ECONOMIC AND FINANCIAL ANALYSIS

A. Introduction

1. **Economic rationale.** Nepal relies heavily on its direct neighbors for international trade, particularly India, with which it shares 19 official trading posts. Biratnagar, located 68 kilometers (km) east of Kanchanpur, is the largest export gateway of the country and handles 29.5% of Nepal's exports, while the port of Kolkata is the primary transit point for seaborne freight. As of fiscal year (FY) 2017, India accounted for 65% of Nepal's imports and 57% of its exports, and the People's Republic of China for 13% of imports and 2.3% of exports. However, hampered by a deficient cross-border infrastructure network, the economy of Nepal suffers from a lack of competitiveness: the agricultural sector employs 69.4% of the labor force, and exports decreased at an average annual rate of 6.1% in real terms during FY2007–FY2017. Excluding India, trade with countries of the South Asia Subregional Economic Cooperation (SASEC) and the South Asian Association for Regional Cooperation (SAARC) accounts for only 0.8% of Nepal's total trade.[1] The SASEC Highway Improvement Project is consistent with the objectives of the Government of Nepal, as set out in the country partnership strategy of the Asian Development Bank (ADB), and included in ADB's country operations business plan 2018–2020 and the SASEC operation plan 2016–2025.[2]

2. **Project road.** The inadequate transport network results in high transport costs and poor national and regional connectivity, and hinders economic growth by limiting the development of competitive industries, impeding trade, and reducing the potential of Nepal to benefit from strong growth in neighboring countries. The proposed project involves capacity augmentation and rehabilitation of the 87 kilometer (km) section of the East–West Highway (EWH) between Kanchanpur and Kamala in southeastern Nepal. The EWH is the main road artery along the length of the country and is the main transport corridor for domestic and international trade. The project will promote economic growth and help improve the competitiveness of Nepal's exporting industries by enhancing the efficiency and adequacy of the transport system, improving national and regional connectivity, and addressing safety deficiencies in the road network. The project supports the strategy of the Government of Nepal and will improve domestic connectivity between provinces, and regional connectivity with Bangladesh and India.

3. **Road design.** The project road currently has a two-lane operational carriageway and does not segregate slow-moving vehicles and pedestrians. The volume of motorcycles, which currently accounts for up to 67% of traffic volumes, presents road safety risks as the frequency and severity of motorcycle accidents are higher than for other vehicle classes. The pavement is in fair to poor condition with an average international roughness index of 5, rough edges, and cracks and potholes on part of its length. The road section requires capacity augmentation and pavement reconstruction to maintain acceptable levels of service. The road will consequently be upgraded to a four-lane, median-divided carriageway to cater to the expected growth in traffic demand. Alternative pavement options were considered in the analysis and an asphalt concrete flexible pavement option was retained in accordance with national standards.[3] Service lanes will be

[1] Government of Nepal, Department of Customs. 2018. *Nepal Foreign Trade Statistics FY2016/17*. Kathmandu. SASEC members are Bangladesh, Bhutan, India, Maldives, Myanmar, Nepal, and Sri Lanka; SAARC comprises Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka.

[2] ADB. 2017. *Country Operations Business Plan: Nepal, 2018–2020.* Manila; ADB. 2013. *Country Partnership Strategy: Nepal, 2013–2017*. Manila; and SASEC Secretariat. 2016. *Operational Plan 2016–2025.* Manila. The ADB country partnership strategy for Nepal for 2020–2024 is under preparation.

[3] Department of Roads. 2014. *Pavement Design Guidelines (Flexible Pavement).* Kathmandu.

provided in settlement areas to improve road safety and reduce conflicts between travel purposes and vehicle classes, notably between bicycles, motorcycles, and cars.

4. **Economic analysis.** The economic analysis of the project was carried out using the Highway Design and Management (HDM-4) model and in accordance with ADB guidelines.[4] The HDM-4 model requires input data on traffic, road geometry, pavement condition, maintenance and improvement costs, vehicle operating costs, and the value of time. Detailed project reports prepared by consultants engaged by the Department of Roads (DOR) provided the required input data. Costs and benefits accruing to the road agency and to road users were calculated in with- and without-project cases, and were used to estimate the net costs and benefits of the project roads and to calculate the economic viability of the project.

