Ex-Ante Evaluation (for Japanese ODA Loan)

South Asia Division 1, South Asia Department, JICA

1. Name of the Project

Country: India

Project: Bengaluru Metro Rail Project (Phase 2)

L/A signing date: March 26, 2021

2. Background and Necessity of the Project

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

Rapid urbanization has progressed in India recently and the number of registered automobiles has also been increasing rapidly (from around 55 million vehicles in 2001 to approximately 230 million vehicles in 2016), leading to increased demand for road transportation, yet the development of public transportation infrastructure has not progressed and traffic jams due to increasing demand for road traffic have been a serious problem in major cities such as Delhi, Mumbai, Kolkata and Bengaluru, etc., aggravating economic losses and health damage due to automobile pollution such as air pollution/noise, etc.

In order to deal with the above problems, the Government of India in its “Metro Rail Policy” (latest version updated in 2017) has set forth a policy promoting the development of public transportation systems such as metro, rail and bus, etc. from the viewpoint of safety/energy efficiency, etc. in addition to mitigating traffic congestion and dealing with the demand for transportation due to recent economic growth. Construction of a metro system in the metropolitan area is particularly recommended to enable high-volume transportation without putting undue pressure on existing road capacity.

Bengaluru, the capital city of Karnataka State, is known as India’s Silicon Valley, with economic growth following its development as an industrial zone, and a 46.7% rate of population increase in the 10-year period from 2001 to 2011, giving an annual average of approximately 3.9%, which is the highest rate of any major city in India. Like other cities, traffic congestion is arising due to the increase of registered vehicles (from around 1.56 million in 2005 to approx. 8 million in 2019), and according to a survey of private enterprises, Bengaluru has recorded one of the world’s highest levels of congestion-related delay, with travel by car taking approximately 1.5 times longer than when there is no congestion (placing Bengaluru 6th out of 416 cities in 57 countries around the world as of 2020), and the Bengaluru Master Plan 2031 (hereinafter referred to as “BMP2031”) indicates that this leads to annual economic loss of approximately 53 billion yen. Also, regarding air pollution for which automobile exhaust fumes are a major source, the annual average of PM2.5 emissions in Bengaluru is about 3 times the WHO standard, and as of 2015 the CO_2 emissions from the transportation sector in Bengaluru were second highest only

following Delhi in India. The number of respiratory illnesses for which air pollution is thought to be a factor increased by approximately 80% in a 5-year period from 2015. Under such circumstances, the Karnataka State Government has been promoting a Metro Construction Plan under the Bengaluru Master Plan 2015, and in 2017 Phase 1 of the plan was completed and opened. The BMP2031 (revised in 2020) aims to increase public transportation coverage (currently at 47%) to 70% by 2031, promoting total extension of the metro system from its current length of approximately 43 km to approximately 320 km. This includes development of a total length of 133.0 km in Phase 2 of the plan, which is set to be completed by 2027, and the Bengaluru Metro Rail Project (Phase 2) (hereinafter referred to as "the Project") establishes 3 lines (lines 2A, 2B and 6, covering a total of approx. 80 km), including lines along the inner-city outer ring road and along the airport road from the current ring-road to the airport on the outskirts of the city. Traffic volume at major intersections located directly above each line is of the largest scale in Bengaluru (up to approx. 250,000 vehicles/day), causing particularly severe congestion on these roads (reference: maximum traffic volume at intersections within Tokyo Metropolitan Area is approx. 90,000 vehicles/day). The Project aims to deal with increasing transport demand in Bengaluru, which is facing the above issues, by constructing a mass rapid transportation system, and contributes to reduction of automobile pollution through mitigation of traffic congestion, development of the regional economy, and mitigation of climate change, etc., so it is positioned as an important project in India's urban transportation sector.

(2) Japan and JICA's Urban Transportation Sector Policy and the Positioning of the Project

Country Assistance Policy for India (March 2016) formulated by the Government of Japan stipulates that the development of railways (including high-speed rail and metro) shall be necessary in order to strengthen connectivity among major industrial cities and economic zones in India by setting forth "Enhancing Connectivity" through the development of transportation infrastructure, etc. as the priority area with the aim at resolving the infrastructure bottleneck against investment and growth. "Strengthening industrial competitiveness" through urban foundation maintenance, etc. is also set out as an important field for assistance, together with the promotion of transportation infrastructure, etc. in major metropolitan areas by constructing subways, etc. with the aim of mitigating traffic congestion, optimizing passenger/freight transport and improving the urban environment, etc. Also, in order to eliminate the bottleneck in economic growth, the JICA Country Analysis Paper for India (March 2018) provides an analysis that, mainly in the industrial agglomeration areas such as special economic zones and economic corridors located in the six major metropolitan areas in India as well as the Chennai – Bengaluru

Industrial Corridor and the Delhi – Mumbai Industrial Corridor Line, cooperation for measures to deal with environment and climate change issues are being promoted as a means of support continuous, comprehensive growth, and it is necessary to promote regional economic development facilitation and logistics optimization, and to support infrastructure development including arterial railroad, urban railway, roads, and harbors which contribute to increased investment from the foreign capital. The Project is consistent with these policies and analyses.

