4. Municipal Solid Waste Management

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Seoul Seeks Breakthrough in Reduction & Utilization of Waste

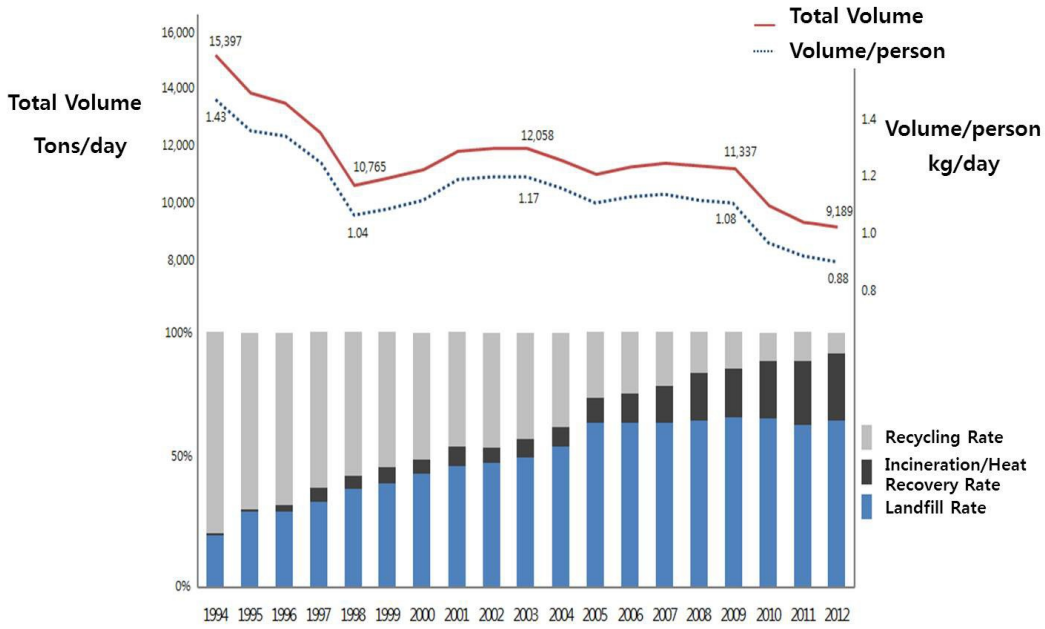
Modern waste management policy tends to place the greatest priority on reduction (reduction at source, reuse) and then recommends utilization (recovery of material and stored energy) of the waste that is unavoidable. Waste for which there is no use is disposed of, for example, by incinerating, or burying to reduce the level of hazard (David C. Wilson, 1996). In other words, waste management policy has a hierarchy, with reduction at the top of the ladder, followed by utilization, incineration, and landfill. This stratum was set up in consideration of various negative aspects such as social conflict in the waste disposal process (disposal concentrated in areas occupied mostly by the socially vulnerable, the "not-in-my-backyard" attitude, negative impact on real estate values, etc.); environmental degradation (traffic congestion generated by waste disposal vehicles and facilities, odor, pests, dust, noise, etc.); and loss of available resources (exhaustive use of land and other natural resources).

Until the 1980s however, the lower levels of the waste management policy hierarchy – incineration and landfill – were more widely accepted than the higher levels – reduction and utilization. While the former were easier for the government to pursue, the latter were only effective if producers and consumers were willing to reduce and recycle. Upon closer look, it can be seen that Seoul' s municipal waste management of the last 20 years reflects this modern concept of waste management. For instance, the total volume of waste generated in 2012 has dropped by 60% (in tons/day), while the volume generated per person (kg/person/day) has fallen 62% since 1994. Landfill, a lower level management method in the hierarchy, was also reduced to one-tenth of the total, from 78.6% in 1994 to 7.9% in 2012. In the meantime, the rate of utilization more than tripled, from 20.5% in 1994 to 65.3% in 2012. In 2012, the waste volume was down 6,200 tons/day over 1994, utilization volume was 6,000 tons/day, incineration and energy recovery volume was 2,500 tons/day, and the landfill volume only 700 tons/day. This order of waste volumes is consistent with the modern concept of waste management.