B. Demand Analysis

5. **Traffic demand.** Base-year traffic volumes were obtained from traffic counts carried out in 2018 for 10 vehicle classes on seven homogenous traffic sections along the EWH between Kanchanpur and Kamala (Table 1). Variations in traffic are caused by major urban sections along the corridor. The traffic composition on the project road sections indicates that passenger vehicle traffic forms 73%–81% of the traffic, with two-wheelers accounting for 44%–67% of total traffic. Goods vehicle traffic averages over 2,000 vehicles per day on the project road.

Table 1: Base Year Traffic Volume on Project Road Sections

Road Section	Length (km)	AADT (units)	Passenger Vehicles Share (%)	Goods Vehicles Share (%)
Kanchanpur–Rupani	20.35	5,755	74.3	25.7
Rupani–Kadmaha	21.68	8,937	80.8	19.2
Kadmaha–Lahan	8.36	13,158	79.2	20.8
Lahan–Dhangarhi	7.40	11,496	78.6	21.4
Dhangarhi–Chourhawa	10.59	9,833	77.9	22.1
Chourhawa–Mirchaiya	5.15	8,754	76.2	23.8
Mirchaiya–Kamala	13.47	6,823	73.2	26.8

AADT = annual average daily traffic; km = kilometer.
Source: Detailed Project Report (2018).

6. **Traffic growth.** Traffic growth forecasts were prepared by vehicle class by comparing (i) registered vehicle growth forecasts, derived from the observed gross domestic product (GDP) and per capita income elasticity of registered vehicle growth, and the economic growth outlook; and (ii) historical traffic growth trends by vehicle class carried out by DOR on the project road corridor. The most conservative values among the two approaches were adopted to adjust national level data to the project area.

7. Vehicle ownership rates are low, at just 0.08 vehicles per capita as of FY2017. However, vehicle sales increased at an average annual growth rate of 17.5% during FY2007–FY2017 (Table 2).[5] The GDP of Nepal grew at an average annual rate of 4.5% during FY2007–FY2017 and is forecast to grow at 5.9% in FY2018 and 5.5% in FY2019, with tapered assumptions over

[4] ADB. 2017. *Guidelines for the Economic Analysis of Projects.* Manila.
[5] Government of Nepal, Department of Transport Management. 2018. *Vehicle Registration Details up to Fiscal Year 2073–74*. Kathmandu. This compares with 0.42 vehicles per capita in India and 0.80 in the United States.

time (Table 3).[6] The traffic growth rate forecasts by vehicle class used for the analysis are summarized in Table 4.

8. **Diverted and generated traffic.** The project road is currently the main traffic corridor for domestic and international trade, and the analysis did not assume a diversion of existing travel demand from existing competing corridors. The magnitude of generated traffic depends on the estimated level of benefits accrued to the project by the improvement of road conditions. Based on the extent of vehicle operating costs and travel time savings, a generated traffic of 10% has been considered in the analysis, which corresponds to the release of latent travel demand and to the increase in traffic frequency due to roadway improvements.

Table 2: Registered Vehicles in Nepal, 1997–2017

	Annual Sales					Total Registered
Year	Car	Motorcycle	Bus	Commercial	Total	Vehicles
1997	4,521	15,739	968	2,537	23,765	203,445
2002	4,379	36,117	1,591	5,073	47,160	364,444
2007	6,030	72,568	2,520	7,617	88,735	626,174
2012	11,847	145,135	3,420	9,682	170,084	1,348,995
2017	32,808	354,071	25,973	31,407	444,259	2,783,428
Annual growth 2007–2017 (%)	18.5	17.2	26.3	15.2	17.5	16.1

Source: Asian Development Bank estimates.

Table 3: Economic Growth Forecasts in Nepal, 2018–2041

Parameters	2018–2022	2023–2032	2033–2041
GDP growth (%)	4.2–4.7	2.9–3.7	3.1–3.7
GDP per capita growth (%)	2.9–3.4	1.6–2.4	1.9–2.4

GDP = gross domestic product
Source: Asian Development Bank estimates.

Table 4: Traffic Growth Forecasts by Vehicle Class
(%)

Vehicle Type	2018–2022	2023–2032	2033–2041
Car	7.8	6.0	5.9
Two-wheeler	11.6	8.9	8.7
Bus	4.2	3.2	3.1
Goods vehicle	4.3	4.8	3.1

Source: Asian Development Bank estimates.

