Sustainable urban waste management system in Metropolitan Seoul, South Korea

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Abstract

Solid waste or garbage from households and small businesses is managed by a challengeable system in Metropolitan Seoul, South Korea. It is known as the Seoul Volume-based Garbage Collection Fee (VGCF) system. Unlike the preceding system, which charged waste generators a fee for waste disposal in proportion to their property taxes, this newly designed system, which came into full effect in 1995, charges a fee according to the amount of garbage. Seoul VGCF system was introduced according to two theoretical principles: (1) public service 'coproduction'-cooperative production between citizen and city government-principle or citizen volunteerism; and (2) 'polluter-pays' principle or pay-as-you-throw. Thus, this system is characterized by two disparately oriented policies. The first of these is that "recyclable materials voluntarily sorted by residents, which are curbside collected at no cost by city government." The other is "the garbage disposal bag collection fee is charged to residents by city government according to the garbage collection volume." In metropolitan Seoul this system successfully reduced per capita waste disposal from 1.3kg in 1994 to 0.9kg in 2000, while at the same time it increased the amount of recycled materials.
Keywords: waste management, sustainable consumption, urban management, recycling, landfill, incinerator, coproduction, polluter-pays principle.

1 Introduction

As the standard of living continues to climb during contemporary times, people continue to generate increasing amounts of by-products, commonly known as waste. Particularly, urban residents generate additional waste due to their higher


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level of personal consumption, including a greater use of disposable items and fast food. In addition, because of their enhanced environmental sensitivity, urban residents demand high-quality waste disposal services. As a result, metropolitan areas throughout the world have experienced similar difficulties in solving their urban waste problems.

2 Seoul's geographical situation and waste problems

2.1 Geographical situation

The capital city of South Korea, Seoul is located in the mid-western part of the Korean Peninsula at 126º-east longitude and 37º-north latitude. Located in the East Asian monsoon belt, Seoul has hot, humid summers and long, dry, cold winters. In summer, high temperatures and heavy rain characterize the climate, while, in winter, by repeating cycles of three freezing cold days followed by four milder days. The yearly mean temperature of Seoul area is 12.2°C; the average precipitation in Seoul is 1,257mm, 72% of which is concentrated during the period of June to September. Seoul is inhabited by 10,470,000 citizens comprising 3,457 thousand households [5]. With a population density of 17,289 persons/Km^2, the overpopulation situation causes many kinds of urban problems such as traffic, housing and waste treatment problems.

2.2 Urban waste problems

In the past, solid waste generated by Seoul Metropolis was dumped into low-lying rice paddy fields. This changed in 1978 when Seoul began disposing of waste at the Nanji Island landfill site. Ironically, the former rice paddy landfill sites were reconstructed for luxurious apartment complexes. In 1992 the 2.7 million square meters Nanji Island landfill site became saturated with 92 million cubic meters of waste. (The Nanji Island landfill was reconstructed for the 2002 World Cup Main Complex). Waste disposal was transferred to the newly constructed Kimpo coastal landfill [10]. However, with a projected life of only about 25 years, and growing resistance from the residents near the Kimpo site, Seoul began considering the increasing difficulties in securing new landfill space. As a result, Seoul began implementing policies to reduce its reliance on landfills through the reduction of waste generation, recycling and incineration.

2.3 A solution to the urban waste problems: Seoul VGCF system

Since the early 1990's, waste problems emerged as one of the biggest urban issues. The rapidly growing economy led to mass production and mass consumption, which in turn resulted in an increase in the amount of waste generated. Complaints, and a strong movement against siting and constructing a new waste treatment facilities-incinerator, landfill, etc.- forced waste problems to be tackled differently, rather than just focusing on the supply of waste treatment facilities. Within this context, Seoul VGCF (Volume-based Garbage Collection Fee) system was introduced. The amount of municipal solid waste generated in

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Seoul came to the daily average of 15,397 tons in 1994. Most wastes were landfilled and 3,159 tons (20.5%) were recycled.

