

ECONOMIC AND FINANCIAL ANALYSES FOR TRANCHE 2

1. **Background.** The Second Rural Connectivity Investment Program will support the Government of India in improving rural connectivity through the Prime Minister's Rural Road Program—Pradhan Mantri Gram Sadak Yojana (PMGSY). The investment program will improve about 12,000 kilometers (km) of rural roads in the states of Assam, Chhattisgarh, Madhya Pradesh, Odisha, and West Bengal. The investment program's road sections form part of the core rural road network and were selected based on the guidelines for the two phases (PMGSY-I and PMGSY-II).¹ Project 1 is under implementation in all investment program states and will construct a total of about 6,254 km of rural roads. Project 2 of the investment program will upgrade 204 rural roads totaling about 2,800 km in Madhya Pradesh. An economic analysis of a sample set of 32 road sections to be financed under the project was carried out to assess its economic viability. The project outputs also include institutional capacity development and technical assistance for road safety audit, which are not included in the economic analysis.

2. **General methodology.** Economic evaluation of the proposed project was undertaken using the Highway Development Model 4 (HDM-4) following the Asian Development Bank's (ADB) guidelines.² The costs to the road agency and road users in the without- and with-project cases were estimated and used to derive the with-project net costs and benefits, and to calculate the economic viability of the project road sections. The analysis uses the domestic price numeraire and assumes 20 years of operation after construction or upgrade. In the terminal year of the project, residual values of assets were considered as per their economic life by applying the straight-line depreciation method.

3. **Project road details.** The details of road sections included in the analysis are given in Table 1. Road sections under consideration are either bituminous paved roads in fair to poor condition requiring rehabilitation and capacity augmentation, or gravel roads in poor condition requiring upgrading to a bituminous paved road. The road characteristics and base-year traffic volumes were obtained from the detailed project reports prepared by the executing agency.

Table 1: Details of Project Road Sections

State	No. of Road Sections	Total Length (km)	Daily Traffic Range (motorized vehicles)	Average Traffic Composition (%)				Daily Traffic Range (non-motorized vehicles)
				Two-Wheeler	Passenger Vehicle	Tractor/Trailer	Truck	
Madhya Pradesh	204	about 2,800	186–1,896	37.3	16.9	32.9	13.0	56–602

Source: Asian Development Bank estimates.

4. **Demand analysis.** Two-wheelers have the highest share in overall traffic, and passenger vehicles, including two-wheelers, account for 54.1%. Agricultural vehicles such as tractors and trailers outnumber trucks with a share of 32.9% and all goods vehicles have a share of 45.9%. The high volume of tractors indicate the extensive use of project roads for transport of agricultural input and output in the project area. Non-motorized traffic is primarily made up of bicycles.

5. Table 2 shows the average real economic growth rate and growth of vehicles experienced during 2010–2016. India's economic growth has rebounded to a range of 7%–8% since 2014 and is projected to maintain this growth rate in the immediate future. The economic growth rate for

¹ Tranche 2 will upgrade roads in Madhya Pradesh in accordance with the PMGSY-II guideline. PMGSY-II enables mobility of self-employment and livelihood opportunities by upgrading existing rural roads that facilitate those impacts in each district.

² ADB. 2017. *Guidelines for the Economic Analysis of Projects*. Manila.

2017 is estimated at 7.4%. The economic growth rate observed for Madhya Pradesh for the period 2012–2017 is 7.7%. The growth in registered vehicles gives an indication of potential traffic growth on the project roads. Table 2 also provides indicative elasticity of vehicle registration growth.

Table 2: Economic Growth Rates and Growth of Registered Vehicles

State	Economic Growth Rate (FY2010–FY2016), %	Growth of Registered Vehicles (FY2010–FY2016), %	Elasticity, Calculated against GDP Growth Rate
Madhya Pradesh	7.2	10.2	1.42
All of India	6.8	10.3	1.51

FY = fiscal year, GDP = gross domestic product.

Sources: Government of India. [NITI Aayog](#); Ministry of Road Transport and Highways. *Road Transport Year Books, 2010–2016*. New Delhi.

6. The growth in registered vehicles in the state gives an indication of the potential for traffic growth on the project roads. Table 3 shows the percentage growth of registered vehicles by category in Madhya Pradesh, as well as for all of India during 2010–2016.

