

Ex-Ante Evaluation (for Japanese ODA Loan)

South Asia Division 1, South Asia Department

Japan International Cooperation Agency

1. Name of the Project

Country: India

Project: Chennai Metro Project (Phase 2) (II)

Loan Agreement: March 31, 2022

2. Background and Necessity of the Project

(1) Current State and Issues of the Railway Sector in India

India has been seeing rapid urbanization in recent years. While the road transportation demand has been increasing more and more with the rapidly increasing number of registered automobiles (from approximately 55 million in 2001 to approximately 230 million in 2016, Statistical Yearbook of India 2018), there has been little progress in the development of public transportation infrastructure. In eight major cities, Delhi, Mumbai, Calcutta, Chennai, Bengaluru, Hyderabad, Ahmedabad, and Pune, traffic congestion from the ever-growing traffic demand has become a serious problem. Economic losses and health problems caused mainly by air pollution and noise from automobiles are becoming more and more serious.

In response to the above-mentioned issues, the Government of India has developed the "Metro Rail Policy" (latest version updated in 2017) and has declared its policy of promoting the development of public transportation systems, including metros, railways, and buses, to cope with the recent surge in transportation demand and alleviate traffic congestion, both of which have been brought about by recent economic growth, and enhance safety and energy efficiency. In large cities, the construction of metros is recommended because they enable mass transportation without straining existing road capacity.

The population of the Chennai Metropolitan Area in 2011 was 8.7 million (2011 National Census of India), the fourth largest in India. The population density of Chennai city is approximately 26,000 people/km², making it one of the most densely populated cities in India (2011 National Census of India). Following the population increase, the number of registered automobiles has increased significantly (from approximately 1.26 million in 2001 to approximately 4.94 million in 2016, Statistical Yearbook of India 2018). As a consequence, the average vehicle speed in the city is approximately 17 km/h as of 2015, and traffic congestion is becoming more and more serious (ranked seventh among 278 Asian cities as of 2019, "Asian Development Outlook 2019 Update," published by the Asian Development Bank). As traffic congestion becomes an increasingly serious problem, economic losses due to traffic congestion and pollution problems caused by automobiles, such as air pollution and noise, have become an issue like other major cities in India. Because of these circumstances, in the comprehensive urban traffic survey formulated by the Chennai Metropolitan Development Authority for sustainable and efficient urban development in the Chennai

Metropolitan Area, the Chennai Metro Project has been positioned as a priority project in this area.

Japan has offered ODA Loans for the Chennai Metro Project (Phase 1) (hereinafter, "Phase 1 Project") over the course of the five tranches and has supported the construction of two lines of the mass rapid transit system, with a total distance of approximately 53 km, in the central area of the Chennai city. However, after the start of the Phase 1 Project, urbanization has reached to the outskirts of the region, leading to increased demand for new urban transportation mainly in the peripheries of the Chennai Metropolitan Area. Based on these circumstances, the Tamil Nadu state government planned the construction of three new lines, lines 3 to 5, as the second development plan for the Chennai Metro Project so that they can cover the outer loop of the lines constructed in the Phase 1 Project. Among these new lines, line 3 (between the Madhavaram Milk Colony and Sholinganallur stations) and line 5 (between the Madhavaram Milk Colony and Chennai Mofussil Bus Terminus (CMBT) stations) will be constructed, as JICA's project, in Phase 2 (hereinafter, the "Project"), as the demand for these sections is high and their construction is a pressing concern mainly in terms of connection to the depot, convenience of transfer to the lines constructed in the Phase 1 Project and other public transportation systems, and profitability. The Project aims to meet the increasing demand for urban transportation in the Chennai Metropolitan Area, which is consistent with the policies of the Government of India and Tamil Nadu state government.