The Project is also expected to contribute to the achievement of Goal 9 (Build resilient infrastructure, promote sustainable industrialization and foster innovation), Goal 11 (Make cities inclusive, safe, resilient and sustainable, and Goal 13 (Take urgent action to combat climate change and its impacts) of the Sustainable Development Goals (SDGs), so the Project's implementation is highly necessary.

(3) Other Donors' Activities

The Indian Government has received funding from the World Bank for the Mumbai Urban Transport Project (approved in 2002 and 2010, total of US$972 million) and the Eastern Dedicated Freight Corridor Project (approved in 2011, 2014 and 2015 total of US$2.725 billion). There has also been support from the Asian Development Bank (ADB) for the Jaipur Metro Rail Project (approved in 2013, US$157 million), and cooperative financing with the New Development Bank for the Mumbai Metro Rail System Project (Lines 2A, 2B, 7; approved in 2019; approved amounts of US$926 million from ADB and US$260 million from co-financing). The Indian Government is raised funds from multiple donors for the Project too. Specifically, there is funding of approximately US$500 million from ADB scheduled for a civil works package covering Lines 2A and 2B (to be approved March 2021), and there is funding of US$583 million from European Investment Bank (EIB) and US$335 million from Asian Infrastructure Investment Bank (AIIB) for the civil works package covering Line 6 (approved in December 2017）(see 3.(3) for details of funding provided by each donor). Also, the Agence Française de Développement has provided 110 million euros in the Bengaluru Metro Rail Project (Phase 1 Construction Plan) and 200 million euros in Phase 2 Construction Plan (separate lines from the Project; extension of east-west and south-north line, etc.). Moreover, the Indian Government has raised as an important issue for fundraising donors the maintenance of public transportation contributing to mitigation of traffic congestion, etc. in India.

3. Project Description

(1) Project Objective

The objective of the Project is to cope with the increase of traffic demand in Bengaluru, the capital city of the State of Karnataka in southern India, by

expanding the mass rapid transportation system, thereby promoting regional economic development, improving urban environment and eventually mitigating climate change, through relief of traffic congestion and decrease of pollution caused by increasing motor vehicles.

(2) Project Site/Target Area

Bengaluru City, State of Karnataka (population: approx. 14 million)

(3) Project Components

a) Civil works (underground railway of about 14 km, above-ground railway of about 2 km, elevated railway of approx. 64 km, and underground, above-ground and elevated road stations (8) (total 48 stations)
b) Procurement of materials for track/switches, ventilation and air-conditioning equipment, etc.
c) Electrical maintenance work for stations, rolling stock maintenance sites and transformer substations, etc.
d) Automatic fare collection system
e) Signaling and train control system
f) Communication system
g) Procurement of rolling stock (318 standard-gauge stock)
h) Construction of rolling stock maintenance sites (3 sites)
i) Consulting services (design review, bidding assistance, construction supervision, etc.)
j) The fields covered by the ODA yen loan as requested by the Indian Government are items 5), 7) and 9). For items 1) and 8), the executing agency is procuring fund from other donors, while items 2), 3), 4) and 6) are to be self-funded by the executing agency. Note that item 9), consulting services, is mainly limited to the fields covered by the ODA yen loan.

(4) Estimated Project Cost

418,062 million yen (including loan amount of 52,036 million yen)

(5) Schedule

March 2021 – August 2029 (102 months in total). The commencement of operation for all the lines (February 2027) shall be the time of the Project's completion.

(6) Project Implementation Structure

1) Borrower: The President of India
2) Guarantor: None
3) Executing Agency: Bangalore Metro Rail Corporation Limited (hereinafter referred to as "BMRCL")
4) Operation and Maintenance Agency: Same as above

(7) Collaboration with Other Schemes and Donors

1) Japan's Assistance Activity: N/A

2) Assistance activities of other donors, etc.: Under approval from the Central Government and Karnataka State Government, BMRCL, the executing agency, is the main constituent raising funds from multiple donors. Assistance for a civil works package for lines 2A and 2B is being received from ADB, and assistance for a similar package for line 6 is being received from EIB and AIIB. Regarding the schedules and interfaces between each package arising from the assistance of multiple donors, BMRCL will regularly and frequently hold meetings at multiple levels and make necessary adjustments.

