal reserve becomes possible if the rate is 90%. The debt gradually declines but still remains in 2005 if the rate is either 80% or 70% (refer to Fig. 4-9-7).

In regard to loan conditions, the total debt is affected by the assumed repayment period and interest rate. Here, the following basic conditions are assumed.

Foreign loans: Repayment over 25 years with a 7-year grace period,
interest 4% per annum

Local loans : Repayment over 20 years with a 5-year grace period.
interest 5% per annum

If the local interest rate is changed to 9% or 11%, the total debt in 2014 will be Rp.54 billion and Rp.130 billion respectively. If the local loan conditions are changed to a 10 year repayment period with grace period of 1 year with the interest rate of 11%, the total debt will greatly improve and shift to a minus in 2014 (in other words, some surplus funds will be generated) (refer to Fig.4-9-8). However, as the debt service ratios in the interim years will become considerably high, in this case, this plan is likely to generate difficulties for the Dinas Kebersihan in relation to other projects.

The foregoing review reveals the importance of establishing an organization capable of actively pursuing fee collection and of managing funds in conformity with its operating conditions.

Incidentally, the difference in cash flow was studied as a difference in loan conditions in case of the Dinas Kebersihan and a public corporation. In the case of a public corporation, the interest rate may be somewhat higher but it will be in a position to apply funds to meet its operating requirements. It is assumed here that the operating surplus generated after establishment of an autonomous source of funding

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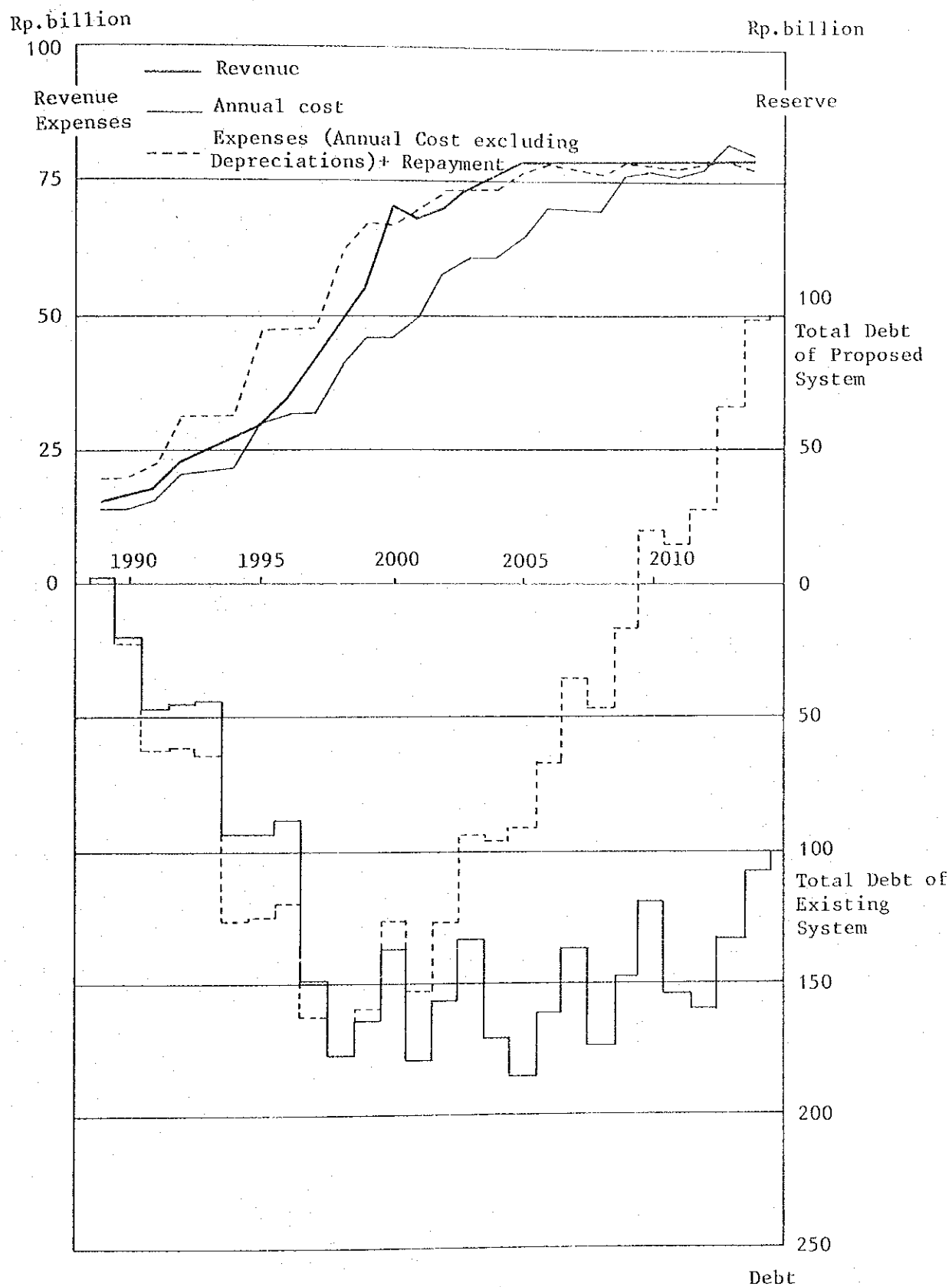


Fig. 4-9-6 Cash Flow of the Existing System

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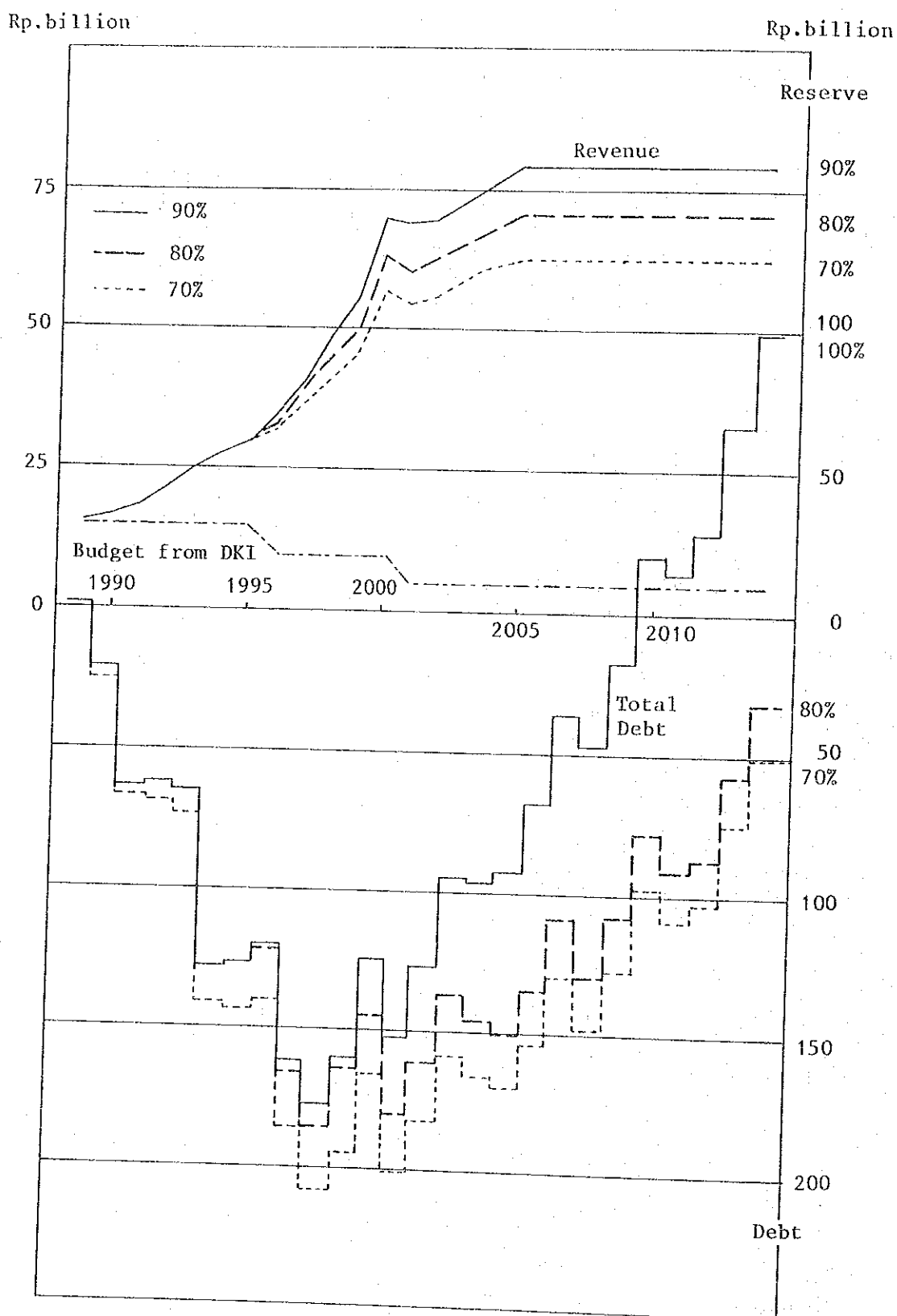