Table 3: Growth Rate of Registered Vehicles, 2010–2016 (%)

State	Two-Wheeler	Car/Jeep/Van	Bus	Goods Vehicle	Tractor	Total
Madhya Pradesh	10.4	12.6	5.4	10.2	6.2	10.2
All of India	10.3	10.0	4.9	7.1	6.2	10.3

Source: Ministry of Road Transport and Highways. *Road Transport Year Books, 2010–2016*. New Delhi.

7. In the absence of historically observed growth on project road sections, a direct correlation between vehicle growth rates and traffic growth rates is assumed, and the elasticity of vehicle growth to socioeconomic growth factors was derived for projecting future growth rates.³ The socioeconomic growth factors used are gross state domestic product, and population and per capita income in the case of buses. Table 4 gives the elasticities of vehicle growth to growth in socioeconomic variables, and also gives adopted values taking into account the all-India values.

Table 4: Transport Demand Elasticities

State	Two-Wheeler	Car/Jeep/Van	Bus	Goods Vehicle	Tractor
Madhya Pradesh	1.33	1.59	1.53	1.30	0.81
All of India	1.43	1.45	1.71	1.07	0.96
Adopted base elasticity	1.30	1.50	1.55	1.25	0.90

Source: Asian Development Bank estimates.

8. With the estimated elasticity values and the growth outlook for economic variables, the growth rates for different vehicle categories are estimated by multiplying the economic variable growth rate with the adopted elasticity values. Some of the vehicle additions will replace older vehicles, and growth in rural areas is likely to be lower than the average growth rates. Future traffic growth rates for the present analysis were derived by reducing the estimated statewide growth rates by 25% to account for replacement of older vehicles and lower growth rates in rural areas. Traffic growth declines over time, so for traffic projections beyond 2023, growth rates are

³ Using the relation $\text{Log}_e \text{RV} = A_0 + A_1 \text{Log}_e \text{EV}$, where RV is registered vehicle volume, A_0 and A_1 are regression coefficients, and EV is the economic variable used.

reduced by 10% every 5 years but are not less than 2% for any vehicle category in the analysis period. Non-motorized traffic is assumed to grow at a marginal 1% per annum.

Table 5: Adopted Growth Rates for Motorized Traffic, 2018–2023

State	Growth Rates (%)				
	Two Wheeler	Car/Jeep/ Van	Bus	Goods Vehicle	Tractor
Madhya Pradesh	6.8	7.9	4.2	6.6	4.7

Source: Asian Development Bank estimates.

9. The project road sections include both bituminous surfaced roads with fair to poor condition, which are upgraded with capacity augmentation; and gravel roads in poor condition, which are upgraded to improve connectivity and access. The potential for traffic diversion is minimal, so none was considered. However, there may be some potential for generated traffic with better roads and savings in vehicle operating costs. In the case of existing gravel roads, upgrading to a paved road will have a significant impact on traffic generation—with the proposed improvements estimated to reduce vehicle operating costs by 30%–50%. For these roads, generated traffic is assumed at 15% (assuming a demand elasticity of -0.5 with cost reduction). For existing paved roads, no additional traffic generation is considered other than normal traffic growth.

10. **Design standards and construction costs.** The project design involves upgrading the road sections to a standard all-weather single- or intermediate-lane road, depending on traffic levels as per the PMGSY-II guidelines. The existing roads are either bituminous paved or gravel surfaced, and will be reconstructed. The proposed upgrades will form the with-project case, with regular routine and periodic maintenance to keep up the level of service; a 5-year post-construction maintenance clause is included in the works contracts. The without-project case will involve minimum maintenance to keep the roads in operation in the short to medium term and reconstruction when the road falls into very poor condition. Construction cost estimates of the sample road subprojects were adopted from the detailed project report prepared by the executing agency and the cost range is shown in Table 6. The economic project cost was derived by removing taxes from the financial cost and adjusting the unskilled labor component by applying a shadow wage rate factor. Where widening to intermediate lanes or construction of bridges and/or cross drains are involved, the costs per km are higher.

Table 6: Improvement Option and Construction Costs

State	Range of Financial Cost (₹ million per km)
Madhya Pradesh	3.84–13.41

km = kilometer.

Source: Asian Development Bank estimates.

11. **Vehicle operating cost savings.** The improvement of project road sections will result in savings to road users and society as a whole in the form of less vehicle operating and time costs for passenger and freight traffic. An economic analysis was carried out using the HDM-4 model, which takes as input the vehicle technical and operational characteristics, vehicle prices, tire prices, fuel price, and maintenance and vehicle operation staff costs. The vehicle price, tire price, and staff costs are based on recent cost examples in the region. Economic fuel prices were derived by excluding all taxes and duties and considering the medium-term fuel price of \$75.0 per barrel. The HDM-4 model calculates the vehicle operating cost savings as the difference between vehicle operating costs without and with the project.

