Topic 7. Waste Management Challenges in Developing Countries and Lessons Learned from JICA Projects

Contents

1 Introduction

The amount of waste generated annually around the world is rising at an unprecedented rate due to rapid urbanization and population growth. According to “What a Waste 2.0 - A Global Snapshot of Solid Waste Management to 2050”, published by The World Bank in 2018, the amount of waste generated each year is projected to reach 3.4 billion tons over the next 30 years if urgent action is not taken, up from 2.01 billion tons in 2016. By 2050, annual waste generation in the sub-Saharan Africa region is forecast to more than triple from 170 million tons in 2016, and more than double in South Asia, up from 330 million tons in 2016. This is due to diverse factors at different stages of waste management that have been systematically organized by JICA from a variety of perspectives (Table 7-1).

Waste problems in developing countries are therefore likely to become even more acute in the future, requiring measures to be taken as soon as possible. Accordingly, Japan has provided support to developing countries based on the knowledge and technologies the country has gained through its experience in overcoming challenges related to waste management. This topic will introduce the experiences of JICA through case studies in the six countries shown in Figure 7-1: the waste management challenges that faced each country, and how the experiences of Japan were utilized and the resulting impacts.

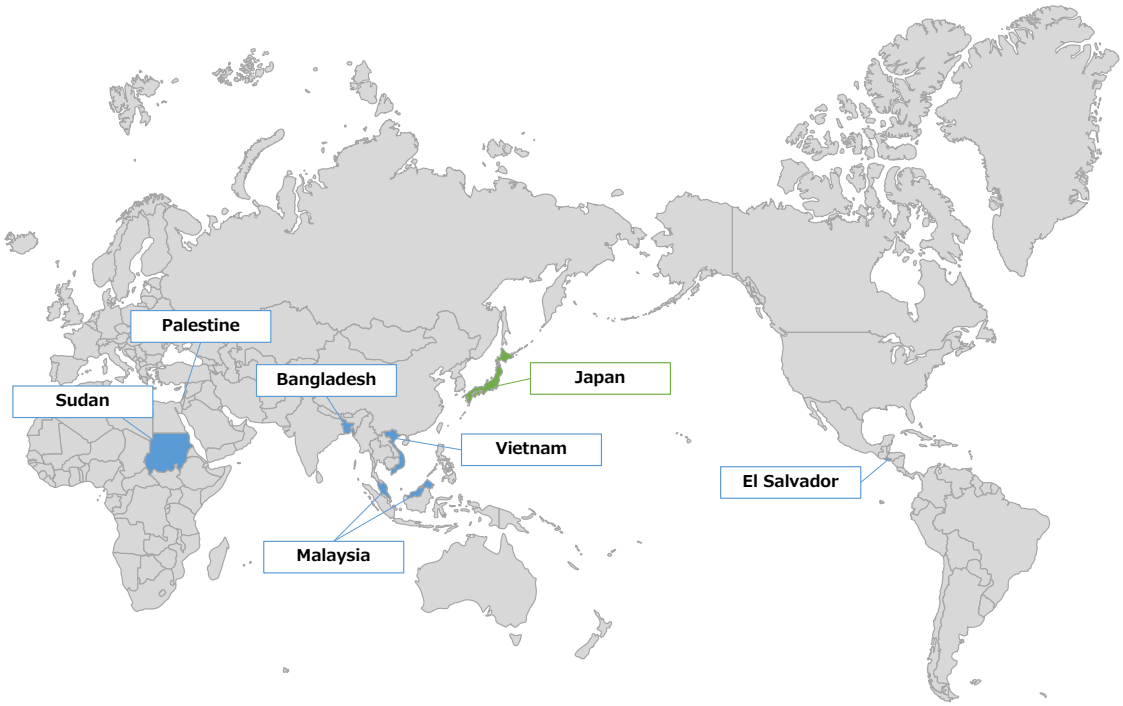


Figure 7-1 Locations of Countries Covered in Topic 7

Table 7-1 Specific Issues Related to Waste Management in Developing Countries

	Generation/Discharge & Storage	Waste Collection and Transport	Intermediate Treatment & Recycling	Final Disposal
Social considerations	• Inadequate measures on control of generated waste • Retention and scattering of waste around collection sites (containers, etc.)	• Elimination of services for low-income groups due to non-payment of fees • Low social status of collection workers • Waste picking during the collection process (including by workers, reduces collection efficiency)	• Incoming waste that has not been completely sorted • Intermediate treatment and recycled products that are not compatible with economic activities (e.g., composting products for which a market has not been secured) • Resistance of residents to siting of facilities	• Unsanitary and hazardous working conditions for waste Pickers • Resistance of local residents to disposal site locations
Institutional considerations	• Lack of rules on waste storage and discharge • Inadequate policies and systems in place to control waste generation and waste sorting for discharge • Lack of illegal dumping countermeasures	• Lack of health and safety measures for workers • Inadequate contracts with private contractors, inadequate permit system and lack of supervisory capacity • Lack of, or inadequate collection plans • Lack of high-level planning (e.g., collection and transportation system concept)	• Lack of health and safety measures for workers • Inappropriate contracts with private contractors and inadequate permit system • Environmental impacts (e.g., failure to set environmental standards) • Lack of high-level planning (e.g., recycling promotion policy) • Lack of future plans and operational plans	• Lack of health and safety measures for workers • Lack of sanitation and safety measures and unregistered waste pickers • Inadequate contracting and permitting systems with private contractors and lack of supervisory capacity • Environmental impacts (e.g., failure to set environmental standards) • Lack of future plans and operational plans

	Generation/Discharge & Storage	Waste Collection and Transport	Intermediate Treatment & Recycling	Final Disposal
Organization	• Lack of guidance system for residents • Lack of cooperation from residents and communities	• Weak management structure (e.g., unassigned managers, lack of workers, etc.)	• Weak management structure (e.g., unassigned managers, lack of workers, etc.)	• Weak management structure (e.g., unassigned managers, lack of workers, etc.)
Financial considerations	• Inadequate, or lack of storage and discharge containers at collection sites • Incomplete setting and collection of waste collection fees	• Low setting of waste collection fee levels • Insufficient fee collection and management systems • Insufficient fee amount collected and used for other purposes than waste operations • Insufficient budget planning and allocation	• Insufficient facility operation and maintenance budget planning and allocation • Insufficient amount of waste tipping fees collected	• Lack of collection and management system for waste disposal fees • Insufficient amount of waste tipping fees collected and used for other purposes than waste operations • Insufficient budget planning and allocation
Technical considerations	• Insufficient waste sorting and separation • Inconsistency between discharge and collection methods	• Lack of operation and maintenance techniques for equipment • Improper collection methods • Lack of collection and transportation equipment	• Immature intermediate treatment technology • Lack of operation and maintenance technology • Environmental impacts (e.g., lack of measures to deal with pollutants) • Inadequate data management system (e.g., amount of incoming waste, etc.)	• Improper disposal methods (e.g., open dumping) • Lack of operation and maintenance technology and equipment • Environmental impacts (e.g., lack of measures to deal with pollutants) • Inadequate data management system (e.g., amount of incoming waste, etc.)

Source: Excerpted from JICA “Issue-Specific Guidelines Waste Management” (2009) with some changes

2 Republic of the Sudan ～ Introduction of "Fixed-Time Fixed-Place (FTFP) Collection"～

Fixed-Time Fixed-Place (FTFP) collection is an effective method for improving collection services efficiency. When introducing FTFP collection, it is practical to initially implement the system on a trial basis in a designated pilot area, and after verifying its feasibility and issues, to consider full-scale implementation. It is essential when introducing FTFP collection, and for its continued implementation to carry out activities to build public awareness so as to ensure the vital cooperation of local residents.

Region: Northeast Africa
Capital: Khartoum
Area: 1.88 million km^2
Population: 42.81 million (2019)
Ethnic groups: Primarily Arab, Nubia, Nuba, Fur, Beja (mix of over 200 tribes)
Languages: Arabic (official language), numerous other tribal languages
Religions: Islam, Christianity, traditional religions

Source: Ministry of Foreign Affairs Website "Republic of Sudan"
https://www.mofa.go.jp/mofaj/area/sudan/data.html#section1 (accessed February 8, 2022)

2.1 Background

In Khartoum, the capital of the Republic of Sudan (hereinafter referred to as "Sudan"), waste was collected and transported by aging and inadequately maintained collection vehicles due to deterioration of the security situation and financial constraints. As a result, uncollected waste was scattered around the city, degrading the sanitary environment, especially in low-income neighborhoods. Residents were not sure when the waste they discharged would be collected. Residents also had very little interest in waste management because adequate waste collection services were not provided, and waste management were implemented without their cooperation or involvement. Table 7-2 shows an overview of the major JICA waste management projects covering FTFP system in Sudan.

Source: Yachiyo Engineering Co., Ltd.

Photo 7-1 Illegally Dumped Waste along the Road

Table 7-2 Overview of JICA Waste Management Projects Covering FTFP in Sudan

Item	Content	
Project name	The Project for Strengthening Solid Waste Management in Khartoum State of Sudan	The Clean Cities Project in Sudan
Project period	May 2014 - March 2017	February 2021, ongoing
Target cities (Population)	Khartoum State (Approx. 7 million people)	Khartoum State (Approx. 8.64 million people) ・North Kordofan State (Approx. 1.21million people) ・Red Sea State (Approx. 650,000 people)
Overall goal	Improved waste management system persists in Khartoum State.	Solid waste management services in the target states will be improved.
Project purpose	Waste management in Khartoum State will be improved to an efficient and effective system.	The management capacity of the target state cleaning corporation will be improved.
Output	1 Khartoum State Waste Management Master Plan will be revised. 2 Waste collection and transportation capacity will be improved. 3 Operation and management of final landfill will be improved. 4 Organizational and financial soundness related to waste management will be proposed.	1 The current status and issues of waste management in the target areas will be identified. 2 The waste management capacity of Khartoum Cleaning Corporation will be strengthened. 3 Strengthening the waste management capacity of the Red Sea Cleaning Corporation 4 Preparation of a national policy on solid waste management will be made based on the data and information collected from all provinces.

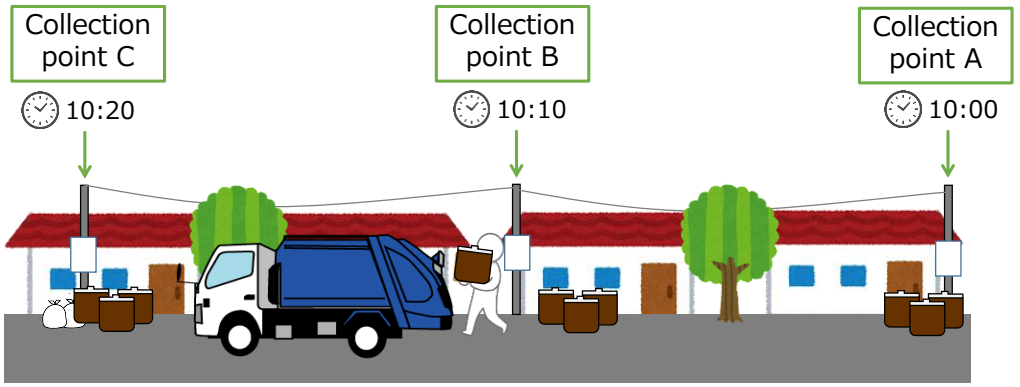
Source: Based on JICA "The Republic of the Sudan Project for Strengthening Solid Waste Management in Khartoum State Project Completion Report" (2017), "The Clean Cities Project in Sudan (Phase 1) Work plan" (2021)

2.2 Application of Japan's Experiences and Technologies

(1) Introduction of Fixed-Time Fixed-Place (FTFP) Collection

The applicability of FTFP collection, conditions for its introduction, and operational policies should all be carefully considered, taking into account the current collection services and lifestyles of residents. Implementation of pilot projects will make it possible to understand FTFP's effectiveness and related issues. In addition, it is important for the government to conduct continuous public awareness activities for residents to ensure that the system is smoothly introduced and facilitate its dissemination.

A decision was made to introduce FTFP collection - which has become a mainstream system in Japan - in Khartoum to improve waste collection. FTFP collection is a method of collecting waste discharged at designated collection times and locations, as shown in Figure 7-2. When introducing FTFP collection, it is necessary for residents and the municipality to coordinate the allocation of collection vehicles, collection routes, etc., as well as collection points and collection times.



Source: Yachiyo Engineering Co., Ltd.

Figure 7-2 Image of FTFP Collection

There are a number of advantages in introducing FTFP collection, which include maintaining the cleanliness of communities by prohibiting the discharge of waste outside of designated collection times, reducing time period collection that vehicles spend on routes, and increasing collection efficiency.

However, FTFP collection also comes with its own set of challenges: residents may feel burdened because they need to bring waste to specific places at designated times, the sense of individual responsibility may be diminished because it is impossible to identify the generators of the waste discharged, and it can sometimes be difficult to select and coordinate collection sites. Table 7-3 provides an overview of the main advantages and challenges of FTFP collection.

Table 7-3 Main Advantages and Challenges of FTFP

Item	Contents
Advantages	• Community cleanliness can be maintained by designating waste collection times and locations • Improved collection efficiency with less time spent by collection vehicles on routes • Lower collection costs by optimizing the number of vehicles and collection workers • Improved working environments for collection workers with no waste scattered around as a result of residents following rules when discharging waste • FTFP provides a good opportunity for residents to recognize waste as their own problem by carrying their own waste to the designated collection point • Local residents can provide guidance to one another about discharging waste
Challenges	• Difficulty identifying generators of discharged waste, which diminishes the sense of individual responsibility • Difficulty identifying generators of discharged waste, which makes it difficult to thoroughly enforce discharge rules • Potential difficulties in selecting collection sites • Potentially difficult for children, women, and the elderly to carry their waste to the stations

Source: Yachiyo Engineering Co., Ltd.

1) Pilot Project

In Khartoum, pilot projects (PP) were carried out in several areas to examine the possibility of full-scale introduction of FTFP collection. A PP is the process of implementing a system that is being considered for full-scale implementation, together with collecting data to test the system and determine whether it is suitable and achieves the objectives set out. The basic implementation flow of the PP is shown in Figure 7-3.

The most important tasks of this flow are “baseline survey” before PP implementation, “monitoring and awareness-raising activities” during PP implementation, and “follow-up survey” after PP implementation. In particular, collecting, analyzing, and verifying data before and after PP implementation makes it possible to measure the effectiveness of PP; if positive results can be confirmed by comparing specific items before and after PP implementation – e.g., improvement in residents satisfaction or fee collection rate – this would indicate that the possibility of introducing FTFP collection is high. Alternatively, if the desired results are not obtained, the results of the PP should be analyzed to identify the reasons why the FTFP collection system did not function as expected - such as inappropriate collection mechanism, confusion over discharge rules, lack of residents’ satisfaction - and to consider improvement measures. Should it be then determined that there is little possibility for improving the FTFP system in the PP area, it will be necessary to consider other collection methods. Surveys conducted before and after PP can also deepen understanding of the behavior and awareness of residents, collection workers, and other related parties, and are useful in identifying issues to be addressed when FTFP collection is introduced. In summary, the

implementation of PP will provide decision-making materials necessary for examining the future direction of the project and knowledge on matters to be considered during the full-scale introduction.

Source: Based on JICA "The Republic of the Sudan Project for Strengthening Solid Waste Management in Khartoum State Project Completion Report" (2017)

Figure 7-3 Basic Implementation Flow of Pilot Project

2) Public Awareness

A public awareness campaign was conducted in Khartoum to promote FTFP collection. FTFP collection places comparatively high burden on residents, which poses a challenge, and the system will not be successful without their cooperation. Therefore, government staff in Khartoum implemented public awareness building activities for the project team (consisting of government officials, community representatives, and other concerned parties) and residents, as shown in Table 7-4. Through these activities, it was possible to provide residents with opportunities to realize the benefits of FTFP collection and recognize that waste is their own problem.[1]

[1] Time and Motion Survey: A survey is to observe and record the status of waste discharge and collection operations. The time and conditions of daily waste collection operations, such as vehicle inspection, movement to the collection area, loading and unloading of waste, etc., are recorded. The collected data is used to identify problems in waste discharge and collection operations, and to consider countermeasures.

Table 7-4 Examples of Awareness-Raising Activities Related to FTFP Implementation

Activity	Target group	Objectives	Details
Regular meetings	Project team[2]	Share information on PP and FTFP collection (challenges, measures, etc.)	• Share the results of monitoring (about once/month) conducted in PP target areas • Discussions on measures to address shared challenges
Training	Project team	Team members are able to implement public awareness activities	• Basic information on FTFP collection (overview, advantages, necessity, etc.) • Division of roles between the administration and residents • Methods of communication with residents
Workshops	Project team	Study good practices from past examples and promote the use of FTFP collection	• Introduce case studies on FTFP collection (background to introduction, progress, details on awareness building activities, etc.)
Community meetings	Representatives from PP target areas (women and men leaders, youth leaders, religious leaders, etc.)	Obtain cooperation and understanding from residents on PP and FTFP collection	• Basic information on FTFP collection (overview, advantages, necessity, etc.) • Division of roles between the government and residents • Need to cooperate with residents • Resident behavior that must be improved
Study tours	Representatives of residents in PP target areas (women and youth groups, etc.)	Study good practices in regions where PP is being implemented smoothly	• Inspect areas where PP is being implemented smoothly • Administrative staff explain activities (i.e., awareness-raising activities for residents, efforts for on-time operation of collection vehicles, etc.)
Contests / campaigns	Residents	Promote understanding by, and the active participation of residents in FTFP collection	• Organize events (waste reduction idea contests, recycled craft contests, clean-up campaigns, etc.)
Educational tools	Residents	Promote understanding by, and the active participation of residents in FTFP collection	• Use tools to build awareness (videos, DVDs, TV commercials, leaflets/booklets, banners, posters, novelty goods, SNS, etc.) at residents' meetings, door-to-door visits, etc.
Door-to-door visits	Residents	Promote understanding by, and the active participation of residents in FTFP collection	• Conduct home visits using educational tools

Source: Based on JICA "The Republic of the Sudan Project for Strengthening Solid Waste Management in Khartoum State Project Completion Report" (2017)

[2] A team consisting of government officials, community representatives, and other interested parties. In Khartoum, it played a central role in the dissemination of FTFP collection.