The central government adopted this management hierarchy via the Wastes Control Act of 1986. However, local governments – governing at the level where municipal waste is actually generated – struggled with collection and disposal of the amount of daily waste. Nanjido Landfill, scheduled to be closed in 1983, was used until 1993. In 1989, the construction of a landfill began in Gimpo, Gyeonggi-do to cover the capital area (Seoul, Incheon, Gyeonggi). In 1991, the City of Seoul planned to build 11 incinerators in Seoul as part of its basic plan to dispose of waste. The development and use of the landfill proved to be very difficult: residents were fiercely opposed, and any waste entering their areas was strictly monitored. Incineration also faced resistance from residents and general society due to the concerns of pollution and usable resources being lost forever. Until completion of the Mapo facility in 2005, Seoul had only 4 facilities with a total capacity of 2,850 tons/day. The only option to make up for the shortfall was to reduce the volume and make greater use of the discarded materials. Fortunately, people reacted very positively. Recycling thus surfaced in 1990,

starting at apartment complexes, and gradually spread to detached houses and commercial arcades. A new system was introduced where fees for waste were charged according to volume, a system to which people also responded favorably. In 1998, the utilization of food waste began. From 2005, all food waste was to be disposed of separately for recycling, which people also willingly followed. A greater diversity of items was collected for recycling, including paper, glass, metal, plastic, electronics, and waste oil. A recycling rate of 65.3% in 2012 was made possible due to both individual and business participation in waste management policies and programs.

Figure 1 - Municipal Waste Generation & Treatment in Seoul



Building a Waste Treatment Infrastructure: Top Priority of the 1980s & 1990s

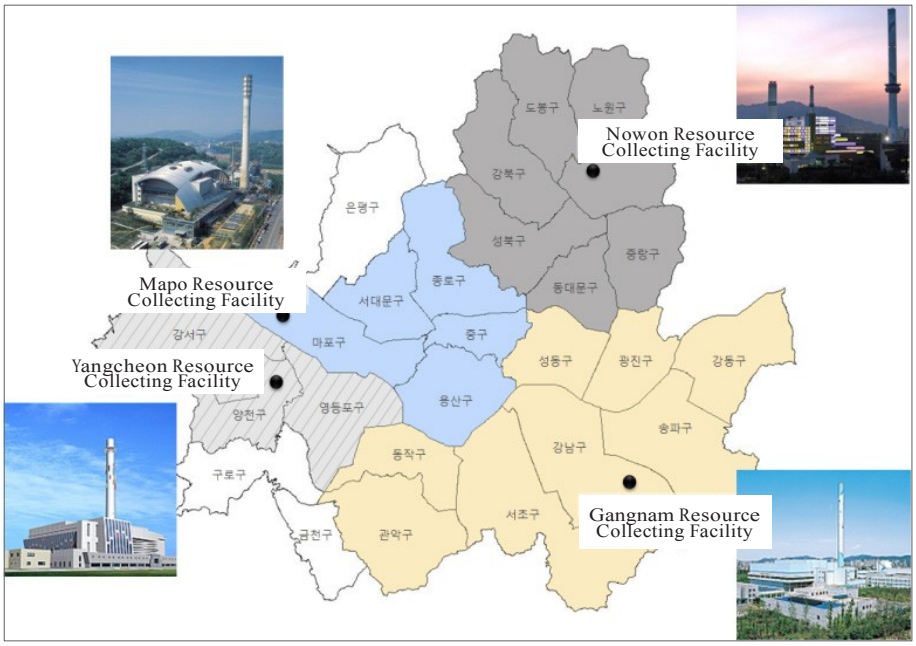
Nanjido Landfill was the first official waste treatment facility for Seoul, taking care of waste from multiple sources (municipal, construction, sewers, etc.) from 1978 to 1993. Before 1978, the city used inorganic waste such as coal briquette ash, soil, or stone for land or Han River development projects. By the 1970s, land development projects were nearing their end. People enjoyed a better quality of life, and waste increasingly included plastic, electronics, furniture, food, and items that were difficult to dispose of. The waste increased in volume as well. Seoul found itself with no space in the city to use for landfill, not after Nanjido was discontinued. Nanjido could be viewed in plain sight from the roads leading from Gimpo and Incheon Airports to Seoul, but nothing could be done except to live with it through the Asian Games in 1986 and the Olympics in 1988: there was simply no other option. And this type of problem was not confined to Seoul itself, but affected the entire capital area. The central government stepped forward and implemented a construction project for a landfill site along the coast near Gimpo, Gyeonggi-do, with the City of Seoul paying 71% of the land purchase.