Fig. 4-9-7 Comparison of Efficiency of Fee Collection

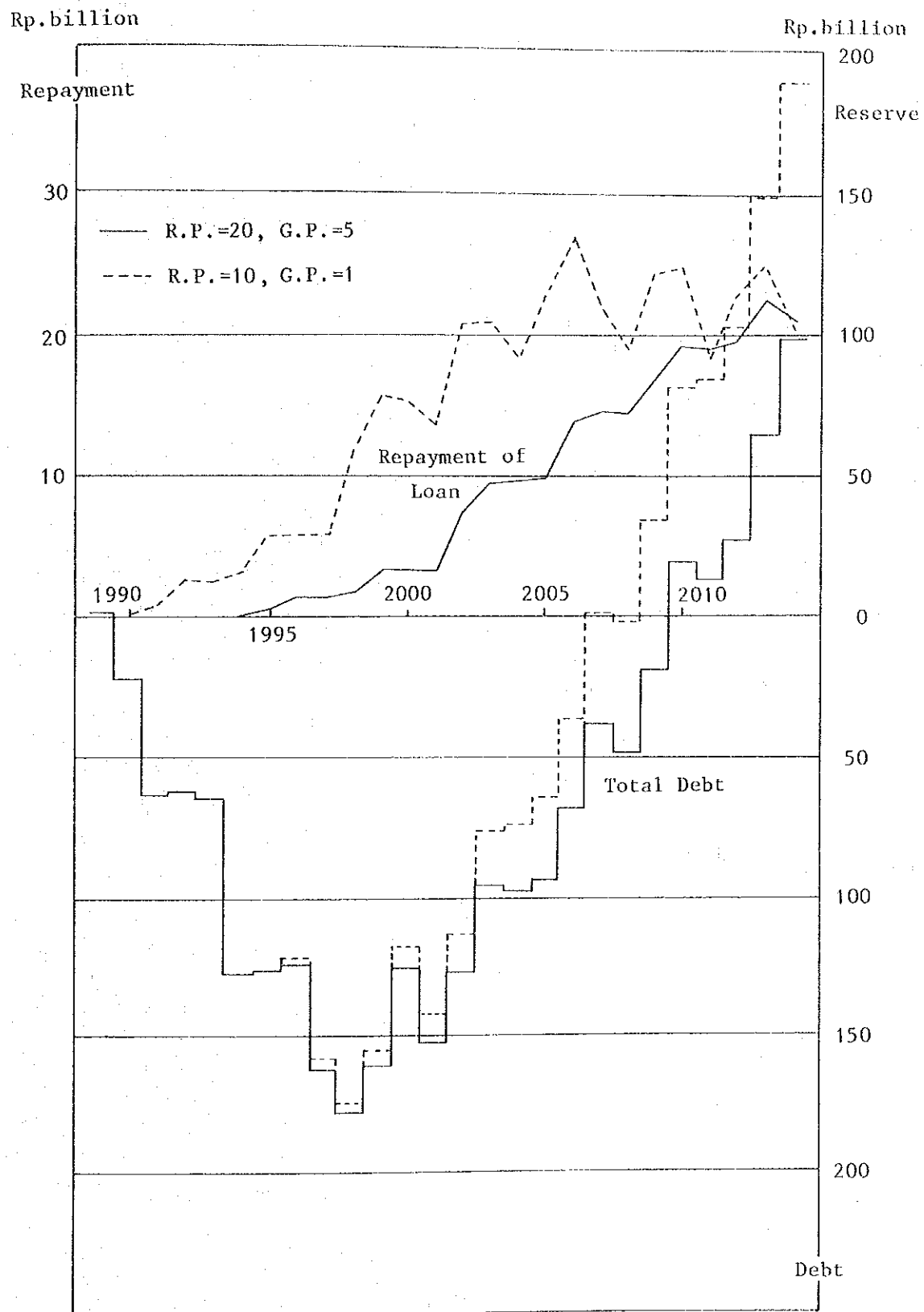


Fig. 4-9-8 Comparison of Loan Conditions (interest 5%)