(2) Japan's and JICA's Railway Sector Cooperation Policy and the Positioning of this Project

Japan's Country Assistance Policy for India (March 2016) indicates "strengthening connectivity" as one of the priority areas, which includes improvements to transportation infrastructure. It also states that to remove infrastructure-based bottlenecks in investment and growth, improvements to rail systems (including high-speed railways and metro) are vital to strengthening connectivity within major industrial cities, as well as connectivity between various economic zones and regions in India. Also, "improvement of industrial competitiveness" through urban infrastructure development is also indicated as a priority area, promoting the development of transportation networks in metropolitan areas by constructing metros for the purpose of alleviating traffic congestion and improving the efficiency of passenger freight transportation and the urban environment. In addition, the JICA Country Analysis Paper for India (March 2018) concluded that there is a need to support the development of infrastructure, including trunk-line railways, urban railways, roads, and harbors with a focus on industrial clusters such as the Special Economic Zones and Economic Corridors of India's 8 major urban centers, the Delhi-Mumbai Industrial Corridor and Chennai-Bengaluru Industrial Corridor. It also states the need to promote cooperation to tackle environmental and climate change issues as a way to support sustainable and comprehensive growth. The Project is consistent with these policies and analyses.

Moreover, the Project is deemed to contribute to Goal 8 (Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all), 9 (Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation), Goal 11 (Make cities and human settlements inclusive, safe, resilient and sustainable) and Goal 13 (Take urgent action to combat climate change and its impacts) of the Sustainable Development Goals, suggesting a strong need to implement the Project.

(3) Other Donors' Activities

The Government of India was funded by the World Bank for its Mumbai Urban Transport Project (approved in 2002 and 2010, 972 million US dollars in total) and Eastern Dedicated Freight Corridor Project (approved in 2011, 2014, and 2015, 2,725 million US dollars). It was also funded by the Asian Development Bank (hereinafter, the "ADB") for Jaipur Metro (approved in 2014, 176 million US dollars) and as syndicated loans involving the New Development Bank (hereinafter, the "NDB") for Mumbai Metro (lines 2A, 2B, and 7, approved in 2019, 926 million US dollars and 260 million US dollars, respectively) and Bengaluru Metro (lines 2A and 2B, approved in 2021, 500 million US dollars). In addition, the Government of India will receive funding from several donors for this second development plan. Specifically, it will receive funding from the Asian Infrastructure Investment Bank (hereinafter, the "AIIB") for line 4 and line 5 between the CMBT and Sholinganallur, and from the NDB only for line 4. None of these fundings cover this Project, which is implemented by JICA.

3. Project Description

(1) Project Objective

The objective of the Project is to cope with the increase of traffic demand in the Chennai Metropolitan Area, Tamil Nadu state, southern India, by expanding a mass rapid transit system, thereby promoting regional economic development and improving urban environment improvement, through relief of traffic congestion and decrease of pollution caused by increasing motor vehicles.

(2) Project Site/Target Area

Chennai Metropolitan Area, Tamil Nadu state (Population: approximately 8.7 million (2011))

(3) Project Components

The Japanese ODA Loan covers the following areas.

- Line 3 (between the Madhavaram Milk Colony and Sholinganallur stations):
Approx. 35 km/40 stations
(Elevated sections: Approx. 9 km/10 stations, Underground sections
Approx. 26 km/30 stations)
- Line 5 (between the Madhavaram Milk Colony and CMBT stations):

Approx. 16 km/17 stations

(Elevated sections: Approx. 11 km/11 stations, Underground sections

Approx. 5 km/6 stations)

The Japanese ODA Loan covers the following components (except for telecommunication work and platform screen doors installed in underground stations in 5) and 6), and 9)).

1) Civil engineering

*6 underground sections among these 12 sections covered by the Japanese ODA Loan (8 underground sections and 4 elevated and aboveground sections)

2) Electricity and machinery (air conditioning equipment in stations, tunnel ventilation equipment, etc.)

3) Rails (rail and turnout installation, etc.)

4) Power equipment (overhead wiring and substation installation, etc.)

5) Signaling and telecommunication

6) Automated fare collection system and platform screen doors

7) Rolling stock (210 cars)

*Only this component is not limited to the above Japanese ODA Loan coverage areas.

8) Depot, etc.

9) Development of station buildings, areas around the stations, transport hubs, etc.

10) Consulting services (basic/detailed design, detailed design review, bidding assistance, construction supervision, support for environmental and social considerations, etc.)

(4) Estimated Project Cost

591,888 million Yen (Japanese ODA Loan (for the tranche II): 73,000 million Yen)

(5) Schedule

December 2018 to August 2028 (117 months in total). Project completion is defined as the service commencement of all facilities (June 2027).

