

Volume-Based Waste Fee (VBWF) System for Municipal Solid Waste

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Background

Implementing a Pay-as-You-Throw System

The amount of daily waste<1> generated by 10.3 million citizens, 4 million households and 780,000 businesses in 2012 was 9,189 tons per day, or 0.88 kg per person. All such waste has to be discarded according to regulations of the 25 autonomous *gu*-districts, who also issue the waste bags that must be used when households dispose of this waste (to be sent to incineration facilities or landfills).

Food waste must go in standard waste bags that are purchased by the consumer, or a chip- or RFID-based system must be used. Large items require that stickers be purchased from the relevant *gu*-districts, which are then attached to the item before discarding, or large items can be delivered to specialized waste collection agents (Ministry of Environment, Nov. 2012; Resource

Recirculation Bureau, Ministry of Environment, Nov. 2012). Items that can be recycled like paper, scrap metal, large and small home appliances, fluorescent lamps, batteries, cooking oil, etc. should be separated and discarded according to government regulations (Ministry of Environment, 2011).

For general and food waste, the consumer covers all or part of the cost of waste collection and handling, which depends on the amount of waste discarded. It is called a "pay-as-you-throw" system. General waste and food waste are measured differently. General waste goes in standard bags which are made according to the standards set by the government. The consumer can purchase the desired size of such bags at convenience stores, grocery stores, laundromats and other designated establishments.

The costs of collecting and handling the waste, producing the bags and paying commissions to the stores are all included in the price of the bags, making them a kind of marketable security.

There are various ways to measure food waste: an RFID-based weighing system, RFID chips (or stickers) or standard waste bags. The RFID-based weighing system imposes disposal fees according to weight. One advantage of this system is the accurate weighing of discarded waste. Disadvantages include that the system is a complicated configuration of weighing devices, a discarder recognition system and storing devices to save information on who threw away how much. Chips or stickers are used with standard containers. Daily and monthly volume measuring are all possible with this method.

Besides recyclables, large items and used coal briquettes, which are allowed to be discarded via other methods, all other waste must be discarded in Seoul according to a volume-based waste fee (VBWF) system. Failure to pay the related fees is a violation of the Waste Management Act and local ordinances, and is subject to the related penalties.

<Table 1> Breakdown of Elements in the Pay-as-You-Throw System in Seoul

	General Waste	Food Waste
Measuring Methods	Standard Bags	RFID-based weighing system Chips or stickers Standard bags
Standard Bags	General: 3ℓ, 5ℓ, 10ℓ, 20ℓ, 30ℓ, 50ℓ, 75ℓ, 100ℓ Reuse: 10ℓ, 20ℓ Public: 30ℓ, 50ℓ, 100ℓ	General: 1ℓ, 2ℓ, 3ℓ, 5ℓ, 10ℓ * 20ℓ and larger can be used during holidays, kimchi-making season, etc.
Standard Bag Colors	General & Reuse: White Public: Blue	General: Yellow
Standard Bag Materials	PE Biodegradable	PE Biodegradable

Examples



Standard bags for general waste



RFID-based weighing system

Background to Introduction of the Pay-as-You-Throw System

In the late 1980s and early 1990s, Korea felt full of self-confidence thanks to its successful hosting of the Asian Games in 1986 and the Seoul Olympic Games in 1988, as well as continuing economic success. A great variety of products were available and plastic was mass-produced thanks to the development of production technologies.

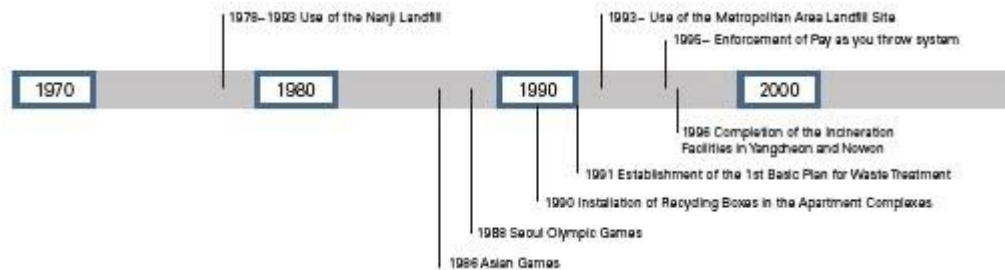
So many products led to increasing amounts of waste. Seoul, the nation's capital, could not secure the space needed for landfills to handle more waste, as the city continued expanding outwards.

As Nanji Landfill (operated from 1978 to 1993) came close to capacity, the central government led a project to establish new waste treatment facilities in the metropolitan area to treat the waste from Seoul, Incheon and Gyeonggi-*do* (province) in 1989. But moving forward proved very difficult due to strong opposition from residents living near the expected locations of these facilities.

The Seoul Metropolitan Government (SMG) also planned to build 11 incineration facilities for all daily waste from Seoul, but encountered opposition from neighboring citizens and civil society concerned about excessive facility construction. By 1996, only the incineration facilities in Yangcheon (400 tons per day) and Nowon (800 tons per day) had been built, and only 4 more (with a total capacity for 2,850 tons of waste per day) after that. To address the increasing quantity of toxic waste, the government started to take an interest in recycling as an alternative.

Recycling boxes appeared in Seoul apartment complexes in 1990, and began to be provided to detached housing neighborhoods the following year. However, people were not familiar with the idea of separating their garbage, and in detached housing neighborhoods, half of the collected recyclables was general garbage. In addition, the changes in waste management cost a lot of money, used landfills a long distance away, and required incineration facilities. As shown in the data from 1991, waste management cost KRW 280 billion while fees covered only KRW 25.4 billion - just 9% of the total bill. Most of the expenses for waste treatment were absorbed by the general account budget, while waste generators, the general public, absorbed very little (SMG, 1992).

<Figure 1> Main Waste Management Projects Before & After Introduction of the Pay-as-You-Throw System



In this situation, the government started seeking ways to fundamentally reduce the amount of waste (waste reduction), lower the dependence on incineration facilities or landfills through recycling (promotion of recycling), and charge waste generators (the general public) for the costs of waste management (securing financial resources). The pay-as-you-throw system was chosen. Entering the 1980s, the necessity of introducing such a system had been raised in a corner of academic circles (Environmental Planning Institute, Seoul National University's Graduate School of Environment, 1983; Jeong-jeon Lee, 1991).

However, prior to 1995, the fees for waste disposal in Seoul had been collected as a kind of tax based on building areas or property taxes, which had nothing to do with the amount of waste produced (Ki-young Yu and Jae-cheon Jeong, 1995). The pay-as-you-throw system was established through creation of the right social atmosphere, conditions for implementation, and

pilot projects, etc., and has gone through several changes before it reached its current form.

<Table 2> Waste Disposal Fee Systems in Seoul Prior to Pay-as-You-Throw

	Types of Waste	Grade	Basis for Calculating Fees
1980s	General waste (small amount)	7	Total building ground area
	General waste (large amount)	-	Weight
	Business waste	6	Total building ground area
Early 1990s	Household waste	9	Total building ground area/ property tax
	Business waste (large amount)	2	Weight
	Business Site Waste (Small Amount)	6	Total building ground area
1994 (Just before introduction of the pay-as-you-throw system)	Household waste	9	Total building ground area
	Business waste (small amount)	6	Total building ground area
	Business waste (normal amount)	1	Volume
	Business waste (large amount)	2	Volume

	Construction waste	-	Volume
	Home appliances	7	Kind, volume
	Furniture	7	Kind, volume
1995 (Enforcement of pay-as-you-throw system)	General/Food waste	-	Size, number of standard bags
	Large items	-	Kind, size, number
	Recyclable items	-	Free

History

- Preparation Stage (1992~1994)

The pay-as-you-throw system was introduced in 1995, but preparations began in the early 1990s with practical arrangements started in 1992 with the government at its center. Surveys and research were conducted from September 1992 to January 1993 by the Korea Society of Waste Management to verify the usefulness of such a system. The main thrust of the survey and research were amendment of relevant legislation, measures for enforcement, expected effects, ripple effects, etc. In 1993, the government began the process of collecting the opinions of people from all walks of life regarding introduction of the system.

