

Policy Responses Towards Improving Solid Waste Management in Seoul City*

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I. Introduction

The Seoul City has been the capital city of the nation for about 600 years. However,

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the City experienced rapid growth only in recent years. The Republic of Korea remained an agricultural country until early 1960s. The rapid industrialization began with the First 5-year Economic Development Plan which started in 1962. The Seoul City grew very rapidly with the success of industrialization. The population of the City increased from 3,471 thousand in 1965 to 10,287 thousand in 1988, which occupies 23.9 per cent of the national total population. The annual population increase rate of the City during the time was 5.07 per cent while the national average was 1.66 per cent.

As results of rapid industrialization and urbanization, the City faced with serious urban problems such as housing, traffic congestion, environmental pollution, and others. Among them, the solid waste management issue emerged as one of the most urgent urban problems in the City. Traditionally, Korean people did not produce any wastes to be dumped collectively: all wastes were recycled in principle. Wastes were either fed to livestock or were utilized as fertilizer. However, the citizens could no more practice recycling as the composition of wastes changed and the City became congested.

The Metropolitan Government organized a department responsible for managing solid wastes only in early 1960s. Open dumping has been the main practice for disposing the wastes until present time. The City made some efforts to improve the solid waste management in the metropolis. But most of them were not very successful because of social and financial constraints. At present, Nanjido, an islet in the Han River, is the only landfill site for the City. The capacity of Nanjido is running out, but it has not been possible to secure a new landfill site for the City until recent time. Therefore, the City keeps on piling up wastes on Nanjido to form a huge refuse mountain.

Unable to find other solutions for the ever increasing solid wastes, Seoul Metropolitan City finally decided to develop a reclamation site in the West Coast for dumping wastes jointly with Kyungki Province which holds many satellite cities of Seoul. Since landfill sites are very limited, the solid waste management issue will remain one of the most urgent problems for the City and continuous efforts should be made to improve the management.

This paper reviews the solid waste management system in Seoul City and analyzes problems and policy responses in the solid waste sector associated with the rapid urbanization of the Seoul City. Through the analyses measures for improving solid waste management are suggested. This study was performed mainly through investigating documents and reports and interviewing relevant government officials and experts,

II. History of Urbanization and Solid Waste Management Practice

1. Brief History of Seoul City

Seoul has been the capital city of the nation since 1394, two years after the establishment of Chosen Dynasty. According to the statistics surveyed in 1428, the population was 103,328 within a city area of 16km². The population reached 200 thousand in 1660 and remained at that level for about 200 years. When Korea opened door to foreign powers in the mid nineteenth century, the City began to swell markedly with the influx of foreign residents.

Japan ruled Korea from 1910 to 1945, and during the time the City experienced a marked change in administration system and in size. At the time of national liberation in 1945, the population reached 900,000 and the area extended to 135km²^{1,2)}.

The population growth during the 1950s was mainly due to the influx of refugees from North Korea during the Korean War. However, the urbanization was not so significant until 1950s since Korea was largely an agricultural country by that time: the rural population occupied about 80 per cent of the total population.

The rapid growth of the City began with the First 5-Year Economic Plan which started in 1962. The population of the City grew to 3,471 thousand in 1965, 5,525 thousand in 1970, 8,364 thousand in 1980, and 10,287 thousand in 1988. As the City grew huge, its influence stretched beyond the city boundary line. So that many of the inhabitants in Incheon City and other cities in Kyungki Province have their job bases in Seoul Metro-

Table 1. Population Increase in Seoul and Capital Area

(Unit : 1000 persons)

Items	1965	1970	1975	1980	1986	Annual Average Increase(%)			
						'65~'75	'75~'80	'80~'86	'65~'86
Total(A)	29,436	30,882	34,707	38,124	41,569	1.66	1.90	1.45	1.66
Seoul(B)	3,471	5,525	6,890	8,364	9,799	7.10	3.95	2.67	5.07
Capital Area(C) ¹⁾	2,984	3,358	4,040	4,935	6,517	3.08	4.08	4.74	3.79
B/A * 100(%)	11.8	17.9	19.9	21.9	23.6	—	—	—	—
(B+C)/A * 100(%)	21.9	28.8	31.5	34.9	39.3	—	—	—	—

Source: Statistical Bureau, Korea Statistical Year Book, 1988

Seoul City, Seoul, Statistical Year Book, 1966~1987

Korea Transportation Development Institute, Studies on the Transportation Basic Plan of Seoul, 1987, p.53

