CHAPTER 1

GENERAL

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1.1 Introduction

Over the past two decades, the sectorial development policy of the Government of Sri Lanka has been to rehabilitate its existing road and rail infrastructure. During this period, only rehabilitation work was undertaken to improve the transportation system, via the execution of a number of road rehabilitation and improvement projects. However, traffic demand has been increasing very rapidly during the past decade and there is a shortage of road capacity to meet the rising demand and proposed development plan. Hence, the Government of Sri Lanka has decided to implement a policy to develop a system of new highways to supplement existing road capacity. These new highways have been identified by the Road Development Authority (RDA) and pre-feasibility and feasibility studies have been carried out with the aim of executing some appropriate projects.

In response to a request from the Government of Sri Lanka, the Government of Japan has decided to implement one of these projects, i.e., "The Feasibility Study on Outer Circular Highway to the City of Colombo" (hereinafter referred to as the Study). The provision of an outer circular road to the City of Colombo is a long felt need and earnest wish for the Government of Sri Lanka. The Colombo Master Plan Project Team formulated a structure plan for the Colombo Metropolitan Region in 1978 envisaging an orderly restructuring of the region. The Outer Circular Highway is to be found in the 1991 proposal of the RDA to conduct pre-feasibility study and the pre-feasibility study was completed in October, 1993 by a local firm, Consulting Engineering & Architects Associated.

Accordingly, the Japan International Cooperation Agency (JICA), the official agency responsible for the implementation of the technical cooperation programs of Japan, undertakes the Study, in close cooperation with the authorities concerned in Sri Lanka and commenced the Study in November, 1998.

1.2 Background

The present supply of transportation facilities and services is inadequate to meet the continuing increases in traffic demand especially in the Western Province (hereon referred to as the Colombo Metropolitan Region or CMR). Hence, there is an urgent need to increase

this supply. That is, as a result of inadequate road network and road capacity, traffic congestion and low travel speeds have become chronic.

One of the problems facing the CMR is the lack of an orbital or outer ring road. Many of the current radial roads are already congested and are operating at capacity. Therefore, the present road network is incapable of dealing with any future increase in travel demand. The purpose of such a road in the CMR is to encourage the development of current or future growth centers, to connect radial routes, and lastly to divert through traffic from the center of the city. That is , the eastern part of the Colombo is already saturated and the Urban Development Authority (UDA) wishes to shift some of the city's core urban functions and population to the outer suburbs in order to reduce congestion and to control urban sprawl.

Although ongoing improvement of the Baseline Road will divert intra-regional trips from going through the center of Colombo, all the other road improvement schemes would funnel more traffic into already congested core of the CMR.

Moreover, none of these schemes would connect the radial routes or connect the present and future growth centers that the RDA envisions in CMR. These two points are crucial if CMR is to solve its problem of congestion, sprawl, increasing transportation cost, raising automobile emissions, etc, that occur with a uni-core city.

Given this background, an outer circular highway (hereinafter referred to as the Outer Circular Highway) has been identified and proposed as one of these new roads for solving the problems. That is, this highway would reduce traffic congestion by providing an effective bypass for north-south bound traffic, as well as by reducing the amount of through traffic that occurs from inter-corridor travel via the improvement of the interconnectivity between the present system of radial trunk roads. Moreover, this highway would disperse and encourage development away from the highly densely populated urban areas of the City of Colombo; thereby, achieving a better balance for growth.

1.3 Objective

The objective of the Study is to examine the feasibility of constructing the Outer Circular Highway for the City of Colombo with the target years of 2010 and 2020.

The Outer Circular Highway, which will be located approximately 20km away the City of Colombo, has been selected in order to efficiently cater to increasing traffic demand, to

minimize traffic congestion on existing trunk roads radiating from the city, and to encourage regional development and a better balance in urban growth. The Outer Circular Road will connect the trunk routes of Colombo-Galle-Hambantota-Wellawaya (A2) at Panadura, Colombo-Ratnapura-Wellawaya-Batticaloa (A4) in between Kottawa and Homagama, Colombo-Hanwella Low Level Road (A110) at Kaduwela, Colombo-Kandy Road (A1) at Kadawata, Peliyagoda-Puttalam Road (A3) at Welisara and the proposed new highways of Colombo-Katunayake Expressway and Southern Transport Corridor.

1.4 Study Area

The Study area consists of the Colombo Metropolitan Region(CMR), which is representative of the Western Province and is made up of the three administrative districts of Gampaha, Colombo, and Kalutara. In respect to the Outer Circular Highway itself, road trace alternatives has been confined to a belt 10 km in width and approximately 50 km in length.

1.5 Scope of the Study

In order to achieve the objective and goals mentioned in the previous clause, the Study covers the work items as agreed upon in the Scope of Work and the related Minutes of Meeting duly signed on 25 June 1998, by the Ministry of Transport and Highways, the RDA, and the Ministry of Finance of the Sri Lankan Government and the resident representative of JICA.

This clause sets forth in detail the contents of this scope, which in turn defines the work and operational parameters of the Study.

1) Review and Analysis of the Present Situation
   (1) Observation of transportation facilities
   (2) Collection and analysis of traffic data
   (3) Collection and analysis of available natural environment data
   (4) Collection and review of present and future urban and industrial development plans
   (5) Collection and review of socioeconomic data and information
2) Execution of Traffic Forecast
   (1) Execution of supplementary traffic surveys
   (2) Drawing up of socioeconomic framework
   (3) Forecasting of future traffic demand

3) Execution of IEE (Initial Environmental Examination) for Road Planning
4) Execution of topographic and aerial photograph survey
5) Determination of the Basic Development Policy for the Outer Circular Highway
   (1) Determination of the regional development policy and road network
   (2) Determination of the basic concept for the Outer Circular Highway
   (3) Determination of the problems and matters concomitant with the Outer Circular Highway.
6) Execution of Road Planning
   (1) Determination of control points
   (2) Determination of design criteria
   (3) Determination of road trace
7) Execution of Detailed Natural Condition Surveys
   (1) Boring survey
   (2) Soil survey
   (3) Hydrological survey
8) Execution of Preliminary Engineering Design
   (1) Determination of road alignment around control points
   (2) Drawing up of designs for road cross sections, structures, and facilities
   (3) Drawing up of designs for bridges
   (4) Drawing up of designs for environmental preservation
   (5) Determination of construction method
9) Execution of EIA (Environmental Impact Assessment)
10) Drawing up of Recommendations for Maintenance and Operation
   (1) Determination of maintenance and operational organization and activities
   (2) Determination of necessary staff and materials for maintenance and operation
   (3) Determination of maintenance and operational cost estimates
11) Drawing up of Quantity and Cost Estimate
12) Drawing up of Project Implementation Scheme
13) Execution of Economic and Financial Analysis
14) Execution of Overall Evaluation and Recommendations for the Project

The Study approach and the detailed description of each of the above-mentioned work items are contained in the following clause. As for the work of the Study, it is divided into missions to Sri Lanka and work carried out in Japan. The work flow of the Study is as shown in Fig.1.1 on the following page.

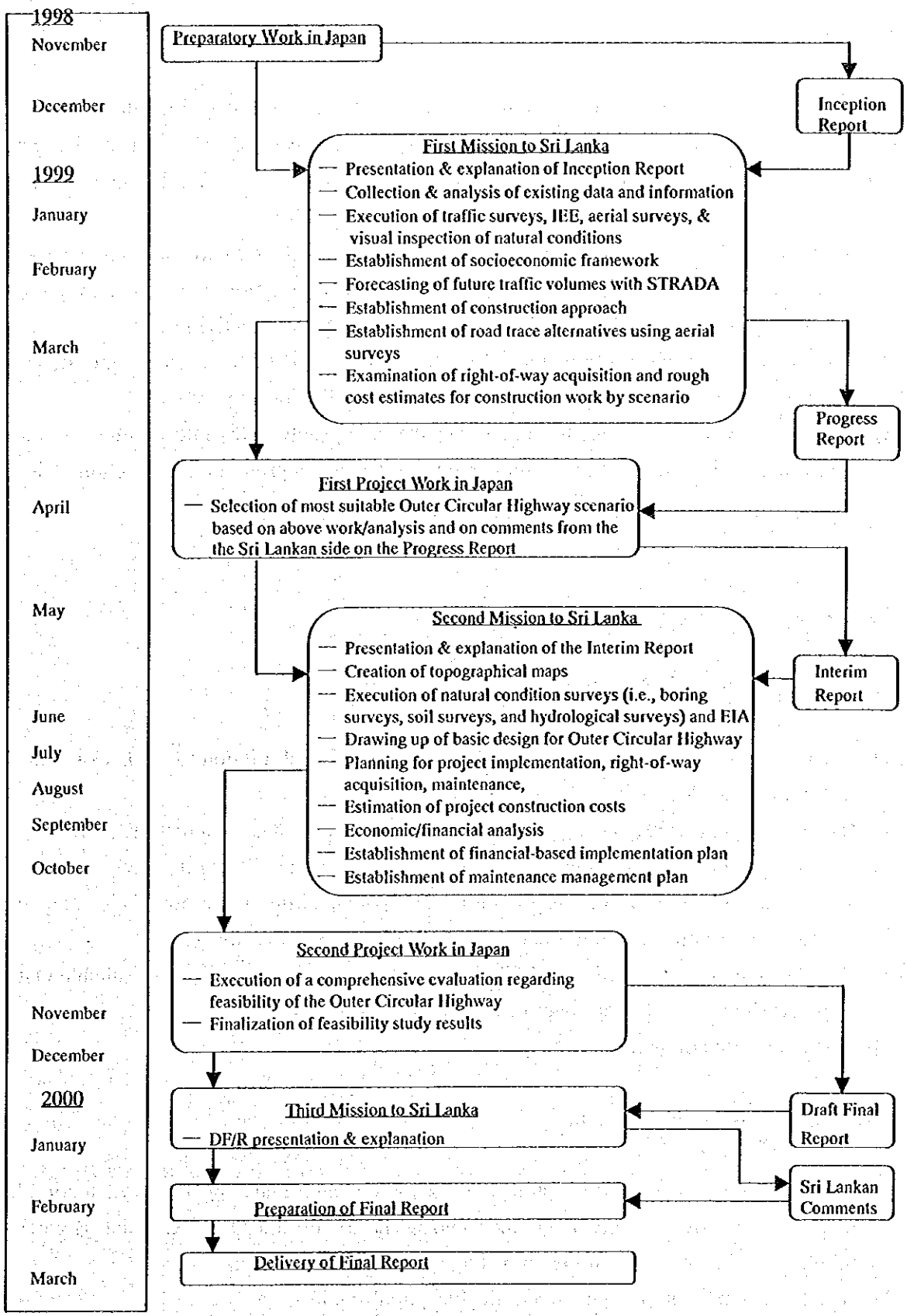

Fig.1.1 Study Flow

1.6 Study Approach

The Study has been executed in accordance with the scope of work described in the previous clause. The major focus of the Study is to select the most feasible alignment for the Outer Circular Highway for the City of Colombo taking into account socioeconomic, environmental, and technical impacts. The basic approach of the Study is as follows:

1) To select the most suitable road trace and scenario for the Outer Circular Highway based on an analysis of existing data/information and data/information gathered from surveys concerning social, transportation, environmental, and technical activities.
2) To maximize the feasibility of the selected road trace and scenario via a more detailed analysis and design regimen, taking all of the above activities into account.
3) To provide a realistic implementation plan that adequately takes into account the local construction market, lifecycle costing, maintenance, and appropriate construction phasing and work packaging.