Photo 7-2 Before PP Implementation (Waste was left on the sides of roads and in vacant spaces, and scattered over a wide area.)

Photo 7-3 During PP Implementation (The amount of scattered waste had been reduced. The area was kept clean.)

Photo 7-4 Study Tour

Photo 7-5 Door-to-door Visits by Administrative Staff (Promoted cooperation among residents to prevent waste from being scattered and to keep the area clean.)

Source: Yachiyo Engineering Co., Ltd.

As a result of implementing the PP in Khartoum collection times decreased by about 20 minutes, as shown in Table 7-5. In addition, residents who have seen the improvements, such as waste collection services and a reduction in scattered waste resulting from the PP showed a willingness to pay fees. Fee collection rates improved from about 10% before the PP to about 40% after implementation. In the post PP survey, the number of residents who said they were satisfied with the collection service was about 50% before the PP was implemented, but increased to about 79% after the PP was implemented.

Table 7-5 Outcomes of Pilot Project

	Before implementation of PP	After implementation of PP
Collection times	91 to 99 minutes	76 to 79 minutes
Fee collection rate	Approx. 10%	Approx. 40%
Level of satisfaction of residents	50%	79%

Source: Based on JICA "The Republic of the Sudan Project for Strengthening Solid Waste Management in Khartoum State Project Completion Report" (2017)

After the Project

As the results of PP implementation FTFP collection was introduced, and waste discharge on days other than collection days and at locations other than the designated ones became less common. However, as of 2022, the FTFP collection has not yet taken root in Khartoum. The main challenges identified so far and possible countermeasures are as follows.

Challenges

- Strict observance of the system by collection trucks is difficult because of insufficient number of collection vehicles, inadequate maintenance, and difficulty to arrange alternative vehicles in case of breakdowns, etc.
- Due to insufficient study of routes served by collection trucks before they enter the FTFP area and after they leave it, sometimes the collection trucks were already full as they entered the FTFP collection area and could not finish collection in the area within the scheduled time.
- The time required for loading and unloading waste at transfer stations and final disposal sites resulted in long waits for the arrival of collection trucks at the FTFP area.
- The type of collection truck did not match the characteristics of the area, and the collection operation took longer than expected (e.g., the truck was too large to enter a narrow road).
- It was particularly difficult for children and women to take out waste from their homes to distant collection points by themselves.
- The waste disposal rules were not thoroughly enforced and various types of containers were used for waste discharge, and sometimes the waste containers were mistakenly collected as waste.
- Waste was scattered at the collection points due to damaged waste containers, etc.

Countermeasures

- Develop and review collection plan

When introducing FTFP collection, it is necessary to design collection routes based on the type and number of collection vehicles available, the characteristics of the collection area, and the number of households to be served (based on which the waste amount to be collected is

estimated), and then organize in detail the elements necessary to successfully implement the FTFP collection system; including the location of collection points, suitable collection time schedule, and methods for notifying the residents of the collection vehicles arrival or reminder to the residents of collection time as a backup for the FTFP system.

In the implementation phase of the plan, it is necessary to confirm on site whether residents are discharging waste at the designated collection points and times, collection crews are able to travel the collection routes on time and without difficulty, as well as to analyze data on waste collection rates, residents' satisfaction levels, and collection rates over time of collection fees if such fees are imposed. It is important to identify issues for improvement in the collection plan through a series of repetitive tasks, and continuously review and improve the plan.

- Training of collection crews and staff

If the collection crew members, who actually do the collection work do not understand the contents of the collection plan and their own roles, it will be difficult to provide smooth collection services. It is necessary to conduct training for collection crews (including on-the-job training, etc.) and PPs for practical collection work to improve their knowledge and skills. Furthermore, the collection crew members should be able to guide residents on waste discharge rules. Collection plans need to incorporate the opinions of collection crew staff in the field on the suitable methods to educate residents, amongst others. Involving collection crews and staff in planning will both raise their motivation as well as ensure that the countermeasures for the issues confronted in the actual work are reflected in the plans.

- Thoroughly inform local residents of the waste disposal rules

FTFP collection is often a new initiative in developing countries, and it is necessary to continuously deepen the understanding of all parties involved, not only before but also after FTFP introduction. Involving residents, who are the generators of waste, is particularly important. If the method and time of waste discharge are not thoroughly understood, the amount of waste left uncollected will increase and the sanitary environment will likely deteriorate. In Japan, the government actively informs residents of the rules for waste discharge through the distribution of waste sorting charts, briefings for residents, SNS and smartphone applications, and other means. When setting rules for waste discharge, it is important to confirm local characteristics and residents requests through PP, and incorporate them into the plan to promote understanding on the part of residents and facilitate smooth waste discharge and collection.

2.3 Lessons

(1) Evaluation of Feasibility through PP Implementation, Identification of Ongoing Challenges and Improvements, and Reflection in Collection Plans

By implementing PP for collecting and analyzing data before and after the introduction of FTFP collection, it is possible to quantitatively evaluate FTFP effectiveness. The issues identified in Khartoum at the time of the introduction of the FTFP collection were also found in projects in other countries, and lessons learned can be utilized to other cases. In the planning stage, information necessary for FTFP collection - type and number of collection vehicles, characteristics of the area to be collected (road conditions, etc.), collection routes, number of households to be collected, location of collection sites, etc. - should be shared in advance among the heads of administrative agencies in charge of waste management, officials in charge of collection planning (personnel and vehicle allocation planning), collection staffs, resident representatives, and other relevant parties. It is important to discuss solutions to possible problems through a series of collection and transportation processes. It is equally important to identify issues and points for improvement through periodic monitoring after the introduction of the FTFP collection, and to continuously review the collection plan.

(2) Need for Continuous Awareness Building Activities

While cooperative at the start of a project, residents can become less motivated with the passage of time. In order for the administration and residents to jointly work together continuously while recognizing their respective responsibilities, administration officials must promote understanding by local residents on waste management through regular meetings and awareness building activities, including public awareness programs and environmental education, and reflect the ideas and opinions collected from residents in waste management services. Regarding awareness-raising, it is important to combine various activities, such as holding community meetings and study tours as well as to maintain the continuity of these activities. There also needs to be a mechanism to involve key persons in the community in the activities and to encourage residents to change their behavior and ways of thinking. On the other hand, residents are also expected to be aware of their own responsibilities for the waste they generate and be actively involved in waste management services provided by the government.

3 Palestinian Interim Self-Government Authority, PA

～ Improving Waste Management through the Introduction of Inter-Municipal Waste Management ～

Inter-municipal waste management, in which waste collection vehicles and treatment facilities are shared and operated among multiple neighboring municipalities, regardless of their respective sizes, is one of the effective methods for achieving efficient waste management.

In introducing this case study two methods of waste management are highlighted; inter-municipal association which can serve as the foundation for an efficient waste management system, and public awareness activities to ensure that residents meet their obligations to pay the waste service fees and thereby secure the financial stability of the waste management system.

Region: Middle East
Administrative capital of the Palestinian National Authority (PNA): Ramallah
Area: 6,020 km^2
Population: 4.97 million (2019)
Ethnic groups: Arab
Languages: Arabic
Religions: Islam (92%), Christianity (7%), other (1%)

Source: Ministry of Foreign Affairs Website “Palestine” https://www.mofa.go.jp/mofaj/area/plo/data.html#section1 (accessed February 8, 2022)

3.1 Background

The Palestinian Interim Self-Government Authority (hereinafter referred to as “Palestine”) is divided into the West Bank bordering Jordan to the east and the Gaza Strip bordering the Mediterranean Sea to the west and Egypt to the south. The municipalities that make up Palestine are small and each municipality is responsible to collect and dispose of its waste. The waste collection rates were extremely low due to a lack of collection vehicles because of the short supply of financial resources in the municipalities providing the cleaning services.

Source: Yachiyo Engineering Co., Ltd.

Photo 7-6 Waste Burned in Disposal Site

The collected waste was not disposed of properly, and instead was openly burned or dumped, and sanitary conditions were poor.

With population growth and transportation barriers, Palestine faced challenges centered around a lack of access to disposal sites, waste management businesses that were not economically viable due to increasing operation and maintenance costs, and improper disposal practices, such as open burning, which created health hazards for residents and environmental pollution problems.[3] Against this background, the autonomous government requested Japan to provide technical cooperation on capacity development in the field of waste management and the establishment of a model for waste management. Table 7-6 shows an overview of the waste management projects implemented in Palestine.

Table 7-6 Overview of Waste Management Projects Implemented in Palestine

Item	Content	
Project name	The Project for Capacity Development on Solid Waste Management in Jericho and Jordan River Rift Velley in Palestine	Project for Technical Assistance in Solid Wastes Management Phase 2
Project period	November 2005 - February 2010	January 2015 - July 2019
Target cities (Population)	Jericho and Jordan River Rift Valley (Approx. 50,000 people)	All of the West Bank of Palestine (Approx. 950,000 people)
Overall goal	1. A basic policy on comprehensive waste management in local cities will be established in the Palestinian Authority and specific policies will be developed. 2. An effective waste management system modeled on the Jericho and Jordan Valley Region (hereinafter referred to as "JJRRV") will be disseminated to local cities throughout Palestine.	Environmental and socially responsible waste management services will be provided throughout Palestine on a sustainable basis.
Project purpose	1. A sustainable and hygienic waste management system will be introduced in JJRRV. 2. JJRRV's improvement case experience will serve as a model case for improving waste management in other Palestinian cities.	A sustainable waste management system by the Regional Administrative Council ("JSC") will be established equally throughout the Palestinian West Bank under policies, plans, institutions, support and coordination well be developed by the Regional Authority ("MoLG").

[3] Due to the long-standing conflict with Israel over land, Palestine has become an enclave, and its land area continues to shrink due to repeated Israeli settlement activities. In order to travel between Palestinian areas, one must pass through "checkpoints" set up by Israel on the border. Palestinians are not allowed to enter without an Israeli permit.

Item	Content	
Output	1. A project management system will be established. 2. Waste management organization system in JJRRV will be established. 3. The current status of waste management at JJRRV will be identified 4. A policy (action plan) for improvement of waste management at JJRRV will be developed 5. An action plan for improving waste management at JJRRV will be established. 6. The Action Plan is implemented, improvements are realized and JJRRV's activities are disseminated. 7. Training sessions will be held in Japan to acquire and disseminate basic knowledge on waste management.	1. MoLG's capacity to provide guidance, support and coordination in the area of waste management to JSCs will be strengthened through its activities with the five target JSCs. 2. MoLG's capacity to develop standards, regulations and guidelines for waste management will be enhanced. 3. MoLG's capacity to develop national policies and plans for waste management will be strengthened. 4. MoLG's organizational management capacity will be strengthened.

Source: Based on JICA "The project for capacity development on solid waste management in Jericho and the Jordan River Rift Valley : consolidation improvement report of solid waste management" (2010), Project for Technical Assistance in Solid Waste Management in Palestine (phase-2) : Final report" (2019)

3.2 Application of Japan's Experiences and Technologies

(1) Creating a Foundation for the Introduction of Inter-Municipal Waste Management

When establishing an inter-municipal association, which serves as a foundation for inter-municipal waste management, it is important to minimize the burden on the individual municipalities. Rather than purchasing new equipment or hiring new personnel at the outset, it is necessary to make effective use of existing resources held by each municipality, and to devise ways to combine and utilize them.

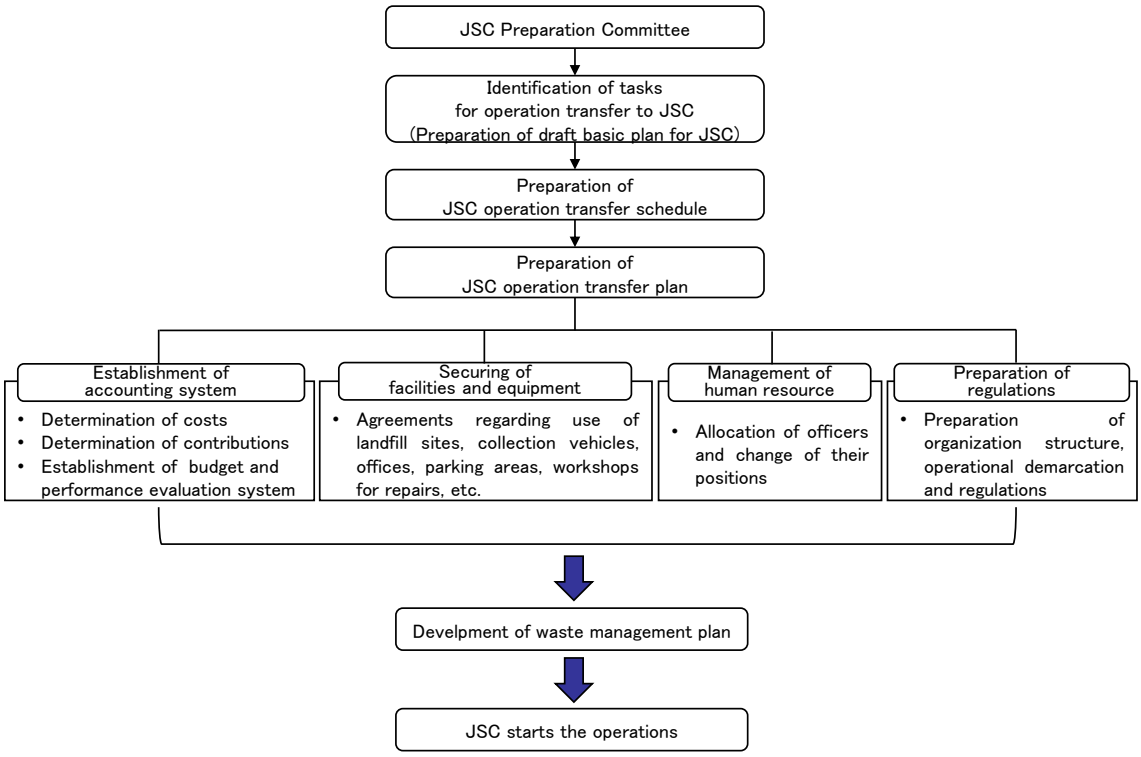
Waste management in Palestine, which had been carried out by smaller municipalities, is to be implemented by a regional association called the Joint Service Council (hereinafter referred to as "JSC"), under a collaborative initiative by several municipalities. The JSC aims to create an inter-municipal waste management system that will place a small burden on each municipality and provide stable waste management services throughout the entire region. In addition to reducing the budgetary burden on each municipality through the efficient operation and maintenance of collection vehicles and sharing the final disposal site, the inter-municipal system will allow for an increase in the size of the disposal sites and improve the efficiency of construction and operation.

The objectives of establishing JSC in Palestine are to: (1) implement environmental protection measures, such as the introduction of sanitary landfills, (2) promote waste reduction and recycling, (3) develop efficient waste management practices, and (4) promote projects where residents, business and

the government can work together. Figure 7-4 shows the basic flow of implementation, up to the establishment of JSC in Palestine, Figure 7-5 shows the basic JSC organizational structure, and Table 7-7 shows the JSC stakeholders and their roles.