1) Capital Area: Incheon and whole Kyungki-do area

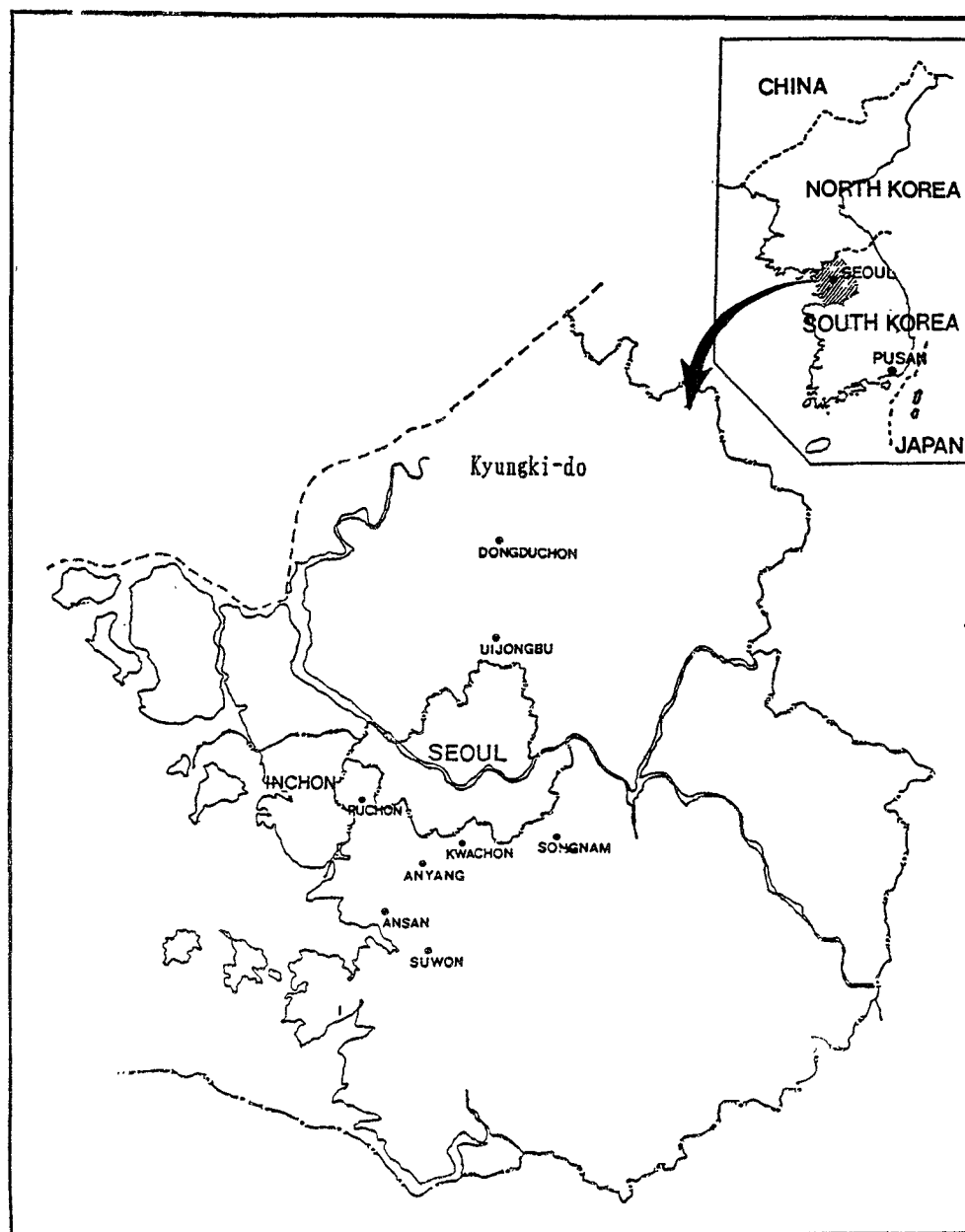


Fig. 1. Map of Seoul and Capital Area

politan City (see figure 1). The population in Seoul, Incheon, and Kyungki amounted to 16,316 thousand in 1986 which is 39.3 per cent of the national total (see table 1)³⁾.

2. Major Problems during the Process of Urbanization

The urban problems associated with the rapid growth of the City included housing

shortage, traffic congestion, environmental pollution, crimes, and others.

The housing rate was 59.2 per cent in 1985, which means that about 40 per cent of the population did not own house.⁴⁾ The housing supply never met the population growth.

The automobiles registered in Seoul City was 221,644 in 1981,⁵⁾ but it increased to about one million in 1989. The City could not prepare for this abrupt increase of automobiles, so that there are heavy traffic congestions within the City. The average traveling speed in downtown was about 18km/hr according to the survey in 1989.⁶⁾ The number of traffic accident increased rapidly also: it increased from 44,261 in 1982 to 91,064 in 1987.⁷⁾

Until 1950s, the Republic of Korea had not been affected by environmental pollution. Pollution was not a familiar word by then. During the Japanese rule, industries were located mainly in the northern part of peninsula, and the Republic of Korea was left an agricultural state after the division of the country. The environmental pollution issue emerged as the industrialization began in the early 1960s, and it became very prominent during 1970s and 1980s. As a newly industrializing country, the Republic of Korea happened to induce pollution-intensive industries and fuels which industrialized countries avoided. As a result, the pollution level in the Republic far exceeded those levels industrialized countries experienced.

The annual mean level of SO₂ in Yangpyung-dong, an industrial area, reached 0.151 ppm in 1979, and in Shinseol-dong, a residential area, it reached 0.183ppm in 1987.⁸⁾ These levels are far beyond those in other metropolitan cities of the world.

Until early 1960s, the Han River which flows through the City was an excellent source of water supply and provided a good bathing during summer season. But now the River even has putrifying odor during dry season, and bathing is unthinkable. The City had to move the intake site for the water supply to about 30km upstream. However, when the qualities of intake waters and tap waters were disclosed this year by mass media, it caused a tremendous sensation nationwide and the government is being forced to invest more budget and efforts to improve the water quality due to the pressure from people.

The amount of solid wastes increased enormously during the last decades: from almost nothing until 1950s to 1.27kg/capita-day in 1970 and 2.80kg/capita-day in 1988,⁹⁾ which is one of the world's largest. The increase was so rapid that the City could hardly respond to the changing needs. As the capacity of the only landfill site left for the City is running out, the solid waste issue emerged as one of the most urgent problems the

City has to solve.

3. History of Solid Management

Traditionally, Korean people did not consider daily life wastes as useless refuses to be discarded. Garbages were fed to livestock, and ashes, night soils, and other wastes were utilized as fertilizer. Korean ethics did not allow these wastes to be discarded to rivers or other improper places because all of them were regarded as useful resources. The violation used to be punished with severe penalties in old times. For example, such a phrase as "thirty lashes for dumping ashes and fifty lashes for dumping night soil" is found in engraved stones to warn village people during the time of Chosen Dynasty. It is known that fifty lashes almost kills a person.

