Sri Lanka Railways

Democratic Socialist Republic of Sri Lanka

Ministry of Transport and Civil Aviation

Colombo Suburban Railway Project
Project Preparatory Technical Assistance

Intercity rail services development study

December 2017

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ADB

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ADB	Asian Development Bank
CLS	Cordon Line Survey
DNS	Do-Nothing Scenario
GDP	Gross Domestic Product
ICE	Intercity Express
IEE	Initial Environmental Examination
IR	Involuntary Resettlement
IPP	Indigenous Peoples Plan
JICA	Japan International Cooperation Agency
MOT	Ministry of Transport and Civil Aviation
NPP	National Physical Plan
OD	Origin -Destination
PPTA	Project Preparatory Technical Assistance
PSA	Poverty and Social Analysis
REA	Rapid Environmental Assessment
RP	Resettlement Plan
SLR	Sri Lanka Railways
SLTB	Sri Lanka Transport Board

1   GENERAL

1.1   Context

1. ADB's Country Partnership Strategy 2012-2016 aims at supporting sustainable economic growth by developing viable multimodal transport systems, including railways and the public transport system.

2. The ensuing project will be processed as a project loan; the scope being defined by this project preparatory technical assistance (PPTA) and project preparation including design and support for procurement and safeguards which will be provided under a proposed technical assistance loan (TA loan).

3. EGIS International in association with Resources Development Consultants (the Consultant), where selected to carry out the PPTA.

4. During the course of preparing the PPTA, the Consultant identified the need to assess potential development of intercity rail services and the capacity of the rail system in the suburban area of Colombo to cope with expected developments of suburban and intercity services. As per today, rail intercity services in Sri Lanka are limited. However, considering the current and expected future characteristics of road transport services especially in terms of price, journey time and comfort, a significant increase of rail modal share can be expected if suited services are being implemented.

5. Expected benefits include positive impacts on economic activities, the environment, and health of residents of Colombo Metropolitan Region (CMR), aligned with the Government of Sri Lanka's Strategic Plan for Transport Management in the CMR. The outcome will be improved transport capacity and service quality in the suburban railway network of Sri Lanka Railways (SLR).

1.2   Objectives of the intercity demand study

6. The main objective of the assignment is to accompany Sri Lanka Railways in the course of defining a commuter rail strategy for Colombo Metropolitan Region to be set up over the next 20 years and define necessary phased investments. This will result in a phased investment programme, at short, medium and long term.

7. The study of the intercity rail services aims at completing the traffic studies that have been realised previously on the Colombo Suburban Railway network. It will define potential level of intercity trains running through/to/from Colombo at several time horizons over a 20 years period. This will allow assessing the necessary capacity to be provided on the lines within Colombo suburban area.

1.3   Purpose of this report

8. This report intends to present the result of intercity traffic forecast from the present period to 2035 time horizon.

9. It will be divided into the following chapters :

❖ Presentation of the methodology of the intercity traffic forecast;

❖ Analysis of current long distance demand,

❖ Analysis of the long distance supply;

❖ Traffic forecast for long distance demand;

❖ Recommendation for improving and developing intercity railway service.

2 METHODOLOGY OF THE TRAFFIC FORECAST

2.1 Traffic model

The Strada model has been used for the traffic studies on the Colombo Suburban Railway network. This model is calibrated to make traffic forecast only on the Colombo Metropolitan Region.

The purpose of this study is to make traffic forecast for the intercity demand. In other words, long distance demand between Colombo Metropolitan Region and the rest of the country will be modelled. The Strada model cannot be used for this kind of work, as the zoning is not appropriated to reconstitute exchange demand between CMR and other parts of the country. Thus, the intercity demand study will require the development of a specific model with an extended zoning at the whole country. A gravity model will be used, will be adjusted on the current demand, in order to forecast the overall demand. Then we will use a time-cost approach to evaluate the railway traffic share.

2.2 Current demand

2.2.1 Available data

All transport modes for the long distance demand will be considered: bus, private vehicles and railway. The current demand can be reconstitute using following data:

- ❖ Ticketing data from Sri Lankan Railways : traffic passengers per day on OD relations in 2016;

- ❖ Cordon Line traffic counts and surveys from Jica's ComTrans study around Colombo area for bus and private cars in 2013.

In addition, traffic counts and OD surveys from Road Development Authority (RDA) will help to adjust the current demand. The demand will be adjusted on year 2016 for all the modes.

Table 1: Available traffic data

Mode	Source	Data type	Area	Year of data collection
Bus	ComTrans	Cordon Line Survey	CMR	February, 2013
	RDA	OD survey	CMR	2012
Railway	Billettique	Passengers OD	All the country	March, 2016
Private vehicles	RDA	Traffic Counts	CMR/Orbital roads/outside CMR	2012
	RDA	OD survey	CMR/Orbital roads/outside CMR	February, 2013
	ComTrans	Cordon Line Surveys	CMR	February, 2013

2.2.2 Additional data: OD surveys on intercity buses

In order to complete the long distance demand data, OD surveys in main intercity bus stations will be done. The surveys on intercity bus passengers aim at identifying:

- ❖ Trip volumes per OD;

- ❖ Main modal choice reasons;

- ❖ Trip purposes and characteristics.

The survey to bus users has been performed during one day in main stations serviced by intercity buses.

The main objective of the intercity traffic study is to estimate **the long distance exchanges between the Colombo area and the rest of the territory**. As a result, the bus stations that have been surveyed are the ones in Colombo surrounding area that have the biggest intercity traffic level:

   ❖ Colombo area stations : Bastian Mawatha, Central bus stand, Maharagama station;

   ❖ Negombo : only passengers of buses that are going in and out of the WR;

   ❖ Avissawela only passengers of buses that are going in and out of the WR;

Passengers that have been surveyed were only the ones using buses that are going in and out of the Western Province.

2.3   Zoning

The model aims at reconstituting long distance demand from and to Colombo area. Zoning has to take into account available data that permits to reconstitute current demand, and to adjust the gravity model. After reconstituting the transport demand, the most appropriated zoning for the long distance model turn out to be District zoning.

Only exchanges with zones that have railway demand are considered. Following maps shows the zoning and the transport network included in the model.
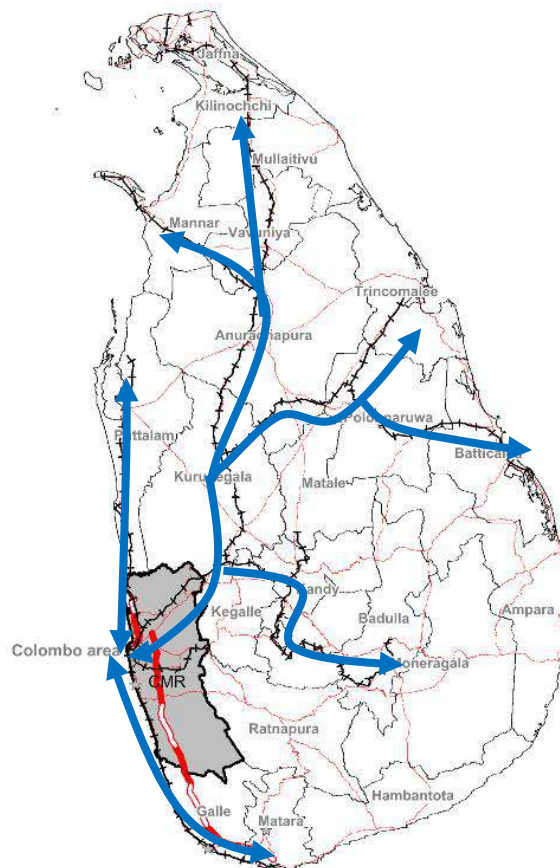
Figure 1: district zoning and modelled flows

2.4   Assumptions for traffic forecast

Traffic forecast will depend on the projection of the main parameters of the gravity model:

- ❖ Population growth: it will be based on the last year trend of evolution for the country. For that, we will use census data.

- ❖ Employment growth: it will be based on the GDP trend of evolution on the last few years.

3   TERRITORY ANALYSIS

3.1   Population

Population of Sri Lanka was evaluated at 20.4 millions of persons during the last census in 2012.

Analysis of population density in Sri Lanka shows that nearly 30% of the population is living in Colombo Metropolitan Region. Population only in Colombo area was 905 000 inhabitants in 2012, for a density of 14 500 inhabitants per km². The population in metropolitan area (CMR) reaches almost 2,500,000 inhabitants and in the Western Region, it is close to 6,000,000 inhabitants.

For the rest of the country, the previous map shows that high density areas (between 1 000 and 2 500 inhabitants/km²) are located along southern line, Puttalam line and Kellany Valley line corridors. To the east of Colombo, districts that are located along the railway corridor (Kegalle, Kandy, Nuwara Eliya, Badulla and Kurunegalla) show density of population between 250 and 1 000 inhabitants per km². Density of population in the East and the Northern country is very lower, less than 250 inhabitants per km. With a population of 165 000 inhabitants, only the Jaffna district has a density superior to 500 inhabitants per km².
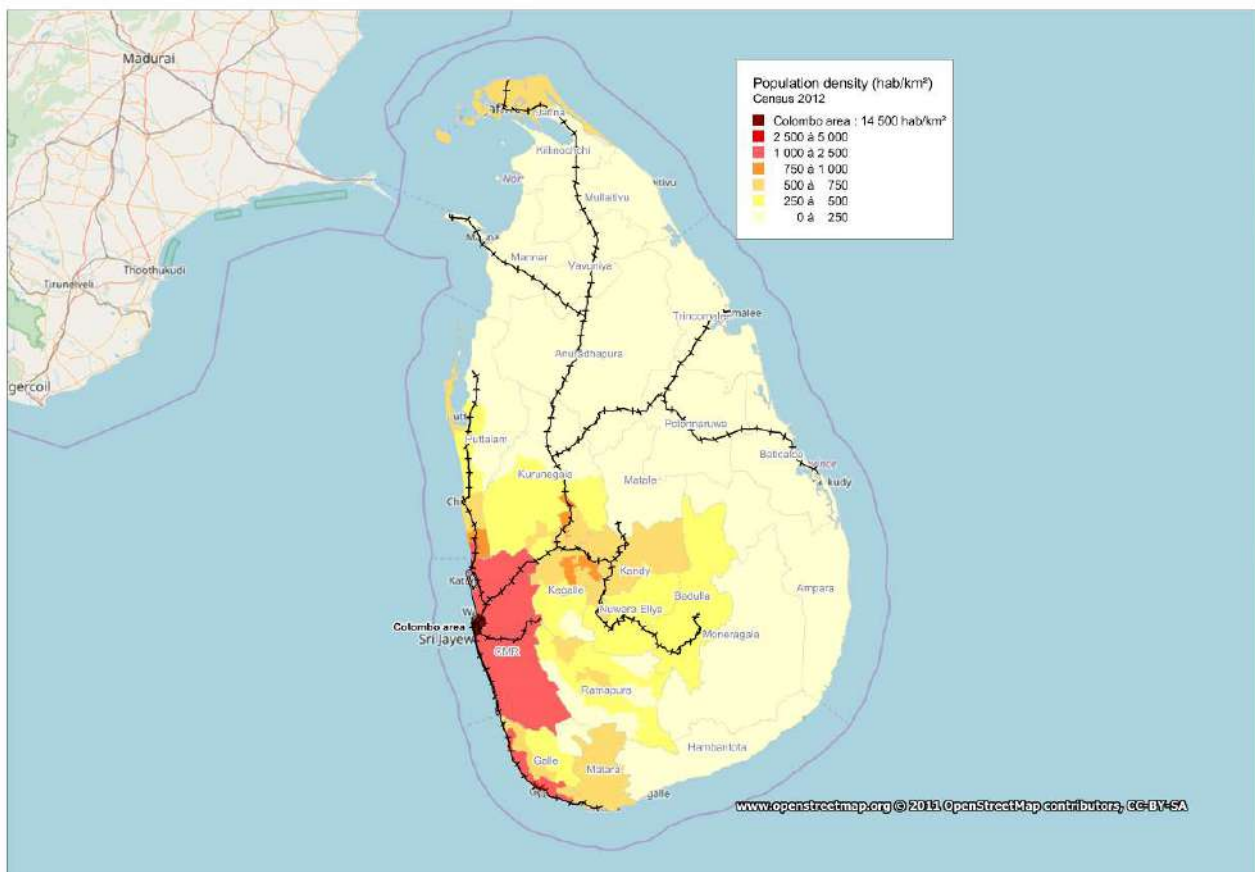
Figure 2 : Population density in Sri Lanka in 2012

Next table shows the population for top 70 main cities, according to 2012 census.

City Name	Adm. Reg.	Population	City Name	Adm. Reg.	Population
Dambulla	CEN	23,814	Kegalle	SAB	15,993
Gampola	CEN	37,871	Ratnapura	SAB	47,105
Hatton-Dickoya	CEN	14,585	Ambalangoda	SOU	19,99
Kadugannawa	CEN	12,654	Galle	SOU	86,333
Kandy	CEN	98,828	Hambantota	SOU	23,236
Matale	CEN	36,462	Hikkaduwa	SOU	27,075
Nawalapitiya	CEN	13,338	Matara	SOU	74,193
Nuwara Eliya	CEN	23,804	Tangalle	SOU	8,473
Thalawakele-Lindula	CEN	4,691	Weligama	SOU	22,377
Wattegama	CEN	8,157	Badulla	UVA	42,237
Akkaraipattu	EAS	30,934	Bandarawela	UVA	24,168
Ampara	EAS	22,511	Haputale	UVA	5,288
Batticaloa	EAS	86,227	Moneragala	UVA	…
Eravur	EAS	24,643	Beruwala	WES	37,793
Kalmunai (incl. Sainthamarathu)	EAS	99,893	Boralesgamuwa	WES	60,11
Kattankudy (Kathankudi)	EAS	40,356	Colombo	WES	561,314
Kinniya	EAS	36,772	Dehiwala-Mount Lavinia	WES	184,468
Trincomalee	EAS	48,351	Gampaha	WES	62,335
Anuradhapura	NCE	50,595	Horana	WES	9,55
Polonnaruwa	NCE	…	Ja-Ela	WES	31,232
Chavakachcheri	NOR	16,129	Kaduwela (Battaramulla)	WES	252,041
Jaffna	NOR	80,829	Kalutara	WES	32,417
Kilinochchi	NOR	…	Katunayake (-Seeduwa)	WES	60,915
Mannar	NOR	24,417	Kesbewa	WES	185,122
Mullaitivu	NOR	…	Kolonnawa	WES	60,044
Point Pedro	NOR	12,334	Maharagama	WES	196,423
Valvettithurai	NOR	8,283	Minuwangoda	WES	7,523
Vavuniya	NOR	34,816	Moratuwa	WES	168,28
Chilaw	NWE	21,441	Negombo	WES	142,449
Kuliyapitiya	NWE	5,509	Panadura	WES	30,069
Kurunegala	NWE	24,833	Peliyagoda	WES	27,736
Puttalam	NWE	45,511	Seethawakapura (Avissawella)	WES	30,308
Balangoda	SAB	16,51	Sri Jayawardenepura (Kotte)	WES	107,925
Embilipitiya	SAB	36,712	Wattala-Mabole	WES	28,031

Table 2: Main cities population

8 out the 10 most populated cities are located in the western region. Also only 2 of the 10 most inhabited cities outside Sri Lanka are still not served by rail: Ratnapura and Kalmunai area.

Over the past 15 years population has varied significantly from one city to another.