However in 1995, the year when the VGCF system started, the amount of the domestic wastes was reduced to the daily average of 14,102 tons by 8.4%, 4,137 tons of which were recycled by 30.9% and only 9,965 tons incinerated or landfilled. The amount of treated wastes diminished by 18.6% and the recycled wastes increased by 31% [3,5]. At a glance, this system appears to be very simple. However, there are two important theoretical backgrounds to be addressed and many difficulties that must be overcome to execute the system.

3 Theoretical background of Seoul VGCF system

3.1 Citizen participation in garbage collection services

Citizen participation in local governance is a question of long-standing interest to urban scholars. Two decades ago, some urban scholars began to recognize that one significant participatory role of citizens has been neglected. This role concerns the potential productive involvement of citizens in the creation and delivery of local government services, what has been termed "coproduction" [6].

The literature on citizen coproduction has emerged as a result of theoretical and empirical analyses of urban service delivery. Especially in the 1980s, American municipal governments developed several new methods to deal with their new financial constraints. One of these methods was coproduction [7,8]. City governments have usually suffered from increasing costs in garbage collection services; however, these governments can't ask their citizens to assume a greater financial burden for service delivery. From a coproductive viewpoint, city governments can ask their citizens for cooperation instead of paying more. Seoul VGCF system is namely one method to reduce garbage collection costs by way of citizen participation in a garbage-sorting program [2]. In this process, citizens pay the city with their labor rather than with money. Therefore, city governments should not forget such prepayment by their citizens.

In the theoretical background of coproduction, we can easily find the importance of citizenship and its morality. By asking their citizens for simple labor instead of money, city governments are not requiring residents to pay additional taxes. With the goodwill, obligation and consciousness of an ordinary citizen, coproduction can be successfully implemented in the municipal garbage collection service process by voluntary citizen participation [2,6]. Therefore, in the context of coproduction, citizen participation in garbage collection services can be based on their environmental consciousness and democratic citizenship.

In regard to this theoretical background, the coproduction concept was very meaningful in the 1990s in Korea. Most Korean citizens were focused on real citizenship or citizen consciousness in the process of democratic political developments-the end of military- coup government, the democratic presidential election in 1987, the successful host of 1988 Olympic Games, the resumption of local autonomy and local elections in a 1991. Especially in the early 1990s, as waste emerged as one of the most serious social problems, the media suggested a

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civil movement "Reduce Wastes." Many citizens agreed with the suggestion. Many environmental NGOs were organized and supported by the public. Some of Korea's urban scholars, including myself, expressed interest in coproduction stimulated by empirical examination of citizens' voluntary participation in urban garbage collecting services. Many Korean citizens became actively engaged in garbage reduction and voluntary garbage sorting programs for recycling without any direct or individual economic rewards [3].

3.2 Polluter-pays principle in garbage collection fee

With citizen coproduction in garbage collection services, the polluter-pays principle or 3Ps principle is the other principal axis in Seoul VGCF system. Compared with coproduction, this principle is based on economic justice [1]. City governments charge waste generators for garbage collection fees according to the amount of waste discarded. In other words, this is a kind of a solid waste management system in which residents pay for garbage collection based on the amount of waste they generate instead of paying a flat fee or surtax. Residents thus have an economic incentive to reduce their solid waste through source reduction and recycling [2,4].

In the United States, over 4,000 communities are using PAYT (pay-as-you-throw) based upon the polluter-pays principle. According to a study conducted by the Institute for Local Self-Reliance (ILSR), when combined with convenient access to comprehensive recycling programs, PAYT plays a major role in achieving high recycling rates [4]. Research shows that more than half of the sampled communities achieving a 50 percent recycling rate, credit PAYT for their success. Janice Canterbury of EPA suggests that: Implementing successful PAYT programs, however, take some planning. First, they are designed with cost saving in mind. Second, convenient access to a wide variety of recycling opportunities must be available, so that residents can act on the price signals that PAYT sends. Last, the program has to be accepted by the community [7].

