

People’s Republic of Bangladesh

FY2017 Ex-Post Evaluation of Japanese Grant Aid Project

“The Programme for Improvement of Solid Waste Management in Dhaka City  
toward the Low Carbon Society”

External Evaluator: Tokiko Ito, Octavia Japan Co., Ltd.

## 0. Summary

This project aims to strengthen the capacity of solid waste collection and transportation and to reduce the daily emission of greenhouse gas of the waste<sup>1</sup> collection vehicles in capital of Bangladesh, South Dhaka City and North Dhaka City (hereafter referred to as “North and South Dhaka Cities”)<sup>2</sup> by procurement of waste collection vehicles, construction of maintenance workshop, and implementation of technical assistance through seminars etc. regarding greenhouse gas reduction and improvement of vehicle maintenance, thereby contributing to the sustainable implementation of waste management service, the improvement of hygiene environment and the promotion of recycling society in the city and the reduction of green gas emission in North and South Dhaka Cities. This project that aimed at increasing the amount of waste collection by procurement of the waste collection vehicles with low emissions of carbon dioxide is consistent with the development policies such as *the Seventh Five-Year Plan (2016)* that states the necessity of environmental sustainability, the development needs for waste collection equipment, Japan’s ODA policy, and thus, its relevance is high. Although the project cost was as planned, the project period exceeded the plan, and the efficiency is fair. The operation rate of vehicles procured in this project is high, and the amount of collected waste has achieved the target value. However, it is judged that the target has been achieved by the increase in the number of collected vehicles in North and South Dhaka Cities and by the synergistic effect with other projects. Furthermore, regarding carbon dioxide emissions, although it is highly likely that North and South Dhaka Cities as a whole have not achieved the reduction target, the emissions by new vehicles by this project has decreased. On the other hand, because it is confirmed that the beautification of the city had been promoted due to an increase in waste collection amount, it is judged that the effectiveness and impacts are high. As for the workshop facilities that operate and maintain the vehicles procured by this project, there are plans to

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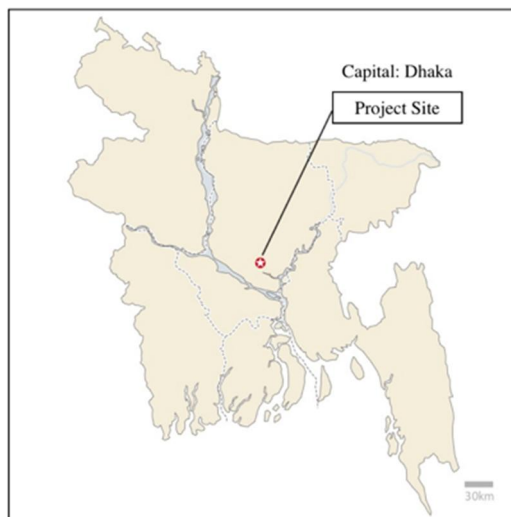
<sup>1</sup> “Waste” defined in this project means home garbage, business garbage, and road cleaning garbage. (Data provided by JICA).

<sup>2</sup> During the project was underway in April 2012, Dhaka City was divided into North and South Dhaka Cities. The administrative district of Bangladesh has Zone and Ward under City. During the project planning, there were 10 zones in the City of Dhaka. It was split into South and North Dhaka Cities, and the zone number was changed by the time of ex-post evaluation (Supplementary document ①).

relocate both in Dhaka North City Corporation (hereafter referred to as “DNCC”), the executing agency, and Dhaka South City Corporation (hereafter referred to as “DSCC”). Although there is a concern about securing functions of operation and maintenance of equipment, there is no particular problem at the time of ex-post evaluation. As no particular problems have been observed in the institutional, technical, financial aspects and the operation and maintenance system of DNCC and DSCC, the sustainability of this project effect is high.

In light of the above, this project is evaluated to be highly satisfactory.

## 1. Project Description



Project location



Procured compactor vehicle

### 1.1 Background

In former Dhaka City, due to the rapid population growth and economic development, the management of increasing quantities of solid waste is the considerable social issue. However, many of the waste collection vehicles owned by the former Dhaka City Corporation (hereafter referred to as “DCC”) were too old, their operation rates have declined due to repair and maintenance, and it was expected that many of the vehicles would no longer be used around 2010 to 2011. The City was aware of the necessity of strengthening solid waste management and has therefore raised related budget for the solid waste management in the current expenditure of general fund. However, there was no prospect of raising funds to purchase equipment like waste collection vehicles etc. necessary to properly manage the waste along the Master Plan of the waste management formulated by JICA technical cooperation projects,

“Solid Waste Management Study in Dhaka City” and the follow up study (October. 2003 – March. 2006). Therefore, the Bangladesh Government requested support from the grant aid project of the Japanese Government.

## 1.2 Project Outline

The objective of this project is to strengthen the capacity of solid waste collection and transportation and to reduce the daily emission of greenhouse gas of the waste collection vehicles in North and South Dhaka Cities by procurement of waste collection vehicles, construction of maintenance workshop, and implementation of technical assistance through seminars etc. regarding greenhouse gas reduction and improvement of vehicle maintenance, thereby contributing to the sustainable implementation of waste management service, the improvement of hygiene environment and the promotion of recycling society in the cities and the reduction of green gas emission in North and South Dhaka Cities.

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|---|--|
| Grant Limit /<br>Actual Grant Amount            | 1,215 million yen / 1,215 million yen  |
| Exchange of Notes Date/<br>Grant Agreement Date | February 2009 / February 2009  |
| Executing Agencies                              | Responsible Agency: Rural Development and Cooperative, Ministry of Local Government<br>Executing Agency: Waste Management Department, former Dhaka City Cooperation (As of Ex-Post Evaluation: Waste Management Department, North Dhaka City Cooperation)  |
| Project Completion                              | May 2014   |
| Main Contractors                                | M/A Abul & Brothers (Construction)<br>Toyota Tsusho Cooperation (Equipment)  |
| Main Consultant                                 | Yachiyo Engineering Co., Ltd.  |
| Procurement Agency                              | Japan International Cooperation System   |
| Outline Design                                  | July 2008 – February 2009  |
| Related Projects                                | <b>【Technical Cooperation】</b><br>“Solid Waste Management Study in Dhaka City” and its follow up study (October. 2003 – March. 2006)<br>“Project for Strengthening of Solid Waste Management in Dhaka City” (February. 2007 – February. 2013)<br>“The Project for Strengthening of Solid Waste Management in Dhaka North City, Dhaka South City and Chittagong City” (May. 2015 - April. 2021) |

|  |   |
|--|---|
|  | <p><b>【Grant Aid Project】</b><br/>         “The Project for Improvement of Solid Waste Management Equipment in the People’s Republic of Bangladesh” (GA May.2015)</p> |
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## 2. Outline of the Evaluation Study

### 2.1 External Evaluator

Tokiko Ito, Octavia Japan Co., Ltd.

### 2.2 Duration of Evaluation Study

This ex-post evaluation was conducted with the following schedule.

Duration of the Study: November 2017 – November 2018

Duration of the Field Study: March to mid-April 2018, June to July. 2018.

### 2.3 Constraints during the Evaluation Study

In this study, the external evaluator was unable to enter the project target country for security reasons, so the field survey (the information and data collection and the interview survey) was conducted mainly by the contracted local survey assistant. The evaluation analysis and judgment are done after the external evaluator has scrutinized the obtained information and data etc.

## 3. Results of the Evaluation (Overall Rating: A<sup>3</sup>)

### 3.1 Relevance (Rating: ③<sup>4</sup>)

#### 3.1.1 Consistency with the Development Plan of Bangladesh

Before the start of the project, the Bangladesh Government considered the environmental pollution as an obstacle to improve people’s health and production capacity, considered its improvement as one of its main goals and stated the improvement of environmental situation and “conversion to the clean fuel (CNG/LPG/LNG<sup>5</sup>)” in order to reduce air pollution from vehicles and the like in the strategy for environment and sustainable development in the *Poverty Reduction Strategy Paper (2005-2006)* approved in 2005.

At the time of ex-post evaluation, the Bangladesh Government formulates *the Seventh Five*

<sup>3</sup> A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory

<sup>4</sup> ③: High, ②: Fair, ①: Low

<sup>5</sup> CNG stands for Natural Gas Car, LPG stands for Liquefied Petroleum Gas and LNG stands for Liquefied Natural Gas.

