

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

COUNCIL FOR DEVELOPMENT AND RECONSTRUCTION (CDR)
REPUBLIC OF LEBANON

THE STUDY
OF
ENVIRONMENTAL FRIENDLY INTEGRATED
TRANSPORTATION PLAN
FOR
GREATER TRIPOLI

FINAL REPORT

EXECUTIVE SUMMARY

DECEMBER 2001

KATAHIRA & ENGINEERS INTERNATIONAL

PREFACE

In response to a request from the Government of Republic of Lebanon, the Government of Japan decided to conduct "The Study of Environmental Friendly Integrated Transportation Plan for Greater Tripoli in the Republic of Lebanon" and entrusted the Study to the Japan International Cooperation Agency (JICA).

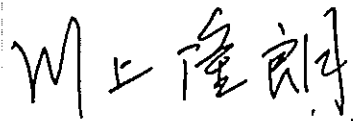
JICA selected and dispatched a Study Team headed by Mr. Tsuneo BEKKI, Katahira & Engineers International to Lebanon, at three different times between October 2000 and December 2001. In addition, JICA set up an Advisory Committee Headed by Dr. Hirohito KUSE, Tokyo University of Mercantile Marine, which examined the Study from technical points of view.

The team held discussions with the officials concerned of the Government of Lebanon, and conducted field surveys at the study area. After the team returned to Japan, further studies were made and the present Final Report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relationship between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of Lebanon for their close cooperation extended to the Study.

December 2001,



Takao KAWAKAMI
President
Japan International Cooperation Agency

Mr. Takao KAWAKAMI
President
Japan International Cooperation Agency
Tokyo, Japan

December 2001

Dear Mr. Kawakami,

Letter of Transmittal

We are pleased to submit to you the report of "The Study of Environmental Friendly Integrated Transportation Plan for Greater Tripoli in the Republic of Lebanon". The report includes the advises and suggestions of the authorities concerned of the Government of Japan and your agency as well as the comments made by the Council for Development and Reconstruction and other authorities concerned in the Republic of Lebanon.

The report analyses the present and future conditions and demand of transport in Greater Tripoli. It comprehensively covers the transport sectors of road, public transport, transport management as well as the issues institution, legislation, financing and environment. The report presents the established Integrated Transport Plan to the year 2020, and the Short-term Improvement Plan for urgent projects to be implemented in the years 2001 - 2005. The output of the Study concludes that the plans are technically, environmentally, economically and socially viable, and will contribute to the development of transportation in Greater Tripoli. In view of the urgency of developing the transport facilities in Greater Tripoli, we recommend that the Government of Lebanon implement the projects with top priority.

We wish to take this opportunity to express our sincere gratitude to your agency, the Ministry of Foreign Affairs and the Ministry of Land, Infrastructure and Transport. We also wish to express our deep gratitude to the Governmental Agencies concerned in the Republic of Lebanon for the close cooperation and assistance extended to us during the Study. We hope this report will contribute to the development of Greater Tripoli.

Very truly yours,



Mr. Tsuneo BEKKI
Team Leader
of the Study of Environmental Friendly
Integrated Transportation Plan for Greater Tripoli
in the Republic of Lebanon