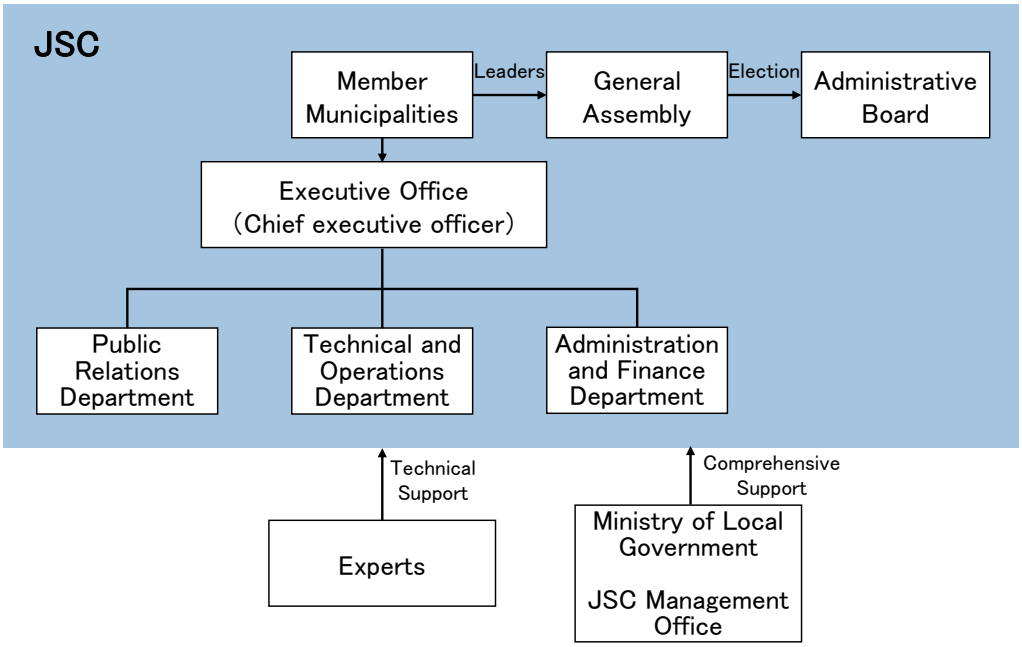
In the example of Jericho and the Jordan Valley region, JSC is composed of 17 municipalities, led by the city of Jericho, the main city in the region. For those municipalities that were reluctant to establish a JSC due to a lack of understanding about inter-municipal waste disposal - such as the JSC mechanism, cost sharing, etc. - representatives from municipalities that were willing to establish a JSC visited them and held discussions on human resources allocation of and cost sharing. Based on these discussions, a draft basic plan was prepared, which included the basic policy of JSC, allocation of personnel and equipment, and budget for waste management. Further discussions on the draft basic plan led to the establishment of the JSC, which was agreed upon by all the member municipalities after considering an effective mechanism that would be less burdensome for each municipality. As shown in Table 7-8, the items decided upon at the time of establishment were formulated as formal regulations, and the rules were clarified to enable the smooth operation of the JSC among the many municipalities involved.

In Palestine, 12 new JSCs were established and 3 existing JSCs were rebuilt. The JSC in Jericho and the Jordan Valley region, was organized by 17 municipalities, creating a system that can provide waste collection services to approximately 50,000 residents.



Source: Based on JICA "The project for capacity development on solid waste management in Jericho and the Jordan River Rift Valley : consolidation improvement report of solid waste management" (2010)

Figure 7-4 JSC Preparation Flow for Starting Operations



Source: Based on JICA "The project for capacity development on solid waste management in Jericho and the Jordan River Rift Valley : consolidation improvement report of solid waste management" (2010)

Figure 7-5 Basic JSC Organizational Structure

Table 7-7 Parties and Roles of JSC

No.	Parties	Role
1	General Assembly	Determination of executive office membership, determination of budget, determination of supplemental budget, nomination and recall of new members, determination of agenda items, consideration of rule changes, determination of contributions, approval of implementation plan, determination of representatives on committees of other organizations
2	Administrative Board	Convening of general assembly, planning of cleaning projects in consideration of environmental protection, advice on collection and transportation, construction of transfer stations and landfills, maintenance, parking depots and containers, public relations for residents regarding environmental protection, human resource development, staff awareness and education, institutional development, and advice related to environmental improvement through cleaning service
3	Executive Office (Chief executive officer)	Planning and monitoring work related to cleaning services, convening board meetings, supervising staff work, making recommendations to the board regarding staff transfers, removal, and discipline, making recommendations to the board regarding new work, and making recommendations to the board regarding staff personnel, labor, compensation, occupational health and safety, education, and training
4	Public Relations Department	Publicize waste management projects to residents, research waste management projects
5	Technical and Operations Department	• Planning and Maintenance Division Planning and development of waste management plans, long-term collection plans, long-term landfill plans, equipment purchase plans, and operation plans; maintenance of collection equipment and landfill

No.	Parties	Role
		heavy equipment; preparation of annual reports • Collection Division Planning, formulating, and implementing collection work plans, dispatching collection equipment, and recording collection operations • Landfill Management Department Develop, formulate, and implement an operational plan for the landfill
6	Administration and Finance Department	Budget, settlement of accounts, related to the contributions of each municipality, general coordination of property management, purchase of goods, contract administration, collection of fees and contributions
External	Ministry of Local Government (JSC Management Office)	Provide comprehensive support to JSCs throughout Palestine
External	Experts[4]	Providing operational advice and technical assistance

Source: Based on JICA "The project for capacity development on solid waste management in Jericho and the Jordan River Rift Valley : consolidation improvement report of solid waste management" (2010)

Table 7-8 Main Provisions and Objectives of the JSC

No.	Provisions	Content	Purpose
1	Jobs	Duties and responsibilities	Clarify roles and responsibilities within the organization and unify the understanding of each department
2	Working Conditions	Working days, working hours, salaries	Clarify working conditions and unify understanding between JSC and officers/workers
3	System	Personnel, health and safety, appointment selection, performance evaluation	Establish a safe and secure work environment by improving the working environment for officers and workers
4	Operation	Equipment maintenance plan, facility maintenance plan, collection and transportation plan	Prevent stagnation in waste management operations by systematically operating and maintaining equipment

Source: Based on JICA "The project for capacity development on solid waste management in Jericho and the Jordan River Rift Valley : consolidation improvement report of solid waste management" (2010)

[4] Refers to a team of experts consisting of several executive directors of other JSCs that were facilitating the operation and the director of the repository.

Photo 7-7 Waste Container Installed at a Touristic Area (Bethlehem JSC)

Photo 7-8 Waste Collection (Gaza South JSC)

Photo 7-9 Waste Collection (Ramallah - Al Bireh JSC)

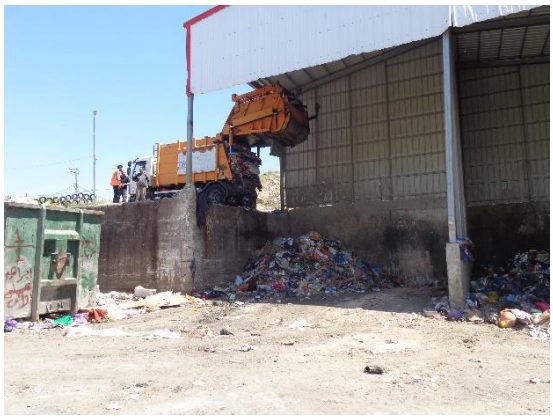


Photo 7-10 Hebron Transfer Station (Hebron JSC)

Photo 7-11 Zahrat Al-Finjan Landfill (Jenin JSC)

Photo 7-12 Workshop (Gaza North JSC)

Source: Yachiyo Engineering Co., Ltd.

(2) Activities to Build Public Awareness on Waste Fee Collection

Operations of the Palestinian Regional Authority are supported by the collection of waste disposal fees from residents, so it is important to improve fee collection rates. When setting collection fees, it is important to set an amount that is affordable and acceptable for residents and to obtain their understanding and consent through steady public awareness activities.

Costs related to inter-municipal waste disposal in Palestine are covered by waste disposal fees collected from residents. In general, compared to other public services (e.g., electricity and water), waste management is often not a top priority for residents, and it is difficult to enforce fee collection systems without their understanding of the importance of collecting fees. While Palestinian residents tend to be less environmentally conscious, some are not aware of the JSC's activities or may be concerned whether the introduction of inter-municipal waste management will actually improve waste management conditions. Therefore, a variety of activities were implemented to help residents understand the need to collect fees, such as the organization of information sessions for residents, and production of newsletters, leaflets and posters, documentary films, and TV advertisements.

Among these activities, explanatory meetings with residents were prioritized, during which the administration could meet face-to-face with residents and hear their opinions directly. In order to make the meetings effective, the explanatory meetings were divided into three stages according to the residents' level of understanding. Stage 1 was designed to explain basic knowledge of waste management and an overview of the JSC to residents who had little knowledge of waste management and were unaware of the existence of the JSC. Stage 2 was an explanatory session that, in addition to the explanation in Stage 1, explained the services provided by the JSC and its business activities, such as cost sharing. Stage 3 was an opportunity to build consensus with residents on JSC's business plan based on the knowledge and information obtained in the Stage 1 and 2 meetings. By conducting the explanatory meetings in this manner, according to the residents level of understanding, it was possible to deepen the residents correct understanding of JSC activities, etc., and to encourage their cooperation in JSC projects and, ultimately, in the collection of fees.

Photo 7-13 Explanatory Meeting

Photo 7-14 Workshop with Residents

Source: Yachiyo Engineering Co., Ltd.

Table 7-9 Activities by JSC to Raise Awareness of Residents

No.	Items	Purpose
1	Newsletters	To publicize JSC activities to residents, the central government, other municipalities, donors, etc.
2	Leaflets	To distribute to government agencies, schools and residents participating in community meetings and inform them about waste management and JSC activities
3	Booklets	Same as above
4	Posters	To inform residents and others about waste management and JSC activities
5	Video production	To raise the awareness of residents and communities about the importance of JSC
6	Campaigns	To raise awareness of residents and students about waste issues
7	Community meetings	To discuss the importance and role of JSC, role of residents, and fees with people in each municipality

Source: Based on JICA "The project for capacity development on solid waste management in Jericho and the Jordan River Rift Valley : consolidation improvement report of solid waste management" (2010)

As shown in Table 7-10, in the City of Jericho and the Jordan Valley region, these long-term and ongoing awareness-raising activities have improved the public awareness of JSC and their level of satisfaction with collection services, which has helped increase fee collection rates.

Table 7-10 Results of Social Surveys Conducted by JSC (Jericho and the Jordan Valley Region)

No.	Items	Before awareness-raising activities	After awareness-raising activities
1	Awareness of JSC	70%	79%
2	Satisfaction with collection services	58%	70%
3	Fee collection rates	66%	81%

Source: Based on JICA "The project for capacity development on solid waste management in Jericho and the Jordan River Rift Valley : consolidation improvement report of solid waste management" (2010)

3.3 Lessons

(1) Improvement of Efficiency of Waste Management through Inter-Municipal Waste Management

Smaller municipalities, where resources are in chronically short, have difficulty continuing to implement quality waste management. One proposed solution is the introduction of a system called "inter-municipal waste management", in which surrounding municipalities come together to jointly implement waste management. When introducing inter-municipal waste management, an inter-municipal association that will function as a secretariat must be established that will be run through the cooperation of participating municipalities.

In order to reduce the burden on each municipality during the organization creation phase, it is important to first investigate the existing equipment, human resources, capabilities, systems, financial resources, mechanisms, and facilities possessed by the municipalities comprising the JSC, and combine them for effective utilization, rather than purchasing new equipment or hiring new personnel at the outset. Reducing the burden in the initial stages will lead to the smooth establishment of the JSC and the continuation of its subsequent operations.

(2) Introduction of Waste Collection Fees

When starting the collection of waste disposal fees, it is important to set an amount that the residents can afford and accept. In the Jericho and Jordan Valley areas, as a result of discussions within JSC, a waste disposal fee was set at an amount that would cover the JSC operating costs and that would not be a burden on the residents. After repeated explanations and discussions with the local residents through explanatory meetings and other means, the residents finally agreed that the waste disposal fee was appropriate.

On the other hand, the actual collection of fees is difficult, and in order to continue the waste management, it is necessary to consider measures such as increasing the fees. In order to improve the rate of fee collection, not only the quality of waste disposal service needs to be improved, but also various measures such as continuous dialogue with residents, suspension and resumption of service, and fee collection together with other public services (electricity, water, etc.) are required.

4 Republic of El Salvador ～ Path to Proper Management of Sanitary Landfill Sites～

In El Salvador, a sanitary landfill, developed and operated under the Fukuoka method, was introduced in 2008 with Japanese assistance, and continuously operated and maintained for more than 10 years. As a result of this project, similar landfills were being developed in other regions of the country.

After the completion of the project, the inter-municipal association has continued to work vigorously to develop and maintain the sanitary landfill, and has secured financial resources by seeking funding sources with the cooperation of the central government. Inter-municipal cooperation is also continuing, with explanations and agreements on revisions for waste disposal fees with each member local government.

Region: Central America
Capital: San Salvador
Area: 21,040 km^2
Population: 6.49 million (2020)
Ethnic groups: Multi-ethnic groups
Mixed Spanish Caucasian and Indigenous people (approx. 84%)
Indigenous groups (approx. 5.6%),
European ancestry (approx. 10%)
Language: Spanish
Religion: Catholic

Source: Ministry of Foreign Affairs Website "Republic of El Salvador"
https://www.mofa.go.jp/mofaj/area/elsalvador/data.html#section1 (accessed February 8, 2022)

4.1 Background

El Salvador did not have a waste management system in place, and waste was usually disposed in open dumps. The resulting increase in disposed waste caused groundwater pollution and soil contamination, creating adverse effects on people's health and ecosystems.

To improve conditions, El Salvador enacted an *Environmental Law* in 1998 requiring all municipalities to close open dumping sites and build sanitary landfills by September 2007. There was an urgent need for the systematic and phased

Source: Yachiyo Engineering Co., Ltd.

Photo 7-15 Open Dumping Site

development of sanitary landfill sites and to reduce the volume of waste, leading the government of El Salvador to decide that it was necessary to bolster the waste management capacities of municipalities. The government of El Salvador requested Japan's assistance on technical cooperation for construction, operation and maintenance of sanitary landfill site in December 2003 with the aim of establishing an inter-municipal waste management system, improving the capacities of people and institutions involved in the processes, and disseminating the outcomes to other municipalities in El Salvador and other Central American countries. In response to this request, a JICA technical cooperation project was implemented from November 2005 to March 2009 in the nine municipalities that make up "La Asociación Intermunicipal de Municipios del Norte del Departamento de la Unión" (hereafter referred to as ASINORLU). The project focused on improving and expanding landfill sites, their operations, maintenance and management, and 3R activities. Table 7-11 provides an overview of the project implemented in El Salvador.

Table 7-11 Overview of the Project Implemented in El Salvador

Item	Content
Project name	The project on Integrated Solid Waste Management for Municipalities in El Salvador
Project period	November 2005 - May 2009
Target cities	San Salvador (Central government), San Miguel (Project execution unit), La Union Province (Landfill, Clean association)
Overall goal	Municipalities implement appropriate Integrated Solid Waste Management (ISWM) to improve the environmental sanitary condition in the Republic of El Salvador.
Project purpose	The Central Government, MARN, MSPAS and ISDEM, strengthen their capacity to apply ISWM to municipalities in the Republic of El Salvador, and decide to implement the ISWM strategic promotion plan within its authority.
Outputs	1. The central government in cooperation with ASINORLU develops sustainable models in the nine municipalities of ASINORLU for ISWM. 2. The central government develops ISWM guidelines, which are feasible and adapted to the present conditions of municipalities in the Republic of El Salvador. 3. The counterpart personnel in the central government acquire the knowledge and experiences on ISWM. 4. The counterpart personnel in the central government acquire the capabilities to conduct training and to raise awareness on ISWM of municipal administrators 5. The central government develops a draft strategic promotion plan of ISWM in the Republic of El Salvador.

Source: Based on JICA "The Project for Integrated Solid Waste Management for Municipalities in the Republic of El Salvador Project Completion Report" (2009)

4.2 Application of Japan's Experiences and Technologies

(1) Construction and Proper Maintenance, Management and Expansion of Sanitary Landfill Sites Using the Fukuoka Method

The improvement of the open dump site and construction of a sanitary landfill site dramatically improved the appearance of the site and the surrounding environment and served to motivate employees and other stakeholders. These conditions made it possible for the association's operations to become self-sustaining. The association has continued to implement activities even after the conclusion of the project, including the expansion of landfill site and a search for funding sources.

In order to improve the open dump site into a sanitary landfill, it was necessary to obtain an environmental permit by conducting an environmental analysis in accordance with the *Environmental Law* of El Salvador. The purpose of the environmental analysis for this project was to determine concrete ways to mitigate environmental pollution caused by the open dump site. ASINORLU conducted surveys on the site topography, geology, and surrounding water quality, as well as fault investigations, and submitted an environmental report describing the necessary mitigation measures - including water quality monitoring and the application of soil cover - to the Department of Environment and Natural Resources. This resulted in a permit for open dump site improvements being granted in October 2006.

Phase 1 of the project involved temporarily moving disposed waste from Santa Rosa de Lima Landfill, which was initially an open dump, and installing leachate collection and gas venting pipes. The relocated waste was then returned to the improved cells, cover soil was applied, and some areas were closed. In addition, fencing and gates were installed, drainage ditches and site roads were constructed, and improvement construction work was completed in approximately three months. The landfill site improved in Phase 1 was used until a new sanitary landfill site was completed in Phase 2.

Phase 2 of the project involved construction and equipment procurement (backhoe loader, bulldozer, and dump truck) of a sanitary landfill using the semi-aerobic landfill method (Fukuoka method) developed in Japan. In the semi-aerobic landfill system, gas venting pipes and leachate collection and drainage pipes are installed to allow air to flow naturally into the interior waste layers. The supply of oxygen to the interior of the disposed waste layers increases the speed of waste decomposition, decreases the concentration of pollutants in the leachate, and suppresses odors and methane gas emissions. As a result, the stabilization period of the landfill site is shortened. The Fukuoka method is becoming popular in developing countries because inexpensive local materials such as waste tires, drums, bamboo, and rubble can be substituted as materials for pipes and paving stones. (for more details on the Fukuoka method, refer to "Topic 4-3.3 (4) Categorizing by Microbe Environment: Anaerobic, Semi-aerobic, and Aerobic Landfills".)

Table 7-12 shows an overview of the technologies used in each phase of the project.

