



Comparative Study of Waste Management Between Seoul and Bandar Lampung to Support Environmental Security

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Abstract. The World Bank states that cities worldwide produce around 2 billion tons of waste annually. The waste will bring problems and threaten the environment's safety, so waste management is vital in city policy. Seoul is a city that used to have waste management problems and managed to make fundamental changes to waste management. While Bandar Lampung already has a Regional Regulation on waste management, it still has many management challenges, which result in environmental damage. For secondary data, this research will use a literature study method from journals, books, and news sites. The concept is used to help analyze Waste Management with five aspects, namely aspects of financing, institutions, technology, community participation, and legal aspects. The results found that Seoul's success in waste management can fulfill all five aspects. Meanwhile, Bandar Lampung can only fulfill legal and institutional aspects. Aspects of technology, financing, and community participation need attention from the Bandar Lampung government to improve waste management services that support efforts to maintain environmental security.

Keywords: Waste management · Environmental Security · Open Dumping · Landfill

1 Introduction

The waste problem is an environmental problem that is widespread in people's lives today. The number of human populations that continues to grow and the rapid development of technology does not only have a positive impact on aspects of people's lives but can also harm people's lives, especially the environment. The development of the industrial sector often disturbs the balance of the environment, where the progress of the industrial sector is the same as takeovers that damage and increase production. Besides that, the number of humans also affects human production activities, resulting in the occurrence of waste in the community.

According to Law no. 18 of 2008 concerning Waste Management, waste is the residue of daily human activities and natural processes in solid form (UU Nomor 18, 2008). In general, waste can be divided into three types: organic waste, inorganic waste, and B3 waste. Organic waste is waste that can decompose quickly; naturally, this waste is produced from biological materials that are biodegradable or can be degraded by microbes, for example, food waste, kitchen waste, fruit peels, vegetables, and others. In contrast to organic waste, inorganic waste is produced from non-biological materials and is unbiodegradable or cannot be decomposed by nature, such as plastic bottles, used glass, cans, and others [1]. Meanwhile, B3 is hazardous and toxic waste that can threaten human health and damage the environment [2].

The existence of waste has a considerable impact on human life. Waste that is piling up from day to day and is not managed properly can be a serious threat to environmental security in people's lives. In addition to disturbing environmental hygiene, poor waste management can cause various diseases, environmental damage, and natural disasters threatening human security. Considering the dangers of the impact of this waste management, it is necessary to have serious handling related to waste management.

The Lampung Province Environmental Service (DLH) reported that in 2020, the waste generated by the people of Lampung reached 4,446.62 tons/day. Where the waste is dominated by food waste, as much as 58.9%, plastic waste by 24.7%, and paper waste by as much as 9.5%. In Bandar Lampung City, waste production is estimated to reach around 639,049 tons/day, with 93.5% of waste being transported to the TPA per day. One example is the Bakung TPA belonging to the City of Bandar Lampung, where the waste entering the TPA reaches 800 tons daily, with a composition of 60% inorganic and 40% organic waste. The Bandar Lampung City Environmental Service stated that currently, there are 3 Waste Banks, namely the Kemiling Garbage Bank, Sukarampe Garbage Bank, and Way Halim Garbage Bank, but only one Garbage Bank is running, namely the Kemiling Garbage Bank, which is currently the Kemiling Garbage Bank has changed into TPS 3R [3].

On the other hand, Seoul also has a population that is also quite dense, reaching more than 9 million people with a total of more than 7000 tons of waste produced per day. Even so, Seoul is one of the cities that manage to manage waste well and is one of the best cities in recycling waste. In 1977, Seoul also had a reasonably severe waste problem and faced many obstacles in overcoming environmental problems. However, Seoul is known to have succeeded in getting out of the waste problem that was a problem for the city, if previously the TPA used by Seoul was still operating using an open dumping system, such as The Nanji landfill was finally closed in 1983 [4]. However, the open dumping system is known to be less effective for use in waste management because this system can cause pollution to rivers around the area. Meanwhile, Bandar Lampung is still using an open dumping system at Bakung TPA.