As the City grew bigger, Seoul Committee, a non-governmental organization, was formed in 1907 and this organization started taking care of the collection and disposal of solid wastes.¹⁰⁾ This was the beginning of modern system in solid waste management. After the liberation from Japan, the Seoul Metropolitan Government assumed the responsibility for the management. Until 1962, Health and Sanitary Bureau, Police Bureau, or Social Affairs Bureau took care of night soil and solid wastes in addition to their main jobs(see table 2).¹¹⁾ But the solid wastes did not cause a serious social problem until this time, because most people still practiced the conventional method.

With the industrialization in 1960s, chemical fertilizers replaced composts and the composition of wastes changed so that they became no more suitable for composting. As the need for managing wastes arised, the Waste Disposal Bureau was established within the Metropolitan Government in 1962.¹¹⁾ However, the Metropolitan Government did not care much about the wastes during 1960s, because there were plenty of dumping sites around the City. Rice paddies and other crop fields within the City served as good dumping sites because these low lands had to be landfilled anyway to be developed for urban land use to meet the land demand caused by the rapid growth of the City.

As the small-size dumping sites ran out in 1970s, the Government had to secure large-scale landfill sites in the outskirts. Nanjido, an islet in the Han River, was the major landfill site developed for the City. As the Government realized the seriousness of the solid waste problem in 1970s, it began to organize the administration structure more systematically and survey statistics related with the solid wastes.

In 1980s, as the land price in Seoul soared and open spaces ran out, it became literally impossible to find proper landfill sites within or near the City, Therefore, the City keeps

Table 2. Division in Charge of Solid Waste Management

Period	Division in Charge
1945 ~1953	Sanitary Div. of Healthy and Sanitary Bureau
1953 ~1962. 2. 1	Security Div. of Policy Bureau→Sanitary Div. of Social Bureau
1962. 2. 1~1973. 7. 1	Waste Disposal 1,2 Div., Waste Disposal Bureau
1973. 7. 1~1979.10. 1	Waste Disposal 1,2 Div., Environment Bureau
1979.10. 1~1981.11. 1	Waste Disposal Div., Environment Bureau
1981.11. 1~	Waste Disposal Div., Parks & Environment Bureau

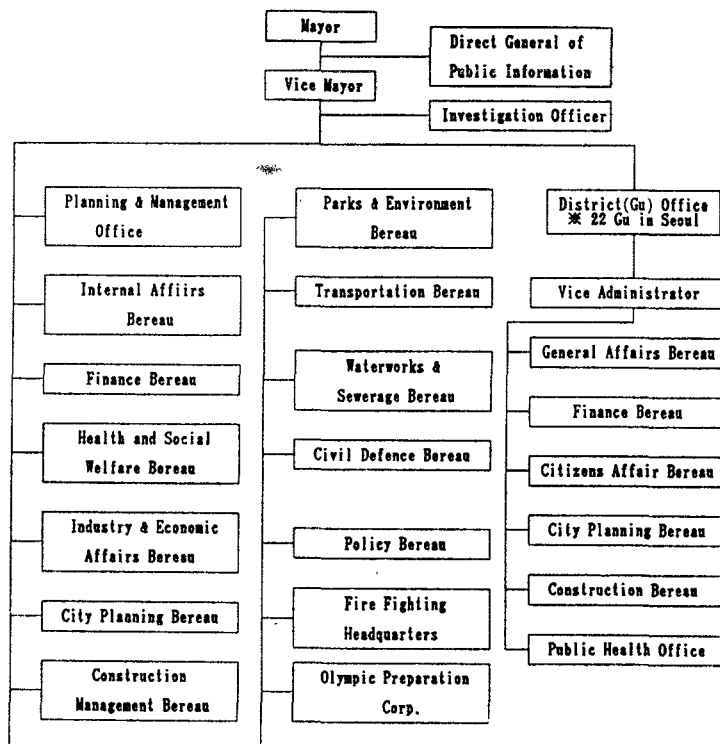
Source : Seoul City, Seoul Si-jung, 1988, pp.189-190

ou piling up wastes on Nanjido, which became no more an isle but a huge refuse hill by the Han River.

The Metropolitan Government is planning to develop a large-scale waste reclamation site in the West Coast jointly with Kyungki Province. The site will be ready for dumping wastes starting from 1991. Sanitary landfill method will be practiced.

4. Present Solid Waste Management System

At present, Waste Disposal Division in Parks and Environment Bureau of Metropolitan



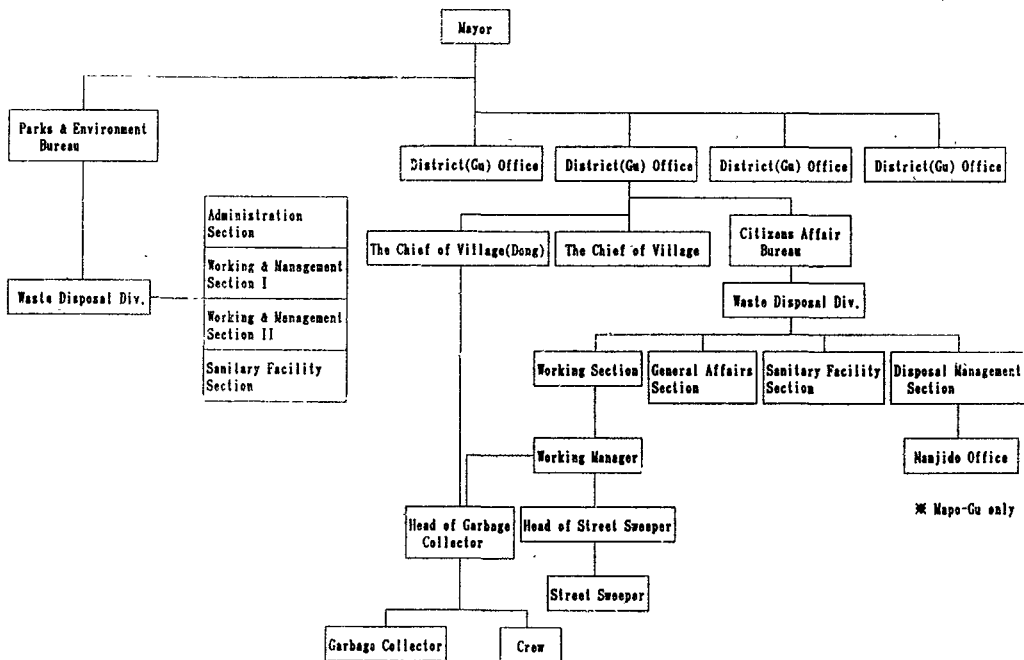
Source: Seoul City, Seoul Statistical Year Book, 1988, pp.504-507

