ECONOMIC AND FINANCIAL ANALYSIS: PROJECT 1

A.   Introduction

1.   Sri Lanka's road network is dense and well laid out, providing basic access to the country's population and economic activity centers. The 132,693 kilometer (km) road network in Sri Lanka is classified into national, provincial, and local authority roads according to administrative responsibility.[1] As a result of large-scale investment, notable progress has been achieved in addressing immediate trunk road network deficiencies,[2] but progress on provincial and rural roads is relatively slow.[3] The challenges include that most rural access roads, including provincial and local roads, cannot provide all-weather access, and part of the trunk road network is in poor condition. To enhance road accessibility in rural areas, the government will implement a rural road connectivity program. The government plans to select about 1,000 rural communities according to their population, development potential, and distance from trunk roads. The investment program will support the government in improving road accessibility between these rural communities and socioeconomic centers. The investment program will comprise five projects: project 1 is in Southern Province, project 2 in Sabaragamuwa Province and the Kalutara District of Western Province, project 3 in Central Province, project 4 in North Central Province, and project 5 in North Western Province.

2.   Project 1 of the investment program has identified 200 road sections in Southern Province for upgrading and/or improved maintenance and operation. The identified roads include 17 national and 10 provincial road sections, with the balance made up of local authority roads. The economic analysis was carried out for project 1 using the 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 total length of all road sections is about 700 km, with individual road sections ranging in length from 0.7 to 15.1 km. The national and provincial roads included are bituminous-surfaced roads with single- to two-lane roadways in fair to poor condition. The local authority roads included are narrow single-lane roads with a roadway width of 2.0–4.0 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. This may be the result of the roads being constructed over time in short sections as funds were allocated.

4.   Traffic volume was obtained from 12-hour classified traffic counts carried out on national and provincial project road sections, and 3-hour traffic counts carried out on local authority roads; 12-hour counts were carried out on about 10% of local roads, which were used to expand

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[1]   National roads, comprising about 11,922 km of class A roads and class B roads, are managed by the central government through the Road Development Authority (RDA). The provincial road network, comprising 15,975 km of class C and D roads, is managed by the provincial councils. In addition, about 80,000 km of local roads (class E) are managed by local governments.

[2]   The proportion of national roads in good condition rose from 35% in 2007 to 48% in 2011, those in fair condition dropped from 19% to 11%, and those in poor condition declined from 46% to 41%.

[3]   The government has established a rural road program, "Maga Neguma", to improve rural roads using the direct labors of RDA. The program has improved about 10,000 km of rural roads upon the request of local authorities since 2004, but there is still about 90% of the whole rural road network requiring rehabilitation.

the 3-hour counts to 12-hour counts. The correction factors established by RDA from historical traffic data for expanding 12-hour to 24-hour counts, and to account for weekly and seasonal variation, were used to calculate annual average daily traffic. Summary features of the project road sections by district are given in Table 1.

Table 1: Summary Details of Project Road Sections in Southern Province

District	Number of roads	Length (km)	AADT (motorized vehicles)	Passenger Vehicles (%)	Freight Vehicles (%)	AADT (non-motorized vehicles)
Local Roads						
Galle	60	161.9	127–1910	86	14	9–1424
Matara	63	193.5	113–1560	85	15	10–664
Hambantota	50	155.2	86–908	86	14	5–392
Provincial Roads						
Galle	6	26.2	428–1973	88	12	72–1076
Matara	2	10.7	750–1087	83	17	192–300
Hambantota	2	15.7	854–960	86	14	158
National Roads						
Galle	9	69.9	1610-–4144	88	12	54–520
Matara	4	30.4	1800–2776	88	12	200–689
Hambantota	4	36.5	2253–4737	87	13	60–103

AADT = average annual daily traffic, km = kilometer
Source: Road Development Authority

5.   Future traffic growth was estimated on the basis of the socioeconomic profile, past traffic and vehicle growth rates, and indicative transport elasticity for the various vehicle categories. Traffic growth rates were estimated by relating growth in population, per capita income, and agricultural gross domestic product to growth in vehicle numbers for Southern Province (where all road sections are located). Records indicated an elasticity of 1.55 for private vehicles with respect to per capita income and 1.15 for goods vehicle with respect to agricultural gross domestic product growth.[4] The growth rate was projected using the linear relationships developed between the relevant variables at the provincial level for provincial and local roads and at the national level for national roads. The additional population anticipated due to the ongoing large development projects in the province was also considered in the projection. The estimated vehicle ownership rates were compared with the past trends in the country and found reasonable. The traffic growth rate estimates used for the traffic projection are in Table 2.

