

GREEN GROWTH IN ACTION

KNOWLEDGE
NOTE SERIES

04



EXTRACTING VALUE FROM MUNICIPAL SOLID WASTE FOR GREENER CITIES: THE CASE OF THE REPUBLIC OF KOREA

EIKO WATAYA WB, **FAROUK MOLLAH BANNA** WB, **INHYE BAK** WB, **DR. JAEMIN SONG** UNIVERSITY OF SEOUL, **SANG HYUN YOON** SUDOKWON LANDFILL SITE MANAGEMENT CORP., **AND DR. SORA YI** KOREA ENVIRONMENT INSTITUTE¹

INTRODUCTION

Municipal solid waste is discarded material that originates mostly from human activities in urban areas. It is well documented that improperly disposed of solid waste can negatively impact human health and the environment. For example, uncollected solid waste is one of the leading causes of flooding in slums, which claims thousands of human lives worldwide every year. Uncollected municipal solid waste can also affect other key sectors, such as tourism, hindering a country's economic growth.

The irony is that much of this waste could be reclaimed as renewable resources and help alleviate raw material and energy shortages in a cost-effective manner. To make municipal solid waste a usable resource, recycling must be encouraged, and ideally collected and separated at the source. Such a shift requires an integrated approach to policy creation that includes governance structures, technologies, investments, and citizen engagement—often challenging in fast-growing urban centers witnessing population growth, rapid urbanization, economic development, changes in human consumption, technology development, and more. As countries urbanize and

¹ This paper has benefited from the peer review and input of Silpa Kaza (Urban Specialist/World Bank) and David Lerpiniere (Consultant/World Bank).

grow economically, the level of waste generation per capita increases. The complexity of the waste stream typically also increases as the proportion of plastics, electronics, and hazardous waste grows and the share of biodegradable materials decreases.

But when solid waste management (SWM) is well planned and implemented, it can be a key driving force for boosting Green Growth. Green Growth is a mechanism to achieve sustainable development and promote economic growth, poverty reduction, improved well-being, social inclusion, job creation, and innovation through a more sustainable use of natural resources. Sound SWM can create jobs and contribute to making urban centers attractive, more efficient, and more resilient to the effects of climate change. Successful SWM contributes to building sustainable, green, and competitive cities—a necessary path toward viable Green Growth.

Sound SWM can create jobs and contribute to making urban centers attractive, more efficient, and more resilient to the effects of climate change. Successful SWM contributes to building sustainable, green, and competitive cities—a necessary path toward viable Green Growth.



Photo: www.shutterstock.com

As cities in developing countries around the world look for solutions, South Korea's experience in SWM can shed light on how regions in the same economic situation that South Korea was in a few decades ago can embark on policy reform to transform the management of solid waste. If South Korea's waste management system appears to be sophisticated today, it is because the country went through a long journey of transformation and sectorial reforms that led to the current situation. At the end of the Korean War (1950-1953), South Korea was struggling with severe poverty, and in 1961, GDP per capita was only USD 92. Economically, it lagged behind developing countries like Liberia and Burkina Faso. Nevertheless, South Korea undertook a series of transformational policies that, over the course of four decades, evolved from a supply-side strategy to a demand-driven one. These policies helped South Korea respond adequately to the challenges posed by waste generation in the context of urbanization, rapid industrialization, and economic development. There are also several other key factors that underpin such transformation, including implementation of effective and efficient laws, policies that consider social context and citizen concerns, and a sound institutional set-up and clear demarcation of institutional responsibilities among all stakeholders—national and local governments, the private sector, the informal sector and citizens, and the SWM sector. This Knowledge Note includes a brief overview of South



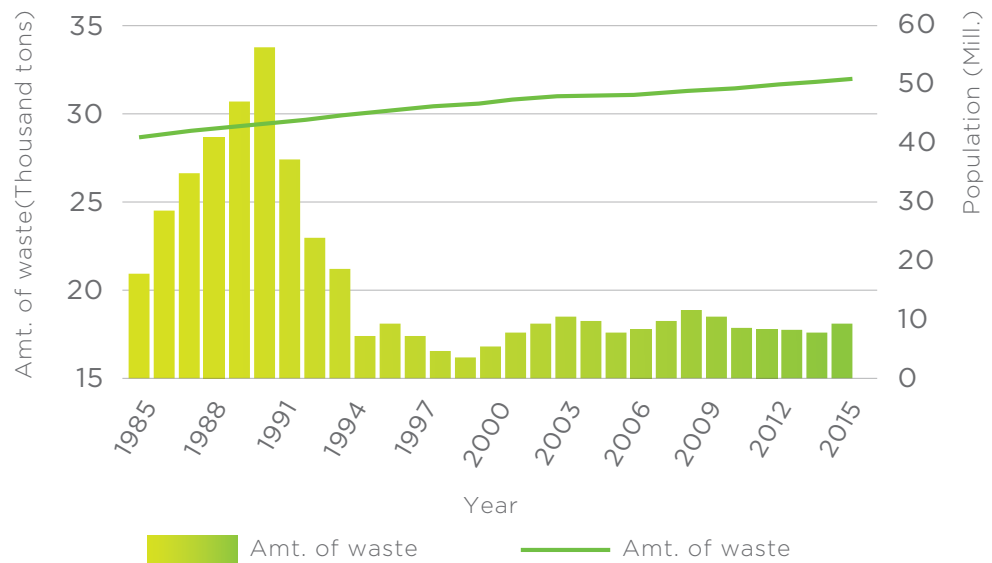
Photo: Sudokwon Landfill Site Management Corporation (SLC)

This Note explains how South Korea implemented change and offers lessons that could inform developing countries who are facing similar challenges.

Korea’s SWM policy and the management systems that have transformed it over the past 40 years, shifting a situation of rapidly growing waste and environmental damage to an opportunity to usefully recover the vast majority of solid waste. Over 80 percent² of South Korea’s solid waste is now recycled. In addition to policy interventions, this shift also required carefully targeted investments and awareness-raising initiatives to encourage behavioral change among citizens and business. This Note explains how South Korea implemented change and offers lessons that could inform developing countries who are facing similar challenges.