Area residents were vehemently opposed, interrupting construction and making countless demands. The landfill project was not going to be easy. Moreover, its estimated service life was only 25 years. The City of Seoul Basic Waste Treatment Plan (1991) was established to build 11 incinerators (able to handle a total 16,500 tons/day), and it reflected the uncertainties surrounding the continued use of the site for landfill from the capital area, the ability to shoulder the cost of transporting waste an average 45 km away, and the wisdom in using a site with such a short service life (25 years). Area residents were worried about environmental degradation from the incinerators, and refused to accept waste from other areas, pointing out the excessiveness of Seoul' s facility plans and the reliability of facilities designed to prevent pollution. In the end, the Yangcheon facility was built in 1996, followed by one in Nowon (1997), Gangnam (2001), and Mapo (2006). Over the course of 13 years, Seoul only built 4 facilities, with a processing capacity of 2,850 tons/day).

While the number of facilities fell far short of the original plan, the bigger problem was that they were not fully utilized. As of 2005, Yangcheon was operating at only 33% capacity, Nowon at 19%, Gangnam at 24%, and Mapo at 59%. The driving causes were the failure of the designs to reflect the circumstances surrounding policy trends with recycling (including food waste), and a significant drop in coal briquette ash (Seoul Metropolitan Council, 2006). From 2001, Seoul decided to expand the use of the incinerators to cover a larger area and share with the adjacent local governments: up to this time, Yangcheon, Nowon, and Gangnam facilities had only accepted waste from their own areas, but were now to accept waste from neighboring areas, while the Mapo facility, which was already treating the waste from Mapo-gu, Jung-gu, and Yongsan-gu, was to accept waste from more areas. With this move, the number of gu districts that used the 4 incinerator facilities rose substantially. Only 6 districts used the facilities in 2005, but by 2010, 20 were sending their waste. In 2012, Dongdaemun-gu was added, followed by Gwanak-gu in 2013. As of 2014, 22 districts were using the

4 incinerator facilities. The joint use pushed operations to increase from 19 – 59% of each facility's capacity (33% of the total facility capacity) in 2006 to 77 – 92% (85% of the total facility capacity) in 2012. As of 2012, only 7.9% (approx. 700 tons/day) of Seoul's municipal waste was going to landfill sites.

