

Key Points

- Improving solid waste management is essential for achieving the Sustainable Development Goals, particularly Target 11.6 (environmental impacts of waste generation in urban areas), which most regions in Asia are not on track to meet.
- Households are not motivated to change their consumption habits and waste disposal practices due to a lack of information about the negative health and environmental implications of ever-expanding landfill sites and open dumping.
- The introduction of enforcement and incentive programs along with education campaigns can encourage the public to view waste more as a resource.
- Collaborative decision making involving all stakeholders when formulating a municipal waste separation plan is crucial for ensuring its acceptance and boosting the chance of success.
- The lessons learned from the pilot implementation, information gathered through public opinion surveys, and feedback from stakeholders should be evaluated before scaling-up throughout cities.

Solid Waste Management in Developing Asia: Prioritizing Waste Separation

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Introduction

Effective solid waste management is critical for achieving sustainable development in municipalities. In the last half century, urban cities around the world have grown significantly, and experts forecast that this trend will continue into the future. Increased populations coupled with rapid urban buildup put enormous stress on municipalities, especially in developing countries. Without proper solid waste management services and practices, there is little chance of achieving the related Sustainable Development Goals (SDGs). This policy brief looks at the problem of rampant solid waste production, both in the global context and in developing Asia, in particular. One of the precursors to developing more advanced waste management systems is in the adoption of waste separation practices. Waste separation, when implemented properly can lead to improved recycling and ultimately help societies shift from linear consumption patterns to a more circular economy, promoting the principles of reducing, reusing, and recycling (3Rs) and reducing overall waste.

Outlook for Global Solid Waste Production and Developing Asia

Asia is now the most economically dynamic region in the world, contributing more than two-thirds of global growth. While the outbreak of the coronavirus disease (COVID-19) pandemic has had immense global socioeconomic impacts, limiting growth prospects in developing Asia to a mere 0.1% in 2020, according to the Asian Development Bank, growth in 2021 is projected to rebound to 6.2% (ADB 2020). In



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addition, Asia’s urban population is expected to grow from more than 1.8 billion people in 2017 to almost 3.0 billion in 2050. Cities are an integral part of the region’s economic growth and they are the locus of structural transformation and innovation, where more productive firms, better paying jobs, and key institutions and amenities are located. According to World Urbanization Prospects data, the number of urban inhabitants in developing Asia has increased almost tenfold since 1950, from 246 million to 2.27 billion in 2018 (UNDESA 2019). The region led the global increase in urban population from 1970 to 2017, accounting for 53% of the total global urban population during that time (ADB 2019).

While the exponential rate of urbanization has been a key driver in the region, the associated exponential growth in waste generation is pushing cities beyond their solid waste management (SWM) capacity. Since urbanization is unlikely to abate, the solution will require a fundamental shift that encompasses appropriate policy, infrastructure, and behavior change, developing

Asia will need to move from a “take, make, and dispose” linear consumption pattern to a circular economy. Waste needs to be seen as a resource, with recycling being the preferred option, rather than disposal. Making this shift could eventually generate savings of 10%–35% for Asian cities and would assist in advancing the 2030 Agenda (UNEP 2015). Apart from the significant financial incentive, policy makers need to consider the health and environmental risks of inaction.

Sustainable Development Goal Indicators Related to Solid Waste Management

SWM is essential for the sustainable development of societies in both developing and developed countries. The related indicators for the 2030 Agenda and their forerunners have been driving SWM reform for decades, particularly regarding public health, the environment,

Table 1: Specific Targets of the Sustainable Development Goals Related to Solid Waste Management

Sustainable Development Goals	Specific Targets
SDG 3: Good health and well-being	<ul style="list-style-type: none"> • 3.2 End preventable deaths of children under 5 years of age • 3.3 End malaria, combat water-borne and communicable diseases • 3.9 Reduce number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination
SDG 6: Clean water and sanitation	<ul style="list-style-type: none"> • 6.3 Improve water quality by reducing pollution, eliminating dumping, and minimizing release of hazardous chemicals and materials, substantially increasing recycling and safe reuse
SDG 7: Affordable and clean energy	<ul style="list-style-type: none"> • 7.2 Increase renewable energy share in the global energy mix
SDG 11: Sustainable cities and communities	<ul style="list-style-type: none"> • 11.1 Ensure access for all to adequate, safe, and affordable basic services, upgrade slums • 11.6 Reduce environmental impacts of cities, particularly municipal and other waste management
SDG 12: Responsible consumption and production	<ul style="list-style-type: none"> • 12.1 Sustainable consumption and production national action plans or targets incorporated into national policies • 12.2 Sustainable management and efficient use of natural resources • 12.3 Halve per capita global food waste at the retail and consumer levels and reduce food loss during production, supply chains, and post-harvest steps • 12.4 Environmentally sound management of chemicals and waste to minimize their adverse impacts on human health and the environment • 12.5 Promotion of 3Rs to substantially reduce waste generation
SDG 13: Climate action	<ul style="list-style-type: none"> • 13.2 Integrate climate change measures into policy and planning • 13.3 Build knowledge and capacity to meet climate change
SDG 14: Life below water	<ul style="list-style-type: none"> • 14.1 Prevent marine pollution, particularly from land-based activities

