

# Ex-ante Evaluation Paper (for Japanese ODA Loan)

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## 1. Basic Information

Country: India

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

Loan Agreement: December 21, 2018

## 2. Background and Necessity of the Project

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

India has been seeing rapid urbanization in recent years, and while the number of registered automobiles and motorcycles has increased dramatically, there has been little progress in terms of improvements to the public transportation infrastructure. In major cities such as Chennai, traffic congestion from the ever-growing traffic demand has become a serious problem, especially with economic losses and health problems caused by air and noise pollution from vehicles being major issues. For this reason, it has become necessary to establish a public transportation system to alleviate traffic congestion and improve the urban environment.

In response to the above-mentioned issues, the government of India has been implementing measures to cope with the recent surge in transportation demand, brought about by economic growth. It has stressed importance of improving the public transportation system from the viewpoint of safety, energy efficiency, and social environment preservation.

The Chennai Metropolitan Area in Tamil Nadu State is the largest metropolitan area in South India, with the fourth largest population in India. The population was 4.5 million in 1981, rapidly increased to 7.06 million in 2001, and reached 8.7 million in 2011. The population density of Chennai city, the center of the area, is approximately 25,000 people/km<sup>2</sup>, making it one of the most densely populated cities in the world. Following the population increase, the number of registered automobiles has increased significantly, having more than tripled between 2001 and 2011. As a consequence, the average vehicle speed on major roads in the city is approximately 17 km/h, and traffic congestion has become a serious issue. There have also been limitations to the increase in transportation capacity of existing public transportation (buses, railways) or to the improvement of road networks. Development of a mass rapid transit system to alleviate traffic congestion and address automobile pollution has therefore been prioritized for policies on urban transportation and measures against urban environmental issues adopted by the Tamil Nadu state government.

Japan has offered ODA Loans for the Chennai Metro Project (hereinafter, "Phase 1 Project") over the series of five phases and has supported the construction of two lines of the mass rapid transit system. Meanwhile, the population of the Chennai Metropolitan Area has continued to increase after the start of the Phase 1 Project, and

urbanization has reached the outskirts of the region, and leading to increased demand for new urban transportation. Based on the results of the feasibility study conducted in response to this demand, construction of three new lines, lines 3 to 5, with a total distance of approximately 107.5 km has been planned so that they can cover the outer loop of the lines constructed in the Phase 1 Project. Among these lines, line 3 (between Madhavaram Milk Colony and Sholinganallur stations) and line 5 (between Madhavaram Milk Colony and Chennai Mofussil Bus Terminus (CMBT) stations), with a total distance of approximately 52.0 km, will be constructed in Chennai Metro Project (Phase 2) (hereinafter the "Project"), as the demand for these sections is high and their construction is a pressing concern. The Project aims to meet the increasing demand for transportation in the Chennai Metropolitan Area and has been positioned as a priority project to realize the plans and policies of the Tamil Nadu state government.

## (2) Japan and JICA's Railways 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 de-bottleneck the infrastructure-based constraints to investment and growth, improvements to rail systems (including high-speed and urban railways) is vital to strengthening connectivity within major industrial cities, as well as connectivity between various economic zones and regions in India.

In addition, the JICA Country Analysis Paper for India (March 2016) concluded the need to support infrastructure with the development of trunk-line railways, urban railways, roads, and harbors—which will promote regional economic development, improve goods distribution efficiency, and encourage increased foreign investment—with a focus on industrial clusters such as the Special Economic Zones and Economic Corridors of India's 6 major urban centers and the Delhi-Mumbai Industrial Corridor. Therefore, the Project is consistent with these policies and plans.

As of the end of November 2018, JICA received authorization to provide ODA Loans to India in the amount of 2,469 billion yen for 64 projects in the general transportation sector, and 1,965.8 billion yen was authorized for 40 projects in the railways sector including the Delhi Metro and other metro projects.

Moreover, the Project is deemed to contribute to Goal 9 (Build resilient infrastructure) and Goal 11.6 (Make cities inclusive, safe, resilient and sustainable) of the Sustainable Development Goals.

## (3) Other Donors' Activity

The World Bank has been supporting development of the Mumbai Urban Transport Project (development of roads and suburban railways) as well as a freight railway construction plan to upgrade the east corridor. As of the end of November 2018, it has approved 81 loans totaling \$18.274 billion.