If PAYT is only based on the polluter-pays principle, Janice's third suggestion, 'community acceptance,' is not necessary. This suggestion is a result of understanding the importance in citizenship or citizen organization. In other words, democratic local self-governance is the building block of effective public service delivery system. It allows citizens to make and carry out important roles in public sectors. Voluntary citizen, nonprofit organizations and public agencies can produce new solid waste management at the local level. Especially in the case of Seoul VGCF system, it will be very good example to understand the relationship between coproduction and polluter-pays principle.

3.3 Two axes model on Seoul VGCF system

In the background of coproduction and polluter-pays principle, this article suggests a simple model to understand the meaning of Seoul VGCF system and then introduces a real case on solid waste management of Metropolitan Seoul, South Korea.

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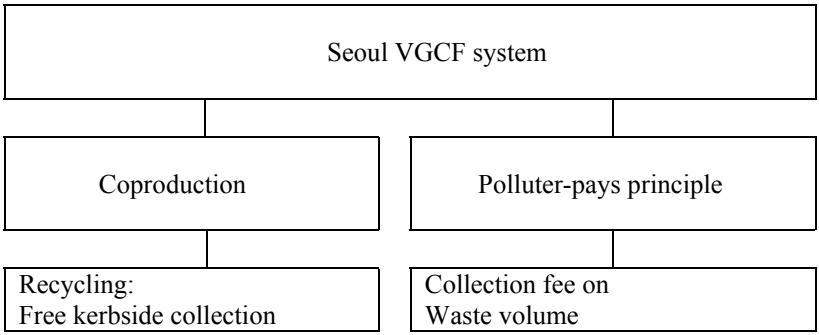

Figure 1: Two axes model on Seoul VGCF system

4 Case study: Seoul VGCF system

4.1 The scarcity of landfill

The Nanji Island landfill in Seoul was already suffering from over-capacity in 1986. As a result, Seoul's waste crisis became high on the national agenda. The Ministry of Environment (ME) and the Seoul metropolitan government urgently tried to search for a new landfill near Seoul. At last, the Kimpo seaside and rural area (50Km away from Seoul downtown) was selected as the new landfill site for Seoul and surrounding suburban areas. The new Kimpo landfill was composed of 5 sections. The construction of each section included waterproof and sanitary facilities to prevent outflow of the sewage water from the landfill. The first landfill section (4,088,000m^2) was completed in the early 1991. However, owing to Kimpo residents' strong and persistent protests, incurring an environmental movement by NGOs and ordinary citizens, the landfill was not opened until the following year [10].

4.2 Looking for alternatives: incinerating vs. recycling

With the difficult experiences of new landfill construction, the Seoul metropolitan government was prepared to construct another waste treatment facility, a huge incinerator, i.e. resource recovery facility. Seoul suggested very strong incentives for it's 25 districts, which have semi-local autonomy. Seoul would supply all the construction costs of the incinerator to any volunteer district, which would want the facility until 2001. Although most district high-level officials agreed with the suggestion of Seoul, the incinerator site neighbours did not agree. A lot of citizens near the incinerator candidate sites began to organize an anti-incinerator movement [3]. This citizen power linked to many environmental NGOs and the Seoul metropolitan government gave up five incinerator-construction plans among a total of nine. Because the recycling movement and VGCF system reduced the amount of waste drastically, the incinerators had difficulty finding a sufficient amount of waste. The average operating ratio of the three existing incinerators is under 35%. Due to the

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possibility of dioxin and the heavy burden of construction and operation costs, most citizens do not like these incinerators [3,5].

Table 1: Conditions of landfill, incinerators in Seoul.