Source: Adapted from Rodic-Wiersma and Wilson (2017).

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the conservation of natural resources, and, more recently, accounting for greenhouse gas (GHG) emissions and the effects of climate change. SWM affects living conditions, public health, sanitation, terrestrial and marine ecosystems, and access to natural resources. From a social, environmental, and economic perspective, SWM plays a key role in achieving at least 7 of the 17 SDGs: SDG 3 (good health and well-being), SDG 6 (clean water and sanitation), SDG 7 (affordable and clean energy), SDG 11 (sustainable cities and communities), SDG 12 (responsible consumption and production), SDG 13 (climate action), and SDG 14 (life below water). Table 1 provides an overview of the specific SDG targets that an improved SWM system can help to achieve.

The relentless pace of urbanization makes it difficult for cities to address the accompanying rise in demand for SWM, especially in developing countries. Migration to cities is driven by a search for better economic opportunities, jobs, higher wages, and a better quality of life. However, in developing Asia, poor migrants often make their way to low-cost housing in urban slums, without essential services, such as waste collection. In doing so, better-quality living standards are no longer assured for these migrants. The targets in Table 1 related to SDGs 3, 6, and 11 specifically address the impacts of inadequate SWM services on public health in urban areas of developing Asia.

Effective household SWM practices, related to SDGs 11, 12, and 14, can also help protect the environment, especially at the municipal and local levels. On an even larger scale, a developed municipal SWM system could help to diversify the global energy mix by adding cleaner energy systems (SDG Target 7.2), such as energy recovery through anaerobic digestion and biogas recovery.

Most regions of Asia are currently not on track to meet Target 11.6, concerning improved waste management. Southeast Asia, although currently lagging, could still achieve the target with accelerated improvement. The Pacific is the only area in the region on track to meet Target 11.6 (UNESCAP 2019). In most cases, since SWM policies and services fall under local government jurisdiction, greater support at the municipal level could

put pressure on higher levels of government to take action and appropriate more funding, which is one of the major barriers. Therefore, local policy makers need to understand the links between SWM targets and other SDGs, and that achieving the former would advance the latter and vice versa.

Current Situation of Waste Management in Developing Asia

In Asia, an estimated 1.2 billion tons of municipal solid waste was generated in 2016, and this figure is anticipated to increase to 1.5 billion tons by 2030, and 1.9 billion tons by 2050 (World Bank 2018). Despite this alarming increase, managing municipal solid waste (MSW) remains a low priority for most Asian cities, particularly when compared with investment in sectors such as infrastructure and transport. Moreover, municipal solid waste disposal in Asia relies heavily on landfill sites, due to lower costs compared to recycling, incineration, or composting (Terazono et al. 2005). Rapid urban expansion, failure to separate waste at source, complicated collection processes, open dumping, and unregulated GHG emissions are critical problems exacerbating Asia's SWM problem (Dhokhikah and Trihadiningrum 2012).

Globally, more than 2 billion people are without access to basic household solid waste collection services (UNEP and ISWA 2015). In Asia, with the exception of a few high-income countries, such as Japan, the Republic of Korea, and Singapore, collection rates are low, with only 44% in South Asia and 71% in East Asia and the Pacific (World Bank 2018). As a result, open dumping of waste continues to be the most commonly deployed waste management approach, especially in cities in low- and middle-income countries, including 79% in South Asia, 64% in Southeast Asia, and 51.5% in South and Central Asia (World Bank 2018). Additionally, many landfill sites are not operated according to scientific or health standards. Furthermore, waste is not pretreated, which leads to hazardous dumpsites. Out of the largest 50 dumpsites in the world, 17 are in Asia, posing major health risks and environmental degradation (Waste Atlas 2014).