C. Economic Analysis

9. **Key parameters.** The economic analysis was conducted using the domestic price numeraire presented in the national currency. All costs and benefits were valued in monetary terms as of May 2018, and expressed in economic prices. A discount rate of 9% was used for calculating the net present value. Key economic analysis assumptions are summarized in Table 5.

[6] Government of Nepal, Central Bureau of Statistics. 2018. *National Accounts of Nepal 2016/17.* Kathmandu; ADB. 2018. *Asian Development Outlook: How Technology Affect Jobs.* Manila; and International Monetary Fund. April 2018. World Economic Outlook Database.

Table 5: Input Parameters Used for the Analysis

Parameter	Value
Analysis period from opening year (years)	20
Discount rate (%)	9
Construction period (years)	3
Construction start year	2019
Opening year for road traffic	2022

Source: Asian Development Bank.

10. **Project costs.** Financial construction cost estimates are based on the bill of quantities and unit rates in accordance with the detailed project reports prepared by DOR. Economic costs include the civil works cost, environmental costs, resettlement costs, utility shifting costs, and physical contingencies. Physical contingencies are included in project costs as they are part of the value of resources to be used in the construction, but price contingencies are excluded from the economic analysis. The economic costs of construction were derived from the financial costs by removing taxes and applying a shadow exchange rate factor of 1.10 for tradable goods, based on Nepal's international trade data.[7] A shadow wage rate factor of 0.70 was applied to unskilled labor components, based on wages in the construction and agriculture sectors. The economic cost of relocation and resettlement is based on the economic value of resettlement allowances given to displaced families and of replacement of private and community structures. The analysis assumes that periodic maintenance needs are met in both the without- and with-project case. Maintenance costs comprise (i) annual routine maintenance, including patching, crack sealing, edge repair, and cleaning of drainage system and structures; and (ii) periodic maintenance, with resurfacing at 5-year intervals.

11. **Residual value.** A straight-line depreciation method is used to calculate the residual value of project elements at the end of the analysis period. Road work is assumed to have a life of 20 years with regular and periodic maintenance as needed, and no residual value at the end of the analysis period. Bridges and culverts are assumed to have a 50-year lifespan, with an estimated residual value of 40% at the end of the analysis period.

12. **Project benefits.** The quantified benefits of the project include travel time savings and vehicle operating cost savings for motorized vehicles resulting from higher vehicle speeds and improved riding quality with the project (Table 6). Carbon dioxide (CO_2) emissions were also quantified as a potential benefit or disbenefit. Speeds will be significantly reduced under the without-project scenario as road capacities will be reached earlier than under the with-project scenario; this would in turn contribute to a higher rate of road degradation. The benefits of generated demand were valued at half of the benefits of base demand.

Table 6: Operating Characteristics in the First Year of Operation

Scenario	Average Roughness (m/km)	Average Vehicle Speed (km/h)	Average Vehicle Operating Cost (NRs/vehicle-km)
Without project	5.7	41.1	11.6 (car), 42.5 (medium truck)
With project	2.1	72.1	11.3 (car), 35.9 (medium truck)

h = hour; km = kilometer; m = meter; NRs = Nepalese rupees.
Source: Asian Development Bank estimates.

[7] International Monetary Fund. *International Finance Statistics* and *Global Financial Stability Report* databases (accessed May 2018).

13. **Vehicle characteristics and costs.** Data required for the HDM-4 analysis were obtained from the detailed project report, including inventory and condition surveys, and the material and pavement investigations. The HDM-4 model predicts the vehicle operating costs as a function of operating conditions, based on inputs that include the vehicle technical and operational characteristics, vehicle prices, tire prices, fuel prices, and vehicle maintenance and operation costs. The study adopted (i) vehicle and tire prices (excluding taxes and labor cost for vehicle maintenance and operation) collected from surveys of vehicle and tire sales agents in the first quarter of 2018; and (ii) fuel prices (excluding taxes and duties) derived from the Nepal Oil Corporation and fuel pumps.

14. **Value of time for passengers.** For passenger vehicles, passenger time values were calculated based on GDP, population, employment rate, and a survey of travelers and drivers. Work trips account for 25%–60% of all trips. The value of time for non-work travel of income-earning persons is taken as 23% of the value of their time. No value of time is considered for travel by non-income earning persons. The value of working time of car users was thus estimated to be 2.9 times that of bus users, and the value of time of users of two- and three-wheelers was estimated to be about 2.1 times that of bus users. The estimated values of time for each passenger-carrying vehicle are summarized in Table 7.