(8) Environmental and Social Considerations, Cross-Sectoral Issues, and Gender Categorization

1) Environmental and Social Considerations

i) Category: A

ii) The project falls into the railway sector under the JICA Guidelines for Environmental and Social Considerations (April, 2010).

iii) Environmental Permit: Although preparation of an Environmental Impact Assessment (EIA) Report regarding the Project is not required under the domestic law in India, reports were prepared by the executing agency (BMRCL) for lines 2A and 2B in September 2020 and for line 6 in August 2017, and these have been internally approved by the executing agency.

iv) Anti-Pollution Measures: Regarding air quality, water quality, waste, noise and vibration during construction work, there are plans to ensure conformance to India's emissions standards and environmental standards by means of sprinklers, covering of transport vehicles, wastewater treatment, excavated earth treatment, use of low-noise machinery, and installation of noise barriers, etc. When facilities are open to the public, there will be some drainage from station buildings and railyards, but water used to wash rolling stock will be separated with oils, etc. collected in separation tanks, after which the water will be stored in a reservoir for reuse, and miscellaneous drainage and sewage will be treated at regional sewage treatment plants. Likewise, any waste that comes from station buildings and railyards will be disposed of in accordance with national law.

v) Natural Environment: Because the project area and its surroundings are not in any protected natural area, there are no particular foreseeable impacts on the natural environment. Trees are being cut down due to the Project, but 10 trees are being planted for every 1 tree cut down.

vi) Social Environment: This Project requires the acquisition of sites amounting to a total area of about 63 ha and the involuntary relocation of 2,131 people (458 households). Both the acquisition of the land and the relocation of the residents have already been completed according to the Karnataka Industrial Area Development Board Act, the national policy on the resettlement and rehabilitation for project-affected families, and resettlement plans based on the regulations of donors such as ADB, etc. It is confirmed that there is no divergence from the JICA Environmental Guidelines regarding compensation standards, site acquisition or the resident relocation process, etc. No objections have been lodged against the Project in consultation meetings with residents. Consent to site acquisition has been obtained from all Project-affected households on all lines as of December 2020.

vii) Other/Monitoring: During construction phase, the executing agency and contractors will monitor air quality, water quality, noise and vibration, and afforestation, etc., and the executing agency will do likewise when the facilities are open to the public. In accordance with ADB guidelines, Lines 2A and 2B will be subject to environmental management by the executing agency as well as periodic evaluation by outside experts during the construction period. Regarding land acquisition, relocation of residents and the living conditions of residents after relocation, these will be monitored by the executing agency and outside experts from the construction phase through until the facilities are open to the public.

2) Cross-Sectoral Issues:

i) Climate change: The Project is thought to contribute to mitigation of climate change as it contributes to the reduction of greenhouse gas emissions by promoting a modal shift. Note that the application of a mass rapid transport system is included as one of the strategies relating to mitigation policy in India's Nationally Determined Contribution (NDC), and the Project is highly regarded. The mitigation effect of the Project on the climate change (rough estimate of GHG emission reduction) is forecast to be about 89,952 tons/year of CO_2 equivalent (as of 2031).

ii) Consideration for Disabilities: In accordance with the domestic laws in India, consideration for usability for the elderly and persons with disabilities will be adopted for the station buildings/passenger cars (elevators, toilets, station announcement, braille blocks, wheelchair space, etc.), and customer care training for all frontline staff including station staffs and train crew is planned.

iii) Controlling AIDS/HIV: It has been confirmed with BMRCL that contracts with construction businesses include implementation of AIDS countermeasures such as activities to make workers aware of prevention, etc. Moreover, at the time of screening, the executing agency agreed to a list of measures that must be taken when formulating projects and implementing projects (total of 36 items) to control COVID-19 infections. Items include the formulation and thorough adherence to behavior patterns for preventing infections, providing contractual consideration for contractors when infections increase, etc.

3) Gender Category:

[Gender Category]: ■GI(S) (Gender Activity Integration Project)

<Description of activities and reason for classification>

In the Project, measures such as introducing women-only carriages, setting priority seats for passengers needing assistance (including women), and installing CCTV cameras in station buildings/trains are being taken. Also, as well as ensuring same wages for men and women on construction sites and providing facilities for female workers, female personnel are also being appointed to manage project implementation, so it is categorized as a Gender Activity Integration Project.