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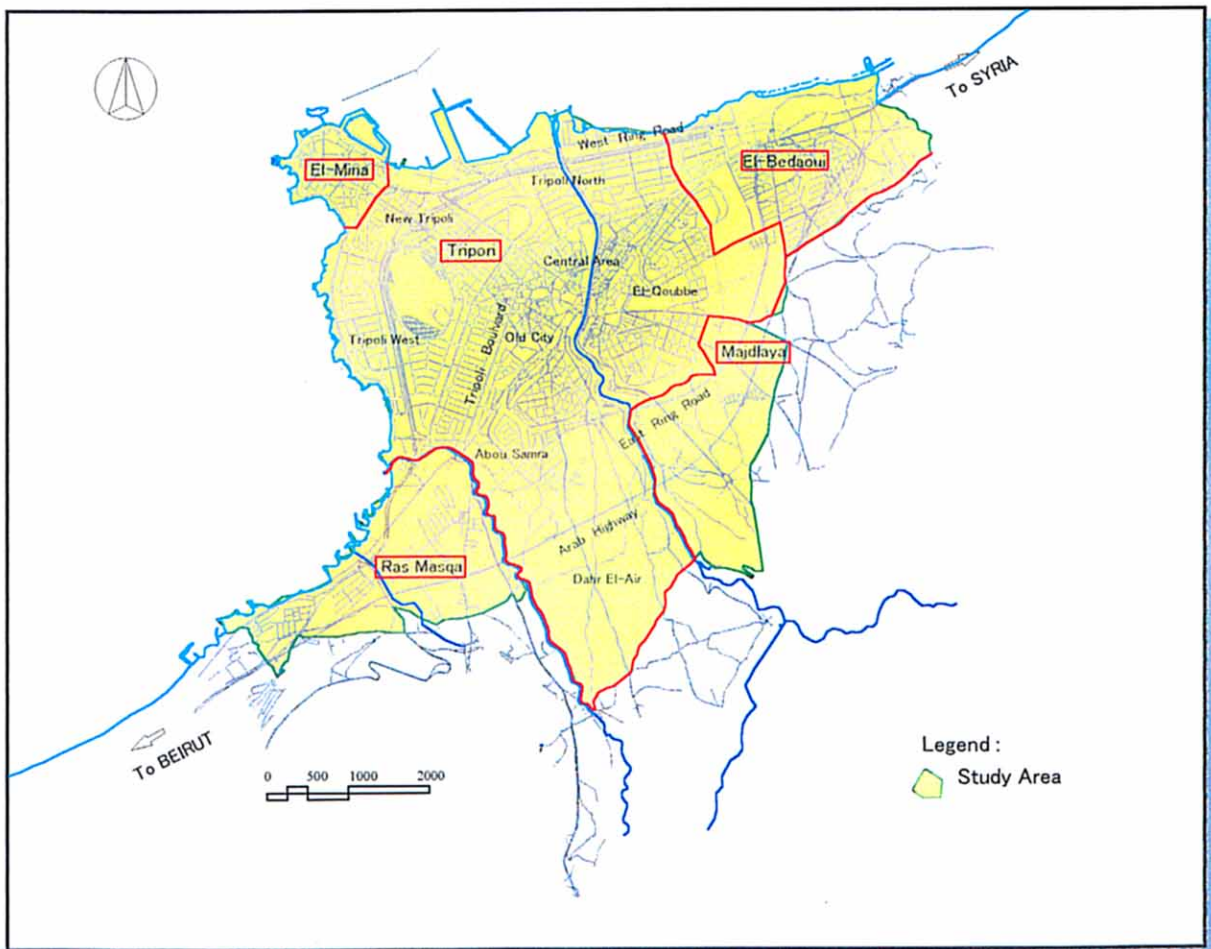
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The exchange rates applied in this Study are:

| | | |
|----------|---|----------|
| US\$ 1.0 | = | LL 1,500 |
| US\$ 1.0 | = | JPY 125 |
| JPY 1.0 | = | LL 12.0 |

(As of July 2001)

LOCATION MAP



SUMMARY

INTEGRATED TRANSPORT PLAN

Background

The transportation system of Greater Tripoli is lacking many facilities and it depends comprehensively on the private cars. The shared-taxi is the most dominant mode for public transportation. With the rapid growth in population, urbanization and motorization in the city, the problem of traffic congestion has imposed itself to be a major issue for concerned authorities, including CDR (Council for Development and Reconstruction), MOPWT (Ministry of Public Works and Transport) and municipalities.

The Lebanese Government decided that, in order to solve the transport problem in Greater Tripoli, an environmental friendly integrated Master Plan that covers the area of road network improvement; public transport and transport demand management should be developed to the target year of 2020. In formulation the Master Plan, integration with other city plans and between transport sub-sector plans is considered.

Study Objectives

- To formulate an Urban Transport Master Plan (M/P) for Greater Tripoli Area to the year 2020, in order to alleviate present traffic congestion and to ensure safe mobility;
- To formulate a 5-year plan composed of priority projects identified under the M/P;
- To pursue technology transfer to Lebanese counterpart personnel in the course of Study.

Plan Components and Project Cost

The M/P identifies a number of projects and measures covering the transport sectors of road development, public transport and traffic management, and classifies their urgency into short, medium and long terms.