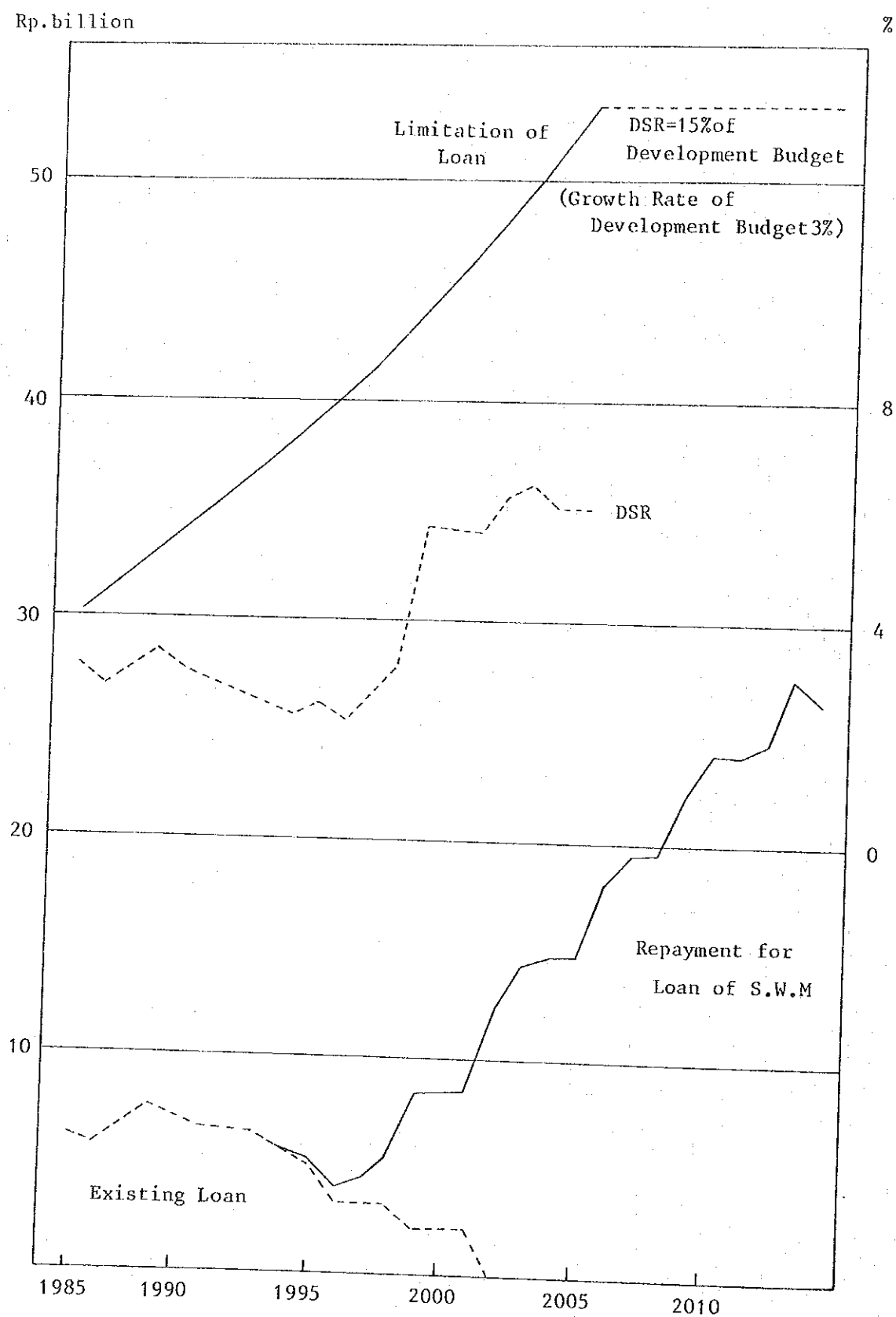


Fig. 4-9-9. Total Loan of DKI and Debt Service Ratio

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will not be turned over to DKI, although this will depend on the nature of the public corporation.

The yearly financial plan and cash flow are shown in Tables 4-9-8 and 4-9-9. These Tables show that the balance in and after 2000 will be in the black and that the total outstanding debt will start decreasing. As a result, internal reserve of Rp.78 billion can be expected in 2014.

The cash flow was planned with the aim of gradually decreasing the burden on the DKI (the burden on the DKI will eventually be only the expenses incurred in street sweeping which is inevitably a public service by nature) and if this condition is relaxed, it will be possible to reduce the outstanding balance of the loans much quicker.

The calculation of the cash flow in the Conceptual Master Plan was based on the following premises.

DKI's contribution	Upto Rp.5 billion per year
Foreign loans	60% of the initial improvement project (Phase I)
Local loans	All the required funds in excess of the foregoing two.

As a result, the weight of local loans became exceptionally high. However, if the Phase I project succeeds in establishing the new fee collection system, there will be a possibility of securing foreign loans for Phase II and subsequent projects, which in turn will improve the cash flow. It is decided, therefore, that the cash flow be examined under the severe conditions here. There is no doubt that the financial burden on the DKI will increase if the present situation is left unattended. It is of crucial importance to set up great objectives and make starts for them.

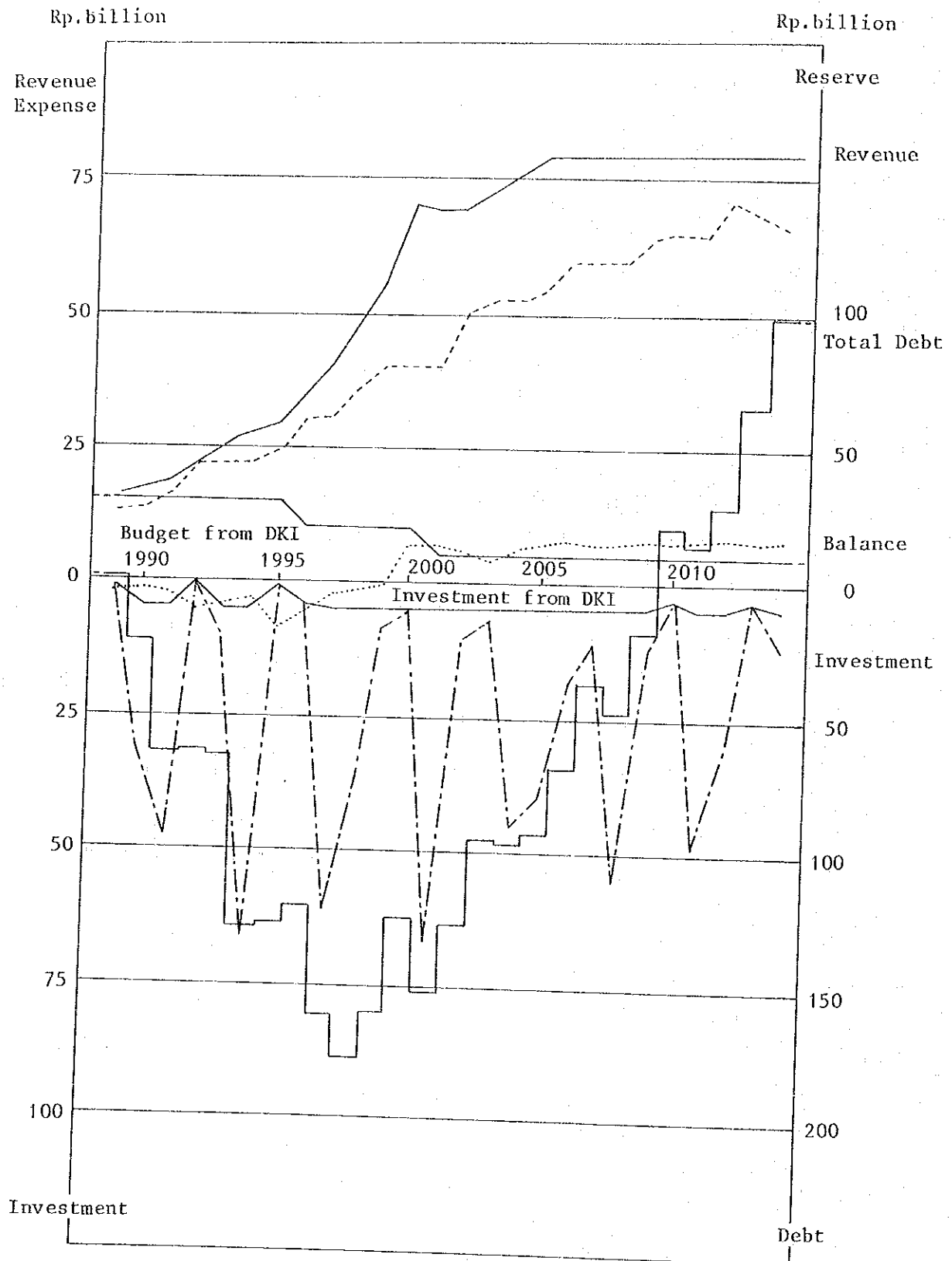


Fig. 4-9-10 Cash Flow of the Project

Table 4-9-8 Money Flow of the Project (Dinas Kebersihan)

1¥=10Rp.