Figure 2 - Seoul Incinerator Facilities & Coverage



Waste Utilization Stabilizes in the 2000s

Until the 1980s, waste utilization was led by the private sector, mostly dealing with paper, metal, and glass bottles delivered for recycling by collectors. Collecting recyclables from the waste vehicles that arrived at Nanjido was one of the most important sources of income for low-income earners. In 1990 when finding a new landfill site proved extremely difficult and incinerators were criticized for causing environmental issues, the Korea Resources Recovery Corporation distributed recycling bins, with distribution including detached houses from 1992. Due to the strengthening opposition to incinerators and landfill at the time, public expectations were high. Yet the public often mixed general waste with recycling and vice-versa, a problem that was unresolved until introduction of fees based on volume of waste in 1995, where standardized garbage bags had to be purchased (larger ones costing more). Recyclables remained free to dispose of in recycling receptacles. This system is extremely useful in terms of separating bulky paper items, glass, plastic, and cans. In the meantime, the government revised the Wastes Control Act in 1998, prohibiting food waste from being buried without proper treatment from 2005. With the volume-based fee system in place, the percentage of food waste grew, causing odor and pests at the incinerators and landfills, further increasing conflict with area

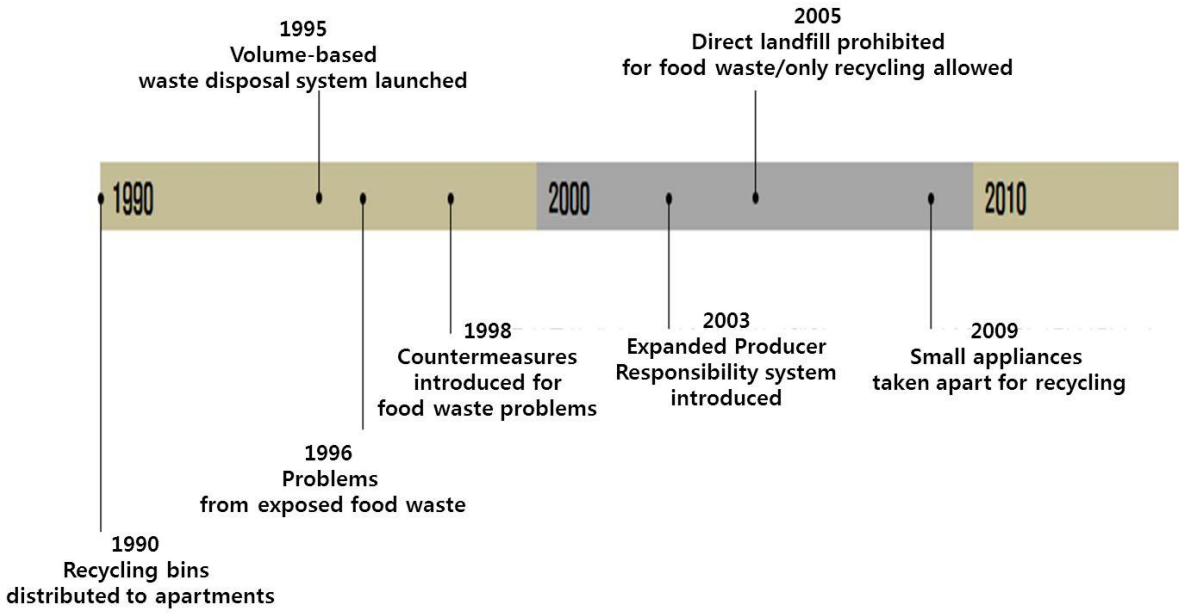
residents.

Gu districts, which were responsible for the treatment of municipal waste, found themselves with more difficulties as the volume of waste to be utilized soared. No market existed to deal with the newly recyclable materials, which were left in piles at the loading sites. The prices recyclable items attracted dropped, removing the motivation for the private sector to collect them. These too ended up at the loading sites. Communities rejected the food waste treatment facilities as strongly as they had incinerators and landfills, and using private facilities led to an increase in cost.

Instability in waste utilization improved in the 2000s, with the Expanded Producer Responsibility introduced in 2003, requiring manufacturers to process their own products collected from recycling. Failure to do so led to a fine. The volume and number of items that producers are required to process is steadily increasing. The central government provided subsidies to local governments who built food waste facilities, while loans were provided to private companies that did so. In this way, communities were able to comply with the restrictions against direct burial of food waste in 2005.