The road development plan includes road improvement, widening, and new construction and grade separation projects. The public transport plan introduces city bus system with improvements in public school bus system and transport facilities such as taxi/bus terminals and transport center. The transport management plan emphasizes the necessity of traffic rules education and enforcement with provision of traffic safety facilities and signals.

Plan Target

- Establishment of transport network in accordance with the land use plan.
- Introduction of an efficient public transport system.
- Development of an efficient, comfortable and safe transport network.
- Establishment of an efficient traffic management system.
- Improvement of urban environment.

Plan Evaluation

Technical Evaluation

Traffic parameters of average speed and congestion rate on the road network are used to assess the network efficiency. Low speeds and high congestion levels on the "Do Nothing" case, in which no improvements will be done on the existing transport network, are widely spread when compared with implementing the "Master Plan" case.

Speed and Congestion

| Parameter | 2000 | 2005 | 2010 | 2020 |
|--------------------------------------|-------|-------|-------|-------|
| Average Speed (km/hr) | | | | |
| Do Nothing | 54.7 | 46.9 | 45.4 | 42.2 |
| Master Plan | | 54.5 | 54.8 | 56.7 |
| Average Volume/Capacity Ratio | | | | |
| Do Nothing | 0.384 | 0.545 | 0.585 | 0.655 |
| Master Plan | | 0.459 | 0.439 | 0.424 |

Economic Evaluation

Savings in Traffic Cost (LL Billion/year)

| Year | Do Nothing | Master Plan | Savings |
|------|------------|-------------|---------|
| 2000 | 135 | - | - |
| 2005 | 169 | 142 | 27 |
| 2010 | 209 | 160 | 49 |
| 2020 | 288 | 198 | 90 |

- Economic Parameters
 - EIRR % 27.75
 - NPV (LL Billion) 180.57
 - B/C 2.52

Environment Evaluation

Projects incorporated in each sector of the Master Plan promote an environmentally sound and health supporting transport system in the Study Area. Reduction in CO emission is predicted as 30% less than the case of "Do Nothing" in 2020.

Master Plan Major Components and Cost (LL Billion)

| Sub-sector | Major Projects and Measures | Total Quantity | Total Cost | Short Term 2001 - 2005 | Medium Term 2006 - 2010 | Long Term 2011 - 2020 |
|-------------------------|--|----------------|---------------|---------------------------|----------------------------|--------------------------|
| Road Development | Road | 64.75 Km | 203.07 | 34.73 | 37.99 | 130.35 |
| | Grade Separation | 6 locations | 80.50 | 30.00 | 10.50 | 40.00 |
| Sub Total | | | 283.57 | 64.73 | 48.49 | 170.35 |
| Public Transport | Bus | | 24.50 | 11.35 | 4.80 | 8.35 |
| | Taxi | | 1.50 | 1.15 | 0.20 | 0.15 |
| Sub Total | | | 26.00 | 12.50 | 5.00 | 8.50 |
| Traffic Management | Signals, Parking, Signs, Marking & Pedestrians | | 4.87 | 3.58 | 1.29 | - |
| | Education & enforcement | | 5.13 | 3.42 | 1.71 | - |
| Sub Total | | | 10.00 | 7.00 | 3.00 | - |
| Total Investment | | | 319.57 | 84.23 | 56.49 | 178.85 |

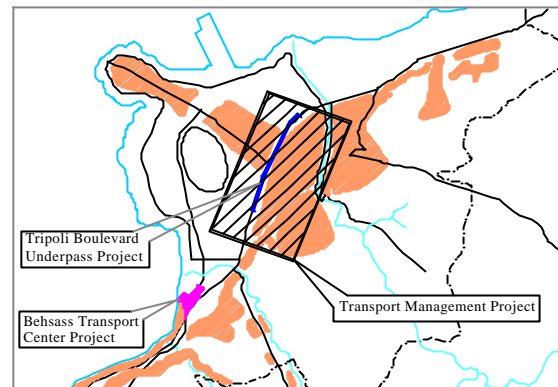
SHORT TERM PLAN

Three (3) urgent transport projects are formulated for implementation during the Short-term Plan (2001-2005) in order to solve major transport problems and greatly improve the environmental conditions.