*Year Plan (2016-2020)* and states the necessity for the environmental strategy and environmental sustainability in harmony with economic growth for the country's sustainable development. Moreover, the environmental management based on the implementation of air and waste management strategies etc. is emphasized and solving waste problems is pointed out as one of the urban environmental issues. Furthermore, the necessity to work on improving the urban air pollution through vehicle improvement, to practice 4R<sup>6</sup> through the dissemination of waste management regulations etc., to raise awareness of the community, and to manage waste through strengthening public and private partnerships etc. are stated.

Based on the above, the Bangladesh Government continues to place importance on the environmental management including air pollution at the time of ex-post evaluation. Therefore, it can be said that the implementation of this project is consistent with the country's development policy at the time of planning and ex-post evaluation.

### 3.1.2 Consistency with the Development Needs of Bangladesh

Prior to the start of the project, the management of increasing waste has become a major social issue in former Dhaka City due to the rapid population growth and economic development. Former DCC's waste collection vehicles were in short and have not been able to collect all the waste generated in the target collection area. As many were aging vehicles purchased before 1999, the operation and maintenance expenses piled up. The repair was also frequently required and their operation rate was decreasing, and it was expected that many could not be used around 2010 to 2011. The uncollected garbage was discarded in rivers etc. and had an adverse effect on the living environment. The city recognized the necessity of strengthening waste management, and the budget related to the countermeasure in the current expenditure of general fund was also increased year by year. However, there was no prospect of raising large funds to purchase the collection vehicles necessary for appropriate waste management.

On the other hand, at the time of ex-post evaluation, the Ministry of Local Government, Rural Development and Cooperative (hereafter referred to as "MLGRD&C"), which is the responsible agency of this project, and the relevant administrative organizations, mainly the Waste Management Departments of DNCC and DSCC, continue to recognize that it is necessary to provide appropriate and high quality public service of waste management. However, even at the time of ex-post evaluation in DNCC and DSCC, it is inevitable to operate aging waste

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<sup>6</sup> 4R consists of Reduce, Reuse, Recycle, and Reclaim according to Bangladesh's *Seventh Five Year Plan (2016 - 2020)*. In the materials provided by JICA, 3R is defined as Reduce, Reuse, and Recycle.

collection vehicles. Furthermore, due to the restricted financial resources, the procurement of new waste collection vehicles is also hindered. Both city corporations have entrusted private companies to collect the waste supplementary. However, continuous improvement of the collection is necessary as the collection rate in 2014 is 65%<sup>7</sup> against the increased waste generation volume and 35% is uncollected.

As a result of the above, the improvement of waste collection in North and South Dhaka Cities is required even at the time of ex-post evaluation, and the necessity of further procurement of waste collection vehicles is high. Thus, the consistency with development needs is recognized both at the time of planning and at the time of ex-post evaluation.

### 3.1.3 Consistency with the Japan's ODA Policy

In the *Country Assistance Plan for Bangladesh (May 2006)* of the Japanese Government, the environment is one of the priority sectors in the social development and human security sectors, and the emphasis was placed on cooperation to improve the urban environment including response to air pollution. In addition, in 2008, the Japanese Government expressed its commitment to actively cooperate on the greenhouse gas reduction efforts as a part of support to the measures for climate change and introduced the *Grant Aid of Environmental Program*<sup>8</sup>. This project supports the improvement of the urban environment and the mitigation measures of greenhouse gas related to the country's assistance plan mentioned above through the improvement of waste disposal and transportation by the procurement of waste collection vehicles to DNCC and DSCC. Thus, it can be said that consistency with Japan's aid policy and this project is recognized.

From the above, this project has been highly relevant to Bangladesh's development plan and development needs, as well as Japan's ODA policy. Therefore, its relevance is high.

## 3.2 Efficiency (Rating: ②)

### 3.2.1 Project Outputs

The contents and actual results of this project are as shown in Table 1.

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<sup>7</sup> Actual value in 2014. The details of the calculation basis are stated in "Effectiveness".

<sup>8</sup> Sub scheme of Grant Aid Project established in 2008 for assisting the greenhouse gas reduction efforts and the measures to climate change issues in developing countries etc.

Table 1: Outputs of the Project Plan/Actual

| Plan<br>(2009: Before the project starts) |  | Actual<br>(2018: Ex-Post Evaluation)   |
|---|--|--|
| <b>【Japanese Side】</b>                    |  |  |
| 1   | Package 1: Waste Collection Vehicles: Total 100 (15 3t-CNG Container carriers, 30 5t-CNG Container carriers, 20 7t-Diesel detachable container trucks (hook haul), 15 2t-Diesel compactor trucks, 20 5t-Diesel compactor trucks), Spare parts.   | As Planned<br>Additional Package 4: Waste Collection Vehicles Total 12 (6 7t-Diesel compactor trucks, 6 7t-Diesel dump trucks)   |
| 2   | Package 2: Construction of workshop facilities and equipment (Vehicle maintenance and machine section: 8 Work bays, 3 Equipment storerooms, 1 Machine room, Tools and equipment. Administration section: 4 Office rooms, 1 Data room, Entrance, Toilets. Total 625 m <sup>2</sup> and Washing and inspection platform) | As Planned   |
| 3   | Soft Component (technical assistance): Public information and residents' education on environment, workshop, technical support for operation and maintenance of vehicle equipment, guidance on safety and operation and maintenance of CNG   | As Planned<br>Addition: Training of mechanic and training of trainers for facility management  |
| 4   |  | Additional Package 3: Construction of storeroom and training facilities and equipment (storeroom, training space, office for training, store staff room, and toilets. Total area 600 m <sup>2</sup> , attached facilities) |
| <b>【Bangladesh】</b>                       |  |  |
| 1   | Securing of land for facility construction site  | As Planned   |
| 2   | Leveling, clearing and relocation of obstacles of the facility construction site   | As Planned   |
| 3   | Construction of gates and fences   | As Planned   |
| 4   | Construction of road: Access road  | As Planned   |
| 5   | Electricity work: Electricity distribution work  | As Planned   |
| 6   | Water distribution work: City water (water supply) work  | As Planned   |
| 7   | Drainage work: Sewage pipe construction (Sewage & Rain water)  | As Planned   |
| 8   | Furniture: General furniture and equipment (office desks and chairs, cabinet)  | As Planned   |
| 9   | To bear commissions to opening the account at the bank based on the banking arrangement  | As Planned   |
| 10  | Transportation and customs clearance procedure and handling of various taxes (To bear tax in Bangladesh, customs clearance procedures and transportation of procured equipment etc., tax exemption of value added tax and bearing tax)   | As Planned   |
| 11  | Maintenance of the facilities and procured equipment   | As Planned   |
| 12  | Other expenses not included in grant aid   | As Planned   |
| 13  | Space necessary for technical assistance   | As Planned   |

Source: JICA documents, Answers to the questionnaire from the executing agency

The output of Japanese side was implemented as planned<sup>9</sup>. Differences in plan and actual results are as follows. ①During the project implementation, there was change in design that the foundation form of the workshop facility was changed from the mat foundation form to the pile foundation form based on the result of the geological survey of the detailed design. The reason is that a soft ground in the upper ground layer of the site was found (it was found that the ground tolerance could not be obtained). In addition, minor design change was made twice concerning the attached equipment of the storeroom facilities<sup>10</sup> based on the request of the executing agency. As a result of bidding for the contractor of Package 2, there was the remaining amount because the proposed price was lower than the estimated price. In response to the request of the Bangladesh Government, the additional procurement policy was decided at the Japanese Ministry of Foreign Affairs in October 2011 after confirming the delivery and operation status of the originally procured vehicles and studying the storeroom and training facilities. As stated above, a total of 12 waste collection vehicles, construction of storeroom and training facilities and a set of equipment, and training as a soft component were added. Based on consultation with the Bangladesh side, additional policy was decided after confirming the utilization status of the initial plan. These changes were approved after consultation with JICA Headquarters. The output of Bangladesh side was also implemented as planned.



Photo 1: DNCC workshop (Front)



Photo 2: Container carrier of DNCC on a truck scale of the final disposal site

### 3.2.2 Project Inputs

#### 3.2.2.1 Project Cost

Regarding the total project cost of this project, the initial plan was approximately 1,216

<sup>9</sup> In the detailed design, there was no change from the outline design.