12. **Value of time.** The values of passenger working and nonworking time were calculated based on wage rates in each state. The unskilled labor component in the value-of-time calculation was multiplied by a shadow wage rate factor 0.72.⁴ The value of nonworking time is taken as 25% of that of the working time.

Table 7: Values of Passengers' Working and Nonworking Time

States	Value of Work Time (₹ per hour)			Value of Non-Work Time (₹ per hour)		
	Bus	Two-wheeler	Car	Bus	Two-wheeler	Car
Madhya Pradesh	50.1	85.3	175.5	12.5	21.3	43.9

Source: Asian Development Bank estimates based on wage rates from the Annual Report 2016–2017 of the Ministry of Labor and Employment, Government of India.

13. **Economic analysis.** An economic analysis was carried out for a representative sample of roads in the investment program. The benefits considered include vehicle operating cost savings for motorized vehicles and travel time savings for passengers of motorized vehicles. With-project and without-project vehicle emissions were quantified but not included because the net impact is negligible.⁵ An analysis period of 20 years and a discount rate of 9% are used. The economic analysis results given in Table 8 indicate that the project is economically viable and has an economic internal rate of return (EIRR) above the desirable rate of 9%. The cash-flow streams for the road sections included in the analysis are in Table 9.

Table 8: Results of Economic Analysis

States	EIRR (%)	NPV (₹ million)
Madhya Pradesh	14.1 (10.2–20.7)	977.4

EIRR = economic internal rate of return, NPV = net present value.

Note: EIRR values given in parentheses are the range of EIRRs for the road sections.

Source: Asian Development Bank estimates.

14. **Sensitivity analysis.** A sensitivity analysis was carried out in each investment program state. The following cases were analyzed:

Case I	Base cost and base benefits
Case II	Increase in capital costs by 10% and base benefits
Case III	Base cost and decrease in benefits by 10%
Case IV	Time benefits reduced by 50%
Case V	Completion of all roads extending to 3 years
Case VI	Increase in capital costs by 10% plus decrease in benefits by 10%

15. The results of the sensitivity analysis are in Table 10. The results indicate that with an increase in capital costs of 10% and/or a decrease in benefits of 10%, the investment program remains economically viable with EIRRs above 9%. The proposed road improvements, especially the upgrades of unsealed road sections, will have positive impacts on agricultural productivity and the local communities' quality of life with better access to health and education services in the project area. However, benefits other than quantifiable transport cost savings are not included in the analysis.

⁴ Estimated based on agricultural and construction worker wages and number of days of employment from Government of India, Ministry of Labor and Employment. 2017. *Annual Report, 2016–2017*. New Delhi.

⁵ The social cost of vehicle emission is valued at \$36.3 per ton equivalent of carbon dioxide emission.

Table 9: Cash-Flow Stream
(₹ million)

Year	Increase in Road Agency Costs		Road User Benefits		Net Benefits
	Capital Costs	Maintenance Costs	Vehicle Operating Costs	Time Costs	
2017	0.0	0.0	0.0	0.0	0.0
2018	343.7	0.0	0.0	0.0	(343.7)
2019	1,947.8	0.0	0.0	0.0	(1,947.8)
2020	0.0	(107.4)	191.2	88.0	386.7
2021	0.0	(17.1)	165.6	71.5	254.1
2022	0.0	(32.0)	185.2	75.3	292.6
2023	0.0	(173.5)	201.3	80.8	455.6
2024	0.0	21.8	144.6	59.5	182.3
2025	0.0	383.5	168.8	69.5	(145.2)
2026	0.0	(42.6)	218.8	86.8	348.1
2027	0.0	20.8	219.4	95.3	293.9
2028	0.0	23.9	268.2	114.6	358.9
2029	0.0	(2.4)	362.5	158.3	523.1
2030	0.0	21.7	413.3	176.7	568.3
2031	0.0	312.8	475.7	210.5	373.3
2032	0.0	22.3	387.5	206.0	571.1
2033	0.0	(4.5)	427.4	227.1	659.1
2034	0.0	(2.7)	417.6	223.3	643.6
2035	0.0	16.0	429.1	227.9	641.0
2036	0.0	(50.7)	453.3	240.8	744.8
2037	0.0	317.3	456.5	235.5	374.8
2038	0.0	(74.0)	458.1	220.8	752.8
2039	0.0	(131.0)	432.5	208.1	771.6
				EIRR (%)	14.1
				NPV @ 9%	977.4

() = negative, EIRR = economic internal rate of return, NPV = net present value.

