

Ex-Post Project Evaluation 2019: Package I-2 (India)

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JAPAN INTERNATIONAL COOPERATION AGENCY

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India

FY2019 Ex-Post Evaluation of Japanese ODA Loan Project
“Kolkata Solid Waste Management Improvement Project”

External Evaluator: Yumiko Onishi, IC Net Limited

0. Summary

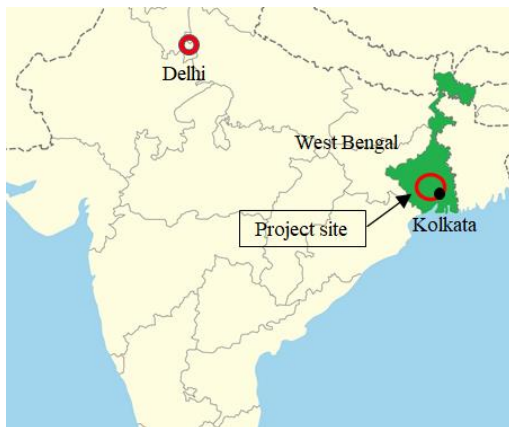
In the beginning of 2000, the living environment for people in the Kolkata Metropolitan Area (KMA) was threatened by odor and unhygienic conditions from a rapid increase in solid waste and a lack of proper waste management. Six municipalities, namely Champdani, Baidyabati, Serampur, Rishra, Konnagar, and Uttarpara-Kotrung located on the western bank of the Hooghly River, were no exception. Therefore, the project was implemented to promote proper management of solid waste generated in the region through establishing a sustainable regional waste management system, including the construction of a sanitary landfill, thereby contributing to improving the living and sanitary conditions of the people and conserving the environment.

Throughout the period between the project appraisal and the ex-post evaluation, the health and sanitation sector and the water supply and sewage sector including waste management have been given an important position in India’s development policy. The issues of odor and unhygienic conditions, which were caused by a lack of solid waste management system and recognized at the time of the appraisal, have been partially solved by the establishment of a regional waste management system by the project. However, the need for such system remains at the time of the ex-post evaluation, and consistency with the development needs is also recognized. Moreover, the project matches Japan’s ODA policy at the time of the appraisal. Thus, the relevance of the project is high. Most of the project scope has been implemented as planned. In addition, because of fluctuations in the exchange rate during the implementation period, the project cost was within the planned amount. On the other hand, the project was delayed significantly because it spent much time on consultant procurement and handing over the land for facility construction to the contractors, rendering its efficiency fair. In regard to operation and effect indicators, while waste disposal to the Regional Waste Management Center (RWMC) has achieved the target, compost plant input is significantly below the target, indicating that there is room for improvement in segregating waste at source. However, three out of the five indicators have achieved the target, a certain degree of improvement in the living and hygiene conditions of the people in the target area is observed, and no adverse impacts were reported during the project on the natural environment, land acquisition and resettlement. Therefore, the effectiveness and impacts of the project are high. Although there are no issues related to technical aspects of operation and maintenance (O&M), because of shortage of funds, manpower and equipment are running short, and sometimes door-to-door waste collection service is not provided and the waste segregated at households is mixed up after the collection. Moreover, although the system for collecting a user fee for solid waste management exists, it is

not implemented. Thus, the sustainability of the project faces a few issues; however, efforts are being made to resolve them. Therefore, the sustainability of the project is fair.

In light of the above, although the project has issues in sustainability, efforts are being made to resolved them at the earliest, and the project is evaluated to be satisfactory.

1. Project Description



Project location



Primary waste collection

1.1 Background

The KMA has Kolkata Port, one of the major Indian ports facing the Bay of Bengal, and has developed as the center of economy, industry and transportation for eastern India since the British colonial period. At the time of the appraisal, the KMA had a population of 15 million, consisting of 41 urban local bodies. The living environment of residents was at risk because of a lack of proper management for the rapidly increasing amount of solid waste. However, because solid waste management was not given high priority, regulations and budget allocation for the issue were insufficient. Thus, issues such as the fragile financial foundation of urban local bodies and the need for acquisition of land suitable for a final disposal site were pointed out. Although the *Municipal Solid Waste (Management and Handling) Rules* were issued in October 2000, no proper regional waste management system,¹ which includes a leachate collection facility and a landfill site using cover soil, has been developed in either the KMA or nationwide.

The six target municipalities of the project (Champdani, Baidyabati, Serampur, Rishra, Konnagar, and Uttarpara-Kotrung) are located on the western bank of the Hooghly River, which flows through the center of the KMA. The total population of the six municipalities was estimated to grow from 790,000 in 2004 to 1,120,000 by 2025. With the projected population growth, the amount of solid waste generated was expected to increase from 100,000 tons to

¹ For efficient management of solid waste, the waste from several local bodies is disposed together.

140,000 tons annually. The lack of a proper regional waste management system was causing the following problems: a) deteriorating living environmental conditions such as bad odor, flies, and rats due to waste that is left uncollected for a long time; b) pollution of soil and groundwater due to unsegregated dumping and illegal dumping in areas without a waste collection system; and c) overflowing of drains during the rainy season owing to dumping to open drains that reduces the drains' carrying capacity.

1.2 Project Outline

The objective of this project is to promote appropriate solid waste management by developing a sustainable regional solid waste management system including sanitary landfill site for the six municipalities in the KMA, thereby improving the living environment and hygienic conditions of the people in the region and safeguarding the natural environment. The project was expected to become a model case for solid waste management in India and to be replicated elsewhere.

Loan Approved Amount/ Disbursed Amount	3,584 million yen / 2,467 million yen
Exchange of Notes Date/ Loan Agreement Signing Date	March 2006 / March 2006
Terms and Conditions	Interest Rate 0.75% Repayment Period 40 years (Grace Period 10 years) Conditions for Procurement General Untied
Borrower / Executing Agency	The President of India / Kolkata Metropolitan Development Authority
Project Completion	July 2017
Target Area	Six municipalities in the Kolkata Metropolitan area in the State of West Bengal
Main Contractor(s) (Over 1 billion yen)	SMS Infrastructure Ltd (India)
Main Consultant(s) (Over 100 million yen)	Senes Consultants India Private Limited (India) / Yachiyo Engineering Co., Ltd. (Japan)
Related Studies (Feasibility Studies, etc.)	Pilot Study for Urban Environment Development and Employment Development (2004) (JICA), SAPROF (2005)

Related Projects	<u>Technical Cooperation</u> Technical Assistance for Kolkata Solid Waste Management Improvement Project (2015–2017) Technical Assistance for Kolkata Solid Waste Management Improvement Project Phase 2 (2018–2020)
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2. Outline of the Evaluation Study

2.1 External Evaluator

Yumiko Onishi, IC Net Limited

2.2 Duration of Evaluation Study

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

Duration of the Study: July 2019–August 2020

Duration of the Field Study: November 4–16, 2019 and February 15–22, 2020

2.3 Constraints during the Evaluation Study

At the time of the ex-post evaluation, the Kolkata Metropolitan Development Authority (KMDA), which was the executing agency, was not directly involved in the operation and maintenance of the project, and the external evaluator was unable to obtain the KMDA's cooperation in collecting information on the project's implementation. Therefore, it was not possible to confirm part of the information required for the evaluation study such as project cost borne by the Indian side.

3. Results of the Evaluation (Overall Rating: B²)

3.1 Relevance (Rating: ③³)

3.1.1 Consistency with the Development Plan of India

The *Tenth Five-Year Plan* (April 2002–March 2007), the development plan of India that was in effect at the time of the project appraisal, mentioned a) providing sustainable access to potable water across the country in accordance with standards for minimum supply of drinking water; b) cleaning the major polluted rivers and improving their watershed environment; c) establishing sanitary landfill sites and water channels as soon as possible as part of urban sanitation policy; d) rendering institutions operating water supply and sewage facilities financially sound for sustainable operation; and e) strengthening the local governing bodies at the municipal and village levels to accelerate decentralization. Moreover, in the National Water Policy (2002), the

² A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory

³ ③: High, ②: Fair, ①: Low

Ministry of Water Resources aimed at providing adequate and safe drinking water to all citizens by giving priorities in the order of water supply, irrigation, and hydropower for allocation of water resources. Furthermore, the Common Minimum Programme of the administration at that time pledged expansion of public investment to the water supply, sewage and sanitation sectors, and gave the highest priority to providing drinking water to all classes in urban and rural areas and expanding the sources of drinking water. Thus, health and sanitation as well as water supply and sewage sectors were given importance in the Indian government's development plan at the time of the appraisal.

Vision 2020, the development plan of the Indian government at the time of the ex-post evaluation, indicates the necessity for infrastructure development on water supply and sanitation in urban areas. To address such situation, the *Vision* points out that strengthening the capacity of local bodies and reform based on appropriate management are essential. Particularly, for the urban poor to escape poverty by 2020, the *Vision* states that more efficient initiatives are the key in sectors such as health, sanitation, water supply and education. The *Three-Year Action Agenda* (FY 2017–2019) of the Indian government promotes a nationwide cleanup mission by the “Swachh Bharat” campaign established by the Modi government in 2014. In addition to abolishing the manual cleaning of feces and open defecation by 2019, Swachh Bharat aims for scientifically sound waste management and improving people's awareness on public health.

The *Municipal Solid Waste (Management and Handling) Rules* issued by the Ministry of Environment and Forest in October 2000, based on the guiding principles on waste management, obliged the local bodies to establish appropriate waste management facilities providing leachate treatment and cover soil and to report the situation on waste management to the Central Pollution Control Board annually. The Rules were revised in 2016 by adding the following items.

- Waste segregation before collection
- Having the local bodies set a user fee for bulk waste generators
- Promoting the use of biodegradable waste (production of compost)
- Promoting the use of compost

Thus, it has been confirmed that, at the time of the ex-post evaluation, the health and sanitation sector and the water supply and sewage sector including waste management are given importance in the development plan of the Indian government.

3.1.2 Consistency with the Development Needs of India

As described in “1.1 Background,” because a proper regional waste management system did not exist at the time of the appraisal, the six target municipalities faced the following issues: a) deteriorating living environmental conditions such as bad odor, flies, and rats due to waste left uncollected for a long time; b) pollution of soil and groundwater due to unsegregated dumping

and illegal dumping in areas without a waste collection system; and c) overflowing of drains during the rainy season owing to dumping in open drains that reduces their carrying capacity.

At the time of the ex-post evaluation, it became evident from the interviews with residents, municipal chairpersons and site inspectors of the six municipalities that illegal dumping of waste and waste left uncollected for a long time decreased compared to the time prior to the project. In a few areas, open drains are cleaned regularly and the overflowing of drains during the rainy season appeared to have decreased.

According to the data provided by the Technical Assistance for Kolkata Solid Waste Management Improvement Project Phase 2, the rates of waste collection and segregation at source as of October 2019 are as follows.

Table 1: Rates of waste collection and segregation at source in six target municipalities
(as of October 2019)

Municipality	Collection	Segregation
Uttarpara-Kotrung	90%	85%
Konnagar	83%	70%
Rishra	85%	70%
Serampur	87%	20%
Baidyabati	97%	90%
Champdani	23%	20%

Source: Materials provided by the Technical Assistance for Kolkata Solid Waste Management Improvement Project Phase 2 Project team

The estimated waste collection rate before the project is 30-40%, and it seems to have improved by the implementation of the project. Waste segregation at source was not implemented before the project.

Considering the situation in the six municipalities at the time of the appraisal, the implementation of the project was consistent with the development needs of the target areas. The interviews with residents and other stakeholders confirmed that the issues recognized at the time of the appraisal saw improvement. As seen in the data on waste collection rates in Table 1, door-to-door collection is relatively high except Champdani. Although described in “3.4 Sustainability,” issues related to the operation of a regional waste management system exist, and it is still necessary to strive to operate the system smoothly.

3.1.3 Consistency with Japan’s ODA Policy

At the time of the appraisal, as focus areas, the Medium-Term Strategy for Overseas Economic Cooperation Operations referred to “economic and social infrastructure development for sustainable growth” and “assistance for global issues and peace building.” With regard to

assistance to India, the strategy mentioned “response to environmental problems” as a focus area. In addition, the project pertains to assistance on “the water issues, directly affecting the people’s health, which is becoming worse with industrialization and urbanization” as mentioned in the Country Assistance Strategy for India of 2005. Furthermore, by providing support centered around “improvement of water supply, sewage and sanitation in urban areas, as effective project scale and high economic return can be secured, and because it contributes to economic infrastructure development for industries which in turn would trigger foreign direct investment” and “improvement of overall living conditions by providing safe and stable drinking water and improving poor public health conditions against the backdrop of a rapid increase in the urban poor,” the efforts for “a) effective use of water resources (water leakage countermeasures and water conservation); b) pursuing the financial health of the project operating institution (increasing fees to the level that meets the maintenance cost, reviewing the fee structure, cost cutting, and reducing the rate of non-revenue water); c) building capacity of the project operating institution (training, review of standards and manuals, improving relationship with customers through activities such as public relations, strengthening the human development and public relations departments, and strengthening the information system); d) consideration for the poor (slum areas) and public awareness; and e) promoting private sector participation (outsourcing operation and maintenance) while keeping in mind cooperation with local bodies of Japan” were to be made. Thus, the project was consistent with Japan’s ODA policy at that time.

This project has been highly relevant to the country’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 planned project scope was implemented almost as planned.

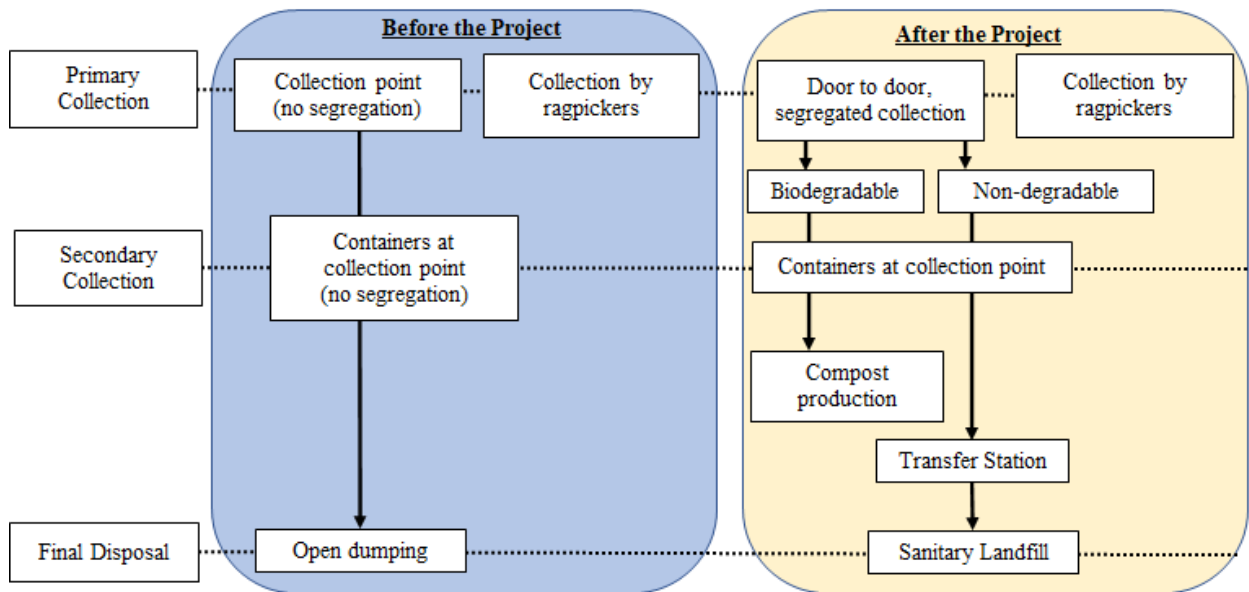


Figure 1: System for Solid Waste Management

Five Transfer Stations (TSs), six compost plants (CPs) and the final disposal site called the Regional Waste Management Center (RWMC) were constructed as per the plan, and the final quantity of equipment and vehicles for the collection system was decided based on the population of each municipality and convenience for transportation. The capacity of the RWMC decreased from the planned 1,537,000 m³ to 1,406,200 m³ because illegal timber factories on the RWMC land did not agree to vacate.