Public hearings and meetings with private organizations, relevant experts, cleaning companies, etc. (Feb. ~ Jul. 1993), meetings with consumer groups, groups of housewives and waste bag manufacturers (Jul. 1993), and meetings with managers of urban and provincial cleaning departments were held during the process, and opinions collected from waste subcommittees (Jul. ~ Aug. 1993). The opinions of related organizations and institutes on the legal status of standard waste bags were also heard

(Sep. 1993). The result was that the waste bags could be regarded as official documents as long as the positions of mayor or district heads as well as the marks of the city hall or the *gu*-district offices were on the bags, and that it would be considered forgery of official documents if anyone were to create and sell their own bags that claimed to be official.

One year before the pay-as-you-throw system was introduced nationwide, pilot projects were conducted in 33 cities, counties and districts (Apr. ~ Dec. 1994). In Seoul, Jung-*gu* participated as a commercial area, Seongbuk-*gu* as a detached housing area and Songpa-*gu* as an apartment area (SMG, 1994). Before that, the central government announced measures to aid implementation of the system, including the waste fees, ways to distribute the standard bags, and handling the expected increase of recyclables (Nov. 1993).

During the pilot projects, the government concentrated on finding details on the waste discarded, standard waste bags, degree of public participation, flow of community opinions, etc. The government assembled a civil assessment team consisting of 7 civic groups including the YWCA, YMCA, Green Korea United, the Korean Federation of Environmental Movements and 165 monitoring agents to provide assessment and reporting on the status of the projects. There were significant concerns about negative effects, such as illegal dumping, but the assessment was mostly positive due to the 40% reduction of total waste, 100% increase in recyclables collected, the reduced cleaning costs, expansion of public awareness about reducing waste, and greater confidence in the program by civil employees.

Based on the problems that appeared during the pilot projects, the central government issued its "Guidelines on the Pay-as-You-Throw System" (Sep. 8th, 1994) to enforce it on a national scale. On November 7th, 1994, it held a meeting with the

related urban and provincial officials to conduct an interim evaluation of the project by local governments. On December 7th of the same year, the government issued guidelines on how to fix the problems identified during the interim inspection, such as the expected rapid increase of regional processing of recyclables, handling the large amount of waste expected to be thrown away just before enforcement of the new system at the end of the year, and increasing the manpower it would need.

In addition, the government revised and amended related ordinances, initiated the manufacturing of the waste bags, designated the stores to sell the bags, and engaged in public relations activities, etc. in preparation for system introduction on Jan. 1st, 1995. In particular, the government carried out a public relations campaign to address complaints from the public about why they should have to pay to throw away their garbage via media outlets such as TV commercials, advertisements in the daily press, and TV talk shows, and made and distributed promotional materials like VTR tapes, PR books, and posters (Ministry of Environment and Korea Environment Institute, 2012).

<Figure 2> Main Projects in Introducing the Pay-as-You-Throw System

1992	1993	1994	1995
■ Sep. 1992~Jan. 1993 Feasibility study for	■ Feb. ~ Aug. 1993 Collection of opinions of	■ Apr. ~ Dec. 1994 Pilot implementation: Jung-gu,	■ Jan. 1st, 1995. ~ Nationwide enforcement

<p>introduction of the Pay-as-You-Throw System</p>	<p>people from all walks of life</p> <ul style="list-style-type: none"> ■ Sep. 1993 Confirmation of the official status of standard bags ■ Nov. 1993 Preparation of guidelines for the pilot projects 	<p>Seongbuk-<i>gu</i> and Songpa-<i>gu</i>, Seoul</p> <ul style="list-style-type: none"> ■ Monitoring of pilot projects by the civic assessment team ■ Preparation for nationwide enforcement ■ Nationwide PR 	<p>of the pay-as-you-throw system</p>
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- Introduction Stage (1995)

The pay-as-you-throw system was implemented nationwide on January 1st, 1995. As a result, the previous waste collection fee was replaced with the price of waste bags, which could only be used in the region printed on the bag. General waste was to be placed up to the dotted line of bags purchased from designated stores and discarded in front of houses. The recyclables were separated into paper, bottles, cans and plastics and then discarded. Large items like refrigerators and cabinets were collected after prior phone notification of the administrative organizations, where callers would give their address, name, type and size of waste. Visiting civil employees would then issue a bill for the disposal. In consideration of low-income households, coal briquette ashes were allowed to be disposed of without using the standard bags. For groups protected by the livelihood protection law and other poor households as authorized by the heads of local governments, around 60₩ of standard bags were provided for free or the purchasing price was reduced (Ministry of Environment, May 1997).

In the beginning, many members of the public had difficulty with the volume-rate waste disposal methods. There were many cases where recyclables were not distinguished from general household waste. Some dumped randomly their household trash prior to enforcement of the pay-as-you-throw system - especially large items like cabinets and refrigerators, which intensified the confusion. However, these things happened often only in the early stages, and became less frequent as time went by.

In April 1995, the government had a meeting 100 days after implementation of the system to evaluate implementation. Before this time, a survey of 1,000 households was conducted, which showed that people had nearly completely adapted to the system within a month after implementation. Ninety-eight percent of the respondents stated they were comfortable with the system, while the most widely-used standard bags were 10ℓ, 5ℓ and 20ℓ, in that order.

The suggestions for improvement in the evaluation meeting were regarding the strength and convenience of the standard waste bags; application of the system to waste in public places; enhancement of convenience for separation of recyclables by displaying the recycling mark; timely collection of recyclables; prohibiting the collection of recyclables mixed with waste; prohibiting excessive packaging of disposable products; initiating the system in government organizations; preparation of criteria for enforcing penalties; establishing and expanding recycling networks; determining an appropriate price for standard bags; securing a budget for the pay-as-you-throw system; and supply and promotion of system-related information.

- Development Stage (From 1996)

Many aspects of implementation of the pay-as-you-throw system concerned the government and inconvenienced the public. However, these were outweighed by the many benefits through the 20 years from its beginnings in 1995 to 2015, including a practical reduction of waste, facilitation of separate disposal of recyclables and expansion of public awareness of the need to reduce waste reduction. In the meantime, the pay-as-you-throw system has been developed and changed continuously.

The most troublesome problem in the beginning was how to handle the collected recyclables. This was resolved by enacting a producer responsibility regulation in 2003, which mandated the separation of recyclables into paper, plastic, scrap metal (including cans) and glass bottles. Under the pay-as-you-throw system, the amount of collected recyclables increased but the demand for recyclables remained the same. The producer responsibility regulation involved a deposit system for a limited number of items including paper packs, PET bottles, steel cans, and glass bottles. However, the system did not increase the demand for recycling, because many manufacturers gave up the deposit.

A decision was made to convert the deposit system into an expanded producer responsibility scheme, which required producers to handle their own recyclables. The applicable items were greatly expanded to include paper, plastic, scrap metal (including cans), glass bottles, large and small home appliances, fluorescent lamps and batteries. As a result, the supply of and demand for recyclables dramatically improved.

In 1997, the government began providing heavy-duty bags exclusively for waste that posed a danger for both discarders and collectors when handling. These special bags were used to hold broken glass, small amounts of construction waste, and other things sharp or heavy enough to cause physical injury, especially in the process of collection, and were made of tough and

easy-to-handle poly propylene.

The standard waste bag, a core component in implementing the pay-as-you-throw system, was a very convenient tool for measuring the amount of waste in a large city like Seoul, where it is difficult to identify the discarders. But it was pointed out repeatedly that the waste bags themselves were disposable products and became waste after a single use. To address this issue, the government recommended that large grocery stores (E-mart, Homeplus, Lotte mart, National Agricultural Cooperative Federation or Nonghyup Hanaro Club and Mega Mart) begin selling these standard waste bags to their customers instead of their usual store-name grocery bags. This began in Seoul in 2010. The bag was called a reusable bag as consumers could also use it as a standard waste bag, and was sold for the same price as the standard bag at other stores.