<sup>10</sup> No change occurred in the contract amount of cost due to the two design changes.



million yen (Japan’s share was 1,215 million yen, Bangladesh’s share was approximately 0.9 million yen). Japan’s actual cost was 1,215 million yen as planned (100% of the plan). The actual cost of Bangladesh was not available. This is because during the project implementation, additional procurement was implemented because of the design changes due to the generation of remaining amount, and “the reimbursement”<sup>11</sup> of the remaining amount was implemented after that. According to the construction supervisory consultant (hereafter referred to as “the Consultant”) of this project, compared with the time of calculating reference price of the project (around August 2008), after the project began (2009), it is considered that price decline is realized because of the various price declines due to the global financial crisis etc., the trend of yen appreciation, and then, the result of competitive bidding among vehicle companies.

### 3.2.2.2 Project Period

Table 2: The plan and actual result of the project period

|  | Plan  | Actual                                 |
|--|---|--|
| Initial Plan                               | 14 months (April 2009 – May 2010 <sup>12</sup> )      | 23 months (April 2009 – February 2011) |
| Consultation for usage of remaining amount |   | 9 months (March – November 2011)       |
| Additional Procurement                     | 28 months (December 2011 – March 2014 <sup>13</sup> ) | 30 months (December 2011 – May 2014)   |

Source: Documents provided by JICA

As shown in Table 2, regarding the initial plan, it was planned to be completed in 14 months, while the actual result was 23 months and exceeded the plan (164% compared to the plan). According to the procurement agency of this project, the factors behind the delays of the initial plan are thought to be ① the delay due to engine remodeling work after importing CNG vehicles that necessity was not grasped at the time of Outline Design (about 6 months), ② the delay of the shipping due to delays in import procedures for vehicles on Bangladesh side (about 3 months), and ③ the delay in construction of workshop by the construction company (about 10 months), etc.<sup>14</sup>. After that, concerning the use of remaining amount, the contract

<sup>11</sup> Since the final amount of remaining amount (4.7 million yen) was less than 3% of the total amount of the loan and the interest, in accordance with the grant agreement, after confirming full payment from the recipient government to the contractors, etc., reimbursement payment, payment of the remaining amount to the recipient country, was implemented.

<sup>12</sup> The start of the period is at the time of contract with the procurement agency and includes the period of bidding main construction and the period of implementing soft component according to the project implementation schedule chart provided by JICA.

<sup>13</sup> The start of the additional procurement period is December 2011, the next month of agreeing the additional procurement content in Bangladesh. The project completion is May 2014 when additional output was completed (Completion Ceremony for Package 3 and Delivery Ceremony for Package 4).

<sup>14</sup> These delays are occurring in parallel due to the delay of each output compared to the original plan. The overall

change was made, and the output increased. At this time, it was necessary to confirm the operational status of the equipment procured based on the initial plan, and it took nine months outside the plan as a period of consultation for use. It is judged that this was the period necessary for judging the executing agency's operation capability of the procurement equipment. Moreover, after the contract change, the project period is extended based on the plan. By taking these factors into consideration and setting the project period again, total project period due to plan changes are considered to be 51 months (14 months (initially planned period) + 9 months (period for consultation of the use of remaining amount) + 28 months (planned period for additional procurement))<sup>15</sup>, and the actual result of the project period (62 months) exceeded the plan (122% compared to the plan).

From the above, although the project cost was as planned, the project period exceeded the plan. Therefore, efficiency of the project is fair.

### 3.3 Effectiveness and Impacts<sup>16</sup> (Rating:③)

#### 3.3.1 Effectiveness

##### 3.3.1.1 Quantitative Effects (Operation and Effect Indicators)

###### 1) Operation Indicator: Total amount of average waste collection per day in North and South Dhaka Cities

In this project, waste collection vehicles, workshop facilities, storeroom and training facilities, and sets of equipment were developed. Table 3 shows the trends of the total amount of average waste collection per day in North and South Dhaka Cities (baseline value, target value and actual value) which is a quantitative operation indicator. Incidentally, at the time of the project planning, the target value of waste collection amount of this project was set based on the target value of waste collection rate of the Master Plan. Therefore, in this evaluation, it was decided that the target value after the design change was set based on the Master Plan and the judgement to be made. The calculation rationale for the target value in Table 3 is shown in the supplementary document ② at the end.

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delay of the project is nine months.

<sup>15</sup> As for the actual period of the Bangladesh side, the executing agency did not grasp information and could not grasp the starting and ending of the period. However, the completion of implementation was confirmed by the defect inspection report of this project (March 2012 and June 2015).

<sup>16</sup> Sub-rating for Effectiveness is to be put with consideration of Impacts.

Table 3: Total amount of average waste collection per day in North and South Dhaka Cities\*

(Unit: t/day)

| Base line | Target                    |                                 | Actual                              |                                      |                                      |                                 |                                  |                                  |
|-----------|---------------------------|---------------------------------|-------------------------------------|--------------------------------------|--------------------------------------|---------------------------------|----------------------------------|----------------------------------|
|           | 2012                      | 2015                            | 2012                                | 2013                                 | 2014                                 | 2015                            | 2016                             | 2017                             |
| 2008      | 2 years after Package 1&2 | 1 year after Project Completion | 1 year after Package 1&2 Completion | 2 years after Package 1&2 Completion | 3 years after Package 1&2 Completion | 1 year after Project Completion | 2 years after Project Completion | 3 years after Project Completion |
| 1,619     | 2,429<br>(2,121)          | 3,052**<br>(2,665)              | 2,374                               | 2,769                                | 3,338                                | 3,636                           | 4,332                            | 5,257                            |

Source: 2012: Documents provided by JICA, 2013: Document provided by the Consultant, 2014-2017: Documents provided by DNCC & DSCC<sup>17</sup>

\* Note: The target value at the time of project planning was calculated based on the target value of the total waste collection amount excluding the collection amount of private consignment in the Master Plan. At the time of ex-post evaluation, the waste collection amount by private consignment was not confirmed, so the target values and actual values are calculated based on the total waste collection amount. The figures in parenthesis are the target value set at the time of the project planning.

\*\* Note: In the Master Plan, target value after 2016 was not set. Therefore, although it is not two years after the completion of the project, year 2015 is set as the target year, and thus, the actual result of that year is indicated by bold line.

As shown in Table 3, the total amount of average waste collection per day in North and South Dhaka Cities exceeded the target value of the output of the initial plan and the target value after the design change. Since it is said that 10-20% of vehicles are not being measured on the track scale<sup>18</sup> of the final disposal site, actual collection capacity is considered to exceed the actual value in the table.

On the other hand, it is considered that the improvement of the primary collection amount<sup>19</sup> also contributes to the increase of the secondary collection amount. According to an interview with the Executive Engineer of the Waste Management Department of DNCC (hereinafter referred to as “DNCC Officer”), and Assistant Engineer of the Waste Management Department of DSCC (hereinafter referred to as “DSCC Officer”) etc., because of JICA’s technical cooperation project, “Project for Strengthening of Solid Waste Management in Dhaka City” (February 2007 - February 2013) that was started in advance to this project and also worked on improving primary collection (collection method, collection stations, etc.) and the fact that

<sup>17</sup> At the time of ex-post evaluation, data of actual amount in 2012 and 2013 are not directly available from DNCC and DSCC due to the problem of data management situation at the final disposal site, etc., so the sources differ from that of the actual amount from 2014 to 2017.

<sup>18</sup> Truck scale is a device that calculates weight of cargo while loading cargo on truck.

<sup>19</sup> Transporting garbage from households to waste collection stations is called primary collection. Collection and transport of waste from collection station to final disposal site is called secondary collection. The place to collect garbage by primary collection is called a secondary collection station.

nearly 80% of households were covered by the collection of the private waste collectors of the primary collection, the amount and rate of primary collection of waste increased after the project started<sup>20</sup>. Furthermore, compared with the time prior to the project implementation, container vehicles increased due to this project, DNCC and DSCC increased containers, and drastically reduced dustbins<sup>21</sup>. As a result, waste transshipment work at the secondary collection stations is becoming prompt<sup>22</sup>. Additionally, the number of new vehicles is also increasing<sup>23</sup>, and the number of daily trips of the collection vehicles on average has increased substantially<sup>24</sup>. It is considered that these increases are also boosting the amount of secondary collection.

## 2) Effect indicator: Average waste collection rate per day for total of North and South Dhaka Cities

The Table 4 shows the transition of average waste collection rate per day for the total of North and South Dhaka Cities (standard value, target value, and actual value). As mentioned above, the target value of this project was set based on the target value of the waste collection rate of the Master Plan. Therefore, in this evaluation, it is decided to make a judgement about the target value after the design change based on the target value of the Master Plan. Furthermore, calculation rationale for the collection rate in Table 4 is shown in the supplementary document ② at the end.