1.7 Study Implementation Plan

1.7.1 Preparatory Work in Japan

The preparatory work in Japan prior to the departure of the first mission to Sri Lanka focuses on the following work items:

1) The collection, review, and analyses of related information, data, and materials.
2) The development of a Study plan and/or approach that will clarify such aspects as organizational policy, survey/inspection methodology and timing, resource allocation and scheduling, existing constraints and assumptions, report submission, etc.
3) The development of a plan that clarifies the steps for determining the most suitable Outer Circular Highway road trace and scenario and its feasibility.
4) The preparation of an inception report.

1.7.2 First Mission to Sri Lanka

The first mission, which has the purpose of gathering and analyzing data to support the selection of the most suitable road trace and scenario for the Outer Circular Highway, concentrates on the execution of the following work items:

1) The Presentation and Explanation of the Inception Report
   A detailed explanation will be given to the Sri Lankan side detailing the scope of work,

the study approach, the work items, the techniques, methodologies, timing, etc., of the Study.

2) The Collection and Analysis of Existing Data and Information

Available data, information, reports, plans, maps, and photographs (including aerial photographs) relevant to the Study shall be collected, reviewed, and analyzed. Data shall include, but not be limited to, the following:

- Socioeconomic and traffic data
- Urban and transportation development plans
- Existing road inventory
- Geographic and topographic data
- Environmental impact assessment data
- Data/information on the natural conditions
- Detail of the project financed by ADB

3) The Execution of Traffic Surveys

Traffic surveys shall be executed in order to collect data that assist in the understanding of traffic demand in the City of Colombo and include, but not necessarily be limited to, the collection of the following information:

- Traffic volume data
- Travel speed data
- Turning movement data at major intersections
- Roadside origin-destination data

4) The Execution of an IEE

An IEE shall be executed to provide a broad-brush method for determining the environmental impacts for the different road traces for the Outer Circular Highway using easily available information.

5) The Execution of Aerial Surveys

Aerial surveys to facilitate the analysis of the road traces for the Outer Circular Highway shall be executed at a scale of 1/20,000 and shall cover a 10 km area that encompasses the road traces over a distance of approximately 50 km in length.

6) Visual Inspection of Natural Conditions

A visual inspection of the natural conditions of the Study area (especially the area of the Outer Circular Highway) shall be carried out in order to assist in determining the environmental approach to the construction of this structure.

7) The Establishment of a Socioeconomic Framework
A socioeconomic framework will be established using data such as population, income, car ownership, economic growth, urban planning data (e.g., land-use data), etc., with the target years of 2010 and 2020.

8) The Forecasting of Traffic Demand
Traffic demand is to be forecasted using the JICA STRADA model for the target years of 2010 and 2020.

9) The Establishment of a Construction Approach for the Outer Circular Highway
Based on the traffic demand forecasts, the determination of control points, and establishment of a socioeconomic framework, the most appropriate approach for constructing the Outer Circular Highway is to be examined, taking into consideration the surrounding road network for the target years of 2010 and 2020, the traffic functions of the Outer Circular Road (e.g., access/egress points, whether or not it should be a toll way), road geometry, and design standards.

10) Establishment of Road Trace Alternatives Using Aerial Surveys
The alternative road traces that are to be examined and analyzed shall be established using the data from the aerial surveys.

11) Examination of Right-of-Way Acquisition
The acquisition of right-of-way shall be examined by taking into consideration the required amount of right-of-way for each of the road traces, the appropriate method of acquisition, compensation, and alleviation countermeasures.

12) Rough Estimate of Project Construction Costs
A rough estimate of the construction costs for each of the road traces shall be carried out based on local market factors, and the costs shall be broken down into foreign and domestic costs .

13) The Preparation and Presentation of a Progress Report
A progress report is to be prepared and presented to the Sri Lankan side prior to the Study Team returning to Japan in March. This report will describe what the Study Team has accomplished and what its schedule for upcoming work is. In addition, this report shall contain a synopsis of outstanding issues and current Study results.

1.7.3 First Project Work in Japan

The first project work in Japan is to focus on selecting the most suitable road trace for the Outer Circular Highway via an examination of the socioeconomic, environmental, and technical issues. Based on this, an interim report has been prepared.

1.7.4 Second Mission to Sri Lanka

The main work items of the second mission, which has the main function of maximizing the feasibility of the selected road trace for the Outer Circular Highway, are as follows:

1) The Presentation and Explanation of the Interim Report
   The Interim Report is to be presented and explained to the Sri Lankan side soon after the Study Team's arrival back in Sri Lanka from their first project work in Japan. The explanation focuses on the logic and grounds concerning the selection of the most suitable road trace.

2) Creation of Topographical Maps
   Detailed topographic maps of all the possible road alignments for the selected road trace at a scale of 1/5,000 with 5m interval contour line (area: approx. 40km×1km) are to be drawn up. Moreover, topographic maps of locations where intersections and elevated structures are located are to be drawn up at a scale of 1/2,000, with each location covering an area approximately equivalent to $1km^2$.

3) Execution of Detailed Natural Condition Surveys
   Detailed natural condition surveys (i.e., boring, soil, and hydrological surveys) are to be executed along the selected road trace in order to ensure the accuracy of the basic design of the Outer Circular Highway.

   The boring survey is to be carried out at 5 locations where the proposed road is to intersect with national highways (1 sample per location) , at 2 land and 2 water locations where it crosses a river (2 river crossings), and at 1 swampy location (2 samples).

   The soil surveys shall carry out unconfined compression test, natural moisture content test, specific gravity test, grain size analysis test and CBR test.

   The hydrological surveys is to focus on the two rivers that the Outer Circular Highway will cross (i.e., the Kelani and Bolgoda rivers) and on their water levels during the dry and wet seasons and their discharges.

4) Execution of EIA

The EIA shall forecast and evaluate the environmental impacts produced during the construction and after the construction of the proposed Outer Circular Highway, based on the results of the IEE and social and environmental surveys. In addition, the EIA shall propose methods to alleviate the influence of impacts and what monitoring may be required during and after construction.

5) Drawing up a Design for the Outer Circular Highway

Based on an examination of the local construction and contractor market, an appropriate phased construction plan is to be drawn up, taking into account the procurement of labor and materials, the selection of construction machinery, construction method, and appropriate construction work scheduling.

6) Planning for Project Implementation, Right-of-way Acquisition, and Maintenance

An appropriate implementation plan is to be drawn up by taking into account the economic/financial effects of such items as construction phasing, cost-efficient work packaging, etc.

An integral part of implementing the project is acquiring the required right-of-way. This is to be achieved by considering revenue-raising schemes, strategic scheduling, compensation, and countermeasures to alleviate adverse impacts, as well as the results of the IEE and EIA, etc.

Finally, even with the implementation of the project, it necessary to consider its aftercare for it to be a success. That is, the concept of lifecycle cost should be taken into consideration when designing the Outer Circular Highway and the costs of maintenance calculated.

7) Estimation of Project Costs

Project costs is to be estimated by taking into consideration the unit costs of labor and materials, which also take into account the sources of procurement, the skill levels of the different types of labor. The costs are to be broken down into a domestic and foreign cost component.

8) Economic/Financial Analysis

An economic and financial analysis, which include a sensitivity analysis to test the effect of different project variables, is to be carried out as one of the crucial factors to test the

feasibility of the project.

The economic analysis is to use the concepts of cash flow, internal rate of return, net present value, and benefit/cost ratio to calculate the benefits and costs that will accrue to society.

The financial analysis will use the concepts of financial worthiness, business prospects, capital flow problems, etc., to calculate the benefits and costs of the project to the owner and or operator. In the case of the Outer Circular Highway being a toll way, the setting of the toll, toll collection methods, etc., should be examined.

9) Establishment of Financial-based Implementation Plan
A feasible implementation plan shall be drawn up taking into consideration the financial capabilities of the project, its appropriate phasing, and the most cost-effective work packaging and work item breakdown.

10) Establishment of Maintenance Plan
A maintenance plan shall be drawn up for the Outer Circular Highway and for facilities such as the road surface, road structures, and relevant ancillary structures. Based on the above plan in 9), a cost-effective maintenance method is to be established and annual maintenance costs calculated for the life span of the Outer Circular Highway.

1.7.5 Second Project Work in Japan

The second project work in Japan consistes of finalizing the results of the project surveys, inspections, analyses, etc., and to execute a comprehensive evaluation of the most suitable alignment for the Outer Circular Highway from a socioeconomic, environmental, and technical viewpoint. Based on this, a draft final report is to be drawn up.

1.7.6 DF/R Explanation Mission to Sri Lanka

The contents of the Draft Final Report shall be explained to the Sri Lankan side in Colombo that facilitate the most effective distribution of this information.

1.7.7 Final Report Preparation Work in Japan

RDA shall provide JICA with its comments within one month after the receipt of the Draft Final Report. The Final Report is to be submitted within two months after the receipt of the

comments from the Sri Lankan side.

1.7.8 Study Organization

The Study shall be carried out jointly by RDA and the Study Team, with guidance to be provided by a JICA advisory committee. The relationship among these institutions is as shown in Fig.1.2 below.

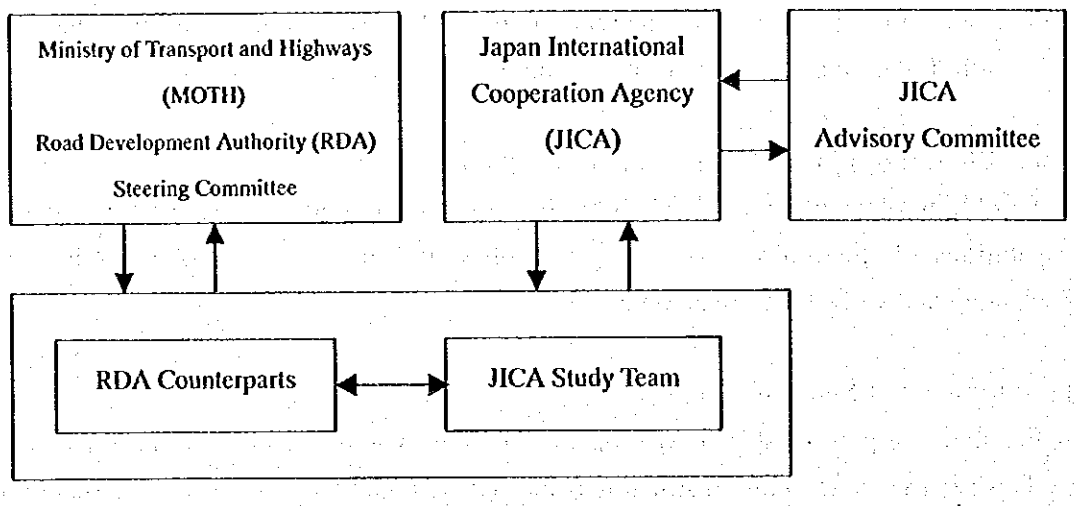

Fig.1.2 Study Organization

1.7.9 Report Submission

The Study Team shall prepare and submit the reports listed below in English to the Sri Lankan Road Development Authority, Ministry of Transport and Highways (RDA). The submission schedule of the reports, together with the individual member assignments of the Study Team, is indicated in Fig.3.

1) Inception Report
   Thirty (30) copies in English.
   This report is to be submitted at the commencement of the Study and is to describe the overall approach and implementation program of the Study.
2) Progress Report
   Twenty (20) copies in English.
   This report is to be submitted by the middle of March 1999, and it will contain mostly the results of the reviews and analyses of data and information collected regarding the present condition of the Study area.
3) Interim Report
   Thirty (30) copies in English.