Seoul can take more effective actions in dealing with waste management. Several policies regarding waste management in Seoul are also slowly changing for the better, starting from the 1980s using safe disposal waste management, changing to reduce, recycle, and safe disposal in the 1980s. In the 1990s and again in the 2000s to reduce, recycle, energy recovery, and safe disposal [4]. Reducing and diverting waste from landfills has also become a priority for South Korea. South Korea's waste disposal

is divided into landfill, composting, recycling, and incineration. During the last three decades, even since the early 1990s, there has been an effective ban on plastic goods and packaging to reduce waste in the region [5].

This study was conducted to compare Bandar Lampung and Seoul waste management in an effort to support environmental safety. The reason for choosing these two cities as the object of study is because they are both sub-national actors at the city government level. Although there are many differences in population, technological progress, and people's behavior, comparing the two is relevant because Seoul also faced similar problems before finally changing its waste management policy. Therefore Bandar Lampung can learn from Seoul's experience in waste management. In addition, the waste problem needs serious attention to be handled because the accumulation of waste can threaten environmental security, and its impact can also threaten public health security in the long term.

2 Waste Management Policy Review

The lack of handling of waste management in Bandar Lampung has threatened environmental security in the area [6]. This non-traditional security will have an impact not only on the health of the surrounding community but also on the health of the soil around the existing TPA. However, the services and policies provided and made by the local government as an institution that oversees and handles waste management in Bandar Lampung are still unable to solve this waste-related problem. Furthermore, the government needs to improve waste management technology and increase collection points before processing it further.

The waste problem is a common problem faced by various cities worldwide. These cities also have waste management problems. The UK, for example, has problems with littering, the capacity and facilities of the landfill to handle littering, as well as the impact of poor waste management on ecological security and regulations or policies related to waste management [7]. Law enforcement factors also play a role in combating illegal waste disposal in the UK. However, the written policies and deterrent effects have not significantly impacted those who pollute the environment. Institutional factors in waste management in the UK are also not good, and this is supported by the placement of a landfill that is less strategic, as well as economic factors [7]. The similarity of the waste management problem can be used as a lesson for other cities. The world city has succeeded in changing the face of its city by making many efforts and issuing various policies. Some cities have succeeded, and some have not or have not. Several factors include waste management and recycling, financial support, education, community gender, and age [8]. The higher the population, the greater the number of waste humans produce. Rapid population growth not only results in increasing economic, industrial, and socio-cultural activities but also affects the transfer of environmental functions that experience shifts in environmental functions and quality that are not under their proper functions. Waste management highlights the actions of various actors, both public entities, the private sector, civic organizations, and individual citizens, in treating resources responsibly [9].

Changes in waste management policies, like other public policies, also experience changes from time to time. The government usually makes changes and innovations

following existing problems. As a megapolitan city, Seoul also initially had not-so-good handling in the 1980s. The policy then changed in line with the development of the City of Seoul [10]. Seoul is developing waste recycling facilities to evaluate the performance of waste management involving the community through the Public Opinion Survey.

Waste management has a direct impact on public health conditions. Therefore, as the authority holder in regional services, the government must have a clear vision and mission for waste management. The right laws or policies will significantly affect how people behave. Internal regulations or policies such as laws governing solid waste management are a benchmark for processes and operations in the field [11]. Poor waste management affects not only adult human health but also the condition of babies in the womb of pregnant women [11].

Conventionally, there are four waste management techniques: landfill, incineration, recycling, and bioconversion [12]. However, experts are still trying to develop alternative sustainable waste management. Final disposal site (TPA) is the most popular conventional waste management technique, although it has a reasonably harmful impact on soil and groundwater quality. Waste incineration is a waste management technique that involves burning to convert waste into gas, liquid, ash, and heat, but the technique is quite risky for human health because the combustion process is a source of air pollution. Then, recycling is changing plastic, paper, glass, and metal waste into materials/objects that can be reused. Then bioconversion is a technique for managing waste by composting organic- organic components from fermented solid waste to produce alcohol or methane and compost products [9].

Seoul and New York City gradually involve various actors to manage waste to achieve environmental safety. Good waste management requires not only public agencies and policies but also the participation of multi-stakeholders from the public, private and civil society sectors [13]. In New York City, the private sector plays more of a role in helping to manage waste than public organizations, in contrast to Seoul, where public organizations collect and treat waste. New York City and.