The prominent example is the Sudokwon Landfill Corporation (SLC) which was created to manage the Sudokwon Landfill site near Seoul. The success of solid waste policies in South Korea has been effective implementation at the local level through the creation of inter-jurisdictional treatment facilities managed by newly created inter-jurisdictional institutions to operationalize policy. The SLC landfill site is presented in this Note as an example of how the policy has been operationalized at the local level. The SLC example demonstrates how solid waste facilities can be developed and efficiently managed and operated for recycling, waste disposal, and energy recovery to

CHART 1: TOTAL AMOUNT OF MUNICIPAL WASTE IN SOUTH KOREA (SOURCE: OECD, WBG)



² Definition of recycling in South Korea includes: i) material recycling, and ii) energy recovery recycling from waste to energy fuels. This figure includes material recycling (mainly due to construction waste, recyclables, and food waste) and energy recovery recycling (SRF, RDE, or Biogasification from food waste).

enable the sustainable Green Growth of cities in line with national policy.

1. SOUTH KOREA'S WASTE MANAGEMENT POLICIES

Devastated after the Korean War, South Korea eventually grew to become a prosperous country, earning the name the “Miracle of the Han River.” After the Korean War, South Korea initially devoted its resources to the recovery and reconstruction of its nation. The country focused on developing its industrial sector, mainly for exports. The rapid industrialization of the country resulted in the generation of large quantities of waste, as well as pollution (see Chart 1). There was no adequate policy, facility, or approach to manage and plan for the increasing volume of waste. As a result, an open dumping site grew in the Seoul Metropolitan Area, causing many environmental and social problems. Thus, managing waste became one of the key challenges for both national and local governments.

THE TRANSFORMATION OF SOUTH KOREA'S SWM APPROACH

South Korea has gone through the following policy transformation to cope with the growing demand for proper waste management.

FIGURE 1:

SUMMARY OF SOUTH KOREA'S SWM POLICY DIRECTION AND OPERATIONAL APPROACH (1960S-2000S)



(Source: Ministry of Environment)

1960S-70S: OPEN DUMPING WITHOUT PROPER TREATMENT

Rapid economic growth that started in the early 1960s, along with urbanization and the accelerated industrialization of South Korea, led to the production of large quantities of waste in urban area. Back in the 1960s, similar to the current situation in many developing countries, waste generated in South Korea was dumped into open spaces in the middle of cities, and in drainage channels, streams, rivers, or oceans without proper treatment. The situation was worse in Seoul, the capital and most populated city in South Korea. Like other cities, Seoul lacked proper facilities and policy actions for proper waste management, but this situation was particularly alarming because the waste produced in Seoul represented 78 percent of the total waste (92 million tons) produced in South Korea between 1978 to 1992. The first legal act related to SWM, “The Waste Cleaning Act,” was created in 1961 and provided a framework for ensuring consistent and fast and regular collection of waste and human waste in particular—in urban area.

1980S: INTEGRATED WASTE MANAGEMENT AND CONSIDERATION OF ENVIRONMENTAL IMPACT

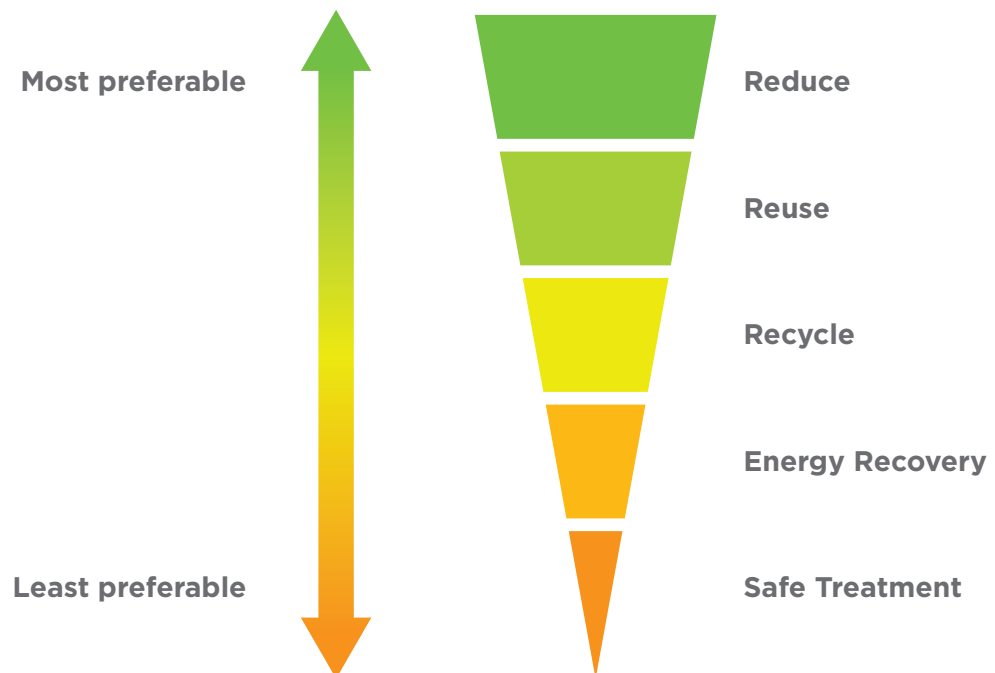
Continued inappropriate waste treatment seriously affected ground and surface water contamination and caused serious environmental and human health issues. Public opinion on harmful waste management systems became incredibly critical. With increasing demand from the public to improve such inappropriate waste management, and with the potential for economic growth in mind, the central South Korean government and local jurisdictions prioritized waste management and decreasing environmental problems. This situation resulted in the implementation of policies focusing on proper treatment of solid

waste. In 1986, “The Waste Management Act,” covering household, human, and industrial waste, was enacted to provide comprehensive and integrated waste management in South Korea. The Ministry of Environment became responsible for SWM issues, marking the first time the environment was considered as important as economic development.