This report shall be submitted by the end of May 1999, and it shall describe the selection process, as well as the results of that process, for choosing the most suitable alignment for the Outer Circular Highway.

4) Draft Final Report

Thirty (30) copies each of the Draft Final Report and its Executive Summary in English.

This report and its summary shall be submitted by the end of January 2000; and, based on the results of the IEE and EIA, the implementation scheme, traffic forecasts, the securing of right-of-way, etc., it contains an economic/financial analysis indicating the feasibility of the most suitable alignment for the Outer Circular Highway, together with recommendations.

5) Final Report

Sixty (60) copies each of the Final Report and its Executive Summary in English.

This report and its summary shall be submitted by the end of March 2000, and it takes into consideration the comments of the Sri Lankan side concerning the Draft Final Report month after the receipt of the written comments on the Draft Final Report from Sri Lanka.

CHAPTER 2

PRESENT SITUATION

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2.1 Natural Conditions

2.1 1 Topography

The main island of Sri Lanka has a maximum length of 435 kilometers in the north-south direction and a maximum width of 240 kilometers in the east-west direction. The land area is 65,525 square kilometers. From sea level, the relief appears to ascend more or less in steps of three peneplains to a maximum elevation of over 2500 meters at Pidurutalagala.

The project area traverses across different types of land topography, which consists of flood plains, hilly terrain, wetlands and flat areas of raised beaches.

Along the proposal route undulating hilly terrain or isolated round hill, consisting of precambrian rocks and its residual soil, rise to about 10 to 50m above the mean sea level (MSL). Intermittently, the valleys are situated between the hills. The valleys are filled with alluvial materials originating from the flood plains of adjacent rivers. Therefore, the low lands between hills are generally flat. Paddy has been cultivated in some of the valleys, particularly those at a higher elevation (more than about 2 to 3m above the mean sea level (MSL). Low-lying valleys (less than 2 to 3m above the MSL) in Welisara, Weliwita and around Bolgoda river consists of marshes.

2.1.2 Climate and Hydrology

The climate of Sri Lanka is characterized by tropical - monsoon with a marked seasonal rhythm of rainfall. The tropical condition is due to her location between latitudes 6° and 10° north of the equator. The monsoonal conditions refer to two seasonal wind regimes separated by two periods of light and variable winds. The two monsoon periods, Southwest Monsoon (SW, May - September) and Northeast Monsoon (NE, December - February) and the two intermonsoon periods, First Intermonsoon(1st IM, March - April) and Second Intermonsoon(2nd IM, October - November), control the rainfall rhythm. The project (Colombo) area receives an annual rain fall of 2,400 mm, consisting of 350 mm during the 1st IM period, 1050 mm during SW period, 700 mm during 2nd IM period and 300mm during NE period

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The project area has a mean temperature of 26℃ during October to February and 28℃ during the warmer months of March to September. The daily temperature rises to a

maximum (30 - 32℃) on the average early in the afternoon and falls to a minimum (22 - 26℃) shortly before dawn. The relative humidity varies from 70% during day to 90% at night. During IM period, the hottest season of the year, the relative humidity remains high.

Excessive rainfall with bursts of intense rain within short intervals is the main cause of floods. Such events are generally associated with cyclone wind circulation in the low and mid troposphere and also with areas of low pressure, depressions and cyclones. Of the 103 river basins, Kelani, Kalu, Gin, Nilwala and Mahaweli experience floods almost annually and about 200,000 people are affected each year. In June 1989 Kalu, Kelani and Gin rivers over flowed their banks by high rainfall, and the lower catchment areas suffered flash floods. Several earth slips occurred in the Kegalle distinct. It was reported that 300 people died and 15,000 houses were damaged. The major floods of May and December of 1982 and June and July of 1984 were disastrous to many areas. The number of families affected in 1982 was 129,469 and the expenditure for relief measures was Rs 14 million while in 1984 Rs 49 million was spent on 297,237 families.

Flooding of Kelani Ganga is important as it affects the city of Colombo. Major floods have occurred in October 1913, May 1927, May 1939, May 1940, August 1947, October 1966, October 1967, July 1989 and June 1992. Minor floods occur almost every year. Many parts of the City of Colombo were submerged on June 5th 1992 when 494 mm of rain full occurred in 24 hours.

Frequent blockages in the drainage canals that carry away rainy water worsen the flood situation in Colombo. Flood protection works in the Kelani Ganga go back to the Dutch period in the 18th century when a small protection bund on the left bank was constructed. A canal system was also constructed for the dual purpose of transport of goods and for drainage of water from the flood plains. The existing flood protection bund was constructed in 1930 by the British. Recently steps have been taken to control floods in Gin Ganga and Nilwala Ganga with protection schemes. The Department of Irrigation with the co-operation of the World Meteorological Organization installed a realtime flood forecasting system for Kelani Ganga as a pilot project. The maximum flood peaks in some river are shown in Tab.2.1.

Tab.2.1 Maximum Recorded Flood Peaks in Some Rivers

Name of River	Catchment Area (sq. km)	Flood Peak (cu.m/sec)	Date of Floods	Observation Period	Station
Kelani Ganga	1463	6808	1989-6-4	1948/96	Glencourse
Kalu Ganga	2597	2829	1942-8-16	1944/96	Putupaula
Gin Ganga	681	1387	1940-5-18	1928/96	Agaliya
Nilwala Ganga	411	2500	1940-5-16	1940/96	Bopagoda

Source: Dep. of Irrigation, Hydrology Division

2.1.3 Geology

Most of part of Sri Lanka is underlain by crystalline rock of Precambrian era, and the rests are made up of Miocene limestone in the north and northwestern coastal regions and of Quaternary deposits along the north western, southern and eastern coastal regions. The Precambrian rocks are very ancient and stable parts of the earth's crust. These are subdivided into three main and one subordinate units or complex, on the basis of the rock types and structures. They are i)the Highland Complex (HC), ii)the Wanni Complex (WC), iii)the Vijayan Complex (VC), iv)the Kadugannawa Complex (KC) (see Tab. 2.2 & Fig. 2.1).

Tab. 2.2 Principal Geological Formations Present Sri Lanka

(Time range shown in millions of years, m.y.)

	ERA	SYSTEM	EPOCH	FORMATION
PHANERAZOIC	CENOZOIC 65 m.y.	QUARTERNARY 1.8 m.y.	Recent Pleistocene 1.8 m.y.	Younger Group - coral reef, alluvium, lagoonal and estuarine clays, beach and dune sands, beachrock Older Group - Red Beds, Terrace Gravels, Older Alluvium, Ferruginous Gravel; Ratnapura Beds
		TERTIARY 65 m.y.	Miocene 24 m.y.	Vanathivillu Limestone; Manner Sandstone, Minihagalkanda Beds
	MESOZOIC 248 m.y.	CRETACEOUS 142 m.y.		Dolerite dykes
		JURASSIC 205 m.y.		Tabbowa Beds; Andigama - Pallegama Beds
PRECAMBRIAN 3800 m.y.	PROTEROZOIC 2500 m.y.			Tonigala and other granites and associated migmatates WANNI COMPLEX - granodioritic to granitic migmatites, granitoid rocks, charnockitic gneisses, rare metasediments VIJAYAN COMPLEX - Granitic gneisses, granitoid rocks, migmatites, tonalitic to leucogranitic; minor metaquartzites and calc-silicate rocks KADUGANNAWA COMPLEX - Kataragama and Maligawila complexes - biltite-hornblende and biotite gneisses, amphibolites HIGHLAND COMPLEX - Kataragama and Maligawila comples - granulite facies metasediments, quartzofeldspathic and charnokitic gneisses
	ARCHAEAN 3800 m.y.			? Basement rock, not seen

Source from ARJUNA's Atlas of Sri Lanka (1997), Page.8

The project area is located in the Wanni Complex (WC) and its boundary to Highland Complex(HC). The WC consists of scattered relics of a metasedimentary series in a suite of complexly folded, hornblende-bearing gneisses and migmatitic (mixed) rocks. These were intruded by a late, microcline-bearing, pink, potassium-rich granite, the Tonigala Granite, together with the surrounding pink, granitic migmatites, which are younger than 1100 m.y. A large extent of charnockitoid terrain, known informally as the "Vavuniya granulites", is present in the northern part of the WC. Preliminary data suggest that the WC rocks are 1000 to 1100 m.y. old.

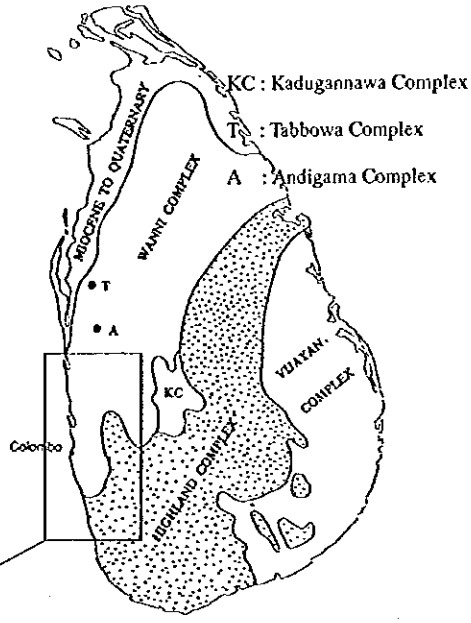

Fig. 2.1 Simplified geological map of Sri Lanka, showing main lithotectonic units *

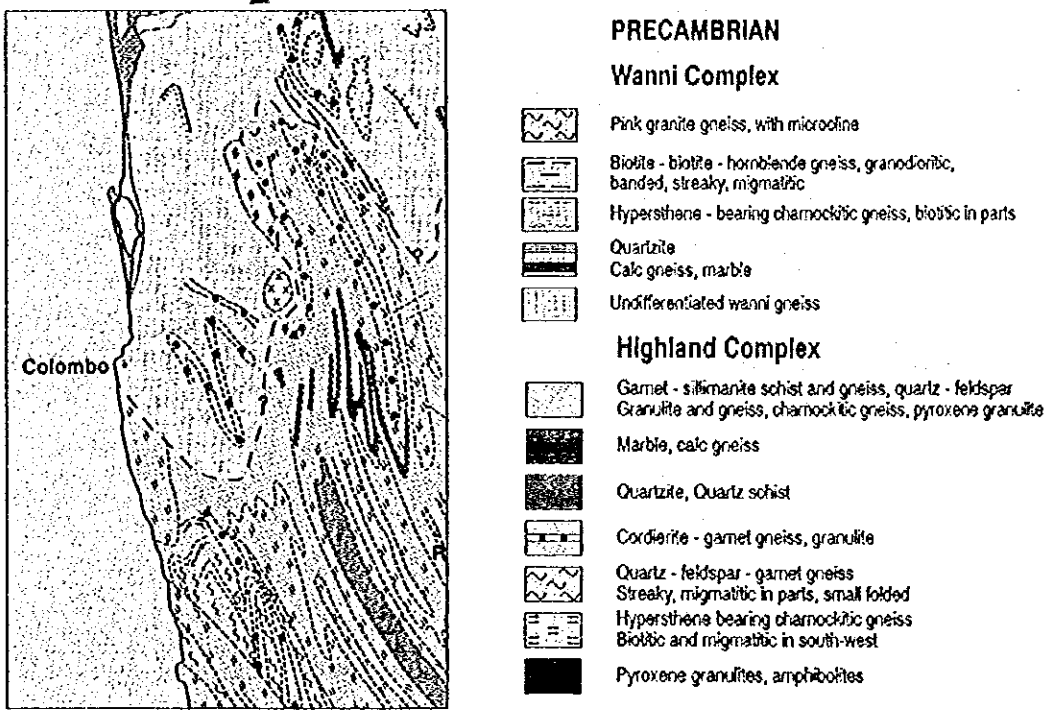

Fig. 2.2 Geological map around Colombo , Sri Lanka *

*) Source from ARJUNA's Atlas of Sri Lanka (1997), Page.8 & 9

The WC rocks are of lower metamorphic grade than those of the HC, but there is no clear structural break between the two units, although several N-S zones of shearing are present between them. There is as yet no conclusive evidence for either the nature or the position of the WC/HC boundary. The WC is structurally the highest Precambrian unit. And its lower, more basic, levels may be intrusive into HC.