Fig. 2. Organization Chart of Seoul Metropolitan Government

Government is responsible for planning and budgeting of the waste management in the City. The City area is divided into twenty-two gu, and Waste Disposal Division in each gu is in charge of daily operation. In a near future, the gu government will obtain autonomy and assume budgeting right. Each gu is divided into dong again. Each dong has a population between several thousands to several tens of thousand. There are 475 dong in Seoul. The gu government dispatches waste collectors to each dong and the chief of dong is responsible for supervising the collectors(see figure 2 and 3).

The collection business in easy areas such as apartment towns and commercial districts in flat terrain is contracted to private agencies. In apartment towns, the wastes usually are deposited in down cellar through dust-chute. Then collectors handpick recyclable wastes and the rest wastes are loaded on trucks and directly transported to Nanjido. The amount collected by private agencies is estimated to be 46 per cent of the total wastes.

In most residential towns, each household is required to put wastes in vinyl bags and place them in alleyside. The wastes are collected using handcart and are carried to transfer station. Then trucks convey them to Nanjido. The handcart is not very efficient in collecting wastes and the transfer station causes sanitary problems, but the narrow roads



Source: Environmental Planning Institute, Graduate School of Environmental Studies, Seoul National University, A Study on the Efficient Management of Urban Solid Waste, 1983, p. 140

Fig. 3. Organization Chart of Solid Waste Management

in most residential areas make such system inevitable. In areas with steep slopes or narrow alleys which do not allow free movement of handcart, residents are required to carry their own wastes to truck stations at the sound of bells. Rarely, in high mountain areas where transportation is extremely difficult, collectors put wastes in larger bags and hand carry them to the carts. In new residential areas with well built road system, trucks collect the wastes and directly transport them to Nanjido.

The wastes are collected two to three times per week. The collection schedule is irregular, so that residents put out waste bags to streets whenever they are full. To prevent littering of wastes from bursting, many residents place plastic dust bins in alleys. The wastes are wrapped in vinyl bags and put in dust bins. However, coal briquette ashes are usually piled up in alleysides as they are because the volume is large and they burn plastics.

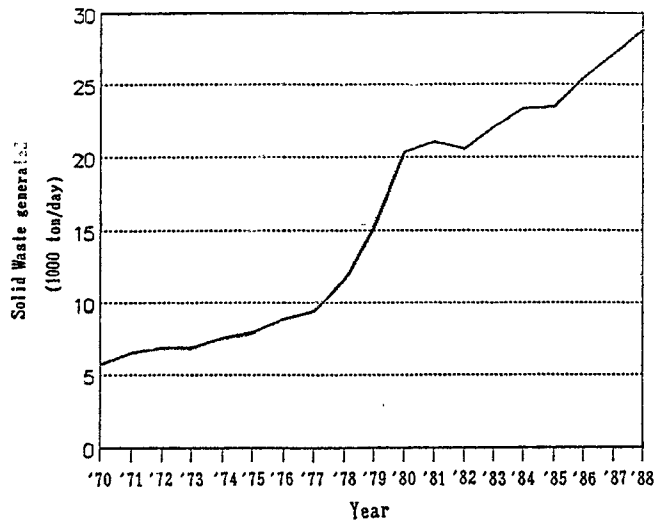
Transfer stations usually occupy street corners. Open space is rarely available. Collected wastes are usually stored in large containers or walled spaces. Because of complaints from residents regarding odor and littering, the Metropolitan Government built a couple of building type transfer stations. But the Government stopped the project due to the strong objection from residents. The wastes collected in transfer stations are loaded on trucks and transported to Nanjido.

Nanjido was originally an isle in the Han River. In the late 1970s, the City began to dump wastes in the waterway between Nanjido and Seongsan-dong, Mapo-gu. Soon the waterway disappeared and the whole isle became a landfill area. Open dumping is practiced in Nanjido, and there are no treatment facilities at all. There are about 1,800 waste pickers living in Nanjido with their family. Originally the City intended to landfill the area until it is safe from flooding. But the City could not find any other landfill sites, so that Nanjido became a huge hill.

III. Problems and Constraints in the Solid Waste Sector

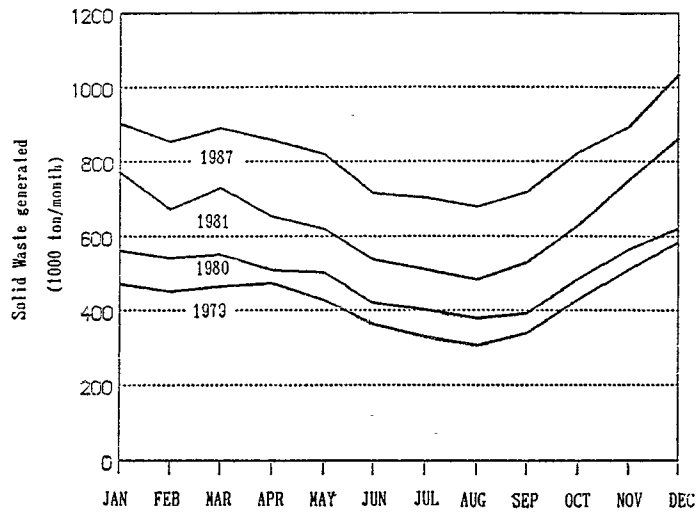
1. Characteristics of Solid Wastes

The amount of solid wastes transported to Nanjido in 1988 was estimated to be 10.5 million tons, which is about 40per cent of the national total(see table 3)¹²⁾. This includes domestic wastes, commercial wastes, street sweepings, and others in Seoul City, but not industrial wastes. This is equivalent to 2.8kg/capita-day, which is one of the world's



Source: Waste Disposal Div., Seoul City
 Environment Administration, Planning and Performance of
 Solid Waste Treatment, 1989, p.5.