The most innovative development was introduction of the weighted food waste disposal system. Many autonomous *gu*-districts could not apply the pay-per-disposal system properly for food waste, as most used the standard food waste containers and imposed the same fee on all households regardless of the amount of food waste they generated. Some districts collected this food waste free of charge. There were reasons for these differences. The standard bag was polyethylene, which became foreign material in food waste treatment, lowering the quality of feed or compost made from the food waste, and making feed or compost consumers reluctant to buy. The districts were also confused about the justification of imposing fees for food waste which could simply go into the regular garbage collection, while they were collecting recyclables free of charge.

However, it was very difficult to turn the enormous amounts of generated food waste into recycled resources or apply the expanded producer responsibility scheme. Thus, the national government decided to introduce a system of weighing food

waste in order to reduce it. The SMG also enacted the system in 2003 (SMG, <https://seoulsolution.kr>).

The government felt that the system should operate not on the basis of volume, but on the basis of weight because food waste is heavier than general waste. As a result of this change, it was reported that food waste was reduced by 10~30% (Korea Institute of Industrial Relations and Korea Environment Corporation, Dec. 2013). Under this system, the amount of food waste is recorded by each individual when it is discarded, and households are charged monthly fees accordingly. However, the system is not used with all households, but only some apartment complexes, as system installation and operation is costly and requires space. For detached houses and restaurants, the standard bags or standard containers with identification chips are generally used (Resource Recirculation Bureau of the Ministry of Environment, Nov. 2012).

<Table 3> Methods & Features of Food Waste Disposal Systems

Item	RFID Weight Method	Chip Method	Standard Bag
Recognition of Discarder	Electronic tag/electronic card	NA	NA
Measuring Unit	Weight	Volume	Volume
Storing	Individual container	Individual container	Bag + base container

Container			
Imposition of Fees	By household/restaurant	By household	By household
Payment of Fees	Deferred payment	Advance payment	Advance payment
Resulting Waste Reduction	9~31%	14%	13%
Items	 <p>RFID weighing system</p>	 <p>A standard container with identification chip</p>	 <p>Standard bags</p>

This metered waste fee system has continued to develop. During the process, the government periodically monitored the system to see how it was operating and to identify any problems. This included system acceptance by the general public,

inconveniences when discarding, problems during cleaning, and issues related to the recycling industry in general. In the beginning, the government annually evaluated system achievements, holding a meeting in 2005 to look back on the system's first 10 years. In 2004, it began to review statistics of standard bag sales by local governments, waste treatment facilities, ways to secure the financial resources for cleaning, enforcement of regulations against illegal dumping, etc. and issued a report. The guidelines for the waste disposal system were amended in 1997, 2001, 2003, 2006, 2008, 2009, 2010 and 2012.

<Figure 3> Sourcebook on Achievements of the Waste Disposal System & Improvements to Implementation



Report on the 10 Year Achievement/ Annual Report on the Pay-as-You-Throw System/ Guidelines for the Pay-as-You-Throw System

Achievements

Accelerating Waste Reduction

According to Seoul statistics, with 1994 as the base year (the year before the pay-as-you-throw system was implemented), the amount of waste decreased by 8% in 1995, and 11% in 1996. In the first year of the system, many large items were discarded because it was free to do so at the time. Therefore, the decrease in the 2nd year, 1996, can be assumed to be more accurate. An 11% reduction of waste equals about 1,712 tons per day. The average capacity of each of the 4 incineration facilities in Seoul is 700 tons per day<1>. In other words, the amount of waste reduced was equal to the capacity of 2~3 incineration facilities.

Of course, there are different arguments regarding the reasons for the reduction. According to some, the rapidly-decreasing use of coal briquettes and regulatory policy on disposable items and product packaging also affected waste reduction (Yong-seon Oh, 2006). On the other hand, another study showed that even when other factors are considered, the waste disposal system was the most significant reason behind the reduction in waste (Kwang-ho Jeong et al, 2007). Such evaluations were not really about the waste reduction itself, but on the impact of the system. The public became more sensitive to over-packaging when choosing products, and when purchasing, left behind the packing, or asked sellers to take packaging back after product delivery. Such reactions by consumers influenced manufacturers and were reflected in product design. After introduction of the pay-as-you-throw system, there were obvious changes in consumption patterns recognized by all.

<Table 4> Before & After Introduction of the Pay-as-You-Throw System: Changes to Amount of Waste Generated

	1994 (Preparation)	1995 (Enforcement)	1996 (2nd Year)
Total (tons/day)	15,397	14,102	13,685
Per person (kg/day)	1.43	1.33	1.31

Early Adoption of Habitual Separation of Recyclables

The outstanding results of the pay-as-you-throw system included the early adoption of effective separation of recyclables in a short period of time. Between 1994 and 1996, the amount of recyclables increased by 881 tons per day. The proportion of total waste made up of recyclable material was 20.5% in 1994, 29.3% in 1995 (enforcement of the system) and 29.5% in 1996, showing an increase of 9% in 1996 (2nd year) over 1994. There were different evaluations of the effects on waste reduction, but general agreement on the early adoption of habitual separation of recyclables, which led to a reduced demand for waste treatment facilities. With an average incinerator capacity of 700 tons per day, the amount of waste reduced equaled the capacity of 1.3 incineration facilities.

<Table 5> Before & After Introduction of the Pay-as-You-Throw System: Changes to Amount of Recyclable Waste

	1993	1994	1995	1996
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	(Fixed Ratio)	(Preparation)	(Enforcement)	(2nd Year)
Total Waste (tons/day)	16,021	15,397	14,102	13,685
Recycled Amount (tons/day)	2,940	3,156	4,131	4,037
Recycling Rate (%)	18.4	20.5	29.3	29.5

Fees to Cover Waste Management Costs

The financial independence rate (revenue from fees, etc. compared to the expenses for waste management) in 1991 was just 9%, meaning that the burden on those generating the waste was very low (SMG, 1992). The pay-as-you-throw system was introduced for this reason. With it, the fees paid by those generating waste increased from KRW 119.9 billion in 1993 to KRW 153.6 billion in 1995 (the growth rate of 28%). Another desirable aspect was that the total waste revenue increased without noticeably increasing the burden per household. The monthly fee per household before the pay-as-you-throw system was KRW 2,102, and KRW 2,288 after introduction. However, the number of households paying the fees expanded from 1.69 million to 2.97 million. In conclusion, the pay-as-you-throw system was effective in improving the fee structure and increasing waste-related revenues.

<Table 6> Changes to Waste Fees with the Pay-as-You-Throw System

	1993 (Fixed Ratio)	1995 (Enforcement)	1995/1993 (Increase)
Fee Revenue (KRW Bil.)	119.912	153.638	28%

Economic Benefits

In 2005, the government evaluated the 10-year performance of the pay-as-you-throw system that had been introduced in 1995. According to the evaluation, 1 ton of waste reduction created a benefit of KRW 144,071, while 1 ton of waste recycling created a benefit of KRW 18,901. The benefits of waste reduction came from the reduced costs for waste collection and transportation, and the installation and operation of treatment facilities. The benefit of recycled waste was the value earned after deducting the cost of collection and transportation, sorting, processing, etc. from the total value of the recyclable items (Korea Institute of Industrial Relations and Korea Environment Corporation, Dec. 2013). In Seoul, it seemed that the cost of waste collection, transportation and processing would be reduced by KRW 90 billion and an additional KRW 6.1 billion would be generated in economic benefit, for a total of KRW 96.1 billion per year if the government evaluations above were applied to Seoul.

<Table 7> Change of Costs under the Pay-as-You-Throw System

	Increase/Decrease Amount (1996-1994, tons/year)	Benefit per Unit (KRW/ton)	Scale of Benefit (KRW bil./year)
Change	-624,880 reduced	+144,071	+90
Recycling	+321,565	+18,901	+6.1
Total Benefits	-	-	+96.1

Meaningful Experiences

- Thorough Preparation

The VBWF system is inconvenient for citizens as discarders of waste. Even experts opposed introduction of the system, saying that other countries hesitated out of concern for illegal dumping. Korea's pay-as-you-throw system was introduced with the support of the government, cities and some scholars concerned about the difficulty in securing the necessary waste treatment facilities, but not the support of the majority of people.