3.2   Employment
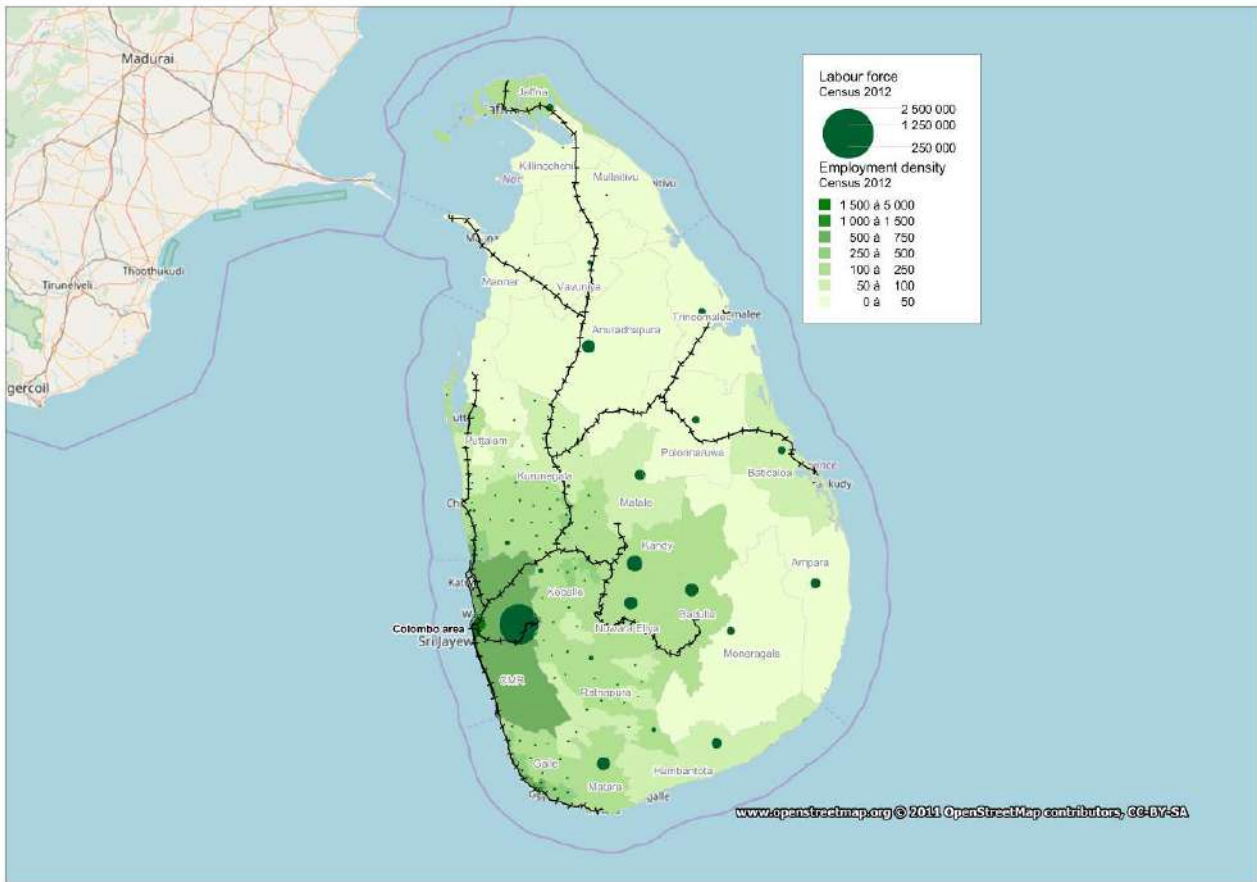
Figure 3 : Employment in Sri Lanka in 2012

The Census of Population and Housing 2012 also gives information about the economic activity in Sri Lanka.

In 2012, the total employed population in Sri Lanka was estimated at 7.2 millions of persons. The unemployment rate was about 6.6% in 2012. As shown in the below map, most of the employment is located in Colombo Metropolitan Region.

4   INTERCITY SUPPLY IN SRI LANKA

4.1   Railway network

4.1.1 Current railway network

The railway covers relatively well the country except the south and south-eastern part of Sri Lanka, connecting. major population centres and tourist destinations. It is constituted of 10 lines:

1. Main Line starts from Colombo and runs east towards Badulla. It goes through difficult terrain (going at almost 2000 m above sea level) on the section from Rambukkana and going through connecting with Gampola, Nawalapitiya, Hatton, Nanu Oya, Bandarawela.

2. Northern Line starts from Main Line at Polgahawela, going through Kurunegala, Anuradhapura, Jaffna, Kilinochci and ends at Kankesanthurai.

3. Coastal Line runs south from Colombo, following the Indian Ocean and links Colombo with Galle and then Matara. Plans for extension to Kataragama are on-going.

4. Batticaloa Line starts from the Northern Line at Maho, to Polonnaruwa then Batticaloa

5. Puttalam Line branches off the Main Line at Ragama, going through Negombo, Puttalam and finishing at Noor Nagar for passenger services and Holcim for freight trains to link with a cement factory.

6. Talaimannar Line starts from the Northern Line at Madawachchiva to Mannar and Talaimannar.

7. Trincomalee Line branches from the Batticaloa Line at Gal-Ova and extends to Trincomalee.

8. Kelani Valley Line starts from Colombo to connect to Avissawella

9. Matale Line starts from the Main Line at Peradeniya junction and connects to Kandy to end up in Matale.

10. Mihintale Line is a short branch line from Northern Line at Mihintale junction to connect with Mihintale.

Figure 4 : Map of Sri Lanka Railways

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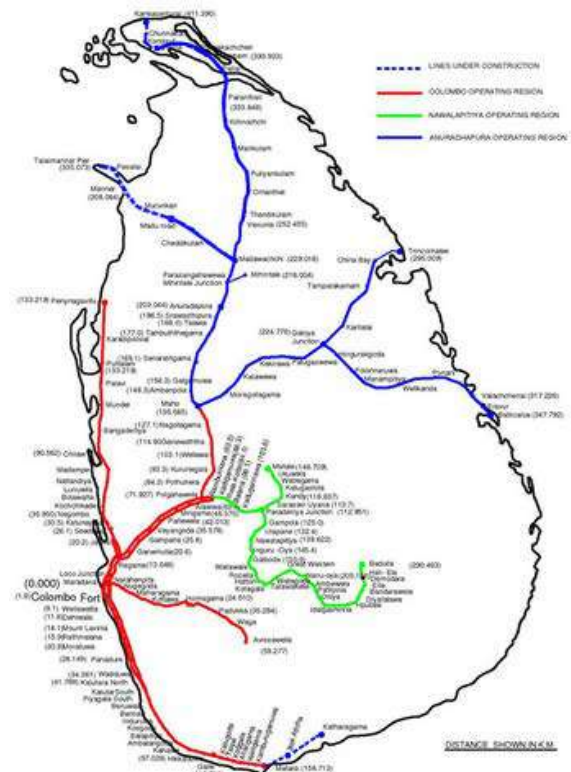
Table 3 : Intercity rail lines (2016)

	Total length (km)	Number of stations	Number of tracks
Main line	292	36	Colombo to Ragama: Triple track Ragama to Rambukkana: Double track Rambukkana to Badulla: Single track
Northern line	339	26	Single track
Coastal line	157	32	Single track
Batticaloa line	212	13	Single track
Puttalam line	121	17	Single track
Talainmannar line	106	9	Single track
Trincomalee line	70	3	Single track
Kelani Valley line	121	17	Single track
Matale line	34	4	Single track
Mihintale line	13	2	Single track

Source: Sri Lankan Railways

4.1.2 On-going projects

Here are below the main ongoing infrastructure projects being realised by Sri Lankan Railways (source: Sri Lankan Railways and Ministry of Transport and Civil Aviation).

4.1.2.1 Construction of the railway track from Matara to Beliatta.

This is the phase one of Matara-Kataragama railway line construction project. Construction work of the 27 Km long railway track was started in August 2013 by China Railway Group with an estimated cost of 278.2 million dollars. It is expected to be completed by mid-2018.

The project aims at improving railway transport facilities in Southern Province as well as accelerating the regional economic development.

4.1.2.2 Doubling the railway track from Kalutara to Payagala.

Doubling the Coast Line tracks on 7km between Kalutara and Payagala is realised in order to improve services reliability, targeting commuter passengers taking suburban trains. Works started in February 2017 and the project is estimated at a cost of 762 million rupees (around 5 million dollars).

Figure 5 : Sri Lankan rail network (current and extension projects, SLR)

4.1.3 Planned projects

Several new lines projects are being considered so to further extend the coverage of the network. As per SLR plans, these projects are listed below:

Project	Project Area	Period	Remarks
Construction of Railway Line from Marara to Kataragama	First Phase – 35 km from Matara to Beliatta	3 years	Track with a design speed of 120km/h will be constructed in two project from Matara to Beliatta and from Beliatta to Kataragama.
Construction of Southern Railway Circle	79 km from Beliatta to Hambantota	3 years	Track with a design speed of 120km/h will be constructed from Beliatta to Hambantota through Suriyawewa. The project is in its design stage..
Construction of Railway Line from Kurunegala to Habarana	81 km from Kurunegala to Habarana		Track with a design speed of 120km/h will be constructed and the Feasibility Study has been completed.

Also a bridge to link Sri Lanka with India, at Talaimannar has been under consideration for more than a century. It hasn't materialised yet.

4.2   Intercity rail services

4.2.1 Operation

The state-owned company, Sri Lanka Railways has a monopoly to operate all types of trains, namely intercity services, commuter rail and freight transport. However some private companies do provide limited services, using Sri Lanka Railways' equipment and infrastructure.

The Viceroy Special, a chartered heritage train run using a preserved steam locomotive, is operated by J.F. Tours & Travels.

Figure 6 : Viceroy Special running on highlands

Also some luxury services are provided through provision of special coaches and on-board services. The so called Exporail train was operated during 6 years and was removed in 2017. The Rajadhani Express is temporarily out of operation.

Figure 7 : Rajadhani Express

4.2.2 Main Line and Matale Line

On the Main and Matale lines, main weekdays intercity train services are as follows (up services described only):

- ❖ 2 express train Colombo Fort – Kandy – Badulla (8 train-car composition with 524 passenger-seat capacity)

- ❖ 1 express train Colombo Fort – Kandy – Hatton (8 train-car composition with 524 passenger-seat capacity)

- ❖ 1 semi-express and 1 night mail trains Colombo Fort – Badulla with no stop at Kandy (7 train-car composition with 224 passenger-seat capacity)

- ❖ 1 commuter train Colombo Fort – Kandy – Matale (8 train-car composition with 524 passenger-seat capacity)

- ❖ 2 Intercity Express (ICE) train Colombo Fort – Kandy (5/7 train-car composition with 224/254 passenger-seat capacity)

- ❖ 2 express trains Colombo Fort – Kandy (9/10 train-car composition with 410/480 passenger-seat capacity)

First class is available only in the ICE trains and some express. Prices to Kandy are respectively Rs. 105 in 3rd class and Rs. 190 in 2nd class. Journey time to Kandy ranges from around 2:30 to 3:30.

4.2.3 Northern Line

On the Northern Line, main weekdays intercity train services are as follows (up services described only):

- ❖ 2 Intercity Express (ICE), 1 long distance and 1 night mail trains Colombo Fort – Kankesanthurai (6/7 train-car composition with 264 to 414 passenger-seat capacity)

- ❖ 1 Intercity Express and 1 long distance train Colombo Fort – Vavuniya

- ❖ 1 commuter train Colombo Fort – Maho

- ❖ 1 commuter train Colombo Fort – Ganewatte

- ❖ 1 commuter train Colombo Fort – Kurunegala

First class is available only in the ICE trains. Prices to Jaffna are respectively Rs. 335 in 3rd class and Rs. 540 in 2nd class. Journey time to Jaffna ranges from around 6:00 to 8:40 (night mail train).

4.2.4 Coast Line

On the Coast Line, main weekdays train services are as follows (down services described only):

- ❖ 2 commuter trains Maradana/Colombo Fort – Galle – Matara

- ❖ 4 express Maradana – Galle - Matara

❖ 1 commuter train Maradana – Galle

❖ 2 long distance trains Maradana/Colombo Fort – Galle – Matara

❖ 1 night mail train Maradana/Colombo Fort – Galle

Only 2nd and 3rd class seats are available at a rate of respectively 180 Rs and 100Rs to Galle. Journey time to Galle ranges from around 1:45 to 3:40.

4.2.5 Batticaloa, Trincomalee and Talainmannar Lines

On the Northern branch lines, main weekdays intercity train services are as follows (up services described only):

❖ 1 semi-express and 1 night mail trains Colombo Fort – Batticaloa (8/10 train-car composition with 488 passenger-seat capacity)

❖ 1 semi-express train Colombo Fort – Trincomalee (12 train-car composition with 636 passenger-seat capacity)

❖ 2 semi-express trains Colombo Fort – Talaimannar (6/9 train-car composition with 376/560 passenger-seat capacity)

2nd and 3rd class seats are available at a rate of respectively 490 Rs and 305Rs to Talaimannar. In one train there are also 1st class seats. Journey time ranges from around 8:00 to 11:00.

2nd and 3rd class seats are available at a rate of respectively 450 Rs and 285 Rs to Trincomalee. Journey time is 9:00.

To Batticaloa, 2nd and 3rd class seats are available at a rate of respectively 500 Rs and 310 Rs. Journey time is around 8:45.

4.2.6 Puttalam Line

On the Puttalam Line, main weekdays intercity train services are as follows (up services described only):

❖ 3 commuter trains Colombo Fort – Puttalam

❖ 8 commuter trains Colombo Fort – Chilaw

❖ 5 commuter trains Colombo Fort – Negombo

Journey time to Puttalam ranges from around 4:00 to 5:00. Only 3rd class is available at a rate of 115 Rs.

4.3   Rolling stock

Services are run with either DMUs or conventional trains pulled by a diesel loco. DMUs tend be used for relatively shorter distances especially on the following routes:

- Colombo-Kandy

- Colombo-Galle

- Colombo-Puttalam

Six types of DMUs are being under operation (from S8 to S12). All but S8 are less than 20 years old. S8 is utilized for suburban rail services only.

Figure 8 : Class S8 train

Figure 9 : Class S9 train

Figure 10 : Class S10 train

Figure 11 : Class S11 train

Figure 12 : Class S11 train

Figure 13 : Podi Menike Class S12 train, on the Main Line

Beside DMUs, for longer distances, services are being provided by conventional trains hauled by one or two diesel locomotives.

Figure 14: Long distance trains

Accomodation proposed included:

❖ Third class seats

❖ Second class seats

❖ First class seats, including observatory coach on some trains and with or without AC

❖ 1st Class Sleeping Berths

❖ Second and Third Class Sleeperates

All first class accommodation must be reserved. For second and third class, it is not mandatory. S12 provides modern accommodation on 1st, 2nd and 3rd class seating arrangements at a comfortable level for long distance trips.

Figure 15: First Class seat arrangement in S12

Figure 16:   Second Class seat arrangement in S12

Figure 17: Third Class seat arrangement in S12

Figure 18: Buffet in S12

Long distance trips are serviced also with other types of rolling stock either DMUs (principally S11) or conventionnal trains composed of coaches and diesel locomotives. Level of comfort on these conventionnal compositions is lower.

Figure 19: inside long distance coaches

4.4 Train journey time and tariffs

Here is below, for main destinations from Colombo stations, the table summarizing the best train journey time (ICE or semi-express service), and the corresponding tariff for the classes available.