(1) Tripoli Boulevard Underpass Project

An Anti-Pollution Facility to reduce Negative Environmental Impact

- Major Components
 - Tunnel Length 585 meters
 - Approach Length 400 meters
 - No. of Lanes 4 lanes
- Implementation
 - Agency CDR
 - Cost (LL Billion) 29.4
- Economic Evaluation
 - EIRR % 32.68
 - NPV (LL Billion) 51.39
 - B/C 3.15



Location of Projects

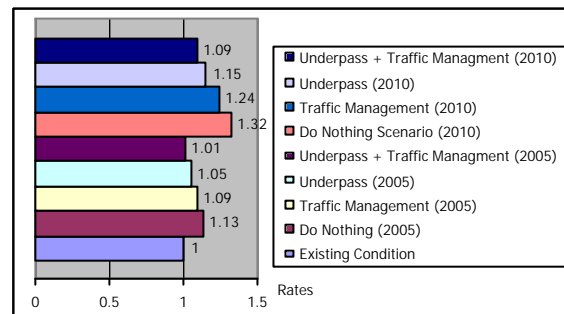
Project Integration

The first (2) projects are located in Central Tripoli which is the most congested area. When the two projects are integrated, they can create the multiplier effect in traffic efficiency and improvement of environment.

(2) Transport Management Project

Environmental Enhancement in Central Tripoli

- Major Components
 - Bus/Taxi system services and terminals
 - One way traffic system
 - Intersection improvement and traffic signals.
 - On-street and off-street parking
 - Traffic safety facilities
- Implementation
 - Agency CDR
 - Operation Transport Management Unit
 - Cost (LL Billion) 6.57
- Economic Evaluation
 - EIRR % 28.49
 - NPV (LL Billion) 4.30
 - B/C 1.78



Reduction in CO Emission

- Economic Evaluation
 - EIRR % 35.11
 - NPV (LL Billion) 64.30
 - B/C 3.18

(3) Behsass Transport Center Project

A Node for Better Movement of People

- Major Components
 - Area 34,000 m²
 - Bus Terminal
 - Taxi terminal
 - Parking
 - Commercial Center
- Implementation
 - Agency MOPWT
 - Cost (LL Billion) 8.30
- Economic Evaluation
 - EIRR % 19.50
 - NPV (LL Billion) 7.27
 - B/C 2.02

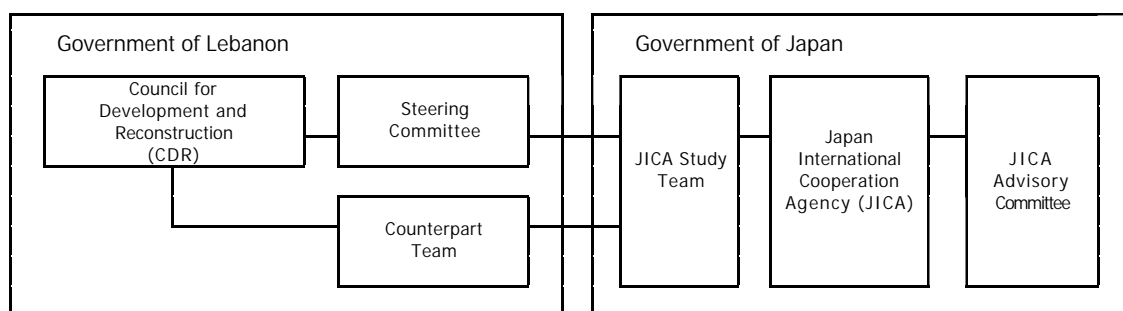
The third project aims to provide an integrated center for transport multi-function such as bus/taxi terminal and commercial center. When the second and third projects are integrated, the service of bus/taxi, as the public transport system in the Study Area, can be operated efficiently and systematically.

The optimum solution to solve many of the transport problems in the Study Area in the short-term comes with the integration of the three projects. This integrated plan will result in improving the transport system for people, decreasing traffic congestion in Central Tripoli, ensuring traffic safety and enhancing natural and social environment.