In consulting services, in addition to overall management of the project, detailed planning, assistance with procurement, and construction management were delivered. Awareness raising and education on the environment and sanitation, waste segregation and the door-to-door waste collection system (the latter two were introduced in the project) were implemented intensively by appointing in each municipality six extension workers known as social mobilizers. For supporting ragpickers (scavengers),⁴ a baseline survey was conducted for the ragpickers working in the target areas, but no specific support program was formed or implemented.

Technical training for the executing agency and officials of the target municipalities, as well as the formulation of a plan for introducing a waste collection fee system was implemented.

⁴ People at the bottom of the caste system who make a living by picking recyclable items from waste collection points and selling them to recycle operators.



Figure 2: RWMC



Figure 3: Posters for awareness

3.2.2 Project Inputs

3.2.2.1 Project Cost

The planned project cost was JPY 4,239 million (out of which JPY 593 million was the foreign currency and JPY 3,646 million was the local currency) and JPY 3,584 million was an ODA loan (out of which JPY 593 million was the foreign currency and JPY 2,991 million was the local currency). The total disbursed amount of the ODA loan was JPY 2,467 million, but it was not possible to confirm details of the cost borne by the Indian side. According to the ODA loan disbursed amount, the project cost was within the plan. The disbursed amount of the ODA loan was less than the Loan Agreement (L/A) amount because of fluctuations in the exchange rate during the project period.

3.2.2.2 Project Period

According to the plan at the time of the appraisal, the project duration was from March 2006 (date of the L/A) to November 2010 (4 years and 9 months, 57 months). Completion of facility construction and consulting services, and the maintenance period of one year after the completion of the regional waste management system were the project completion. In reality, the consulting service completed in March 2015 and construction completed in March 2016; however, the project duration including the maintenance period supported by the Japanese ODA loan was from March 2006 (date of L/A) to July 2017 (11 years and 5 months, 137 months), which is 240% against the plan, significantly longer than planned. The main reasons for the prolonged project duration are as follows:

- The project was the first Japanese ODA loan project for the executing agency, which was not familiar with procedures for international competitive bidding, and thus took more time than necessary to procure consultants.
- Lands for constructing TSs and CPs were originally used as dumping sites, and it took time to find alternative sites for waste collection and dumping. In addition, it took time

to vacate people who were illegally occupying the lands, and the beginning of construction was delayed.

- The progress of the contractor who was constructing TSs and CPs was not satisfactory, and the contract was divided into multiple parts. Thus, it took time to split the task into smaller procurement packages and to re-tender.

Because of delays listed above, the disbursement period was extended. Moreover, because financial sources for the maintenance cost were not secured, thus, the disbursement period was extended for the second time by applying the unused portion of the Japanese ODA loan for the maintenance cost.

Considering that the project was the first Japanese ODA loan project for the executing agency, the timeline for consultant procurement should have been set by giving some additional time instead of applying the standard schedule. In regard to the delay in starting the construction, it was not necessarily possible to foresee beforehand. On the other hand, regarding the second-time extension of the disbursement period, while the necessity to apply unused funds for O&M is understandable, the need to secure funds for O&M for the project was pointed out from the time of the planning.

3.2.3 Results of Calculations for Internal Rates of Return (Reference only)

In a solid waste management project, revenues from it usually do not reach the level to yield benefits in the Financial Internal Rate of Return (FIRR). Thus, only the Economic Internal Rate of Return (EIRR) was calculated for this project. Table 2 shows the EIRR at the time of the appraisal and the ex-post evaluation along with assumptions.

Table 2: EIRR and assumptions

Cost	Project cost, operation and maintenance cost
Benefit	User fee, economic impact of RWMC (cost borne by the six municipalities), revenue from compost and recyclables, cost saving on alternative facilities in the six municipalities by establishing RWMC, saving of drainage cleaning cost due to reduction in waste dumping into open drains, land cost saving of final disposal site for the six municipalities, effect from leachate treatment (preventing ground water pollution) and annual O&M cost for leachate treatment, reduction in CO ₂ from preventing emission of methane gas
Project life	16 years
EIRR	At the time of the appraisal: 8.77% At the time of the ex-post evaluation: -17.40%

The EIRR from the appraisal has been recalculated in accordance with the ex-post evaluation reference based on documents that provide details of the original calculation by taking the L/A

year as the first year of calculation. As a result, the EIRR at the time of the appraisal was 8.77%. In recalculating the EIRR at the time of the ex-post evaluation, cost saving from the cleaning of open drains was not considered as drainage cleaning is regularly carried out even now. The EIRR at the time of the ex-post evaluation became -17.40%. There is a significant gap between the EIRR at the time of the appraisal and the one at the time of the ex-post evaluation for the following reasons: the handover of facilities was delayed compared to the plan from the time of the appraisal; revenues from compost and recyclables were less than anticipated; there was no cost saving in drainage cleaning from reduced waste dumping into open drains; and the amount of the user fee collected is less than the assumption at the time of the appraisal.

Although the project cost was within the plan, the project period exceeded the plan. Therefore, the efficiency of the project is fair.

3.3 Effectiveness and Impacts⁵ (Rating: ③)

3.3.1 Effectiveness

3.3.1.1 Quantitative Effects (Operation and Effect Indicators)

The table below indicates the baseline and target values for the operation and effect indicators, and actual figures at the time of the ex-post evaluation.

Table 3: Operation and Effect Indicators

	Baseline	Target	Actual
	2004	2011	2019
		2 Years After Completion	2 Years After Completion
Compost plant input (t/year)	-	20,000	6,400
Waste disposal volume (t/year)	94,500	64,000	65,043
BOD concentration of effluent (Leachate treatment plant) (mg/l)	-	<100	95* (as of July 2019)
BOD concentration of effluent (Septic tank sludge treatment system) (mg/l)	-	<30	N/A
Waste capture (% of households collected)	-	75	23 - 97 (average 78%)

Source: Materials provided by JICA, Technical Assistance for Kolkata Solid Waste Management Improvement Project, and RWMC

*Wastewater from the leachate treatment plant is treated at aerobic lagoons and sedimentation ponds. The results of monitoring are obtained from the samples from the sedimentation ponds.

The actual figure of the compost plant input is much lower than the target one. Although the waste disposal volume did not decrease sufficiently to meet the target, it was confirmed that the

⁵ Sub-rating for Effectiveness is to be put with consideration of Impacts.

disposal volume decreased to a certain extent. Against the planned capacity of the RWMC, which is 200 tons/day, over 300 tons of waste is being transported currently. At the same time, the probable reason the compost plant input is less than the expected is that waste is not segregated properly at source or during collection and transportation.

Regarding the BOD concentration of effluent, the wastewater discharged from the septic tank sludge treatment system, which is in the premises of the RWMC, meets the wastewater from leachate treatment plant in the aerobic lagoon. The wastewater treated in the two lagoons and the sedimentation pond is reused in the septic tank sludge treatment system, instead of being discharged outside the RWMC.⁶ According to the most recent water quality testing from the sedimentation pond, the BOD concentration is approximately 100 mg/l. The wastewater produced in the septic tank sludge treatment system flows into the lagoon and then merges with the wastewater from the leachate treatment plant. Thus, the BOD concentration of the wastewater from the septic tank sludge treatment system is not separately monitored.

As of October 2019, the average rate of waste capture from the households across the six municipalities is 78%, which has exceeded the target. At the time of the field work in February 2020, it was reported from the municipalities that the rate was on an improving trend.

Out of the five indicators, it is fair to say that three have achieved the target. Therefore, the project has been able to bring about a certain degree of effectiveness.

3.3.1.2 Qualitative Effects (Other Effects)

Described in the “Impacts” section.

3.3.2 Impacts

3.3.2.1 Intended Impacts

The impacts of the project are defined as “improving the living environment and hygienic conditions of the people” and “safeguarding the natural environment.” Because it is difficult to prove the causal effects between these impacts and the project, in the ex-post evaluation, “improving the quality of life in the target area” and “improving environmental awareness of people in the target area,” which are the qualitative effects that can be confirmed as impacts of the project, were taken up.

Through interviews with the project consultants and officials of the six municipalities and group discussions with social mobilizers and local residents,⁷ the following points were confirmed.

⁶ As the wastewater discharged from the leachate treatment plant is reused within the RWMC, the BOD concentration of effluent must meet the standard of less than 100 mg/l. If the wastewater is discharged from the leachate treatment plant to the canal outside, the BOD concentration must be less than 30 mg/l in accordance with the standard set by the Pollution Control Board.

⁷ Group discussions with the local residents were conducted with several to about 30 people depending on the location mainly with women in the age groups between 20s and 50s whom the social mobilizers summoned.

- Waste collection (segregation and door-to-door collection): A waste collection system existed before the project. However, the service was not well-established and door-to-door collection was irregular, causing people to dump their waste illegally. Currently, door-to-door collection is practiced regularly in many areas. Because illegal dumping has become less rampant, incidents of water overflowing from the drains during the rainy season have decreased. On the other hand, because of the shortage of waste collectors and equipment, there are cases where waste cannot be collected from the same area daily and the segregated waste from households gets mixed up during collection.
- Each municipality has a noticeable tendency of unsegregated waste from households and inappropriate ways of taking out the waste, particularly among residents of apartment complexes.
- Social mobilizers have called on the people to improve awareness on health and sanitation and the environment in addition to methods of waste segregation and collection. The people feel that vector-borne diseases have decreased in recent years.

The project conducted its awareness activities by engaging six social mobilizers. Women were appointed for all the social mobilizer's posts considering that they will be reaching out to women, who mainly take out the waste from home, and that the activities targeting self-help groups (SHGs), where most members were women, were planned. Through existing groups such as SHGs, they encouraged people to participate in meetings and various awareness activities. Moreover, by working with healthcare workers in the area and going around daily with waste collectors, they provided on-the-job training to the waste collectors and monitored the situation of waste segregation.

In 2016, the project received a C40 Cities Award.⁸ In 2017, a Deputy Collector of Hooghly District, where the six municipalities are located, visited the project and started preparing for establishment of a regional waste management system including five surrounding villages. In the five villages, as was done in the project, waste was to be segregated into biodegradable and other types, and then collected and transported to the TSs and CPs of the project.⁹ According to the interviews with project stakeholders at the time of the ex-post evaluation, there was a plan to replicate a regional waste management system based on the model from the project in seven locations in the State of West Bengal. Furthermore, out of the six municipalities, three of them (Uttapara-Kotrung, Rishra and Baidyabati) have been awarded the status of model city for solid

⁸ C40 is a network of global cities working against climate change. It assists cities to undertake sustainable actions by working together and by sharing knowledge on climate change. C40 Cities Awards select best initiatives from cities around world that other cities can emulate, and honor outstanding activities that have shown a high level of performance that contributes to the environment even under difficult circumstances.

⁹ Final Report of the Technical Assistance for Kolkata Solid Waste Management Improvement Project

waste management from the West Bengal state government.

With regard to improving the quality of life in the target area and improving environmental awareness of people in the area, the living conditions appear to have improved because of regular waste collection by the project. Residents of the target area feel that the incidence of diseases such as malaria has decreased compared to earlier times because of improved sanitation. As the establishment of a regional waste management system based on the project as a model is being considered, it is fair to say that the project brought a certain impact.



Figure 4: Waste segregated at households



Figure 5: Transfer station (Konnagar)

3.3.2.2 Other Positive and Negative Impacts

Impacts on the Natural Environment

The project target area does not fall into the category of sensitive areas or their surroundings that may be easily affected by the project such as nature reserve. Thus, an undesirable impact on the natural environment was assumed to be minimal and the project was classified as Category B according to the JBIC Guidelines for Confirmation of Environmental and Social Consideration. As an anti-pollution measure in the project, soil cover was to be applied at a sanitary landfill and leachate was to be properly collected and treated; thus, no particular adverse impact was anticipated. Moreover, as an anti-scattering measure during transportation, waste was to be transported in a container with lids. In addition, the KMDA, the executing agency, was expected to monitor the quality of ground water, etc., around the RWMC.

In January 2010, the project obtained environmental clearance from the State Environmental Impact Assessment Agency. The clearance included compliance conditions stating that the design, construction and operation of various facilities should be carried out as per the plan. The conditions set in the clearance required the project to design, construct and operate facilities according to the project plan, and most of them seem to be complied with.

At the time of the ex-post evaluation, although not on a regular basis, cover soil was being

used to prevent odor at the RWMC. Leachate is treated in the aerobic lagoons and sedimentation pond, and reused within the RWMC thereafter, and it is not discharged outside the premises. No specific adverse impacts and complaints are reported from around the TS and CP.

Resettlement and Land Acquisition

Lands for TSs, CPs and the RWMC were all owned by either municipalities or the KMDA except in Konnagar. For construction of the TS and CP in Konnagar, 2.5 acres of vacant private land was acquired according to the domestic law. No resettlement took place in the project.

Unintended Positive/Negative Impacts

As part of the consulting service in the project, by understanding the details of ragpickers' age, gender and domicile, a plan for improving their income and health was to be formulated. In addition, it was expected that ragpickers would be employed in the regional waste management system established by the project. However, the support to ragpickers in the project was limited to the baseline survey. Nevertheless, the project has provided place for the ragpickers in TSs and the RWMC to segregate recyclable waste and made an effort to work with them. Waste collectors who collect waste from households are employed by the municipalities. Although several waste collectors were interviewed during the field survey, they did not necessarily have a ragpicker background. Thus, no particular contribution was found in increasing employment opportunities or improving the livelihood of ragpickers.

This project has achieved most of its objectives. Therefore, the effectiveness and impacts of the project are high.

3.4 Sustainability (Rating: ②)

3.4.1 Institutional / Organizational Aspect of Operation and Maintenance

In West Bengal State, the Department of Urban Development and the Department of Municipal Affairs were consolidated in 2016 and became the Department of Urban Development and Municipal Affairs. As a result, the KMDA, which implemented the project, and the State Urban Development Agency (SUDA), which supervises the municipal administration including the six target municipalities of the project, came under the Department's umbrella.

According to the plan at the time of the appraisal, regarding the maintenance of the project, the six municipalities were to look after the primary and secondary collection systems while the KMDA was to take care of TSs, CPs, and the RWMC. However, based on discussions among the stakeholders during the project, it was decided that the primary and secondary collection systems and, TS, and CP would be operated by each of the six municipalities. The O&M of the

RWMC is taken care by Baidyabati municipality, where the RWMC is located. Although an option was considered to have the management committee, formed by the target six municipalities, take charge of the O&M of the RWMC, the RWMC was transferred to Baidyabati municipality in April 2017 and a contractor is operating the facilities. According to interviews with project stakeholders, although several municipalities are using the facilities, the other municipalities are not at all involved in the O&M, and coordination between Baidyabati municipality and other municipalities seems difficult when problems such as hauling of unsegregated waste occur.

Each municipality is headed by chairperson and the Conservancy Department is in charge of the O&M from the stages of primary collection to transporting the waste to the RWMC. Each municipality faces a shortage of manpower required for waste collection and operating vehicles due to a lack of funds. According to an interview with a project stakeholder, while the national average ratio between the number of households and primary waste collection is 180 households per waste collector, it is 220 households per waste collector in the project area.

After the project, six mobilizers deployed in each municipality have been absorbed by the Technical Assistance for Kolkata Solid Waste Management Improvement Project Phase 2. As the technical cooperation project will terminate in March 2020, each municipality is considering continuing the engagement of social mobilizers with its own budget. Serampur is already using the social mobilizers to collect user fees for waste management from commercial establishments.

Solid waste management is enacted as the responsibility of municipalities under the *West Bengal Municipal Act* of 1993. Under the Act, the municipalities are allowed to collect user fees related to solid waste management; however, as described in detail in “3.4.3 Financial Aspect of Operation and Maintenance,” hardly any fee collection has been implemented so far. Because of the shortage of manpower and equipment due to a financial crunch, there are situations where door-to-door collection service has not been able to cover everywhere and the segregated waste from the households is mixed up after collection, and institutional arrangements on waste management service delivery face issues. The O&M and institutional arrangements of the regional waste management system, including fund sources, were discussed repeatedly among the stakeholders in the past several years. As of February 2020, the Department of Urban Development and the Department of Municipal Affairs decided to assist in meeting the gaps of manpower and equipment for primary and secondary collection in the six municipalities, and to outsource the operation of TSs, CPs, the RWMC and transport to the RWMC¹⁰, based on a micro-plan described in a later section, and was preparing for the tendering procedure.