Table 7-12 Overview of Technologies Used in Each Phase of the Sanitary Landfill Construction and Proper Operation and Maintenance

Phase	Technology Overview
Obtaining environmental permit	(1) Environmental diagnosis - Survey of geological features, water quality, etc. (2) Suggesting Mitigation Measures - Water quality monitoring, Soil cover, etc.
Phase 1 - Improvement of open dump site December 2006 - March 2007	(1) Relocating existing wastes, using the sanitary landfill technique (2) Definitive closure of some areas (3) Countermeasures to the waste pickers
Phase 2 - Sanitary landfill Construction October 2007 - July 2008	(1) Construction of Semi-aerobic sanitary landfill (Fukuoka method) (2) Staff acquired experience in implementing soil cover, heavy equipment operation and maintenance, etc.
Sanitary landfill Operation and Maintenance	Preparation of operation and maintenance manual, Daily soil cover, Leachate recirculation, Operation of aerators, Preventive maintenance of machinery

Source: Based on JICA "The Project for Integrated Solid Waste Management for Municipalities in the Republic of El Salvador Project Completion Report" (2009)

Photos of open dumping before construction (2005), the sanitary landfill site (Phase I) and the newly constructed sanitary landfill (Phase II, 2007) are shown in Photo 7-18~7~24. Waste is no longer scattered around the sanitary landfill site as it was with open dumping, which indicates a dramatic improvement in environmental conditions as well.

The reasons behind the site's proper maintenance as a sanitary landfill is the application of daily soil cover over the freshly disposed waste, thorough cleaning of storm water drains and site roads, and preventive maintenance of heavy equipment. On-the-job training (OJT) for employees responsible for operating the landfill site, who were hired at the time the sanitary landfill was being constructed, also played an important role in achieving appropriate maintenance and management of the site. Particular focus was placed on providing guidance for the landfill operations in areas of the site where impermeable liners were laid to avoid damaging the liner system when landfilling. The development of a manual on the maintenance and management of landfill sites also helped to reinforce landfill operation and maintenance capabilities.

This change from open dumping to a sanitary landfill site raised confidence and motivated ASINORLU and staff at the landfill, which in turn, led to the sustainable operation and maintenance practices of the landfill site after the project was completed.

Photo 7-16 Leachate Collection Pipes

Photo 7-17 Sanitary Landfill under Construction (Phase2)

Photo 7-18 Practice of Applying Soil Cover

Photo 7-19 The Use of Aerators in the Leachate Pond

Source: Yachiyo Engineering Co., Ltd.


Photo 7-20


Photo 7-21


Photo 7-22


Photo 7-23


Photo 7-24


Photo 7-25

Open Dump Site (Before Phase1) | **After Improvement（After Phase 1）**

Photo 7-26 Newly Constructed Sanitary Landfill (Phase 2)

Source: Yachiyo Engineering Co., Ltd.

View of the Open Dump Site, during Phase 1 and 2

After the Project

After the project was completed in 2009, in 2017 a new Fukuoka Method landfill area was constructed as Phase 3. This new landfill area had an expected landfill period of four years, and was supported by a German financial institution - the construction cost of approximately US$1.8 million is to be repaid by the central government as a loan.

In the meantime, ASINORLU implemented the planning and design of the new landfill area, reclaimed the valley land between the phases in order to keep the landfill in use longer, and sought financing sources with the cooperation of the central government, etc. While the amount of waste received at the end of 2008 was about 30 ton/day, the amount of waste received in 2021 was approximately 120 ton/day. Construction on a new landfill area using the Fukuoka Method, with an expected landfill period of seven years, is scheduled to start in 2022. This project, Phase 4 will cost approximately US$2.8 million and will be funded by the government of El Salvador. This is the first time that funding from the government of El Salvador is being used for the construction of a sanitary landfill site, and is in recognition of ASINORLU's ongoing activities. Procuring funds for construction, maintenance, etc. can always be a challenge in developing countries, but as in this case, sources of funding must be systematically sought and found to expand the landfill in the future.

Photo 7-27 Landfill of Phase 3 (Lower part)

Photo 7-28 Landfill of Phase3 (Upper part)

Photo 7-29 Panoramic View of the Landfill of Phase 3

Source: Yachiyo Engineering Co., Ltd.

Sanitary Landfill (August 2021)

(2) Introduction and Expansion of Regional Waste Treatment through Inter-Municipal Cooperation

ASINORLU made efforts to gain understanding of the need for inter-municipal waste management and the importance of the 3Rs through consensus building and careful explanation to each member municipality in the association. ASINORLU also conducted environmental education programs and facility tours for the residents of these municipalities so that they could better support their municipalities. Efforts such as these resulted in the smooth operation of inter-municipal waste management.

ASINORLU, the regional association responsible for the operation, maintenance and management of the disposal site, is composed of nine cities. It is necessary to reach agreements with each of the nine cities on setting disposal (tipping) fees to be paid to ASINORLU in order for waste to be accepted at the landfill site. The key points of this process are shown in Table 7-13.

Table 7-13 Key Points in the Process for Introduction of Inter-Municipal Waste Management by ASINORLU

Process	Key points
Agreement on disposal costs	ASINORLU carefully explained to the mayors of each city and others that payment of disposal fees based on the amounts of waste delivered to the landfill is necessary for the operation and management of the landfill. **Examples of items explained to the mayor** ・Concept of Sanitary Landfill ・Personnel required to implement waste management ・Operation and maintenance of sanitary landfill and necessary costs ・Outline of ASINORLU waste management plan ・Disposal fees to be paid to ASINORLU by each city, etc.
Public participation	Through environmental education and 3R activities at schools and city offices, ASINORLU promoted citizens understanding of waste management. In addition, ASINORLU actively conducted educational tours of landfill sites. **Examples of Environmental Education programs in schools** ・Separation of PET bottles, aluminum cans, and steel ・Bus tours to sanitary landfills and open dump sites ・Creation of posters and leaflets, promotion of the use of eco-bags, etc.
Strengthening organizational capacity	The capacity of staff in charge was strengthened through presentations at workshops and seminars and by acquiring knowledge through training in Japan. In addition, personnel and budget were secured to strengthen ASINORLU's organizational structure. **Examples of workshops and seminars** ●**Regional and national seminars** (2 times during project period) Target: Administrative officials, municipal officials, etc. related to waste management in Central American countries

	Examples of contents: The following items related to waste management, collection and transportation, public awareness and environmental education, environmental and social considerations, 3R promotion, final disposal, organization, system, finance, 3R promotion, final disposal, organization, system, finance, etc. ●**Municipal training courses** (6 times during project period) Target: Mayors, Technicians, NGOs, community leaders Improved capacity: Ability to select participants according to objectives Ability to tailor the program to the participants attending Ability to prepare presentation materials and conduct presentations, etc.

Source: Based on JICA "The Project for Integrated Solid Waste Management for Municipalities in the Republic of El Salvador Project Completion Report" (2009)

Photo 7-30 Briefing to the Mayor

Photo 7-31 Site Visit at the Regional and National Seminar

Source: Yachiyo Engineering Co., Ltd.

After the Project

● **Treatment Fees Collected from Each City**

As of September 2021, 26 cities transport waste to the Santa Rose de Lima landfill operated by ASINORLU, of which 17 cities have been added to the nine member cities of the association. As a result, the disposal fees collected from each city have increased to cover the maintenance and labor costs for the disposal site, as shown in Table 7-14. Disposal costs are determined based on the cost of fuel, facility operation and maintenance, and increased staffing costs, etc. ASINORLU ensured the sustainable operation of the inter-municipal landfill by revising fees as appropriate. Since waste management is not always a high priority for mayors, ASINORLU provided detailed explanations to each mayor and obtained their consent to increase the cost for disposal. ASINORLU provided explanations whenever a new mayor took office, in particular, seeking their understanding about the importance of waste management. As of 2021, each municipality is responsible for collection and transportation as in the original plan.

Table 7-14 Changes in Disposal Costs Collected from Cities

Paying entity	2008～	2016～	2020～	2022～ (provisional)
Disposal site host city	17 USD/ton	17 USD/ton	17 USD/ton	25 USD/ton
Other 8 cities in ASINORLU	23 USD/ton	23 USD/ton	23 USD/ton	25 USD/ton
Cities outside ASINORLU	26 USD/ton	26 USD/ton	35 USD/ton	35 USD/ton
Tariffs (dangerous items, etc.)	55 USD/ton	75 USD/ton	75 USD/ton	75 USD/ton

*: Red color: Adjustment of fees
Source: Yachiyo Engineering Co., Ltd.

● **Environmental Education and Awareness-Raising Activities**

Environmental education has been expanded to all elementary schools (203 schools) in the nine member cities of ASINORLU. The disposal site has been improved to accommodate visitors, with an educational building available for lectures and an observation deck open to visitors. This has resulted in an increase in the number of students and local government officials visiting the site.

ASINORLU is also devising its own way to promote the 3Rs as a new initiative by exchanging recyclables, such as PET bottles and cardboard for vouchers called “eco-dollars” and setting up stores where these eco-dollars can be used and exchanged for daily necessities. This activity aims to promote the source separation and separate collection of waste by providing incentives for separate discharge of recyclables, and to make the 3Rs an indispensable and familiar part of daily life for residents by exchanging eco-dollars for daily necessities.

Photo 7-32 Educational Building for Lectures (near the Landfill)

Photo 7-33 Observation Deck for Visitors

Source: Yachiyo Engineering Co., Ltd.

Photo 7-34 The Conversion of PET Bottles into Eco-dollar Bills

Photo 7-35 Purchasing Goods with Eco-dollar Bills

Source: by ASINORLU

Column: Waste Bank in Indonesia

In Indonesia, the Ministry of Environment and Forestry Decree No. 13 (2012) provides guidelines for promoting 3R activities through "Waste Bank", and certain support is provided by the government, including the development of facilities. Waste Banks are generally operated on a volunteer basis at the community level, and as of 2017 were in operation in more than 4,000 locations nationwide.

Waste banks purchase recyclables - PET bottles, plastic containers, empty cans, empty bottles, used paper, etc. - brought in by residents and sell them to recycling companies when a certain amount is collected. Residents are provided with a bank book equivalent to a regular bank passbook, and the amount equivalent to the market value of the recyclables (the purchase amount) is recorded in the book. After a certain period of time, the accumulated amount can be withdrawn as cash. The activities of the Waste Bank are said to have contributed to raising awareness of the 3Rs, changing the behavior of residents regarding waste separation, and beautifying the community.

Photo 7-36 "Sakura Waste Bank" in Palembang City

Photo 7-37 Mobile Waste Bank in Palembang City

Source: Yachiyo Engineering Co., Ltd.

● **Expanding Inter-Municipal Waste Management to Other Parts of El Salvador and Other Countries**

Attempts are being made to develop the inter-municipal waste management model in other parts of El Salvador based on ASINORLU's experiences. Table 7-15 provides an overview of the associations in El Salvador that have attempted to introduce inter-municipal waste disposal and the sanitary landfill sites they own. Two other sanitary landfill sites are being operated as regional waste disposal sites, in addition to ASINORLU. The experience gained by ASINORLU, including detailed explanations to each of the member cities of the association, was instrumental to the success of inter-municipal waste management.

However, one inter-municipal waste disposal facility was constructed but not put into operation, and two disposal sites were not constructed due to opposition from residents. Both of the sites that were not constructed were new construction sites, and the projects were abandoned due to opposition from local residents to the planned sites and the inability to relocate residents to other areas. Waste-related facilities, including the landfill, are described as NIMBY[5] facilities, and the failure to properly disclose information and respond to local residents was the cause of the setback, highlighting the difficulty of reaching a consensus with local residents on the construction of new landfill sites.

Especially the case of the new acquisition of land highlighted the need for the government to avoid selecting sites unilaterally and to only do so through exchange with residents in the surrounding area before selecting a site.

ASINORLU has also provided guidance in the field on waste management to municipalities in Honduras for a period of five years since 2013, and is providing guidance online in response to a request from Peru in 2020. Consequently, ASINORLU's activities related to the ongoing operation and maintenance of the sanitary landfill site and inter-municipal waste management have become a model not only for municipalities in El Salvador, but for other Latin American countries as well.

Reasons why AISNORLU has continued activities even after this project ended may be explained by the fact that staff gained confidence in their ability to improve people's lives and the environment by transforming open dumps into sanitary landfills.

[5] NIMBY is an abbreviation for "not in my backyard", a term used to describe residents who agree that a facility is necessary for the public, but are opposed to it being built on, or near their own residential property, or have such an attitude.

Photo 7-38 Panoramic View of Sanitary Landfill

Source: Yachiyo Engineering Co., Ltd.

Photo 7-39 Gas Venting Pipes

Chalatenango landfill, August 2021 – an Example of Inter-Municipal Landfill Spreading throughout the Country in El Salvador

Table 7-15 Overview of Associations that Have Attempted to Introduce Inter-Municipal Waste Management in El Salvador and their Sanitary Landfill Sites

No.	No. Municipalities	Construction of disposal site	Landfill system	Status of operation	Status of expansion	Funding sources for facility development and improvement	Difficulties faced, other
1 ASINORLU	9	Completed	Fukuoka Method	In operation	Completed	Phase I: JICA Phase II: JICA Phase III: KfW*1 Phase IV: Central government budget (provisional)	Continued with support from JICA. No particular issues with regional waste treatment system itself. There were issues with development in Phase III, but support was obtained from KfW*1 through donor coordination by MARN*2
2	5	Completed	Phase I: Fukuoka Method Phase II: Semi-anaerobic *3	In operation	Completed	Phase I: DAC*4 (With support from central government) Phase II: KfW*1	Regional waste treatment was introduced based on ASINORLU's experience. Development costs were provided through support from DAC*3 and KfW*1 with donor coordination by MARN*2.
3	13	Completed	Phase I: Fukuoka Method Phase II: Semi-anaerobic *3	In operation	Completed	Phase I: DAC*4 Phase II: KfW*1	Although residents were opposed to the site, agreement was received from each city as a result of detailed explanations based on ASINORLU's experience. The relationship between the mayors was also good.
4	12	Completed	Fukuoka Method	Failed to be put into operation	None	El Salvador government, Spanish Cooperation Fund	In addition to opposition from residents, the project had to be abandoned when 35 households could not be relocated.
5	9	Not completed	—	Failed to be constructed	—	—	Consent was not obtained from residents for the construction site of the new proposed disposal facility.
6	19	Not completed	—	Failed to be constructed	—	Design: KfW*1	The original land was too small, and some local governments opposed the acquisition of new land for the project. Funds were raised, but the project was abandoned due to opposition.

*1: KfW: Kreditanstalt für Wiederaufbau (German state-owned investment and development bank)
*2: MARN: Ministerio de Medio Ambiente y Recursos Naturales
*3: The El Salvadoran side of the sanitary landfill developed with KfW funds is a semi-anaerobic system
*4: DAC: Development Assistance Committee
Source: Yachiyo Engineering Co., Ltd.

4.3 Lessons

(1) Political - Examining the Impacts of Changes in Government Administration

In El Salvador, the term of office for the President is five years, while the term of office for mayors is three years. A change in government, including political party, can result in significant changes in policy. In some cases, waste management falls in priority, budgets are reduced and, the introduction of inter-municipal waste management by associations has been postponed for reasons such as these. Every time the mayor of a city in the association changes, it is important for staff from the association to visit the city and provide a detailed explanation of the situation to the new mayor and city council.

(2) Financial - Securing Funding

It is important for the central government to establish a budgetary framework for the development of inter-municipal waste management facilities. Only with this framework can inter-municipal cooperation be promoted in detail, and it will be easier to obtain the commitment of each municipality. The role of the central government should be to raise funds from donors and promote the allocation of the country's budget.

(3) Public Participation - Importance of Disclosing Information

An important factor in promoting inter-municipal waste management is the fair disclosure of information about project plans and outlines, and impacts on areas around facilities from the early stages of the planning process. As a first step, it is important to provide examples of proper development and operation and maintenance of landfill sites to avoid NIMBY-related problems.

Participation by residents and communities is an essential part of the waste management process, and incorporating their opinions, including opposing views, into project plans from an early stage and solving problems that arise will put the project on a fast track to implementation. There have been several cases where projects did not make it to the implementation phase due to failures to disclose information. Encouraging residents to actually visit sites through field trips to landfill sites and treatment facilities will also help them see waste issues as something that concerns them and will dispel causes for anxiety.

(4) Organizational - Securing Human Resources

As counterparts of projects move on, the experience and knowledge from the project and results of training in Japan may leave with them. However, in ASINORLU, counterparts are still directly involved in waste management, and significant developments have been observed even after the project ended. When staff are replaced within an organization, it is necessary to devise ways to retain the skills and methods developed through the project within the organization.

(5) Organizational - Improvement of Staff Motivation

In order to continuously maintain and manage a facility, it is important to motivate and maintain the staff involved in operation and maintenance management. In addition to a good working environment and a stable salary, visualization of work results, appropriate evaluation of work, and attention from others can also effectively motivate employees.

(6) Country Differences - Challenges in Expanding Systems to Other Countries

El Salvador is working on expanding lessons learned to other countries in Latin America based on ASINORLU's experience. However, it is not always possible to be applied successfully due to differences in laws and political systems in target countries. Conditions in other countries must be taken into account, and cooperation is needed to develop countermeasures to address this.

5 People's Republic of Bangladesh ～ Community Participation in Waste Management～

With the introduction of the "ward-based approach" Bangladesh has strengthened its waste management based on the smallest administrative unit. Under this approach the collection service area is subdivided into wards, each of which has its own administrative structure under the city's administrative reach, and can administer on its own parts of its waste management. It is also important to improve the working environments of the cleaners.