1990S: WASTE REDUCTION AND RECYCLING

In the 1990s, the emphasis on waste treatment gradually moved from collection to recycling. In the mid-90s, South Korean society faced two opposing forces in respect to waste treatment. First, a democratization process in the 1980s increased citizen awareness of environmental protection and triggered a wide public effort for waste minimization and reduction. Secondly, the NIMBY (“not in my backyard”) syndrome began to spread, forcing decision makers to think outside of the box on how to prolong the life of solid waste treatment and disposal services. These two social phenomena resulted in a tightening of municipal solid waste policy. The need for waste-treatment facilities like sanitary landfills and incineration plants increased, but there were still big challenges regarding public opinion about where to build those facilities. For example, the Seoul city government proposed a “1 District, 1 Incineration” policy in 1993 but was confronted by public opposition because of concerns over dioxin emissions. At the same time, since South Korea has no natural resource imports, it was becoming clear that the country was going to have to maximize the use of local resources by recycling and reusing waste. In the end, the traditional supply-side approach of providing waste treatment facilities for disposal gradually shifted to a demand-side approach that reduced waste at the source and maximized recycling. In the new approach, solid waste was considered a resource. “The Promotion of Saving and Recycling of Resources Act” was enacted in 1992 and triggered citizen action around waste reduction and separation. The “Promotion of Installation of Waste Disposal Facilities and Assistance to Adjacent Areas Act” was enacted in 1995 to support and address the concerns of communities who didn’t want a waste facility in their neighborhood.

FIGURE 2: WASTE MANAGEMENT HIERARCHY



(Source: Waste Management in Korea, Ministry of Environment, Republic of Korea)

2000S: DIVERSIFICATION OF WASTE MANAGEMENT

The composition of the waste generated in the country continued to diversify due to rapid industrialization and economic growth. The new economy, which was dominated by heavy construction, electronics, and the automobile industry, was a source of new categories of waste, including e-waste, construction material, vehicle scraps, and more. In response to increased volumes of these materials, South Korea created several laws dealing with non-conventional household waste (in addition to a conventional waste management act). New acts, such as “The Construction Waste Recycling Promotion Act” (2005) and “The Act on the Resource Circulation of Electrical and Electronic Equipment” (2008), were enacted to properly manage new waste streams and promote recycling and programs that turn waste into energy. Food waste was another area that needed to be tackled so the central government also enacted “The Comprehensive Measure for Reducing Food Wastes” (2005). This law, aimed at reducing and recycling food waste, required public and private sector participation, with financial and action plan support from the government. This new direction led to more comprehensive approaches for waste management that focused on waste as a resource. And this is the waste reduction policy and SWM system that people can see today in South Korea.

BOX 1. MAJOR POLICY INSTRUMENTS

Reduce	1. Volume-based waste-fee system
	2. Waste charge on the producers of hard-to-recycle products
	3. Restriction on the use of disposables
	4. Packaging reduction
	5. Industrial- and construction-waste reduction
Reuse	6. Guarantee money on empty vessels
	7. Promotion of package reuse
Recycle	8. Extended producer responsibility (EPR) system
	9. Eco-assurance system
	10. Food-waste recycling
	11. Construction-waste recycling
	12. Local-based eco-industrial towns
Energy Recovery	13. Expanded waste-to-energy facilities
	14. A clean energy park in the metropolitan area
	15. Waste manifest (ALLBARO) system
	16. Waste import and export management
Safe Treatment	17. Hazardous waste management
	18. Medical waste management
	19. Neglected waste management

(Source: Waste Management in Korea, Ministry of Environment, Republic of Korea)

2. WASTE MANAGEMENT IMPLEMENTATION AT THE NATIONAL LEVEL

In order to mitigate the negative impacts of SWM and create value from waste, South Korea has a set of comprehensive policy instruments to tackle both the upstream and downstream effects of waste generation and disposal. Those instruments have evolved with policy transformation around four areas: waste prevention and reduction, waste recycling, resource recovery, and sustainable management of waste treatment facilities.

1. WASTE PREVENTION AND REDUCTION

Volume-based waste-fee systems (VBWFs): The key principle behind VBWFs is that the “polluter pays.” Waste generators are responsible for their waste. VBWFs aim to reduce waste generation at the source and encourage recycling by providing free collection services for recyclable materials.

BOX 2. DRIVERS OF CHANGE

The emphasis of South Korea’s waste management policy has moved from achieving safe disposal and treatment to maximizing reduction, reuse, recycling, and recovery (the 4Rs). In summary, what made South Korea change its policy direction?

Increased cost for waste treatment: At the early stages of SWM, the South Korea government focused on establishing waste management facilities—mainly landfills—and basic laws, regulations, and institutional arrangements. Over time, environment policies and standards on the waste management process, including collection, transport, and treatment, were getting more stringent, increasing the cost of regulation. Among waste treatment facility options, landfills are the cheapest. However, the cost of waste collection and treatment is still increasing; it was USD 51/ton in 1995, and three times that in 2012, at USD 153/ton, due to continuous upgrades in the waste collection process, transportation, disposal, and the large use of incineration treatment, as well as high-end recycling technology. (See Chart 2.)

Limited land: Moreover, South Korea has limited space for waste treatment facilities. Mountainous areas compose 70 percent of national land, and available remaining land is very limited.

Resource scarcity: Availability of resources is a big challenge in South Korea, which imports 97% of the natural resources it needs from other countries. Due to the very high proportion of imports, South Korea needed to explore all opportunities for using waste materials. Promoting waste recycling and recovery has maximized resource efficiency. In short, South Korea has saved or earned money by reducing, recycling, and recovering waste in a proper way.

CHART2: COST OF WASTE TREATMENT AND WASTE REDUCTION IN KOREA
(SOURCE: MINISTRY OF ENVIRONMENT, KOREA)



- **Waste generator-pay model:**

Waste generators pay based on volume. Dischargers of non-recyclable waste and food waste pay waste treatment costs in proportion to the amount of waste disposed of or collected.

- **Unit pricing systems (for household solid waste generation and recycling):**

Households have to purchase pre-paid bags to dispose waste in, excluding recyclable products. Local governments sell the bags with their own pricing, using the revenue for waste management budgets. For example, the Korea Environment Corporation³ relies on such sales for 15 percent of its total waste-management budget.

- **Incentives:**

There is free collection for household recycling and lower fees for generating less waste. And local governments save transportation and landfill costs when waste is reduced at the source.

FIGURE 2:



Waste-charge systems: Manufactures or importers pay for part of the cost for the disposal of products that are difficult to reuse or recycle, or contain hazardous materials. This waste-charge system is intended to minimize production of non-recyclable wastes and promote efficient disposal. The charge rate is based on each product’s environmental impact.