Unit: Rp. billion

Year	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
Revenue																											
Basic Fee	0.9	1.9	3.0	4.0	5.0	5.9	7.0	11.8	15.1	18.5	21.8	28.3	29.3	30.4	31.4	32.5	33.6	33.6	33.6	33.6	33.6	33.6	33.6	33.6	33.6	33.6	582.8
Special Fee	0.0	0.0	0.0	4.1	5.4	6.7	8.0	13.3	17.0	20.6	24.3	31.9	33.5	34.4	36.6	38.3	39.8	39.8	39.8	39.8	39.8	39.8	39.8	39.8	39.8	39.8	672.1
Budget from DKI	15.0	15.0	15.0	15.0	15.0	15.0	15.0	10.0	10.0	10.0	10.0	10.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	225.0
Subtotal (A)	15.9	16.9	18.0	23.1	25.4	27.6	30.0	35.1	42.1	49.1	56.1	70.2	67.8	69.8	73.0	75.8	78.4	78.4	78.4	78.4	78.4	78.4	78.4	78.4	78.4	78.4	1,479.9
Expense																											
Depreciation (B1)	6.1	6.1	6.8	12.2	12.2	12.2	17.9	17.9	17.9	20.3	21.8	21.9	22.6	23.5	23.8	23.8	23.8	23.8	23.3	23.3	23.2	23.2	23.2	23.2	23.2	23.2	500.4
Personnel	9.8	10.1	10.4	11.7	12.1	12.4	12.2	12.1	12.0	11.6	11.5	11.4	11.6	11.8	12.1	12.3	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	309.1
Maintenance	2.6	2.6	2.9	4.9	4.9	4.9	6.6	6.6	6.6	7.4	7.8	7.8	8.0	8.3	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	182.7
Fuel & Others	1.2	1.2	1.2	2.1	2.2	2.3	3.3	3.5	3.6	4.1	4.2	4.4	4.5	4.7	4.9	5.0	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	103.4
Interests	0.0	0.0	1.2	3.1	3.1	3.3	6.3	6.3	6.2	8.9	10.4	10.3	10.0	12.9	12.6	12.0	13.3	14.4	14.2	13.6	15.2	14.5	13.4	14.4	14.5	13.2	247.3
Subtotal (B)	19.7	20.0	22.5	34.0	34.5	35.1	46.3	46.4	46.3	52.3	55.7	55.8	56.7	61.2	61.8	61.5	63.0	64.1	63.4	62.8	64.3	63.6	62.5	63.5	63.6	62.3	1,342.9
Balance (A-B)	-3.8	-3.1	-4.5	-10.9	-9.1	-7.5	-16.3	-11.3	-4.2	-3.2	0.4	14.4	11.1	8.6	11.2	14.3	15.4	14.3	15.0	15.6	14.1	14.8	15.9	14.9	14.8	16.1	137.0
Resource of Investment																											
Budget from DKI (C1)	1.0	5.0	5.0	0.0	5.0	5.0	0.7	4.1	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	3.5	5.0	5.0	4.0	5.0	113.3
Long Term Loan																											
Local (C2)	0.0	8.0	14.4	0.0	5.4	24.6	0.0	0.0	55.6	33.0	4.1	1.0	61.9	6.3	2.3	40.1	35.2	13.7	6.9	50.4	7.3	0.0	44.0	25.1	0.0	7.2	446.5
Foreign (C3)	0.0	19.4	29.0	0.0	0.0	44.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	92.9
Subtotal (C)	1.0	32.4	48.4	0.0	10.4	74.1	0.7	4.1	60.6	38.0	9.1	6.0	66.9	11.3	7.3	45.1	40.2	18.7	11.9	55.4	12.3	3.5	49.0	30.1	4.0	12.2	652.7
Repayment (D)	0.0	0.0	0.0	0.0	0.0	0.0	0.5	1.5	2.6	4.6	6.2	6.2	6.2	12.4	14.6	14.9	14.9	19.1	19.5	19.6	22.3	24.1	24.1	24.5	27.5	26.4	291.7
Remain of Loan	0.0	27.4	70.8	70.8	76.2	145.3	144.8	143.3	196.3	224.7	222.6	217.4	273.1	267.0	254.7	279.9	300.2	294.8	282.2	313.0	298.0	273.9	293.8	294.4	266.9	247.7	
Money Demand (E)	14.6	46.3	64.1	21.8	32.7	97.0	29.6	34.1	91.6	74.6	49.2	46.1	107.2	61.4	59.9	97.7	94.3	78.1	71.5	114.5	75.7	68.0	112.4	94.9	71.9	77.7	
Short Term Loan (F)	-2.3	-3.0	-2.3	-1.3	-3.1	-4.7	-1.1	-5.1	-11.1	-12.5	-16.0	-30.1	-27.5	-19.7	-20.4	-23.2	-24.3	-19.0	-18.8	-19.3	-15.0	-13.9	-15.0	-13.6	-10.5	-12.9	-345.7
Total of Debt (G1)		22.1	63.2	61.9	64.2	128.6	127.0	120.4	162.3	178.2	160.1	124.8	153.0	127.2	94.5	96.5	92.5	68.1	36.7	48.2	18.2						
Reserve Fund (G2)	2.3																					19.8	14.9	27.9	65.9	98.0	

Comment

E=(B-B1)+C+D

Foreign loan

Interest = 4%

Repayment Period = 25 years

Grace Period = 7 years

F=E-C-A

Local loan

Interest = 5%

Repayment Period = 20 years

Grace Period = 5 years

(Proposed System)

UNIT : 200. billion

$$1x = 1000$$

Comment
E=(B-B1)+C+D
F=E-C-A

Interest : 9%

17.8 17.0 33.0 74.3 10.3

4.10 Citizen Participation Plan

4.10.1 Promotion of Citizen Participation

The following shall be established at each Suku Dinas Kebersihan to promote citizen participation.

- a. Complaint window
- b. Public relations unit
- c. Citizens' guidance unit

4.10.2 Contents of the Citizen Participation Plan

a. Waste collection by RT/RW

RT/RW shall be guided to implement waste collection as part of the community activities in those Areas in which depots can be built. The improvement and provision of hadcarts shall be supported to assist such community activities.

b. Communal cleansing days

Several days a year shall be designated communal cleansing days and all inhabitants of a given area shall be urged to participate in the cleaning of streets, vacant lots and micro-ditches. Suku Dinas Kebersihans shall provide collection and haulage services for the disposal of the waste collected by the inhabitants.

c. Useful material recovery

Containers for reclaiming reusable materials (glass, metal and cloth) from waste shall be provided at every RT/RW and inhabitants shall be urged not to discharge reusable materials as waste. In order for the RT/RW to apply the proceeds from reusable waste to their funds private junk dealers shall be introduced.

d. Cooperation for fee collection

Citizens shall be urged to pay their fees by informing them that a large amount of money is needed to maintain the sanitary standard of their environment.

4.11 Policy Measures

Policy measures based on a very long-term perspective and the contents of the Conceptual Master Plan shall be enforced in view of the latter's effective implementation.

4.11.1 Legal systems

The development of an appropriate legal system is indispensable for solid waste management. The development of legal systems for the following is particularly important.

- Division of responsibility for solid waste management Control
- Supervision of private waste collection business Control
- Supervision of small scale disposal sites
- Penalty provisions against illegal dumping of waste

Table 4-11-1 summarizes the required improvements to the legal systems in view of the present conditions and efforts to be made to develop such legal systems.