Fig. 4. Trend of the Amount of Solid Wastes Generated in Seoul



Source: Waste Disposal Div., Seoul City

Fig. 5. Monthly Fluctuation of Solid Waste Generation

largest. The national average emission factor is 2.19kg/capita-day. This high emission factor is mainly due to the coal briquette ash which occupies 44 per cent of the total wastes¹³⁾.

The waste emission surveyed in 1970 was 1.27kg/capita-day. This means that the annual

Table 3. Amount of Solid Wastes Generated (AS of 1988)

Area	Total Amount (Ton/Yr)	Daily Amount/Person (kg/psn/day)	Local Ratio (%)
In-country	26,607,405	2.191	100
Seoul	10,512,000	2,800	39.5
Pusan	2,596,245	1.887	9.8
Incheon	1,505,260	2.527	5.7
Kyungki-do	3,230,615	2.024	12.1

Source : Environment Administration, Planning and Performance of Solid Waste Treatment, 1989, p.5

Table 4. Physical Composition of Solid Wastes in Seoul (Unit : %)

Composition		Spring	Summer	Autumn	Winter	Average
Combustibles	Sub-total	55.43	80.99	47.71	29.07	49.87
	Paper	16.10	22.81	14.33	8.06	14.35
	Rubber, Plastic	8.56	8.81	6.48	2.05	6.06
	Fabric, Leather	1.90	2.59	0.92	0.67	1.41
	Garbage	26.16	45.03	23.34	16.84	25.93
	Wood, etc.	2.71	1.75	2.64	1.45	2.12
Noncombustibles	Sub-total	44.57	19.01	52.29	70.93	50.13
	Coal Ash	37.21	10.29	45.02	68.84	44.23
	Glass, Metal, etc.	7.36	8.72	7.27	2.09	5.90

Source : Seoul City, Basic Plan of Solid Waste Treatment in Seoul, 1988, p.139

increase rate of the per capita wastes was 4.5 per cent. The total wastes generated in Seoul increased five times since 1970, which means annual increase rate of 9.4 per cent (see figure 4)¹²⁾.

The solid waste production is minimum in August and maximum in December. The amount of wastes generated in December is 1.5 to 2 times that in August. This is due to the waste vegetables from pickling kimchi and increased use of coal. And there is a slight increase of wastes in March, which is probably because of the cleaning up of the wastes accumulated during winter season(see figure 5)¹⁴⁾.

Looking at the composition of the wastes, the coal briquette ash occupies 44 per cent of the total wastes, garbage 26 per cent, papers 14 per cent, rubber and plastics 6per cent, and glasses and metals 6 per cent(see table 4)¹³⁾. The composition markedly changes with season because of the coal briquette ash, which occupies 69 per cent during winter (December, January, and February) while only 10 per cent during summer (June, July, and August). However, the proportion of coal briquette ash is steadily decreasing due to

the increased use of oils and natural gases for domestic heating.

For combustible wastes, the moisture content, was 56 per cent, low heat value 1290kcal/kg, and the C/N ratio 46. The heat content during summer season is low because of high moisture content in garbages (see table 5).

2. Major Problems and Constraints in the Solid Waste Sector

2.1. Problems and constraints in solid waste characteristics

The first problem to be noted is the inaccuracy of the statistical data concerning the characteristics of solid wastes. The amount of solid wastes in Seoul is being estimated based on the count of vehicles entering Nanjido. Thus, the statistical data are not very accurate because it has not been precisely known to what capacity the trucks are loaded. There have been several studies on estimating the amount of solid wastes in Seoul. But most of the studies were not so intensive and the results showed quite a significant variation depending on season, type of house, income, way of living, and others. And it is very probable that many synthetic materials are falsely classified into fabric or leather. The lack of reliable data makes it difficult to estimate future trend in the amount and composition of wastes for planning.

Another difficulty in future planning lies in the rapid change of the waste characteristics. The statistical data are available only starting from 1970 and the amount of wastes and the composition changed so rapidly that it is not easy to tell to what level and when the trend will be stabilized. For example, a refuse-derived-fuel(RDF) plant which is supposed to produce pelletized fuel failed because the wastes turned out to contain more moisture and plastics than expected. Since 1980, the amount of papers and plastics increased to about 2.5 times while the coal briquette ash rather decreased.

The great fluctuation of waste characteristics with season makes it difficult to treat the wastes efficiently. Both the amount and the composition change with season significantly.

Table 5. Chemical Composition of Solid Wastes in Seoul¹⁾

Composition	Spring	Summer	Autumn	Winter	Average
Water Content(%)	46.90	67.00	53.60	56.28	55.95
Ash (%)	9.13	8.29	8.88	8.61	8.73
C/N Ratio	50.3	44.1	47.7	41.6	45.8
Low Heat Value(Kcal/kg)	1817	717	1414	1320	1294

Source: Seoul City, Basic Plan of Solid Waste Treatment in Seoul, 1988, pp.143-145, 150, 152

1) For combustible wastes only.