2. WASTE RECYCLING

Extended producer responsibility (EPR) systems: Manufacturers and importers are responsible for recycling four different packaging materials (metal cans, glass bottles, carton packs, and synthetic resin packaging material that are used to package food and beverages, agricultural products, marine products, livestock products, cleansers, medicines, cosmetics, and more) and 27 products⁴, including household packaging and household electrical appliances.

Recycling obligations: Municipalities are responsible for establishing and operating centers that facilitate the exchange of second-hand goods, as well as operating public facilities to collect, store, sort, and pre-treat recyclables. Manufacturers make an effort to make second-hand parts and products that

³ Korea Environment Corporation (K-eco) is a quasi-governmental organization under the Ministry of Environment and is aimed at becoming a global, total environment services provider.

⁴ Television, refrigerator, washing machine, air conditioner, computer, audio, mobile phone, copier, fax machine, printer, automatic dispenser, electric water purifier, electric oven, microwave, food waste disposer, dish washing machine, bidet, air purifier, electric stove, electric cooker, water softener, humidifier, iron, fan, blender, vacuum machine, video cassette recorder (Ministry of Environment, Korea) Doesn't include paper, clothing and metal scraps. (The amount to be recycled is annually announced by the Ministry of Environment.)

can be easily reused or recycled—through Korea Environment Corporation certification, under the Ministry of the Environment (MoE).

3. RESOURCE RECOVERY

Energy recovery from both combustible and organic wastes: The South Korean government, through the MoE, supports waste-to-energy programs and other resource recovery treatment technologies by co-financing their costs with local governments. The ratio of waste treatment facility fiscal support between national and local governments is 30 percent to 50 percent. (But the ratio varies depending on the type of facility owner.)

4. SUSTAINABLE MANAGEMENT OF WASTE-TREATMENT FACILITIES

Promoting shared responsibility of waste-treatment facilities: Waste-treatment facilities are shared across jurisdictions. For example, the Sudokwon Landfill site is used by three local governments: Seoul Metropolitan Area, Incheon Metropolitan Area, and Gyeonggi Province.

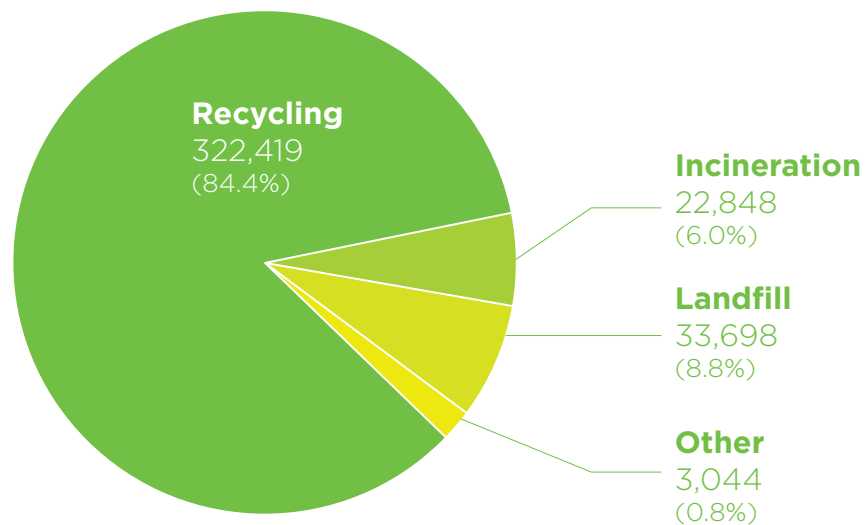
5. MAJOR ACHIEVEMENTS

Achievements in waste generation: Daily municipal waste per capita in 2011 was 58 percent less than that of 1991, even with the fast-economic growth of the 1990s and 2000s.

Achievements in recycling and resource recovery: As of 2012, more than 84 percent of waste is recycled or valorized—the world’s leading recycling rate. For household waste recycling, South Korea ranks among the top of OECD countries.

Achievements in waste-treatment facilities: After 20 years of efforts by central and local governments, institutions, citizens, NGOs and others working on integrated waste-management policy, most of South Korea’s waste is now treated in waste-treatment facilities in a safe, effective, and efficient way. Waste generated from metropolitan areas, including Seoul, is now sorted and collected at the source and is incinerated and put in a sanitary landfill, meeting requirements and standards set by the government.

FIGURE 3: WASTE MANAGEMENT HIERARCHY



(Source: Waste Management in Korea, Ministry of Environment, Republic of Korea)



Photo: (Left-Top) Sudokwon Lanfill Site Management Corporation (SLC)
(Right-Top) <http://parks.seoul.go.kr/parks/detailView.do?pldx=6#target01>
(Left-Bottom & Right-Bottom) Dream park 1 & 2 - Sudokwon Lanfill Site Management Corporation (SLC)

3. GOVERNANCE OF THE SWM SECTOR

1. DEMARCATIONS OF ROLES AND RESPONSIBILITIES BETWEEN NATIONAL AND MUNICIPAL GOVERNMENTS

National level: Because SWM needs to take into consideration environmental concerns, the Ministry of Environment (MoE) has been responsible for overall environmental policy formulations of SWM since the 1980s. MoE's main responsibilities are to enact and amend relevant laws and acts; formulate mid- to long-term waste-management policies; and provide technical and financial support to municipal governments to implement SWM. Under the MoE, the Korea Environment Cooperation (K-eco) acts as an operational support agency for SWM policy implementation, technical support for municipalities, and implements campaigns for citizen awareness.

Municipal level: Municipal governments are mainly responsible for SWM operations in their districts. In the case of industrial and hazardous waste, the discharger is responsible for final disposal. Municipal governments are responsible for waste collection, recycling, and the treatment of all waste from household and commercial businesses. Costs for waste management are covered by tipping fees (paid by anyone disposing of waste at a landfill in a VBWF system) and citizen taxes.