Table 4-11-1 Improvement to the Legal System

Present status	Policy for amendment of applicable system
1. Disposal system Industrial waste: Captive disposal Other waste: by self-governing body	<p>Ordinary waste: Self-governing body (cleansing responsibility)</p> <p>Industrial waste : Self-treatment/disposal (under the supervision and guidance of the self-governing body)</p> <p>Hazardous wastes: Self-treatment/disposal (under the supervision and guidance of the national government and self-governing body)</p> <p>* On industrial waste and hazardous wastes, the essential reforms are establishment of the system of the amounts and compositions of waste and the approval system for installation of facilities.</p>
2. Duties of the national govern- ment	<p>* Technical standards for treatment and</p> <p>* The facilities development policy shall be determined and the subsidizing system and accommodation for foreign aid shall be applied to the facilities conforming to the above policy</p>
3. Fee collection * Cost recovery	<p>* Beneficiaries shall pay the cost.</p> <p>* Standards applicable to indirect fee collection, addition of fees to water supply fee or electricity fee or taxes and the procedures for same shall be developed.</p>
4. Development of pri- vate waste management businesses	<p>* Licensing system for businesses en- gaged in cleansing services and direct hauling of waste</p> <p>* The licensing system shall be expanded to cover the cleansing service, collection, treatment and disposal services of private businesses</p>
5. Improvement of the systems for collect- ion, treatment and disposal	

Present status	Policy for amendment of applicable system
<ul style="list-style-type: none"> * Establishment of small scale disposal sites is subject to approval by Dura 	<ul style="list-style-type: none"> * Establishment of disposal sites shall be made subject to the permission of the Cleansing Department and approval of the Mayor. * Official requirements for the establishment of disposal sites shall be developed. * Sanitary standards for cleansing work shall be developed.
6. Measures for wide area waste disposal	<ul style="list-style-type: none"> * Inducement of a system for guidance and adjustment by the national government in relation to waste disposal in a wide area. * Enactment of a law concerning establishment of an organization for joint disposal.
7. Prohibition of illegal dumping	
<ul style="list-style-type: none"> * Prohibition of illegal dumping * Penal provisions (50,000 Rp) 	<ul style="list-style-type: none"> * Standards for collection, treatment and disposal of wastes shall be developed to clarify the contents of illegal dumping. * Strict application shall be attempted.
8. DKI's cleansing organizations	
<ul style="list-style-type: none"> * Under the supervision of Suku Dinas Cleansing Division and 	<ul style="list-style-type: none"> * Suku Dinas Kebersihans shall be placed under the supervision of the Cleansing Department to improve their independence. * Introduction of a public announcement system at the locations of LPS facilities and the areas from which waste may be hauled to each LPS.

4.11.2 Social Education

In order to keep the streets beautiful and clean, the citizens' participation in "No littering" and "Help keep the streets clean" is indispensable.

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School education: The importance of keeping the streets clean and an outline of cleansing activities shall be taught as a compulsory course. School children shall learn these through actual practice. Textbooks and auxiliary teaching materials, such as audio-visual materials (video, movie, etc.), shall be improved to help schoolchildren understand more easily. Tie-ups with other courses shall be attempted, such as letting the school children draw posters on cleaning in the art class.

Social education: Events and lecture courses shall be held at community gatherings of RT/RW. Practical action by RT/RW shall also be urged. The existing cleansing day shall be expanded and made into an event in which all inhabitants shall participate. The Dinas Kebersihan shall provide RT/RW with consulting services for the improvement of handcart collection and those other services now performed by RT/RW. Tie-ups with women's associations and volunteer movements shall also be attempted.

4.11.3 Human Resources Management

Training shall be particularly given to administrators and planners. Competent personnel shall also be dispatched to the working functions of Suku Dinas Kebersihans to strengthen these functions and to upgrade the quality of their personnel.

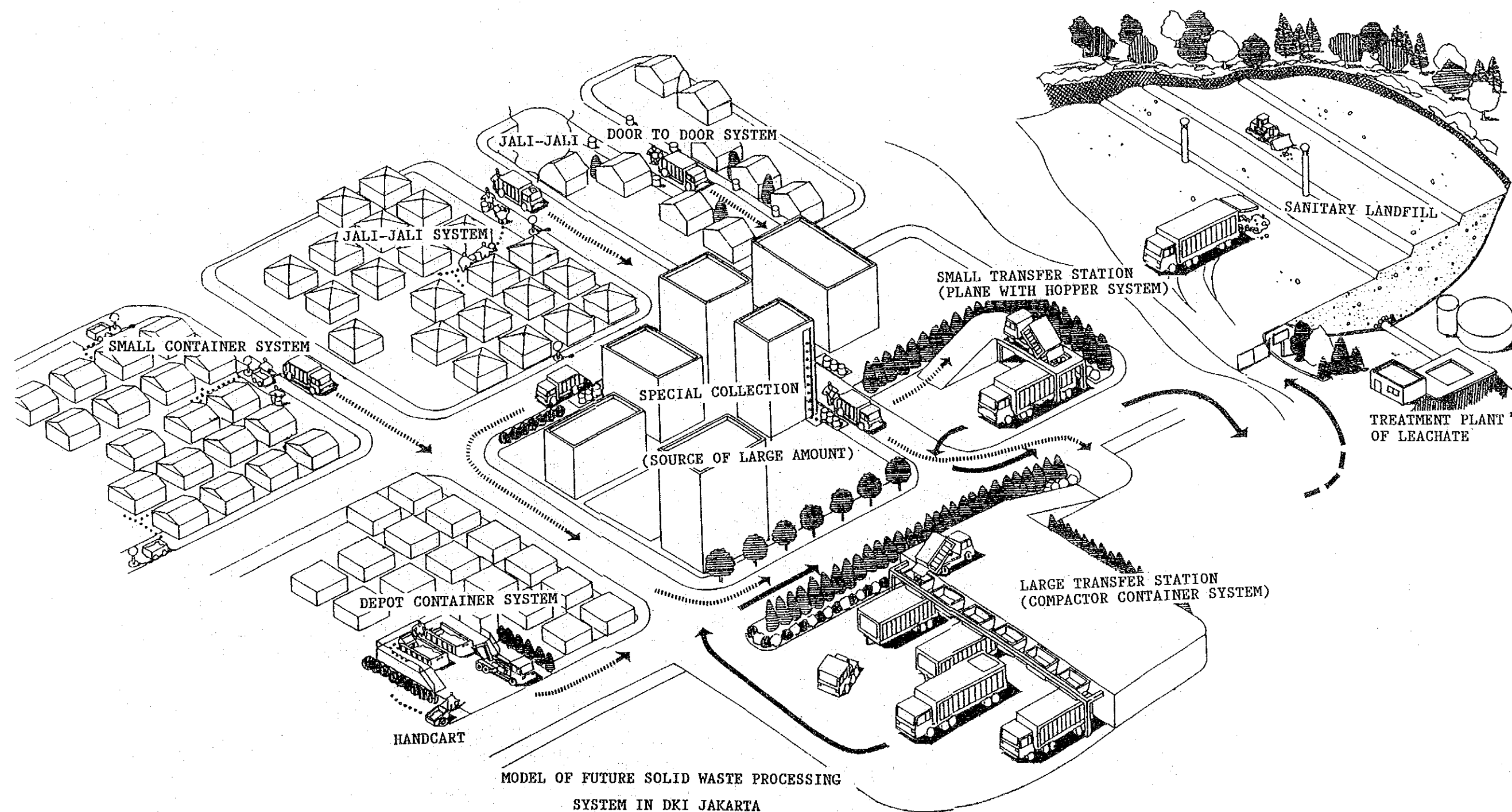
Through training, the trainees shall acquire the ability to formulate effective plans and schedules so as to improve the regularity and efficiency of the collection service.