(6) Project Implementation Structure

1) Borrower: President of India

2) Guarantor: None

3) Executing Agency: Chennai Metro Rail Limited (CMRL)

4) Operation and Maintenance Agency: Same as 3). Note that CMRL decided to basically outsource their operation and maintenance except for the core parts of operation (operation management and signal equipment and telecommunication equipment maintenance) and safety measures, and in 2017, started to outsource them in the Phase 1 Project. Since the start of outsourcing, no accidents or operation-related troubles, such as delays, have occurred in the already opened sections, and the on-time rate is 99% or better. In this Project, the same framework will be applied for operation and management.

(7) Collaboration and Sharing of Roles with Other Donors

1) Japan's Activity: N/A2) Other Donors' Activity: The executing agency will be funded by multiple donors under the approval of the Indian central government and state government. They will receive funding from ADB and AIIB for lines 4 and 5 between the CMBT and Sholinganallur stations, and from NDB for line 4. The schedule and interface between the funding components from different donors will be confirmed and coordinated by the executing agency through consultation with the relevant parties.

(8) Environmental and Social Considerations/Cross-Sectoral Issues/Gender Category

1) Environmental and Social Consideration

① Category: A

② Reason for Categorization:

This Project falls under the railways sector listed in the "JICA Guidelines for Environmental and Social Considerations" (hereinafter, the "JICA Guidelines") (established in April 2010).

③ Environmental Permit:

The Environmental Impact Assessment (EIA) report for the Project was approved in November 2017 by CMRL although the creation of the report was not required under Indian law.

④ Anti-Pollution Measures:

During the works, water sprinkling, dust sheets, and wastewater treatment plants are used to address air and water pollution due to excavation and operation of construction machinery. As for waste, part of the large amount of excavated soil due to tunnel works will be reused as fill for the construction of the depot and stations, and the rest of the soil will be disposed of in an appropriate manner at a designated disposal site. Tunnel works will take place at locations where the ground is relatively firm, and a shielded construction method will be adopted to prevent soil loosening and groundwater inflow. Therefore, no significant negative impact on the ground from subsidence is expected. When in operation, running noise will be minimized by installing sound barriers and adopting a two-layer rubber pad structure. Vibration of underground and elevated portions will be reduced through periodic track maintenance and compliance with speed limits.

⑤ Natural Environment:

The target area is not situated in or near any vulnerable areas such as national parks. Although 934 trees will be cut down due to the construction of the depot and tracks, replacement trees will be planted by CMRL.

⑥ Social Environment:

The Project requires the resettlement of 46 households, acquisition of 73 ha of land, and relocation of the economic activities of 182 households. Procedures

for resettlement and land acquisition are underway based on the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act in India, resettlement procedures of the Tamil Nadu state government, and the resettlement action plan prepared in accordance with JICA Guidelines. Approximately 93% of the land acquisition has been completed as of December 2021 and it will be completed by May 2022. Matters such as project overview, environmental and social impact, and compensation policies were explained to affected residents through a census survey, with personal visits and consultations with residents. No opposition was raised from the residents with regard to the implementation of the Project.

⑦ Other/Monitoring:

During the works, the contractor, under the supervision of CMRL, will monitor air quality, water quality, noise and vibration, waste, vegetation, and other issues. After service commencement, CMRL will monitor noise, vibration, vegetation, and other issues. It will also monitor resettlement, land acquisition, and recovery of livelihood, which will be reported to JICA.

2) Cross-Sectoral Issues

(Climate change) By constructing a mass rapid transit system, the Project aims to alleviate traffic congestion caused by automobile use, thereby helping reduce greenhouse gas (GHG) emissions. India's NDCs (Nationally Determined Contributions) include the utilization of a mass rapid transit system as a strategy for traffic congestion alleviation, which is emphasized in the Project. The Project alleviates global warming by reducing GHG emissions by approximately 80,000 tons of CO₂ equivalent per year (estimation for 2029). The above only applies to this Project plan (line 3 between the Madhavaram Milk Colony and Sholinganallur stations and line 5 between the Madhavaram Milk Colony and CMBT stations).

(Special attention to disabled persons) In accordance with the domestic law of India, the design of stations and cars takes use by elderly and disabled persons into consideration (i.e., elevators, escalators, station announcements, textured paving blocks to guide the blind, wheelchair spaces).