Region: South Asia
Capital: Dhaka
Area: 147,000 km^2
Population: 164.68 million (2020)
Ethnic groups: Bengalis, other minority groups
Language: Bengali (national language)
Religions: Islam (90.4%), other
(Hinduism, Buddhism, Christianity)

Source: Ministry of Foreign Affairs Website "People's Republic of Bangladesh"
https://www.mofa.go.jp/mofaj/area/bangladesh/data.html#section1 (accessed February 8, 2022)

5.1 Background

The population of Dhaka, the capital of Bangladesh[6], is estimated to be over 20 million. With rapid urbanization, the city is facing growing urban environmental problems, such as waste, air and water pollution. In Dhaka, waste management was being collectively implemented by the city government, but in such a large city it was difficult for an individual organization to be consistent in managing the discharge, collection and transport, intermediate treatment, and final disposal of waste. In addition, waste management in Dhaka City had been stagnating due to weak organizational structures, lack of equipment, and low sanitary awareness among the population. Table 7-16 provides an overview of major waste management projects implemented in Bangladesh through the support of JICA.

Source: Yachiyo Engineering Co., Ltd.

Photo 7-40 Illegal Dumping in the City

[6] The term "Dhaka City" refers to the former Dhaka City before the partition of the city into North and South Dhaka in 2011, which is now the combined area of Dhaka North City and Dhaka South City. In this material, "Dhaka City" is used for the sake of convenience.

Table 7-16 Overview of Projects Implemented in Bangladesh Related to Community Participation in Waste Management

Item	Content	
Project name	Project for Strengthening of solid waste management in Dhaka city	Project for Strengthening of Solid Waste Management in Dhaka North City, Dhaka South City and Chittagong City
Project period	February 2007 - March 2013	July 2017 -
Target cities (Population)	Dhaka City (Approx. 12 million people)	Dhaka North City (Approx. 6.11 million people) Dhaka South City (Approx. 4.49 million people) Chittagong City (Approx. 2.58 million people)
Overall goal	Waste management services in Dhaka City will be implemented sustainably.	Proper waste management will be implemented in Dhaka North City and Dhaka South City based on the New Master Plan for Waste Management (hereinafter referred to as the "New Master Plan"). Appropriate waste management is implemented in Chittagong City.
Project Goal	Waste management services in Dhaka City will be improved.	Waste management system in Dhaka North City and Dhaka South City will be improved based on the New Master Plan. Waste management system will be improved in Chittagong City.
Output	(1) Capacity for management and coordination of waste management activities will be improved. (2) Capacity for waste collection and transportation will be improved. (3) Proper operation and maintenance of final disposal sites (4) Accounting system for waste management will be improved.	(1) A new master plan for Dhaka North City and Dhaka South City with a target year of 2032 will be developed. (2) Ward-based approach activities will be improved in Dhaka North City and Dhaka South City (3) Chittagong City will formulate a waste collection and transportation plan and introduce an appropriate waste collection and transportation system. (4) Sustainable workshop management system will be established in Dhaka North City, Dhaka South City and Chittagong City. (5) Information exchange meetings on waste management initiatives among all Special Municipal Authorities and the medium-sized municipalities in Dhaka North City and Dhaka South City will be held under the leadership of the Department of Local Government of the Ministry of Local Government and Regional Development. (6) Public information campaign on waste management in Dhaka North City and Dhaka South City will be promoted. (7) Measures to extend the life of existing disposal sites in Dhaka North City and Dhaka South City will be implemented, and new disposal sites will be secured.

Source: Based on JICA “Project for Strengthening of solid waste management in Dhaka city (extension) Project Completion Report” (2013), “Project for Strengthening of Solid Waste Management in Dhaka North City, Dhaka South City and Chittagong City (Phase 1) Project Completion Report” (2019)

5.2 Application of Japan's Experiences and Technologies

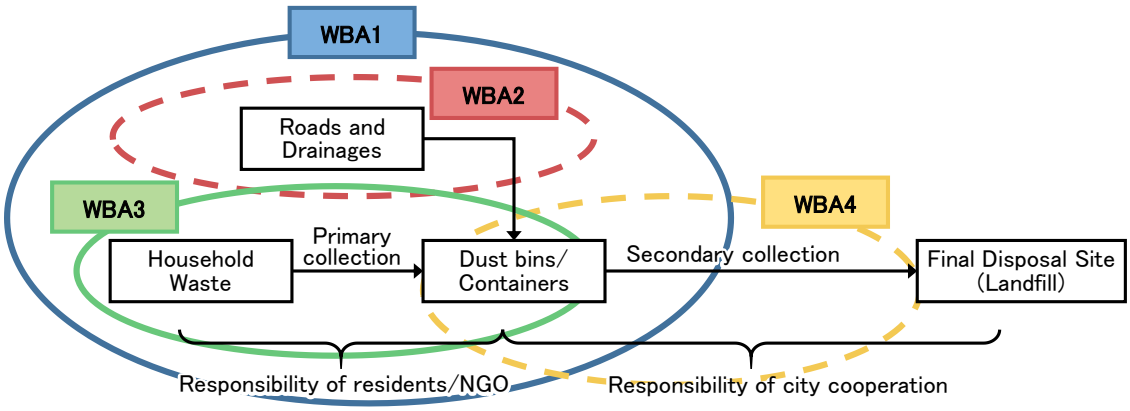
(1) Ward Based Approach (WBA)

The Ward Based Approach is a method for implementing and improving waste management in each ward, the smallest administrative unit in Dhaka City, through four activities: (1) construction of ward cleaning offices and strengthening field management, (2) improvement of working environment for cleaner, (3) promotion of public participation, and (4) improvement of collection and transportation.

Waste management operations, especially waste collection and transportation, cannot be improved simply by the introduction of collection vehicles and other equipment, but require fundamental improvements in the collection system, such as improved staff capacity and more efficient allocation of collection vehicles. However, in a large city like Dhaka, it is difficult to centralize the management of waste discharge, collection, transportation, and disposal in the Dhaka City Waste Management Department alone. Therefore, the Ward Based Approach (WBA), a management method for stable and continuous implementation of field-led waste management in wards[7], which are the smallest administrative units in Dhaka City, was introduced. Through WBA, for each ward, various activities such as staff training and awareness raising, improvement of organizational functions, improvement of equipment, and improvement of collection systems are combined in a synergistic manner to improve waste management. As shown in Figure 7-6 and Table 7-17, WBA consists of four activities: (1) Construction of ward cleaning offices and strengthening field management, (2) Improvement of working environment for cleaner, (3) Promotion of public participation, and (4) Improvement of collection and transportation. WBA's goals were to achieve a minimum civilian[8] standard of living and to provide administrative services to all residents of Dhaka.

[7] The smallest administrative unit of a city area. Multiple wards make up a single zone. As of 2022, there are approximately 130 wards in Dhaka City (Dhaka North City: 54 wards in 10 zones; Dhaka South City: 75 wards in 10 zones). The population per ward consists of tens to hundreds of thousands of people.

[8] Civil Minimum: The minimum standard of living conditions that a municipality is required to guarantee for the livelihood of its residents.



WBA 1	Construction of ward cleaning office and strengthening of site management
WBA 2	Improvement of the working environment for cleaners
WBA 3	Activities of public awareness
WBA 4	Improvement of waste collection and transportation

Source: Based on JICA "Project for Strengthening of Solid Waste Management in Dhaka North City, Dhaka South City and Chittagong City (Phase 1) Project Completion Report" (2019)

Figure 7-6 Framework of WBA

Table 7-17 Advantages and Challenges Related to the Ward-based Approach in Dhaka

WBA	Content	Advantages	Challenges
WBA 1	・Construction of ward cleaning offices and strengthening management in the field (office construction, management of cleaner)	・Provides a space for cleaner to meet, store cleaning tools, and take breaks. ・Offers a point of contact for residents to reach out to the government with questions or complaints on waste management.	・Difficulty acquiring land for construction of ward cleaning offices. May be difficult to raise funds for the operation and maintenance of cleaning offices.
WBA 2	・Improvement of working environment for cleaner (conducting safety trainings, preparing work manuals, providing safety equipment)	・Allows cleaner to work in a safe and hygienic environment. ・Leads to increased awareness on health and safety and improves work efficiency.	・Takes time to try and change awareness of cleaner on waste management and safety.
WBA 3	・Promotion of public participation (preparation and implementation of action plans for public awareness and community cleanup activities, etc.)	・Allows residents and workers to work together on waste management. ・Makes sustainable and hygienic waste management possible.	・Takes time to attempt to change the attitudes of residents towards waste.
WBA 4	・Improvement of collection and transportation (removal of dust bins, improvements to containers, introduction of fixed-time fixed-place collection (FTFP) method)	・Improves efficiency of collection work with the introduction of compactor trucks and other equipment. ・Allows waste to be collected in a hygienic manner.	・Takes time to change collection systems because the behaviors of both residents who discharge the waste, and government workers, who collect the waste, must be changed. ・Difficulties may arise when vested interests are involved.

1) WBA1 - Construction of Ward Cleaning Offices and Strengthening Field Management

The development of a base office is important for waste management in the ward. In Dhaka City, the office is used as an important place with many roles, such as an office space for the cleaning supervisor - the government official responsible for waste management in the ward - to perform his/her management duties, a work office for the cleaner, and a contact point for residents related to waste management.

A cleaning supervisor was assigned to each ward, but since there were no offices, the cleaning supervisor, while also responsible for management in the ward, was often in the field together with the cleaner, patrolling the cleaning and collection sites in the ward. Therefore, in order to create a base in each ward to help wards improve waste management on their own, ward cleaning offices were constructed, and their functions strengthened. The offices were built to serve a number of functions, including; as a point of contact for residents to reach out with complaints, a base for labor management and guidance for cleaner, a place for cleaner to take breaks, and a storage space for cleaning tools. Cleaning supervisors, who had been more engaged in patrolling the sites, were now able to concentrate on their own ward management duties, in addition to their patrol work.

Photo 7-41 Ward Cleaning Office

Photo 7-42 Meeting with Cleaners in Ward Cleaning Office

Source: Yachiyo Engineering Co., Ltd.

2) WBA2 - Improvement of the Working Environment for Cleaner

Efforts to improve the working environment for cleaners are not limited to simply improving the environment, but can also lead to increased awareness of the fact that cleaners are involved in waste management as government employees, which in turn can improve their motivation. A better working environment also ensures that work is not disrupted due to the absence of cleaner because of injury or illness, which also helps with the provision of stable services.

In Dhaka, the social status of cleaner is very low, and they face discrimination because of their occupation. Furthermore, awareness on hygiene and safety of cleaner is extremely poor. They work in unhygienic environments handling waste directly with their bare hands. In addition, because they worked without basic knowledge about waste collection, they did not understand points that needed to be taken into consideration during collection, which often resulted in traffic accidents. Not only do such accidents and illnesses affect the staffing and dispatch plans of the cleaner, making it difficult to provide stable and continuous waste management services, but the decline in the quality of waste management also leads to loss of trust from the residents, who are the service beneficiaries.

To avoid this situation, it is important to take steps to ensure that cleaner can work in a safe and sanitary environment. In Dhaka City, a safety and health committee was established to raise safety and health awareness and improve work efficiency, thereby providing a foundation for ensuring the occupational safety of the cleaner. A manual with diagrams was prepared for cleaner so that even those who couldn't read were able to understand the contents, and points to be kept in mind relating their work were made known to them. In addition, safety gear such as masks and gloves were distributed to cleaner to protect their health and safety, and information on how to use first aid kits and nearby hospitals were provided. Furthermore, a workshop was held to share with the cleaner the aims of waste management in Dhaka and to encourage their awareness that they, as city employees, are involved in the waste management.

The implementation of the four steps shown in Figure 7-7, i.e., (1) identify problems at the cleaning work site, (2) analyze the causes of the problems, (3) discuss solutions, and (4) implement the solutions, was facilitated for the on-site staff, including the cleaning supervisors who manage the cleaners. Regular implementation of these steps led to monitoring of the cleaning work environment and implementation of solutions.

1. Identification of problems at cleaning work sites	2. Problem cause analysis
No safety gear used First aid kit empty Accidents during cleaning work	The system is not restocked after consumption Cleaners do not understand how to use the equipment
Cleaning work is not being done properly	Cleaners do not meet at set times, so group cleaning work is not possible.
Work environment is not sanitary	Lack of facilities for hand washing, etc. No regular supply of safety gear, etc.
Cleaners do not keep scheduled work hours	Failure to control cleaners by cleaning monitors

3. Discussion of solutions / 4. Implementation of solutions

- Regular supply of safety gear is ensured by city cooperation (local government)
- An executive staffs of city cooperation will be responsible for properly running the Safety and Sanitation Committee
- Increase the number of cleaners
- Establish sanitation facilities (e.g., hand washing stations) for hand washing at each ward to maintain health

Source: Based on JICA "Project for Strengthening of solid waste management in Dhaka city (extension) Project Completion Report" (2013),

Figure 7-7 Major Challenges, Causes and Proposed Solutions identified at Cleanup Work Sites

Photos 7-43 Workshop for Cleaner (The Director General of the Waste Management Department explained the waste management projects that should be aimed at, etc.)

Photos 7-44 Part of the Cleaner Work Manual (The manual is designed with many figures for both literate and illiterate staff)

Source: Yachiyo Engineering Co., Ltd.

3) WBA3 - Promotion of Public Participation

Public participation is an essential part of waste management. One of the most effective ways to promote public participation is to identify key people, such as community leaders or influential people in the area and set up a community organization that includes them. Having these community organizations conduct awareness-raising activities for residents in the same area makes it possible to create an environment where residents can educate one another.

In Dhaka City, many residents previously did not know the location of the nearest collection point, and some residents would dump their waste on the street or in vacant lots. As a result, the deterioration of local sanitation environment became a problem, and the city considered how to involve residents in waste management and maintain local sanitation environment. The focus was on the existence of various local residents organizations, such as voluntary mutual self-help groups, religious groups, and youth clubs. In order to implement community-based participatory waste management, it was necessary to attract the attention of many residents and encourage them to change their behavior, and the participation of influential figures in the community was essential. Therefore, a survey was conducted to identify representatives and influential figures of local residents' organizations in each ward and new residents' organizations for waste management were established, with the identified individuals as key persons.

Activities were mainly carried out through these community organizations to encourage the participation and cooperation of local residents in waste management. Activities included a march by local residents calling for city beautification projects, campaigns to raise awareness of the environment through plays and musical events, and clean-up campaigns organized together with cleaners. An active community organization in one of the wards was monitoring conditions of road cleanliness. This resulted in the cleanup of illegal dumping sites that were discovered over the course of activities in cooperation with residents. Other community organizations also contributed to activities to beautify the community through independent voluntary activities.

Photo 7-45 River Cleanup Campaign by Residents' Groups

Photo 7-46 Residents Cleanup Activities

Source: Yachiyo Engineering Co., Ltd.

4) WBA4 - Improvement of Collection and Transportation

There are a number of different methods used to collect and transport waste, such as those that utilize dust bins, containers, and compactor trucks. It is important to identify the features of each of these methods and introduce collection methods that are appropriate for each individual area.

Waste collection and transportation in Dhaka City is classified into primary and secondary collection. Primary collection is the transportation of waste from the source to the collection point (in the case of Dhaka City, dustbins and containers). There are primary collectors who carry out this primary collection on behalf of residents and others, and rickshaw[9] vans are used for collection. Secondary collection is the collection of waste from dustbins and containers in the city and transport the waste to the final disposal site, which is handled by the government. The aim of WBA4 is to improve collection and transportation, especially secondary collection.

In Dhaka City, waste collection by open trucks had been the mainstream, but the area around the dustbin, where waste can be discharged 24 hours a day, was always overflowing with waste, resulting in unsanitary conditions. Later, the city gradually switched to container collection, but like the dustbins, the waste can be discharged 24 hours a day, so the unsanitary conditions persisted. In addition, containers were often placed along the side of the road, and large containers blocked parts of the road, causing traffic congestion. Therefore, in order to remove large dustbins and containers, Dhaka City introduced compactor trucks for secondary collection. In parallel, the city introduced fixed- place collection, in which waste is discharged at a designated time and place. Unlike dustbins and containers, the time that waste was kept in the city was reduced, contributing to improved sanitation.

Photo 7-47 Waste Collection from Dustbins by open Trucks
Source: Yachiyo Engineering Co., Ltd.

Photo 7-48 Waste Collection by Compactor (Fixed-Place Collection at Regular Intervals)

[9] A three-wheeled bicycle with a box-shaped cargo box. It is mainly used for primary collection in Dhaka.

After the Project

Although collection operations have improved with the introduction of compactors, the complete removal of dustbins and containers and the establishment of regular, fixed- place collection have not been achieved (as of March 2022). As shown in Table 7-18, Dhaka City decided to continue using dustbins and containers because the collection methods using dustbins and containers provided the residents with many advantages, such as ease of waste removal, the ability to transport large amounts of waste at a time, and high collection efficiency. On the other hand, the careless placement of dustbins and containers along the side of the road and in other areas of the city contributed to the deterioration of the sanitary environment, so the city started promoting the installation of containers inside of transfer stations that are enclosed by walls, aiming to shift to waste collection that has less impact on the surrounding environment.

Photo 7-49 Containers Installed at a Transfer Station

Source: Yachiyo Engineering Co., Ltd.