(9) Other Important Issues: None in particular.

4. Targeted Outcomes

(1) Quantitative Effects

1) Outcome (Operation and Effect Indicator)

Indicator	Baseline (results from 2020)	Target (2029) (2 years after completion)
Operation rate (%/ year)	—	
Line 2A	—	92
Line 2B	—	92
Line 6	—	92
Running distance (thousand km/ year)	—	
Line 2A	—	5,242
Line 2B	—	9,161
Line 6	—	5,248
Number of trains (number of running trains / day / direction)	—	
Line 2A	—	150
Line 2B	—	233
Line 6	—	125

Transportation volume (million passenger - km/ day)	—	
Line 2A	—	3.1
Line 2B	—	6.9
Line 6	—	4.7
Income from passenger (million Rupees/ day)	—	
Line 2A	—	10.0
Line 2B	—	18.9
Line 6	—	17.0
Running distance of women-only cars(thousand km/ year)	—	
Line 2A	—	874
Line 2B	—	1,527
Line 6	—	875

Note: Target section from start point to terminus of each line

(2) Qualitative Effects

Improvement of traffic conditions in Bengaluru, Mitigation of traffic pollution; Mitigation of climate change, Mitigation of health issues caused by air pollution, Improvements of convenience by ensuring punctuality of movement, The economic development of Bengaluru, and Enhancement of female empowerment in Bengaluru.

(3) Internal Rate of Return

According to the following preconditions, the Project's Economic Internal Rate of Return (EIRR) and the Financial Internal Rate of Return (FIRR) will be 15.4% and 5.8%, respectively.

[EIRR]

Cost: Project cost, operation and maintenance cost (all excluding tax)

Benefits: Shortening effect on traveling time for the users of metro and roads, reduction of vehicle maintenance costs for metro and road users, reduction of maintenance costs for road traffic infrastructure, traffic accident decline and emission reduction effect of environmental pollutants.

Project Life: 30 years

[FIRR]

Cost: Project cost, operation and maintenance expenses (including tax)

Benefits: Fare box revenue, advertisement revenue, and station commercial and front area development revenue, etc.

Project Life: 30 years

5. Preconditions and External Factors

(1) Preconditions: None

(2) External Factors: None

6. Lessons Learned from Past Similar Projects and Application in this Project

From the ex-post evaluation reports of India's Delhi Mass Rapid Transport System Project and Phase 2 of the same project (evaluation years 2010 and 2015), etc., reinforcement of the skills and abilities of internal personnel taking into account Delhi Metro Rail Corporation's continuous phase implementation has been evaluated as good practice. As part of the consulting services for internal personnel, skills transfer of project management-related know-how was carried out, which enabled internal personnel to independently manage the project in Phase 2, one highlighted reason for which is contribution to dispersion of the necessary skills and abilities for metro rail management by undertaking external projects such as metro construction projects, etc. both domestically and abroad. Another issue raised in the same evaluation reports is that of ensuring convenient transfer to other public transportation at subway stations, from which the lesson has been learned that it is desirable to establish station squares based on coordination with public transportation operating public transportation systems such as feeder buses, etc.

In the Project, like Delhi Metro Rail Corporation, BMRCL, based on its previous initiatives to reinforce internal personnel, is planning to implement continuous technology transfer relating to supervision of project implementation and operation, management and maintenance of the metro system through consulting services for the Project with the aim of further enhancing the abilities of these internal personnel. Also, based on the overall urban plan in BMP2031 (which is currently being formulated), the Project stresses connectivity with other modes of transportation, and BMRCL is set to pick up from the Phase 1 Project by promoting construction of highly convenient station squares for transfers, etc. There are plans for stations established in the Project to have platforms for feeder buses and auto rickshaws. Also, while line 2B is an airport connection line, there are plans to directly connect the terminus inside the airport to maximize convenience at the terminal station.

7. Evaluation Results

The Project aims to cope with the increase of traffic demand in Bengaluru, the capital city of the State of Karnataka in southern India, by expanding the mass rapid transportation system, thereby promoting regional economic development, improving urban environment and eventually mitigating climate change, through relief of traffic congestion and decrease of pollution caused by increasing motor vehicles and is consistent with the development issues and policies of India and the assistance policies and analysis of the Government of Japan and JICA.

The Project is also expected to contribute to the achievement of Goal 9, Goal 11, and Goal 13 of SDGs, so there is a great necessity for assisting with the implementation of this Project.

8. Plan for Future Evaluation

(1) Indicators to be Used

As indicated in section 4 above.

(2) Timing of the Next Evaluation

Ex-post evaluation: 2 years after the Project's completion

END