Generally, the rate of recycling in cities that do not utilize organic waste tops out at 40%. Adding organic waste to this could bring the rate to 60% or more. Seoul' s recycling rate of 65% in 2012 is evidence that the system of waste disposal, collection, and treatment processes work. In 2009, Seoul launched a program where small appliances are taken apart for recycling, expanding the scope of utilization even further.

Figure 3 - Seoul's Waste Utilization Timeline



Volume-based Waste Disposal Fee System: the Key to Waste Management

In 1995, South Korea introduced a volume-based waste disposal fee system, except in rural agricultural areas, being the first nation to adopt such a system at the national level. Before implementation, Seoul piloted the program in the commercial arcades in Jung-gu, detached housing in Seongbuk-gu, and apartments in Songpa-gu (Seoul Metropolitan Government, 1994.3). Volume was measured through standardized garbage bags, which were taken by the gu district offices to be divided into household, commercial, and business use. Bags are in 2, 3, 5, 10, 20, 30, 50, 75, and 100 liter sizes, with people able to purchase the size and quantity of bags they wish at designated stores. Money raised in this way covers collection/transport, treatment, and bag production, as well as a profit for the outlets carrying the bags. For instance, a 20-liter bag for household use is priced between KRW 340 and 400. In 2010, multi-purpose bags were introduced. The garbage bags available up to then were single-use, just like other plastic bags. To improve on this, the government allowed warehouse stores (E-mart, Home Plus, Lotte Mart, Nonghyup Hanaro Club, Mega Mart, etc.) to sell multi-purpose bags to their customers, who purchase these bags instead of regular plastic grocery bags to use for shopping and then later as garbage bags. In 2013, the City of Seoul applied this fee system to food waste as well. Until then, it was up to the gu district offices to decide whether they would charge any fees: food waste was collected for free, all homes paid the same fee regardless of how much they discarded; or the fees varied according to certain criteria. However from 2003, the volume-based system was also applied to all food waste, but with options to choose from: standard bags, stickers, or RFID weight scale. As such, the system has steadily evolved since it was launched in 1995, with 2015 being the 20th anniversary.

The nature of this system is quite simple: people pay to dispose of waste. However, the system has gone beyond this simple mechanism to help modernize the South Korean waste management system. First of all, it has contributed significantly to reducing the volume of municipal waste, although some cities say this was largely due to the decrease in the use of coal briquettes, a switch from volume to weight-based measurement, the Asian financial crisis in 1997, and the government's policy of waste reduction (Son Yeong-bae, 2001; Oh Yong-seon, 2006). After the system was introduced, many people began asking stores to take the packaging from products they purchased, and sometimes avoided products with a large amount of packaging. This of course pressured manufacturers to change their product packaging, something which certainly contributed to waste reduction to a certain degree, as statistics given by Jeong Gwang-ho et al (2007) reveal. Secondly, the volume-based fee system contributed definitively to a widespread willingness to take items apart for recycling. In Korea, recyclables are collected free of charge. Paper, plastic, and metal products take up a large space until they are taken apart or otherwise reduced in volume. Because of this, the recycling rate, which was 21% in 1994, jumped to 29% by 1995. This also led to fewer burdens on incineration or landfill. Thirdly, the system improved the shortcomings of the existing fee system, where fees were imposed according to housing or asset ownership. This was based on a hypothesis that the richer people were, the more waste

they generated. Previously, households paid between KRW 1,156 and KRW 2,102 per month, a difference of about KRW 1,000, but under the newer system, monthly fees per household decreased to KRW 2,224 – 2,288 (Yu Gi-yeong, Jeong Jae-chun, 1995). Now that the fees are equalized, gu district offices will be more convincing in their logic when they wish to adjust the fees to secure financing for waste disposal.

Figure 4 - Weight Scale for Waste Generated in Seoul

Standard Bag for General Waste

Weight Scale for Food Waste

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