

ECONOMIC AND FINANCIAL ASSESSMENTS FOR TRANCHE 3

A. Introduction

1. The road connectivity to rural centers have not kept pace with the development in Sri Lanka's road sector and the conditions of rural road links have deteriorated affecting the socio-economic development of the rural areas. The Government of Sri Lanka intends to provide better social infrastructure facilities in several identified villages which may function as rural hubs serving several villages in the vicinity. The Integrated Road Investment Program (iRoad) will improve connectivity to these rural hubs. The first iRoad project has identified 198 road sections for reconstruction or rehabilitation and operation in Southern Province. Subsequent projects selected 560 road sections covering Sabaragamuwa, North Central, Central, North Western Provinces and Kalutara District in Western Province. Summary features of project road sections by district are given in Table 1.

2. The economic analysis was carried out for the proposed improvements to the selected road sections using Highway Development Model (HDM) IV. The inputs include data on traffic, road geometry, road condition, pavement structure and material characteristics of the existing road, maintenance and road improvement costs, and vehicle operating cost parameters for representative vehicles.

B. Demand Analysis

3. The local roads included are narrow single lane roads with roadway width of 2.5 to 4.0 m and are mostly gravel or bituminous surfaced. There are short sections of concrete surfacing on many of the roads. The surface condition is mostly poor. Many of the roads have a combination of surface types including non-motorable and motorable sections. These may be the result of the roads being constructed over time in small sections, as funds get allocated. The national and provincial roads included are bituminous surfaced roads with single to two lane carriageway in fair to poor condition.

4. Traffic volume was obtained from the classified traffic counts carried out on project road sections for 12 hours on all road sections included in the project. The expansion factors established by RDA planning division from historical traffic data for expanding 12 hour traffic to 24 hours and weekly and seasonal variation was used to arrive at annual average daily traffic for the base year.

5. Traffic growth trends were established by relating growth in population, per capita income, and agriculture GDP of the province to that of buses, private vehicles and goods vehicles, respectively, for each of the five provinces.¹ The linear relationships developed were used in deriving likely future traffic growths. The projected vehicle fleet for years 2025 and 2036 were estimated using the linear regression equations developed with the relevant variables and vehicle fleet in the provinces for provincial and local roads, and country-wide values for national roads. The vehicle fleet growth rate thus derived is taken as a proxy for traffic growth rate. The population growth rate observed (0.6 to 0.8% per annum except in North Central where it is 1.2% per annum) in the past decade was assumed to continue for the next 20 years. In the case of per capita income growth and agriculture GDP, linear projection of time series data for each Province was used to estimate the projected values for 2025 and 2036 and these were used in the regression equations to estimate the projected vehicle fleet. The estimated vehicle

¹ Published data on Central Bank of Sri Lanka website. <http://www.cbsl.gov.lk/>

ownership rates were also compared with the past trends in the country and were found reasonable. The traffic growth rates thus derived and used for traffic projection are given in Table 2.

Table 1: Summary Details of Project Road Sections

District	Number of roads	Length (km)	AADT (motorized vehicles)	Passenger Vehicles (%)	Freight Vehicles (%)	AADT (non-motorized vehicles)
Local Roads Selected for CRC						
Kegalle	46	146.5	161-1135	93.4	6.6	66-820
Ratanapura	13	95.4	239-905	90.1	9.9	44-431
Anuradapura	37	150.9	196-2792	87.0	13.0	65-1592
Polonnaruwa	36	90.4	260-2117	84.7	15.3	149-1297
Kandy	32	135.2	225-1769	83.1	16.9	82-1096
Matale	42	148.4	200-2789	84.4	15.6	90-1177
Nuwara Eliya	27	90.3	178-1348	80.5	19.5	30-2088
Kurunegala	47	256.0	298-2080	91.8	8.2	48-1014
Puttalam	19	118.0	281-2038	90.0	10.0	70-1176
Kalutara	80	254.9	196-1975	91.8	8.2	120-1272
Galle	59	161.4	130-1910	88.1	11.9	9-1424
Matara	63	193.5	113-1560	87.0	13.0	10-664
Hambantota	49	151.0	140-908	87.5	12.5	5-392
Provincial Roads Selected for CRC						
Kegalle	17	70.6	266-946	91.0	9.0	52-570
Ratanapura	25	159.6	230-1153	88.2	11.8	30-462
Anuradapura	23	178.4	355-2885	86.9	13.1	130-741
Polonnaruwa	19	79.2	325-2100	82.4	17.6	39-1480
Kandy	18	85.7	226-2959	86.7	13.3	121-1150
Matale	9	45.9	242-1811	84.7	15.3	130-905
NuwaraEliya	16	89.1	169-1624	83.8	16.2	32-1775
Kurunegala	29	228.5	461-2374	88.1	11.9	71-2342
Puttalam	19	101.6	480-2646	89.0	11.0	110-1822
Kalutara	3	21.1	391-1043	88.3	11.7	171-888
Galle	6	26.2	433-1973	86.5	13.5	62-1076
Matara	2	10.7	750-1087	85.5	14.5	192-300
Hambantota	2	15.7	854-960	86.0	14.0	158-159
National Roads Selected for CRC						
Galle	1	9.5	1650	82.0	18.0	520
Matara	2	13.3	1800-2776	84.1	15.9	241-650
National Roads Selected for RMC						
Southern Province	14	109.0	1582-4737	81.7-90.2	9.8-18.3	54-689
Other Provinces ^a	3	120.3	11085-16546	83.7-94.1	5.9-16.3	1300-2100