Earthquakes

The country is located outside the global earthquake belts and land is considered to be of low seismicity. But it was recorded that in 1614 an earthquake caused 200 houses to collapse in Colombo Fort. Many deaths was reported (National Achieve Report). Since then, from 1614 to 1995, about 60 shocks had been physically felt. The latest to be recorded was on December 6th 1993 when the shock was felt throughout the country. The epicenter was 170 km west of Colombo. Other notable earthquakes were in August 30, 1973 and September 10, 1988.

References

1. Dharmasena G.D.(1995) Hydrological Annual, 1994/95, Hydrology Division, Irrigation Department, Colombo
2. Cooray P.G.(1984) Geology of Sri Lanka National Museum, Colombo
3. Dharmasena G.T.(1996) Flood in Sri Lanka - Communication to Chief Editor
4. Department of Social Services(1995) Statistics on Disaster Events in Sri Lanka
5. Survey Department, (1988) National Atlas of Sri Lanka, Colombo
6. Arjuna Consulting Co Ltds. (1997) Atlas of Sri Lanka, Dehiwala, Sri Lanka

2.2 Socio-Economic Characteristics

2.2.1 Administrative Structure of Colombo Metropolitan Region (CMR)

Sri Lanka consists of nine Provinces, which are Western, Central, Southern, Northern, Eastern, North Eastern, North Central, UVA and Sabaragamuwa. Western Province, which consists of Colombo, Gampaha and Kalutara Districts, is regarded as Colombo Metropolitan Region (CMR).

Each District, in turn, consists of some Divisional Secretariat Division (DS Division). The Fig. 2.3 shows the Administrative Structure of the CMR. As showed in the figure, there are 32 DS Divisions in the CMR, among which 14 DS Divisions fall within the Study Area. Fig. 2.4 shows the location of DS Divisions and the Study Area.

2.2.2 International and National Socio-Economic Context of the CMR

1) **International Context**

A great number of populations of Sri Lanka concentrate in the CMR. According to UDA, the population of the CMR in 1994 accounted for 26% of the total population of the country. The City of Colombo, in particular, plays a major role in terms of economic, administrative and social aspects in Sri Lanka.

In international context, the CMR plays various important roles. As an international shipping center, the Colombo Port has a significant role in terms of meeting the demand for container traffic, both trans-shipment and imports and exports of goods. According to statistics for 1997, Colombo Port recorded 1.5 Mn TEUs with an increase of 38% within a single year (UDA, 1998).

On the other hand, since 1977, the CMR has turned into an international investment center. Due to the open economy policy, in which the Government had created an attractive business environment for both foreign and local investors through tax, tariff, trade an fiscal reforms together with other facilities and incentives, the CMR attracted 73.7% of the total enterprises in the country by the end of 1995 (UDA, 1998).

The CMR is also important as a tourist center, which catered for 42% of the total number of tourists who visited the country in 1995.

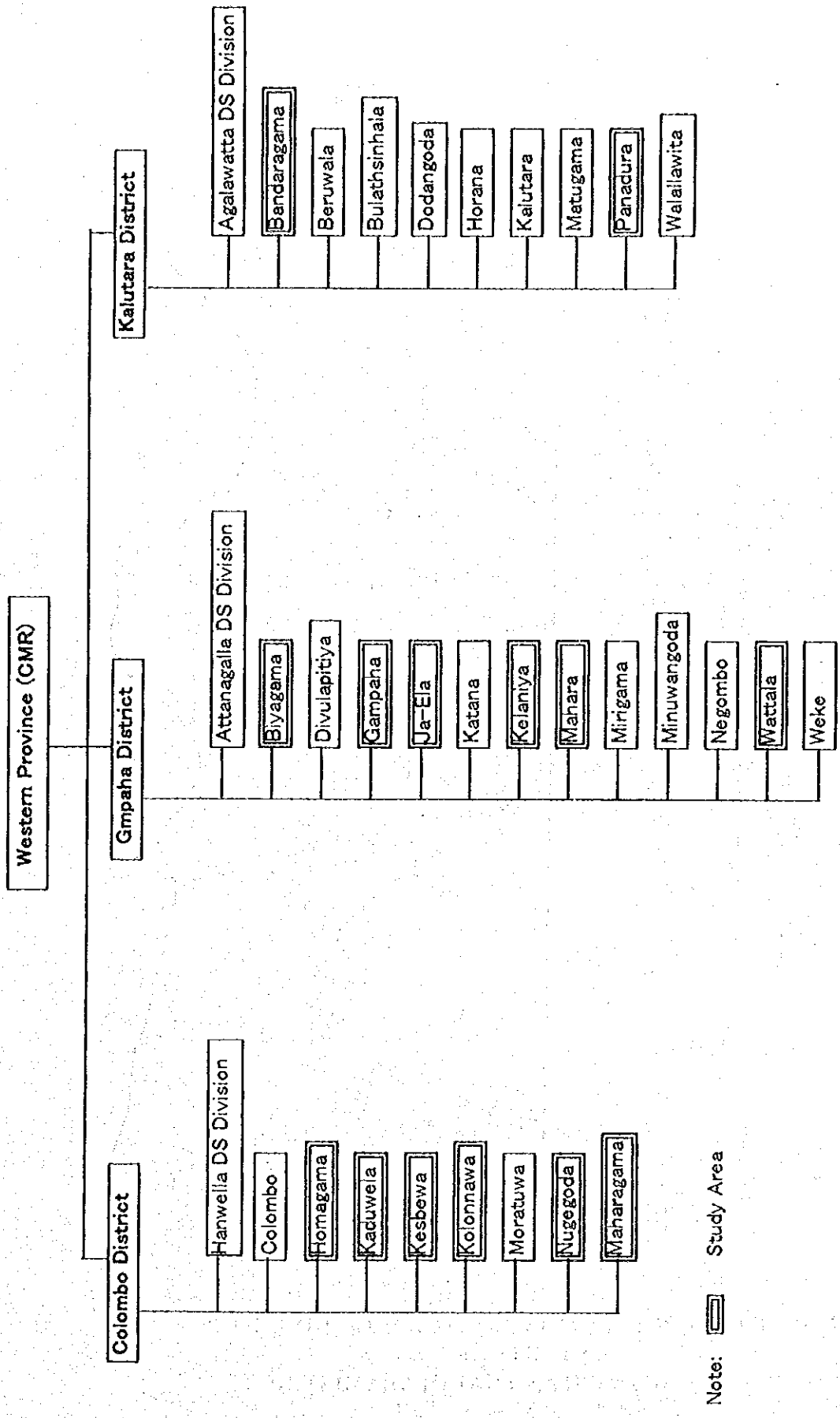

Figure 2-3 Administrative Structure of CMR

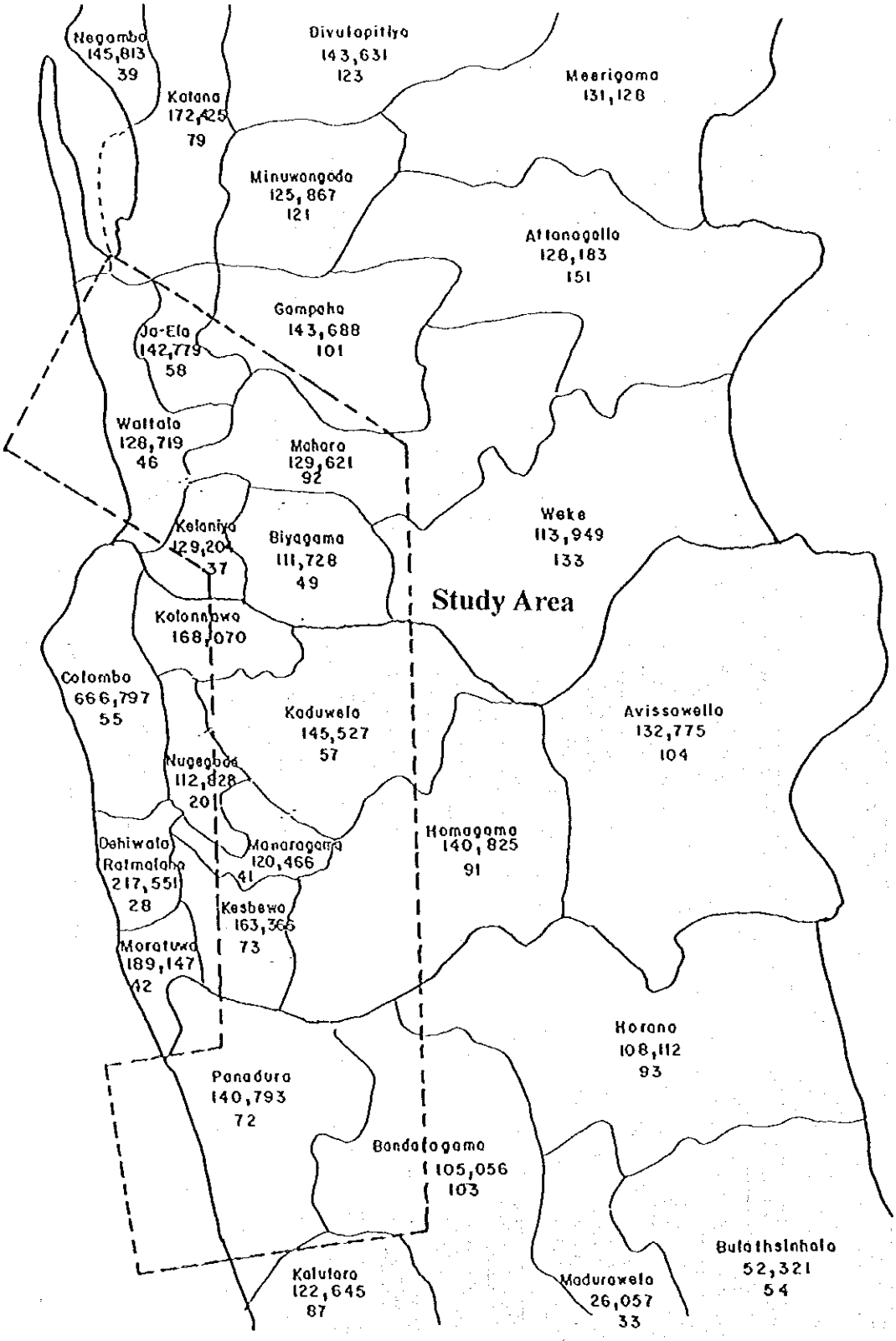

Figure 2-4 DS DIVISIONS, POPULATION AND NO. OF GN DIVISIONS
IN PARTS OF
GAMPAHA, COLOMBO AND KALUTARA DISTRICTS
(Dept. of Census & Statistics – 1994)

2) National Context

Colombo, the capital of the CMR has been the commercial and administrative center of Sri Lanka during the last four centuries. Accordingly most of the trade and banking institutions, wholesale markets are located within the CMR. It is also the distribution center of goods and services for the entire country. In fact, in 1995, the trade and banking sector in the CMR contributed to 28% of the national GDP whereas all the other eight provinces contributed 72% (UDA, 1998).