Table 7: Adopted Values of Passenger Time
(NRs per hour)

Vehicle Type	Value of Time for Work Travel	Value of Time for Non-work Travel
Motorcycle	168.9	38.1
Car	225.2	50.8
Bus	78.8	17.8

NRs = Nepalese rupees.
Source: Asian Development Bank estimates.

15. **Value of time for freight.** For goods-carrying vehicles, the value of time for cargo was calculated in accordance with the suggested methodology of the HDM-4, using the value of goods carried times the commercial interest rate paid by the owners as an inventory cost. Considering the predominance of regional trade and main goods carried, a cargo value of NRs100,000/ton was assumed, and the opportunity cost of cargo delay or value of time for cargo was estimated considering an interest rate of 12%.

16. **Construction.** The impact of construction on road user costs and travel time has been considered as neutral in the analysis. The project road is in poor to fair condition, and vehicle operating costs and time savings will be increasingly improved on upgraded road sections as the road construction progresses. The road design was also prepared to minimize disturbance during construction, notably as the 54 existing two-lane bridges will be preserved.

17. **Carbon dioxide emissions.** Carbon dioxide emissions were valued at $36.3/ton in 2016 values, increasing at 2% per year in real terms. The project will result in an overall increase in CO_2 emissions, as higher traffic volumes will offset the decrease in unit emission rates per vehicle-kilometer due to improved pavement conditions and improved speeds.

18. **Unquantified benefits.** In addition to quantified benefits, the project is expected to deliver significant economic benefits that have not been quantified in the analysis. Primarily, these benefits include (i) an expected reduction in traffic accidents and fatalities resulting from improved road geometry and signage, notably for vulnerable road users (pedestrians, cyclists, and

motorcyclists) residing in settlements where service lanes are provided and on the project road, which will be median-divided; (ii) a contribution to economic growth and overall trade between SASEC countries through additional investments expected under improved road transport infrastructure, particularly in the industry, agriculture, and tourism sectors; and (iii) improved access to markets, employment, and social and educational opportunities.

19. **Economic analysis.** The overall economic internal rate of return of the project is estimated at 13.4%, above the 9% threshold (Table 8). Cost and benefit streams are in Table 9.

20. **Sensitivity analysis.** Sensitivity tests were carried out to investigate the robustness of the project to adverse changes in costs and benefits in the following cases: (i) 10% increase in capital costs, (ii) 10% decrease in benefits, (iii) 10% increase in capital costs and 10% decrease in benefits, (iv) 20% decrease in the value of time, (v) 2-year delay in construction, and (vi) CO_2 emissions excluded from the analysis. In the most sensitive case, with a 10% increase in capital costs and a 10% decrease in benefits, the project has an economic internal rate of return of 11.3%, which remains above the 9.0% threshold (Table 8). The sensitivity analysis demonstrates the economic viability of the project to adverse changes in costs and benefits, and the project is thus recommended for implementation on the basis of its economic benefits.

Table 8: Economic Analysis Results

	Scenario	EIRR (%)	NPV (NRs million)	Switching Value (%)
	Base Case	13.4	9,685	
1	Increase in capital costs by 10%	12.4	7,925	55.0
2	Decrease in benefits by 10%	12.2	6,813	(33.7)
3	Increase in capital costs by 10% and decrease in benefits by 10%	11.3	5,054	20.9
4	Decrease in value of time by 20%	11.6	5,432	(45.5)
5	2-year delay in construction	12.9	8,175	
6	CO_2 emissions excluded	14.0	11,065	

( ) = negative; CO_2 = carbon dioxide; EIRR = economic internal rate of return; NPV = net present value; NRs = Nepalese rupees.

Note: The switching value indicates the percentage by which cost increases and benefits decrease to result in a net present value of 0.

Source: Asian Development Bank estimates.