AADT = Average Annual Daily Traffic; CRC = Conventional Road Contracts; km = kilometer; RMC = Road Management Contracts.

^a Selected project roads are located in Central, Sabaragamuwa and North Western Provinces.

Source: Road Development Authority, Sri Lanka.

Table 2: Traffic Growth Rates (%)

Province	2015–2025			2026–2036		
	Public Transport	Private Transport	Freight Transport	Public Transport	Private Transport	Freight Transport
Sabaragamuwa	5.5	5.5	4.3	4.0	3.3	2.8
North Central	5.7	6.6	4.0	4.2	3.7	2.7
Central	4.1	5.9	2.7	3.3	3.4	2.0
Western	3.0	4.1	2.0	2.9	2.8	1.6
North Western	4.5	5.0	2.4	4.0	3.1	1.9
Southern	4.8	5.0	2.8	3.9	3.1	2.1
National Roads	4.3	5.2	3.0	4.1	3.2	2.2

Source: Asian Development Bank estimates.

C. Engineering Design

6. The project road sections are proposed to be rehabilitated or reconstructed based on the existing road conditions with asphalt concrete surfacing. Based on the class and function of roads, the carriageway will be widened to two lanes in case of national roads, intermediate lane in case of provincial roads and single lane in case of local roads. For local roads with higher traffic levels, provision of a wider carriageway is considered where roadway width is available for increased road safety. The final engineering design shall have measures to improve road safety and control speed at locations with limited visibility such as curves and commercial areas. The road improvement works are planned using conventional road contracts (CRCs) for all provincial and local roads and road management contracts (RMCs) which involve rehabilitation and performance based maintenance over seven years for all national roads.

D. Economic and Financial Analysis

7. The economic analysis was carried out following ADB's guidelines and using the HDM IV by comparing transport costs for road agency and transport users with- and without-project options.² The without-project option included routine and periodic maintenance for roads in fair condition and only minimum maintenance for roads in poor or bad condition and no capacity improvement. The with-project option included widening to the specified standard for each road category and rehabilitation or reconstruction with asphalt paved surfacing. The analysis used 2015 constant prices. A standard conversion factor of 0.97 estimated from trade data was used for approximating the border price equivalent of non-traded inputs and outputs.

8. The project's cost estimates are based on the awarded contract amounts and engineering estimates. The costs include those for civil works, environmental impact mitigation (to control dust, noise, waste, and traffic disruption caused by construction), shifting utilities, quality control, construction supervision, project management and physical contingencies. The estimated financial cost was converted to economic cost by removing taxes and duties and applying the standard conversion factor and shadow wage rate factor as applicable.³ Operation and maintenance costs were also estimated for each year of the analysis period.

² ADB. 1997. *Guidelines for the Economic Analysis of Projects*. Manila.

³ A shadow wage rate factor of 1.0 for skilled and semi-skilled workers and 0.72 for unskilled labors was used based on Consultant estimates.

9. Key parameters used in the economic analysis are in Table 3. The all-weather paved roads connecting the villages will provide significant benefits, including easier access to health and education, increased agriculture productivity and diversification, poverty reduction and better employment opportunities to the rural population in addition to the large vehicle operating cost and time savings. As these social benefits are not captured by the economic analysis, which accounts only for transport cost savings, the economic internal rate of return (EIRR) threshold of 10% was adopted for testing economic viability of individual provincial and local road sections whereas 12% is used for national road sections. The project includes widening and structures with an asset life much longer than the analysis period. Salvage value for road sections at the end of the analysis period were calculated using straight-line depreciation.⁴ The land width available may not allow temporary diversion and may require blocking traffic for a short time for each of the construction operation and may result in some traffic detour but for the rest of the period, the section will offer a better level of service. The negative benefits during the detour and the positive benefits for the rest of the construction duration are assumed to balance out and therefore not considered.