Table 4: train travel times and tariffs (source: Sri Lankan Railways)

Line	Origin	Destination	Distance Rail	Travel Time ICE	Travel Time SemiEx	Tariff 1st class ICE	Tariff 2nd class ICE	Tariff 3rd class ICE	Tariff 1st class SemiEx	Tariff 2nd class SemiEx	Tariff 3rd class SemiEx
Puttalam	Colombo	Negombo	38.9		1:00	-	-	-	-	70.00	40.00
Puttalam	Colombo	Chilaw	82.5		2:00	-	-	-	-	140.00	75.00
Puttalam	Colombo	Puttalam	135.1		3:47	-	-	-	-	210.00	115.00
Main	Colombo	Gampaha	27.5	0:29	0:31	280.00	250.00	180.00	100.00	50.00	25.00
Main	Colombo	Gampola	126.9		3:04	-	-	-	360.00	200.00	110.00
Main	Colombo	Badulla	292.4		9:32	-	-	-	600.00	450.00	285.00
Matale	Colombo	Kandy	120.7	2:31	2:33	800.00	280.00	180.00	340.00	190.00	105.00
Matale	Colombo	Matale	148.6			-	-	-	400.00	230.00	125.00
Coast	Colombo	Mount Laviniy	12.2		0:15				-	20.00	15.00
Coast	Colombo	Panadura	26.2		0:31				-	50.00	25.00
Coast	Colombo	Kaluthara Sou	41.9		0:41				-	80.00	40.00
Coast	Colombo	Galle	113.9		1:44				-	180.00	100.00
Coast	Colombo	Matara	156.8		2:30				-	230.00	130.00
Northern	Colombo	Kurunegala	95.3	1:41	1:55	280.00	250.00	180.00	300.00	160.00	85.00
Northern	Colombo	Anuradhapura	204.9	3:25	4:05	1 000.00	450.00	280.00	520.00	370.00	240.00
Northern	Colombo	Vavuniya	254.4	4:20	5:10	1 500.00	480.00	320.00	600.00	420.00	265.00
Northern	Colombo	Jaffna	393.9	6:06	8:02	1 500.00	700.00	520.00	1 020.00	540.00	335.00
Batticaloa	Colombo	Polonnaruwa	259.7		6:25	-	-	-	-	420.00	265.00
Batticaloa	Colombo	Batticaloa	349.7		8:40	-	-	-	-	510.00	310.00
Trincomalee	Colombo	Trincomalee	296.9		8:00	-	-	-	-	450.00	285.00
Talainmannar	Colombo	Talaimannar	332.9		8:03	-	-	-	760.00	490.00	305.00

For ICE services on above mentioned six main destinations, the ticket price per kilometer is higher for short distances (the maximum being Colombo – Gampaha with 6.54 rupees/km, 3rd class) than for longer ones (around 1.30 rupees/km from Colombo to Vavuniya or Jaffna, 3rd class).

For the 21 semi-express services in the table above, the average ticket price per kilometer is around 0.94 rupees (3rd class), the most expensive being Colombo – Mount Laviniya (1.23 rupees/km, 3rd class) and the cheapest being Colombo – Matara (0.83 rupees/km, 3rd class). There is neither particular trend between the price per kilometer and the origin/destination distance, nor significant discrimination between rail lines.

Comparing ICE and semi-express services, while expected travel times are similar for both Colombo – Gampaha and Colombo – Kandy, corresponding tariff can be up to 7.20 times higher for ICE seats (3rd class to Gampaha).

4.5   Road network

4.5.1 Current national road network in Sri Lanka

The National Transport Commission Statistics 2016 provides a description of the Sri Lankan Road network.

Road network in Sri Lanka comprises with Expressways, National Highways, Provincial roads, unclassified local authority roads and other roads maintained by several government departments and other state sector agencies.

In 2015, the entire road network in the country is about 31 280 km, broken down as follows:

- ❖ 170 km of Expressways,

- ❖ 4 212 km of National Highways (or "A" class roads), trunk roads connecting Provincial capitals and the National capital with Administrative District capitals,

- ❖ 7 995 km of "B" class roads, connecting important towns to the District capitals and providing the link to trunk road system,

- ❖ The rest being "C" roads (agricultural and local roads), "D" roads (gravelled roads) and "E" roads (non-motorable roads)

Road Development Authority as the premier highway authority in the country is responsible for the maintenance of the Expressways, the National Highways and other national roads ("B" class)
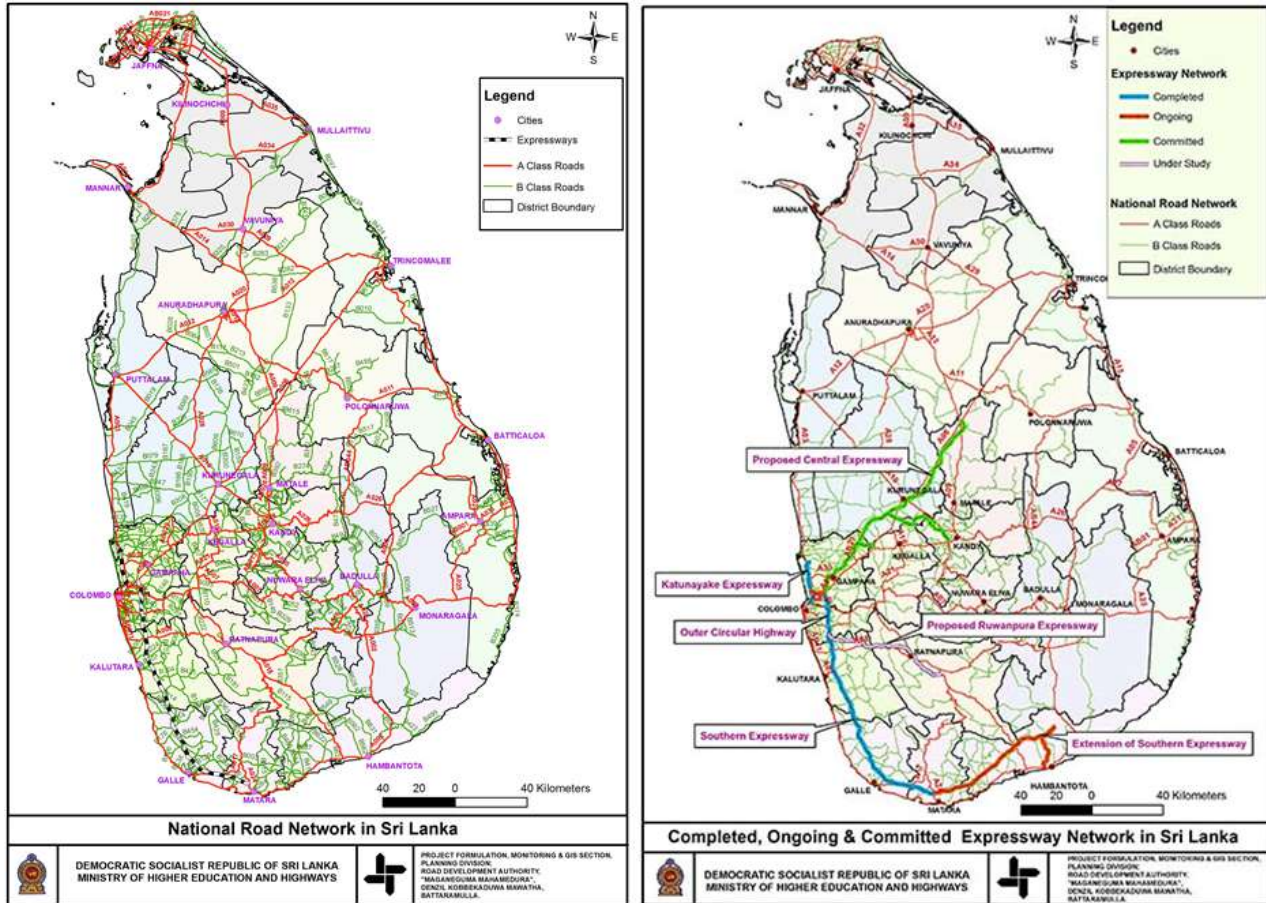
Figure 20 : National Highways Network and Expressway Network as at 2017

(source: Road Development Authority)

4.6 Bus services

The National Transport Commission Statistics 2016 provides a description of the Sri Lankan bus transportation services. Both public and private operators deliver intercity bus services from Colombo to the main Province cities. On the public side, Sri Lanka Transport Board (SLTB) runs intercity A/C buses from Colombo to cities serviced by Expressways: Negombo, Galle, Matara…

Concerning private services, of the total regulated bus fleet, nearly 3106 inter-provincial operated in 2015. Four types of bus exist: Super Luxury, Luxury, Semi-Luxury and Standard buses. They can be distinguished through a bus board colour code as indicated below:

Figure 21: Bus colour code

All intercity bus services from Colombo start from Colombo-Fort, Central Bus Stand for public services and Bastian Mawatha Bus Station for private operators. These are close to rail services and suburban bus services, as illustrated below:

Figure 22: Colombo Intercity bus stands

Normal Service

These are the most common bus service and served all the bus routes excluding expressways. Buses are not air-conditioned, quite uncomfortable. They tend to be filled to the maximum, with numerous people standing. They tend to stop at all bus stops. They are quite slow depending on the number of stops.

Semi Luxury Service

Semi luxury buses are not air-conditioned and seats are better than in normal buses, but leg space is limited. Usually, there are curtains. A seat is not guaranteed and they can take more passengers than the offered seating capacity. They stop only in major bus stops and hence quicker than normal buses. The price is 50% higher than the tariff of normal buses.

Luxury Service

Luxury buses are air conditioned and do not take more passengers than the offered capacity. They have fewer stops than normal buses, stopping at major cities. The rate of the full journey is usually required even if the user is not going on the whole route. The fare is twice the standard fare.

Super Luxury Service

Super Luxury service is usually running on expressways and long distance routes. They are modern buses with AC and have better seats with bigger legroom. Tariffs is usually 3 times the normal fare. However higher rates can be found. The rate of the full journey is to be paid even if the user is not going on the whole route.

Usually it is not possible to make reservation, but some private agents can organise reservation at an extra charge, which can be exceptionally high, especially for super luxury buses. In case the journey requires the use of more than one bus, there are no combined ticket. Safety is acceptable except on standard buses, where door is not closed.

The following description of bus services indicators proposes to explain the current situation. However, this may not be exhaustive, due to the important number of bus services existing in the study area.

Table 5: bus travel times and tariffs (source: SLTB, private operators' websites)

Origin	Destination	Travel Time Bus	Tariff Standard Bus	Tariff Semi Luxury Bus	Tariff AC Bus	Tariff Super Luxury Bus	Quantity of Standard Bus per day	Quantity of Semi Luxury Bus per day	Quantity of AC Bus per day	Quantity of Super Luxury Bus per day	Quantity of Bus (Total)
Colombo	Negombo	02:00	61	95	130	0	124	82	110	0	316
Colombo	Chilaw	03:00	107	161	230	0	65	82	43	0	190
Colombo	Puttalam	03:30	168	252	350	0	38	82	35	0	155
Colombo	Gampaha	01:20	45	0	0	0	55	0	0	0	55
Colombo	Gampola	03:45	168	252	335	0	33	17	2	0	52
Colombo	Badulla	07:30	318	485	645	970	10	32	19	1	62
Colombo	Kandy	04:10	160	239	320	0	150	0	47	0	197
Colombo	Matale	04:00	189	0	380	0	28	0	20	0	48
Colombo	Mount Laviniya	00:35	29	35	60	0	40	64	228	0	332
Colombo	Panadura	01:00	48	72	95	0	313	64	228	0	605
Colombo	Kaluthara South	01:30	67	101	135	0	293	64	227	0	584
Colombo	Galle	03:30	152	228	305	440	60	14	47	43	164
Colombo	Matara	04:45	203	305	405	530	73	12	21	28	134
Colombo	Kurunegala	03:30	128	378	255	0	98	18	30	0	146
Colombo	Anuradhapura	05:45	261	417	520	0	10	12	1	0	23
Colombo	Vavuniya	07:00	323	485	640	0	5	24	2	0	31
Colombo	Jaffna	10:00	501	752	995	1500	0	0	1	23	24
Colombo	Polonnaruwa	06:00	281	414	560	0	52	5	6	0	63
Colombo	Batticaloa	08:05	388	582	775	1160	2	0	3	2	7
Colombo	Trincomalee	06:45	325	488	650	980	0	0	5	2	7
Colombo	Talaimannar	07:30	421	576	785	0	0	13	0	0	13

For standard bus seats, the average price per km is around 1.29 rupees, with highest tariffs observed in Colombo suburban area (up to 1.81 rupees/km for Colombo – Mount Lavinya).

4.7   Air services

Several air travel companies operate domestic flight in Sri Lanka, mainly designed for tourism. For example, the national company Sri Lankan Airlines proposes charter services ("Sri Lankan Air Taxi") from Colombo to touristic sites such as Bentota, Sigiriya, Kandy, Batticaloa, etc. The capacity of the airplane does not exceed 15 passengers.
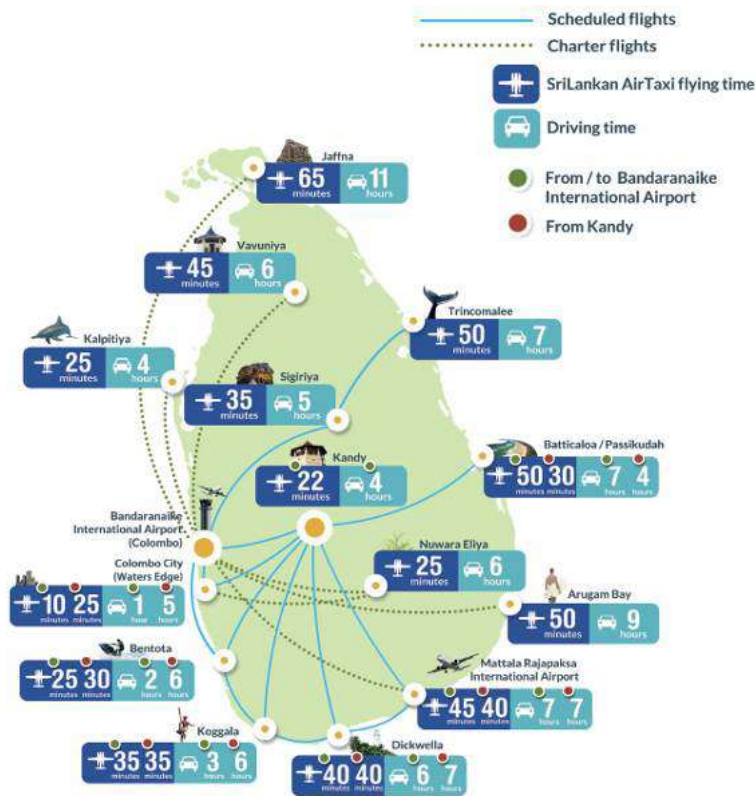
Figure 23: domestic flight services operated by Sri Lankan Air Taxi (source: Sri Lankan Airlines)

Air travel times are highly competitive compared to car, bus or train travel times, even taking into account access and boarding time, and especially on longer distance trips. However plane tickets are much less affordable: the company Cinnamon Air provides on its website some examples on prices applied on air services.

Table 6: Examples of airplane ticket price (source: Cinnamon Air)

Origin	Destination	Price (USD)	Price (LKR)
Colombo	Trincomalee	262	40610
Colombo	Kandy	176	27280
Colombo	Hambantota	265	41075
Colombo	Hatton	575	89125
Colombo	Batticaloa	265	41075
Colombo	Sigiriya	229	35495
		Rate : 1 USD = 155 LKR	

4.8   Intercity transport supply competition analysis

Analysing the intercity transport supply in Sri Lanka leads to the comparison of four modes: air, car, bus and train. Because of unaffordable air travel prices and relatively high car operating costs (purchase cost, fuel, spare parts, insurance costs, etc.), the two main competitive modes on medium to long distance trips remain bus and train.

Public and private bus companies provide services to main cities on a very frequent basis compared to the train, explaining their competitiveness and success among travellers. However, on both journey time and ticket prices, train takes the lead.

Comparing the two modes, it appears that for all origin/destination couple, bus is more expensive than train (on average 1.4 times higher for standard/3rd class seats), especially on short trips (Colombo suburban area) where the bus ticket can be almost twice as high as train ticket. Semi-Luxury bus tickets are also more expensive than corresponding 2nd class train ticket: on average, for 19 destinations, bus tickets are 1.3 times higher.

Regarding travel times, train is faster for 14 destinations out of 20. Train is particularly efficient for relatively short distances (below 100 km) where travel time is on average twice as less than bus travel time.