Out of the total population in the country, which was 17.6 million in 1993, 4.5 million or 25% were in the CMR (Fig. 2.5). The total urban population in the CMR consisted of 3.06 million or 67% of the total population in the CMR, whose number equals to 51% of the total urban population in Sri Lanka. The 49% of urban population scattered in urban settlements of the other eight provinces (UDA, 1998).

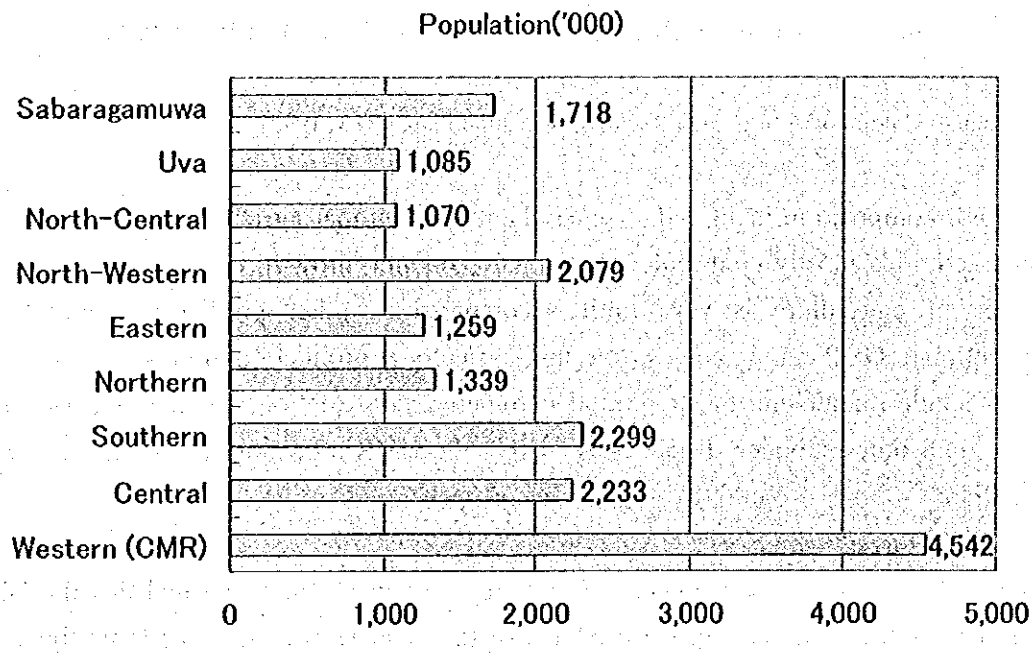

Fig. 2.5 Population by Province in 1993

Source: Colombo Metropolitan Regional Structural Plan, UDA, 1998

As far as the economic significance of the CMR is concerned, the regional breakdown of GDP in 1995 of Rs. 394,958 million in market prices revealed that the CMR or Western Province had accounted for Rs. 174,258 million or 44.1% of the total economic activity of the country (Fig. 2.6).

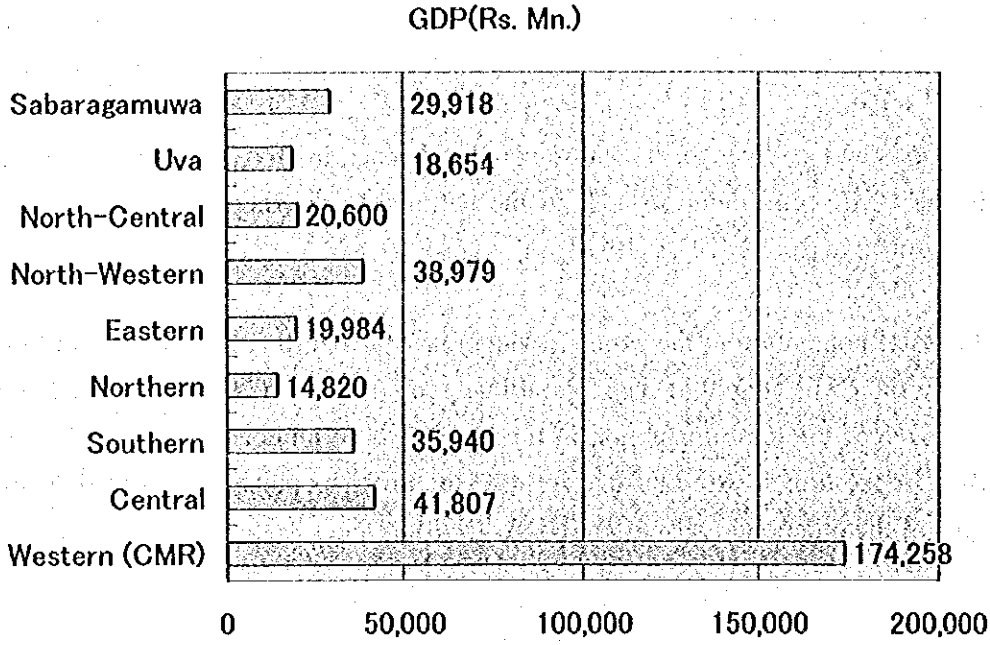

Fig. 2.6 Regional Breakdown of the GDP in Sri Lanka in 1995

Source: Colombo Metropolitan Regional Structural Plan, UDA, 1998

A sectoral composition of the GDP in Sri Lanka shows that agricultural production and related activities mostly contribute to national economic growth, however, in the CMR, the role of agriculture is very limited compared to other provinces. The CMR's contribution to GDP mainly comes from non-agricultural production of goods and services, which include manufacturing, trade and commerce, construction, banking and financial services and other services. It can be said that the CMR's economic activities are well diversified.

As far as labor force is concerned, Labor Force Survey in 1994 revealed that the labor force of the CMR had accounted for 31.1% of the total. However, at the same time, the CMR reported a higher unemployment rate of 15.6% compared to the national unemployment rate of 14.7% in 1994 (UDA, 1998). This is due to the fact that although the employment opportunities significantly increased in the CMR since the liberalization of the economy in 1977, the industrial sector had not been developed well enough in order to absorb the increasing labor force, which mainly had migrated from rural areas. This situation has caused a significant expansion of informal economic activities in the CMR.

2.2.3 Socio-Economic Characteristics in the Study Area

In order to understand the present situation of socio-economic characteristics in the Study Area, the Study Team conducted a field survey. The field survey consists of data and information collection at each relevant DS Division Office, and a Focus Group Meeting in each DS Division. The detail of the findings is presented in Initial Environmental and Social Examination (IEE and ISE) in Annex II.

1) Population of the Study Area

The Study Area consists of 14 DS Divisions and, in general, there is at least one township in each DS Division, which falls within the road corridor. The population density in these towns is very high compared to the interior areas of the DS Divisions. On the other hand, the population density in the Study Area as a whole is higher than the national average of 273 persons per km 2. The extent of DS Divisions covered in the Study Area, the total population and the population density in each Division are shown in Tab. 2.3.

Tab. 2.3 Population in the Study Area

DS Division	Extent in sq.km	Population	Population density persons per sq. km ^{2}
Ja-Ela	65.3	198835	3044
Maharagama*	39.40	201389	5111
Kelaniya	23.1	128258	5552
Biyagama	61.6	115911	1881
Kaduwela	87	145525	1672
Kesbawe	35.75	128307	3589
Mahara	49.4	87327	1767
Wattala	54.6	153477	2810
Kollonnawe	13	103405	7954
Bandaragma	58	66227	1141
Homagama	67	100803	1504
panadura	59	178652	3028
Gampaha	14.6	25747	1763
Nugegoda	1.8	13411	7450
Total	**629.43**	**1647276**	**2610**

Source: DS Division Offices

*Note: Maharagama DS Division is relatively newly formulated. Accordingly, in other chapters such as Socio-Economic Framework and Traffic Study, they do not count this DS Division due to the lack of data/information.

The population density is highly uneven within the Study Area. The Population density in

Bandaragama, Homagama, Gampaha, Mahara, Kaduwela, and Biyagama are less than the average density of the Study Area. In general, the rest of the Divisions have larger areas coming under either semi-urban or urban environments and, therefore, the average population density is higher in them. The town areas of these Divisions are highly populated while the rural areas are comparatively less populated.

About 320,016 families reside in the corridor. Of these a large number of families live in Ja-Ela, Kaduwela and Panadura DS Divisions. The number of families concentrated in the townships and that of along main roads is higher than that of the remote areas in the interior in almost all the Divisions.

The family size of the population would be an important feature in the demography with regard to the proposed project. The average family size in the Study Area is about five while it varies within the 14 Divisions in the corridor. The highest number six is reported from Ja-Ela, Maharagama, and Nugegoda Divisions. The focus group meetings held in the Study Area indicate that family size in interior areas of all the Divisions is slightly higher than that of the urban areas, which indicates the general trend in the entire country. Table 2-4 shows the details of family size in each DS division.

Tab. 2.4 Family Size in the Study Area

DS Division	Total population	Family size
Ja-Ela	198835	6.1
Maharagama	201389	6.8
Kaleniya	128258	5.2
Biyagama	115911	4.6
Kaduwela	145525	4.2
Kesbawe	128307	4.6
Mahara	87327	4.9
Wattala	153477	5.1
Kollonawe	103405	5.8
Bandaragama	66227	4.3
Homagama	100803	4.3
Panadura	178652	5.2
Gampaha	25747	3.3
Nugegoda	13411	6.3
Total	**1647276**	**5.1 (average)**

Source: DS Division Offices

Gender aspect of population is not a significant feature of demography with regard to the proposed project. However, it was revealed that more or less an equal number of females

and males are reported from the Study Area. The most important feature of the demography with regard to the road project is rural and urban aspects of population. Ja-Ela, Wattala, Mahara and Nugegoda are more urbanized DS Divisions in the corridor. Even in these Divisions certain areas are rural. In all the other Divisions significant areas can be categorized as rural.

2) Socio-Economic Environment in the Study Area

The physical and biological environments of the road corridor heavily influence its socio-economic environment of the Study Area. The infrastructure and other features, emerging due to rapid development, influence the way of life of the people.

(1) Socio-Economic Situation in Townships

The livelihood systems and social relations depending on them are based on the existing physical system. Townships in the corridor are one such livelihood system. They can be categorized as small, medium and large-scale townships. Several main roads fall within or run across them. The socio-economic environment of these towns is characterized by the following.

a) Physical Features

-Houses and business centers are located along the existing roads. Majority of roads has expanded up to the maximum possible levels. There is no reservations left for further expansion.

-Certain main roads such as the new Kandy Road running across several DS Divisions (Biyagama, Kaduwela) have been recently expanded and many houses and other buildings have been shifted for this purpose. Further expansion would lead to create social unrest among community members who have already been affected.

-In general land-holding size ranges from 5 – 20 perches. On the other hand, the houses occupy the major portion of limited land areas. There is no land space left for on-site resettlement.

b) Socio-Economic Features

-The people are fully involved in business activities or employment. Many go to Colombo City for employment to return home late in the evening. They have no time to interact with each other.

-Many families are migrants from other areas of the country. There is no strong social relation among them as normally seen in rural Sri-Lanka. On the other hand, most of the community members lead more socially independent lives and therefore, there is no strong patron client type of relations seen in the rural areas of the country. Although some NGOs

and community-based organizations are reported from the road corridor, majority of which is in rural areas. Formal kind of organizations like Lions clubs and Rotary clubs are generally based in urban centers.