2. FINANCIAL SUPPORT (THE ALLOCATION OF THE NATIONAL BUDGET TO SUPPORT MUNICIPAL SWM)

In order to mitigate the risks associated with municipal solid waste, sound planning and operations must be informed by local resources and context. SWM is an integral part of building sustainable,

efficient societies. However, many countries have trouble securing and allocating SWM budgets, and identifying which department is in charge of financing waste management. In the case of South Korea, each municipality has financial responsibility for its own waste management, but the central government supports municipalities financially in the following ways:

Construction: The central government supports the costs of hard infrastructure construction and technology in municipalities, including waste disposal plants and recycling facilities. K-eco provides technical support for waste-management facilities. Subsidies vary based on a municipality’s financial status and the type of facility (e.g. landfills, recycling centers, etc.). Local governments still usually cover more than 50 percent of the costs.

Operation costs: The budget for operations and management of SWM facilities comes mostly from local governments, and citizens. On average, 28 percent of costs are covered by residents, while the national government and local governments cover the rest. Citizen costs among provinces as shown below. National government support averages about 5 percent of total operating budgets, depending on the financial capability of municipality.

TABLE 1: RESIDENT PORTION OF SWM OPERATING BUDGETS (2015)

Province	Resident portion	Province	Resident portion
Korea	28.5%	Gyeonggi-do	26.2%
Seoul	47.7%	Gangwon-do	17.5%
Busan	49.4%	Chungcheongbuk-do	21.2%
Daegu	31.2%	Chungcheongnam-do	13.5%
Incheon	42.2%	Jeollabuk-do	20.1%
Gwangju	42.8%	Jeollanam-do	13.7%
Daejeon	43.2%	Gyeongsangbuk-do	12.1%
Ulsan	52.8%	Gyeongsangnam-do	35.3%
Sejong	15.3%	Jeju-do	12.3%

Source: Ministry of Environment, Korea Environment Corporation)

3. CITIZEN ENGAGEMENT

Rapid urbanization makes it very difficult to collect waste in unplanned areas of cities and slums, and to find sites for new solid waste management facilities. Land prices are expected to increase due to population growth and urbanization, making it even more difficult to acquire land for solid waste management infrastructure. Also, waste-management facilities like landfills, incinerators, and wastewater-treatment plants are regarded as unpleasant and potentially dangerous, prompting citizens to take a NIMBY (“not in my backyard”) attitude. This makes citizen education critical for implementing new policies successfully. Not only does it help in changing the public perception of these facilities, it helps on a household level by promoting waste reduction and proper sorting. To this end, the Government of South Korea funds environmental education and public relations campaigns and provides tools to local community members for managing their own waste. Even children’s education on waste, recycling, and reuse starts in kindergarten.

4. NEXT STEP OF SOUTH KOREA’S SWM POLICY

In 2016, the government of South Korea enacted new policy instruments and started a new challenge for a greener society for future generation. “The Framework Act on Resource Recirculation” will reduce

the use of natural resources and energy by further minimizing incineration and landfill waste, and maximizing recycling. The new plan includes primary goals such as achieving a target of zero landfill waste by 2025.

5. OPERATIONALIZATION OF THE POLICY AT THE LOCAL LEVEL: THE SUDOKWON LANDFILL SITE CASE

The Sudokwon Landfill Corporation (SLC) was established under the Ministry of Environment in July 2000 as a federal venture to promote the appropriate treatment of urban waste material, as well as resource recovery and protection. SLC was formed under South Korea's SWM policy and acts as a cross-jurisdictional implementation and service delivery entity.

South Korea's first sanitary landfill site, Sudokwon Landfill, takes and processes municipal solid waste from 25 million people living in Seoul, Incheon, and Gyeonggi-do. The whole landfill site, occupying 20 million square meters⁵, is South Korea's, and the world's, largest. Sudokwon accounts for around 57 percent of the landfill area in South Korea. When Sudokwon Landfill started to receive municipal solid waste in 1993, the volume of solid waste being processed properly jumped to more than 60 percent.

The Sudokwon Landfill Site Project demonstrated key major points for successfully shifting from unsanitary to sanitary landfills, operationally and environmentally. For example:

- **It had strong commitment and support from national and municipal governments.**
- **It is a good example of an inter-jurisdictional waste management institution because it was established by three provinces as a single entity to plan and implement SWM operations.**
- **Citizen involvement in planning and education were a priority.**
- **It established a revenue generating system.**
- **It integrated green space into landfill design. Sudokwon Landfill comprises four landfill parts, occupying a total area of 16.85 million square meters. Part of that area is the Ara Canal and Environment Research Complex. The first landfill accumulated 64,000,000 tons of municipal solid waste before it closed in October 2000. Stabilization work was completed in 2004 and it was turned into an eco-friendly golf course, opened to the public in 2013.**

BACKGROUND

Before the Sudokwon Landfill Project, Seoul designated a small island called Nanjido as a landfill site in 1978. While experts initially expected that landfill site to reach maximum capacity in 1984, it stayed open, and over capacity, until 1993, because the city couldn't find an alternative site. It was an open dumping site, eventually creating a large waste mountain. Since 1978, trash had been gushing out, and in 1988, the dump was seeing 28,877 tons of waste per day.⁶

Moreover, Nanjido was near Han River—the river crossing the middle of Seoul. The dump caused water contamination, unpleasant odors, air pollution from waste burning, and other problems. Seoul was not the only government to face this problem; Incheon and Gyeonggi-do also had to find new landfill sites, so the three regions collaborated on the Sudokwon Landfill Project.

⁵ <http://eng.me.go.kr/eng/web/index.do?menuId=54>

⁶ <https://www.seoulsolution.kr/en/content/landfill-recovery-project-transformation-landfill-ecological-park>

In June 1980, a private developer started to reclaim the western coastal area near Incheon for agricultural use. The reclaimed land was procured by the South Korean government in January 1988, and it was transformed into a landfill alternative to Nanji-do. Landfill construction work began in February 1989 and was finished in November 1991.

PLANNING

Site selection process: The Sudokwon Landfill Project site is located 30 kilometers west of Seoul. This location served all three local governments that were facing difficulties finding a new waste disposal site. The location was chosen primarily for the following reasons: **First** the site had to be large enough to process increasing waste volumes. **Second**, the site had to have a minimum neighboring population in order to avoid local resistance.

Third, the site had to be cheap to procure. Because it was a regional effort, the Seoul Metropolitan Government (SMG), in consultation with the two other local governments, requested that the MoE take the lead on a long-term SWM facility plan.