¹⁰ At the same time, two neighboring municipalities will be included in the regional waste management system established by the project. Construction of new facilities in these two municipalities, solid waste management services beyond secondary collection and augmenting existing facilities of the six municipalities are to be included in the agreement with the contractor.

3.4.2 Technical Aspect of Operation and Maintenance

Technical training for municipal personnel who are responsible for the O&M of TSs and other facilities was conducted during the project. Various facilities were initially operated and maintained by contractors, and technical guidance to the workers was provided during that time, but it was not sufficient. Maintenance manuals for the facilities were developed by Technical Assistance for Kolkata Solid Waste Management Improvement Project; however, the O&M of these facilities does not require advanced technical skills, and the municipal staffs do not seem to be using the manual continuously.

Books for recording waste transported into TSs and CPs were developed in the Technical Assistance for Kolkata Solid Waste Management Improvement Project. Waste brought into TSs and the RWMC is recorded by measuring at a weighing bridge. In most facilities, records are entered every day. However, at such facilities as one in Champdani, records were not being made because the weighing bridge was not working. Manuals for collection, transportation, and O&M are prepared, and training sessions to conservancy personnel and workers were conducted. Small booklet manual developed for the waste collectors is used by the waste collectors and social mobilizers even now.

Primary and secondary collection of waste and the O&M of facilities constructed by the project do not require advanced techniques, and municipal personnel, workers, and waste collectors have appropriate skills.

3.4.3 Financial Aspect of Operation and Maintenance

As in the case of a sewage project, it was recognized from the beginning that securing the funds for maintenance after the project completion was important for a solid waste management project. To address this issue, the project was aiming to improve the financial situation of each municipality by increasing the collection rate of property tax through managing property registries in addition to grants from the State government, tax revenues of the six target municipalities, revenue from compost sales, introduction of and gradually increasing the user fee as a source of the maintenance budget. By taking the steps above, the project aimed to operate without grants from the State government in the future.

User fee collection for the solid waste management service was introduced temporary around 2009 based on the user fee collection plan formulated in the project; however, when the current government won the State election in 2011, fee collection was stopped citing that waste management is a basic service. Therefore, no user fee is currently collected from the general households. However, from around September 2019, some of the municipalities started collecting a user fee from commercial establishments such as restaurants. In addition, the municipalities started collecting the fee targeting bulk waste disposed from companies and the waste from households that hold celebrations such as wedding whenever possible.

Each municipality is required to devise the budget covering the steps from primary collection to operation of TS and CP. However, in addition to each municipality's weak financial foundation, grants have not been allocated regularly despite continued discussions with the State government for several years. On the other hand, as described earlier, the state government is getting ready to outsource the O&M of TS and CP of each municipality and the RWMC to private contractors in February 2020. Thus, if a private contractor is selected and begins operating the facilities, the financial problems that the municipalities and the RWMC have faced are likely to improve. The table below presents the estimated O&M cost of facilities in each municipality in 2017.

Table 4: O&M cost of facilities in each municipality

Unit: INR thousand

Municipality	Annual O&M cost
Uttarpara-Kotrung	3,788
Baidyabati	3,855
Champdani	3,068
Konnagar	3,995
Serampur	3,870
Rishra	4,863

Source: Technical Assistance for Kolkata Solid Waste Management Improvement Project final report

The annual O&M cost for the RWMC is estimated to be INR 17.9 million. In August 2016, it was decided that the Department of Urban Development and Municipal Affairs would bear the operational cost of the RWMC. The cost was estimated as INR 1,530,000 per month, but the subsequent budget was to be recalculated based on the actual waste disposal amount and expenditure. According to interviews with project stakeholders at the time of the ex-post evaluation, the payment from the Department to the contractor operating the RWMC is not made on a regular basis.

The amount of compost manufactured in the CPs of the project as of October 2019 was 9.7 tons per day. Five municipalities other than Champdani began selling the compost, and the amount of compost sold has been shifting around 36 to 77 tons per month¹¹ since July 2019. Compost is packaged for household and industrial uses. Some of the municipalities have worked with distributors, and steady sales in the future are expected. Targeting local residents, expansion of sales channels is being worked on through awareness-raising activities and advertising while door-to-door waste collection is done.

¹¹ The amount of compost sold is the total of four municipalities excluding Baidyabati. The CP of Baidyabati is operated by a private contractor and does not disclose the amount of compost sold.



Figure 6: Compost plant



Figure 7: Compost

The tax revenue of each municipality accounts for 30-40% of the total revenue of the municipality; however, the property tax is only about 7% of the total revenue.

Considering that a shortage of funds in municipalities is affecting the availability of manpower and equipment as well as the quality of solid waste management service, micro-plans, which spell out the required manpower and equipment and their shortage for solid waste management services, were formulated based on the population in each ward and the amount of waste generated in each municipality. Based on the micro-plans, the Department of Urban Development and Municipal Affairs is preparing to assist in providing manpower and equipment shortage for primary and secondary collections in the six municipalities and to delegate to a private contractor the operation of the TSs, the CPs and the RWMC as well as transport to the RWMC. It is essential to resolve the financial issues as soon as possible in order to operate and maintain the solid waste management services properly. As of February 2020, the State government is proceeding with procurement of a private contractor and the contract should be signed in the next one to two months. If the contract is signed with the private operator and the State government assures regular payment, the issues will be resolved. The municipalities are to pay a service charge to the State government in the near future. Considering such situation, by resuming the user fee collection from the households and strengthening the financial foundation of the municipalities, a certain amount of the O&M cost to be borne by the municipalities can be secured from municipal tax revenues, compost sales, and fee collection.

3.4.4 Status of Operation and Maintenance

The field work in the ex-post evaluation revealed that solid waste management services as a whole were properly operated, but breakdown of and damage to the weighing bridges, equipment, and vehicles are seen in some of the facilities. Waste taken from each household is thrown into green and blue bins placed on the rickshaw cart pulled by the primary collector;

however, some residents and waste collectors were placing the waste in the wrong bins. Bins for waste segregation at the household level were initially distributed by the project; however, many years have passed and these bins were broken. Thus, in some households, one bin was not sufficient for waste segregation.

The TS and CP in each municipality receive biodegradable and other types of waste collected within the municipality, and their premises are cleaned thoroughly. At the same time, there are CPs whose compost production started only recently, and the amount of degradable waste brought into the CPs is limited and the production unit of compost is not fully established. As described earlier, most of the TSs and CPs weigh the waste brought into the facilities. However, in Champdani, the weighing bridge is not working, and records are not made daily. Equipment for waste collection and vehicles such as tipper trucks were mostly procured around 2011, and some were either broken or not being used. Those equipment and vehicles that passed their durable life either need to be repaired or replaced. As of February 2020, the State government has provided vehicles and equipment to some of the municipalities according to the micro-plan.

The RWMC receives the waste from each municipality and keeps records of weighing. No particular damage was seen on the impermeable lining at the landfill site; however, according to the personnel there, sometimes the sheet gets torn because of waste with sharp edges or a vehicle going directly into the landfill site. The leachate treatment plant is working, but the sludge treatment system has had a problem on digester from the beginning and not in proper use. Although there is no definite plan on repairing the sludge treatment system, the system is expected to be repaired once the RWMC is contracted out to a private party.

Some minor problems have been observed with regard to the institutional, organizational, and financial aspects; however, considering that outsourcing to a private contractor is being processed under the leadership of the State government and solving these issues in the future is anticipated, the sustainability of the project effects is determined to be fair.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

In the beginning of 2000, the living environment for people in the KMA was threatened by odor and unhygienic conditions from a rapid increase in solid waste and a lack of proper waste management. Six municipalities, namely Champdani, Baidyabati, Serampur, Rishra, Konnagar, and Uttarpara-Kotrung located on the western bank of the Hooghly River, were no exception. Therefore, the project was implemented to promote proper management of solid waste generated in the region through establishing a sustainable regional waste management system, including the construction of a sanitary landfill, thereby contributing to improving the living and sanitary conditions of the people and conserving the environment.

Throughout the period between the project appraisal and the ex-post evaluation, the health and sanitation sector and the water supply and sewage sector including waste management have been given an important position in India's development policy. The issues of odor and unhygienic conditions, which were caused by a lack of solid waste management system and recognized at the time of the appraisal, have been partially solved by the establishment of a regional waste management system by the project. However, the need for such system remains at the time of the ex-post evaluation, and consistency with the development needs is also recognized. Moreover, the project matches Japan's ODA policy at the time of the appraisal. Thus, the relevance of the project is high. Most of the project scope has been implemented as planned. In addition, because of fluctuations in the exchange rate during the implementation period, the project cost was within the planned amount. On the other hand, the project was delayed significantly because it spent much time on consultant procurement and handing over the land for facility construction to the contractors, rendering its efficiency fair. In regard to operation and effect indicators, while waste disposal to the RWMC has achieved the target, compost plant input is significantly below the target, indicating that there is room for improvement in segregating waste at source. However, three out of the five indicators have achieved the target, a certain degree of improvement in the living and hygiene conditions of the people in the target area is observed, and no adverse impacts were reported during the project on the natural environment, land acquisition and resettlement. Therefore, the effectiveness and impacts of the project are high. Although there are no issues related to technical aspects of O&M, because of shortage of funds, manpower and equipment are running short, and sometimes door-to-door waste collection service is not provided and the waste segregated at households is mixed up after the collection. Moreover, although the system for collecting a user fee for solid waste management exists, it is not implemented. Thus, the sustainability of the project faces a few issues; however, efforts are being made to resolve them. Therefore, the sustainability of the project is fair.

In light of the above, although the project has issues in sustainability, efforts are being made to resolve them at the earliest, and the project is evaluated to be satisfactory.

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

This recommendation is for the West Bengal Department of Urban Development and Municipal Affairs as the executing agency was not directly involved in O&M. With regard to the O&M funds for the facilities constructed in the project, discussions took place repeatedly among the stakeholders from the project implementation stage. A shortage of funds is affecting the manpower and equipment required for solid waste management services, and deterioration

in the service quality may reduce the motivation of the local residents who have been practicing waste segregation at source. At the time of the ex-post evaluation, based on the micro-plan, providing necessary equipment and appointing private contractor for the O&M of facilities are in progress. This task must be done steadily and completed as soon as possible. Furthermore, to strengthen the financial base of the municipalities, it is necessary to collect a user fee from general households. However, in case the user fee collection is impossible for political reasons, the stakeholders need to coordinate so the state government can allocate necessary budget.

4.2.2 Recommendations to JICA

None

4.3 Lessons Learned

Raising people's awareness and establishing a solid waste management system by deploying social mobilizers

In the project, together with awareness raising to the local residents on waste segregation and door-to-door collection, social mobilizers were assigned in each municipality as bearers for environmental education and sanitation. The social mobilizer team comprising six women visited house to house in each neighborhood and promoted people's understanding on the solid waste management system by explaining waste segregation at home and how the waste is collected under the system. The social mobilizers were present on the spot of waste collection with primary waste collectors; by doing so, they provided training to the waste collectors and monitored the quality of services. Moreover, they contributed to raising people's awareness on health and sanitation, and even environmental conservation by working with health workers, SHGs, and schools in the area. To establish a solid waste management system, understanding and cooperation from the local people is indispensable along with the construction of facilities. The outreach to the people using the social mobilizers was an essential part of achieving the project's outcome.

Political lobbying for securing O&M funds

At the time of the project appraisal, one of the lessons learned from similar projects in the past was that it is important to confirm how to secure O&M funds from the financial aspect. Based on the lesson, the project was collecting a user fee at one point. Although many residents approve of user fee collection, it was discontinued for a political reason. Although O&M institutional arrangements and sources of funds have been discussed among the State government, municipalities, and JICA since the implementation stage, the project came to an end without a specific way out including the implementation of fee collection as mentioned above. This has resulted in municipalities struggling with a shortage of funds. In the future, it is

crucial to consider possible solutions and confirm the possibility of implementing them such as financial support from the Department of Urban Development and Municipal Affairs and lobbying politicians to request their understanding on the importance of fee collection, among the stakeholders before the project completion.

Comparison of the Original and Actual Scope of the Project

Item	Plan	Actual
1. Project Outputs	a) Procurement of equipment for improving collection system b) Introduction of collection system to the slum areas c) Construction of TS: 5 locations (excluding Baidyabati) d) Construction of CP: 6 locations, 120 tons/day capacity e) Construction of landfill site: 1 location, 1,537,000 m ³ capacity f) Access road improvement: 16.9 km g) Consulting services <ul style="list-style-type: none"> • Detail design, procurement, construction management, overall project management, etc. • Education on the environment and sanitation, public awareness on new solid waste management system to be introduced by the project such as waste segregation and door-to-door collection, assistance to ragpickers, capacity building of project personnel, formulating plan on introducing user fee 	As planned As planned As planned As planned 1 location, 1,406,200 m ³ capacity 10.8 km Almost as planned
2. Project Period	March 2006 – November 2010 (57 months)	March 2006 – July 2017 (137 months)
3. Project Cost		
Amount Paid in Foreign Currency	593 million yen	Unknown
Amount Paid in Local Currency	3,646 million yen (1,464 million Indian rupees)	Unknown
Total	4,239 million yen	Unknown
ODA Loan Portion	3,584 million yen	2,467 million yen
Exchange Rate	1 Indian rupee = 2.49 yen (As of July 2005)	- -
4. Final Disbursement	July 2017	

India

FY2019 Ex-Post Evaluation of Japanese ODA Loan Project
“Bangalore Metro Rail Project/Bangalore Metro Rail Project (II)”

External Evaluator: Yumiko Onishi, IC Net Limited

0. Summary

In the beginning of the 1990s, traffic congestion was a serious issue in urban India, urgently requiring the establishment of a mass public transport system. Under such circumstances, by constructing a mass rapid transit (MRT) system (metro) in the southern city of Bangalore, the project was implemented with the objective to contribute to developing the regional economy and improving the urban environment through reducing traffic congestion and traffic pollution.

The urban transport sector, particularly the MRT system, has been considered important in India’s development policy from the time of the appraisal to the ex-post evaluation. Traffic congestion, particularly in the central part of the city, remains a serious issue even at the time of the ex-post evaluation. The need for the people to switch to rail-based transport, who were dependent on road transport, is recognized even now, and development needs on MRT continue to exist. The project was consistent with Japan’s ODA policy at the time of the appraisal, and the relevance is high.

According to the original plan, a MRT system with the total length of 33 km, comprising the East-West and South-North lines, was to be built. However, the project included the extension of the South-North line in 2011, and a network of 42.3 km in total was constructed. Because of limited ridership at the time of opening, less rolling stock was procured than originally planned. Although the project cost was within the plan, there was a significant delay in the project period caused by geological conditions not anticipated during the detailed design, such as uneven bedrock, which were found after the project started. This has made the efficiency of the project fair.

Regarding the achievement of operation and effect indicators, only the operating rate achieved the target, and other indicators achieved 29–77% of the targets owing to less ridership than the initial estimate. On the other hand, many metro users feel that the opening of metro has reduced the city’s traffic congestion and air pollution. With regard to the natural environment, necessary actions were taken during the implementation of the project. As regards land acquisition and resettlement, there are no specific issues. Therefore, the effectiveness and impacts of the project are fair.

In Bangalore Metro Rail Corporation Limited (BMRCL), the organization operating and maintaining Bangalore Metro, has necessary institutional arrangements for operating and maintaining the existing network, and its employees have necessary technical skills. BMRCL has an internal training system to maintain and improve the skill level of its employees. As regards the financial aspect, BMRCL is running a deficit, but its farebox revenue is at a

sufficient level to meet the operation and maintenance costs. Stations, trains, and other equipment are appropriately managed, and the sustainability of the project is high.

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

1. Project Description



Project Location



East-West line of Bangalore Metro constructed by the project

1.1 Background

The urban population of India, which was 217 million in 1991, recorded 285 million in 2001, and was expected to increase further.¹ With the rapid increase of the urban population, the number of registered vehicles and two wheelers was growing at an annual average of 11% from 2002.² In addition, the share of public transport in the number of instances of mobility³ in urban areas decreased from 69% in 1991 to 55% in 2001.⁴ On the other hand, because development of public transport infrastructure was not keeping up, traffic congestion due to the increase in the number of registered vehicles and two wheelers in urban India was a serious issue. An increase in the ratio of population owning vehicles with an increase in income, a reduction in the ratio of public transport for movement, and a shift from owning two wheelers to four-wheel vehicles are expected beyond 2006 as well, and a prompt response to traffic congestion was essential. Particularly, in large cities such as Delhi and Bangalore, congestion was worsening because of increasing demand on road transport. In addition, health problems arising out of air and noise pollutions from the vehicles, as well as economic loss, have become a serious issue. To reduce traffic congestion and automobile-related pollutions, it was necessary to develop a large-scale public transport system based on urban development plans.