2.2. Problems associated with collection and transport

The alleyside collection system began only recently. Before then collectors emptied waste boxes in each house except for the bell collection areas. The boxes were either fixed to wall or portable, and were placed either within or outside of house (see table 6). This system was very inefficient in terms of manpower requirement, especially fixed containers required a great deal of manpower. The Metropolitan Government now recommends citizens to use vinyl waste bags and place it in alleysides. Citizens are responding to the Government's policy slowly and are in the process of changing waste box to comply with the new policy. Therefore as shown in table 7, various types of waste box are in use at the moment. The difference in the type and the location of waste box makes collection not so efficient. The standard waste vinyl bags the Government recommends are easily ruptured because of poor quality, and for this reason citizens are not very favorable about using the bags.

In apartment towns, wastes are usually stored in cellar through dust-chute. This waste cellar causes odor and pest problems. And it is not easy to recover recyclables from the mixed wastes. Sometimes hot coal ashes can cause fire.

The Metropolitan Government plans to practice sanitary landfill method in the newly developing landfill site. The coal briquette ash will be used as daily cover soil. In that case, the coal ash needs to be collected separately from other wastes. Besides, for the efficient operation of intermediate treatment facilities such as incinerators and for the improvement of resource recovery, it will be better to collect wastes by composition. The Government began practicing separate collection system, which means separate collection of coal briquette ash and other wastes, to make citizens accustomed to the future policy. But an investigation in 1988 showed that only 50 per cent of the coal wastes were collected separately. But the questionnaire survey with citizens revealed that over 90 per cent of the citizens were willing to cooperate to the separate collection system as the Government requested.

Table 6. Location of Waste Storage Box

Items	Total	Indoor		Outdoor		Others
		Fixed	Portable	Fixed	Portable	
Sample	2,464	681	374	637	732	40
Ratio(%)	100	27.6	15.2	25.9	29.7	1.6

Source: Seoul City, Basic Plan of Solid Waste Treatment in Seoul, 1988, p.12

Table 7. Type of Waste Storage Box

Item	Total	Vinyl Bag	Paper Bag	Plastic	Concrete	Steel	Chute	Others
No. of Sample	2,478	932	43	599	340	131	408	25
Ratio (%)	100	37.6	1.7	24.2	13.7	5.3	16.5	1.0

Source: Seoul City, Basic Plan of Solid Waste Treatment in Seoul, 1988, p.13

The handcart is not very efficient in collecting wastes. The capacity is 500 to 1,000kg. It often causes accident in steep slopes. A collector usually is in charge of a certain area. Thus, it is very easy to supervise the performance of an individual collector, but collectors do not need to keep the collection schedule. The Metropolitan Government recommends citizens to put out their waste bags at a designated time, but they mostly don't know when that time is. And there are some complaints among citizens regarding tips paid to collectors.

The transfer station is needed to collect wastes from handcart and to load them on trucks. In most cases the transfer operation is done in open spaces, and it causes odor and particulate pollution. Majority of them are located in street corners, and it causes traffic problem also (see table 8).

Trucks employed in transporting wastes are mostly 2.5ton, 4.5ton, and 8ton trucks. The 8ton truck occupies 57 per cent of the total. The small-size trucks are not very efficient and causes littering and traffic problems.

2.3. Problems associated with resource recovery and disposal

The recovered resources from wastes were estimated to be about 152 thousand tons in 1988, which is about 1.4per cent of the total wastes generated. About one third of them are recovered at transfer stations and two thirds at Nanjido. The recovery rates of papers, plastics, and bottles, etc. are lower than those in Japan and Taiwan. The main reason is the market for recovered wastes is not very active. This in turn is because of low economic incentives for recovery and inefficient and unstable market system for the recovered materials. Another reason is that citizens store wastes mixed and therefore it is difficult to recover recyclable wastes.

The only intermediate treatment facility in Seoul is an incinerator located in Mokdong apartment town. This incinerator was constructed in 1986 and treats 150tons of wastes per day, which is only 0.5 per cent of the total wastes in Seoul.

The operation is successful, however there are some complaints from residents in nearby areas about the odor from incineration.

Table 8. Type and Location of Transfer Stations (As of '89)

Type and Location		No of Station	Ratio(%)
Type	Open Space	63	10.0
	Space with Wall	228	36.2
	Building	6	1.0
	Container	333	52.9
	Total	630	100.0
Location	Trunk Line	86	13.7
	Branch Line	309	49.1
	Open Space	96	15.2
	River Side	74	11.7
	Residential Area	65	10.3
	Total	630	100.0

Source : Waste Disposal Div., Seoul City

In Nanjido, there are various environmental problems such as odor, particulate emission, fire from landfill gases, pests such as flies and rats, pollution of the Han River from leachate, and others. The most frequent complaint from neighbor residents is about the odor. There also are some social problems associated with the waste pickers living in Nanjido. Inadequate living environment and safety accidents such as fire or explosion are the main problems.

2.4. Problems and constraints in administration and management system

According to the personnel management policy of the City Government, officials are not allowed to stay in a position for more than several years. In the Waste Disposal Division of the Metropolitan Government, seventy per cent of the officials turned out to be working for less than three years. This system may prevent corruption. But, officials can not accumulate knowledge in this field, and policies may lack consistency.

The waste collectors are in bad working condition in terms of salary and work load in addition to the bad working environment. The average monthly salary for the collectors, 445,300 won, is about 71 per cent of the average labor's earning in the City 631,000 won¹⁵⁾. In average a collector takes care of 3.8 tons of wastes per day, which is a heavy work load so that often family members help collectors to finish the work within time. It seems that collectors make up for their earnings by tips. According to a survey in 1988, fifty-five per cent of citizens replied that they paid tips to collectors, and seventy-four per cent objected the tip system.

There are 630 transfer stations in Seoul and to each station one or two trucks are

allocated. The City does not have enough spare trucks. Therefore, when vehicles fail, the collection schedule has to be changed.