Seoul produce comparable amounts of waste per year, but the two countries have differences in landfill recycling ratios. Where in Seoul, most of the waste is processed by recycling, while in New York City, it is stockpiled. In Seoul, individual citizens are required to recycle waste and pay for non- recyclable items, whereas in New York City, the role of individual citizens is more limited. In addition to recycling, in Seoul, waste management is carried out by burning 22.8% of waste and using incineration techniques which produce 15- 67% of home heating energy. Meanwhile, New York City has stopped and does not use such techniques because they can invite pollution and impact health and the environment [9].

3 Finding

3.1 Seoul Waste Management

Bandar Lampung and Seoul are indeed different in size and population. In addition to income, welfare levels and technological advances are much different. Bandar Lampung has a total population of 1,051,500 people with an area of 197.22 km² [14]. Meanwhile, Seoul has a population of 9,725,417 people with a total area of 605.21 km² [15]. Seoul

has a total of 25 districts, while Bandar Lampung has 20 districts. Statistically, the two cities are not equal, but some important lessons can be drawn from the experience of the City of Seoul in its waste management. South Korea has issued regulations on waste management since 1986, which contain waste categorization, division of responsibilities, and management techniques such as recycling techniques. However, along with rapid population growth, industrialization, and increasing consumption levels due to the increase in people's living standards, Seoul's landfills are starting not to be able to accommodate the high volume of waste that comes in every day. Therefore, there must be a fundamental change in waste management, including reducing the number of waste products from households, factories, construction sites, and others. Another factor that pressures the government to find the best solution for waste management is the high cost incurred by the government to manage the waste of Seoul residents daily. For example, in 1991 per day, the Seoul Metropolitan Government had to incur management costs of 280 billion dollars per year with 9% public funding assistance [16].

The rapid industrialization of South Korea has encouraged the development of Seoul to become not only an administrative city but also an industrial city. Every day factories produce garbage and waste that pollutes groundwater and the surrounding environment. However, at that time, South Korea, including Seoul, still established an open dumping system, where waste was disposed of in the open or at a Final Disposal Site (TPA) without any processing. The landfill operating at that time was the Nanji TPA, located in the center of Seoul City [4]. Its location right in the center of the city certainly raises new problems, such as environmental pollution around the landfill and the emergence of disease outbreaks that have resulted in protests from affected residents. Finally, the Seoul City government officially closed this landfill in 1993.

In order to achieve the target of a 71% recycling rate, a 30% reduction in food waste, and minimizing landfill use, Seoul completely changed its waste management system. The Seoul Metropolitan Government introduced a national policy on solid waste management in 1990. The focus of this policy is to reduce waste at the source and utilize the waste generated. In 1990 recycling was introduced and socialized to the public, then in 1995, a policy of implementing a fee was issued, known as the Volume-Based fee (VBF). Before this VBF was implemented, the people of Seoul were charged an indirect management fee through property ownership without considering the type and volume of waste.

The VBF system requires residents to pay a fee based on the volume and type of waste they dispose of. This is a consideration for the community to reduce the waste they produce daily because it will affect the costs they pay. The more waste they produce, the greater the costs they have to pay. This system forces waste generators to produce as little waste as possible [17]. Seoul residents must dispose of their trash using government-approved garbage bags (the government requires the public to buy garbage bags that can be found in retail stores). If they use inappropriate containers, they will be fined. Supervision is also carried out by relying on the community and all surveillance cameras throughout the city. The types of waste determined by the government (must be disposed of according to category) are organic waste, inorganic waste, and non-organic or inorganic waste such as diapers, sanitary napkins, and so on [4] (Fig. 1).