Table 2: Traffic Growth Rates (%)

Description	2014–2025		2025–2035	
	Local/Provincial	National	Local/Provincial	National
Public Transport	4.8	4.3	3.9	4.1
Private Transport	5.0	5.2	3.1	3.2
Freight Transport	2.8	3.0	2.1	2.2

Source: Road Development Authority

C.   Engineering Design

6.   The project road sections will be rehabilitated or reconstructed based on the existing road conditions with asphalt concrete surfacing. Based on the class and function of roads,

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[4] Central Bank of Sri Lanka. 2013. *Economic and Social Statistics of Sri Lanka*. Colombo.

national roads will have a two-lane carriageway width, provincial roads an intermediate roadway width, while local roads will have a single-lane carriageway. For local roads with higher traffic levels, roadway width will be slightly greater for increased road safety where such width is available. The final engineering design will include measures to improve road safety and control speed at locations with limited visibility, such as curves and commercial areas. In the engineering design, the required improvement works have been optimized for economy and construction efficiency in accordance with applicable design standards. The road improvement works are planned in two separate contracting modalities. Conventional road contracts involve all provincial and local roads and three isolated national road sections that require reconstruction and performance-based maintenance for 3 years. Road management contracts involve output- and performance-based road rehabilitation and maintenance over 7 years.

D.   Economic and Financial Analysis

7.   The economic analysis was carried out following ADB guidelines and using the HDM IV model, and compared transport costs for road agency and transport users under with- and without-project options.[5] 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, with 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 2014 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 preliminary engineering design. The costs include those for civil works, environmental impact mitigation, 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,[6] as applicable. Operation and maintenance (O&M) costs were also estimated for each year of the analysis period.

9.   Key parameters used in the economic analysis are in Table 3. The all-weather paved road connectivity to the villages will provide significant social benefits—including easier access to health and education services, increased agriculture productivity and diversification, poverty reduction and better employment opportunities for the rural population—in addition to 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 the economic viability of provincial and local road sections.[7] The project includes road widening, which has an asset life much longer than the analysis period. Salvage values for road sections at the end of the analysis period were calculated using straight-line depreciation.[8] The construction will progress with short sections blocked for a short time for each of the construction operations, thereby avoiding the

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[5] ADB. 1997. *Guidelines for the Economic Analysis of Projects.* Manila.
[6] . A shadow wage rate factor of 1.0 for skilled and semi-skilled workers and 0.72 for unskilled labors was used.
[7] ADB. 2003. *Operations Manual G1/OP: Economic Analysis of Projects.* Manila. Para. 2(vi)(b) provides that where "significant unquantifiable net benefits are believed to be likely, the discount rate or EIRR may be between 10% and 12%." An EIRR threshold of 10% is adopted in similar projects (e.g. ADB. 2012. *Report and Recommendation of the President to the Board of Directors: Proposed Multitranche Financing Facility, Technical Assistance, and Administration of Technical Assistance to India for Rural Connectivity Investment Program.* Manila*).*
[8] The depreciation period for earthworks and the sub-base and base layers of widened portions is 40 years, for bituminous pavement 20 years, and for structures 40 years.

requirement for temporary acquisition. The blocking of short sections may result in some traffic detours, 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 considered in the analysis are assumed to balance out and are therefore not considered in the analysis. Materials will be brought from established borrow areas and the resource cost is considered in the analysis.

Table 3: Input Parameters

Parameters	Value
Analysis period (years)	20
Discount rate (%)	12
Construction period (years)	2
Construction start year	2014-2015
Opening year to traffic	2016-2017

Source: Asian Development Bank assessment.