3) Gender Category

■ Gender Informed (Significant)(Gender activity integration project)

<Details of Activities/Reason for Categorization> In order to ensure safe and comfortable use of metros by women, the Project includes a number of efforts that include women-only cars, priority seats for passengers who need assistance, including women, installation of CCTV cameras in stations and cars, and low-hanging handgrip straps. In addition, these efforts include ensuring equal pay for men and women at

construction sites, provision of facilities necessary for female workers, and appointment of women to project management positions. For these reasons, the Project is classified as a "gender activity integration project."

(9) Other Important Issues

It is expected that Japanese technologies will be used, for example, in tunnel boring machines, elevators, escalators, head heat-treated rails, signal systems, automated fare collection systems, and cars.

4. Target Outcomes

(1) Quantitative Effects

Outcomes (Operation and Effect Indicators)

Indicator	Baseline (Actual value in 2017)	Target (2029) (2 years after project completion)
Operating rate (%)	n/a	92.0
Running distance per day (1,000 km)	n/a	31.1
Running distance of women-only cars per day (1,000 km)	n/a	10.4
Number of running trains per day (per direction)	n/a	408
Volume of transportation per day (million people•km)	n/a	11.3
Income from passengers per day (million rupees)	n/a	48.7

These targets only apply to this Project plan (line 3 between the Madhavaram Milk Colony and Sholinganallur stations and line 5 between the Madhavaram Milk Colony and CMBT stations), which is not on the premise of the completion of line 4.

(2) Qualitative Effects

The qualitative effects of the Project include the reduction of noise levels, reduction of air pollution, improved convenience through the establishment of reliable travel times, economic development of the Chennai Metropolitan Area, increased land value along the lines, and promotion of women's participation in society.

(3) Internal Rate of Return

Based on the assumptions listed below, the economic internal rate of return (EIRR) for the Project is 14.8%, and the financial internal rate of return (FIRR) is 2.6%.

[EIRR]

Cost: Project cost, operation and maintenance cost (both excluding taxes)

Benefit: Effects of reducing the travel time of metro and road users, the vehicle maintenance costs of metro and road users, the development costs for road traffic infrastructure, the number of road traffic accidents, the environmental pollutant emissions in road traffic, etc.

Project Life: 40 years

[FIRR]

Cost: Project cost, operation and maintenance cost

Benefit: Passenger revenue, advertisement revenue, and revenue from the development of stations and areas around the stations

Project Life: 40 years

5. External Factors and Risk Control

- (1) Preconditions: None
- (2) External Factors: None

6. Lessons Learned from Past Projects

Based on the ex-post evaluation results of the Japanese ODA Loan Project for India, "Delhi Mass Rapid Transport System Projects (I) - (VI)," it should be checked whether different public transportation systems end up competing with one another. They should not compete, but constitute a single urban transportation system. If deemed inadequate, they should be encouraged to do so in order to ensure profitability.

In the Phase 1 Project, a plan for a feeder bus service was prepared and submitted to the Chennai Metropolitan Transport Corporation (MTC), the organization responsible for the public bus service in Chennai, to increase revenue of the executing agency. MTC is now operating a bus service based on the plan. Also, in the Phase 1 Project, the executing agency signed contracts with private businesses, for example, for advertisements inside and outside cars and in stations, rental of real estate and installation of kiosks and ATMs for the effective use of spaces in and around stations, and parking lot business in front of stations and under the elevated railway tracks in order to supplement passenger revenue and increase profitability. In this Project, the same efforts will be made.

7. Evaluation Results

This Project will cope with the increase of traffic demand in the Chennai Metropolitan Area by expanding a mass rapid transit system and is thus judged to be consistent with the Government of India's policies on development and solving issues, as well as Japan and JICA's policies and analyses on cooperation.

Moreover, given that the Project is deemed to contribute to Goal 8 (Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all), Goal 9 (Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation), Goal 11 (Make cities and human settlements inclusive, safe, resilient and sustainable) and Goal 13 (Take urgent action to combat climate change and its impacts) of the Sustainable Development Goals, the need for JICA to support the implementation of the Project is high.

8. Plan for Future Evaluation

- (1) Indicators to be Used
As described in 4.(1) to (3).

(2) Future Evaluation Schedule

Ex-post evaluation: 2 years after project completion

End