To cope with this negative atmosphere, it was necessary to remove the institutional obstacles in advance, create an amicable situation for the system, identify the benefits and problems through pilot projects and persuade people of the benefits. It was particularly imperative to find the best methods for implementation in each city during the preparation stages. In Seoul, it was not easy to identify waste discarders because there are many commercial and residential high-rises and the city space is small and narrow. This is why Seoul decided to use standard waste bags as the way to measure the amount of waste.

However, it was desirable to use bins only for waste in areas with many detached houses and developed roads because it was possible to prevent excessive waste of disposable bags and illegal dumping through an agreement with the public on the size of waste bins and to reduce the cost of waste collection with an automated bin loading vehicle system.

Cooperation with the Public

Environmental associations played a large role in the public adapting the pay-as-you-throw system in Korea. During discussions on introduction of the system, the general public did not have a favorable opinion, due to concerns about illegal dumping to avoid paying the fees and unease with the intention of government to shift the responsibility for reducing and recycling waste onto the people. However, the positive aspects of the system became better known with people participating in site monitoring activities and pilot projects during the first year of project implementation.

The public has continued to participate in evaluations of the pilot project and the first, second and tenth years of implementation. Even now it is involved in assessing the food waste disposal system. Positive evaluations from society have contributed greatly to the change of attitude in the mass media and national consciousness.

Handling the Increased Amount of Recyclables

The collection of separated recyclables free of charge was implemented in a short time, but processing the collected recyclables became the task of the government. The biggest headache was the non-PET plastic containers (PE, PP, PS and PVC materials). While designated as recyclables, there was insufficient infrastructure to treat such plastic products. In addition, the producers were not responsible for the treatment of waste plastic because the waste handling fees were imposed on most plastic containers.

The issue was resolved in 2003 when the government lent financial support to plastic recycling operators to assist with facility installation and operations, had the public sector purchase products of recycled plastic over new plastic, and imposed on manufacturers the obligation to collect and process recyclables (including the plastic containers) where the recycling market was weak (Extended Producer Responsibility Scheme).

With introduction of the pay-as-you-throw system, an unplanned recycling component was added. Because of the strong odors from landfills, many complaints were raised one year after system introduction. The same complaints were heard about roads leading to waste treatment facilities. The cause of the problem was food waste and the paper used to wrap it. This paper acted as an odor buffer in standard bags, absorbing the leachate and blocking the smell of the food waste to some degree, but the paper was classified as a recyclable item.

The main cause of the odor was that this paper was no longer discarded with general waste, a problem that was resolved by collecting the food waste separately and changing the treatment system on a large scale. Landfill for any kind of food waste was prohibited in 2005, and the government began constructing food waste treatment facilities in 1998. Seoul has 5 such locations, with private facilities providing extra capacity.

Preventing Illegal Behavior

When reviewing the system, the most concerning side effect was the illegal dumping done to avoid paying the fees. Many people dumped household or business trash in public wastebaskets or in quiet or abandoned places and did not use the standard waste bags. To prevent this, reflectors were installed and flower gardens put where illegal dumping was common. Some districts removed public wastebaskets on downtown streets.

This reduced illegal dumping significantly, but did not eliminate it. In the meantime, the systems supporting the imposition of penalties for illegal waste disposal and providing standard bags to low-income households free of charge were prepared.

<Figure 4> Illegal Dumping & Countermeasures



Garbage dumped in the suburbs (<http://waste21.or.kr>)



Non-standard bags (<http://waste21.or.kr>)



Flower bed in common dumping area (<http://dong.jungnang.seoul.kr>)



Reflectors & sign (<http://www.cpdcr.re.kr>)

- Revision of Legislation

The basis for enforcement of the pay-as-you-throw system is the Waste Management Act. Local governments are authorized

to determine the details of implementation through ordinances. The Act also deals with penalties for illegal dumping.

Each district has specific regulations on enforcing the system in its own ordinances. It regulates the kinds of waste to which the pay-as-you-throw system applies, as well as the methods of disposal, fees, standard bag type/color/material, supervision of manufacture and management of standard bags, designation of and guidelines for the stores that will sell them, and criteria on cancelling a standard bag seller agreement, etc.

The bag size, material, strength and type are determined by the Korean Standard on Plastic Products, to which all specifications are subject and those that do not meet the standard are failed during inspections. To prevent counterfeiting, the seals for printing on the bags are kept by each autonomous *gu*-district and handed over to the manufacturers only when they have already produced the standard bags. Anybody caught making or distributing counterfeit bags is subject to punishment under criminal law on unauthorized fabrication of official documents.

<Table 8> Legal Systems Related to Enforcement of Seoul's Pay-as-You-Throw System

Legislation/Documentation	Description
Waste Management Act	Recommendations on enforcement of the pay-as-you-throw system Legislation of ordinances related to enforcement of the pay-as-you-throw system

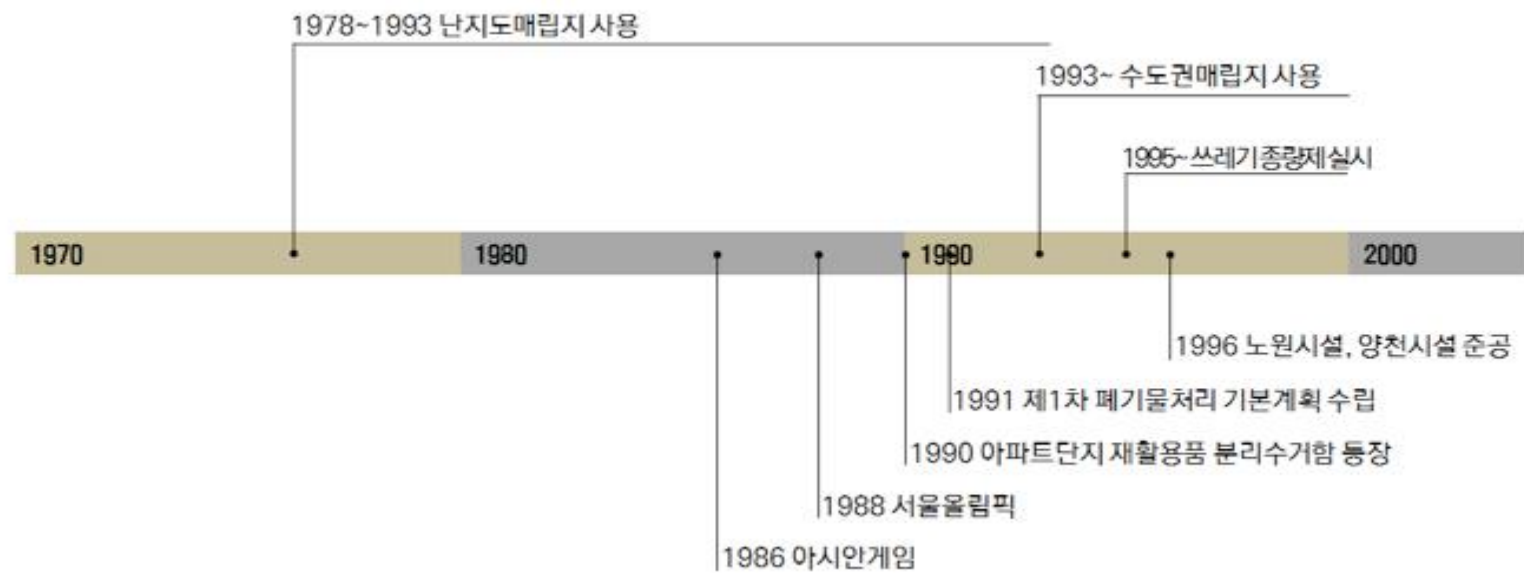
	<p>Prohibition of illegal dumping and imposition of related penalties</p> <p>Revision of regulations related to the autonomous districts: Ordinances and regulations, guidelines on enforcement of the pay-as-you-throw system, guidelines and fees for discarding food waste</p>
Autonomous District Ordinances on Waste Management	<p>Waste to which the pay-as-you-throw system applies, ways to discard the waste, fees, standard bag type/color/material, supervision of standard bag manufacturing and safe management, and designation of stores to sell standard bags</p>
Korean Standard on Plastic Products	<p>Types: standard bags of PE material, standard bags of LLDPE material and standard bags containing calcium carbonate</p> <p>9 types of bio-disintegrable plastic bags</p>
Reports on Performance	<p>Enforcement: standard bag manufacturing and sales, waste collection method and collection cycles, financial independence rate in cleaning, disposal of large items and collection of disposable plastic bags, effectiveness of illegal dumping regulations, etc.</p>
Criminal Law	<p>Manufacturing and distribution of counterfeit standard bags correspond to fabrication of official documents</p>