Bus is faster mostly on branch lines (to Batticaloa, Trincomalee, Talaimannar, Badulla…), however bus travel time is on average only 0.9 less than train travel time (with a maximum of two hours difference for Colombo – Badulla).

Table 7: Comparison between train and bus services

Origin	Destination	Distance Rail	Travel Time ICE	Travel Time SemiEx	Tariff 1st class ICE	Tariff 2nd class ICE	Tariff 3rd class ICE	Tariff 1st class SemiEx	Tariff 2nd class SemiEx	Tariff 3rd class SemiEx	Distance Road	Travel Time Bus	Tariff Standard Bus	Tariff Semi Luxury Bus	Tariff AC Bus	Tariff Super Luxury Bus
Colombo	Jaffna	393.9	6:06	8:02	1 500.00	700.00	520.00	1 020.00	540.00	335.00	393	10:00:00	501	752	995	1500
Colombo	Talaimannar	332.9		8:03	-	-	-	760.00	490.00	305.00	342	07:30:00	421	576	785	0
Colombo	Batticaloa	349.7		8:40	-	-	-	-	510.00	310.00	319	08:05:00	388	582	775	1160
Colombo	Trincomalee	296.9		8:00	-	-	-	-	450.00	285.00	266	06:45:00	325	488	650	980
Colombo	Vavuniya	254.4	4:20	5:10	1 500.00	480.00	320.00	600.00	420.00	265.00	254	07:00:00	323	485	640	0
Colombo	Polonnaruwa	259.7		6:25	-	-	-	-	420.00	265.00	228	06:00:00	281	414	560	0
Colombo	Badulla	292.4		9:32	-	-	-	600.00	450.00	285.00	225	07:30:00	318	485	645	970
Colombo	Anuradhapura	204.9	3:25	4:05	1 000.00	450.00	280.00	520.00	370.00	240.00	200	05:45:00	261	417	520	0
Colombo	Matara	156.8		2:30				-	230.00	130.00	185	04:45:00	203	305	405	530
Colombo	Matale	148.6			-	-	-	400.00	230.00	125.00	155	04:00:00	189	0	380	0
Colombo	Galle	113.9		1:44				-	180.00	100.00	145	03:30:00	152	228	305	440
Colombo	Puttalam	135.1		3:47	-	-	-	-	210.00	115.00	139	03:30:00	168	252	350	0
Colombo	Gampola	126.9		3:04				360.00	200.00	110.00	137	03:45:00	168	252	335	0
Colombo	Kandy	120.7	2:31	2:33	800.00	280.00	180.00	340.00	190.00	105.00	135	04:10:00	160	239	320	0
Colombo	Kurunegala	95.3	1:41	1:55	280.00	250.00	180.00	300.00	160.00	85.00	103	03:30:00	128	378	255	0
Colombo	Chilaw	82.5		2:00	-	-	-	-	140.00	75.00	84	03:00:00	107	161	230	0
Colombo	Kaluthara Sou	41.9		0:41				-	80.00	40.00	62	01:30:00	67	101	135	0
Colombo	Negombo	38.9		1:00	-	-	-	-	70.00	40.00	38	02:00:00	61	95	130	0
Colombo	Panadura	26.2		0:31				-	50.00	25.00	32	01:00:00	48	72	95	0
Colombo	Gampaha	27.5	0:29	0:31	280.00	250.00	180.00	100.00	50.00	25.00	30	01:20:00	45	0	0	0
Colombo	Mount Laviniy	12.2		0:15				-	20.00	15.00	16	00:35:00	29	35	60	0

5   CURRENT INTERCITY DEMAND

This study aims at modelling the intercity traffic that is impacted by the Colombo suburban project, which means:

- ❖ Exchange traffic between Colombo area the rest of Sri Lanka;

- ❖ Transit traffic between areas outside of CMR and crossing Colombo area.

5.1   Railway

According to the ticketing data that are available for 2016, the total railway demand in Sri Lanka represents about 371 855 passengers per day.

The exchange traffic between Colombo Metropolitan Region and the rest of the country represents about 61 250 passengers per day, which is 16.5% of the total demand on the railway network. About 41 150 of this passengers board or alight in Colombo area (11% of the total demand).

Transit traffic between railway lines via Colombo area is about 990 passengers per day.

Remaining traffic either internal to the Colombo Metropolitan Region (276 000 passengers/day in 2016, representing 74.3% of SLR daily traffic) or is internal to one of the railway lines in Sri Lanka with no link with the Colombo Metropolitan Region (33 500 passengers/day in 2016).

Table 8: railway traffic

	Traffic per day	Part
Exchange traffic		
CMR - Area outside of CMR	61 250	16.5%
of which Colombo - Area outside of CMR	*41 150*	
Transit traffic via CMR	990	0.3%
Intrazonal traffic		
Colombo Metropolitan Region	276 215	74.3%
Lines outside of CMR	33 400	9.0%
Total railway traffic	371 855	100%

5.1.1 Exchanges between Colombo and the rest of the territory

The exchanges between Colombo area and the rest of the country represent the majority of the long distance demand that will impact the Colombo suburban network: about 41 150 passengers per day in 2016.

The following table shows the repartition of the exchange traffic between Colombo area and the other railway lines:

Table 9 : exchanges between Colombo and the rest of the territory

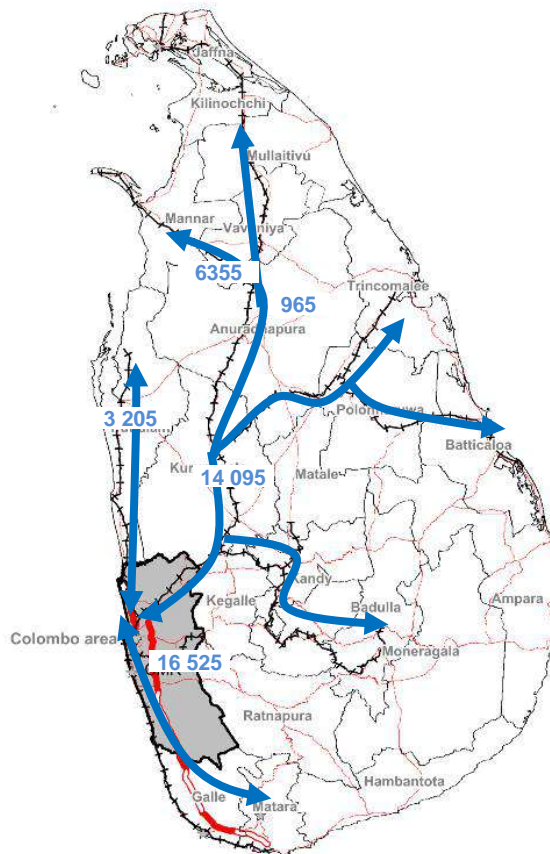| Exchange traffic between Colombo area and the other lines	Passengers per day (both direction)
Batticaloa Line	680
Coast Line Ext	16 525
Main Line Ext	11 955
Matale Line	2 140
Northern Line	6 140
Puttalam Line Ext	3 205
Talaimannar Line	215
Trincomalee	285
TOTAL	**41 140**

Figure 24 : Railway exchange traffic between Colombo area and the other lines (2016)

5.1.2 Transit traffic

With only 1 000 passengers per day, transit intercity traffic via Colombo area does not appear very significant in the analysis. It may be explained by the fact that railway offer is not appropriate for this kind of demand. Connections between 2 lines in Colombo may not be optimized. Most of the transit traffic is linked to the stations of the coast line.
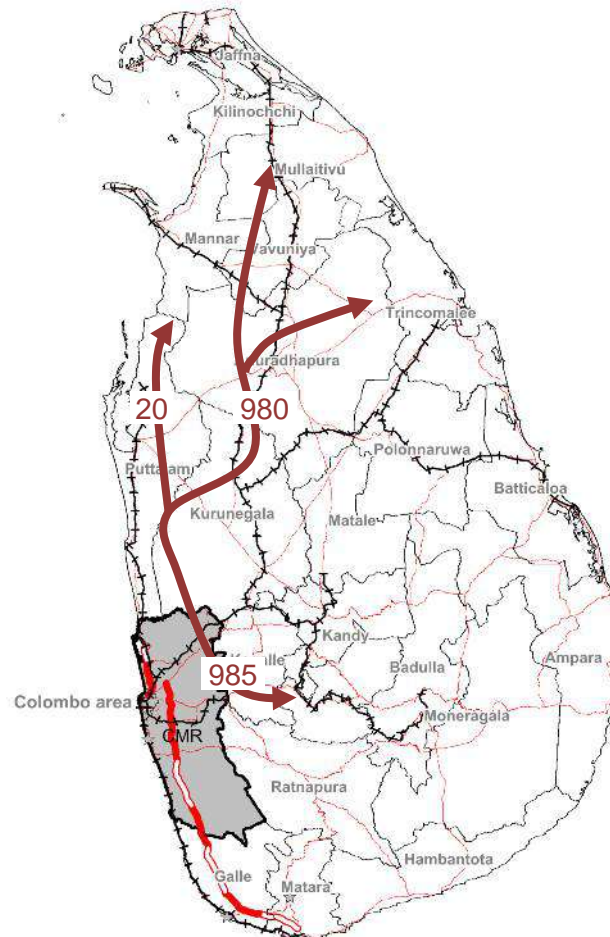
Figure 25 : Railway transit traffic via Colombo area

5.1.3 Intercity traffic outside of CMR

In order to make this analysis complete, we also have to take into account the rest of the intercity demand that won't be impacted by Colombo suburban project. It concerns the internal traffic for each line that does not cross CMR area. It represents 33 400 passenger per day. Most of this demand is internal traffic on Main line (34%), Coast line (21%), Matale line (13%) and Northern line (8%). There also are some exchanges between Matale line and Main line (13%). The last 10% are internal and exchanges traffic on Puttalam, Batticaloa, Trincomalee and Talaimannar lines.

5.1.4 Principal OD in the demand

The analysis of the long distance demand considering the OD shows that:

❖ 66% of the long distance railway demand linked to the Colombo area has Colombo fort as an origin or a destination. 25% has Maradana as boarding or alighting station.

- ❖ About 60% of the total long distance demand linked to Colombo is covered by 10 stations outside of the CMR: Galle, Polgahawela, Rambukkana, Ambalangoda, Matara, Kurunegala, Kandy, Alawwa, Hikkaduwa.

- ❖ Considering the stations that are located outside of the CMR, the weight of the traffic linked to Colombo city on their total traffic is:

Table 10: Principal OD in the demand

Stations	Railway intercity impacted traffic (B+A)	Weight of the traffic linked to…		
		Colombo Fort	Maradana	Colombo area
GALLE	6427	32%	38%	72%
POLGAHAWELA	5502	52%	4%	65%
RAMBUKKANA	4647	53%	11%	73%
AMBALANGODA	4407	26%	40%	69%
ALAWWA	4075	31%	7%	45%
MATARA	3929	53%	18%	72%
KANDY	3176	63%	0%	64%
KURUNEGALA	2859	65%	4%	72%
TOTAL	35023	45%	17%	67%

The traffic linked to Colombo main stations is an important part of the demand for stations outside of CMR: as high as 73% for Rambukkana. But this should not hide the traffic that exists with the other stations in CMR. For instance, Alawwa stations has just 45% of his demand connected to Colombo, the rest of the demand is dispatched on other stations of the CMR.

5.2   Buses

Bus demand has been reported from Cordon Line Survey on bus made in 2013 by ComTrans for JICA studies. The survey was conducted at 14 locations at the boundary of CMR. Among those locations, the survey was conducted at 12 locations on major arterial roads for 16 hours and 2 locations at bus stands for highway buses for 16 hours.
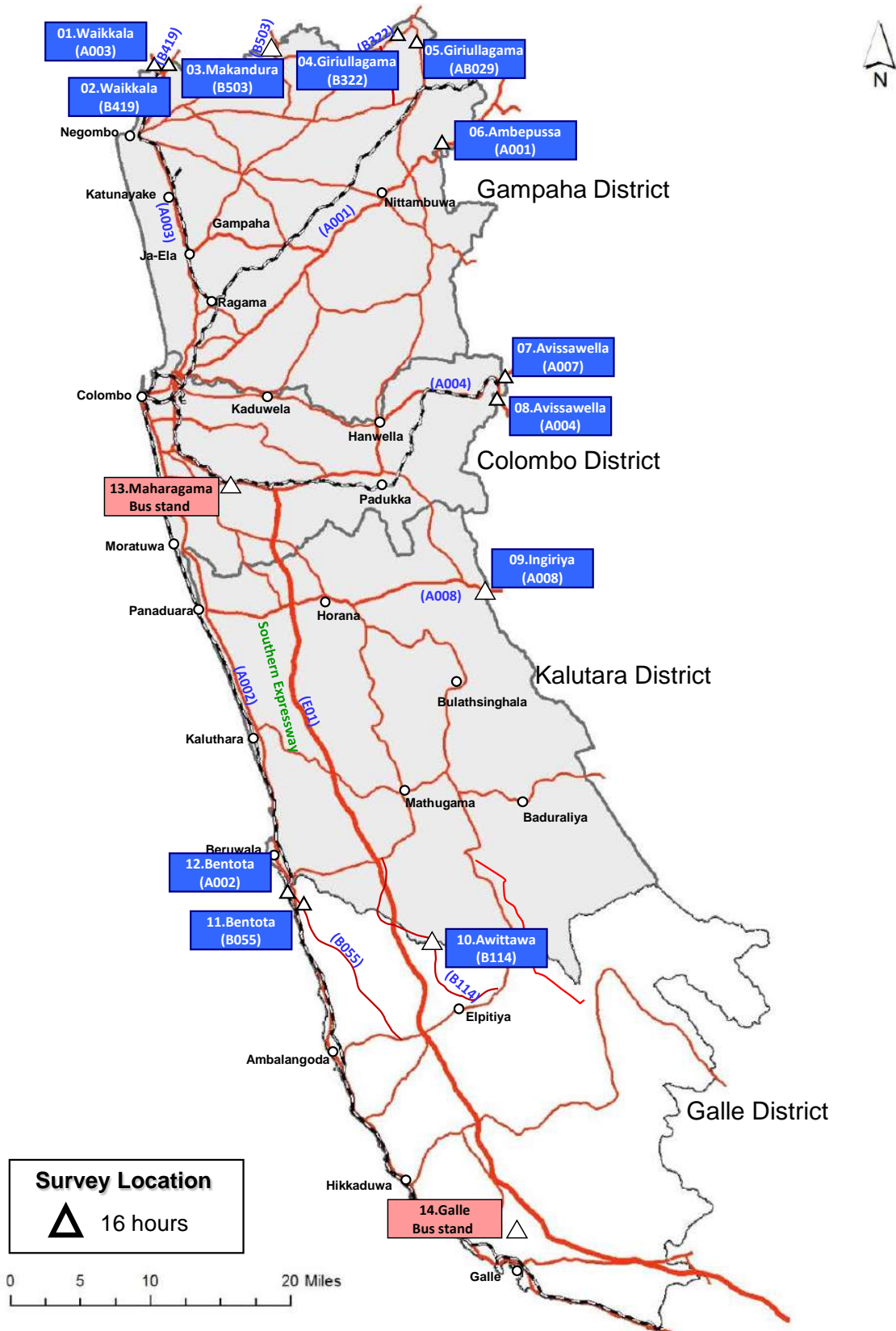
Figure 26: Survey location - buses

The surveys conducted on bus users in Colombo area in June 2017 have been used in order to readjust the current bus intercity demand. The global intercity bus demand in 2017 from and to Colombo is around 45 560 passengers.