An effective and simple measure lacking in most developing countries is the concept of waste separation. When adopted, it greatly reduces the amount of waste destined for dumpsites. However, residents are not motivated to change their consumption habits and waste disposal practices due to a lack of information about negative health and environmental implications of ever-expanding landfill sites and open dumping. Households need to be the key players in improving waste management by separating solid waste into categories for collection and treatment, thereby promoting the 3R principles of reducing, reusing, and recycling.

In most developing countries, another factor limiting the transition to the 3Rs is inadequate resources for organized and efficient waste collection services. While governments may view expenditure on waste collection as a low priority, without proper management, the increase of solid waste generation causes severe pollution, groundwater contamination, respiratory and airborne diseases, and excess GHG emissions, and urban flooding, all of which endanger lives and compromise livelihoods, particularly for the poor and marginalized groups (McIntyre 2017). Sizeable investments are needed to address the lack of adequate SWM systems and to fund education campaigns on the importance of waste separation. Without the appropriate financial commitments, inadequate waste management practices will continue to hinder sustainable development, especially in Asia's growing urban centers.

Challenges and Implications of Current Solid Waste Management Policies in Developing Asia

Although improving SWM systems in developing Asia will be costly, their potential contribution toward achieving various targets of the SDGs, and wider spillover effects on health and the economy should not be ignored. Existing country policies for addressing the SWM SDG targets are often not coordinated with municipal governments, which are ultimately responsible for their implementation. Municipalities need to be fully onboard with SWM policies, including financing modalities. Currently, there is a heavy reliance on public funding, but municipalities could be instrumental in developing public-private partnerships to offset the costs.

Additionally, because of the lack of coordination between various industries and gaps in the current policies toward improving SWM, it is challenging to convince

citizens to adopt better household practices, such as sorting and recycling. Citizens need to be informed about the importance of waste separation and should be accountable for their waste disposal practices. At the municipal level, clear regulations coupled with incentive and/or enforcement procedures should be considered.

Educating citizens about the different types of household waste and how to properly separate for either disposal, reuse, or recycling is critical as a first step, but without the involvement of a diverse mix of stakeholders in the planning process and the promotion of public-private partnerships, implementing a comprehensive SWM system is doubtful. The effectiveness of implementing sound policies with education campaigns and the involvement of various stakeholders is illustrated in the case of Yokohama City in the following section.

Learning from Policy Development and Solid Waste Management Transformation in Yokohama (Focus on Best Practices)

Yokohama City, the second-largest city in Japan, with a population of 3.7 million and 1.6 million households, provides a model example for MSW. The city transitioned from a waste management and public cleansing approach in 1970, which relied heavily on the total incineration of waste, to a system based on the 3Rs in 2000, at which point the city had reached its maximum level of waste generation, 16 times more than 3 decades prior. The development of the Yokohama Municipal Solid Waste Management Master Plan (2002–2010), also known as the Yokohama G30 Plan, aimed for a 30% reduction in the volume of generated waste by 2010 compared to the baseline from 2001. Citizens, industries, and the local government adopted practices of waste separation and recycling in Yokohama and, as a result, were able to achieve the 3Rs and an environmentally friendly outlook for the city.

The implementation of the G30 Plan also included upgrading infrastructure, backed by extensive monitoring and sanctions. The fundamental idea of the plan was to reduce waste through mandatory separation at source. For this, the number of waste segregation categories at source was increased from 5 (household or burnable waste; oversized waste; cans, bottles, and plastic bottles; small metals; and dry batteries) to 10, adding categories for plastic containers and packaging, incombustible waste, spray cans, used clothing, and used

paper. In addition, waste items were given more detailed separation guidelines, with the categories increasing from 7 to 15 for materials such as containers, packaging, and used paper (e.g., newspapers, magazines, corrugated cardboard, and paper packs). In this way, Yokohama City transformed its approach to waste by prioritizing resource recovery over waste disposal.

Implementing a separated waste collection system:

To make the waste separation system more effective, citizens are expected to discharge sorted waste at collection points shared by several households. The municipality collects the separated waste on designated days depending on the waste category and transports it to recycling or treatment facilities. Another strategy contributing to Yokohama's success was information dissemination and in-depth explanations for local citizens about waste separation procedures. Over 11,000 public meetings were held over 2 years, and city officials also reached out directly to residents via early morning campaigns conducted at collection points and in front of public gathering places, such as bus and train stations. Also, frequent educational trips to primary and secondary schools helped to gain the support of younger generations in waste reduction. Some schools participated in pilot projects using lunch leftovers as compost or pigfeed through the installation of food waste disposers at elementary schools. Celebrity campaigns also helped to promote the 3Rs concept.