A piece of reclaimed land along the western coast of Incheon was chosen. Despite the difficulty in leachate management and long transfer distances, this reclaimed land had advantages because it was not expensive and there was less public resistance toward constructing a waste-management facility there.

INSTITUTIONAL SETTING

The Sudokwon Landfill Project is a complex project, including large-scale construction, multi-jurisdictional coordination, national government participation, community and private sector involvement, and more. Each project stage (i.e. planning, construction, and operation and maintenance) requires clear decision-making and multi stakeholder involvement. To address these needs, several groups were formed to help streamline processes:

Coordination Committee for Sudokwon Shore Landfill (1984)

This committee deals with issues regarding new landfills or expansion of existing landfills and is comprised of officials from the MoE and the three local governments.

Sudokwon Landfill Operational Management Association (1991) and Environment Management Corporation

As the first landfill was completed, in November 1991, Seoul, Incheon, and Gyeonggi-do agreed to establish the Sudokwon Landfill Site Operational Maintenance Association for effective operation and management of the landfill. But due to a lack of management expertise, the union made a consignment contract in O&M with the Environment Management Corporation. Although both agencies had different responsibilities (one handled administrative tasks and finances, the other handled technical aspects), the co-management system between the two entities lacked clear delineation of responsibilities and obligations, and therefore actually served to delay decision-making.

Sudokwon Landfill Site Management Corporation (SLC) (2000)

With fragmented management of the landfill site, conflicts and confusion arose between different organizations over roles and responsibilities. To resolve these issues, the roles of the above two entities were consolidated. This merger also brought together the three municipal governments, and in 2000, the SLC, affiliated with the MoE, launched under the “Law on the Establishment and Operation of Sudokwon Landfill Site Management Corporation.”

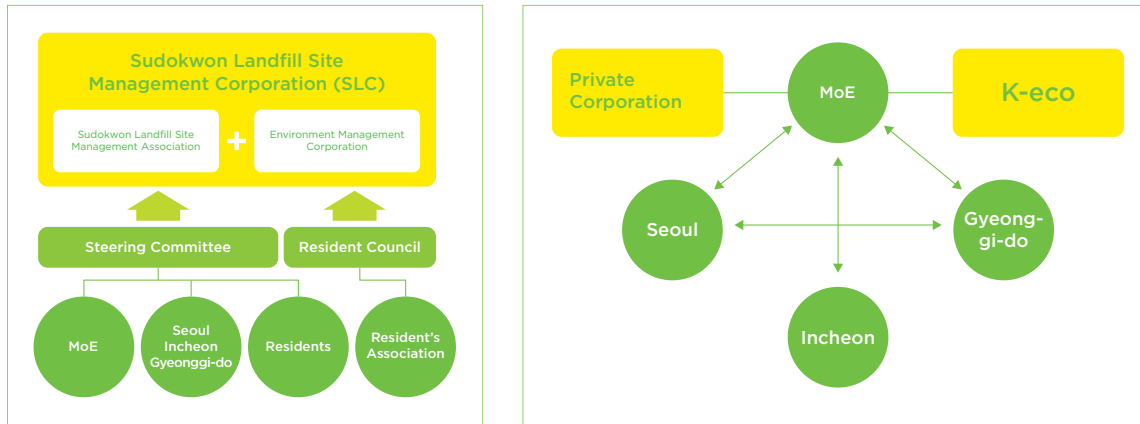
Steering Committee

The SLC then formed a steering committee to connect MoE, the three municipal governments, and

resident representatives. Together they advise the Board of Directors of the SLC on major issues related to SLC management. (Major decisions are determined by the resolution of the SLC Board of Directors.)

FIGURE 4:

SLC INSTITUTIONAL FRAMEWORK (LEFT) KEY STAKEHOLDER INVOLVEMENT IN FORMING SLC (RIGHT)



(Source: SLC, WB)

CONSTRUCTION COST SHARING

The original agreement was for the MoE to cover 100 percent of the construction of the landfill. But the tax revenue to the central government significantly decreased in 1989 due to changes in tax policy, and the MoE could not cover the costs as agreed. Instead, SMG covered 71 percent of the land purchase and construction costs were shared among the three local governments. A ration of cost sharing allocation was decided by population (as of 1998) and local government unit financial status. As a result, it was arranged as SMG at 76 percent, Incheon Metropolitan Government at 12 percent, and Gyeonggi Province Government at 12 percent. The decision-making was done by the Coordination Committee.

TABLE 2: CONSTRUCTION COST SHARING

Unit: USD Mill.	Ministry of Environment (MoE)	Seoul Metropolitan Government (SMG)	Incheon Metropolitan Government	Gyeonggi Provincial Government	Total
Land purchase	\$12.5M (29%)	\$31M (71%)	0 (0%)	0 (0%)	\$43.5M (100%)
Construction costs	0 (0%)	\$21.3M (76%)	\$3.4M (12%)	\$3.4M (12%)	\$28.1M (100%)

(Source: SLC, 2010. *Dream the Green: Ten Years History of Sudokwon Landfill Site Management Corporation.*)

IMPLEMENTATION STAGE

Revenue: SLC's revenue comes from three different sources: tipping fees (levied upon waste received), funds by municipalities, and reserves that are paid by the local governments of Seoul, Incheon, and Gyeonggi-do proportionally. All expenditures are strictly controlled and monitored in accordance with internal regulations.

The revenue derived from the tipping fees is used exclusively for general administration and operations of SLC and the landfill. Meanwhile, revenue derived from the funds and reserves are used for maintenance and expansion of infrastructure and energy recovery facilities.

TABLE 3: SLC'S FY 2016 BUDGET

(Unit: USD 1,000) (Note: USD1=KRW1,150)

Total	Tipping fees	Funds from municipalities	Infrastructure reserves	Golf-club O&M	Others
288,750 (100%)	180,690 (62.6%)	32,340 (11.2%)	39,210 (13.6%)	13,820 (4.8%)	22,690 (7.8%)

(Source: Budget for 2016, SLC, 2016)

Creating a financially self-sufficient model: In the beginning, support from both the national and local governments was essential. However, SLC is now making enough of a profit through its green businesses, including a landfill-fueled gas power plant, to cover operations and maintenance costs. It shows that with well-designed and carefully implemented policy, even waste-treatment facilities can be a revenue generating venture, creating jobs and benefits for surrounding communities.