Meanwhile, the Asian Development Bank has provided 60 loans totaling \$13.606 billion as of the end of November 2018, and \$176 million for Jaipur Metro.

Agence Française de Développement has approved 180 million Euros for Kochi Metro in February 2014 as well as 310 million Euros for Bengaluru Metro in January 2016. AIIB and EIB also approved a joint loan to Bengaluru Metro in December 2017 (\$335 million and \$583 million, respectively).

### **3. Project Description**

#### (1) Project Objective

The objective of the Project is to cope with the increase in traffic demand in the Chennai Metropolitan Area by constructing a mass rapid transit system with a total distance of approximately 52.0 km, thereby contributing to increased mobility in the city, mitigation of road traffic congestion, promotion of measures against air pollution and noise caused by the increasing number of motor vehicles, and economic growth of the region.

#### (2) Project Site/Target Area

Chennai Metropolitan Area, Tamil Nadu state

#### (3) Project Components

1) Civil engineering (international competitive bidding (tied))

##### ➤ Line 3: Approx. 36.0 km/40 stations

(Elevated: Approx. 9.0 km/10 stations (2 sections), Underground: Approx. 27.0 km/30 stations (5 sections))

##### ➤ Line 5: Approx. 16.0 km/18 stations

(Elevated: Approx. 4.7 km/5 stations, Overground: Approx. 0.3 km/1 station (1 section for elevated and overground parts combined), Underground: Approx. 11.0 km/12 stations (2 sections))

\*The total number of stations will be 57, as there is one station that serves both lines 3 and 5.

2) Electricity and machinery (international competitive bidding (tied))

3) Elevators and escalators (international competitive bidding (tied))

4) Depot (international competitive bidding (tied))

5) Rails (international competitive bidding (tied))

6) Tracks (international competitive bidding (tied))

7) Power equipment (international competitive bidding (tied))

8) Signals (international competitive bidding (tied))

9) Automated fare collection system (international competitive bidding (tied))

10) Platform screen doors (international competitive bidding (tied))

11) Rolling stock (210 cars, comprising 3 cars per line x 30 lines and 6 cars per line x 20 lines) (international competitive bidding (tied))

\*Trains comprising of 3 cars and 6 cars will run at the start of the operation. The former is to be gradually replaced with the latter, as demand is expected to

increase in the future.

12) Consulting services (basic/detailed design, bidding assistance, construction supervision, support for environmental and social considerations, etc.) (short-list method (tied))

13) Development of station buildings, areas around the stations, and transport hubs, etc. (international competitive bidding)

Japanese ODA Loan covers three underground sections of line 3 and one underground section of line 5 in above 1), as well as 2) to 12).

(4) Estimated Project Cost

725,415 million yen (of which, the ODA Loan amount is 357,476 million yen and the loan amount for this phase is 75,519 million yen)

(5) Schedule

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

(6) Project Implementation Structure

1) Borrower: The President of India

2) Guarantor: None

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

4) Operation and Maintenance agency: Same as above 3). Note that since 2017, CMRL has started to outsource the operation of trains and the maintenance of some railway facilities (tracks, stations, air conditioning in tunnels, elevators, escalators, and power equipment (substations and overhead equipment)), including the rolling stock. Necessary capacities are reviewed when selecting a contractor, based on factors such as similar business background/similar experience in past. There have been no major issues in operation, and on-time rates have been high.

(7) Collaboration with Other Schemes and Donors

None in particular.

(8) Environmental and Social Considerations/Poverty Reduction and Social Development

1) Environmental and Social Considerations

① Category: A

② Categorization Rationale: This Project falls under the railways sector listed in the 'JICA Guidelines for Environmental and Social Considerations' (dated April 2010).

③ Environmental Permit: The Environmental Impact Assessment (EIA) report for the Project was approved in November 2017 by Chennai Metro Rail Limited (hereinafter "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 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 around any vulnerable areas such as national parks. Although 934 trees will be cut down due to the construction of depot and tracks, replacement trees will be planted by CMRL.
- ⑥ Social Environment: The Project requires the resettlement of 10 households, acquisition of 163 ha of land, and relocation of economic activities of 153 households. Procedures for resettlement and land acquisition will be taken based on the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013 in India, resettlement procedures of Tamil Nadu state government, and the resettlement action plan prepared by JICA. 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 resettlement, land acquisition, and recovery of livelihood.