	Kimpo (Sudokwon) Landfill near Seoul
Area, capacity	20,749,000m2 / 289,000,000 m3
Expected using Period in 1992 (Before VGCF)	1992- 2017
	(After VGCF, revised expected using period in 2000: extended 10-20 years)
Operation Summary	Watchmen who are selected by Kimpo residents, experts, and closed-circuit TV examine waste with the hauling amount and its peculiar characters of each waste collection area. The result of aggregated data can be very useful for imposing landfill fee to each local authorities (landfill users) as well as making waste management policy
	Incinerator construction and operation in Seoul
Facilities under Operation – 3 Facilities	Yangchon incinerator, capacity: 400tons/day (completed in 1996)
	Nowon incinerator, capacity: 800ton/day (completed in1997)
	Gangnam incinerator, capacity: 900ton/day (completed in 2000)
Facilities under Construction – 1 Facilities	Mapo incinerator, capacity: 750ton/day (will be completed in 2005)

Source: Documents of Sudokwon (Kimpo) Landfill Site Management Corp. and Seoul Metropolitan Government in 2003

4.3 The embarking on Seoul VGCF system

4.3.1 Actual data collection on waste generation by sources

Because the Kimpo landfill facility is equipped with a computerized waste measurement system at the entrance, Seoul metropolitan government was able to get actual data on the exact amount of waste generation and its sources in 1994. This data was the basis for considering and executing the new VGCF system. The data can give the waste manager important information on (1) who are waste generators, (2) what they are throwing, and (3) how much they have to pay. Because every registered hauling truck has their waste measured, the Kimpo Landfill Corporation can account for the exact amount of waste from a specific collection section.

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4.3.2 Types and capacity of the standardized garbage bag

The official garbage bags, produced locally at each district, are of two types: HDPE and LDPE. HDPE garbage bags are fit for using at the incineration facilities, LDPE garbage bags are fit for using at the direct landfill. The capacities of each garbage bag vary according to the consumers' necessity. There are usually 3 kinds- 20 litre, 50 litre, and 100 litre. The shape of garbage bag is similar to the translucent vinyl shopping bag and the part of its grip can be tied together.

4.3.3 Garbage collection fee

The price of the standardized garbage bags is directly linked to the garbage collection fee in the VGCF system. If a garbage generator wants to throw away 20 liters of garbage, for example, he or she has to buy a 20-liter garbage bag at a nearby supermarket. Before the VGCF system, Seoul metropolitan government charged the waste generators the fee for waste disposal in proportion to their property taxes as surtax. After the system, every district in Seoul has decided differently on their collection fees or prices of the garbage bags according to the different collection costs. The average prices of garbage bags in 2002 was as follows:

Table 2: Average prices of Garbage bags in 2002.

	Vol. (Liter)	Retail Price (US $)	Particulars on retail prices of garbage bags (%)			
			Collection Service Fee Ratio	Garbage Bag Production Cost ratio	Land -fill Fee Ratio	Retail Sales Profit Ratio
Household Garbage Bag	20	0.31	60%	5-12%	24%	3-5%
	50	0.77				
	100	1.58				
Business Garbage Bag	20	0.51	65%	5-10%	26%	3-5%
	50	1.14				
	100	2.17				

Source: Documents of Seoul Metropolitan Government in 2003

4.3.4 Household, small business garbage collecting

The one who discharges waste must purchase his or her district-designated bags that are provided by the district local authority. Non-recyclable waste is placed inside the bags and bags are put out for collection. (For the citizen's convenience, curbside collection is usual; however, a garbage collection station can be used at apartment and building complexes). Because larger bags are more expensive, citizens are encouraged to reduce the amount of garbage they generate in order to save the expense of buying bags. The designated bags are

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usually sold at neighbor supermarket. The lower-income residents can be supplied limited free bags at each community center. However, such as paper, iron, aluminum cans, glass and plastic are not to be put in the bags, but to be put aside separately. Private collectors take the profitable materials, such as paper and iron, and sell them to various recycling re-manufacturers. The local government collects less profitable materials, such as plastic and so on.