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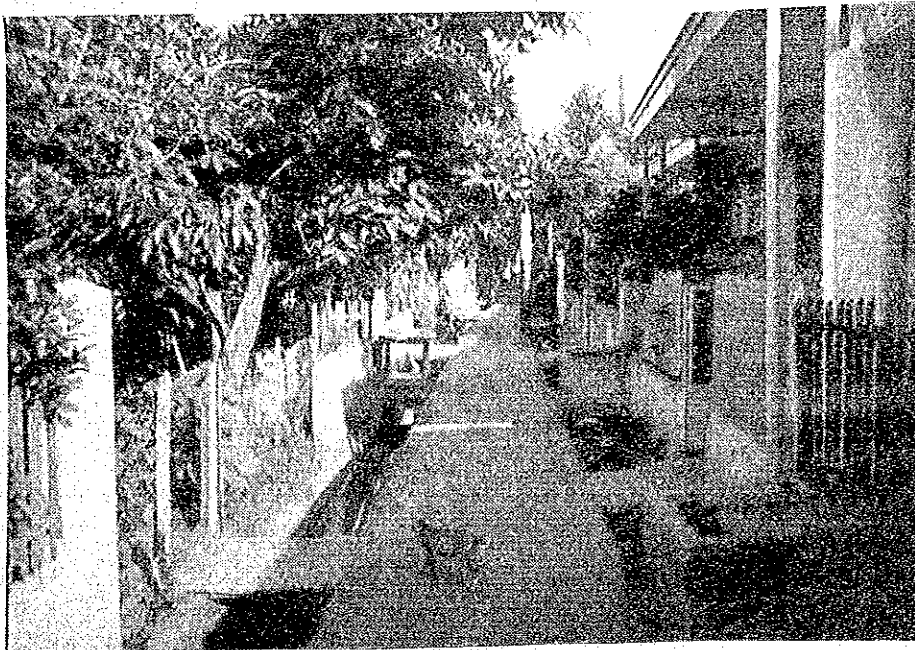
4.11.4 Research and Technological Development

Research and development shall be pursued in the following subjects to determine the future direction of collection, treatment, disposal and financing of cleansing activities.

- a. Analysis of waste quality and investigation of waste amount
- b. Collection and haulage
- c. Sanitary landfill
- d. Intermediate treatment (incineration, etc.)
- e. Fee collection
- f. Treatment and disposal of industrial waste and hazardous waste



CHAPTER 5 STAGE PLAN



CHAPTER 5 STAGE PLAN

5.1 Constraints and Development Policy

5.1.1 Constraints

The key points for the successful development of solid waste management in Jakarta, i.e. the establishment of a rational collection method and the construction of sanitary landfill disposal sites at Bekasi and Tangerang, are to secure the funding for both investment and repayment. As it is estimated that investment of Rp.260 billion will be required for the construction of facilities up to year 2005, this investment is bound to come from loans under the present financial situation. This means that financial sources for the repayment of these loans will be needed for a certain period in the future. As suggested above, ordinary revenue sources cannot be relied on for this purpose and, therefore, the service fees collected from the beneficiaries will comprise the only financial source for repayment. However, this will raise some difficult problems. Firstly, there will be a limit on the amount payable by the beneficiaries. Secondly, it will be difficult to establish a proper fee collection system, and thirdly, it will be necessary to simultaneously introduce the fee collection system with the improvements of the collection service.

In view of the above constraints, it is clear that the development of the solid waste facilities should be carried out in stages. At the early stage in particular, substantial income from the collected fees cannot be anticipated and the available official budget will remain at some Rp.20 billion a year. The facility construction must, therefore, be carried out under these constraints.

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5.1.2 Development Policy

1) Priority Project

The phased construction of the solid waste disposal facilities must take the progress of fee collection with securing of final disposal sites and considering urbanization.

Since a lot of effort and a long time will be required to establish the fee collection system, a model project where the introduction of the system appears fairly easy should be firstly selected. The system will then be subsequently expanded to other area whenever the preconditions for introducing the system are met.

The development policy corresponding to secure the disposal sites is placed on to those Wilayahs where it is difficult to secure the sites. Sites for other Wilayahs will then be secured depending on the urgency.

With regard to the problem of rapid urbanization, facility construction will be firstly implemented for those Wilayahs where urbanization is advanced, gradually covering other Wilayahs.

In view of the above, the urgency of the construction of solid waste disposal facilities for each wilayah is assessed to be as follows.

Wilayah	Readiness for Fee Collection	Difficulty of Securing Disposal Site	Progress of Urbanization	Ranking
Pusat	A	A	A	1
Barat	C	C	C	4
Utara	B	C	B	3
Selatan	B	B	B	2
Timur	C	C	C	4

KEY: A : Good, B : Fair, C : Bad

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It is clear from the above assessment that Jakarta Pusat should be selected as the first priority Wilayah for the disposal facilities development. Moreover, this decision has strategic significance in spreading its consequences to all Jakarta. As Jakarta Pusat has symbolic status throughout Jakarta, the creation of a sanitary environment in this wilayah with the successful implementation of the fee collection system will result in public awareness of the necessity to pay for the improvement of their living environment. Furthermore, it will reinforce the Suku Dinas Kebersihans in the surrounding Wilayahs confidence in achieving their objectives if they try hard. The selection of Wilayahs where the conditions for the Project's success are ripe and where the collection of fees appears fairly easy, must be understood to be crucial requirements for the positive encouragement of these Suku Dinas Kebersihans. Jakarta Pusat satisfies these conditions and ① the improvement of the solid waste collection system, ② the construction of a transfer station and ③ the construction of a sanitary landfill site at Bekasi will be implemented, coping with the solid waste generated in Jakarta Pusat.

2) Expansion of Development Project

The next step consists of the construction of sanitary landfill disposal sites and transfer stations in those Wilayahs where it appears difficult to find disposal sites. In addition, the improvement of the collection system and the establishment of the fee collection system should be achieved in those Kecamatan where the degree of urbanization is similar to that of Jakarta Pusat. As the investment for disposal sites and transfer stations is fairly large, making it impossible for them to be constructed in every Kecamatan, disposal sites and transfer stations will be introduced in those Kecamatan where the foregoing conditions for construction are met. In reality, Kecamatan with such satisfactory conditions are those around Jakarta Pusat with a high degree of urbanization. The solid waste collection system in Jakarta Pusat and the surrounding urbanized Kecamatan should be simultaneously improved. Those Kecamatan where the time is ripe for the implementation of

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such construction, as well as improvement, work and the stages of work implementation are as follows.

- | | |
|--------------------|--|
| a. JAKARTA UTARA | Penjaringan
Tanjung Priok
Koja |
| b. JAKARTA BARAT | Grogol Petanburan
Taman Sari
Tambora |
| c. JAKARTA SELATAN | Kebayoran Baru
Tebet
Setia Budi
Mampang Potraphatan
Kebayoran Lama |
| d. JAKARTA TIMUR | Matraman
Pulo Gadung |

This series of construction work should eventually arrive at the stage which consists of the expansion of the sanitary landfill sites and transfer stations for the whole of Jakarta and the improvement of the solid waste collection system and the establishment of the fee collection system in such Wilayahs as Utara, Barat, Selatan and Timur where urbanization is expected to advance in the future.