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<sup>20</sup> At the time of preparing the Master Plan for waste management, regular fixed-point collection by the introduction of compactor vehicles included in this project was considered to be premature due to the systematic issues of equipment maintenance of the executing agency. However, in line with the progress of the technical cooperation project, the stakeholders confirmed the direction to carry out regular fixed-point collection by compactor vehicles, and by such a background, it has been reached that the implementation of grant aid for introducing vehicles. On the other hand, in the technical cooperation project, on the premise of the start of regular fixed-point collection by introducing the vehicle, further improvement of the primary collection has been worked out.

<sup>21</sup> About 380 containers in former Dhaka City before the project have been increased to 513 in total in North and South Dhaka Cities by the time of the ex-post evaluation. 688 dustbins in former Dhaka City before the project was eliminated in North Dhaka City by the time of the ex-post evaluation. About 100 dustbins are used in South Dhaka City which has a lot of narrow alleys but have been decreased significantly.

<sup>22</sup> From the time when the city was former Dhaka City, residents or contractors are supposed to carry waste to a secondary collection stations (dustbin or container) in the North and South of Dhaka Cities. Since garbage is put in dustbins directly without using bags, etc., it faces the problems of unsanitary, garbage scattering and odor. Furthermore, at the secondary collection stage, although containers can be piled directly on container carrier vehicles, it is necessary for waste in the dustbin to be manually reloaded. Therefore, it is said that efficiency of dustbin is particularly poor.

<sup>23</sup> Additional procurement of new vehicles has been started also by “The Project for Improvement of Solid Waste Management Equipment in the People’s Republic of Bangladesh” of JICA.

<sup>24</sup> The average number of daily trips for each existing DCC vehicle at the time of project planning is 1.5 times (open track 3t) to 2.8 times (container carriers 3t and 5t). At the time of ex-post evaluation, measured data of average number of trips per DSCC-owned operating vehicle at a final disposal site for a given day was 4.0 times (container carrier (collection capacity unknown)) to about 5.0 (dump truck (collecting capacity unknown)), and between 1.5 and 2.5 times for compactor (collection capacity unknown).

Table 4: Average waste collection rate per day for total of North and South Dhaka Cities\*

(Unit: %)

| Base line | Target                    |                                 | Actual                              |                                      |                                      |                                 |                                  |                                  |
|-----------|---------------------------|---------------------------------|-------------------------------------|--------------------------------------|--------------------------------------|---------------------------------|----------------------------------|----------------------------------|
|           | 2012                      | 2015                            | 2012                                | 2013                                 | 2014                                 | 2015                            | 2016                             | 2017                             |
| 2008      | 2 years after Package 1&2 | 1 year after Project Completion | 1 year after Package 1&2 Completion | 2 years after Package 1&2 Completion | 3 years after Package 1&2 Completion | 1 year after Project Completion | 2 years after Project Completion | 3 years after Project Completion |
| 58        | 67                        | 77**                            | 66                                  | No Data                              | No Data                              | 91                              | No Data                          | No Data                          |

Source: 2012: Documents provided by JICA, 2013: Document provided by the Consultant, 2014-2015: Documents provided by DNCC & DSCC

\* Note: The target value at the time of project planning is calculated by the amount of discharged waste based on the Master Plan (the expected discharged amount, excluding the amount of waste for recycling, etc. from the amount of generated waste) as the denominator. Furthermore, it excluded collection amount of private consignment. At the time of ex-post evaluation, when calculating the target value and the actual value after the design change, the waste collection amount including the amount by private consignment and the discharged amount calculated based on the Master Plan (acquired only for 2012 and 2015) are adopted.

\*\* Note: In the Master Plan, target value after 2016 was not set. Therefore, although it is not two years after the completion of the project, year 2015 is set as the target year, and thus, the result of that year is indicated by bold line.

As shown in Table 4, the average daily waste collection rate for the total of North and South Dhaka Cities is significantly higher than the target value of the initial plan of output and the target value after design change. However, the actual amount of waste generated in the project completion year (2014) was 5,100 t/day, exceeding the estimate of the Master Plan by 14%. Therefore, when the collection rate for 2015 was calculated using this increase rate for reference, the estimated amount of generated waste was still 5,271 t/day, the estimated collection rate was 80%, and they achieved the target value. It is also a reference, and in reality, there is a possibility that the target value has not been achieved. However, this is due to a sudden increase in the amount of generated waste compared to the estimated value in the Master Plan, and it is considered that a certain contribution to the increase of the collection rate from this project can be confirmed.

Regarding the daily operation rate of the waste collection vehicles of DNCC and DSCC, 297 vehicles out of 366 vehicles owned by former DCC were in operation at the time of project planning according to the document provided by JICA. Many vehicles were aging which required frequent repairs even among operating vehicles, and the operation rate was 88.4% in order to repair frequently (operation rate of owned entire vehicles including non-operating vehicles was 72%). According to the Consultant, based on the experiences of vehicle

procurement, “Sometimes vehicles that cannot be used normally range from 30% to 40%”, and it is considered that the situation was close to such a state. 112 vehicles procured through this project were distributed to DNCC and DSCC, and at the time of the ex-post evaluation, 111 vehicles were operating<sup>25</sup> as shown in Table 5. Therefore, the vehicles of this project are largely in operation. Furthermore, at the time of the ex-post evaluation, although actual data on the operation status of each vehicle could not be obtained, according to an interview with the procured vehicle’s drivers etc. of this project, the operation rate of procured vehicles by this project is thought to be about 95%<sup>26</sup>. And it exceeds the operation rate of the existing vehicle at the time of project planning. In other words, it is considered that the waste collection vehicles of this project can operate more stably with a high operation rate and contribute to an increase in the amount of waste collection.

Table 5: Management status of waste collection vehicles procured by this project (for vehicles owned by DNCC & DSCC)

(Unit: Vehicle)

| Fuel Type | Vehicle Type                              | DNCC | DSCC | Total |
|-----------|---|------|------|-------|
| CNG       | Container Carrier 3t                      | 3    | 12   | 15    |
|           | Container Carrier 5t                      | 11   | 19   | 30    |
| Diesel    | Detachable container truck 7t             | 8    | 12   | 20    |
|           | Compactor 2t                              | 4    | 10   | 14    |
|           | Compactor 5t                              | 15   | 5    | 20    |
|           | Compactor 5t<br>(additional procurement)  | 4    | 2    | 6     |
|           | Dump Truck 7t<br>(additional procurement) | 4    | 2    | 6     |
| Total     |   | 49   | 62   | 111   |

Source: Document by Waste Management Department of DNCC and DSCC

### 3) Effect indicator: Greenhouse gas (carbon dioxide) emissions per day

Table 6 shows the transition of greenhouse gas (carbon dioxide) emissions of waste collection vehicles of DNCC and DSCC per day (standard value, target value, and actual value).

<sup>25</sup> Among the vehicles procured in Package 1, one diesel compactor 2t to DSCC became a scrapped vehicle by an accident by March 2012 (Before division of former Dhaka City).

<sup>26</sup> The rate for totally 99 vehicles was calculated under the following conditions. At the time of ex-post evaluation, ① The repair of the fault of custom engine which was remodeled to CNG specification occurs once a month taking a day, ② the repair of diesel vehicles occurs less frequently than ①, ③ the periodic inspection is conducted once every two months in DNCC and once a quarter in DSCC, and ④ repairs are conducted simultaneously at the time of the periodic inspection.