Policy Implementation Period

- 1994 Piloted volume-based waste fee system (Commercial arcades - Jung-*gu* / detached housing area – Seongbuk-*gu* / apartments - Songpa *gu*)

- 1995 Volume-based waste fee system launched (first nationwide implementation)
- 2010 Reusable VBWF bags in place
- 2013 Volume-based food waste fee system launched

Figure 1. Seoul's Waste Treatment Before & After Launching of the Volume-Based Waste Fee System



Source: The Seoul Institute (2015)

Background

From the 1980s, Korea enjoyed unprecedented economic growth and an abundance of industrial products through the nationwide development that began in earnest in the 1960s and overall changes to the industrial structure. The amount of waste generated in the city skyrocketed due to mass production and consumption of affordable plastic products and synthetic packaging from developments in domestic production technology.

In the meantime, due to the shift in the city's population, who used to flock to the capital for jobs and accommodations but now began moving out to the suburbs, Seoul's neighboring cities were becoming "new towns" for its excess population. As a result, it became more difficult to secure landfill sites in those suburbs and even more impossible to do so in Seoul, which had been major waste treatment facility. Gyeonggi Province and Incheon had similar problems. These three governments took the lead in promoting establishment of Sudokwon Landfill Site, which they could share. However, due to the widespread dislike of facilities like landfills, this also proved very difficult.

While searching for suitable landfill sites and encountering strong resistance, Seoul established a waste management plan that focused on reducing dependence on landfills in 1991. The plan mainly covered the construction of 11 incineration facilities, but this was also severely opposed by residents of the designated facility areas. Civic groups pointed out problems in the plan, arguing the size and number of planned incinerator facilities was excessive. As a result, only 4 were built in Seoul.

As an alternative to reducing the volume of waste to be buried, recycling was promoted. In 1990, recycling bins started being

delivered to apartment complexes. Due to the level of success, the bins were delivered to detached houses as well. However, residents were not accustomed to separating their recyclables and garbage so it was not unusual to find trash in the recycling bins.

Constructing incinerator facilities and promoting recycling to avoid having to find landfill sites farther away from the central business district cost a lot of money. In 1991, Seoul and the autonomous *gu*-districts spent a whopping KRW 280 billion in waste management while residents, who disposed of the majority of garbage, spent only KRW 25.4 billion, or 9% of the cost of waste management.

Due to such situations in the 1980s and 1990s, governments became desperate to find ways to gain active public participation in recycling and pass on more of the growing costs of waste management onto the public.

The VBWF system is a sort of solution based on the “polluter pays” principle. This idea in support of the need for a VBWF system had already been raised in the 1980s. However, before this system, waste treatment fees were levied according to the gross area of the building or the amount of property tax. Back then, waste treatment fees were collected as a type of tax. Table 8 below summarizes the changes in waste fee systems up until implementation of the VBWF system in 1995.

Table 1. Seoul’s Waste Fee System until 1995

	Type of Waste	Fee Grade	Basis for Fee Imposition
1980s	General waste (Small quantities)	7	Building total floor area
	General waste (Large quantities)	-	Weight
	Business waste	6	Building total floor area
Early 1990s	Residential waste	9	Building total floor area/property tax
	Business waste (Large quantities)	2	Weight
	Business waste (Small quantities)	6	Building total floor area
1994 (Preparation Period)	Residential waste	9	Building total floor area
	Business waste (Small quantities)	6	Building total floor area
	Business waste	1	Volume

	(Medium-sized quantities)		
	Business waste (Large quantities)	2	Volume
	Construction waste	-	Volume
	Discarded home appliances	7	Type/Volume
	Discarded furniture	7	Type/Volume
1995	General/Food waste	-	Size/Number of standard trash bags
(Implemented Year)	Bulky items	-	Type/Size/Number
	Recyclables	-	Free

Source: The Seoul Institute (2015)

Importance of the Policy

The type of waste subject to the VBWF system is municipal solid waste generated from households, the commercial sector and small businesses, but is not designated and industrial waste as defined by the Waste Management Act. The system is based on the pay-as-you-throw principle, which charges according to the amount of waste being disposed, by requiring that standard garbage bags be purchased.

The VBWF system was designed to levy fees in proportion to the amount of waste disposed of and to the costs required for handling. People are induced to reduce their waste on a voluntary basis. Recyclable goods are exempt from collection fees, thus inducing the separation of recyclables from general garbage, which benefits both residents and the authorities. Less waste means less in fees for residents and less dependence on incinerator facilities and landfills. The VBWF system is meaningful as a policy as it changes residents' waste disposal patterns.

The efforts to change the public's pattern of waste disposal through awareness campaigns or education may be more convenient but may not gain the desired results or gain them too slowly. As a way to change attitudes against protection of the environment, government rules and regulations have long been resorted to but enforcement requires human resources, adding high costs to policy implementation or a lack of enforcement due to insufficient personnel. A regulation-oriented approach may not encourage people to voluntarily reduce waste below a certain level. On the contrary, when residents are encouraged to change their behavioral patterns through economic incentives (the VBWF system in this case) proportional to the reduced amount of disposed waste, this is more successful. In the end, the VBWF system is a very environmentally-desirable and effective way to bring about changes in people's behavioral patterns.

Relevance with Other Policies

Today's waste management policy aims to reduce waste volumes at source and reuse of recyclables. It also aims to recover material or energy from waste and turn them into resources. Lastly, the garbage not processed during the previous two steps is then to be safely incinerated and buried.

Therefore, it is very important to make a reasonable estimation and strike a balance between the amount of waste generated, waste recovered as resources, and waste to be processed by burning or burying. The VBWF system has a particularly direct impact on related waste management policies including those on waste management facilities, as it makes a huge contribution to suppressing waste generation, the first phase of waste management policy.

Until the 1980s, the private sector took the lead in recycling, and the focus was on collecting discarded paper, scrap metal and glass bottles. Recyclable waste was collected by "junk men". For low-income earners, scavenging for recyclable items had been a crucial means of earning a living at the Nanjido landfill. Recycling bins installed by civic groups and the Korea Resources Recovery and Reutilization Corporation (KORECO) started to appear by the time the difficulties began in securing landfill site and incineration facilities in 1990.

Recycling bins started to spread into detached housing areas in 1992. As societal conflict intensified over incineration facilities and landfills, expectations were pinned on turning waste into recyclable items as an alternative to incineration and reclamation. Of course, recyclables were not yet completely separated before disposal, and it was not unusual to find them mixed together. The VBWF system implemented in 1995 solved such problems. It has been remarkably effective in Korea towards spreading habits of separating trash and disposing of copious amounts of paper, plastic containers and cans, by mandating the purchase of standard waste bags to attach a cost to the amount of garbage thrown away.

The Waste Management Act was revised in 1998, which stated that beginning in 2005, the direct disposal in landfills of food

waste generated in urban areas would be completely banned. With implementation of the VBWF system, residents expressed opposition to nearby waste treatment facilities, as food waste was disposed of with the VBWF bags, which gave rise to various environmental problems including serious odor and harmful insects.