4.3.5 Preliminary and full enforcement of the VGCF system

In 1994, Seoul selected several districts to test the preliminary VGCF system. However, the city did not have sufficient time for trial and error. The local government system was scheduled to be totally changed, because all of the city mayors and head of districts would be elected by the citizens in June 1995. This local election was resumed after 30 years; district local authorities regained a lot of their autonomic decisions, including waste collection and treatment ordinances from Seoul and central government. Although there were hard debates on full enforcement of the VGCF system, the system began on the first day of 1995 in Seoul, as well as across the country.

Debates on the system were mainly over the drastic changes of waste management and the economic equilibrium problem between the poor and the rich. Nevertheless, most of citizens have recognized the system as follows: (1) VGCF system is cheaper than before surtax-collection fees. Extra collection tips to garbage collectors disappeared because citizens bought the garbage bags with their visible money at the market (Seoul citizens thought the garbage collection services were free, they used to give some tip to the collectors during big holidays). The volume based garbage fee is relatively lower than the preceding surtax-collection fee based on full amount of garbage. Recyclable goods are free collection, throwing garbage is only charged by garbage bag volume. (2) The VGCF system is useful for the citizens to recognize how much they throw and how much they pay. Therefore citizens do not want disposables, over-packaging and recycling difficult goods. These changing attitudes in consuming behaviors can affect the producers differently too. One of the important marketing strategies at companies naturally focused at the environmentally friendly goods, which are easy to reduce waste and recycle more.

4.4 Policy performance of Seoul VGCF system

The VGCF system has proven to be helpful in collecting recyclable garbage. Recycling enjoys broad popular support because of the system. Such public support does not come from the city government only. Support from NGOs is stronger than that from the government. Based on the VGCF system, citizens find it easy to participate in the discharger separating recyclables programs for less waste, more recycle. For examples, there are five kinds of separate garbage containers for paper, bottles, plastics, and metals in front of each apartment buildings and community centers. By the VGCF system, Seoul has got the policy performance as follows:

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Table 3: Policy performance of Seoul VGCF system.

Performace1: Waste reduction	VGCF system successfully reduced per capita waste amount from 1.3Kg in 1994 to 0.9Kg in 2000 (33% decline).
Performance2: Landfill useful Life extension	After the system, the expected useful life of Kimpo landfill extended 10 - 20years.
Performance3: Planned Incinerators Cancellation	Seoul canceled five incinerator construction plans among a total of nine planned incinerators because of reduction in the volume of waste.

Source: Documents of Seoul Metropolitan Government in 2002

4.5 Policy implications from Seoul's experience

From Seoul's experience, the VGCF system's policy implications are as follows: (1) Seoul VGCF system should be based on the two axis of coproduction and polluter-pays principle. Recycle materials voluntarily sorted by residents (coproduction axis) should be free curbside collected by city government their houses or offices. Garbage collecting fee (polluter pay principle axis) should be charged on waste generation amount. (2) Seoul VGCF system does not mean reduced costs at collection on services even though waste reduction ratio increases. Because the additional free curbside collection of recyclable materials is necessary for executing the system successfully. (3) VGCF system does not mean labor reduction but mean more labor from citizens instead of their money. The VGCF system requires more jobs to collect and sort recyclables rather than capital to construct landfill, incinerator facilities.

5 Conclusion

From the case study on Seoul VGCF system in Seoul, this article would like to say something about 'Balancing' between citizen's role and governmental policy institution. The balancing can be explained as the leverage between coproduction and polluter-pays principle. If the balancing were lost, Seoul VGCF system would be failed. For reducing garbage, if garbage collection fee is raised, based on only polluter-pays principle, then city government may suffer from illegal dumping and illegal incinerating. Therefore, coproduction is very important factor executing VGCF system successfully. If Seoul VGCF System had been only based on the polluter-pays principle, the system might have been another garbage. With the goodwill, obligation and consciousness of an ordinary citizen, coproduction can be successfully implemented in garbage collection service process. Therefore this article says, last but not least, city government should do something for citizens to have willingness to participate in voluntary garbage sorting program and then, in the process of VGCF system, the government must be accompanied by free curbside recycling.

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