Table 6: Greenhouse gas (carbon dioxide) emissions of waste collection vehicles of DNCC & DSCC per day (As of October 2017)

| Vehicle Type  | Baseline                            | Target                               | Actual                               |       |       |                         |
|---|-------------------------------------|--------------------------------------|--------------------------------------|-------|-------|-------------------------|
|   | 2008                                | 2016                                 | 2017 <sup>27</sup>                   |       |       |                         |
|   |                                     | 2 years after the project completion | 3 years after the project completion |       |       | Carbon dioxide(kg)<br>* |
|   |                                     |                                      | DN CC                                | DS CC | Total |                         |
| Diesel vehicle at the time of planning                | 297 vehicles (45.20kg/vehicles/day) | 93 vehicles (45.20kg/vehicles/day)   | 21                                   | 82    | 103   | 4,655.60                |
| New Diesel vehicle by this project                    | -                                   | 55 vehicles (18.75kg/vehicles/day)   | 35                                   | 31    | 66    | 1,237.50                |
| New CNG vehicle by this project                       | -                                   | 45 vehicles (16.91kg/vehicles/day)   | 14                                   | 31    | 45    | 760.95                  |
| Other new vehicle                                     | -                                   | - (18.75kg/vehicles/day)             | 60                                   | 62    | 122   | 2,287.50                |
| Total of above  | 297 vehicles                        | 193 vehicles                         | 130                                  | 206   | 336   | 8,941.55                |
| Carbon dioxide emissions per day (kg/day)             | 13,424.40                           | 5,995.80                             |                                      |       |       | 8,941.55                |
| Carbon dioxide emissions per vehicle (kg/vehicle/day) | 45.20                               | 30.97                                |                                      |       |       | 26.61                   |

Source: Documents provided by Waste Management Department of DNCC & DSCC and the Consultant

\*Note: It is not actually measured data but was calculated based on the amount of carbon dioxide emissions (in parentheses) for each type of vehicle set at the time of project planning. At the time of project planning, it was assumed that new vehicles were made in developed countries, and travel distance was calculated assuming to increase by 25% from the distance traveled at that time.

As shown in Table 6, the daily carbon dioxide emissions for waste collection vehicles of DNCC and DSCC at the time of ex-post evaluation have not achieved the reduction target. In DNCC and DSCC, old vehicles are still in operation. While other new vehicles are also introduced, and the total number of vehicles has increased, the number of collection trip is also increasing as mentioned above. Therefore, the total carbon dioxide emissions per day may be higher than the values in Table 6. Concerning only the vehicles procured by this project, both diesel vehicles and CNG vehicles contribute to the reduction of carbon dioxide emissions merely by introducing them because the amount of carbon dioxide per unit is smaller than the existing vehicles at the time of planning. However, since the indicator is set for the entire waste collection vehicles of DNCC and DSCC, there are influences of other vehicles which could not be estimated at the time of designing. Thus, it is considered that the indicator is not necessarily

<sup>27</sup> Data before 2017 could not be obtained.

appropriate for judging the direct effect of this project. Judging from the amount of carbon dioxide emissions per vehicle, as shown in Table 6, it is considered to be highly possible that carbon dioxide emissions per waste collection vehicle of DNCC and DSCC have reached the target value at the time of ex-post evaluation<sup>28</sup>. Furthermore, DNCC and DSCC are pursuing replacement of old vehicles and new vehicles, and that is considered to contribute further to the reduction of carbon dioxide emissions from now on.



Photo 3: Container of DNCC

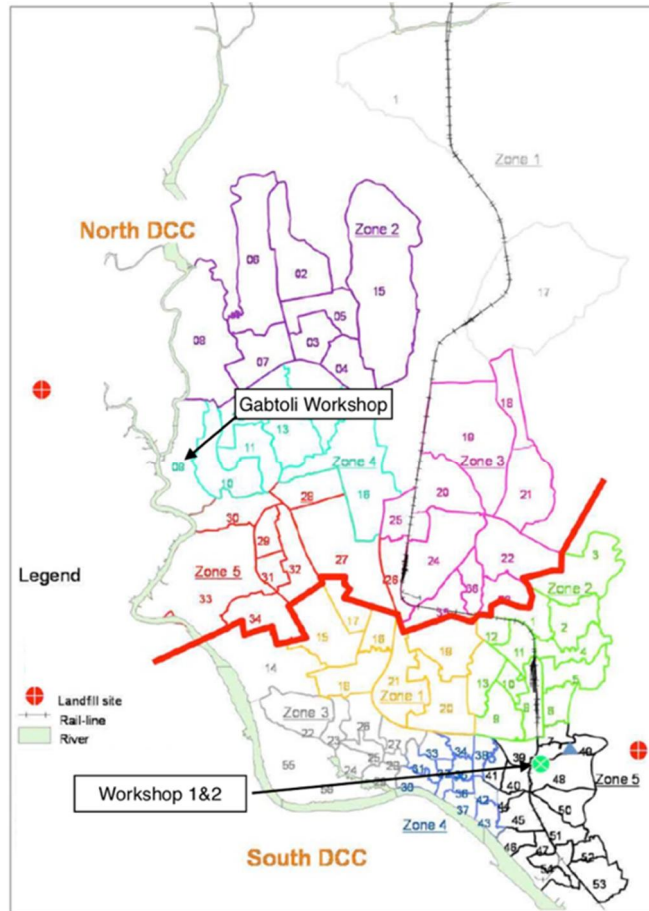


Photo 4: Building for storeroom and training of DNCC

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<sup>28</sup> Among “other new vehicles”, 84 (48 in DNCC and 36 in DSCC) vehicles are made in India and China. If the carbon dioxide emissions per day of vehicles manufactured by both countries exceed 35.96 kg/day, the target value of carbon dioxide emissions per day per vehicle in DNCC and DSCC cannot be achieved. However, it is considered to be unlikely that the carbon dioxide emissions of vehicles made in both countries against one made in developed countries are nearly double for new vehicles with almost the same load capacity.





Source: Information added by the evaluator based on the document provided by JICA

Chart 1: Location of Project Site

### 3.3.1.2 Qualitative Effects (Other Effects)

1) Appropriate operation and maintenance of vehicles by vehicle managers, mechanics and drivers

At the time of ex-post evaluation, the periodic inspections of waste collection vehicles are carried out once every two months at DNCC and once a quarter at DSCC. According to the DNCC and DSCC Officers etc., operation and maintenance are more sincerely and reliably carried out than before, and the reputation for inspection done by mechanics of the Waste Management Department is high. It is said that the drivers conduct the pre-operation inspection almost every day and implement idling off for mainly compactor vehicles and stopping engine at the secondary collection stations. According to the DNCC and DSCC Officers, etc., although it cannot be concluded that consideration for the environment is the main motivation, changes in the knowledge and behavior of vehicle management and operation of concerned parties are considered to have appeared.

Based on the above, it is considered that this project contributes to the reduction of greenhouse gas emissions as the appropriate operation and maintenance and the improvement of operation method of waste collection vehicles are seen.

## 2) Recognition of importance of waste and necessity of reduction of greenhouse gas by general residents

According to the DNCC and DSCC Officers and representatives of the residents, the residents of North and South Dhaka Cities are increasingly aware of the waste collection compared with the previous time because of the decrease in vacant lands due to urbanization and the change of consciousness to living environment. However, in North and South Dhaka Cities, which have a population over 10 million people, it is hard to consider that only the seminar on the countermeasures of climate change and the publicity campaign activities on reducing greenhouse gas emissions and methods of disposing waste conducted by this project are directly changing residents' consciousness. Meanwhile, the waste collection vehicles of this project impress the residents favorably<sup>29</sup>, such as the request for the operation has also been submitted from residents outside the area subject to the vehicle operation. Thus, it is also considered that the residents' concern for waste collection has increased. From the above, although the direct change to the residents' awareness by this project is not confirmed, the residents recognize the difference between waste collection vehicles of others and of this project's. Given that fact, this project is considered to support the improvement of the general residents' awareness towards improvement of waste collection.

### 3.3.2 Impacts

#### 3.3.2.1 Intended Impacts

##### 1) Improvement of costs for the waste collection and transportation and the equipment operation and maintenance

Regarding the waste collection and transportation and the equipment operation and maintenance costs, the actual data on details was not obtained as both DNCC and DSCC did not compile the data because the operation and maintenance were carried out by several departments, etc. According to the DNCC and DSCC Officers, there is a possibility that the maintenance and management cost is being kept low as there is still few defect of the vehicles

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<sup>29</sup> According to the DNCC Officer, "The vehicles of this project are noticeable by the decoration of two colors of pink and green. The residents welcome because the compactor vehicle particularly is odorless, and the new vehicle does not spur black smoke exhaust gas."

procured by this project<sup>30</sup>. On the other hand, regarding DSCC, the repair cost for waste collection vehicles other than this project are increasing (Supplementary document ③ of the end). As mentioned before (3.3.1.1 Quantitative Effect), it is considered that both DNCC and DSCC may have increased the cost of the waste collection and transportation and the equipment operation and maintenance as a whole because of the facts that the number of the waste collection vehicles and the collection trips increase, and that ageing vehicles are still in operation. As same as “effectiveness”, although the cost of waste collection and transportation per trip per vehicle may have improved, from the above, it could not be judged whether improvement was made in the cost of the equipment operation and maintenance of DNCC and DSCC as a whole through introduction of vehicles of this project.