Photo 7-50 Workers Collecting Waste around a Container at a Transfer Station

Table 7-18 Advantages and Disadvantage of Primary Collection Methods

Type	Advantages	Disadvantage
Dust bins and containers	• Waste can be discharged at any time • Efficient because a large amount of waste can be transported at one time • Easier to maintain compared to compactor trucks	• Loading takes time and labor (if the collection vehicle is an open truck). • Waste tends to be scattered around dust bins and containers, which degrades the sanitary environment • Depending on where they are placed, they become a source of traffic congestion.
Compactor trucks	• Suitable for the collection of large volumes as compactor trucks can compress waste • Can be used to collect waste in a sanitary manner	• Difficult to transport a large amount of waste at one time compared to containers • Complex structure makes maintenance difficult

5.3 Lessons

(1) To Improve Integrated Waste Management

WBA is an effective method for developing site-driven participatory waste management in the community. The construction of the ward cleaning office provides administrative work space for the cleaning supervisors and a place for the cleaner to rest and store their safety gear. It also serves as a point of contact for residents to casually discuss waste management issues, helping to build a relationship between the government and residents.

Protecting the occupational safety of cleaner is also important to avoid the sudden absence of staff due to injury or illness, especially if weakness in occupational safety interferes with collection work. Collection services can be improved by selecting appropriate collection methods, allowing services to be provided that not only consider the sanitation of local residents and the surrounding environment, but also the health and safety of the cleaner who perform collection work.

In order to encourage the participation of residents, who play an essential role in promoting proper waste management, it is important to identify local representatives and influential people in the community and establish a resident's organization led by these individuals. The existence of such an organization will establish a foundation for local residents to work together and contribute to the implementation of activities to improve the sanitation environment in the community.

Column: Identification of Constraints and Introduction of Appropriate Technologies

Regional characteristics, even in the same country or city, are completely different. There are a number of factors that are related to waste management systems, such as topography, religion, climate, politics, and the presence of residential and commercial facilities. It is therefore difficult to properly dispose of waste without a waste management system that is suited to these characteristics. It is necessary to identify these characteristics and consider what type of waste management system would be best suited. Examples of constraints in the waste management sector are shown in the table below.

Table 7-19 Examples of Constraints in the Waste Management Sector

No.	Constraints		Measures
1	Human and technological factors	Lack of human resources and capacity	Conduct trainings, promote public participation, implement simple systems
		Energy insufficiency	Securing new energy sources (small-scale power generation facilities, use of biogas/landfill gas, etc.)
		Shortage of construction materials	Use locally available materials
2	Financial factors	Lack of funds	Introduce low-cost technologies, mobilize external funds
3	Organizational structure and institutional factors	Unclear division of roles and authority	Establish legal systems and neutral professional organizations
		Insufficient development and maintenance of laws and regulations	
4	Social factors	Social systems	Community and NGO partnerships for public participation, environmental education, and waste picker countermeasures
		Culture and customs	
5	Geographical factors	Steep slopes, lowlands, highlands, etc.	Innovations in design
		Arid regions	Reuse and recycle water
		Flood-prone areas	Introduce flood prevention measures and technologies
		Regions with high and low temperatures	Review/revise design conditions
		Land shortages	Introduce space-saving and advanced technologies
6	Environmental factors	Presence of wildlife	Innovations in design
		Presence of pests and vermin	Innovations in design and usage
		Presence of endemic diseases	Education on causes of infection, dissemination of proper techniques (e.g., introduction of incineration, implementation of soil cover at final disposal sites, etc.)
		Insufficient environmental capacity	Innovations in equipment/facility layouts and treatment methods

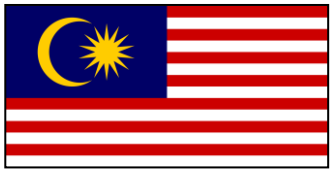
*: Refers to the allowable capacity of a pollutant that does not cause problems in the natural environment.

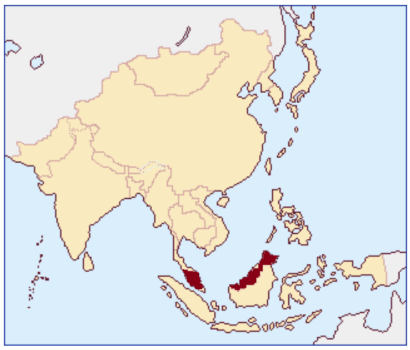
Source: Based on Kitawaki Hidetoshi "Appropriate technology in the field of environmental health in developing countries" (1997), JICA "To Support Capacity Development in the Waste Sector in Developing Countries Toward Improving the Waste Management Capacity of Society as a Whole" (2005)

6 Malaysia ～ Data Management Systems, Dissemination of 3R Activities and Environmental Education ～

A multifaceted approach was taken in Malaysia to promote waste reduction, including the establishment of a data and information management system, source separation, 3R activities and environmental education.

Malaysia has a per capita GDP of approximately US$10,000 (in 2020) and is positioned as a middle-developed country. The waste management level corresponding to the country's stage of development set by JICA is shifting from the second stage "reduction of environmental burden and pollution prevention" to the third stage "establishment of a sound material-cycle society through the 3Rs". Therefore, the results of this project have many implications for developing countries seeking to transition from one stage to another.





Region: Southeast Asia
Capital: Kuala Lumpur
Area: 330,000 km^2
Population: 32 million (2017)
Ethnic groups: Malay (approx. 69%), Chinese (approx. 23%), Indian (approx. 7%)
Languages: Malay (national language), Chinese, Tamil, English
Religions: Islam (official religion, 61%), Buddhism (20%), Confucianism/Daoism (1.0%), Hinduism (6.0%), Christianity (9.0%), other

Source: Ministry of Foreign Affairs Website "Malaysia"
https://www.mofa.go.jp/mofaj/area/malaysia/data.html#section1 (accessed February 8, 2022)

6.1 Background

In Malaysia, prior to the transfer of waste management and recycling administration to the central government (National Solid Waste Management Department) in 2011, waste management was a local government task and the Ministry of Housing and Local Government (MHLG) was in charge of waste administration. Since the mid-1980s, Malaysia has experienced an increase in the amount of waste generated due to urbanization and diversification of lifestyles in line with economic development, as well as problems with disposal costs and securing landfill sites. Therefore, the National Development Policy has emphasized the concepts of reduce, reuse, recovery, and recycling, and made recommendations on the use of environmentally friendly products. In addition, the Ministry of Housing and Local Governments (MHLG) has been promoting recycling and raising awareness with

citizens on the 3Rs at the national level, while local governments have promoted recycling activities.

However, these efforts were limited to only a few local governments that had an advanced level of environmental awareness, and recycling rate was only 2% to 5%. In this context, the Malaysian government requested the support of Japan to implement a project with the aim of developing a clear concept, strategy and plan for the creation of a sound material-cycle society. The project was implemented during the period from July 2004 to July 2006. Table 7-20 provides an overview of the project.

Table 7-20 Overview of Project Implemented in Malaysia

Item	Content
Project name	The Study on National Waste Minimization in Malaysia
Project period	July 2004 - July 2006
Target cities	Kuala Lumpur (Government agencies), Penang, Subang Jaya, Miri, Johor
Project Purpose	(1) Formulate master plans, action plans, and guidelines to promote waste reduction (reduce, reuse, recycle) based on the National Strategic Plan for Solid Waste Management. (2) Strengthening of public sector organization for waste reduction
Output	(1) Waste Minimization Master Plan (Target: Municipal waste across Malaysia, Target year: 2020) (2) Solid Waste Minimization Action Plan for Federal Government (Target year: 2010) (3) Guideline ・Guidelines for the Enhancement of 3Rs Activities in Schools ・Guideline for Formulation of Local Action Plan on Waste Minimization ・Guidelines for Source Separation of Municipal Solid Waste ・3Rs Action Guide (4) Implementation of the pilot projects ・PP-I：National Recycling Information System ・PP-II：Local Waste Minimization Unit and Source Separation of Municipal Solid Waste ・PP-III：Waste Minimization Awareness and 3Rs Programme and Activities in Schools (5) Solid Waste Minimization Action Plan for Local Authorities in model cities (Subang Jaya, Kinta Selatan, Miri, Penang)

Source: Based on JICA “The Study on National Waste Minimization in Malaysia Final Report” (2006)

6.2 Application of Japan's experiences and technologies

(1) Development of a Data and Information Management System

Creating a database of information related to waste is effective when used in planning and promoting efficient waste management. However, it is important to have a structure in place that can be used to maintain and manage the system, including securing the necessary human resources.

In Japan, the Ministry of the Environment of the central government, requests local governments to submit data to a centralized database on waste. (for more details on the database created by the Ministry of the Environment of Japan, refer to "Topic 1-2.1 Management of Waste-Related Data".) One of the Japanese technologies that has been applied under the project in Malaysia is for creating databases on waste. The basic structure of the information management system is shown in Figure 7-8. A database was created in an information management system using data on the collection of recyclable materials digitally submitted by local governments and key information related to recycling. The database contains the following information.

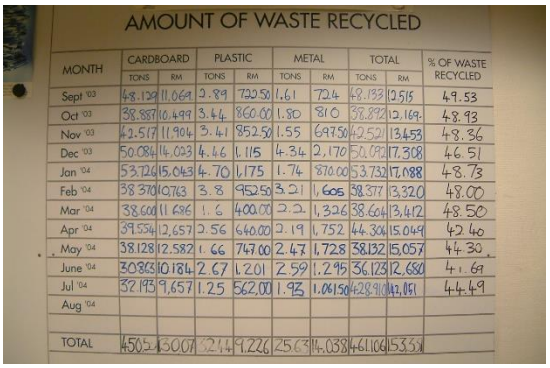
- General information about the local government: address, contact information of officer(s) in charge, website URL, etc.
- Collection centers, collection container locations, administrators
- Types of recyclable materials collected
- List of related organizations submitted by the local government

This database has made it possible to access and search key data, as well as create tables and graphs for purposes of research, analysis, and publication.

Creation of a database is important because it leads to the creation of waste flow diagrams and preparing plans using the data. In order to make effective use of the data, training of personnel submitting the data and those managing the data is also required. Therefore, on-the-job training was provided to national and local government officials on how to input and manage data.

Photo 7-51 On-the-job Training on Data Management for Municipal Employees

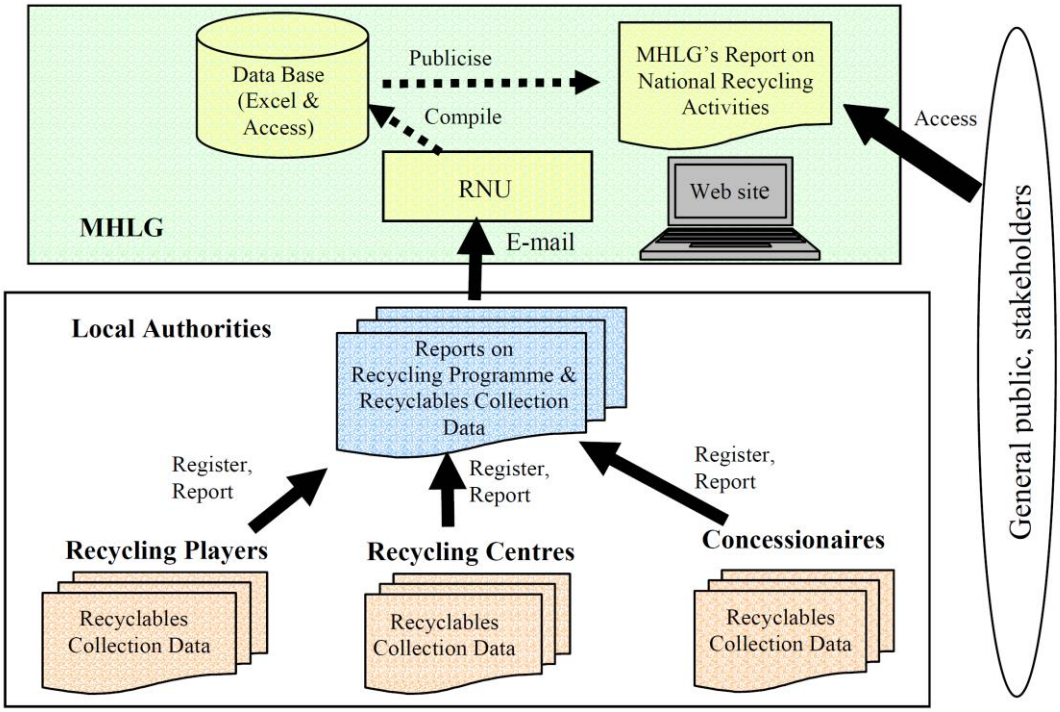
Source: Yachiyo Engineering Co., Ltd.



AMOUNT OF WASTE RECYCLED

MONTH	CARDBOARD		PLASTIC		METAL		TOTAL		% OF WASTE RECYCLED
	TONS	RM	TONS	RM	TONS	RM	TONS	RM	
Sept '03	48.139	11.069	2.89	722.50	1.61	724	48.133	12.515	49.53
Oct '03	38.887	10.499	3.44	860.00	1.80	810	38.892	12.169	48.93
Nov '03	42.517	11.904	3.41	852.50	1.55	697.50	42.521	13.453	48.36
Dec '03	50.084	14.023	4.46	1.115	4.34	2,170	50.090	17.308	46.51
Jan '04	53.726	15.043	4.70	1,175	1.74	870.00	53.732	17.088	48.73
Feb '04	38.370	10.743	3.8	952.50	3.21	1,605	38.377	13.320	48.00
Mar '04	38.600	11.696	1.6	400.00	2.2.	1,326	38.604	13.412	48.50
Apr '04	39.554	12.657	2.56	640.00	2.19	1,752	44.304	15.049	42.40
May '04	38.128	12.582	1.66	747.00	2.47	1,728	38.132	15.057	44.30
June '04	30803	10184	2.67	1.201	2.59	1.295	36.173	12.680	41.69
Jul '04	32.193	9,657	1.25	562,00	1.93	1.06150	428.910	42,051	44.49
Aug '04									
TOTAL	450.2	43007	32.49	9.226	25.63	14.038	461.06	153.51	

Photo 7-52 Example of Data Collection Form at a Recycling Center



*: A concessionaire is a private contractor that operates a collection business under a concession contract with the government.
Source: JICA, Yachiyo Engineering Co., Ltd., EX Research Institute Ltd. "The Study on National Waste Minimisation in Malaysia Final Report" (2006)

Figure 7-8 Basic Structure of the Information Management System (IMS)

After the project was completed

On the website[10] of the Ministry of Housing and Local Government, data on waste is available to the public and can be downloaded by anyone in Excel format. The data has been accumulated since 2012, and in addition to basic data such as the amount of waste generated, recycling rate, and disposal sites, the number of complaints and illegal dumping are also available.

[10] Ministry of Housing and Local Government Website, data viewing page: https://www.data.gov.my/
It is possible to search for data of waste by searching for "Sisa Pepejal "(Malay for solid waste).

(2) Source Separation

Separation at the source is essential for waste reduction. Collection methods and waste to be sorted were established according to different conditions - such as single-family houses, apartment buildings, office buildings, mega-marts, and hotels - and source separation was conducted.

In order to reduce waste, it is necessary to understand waste flows and separate waste at source. Five target groups were selected in this project to verify source separation under different conditions: (1) general households (single-family houses), (2) general households (apartment complexes), (3) office buildings, (4) mega-marts, and (5) hotels. Methods differ for each of the source separation systems introduced and implemented in the target groups, and were selected according to the local characteristics of the collection methods and collectors. An overview of source separation systems is shown in Table 7-21.