Meanwhile, Seoul's autonomous *gu*-districts, responsible for municipal solid waste, faced more difficulties when the supply of recyclables increased. It was not unusual to see recyclable items piled up in regional recycling depositories as the market was not prepared for such amounts. Also, due to a freefall in prices from the glut, the private sector refused to purchase any more. Selecting and securing food waste treatment facilities was also a serious headache as residents around the potential sites were violently opposed to them and the other option of using private facilities was simply too expensive.

In the end, the VBWF system met the policy goals of reducing waste and separating garbage and recyclables for disposal but it generated the demand for policies to secure a market for the supply of recyclable materials and establishing food waste management facilities, which led to the introduction of Expanded Producer Responsibility (EPR) in 2003 and a ban on direct disposal of food waste in landfills in 2005.

Policy Objectives

Reduce waste generation at source

Establish habit of separating garbage and recyclable materials before disposal

Reduce dependence on waste processing facilities (incinerating facilities and landfills)

Main Policy Details

The VBWF system charges fees in proportion to the amount of trash thrown away. In Seoul, all disposal must follow this system, with the exception of recyclable items, bulky waste and coal briquettes. Garbage is measured differently by type, and divided into general waste (or municipal solid waste), food waste, and recyclable material.

General waste refers to waste to be incinerated or buried. Waste volume is measured through standard garbage bags, which are divided into household, commercial, and business use by *dong*- or *gu*-district offices. 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. General waste is therefore handled according to volume.

Food waste can be disposed of in a variety of ways: standard bags sold by local authorities, standard plastic containers with electronic chips or stickers, and for payments based on weight using an electronic card with RFID. For RFID-based handling of food waste, the person disposing swipes a card before gaining access to the residential waste bins. The chip contains the user's name and address and allows the authorities to monitor the weight of waste disposed with that card. The system accumulates fees on a monthly basis, and each household receives a monthly food waste disposal bill.

Other items such as paper, plastic packaging, glass bottles, scrap metal, discarded home appliances, discarded fluorescent lamps, used batteries and used cooking oil are classified as recyclable and should be disposed of in the way prescribed by the Ministry of Environment.

Table 2. Measuring & Charging According to Seoul's VBWF System

	General Waste	Food Waste
Measurement	VBWF bags (Standard waste bags)	RFID-based weight measuring device Chip or sticker VBWF bags (Standard waste bags)
Types of VBWF bags	For General Use: 3ℓ, 5ℓ, 10ℓ, 20ℓ, 30ℓ, 50ℓ, 75ℓ, 100ℓ Reusable Bags: 10ℓ, 20ℓ For Public Use: 30ℓ, 50ℓ, 100ℓ	General Use: 1ℓ, 2ℓ, 3ℓ, 5ℓ, 10ℓ *VBWF bags larger than 20ℓ are allowed only during national holidays or <i>kimchi</i> -making season when more waste is unavoidable.
VBWF bag colors	Bags for general use and reusable bags: White	General Use: Yellow

		For Public Use: blue	
VBWF materials	bag	PE bags Biodegradable bags	PE bags Biodegradable bags

However, ordinary VBWF bags are little better than disposable trash bags which can be used only once. The Korean government, for its part, sought to at least partly resolve this issue, by having shopping giants such as E-mart, Homeplus, Lotte Mart, Nonghyup Hanaro Mart, and Mega Mart offer reusable VBWF bags which customers could then use as standard trash bags.

Since 2013, food waste has been disposed of according to a VBWF system in Seoul. Chips or stickers require households to buy a payment chip or sticker and attach it to a standard collection container for pick up. The container serves as a disposable or monthly volume measuring device. The advantage of an RFID system is that it accurately weighs waste volume, after which the appropriate fees can be charged. However, it can be quite complicated as it requires a weight measuring device, a chip recognition system, and volume tracking & storage devices.

Persons disposing of large items must buy a sticker for each item from the local authorities and place it on the items before pick up, or pay for private garbage haulers to pick up.

Disposal Fees

In accordance with the VBWF system, people pay all or part of the costs of collecting and treating garbage when they throw away municipal solid waste or food waste. The fee is determined by the volume of disposed waste, which is why the system is called a volume-based waste fee system. The price of VBWF bags includes the cost of collection and handling of the garbage, as well as manufacturing of the bags and some profit for the companies involved.

Policy Effects

1) Household Solid Waste Reduced

According to statistics, the volume of waste generated in Seoul decreased by 8% in 1995 and 11% in 1996, both over 1994, tantamount to reducing 1,712 tons/day. Since institution of the VBWF system, there has been a change in consumer patterns of waste generation and an improved awareness of waste disposal, which explains the reasons for the reductions. For example, consumers have become sensitive to product over-packaging, leaving the packaging at the sales shop after purchasing or asking the seller to take the packaging after product delivery. This in turn has affected packaging design. Some quarters, of course, argue that the reduction was hardly due to the VBWF system, but due to the reduced consumption of coal briquettes, changes from volume to weight when determining fees, dwindling production and consumption in the wake of the financial crisis that hit Korea in 1998 and the government's implementation of relevant but separate policies. However, less waste was

a very natural consequence of the VBWF system, which carefully considers the principle of environmental policy. Therefore, the degree of policy impact may be debatable, but not the fact that it has had a positive impact.

Table 3. Changes in Generation of Waste

Change	1994 (Preparation)	1995 (Implementation)	1996 (Institutionalization)
Total Volume (ton/day)	15,397	14,102	13,685
Volume Per Person (kg/day)	1.43	1.33	1.31

2) Contribution to the Habit of Separating Garbage & Recyclables Before Disposal

The most apparent outcome of the VBWF system is its contribution to the quick formation of a habit of separating recyclables from garbage. In accordance with the VBWF system in Korea, discharged recyclables are collected by the authorities free of charge. Paper, plastic and metal items are in household waste in sufficient amounts to save households money when they recycle them instead of throwing them away in VBWF bags.

Recycling performance (in terms of amount) in 1996 had increased by 881 tons/day over 1994. As a percentage of all waste

being handled, recyclable materials rose significantly from 20.5% in 1994, to 29.3% in 1995 (the year VBWF system was introduced), to 29.5% in 1996. The separation of garbage and recyclables had successfully reduced demand for waste treatment facilities.

Table 4. Changes Prior to and After the VBWF System

	1993 (Base Rate)	1994 (Preparation)	1995 (Implementation)	1996 (Institutionalization)
Waste Generated (tons/day)	16,021	15,397	14,102	13,685
Waste Generated by the Recyclables Generation (tons/day)	2,940	3,156	4,131	4,037
Recycling rate (%)	18.4	20.5	29.3	29.5

3) Covering Waste Treatment Costs with VBWF System Profit

In 1991, Seoul's cleaning budget financial independence was as low as 9%, which was calculated by dividing the total revenues from the sales of waste bags and recyclable materials, fees for the disposal of bulky waste, and penalties by the annual total

cost of waste disposal. In other words, the share of responsibility for those generating the waste was very low (SMG, 1992). With implementation of the VBWF system, this share of payment rose by 28% in 1995 from KRW 119.9 billion in 1993 to KRW 153.6 billion. While the fees from the VBWF system had risen overall, the cost per household had not. This was due to greater equity of the system: the monthly payment per household only rose from KRW 2,102 to KRW 2,288 KRW, while the number of households paying the fees rose from 1.69 million to 2.97 million. Implementation of the VBWF system had improved cost recovery, which led to a rise in waste management revenue.