10. The improved roads will result in 15% to 35% time savings to the road users, which is included in the analysis as the value of time saved. The value of time estimates for passengers given in Table 4 are based on current income levels and published data in Sri Lanka,[9] which defines different types of public and private transport users by linking them to particular income categories. The average value of cargo delay was derived using the approach suggested in the HDM manual and was estimated at Rs. 100/ton/hour for light commercial vehicles and Rs. 140/ton/hour for trucks. The shadow wage rate factor for unskilled workers was applied to the public transport user time value, and all time values were converted to border price equivalent.

Table 4: Value of Time for Passengers and Occupancy Rates

Vehicle Type	Value of work Time (Rs/hr)	Value of non-work time (Rs/hr)	Occupancy Rate
Two & Three Wheeler	107.5	17.9	1.5
Car	565.8	94.3	2.5
Van	565.8	94.3	4.5
Public Transport	44.4	7.3	25–40

Source: Asian Development Bank estimates.

11. The economic analysis estimates two categories of benefits: (i) savings of vehicle operating costs due to improved road conditions, and (ii) savings of travel time due to increased travel speeds. The vehicle operating costs and travel time costs are estimated using the HDM IV model. Economic analysis conducted on the project road sections by contract packages indicated that the investment program is economically viable, with EIRRs of 16.1%–24.5% for the three districts in Southern Province. The overall estimated EIRR is 19.1%. The economic analysis of all road sections individually indicates an EIRR of more than 10% for provincial and local roads and 12% for national roads. The summary economic analysis results are shown in Table 5. The stream values of net benefits for each project road are shown in Table 6.

Table 5: Economic Analysis Results

Contract	District/Package	Road Type	Length (km)	EIRR (%)	NPV (Rs. Mn.) @ 12%
		Local	161.9	19.7	1241.9
	Galle	Provincial	26.2	18.1	228.4
		National	9.5	22.5	289.4
CRC		**All**	**197.6**	**19.0**	**1626.9**
		Local	193.5	20.3	1600.9
	Matara	Provincial	10.7	16.1	68.4
		National	13.3	24.5	691.2

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[9] Ministry of Finance and Planning, Sri Lanka. 2001. *Assessing public investment in the transport sector*. Colombo.

Contract	District/Package	Road Type	Length (km)	EIRR (%)	NPV (Rs. Mn.) @ 12%
		All	**217.5**	**20.8**	**2360.5**
		Local	155.2	18.4	982.5
	Hambantota	Provincial	15.7	17.5	116.0
		National	0		
		All	**170.9**	**18.3**	**1096.7**
RMC	Galle	National	60.4	18.7	974.4
	Matara/Hambantota	National	53.6	23.5	1078.3
	Overall Project 1		**700.0**	**19.1**	**6799.2**

CRC = conventional road contracts, RMC = road management contracts, EIRR = economic internal rate of return, km = kilometer, Mn. = million, NPV = net present value.
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	VOC	Time Cost	NMT Cost	
2014	1,267.6					(1,267.6)
2015	6,977.4					(6,977.4)
2016	4,555.6					(4,555.6)
2017		(578.8)	613.6	632.0	80.2	1,904.6
2018		58.7	950.5	1,145.4	118.4	2,155.6
2019		(693.3)	1,027.3	1,244.8	124.4	3,089.8
2020		(24.6)	961.7	1,308.7	101.2	2,396.2
2021		(186.5)	1,073.6	1,424.2	117.6	2,801.9
2022		(23.4)	1,168.3	1,556.1	136.7	2,884.5
2023		(402.6)	1,251.9	1,695.3	145.4	3,495.2
2024		262.6	1,284.5	1,830.5	140.6	2,993.0
2025		(13.3)	1,288.7	1,945.9	120.7	3,368.6
2026		(22.1)	1,410.2	2,099.6	142.5	3,674.4
2027		(362.0)	1,510.4	2,269.2	164.6	4,306.2
2028		2,629.7	1,495.3	2,409.0	160.0	1,434.6
2029		(734.7)	1,637.7	2,580.4	178.8	5,131.6
2030		(177.5)	1,552.0	2,697.3	147.8	4,574.6
2031		(235.9)	1,669.6	2,911.2	174.5	4,991.2
2032		468.6	1,737.6	3,146.2	197.7	4,612.9
2033		(28.3)	1,818.3	3,375.0	195.5	5,417.1
2034		(389.5)	1,919.4	3,620.2	191.4	6,120.5
2035		(460.7)	1,885.4	3,884.4	167.6	6,398.1
2036	(1,750.6)	(378.1)	649.4	1,259.8	23.6	4,061.5
				EIRR (%)		19.1
				NPV @ 12%		6799.2