When these stages are completed, the main objectives of the Projects next step will be taken in the development of outskerts of Jakarta then on renewal of facilities, recycling of reusable waste and improved efficiency of solid waste management by the introduction of separate collections of different waste.

3) Development Contents of Each Phase

At least 2 years will be required to consolidate the project implementation system, to prepare the detailed plan and to establish the procedure for securing the necessary funds. Therefore, the actual implementation of the Project will commence around 1989. It will be appropriate to divide this 15 year; from 1989 to 2005 which is the target completion year of the Master Plan, into 3 phases, each consisting of 5 years.

Phase I - A : 1989 - 1992

B : 1993 - 1995

Phase II : 1996 - 2000

Phase III : 2001 - 2005

Based on the development policy given earlier, the actual contents of each phase are as described as follows.

5.2 Stage Plan

1) Phase I : 1989 - 1995

Phase I consists of the initial improvement projects in Jakarta Pusat and similar projects in the urbanized kecamatan in Jakarta Utara, Barat, Selatan and Timur.

a. Improvement Projects in Jakarta Pusat

- . Improvement of solid waste collection system
- . Construction of the Sunter transfer station
- . Stage I construction of the Bekasi final disposal site
- . Promotion of fee collection

In addition, reinforcement of organization in Jakarta Pusat will be simultaneously conducted.

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b. Improvement Projects in Urbanized Kecamatan in Jakarta Utara, Barat, Selatan and Timur

- . Improvement of solid waste collection system
- . Construction of the Shraung transfer station
(mainly for the solid waste generated in Selatan)
- . Stage I construction of the Tangerang final disposal site
(mainly for the solid waste generated in Selatan)
- . Promotion of fee collection in those Kecamatan
where the solid waste collection system is improved

In addition, reinforcement of organization in these 4 Wilayahs will be conducted.

2) Phase II : 1996 - 2000

a. Improvement Projects in Kecamatan Subject to Urbanizing in Jakarta Utara, Barat, Selatan and Timur

- . Improvement of solid waste collection system
- . Promotion of fee collection

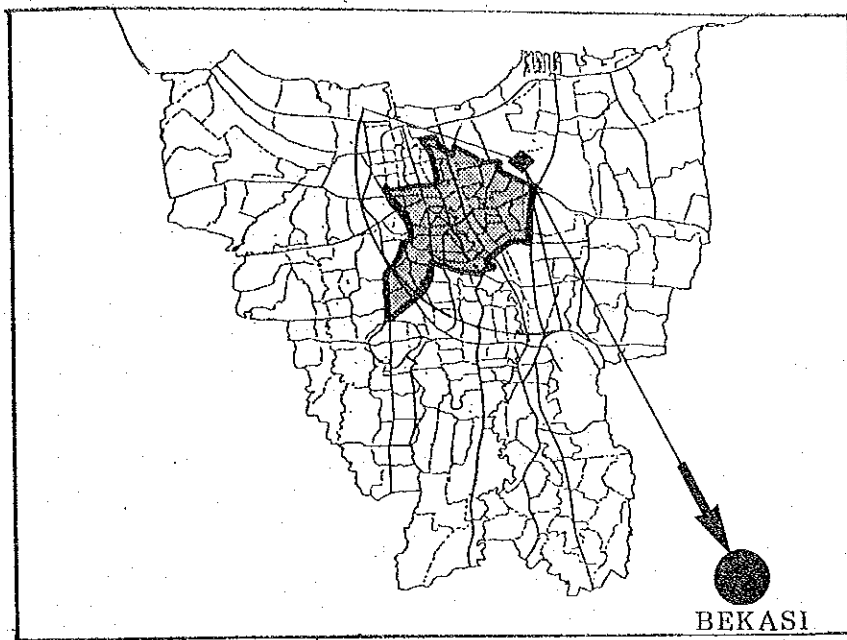
b. Consolidation of Final Disposal Sites

- . Construction of transfer station in Jakarta Utara, Barat and Timur
- . Stage II construction of the Bekasi final disposal site
- . Stage II construction of the Tangerang final disposal site

3) Phase III : 2001 - 2005

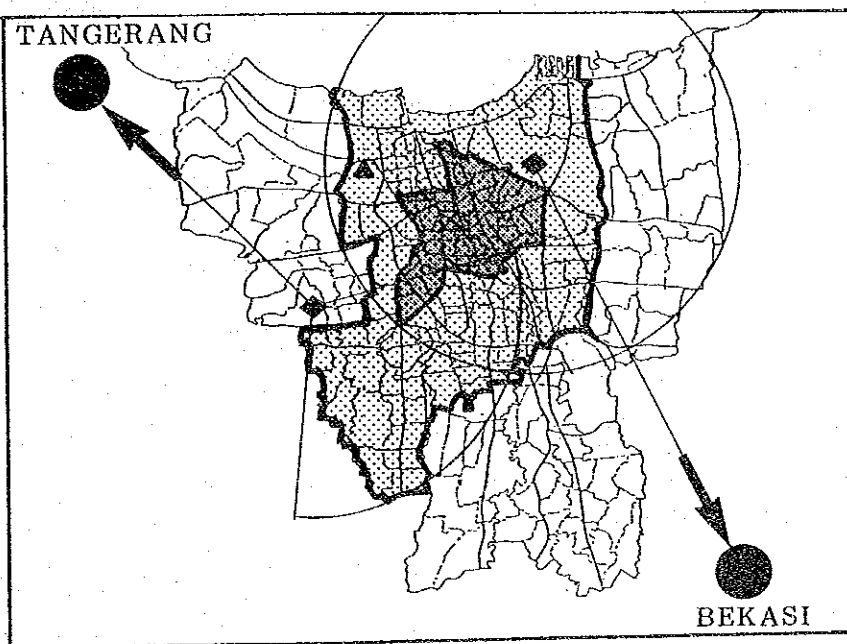
The improved or constructed facilities in the foregoing phases will be renewed or their handling capacities will be expanded in this phase.

- . Expansion of solid waste collection capacity in the subject areas of Phase I
- . Strengthening of the handling capacities of the Sunter and Shraung transfer stations

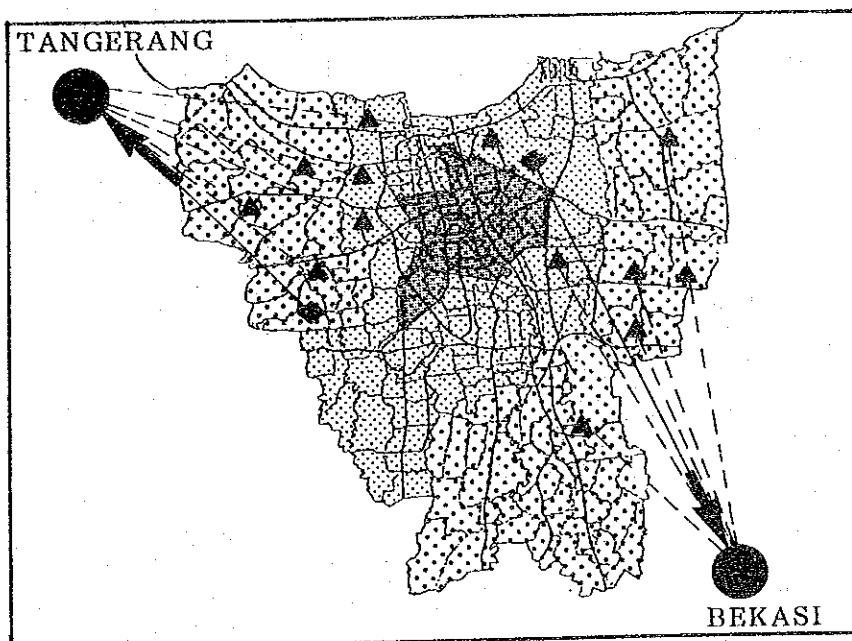


PART II

PHASE I - A
(1989-1992)