## 2) Cross-cutting Items

(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. The Project alleviates global warming by reducing GHG emissions by approximately 80,000 tons of CO<sub>2</sub> equivalent per year.

(Special attention to disabled persons) In accordance with domestic law of India, the design of stations and cars makes allowances for use by elderly and disabled persons (i.e. accessible elevators, escalators, station

announcements, textured paving blocks to guide the blind, wheelchair spaces, etc.).

### 3) Gender Classification:

[Gender Project] GI (S) (Gender Integrated Project)

<Activities/Classification Rationale> In order to ensure that women can enjoy the use of the subway in safety and comfort, the Project includes a number of efforts that include introduction of women-only cars, introduction of priority seats for passengers who need assistance, including women, installation of CCTV cameras in the station and cars, and low-hanging handgrip straps. For these reasons, the Project is classified as a "gender integrated project."

### (9) Other Important Issues

As the Project will be implemented under tied conditions, Japanese technology is expected to be utilized in tunnel boring machines, elevators, escalators, head heat-treated rails, signal systems, automated fare collection systems, platform screen doors, and cars.

## 4. Targeted Outcomes

### (1) Quantitative Effects

#### 1) Outcomes (Operational and Effect Indicators)

Indicator	Baseline (Actual value in 2017)	Target value (2029) [2 Years after completion]
Operating rate (%)	-	92.0
Running distance (1000 km)	-	31.1
Number of running trains per day	-	408
Volume of transportation per day (million people · km)	-	11.3
Income from Passenger per day (million rupees)	-	48.7

The targets have been set based on the plan for the Project (a part of line 3 and a part of line 5), not on the premise of the completion of line 4.

### (2) Qualitative Effects

The qualitative effects of the Project include a reduction of noise levels, reduction of air pollution, improved convenience through the establishment of reliable travel time, economic development of the Chennai Metropolitan Area, and increased value along the lines.

### (3) Internal Rate of Return

Based on the assumptions below, the Economic Internal Rate of Return (EIRR) of the Project is 14.61%, and the Financial Internal Rate of Return (FIRR) is 2.98%.

[EIRR]

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

Benefits: Effects of reducing the operation and maintenance costs of the existing transportation system and roads, travel time of users of this line and other transportation users, operation and maintenance costs of buses and other transit system by mitigating traffic congestion, and the number of traffic accidents and pollution

Project life: 30 years

[FIRR]

Cost: Project cost, operation and maintenance cost

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

Project life: 30 years

## **5. External Factors and Risk Control**

(1) Preconditions: Land acquisition and resettlement by the India side, as scheduled

(2) External Factors: None in particular

## **6. Lessons Learned from Past Projects**

Based on the ex-post evaluation results of the “Delhi Mass Rapid Transport System Project (VI)” in India, it is preferable that public transportation bodies cooperate, not compete, with each other and establish a systematic urban transport system to achieve efficient operation of public transport as a whole. In the Project, a plan for feeder bus services was prepared and submitted to the Chennai Metropolitan Transport Corporation (MTC), the organization responsible for public bus services in Chennai, to increase revenue of the executing agency. MTC is now operating buses based on the plan.

Also, based on the ex-post evaluation results of the “Delhi Mass Rapid Transport System Project (VI),” it is desirable to check that conditions for profitability are met and, if found to be insufficient, accelerate measures to meet the conditions. In the Phase 1 Project, the executing agency signed a contract (with private businesses) pertaining to the installation of vending machines, kiosks, and ATMs at the stations and management of parking lots around the stations, in order to supplement passenger revenue and increase profitability.

## **7. Evaluation Results**

In light of rapid urbanization extending to the outskirts of Chennai, this Project will contribute to balanced economic and social development of the Chennai Metropolitan Area through alleviation of traffic congestion and reduction of pollution caused by the increasing number of motor vehicles in the region by networking mass rapid transit

systems. Continued support to this Project, following the support to the Phase 1 Project, 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 policy on assistance. Moreover, given that the Project is deemed to contribute to Goal 9 (Build resilient infrastructure) and Goal 11.6 (Make cities inclusive, safe, resilient and sustainable) 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 indicated in sections 4. (1) to (3)

### (2) Timing of the Next Evaluation

Ex-post evaluation: 2 years after project completion