¹ Ministry of Urban Development, India

² Ministry of Road Transport and Highways, India

³ Share of public transport such as buses, which people use when traveling, in the transport mode (means).

⁴ Ministry of Urban Development, India

1.2 Project Outline

The objective of this project is to cope with the increase of traffic demand in Bangalore by constructing a new mass rapid transportation system, thereby promoting regional economic development and improving the urban environment through mitigation of traffic jams and decrease of pollutions caused by increasing motor vehicles.

Loan Approved Amount/ Disbursed Amount	(I) 44,704 million yen / 38,181 million yen (II) 19,832 million yen / 19,659 million yen
Exchange of Notes Date/ Loan Agreement Signing Date	(I) March 2006 / March 2006 (II) June 2011 / June 2011
Terms and Conditions	Interest Rate (I) 1.3%, (II) 1.4% (civil portion), 0.01% (consulting services) Repayment Period 30 years (Grace Period 10 years) Conditions for Procurement General untiled
Borrower / Executing Agency	The President of India / Bangalore Metro Rail Corporation Limited
Project Completion	June 2017
Target Area	Bangalore, Karnataka State
Main Contractors (Over 1 billion yen)	Alstom Transport SA (France)/Alstom India Ltd. (India)/Sumitomo Corporation (Japan)/Thales Portugal S.A. (Portugal), Soma Enterprise Limited (India)/CEC International Corporation (India) Pvt. Ltd. (India)/Continental Engineering Corporation (Taiwan), Blue Star Ltd. (India), Guangdong Yuantian Engineering Co. (China)/Coastal Projects Ltd. (India), Coastal Projects Ltd. (India)/Transtunnelstory Limited (Russia), ETA Engineering Pvt. Ltd. (India)/Emirates Trading Agency (U.A.E.), Kalindee Rail Nirman (Engineers) Limited (India)/Samsung SDS Co. Ltd. (South Korea)
Main Consultants (Over 100 million yen)	Systra S.A. (France)/RITES LTD. (India)/Oriental Consultants Co., Ltd. (Japan)/Parsons Brinckerhoff International, INC. (the U.S.)
Related Studies (Feasibility Studies, etc.)	2003: Feasibility Study (State Government of Karnataka), 2005: SAPROF
Related Projects	<u>Japanese ODA Loan</u> Delhi Mass Rapid Transport System Project Phase 1 (I)-(VI) (February 1997, March 2001, February 2002, March 2003, March 2004, March 2005) Delhi Mass Rapid Transport System Project Phase 2 (I)-(V) (March 2006, March 2007, March 2008, March 2009, March 2010) Kolkata East-West Metro Project (I)-(III) March

	2008, March 2010, September 2018) Chennai Metro Project (I)-(V) (November 2008, March 2010, March 2013, March 2016, March 2017) Delhi Mass Rapid Transport System Project Phase 3 (I)-(III) (March 2012, March 2014, October 2018) Mumbai Metro Line III Project (I) (II) (September 2013, March 2018) Ahmedabad Metro Project (March 2016) Chennai Metro Project Phase 2 (December 2018) <u>Asian Development Bank (ADB): Bangalore Metro Rail Transit System Project (2011-)</u> <u>European Investment Bank (EIB): Bangalore Metro Rail Project Line R6 (2017-)</u>
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2. Outline of the Evaluation Study

2.1 External Evaluator

Yumiko Onishi, IC Net Limited

2.2 Duration of Evaluation Study

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

Duration of the Study: July 2019–August 2020

Duration of the Field Study: November 24–December 6, 2019 and February 23–March 4, 2020

3. Results of the Evaluation (Overall Rating: B⁵)

3.1 Relevance (Rating: ③⁶)

3.1.1 Consistency with the Development Plan of India

Since the 1990s, various policies and development plans of the Indian government have recognized the importance of development of the urban transport sector to respond to mobility requirements caused by increase in the urban population as well as for solving traffic congestion triggered by increased demand on road transport. The *Tenth Five-Year Plan* (April 2002–March 2007) and the *Common Minimum Programme* of the Modi administration, which took office in 2014, pointed out the importance of developing urban transport infrastructure such as MRT systems.

The importance of the urban transport sector, particularly MRT systems, has not changed at the time of the ex-post evaluation. *Vision 2020*, made by the erstwhile Planning Commission of India, says that the development of a rail-based transport system is the most realistic option for solving urban transport issues in large cities in the long run. Moreover, the *National Urban Transport Policy*, formulated in 2014, regards the MRT system as the key to public transport.

⁵ A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory

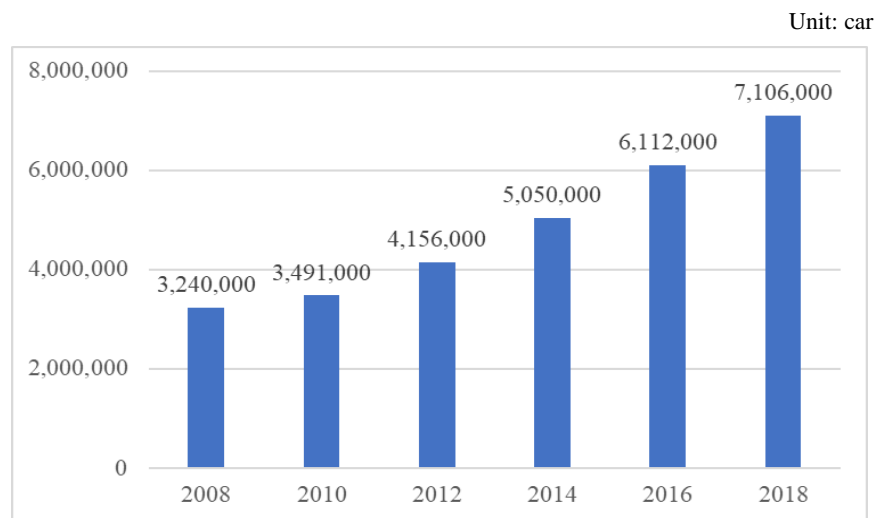
⁶ ③: High, ②: Fair, ①: Low

As of November 2019, Phase 2 of the project is in progress.⁷ In Phase 2, a new network is planned in addition to the extension of the existing network. From the time of the appraisal to the time of the ex-post evaluation, the project is consistent with the development policy of the Indian government.

3.1.2 Consistency with the Development Needs of India

Bangalore is called the Silicon Valley of India, and many companies including the software industries are operating there. With the booming of economic activities through the clustering of these industries, the population of Bangalore City increased from 3.0 million in 1981 to 5.7 million in 2001. The 2011 national census recorded the city’s population as 8.44 million, and the World Population Review estimates that it is increasing at the rate of 4% per annum.

The number of registered vehicles in the city also increased from 0.33 million in 1986 to 1.56 million in 2001 and 2.56 million in 2005. In addition, the urban transport network depending on surface transport was reaching its limits as there is little room for widening the existing road network because of limited land availability and the average vehicular speed in the city remained between 10–12 km/hour. The figure below shows changes in the number of registered vehicles in Bangalore from 2008 onwards.



Source: Karnataka Transport Department

Figure 1: Changes in Number of Registered Vehicles in Bangalore

The number of registered vehicles in the city has been increasing at the rate of about 10% per annum since 2008, and it is increasing faster than the city’s population. According to *Urban Master Plan 2031* of Bangalore, the average speed of buses at the time of the ex-post evaluation is 7–18 km/hour in the central part of the city. Moreover, because of the increase in road

⁷ As of February 2020, Phase 2 is not implemented by Japanese ODA but by other funding sources including ADB.

transport, air pollution caused by the poor quality of fuel and the use of outdated engines is a serious issue from the time of the appraisal to the ex-post evaluation.

According to the interviews with metro users at the time of the ex-post evaluation, some opined that they feel the traffic congestion in the city has somewhat eased after the operation of metro started, but the traffic congestion in places such as the central part of the city is still a serious issue even at the time of the ex-post evaluation. The need to shift from road transport, on which the people was dependent so far, to rail transport is still recognized; thus, the development need for an MRT system remains. Therefore, the project was consistent with the development needs of Bangalore at the times of both the appraisal and the ex-post evaluation.

3.1.3 Consistency with Japan's ODA Policy

At the time of the appraisal, as focus areas of the *Medium-Term Strategy for Overseas Economic Cooperation Operations* (2005), "development of a foundation for sustained growth" and "assistance for global issues and peace building" were mentioned while "development of economic infrastructure" and "response to environmental problems" were cited in the *Country Assistance Strategy for India* as focus areas. In addition, in the *Country Assistance Policy for India* in 2005, the urban transport sector was part of the transport sector, which was the core sector for assistance to India. As a principle of assistance to the transport sector, the 2005 policy stated that assistance would be provided for developing urban transport infrastructures (including flyovers and bridges), particularly an MRT system, as they contribute to reducing traffic congestion and enhancing environmental protection by such means as reducing air pollution. The project is consistent with Japan's ODA policy at the time of the appraisal.

This project has been highly relevant to the country'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 (for details, see "Comparison of the Original and Actual Scope of the Project" on the last page of this report)

At the time of the appraisal in 2006, the scope of civil works for the project was a 33-km network of the East-West and South-North lines in total; however, it was decided thereafter to include in the scope the 9.3km extension of the South-North line based on the master plan of Bangalore City. The extended portion connects to the existing industrial and residential areas as well as areas newly planned for construction (see Annex 1 for the network map). In particular, the coming of many IT companies to the city since 2003 has increased the need for the extension, which was included in the project at the time of the Tranche II appraisal.



Figure 2: Maintenance at a Depot



Figure 3: Inside a Metro Station

Compared to the plan at the time of the Tranche II appraisal, output was almost as planned except the number of rolling stock procured. For the rolling stock, procurement of 168 coaches was planned, but because of the delay in the start of commercial operation, which will be described later, ridership was limited when the operation started; thus, the number of coaches procured was reduced 150.⁸

The extension of the South-North line resulted in an increase in the project cost. However, it was appropriate as it connected to the existing as well as planned industrial and residential areas based on the master plan of Bangalore.

3.2.2 Project Inputs

3.2.2.1 Project Cost

The planned project cost at the time of the Tranche II appraisal was JPY 306,809 million, out of which JPY 67,482 million was foreign currency and JPY 239,327 million was local currency. The ODA loan was JPY 64,536 million, out of which JPY 18,639 million was foreign currency and JPY 45,897 million was local currency. In Tranche II, an additional loan of JPY 19,832 million was provided. In addition to the extension of the South-North line as described earlier, the main reasons for the provision of the additional loan included the escalation of the prices of materials and equipment due to the delay in the project and the cost of the additional underground civil works. With regard to the prices of major materials and equipment, taking 2005 as the base year, they fluctuated as shown in the table below as of 2010 when the necessity of Tranche II was considered.

⁸ As of February 2020, additional rolling stock have been procured in Phase 2 of the project, and all trains are operated with six coaches.

Table 1: Changes in Prices of Major Materials and Equipment

Material/equipment		FY 2010 index (compared to 2005)
Material	Cement	1.54
	Steel	1.93
	Aggregate	1.89
	Sand	7.7
Heavy equipment		1.24

Source: Karnataka Department of Industries and Commerce

Although the route passing through a park was agreed upon with local residents based on the discussions at the time of the appraisal, the additional underground civil works include the increase in works based on demand from the NGOs and citizens on route change for environmental conservation and the increase in the cost of works because of the discovery of bedrock that was more uneven than estimated at the time of detailed design.

The actual total project cost was JPY 235,498 million (out of which JPY 66,990 million was foreign currency and JPY 107,327 million was local currency) and the disbursement of the ODA loan was JPY 57,840 million (Tranche I: JPY 38,181 million; Tranche II: JPY 19,659 million), making the total project cost 77% of the plan. Although the reason for reduced cost borne by the executing agency has not been ascertained, for the ODA loan portion, one of the reasons why the actual project cost was within the planned one was that the consulting service fee was controlled. As described earlier, the number of rolling stock procured was short by 18 coaches compared to the plan; however, even if the 18 coaches were procured in the project, the project cost would have been within the plan.

3.2.2.2 Project Period

According to the plan at the time of the 2006 appraisal, the original project period was March 2006 (L/A) to April 2012 (6 years and 2 months, 74 months). However, at the time of the Tranche II appraisal in 2011, it was extended until June 2013 (7 years and 4 months, 88 months). Project completion was defined as the start of commercial operation. In reality, delays were caused by various reasons, and the actual project period was from March 2006 (L/A) to June 2017 (11 years and 4 months, 136 months), making it 155% of the plan. The following are the main reasons for and the durations of the delays.

- Delay in underground civil works caused by hard rocks (30 months)
- Breakdown of a tunnel boring machine (7 months)
- Delay in securing land for construction (27 months)
- Delay in relocating utilities such as water pipes and telephone lines (6 months)
- Contractors running short of funds (30 months)

Out of the above, regarding the hard rocks, bedrock that was more uneven than anticipated at the time of detailed design was found, while the geological survey at the time of detailed design was conducted at an interval which was normal by Japanese standards. Moreover, regarding the land for construction, metro construction was planned on the land owned by Indian Railways. While frequent coordination was attempted with Indian Railways to have it provide the land, it took time to obtain the consent of the organization. According to BMRCL, the executing agency, negotiations on land with Indian Railways were an important step in integrating the project with the railway as described later. The project's persistent effort to negotiate for the land so that metro users can come and go smoothly between the metro and railway stations is a major reason that the project's integration with other transport modes is working well today. Furthermore, although the project tried to implement prompt relocation of facilities such as water pipes through the coordination committee with relevant government departments, it took the committee some time to reach the final decision. Regarding shortage of funds of the contractors, to prevent further delay, BMRCL, the executing agency, approved frequent payments and paid the contractors directly.

3.2.3 Results of Calculations for Internal Rates of Return (Reference only)

For the project, both the Financial Internal Rate of Return (FIRR) and the Economic Internal Rate of Return (EIRR) were calculated at the time of the appraisal as shown in the table below. In accordance with the ex-post evaluation reference, internal rate of return at the time of the appraisal has been calculated again taking the year of L/A as the first year from the materials in which the details at the time could be confirmed. As a result, the figures came out as shown in the table below. FIRR calculated at the time of ex-post evaluation was -4.81%. Reasons for gap between the FIRR at the time of appraisal and ex-post evaluation are that more investment has been made earlier than the plan at the time of the appraisal and that duration of benefit became shorter than the time of the appraisal because of delay in commercial operation. Regarding EIRR, it could not be calculated at the time of the ex-post evaluation because data from several sources are required for calculating actual and forecast for the benefits, and the data were not easily available.

Table 2: Internal Rates of Return at the Time of the Appraisal and Assumptions on Them

	FIRR	EIRR
IRR	At the time of the appraisal: -0.85% At the time of the ex-post evaluation: -4.81%	At the time of the appraisal: 8.13% At the time of the ex-post evaluation: Not recalculated
Cost	Project cost, operation and maintenance (O&M) cost	Project cost (excluding taxes and duties), O&M cost
Benefit	Farebox revenue, advertisement revenue, property development revenue	<ul style="list-style-type: none"> ▪ Saving of the cost for conventional transport modes and roads, saving of time of users of MRT and other

		transport modes, savings of operating costs for transport systems such as buses due to alleviation of road congestion, and reduction in accidents and pollutions
Project life	30 years	

Based on the above, although the project cost was within the plan, the project period exceeded the plan. Therefore, the efficiency of the project is fair.

3.3 Effectiveness and Impacts⁹ (Rating: ②)

3.3.1 Effectiveness

3.3.1.1 Quantitative Effects (Operation and Effect Indicators)

For evaluating the operation and effect indicators, figures set at the time of the Tranche II appraisal were taken as the project's target considering the final scope of the project. Ridership was not originally included in the indicators. However, since it is considered as a standard indicator that represents the effectiveness of the metro project, it was added as one of the operation indicators at the time of the ex-post evaluation.