## 2) Reduction of generation of greenhouse gases in North and South Dhaka Cities

The situation of the generation of greenhouse gases in North and South Dhaka Cities was not obtained because the figures were not summarized. As mentioned in “3.3.1.1 Quantitative Effect 3”, the total amount of carbon dioxide generated by the waste collection vehicles is likely to increase in North and South Dhaka Cities as a whole. Furthermore, at the improvement stage of waste management, it is considered that the carbon dioxide emissions from waste collection vehicles and the amount of waste collection are inversely proportional. Meanwhile, the DNCC and DSCC Officers show opinions that the amount of discharged waste in North and South Dhaka Cities continues to increase and that it is still required to increase vehicles. Although consideration is given by the introduction of new vehicles with low carbon dioxide emissions and by the vehicle operation through appropriate maintenance and operation methods, it is considered that the increase of emission of carbon dioxide for waste collection is an unavoidable to some extent. Meanwhile, according to the DNCC and DSCC Officers, it is possible that the increase in primary collection of waste might have the effect of decreasing the frequency of burning garbage independently and might reduce the greenhouse gas generation. That is, it is considered that there is a possibility that this project supports the reduction of greenhouse gas.

## 3) Beautification and sanitation improvement of the city

According to an interview with the DNCC and DSCC Officers and the representative of residents’, before the start of this project, residents had dumped waste on vacant lands and roads,

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<sup>30</sup> When the diesel and CNG vehicles of this project are compared, CNG vehicles has more frequent occurrence of engine repair, the fuel efficiency is also worse, but the fuel price is lower.

but during the project, they began to ask for handling waste regularly to the paid private primary collectors of waste etc. It is thought that these are because ① residents' standard of living has been improved and environmental consciousness also increased due to the economic development, thus, between neighbors the problems about handling garbage increased, ② the private primary collectors of waste have become more organized and gather waste more extensively and more effectively, and ③ with the introduction of new vehicles, etc., the cities have begun to collect regularly efficiently during this period. Therefore, it is considered that the cooperation for collection is also progressing because as the awareness about the hygiene environment by residents improves, the improvement of waste collection service is recognized. According to the DNCC Officer, "The residents welcome the improvement of waste collection services by the administration. The results of improvement of primary collection and secondary collection can be seen. This is considered that the effect of the "Project for Strengthening of Solid Waste Management in Dhaka City" is also compatible.<sup>31</sup>" In other words, based on the recognition of the DNCC and DSCC Officers, it is considered that the increase of the amount of waste collection by improvement of primary collection and secondary collection is related to the effect of technical cooperation project in addition to this project, and it is presumed to have a certain synergistic effect with this project.

Furthermore, according to the Consultant, such improvements were observed that at the secondary collection station facing the park where the containers were removed following the start of the operation of the compactor vehicles of this project, a cafe has been opened at the park side by the time of ex-post evaluation, and that at the secondary collection station where the dustbin was removed due to the regular fixed-point collection, the flowerbed was made by the residents. These are thought to be examples of improvement of waste collection contributing to the beautification of the city. As described above, it is confirmed that the improvement of the secondary collection method and collection station including the introduction of vehicles by this project contributes to the beautification of the city.

### 3.3.2.2 Other Positive and Negative Impacts

#### 1) Impacts on the Natural Environment

In this study, through interview with the DNCC and DSCC Officers, it is confirmed that there was no negative influence on the environment, as noise, vibration and waste generation during

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<sup>31</sup> According to the supervisory staff of the Zone Waste Management Office in DNCC, "Primary collection has been improved as they received multiple training by the project together with the community and primary collectors and created the community action plan for each ward (also at the time of ex-post evaluation)".

the project were in the usual range, and the waste was properly handled. In addition, because the vehicles including CNG vehicles procured through this project were provided with consideration for air pollution on the premise of replacement with aged vehicles owned by former DCC before the project, it is considered that the possibility of a negative environmental impact is low after the project completion.

## 2) Resettlement and Land Acquisition

It is confirmed through interview with the DNCC Officer that this project was to construct a workshop using the existing site of former DCC, and there was no acquisition of new land and resettlement of residents relating to the acquisition.

Regarding the waste collection in North and South Dhaka Cities, the average daily collection amount after the completion of this project was exceeded the target value of initial and after design change because of the increase in the amount of primary collection, the improvement in efficiency of secondary collection through the increase in containers and the increase in the number of other vehicles. On the other hand, the average daily collection rate may not have been reached the target value. It is considered as a factor that the amount of generated waste increased beyond the initial estimation during the extension of the project period. Therefore, although there is a high possibility that the increase in waste collection amount is not due to this project alone, it is considered that this project contributes to improve the amount of waste collected in North and South Dhaka Cities to a certain extent through a synergistic effect with other initiatives. It is also possible that the amount of greenhouse gas emissions of waste collection vehicles per day and the amount of greenhouse gas generated in the North and South of Dhaka Cities may not have achieved their targets due to same factors as the collection amount. However, as far as the vehicles of this project are concerned, carbon dioxide emissions are reduced<sup>32</sup>. On the other hand, there is a possibility that this project supports the reduction of greenhouse gas emissions such as decrease of general garbage incineration by the increase of waste collection.

Based on the above, it is considered that effectiveness and impacts of this project are high.

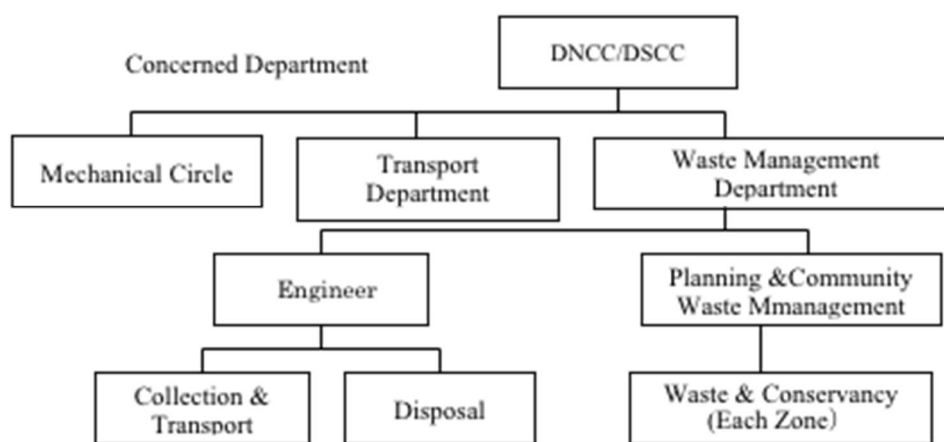
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<sup>32</sup> In other words, it does not mean that this project has no effect. It is considered that in order to increase the amount of waste collection that does not reach 100% yet, the increase of emission of carbon dioxide is unavoidable to some extent. If this project was not implemented, it is obvious that the emission of carbon dioxide would have increased further.

### 3.4 Sustainability (Rating: ③)

#### 3.4.1 Institutional / Organizational Aspect of Operation and Maintenance

The responsible authority of this project is MLGRD&C. MLGRD&C has appointed DNCC as the executing agency when former Dhaka City was divided into the north and south and approved the establishment of the Waste Management Department in DNCC and DSCC with the Ministry of Finance and the Ministry of Public Administration. The institutions of operation and maintenance of the vehicles by this project are DNCC and DSCC. The organization of DNCC and DSCC is shown in Figure 2.



Source: Documents provided by JICA “the Project for Strengthening of Solid Waste Management in Dhaka North City, Dhaka South City and Chittagong City”

Figure 2: Organization Chart of Waste Management related sections in DNCC and DSCC

Both DNCC and DSCC are in the process of establishing a waste management system by the integrated management of the Waste Management Department. Although the Engineer department is responsible for carrying out collection, transportation (secondary collection) and final disposal in the Waste Management Department, some responsibilities are shared with the mechanical circle and the transport department as concerned departments as shown in Table 7, and the personnel are also arranged from those two departments. It is planned by the integration to the Waste Management Department to enable effective and efficient management by the department overseeing and managing all the processes related to the waste management. However, there are some points which have not been achieved because it is still necessary to share the responsibilities with several concerned departments.