Table 3: Input Parameters

Parameters	Value
Analysis period (years)	20
Discount rate (%)	10% for local & provincial roads; 12% for national roads
Construction period (years)	2
Construction start year	2015
Opening year to traffic	2017

Source: Asian Development Bank assessment.

10. The HDM estimates that the average speeds on existing unsealed local and provincial roads in poor condition will almost double, while travel time will be reduced by 40-50% with the upgrade to bituminous surfacing and standard roadway cross section. The capacity expansion and improved maintenance on the remaining roads will improve the speeds on those roads and reduce the travel time by 15 to 30%. The travel time without and with project is estimated by HDM and value of time saved is included in the analysis. The unit value of passenger time used in the HDM is given in Table 4. The value of passenger time was estimated based on current income levels and published data in Sri Lanka using the methodology from the manual which define users of public and private transport by income categories.⁵ The passenger value of time is assumed to grow in line with per capita income growth in real terms. The per capita income has been growing at an average of 5.2% in real terms during the period from 2007 to 2014. For the analysis, a 3% per annum real per capita income growth is considered. The value of cargo delay was derived as the opportunity cost of capital tied up in delayed cargo (value of cargo multiplied by the interest rate) and was estimated at SLRs 22 and SLRs 66 per hour for light commercial vehicles and trucks, respectively, assuming a cargo value of SLRs 200,000-250,000 per tonne for light commercial vehicles and trucks, an interest rate of 15% and two-thirds of cargo vehicles are benefited. Shadow wage rate factor for unskilled workers was applied to public transport user's time value assuming one-third of public transport users are unskilled workers and all time values were converted to border price equivalent.

⁴ Earthwork, sub-base and base layers of widened portion over 40 years, bituminous pavement over 20 years, structures over 40 years.

⁵ Ministry of Finance and Planning, Sri Lanka. 2001. *Assessing Public Investment in the Transport Sector*. Colombo.

Table 4: Value of Time for Passengers and Occupancy Rates, 2015

Vehicle Type	Value of work Time (SLR/hr)	Value of non-work time (SLR/hr)	Occupancy Rate ^a
Two & Three Wheeler	110.7	18.4	1.5
Car	582.8	97.1	2.5
Van	582.8	97.1	4.5
Public Transport	57.7	9.6	25 - 40

^a Occupancy rate of three-wheeler not including the driver.

Source: Asian Development Bank estimates.

11. The economic analysis has estimated two categories of benefits: (i) savings in vehicle operating costs due to improved road conditions, and (ii) savings in travel time due to increased travel speeds. The vehicle operating costs and travel time costs are estimated using HDM IV in without and with project cases. Economic analysis conducted by individual project road sections and contract packages indicated that the investment program is economically viable with EIRRs ranging from 14.5% to 23.2% at district level for the local and provincial roads selected for CRCs. In addition, roads selected for RMCs in Southern province and other provinces record EIRR of 18.6% and 27.7%, respectively. The estimated EIRRs for all project roads in Tranches 1 and 2 are 18.9% and 18.3%, respectively, while EIRR for overall project is 18.4%. The economic analysis of each road sections also indicates an EIRR above the respective threshold values of 10% and 12% for local/provincial roads and national roads. The summary of economic analysis results are shown in Table 5. The cost benefit stream for the overall project is shown in Table 6.