Table 3: Operation and Effect Indicators

Indicator	Target	Actual			Achievement (Actual in FY 2019/Target)
	2015 (2 Years After Completion)	FY 2017 ¹⁰	FY 2018	FY 2019 (2 Years After Completion)	
Operating rate (%/year)	92	100	100	97	105%
Running distance (thousand km/day)	16.12*	10.20	12.37	11.78	73%
Number of running trains (two directions/day)	780**	505	586	542	70%
Volume of transportation (million man km/day)	10.12	2.72	3.46	3.74	37%
Income from passengers (INR million/day)	17.0	7.70	9.72	10.59	62%
Ridership (persons/day)	1,020,000	299,197	366,407	393,799	29%***

⁹ Sub-rating for Effectiveness is to be put with consideration of Impacts.

¹⁰ The fiscal year in India is from April to March of the following year.

Source: Materials provided by JICA, BMRCL

*At the time of the appraisal, it was calculated as network length x number of running trains x round trips x number of coaches = 48.3 thousand km/day. However, BMRCL normally uses the following formula: running distance = number of running trains x network length. Thus, the target anticipated at the time of the appraisal has been re-calculated.

**In the documents at the time of the appraisal, the number of running trains was 390 based on one-way trip (single direction), but round trip (two directions) was used to compare with the actual.

***Target was for the year of full commercial operation. Therefore, 2017 was used as the year of comparison for achievement.

Looking at the achievement against the target for each indicator, only the operating rate has achieved the target while the achievement rates for the other indicators are between 29 to 73%. Running distance, number of running trains, volume of transportation and income from passengers have not achieved the targets owing to less ridership than the original estimate. According to the 2011 estimate, 1,020,000 ridership was expected in the year of full commercial operation. However, according to the ridership revised in the detailed design of Phase 2 of the project, it is estimated to be 1,080,000 for the total length of 71.4 km, which includes the extension of the East-West and South-North lines, indicating that the ridership estimates of the project do not necessarily reflect the reality. When ridership is calculated for the project (a total length of 42.3 km) based on the conditions confirmed for Phase 2, it turns out to be 645,000 persons. Nevertheless, even if the target is revised, the actual ridership is only about half of it.

One of the reasons why ridership is less than the target is that people who do not live within the walking distance of the metro stations do not use the metro because last mile connectivity (linkage between a metro station and the destination or the point of departure) is not necessarily secured although the project is integrating the metro with other transport modes such as Indian Railways, long distance buses, and city buses. According to a metro passenger survey¹¹ by the Environmental Management and Policy Research Institute (EMPRI) in 2017, many of the metro users live within the walking distance of metro stations, revealing that use of metro by people living outside the walking distance to the metro stations is limited. Considering that an inclination many of the current metro users live within the walking distance of the nearest metro station and many people have pointed out that parking space is insufficient at metro stations, access to the metro stations is an issue to certain extent. However, according to the same survey, out of the 1,057 persons who responded to the questionnaire, 1,048 (99%) feel that using the metro has reduced the travel time.

BMRCL recognizes issues such as the lack of last mile connectivity mentioned above, which is detrimental to gaining ridership, and competition with app-based taxis that have become quickly and highly popular in India in recent years. Particularly, to improve access between the metro station and the destination or point of departure, BMRCL is setting up stands for auto rickshaws, which are a popular means of transport for people, and working with service

¹¹ EMPRI (2017). *Assessing metro railway system as a means of mitigation strategy to climate change*.

providers of rental bicycles and motorbikes.

Table 4: Integration with Other Transport Modes and Provision of Facilities at Metro Stations

Integration/facility	Number of metro stations
Bus terminal	3
Indian Railways	3
Feeder bus	18
Auto rickshaw stand	40
Parking	28

Source: BMRCL

BMRCL has integrated with Bangalore Metropolitan Transport Corporation from early on, and 36 routes of feeder buses are operating in the city. In addition, BMRCL is working with private rental cycle and motorbike agencies, and the passengers can rent cycles and motorbikes at the metro stations.



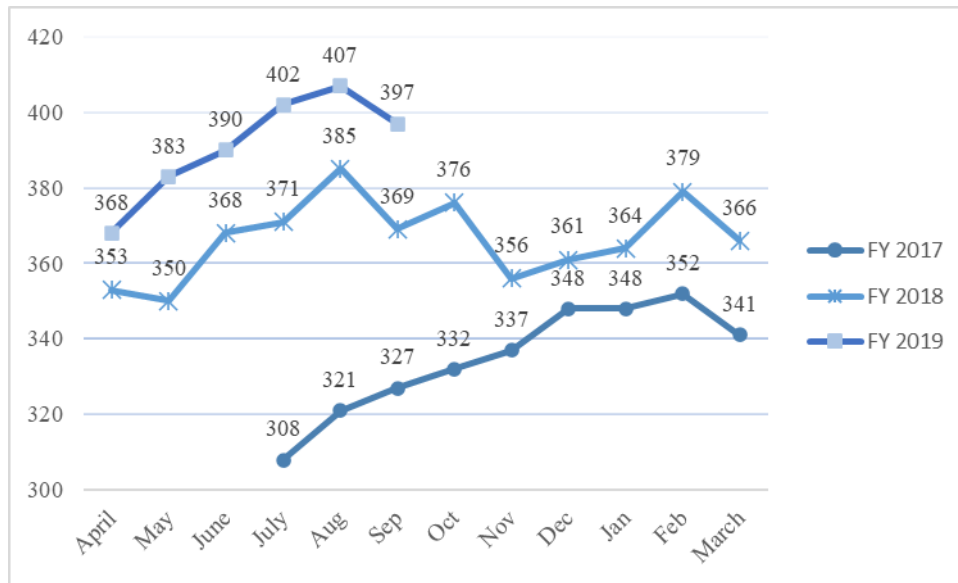
Figure 4: Signage for Transfer to Indian Railways



Figure 5: Auto Rickshaw Stand at a Metro Station

Because ridership was less than expected when commercial operation started, as of November 2019, the East-West line was operating with six coaches while the South-North line was operating with three coaches and partially with six coaches. The frequency of the trains was about every four minutes in peak hours and every seven to ten minutes during off-peak hours; this made the trains with three coaches very crowded. Initially, some passengers said that they do not use the metro because they do not like crowded coaches during peak hours; however, as the metro network expanded and people began to gradually recognize the convenience of the metro. In reality, average daily ridership is steadily increasing in the project since the opening of the metro. As of February 2020, all the trains have six coaches. Thus, improvement in ridership is expected in the future as well.

Unit: Thousand persons/day



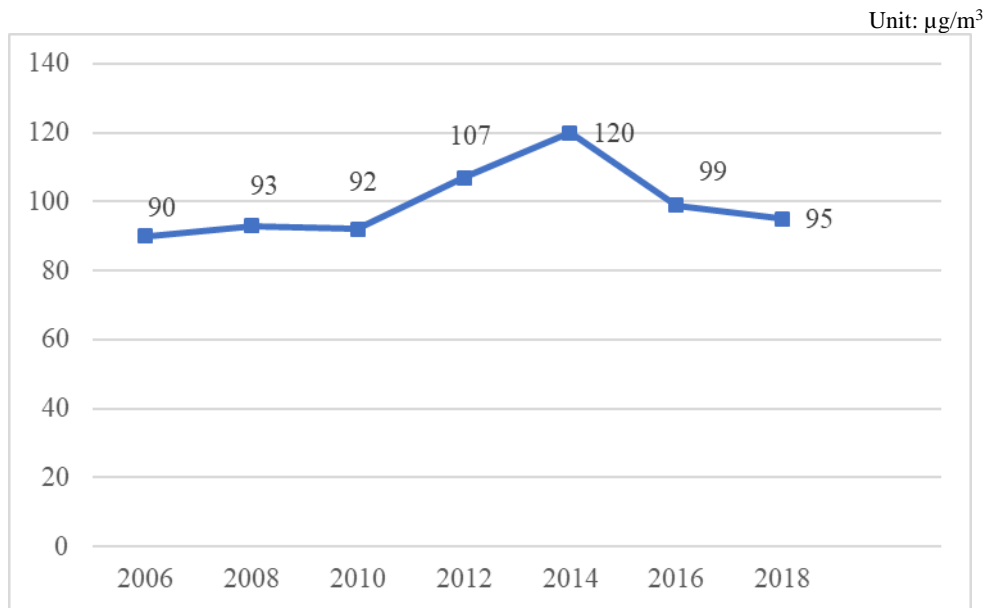
Source: BMRCL

Figure 6: Average daily ridership

3.3.1.2 Qualitative Effects (Other Effects)

The qualitative effects expected from the project were reduction of traffic congestion, improvement of the safety and comfort of urban life, and improvement of convenience by securing on-time mobility in Bangalore. The extent of the realization of qualitative effects has been checked based on the results of the previously mentioned survey by EMPRI in 2017 and by interviews with passengers at the time of the ex-post evaluation. Targeting 1,067 metro users, EMPRI surveyed socioeconomic changes brought by the metro operation and accessibility of the metro. In the survey, 53% of the users stated that traffic congestion decreased a little or partially in the city after the metro began operating. Moreover, 90% of the respondents felt that air pollution decreased a little or to a certain extent.

At the time of the ex-post evaluation, an interview survey was conducted with 18 users in the metro stations. The survey revealed that 11 of them felt metro operation helped ease the traffic congestion in the city somewhat. On the other hand, the opinions regarding air pollution were split: eight felt it decreased, six felt no change, and four said they do not know. The figure below shows the annual average of suspended particulate matter (SPM) in Bangalore since 2006.



Source: Created by the external evaluator based on data from the Central and State Pollution Control Board

Figure 7: Annual Average of SPM in Bangalore

According to the annual average SPM, there is an improving trend since the time of the appraisal; however, it cannot be concluded that the change was brought by the project. Nevertheless, with the construction of the MRT system, the people have gradually shifted from cars to the metro. As a result, the number of running vehicles has decreased somewhat, reducing air pollution to a certain extent. Thus, it is fair to say that the project contributed to the reduction of air pollution to some degree.

Regarding comfort and safety, all the respondents said that the metro is better than other transport means, while five respondents said that taxis and auto rickshaws are easier to use considering the crowded metro trains during peak hours and train frequency during off-peak hours. Other opinions are the following: using the metro has helped decrease travel time compared to before; people can travel on-time, and the use of the private car has decreased. Some users opined that, when they come to Bangalore from other regions, it is convenient to move to the metro from Indian Railways stations and bus terminals as the metro stations are connected to the railway and buses.¹²

As described above, many of the metro users feel that the opening of the metro has reduced traffic congestion somewhat. There are users who feel that air pollution has also decreased. Passengers have generally favorable impressions on the opening and use of the metro, and it is fair to say that the project has brought improvement to urban life to a certain extent.

¹² The responses from the interviewees and the reasons cited for the responses are not necessarily a collection of the results of one-on-one interviews.

3.3.2 Impacts

3.3.2.1 Intended Impacts

The impacts expected of the project were “promoting regional economic development and improving the urban environment through mitigation of traffic jams and decrease of pollution.” At the time of the ex-post evaluation, to confirm the contribution of the metro to the regional economy, interviews were conducted with seven industrial and commercial associations whose related businesses are located along the metro lines.¹³ From the start of the project, a shopping mall directly connected to a metro station invested in the construction of the station and advertisements to attract more customers, and started developing offices and residential complexes nearby. Regarding the businesses along the metro lines, some moved to locations nearby because of the metro construction, while others reported a decrease in revenues because the number of customers decreased owing to a long construction period and dust. On the other hand, economic associations have pointed out that the opening of the metro has enhanced the mobility of their employees and executives. Moreover, many interviewees cited a lack of parking space around the metro stations. The need for parking at the metro stations was pointed out in the EMPRI survey as well.

Some of the businesses that were forced to relocate because of the project have been affected adversely by the metro construction. However, the industrial and commercial associations have opined in general that the project, as a means of transport, has contributed to economic development to a certain extent. Thus, it is fair to say that the project is contributing to developing the regional economy and improving the urban environment of Bangalore.

3.3.2.2 Other Positive and Negative Impacts

Impacts on the Natural Environment

The project falls into the rail sector according to the JBIC Guidelines for Confirmation of Environmental and Social Consideration, and is classified as Category A because it included a large-scale involuntary resettlement.

During the construction, the contractors monitored such elements as air quality, noise, and water quality under the supervision of an environmental officer from BMRCL. Monitoring was conducted at the frequency of one to two weeks depending on parameters, and no issues were reported from this monitoring. An information board with the contact information of the officer in charge was displayed at each construction site. When there were complaints from people living in the vicinity regarding dust from the construction sites and vibration during excavation, BMRCL took proper actions such as watering regularly at the sites and stopping construction

¹³ ① Mantri Square Mall management office, ② Karnataka Small Scale Industries Association, ③ Brigade Road Trader’s Association, ④ CMH Road Shops and Establishments Association, ⑤ M.G.Road Trader’s Association, ⑥ Peenya Industries Association, ⑦ Karnataka Hosiery & Garment Association.

work at night.

Since the opening of the metro, no environmental monitoring has been conducted in the same areas. Rails were fitted with soundproof pads and measures against noise are taken.

While implementing the project, 950 trees were cut. To minimize the felling of trees, pruning and transplanting were practiced to the extent possible. For each tree cut, ten trees were planted in its place.

Resettlement and Land Acquisition

The total land area acquired for the project was 126 ha. The number of affected structures was 877 while the one of affected households was 2,288. Out of the affected households, 169 in the slum areas were moved to two locations provided by BMRCL. The remaining households received compensation money and relocated on their own. Resettlement plan was formulated based on *JBIC Guidelines for Confirmation of Environmental and Social Considerations* (April 2002). Compensation was provided in accordance with the *Karnataka Industrial Area Development Act* (1966). Guidelines on compensation and resettlement were prepared, and compensation money and allowance for the transition period were provided on the basis of the size of the affected land area and the way that the land had been used prior to the project.

Two resettlement sites provided by BMRCL were visited during the ex-post evaluation and interviews were conducted with the people affected by the project. The houses provided in both locations were constructed in the same layout as the adjoining BMRCL staff housing. The houses were registered in the names of the female heads of the households by BMRCL; BMRCL paid the cost of the registration. People who relocated to Peenya colony had lived in houses with asbestos, and the water came from the community tap while toilets were also shared with the community. However, in the relocation site, water supply and toilets are provided in each household and the people had no issues with water. The people relocated from the same original area, and many of them work as carpenters and household helps, and some of them landed work as household help in the BMRCL staff housing. The housing conditions in Srigandhakaval colony were essentially similar; however, Srigandhakaval was further away from the city center compared to the previous colony, and some said that their income decreased or they lost jobs because commuting became difficult. Moreover, access to the public bus network is bad from the resettlement site, and people seemed to be struggling with means of transport. In the project, BMRCL was to hire an NGO with its own funds and monitor the living conditions after the relocation, but the resettlement officer of BMRCL visited the relocation site regularly during and soon after the resettlement, and responded to requests and complaints from the project-affected people, and thus the monitoring by NGO was not conducted.



Figure 8: Resettlement Site



Figure 9: Temple Built at a Resettlement Site

Unintended Positive/Negative Impacts

In the construction phase of the project, Karnataka State AIDS Prevention Society implemented HIV prevention activities targeting migrant workers.

In addition, Samarthyam, an organization that supports the physically challenged, provided advice during the implementation of the project to make the stations and coaches accessible to such people. During a field visit, it was confirmed that elevators are installed in each station. Although tactile paths for the visually challenged are in place, it was observed in some of the stations that portions of the tactile paths are not continuous. A similar issue was pointed out in the metro survey conducted by the visually challenged in 2019.¹⁴ Space for a wheelchair is available in the first and last coaches.

In effectiveness, the operation and effect indicators have not achieved the targets except the operating rate because of less ridership than initially expected. On the other hand, initiatives such as improving access to the metro stations and adding coaches are taken, and the ridership has been increasing since the opening of the metro. The metro is becoming an important means of transport for the people of Bangalore, and thus, the improvement in a number of indicators is expected in the future. Moreover, the project has contributed to reducing the traffic congestion and air pollution in Bangalore a certain extent, as well as the development of the regional economy. This project has achieved its objectives to some extent. Therefore, the effectiveness and impacts of the project are fair.