The City Government is in charge of planning and budgeting, the district (gu) government is responsible for daily operation, and collectors are under the supervision of the chief of village (dong). However, there often arise conflicts between them. The final operation of city cleansing depends upon the supervision of the chief of dong, and his main job is not with the waste collection. This may impose an obstacle in achieving clean villages. Street sweeping is the responsibility of the waste disposal division of the gu government. In Seoul City, streets are usually cleaner than villages.

IV. Policy Responses to Improve Solid Waste Management

1. Policy Responses to Improve Resource Recovery

To encourage recycling of wastes, there are various public campaigns such as placards in streets, education in school, television campaign, and others. And the Korea Resources Recovery and Reutilization Corporation was established especially to recover waste papers and plastics. However, these attempts have not been very successful. The recovery rates of papers, plastics, and bottles, etc. are still lower than those in Japan and Taiwan. The main reason is low economic incentive for waste recovery. The prices for recovered materials are very low. The collectors for recyclable wastes are not very active, because the job is not very profitable and the markets are not stable.

2. Policy Responses in Collection and Transportation of Wastes

Since January of 1988, citizens are asked to wrap wastes except coal briquette ash in vinyl bags and place them in alleysides. The purpose was to improve the efficiency of collection and to separate coal briquette ash from other wastes. The Metropolitan Government is examining a plan to supply the waste bags free by allowing advertisement and allocating city budget. But at the moment the bags are on sale and they are not mandatory. The present waste bags are of poor quality and are easily ruptured. Since people can obtain free vinyl wrapping bags from markets, which are of better quality, the waste bags are not widely used. The free wrapping bags are usually small and are not completely sealed. This causes littering and odor problem.

As pointed out in the previous chapter, the handcart is not efficient in collecting wastes and is causing safety accidents. The Government is in the process of changing the handcart

to a small-size truck such as a 2.5-ton truck, which can be driven in most of the Seoul alleys. The handcarts will be left only in areas where this truck cannot reach. The City needs 11,640 trucks but owns only fifty-four as of 1988. This plan will cost 17.5 billion won, but will save 1,560 collectors, who are to be allocated to difficult areas such as high mountain areas.

The Metropolitan Government plans to change the present small-size transfer station to larger one by 1994 to improve the efficiency and to solve the complaints from residents. At present there are 1.4 stations in a dong in average, but the larger station means one station for about five dongs. The City before constructed two building type transfer station in residential areas, but could not use them because of protests from residents. Residents put up with open-type stations hoping that they move out in future, but would not allow permanent stations even though they cause less nuisance. The new station will be building type also, but the locations will be carefully chosen.

The Government also plans to build intermediate treatment plants which have incinerator, compaction devices, and such facilities by 1996. One plant will cover three gus. These plants will be built in remote areas such as green belt or river bank so that they will not cause complaints from residents.

When the West Coast reclamation site is ready for landfill, small trucks will be very inefficient for transporting wastes, the City plans to replace present 4 to 8.5-ton truck to 24-ton container trailer by 1996. This will cost 22.5 billion won.

3. Policy Responses in Treatment and Disposal of Wastes

To solve the coal briquette ash problem, the City once built an ash brick plant. But the plant failed because this brick readily absorbed moisture, and thus was not suitable for building houses. There also has been an attempt to use the coal briquette ash as an additive material for composting night soil. The ash is very efficient in absorbing moisture and in supplying oxygen. However, this attempt has not been very successful either because of the lack of government's support. The Korean Government has very strict regulations on fertilizer goods and as a result this system supports chemical fertilizer industry which has more than enough capacity in domestic market.

A RDF plant for pelletized waste fuel plant was built in Nanjido in 1987 to recover energy from wastes. It costed about 10 billion won, but failed. The main reason is that the waste composition was different from the designed one. The technology came from Western Europe. However, unlike European wastes, ours turned out to contain more

garbages and plastics. Garbages raised moisture content and plastics hindered pelletizing process. In the feasibility study, the waste characteristics were surveyed, but this result proves that the survey was not very accurate in selecting samples to represent the general trend.

The City have not even tried composting which has been frequently recommended by many environmental experts. In fact, the demand for the product is uncertain as long as the chemical fertilizer industry in Korea has more capacity than enough.

While many efforts to improve the management of solid wastes failed, incineration has been quite successful. A large-scale incinerator has been in operation within a huge apartment town in Mok-dong. This plant burns wastes from apartments in this town and supplies heat to them. However, there are some complaints regarding air pollution from the plant. Originally, the plant was supposed to install absorption towers to remove gaseous pollutants and odor in addition to electrostatic precipitators. But the plant is only equipped with electrostatic precipitators.

Since the capacity of Nanjido is running out and it becomes impossible to secure landfill sites near Seoul, the City and Kyungki-do decided to develop a joint reclamation site in the West Coast for dumping wastes. The area is 20.8km² and 14.1 billion wons will be invested until 2013 for facilities such as a leachate treatment plant, gas collection system, roads, and bridges. Sanitary landfill method will be practiced. The site will be available for landfill from 1991.

4. Policy Responses in Administration Management

The Metropolitan Government responded rather quickly to the needs for revising the administration system for the solid waste management. Until 1950s when the solid wastes did not impose a serious problem at all, Police Bureau or Social Affairs Bureau was in charge of the night soil and solid waste management. And Waste Disposal Bureau was established in 1962, which is the year the First 5-year Economic Development Plan started and our industrialization began. As the City grew, new gus were established in time for a proper size of population and the responsibility for daily operation was given to the gu government.