Table 5: Economic Analysis Results

Category/ District	Length (km)	EIRR (%)	NPV (SLR Mn.) @ 12%	EIRR Range		
				Rural	Provincial	National
Galle	197.1	16.9	1,351.7	11.7 - 28.3	12.2 - 23.5	19.1
Matara	217.5	23.2	2,660.1	12.3 - 32.3	20.2 - 30.5	27.5 - 29.6
Hambantota	166.7	17.9	1,839.0	11.7 - 24.8	16.1 - 18.6	n.a.
Roads selected for RMC (Southern Province) ^a	109.0	18.6	1,901.0	n.a.	n.a.	16.9 - 21.3
All Project Roads (Tranche 1)	690.3	18.9	7,751.8	11.7 - 32.3	12.2 - 30.5	16.9 - 29.6
Kegalle	217.1	14.5	636.3	10.0 - 32.0	12.0 - 21.9	n.a.
Ratanapura	255.0	15.6	1,218.0	10.0 - 22.4	12.2 - 27.6	n.a.
Anuradapura	329.3	19.6	2,735.4	10.2 - 33.3	12.5 - 30.5	n.a.
Polonnaruwa	169.6	17.6	1,184.2	10.1 - 33.3	12.1 - 24.7	n.a.
Kandy	220.9	15.3	1,009.7	10.0 - 27.3	12.0 - 28.5	n.a.
Matale	194.3	16.1	893.4	10.3 - 28.2	12.1 - 21.8	n.a.
Nuwara Eliya	179.4	14.6	766.3	10.4 - 26.5	12.0 - 22.6	n.a.
Kurunegala	484.5	17.4	2,553.4	10.3 - 32.2	12.0 - 32.6	n.a.
Puttalam	219.6	16.0	1,078.7	10.1 - 29.1	12.0 - 25.1	n.a.
Kalutara	276.0	15.1	1,004.9	10.4 - 25.0	12.0 - 23.4	n.a.
Roads selected for RMC (Other Provinces)	120.3	27.7	9,936.2	n.a.	n.a.	21.8 - 30.5
All Project Roads (Tranche 2)	2,666.0	18.3	23,016.5	10.0 - 33.3	12.0 - 32.6	21.8 - 30.5

Category/ District	Length (km)	EIRR (%)	NPV (SLR Mn.) @ 12%	EIRR Range		
				Rural	Provincial	National
Overall Project	3,356.3	18.4	30,768.3	10.0 - 33.3	12.0 - 32.6	16.9 - 30.5

EIRR = economic internal rate of return; km = kilometer; NMT = Non-motorized traffic; NPV = net present value; RMC = Road Management Contracts.

^a Include road length of 49.5 km selected for routine periodic and maintenance only.

Source: Asian Development Bank estimates.

Table 6: Cash Flow Stream for All Project Roads (SLRs Million)

Year	Increase in Road Agency Costs		Decrease in Road User Costs			Net Benefits
	Capital Costs	Maintenance Costs	Vehicle Operating Costs	Time Costs	NMT Costs	
2015	14,958.7	- 334.2	- 0.2	-0.0	- 0.1	-14,624.9
2016	30,564.5	-116.4	354.0	5.9	124.6	-29,963.7
2017	18,894.0	- 47.9	1,615.5	774.5	223.8	- 16,232.3
2018		- 890.5	5,850.9	4,089.8	880.9	11,712.1
2019		- 663.3	6,181.5	4,324.3	698.8	11,867.8
2020		-1,734.9	7,267.5	4,568.0	910.9	14,481.3
2021		-1,165.8	6,448.5	4,704.0	966.1	13,284.4
2022		-159.7	6,488.7	4,901.6	963.2	12,513.2
2023		-3,187.1	6,811.0	5,081.5	982.8	16,062.4
2024		1,133.0	6,332.6	5,262.4	724.9	11,186.9
2025		-212.1	7,740.8	5,527.2	969.1	14,449.2
2026		-65.5	8,258.8	5,779.0	1,023.5	15,126.8
2027		-495.3	8,815.5	6,010.1	1,091.5	16,412.4
2028		-941.2	9,147.7	6,175.6	1,098.5	17,362.9
2029		11,075.6	9,020.6	6,344.8	870.4	5,160.3
2030		-2,019.9	10,039.6	6,611.8	1,162.9	19,834.3
2031		-1,165.6	8,807.8	6,943.6	1,181.7	18,098.8
2032		957.3	9,283.7	7,405.2	1,227.3	16,958.9
2033		-1,095.8	10,079.5	7,786.5	1,266.7	20,228.5
2034		-471.0	10,200.6	8,272.0	1,038.0	19,981.7
2035		-2,415.6	11,420.4	8,835.0	1,304.9	23,975.9
2036	-13,424.6	-224.7	11,854.2	9,427.4	1,319.8	36,250.8
EIRR	18.4		NPV @ 12%			30,768.3

EIRR = economic internal rate of return; NMT = Non-motorized traffic; NPV = net present value.

Source: Asian Development Bank estimates.

E. Sensitivity Analysis

12. The cost and benefit estimates involve uncertainties as those are not based on the detailed design and construction drawings, and traffic growth rates are estimated based on past economic and vehicle fleet growth trends. Sensitivity analysis was carried out with respect to adverse changes in the costs and benefits that can influence the project's economic viability.

The results (in Table 7) indicate the project remains viable in all scenarios as the EIRRs exceed the thresholds of 10% for local/provincial roads and 12% for national roads.