3.4 Sustainability (Rating: ③)

3.4.1 Institutional/Organizational Aspect of Operation and Maintenance

The executing agency and operation and maintenance (O&M) organization of the project is

¹⁴ Varun and Vanitha (2019). *Study of challenges faced by visually impaired persons in accessing Bangalore Metro service.*

BMRCL, established in 1994 by the *Indian Companies Act (1956)*. In 2005, BMRCL became a fifty-fifty joint venture of the central government and the Karnataka state government. Headed by the Managing Director, the organization has a wing in charge of O&M of the network already in operation and a project wing in charge of the construction of a new network. The O&M wing is headed by the Director of O&M and has 1,375 personnel as of October 2019. The vacancy rate is about 15%, but according to an interview with BMRCL, there is no particular problem arising out of manpower shortage. Specifically, all the 143 Station Superintendent posts are vacant; however, these posts are currently looked after by 455 Station Controllers and Train Operators, and some of them will be promoted to be Station Superintendents. In the O&M wing, responsibilities are clearly divided based on job categories and train lines, and separation of duties is clear. The turnover rate since the start of commercial operation is about 4%, low compared to Indian average of 13%.¹⁵ The maintenance of such facilities as elevators and escalators as well as cleaning duties are outsourced to agencies.

As described earlier, BMRCL has strived to work with various transport related institutions in Bangalore from the project's planning and implementation stages. Even now, BMRCL is regularly coordinating with Bangalore Metropolitan Transport Corporation, Indian Railways, and the Urban Transport Department, and institutional arrangements for O&M are in place.

3.4.2 Technical Aspect of Operation and Maintenance

BMRCL has its own training institute located within the Baiyappanahalli depot. The training institute holds courses for new recruits and refresher training, and provides training for new metros in India. New recruits undergo several months of technical training according to job categories. Train Operators and Station Controllers are supposed to switch their duties every few years, and training programs for switching the jobs and for promotion are in place. According to the training records of the last three years at the institute, courses are conducted as per the training plan each year. This indicates that there is a system for learning, maintaining, and improving technical skills required for O&M within the organization.

From the beginning, BMRCL has recruited the engineers who retired from Indian Railways and engineers with working experience in Singapore MRT so as to meet the technical requirements for civil works and after starting commercial operation. Even at the time of the ex-post evaluation, many of the managerial-level personnel are those who came to BMRCL with experience in Indian Railways and central and state government agencies. New employees associated with O&M are required to have appropriate education and skills for their job, and have been hired through recruitment exams including written test and interview, and they receive training of a specific duration after taking up their job. No accidents have been reported

¹⁵ Oman Consultants (2019). *Increment Trend – 2019*.

in the project from the time of the opening to the ex-post evaluation. It has been reported that there is no issue with technical skills of employees, and the skills are at an appropriate level.

O&M manuals are prepared for each facility, while manuals for coaches are available for each part and equipment item. The O&M status of coaches is described in “3.4.4 Status of Operation and Maintenance.”

3.4.3 Financial Aspect of Operation and Maintenance

As shown in Table 5, BMRCL’s balance sheet for the last three years shows a loss. However, most of it is due to expenditures on O&M and depreciation.

Table 5: Balance Sheet of BMRCL

Unit: INR million

	FY 2016	FY 2017	FY 2018
Revenue			
Farebox	1,101	2,810	3,550
Advertisement	52	71	77
Property development	298	492	567
Reimbursement of cash loss	-	2,023	1,164
Total revenue	1,451	5,395	5,359
Expenditure			
O&M	1,723	2,629	3,352
Depreciation	3,642	5,158	5,839
Interest	662	1,118	1,125
Total expenditure	6,027	8,906	10,317
Profit/Loss	-4,576	-3,511	-4,958

Source: BMRCL

Current ratio of BMRCL is sound at 2.42 in FY 2017 and 1.82 in FY 2018. For repayment of debt, reimbursement for cash loss is provided by the Karnataka state government, in addition to repayment from BMRCL’s revenue. BMRCL requests the reimbursement for the loss for a particular fiscal year to the state government, and the budget provision is made by the government. Basically, the whole requested amount is sanctioned, but it is provided in phases from the state government’s budget in the subsequent fiscal year onwards.

As regards the passenger fare, it has not been revised for eight years since the metro started its commercial operation (in case of the token, the minimum fare is INR 10 and the maximum INR 42, while a 15% discount is applied for a ride using Smart Card). Fare structure for the metro is more expensive compared to city buses. For instance, traveling for distance of 3 km is

INR 15 for the metro while INR 10 for the bus, and it becomes INR 42 and INR 37 respectively for the distance of 18 km. In other cities in India, the metro fare is also more expensive than the bus fare. Fare revision is decided by the Fare Fixation Committee constituted by the central government. So far, BMRCL has requested a fare revision to the central government considering the price escalation since it started operating the metro and an increase in the O&M cost in the future, but there seems to have been no specific progress. On the other hand, the share of the fare revenue in the O&M cost was 64% in the opening year, and it has been more than 100% thereafter. Currently, the fare structure does not seem to pose any issue for meeting the O&M cost. However, as the O&M cost may increase gradually in the future, it is important to prepare for fare revision considering the market situation. Moreover, BMRCL is working hard to increase the advertisement revenue in the future, and its financial status appears to be sound.

3.4.4 Status of Operation and Maintenance

From a field visit during the ex-post evaluation, it was confirmed that the stations, coaches, and railway depots were properly maintained. Automatic vending machines procured with funds from the Indian side had problems with the coin slot, and were not installed at the stations at the time of starting commercial operation. By 2020, adjustments have been made to the machines and 11 of them have been installed at nine stations, and more machines are to be installed at other stations.

Coaches are cleaned and inspected every day and checked according to the check sheet before starting service. In addition, regular maintenance is performed based on the running distance of each coach.

None of the spare parts is difficult to procure in India, and the Indian metro projects in recent years have been procuring coaches and related parts from the manufacturers who have production units in the country. Thus, spare parts do not pose an issue.

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

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

In the beginning of the 1990s, traffic congestion was a serious issue in urban India, urgently requiring the establishment of a mass public transport system. Under such circumstances, by constructing a metro in the southern city of Bangalore, the project was implemented with the objective to contribute to developing the regional economy and improving the urban

environment through reducing traffic congestion and traffic pollution.

The urban transport sector, particularly the MRT system, has been considered important in India's development policy from the time of the appraisal to the ex-post evaluation. Traffic congestion, particularly in the central part of the city, remains a serious issue even at the time of the ex-post evaluation. The need for the people to switch to rail-based transport, who were dependent on road transport, is recognized even now, and development needs on MRT continue to exist. The project was consistent with Japan's ODA policy at the time of the appraisal, and the relevance is high.

According to the original plan, an MRT system with the total length of 33 km, comprising the East-West and South-North lines, was to be built. However, the project included the extension of the South-North line in 2011, and a network of 42.3 km in total was constructed. Because of limited ridership at the time of opening, less rolling stock was procured than originally planned. Although the project cost was within the plan, there was a significant delay in the project period caused by geological conditions not anticipated during the detailed design, such as uneven bedrock, which were found after the project started. This has made the efficiency of the project fair.

Regarding the achievement of operation and effect indicators, only the operating rate achieved the target, and other indicators achieved 29–77% of the targets owing to less ridership than the initial estimate. On the other hand, many metro users feel that the opening of metro has reduced the city's traffic congestion and air pollution. With regard to the natural environment, necessary actions were taken during the implementation of the project. As regards land acquisition and resettlement, there are no specific issues. Therefore, the effectiveness and impacts of the project are fair.

In BMRCL, the organization operating and maintaining Bangalore Metro, has necessary institutional arrangements for operating and maintaining the existing network, and its employees have necessary technical skills. BMRCL has an internal training system to maintain and improve the skill level of its employees. As regards the financial aspect, BMRCL is running a deficit, but its farebox revenue is at a sufficient level to meet the operation and maintenance costs. Stations, trains, and other equipment are appropriately managed, and the sustainability of the project is high.

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

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

Currently, the farebox revenue from the project is at sound level compared to O&M cost. However, O&M cost may gradually increase in the future. Since fare revision may take more time than necessary for coordinating within the government, it is desirable to follow-up on fare

revision and to strengthen the revenue sources by increasing the revenue from advertisement and property development.

4.2.2 Recommendations to JICA

None

4.3 Lessons Learned

Coordination with other transport modes

From the time of project formulation, the project consciously coordinated with Indian Railways, long distance buses, and city buses while it was constructing the metro network and stations. This has resulted in several stations in the metro lines where transfer to other transport modes can be easily made. Integration between the metro and other transport modes is convenient for the users who come from outside the city, and it has contributed to gaining some degree of ridership. To integrate with other transport modes after the construction of metro lines requires changes in the design of stations. To connect to Indian Railways, land had to be provided by Indian Railways to construct a passageway from the metro on the land owned by the national railway company. Although it took time to secure the land, the project negotiated persistently and repeatedly with other transport institutions and enhanced the convenience and mobility of people using transport.

Comparison of the Original and Actual Scope of the Project

Item	Plan	Actual
1. Project Outputs	<p>a) Civil works</p> <ul style="list-style-type: none"> • East-West line: 18.1 km • South-North line: 24.2 km • 33 at-grade and elevated stations and 7 underground stations <p>b) Electric, communication and signaling systems</p> <p>c) Procurement of coaches: 168</p> <p>d) Construction of depots</p> <p>e) HIV prevention activities</p> <p>f) Consulting services</p> <ul style="list-style-type: none"> • Detail design, preparation of tender documents, assistance in bidding • Construction management, quality control, test drive • Preparation of O&M manuals, training program 	<p>As planned</p> <p>As planned</p> <p>150 coaches</p> <p>As planned</p> <p>As planned</p> <p>As planned</p>
2. Project Period	March 2006 – June 2013 (88 months)	March 2006 – June 2017 (136 months)
3. Project Cost		
Amount Paid in Foreign Currency	67,482 million yen	66,990 million yen
Amount Paid in Local Currency	239,327 million yen (127,301 million Indian rupees)	177,657 million yen (99,720 million Indian rupees)
Total	306,809 million yen	235,498 million yen
ODA Loan Portion	64,536 million yen	57,840 million yen
Exchange Rate	1 Indian rupee = 2.49 yen (As of September 2010)	1 Indian rupee = 1.90 yen (Average between January 2007 to December 2017)
4. Final Disbursement	September 2017	

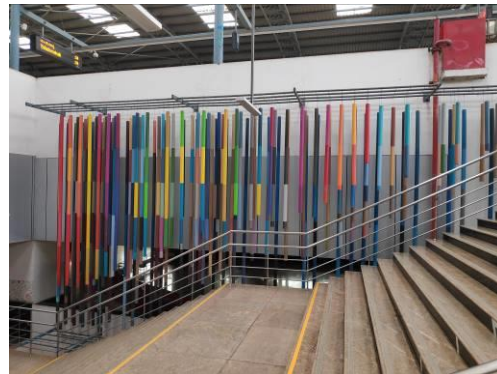
【Column: Interaction with citizens through the metro】

Bangalore has many parks and is endowed with plentiful greeneries for a large city, which is why it is also known as Garden City. Cubbon Park, which is called the city's lung, is located in the central part of the city, and has the metro station with the same name. Anybody who sets foot in the Cubbon Park station is bound to be mesmerized by the colorful exterior of the station and the works of art installed inside the station. At the Cubbon Park, Chickpete, and Peenya stations, a local college is undertaking the "Art in Transit" initiative using the space in and out of the stations. By installing works of art in the metro, which is a public place, the initiative is using it for facilitating dialogue and interaction with the local people. The initiative provides opportunities for the people in transit to think and discuss Bangalore's history, identity, and social issues, while the works of students studying art, design, and technologies are displayed and the space is used for experiment. Some of the metro stations have entrances and exits that were built in anticipation of a future increase in passengers but are not currently used. Art in Transit uses such space as studios. At times, theater and workshops are conducted there, and some come to the stations for such events even if they do not use the metro.

The vicinity of the Peenya station is an industrial zone with a dusty and dim image. A student who took part in Art in Transit walked around the neighborhood of Peenya and photographed the colors of the area. From the photographs, she took out the vibrant hues of the area, and set up an art object in the station using them. The object helps passers-by feel at ease.



Walkway outside MG Road Station



Installation at Peenya Station

Art in Transit focus on more than just art. Recently, it conducted a questionnaire survey on the safety of women at specific stations, and studied their safety between the stations and their homes. The findings were shared with BMRCL and the local police. As a result, the Bangalore police launched an app for women SOS.

Furthermore, BMRCL uses the space under the elevated MG Road station as small theater, gallery and children's park. BMRCL turned the space, which had been a walkway before the metro construction, into new space for the community.

Annex 1: Bangalore Metro Network



Republic of India

FY2019 Ex-Post Evaluation of Japanese ODA Loan Project

“Visakhapatnam Port Expansion Project”

External Evaluator: Chizuru Asahina, IC Net Limited

0. Summary

Visakhapatnam Port is one of the 13 major ports in India and boasts the largest export volume of iron ore in the country. However, with the increasing size of vessels worldwide, the port had not been able to accommodate vessels of 200,000 DWT (Deadweight Tonnage) or larger. In addition, because of the deterioration of port facilities, the efficiency of transportation capacity declined. For these reasons, this project came to be implemented to improve the iron ore transport capacity and efficiency by enhancing dredging and existing facilities, thereby contributing to the economic development of the country through the expansion of iron ore exports.

It is recognized that strengthening transportation capacity and modernizing port facilities through port expansion work are important in India's development policy from the time of the appraisal to the time of the ex-post evaluation. Although the export volume of iron ore, which was expected to increase at the time of the appraisal, was on a declining trend throughout the country, the need for improving transport capacity by accepting large vessels remained unchanged at the time of the ex-post evaluation and is consistent with development needs. This project is highly relevant as it is consistent with Japan's aid policy. Owing to the introduction of Public Private Partnership (PPP), the scope of the project was reduced and only the marine works were covered by the ODA loan. Thus, the project cost and period changed significantly from the time of the appraisal. The project cost was within the plan owing to a fluctuation in the exchange rate. During the project period, it took a long time to select a consulting company and a contractor, causing a major delay. Thus, efficiency was fair. Regarding operation and effect indicators, only the maximum deadweight tonnage and the number of large vessels were used as indicators and the targets were achieved. Regarding the improvement of the safety of vessel navigation, since larger vessels started entering the port after the implementation of this project and many captains are unfamiliar with the port, the safety has been secured by establishing a system of small vessels waiting and towing those entering vessels. In addition, the port user companies said that the port was relatively safe as it had been before the implementation of the project. Regarding the improvement of port efficiency, the berth occupancy rate and the average waiting time have exhibited certain effects, contributing to the improvement of transport capacity. Concerning the amount of cargo handled, the number of incoming vessels, and the tonnage of incoming vessels, all of which were expected to have a synergistic effect with the PPP project, no significant effect was shown. On the other hand,

although the export volume of iron ore is declining in India as a whole, it was found that the share of iron ore export at Visakhapatnam Port increased. In addition, no negative impact on the natural environment, resettlement, and land acquisition has been confirmed; thus, the effectiveness and impacts are fair. No major problem was seen with regard to the operation and maintenance systems, technical aspects, or financial aspects. Moreover, the division of roles is clear between the project and the companies that took part in the PPP components such as Essar Vizag Port Ltd. (EVTL) and Vedanta. Accordingly, it is fair to say that the sustainability is high.

Considering the above, this project is evaluated to be satisfactory.

1. Project Description



Project Location



Mooring dolphin constructed by this project

1.1 Background

In India, 200 ports in total, which consist of 13 major ports and 187 minor ones,¹ are operating. India's port cargo handling volume has grown rapidly because of the Open-Economy Policy of the country. In the five fiscal years from 2001 to 2005, the total cargo handling volume of the 13 major ports increased from 287.6 million tons to 423.4 million tons at a high growth rate of about 10% per year. Seventy-nine percent of the total cargo handled was related to petroleum products, iron ore, and coal resources. The volume of containers also increased from 37 million tons in 2001 to 51 million tons in 2003.