Conflicts with residents: The South Korean government, municipal governments, and local residents finally came to agreement over the landfill site through a reconciliation committee. All parties agreed to the following points:

- **Arrangements for expansion and additional waste must be approved by residents.**
- **Residents are allowed to inspect incoming waste at the site.**
- **Residents will be commissioned as monitoring personnel.**
- **Residents are compensated.**

Citizen participation: After establishment of SLC, SLC and local residents made agreements on including residents as members of:

- Sudokwon Landfill Operation Committee, which is comprised of resident representatives, public officials, and environment experts. The Committee deliberates and makes critical decisions regarding waste management and the operation of SLC.**
- Sudokwon Landfill Resident Council, which is a legal entity comprised of resident representatives, environment experts and others within the areas under influence of the Landfill. The Council serves as a communication channel between local residents and SLC by accepting feedback from the residents and consulting them about various project by SLC.**

Citizen participation was institutionalized through the adoption of new regulations such as “Resident Steering Committee Regulation,” “Community Monitoring Personnel Service Regulation”, and “O&M Regulation for Resident supports fund.”

Resident Support Fund: 10 percent of the revenues derived from tipping fees are reserved for a Resident Support Fund in accordance with the “The Law for the Promotion of Waste Disposal Facility Installation and Assistance to Adjacent Area” of 1995. Based on the resolution of the Resident Supporting Council, this fund is being used to increase local resident’s income levels and welfare systems.

6. SWM AND GREEN GROWTH

As we’ve seen with the SLC, sound solid-waste management can turn Green Growth concepts into reality. Well-planned investment in greening efforts can generate economic, environmental, and social benefits. The SLC creates a virtuous circle under the concept of the 4Rs—reduce, reuse, recycle, and

TABLE 4: RESIDENT SUPPORT FUND EXPENSES, AS OF DECEMBER 2015 (UNIT: USD 1,000)

Project		Budget (Unit: USD 1,000)	Remarks
Landfill Cell - 1	Living condition improvement	27,304	House repair, agricultural equipment
	Community hall, Water supply system	90,829	Community hall construction (33), upgrading water supply system and road-pavement
	Welfare center	14,277	Welfare center construction (4)
	Others	7,909	Relocation of damaged houses, school cafeteria facility, shuttle bus for villagers, heating oil/gas for senior centers
Total		140,319	
Landfill Cell - 2	Household support	41,185	Each household affected by landfill
	Village recreating	17,653	Painting, children's playground and village hall construction
	Community welfare-town	24,206	Daycare center and nursing homes
	Others	35,234	Medical check-ups, scholarships, education funds, senior center construction, and charity programs
Total		118,278	

(Source: SLC homepage)

recovery. In adopting waste-to-revenue models, the SLC has also contributed to greenhouse gas emission reductions. (Landfill methane collected through pipes and recyclable gas is transferred to a landfill gas power plant.) Such landfill gas uses for fuel and energy for vehicles also serve as a valuable source of revenue for the community. In addition, SLC built an eco-friendly park to restore nature to the landfill site and offer green space for citizens, improving the environment and quality of life.

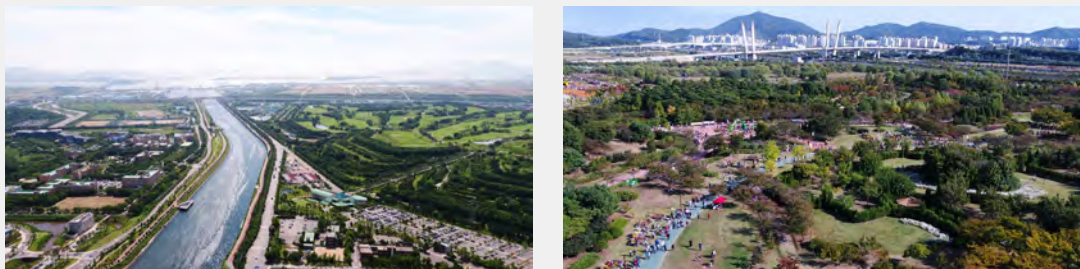
On the social and economic sides, **community involvement in the development of the SLC established a win-win situation** for both residents and local governments by creating job opportunities.

It took many years of twists and turns to come to what the SLC is today, but it has become obvious that total waste management—from collection, sorting, and treatment to disposal and recycling—can make waste a valuable resource.

BOX 4. DREAM PARK

The goal of Dream Park is to optimize a reclaimed landfill and to become an ecological park. The development of the ecological park aims to change the perception of the area from a waste landfill to a daily living space. The park will not only provide a place to relax for the residents of the metropolitan and regional areas, but also eventually stand as a globally reputable resort.

Photo: Sudokwon Lanfill Site Management Corporation (SLC)



7. LESSONS LEARNED

The assessment of the waste management system in South Korea and the SLC case study illustrate the importance of an integrated approach in managing complex environmental, social, and economic aspects of SWM. One of the key messages South Korea tried to convey to citizen is that “waste is not a waste; value can be extracted from waste.” And without changing public perception of SWM sites, the governments involved would never have been able to move ahead successfully. Here are other reasons the project became a landmark example of Green Growth in action:

A strong policy commitment from governments, supported by the appropriate regulatory and legislative instruments. This commitment helped move SWM from unsanitary open-dumping sites to a sanitary landfill site and a vision that a new model for SWM could be a win-win for the economy, local residents, and the environment. Estimates of the economic losses and costs due to poor waste management are generally greater than the amount required to provide a clean, efficient resource.

Early planning. Cities need to make solid waste management planning an integrated part of overall city master plans. The planning process must involve a deep understanding of the baseline situation in order to design plans for sanitary landfills in their own context.

Thorough consultation of communities around landfill sites (even after the facility has closed). NIMBY attitudes are a common challenge in solid waste management. However, what the Sudokwon Landfill case study demonstrates is that such complex relationship with the neighboring community can be better managed by implementing a thorough consultation and engagement process with the surrounding communities, starting from the onset of the project. This could be in the form of focus groups to discuss the planning, development, and monitoring of a project.