PHASE I - B
(1993-1995)



PHASE II
(1996-2000)

◆ | TRANSFER
▲ | STATION

Fig. 5-3-1 Improvement Stage Plan

5.3 Improvement Process

The improvement process of the solid waste collection and the construction/consolidation process of the facilities based on the Stage Plan are as shown in Fig. 5-2-1. and refer to Fig. 4-6-2 for the landfill process of a final disposal.

It is clear from Fig. 4-9-1 that the amount of the collected fees will not be able to quickly catch up with the increase of the solid waste management cost due to the increased volume of solid waste and the construction/consolidation of the relevant facilities. As a result, substantial financial support will be necessary upto the year 2000.

5.4 Solid Waste Management Prior to Phase I Completion

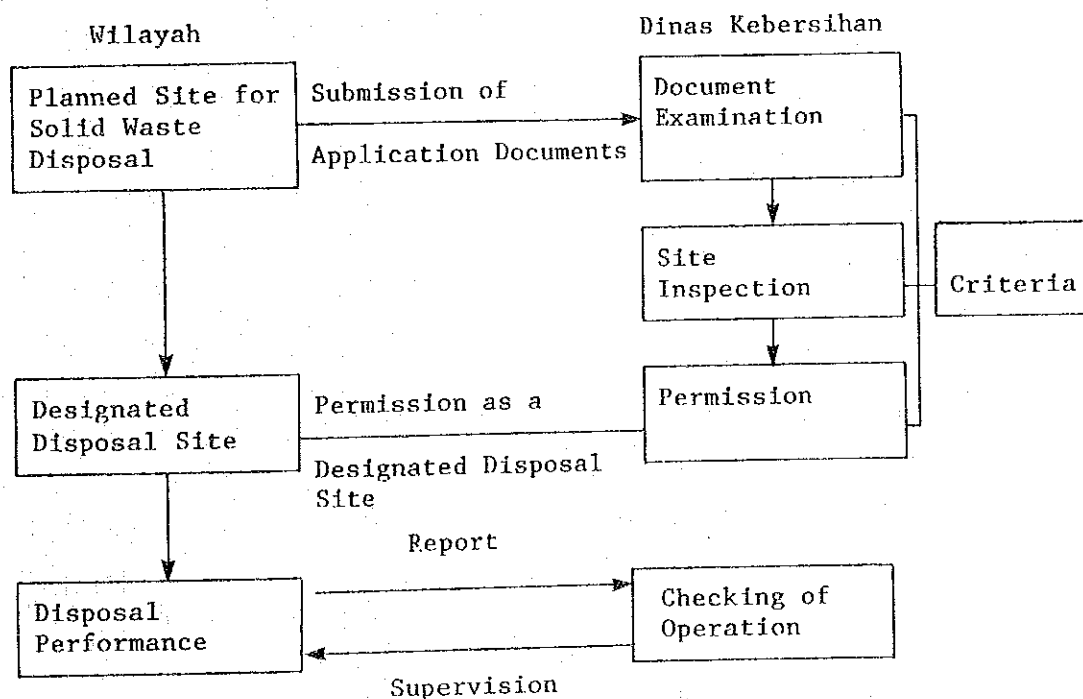
Prior to the commencement of the Project in 1989 and during the Phase I-A construction and improvement period, solid waste management must be implemented with the existing collection and disposal (open dumping) systems. If these systems are not properly managed, adverse effects on the Project implementation will be incurred necessitating the improvement of the present management system. The subjects of managerial improvement are as follows.

- a. Permission system for disposal sites and control of their operation
- b. Control of solid waste collection work
- c. Proper treatment (remuneration, etc.) of collection workers
- d. Tight control of illegal dumping

1) Permission System for Designated Disposal Sites and Control of Their Operation

In principle, the solid waste collected in each wilayah must be disposed of at those disposal sites of the Dinas Kebersihan. However, the solid waste generated in those areas where the transportation conditions are poor may be disposed of at those disposal sites where it is specially permitted under certain conditions in the areas. The Dinas Kebersihan examines whether or not those disposal sites prepared by the wilayahs satisfy the official criteria and permits their use after confirming their locations and the planned duration of use.

The following system should be introduced to permit special disposal sites.



The Dinas Kebersihan should prepare judgement criteria on the following items for a designated disposal site.

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- o Size (Minimum Size)
- o Road Conditions
- o Surrounding Environment
- o Disposal Plan
- o Disposal Method
- o Site Requirements
- o Water Utilization in Surrounding Areas
- o Future Land Use
- o Locational Relationship with Subject Collection Area

In permitting a designated disposal site, the assurance of the proper operation and management at the site and the submission of operation records to the Dinas Kebersihan must firmly be kept. The Suku Dinas Kebersihan in each Wilayah must confirm the following items whenever solid waste is taken to such a designated disposal site.

- o Responsible Collector
- o Vehicle Registration Number and Model
- o Driver
- o Disposal Period

2) Control of Collection work

The Dinas Kebersihan will prepare the standards on the following points in order that the collection work in each Wilayah is properly conducted and will instruct each Wilayah to follow these standards.

- o Provision of a map for each Kecamatan to control the collection work
- o Recording of collection areas and container installation locations on the maps

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- o Decision on collection day(s) for each collection point
- o Introduction of a weekly time schedule (required work amount) for each collection vehicle
- o Control of collection hours
- o Recording of collected solid waste volume
- o Preparation of a monthly evaluation report on collection work

Each Wilayah will be requested by the Dinas Kebersihan to prepare the necessary documents concerning the above and these documents will be checked by the Dinas Kebersihan. In addition, the Dinas Kebersihan will conduct checks on the operation management of each designated disposal site by examination of the monthly evaluation report submitted by the Wilayah.

3) Proper Treatment of Collection Workers

The Dinas Kebersihan will prepare guidelines to assess the work of drivers and collection workers using data on the operation and control at the designated disposal sites and the data on the collection work. Based on this assessment, the proper treatment of collection workers should be implemented in terms of providing incentives for capable workers, etc.

4) Tight Control of Illegal Dumping

The Dinas Kebersihan will prepare guidelines to check illegal dumping and will instruct each Wilayah to adhere to these guidelines. The contents of the guidelines will be as follows.

- o Regular patrols
- o Identification of troublesome locations
- o Sanitary evaluation of each RW
- o Education and campaign aimed at residents to prevent illegal dumping and to enlist their cooperation in solid waste management

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The Dinas Kebersihan will prepare guidelines for (1) - (4) above and will develop a solid waste management system in each Wilayah pursuant to these guidelines. This system should be established by 1992 when some of the facilities newly constructed under the Project will commence operation. The development process in the subsequent years is as follows.