Table 7: Items assigned to each department in operation and maintenance of the waste collection vehicles

| Items in charge   | Vehicle      | DNCC  | DSCC  |
|---|--------------|---|---|
| Own vehicles  | This project | Waste Management Department                                   | Waste Management Department                                   |
|   | Others       | -   | Mechanical Circle   |
| Periodic Inspection   | This Project | Waste Management Department                                   | Waste Management Department                                   |
|   | Others       | Mechanical Circle   | Waste Management Department & Mechanical Circle               |
| Repair  | This Project | Mechanical Circle   | Waste Management Department                                   |
|   | Others       | Mechanical Circle   | Mechanical Circle   |
| Driver  | This Project | Waste Management Department (23people) & Transport Department | Waste Management Department (26people) & Transport Department |
|   | Others       | Transport Department  | Transport Department  |
| Allocation of vehicle & driver, Distribution of fuel costs & Placement of container |              | Transport Department  | Transport Department  |
| Container Manufacturing   |              | Waste Management Department                                   | Waste Management Department                                   |

Source: Interviews to Waste Management Department, Mechanical Circle and Transport Department of DNCC and DSCC

DNCC and DSCC distributed the maintenance spare parts and furnishings procured through this project between them, and as for the spare parts that can be procured in the market, strive to procure good quality supplies (oils and filters, etc.). Through the interviews with the DNCC and DSCC Officers, the division of roles within the organization and the distribution of procured vehicles and facilities etc. are confirmed, and it is also confirmed that there is no shortage of personnel by sharing responsibilities with the concerned departments. It is confirmed that there are no major problems in terms of maintenance. In the future, both the North and South Dhaka Cities will further pursue the integrated management system according to the overall budget allocation etc. From the above, it is judged that there are no particularly serious problems for realization of the project effect with regard to the institutional and organizational aspect of operation and maintenance at the time of ex-post evaluation.

### 3.4.2 Technical Aspect of Operation and Maintenance

Through interviews with the Waste Management Department, Mechanical Circle, and Transport Department of DNCC and DSCC each, it is confirmed that both DNCC and DSCC allocate the designated vehicles for regular collection at each secondary collection station, record the amount of collected waste, and there are no particular problems with technical matter of the waste collection and transportation and the vehicle operation and transport management<sup>33</sup>.

<sup>33</sup> Regarding monitoring skills, both DNCC and DSCC measure the amount of collected waste (= load capacity) on the track scale of the final disposal site and submit the record to the Chief Waste Management Officer as a monthly

Regarding daily and periodic inspections of vehicles, at DNCC, both mechanics and drivers are equipped with skills through participating trainings of this project and of its own budget. Although DSCC does not have participants of trainings of this project, and some manuals are not shared by DNCC, some people received training from the vehicle manager of DNCC, and it is said that they have skills based on their experience. Regarding repair of the vehicles, the contractor is responsible for the CNG vehicles and the affiliated mechanics are in charge of the others. Based on the regulation, such work as parts replacement is supposed to outsource as necessary. From the above, it is considered that there is no particularly serious problem for realization of the project effect on the technical aspect of operation and maintenance of this project at the time of ex-post evaluation.

### 3.4.3 Financial Aspect of Operation and Maintenance

Tables 8-1 and 8-2 show the budget related to the waste management of DNCC and DSCC.

Table 8-1: Annual budget allocation of DNCC waste management

| Financial Year (Jul – June) |   | 2012/13 | 2013/14 | 2014/15 | 2015/16 | 2016/17 |
|-----------------------------|---|---------|---------|---------|---------|---------|
| Regular Expenditure         | Fuel                                    | 228.4   | 244.8   | 259.0   | 266.6   | 251.6   |
|                             | Workshop of Mechanical Circle           | 15.2    | 24.1    | 25.3    | 33.6    | 26.0    |
|                             | Workshop of Waste Management Department | 0.2     | 9.6     | 2.1     | 0.8     | 5.5     |
|                             | Operation and Maintenance               | 14.0    | 38.4    | 22.5    | 24.1    | 29.6    |
|                             | Sub-total                               | 1,307.0 | 1,611.0 | 1,769.0 | 2,175.0 | 2,850.0 |
| Development Budget          |   | 2,706.0 | 2,661.0 | 2,505.0 | 2,499.0 | 3,821.0 |
| Others                      |   | -       | 92.0    | 213.0   | 8.0     | 3.0     |
| Total                       |   | 4,013.0 | 4,364.0 | 4,487.0 | 4,682.0 | 6,674.0 |

Source: DNCC Accounting Department

Table 8-2: Annual budget allocation of DSCC waste management (Modified Budget)

| Financial Year (Jul – June) |   | 2012/13  | 2013/14 | 2014/15 | 2015/16 | 2016/17  |
|-----------------------------|---|----------|---------|---------|---------|----------|
| Regular Expenditure         | Fuel                                    | 340.0    | 350.1   | 399.0   | 450.0   | 420.0    |
|                             | Workshop of Mechanical Circle           | 27.5     | 42.1    | 65.0    | 100.0   | 150.0    |
|                             | Workshop of Waste Management Department | 12.0     | 2.1     | 10.0    | 12.5    | 30.0     |
|                             | Operation and Maintenance               | 60.0     | 24.6    | 72.0    | 82.5    | 76.4     |
|                             | Sub-total                               | 2,030.0  | 1,838.0 | 2,606.0 | 3,246.0 | 4,301.0  |
| Development Budget          |   | 10,123.0 | 4,198.0 | 3,044.0 | 6,133.0 | 11,772.0 |
| Others                      |   | 86.0     | 57.0    | 276.0   | 367.0   | 450.0    |
| Total                       |   | 12,239.0 | 6,093.0 | 5,925.0 | 9,746.0 | 16,523.0 |

Source: DSCC Accounting Department

\* For both DNCC and DSCC, the items related to the waste collection vehicles are stated for the breakdown of the regular expenditure. The total amount is the amount including other items. Regarding financial year 2016/2017 of DSCC, it is assumed that the modified budget amount is higher than the past due to an increase in the development budget amount which was not confirmed.

report.



As shown in Tables 8-1 and 8-2, the budget for regular expenditure of waste management in DNCC and DSCC are on an increasing trend. According to the DNCC and DSCC Officers, “The budget related to vehicle operation and maintenance is allocated without problems. There is no problem with the prospect of future allocation”. Therefore, it is judged that there is no particular shortage of the operation and maintenance budget of this project, and it is judged that no major problem regarding financial aspects can be seen.

#### 3.4.4 Status of Operation and Maintenance

At the time of ex-post evaluation, it is confirmed that the vehicles by this project are largely operated without problems in operation status with maintenance such as periodic inspections and repairs through the observation and interviews at the field survey. Some spare parts related to compactor vehicles cannot be procured domestically, and the imitations are manufactured and procured in the county although they do not work like a perfect genuine product. Furthermore, as mentioned above, according to the Consultant, “Because vehicles that cannot be used may occupy 30-40%, the maintenance status up to the time of ex-post evaluation can be highly appreciated.” The storeroom and training facilities and equipment by this project are managed, and procurement also has no special problem at the time of ex-post evaluation. However, regarding the training facility owned by DNCC, the usage is very limited. It is said that the mechanics and drivers who received the training of this project continue to work in DNCC and there has been no necessity for new training by the time of ex-post evaluation. According to the DNCC Officer, ways to utilize the storeroom and training building will be considered in the future.

#### 【About Workshop Facilities】

At the time of this project planning, former DCC had two adjacent workshops (Workshop 1 and Workshop 2)<sup>34</sup> which were used by the Mechanical Circle and the Transport Department. In this project, the workshop facilities for operation and maintenance of the vehicles belong to the Waste Management Department and the storeroom and training facilities were built in the premises of Workshop 1. After former Dhaka City’s division, the position of the Workshops became the area of South Dhaka City, the Workshop 1 (hereafter referred to as “DNCC Workshop”) was allotted to DNCC, and the Workshop 2 (hereafter referred to as “DSCC

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<sup>34</sup> At the time of former DCC, at the Workshop 1, operation and maintenance of vehicles, mainly waste collection vehicles, were carried out, and at the Workshop 2, heavy equipment necessary for road operation and maintenance etc. was operated and maintained.

Workshop”) was allotted to DSCC. It was also considered to jointly use these facilities by the Waste Management Department of DNCC and DSCC each, but only the Waste Management Department of DNCC is using at the time of ex-post evaluation.