Enforcing a separated waste collection system: To ensure compliance with the new G30 Plan, under the City Ordinance, Yokohama City introduced a system of fines for those who failed to comply with waste separation. Warnings were issued first, and repeat offenders were fined. As a result of the combined educational outreach and enforcement measures, the city was able to gain the cooperation of its citizens and businesses in implementing the 3Rs.

Technical and infrastructure development: The G30 Plan also called for integrated planning of the waste management system and required infrastructure. Recyclable materials such as plastic containers and packaging; cans, glass, and PET bottles; used paper; clothes; and oversized waste items are collected separately and reused or recycled by the plant's partner firms. Yokohama City now has four recycling resource separation centers with equipment that can further separate cans, glass, and PET bottles by type and color before compressing, packaging, and sending to recycling corporations. Only nonrecyclable waste is sent for incineration.

Results of the initiative: The G30 Plan led to significant achievements in Yokohama's SWM, most notably, the volume of waste was reduced from 1.6 million tons in 2001 to 0.9 million tons in 2010, achieving an approximate 43% reduction. This dramatic improvement was achieved mainly through the introduction of waste separation at source and diverting household waste into burnable and recyclable material, using the recategorization outlined above. Yokohama's waste reduction resulted in savings of ¥600 million (\$6 million) annually on waste management services and ¥3 billion (\$30 million) annually on incineration maintenance costs.

Important environmental achievements were also realized. The number of incineration plants was reduced from seven to four, thereby reducing the amount of ash disposed at landfill sites. There was a reduction in GHG emissions from 609,000 tons of CO₂ in 2000 to 213,000 tons of CO₂ in 2009. Approximately 78% of the reduction is attributed to improvements in municipal solid waste incineration and 22% from improvements in industrial solid waste incineration. From a product life cycle perspective, there was a significant reduction in the production of virgin materials, and the city was able to reduce waste and emissions, despite significant population growth over the same period.

Description of the ADBI–Yokohama City Solid Waste Management Event and Its Objectives and Methodology

The Asian Development Bank Institute, in collaboration with Yokohama City, held a workshop to highlight the city's solid waste reduction efforts and best practices for waste separation, including hazardous materials and pollutants, recycling, incineration, and community engagement. The workshop examined SWM strategies and experiences from cities around Asia and the Pacific, including Batam, Indonesia; Da Nang City, Viet Nam; Mandaue City, the Philippines; and Suva, Fiji. These cities provide a diverse snapshot of the current SWM situation in developing Asia. Local government officials from these cities were invited to attend the 3-day event to analyze the current challenges and opportunities for improving SWM in their respective municipalities. Government officials were joined by policy experts, private sector representatives from around the region, and officials from Yokohama City. The event used the Yokohama example to convey options for other municipalities in developing frameworks for SWM policies.

Current Waste Management Practices and Policies in Four Asian Municipalities

None of the participating municipality officials indicated fully functioning solid waste collection services in their respective cities. In three of the four municipalities, waste is dumped at open landfill sites without any controls or environmental regulations. Mandaue City, the only exception, disposes waste in a sanitary landfill site operated by a private company. It was evident that other cities had not developed formal waste management systems. As shown in Table 2, waste separation at source is voluntary in the case of the two Fijian cities, Lautoka and Suva. In the other cases, waste separation is mandatory to some extent under regulations set by the city or national government. Although these waste separation programs (whether voluntary or mandatory) are still limited to a pilot scale (i.e., covering less than 20% of the city limits), all cities have had customary practices of waste separation for many decades. Most cities have a three-bin system, which requires citizens to separate waste into dry (recyclables), wet (organic

and/or domestic), and hazardous or residuals. In Suva and Lautoka, Fiji, collection services only collect separated recyclable materials such as paper, cans, and PET bottles. In Batam and Da Nang, however, waste is separated into recyclable, hazardous, and domestic categories. Mandaue, with the most developed waste separation system, also separates bio waste for composting. Since a large portion of solid waste is organic, separation is imperative to achieve higher recycling targets and cleaner materials for recycling.