Table 5. Changes in Waste Management Revenue from the VBWF System

	1993 (Base)	1995 (Implementation)	Rate of Increase
VBWF Revenue (KRW billion)	119.912	153.638	28%

4) Economic Benefit

In 2005, the government evaluated the 10-year performance of the pay-as-you-throw system that had been introduced in 1995. According to the evaluation, 1 ton of waste reduction created a benefit of KRW 144,071, while 1 ton of waste recycling created a benefit of KRW 18,901. The benefits of waste reduction came from the reduced costs for waste collection and

transportation, and the installation and operation of treatment facilities. The benefit of recycled waste was the value earned after deducting the cost of collection and transportation, sorting, processing, etc. from the total value of the recyclable items (Korea Institute of Industrial Relations and Korea Environment Corporation, Dec. 2013). In Seoul, it seemed that the cost of waste collection, transportation and processing would be reduced by KRW 90 billion and an additional KRW 6.1 billion would be generated in economic benefit, for a total of KRW 96.1 billion per year if the government evaluations above were applied to Seoul.

Table 6. Changes in Cost under the VBWF System

Category	Change (1996-1994, tons/year)	Benefits (KRW/ton)	Scale of Benefits (KRW bil./year)
Change	-624,880	144,071	90.0
Recycled	+321,565	18,901	6.1
Total Benefits	-	-	96.1

Challenges & Solutions

1) Supply of Recyclable Waste

Recyclable waste is categorized into paper, plastic, scrap metal (including cans) and glass bottles. The VBWF system, which stipulates that collection of recyclable goods shall be for free, helped establish, in a short period, the habit of separating recyclables from garbage. In the meantime, recyclables had not been well utilized, which became the burden of the government. Particularly problematic was what use to make of non-PET plastic containers (PE, PP, PS or PVC). Even though they are designated as recyclables, the supporting infrastructure was inadequate. Moreover, as the VBWF system focused on imposing charges on plastic containers, producers were not responsible for recyclable waste. A deposit system was in place, which levied a refundable container deposit on consumers. However, that system applied to only a few items such as paper packs, PET bottles, steel cans and glass bottles. Unfortunately, many producers gave up the deposit, rendering the deposit system ineffective in utilizing the collected recyclable waste.

Solutions

The government offered loans to plastic recycling facilities to assist with installation and operation.

In addition, products manufactured with recycled plastics were preferentially purchased by the public sector. Also, in 2003, an expanded producer responsibility (EPR) was imposed on manufacturers, which replaced the deposit system and held the manufacturer responsible for the costs of managing their products at end of life. The EPR's coverage was also extended to include paper packs, plastic containers, scrap metals (including steel cans), glass bottles, large and small home appliances, discarded fluorescent lamps, and used batteries. This dramatically improved the supply and demand situation.

2) Food Waste

Difficulties in Implementing the VBWF System

Even though the VBWF system was in place, food waste was thrown out in the standard food waste bin in most autonomous *gu*-districts and a flat rate levied on each household regardless of the amount generated. Some districts did not use the VBWF bags and collected the food waste free of charge. The standard bag was polyethylene, which became foreign material in food waste treatment, lowering the quality of feed or compost made from the food waste, and making feed or compost consumers reluctant to buy.

The districts also had a hard time justifying imposing fees for food waste which could simply go into the regular garbage collection, while they were collecting recyclables free of charge.

Solutions

It was very difficult to turn the enormous amounts of generated food waste into recycled resources or apply the expanded producer responsibility scheme. Thus, the SMG decided to introduce a system of weighing food waste in order to reduce it.

The government felt that the system should operate not on the basis of volume, but on the basis of weight because food waste is heavier than general waste. As a result of this change, it was reported that food waste was reduced by 10~30% (Korea Institute of Industrial Relations and Korea Environment Corporation, Dec. 2013). Under this system, the amount of food waste is recorded by each individual when it is discarded, and households are charged monthly fees accordingly. However, the system is not used with all households, but only some apartment complexes, as system installation and operation is costly and requires space. For detached houses and restaurants, the standard bags or standard containers with identification chips are generally used.

Odors from Food Waste

Because of the strong odors from landfills, many complaints were raised the first year of system introduction. The same complaints were heard about roads leading to waste treatment facilities. The cause of the problem was food waste and the paper used to wrap it. This paper acted as an odor buffer in standard bags, absorbing the leachate and blocking the smell of the food waste to some degree, but since the VBWF system was introduced, this paper was classified as a recyclable item and separated.

Solution

The problem of odor was resolved by a massive change in the system for handling food waste, where it was disposed of, collected, and processed separately. Since 1998, the SMG has embarked on the construction and operation of 5 public food

treatment facilities and also has commissioned private facilities as well. In 2005, food waste was banned from any landfills.

3) Waste Bags

Material

Broken glass and construction waste are sharp and heavy, often injuring sanitary workers, particularly during collection.

Solution

Since 1997, special VBWF bags have been manufactured especially for such physically dangerous waste. These bags are made of durable poly propylene.

Environmental Issues

VBWF bags, the essence of the VBWF system, are very convenient, especially in big cities like Seoul as the system inherently passes the cost of handling waste onto the people who generate it. However, many have asked whether it is appropriate to use single-use VBWF bags.

Solution

As a way to partially resolve this, the government had shopping giants (including E-mart, Homeplus, Lotte Mart, Nonghyup Hanaro Mart, and Mega Mart) sell VBWF bags to shoppers instead of offering their customary free plastics bags. These VBWF bags are called "reusable" in Korea as they are used at least once as shopping bags and then finally as VBWF bags. The price of the bags is identical to VBWF bags available elsewhere.

4) Negative Public Sentiment toward the VBWF System

The VBWF system was instituted with the strong support of government, cities and some academics who felt a sense of crisis due to the difficulties in securing sites for waste treatment facilities, but not with the support of the general public. After all, the system is quite inconvenient from the perspective of citizens, who generate the waste, and many experts argued that other nations would not introduce it for fear of widespread illegal dumping.

Solution

To overcome the negative feelings about the VBWF system, the authorities made efforts to get rid of institutional stumbling blocks and explored the benefits and effects as well as possible problems, and were able to persuade the population.

- Thorough Preparation

It was imperative to figure out what type of VBWF system was best for the city during the preparation stages. Seoul chose the VBWF bags as a means to measure waste volumes as otherwise it is quite costly to identify every person who disposes of waste in a densely-populated city with plenty of residential and commercial high-rises.

However, it was desirable to use bins only for waste in areas with many detached houses and developed roads because it was possible to prevent excessive waste of throw-away VBWF bags and illegal dumping through an agreement with the public on the size of waste bins and to reduce the cost of waste collection with an automated bin loading vehicle system.

- Cooperation with Civic Groups

Environmental associations played a large role in the public adapting the pay-as-you-throw system in Korea. During discussions on introduction of the system, these associations did not have a favorable opinion, due to concerns about illegal dumping to avoid paying the fees and unease with the intention of government to shift the responsibility for reducing and recycling waste onto the people. However, the positive aspects of the system became better known with people participating in site monitoring activities and pilot projects during the first year of project implementation. These associations have continued to participate in evaluations of the pilot project and of the first, second and tenth years of implementation. Even now they are involved in assessing the food waste disposal system. Positive evaluations from society have contributed greatly to the change of attitude in the mass media and national consciousness.

5) Illegal Dumping

When reviewing the system, the most concerning side effect was the illegal dumping done to avoid paying the fees. Many people dumped household or business trash in public wastebaskets or in quiet or abandoned places and did not use the standard waste bags.

Solution

To prevent this, reflectors were installed and flower gardens put where illegal dumping was common. Some districts removed public wastebaskets on downtown streets. This reduced illegal dumping significantly, but did not eliminate it. In the meantime, the systems supporting the imposition of penalties for illegal waste disposal and providing standard bags to low-income households free of charge were prepared.

Figure 4. Illegal Dumping & Countermeasures



6) Legal Framework for Institutionalization of the Volume-based Waste Fee System

- Legal Grounds for the Volume-based Waste Fee System

The basis for enforcement of the VBWF system is the Waste Management Act. Local governments are authorized to determine the details of implementation through ordinances. The Act also deals with penalties for illegal dumping.

Each regional authority has specific regulations on enforcing the system in its own ordinances. It regulates the kinds of waste to which the pay-as-you-throw system applies, as well as the methods of disposal, fees, standard bag type/color/material, supervision of manufacture and management of standard bags, designation of and guidelines for the stores that will sell them, and criteria on cancelling a standard bag seller agreement, etc.