Source: Asian Development Bank assessment.

Table 10: Sensitivity Analysis Results
(%)

State	Economic Internal Rate of Return					
	Case I	Case II	Case III	Case IV	Case V	Case VI
Madhya Pradesh	14.1	12.8 (51.0)	12.6 (33.0)	11.7 (100.0)	13.0 (NA)	11.4 (+/-20.0)

NA = not applicable.

Note: Values given in brackets are switching values.

Source: Asian Development Bank estimates.

16. **Financial assessment.** The project does not generate revenue. The maintenance of roads under PMGSY-I and PMGSY-II is funded by the state governments, as required under the PMGSY guidelines. The sustainability of roads constructed under the project is ensured through the inclusion of a 5-year post-construction maintenance in the civil works contracts. The road maintenance after the 5-year maintenance period will be managed by the rural road network management units (RRNMUs) established under the first Rural Connectivity Investment

Program.⁶ Under the oversight of the RRNMUs, the road maintenance activities in Madhya Pradesh are performed by project implementation units (PIUs) in each district, with the help of contractors on a 5-year performance-based contract. During the project completion review missions of the previous projects under the Rural Road Sector II Investment Program, the project team recognized that the 5-year post-construction maintenance contract has helped the implementing agency maintain the designed service level of the rural roads under the PMGSY program.

17. In fiscal year (FY) 2018, the Madhya Pradesh Rural Road Development Authority (MPRRDA) spent a total of \$144.89 million on the maintenance of PMGSY roads, which was about 10% increase from that of FY2017. The annual maintenance for rural roads under project 2 is estimated to cost about \$3.3 million.⁷ The incremental recurring costs for the state governments on the rural roads built under project 2 are estimated at about 2.3% of the total state's expenditure on the road maintenance under the PMGSY program. Table 11 shows the state's expenditures on the rural road investment under the PMGSY program, including the corresponding budgets and expenditures on maintenance in the last 3 years.

Table 11: Expenditures on PMGSY Program in Madhya Pradesh
(\$ million)

Financial Year	PMGSY Investment			PMGSY Maintenance	
	Regular PMGSY	ADB-assisted PMGSY	Total	Budget ^a	Actual Expenditure ^a
FY2016	181.04	89.25	270.29	142.49	127.79
FY2017	215.24	33.75	248.99	172.49	131.84
FY2018	274.34	11.40	285.74	182.99	144.89

ADB = Asian Development Bank, PMGSY = Pradhan Mantri Gram Sadak Yojana (Prime Minister's Rural Roads Program).

^a Including 5-year maintenance, post 5-year maintenance, and other routine expenditures for both regular and ADB-assisted PMGSY roads.

Source: Asian Development Bank estimates.

18. Table 11 also shows that there are about 10%–20% of the maintenance budget unspent in the last 3 years, which indicates the need for better maintenance programming. The MPRRDA has indicated PMGSY maintenance budgets for about \$201 million for FY2019 and \$219 million for FY2020. Although funding for maintenance has been ensured as per the PMGSY guideline, the critical aspect that the investment program will help address is to ensure that the funding is sufficiently estimated and utilized efficiently and effectively, and that the maintenance activities are done to the extent required.⁸ The investment program will support the RRNMU in each investment program state in preparing a systematic road maintenance program. This programmatic approach will enable the state rural road development agencies to allocate sufficient budget for rural road maintenance, as required in the PMGSY guidelines.

⁶ The PMGSY guidelines recommended that after the 5-year post-construction maintenance period, the responsibility for managing and maintaining the rural road should be handed over to the district *panchayat* (a body of directly elected people responsible for development activities in the area). However, the investment program states decided to manage the rural roads through the project implementation units and the rural road network management units (RRNMU). There are seven RRNMUs established in Madhya Pradesh.

⁷ Based on the engineer's estimate on the 5-year maintenance contract of each subproject under tranche 2.

⁸ In addition to the state budget for PMGSY maintenance, the Madhya Pradesh Rural Road Development Authority (MPRRDA) also received additional funding as an incentive from the central government for the MPRRDA's achievement in meeting the targets of the Ministry of Rural Development, plus additional funding from a difference state government's scheme to develop rural markets (*mandi* scheme).