Policy Makers Put Training into Practice

Following the workshop, policy makers returned to their home countries to further develop their SWM policies. In Da Nang, the city has set a goal of recycling 12% of their municipal solid waste. To reach this goal, pilot projects have been developed and the city has partnered with other government agencies and the private sector. Also, committees were established so that local citizens can give their views during the planning process, and training and briefings are conducted at schools and townhall

Table 2: Waste Separation Systems in Participating Cities

City	Waste Separation at Its Source?	Laws and Regulations	Priority Waste Stream
Lautoka, Fiji	Yes (to some extent)	Voluntary	
Suva, Fiji	Yes (to some extent)	Voluntary	3 types (paper, cans, PET bottles)
Da Nang, Viet Nam	Yes (pilot project covering about 20% of households)	Mandatory <ul style="list-style-type: none"> Decision No. 2149 /QD-TT (national strategy on integrated management of solid waste up to 2025, with a vision to 2050) Decision No. 9019/QD-UBND (planning of solid waste treatment in Da Nang city up to 2030, with a vision to 2050) Decision No. 389/QD-UBND (Project of Solid waste management to promote sorting and recycling in Da Nang city funded by Japan International Cooperation Agency) Decision No. 1577 / QD-UBND on 11 April 2019 (Promulgating the plan to deploy solid waste sorting activities at source in Da Nang city) 	3 types (recyclable, hazardous, domestic)
Mandaue, Philippines	Yes (about 20% of households)	Mandatory <ul style="list-style-type: none"> RA 9003, commonly known as the Ecological Solid Waste Management Act of 2000, and city ordinances 	4 types (compostable, recyclable, residual, special)
Batam, Indonesia	Yes	Mandatory <ul style="list-style-type: none"> Batam City Regional Regulation No.11 (Garbage Retribution, 2011, and Waste Management of Batam, 2013) 	3 types (organic, nonorganic, hazardous)

Source: Compiled by authors based on the city presentations at the Solid Waste Management Workshop organized by the Asian Development Bank Institute and Yokohama City, 9–11 December 2019 in Tokyo.

meetings. The city is also developing a guidebook on waste separation, for distribution to local residents.

A similar approach is being taken in Mandaue, where the city is working to develop an improved SWM program. Following the ADBI–Yokohama City event, the mayor of Mandaue approved the establishment of a technical working group consisting of representatives from board member offices, which is tasked with providing a cost structure for the SWM plan to be incorporated into the city’s annual budget.

Framework Implementing a Waste Separation Plan for Municipalities in Developing Countries in Asia

The exemplary case of Yokohama City shows that the separate collection of MSW is a precondition for transitioning from waste to resource management and fostering high-quality recycling rates in cities (Gamaraalage 2019). However, prior to formulating a waste separation plan for the city, it is necessary to understand the existing waste situation. In this process, a waste profile, relevant data on total waste generation, waste composition, and current waste management practices (i.e., including collection transport, recovery, recycling, and disposal methods), and key stakeholders should be identified. After the SWM situation is properly determined and supported with data, a municipal budget should be developed. The participating cities in the workshop proposed frameworks integrating their own experiences with the case of Yokohama City, prioritizing waste separation at source. Key steps in the process are summarized in Figure 1, followed by a brief explanation of each.

Step 1: Administrative Preparation

To ensure ownership for the process, it is vital at the outset to secure the commitment of top political leaders, such as the mayor and city councilors. Although the respective departments, most probably waste management or resource circulation departments, are responsible for developing a new waste separation program for the

Figure 1: Key Steps in Developing a Waste Separation Plan in Developing Cities



Source: Developed by authors based on the discussions at the workshop and literature review.

city, it is recommended to formulate a task force to seek guidance and advice for the plan. When selecting task force members, criteria can include experience in MSW activities, particularly waste separation and recycling, to ensure best practices are integrated and eventually implemented.

Step 2: Planning a Municipal Waste Separation Plan

Understanding waste flow is essential to identify and obtain the most reliable information on recycling activities for both formal and informal sectors in the city. During

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this process, it is also essential to identify the full range of potential stakeholders at an early stage to allow for participation in the formulation of the plan. To make waste separation programs a success, separated waste must be collected properly and transported to recycling businesses or treatment facilities; however, this can be a major challenge for all cities due to limited resources, including human capital, equipment, and financing. Most cities participating in the workshop hire either public or private companies to provide such services on behalf of the city, which may include private service providers, recycling operators, nongovernment organizations and community-based organizations, manufacturers, schools and academic institutions, and even religious institutions. Involving all key stakeholders is an important element in successful SWM policy development.