D. Financial Sustainability

21. The project is not revenue-generating and recovery of capital costs will not be sought. The financial sustainability analysis was conducted in accordance with ADB guidelines by assessing the sustainability of incremental recurrent costs.[8] Road maintenance is funded through the Roads Board of Nepal, which receives its funds from allocations of the Ministry of Finance and from toll revenues. The annual budget for the maintenance of the strategic road network increased 107% during FY2012–FY2019, from NRs2.61 billion to NRs5.50 billion, representing an average annual increase of about 4.7% in real terms.[9] The funding allocation since FY2012 covered 100% of routine and 70% of periodic maintenance needs, and the Ministry of Finance has committed to financing 100% of periodic maintenance needs, provided that budget utilization increases along with the budget allocation. Incremental recurrent costs associated with the project are estimated at 1.1% of the annual maintenance budget of the strategic road network. Consequently,

[8] ADB. 2005. *Financial Management and Analysis of Projects.* Manila.

[9] Government of Nepal, Ministry of Finance. May 2018. *Budget Speech FY2018–19.* Kathmandu.

considering the past budget allocation trends and the priority given to the main road corridors, it is reasonable to expect that the budget allocation will be sufficient to meet the maintenance costs.

22. The project further supports DOR in strengthening road maintenance capacity by including 6 years of contracted maintenance after completion of construction, and will ensure the availability and utilization of maintenance funds in the initial phase following completion of construction.[10] The project also supports the road asset management system recently developed with the assistance of ADB (footnote 10). An individual consultant will be engaged in the project management unit to assist with the development, data collection, and maintenance of the road asset management system. The project will thus promote sustainable maintenance of the project roads under the supervision of DOR.

[10] ADB. 2018. *Technical Assistance Grant to Nepal for Capacity Strengthening for Sustainable Road Transport: Final Project Report, Volume 3.* Manila (TA 8413-NEP). Maintenance after completion of construction includes a 1-year defect liability period and 5 years of performance-based maintenance. Performance-based maintenance contracts were prepared with ADB assistance.

Table 9: Economic Costs and Benefits Streams
(NRs million)

	Incremental Costs		Incremental Benefits					
			VOC		Travel Time		CO_2 Emissions	
Year	Capital Works	Recurrent Works	Normal Traffic	Generated Traffic	Normal Traffic	Generated Traffic		Net Benefits
2019	4,280.4	(16.3)						(4,264.1)
2020	6,420.6							(6,420.6)
2021	10,701.0							(10,701.0)
2022		(5.1)	329.6	16.5	1,156.6	57.8	(86.1)	1,479.4
2023		0.0	395.2	39.5	1,303.6	130.4	(135.1)	1,733.6
2024		(5.1)	475.6	47.6	1,458.5	145.8	(143.2)	1,989.3
2025		(5.1)	561.9	56.2	1,626.6	162.7	(151.4)	2,261.1
2026		0.5	661.7	66.2	1,815.7	181.6	(159.6)	2,565.1
2027		(4.2)	786.9	78.7	2,038.6	203.9	(167.2)	2,945.1
2028		(1.7)	923.7	92.4	2,282.5	228.2	(174.3)	3,354.2
2029		823.0	1,080.7	108.1	2,557.9	255.8	(180.7)	2,998.8
2030		0.0	1,241.2	124.1	2,953.5	295.3	(197.8)	4,416.4
2031		(44.4)	1,458.0	145.8	3,338.2	333.8	(204.8)	5,115.4
2032		(4.6)	1,487.8	148.8	3,566.2	356.6	(220.3)	5,343.7
2033		(141.3)	1,736.1	173.6	4,030.5	403.0	(227.3)	6,257.2
2034		(98.6)	1,442.4	144.2	3,936.5	393.6	(254.9)	5,760.4
2035		(59.4)	1,364.2	136.4	4,133.7	413.4	(274.1)	5,833.0
2036		72.7	1,068.7	106.9	4,135.5	413.6	(307.5)	5,344.5
2037		401.0	1,272.1	127.2	4,690.0	469.0	(323.6)	5,833.6
2038		278.0	1,505.3	150.5	5,403.9	540.4	(351.4)	6,970.7
2039		(0.4)	1,764.8	176.5	6,175.7	617.6	(378.4)	8,356.6
2040		(0.4)	2,080.4	208.0	6,942.5	694.3	(395.3)	9,530.5
2041	(2,060.6)	(1.5)	2,454.3	245.4	7,783.8	778.4	(412.1)	12,912.0
						EIRR		**13.4%**
						NPV		**9,684.9**

( ) = negative; CO_2 = carbon dioxide; EIRR = economic internal rate of return; NPV = net present value; NRs = Nepalese rupees; VOC = vehicle operating cost.
Source: Asian Development Bank estimates.