While the amount of cargo handled at the ports was growing rapidly, the ports' operational efficiency was generally low for the following reasons: the project to expand the ports was not fully implemented due to the lack of financial resources of the Port Trust, the facilities were deteriorating, and the overall productivity and service level of workers were low. Furthermore, it became an issue that the number of berths, lengths, and water

¹ The major ports refer to those under the jurisdiction of the central ministries; and the minor ones are those under the jurisdiction of the state governments.

depths of major ports in India were smaller than those in other countries as large-scale vessels such as container ships and bulk carriers came into use all over the world.

1.2 Project Outline

The objective of this project is to increase the iron ore transportation capacity and enhance the transportation efficiency by upgrading the existing iron ore handling facilities at the Visakhapatnam Port, one of India's major ports located in southern Andhra Pradesh state, thereby contributing to the country's economic development through expanding iron ore export quantity.

Loan Approved Amount/ Disbursed Amount	4,129 million yen / 1,888 million yen
Exchange of Notes Date/ Loan Agreement Signing Date	March 2007 / March 2007
Terms and Conditions	Interest Rate 0.75% Repayment Period 15 years (Grace Period 5 years) Conditions for Procurement General untied
Borrower / Executing Agency	President of India / Visakhapatnam Port Trust
Project Completion	October 2016
Target Area	Andhra Pradesh, South India
Main Contractor (Over 1 billion yen)	International Seaport Dredging (India)
Related Studies (Feasibility Studies, etc.)	Feasibility Study by Visakhapatnam Port Trust (F/S) (2005)
Related Projects	[ODA Loan] Tuticorin Port Dredging Project (December 1997 - March 2002)

2. Outline of the Evaluation Study

2.1 External Evaluator

Chizuru Asahina, IC Net Limited

2.2 Duration of Evaluation Study

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

Duration of the Study: July 2019 – August 2020

Duration of the Field Study: November 17–30, 2019; February 20, 2020 – March 5, 2020

2.3 Constraints during the Evaluation Study

As described later in “3.1.4 Appropriateness of the Project Plan and Approach,” after the signing of the ODA loan agreement, only the marine works were covered by the ODA loan for this project, and other works were implemented under PPP. It was decided at the time of the scope change that the project should be evaluated as a whole, including the PPP components, in order to ensure that the project generates the intended effects. However, because there was a time lag between the marine works and the PPP components, the latter not monitored, and therefore it is difficult to obtain detailed information on the PPP components. For this reason, there are constraints on the evaluation of the entire project including the PPP components. Therefore, only the marine works that were covered by the ODA loan after the project scope was changed were assessed in the ex-post evaluation.

3. Results of the Evaluation (Overall Rating: B²)

3.1 Relevance (Rating: ③³)

3.1.1 Consistency with the Development Plan of India

At the time of the appraisal, the *Tenth Five-Year Plan* (2002-2007) and the *Eleventh Five-Year Plan* (2007-2012) recognized the need to move towards increasing the cargo handling capacity of ports and modernizing port facilities. In addition, the *National Maritime Development Program* issued by the Ministry of Shipping in July 2005 announced to implement 219 projects, including this one, in the subsequent 10 years, focusing on expansion and rehabilitation of major ports and business development such as dredging and improvement of access to ports.

At the time of the ex-post evaluation, in the *Twelfth Five-Year Plan* (2012-2017) and the *Three-Year Action Agenda* (2017-2019), emphasis was placed on strengthening the cargo handling capacity for receiving large vessels and large containers, improving efficiency at facilities equipped with IT, improving efficiency by reducing waiting time, and creating job opportunities through trade. From April 2005 to May 2012, a total of 276 projects were implemented, including the repair of port facilities planned by the Ministry of Shipping’s *National Maritime Development Program*. Subsequently, the *Sagarmala Policy*, which the Ministry issued in 2016 focusing on port development, stressed on the following points.

- Capacity enhancement and efficiency improvement of the existing ports
- Efficient transportation of port cargo by rail, road, and inland water

² A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory

³ ③: High, ②: Fair, ①: Low

- Port- and ship-related industry promotion
- Economic uplift of underdeveloped waterfront areas as a whole through job creation

As mentioned above, it can be seen that, at the times of both the appraisal and the ex-post evaluation, the Government of India attached great importance to improving transport capacity by accommodating large vessels in ports and improving efficiency by refurbishing equipment. At the time of the ex-post evaluation, there were no external factors that would cause the project to lose relevance that it had at the beginning, and the project is highly consistent with India's development plan.

3.1.2 Consistency with the Development Needs of India

India's 5,560 km coastline has 13 major ports, and Visakhapatnam Port is operated as one of them. The port's annual cargo handling volume in 2005 was 55.8 million tons, making it the largest port in India. In particular, the port was positioned as a major export port for high-grade iron ore mined from the Bailadila mine, and the amount of iron ore handled at the time of the appraisal was 16.0 million tons. The amount of iron ore handled at the outer harbor reached 15.7 million tons in 2012, and it was expected that vessels entering the port would also become larger. However, because only vessels up to 150,000 tons were able to enter the port, there was a growing need to expand the port facilities that could accommodate large vessels of 200,000 tons or larger. As for cargo handling equipment, it was installed in 1976 and deteriorated significantly. Thus, it was necessary to renew the equipment.

In addition, at the time of the appraisal, India was the third largest iron ore exporter to Japan, and the Metals and Minerals Trading Corporation of India (MMTC) and Nippon Steel Corporation kept renewing a contract every five years since 1958. In 2018, they concluded a three-year contract and export 3 to 4.3 million tons per year. On the other hand, according to the materials obtained at the time of the ex-post evaluation, the export volume of iron ore at Visakhapatnam Port has been declining since 2011. However, the country's iron ore export volume is also decreasing at the same time, and Visakhapatnam Port's share in India's iron ore export volume as a whole is increasing (see the "Effectiveness and Impacts" section below for details). From the time of the appraisal, it was necessary to strengthen the capacity of freight transportation and renew aging equipment; thus, the needs of this project were high.

After the ODA loan was provided, the project focused on improving the transport capacity through the introduction of PPP. The need to strengthen transport capacity remains the same at the time of the ex-post evaluation. Accordingly, the project is highly consistent with the development needs of India.

3.1.3 Consistency with Japan's ODA Policy

The Government of Japan stated in the *Medium-Term Strategy for Overseas Economic Cooperation Operations Country Assistance Strategy* that “improving the foundation for sustainable growth” was the overall priority area, and that “improving economic infrastructure” was the priority area of the country policy for India. Furthermore, in the *Country Assistance Policy for India* in 2006, the transportation sector, including ports, was positioned as a major sector to support in India, and the support policy for the sector was “to support the development of infrastructure that contributes to efficient logistics.” Thus, at the time of the appraisal, Japan's ODA policy was highly consistent with this project.

3.1.4 Appropriateness of the Project Plan and Approach

After signing the ODA loan agreement, around 2010, there was a transition toward PPP in all infrastructure projects in India. Considering technical and economic efficiency, only marine works with highly public nature were covered by the ODA loan, and it was decided to transfer other components to PPP. Based on this, the project scope of the marine works was changed. This change was difficult to foresee at the time of project planning, but it was an approach that flexibly responded to Indian public policy.

From the above, although there was a problem that the project was not fully monitored owing to the transition of some undertakings to PPP, this project has been highly relevant to India'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

Initially, after the signing of the loan agreement (L/A) for this project, the ODA loan covered civil works, marine works, mechanical and electrical works, social development, and consulting services. However, in 2008, there was a growing movement in India to implement through PPP overall infrastructure projects including ports, and PPP guidelines were established. The table below summarizes the project scope at the time of the signing of the L/A and the change in the scope (for details, see “Comparison of the Original and Actual Scope of the Project” on the last page of the report).

Table 1 Project Scope Comparison at the Time of L/A Signing and Scope Change

At the Time of L/A Signing	After the Scope Change
1 Civil Engineering Works 1.1 Stockyard Preparation 1.2 Transfer Tower and Galleries	Implemented through PPP.

1.3 Train Siding (New Tracks) 1.4 Train Siding (Dismantling Existing Tracks)	
2 Marine Works 2.1 Mooring Dolphin Construction 2.2 Dredging	Implemented through ODA loan, but partially implemented through VPT's internal funds
3 Mechanical and Electrical Works 3.1 Mechanical Works 3.1.1 Ship loader 3.1.2 Reclaimer 3.1.3 Stacker 3.1.4 Belt Conveyor System 3.2 Electrical Works	Implemented through PPP
4 Innovative Social Intervention Component	Implemented through PPP
5 Consulting Services	Implemented through PPP

Considering technical and economic efficiency, the scope of the project was changed. As a result, only marine works, which are highly public in nature, were covered by the ODA loan, and other works were carried out under PPP. Therefore, in this ex-post evaluation, as described in 2.3, only marine works are targeted for evaluation. The executing agency, Visakhapatnam Port Trust (VPT), carried out marine works including the construction of mooring dolphins and dredging of the channel and the anchorage without delay. The table below presents the original and actual scope of this project.

Table 2 Comparison of Scope (Original and Actual)

	Original	Actual	Differences
Marin Works			
Mooring dolphin	An additional mooring dolphin for 200,000 DWT	An additional mooring dolphin for 200,000 DWT	No change. It was implemented through VPT's internal funds.
Amount of dredged soil	2.35 million m ³	2.35 million m ³	No change. It was implemented partially through VPT's internal funds.
Dredging of channel	Water depth 22 m	Water depth 22 m	
Dredging of anchorage	Water depth 21 m	Water depth 21 m	
Dredging of approaches to iron ore berth	Water depth 20 m	Water depth 20 m	

3.2.2 Project Inputs

3.2.2.1 Project Cost

In 2011, the scope was changed, and the amount of marine works budget was revised. In this project, all the components except marine works were moved to PPP, and there was no

detailed information on the PPP components; thus, it is impossible to make a comparison using the total project cost. Therefore, instead of using the total project cost, only the project costs of marine works covered by the ODA loan is used for comparison. The comparison was first made between the planned amount at the time of appraisal and after the scope change, then between the planned amount after the scope change and the actual cost.

The plan at the time of the appraisal was 1,101 million yen for the entire marine works. When the scope was changed, the cost of the construction of mooring dolphins was revised to 46 million rupees (98 million yen) and the dredging of channels and anchorages to 1,144 million rupees (2,288 million yen), resulting in a total project cost of 2,386 million yen.

The following are the reasons why the construction cost at the time of the scope change became twice the one at the time of the appraisal: (1) the inflation rate became 9.5%; (2) the estimated cost of dredging at the time of the appraisal was 300 rupees/m², but when the scope was changed, the successful bid was 471 rupees/m², (3) as a result of the survey at the time of the scope change, hard dredging such as shaving rocks, was found to be necessary for construction work that was thought to be only soft dredging to dig up soft sand, and the cost increased due to the procurement of hard dredging equipment for this purpose.

The actual costs of the project were 94 million rupees (160 million yen) for the construction of mooring facilities and 1,180 million rupees (1,926 million yen) for channel and anchorage dredging, for a total of 2,086 million yen. Of this amount, 1,888 million yen was funded by ODA loans, and the remaining 198 million yen was covered by VPT's internal funds.

Comparing the planned and the actual, the project cost was within the plan as a whole (87% compared to the plan). Although the actual value exceeded the planned one by about 10% on the Indian rupee basis, it was reduced by the yen appreciation of around 30% on the yen basis.

3.2.2.2 Project Period

The planned period was from March 2007 (when the L/A was signed) to September 2012 (5 years and 6 months = 66 months), and the actual one was from March 2007 to October 2016 (9 years and 7 months = 115 months). As a result, the ratio of the actual period to the planned one was 174%. This was because, as mentioned in the Output section, the Government of India proposed the transition to PPP after the ODA loan was provided, and it took time for coordination. The table below shows the planned and actual periods of marine works.

Table 3 Planned and Actual Periods of Marine Works

Marine Works	Plan	Scope Change	Actual
Mooring dolphin construction	February 2009-March 2010	June 2011-August 2012 (1 year and 2 months)	July 2015-October 2016 (1 year and 3 months)
Dredging of channel and anchorage	May 2009-March 2010	May 2011-September 2012 (1 year and 4 months)	October 2013-March 2014 (6 months)

Comparing each project period, the construction of the mooring dolphin was delayed by about one month, but the dredging was completed in about half the planned period. The reason for the delay in the start of marine works was the delay in the Indian government's approval to transfer some components of the project to PPP. When the scope was changed, the construction of the mooring dolphin was scheduled to start a month after the dredging. This was for selecting a consulting company and a contractor separately from the dredging because the construction of the mooring dolphin was going to be carried out with the internal funds of VPT. However, it took time for VPT to select a consulting company and a contractor, which delayed the start of mooring dolphin construction. In addition, the direct hit by a major cyclone in October 2014 had a significant impact. Although the construction itself did not take long, it took much time to coordinate the transition to PPP and start the construction work for the mooring dolphin. Thus, the period of the whole marine works exceeded the plan.

3.2.3 Results of Calculations for Internal Rate of Return (Reference Only)

Most components of this project were transferred to PPP after signing the loan agreement, and it is difficult to provide the necessary basis for calculating the financial internal rate of return (FIRR) and the economic internal rate of return (EIRR). The calculation method of FIRR/EIRR when the scope was changed was also unclear. Therefore, FIRR/EIRR is not recalculated.

Based on the above, although the project cost was within the plan, the project period exceeded the plan. Therefore, the efficiency of the project is fair.

3.3 Effectiveness and Impacts⁴ (Rating: ②)

3.3.1 Effectiveness

3.3.1.1 Quantitative Effects (Operation and Effect Indicators)

As explained in "2.3 Constraints during the Evaluation Study" and "3.1.4 Appropriateness of the Project Plan and Approach," although the entire project including

⁴ Sub-rating for Effectiveness is to be put with consideration of Impacts.

the components transferred to PPP were targeted for evaluation and either the objective or the indicators were not changed, the PPP components were not monitored by JICA. Thus, the overall evaluation could not be done due to the lack of information. It cannot be said that only the marine works component has direct effects on the amount of cargo handled, the number of ships entering the port, the tonnage of ships entering the berth, the berth occupancy rate, and the average waiting time. Although it may contribute to these indicators, there are many other factors such as the upgrading of facilities and equipment through PPP that could have more direct influence on them. It is hard to say that there is a correlation that marine works directly produced these effects. Therefore, the initially assumed indicators and contributions to the achievement of project objectives shall be verified as impacts; and it is appropriate to say that only the maximum deadweight tonnage entering the port and the number of large vessels with the maximum load of 160,000 DWT or more, which is a direct effect of marine works, are used as the indicators of effectiveness.

Table 4 Quantitative Effects (Operation and Effect Indicators)

	Baseline	Target	Actual		
	2006	2013	2016	2017	2018
		2 Years After Completion	Completion Year	1 Year After Completion	2 Years After Completion
Maximum Deadweight Tonnage (DWT ⁵)	151,982	200,000	200,000	200,000	200,000
Number of Large Vessels*1	0	N/A	21	21	14

Source: Project Completion Report, VPT's answers to a questionnaire

Note 1: Here, to measure the effect of dredging work, a vessel with the maximum load of 160,000 DWT or more is designated as a "large vessel."

The maximum deadweight tonnage achieved the target because the dredging work enabled large vessels to enter the port. Before the project was implemented, 150,000 DWT was the maximum deadweight tonnage in the port, but this project enabled large vessels up to 200,000 DWT to enter the port. Since 2016, after the completion of the project, 21 large vessels of more than 160,000 DWT have entered the port. It can be seen that due to the dredging work at the outer harbor and the construction of mooring dolphin, large vessels can now enter the port and are actually in operation.

⁵ DWT is the abbreviation of deadweight tonnage. It is a unit that represents the loading capacity of a sailing vessel or the amount of cargo they can safely carry.

3.3.1.2 Qualitative Effects (Other Effects)

Mentioned in the Impacts section.

3.3.2 Impacts

3.3.2.1 Intended Impacts

The impact of this project at the time of the appraisal was "creating employment opportunities in the hinterland." There were seasonal workers who engaged in the marine works, but no large impact on "creating employment opportunities" after implementing the project was confirmed. Moreover, the external evaluator tried to interview PPP-related companies as the scope was changed to only the marine works, but no information was provided. Thus, in relation to "creating employment opportunities in the hinterland," the impact of this project including the components transferred to PPP was not confirmed.

This section analyzes "safety improvement of vessel navigation" and "improvement of port efficiency" of this project as impacts after the scope change.