However, the Government was not consistent in assigning agency for the duty of waste collection. Sometimes the government directly operated the service and other times it was contracted to private agencies. At present government and private agencies share the job (see figure 6). Private agencies are more efficient in terms of economy, but they are in

1945		1955		1965		1975		1985		1988	
'48.10		'53.03		'63		'66.04		'78			
Gov't	Private Agency	Government		Pri- vate	Government		Gov't with Partial Private Agency				

Source: Seoul City, Seoul Si-jung, 1974~1988

Fig. 6. Agencies in Charge of Waste Collection

charge of only easy areas which are mostly rich towns. The Government is in charge of difficult areas which usually are poor to middle-class towns. Poor town usually takes more labor. Therefore if the service is left to private agencies, poor people will have to pay more for the wastes. The government policy is to help poor town with the city budget. But the tip problem makes the effect doubtful. The tips are usually paid to government collectors, not to private agencies.

The City offers an incentive to collectors by promising to transfer those ones showing good performance to areas with better working environment. But collectors do not appreciate this offer very much.

V. Role of Citizens' Participation

In order to reduce the amount of wastes, recycling has been encouraged through public campaign, education in schools, and others. Especially in elementary school, children are requested to bring used books and recyclable wastes such as papers, aluminum cans, and bottles regularly, usually once a month. The purpose is not to raise money but to teach to recycle wastes. This method is believed to be very effective in building awareness among growing generations. And this also may influence the attitude of children's parents. The effects may not show immediately, but it is believed that the children and parents who practiced recycling will respond favorably to government policies on solid waste management.

Bansanghoi meeting can be used for informing directions and guidances related to solid waste policies to residents. The City is divided into twenty-two gus, gu into dong, dong into tongs, and tong into bans. A ban consists of upto twenty or thirty households of close neighbor. The Bansanghoi meeting is held among a ban members once a month, usually 25th of each month, which is a part of Saemaetul Movement. In this meeting. various subjects related to the welfare of the town can be discussed and their demands

can be publicized. And governments use it for informing policies and asking citizens' cooperation. This meeting is becoming less active, but it still serves as a useful tool to inform new policies to residents. However, citizens are in fact indifferent to neighbors and environment so that there is no such thing as community surveillance. Even though a citizen litters or violates waste disposal ethics, neighbors usually pretend that they do not notice it.

Television is the most frequently used tool for public campaign. For example, a few sentences or phrases about keeping clean environment or no littering in parks are inserted between programs. The effects are not known.

Non-governmental organizations such as consumer organizations or various women's organizations are very active on environmental issues. For example, they are campaigning against using excessive wrappings in merchandises, demanding more incentives for recovered wastes, and watching government policies and industries, etc. The activities of consumer organizations are well publicized through newspapers, and therefore they are very effective in building public awareness.

VI. Suggestions for Improving Solid Waste Management

Before the West Coast landfill site was finalized, the solid waste problem was one of the most urgent issues the Seoul Metropolitan Government had to solve immediately. Thus in 1988, the Government launched a project to set up a long-term master plan to manage the solid wastes.¹³⁾ The author was involved in the project also. This plan, parts of which are introduced in the previous chapter, already included many measures to solve the present problems in solid waste management. Reflected in the plan are suggestions to solve problems in handcart, transfer station, intermediate treatment plant, landfilling, and others. Therefore, in this chapter only minor suggestions which are not included in the plan will be described.

As evidenced by the failure of the RDF plant, the Seoul City still lack reliable data on the amount and the composition of solid wastes. Most survey studies on wastes were conducted with a limited number of samples and were not continuous. The waste characteristics fluctuate greatly with sample and time. Therefore, we can not expect that such results be very accurate. In future, the waste treatment should be more diversified. And in order to avoid failure in the planning of treatment, there should be more comprehensive and continuous survey on the characteristics of wastes.

In order to reduce the amount of solid wastes generated, which is one of the world's largest, it is true that there should be continuous campaigns to citizens through school education, mass media, and others. Up to present the Government focused on campaigning against citizens. However, the most important factor affecting the citizen's habit is not education, but an economic incentive. The Government will have to be able to offer proper incentives to citizens and dealers for recycling wastes. There are too many middlemen involved in the circulation of recovered materials, and the collectors of recovered materials do not obtain much profit. Besides, the demands are unstable and the prices fluctuate. Therefore, the collectors and the dealers of recovered materials take their job as a temporary one, and they work only in profitable seasons. They deserve government's financial support because they actually contribute to save government's budget not only in the solid waste management but also in various ways by saving energy and resources. It is suggested that the Government should support the dealers to make the job more profitable and the market stable. The Government also should watch over the policies which may encourage people to produce more wastes. For example, there should be more tax on disposable merchandises such as disposable lunch boxes and cups.

The Government recommends to use a standardized vinyl waste bags to improve the collection efficiency. But citizens are not responding favourably to the policy. That is because the bags the Government recommends cost money and are easily ruptured while the wrapping bags from markets are free and strong. Therefore it will be better if the market's wrapping vinyl bags be standardized to be used as waste bags. The Government can allow advertisement in bags or even can financially support manufacturing the bags.

The Seoul City plans to build a few intermediate treatment plants to reduce the amount of wastes finally disposed. The treatment method frequently considered is incineration. However, the Korean wastes contain a lot of garbages, so that they are high in moisture content and low in heat content. Therefore incineration may not be the best method. Composting should be considered as a probable alternative. At present composting is risky because of strict regulations on fertilizer products and uncertain market system. But this economic environment may change someday and more diverse methods should be considered for future.

In the administration sector, the most frequently discussed social issue in mass media is the welfare of waste collectors. They perform a heavy work load and frequently are victims of safety accident. Their earnings are considerably lower than the average labors in Seoul,

and this probably is the cause of tips citizens complain about. Therefore, their working condition as well as their pay should be improved. Another problem to be noted in the administration sector is in the lack of experts among government officials in the solid waste departments. It is suggested that in fields where special knowledge is required officials be allowed to stay longer than the policy permits and more professional experts be hired without the normal recruiting process.

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