(2) Socio-Economic Situation in Rural Areas

Except Ja-Ela, Mahara and Wattala a larger area of the road corridor has a semi-urban or rural atmosphere. This particular rural set-up help forming its socio-economic environment has the following specific physical features.

a) Physical Features

-Infrastructure in the area is not developed to meet the present day requirements. This is common to all other Divisions except Wattala, Mahara, Ja-Ela, and Kelaniya.

-Lack of health and education facilities are common in rural areas and rural community has to reach nearby towns and also Colombo City to enjoy the benefit of such facilities. This has resulted in daily migration of a significant number of people from these villages and semi-urban areas to nearby towns and Colombo City.

-In general, land holdings are larger than that of the town areas. In this rural set up, well-developed home gardens with vegetable and other perennial crop cultivation is one main important feature. In addition, paddy, coconut and rubber plantations are common in these parts of the corridor.

b) Socio-Economic Features

-Traditional type of communities whose livelihood is based mainly on agriculture, still live in the area. The second and third generation members of these families have changed their dependence on agriculture and moved to other economic activities such as monthly paid government and private sector employment, self-employment through small income generating activities like small scale business or industrial enterprises.

-These communities have close social relations. In many cases children live in their parents' lands even after their marriages. This has resulted in fragmentation of the land holdings significantly. People in almost of all these villages have organized themselves in community organizations. In all the rural villages at least one such organization can be observed.

(3) Common Socio-Economic Features in Both Urban and Rural Areas in the Study Area

Apart from marginal differences between urban and rural areas in the corridor, the following common features with regard to its socio-economic environment were observed:

a) Ethnic Groups

People belonging to all the major ethnic groups in Sri-Lanka live in this area. The ethnic categories include, Sinhalese (about 90%), Tamil (3%), Muslim (5%), Burger (.4%), others (2%). (Although the official databases in the DS offices indicate that 2% belong to other ethnic groups, in reality this is inaccurate because there is no ethnic groups other than the categories given above. We can assume that this "Other category" too is Muslim, Tamil or Burger).

The life styles of these categories have clear differences. The majority of Sinhalese people have been living in these areas for centuries. The Tamils have migrated from outside areas, mainly from northern or the central parts of the country. Many of them are migrants who have migrated for employment or business. They live mainly in towns and not in rural areas. On the other hand they are scattered in the corridor. The majority of Muslims have been in the area for long period and they live, in many cases, in separate clusters (villages). This is a common feature in the other rural areas of the country too. The majority of Muslims in towns is businessmen. The Burger population, too, lives in towns and their main livelihood is private sector employment. They have poor social relations even among their own community members.

b) Economic Activities

When compared with other parts of rural Sri-Lanka, the majority of families in the Study Area has assured and regular income sources. In the towns the major income source for the rich is business and industries while it is wage work and different kind of employment in formal and informal sectors. In the rural areas main sources of income are from employment either in public and private sector or sometimes from agriculture itself. There are many people engaged in self-income generating activities along the corridor. The locations of their houses on roadside provide them and opportunity to run a shop or involve in a petty commodity production activity. It can be observed that a significant number of people work in foreign countries. The livelihood systems adopted by the people in the corridor, in general, are more urban than rural. These economic activities are shown in Tab. 2.5.

Tab. 2.5 Composition of Economic Activities

Category	Number of Persons	%
Govt. employment	106597	28.2
Private sector employment	126269	33.4
Labor work (daily paid)	35388	9.3
Agriculture	13268	3.5
Business	10213	2.7
Foreign employment	13883	3.6
Self employment	71716	19.0
Total	**377334**	**100**

Source: DS Division Offices

The data in the table above indicates some specific features of the socio-economic environment of the Study Area. Such features include:

Majority is employed in the private sector. This is somewhat different from the general situation of the other parts of the country where private sector is not developed to provide such employment in large scale. In general, public sector employment is higher in those areas. However, in these semi-urban localities close to the capital, private sector is the dominant mode of employment. This has tended to increase tremendously with the open market policies adopted by the Governments since 1997.

Lesser number is involved in full time agriculture. Agriculture-related employment is confined to rural areas of the corridor.

A significant number is in foreign countries for employment. This indicates the exposure of this community to countries outside. One main reason for this may be that people with better education and skills can not find well-paid employment in the country even though they live in urban areas.

Self-employment includes small industries.

c) Education Levels of Population

In general, education level of people in the corridor is higher than that of the national levels. About 298 schools are located in the corridor area. The density of schools is significantly higher. Approximately at every 2 sq.km a school can be observed. These schools are mainly concentrated in the towns located in the corridor. A significantly higher number of people are reported of having completed secondary education and higher

education (University education) when compared with the education achievements in the other parts of the country. Tab. 2.6 is indicative of this situation in the corridor.

Tab. 2.6 Education Levels of Population in the Study Area

Category	Number of Persons	%
Primary	679133	64.0
Secondary	347565	32.7
University	32264	3.0
Professionals	3018	0.3
Total	**1062278**	**100**

Source: DS Division Offices

d) Health Facilities

Availability of health facilities is another factor influencing the socio-economic environment. The area is generally endowed with these facilities. There are 29 Government hospitals located in the area. It means every 29 km2 has a hospital. The problem that was observed in this respect is the uneven distribution of these facilities. Most of the hospitals are located in the towns.

e) Energy Facilities

As far as energy facility is concerned, more than 80% of the houses in the Study Area has electricity. In general, the entire area of the Study Area has access to electricity although some households have not yet obtained an access to this facility.

f) Water Services

As for water services, pipe born water is available in all the townships in the corridor. But in rural areas a significant number of households depend on ground water. This information clearly indicates that although the rural areas of the corridor are close to the Colombo City, they lack basic infrastructure facilities such as good quality water.

g) Housing

Nature of houses is another aspect of the socio-economic environment. The Study Team observed modern houses coming up in the areas close to the towns in the corridor. Many of these houses are being built by the recently migrated people from other areas for employment in Colombo. Since there is no sufficient land available within Colombo where land price is not affordable even for middle class families, the people tend to buy land in the sub-urban areas close to Colombo town. This feature is especially observed in Kaduwela, Maharagama, Biyagama, and Homagama DS Divisions.

There are significant numbers of migrated people who have built modern houses in the area recently. In general, the houses located in the Study Area are either permanent or semi-permanent. Only a small percentage of houses are temporary. (85% permanent houses, 10% Semi-permanent and about 10% temporary houses are found in the Study Area). This information indicates that many people have built houses with funding from banks and also with difficulties. On the other hand, finding land for housing in the areas close to the towns in the corridor is rather difficult.

3) Significant Aspects of the Existing Socio-Economic Environment in the Study Area

As far as the proposed road project is concerned all the features in the socio-economic environment are not equally significant. The most significant features are summarized in Tab. 2.7.

Tab. 2.7 Sensitive Features of the Socio-Economic Environment in the Study Area

Sensitive features	Its relevance to the proposed development project
• Population density	• High density along roads, and towns. • In rural areas also cluster type residences with high concentration of households are found. • Government built housing schemes. • Recently migrated population.
• Historical aspects of existing population	• Long stay in rural villages • Strong social ties. • Living with relatives and friends • Psychological affiliation to the area • Towns are not so sensitive as villages in this respect.
• Housing	• Recently built modern houses. • Built with bank loans • Built on small land holdings • Rural areas are not sensitive with regard to houses and land holdings
• Livelihood system	• Employment relations built over a long period • Employment in the area itself, self employment attached to the residence it self • Similar employment are not available out side of the present residential area • Day today labor work attached to specific places in the area and also specific employers in the area.
• Available facilities	• Town areas endowed with well-developed infrastructure such as roads, telecommunication, water, health, and schools. • Rural areas are not so sensitive in this respect.

Reference:

Urban Development Authority (UDA) (1998) *Colombo Metropolitan Regional Structure Plan, Vol. I*

2.3 Transportation

In the Colombo Metropolitan Region (or the CMR), the transportation network is comprised of both road-based and rail-based modes of transportation. Below, the status of these modes of transportation is described in detail.

2.3.1 Road Transport

Road-based transport in the CMR accounts for the vast majority of motorized person trips, i.e. approximately 95% of the total by some estimates[1]. As for the composition of road traffic, a 12-hour traffic surveys carried out by the Consultant in early 1999 on the major arterial roads of the city indicated that about 75% of the traffic consisted of private vehicles (passenger cars, motorcycles, and 3-wheelers), 15% freight vehicles, and 10% buses. As for the number of vehicles crossing into the inner-city area over a 24-hour period, the Consultant estimated the total to be approximately 136,000. The road network and its structure for meeting this demand are described below.

1) Road Network Density

The CMR (which is assumed to be synonymous with the Western Province) accounts for over 43% of Sri Lanka's total GDP and contains approximately 25% of the country's population in an area equivalent to 5.6% of its land mass[2]. It is also the location of the nation's capital. To support this concentration of socioeconomic and political activity, the road infrastructure of the CMR has become more developed than that of the other Sri Lankan provinces. As Table 2.8 indicates, there is 0.95 km of road per sq. km in the CMR as compared to the national average of 0.48 km of road per sq. km, or about 2 times the national mean[3].

Tab. 2.8 Length and Density of Public Roads by Province (1993)

Name of Province	Length of Public Roads (km)	Road Density (km/km^2)
Western Province (CMR)	3447	0.95
Central Province	3988	0.71
Southern Province	2944	0.53
Northern Province	4900*	0.56
Eastern Province	4913	0.51
North-Western Province	3317	0.42
North-Central Province	2773	0.27
Uva Province	2439	0.29
Subaragamuwa Province	2183	0.44
National Average	3433	0.48

Source: Dept. of Census and Statistics, 1997. Note: * is 1990 data.

As for the status of road infrastructure in the districts of Colombo, Gampaha, and Kalutara

that constitute the CMR, as Table 2.9 indicates, Kalutara District has a much lower road density than either of the other two districts, with Colombo District having 1.67 times and Gampaha District 1.73 times the road density, respectively. This is due to Kalutura having a lower population density and a larger proportion of its industry based in agriculture.

As for Colombo and Gampaha, they have approximately the same road density in regards to trunk roads and main distributor roads (i.e., Class A and Class B roads), or 0.41 and 0.46 km/km^2, respectively. These roads are national roads and are administered by the Road Development Authority (RDA). However, it should be noted that municipal councils are responsible for the maintenance of those national roads that fall within their district. As for Class C and Class D roads, which serve as access/local roads and are administered by the local councils, Colombo and Gampaha have almost the same road density, or 0.66 and 0.65 km/km^2 of road. Class E roads are not considered since they are insignificant in number and are generally not motorable[4].

Tab. 2.9 Road System Length & Density by District in the CMR

Type Of Road	District					
	Colombo		Gampaha		Kalutara	
	Length of Road (km)	Road Density (km/km^2)	Length of Road (km)	Road Density (k/km^2)	Length of Road (km)	Road Density (km/km^2)
A	99	0.15	161	0.12	80	0.05
B	170	0.26	473	0.34	259	0.16
C	311	0.47	447	0.32	479	0.30
D	122	0.19	452	0.33	194	0.12
E	-	-	5	-	-	-
Total	702	1.07	1538	1.11	1012	0.64

Sources: Colombo Metropolitan Structure Plan, UDA (1998); Dept. of Census and Statistics (1997).
Note: The area for the districts excludes large inland water areas.