The following table summarizes the reconstituted bus demand between Colombo area and the different railway corridors for current base year:

Table 11: Bus exchanged traffic with Colombo

Railway corridor	Bus exchange traffic with Colombo (both direction)
Batticaloa Line	910
Coast Line Ext	8 610
Main Line Ext	16 240
Matale Line	6 950
Northern Line	2 420
Puttalam Line Ext	2 760
Talaimannar Line	1 770
Trincomalee	1 900
TOTAL	**41 560**

5.3　Private vehicles

Just as buses demand, private vehicles demand could be reconstituted using existing the roadside Cordon Line Survey made in 2013 by ComTrans for JICA studies. The survey was conducted at 21 locations at the boundary of CMR. Among those locations, the survey was conducted at 9 locations on major arterial roads for 24 hours and 12 locations on arterial roads in the suburbs and Southern Expressway for 16 hours. It was readjusted using the Classified Vehicle Count Survey conducted at the same locations.
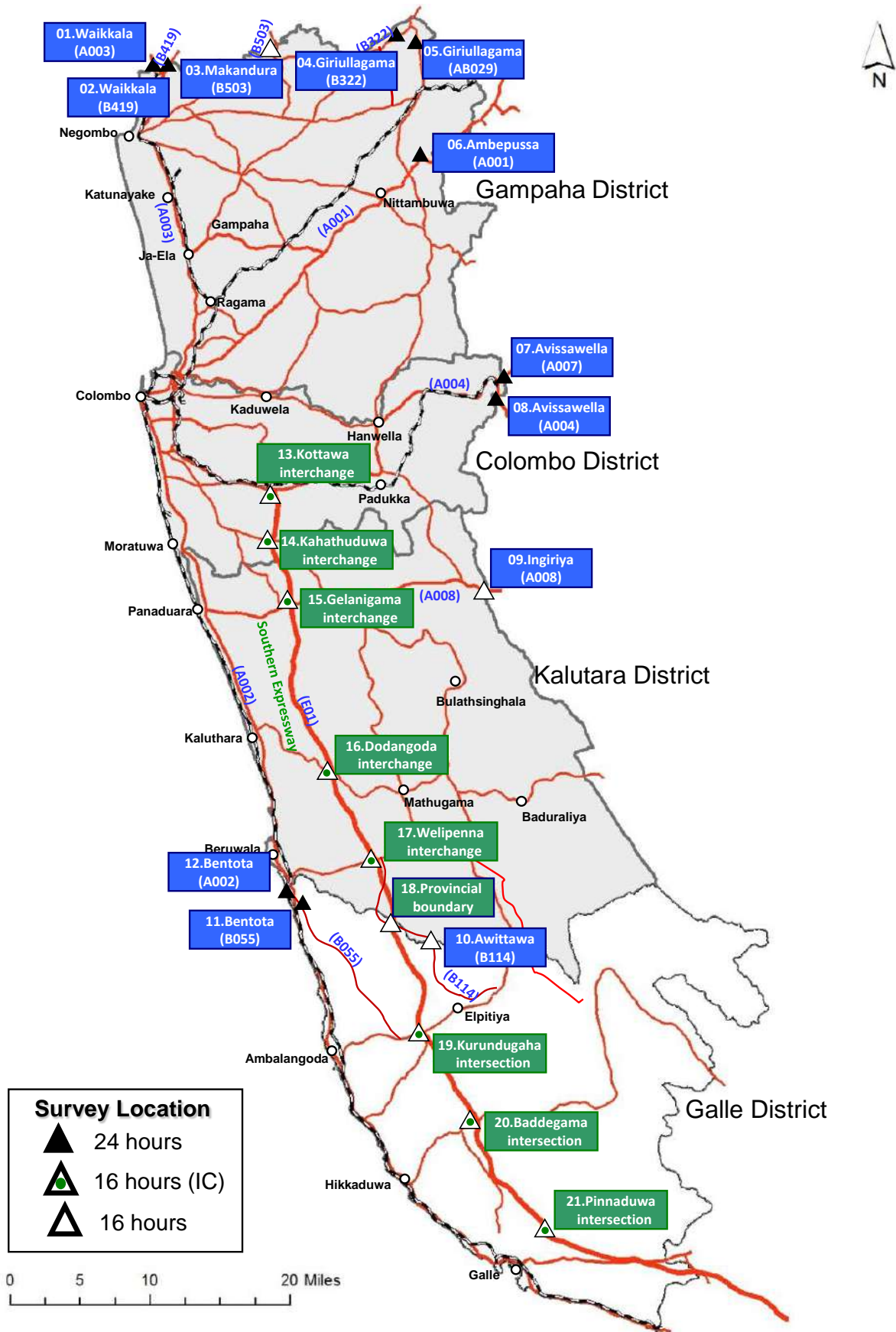
Figure 27: Survey days, durations and location – private vehicles

In order to reconstitute private vehicles demand for current base year, the annual growth rate of bus demand by district has been used. The following table shows the reconstituted private vehicle demand along the railway corridor:

Table 12: Private vehicles exchanged traffic with Colombo

Railway corridor	Private vehicles exchange traffic with Colombo (2016, both directions)
Batticaloa Line	200
Coast Line Ext	4 730
Main Line Ext	2 530
Matale Line	1 110
Northern Line	740
Puttalam Line Ext	2 310
Talaimannar Line	30
Trincomalee	120
TOTAL	**11 770**

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5.4   Synthesis of the global intercity demand

The intercity demand for exchanges between Colombo area and districts of Sri Lanka outside of CMR is summarize in the figure below.
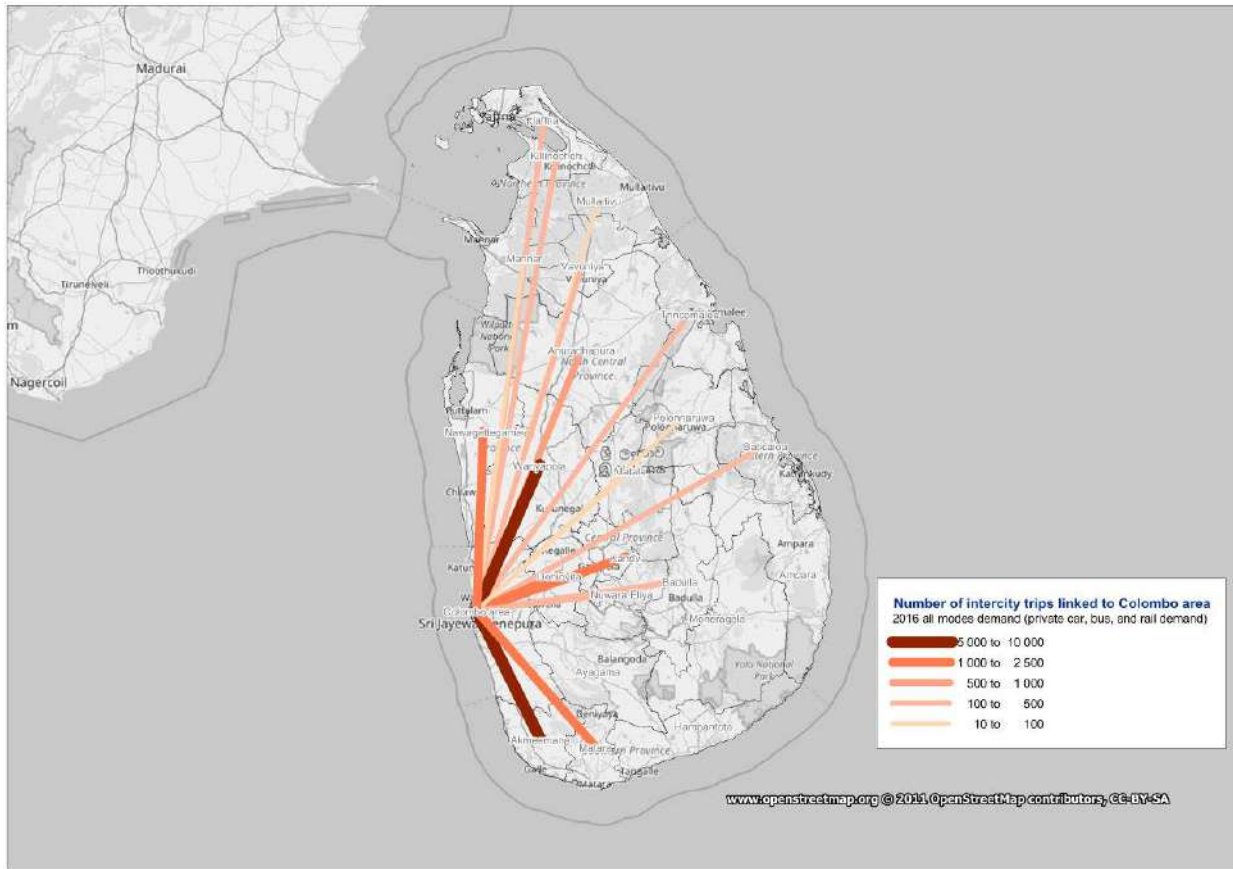
Figure 28: Synthesis of the global intercity demand

6 HYPOTHESIS FOR FUTURE HORIZONS

Three time horizons have been studied: 2021, 2026 and 2035.

6.1 Population and employment forecast

6.1.1 Population

The principal assumptions for the population growth rates are taking into consideration the National Physical Planning Policy and Plan (NPP Policy and Plan) for Sri Lanka between 2011 and 2030. This document gives main objectives for the development of each Province of Sri Lanka for the next years.

By 2030, Sri Lanka population is estimated to be 25 million. In order to accommodate such, the NPP Policy and Plan aims at supporting the development of new cities while restricting the development in the protected area network and the central fragile area.

The settlement pattern for year 2030 and the location of future metropolitan cities is shown in the figure below:

Figure 29: Sri Lanka settlement pattern – year 2030

Distribution of the future 2030 population in the different districts area is summarized in the following table:

Distribution of Population - 2030

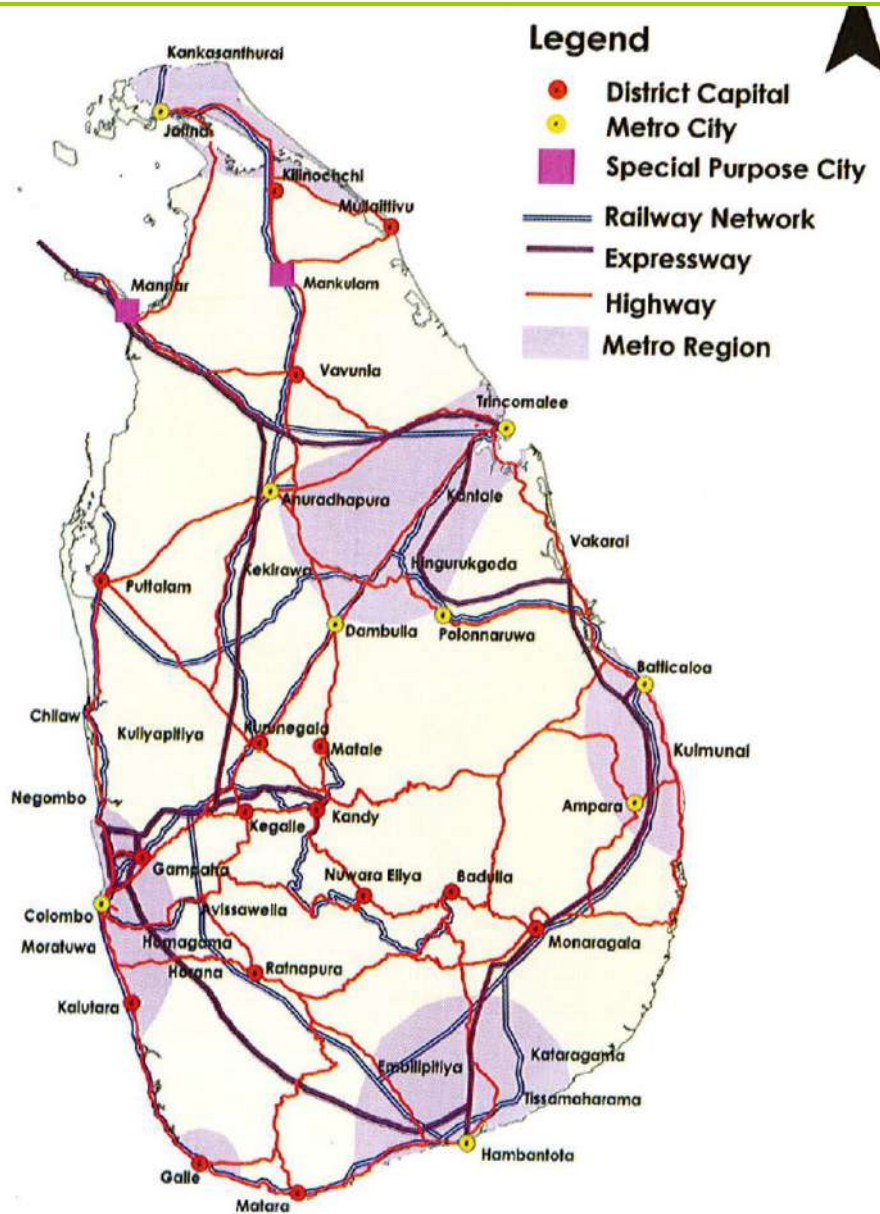| City Type	City Name	Target Population	
	Western Metro Region		
Metro City	Colombo	2,000,000	
District Capital	Gampaha	750,000	
District Capital	Kalutara	750,000	3,500,000
	North Central Metro Region		
Metro City	Anuradhapura	1,500,000	
Metro City	Dambulla	1,000,000	
Metro City	Polonnaruwa	500,000	
Metro City	Tricomalee	1,000,000	4,000,000
	Eastern Metro Region		
Metro City	Ampara	500,000	
Metro City	Batticalou	500,000	1,000,000
Hambantota Metro Region			
Metro City	Hambantota	1,000,000	1,000,000
Jaffna Metro Region			
Metro City	Jaffna .	1,000,000	1,000,000
	Major Cities		
District Capital	Badulla	75,000	
District Capital	Galle	300,000	
District Capital	Kandy	100,000	
District Capital	Kegalla	50,000	
District Capital	Kilinochchi	50,000	
District Capital	Kurunegala	200,000	
District Capital	Manner	200,000	
District Capital	Matale	100,000	
District Capital	Matara	100,000	
District Capital	Monaragala	100,000	
District Capital	Mulativu	50,000	
District Capital	Nuwara Eliya	50,000	
District Capital	Puttalam	100,000	
District Capital	Ratnapura	75,000	
District Capital	Vavuniya	200,000	1,750,000
	Special Purpose Cities		
	Mankulam City	500,000	
	Mannar City	100,000	600,000
Urban			12,850,000
Rural			12,150,000
Total			25,000,000