The bag size, material, strength and type are determined by the Korean Standard on Plastic Products, to which all specifications are subject and those that do not meet the standard are failed during inspections.

To prevent counterfeiting, the seals for printing on the bags are kept by each regional authority and handed over to the manufacturers only when they have already produced the standard bags. Anybody caught making or distributing counterfeit bags is subject to punishment under criminal law on unauthorized fabrication of official documents.

Table 7. Legal Framework for Implementation of Seoul's VBWF System

Legislation/Documentation	Details
Waste Management Act	<ul style="list-style-type: none"> ▸ Recommendations on enforcement of the VBWF system ▸ Legislation of ordinances related to enforcement of the VBWF system ▸ Prohibition of illegal dumping and imposition of related penalties ▸ Revision of regulations related to the regional authorities: Ordinances and regulations, guidelines on enforcement of the VBWF system, guidelines and fees for discarding food waste
Autonomous District Ordinances on Waste Management	<ul style="list-style-type: none"> ▸ Waste to which the pay-as-you-throw system applies, ways to discard the waste, fees, standard bag type/color/material, supervision of standard bag manufacturing and safe management, and designation of stores to sell standard bags
Korea Federation of Plastic Industry Cooperation (KFPIC)	<ul style="list-style-type: none"> ▸ Types: VBWF bags made of PE, LLDPE, or containing LDPE (CaCO₃+HDPE) ▸ 9 types of biodegradable VBWF bags
Progress Reports	<ul style="list-style-type: none"> ▸ Contents: Implementation, manufacture and sales of VBWF bags, method and frequency of waste collection, financial independence of waste management and financial dependence allotment rate, discharge of bulky waste and collection of disposable plastic

	bags, enforcement of illegal activities, etc.
Criminal Law	▶Manufacturing and distribution of counterfeit standard bags correspond to fabrication of official documents.

Phased Price Increase of VBWF Bags

On August 1, 2015, the prices of VBWF bags rose in 4 autonomous *gu*-districts in Seoul: Yongsan-gu, Nowon-gu, Youngdeungpo-gu, and Dongjak-gu. For 20 liter VBWF bags for municipal solid waste, the price was previously determined as KRW 340-380 but rose to KRW 400-490. Two-liter VBWF bags for food waste rose from KRW 50-80 to KRW 140-210. In total, 14 autonomous *gu*-districts had raised bag prices during the first half of 2015, with other districts planning to do the same.

Table 8. Basic Cost of General & Food Waste Handling Incorporated into VBWF Bag Prices (in KRW)

		Collection & Transport Fee	Treatment	Bag Manufacture	Profit	Total	Deviation
General Waste	20L (Base Cost)	402	190	51	22	665	1.00
	20L (Current)	308	12	21	22	363	0.55

Food Waste	2L (Base Price)	142	149	10	4	305	1.00
	2L (Current)	101	5	10	4	120	0.39

Seoul had good reason to raise the price of its VBWF bags. The share of waste management costs shouldered by its residents included in the price of the bags had been the lowest of all local autonomies. It cost KRW 665 to dispose of 20 liters of municipal solid waste while the price of a 20 liter VBWF bag was only KRW 363, which meant Seoul residents paid only 55% of waste treatment costs. For food waste, the situation was even more unsustainable. The price of a 2 liter VBWF bag for food waste was KRW 120 while the cost of treatment for that volume was KRW 305, meaning residents shouldered only 39% of the actual related expense.

Table 9. Average VBWF Bag Prices (Nationwide)

(2014, 2014)

	National Average	Average in Metropolitan Cities	Seoul	Busan	Daegu	Incheon	Gwangju	Daejeon	Ulsan
Price (KRW)	457	650	363	850	430	620	740	660	600

While the national average price for 20L VBWF bags was KRW 457, the price in Seoul was KRW 363, or only 80% of the national average and the lowest in the nation. Even if we factor in different processing methods and costs for local autonomies, VBWF bags in Seoul were still cheaper than in other regions.

As residents' share of waste treatment costs remained low, district financial strain worsened. While the price of VBWF bags had not changed much since 1995 (the year the system was introduced), the cost of waste management continued rising. In addition, VBWF bag sales have had a direct impact on each district's financial condition as, starting in 2015, profits from these sales have been directly managed by the districts.

Table 10. Price Increase Guidelines for VBWF Bags

	Current Fee	Average of All Autonomies	2015	2017
General waste (20ℓ)	KRW 340 ~ 400	KRW 363	KRW 437	KRW 492
Food waste (2ℓ)	KRW 40 ~ 160	KRW 120	KRW 133	KRW 187

Seoul released guidelines on the price rise in its efforts to address this impending crisis, bringing the wide-ranging prices of

VBWF bags from district to district to greater similarity and increasing the lowest price of VBWF bags in Seoul in phases until 2017.

In other words, by 2018, the price of VBWF bags will have been raised gradually to where prices in all autonomous *gu*-districts in Seoul will be similar. The final prices for 20 liter VBWF bags will be KRW 492 and KRW 187 for 2 liter food waste bags.

To sum up, these price increases mainly aim to reduce the financial burden of local districts, as well as reducing waste.

People would throw away less if VBWF bags cost more, and even go so far as to not generate as much waste in the first place. To these ends, the VBWF system has been instituted and the prices raised.

Model Cases of the Volume-Based Waste Fee System

The model cases in Dobong-gu, Seoul

Separate Disposal and Collection of Recyclable Waste

Dobong-gu (*gu* is an administrative district) came up with different guidelines for each of 6 housing types. Basically, disposal of waste from apartment complexes could be done independently by residents while those living in other residential areas required active involvement of the district office in the collection and disposal of waste and recyclables.

a) Professional Collection System

Garbage collection teams were organized in each *dong* (sub-district), and two personnel (a cleaner and a driver) took a waste management vehicle to collect the recyclable waste at the side of the road, joined by a city employee responsible for waste management from the *dong*-district office. These three persons entered into a business relationship with recycling shops on behalf of the *dong* district. The team members brought and sold the collected recyclable materials at the shops. Profitability was maximized and resident involvement increased.

b) Compensation for Recyclable Materials

The Volume-based Waste Fee System is a good way to encourage the separation of waste for disposal and collection but can seem very inconvenient to residents. It does not make any sense if the recyclable materials are to be collected free of charge while residents are asked to considerably inconvenience themselves in following the system. Compensation (toilet paper) given for the recyclable materials served to motivate residents to participate and to promote the system in a short space of time.

c) Separation of Recyclables into 5 Types

There are 5 types of recyclable materials - newspapers, other paper, milk cartons, bottles, metal - and there are certain ways of disposing of each. Once separated, these recyclables could be sold at recycling shops immediately upon collection.

d) Daily Collection Drive in a Single Zone

The one-size-fits-all approach was not pursued in waste collection for *dong*-districts, but flexibility added instead to ensure

appropriate collection methods and schedules, etc. In other words, they divided the entire *dong* into five zones and focused on the promotional drive and thorough collection of waste in one zone each day, rather than covering all five. The sanitary workers were ordered not to collect garbage that had been disposed of improperly at the door and induce the residents to load their garbage bags onto the waste collection truck when they heard the truck's electronic tune.

e) Collection and Selling on the Same Day

As the recyclable materials were collected in the morning and sold in the afternoon, a recyclable selection yard was no longer necessary. The recovered materials were sold directly to private recycling shops as well as to the public recycling companies. In that way, profit from management of recyclables could be returned to the residents.

f) Implications

The key drivers for success were 1) the active involvement of residents who were encouraged to do what they had to, 2) high proceeds from the sale of recovered recyclables by the relevant administrative authorities, 3) return of the proceeds to residents, and 4) efforts by the authorities to motivate residents to participate. To ensure success, in-depth educational sessions were conducted, hosted by the head of the *dong*-district office. And instead of perfunctory committee gatherings, civil servants had face-to-face meetings with residents to promote the program.

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