2) Road Network Structure

The road network structure of the CMR is mainly radial and runs in an east-to-west direction (see Fig. 2.7). Most of these roads are two- or three-lane undivided highways with optimum capacities of approximately 1200 pcus per hour per lane. Except for Galle Road, there are very few major north-south routes (i.e., cross-town connections). Moreover, except for the Baseline Road (which is under construction and will serve essentially as an inner ring road), there are no orbital routes in existence. This means a large proportion of trips in the CMR are generated in the eastern suburbs and rural areas and have their destinations

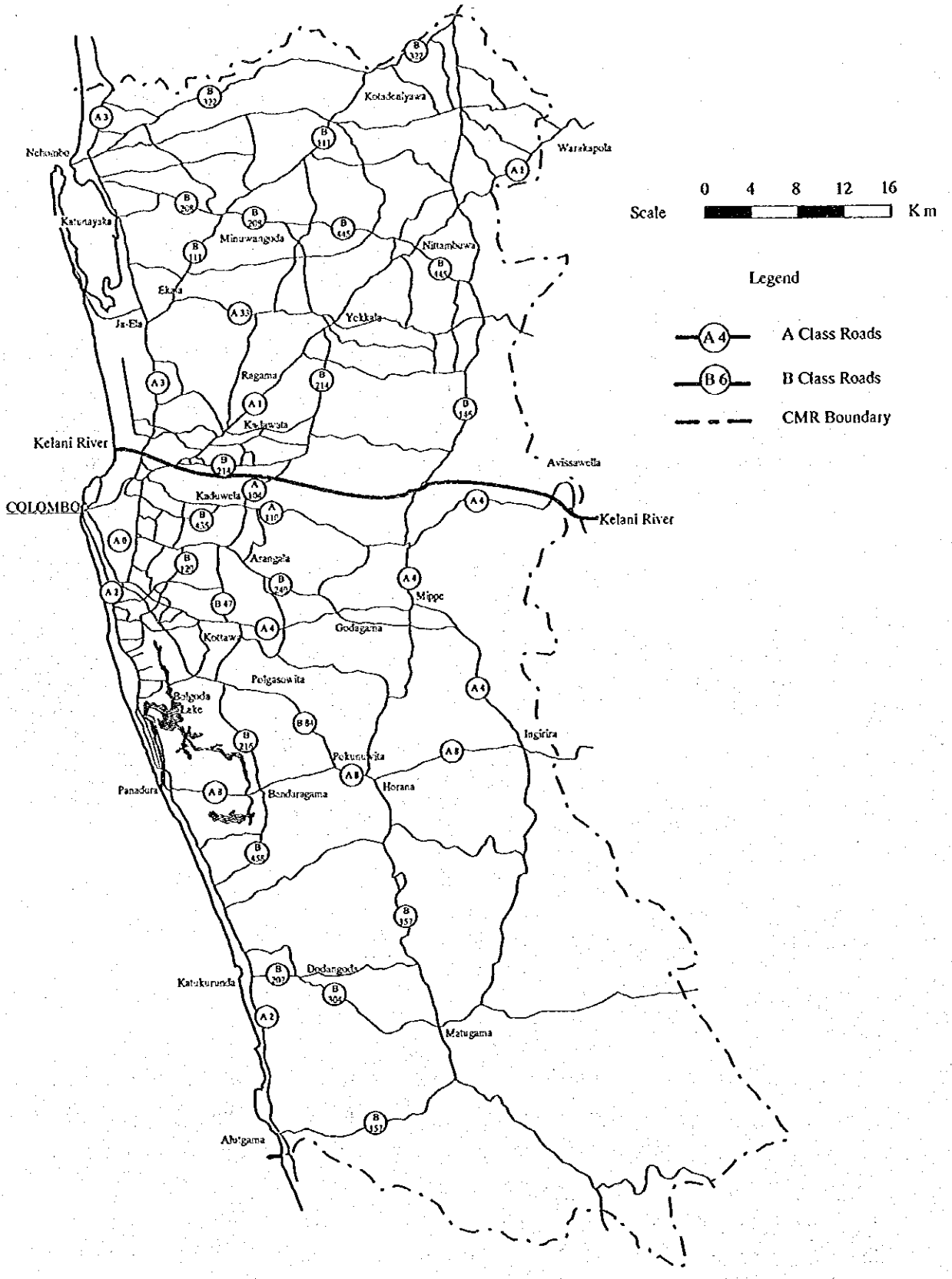

Fig. 2.7 Outline of Road Network Structure

concentrated at the core of the CMR in the west, i.e., the Colombo Division. There are eight major east-west routes that serve as the main radial routes for CMR and they are as follows:

1) Route A3 (Peliyagoda-Puttalam Road),
2) Route A1 (Colombo-Kandy Road),
3) Route A110 (Colombo-Hanwella Road),
4) Route A1Sp (Kollupitiya-Sri Jayawardena Pura Road),
5) Route A4 (Colombo-Ratnapura-Wellawaya-Batticaloa Road),
6) Route B84 (Colombo-Horana Road),
7) Route A8 (Pandura-Nambapana-Ratnapura Road), and
8) Route A2 (Colombo-Galle-Hambantota-Wellawaya Road).

Another important characteristic of the road network is that it provides few inter-modal transfer opportunities with the railway, which runs parallel with significant portions of A2, A1, A3, and A4. In fact, the only good inter-modal transfer location is in Fort[5].

3) Road Accidents

As shown in Fig. 2.8 below, the annual auto injury rate in Colombo has declined recently from a high in 1993 of about 2500 accidents per annum to about 1900 accidents per annum in 1995.

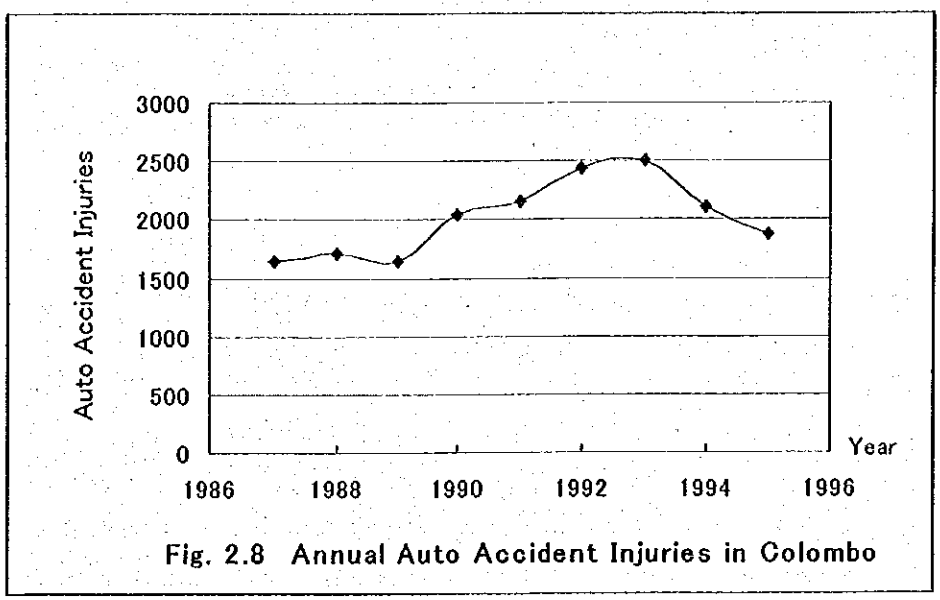

Fig. 2.8 Annual Auto Accident Injuries in Colombo

On the other hand, the number of fatalities in Sri Lanka due to auto accidents has been rising again recently and is nearing the peak of about 1800 deaths per annum, as shown in Fig. 2.9[6]. As Tab. 2.10 shows, the fatality rate per population for Sri Lanka is higher than that of Japan;

although, the rate of motorization is about 6 times less. This seems to indicate that traffic safety is still a problem.

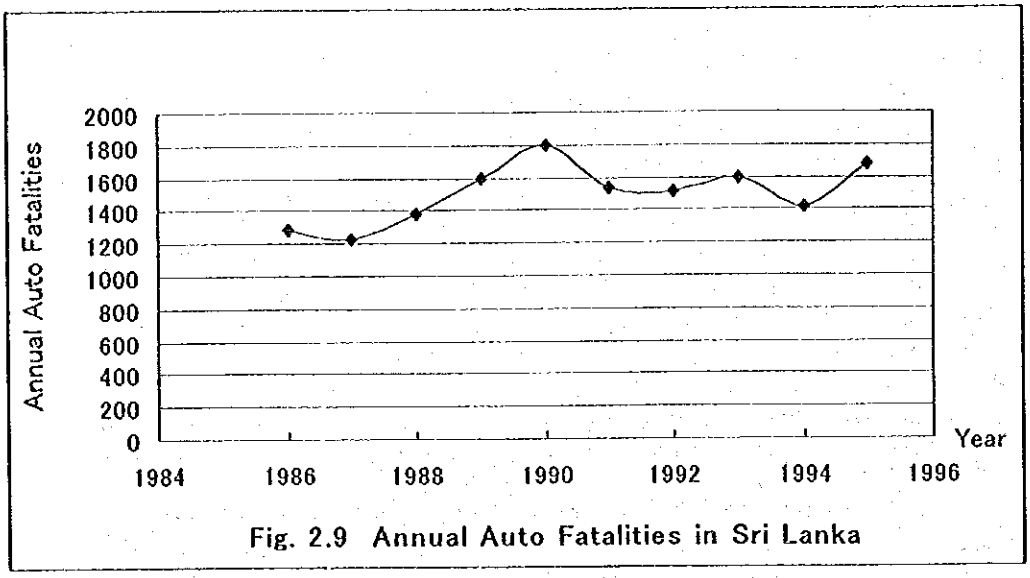

Fig. 2.9 Annual Auto Fatalities in Sri Lanka

Tab. 2.10 Comparison of Auto Fatality Rate

	U.S.A	Japan	Sri Lanka
No. of Accidents	2,335,434	641,481	-
No. of Fatalities	46,385	10,344	1,411
Population	2,445	1,229	150
No. of Vehicles Registered	17,904	5,253	116
Rate of Motorization	73.2	42.8	7.7
Fatality Rate	19.0	8.3	9.4

Note) Units: Population = 100,000 persons, Vehicles registered = 10,000 vehicles,
Rate of Motorization = Vehicles per 100 persons, Fatality Rate = per 100,000 persons

2.3.2 Rail Transport

As mentioned previously, rail transport accounts for only a small number of the total trips made in the CMR, despite its routes running parallel to highly congested road corridors. This is due in great part to poor levels of service. Of these trips, about 51% have both their origin and destination within the CMR and another 29% have a trip end outside of the CMR boundary. Over the past decade, the growth of intra-CMR trips has grown much faster than that of inter-regional trips, meaning that the railway is becoming an increasingly important urban and/or commuter service[7]. In fact, during peak hours, many trains carry passenger loads well in excess of design capacity (see Tab.2.11). However, on all of the four railway lines in Colombo (see Fig. 2.10), the busiest sections are away from the city center, indicating that rail is also used as public transport in local areas[8].