- Safety Improvement of Vessel Navigation

According to an interview with VPT, after the dredging, large vessels started entering the port, but many of their captains are unfamiliar with the port. Thus, a system that small vessels wait for large vessels and tow them has been established. This not only ensures safety but also contributes to improving port efficiency in such aspects as shortening waiting time. In the interviews with five user companies, it was recognized that the safety assurance had been in place and that it was maintained by VPT, rather than improved after the construction. With regard to safety, user companies have high confidence in VPT.

- Improvement of Port Efficiency

Out of the five user companies of the outer harbor, EVTL (iron ore) and Vedanta (coal), which implemented civil engineering, mechanical and electrical work through PPP, stated that the transport capacity has increased because large vessels can enter the port. According to EVTL, cargo handling time has been reduced thanks to the new mooring dolphin installed at the iron ore berth that allowed larger vessels to enter the port, coupled with the impact of the upgraded cargo handling facilities and equipment from the mechanical and electrical work carried out through PPP. Vedanta has said that it can transport cargoes efficiently by using one of the five Indian ports that can accommodate large vessels.

The table below summarizes the indicators of traffic volume at Visakhapatnam Port.

Table 5 Indicators on Traffic Volume at Visakhapatnam Port

Indicator	Baseline Value (2006)	Target Value (2013: 2 years after project completion)	Actual Value (2017)	Actual Value (2018: 2 years after project completion)	Actual Value (2019)
Berth Occupation Rate (%)	81	54	65	53 (98.1%)	82
Average Waiting Time (Hour) ^{*1}	N/A ^{*2}	N/A ^{*2}	0.79	1.84 (149%)	1.65
Total Cargoes (MT, iron ore related in outer harbor)	13.7	15.7	9.6	9.64 (61.4%)	6.81
Number of Vessels	225	172	119	119 (69.1%)	131
Total Gross Tonnage (MT)	8.91	9.07	6.35	5.87 (64.7%)	4.33

Note 1: The definition of the average waiting time is "the time it takes from the time the vessel is determined to be ready to dock after submitting all the required documents to the time it is actually anchored.

Note 2: As the average waiting time is an additional indicator, the baseline and target values are not shown.

The dredging work has allowed larger vessels to enter the port, which has resulted in a berth occupancy rate of 53% in 2018 and 75% in 2019, from 81% in 2006. The berth occupancy rate is the ratio of the actual operating hours (converted to the number of days) to the annual usable days (365 days) of the berth. Therefore, the waiting time of the vessels tends to be longer when the berth occupancy rate becomes higher than the appropriate value.

With regard to the average waiting time, it was 1.84 hours in 2018, which is less than one-third the baseline value of 5.65 hours in 2007. One of the reasons for this is that the number of vessels itself has decreased as it became possible for large vessels to enter the port.

On the other hand, the decrease in the number of vessels entering the port was below the expected value. As it is hard to obtain information on the transaction status of user companies, it is not possible to determine the factors involved. However, VPT points out that the number of user company transactions using the outer harbor is decreasing. The same applies to the volume of cargoes handled and the tonnage of ships entering the port.

The table below indicates the export volume of iron ore at Visakhapatnam Port and in India as a whole.

Table 6 Export Volume of Iron Ore at Visakhapatnam Port and in India

Year	Export Volume of Iron Ore at Visakhapatnam Port (MT) ^{*1}	Export Volume of Iron Ore in India (MT) ^{*2}	Share of Visakhapatnam Port (%)
2007-08	13.93	104.27	13%
2008-09	13.70	105.87	13%
2009-10	12.14	100.00	12%
2010-11	12.28	46.90	26%
2011-12	10.02	47.20	21%
2012-13	9.58	18.00	53%
2013-14	6.79	16.00	42%
2014-15	5.76	16.30	35%
2015-16	5.45	30.48	18%
2016-17	8.42	-	-
2017-18	9.50	30.73	31%
2018-19	9.68	24.19	40%

*1 Source: Questionnaire to VPT

*2 Source: Statista

(<https://www.statista.com/statistics/268653/indian-iron-ore-exports-since-2006/>)

Although the export volume of iron ore at Visakhapatnam Port has been on the decline since 2011, Table 6 indicates that the export volume of India as a whole has also been decreasing because of the impact of the world economy. The rate of decrease in iron ore export at Visakhapatnam Port is small compared to the decrease in India's total export. Furthermore, it can be said that there is an increasing trend after the completion of this project in 2016. In addition, the total ratio of Visakhapatnam Port's iron ore export to that of India is on the rise, and the port's economic contribution to the entire country can be seen.

3.3.2.2 Other Positive and Negative Impacts

Impacts on the Natural Environment

This project was classified under category A because it fell under the port sector, which was listed as one of the sectors that were likely to have an impact on the environment in the *JBIC Guidelines for Confirmation of Environmental and Social Considerations* (established in April 2002). In November 2006, the Environmental Impact Assessment (EIA) report was approved by the Ministry of Environment and Forests. Regarding sewage and waste generated in the port, they were to be processed in such a way that meets domestic standards based on VPT's own standards and the *Marine Pollution Control Convention*, etc., and such standards were adhered to even after the transition to PPP. The

dredged soil was dumped on the seabed about 3 km away from the outer harbor, which is an appropriate method recommended on the basis of the results of a study by a research institute called Central Water Power Station. Environmental monitoring and measurement equipment were installed at three locations near the VPT facility and Visakhapatnam Port to record environmental data. No major environmental impact by this project has been confirmed.

After the project started, there were complaints mainly from residents in neighboring areas about air pollution during the construction of the belt conveyor connecting the iron ore yard with the cargo handling area and the construction of the mooring dolphin at the outer harbor. For this reason, the environmental measures team headed by the Deputy Director of the Transportation Section of VPT conducts monitoring twice a day at the port between 6 a.m. and 10 p.m. In addition, chaired by Professor Prasada Rao of Andhra University, the Environmental Monitoring Committee is held once every two months with VPT, port user companies, and neighboring residents.

As dust is apt to fly around the conveyor and the stockyard of coal and iron ore, water is sprinkled every few hours daily, and the coal and iron ore in the stockyard is covered with vinyl sheets. As the green belt activity,⁶ afforestation is being carried out on the main roads leading to the port and roads in the port.

VPT works hard on measures against environmental problems, and has won the Greentech Award for organizations, companies, and groups in India sponsored by the Greentech Foundation for four years in a row. Visakhapatnam Port is an environmental model for the city of Visakhapatnam.



Watering by sprinklers



Tree planting near a conveyor

Resettlement and Land Acquisition

There was no resettlement and land acquisition for dredging and mooring dolphin construction at Visakhapatnam Port.

⁶ A green belt refers to a greenery area created on median roads and by urban planning.

Other Positive/Negative Impacts

At the time of the appraisal, construction workers were to be seasonal workers from rural areas, and there was a plan to carry out an HIV prevention activity for workers and neighboring residents. However, it was decided not to implement this activity in this project when the scope was changed. There was a report from Vedanta that they did not implement the activity through PPP.

At the school located near the container terminal of the port, there was a concern about traffic accidents involving children going to school as the volume of trucks carrying containers increased after the project. At the request of the school, the Environmental Monitoring Committee has taken measures to prevent accidents, such as banning vehicles on the road in front of the school when children are going to school (8:00-8:45).

According to the Union Director of the fishing port next to the port, because the boundary between the fishing area and the route of vessels entering Visakhapatnam Port is clear, there was no major issue either during the dredging work or at the time of the ex-post evaluation, and there has been no pollution of seawater by user companies at the port so far.

Based on the above, it is fair to say that this project has achieved its objectives to some extent. Therefore, the effectiveness and impacts of the project are fair.

3.4 Sustainability (Rating: ③)

3.4.1 Institutional/Organizational Aspect of Operation and Maintenance

The operation and maintenance of the entire Visakhapatnam Port are overseen by the Mechanical Engineering Department of VPT. Because PPP was introduced in this project, VPT established a PPP unit in the Mechanical Engineering Department's third section, and this unit oversees coordination and cooperation with PPP-related companies. VPT's staff in charge conduct inspections of the outer and inner harbors daily and maintain them. Regarding the entry of vessels, the Traffic Management Division is in charge. The division grasps the entry schedule of vessels and the usage status of berths and coordinates with each company.

Each company is responsible for the operation and maintenance of its own berth and the sea area within a radius of 5 km from the berth. Vedanta has established a facility operation and maintenance manual for its personnel and always informs them of necessary matters at the time of daily shift changes.

Therefore, the following division of roles is clear: VPT is responsible for the operation and maintenance of the entire port, and private companies operate and maintain each

terminal. There is no problem with the operation and maintenance system.

3.4.2 Technical Aspect of Operation and Maintenance

Many VPT managers are involved in port operation and maintenance. Because there is a unit in charge of ISO (International Organization for Standardization) and it operates according to the standards, there is no particular problem. Regarding maintenance, maintenance dredging is planned and implemented based on a survey by a specialized organization. Regarding the management of vessels entering the port, the Traffic Management Division manages the schedule and distribution of berths collectively, ensuring the safety of the port.

Regarding Vedanta, it was confirmed that the company complied with ISO and there was no major issue.

3.4.3 Financial Aspect of Operation and Maintenance

Below is the transition of revenue and expenditure of Visakhapatnam Port.

Table 7 Revenue and Expenditure of Visakhapatnam Port
(Unit: million INR)

Year	Revenue	Expenditure
2010	8,163	6,422
2011	17,713	12,763
2012	8,895	8,524
2013	9,497	9,716
2014	9,622	8,588
2015	12,494	12,237
2016	10,402	9,949

Source: Annual Accounting Report of Visakhapatnam Port

Revenues declined temporarily in the fiscal year 2012 but have been on an increasing trend since then. Even from the latest financial statements, the balance of final profit and loss is not in deficit, and there seems to be no problem with the financial aspect of operation and maintenance.

3.4.4 Status of Operation and Maintenance

Regarding the dredging part of marine works, maintenance dredging is conducted every December based on the maintenance plan. Before the ocean current reaches the dredged area, a hole (0.7 million m³) is dug so that the dredged area will not be buried by the sand carried by the ocean current. The dirt from the hole is used to reclaim a seaside park just beyond the port. As a result, the dredged area can maintain a constant water depth. The

mooring dolphin is currently used only at EVTL's iron ore berth, so EVTL operates and maintains it. Regarding the berth of each company, a PPP business contract stipulates that each company is responsible for the maintenance dredging of its own terminal, and interviews have revealed that Vedanta performs maintenance dredging once every two years.

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

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

Visakhapatnam Port is one of the 13 major ports in India and boasts the largest export volume of iron ore in the country. However, with the increasing size of vessels worldwide, the port had not been able to accommodate vessels of 200,000 DWT (Deadweight Tonnage) or larger. In addition, because of the deterioration of port facilities, the efficiency of transportation capacity declined. For these reasons, this project came to be implemented to improve the iron ore transport capacity and efficiency by enhancing dredging and existing facilities, thereby contributing to the economic development of the country through the expansion of iron ore exports.

It is recognized that strengthening transportation capacity and modernizing port facilities through port expansion work are important in India's development policy from the time of the appraisal to the time of the ex-post evaluation. Although the export volume of iron ore, which was expected to increase at the time of the appraisal, was on a declining trend throughout the country, the need for improving transport capacity by accepting large vessels remained unchanged at the time of the ex-post evaluation and is consistent with development needs. This project is highly relevant as it is consistent with Japan's aid policy. Owing to the introduction of Public Private Partnership (PPP), the scope of the project was reduced and only the marine works were covered by the ODA loan. Thus, the project cost and period changed significantly from the time of the appraisal. The project cost was within the plan owing to a fluctuation in the exchange rate. During the project period, it took a long time to select a consulting company and a contractor, causing a major delay. Thus, efficiency was fair. Regarding operation and effect indicators, only the maximum deadweight tonnage and the number of large vessels were used as indicators and the target was achieved. Regarding the improvement of the safety of vessel navigation, since larger vessels started entering the port after the implementation of this project and many captains are unfamiliar with the port, the safety has been secured by establishing a system of small

vessels waiting and towing those entering vessels. In addition, the port user companies said that the port was relatively safe as it had been before the implementation of the project. Regarding the improvement of port efficiency, the berth occupancy rate and the average waiting time have exhibited certain effects, contributing to the improvement of transport capacity. Concerning the amount of cargo handled, the number of incoming vessels, and the tonnage of incoming vessels, all of which were expected to have a synergistic effect with the PPP components, no significant effect was shown. On the other hand, although the export volume of iron ore is declining in India as a whole, it was found that the share of iron ore export at Visakhapatnam Port increased. In addition, no negative impact on the natural environment, resettlement, and land acquisition has been confirmed; thus, the effectiveness and impacts are fair. No major problem was seen with regard to the operation and maintenance systems, technical aspects, or financial aspects. Moreover, the division of roles is clear between the project and the companies that took part in the PPP components such as Essar Vizag Port Ltd. (EVTL) and Vedanta. Accordingly, it is fair to say that the sustainability is high.

Considering the above, this project is evaluated to be satisfactory.

4.2 Recommendation

4.2.1 Recommendations to the Executing Agency

Companies such as EVTL and Vedanta deal with industries that easily affect the environment, such as iron ore, coal, oil and gas, and daily efforts are required. As an example of measures with room for improvement, during the repair of the conveyor carried out under the PPP components, the conveyor was covered on three sides to prevent dust from scattering, but the trees planted near the conveyor were discolored because of the dust leaking from the product, meaning that some scattering was not prevented. As the neighborhood of the conveyor is a residential area that has schools, it may lead to the health damage of its residents if the leak continues. It is recommended that VPT work with companies such as EVTL and Vedanta to enclose the conveyor with something like a pipe to prevent dust from leaking.

4.2.2 Recommendations to JICA

None.

4.3 Lessons Learned

Monitoring the entire project after introducing PPP

In this project, the Government of India started actively promoting the PPP mode after the ODA loan was provided, so only marine works, which were of a highly public nature,

were covered by the ODA loan, and other works were transferred to PPP. In view of the overall purpose of this project, there was a plan to monitor the PPP components to confirm the synergistic effects synergistic effects with the ODA loan project. However, monitoring of the whole project was not conducted because the arrangements on monitoring were unclear between VPT and JICA, and because of such factors as the change of the person in charge and the delay in starting the PPP components. Therefore, it was not possible to confirm the effects of this project as a whole, including the components covered by PPP, on the improvement of the transport capacity and efficiency of Visakhapatnam Port, as well as its contribution to the economic development of India. At the same time, although some components of this project have been moved to PPP, the impact of those components on the environmental and social aspects such as air pollution and water pollution cannot be considered separately. The impacts on environmental considerations of this project and PPP components were confirmed because the Environmental Monitoring Committee consisting of experts, hinterland residents, and related organizations continued to monitor the entire port.

The number of projects introducing PPP is expected to increase in various sectors in the future; but considering the difficulty of sharing information with private companies, it is realistic to focus on ODA loan-assisted parts of the project in principle for ex-post evaluation. However, with regard to a project that aims to produce synergy between an ODA project and PPP, if it is necessary to confirm the manifestation of such synergy effect, then it is desirable to discuss in advance among the executing agency, JICA, and the PPP member companies the necessity and implementation method of project monitoring, and agree on as much detail as possible. In addition, if some components of the ODA loan project are converted to PPP and the environmental and social considerations are still deemed interconnected, it is desirable to continue monitoring the entire project.

Comparison of the Original and Actual Scope of the Project

Item	Plan	Actual
1. Project Outputs	1. Marine works 1.1 Construction of mooring dolphin Construction of an additional mooring dolphin for 200,000 DWT 1.2 Dredging 2.35 million m ³	As planned As planned
2. Project Period	March 2007 – September 2021 (66 months)	March 2007 – October 2016 (115 months)
3. Project Cost		
Amount Paid in Foreign Currency	0 yen*	198 million yen
Amount Paid in Local Currency	2,386 million yen (1,190 million rupees)	1,888 million yen (1,135 million rupees)
Total	2,386 million yen	2,086 million yen
ODA Loan Portion	2,386 million yen	1,888 million yen
Exchange Rate	1 rupee = 2 yen (As of May 2011)	1 rupee = 1.6956 yen (Average between October 2013 and October 2016)
4. Final Disbursement	January 2016	

*At the time of the scope change, no foreign currency amount was set because the marine works were scheduled to be implemented only through an ODA loan.