The costs associated with a comprehensive SWM system also need to be considered. While citizens pay for waste collection services through user fee charges or taxes, this revenue does not cover all costs associated with waste management. To compensate for this difference, additional funds must be covered by the municipality, thereby adding another item to what is usually an already squeezed budget.

Selecting the target areas and/or groups: First, it is essential to carefully select the target areas and/or groups, which will be included under the plan. The target area and/or group can be a residential area, a commercial area, or an institutional area. When selecting target areas and/or groups, it is recommended to first select a pilot area with high potential and motivation to implement waste separation. The pilot area could be chosen according to the strength of its relationship with the local government, and its success in implementing previous initiatives.

Selecting the target waste streams: When deciding on which materials to be collected separately, easy separation and marketability should guide the selection, such as paper, cardboard, cartons, PET bottles, glass, and metal. In addition to these main recyclable streams, cities could consider separate collections for household hazardous waste, green waste (e.g., tree cuttings), and bulk waste.

Separated collection system: Based on the experiences of the participant cities, it is recommended to introduce a basic method for segregating waste into either two (organic and nonorganic) or three groups (organic, nonorganic, and hazardous). Additionally, there are options for waste collection systems, including door-

to-door collection, collection sites, civic amenity sites, and deposit refund systems. These collection systems need to be easy to use, conveniently located, and open during suitable hours. Investing time and money in visiting and comparing existing collection schemes in other municipalities and learning from both good and bad cases before tendering the required infrastructure is highly advised.

Step 3: Pilot Implementation

Awareness and communication: One of the biggest challenges in managing waste separation systems at source is the lack of cooperation from citizens (household level), and as a result, it is common for waste separation programs to be discontinued, especially in developing countries. For this reason, a pilot project in a specified area is advised, before expanding to the entire city. As previously mentioned, awareness and proper communication campaigns are essential in raising the levels of participation in the target areas. Citizens should also be encouraged to take an interest in how their waste is managed, and each step of change should be accompanied with targeted awareness campaigns using different information channels to inform and motivate users to participate in waste separation programs. Proper educational outreach programs could lead to strengthened environmental conservation interests among residents. While a combination of civic commitment, environmental consciousness, public publication education, and convenience of deposit facilities are factors that promote sustainable separation practices and increase citizen compliance in developed countries, in developing countries, there may be weak civic concern and environmental awareness.

Measures for enforcement and incentives: Supplementary to awareness and communication programs, it is recommended to introduce enforcement and incentive measures. The application of a “pay-as-you-throw” system provides incentives to households to produce less waste and properly separate waste. In addition, community-based recycling programs like waste banks can encourage households to exchange their separated waste for cash. In addition to education and information campaigns, waste separation could be made mandatory by law, along with strong enforcement measures and penalties for noncompliance, such as fines or suspension of collection services.

Integration of the informal sector and others: The informal sector still plays an important role in waste

collection and recycling (waste banks) in developing countries, offering residents a ready market for their recyclable waste. However, such informal activities tend to decrease as cities adopt more organized and advanced waste management systems. Another option for cities in developing economies is to involve nongovernment organizations and community-based organizations since they can help to promote separate collection and provide input for selecting the most cost-efficient collection methods at the neighborhood level.

Step 4: Review and Upscaling

The lessons learned from the pilot implementation should be properly evaluated before scaling-up throughout the city. Information gathered through public opinion surveys, stakeholder workshops, and feedback from waste collectors and recycling businesses (i.e., the informal sector) need to be compiled and analyzed. The costs and benefits of the new waste separation and collection system should also be included in the assessment. These findings will provide insight into whether the pilot plan should be scaled-up or revised first. In addition, a training and capacity building program for municipality employees and residents is recommended.

Conclusion

Improved solid waste management systems have the potential to address multiple SDGs, both directly and indirectly, in developing economies throughout Asia. However, while many cities already have recycling and other household solid waste separation systems in place, there is a lack of support and understanding of their importance among citizens. Moreover, the gaps in the current policy frameworks do not promote public-private partnerships to offset the high costs for operating such systems but instead rely solely on public funding, which is often inadequate and unsustainable. Collaborative decision making involving all stakeholders when formulating a municipal waste separation plan is crucial for ensuring its acceptance and boosting the chance of success. In the long term, institutionalized waste separation is an essential element of a sustainable SWM system and can eventually accelerate the process of transitioning from a linear system of production, consumption, and waste to a circular economy. A transition to more sustainable production and consumption practices will be imperative for Asia to achieve the 2030 Agenda for Sustainable Development.

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