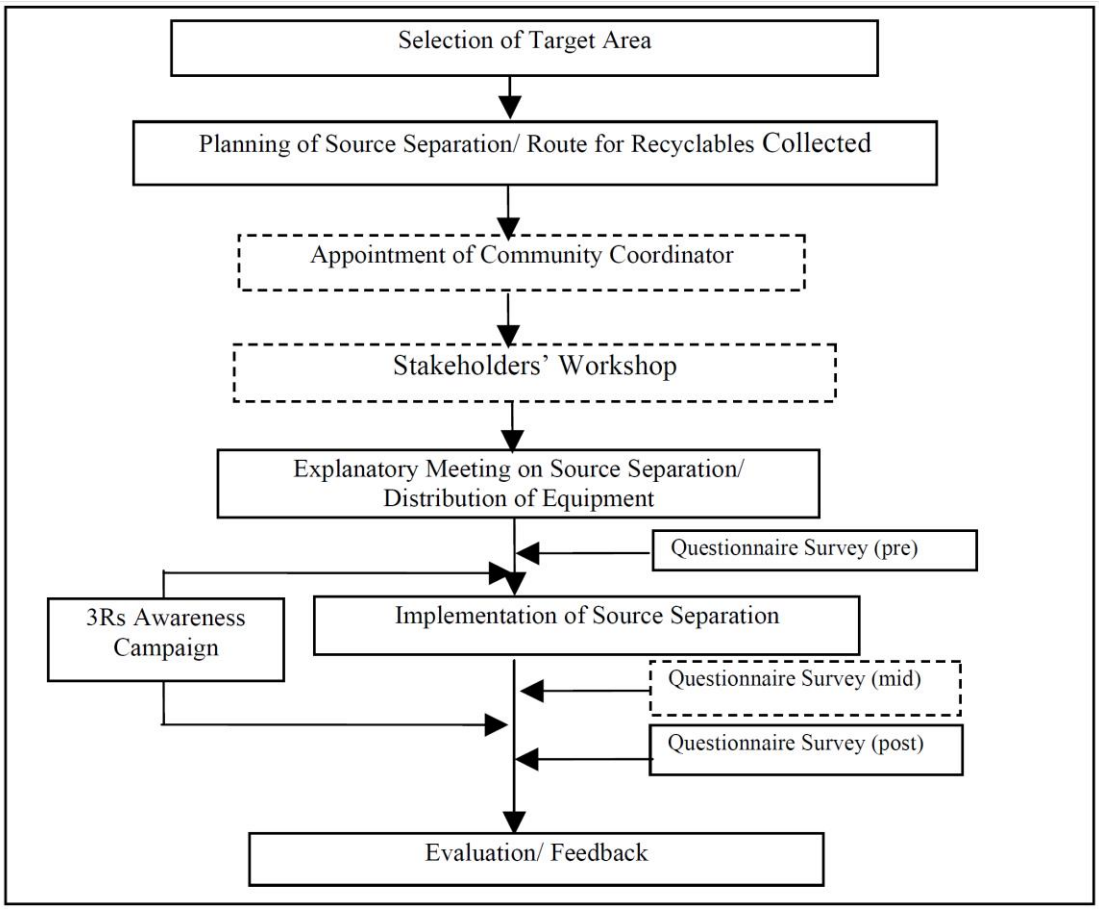
Table 7-21 Overview of Source Separation Systems

Target	Activity	Target items	Equipment/facility	Collectors	Collection frequency
General households (single-family houses)	Door-to-door collection	Paper Plastic Metal Glass	One HDPE* container Separated into 2 types	Recycling companies	Once/week
	Door-to-door collection Station collection		One Plastic bag and one box for waste paper Separated into 3 types	NGOs	Once biweekly
				City contracted collectors	Once/week
General households (apartment complex)	Station collection		Three Plastic bags and collection containers (4 locations) Separated into 4 types	Recycling companies	Once/week
Office buildings	Reduced paper consumption	Paper	Three types of collection containers	Concessionaire	Once/week
Mega-marts	Establishment of purchase center	Paper, plastic, metal, glass	Cabin for purchase center	Concessionaire	Daily
Hotels	Separation by housekeepers and guests		Collection containers, bags, boxes	Recycling companies	Once/week

*: HDPE：High-density polyethylene
Source: JICA, Yachiyo Engineering Co., Ltd., EX Research Institute Ltd. “The Study on National Waste Minimization in Malaysia Final Report” (2006)

Figure 7-9 shows the procedures used in separating waste at source in the project. After targets were selected, waste was separated at source through the establishment of separation methods and collection routes for resources, and the organization of workshops and briefings to obtain stakeholders' understanding and cooperation. Finally, source separation guidelines were developed to promote separation at source.

Since there was no clear specific law regarding source separation for commercial facilities, the project team coordinated individually with each business operator targeted for the pilot project, such as Mega Mart, hotels, etc., in the context of social contribution such as CSR (Corporate Social Responsibility). For each business operator, it took time to coordinate with the pilot project for introduction of source separation, because they were required to bear the costs of labor for sorting the waste, costs to purchase containers for the sorted recyclables, as well as to allocate personnel and consider a location for placing the containers. It is necessary to enact a law that stipulates the responsibilities of business operators, similar to Japan's recycling-related laws.



Source: JICA, Yachiyo Engineering Co., Ltd., EX Research Institute Ltd. "The Study on National Waste Minimization in Malaysia Final Report" (2006)

Figure 7-9 Flow Chart of Source Separation Activities

Photo 7-53 Briefing on Source Separation Activities to Residents

Photo 7-54 Collection of Recyclables from Single Family Homes

Source: JICA, Yachiyo Engineering Co., Ltd., EX Research Institute Ltd. "The Study on National Waste Minimization in Malaysia Final Report" (2006)

(3) 3R Activities and Environmental Education

Environmental education in schools is effective in promoting the 3Rs, and it is expected that the students will spread the 3Rs to their families and the society. In Malaysia, a key point was to classify the schools into levels according to the extent that the 3Rs were being promoted in each school, and then set and implement 3R activities according to that level. When implementing programs, it was also important to devise methods for selecting target schools, such as selecting schools with different levels of 3R activities and those with relatively high levels of awareness through questionnaires and briefing sessions

Prior to the start of activities, guidelines were developed for promoting the 3Rs in schools in collaboration with the ministries in charge of waste management, Ministry of Education, local governments, and school teachers. Based on these guidelines the schools were classified into levels according to the extent existing waste reduction programs were already being implemented. The guidelines also indicated the need to incorporate PDCA (Plan, Do, Check, Act) cycles to review and improve 3R activities that have been planned and implemented. For example, the "Check" component of PDCA included specific instructions for use, such as measuring the amount of paper, PET bottles, cans, and other waste generated at the school each day and evaluating the numerical amount of weight reduction achieved by recycling. It was important to initially provide appropriate guidance to school teachers so that guidelines could be properly implemented in educational settings, and therefore 3R workshops were also organized for teaching staff. An overview of these guidelines is shown in Table 7-22.

Table 7-22 Overview of Guidelines Promoting 3R Activities in Schools

Purpose	(1) Streamlining 3R activities in schools (2) Promoting participatory approach (3) Evaluating 3R activities (4) Ensuring the sustainability of 3R programs in schools
Classification of schools	Level 1: Schools with no waste reduction programs in place Level 2: Schools with basic waste reduction programs in place Level 3: Schools with active waste reduction programs in place
Contents	Chapter 1: What are the 3Rs? Chapter 2: Why do we need the 3Rs? Chapter 3: The PLAN-DO-CHECK-ACT approach Chapter 4: Where should we start? Chapter 5: Step 1: Planning (PLAN) Chapter 6: Step 2: Implementing (DO) Chapter 7: Step 3: Monitoring & measuring (CHECK) Chapter 8: Step 4: Reviewing & improving (ACT) Chapter 9: 3R PDCS for beginners (Level 1) Attachments

Source: JICA, Yachiyo Engineering Co., Ltd., EX Research Institute Ltd. "The Study on National Waste Minimization in Malaysia Final Report" (2006)

Next, 3R programs and 3R award programs were set up in the target cities, and each program was implemented after schools were selected in each city.

- Miri City: Nine schools were selected based on questionnaires and information sessions to confirm their intent to participate. A 3R award program was organized, with the winning school identification at the award ceremony where each school gave a presentation on their activities.

- Johor State: A total of six elementary and junior high schools having different levels of 3R activities were selected by the state board of education to conduct activities in classrooms, staff rooms, cafeterias and students' homes, as shown in Table 7-23.

Table 7-23 Overview of the 3R Program in Schools in Johor State

Level	Level 1	Level 2	Level 3
Purpose	・Improve level of awareness of the 3Rs among students and teachers ・Reduce waste generated at schools		
	・Introduce the concept of separating waste at source	・Reduce the number of plastic bags in cafeterias	・Impart a message on the 3Rs to families through students
Targets	Classrooms, staff rooms	Cafeterias	Students' homes
Activities	・Establish 3R organizations ・Conduct waste surveys in classrooms ・Set up collection points for recyclables in each classroom	・Establish 3R organizations ・Conduct waste surveys in cafeterias ・Replace plastic bags with reusable cups for beverages ・Encourage teachers and students to bring their own cups to school	・Establish 3R organizations ・Conduct waste surveys of households

Source: JICA, Yachiyo Engineering Co., Ltd., EX Research Institute Ltd. "The Study on National Waste Minimization in Malaysia Final Report" (2006)

The use of an inter-school competition to provide incentives to students in the 3R award program in Miri City was expected to increase the students' motivation to engage in 3R activities and build a sense of unity in the entire school as well. In addition, both schools in Johor and the families of students were included in 3R activities, so that activities could be extended to the families of students. Devising places and methods for implementing the 3Rs resulted in even more effective activities. Environmental education at schools has resulted in increased awareness of recycling and contributed to the spread of buy-back centers, which are facilities for purchasing recyclables.

In the project, the collected recyclables were handed over to a contractor, and efforts were made to reuse it at schools - such as making chairs from PET bottles, craft activities using unwanted materials, and making statues from aluminum cans. Resource waste obtained through recycling becomes meaningful as a resource when there are recipients and it is used effectively and appropriately. Therefore, in order to carry out 3R activities, it is a prerequisite that there is a place for effective use of separated recyclables.

Photos 7-55 Awareness Survey on 3Rs in Schools

Photos 7-56 3R Workshop for Junior High School Students

Photos 7-57 3R Workshop for Government Officials

Photos 7-58 Guidance on Sorting by City Staff

Photos 7-59 3R Workshop for School Teachers

Photos 7-60 Seminar on Waste Reduction

Source: JICA, Yachiyo Engineering Co., Ltd., EX Research Institute Ltd. “The Study on National Waste Minimization in Malaysia Final Report” (2006)

6.3 Lessons

(1) Training and Securing Competent and Appropriate Human Resources

Data management, updates to networks, and monitoring are essential aspects of waste management operations. Therefore, in order to maintain data management systems, it is necessary to educate not only the central ministries and agencies that manage the databases, but also the local government administrators who collect and submit data, and to appoint competent, appropriate, and trained personnel to maintain the systems.

(2) Coordination between Stakeholders on Source Separation

It took time to coordinate with the parties concerned, as they were required to bear the costs of labor and sorting containers for the introduction of source separation, as well as to allocate personnel and secure an installation site. Source separation programs for commercial facilities, such as supermarkets and hotels, faced various problems such as informing customers and gaining their understanding of cost burdens, etc. in terms of coordinating and negotiating with stakeholders. These problems lay beyond the control of local governments and the project team, and caused significant delays in the implementation of the program. For separation at source, it is necessary to coordinate with households and commercial facilities separately, and pay particular attention to the interests of stakeholders of commercial facilities.

(3) Strategic Implementation of Educational and Dissemination Programs through Inter-agency Collaboration

In order to introduce sustainable waste reduction practices, it is necessary to teach the philosophy of the 3Rs to the younger generation through practical school education and extracurricular activities. Collaborative activities between ministries responsible for waste management (in this case, the Ministry of Housing and Local Government) and the Ministry of Education are essential for the introduction of sustainable and strategic educational and awareness programs suitable to students. The Ministry of Education and teachers were involved from the initial stage in developing guidelines to promote 3R activities in schools, which made the guidelines even more applicable in educational settings. It is important for multiple ministries and agencies to collaborate in order to efficiently implement educational and awareness programs.

Column: Implementation of the E-Waste Management System in Malaysia

E-waste refers to waste from electrical and electronic equipment, which contains hazardous substances such as lead and mercury, as well as rare metals. This makes recovery of these wastes important from the perspective of the sustainable use of resources.

Since 2019, E-waste in Malaysia has been managed under ministries responsible for collection, treatment and disposal under laws and regulations on hazardous waste in Malaysia for industrial systems (manufacturing and assembly of electrical and electronic equipment). However, the disposal of electrical and electronic equipment waste from households and businesses is in a legal grey zone, as specific roles and responsibilities for its management have not been legally clarified and systems for its implementation have not been specified within the government. Therefore, most electrical and electronic equipment wastes (air conditioners, PCs, and cell phones that include rare metals) that contain a significant amount of recyclables are collected by resource recovery and recycling companies, including those in the informal sector, either free of charge or for a fee, disassembled or dismantled using simple processes, and then recyclables are recovered and sold. However, it is currently impossible to adequately control the health and safety hazards caused by inappropriate treatment and disposal and the pollution caused by discharging hazardous substances into the environment.

In response, the ministry has promoted the development of legislation for “E-waste management regulations” and has specified the six items described in Table 7-24, in “electrical and electronic equipment waste” disposed by households and business establishments as “designated hazardous waste”, with an aim to establish the treatment flow shown in Figure 7-10. In connection with this, ministries and agencies are implementing the individual/station collection of E-waste and establishing/operating collection centers, while the private sector is collecting and purchasing such waste.

To formalize informal collection, it is desirable to visualize resource and financial flows. To this end, it is first important to understand the volume of household appliances sold (imported and produced domestically), which is the basic information for estimating the volume of E-Waste generated.

It was also estimated that in Malaysia, much of the E-Waste is collected on delivery of new appliances when they are replaced, but much of the collected E-Waste is passed on by delivery drivers to informal recyclers such as junk shops, etc. In order to eliminate the improper treatment of E-Waste, it is necessary to establish a system whereby E-Waste flows from generators through authorized channels (Authorized Collection Centers/ Collectors, Authorized Retailers) to formal treatment, as shown in Figure 7-10.

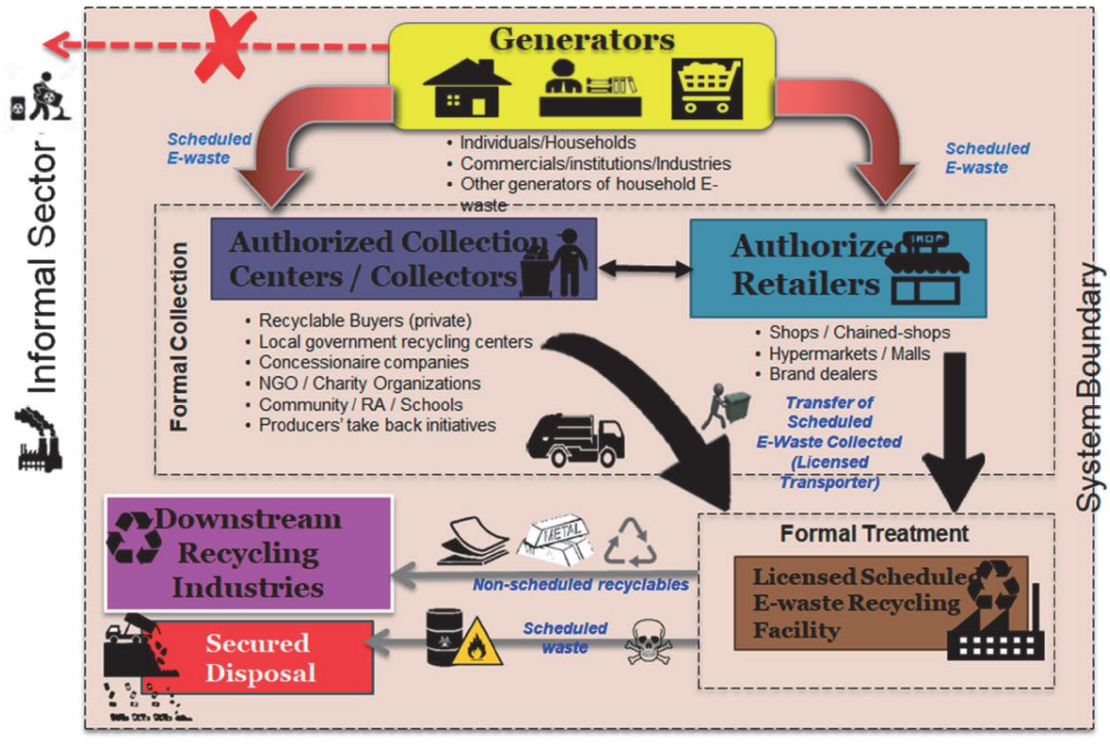
By clarifying the resale price to informal recyclers, price incentives can be considered to collect and process E-Waste through regular channels.

In other developing countries, laws are expected to be developed in the future from the perspective of environmental protection and resource recycling, which will cause shifting from informal to formal collection. It should be noted that employment opportunities will be lost in the informal sector, and that it will be necessary to obtain the cooperation of local residents in the separation and collection of waste.

Table 7-24 Waste Designated as Hazardous as Defined by E-Waste Management Regulations

1	TVs (including cathode-ray tube TVs and flat TVs)
2	Refrigerators
3	Washing machines (including clothes dryers)
4	Air conditioners (including integrated and separated types)
5	PCs (including desktops and laptops)
6	Cell phones (including feature phones, smartphones, and tablet PCs)

Source: Based on JICA "The Project for Implementation of Scheduled E-waste Management System in Malaysia Final Report" (2019)



Source: JICA "The Project for Implementation of Scheduled E-waste Management System in Malaysia Final Report" (2019)

Figure 7-10 E-Waste Recycling and Treatment Flow Based on the "E-Waste Management Regulation"

7 Socialist Republic of Vietnam ～ 3R Activities Involving Multiple Stakeholders～

Vietnam is taking a step forward from the realization of proper waste management to the establishment of a sound material-cycle society, and the project described in this section has launched 3R initiatives, including the introduction and dissemination of source separation. The efforts related to 3R activities involving various stakeholders, centering on local residents are introduced hereafter.

Region: Southeast Asia
Capital: Hanoi
Area: 329,241 km^2
Population: 97.62 million (2020)
Ethnic groups: Kinh (Vietnamese people) approx. 86%,
53 other ethnic minorities
Language: Vietnamese
Religions: Buddhism, Catholicism, Caodaism, other

Source: Ministry of Foreign Affairs Website "Malaysia"
https://www.mofa.go.jp/mofaj/area/vietnam/data.html#section1 (accessed February 8, 2022)

7.1 Background

Environmental pollution in Hanoi, the capital of Vietnam, was worsening due to un-collected solid waste scattered on public roads and illegal waste dumping in lakes. Under the nation's environmental strategy to recycle 30% of waste by 2020, the government had been trying to promote a recycling movement for solid waste, but the collection of recyclables remained mainly limited to informal waste collectors.