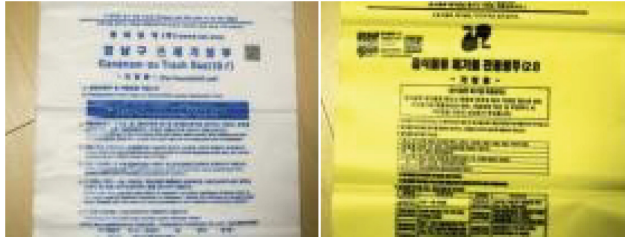


Fig. 1. Plastic waste used by the City of Seoul in sorting waste

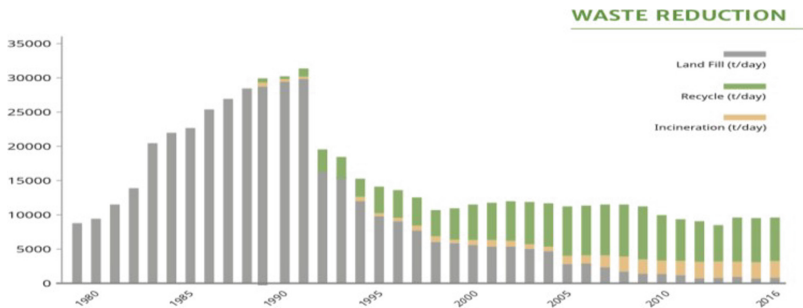


Fig. 2. Waste reduction in the City of Seoul [16].

This policy only reduced the pile of waste by 8% in the first year it was enacted. Therefore, the government expanded the recycling area in Seoul due to an increase of up to 30%, and 70% of household waste was successfully recycled. Even in 2012, Seoul managed to increase the recycling rate by more than 30%, equivalent to 6,200 tons of waste daily. From 1994–2012, household waste in the TPA decreased to only 10% (SUSA, 2022b). An increase also followed the positive impact of increasing recycling activities in the number of households contributing to waste management, from the previous 1.69 million to 2.97 million. Waste management charged to the community allows the government to save 87.4 billion dollars annually (Fig. 2).

The development of the tourism industry, driven by South Korea's success in introducing its popular culture throughout the world, has created new problems in waste management. This is also in line with the high level of consumerism in urban communities, which impacts the increase in food waste in the city of Seoul. Finally, the Seoul City Government implemented a policy to increase the cost of food waste disposal in 2013 so that any food waste produced by the community will also be subject to a disposal fee. Some districts apply a fee based on volume or weight, but some apply the same fee as general waste, differing by the type of bag used.

Thanks to the policy, food waste disposal decreased by 7.3% in the first year of its implementation. This policy has successfully reduced 14% of household food waste and contributed \$10.9 million in savings in processing costs (SUSA, 2022b). The Seoul City Government also provided financial assistance to the district government to process food waste before sending it to a landfill. This process reduces the volume of water contained in the waste, thereby reducing the volume of waste by up to 80% [18]. The most recent



Fig. 3. Seoul City Waste Management [17]

waste management policy issued by South Korea, including Seoul, prohibits draining waste water directly into the sea [19]. With this policy, Seoul initiated treating food wastewater with the latest technology, and the results can be enjoyed again and even have economic value. This technology converts wastewater into biogas and can be used for many things.

The advanced technology owned by the City of Seoul turns waste into a resource of economic value. Seoul implements clean incineration, which burns solid waste, and the combustion products can be processed and produce renewable energy. Yangcheong is the first processing facility established by the Seoul city government, with four facilities in one neighborhood. The facility can treat 2,850 tonnes of solid waste daily from around Yangcheong. The mechanism is to burn solid waste at a temperature of 8500-9000C to produce heat energy used by the surrounding community for heating in winter and clean electricity. In addition, non- combustible bottom ash is reused to become the primary construction material [17]. The state-of-the-art facility is managed by Sudokwon Landfill Corporation (SLC) and operates in the Incheon area. SLC was formed in 2000 and is a South Korean state-owned enterprise with a contract until 2046 [19] (Fig. 3).

Based on the explanation above, we can see that the City of Seoul has successfully fulfilled the aspects of waste management. On the regulatory aspect, the government issued a policy in 1986 and then developed technical and operational as well as institutional. The initial steps for Seoul's successful waste management were also supported by the financing aspect, which was carried out by establishing a BUMN SLC. Nevertheless, the most critical aspect we can learn from Seoul is community participation. Sophisticated technology and a sound system will not succeed if it is not supported by public awareness and readiness to support programs issued by the government. The residents of Seoul voluntarily obey the rules of waste classification and all existing regulations. This is, of course, supported by the government, which is ready to enforce the regulations. The lesson learned in Seoul is that all aspects of waste management must complement each other to function correctly.