Figure 30: Distribution of Population - 2030

Taking into consideration those projects plan, the future population by district has been extrapolated for 2035 time horizon. Following map shows it distribution by district:
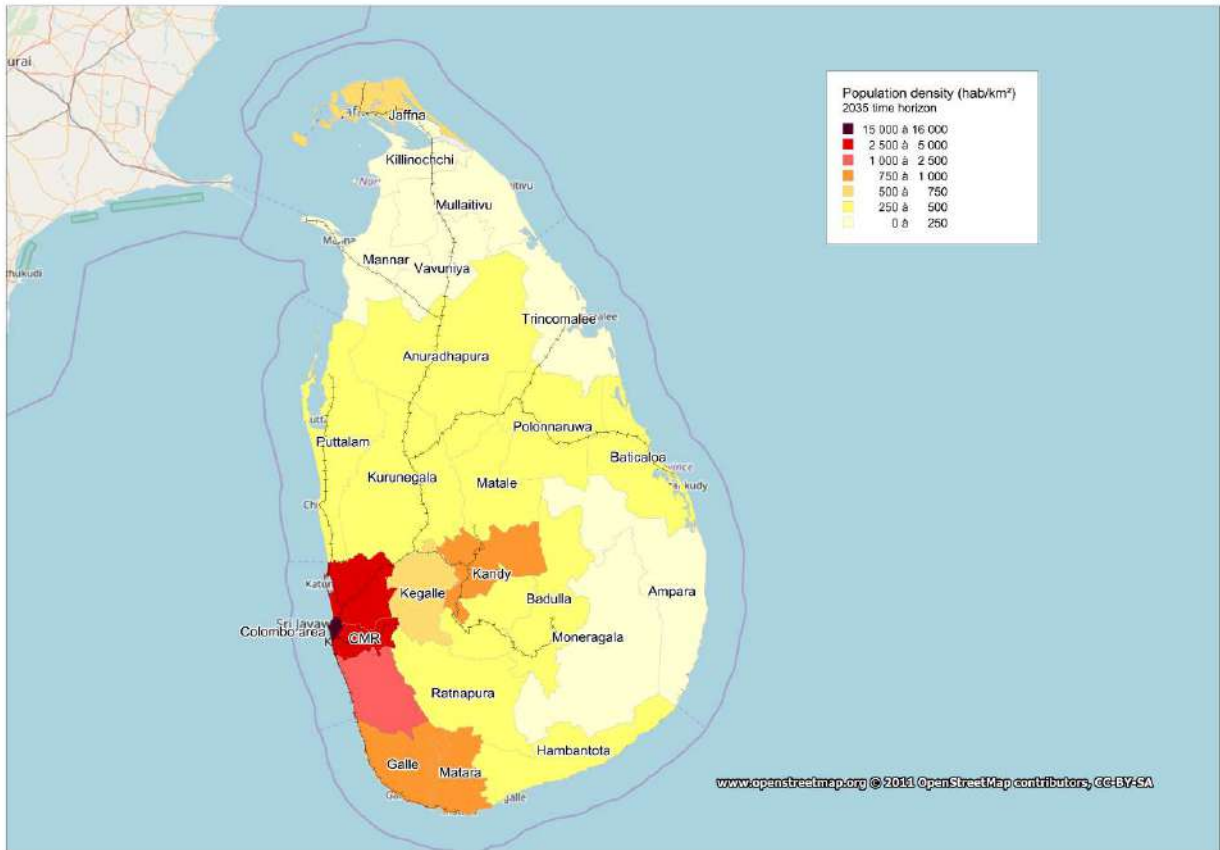
Figure 31 : Population density in Sri Lanka in 2035

6.2   Employment growth

Employment growth assumptions are based on the GDP trend of evolution on the last few years. The result of employment by district at 2035 time horizon is shown in the map below:
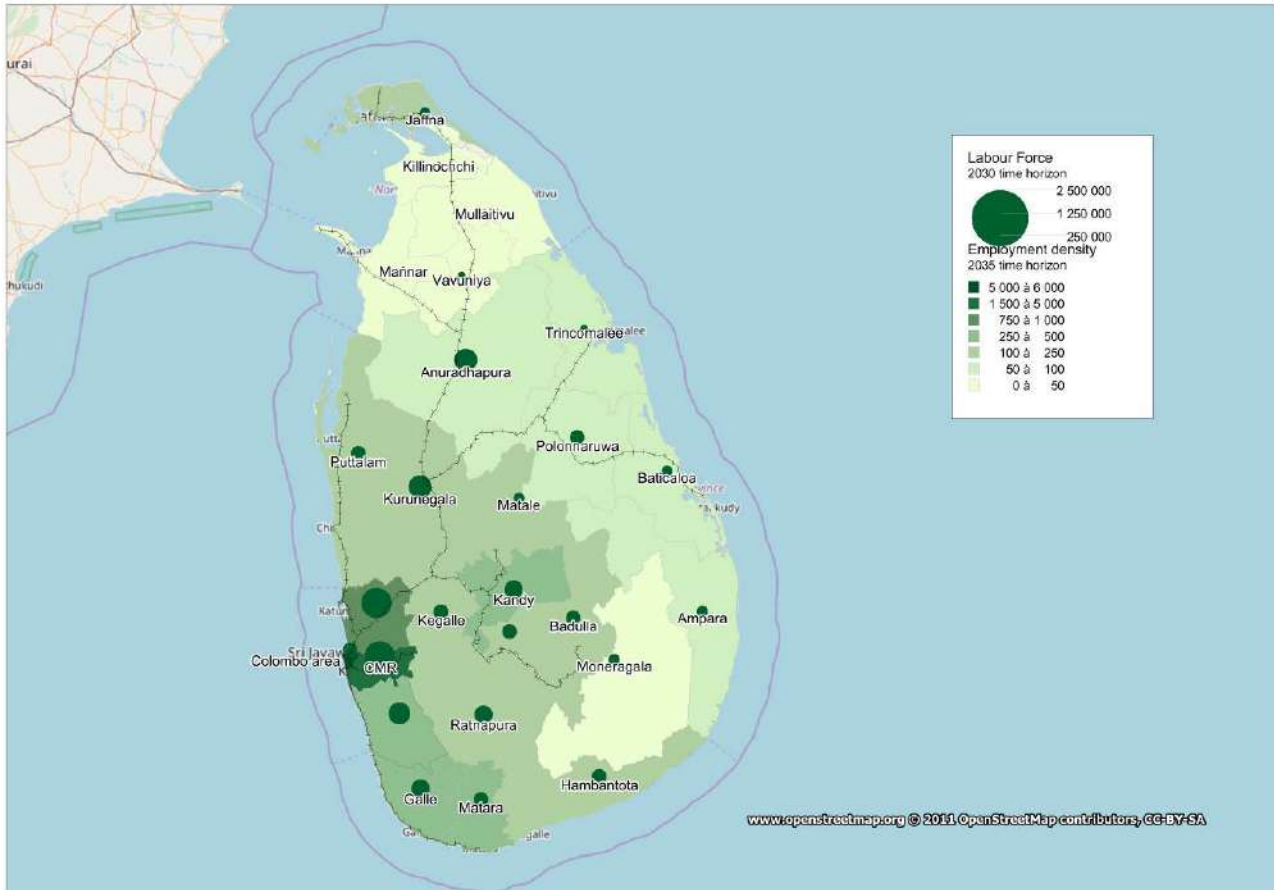
Figure 32 : Employment density in Sri Lanka in 2035

6.3 Estimation of the future demand

The intercity demand in the future is estimated in two steps. First, a gravitational model has been developed on the basis of current socio economic situation and expected evolution of such factors. This allowed us to assess the potential overall traffic between main O/D. Second, we use a generalized cost model to estimate the evolution rail transport share.

6.3.1 Gravity model

The gravity model is inspired by Newton's theory of gravity. The gravity model assumes that the trips produced at an origin and attracted to a destination are directly proportional to the total trip productions at the origin and the total attractions at the destination.

The calibrating term or "friction factor" represents the reluctance or impedance of persons to make trips of various duration or distances. The general friction factor indicates that as travel times increase, travelers are increasingly less likely to make trips of such lengths. Calibration of the gravity model involves adjusting the friction factor.

The socioeconomic adjustment factor is an adjustment factor for individual trip interchanges. An important consideration in developing the gravity model is "balancing" productions and attractions. Balancing means that the total productions and attractions for a study area are equal.

Before the gravity model can be used for prediction of future travel demand, it must be calibrated. Calibration is accomplished by adjusting the various factors within the gravity model until the model can duplicate a known base year's trip distribution.

In the case of intercity demand in Sri Lanka, production of trips is supposed to be a function of population, and attraction of trip a function of employment. The gravity model can be written like this:

$$Tij = K \times (Pop_i^{\alpha} \times Emp_j^{\beta}) / d_{ij}^{\gamma}$$

Where

❖ Pop_i = Population of the origin zone

❖ Emp_j = Employment in the destination zone

❖ α, β = calibration terms for production and attraction trips

❖ d_{ij} = distance between zone i and zone j

❖ γ = Friction factor

The different parameter are estimated using linear regression (the gravity model is log-linear). The following table presents the estimation for the different parameters:

Table 13: Parameters used for the gravity model

	Coefficients	Std Error	t Stat	P-value
ln(K)	-16,81	6,35	-2,65	0,013
α	1,18	0,23	5,20	0,000
β	1,15	0,20	5,64	0,000
γ	-1,29	0,37	-3,50	0,001

All the parameters are significant with a 5% error margin following the student statistic. The overall calibration is satisfying with an adjusted R-square of 84%. And the model correctly reproduces the current traffics per origin-destination. The following graph shows observed and estimated total demand per OD for current situation.
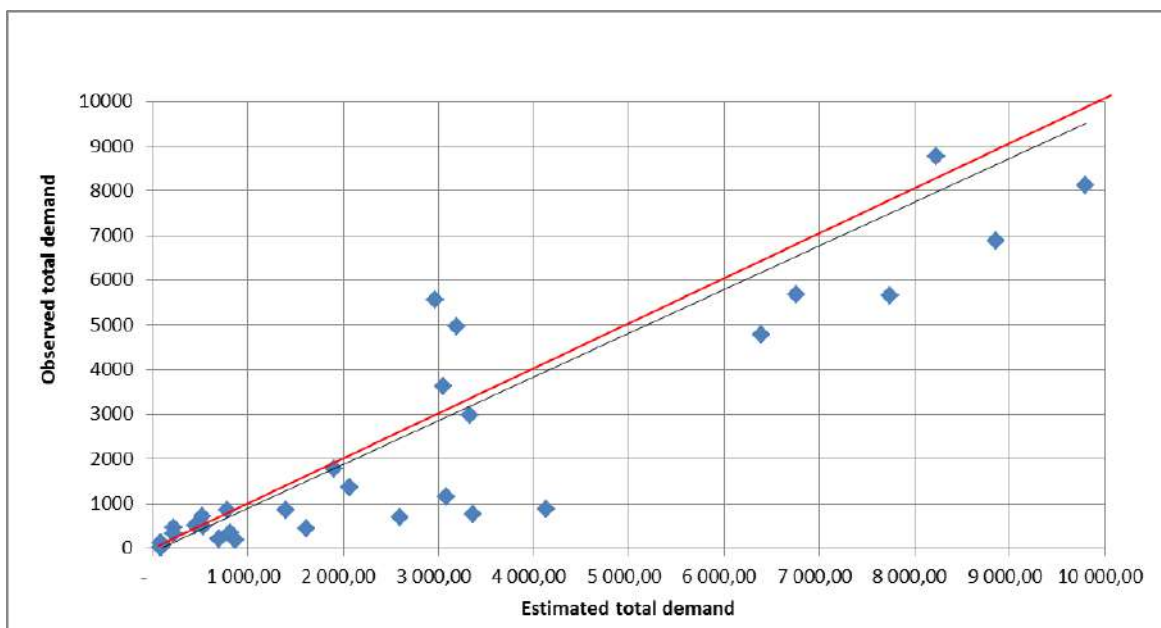

Figure 33: Estimated total demand

6.3.2 Estimation of transport modes shares

The generalized cost model we use allows estimating mode shift resulting in an improvement of rail service, as well as induced traffic.

The generalized cost for rail trip C_{Rail} is written:

$$C_{Rail} = p + h \times (T + 0,5 \times I)$$

Where:

- ❖ p is the ticket price,

- ❖ h the value of time for rail,

- ❖ T is the travel time (door to door including in-vehicle time as well as access time to station),

- ❖ I is the average interval between two trains.

For the current situation, where we can observe market shares for the different transport modes, the generalized cost for road C_{Road} satisfy the following condition (equilibrium condition):

$$(C_{Road} / C_{Rail})^n = t_{Rail} / t_{Road} = t_{Rail} / (1 - t_{Rail}),$$

where:

- ❖ C_{Rail} is the generalized cost for rail trip,

- ❖ t_{Rail} and t_{Road} are respectively the market shares of the two modes.

This equilibrium generalized cost for road can be estimated as following:

$$C_{Road} = VoC \times L + h \times T$$

Where:

- ❖ VoC is the Vehicle operation Cost per kilometer for private car,

- ❖ h is the value of time for road,

- ❖ T is the average travel time,

- ❖ L is the length of the trip.

When the railway service is improved due to new developments, the growth is rail transport share is calculated in relation with the evolution of rail trip generalized cost and road trip generalized cost for future years. The new rail transport share t'_{Rail} obtained because of mode shift is obtained as following:

$$(C'_{Road} / C'_{Rail})^n = t'_{Rail} / t'_{Road} = t'_{Rail} / (1 - t'_{Rail})$$

Where:

- ❖ C'_{Rail} is the generalized cost for rail trip after rail service improvement,

- ❖ C'$_{Road}$ is the generalized cost for road trip for future years (taking into account increase of road VoC for instance),

- ❖ t'$_{Rail}$ and t'$_{Road}$ are respectively the market shares of the two modes after rail service improvement for future years.

The parameter n value is 1.5.

7 TRAFFIC FORECAST

7.1 Do Nothing Scenario

First we consider a Do Nothing Scenario. We assume that transport offers remain the same (except for transport which are assumes to grow as GDP per capita) and we estimate the growth in demand depending only of socioeconomic parameters (population and employment forecasts) using the gravity model calibrated on current situation.

Overall intercity demand between Colombo area and districts outside of Colombo Metropolitan Region is growing from 93 450 trips in 2016 to 156 485 trips in 2035 (+67%).

Traffic on Railway is growing from 40 750 trips to 72 976 trips (+79%) and traffic on road (private vehicles and buses) is growing from 52 700 trips in 2016 to 83 509 in 2 035 (+58%).

Table 14: Intercity traffic results for the DNS

Intercity Traffic - Results	2016	2021	2026	2035 - DNS
All modes	**93 450**	**101 250**	**116 700**	**156 485**
Road	*52 700*	*57 350*	*66 300*	*83 567*
Rail	*40 750*	*43 900*	*50 400*	*72 917*
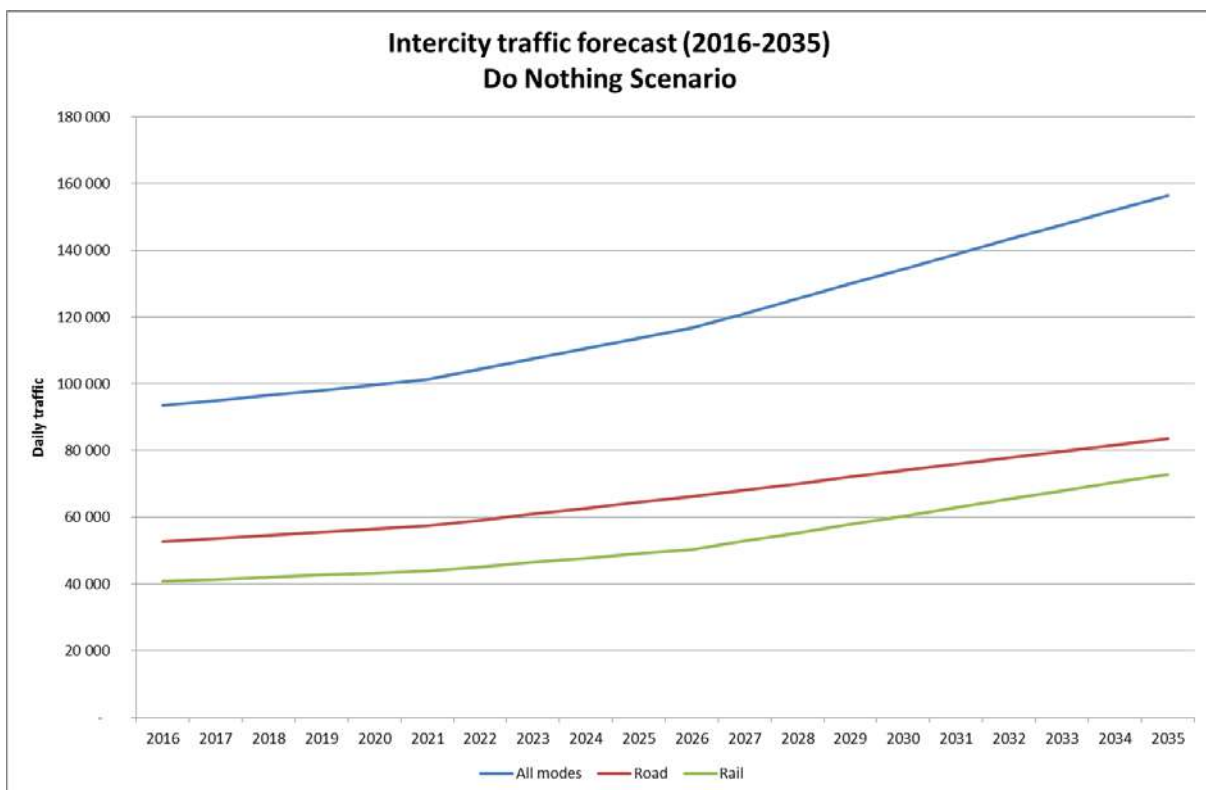
Figure 34: Intercity traffic forecast – Do Nothing Scenario

The modal share of the intercity demand on major OD in the railway corridor reaches 47% for rail and 53% for road (buses and private car included).