The 3R Initiative, which combines the Reduce, Reuse and Recycle of waste, was positioned as a key component in the country's environmental strategy. The Ministry of Natural Resources and Environment was established in 2002 to work with local governments on environmental measures related to water and air quality and solid waste management. However, due to a lack of technical, managerial and administrative capacities, the Vietnamese government requested technical cooperation from Japan to build up these capacities. As a result, Japan supported this project which was implemented from November 2006 to November 2009. Table 7-25 provides an overview of the project.

Source: Yachiyo Engineering Co., Ltd.

Photo 7-61 Collection Containers Overflowing with Waste

Table 7-25 Overview of the Project Implemented in Vietnam

Item	Content
Project name	Implementation support for 3R INITIATIVE of Hanoi City for Cyclical Society
Project period	November 2006 - November 2009
Target cities (Population)	Hanoi City (Approx. 3 million people) Model districts Hoan Liem block (Approx. 8,000 people), Hai Ba Trung block (Approx. 11,000 people), Ba Dinh block (Approx. 25,000 people), Dong Da block (Approx. 29,000 people)
Overall goal	(1) Establish a sound material-cycle society in Hanoi (long-term goal) (2) Harmonized 3R initiatives based on sorted collection will be implemented in Hanoi (mid-term goal).
Project purpose	To prepare for a harmonized 3R approach based on separate collection throughout Hanoi City.
Output	(1) Through the model project of separate collection and composting of food waste, the collection situation in the model districts will be improved. (2) Awareness of residents in the model districts will be improved through 3R environmental education and PR activities based on the "Mottainai Spirit" (3) The food waste sorting and collection program, environmental education program, and 3R concept will be disseminated. (4) Based on the food waste sorting and collection program, a strategy paper and action plan to improve the municipal waste collection system will be developed.

Source: Based on JICA "Project for Implementation Support for 3R INITIATIVE in Hanoi City to Contribute to the Development of a Sound Material-Cycle Society Final Report" (2009)

7.2 Application of Japan's Experiences and Technologies

(1) Public Participation Initiatives Involving Various Stakeholders

3R projects can be effectively promoted through the independent activities of the general public, such as students and community groups. In addition, raising the public awareness on the 3R activities through the media will contribute to successfully expanding these activities.

Hanoi's 3R project, with its spirit of "*mottainai*", which involved a diverse range of stakeholders, including residents, local communities, government, media, students, experts, the private sector, and NGOs, attempted to position local residents at the center of the project and turn the focus on them. This was an attempt to apply Japan's experience and knowledge of public participation as a key factor in the sustainable implementation of waste management and the 3Rs.

Key Points on Public Participation:

1. Multi-faceted initiatives to raise awareness and encourage changes in the behaviors of residents
2. Involvement of various stakeholders with a focus on residents

Over the course of the project, 85 organizations and individuals, including representatives from government agencies, universities, the media, private companies, and model districts, came together to form the "3R Stars", and actively adopted initiatives focused on the 3R Stars. The "3R Stars Meeting" organized by the members of the 3R Stars was held six times during the project period, and involved 650 participants from 85 organizations. The 3R Stars Meeting, along with the drafting of the "Action Plan for Expanding Sorted Collection throughout Hanoi" and "Strategy Paper for Promoting the 3R Initiative" provided the basis for discussions on revising the waste ordinances in Hanoi in order to secure funding for 3R activities.

Table 7-26 Groups that Engaged in the 3R Activities and their Contribution to these Activities

Group	Members	Activities
3R Stars	Government organizations, universities, the media, private companies, and representatives of residents in model districts	The 3R Stars Meeting was held six times during the project period, with 650 participants from 85 organizations. It served as a basis for discussing revisions to the Hanoi Waste Ordinance.
3R Volunteers Club	High school and university students	More than 50 activities were carried out in cooperation with the project. These activities included instruction on sorting waste on the streets and in parks, participation in environmental events and other 3R publicity activities, and extracurricular 3R classes at elementary schools.
3R Supporters	Residents groups in model districts	Conducted more than 20 3R promotional events. The groups focused on 3R awareness-raising activities, such as providing guidance on sorting in the community and preparing and distributing leaflets on sorting methods.

Source: Based on JICA "Project for Implementation Support for 3R INITIATIVE in Hanoi City to Contribute to the Development of a Sound Material-Cycle Society Final Report" (2009)

In addition, a team of about 10 JICA Overseas Cooperation Volunteers (JOCV) were sent from JICA's head office to work on the project, which attracted media attention and gradually increased momentum for expanding the 3Rs. The project also received local support from two prominent individuals in Japan, Dr. Kitano Masaru, a Chemist and Ms. Kato Tokiko, a singer. In addition, the 3Rs gradually gained traction in Hanoi with the production of TV commercials and 3R songs as part of the PR activities which were covered in the local media.

These activities motivated the mayor of Hanoi to issue the Hanoi 3R Stars Declaration, which set targets for actions to be taken by the residents related to 3Rs. This is also believed to have contributed to changes in the behaviors of residents in relation to the introduction of source separation.

Targets for 10 Actions Related to 3R in the "Hanoi 3R Stars Declaration"

1. Contribution to building a recycling-based society
2. Promotion of 3Rs
3. Promotion of the *Mottainai* spirit
4. Support for introduction and expansion of waste separation at source
5. Promotion of eco-bag use
6. Terminate littering in public places such as streets
7. Support raising awareness on 3R
8. Support building partnerships to implement 3R activities between citizens, government, and the private sector
9. Supporting activities of 3R partners
10. Promotion of compost use in the agricultural sector

Photo 7-62 3R Stars Meeting

Photo 7-63 3R Meeting with Residents

Photo 7-64 3R Event

Photo 7-65 JICA Booth at a 3R Event

Photo 7-66 Mottainai Fair Held by the 3R Volunteers Club (annual event)

Photo 7-67 Publicity Activities on the Street by 3R Volunteers

Photo 7-68 Waste Separation Explanation and Discussion in the Women's Association

Photo 7-69 Environmental Education at the Elementary School

Source: Yachiyo Engineering Co., Ltd.

After the Project

In 2020, the *Law on Environmental Protection* was amended to require residents to basically sort their waste into three categories: recyclables, food waste, and other waste. The Law stipulates that residents shall bear the cost of collection, transportation, and disposal of unsorted waste and other waste that cannot be reused or recycled, and also stipulates the collection of fees based on a pay-as-you-go system. The law also stipulates the reduction, reuse, and recycling of plastic waste for the purpose of preventing and controlling marine plastic pollution.

The Hanoi Urban Environment Company (Hanoi URENCO), in cooperation with its sponsors, launched the "Trash for Gift" program in 2020 to promote recycling and raise residents' awareness on waste separation. Exchange stations have been set up in various locations in the city to exchange recyclables brought by citizens for "gifts" in the form of daily necessities every Saturday morning (the program was temporarily suspended due to the Covid-19, but resumed in November 2021).

Photo 7-70 Exchange Station of Trash for Gift Program

Photo 7-71 Daily Goods Exchanged as Gifts for Trash

Source: Yachiyo Engineering Co., Ltd.

(2) Separate Collection and Composting

Cooperation from residents is an essential aspect of source separation and separate collection of waste. Of no less importance is to secure recipients for the separated waste before implementing separate collection.

The same holds true for compost; it is necessary to confirm that there are buyers for compost or develop the market before the compost can be commercialized.

As a result of the model project implemented in the four districts (total of four districts: about 18,300 households, population of 72,820) there have been improvements in the separate collection of the recyclables, collection of the food waste, as well as composting.

・The introduction of fixed-time fixed-place (FTFP) collection using containers and collection vehicles

(trucks and hand-pushed waste carts) for use on narrow roads has made it possible to collect separated waste regularly even in densely populated residential areas. This has improved the rate of separate collection of food waste. With the cooperation of residents, the average weight reduction rate of before and after the model project ranged from 31.2% to 45% (as of August 2009).

- The quality of compost improved with upgrades to the composting process. A better understanding of the demand for compost was formed and then market expansion was attempted.

Key points on the introduction of separate collection:

1. Adequate advance preparation (including explanations to residents) and development of monitoring systems after implementation
2. Changes in behavior of residents and establishment of checking mechanisms
3. Consistency in separating waste items and collection systems
4. Introduction of fixed-time fixed-place (FTFP) collection and collection days
5. Securing recipients for separated recyclables (determine items to be separated)
6. Building momentum throughout the society on source separation (use of media, etc.)

Photo 7-72 Containers for Designated Wastes at Collection Points

Photo 7-73 Containers for Designated Wastes in the Park

Source: JICA "Project for Implementation Support for 3R INITIATIVE in Hanoi City to Contribute to the Development of a Sound Material-Cycle Society Final Report" (2009)

Key points on introducing composting:

1. Ensure compost quality by increasing the proportion of organic waste brought to facilities through separation at source or identification of suitable sources (e.g., market waste, etc.)
2. Shorten periods for maturing compost from 8 weeks (with an air blower fan) to 5 weeks by using the "turn-over" method with a wheel loader to mix fermenting compost and feed in air.
3. Secure demand for compost products through market research and development
4. Ease regulations on the quality of compost products and their use

Photo 7-74 Composting Facility

Photo 7-75 Production of Compost

Source: JICA "Project for Implementation Support for 3R INITIATIVE in Hanoi City to Contribute to the Development of a Sound Material-Cycle Society Final Report" (2009)

After the Project

• Separate collection

The separate collection that was introduced in the four districts of the city during the Hanoi 3R Project has almost ceased to be implemented since the project was completed. This may be due to the fact that collection in narrow alleys and transportation from waste collection points to collection vehicles were burdensome for collection workers, and that only one type of container could be installed. In order to implement separate collection, costs for collection containers, containers for separated waste items, additional collection vehicles, public awareness, and education and training of collection workers needed to be covered, but there was no budget allocated for these costs.

• Composting

After the project was completed, the amount of food waste brought to the composting plant from the model districts decreased (3,245 tons in 2012 compared to a total of 4,744 tons in 2008). Although a system to separate food waste had been introduced, the main reason for this decrease in food waste was that the inedible parts of fish, meat, and vegetables were removed in fresh markets before they were sold, which resulted in decreasing the amount of food waste generated by households.

In addition, management conditions at composting plants were becoming more difficult. The primary reasons were that the income from sales (500 VND/kg) was much lower than the production cost of compost (1,800 to 2,000 VND[11]/kg), farmers preferred chemical fertilizers that provided immediate effects, and the demand for compost came from a location far from Hanoi where the manufacturing plant was located. All these negative factors made it difficult to expand the compost market, and an understanding of the soil improvement effects of compost could not be fully realized. During the Hanoi 3R project, the project team conducted surveys of compost demand and fertilizer

[11] VND: Vietnam Dongs, Currency Units in Vietnam (1USD ≒ 22,700VND January 2022)

effectiveness among customers and farmers, and then coordinated with the Ministry of Agriculture to promote acceptance of compost products among farmers, expand the market, and promote sales, but these efforts were mostly discontinued after the project was completed. As a result, the composting plant completed in 2002 was closed at the end of 2014.

Thus, it is not simply a matter of securing a sustainable source of compost. When introducing sorted collection, it is necessary to check in depth whether a sustainable source to receive sorted items including compost can be secured.

7.3 Lessons

(1) Mobilize and Promote Public Participation of a Wide Range of Stakeholders to Effectively Implement the 3Rs Initiative

The creation of the 3R volunteer program was an opportunity for young people to become interested in the 3Rs and environmental issues and led to independent activities involving residents. In addition, a wide range of stakeholders were invited to take part in discussions at the 3Rs Stars Meeting and to propose their ideas to policy-making organizations.

These activities encouraged public participation and increased the effectiveness and impacts of the project. The greater the interest and louder the voices of the residents, the harder it is for policymakers to ignore them. In today's world, it is necessary to find ways to engage the public that are appropriate to local conditions, such as the use of social networks.

(2) Need for Innovation when Introducing Source Separation

Public participation and behavioral changes are essential when introducing source separation. Even if rules for source separation are established, they will generally not be followed or sustained. Furthermore, consistency between source separation and collection systems and securing a place to pick up separated waste are also essential conditions. In order to introduce source separation and establish relating rules, the introduction of incentives for residents and pick-up locations is considered a challenge, but with the city's budget constraints, no solution has been found.

As with Hanoi's 3R initiatives, one solution may be to motivate residents by involving all stakeholders and guide the momentum of society as a whole in the same direction. However, since it is difficult to ensure sustainability only with the participation of local residents, synergistic effects from multifaceted efforts, such as technological and operational improvements at recycling facilities and the widespread use of reusable containers, are desired. In addition, in a large city such as Hanoi, the challenges of rapid urban expansion continue, and in the waste agenda as well, there is a need to review collection methods along with the development of transfer stations and incineration facilities, and to position source separation and 3Rs in consideration of this background.

Column: Waste Wise Cities Tool (WaCT)

The use of quantitative data to understand the status of municipal solid waste (hereafter referred to as MSW) management and the effectiveness and improvement of projects introduced in this Topic is an important lesson learned.

Furthermore, the use of data management tools such as the Waste Wise Cities Tool (WaCT) are useful for objectively evaluating the current status and issues in one's own country and city through comparison with other countries and cities, and for measuring the degree of achievement of common global goals, such as the Sustainable Development Goals (SDGs).

(1) What is WaCT?

In 2021, UN-Habitat (United Nations Human Settlements Programme) launched the Waste Wise Cities Tool (WaCT), which is a tool to collect information on municipal waste management, especially in low- and middle-income countries.

The tool helps to collect important information, through primary data collection and set parameters based on indicator 11.6.1 of Goal 11 of the SDGs. The statement of Goal 11 is to "Make cities and human settlements inclusive, safe, resilient and sustainable", and Indicator 11.6.1 is defined as the "Proportion of municipal solid waste collected and managed in controlled facilities out of total municipal waste generated, by cities".

By using this tool, it is possible to collect unified data from each country and easily compare the current situation among the countries. It will also enable the collection of information for the development of waste and resource management strategies and action plans, as well as for funding and stakeholder engagement.

(2) Expected Effects through WaCT

- Collect data on MSW generated, collected, and managed in controlled facilities, and establish a baseline;
- Identify the MSW recovery chain and its related factors, as well as check the environmental control level of waste management facilities;
- Measure plastic leakage from MSW management systems;
- Develop a Waste Flow Diagram (WFD) - waste flows and plastic leakage maps;
- Identify infrastructure gaps in MSW management system;
- Engage all waste chain stakeholders, from waste pickers, to recycling and collection companies, and in a participatory approach identify key intervention areas.

(3) How to Collect Data

WaCT consists of 7 steps as shown in Table 7-27. Through implementation of each step, the following items can be covered: (1) Preparation, (2) Discharge, Collection and Transportation, (3) Intermediate Treatment, (4) Final Disposal, and (5) Other Important Items (food waste, recycling, plastics leakage, greenhouse gas emissions and air pollution, etc.). The Guideline of Waste Wise

Cities Tool includes a summary of the work to be implemented in each step and considerations to kept in mind.

The collected data can be compiled and analyzed in a spreadsheet with macro functions called "WaCT Data Collection Tool". After the application is approved by UN-Habitat, the "WaCT Data Collection Tool" can be used.

Table 7-27 Steps of WaCT

No.	Indicator
1. Preparation	
1.1	Gain political and senior management endorsement and support
1.2	Establish a working team
1.3	Prepare tools and equipment
1.4	Identify key stakeholders and partnerships
1.5	Prepare workflow and budget
1.6	Obtain necessary data from statistics office
2. Household MSW Generation and Composition	
2.1	Preparation
2.2	Waste sampling and waste composition analysis
2.3	Calculate per capita household solid waste generation
3. Non-Household MSW Generation	
3.1	Using the proxy for non-household MSW
3.2	Identify premises to be interviewed
3.3	Interview selected premises and each contracted collection company
3.4	Obtain waste data from public spaces
3.5	Calculate MSW generated by non-household sources
4. MSW Received by Recovery Facilities and Control Level of Recovery Facilities	
4.1	Identify recovery facilities
4.2	Arrange visits and interviews with identified recovery facilities
4.3	Evaluate the level of control of recovery facilities
4.4	Compile the collected information
5. MSW Received by Disposal Facilities and Control Level of Disposal Facilities	
5.1	Identify disposal facilities
5.2	Arrange visits and interviews with identified disposal facilities
5.3	Evaluate the level of control of disposal facilities
5.4	Compile the collected information
6. Waste Composition at Disposal Facilities	
6.1	Preparation
6.2	Waste sampling and composition analysis
7. Calculating Food Waste, Recycling, Plastic Leakage, Greenhouse Gas Emissions and Air Pollution	
7.1	Food waste
7.2	Recycling
7.3	City Plastic Leakage
7.4	Greenhouse Gas Emissions and Air Pollution

Source: Based on UN-Habitat "Waste Wise Cities Tool -Step by Step Guide to Assess a City's Municipal Solid Waste Management Performance through SDG indicator 11.6.1 Monitoring" (2021)

(4) References

- Website of Waste Wise Cities
  (https://unhabitat.org/waste-wise-cities)
- Guideline for Waste Wise Cities Tool (English/French)
  (https://unhabitat.org/wwc-tool)
- User Manual for Waste Wise Cities Tool (English)
  (https://rwm.global/docs/WaCT-DCA-Manual.pdf)
- Introduction to the Waste Wise Cities Tool (English)
  (https://www.youtube.com/watch?v=_SnL6Bdxn70)