F. Financial Sustainability

13. The financial requirements for operation and maintenance of project roads will decrease after the construction is completed because the road condition will be improved and regular maintenance can extend the life of the pavement over a longer period. The CRC packages include 3 years of maintenance, and the RMC packages include 7 years of maintenance. The required operation and maintenance costs for national roads included in the project (which constitute 1.5% of the national road network) is estimated at 0.5% of the Road Development Authority's maintenance budget in 2014 (about SLRs 5,000 million) indicating adequate maintenance funding. The government's long term strategy envisages that the road maintenance trust fund in the long term will allow access by provincial and local road agencies. The maintenance requirement (routine and periodic) for provincial and local roads is estimated at about SLRs 900 million per year and access to the road maintenance trust fund will ensure the financial sustainability of rural roads. The investment program will build capacity of provincial and local road agencies to facilitate the process and enhance the financial sustainability of rural roads.

Table 7: Sensitivity Analysis Results

Category/District	Economic Internal Rate of Return (%)															
	Base Case				15% Increase in Construction Cost				15% Decrease in Benefits				Combined (Cost & Benefits)			
	LR	PR	NR	All	LR	PR	NR	All	LR	PR	NR	All	LR	PR	NR	All
Galle	16.4	17.8	19.0	16.9	15.3	15.7	17.0	14.9	14.1	15.4	16.6	14.6	13.1	13.5	14.8	12.8
Matara	21.9	22.9	28.5	23.2	19.5	20.4	25.7	20.7	19.2	20.2	25.3	20.4	17.0	18.0	22.8	18.1
Hambantota	17.9	18.2	n.a	17.9	16.1	16.1	n.a	15.8	15.5	15.9	n.a	15.5	13.8	13.9	n.a	13.6
Roads selected for RMC (Southern Province)	n.a	n.a	18.6	18.6	n.a	n.a	16.5	16.5	n.a	n.a	16.5	16.5	n.a	n.a	14.3	14.3
All Project Roads (Tranche 1)	18.6	18.5	19.8	18.9	16.4	16.4	17.6	16.8	16.1	16.1	17.4	16.5	14.1	14.1	15.3	14.5
Kegalle	14.3	14.9	n.a	14.5	12.3	12.8	n.a	12.4	12.1	12.5	n.a	12.2	10.2	10.6	n.a	10.4
Ratanapura	14.4	16.2	n.a	15.6	12.5	14.1	n.a	13.5	12.3	13.9	n.a	13.3	10.5	11.9	n.a	11.4
Anuradapura	20.9	18.9	n.a	19.6	18.4	16.6	n.a	17.2	18.2	16.3	n.a	17.0	15.8	14.2	n.a	14.8
Polonnaruwa	18.1	17.2	n.a	17.6	15.8	15.1	n.a	15.5	15.6	14.8	n.a	15.6	13.5	12.9	n.a	13.2
Kandy	14.6	16.6	n.a	15.3	12.6	14.4	n.a	13.3	12.4	14.2	n.a	13.0	10.5	12.2	n.a	11.1
Matale	16.1	16.1	n.a	16.1	14.0	13.9	n.a	13.9	13.8	13.6	n.a	13.7	11.8	11.6	n.a	11.7
Nuwara Eliya	13.9	15.4	n.a	14.6	11.9	13.4	n.a	12.7	11.8	13.2	n.a	12.4	10.0	11.4	n.a	10.6
Kurunegala	17.6	17.3	n.a	17.4	15.3	15.1	n.a	15.2	15.1	14.9	n.a	15.0	13.1	13.0	n.a	13.0
Puttalam	17.0	15.0	n.a	16.0	14.9	13.0	n.a	14.0	14.7	12.9	n.a	13.8	12.7	11.1	n.a	11.9
Kalutara	15.2	14.6	n.a	15.1	13.1	12.6	n.a	13.1	12.9	12.5	n.a	12.9	11.1	10.6	n.a	11.0
Roads selected for RMC (Other Provinces)	n.a	n.a	27.7	27.7	n.a	n.a	24.5	24.5	n.a	n.a	24.4	24.4	n.a	n.a	21.6	21.6
All Project Roads (Tranche 2)	16.0	16.6	27.7	18.3	13.9	14.5	24.5	16.0	13.7	13.9	24.4	15.8	11.8	12.3	21.6	13.7
Overall Project	16.7	16.7	24.7	18.4	14.6	14.6	21.9	16.2	14.3	14.4	21.8	15.9	12.4	12.4	19.3	13.9

LR = local roads; NR = national roads; PR = provincial roads; RMC = Road Management Contracts.
Source: Asian Development Bank estimates.