Moreover, in late 2017, the Mechanical Circle and the Transport Department of DNCC relocated the workshop function to a DNCC’s temporary facility located in Gabtoli in the area of DNCC. The main reason is that drivers have got tired of the periodic inspections due to the distance<sup>35</sup> to the DNCC workshop in the area of South Dhaka City. In the Waste Management Department, the mechanics move the necessary equipment to Gabtoli and regularly inspect the waste collection vehicles owned by the Department. The facilities developed by this project in the DNCC Workshop are used for operation and maintenance of parts and heavy equipment of waste management. DNCC is planning to develop formal facilities for the vehicle operation and maintenance including the one for the Waste Management Department in Gabtoli, and the budget is also planned to be accounted. On the other hand, the Waste Management Department of DSCC shares the DSCC Workshop with the mechanical circle and the transport department at the time of ex-post evaluation, but there is no facility for vehicle inspection and repair. However, there is a plan for the development of workshop of the Waste Management Department, and it is said that contractors are entering the bidding stage. There is concerns about ensuring appropriate functions of workshop as the Waste Management Department after relocation for both DNCC and DSCC, but in both of them, there has been no problem arising in the maintenance of the vehicles at the time of ex-post evaluation.

Based on the above, there are no particularly serious problems in the status of operation and maintenance concerning the effects of the project at the time of ex-post evaluation.

No major problems have been observed in the institutional, technical, financial aspects and current status of the operation and maintenance system. Therefore sustainability of the project effects is high.

#### **4. Conclusion, Lessons Learned and Recommendations**

##### **4.1 Conclusion**

This project aims to strengthen the capacity of solid waste collection and transportation and to reduce the daily emission of greenhouse gas of the waste collection vehicles in North and

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<sup>35</sup> The distance from the northern end zone in the North Dhaka City to the DNCC workshop is considered to be around 25 km, and it takes about 2 hours to move in a traffic jam.

South Dhaka Cities by procurement of waste collection vehicles, construction of maintenance workshop, and implementation of technical assistance through seminars etc. regarding greenhouse gas reduction and improvement of vehicle maintenance, thereby contributing to the sustainable implementation of waste management service, the improvement of hygiene environment and the promotion of recycling society in the city and the reduction of green gas emission in North and South Dhaka Cities. This project that aimed at increasing the amount of waste collection by procurement of the waste collection vehicles with low emissions of carbon dioxide is consistent with the development policies such as *the Seventh Five-Year Plan (2016)* that states the necessity of environmental sustainability, the development needs for waste collection equipment, Japan's ODA policy, and thus, its relevance is high. Although the project cost was as planned, the project period exceeded the plan, and the efficiency is fair. The operation rate of vehicles procured in this project is high, and the amount of collected waste has achieved the target value. However, it is judged that the target has been achieved by the increase in the number of collected vehicles in North and South Dhaka Cities and by the synergistic effect with other projects. Furthermore, regarding carbon dioxide emissions, although it is highly likely that North and South Dhaka Cities have not achieved the reduction target, the emissions by new vehicles by this project has decreased. On the other hand, because it is confirmed that the beautification of the city had been promoted due to an increase in waste collection amount, it is judged that the effectiveness and impacts are high. As for the workshop facilities that operate and maintain the vehicles procured by this project, there are plans to relocate both in DNCC and DSCC. Although there is a concern about securing functions of operation and maintenance of equipment, there is no particular problem at the time of ex-post evaluation. As no particular problems have been observed in the institutional, technical, financial aspects and current status of the operation and maintenance system of DNCC and DSCC, the sustainability of this project effect is high.

In light of the above, this project is evaluated to be highly satisfactory.

## 4.2 Recommendations

### 4.2.1 Recommendations to the Executing Agency

It is recommended for DNCC and DSCC each to proceed the development of environment of the workshops in the Waste Management Departments for the operation and maintenance of vehicles procured by this project. This is because the operation and maintenance workshop of the waste collection vehicles is a necessary facility to utilize the vehicles in good condition in

the long term. At the time of ex-post evaluation, both cities are in the process of improvement, but it is recommended to promote the development of the workshop environment as soon as possible so as not to hinder the operation and maintenance of the vehicles.

#### 4.2.2 Recommendation to JICA

None

#### 4.3 Lesson Learned

##### Synergistic effects between schemes and timing of implementation

It is considered that the amount of primary waste collection increased, the loading efficiency at the secondary collection station improved, and the number of trips of waste collection vehicles increased because of the improvement of collection undertaken by the JICA Technical Cooperation Project, “Project for Strengthening of Solid Waste Management in Dhaka City”, that has been implemented prior to this project. It is considered that the awareness of residents about environment which had been potentially improving has further improved due to the beautification of the city by the regular collection and the increase of collection amount of the secondary collection, and that the primary collection has been further promoted. These are thought to be a synergistic effect because in the projects of waste management measures, the timing and contents of the relevant activities were matched even though the schemes are different. Furthermore, the implementation of this project was not planned at the beginning of the preceding technical cooperation project. Along with the progress of the technical cooperation project, the fact that the direction of vehicle procurement centered on the compactor vehicles was confirmed among the stakeholders is also the background of this project. In similar projects in the future, it is considered to be meaningful to explore the possibility of the synergistic effect by utilizing the features of different schemes at the project formulation and planning stage. Moreover, based on a timing and details of the activities of the project, it is considered to be meaningful to carefully and flexibly incorporate efforts that take advantage of the features of different schemes when examining methods of promoting realization of effects and methods of solving problems during the project implementation.

Supplementary Documents:

① Zones under DNCC and DSCC

| Division of local government | Zones at the time of planning | Zones at the time of ex-post evaluation |
|------------------------------|-------------------------------|---|
| North Dhaka City             | Zone10                        | Zone 1                                  |
|                              | Zone 8                        | Zone 2                                  |
|                              | Zone 9                        | Zone 3                                  |
|                              | Zone 7                        | Zone 4                                  |
|                              | Zone 6                        | Zone 5                                  |
| South Dhaka City             | Zone 5                        | Zone 1                                  |
|                              | Zone 4                        | Zone 2                                  |
|                              | Zone 3                        | Zone 3                                  |
|                              | Zone 2                        | Zone 4                                  |
|                              | Zone 1                        | Zone 5                                  |

Source: Documents provided by Waste Management Department of DNCC and DSCC

② Calculation basis concerning trends in the total amount and rate of waste collection per day in DNCC and DSCC \*

(Unit: t/day)

| Item                  |                | 2008  | 2012  | 2013  | 2014  | 2015  | 2016  | 2017  |
|-----------------------|----------------|-------|-------|-------|-------|-------|-------|-------|
| Waste generation      | Master Plan    | 3,670 | 4,196 | 4,323 | 4,471 | 4,624 | n.a.  | n.a.  |
|                       | Actual**       | n.a.  | n.a.  | n.a.  | 5,100 | 5,271 | n.a.  | n.a.  |
| Waste discharge       | Plan (a)       | 3,186 | 3,621 | n.a.  | n.a.  | 3,977 | n.a.  | n.a.  |
|                       | Actual (b)     | n.a.  | n.a.  | n.a.  | n.a.  | 4,533 | n.a.  | n.a.  |
| Waste collection      | Plan (Target)  | 1,718 | 2,429 | n.a.  | n.a.  | 3,052 | n.a.  | n.a.  |
|                       | Actual (c) *** | n.a.  | 2,374 | 2,769 | 3,338 | 3,636 | 4,332 | 5,257 |
| Waste collection rate | Plan (Target)  | 58%   | 67%   | /     | /     | 77%   | /     | /     |
|                       | (c) / (a)      | n.a.  | 66%   | n.a.  | n.a.  | 91%   | n.a.  | n.a.  |
|                       | (c) / (b)      | n.a.  | n.a.  | n.a.  | n.a.  | 80%   | n.a.  | n.a.  |

Source: Documents provided by JICA, the Consultant, DNCC and DSCC

\*Note: All amount of waste generation, discharge, collection include amount of the private consignment

\*\*Note: 2014: Document provided by JICA, 2015: Approximate amount calculated based on the document provided by JICA.

\*\*\*Note: 2008, 2012: Document provided by JICA, 2013: Document provided by the Consultant, 2014-2017: document provided by DNCC and DSCC.

③ Repair cost of DSCC waste collection vehicle (excluding vehicle of this project)

(Unit: Million BDT)

| Financial Year          | 2012-2013 | 2013-2014 | 2014-2015 | 2015-2016 | 2016-2017 |
|-------------------------|-----------|-----------|-----------|-----------|-----------|
| Repair cost of vehicles | 13.9      | 13.2      | 18.6      | 24.7      | 30.3      |

Source: Document provided by Mechanical Circle of DSCC