The following map shows how the traffic is distributed over the different intercity lines:

❖ Main Line and Coast Line concentrate each around 35% of the intercity rail traffic.

❖ Northern line is the third most important line with 10% of the traffic.

❖ Matale and Puttalam lines have a traffic above 5 000 passengers per day each.

Table 15: Intercity rail traffic Colombo area and the other lines (2035, *DNS*)
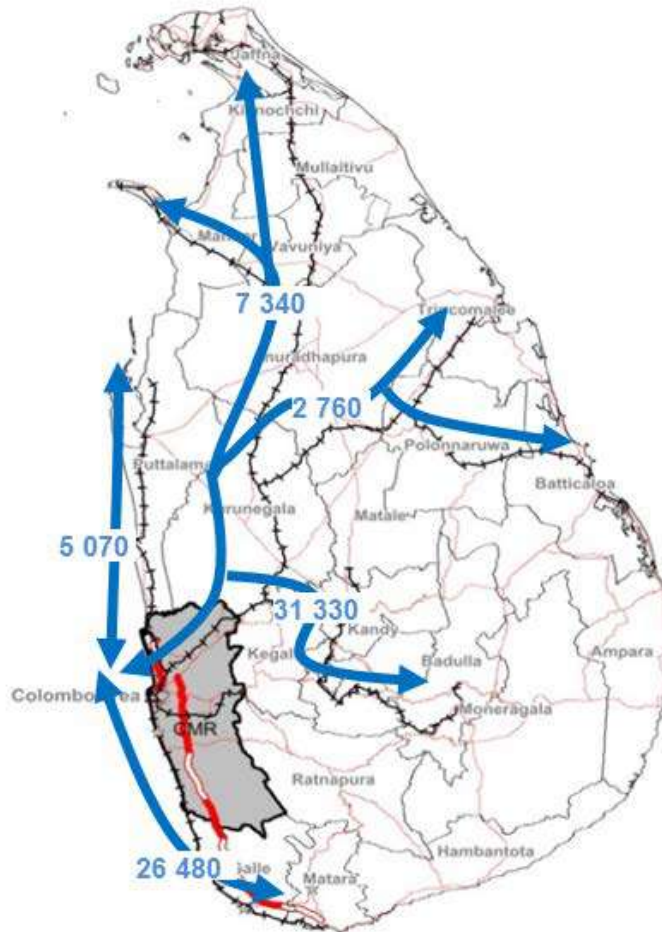
Intercity rail traffic with Colombo area	Passengers per day 2035 (both direction)
Batticaloa Line	2 345
Coast Line	26 478
Main Line	25 765
Matale Line	5 523
Northern Line	7 175
Puttalam Line	5 064
Talaimannar Line	159
Trincomalee Line	408
TOTAL	**72 917**

7.2   Railway transport improvement in 2035

We consider for 2035 an improvement of the rail service on the different intercity lines. The impact on rail demand is then assessed using the generalized cost model previously described.

Regarding to the Do Nothing Scenario in 2035, intercity rail demand raises by 49 670 trips (+68%) due to the improvements in the rail service. This increase is provided by:

❖ Mode shift from private car and buses: 16 100 passengers/day. The road demand is reduced by 19.3% between DNS and the rail improved scenario.

❖ Traffic induction: 33 500 new passengers/day. Induction represents an increase of 21% of the overall intercity demand. This includes also mode shift from air.

Table 16: Intercity traffic results – Railway transport improvement 2035

Intercity Traffic - Results	2016	2035 - DNS	2035 - Rail improved
All modes	**93 450**	**156 485**	**190 048**
Road	*52 700*	*83 567*	*67 460*
Rail	*40 750*	*72 917*	*122 588*
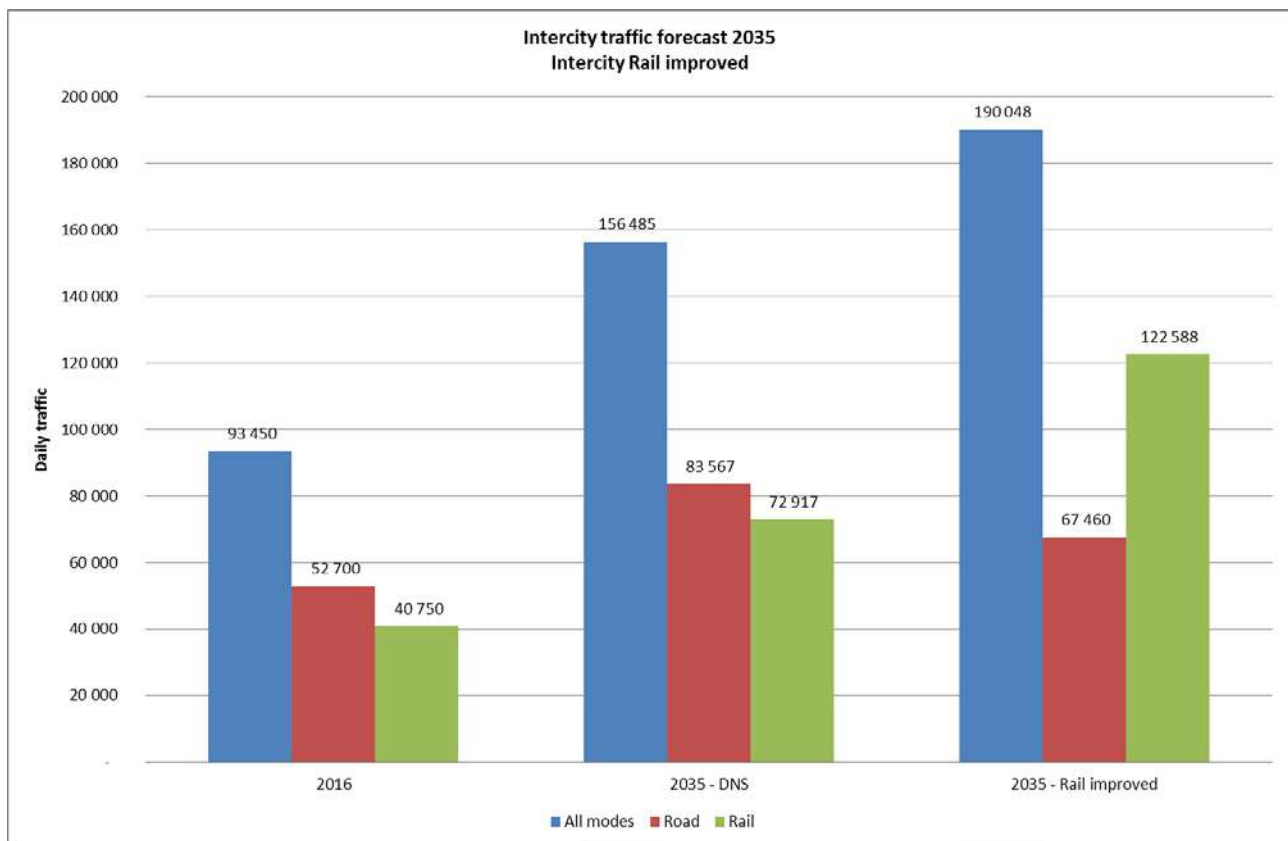
Figure 35: Intercity traffic forecast – railway traffic improvement 2035

The mode share of the intercity demand in the railway corridor is reversed in comparison to the DNS: it reaches 65% for rail and 35% for road with the rail improved scenario, instead of 47% for rail and 53% for road with the DNS scenario.
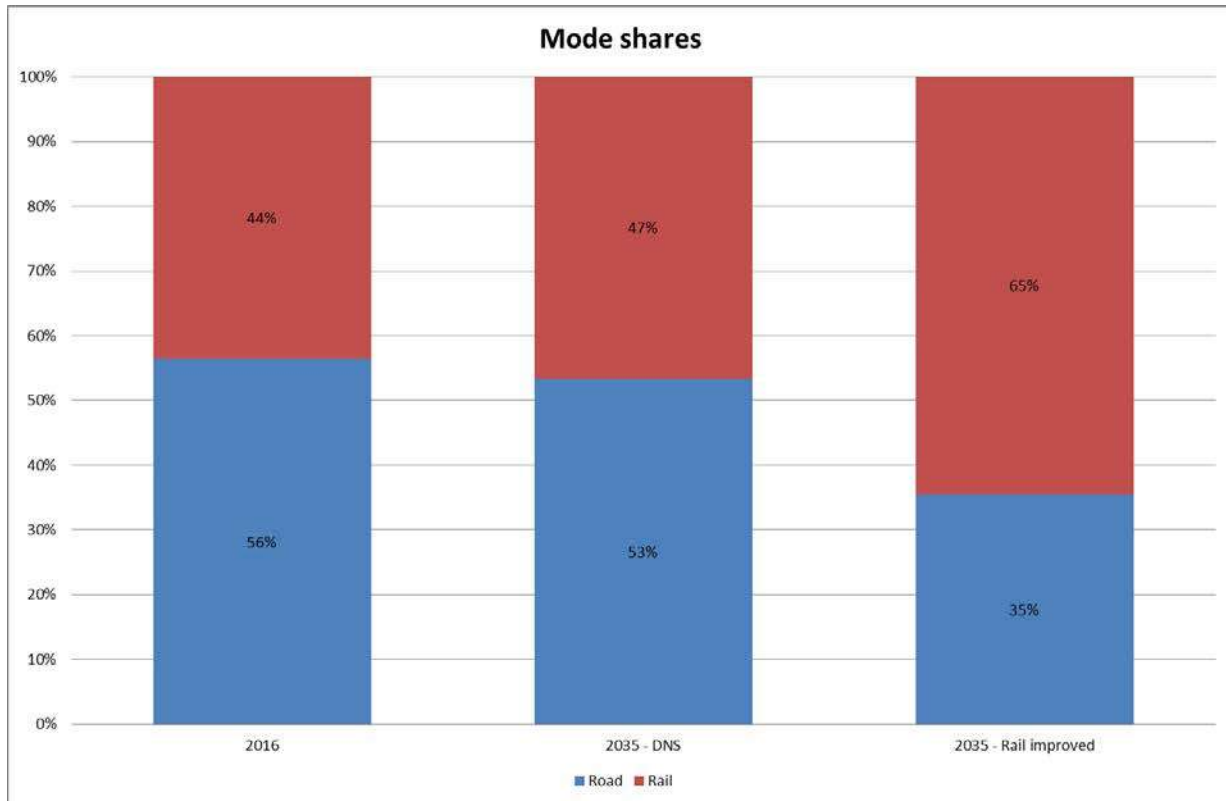
Figure 36: Modal share

The following map shows how the traffic is distributed over the different intercity lines:

❖ Main Line and Cost Line traffic rise substantially by more than 70% compared to DNS and reach a traffic above 40 000 passengers per day.

❖ Northern line is still the third most important line with 11 500 passengers per day.

❖ Puttalam and Matale line reach a traffic around 8 000 passengers per day.

Table 17: Intercity rail traffic Colombo area and the other lines (2035, *Rail service improved)*

Intercity rail traffic with Colombo area	Passengers per day 2035 (both direction)	Increase / DNS
Batticaloa Line	2 345	0,0%
Coast Line	47 150	78,1%
Main Line	44 629	73,2%
Matale Line	7 775	40,8%
Northern Line	11 559	61,1%
Puttalam Line	8 563	69,1%
Talaimannar Line	159	0,0%
Trincomalee Line	408	0,0%
TOTAL	**122 588**	**68,1%**
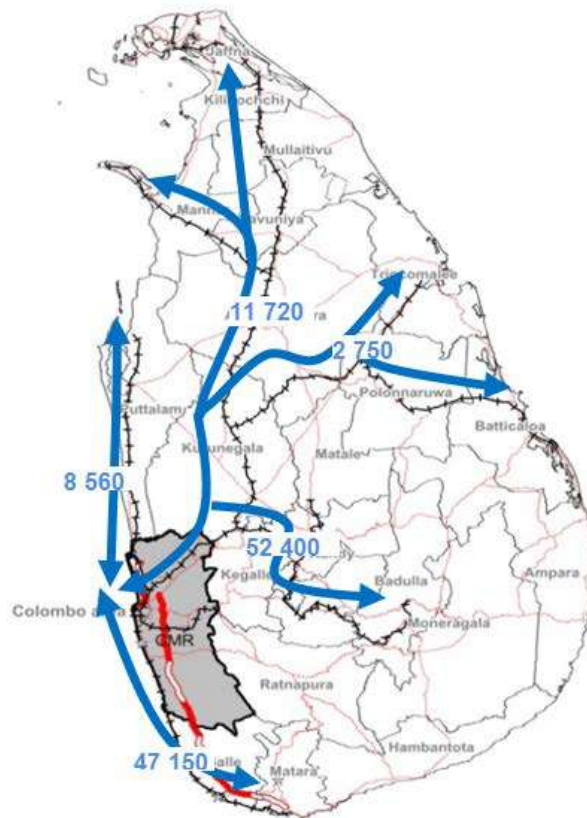
8 RECOMMENDATIONS FOR IMPROVING AND DEVELOPING INTERCITY RAIL SERVICES

8.1 Main issues related to long distance passenger services

Following the diagnosis made and the survey carried out, 5 main issues hampering the development of such rail services were identified:

1. Frequency

2. Delays

3. Timetable

4. Speed

5. Comfort

6. Passenger information

7. Booking facilities and easiness

8. Seat availability

9. Stopping pattern

10. Multimodality

Also some positive points were noted:

1. Price

2. Safety

To overcome these issues, we recommend a number of actions to give more attractiveness and competitiveness to rail services. These are:

❖ Infrastructure improvements (doubling track and improvement of speed)

❖ Improvement of supply of rail services including ntroduction of clock wise services on main O/D at medium distance

❖ Tariff policy

❖ It, passenger information systems and ticketing

❖ Journey patterns

8.2 Infrastructure improvements

8.2.1 Context of planned infrastructure projects

According to Sri Lankan Railways, "Investment Proposal 2015-2020"- Appendix II (from the Ministry of Transport website), future rail infrastructure projects are among others, for existing lines:

❖ For the Coast line

■ Construction of Double track between Payagala South to Aluthgama (10.4 km)

❖ For the Main Line and Matale Line

■ Construction of Double track between Peradeniya and Kandy (5.9 km)

■ Construction of Double track between Peradeniya and Gampola (12.1 km)

■ Construction of Double track between Peradeniya and Kadugannawa (9.3 km)

■ Construction of Double track between Kandy and Katugastota and extension from Katugastota to Digana (18 km)

■ Construction of Ragama – Veyangoda third line (22.0 km)

❖ For the Northern Line, Batticaloa and Trincomalee Lines

■ Construction of Double track between Polgahawela and Kurunegala (21.5 km)

■ Construction of Railway Triangle at Maho (1.5 km)

■ Upgrading of the line between Maho and Anuradhapura (66.4 km)

■ Upgrading of the line between Anuradhapura and Vavuniya (49.4 km)

■ Rehabilitation of Railway track between Gal Oya and Trincomalee (70.2 km)

■ Rehabilitation of Railway track between Gal Oya and Batticaloa (123 km)

❖ For the Puttlam Line

■ Construction of Double track between Katunayake and Kochchikade (12.6 km)

And for new lines and extension projects:

- ❖ Construction of Railway Line from Matara to Kataragama – second phase : from Beliatta to Kataragama

- ❖ Construction of Southern Railway Circle: 79 km from Beliatta to Hambantota (design stage)

- ❖ Construction of Railway Line from Kurunegala to Habarana: 81 km between the two cities, via Dambulla (feasibility study is completed)

- ❖ Construction of Railway line from Maho to Palavi (53 km)

- ❖ Construction of new railway line from Batticaloa to Pottuvil

8.2.2 Proposed rail improvements

Some minor improvements have been considered to reduce travel times, limit delays and increase capacity.