3.2 Bandar Lampung Waste Managements

Through the Ministry of Public Works and Public Housing, the Government of Indonesia issued a waste management policy under the Indonesian National Standard (SNI) 3242:2008 concerning Waste Management in Settlements. Referring to the policy, there are five essential components in waste management, namely: institutional aspects, financing aspects; legal aspects; aspects of community roles, and technical aspects [20]. With



Fig. 4. Bakung TPA [23]

this policy, all cities in Indonesia should implement appropriate waste management. However, cities in Indonesia are not fully able to implement this policy due to existing obstacles, including Bandar Lampung.

Bandar Lampung can be said to have fulfilled one aspect: the legal aspect. Because Bandar Lampung City already has a Regional Regulation that regulates waste management which has been ratified since 2015. The regional regulation regulates all aspects of Bandar Lampung City waste management based on responsibility, sustainability, benefit, justice, awareness, togetherness, safety, security, and economic value. The goal is to improve public health and environmental quality, including making waste a resource that can be utilized [21]. This regional regulation also regulates institutional and organizational aspects, in which the articles have regulated all components of society's duties, authorities, and obligations. For example, the authority to determine the final disposal site (TPA) owned by the government, the community is obliged to manage household waste, and other institutional roles. It also fulfills the aspect of community participation in municipal waste management. In chapter VIII, community participation is regulated in detail, including socialization, mobilization, cooperation activities, incentives, and disincentives. Other technical and financing aspects still require further studies because they have not been regulated in detail. The local regulation only regulates user fees from the community. The Bandar Lampung city government has several obligations, namely [22] (Fig. 4):

- Maintaining TPS, integrated waste disposal sites (TPST), and TPA and their development.
- Provide facilities and infrastructure as well as the process of transporting waste from TPS-TPST to TPA
- Providing facilities and processing waste at TPS. TPST and TPA
- Provide waste sorting facilities at TPS, TPST, and TPA

Like other cities in Indonesia, Bandar Lampung still applies an open dumping system in its waste management. Open dumping is one of the methods used in waste management by disposing or burying waste. This method does not require advanced technology and minimal processing costs. However, the impact is also terrible on the environment because it is suspected to damage groundwater and cause various diseases [24]. The Lampung Forum for the Environment studied that open dumping caused problems with leachate (liquid produced from rainwater in landfills) flowing into rivers around the

Bakung TPA and crossing residential areas around Umbul Kunci Village. This leachate is considered a source of disease for residents and damages groundwater.

4 Conclusion

Waste management in Indonesia still uses an open dumping system, while South Korea already uses a sanitary landfill system. Waste management in Indonesia is, in fact, still not optimal compared to waste management in South Korea [2]. This also occurs at the sub-national level between Bandar Lampung and Seoul. Bandar Lampung is still far from ideal for waste management, while Seoul has successfully fulfilled the aspects of waste management. This is caused by various aspects, including institutional, funding, social, policy, and operational and technical aspects. Using an open dumping system and not implementing sustainable waste segregation harms social, environmental, and health. Meanwhile, South Korea has used a sanitary landfill system and has established a policy of sorting waste based on the type of waste so that the level of waste recycling in South Korea is relatively high.

In addition, from the social and policy aspects, based on government participation and policies, Bandar Lampung itself is still relatively low in community participation, where the community is still not included in the handling of waste management. As for Law No. 18 of 2008 concerning waste management, the Regional Regulation issued in 2015 also has not changed the face of waste management in Bandar Lampung, resulting in low waste management services. In contrast to Seoul, where community participation is relatively high, this can be seen from the high participation and compliance of the community in managing waste, where they are required to first sort waste based on the type of waste before putting it into plastic waste. In addition, the community is also encouraged to carry out the process of recycling waste; the community is also active in forming communities to oversee waste management in their respective environments. In addition, Seoul, through the South Korean government, also supports the handling of waste management through the resulting laws and policies. Even Seoul has started to manage liquid waste so as not to pollute the sea.

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