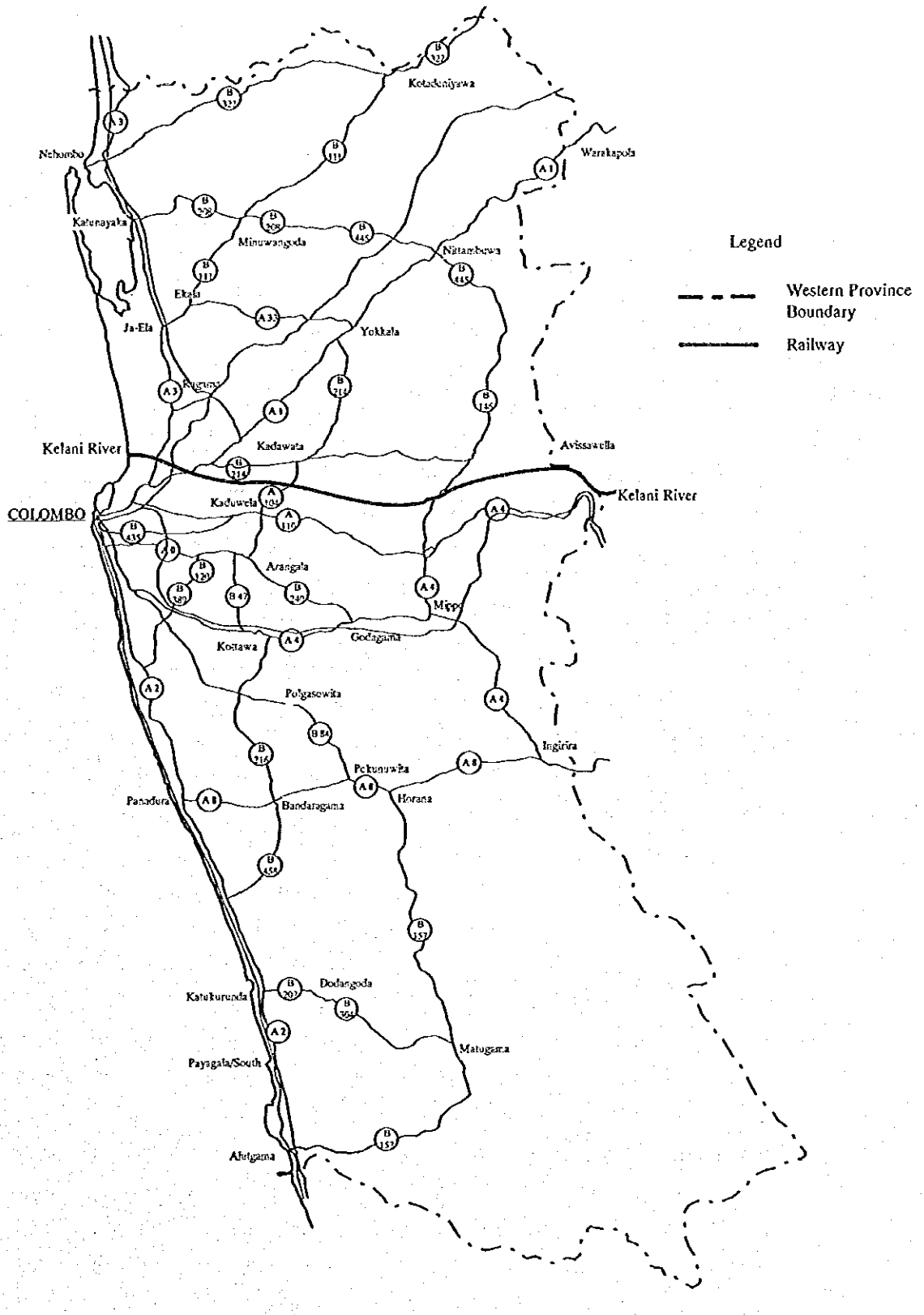

Fig. 2.10 Existing Railway Network in CMR

Tab. 2.11 Maximum Train Load Factors

Line	Rolling stock	Design capacity	Maximum load	Load factor
Main	Loco+14	2,160	3,083	137%
	S8 unit	1,331	2,114	159%
Coast	S8 unit	1,331	1,695	127%
Kelani V.	S7unit	687	1,194	174%

Source : SLR load survey

2.3.3 Problems with Transportation System

1) Road Transport

The problems that are facing the CMR road network are essentially as follows:

(1) Because of the radial structure of CMR's road network, sprawl is occurring along the radial routes. Moreover, trip times and travel distance are continuing to increase as people move further out along the radial routes from the core of the city.

(2) Excluding the Baseline Road, there is no major orbital road to connect the radial routes to serve non-radial traffic.

(3) As a result of (1) and (2), the situation is not environmentally or perhaps economically sustainable in the long term. That is, since the number of cross-town routes (i.e., north-south routes) is inadequate, businesses and residences are unable to locate in areas close to the city, resulting in transportation costs and exhaust emissions increasing.

(4) As a result of the weak north-south network structure, there are many missing links and many different types of trips and people can not be served. That is, a radial system such as Colombo's should also have good cross-town routes in order to provide for a variety of destinations and trip types.

(5) Many of the current radial roads are already congested and are operating at capacity. Therefore, the present road network is incapable of dealing with any future increases in travel demand.

(6) Even though the network is radial in nature, there are only 4 radial routes that continue out to the outer suburbs and beyond. This means that between Kandy Road and High Level Road and High Level Road and Galle Road there are large areas containing new developments (both residential and industrial) that are poorly connected to the center and to the main road network.

2) Rail Transport

Some of the major problems confronting rail transport are as follows:

(1) There is a lack of integration with road-based transport, which will prevent the railway from effectively alleviating the ever-increasing congestion on roads.

(2) Low levels of service will hinder present and future ridership. That is rail transport is:

(a) Too slow: average speed is less than 30 km/h

(b) Too unreliable: less than 50% of trains arrived within 6 minutes of scheduled time

(c) Too overcrowded: Tab. 2.11 shows peak ridership well in excess of design capacity

(3) Lack of adequate equipment to remedy (2). That is, the following hardware problems affect the ability to provide good service:

(a) Poor track

(b) Insufficient amount of rolling stock to permit operation on schedule as well as a lack of availability

(c) Obsolete and unreliable signaling equipment

2.3.4 The Direction Forward

One of the important issues indicated in the previous sections is that the overly radial nature of the road network and unchecked urban growth, together with a lack of road and rail-based modal integration, are causing excessive levels of congestion and undesirable urban sprawl.

To deal with this problem, the Colombo Metropolitan Regional Structure Plan (the CMRSP) proposed controlling urban sprawl by strategically designating growth centers and building the necessary transportation infrastructure necessary to support them. The purpose of this is to create a sustainable urban structure, which the Outer Circular Highway can play a crucial role in achieving.

Sustainability means building a city that can be environmentally, economically, and socially feasible. A step in this direction is to create an urban structure that is efficient, which the CMRSP advocates. For example, high urban density (see Fig. 2.11 below), which is an indicator of efficiency, usually results in much less energy consumption per capita[9].

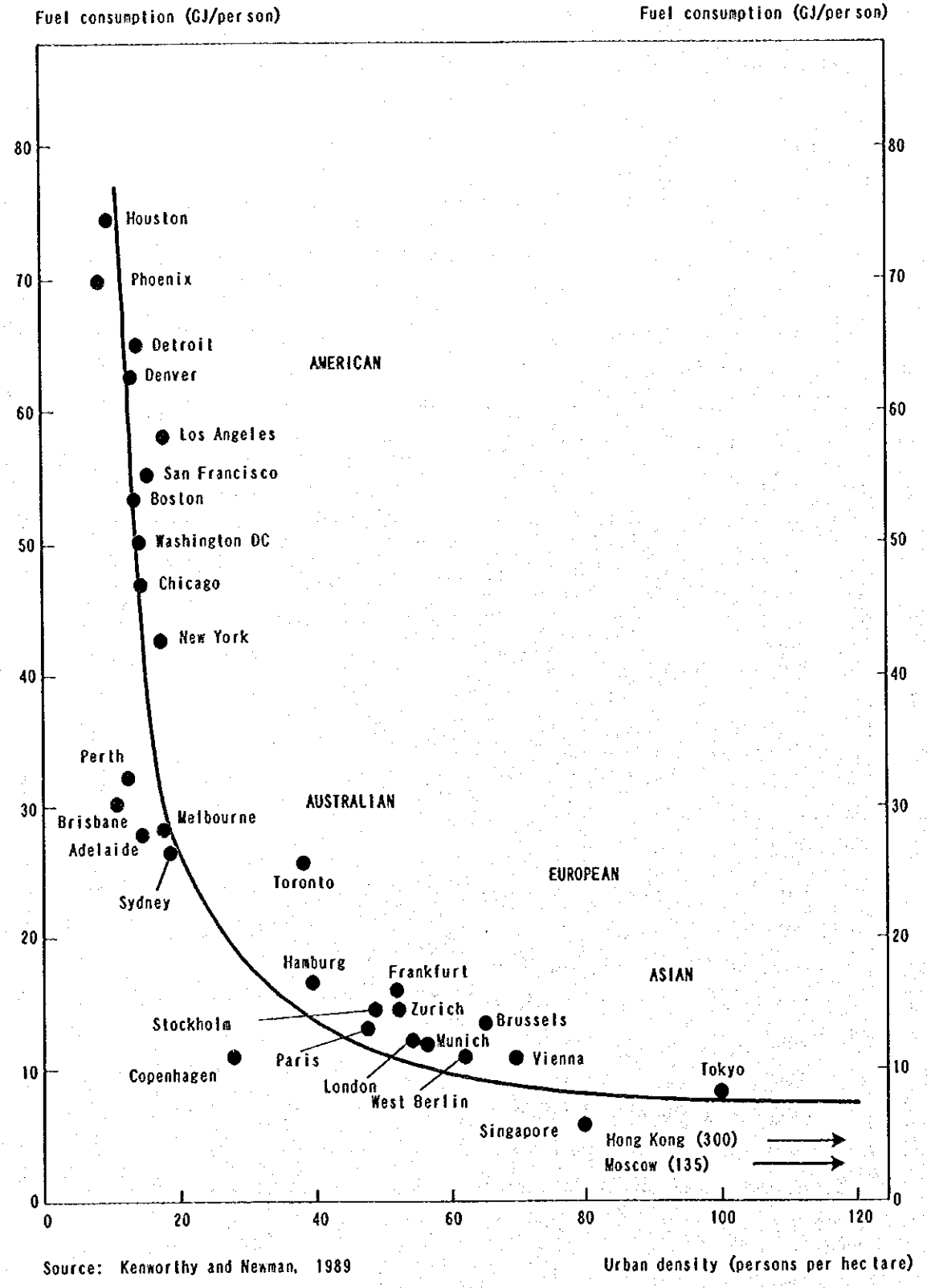

Fig. 2.11 Urban Density & Fuel Consumption

References

1. Halcrow Fox & Engineering Consultants Ltd., Colombo Urban Transport Study: Urban Railway Development, Working Paper No 12. pg. 1.1996.
2. Urban Development Authority, Sri Lankan Ministry of Housing & Urban Development. *Colombo Metropolitan Structural Plan*, Vol. II, The Plan. pg. 10-11. 1998.
3. Dept. of Census and Statistics, Sri Lankan Ministry of Finance and Planning. *Statistical Abstract*. pg. 7-8, pg. 147. 1997.
4. Halcrow Fox, Sri Lankan Ministry of Transport. *Colombo Urban Transport Study*, Vol. 1, pg. 3. 1995.
5. Road Development Authority. *Pre-Feasibility Study for an Outer Circular Road to City of Colombo with a Road Link to Ratnapura*. Consulting Engineers & Architects Assoc. pg. A3-11. 1993.
6. Dept. of Census and Statistics, Sri Lankan Ministry of Finance and Planning. *Statistical Abstract*. pg. 149-150. 1997.
7. Urban Development Authority, Sri Lankan Ministry of Housing & Urban Development. *Colombo Metropolitan Structural Plan*, Vol. II, The Plan. pg. 93. 1998.
8. Halcrow Fox & Engineering Consultants Ltd., Colombo Urban Transport Study: Urban Railway Development, Working Paper No 12. pg. 7.1996

10.OECD. *Urban travel and sustainable development*. pg.96. 1995.