As per today the network is single track except in area of Colombo where suburban trains are running. The table below shows status of maximum speed and number of tracks as per today and propose interventions to adding track by the year 2025.

In addition to the Colombo suburban program which includes already addition of tracks on main and coast line, the planned double tracking programme outside CMR would represent around 10 km on coast and northern lines.

Line		Distance KM - Colombo Fort	Speed limit (kmph)	Number of tracks (current)	Number of tracks (future)
Main Line	Maradana	1,9	100	Triple track	Quadruple track
Main Line	Ragama	15,546			
Main Line	Walpola	18,116	100	Double track	Triple track up to Veyangoda
Main Line	Mihirigama	50,27			
Main Line	Wilwatte	52,108	100	Double track	Double track
Main Line	Rambukkana	84,437			
Main Line	Kadigamuwa	90,239	32	Single track	Single track
Main Line	Kadugannawa	105,537			
Main Line	Pilimatalawa	109,446	40	Single track	Single track
Main Line	Peradeniya	114,851			
Main Line	Koshinna	117,36	64	Single track	Single track
Main Line	Gampola	126,931			
Main Line	Tembligala	130,873	40	Single track	Single track
Main Line	Nawalapitiya	141,522			
Main Line	Inguruoya	147,307	32	Single track	Single track
Main Line	Badulla	292,393			
Matale Line	Peradeniya	114,851	72	Single track	Single track
Matale Line	Kandy	120,737			
Matale Line	Mahaiyawa	122,402	32	Single track	Single track
Matale Line	Katugastota	126,285			
Matale Line	Udatalawinna	128,784	40	Single track	Single track
Matale Line	Matale	148,609			
Puttlam Line	Ragama	15,546	64	Single track (double track under construction)	Single track (double track under construction)
Puttlam Line	Negombo	38,85			
Puttlam Line	kattuwa	42,138	64	Single track	Single track
Puttlam Line	Chilaw	82,462			
Puttlam Line	Manuwangama	88,84	56	Single track	Single track
Puttlam Line	Bangadeniya	91,693			
Puttlam Line	Arachchikattuwa	96,18	72	Single track	Single track
Puttlam Line	Puttalam	135,119			
Nothern Line	Poplgahawela	73,827	56	Single track	Double track
Nothern Line	Potuhera	86,273			
Nothern Line	Nailiya	91,674	80	Single track	Double track
Nothern Line	Maho	138,585			
Nothern Line	Mihintale Junction	206,444	80	Single track	Single track
Nothern Line	Kankesanthurai	411			
Batticoloa Line	Maho	138,585	56	Single track	Single track
Batticoloa Line	Valachchenei	319,126			
Batticoloa Line	Kalkudah	322,037	80	Single track	Single track
Batticoloa Line	Batticaloa	349,692			
Trincomalee Line	Galoya Junction	226,676	64	Single track	Single track
Trincomalee Line	Kantale	256,381			
Trincomalee Line	Mollipatana	268,493	56	Single track	Single track
Trincomalee Line	Chinabey	290,306			
Trincomalee Line	Trincomalee	296,909	48	Single track	Single track
Coast Line	Fort	0	100	Double track	Triple track up to Panadura
Coast Line	Kaluthara South	41,857			
Coast Line	Katukurunda	44,667	100	Single track (double track under construction)	Double track
Coast Line	Payagala south	49,256			
Coast Line	Maggona	51,151	100	Single track	Double track
Coast Line	Galle	113,88			
Coast Line	Katugoda	118,269	72	Single track	Single track
Coast Line	Matara	156,813			
Coast Line	Beliatta	183	120	Single track	Single track
KV Line	Fort	0	32	Single track	Single track
KV Line	puwakpitiya	57,47			
KV Line	Avissawella	61,177	24		
Talaimannar Line	Cheddikulam	250,336	80	Single Track	Single Track
Talaimannar Line	Talaimannar	332,854			

Table 18: current and future number of tracks per section

8.3 Proposed train scheme

In order to estimate the potential for future intercity train services, it is proposed to assess the current capacity of bus services on similar origins/destinations. From Table 3 ("bus travel times and tariffs"), based on the average bus capacity defined in the table below, and an average train capacity of 500 seats, it is possible to "convert" the bus capacity into "potential train capacity".

Table 19: theoretical and observed bus capacity (number of seats)

Bus type	Standard	Semi Luxury	AC	Super Luxury
Theoretical bus capacity	54	54	35	60
Observed bus capacity	100	75	35	60

Although the full programme of infrastructure projects described above may not be implemented in a relatively long-term, some line extension or line upgrading are already on tracks. In this context, the transport services supply should adapt to the increasing capacity that is available. Following the transport study realised in this report, here is below a train scheme proposed for long distance train services:
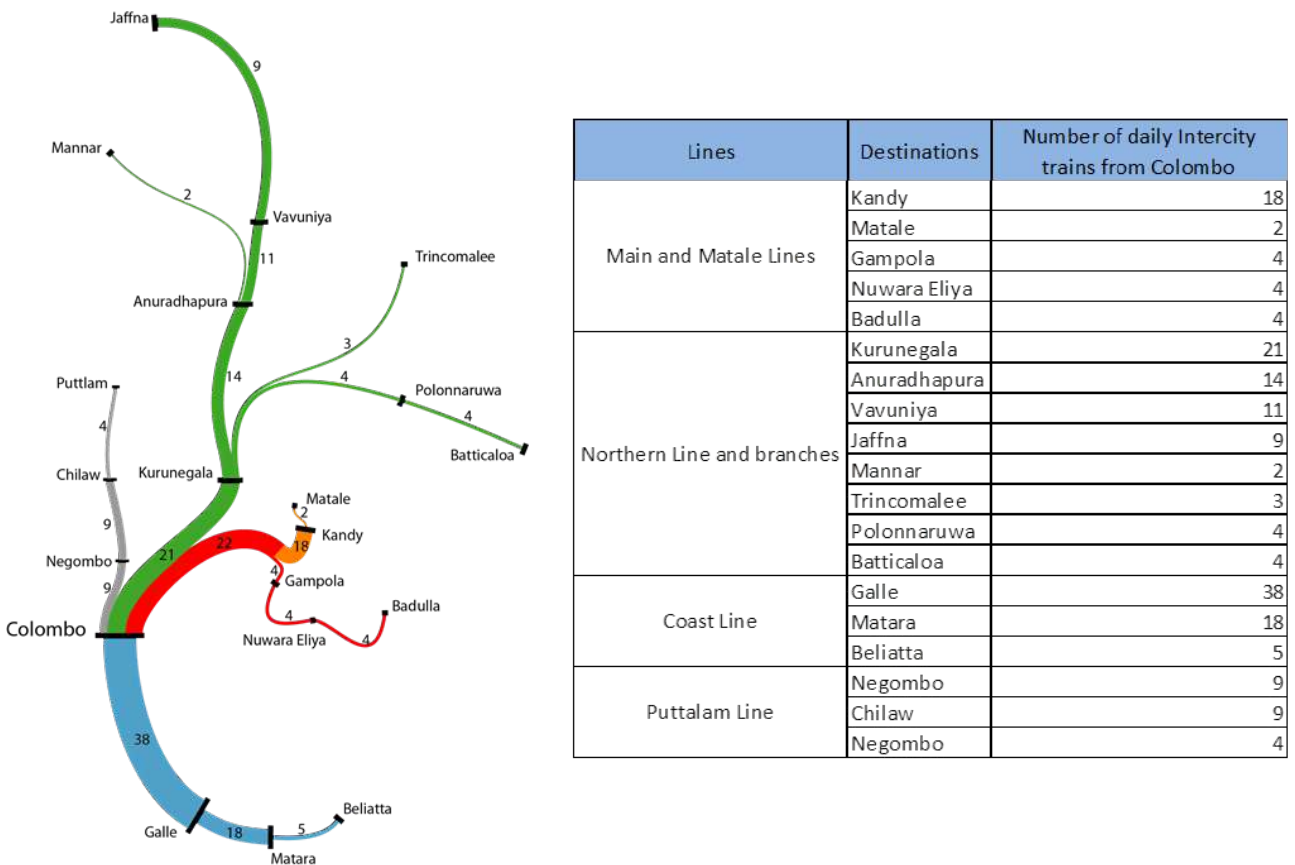

Lines	Destinations	Number of daily Intercity trains from Colombo
Main and Matale Lines	Kandy	18
	Matale	2
	Gampola	4
	Nuwara Eliya	4
	Badulla	4
Northern Line and branches	Kurunegala	21
	Anuradhapura	14
	Vavuniya	11
	Jaffna	9
	Mannar	2
	Trincomalee	3
	Polonnaruwa	4
	Batticaloa	4
Coast Line	Galle	38
	Matara	18
	Beliatta	5
Puttalam Line	Negombo	9
	Chilaw	9
	Negombo	4

Figure 37 : Proposed future Intercity train scheme (number of trains per day)

These services would be in addition to local train services.

For example, on the coast line, it is proposed to implement the new services in two steps, following the doubling of the tracks between Colombo and Panadura: first, 1 train per hour to Panadura, and finally up to 2 trains per hours (38 per day on the figure above) between Colombo and Galle when the doubling will be completed.

Based on the above, the resulting number of long distance train services during peak hours shall be:

- ❖ On coast line 2 trains per hour, going to Galle or further

- ❖ On main line 3 trains per hour going to either Puttalam line, Northern line or Main line

This would lead to reach 19 trains per peak hour on a 3-tracks line on Coast line and 25 trains per peak hour on Main line on a 4-tracks line.

Also the long distance timetable shall not be affected by peak hour commuter traffic, meaning that there shall not be a reduction of frequency during this period.

Only freight trains and local trains shall not use train paths during peak periods.

8.4 Type of trains

At the moment four main types of trains are running:

- ❖ ICE

- ❖ Express

- ❖ Long distance/Night trains

- ❖ Commuter

The wording commuter shall not be used for long distances services. It is proposed to associate also the name of the train to the nature of service pattern provided and the type of rolling stock. As a result the existing categories shall not be necessarily modified but their definition needs to be clarified.

Intercity (ICE)

These trains shall be DMUs running on relatively shorter distances (less than 200 km), with mandatory booking, and proposing 1st, 2nd and 3rd class with inclusion of a bar/cafeteria. Average speed shall be the highest of all trains with a limited number of stops. These would include typically trains to Kandy and Galle/Matara and eventually one train per day towards Jaffna, Batticaloa and Trincomalee.

Express trains

They would be similar to ICE in terms of service provided (1st, 2nd and 3rd class with inclusion of a bar/cafeteria) and average speed, but made of coaches trailed by a locomotive.Booking shall also be made mandatory.

Long distance trains

They are similar in terms of rolling stock but reduced speed, more stops and offering only 2nd and 3rd class with no obligation for booking.

Regional trains

Commuter shall be called regional trains and would include stops at almost each station. Only 2nd and 3rd class would be proposed, without prior mandatory booking.

Considering the need to restructure and improve/increase the supply of rail passenger services with appropriate rolling stock, investments will need to be performed in a rationalized way so to provide standardized the train characteristics by nature of train. Maximisation of the use of DMUs, together with improvements on the infrastructure (leading to increase speeds and reduction of delays) and good timetable shall allow to optimise the use of available rolling stock and the procurement of rolling stock. However some fleet renewal is to be performed so to provide better services and to improve the overall image of rail services.

8.5   Tariff policy

As per today 2nd and 3rd class services are loss making, while 1st is breaking even. Prices are set and do not vary depending on the period or type of train. Therefore the overall pricing strategy is to be redefined.

It is proposed to adjust tariffs of train services ticket to competition (especially buses) and demand levels. Whenever a need to operate certain services with so called "social tariffs", it is proposed to develop the Public Service Obligations concept. It is proposed to keep some trains (commuter or local/slow trains) with reduced fares third class seats. The first measure is to converge to bus ticket prices, especially for 2nd class and 1st class. The objective is to maximise the passenger ticket revenues for Sri Lankan Railways, given the significant gap between train and bus tariffs observed today. Indeed, from the transport supply analysis done in the report, it can be noticed that while train services have competitive travel times, tariffs are 1.3 to 1.4 lower than bus ones. In the context of the service scheme proposed above, with more frequent and regular train services, it would be reasonable to increase these ticket prices. That would lead for instance to increase 2nd class train ticket prices to the same level as bus ticket prices of similar class (Semi-Luxury), and to have 1st class train tickets 20% more expensive than AC bus or Super Luxury bus tickets. These proposals have been tested through the traffic model, without significant impact on the train traffic.

It is proposed also to develop yield management in order to adjust prices to the level of demand. This would be done only on trains where reservation is mandatory.

8.6   IT, passenger information systems and ticketing

Modern ticketing and booking systems are to be developed so to accompany the improvement of rail long distance services. Passenger information systems in stations and through internet will need to be also further developed.

8.7   Multimodality

Improvement in multimodality are needed. Recommendations are going into three directions:

- ❖ Improvement of stations
- ❖ Fare integration
- ❖ Coordination of timetabling

8.7.1 Improvement of stations

Improved access for passengers from their starting and ending point to railway stations is a key measure to increase the use of rail services, where bus services tend to stop in a high number of location. This means to organize spaces next to the rail station for different types of vehicles to either park, stop and/or collect passengers. This concerns especially buses, Tuk Tuk and private

cars. In Colombo, by 2025 and 2035, when RTS lines are put into operation, easy physical connection between the 2 modes is to be implemented.

Potential improvements in the station vicinity and development of railway stations with related facilities are to be considered, consider aspects of urban development in the station area.

8.7.2 Fare integration

The first issue that can be solved easily relates to charging long distance services and local rail services to access to main stations. While tariffs should be increased, it is proposed for trains requiring a seat reservation to include in the price (without additional charging) the access to the main train station from the initial station of departure/to the station of final destination. This would have a limited cost and shall foster the use of long distance services and justify/facilitate the reduction of stopping stations.

The second aspect relates to fare integration between modes. This can be achieved through negotiation with bus operators, especially the CTB buses.

8.7.3 Coordination of timetabling

An integrated timetabling is to be implemented between different nature of rail services (local and commuter trains with long distance) and between rail and bus (especially but not limited to normal buses). This means also that development of intermodal rail stations whereas long distance and local buses should stop are to be developed especially on main stations with appropriate information

9   CONCLUSION

Considering current and potential competitiveness of rail services, a significant growth of number of non-suburban trains is expected. On the basis of traffic forecasts carried out, the resulting number of long distance trains would not exceed 3 trains per hour on main line and two on coast line. With the envisaged number of suburban trains running at peak hours together with the proposed addition of tracks, the capacity proposed is enough to cater these trains. However the current scheme with both Maradana and Fort accommodating long distance trains would need to be considered so to avoid creating bottlenecks in these 2 stations due to insufficient number of tracks/platforms. One recommendation would be to use the same track and platform for DMU going north and south and therefore, whenever necessary, to extend platform length. Within that frame, the creation of a new central station merging both Maradana and Fort should be analysed in further details.