( ) = negative, EIRR = economic internal rate of return, NPV = net present value, NMT = non-motorized traffic, VOC = vehicle operating cost
Source: Asian Development Bank estimates

E. Sensitivity Analysis

13   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 confirm the project's economic viability.

Table 7: Sensitivity Analysis Results

Contract	District/Package	Type	Economic Internal Rate of Return (%)				
			Base case	15% Increase in Construction	15% Decrease in	1-Year Construction	Combined (Cost &

				Cost	Benefits	Delay	Benefits)
CRC	Galle	Local	19.7	17.5 (71.8)	17.6 (50.4)	19.1	15.6 (29.2)
		Provincial	18.1	15.9 (53.5)	16.1 (44.2)	17.4	14.1 (23.9)
		National	22.5	20.3 (117.3)	20.3 (72.7)	21.9	18.3 (40.8)
	Matara	Local	20.3	18.0 (75.5)	18.1 (53.3)	19.7	16.0 (30.9)
		Provincial	16.1	14.0 (33.6)	14.3 (34.1)	15.5	12.4 (17.1)
		National	24.5	22.1 (134.0)	22.2 (69.8)	23.8	19.9 (45.5)
	Hambantota	Local	18.4	16.3 (58.8)	16.4 (45.5)	17.8	14.5 (25.6)
		Provincial	17.5	15.5 (51.2)	15.8 (44.8)	16.8	13.9 (23.8)
RMC	Galle	National	18.7	16.3 (51.9)	16.7 (46.1)	18.1	14.4 (23.9)
	Matara/Hambantota	National	23.5	21.0 (116.1)	21.2 (67.8)	22.8	18.9 (42.9)
	Overall Project		**19.1**	**17.4 (86.2)**	**16.8 (42.5)**	**18.5**	**15.3 (28.5)**

CRC = conventional road contracts, RMC = road management contracts.
Note: Figures in bracket indicate the switching values
Source: Asian Development Bank estimates.

F.   Financial Sustainability

14.   Road users will not be tolled for using the improved project roads. No revenues will be directly generated from operation of the roads. Therefore, a financial analysis is not required for the project. The unit costs related to O&M of project roads will decrease after the construction is completed because the road condition will be improved. The conventional road contract packages include 3 years of maintenance, and the road management contract packages include 5 to 7 years of maintenance. In the long term, it is expected an O&M scheme will be established in Sri Lanka. The required O&M costs for national roads are estimated at 0.3% of the Road Development Authority's maintenance budget in 2012 (about SLRs 6,000 million) and 0.0002% of the public investment into the road sector during 2011. In view of recent trends, an adequate budget allocation for national roads is expected. The government envisages that in the long term the road maintenance trust fund will be accessed by provincial and local road agencies. The investment program will build the capacity of the provincial and local road agencies to facilitate the process of granting to provincial and rural roads the access to trust fund and enhance the financial sustainability of rural roads.

G.   Conclusions

15.   The results of economic analysis indicate the project is economically viable, with an overall EIRR of 19.1% over a 20-year analysis period. Sensitivity analysis further confirms that economic viability is robust. In addition to the quantified benefits, the project will bring significant benefits to the overall regional development in the following respects.

(i)   The rural access roads will provide improved connectivity to villages. The majority of road local road sections included in the project have gravel surfaced sections, which make travel difficult during heavy rains. Travel time from villages to market centers will be considerably reduced.

(ii)   Access to markets will be improved and will result in increased household income after project completion.

(iii)   People from local communities will benefit from construction employment.

(iv)   The benefits will accrue to the poor through savings in vehicle operating costs that will be passed on to the poor through lower freight rates, lower passenger fares, and time savings.

(v)   Better access to health and educational facilities will facilitate overall socioeconomic development of the province.