Cooperation between the central and local governments in all phases of the solid waste management project. The involvement of the government should include co-financing of the capital costs, as well as providing overarching policies for improving waste management. Furthermore, the national government should be involved in the planning, construction, and operational stages. Communication channels among all stakeholders and a transparent decision-making process are also key. Deep involvement of the national government does not mean that the national government takes over the management of the sector. In most countries, this is a responsibility delegated to local government.

What the Sudokwon Landfill case study demonstrates is that such complex relationship with the neighboring community can be better managed by implementing a thorough consultation and engagement process with the surrounding communities, starting from the onset of the project.



Photo: Sudokwon Landfill Site Management Corporation (SLC)

National governments designed adaptive policies to respond to emerging challenges over time. As countries urbanize and develop economically, so does the quantity and composition of the waste generated. The methods of treating these wastes require the exploration of new approaches—often funded by economic growth.

Working on behavior change to increase public participation in better waste management, recycling, and composting, as well as monetizing waste. No matter what measures policymakers deploy to collect, recycle, and process waste, they will never achieve such objectives without a fundamental shift in public behavior toward reduction in consumption and littering, as well as recycling.

System and institutional capacity. For both an operational entity (i.e. legislation, funding, and technical capacity and staffing for operations) and proper coordination with multiple stakeholders.

A successful cost-recovery model. This is one of the major challenges that facilities face in developing countries. The SLC facility has succeeded in developing a cost-recovery model comprising a blend of various revenue sources. With the introduction of the VBFS, tipping fees have become one of the major sources of revenue. The revenue from the tipping fees is supplemented by revenue from various cost recovery activities, such as the sale of electricity and the sale of recyclable materials.

REFERENCES

- Clean Development Mechanism (CDM) Bazaar website, <http://www.cdmbazaar.net/repo/sellers/seller-265830069>
- Ministry of Environment, Republic of Korea, 2014, Case Study for OECD Project on Extended Producer Responsibility, Republic of Korea
- Ministry of Environment, Republic of Korea, Environmental Statistics Portal, 2016, Environmental Statistics Annual Report, <http://stat.me.go.kr/nesis/index.jsp>
- Ministry of Environment website, <http://eng.me.go.kr/eng/web/index.do?menuId=54>
- Ministry of Environment, Republic of Korea, 2016, Waste Management in Korea
- 환 경 부, 폐기물처리시설 국고보조금 예산지원 및 통합업무처리지침 (in Korean)
- (Ministry of Environment, Republic of Korea, 2017, Waste Treatment Facility, Government Subsidy Budget Support and Integrated Processing Guidelines)
- Ministry of Environment, Korea Environment Corporation, Republic of Korea, 2012, Statistics of Volume-Based Waste-Fee System
- Ministry of Environment, Republic of Korea, Sudokwon Landfill Site Management Corp. <http://eng.me.go.kr/eng/web/index.do?menuId=54>
- OECD, OECD Data, Municipal Waste, <https://data.oecd.org/waste/municipal-waste.htm>
- Seoul Metropolitan Government, 2017, Seoul Solution: Landfill Recovery Project: Transformation of Landfill to Ecological Park, <https://www.seoulsolution.kr/en/content/landfill-recovery-project-transformation-landfill-ecological-park>
- Song, Jaemin, Seoul Metropolitan Government, Policy Note Series, Developing Solid Waste Landfills for Large Metropolitan Areas: The Case Study of the Sudokwon Landfill in the Republic of Korea, GPSURR, World Bank
- Song, Jaemin, University of Seoul, Smartening Solid Waste Management, Lessons from Korea's Experience (presentation material)
- Sudokwon Landfill Site Management Corp. Budget for 2016, SLC internal document
- Sudokwon Landfill Site Management Corp., Converting Waste Resources Into Energy Landfill to Dream Park
- Sudokwon Landfill Site Management Corp. website, <http://www.slc.or.kr/slc/mb/cc/citiCoo04.do#/eyJ3ZWJQYWdlTm8iOiIyMTYiLCJ0YWJObyI6MH0=>
- Sudokwon Landfill Site Management Corp., 2010, Dream the Green: Ten Years History of Sudokwon Landfill Site Management Corporation
- World Bank Group, World Development Indicators, Population Total website, <http://data.worldbank.org/indicator/SP.POP.TOTL?locations=KR&view=chart>
- Acknowledgement: This Note was edited by Tasha Eichenseher, Korea Green Growth Trust Fund.

Korea Green Growth Trust Fund

The World Bank Group

1818 H St NW, Washington, D.C., 20433

<http://www.wbgkgtf.org>

The Korea Green Growth Trust Fund is a partnership between the World Bank Group and the Republic of Korea, established in 2011 to support client countries as they shift to green development path. Both partners share a common goal to reduce poverty and promote shared economic prosperity in an environmentally responsible and socially inclusive way.

The Trust Fund finances on-the-ground programs as well as knowledge exchange activities, and to date has approved 132 programs in the urban, transport, information and communication technology, energy, environment, water, and climate sectors. Based on strong performance, as well as increasing demand for collaborative development implementation programs, the fund has grown from US\$40 million to US\$88 million WBG programs through 2021.

© 2014 International Bank for Reconstruction and Development / The World Bank
1818 H Street NW
Washington DC 20433
Telephone: 202-473-1000
Internet: www.worldbank.org

This work is a product of the staff of The World Bank with external contributions. The findings, interpretations, and conclusions expressed in this work do not necessarily reflect the views of The World Bank, its Board of Executive Directors, or the governments they represent.

The World Bank does not guarantee the accuracy of the data included in this work. The boundaries, colors, denominations, and other information shown on any map in this work do not imply any judgment on the part of The World Bank concerning the legal status of any territory or the endorsement or acceptance of such boundaries.

Rights and Permissions

The material in this work is subject to copyright. Because The World Bank encourages dissemination of its knowledge, this work may be reproduced, in whole or in part, for noncommercial purposes as long as full attribution to this work is given.

Any queries on rights and licenses, including subsidiary rights, should be addressed to World Bank Publications, The World Bank Group, 1818 H Street NW, Washington, DC 20433, USA; fax: 202-522-2625; e-mail: pubrights@worldbank.org.