Project Cost for Short Term Improvement Plan (LL Billion)

| Project | Total Cost | 2002 | 2003 | 2004 | 2005 |
|-----------------------------|--------------|-------------|--------------|--------------|-------------|
| Tripoli Boulevard Underpass | 29.40 | 1.66 | 13.87 | 13.87 | - |
| Transport Management | 6.57 | 0.27 | 2.10 | 2.10 | 2.10 |
| Behsass Transport Center | 8.30 | - | 3.25 | 3.25 | 1.80 |
| Total | 44.27 | 1.93 | 19.22 | 19.22 | 3.90 |

STUDY ORGANIZATION



Lebanon Side: CDR Steering Committee and Counterpart Team

Steering Committee

| | |
|--------------------------|---|
| Mr. Elias Helou | Project Coordinator/Transport and Traffic, CDR |
| Ms. Nada Mufarej | JICA Liaison/Grant Coordinator, CDR |
| Dr. Wafa Charafeddine | Environmental and Regional Development, CDR |
| Ms. Nathalie Rayes | Transportation Economist, CDR |
| Mr. Jawdat Abou Jaoude | Urban Planning, CDR |
| Mr. Abboud Khayr | Regional Director, Ministry of Public Works and Transport |
| Dr. Nabil Harb | Technical Advisor, Ministry of Public Works and Transport |
| Mr. Mikael Kareh | Mayor, Ras-Maska Municipality |
| Mr. Abdallah Abdul-Wahab | Head of Engineering Department, Union of Al-Fayhaa Municipalities |
| Mr. Nazih Raad | Head of Engineering Section, Municipality of Tripoli |
| Mr. Jalal Abs | President of Urban Planning Committee, Municipality of Tripoli |
| Mr. Ghassan Chmeiseh | President of Planning Committee, Municipality of Tripoli |
| Mr. Said Lebien | Civil Engineer, Union of Coastal Municipalities, Representative of Mejdlaya Municipality |

Counterpart Team

| | |
|------------------------|--|
| Mr. Elias Helou | Project Coordinator/Transport and Traffic, CDR |
| Dr. Wafa Charafeddine | Environmental and Regional Development, CDR |
| Ms. Nathalie Rayes | Transportation Economy, CDR |
| Mr. Jawdat Abou Jaoude | Urban Planning, CDR |

Japan Side: JICA Headquarter, Advisory Committee and Study Team

JICA Headquarter

| | |
|---|---------------------|
| First Development Study Division, Social Development Study Department | |
| Mr. HIRAI Toshio | Director |
| Mr. KAIBARA Takao | Ex. Director |
| Mr. UMENAGA Satoshi | Deputy Director |
| Ms. HONDA Eri | Ex. Deputy Director |
| Mr. KONYA Kenichi | |
| Mr. KOIZUMI Yukihiko | |

JICA Advisory Committee

| | |
|-------------------------|---|
| Prof. Dr. KUSE Hirohito | Chairman, JICA Advisory Committee Tokyo University of Mercantile Marine |
| Mr. MORI Hideki | Member, JICA Advisory Committee Yokohama City, Planning Division |
| Mr. YOSHIDA Nobuhiro | Member, JICA Advisory Committee Ministry of Land, Infrastructure and Transport |
| Mr. OBATA Akihiro | Member, JICA Advisory Committee Ministry of Land, Infrastructure and Transport |

JICA Study Team

| | |
|----------------------|--------------------------------------|
| Mr. BEKKI Tsuneo | Team Leader / Transport Planner |
| Dr. HANI Abdel-Halim | Deputy Team Leader / Road Planner |
| Mr. KURAUCHI Katsumi | Urban Planner |
| Mr. KIUCHI Mitsuo | Traffic Survey / Forecast Expert |
| Mr. NISHIDA Takashi | Institution / Organization Expert |
| Dr. Ahmed EL-HAKIM | Traffic Management Planner |
| Mr. KIMURA Toshio | Traffic Management Planner |
| Mr. YUMITA Kazuo | Transport Economist |
| Mr. Sudad RAAD | Natural / Social Environmentalist |
| Mr. YASHIRO Shuichi | Traffic Survey / Forecast Specialist |

INTRODUCTION

INTRODUCTION

BACKGROUND

Since the end of the civil war in early 90s, the Government of Lebanon has focused its activities on the reconstruction and development throughout the country. In 1994, "Horizon 2000" was established with the approval of the cabinet as the core policy of a national development plan, through some reviews and alterations of previous development plans. The target year of the present program, which is covering all the development sectors, is the year 2007. The program emphasizes on the need to improve the road transport sector as one of the basic infrastructures. In addition, the national policy is calling for the decentralization of Government bodies, which gives Tripoli higher future role as the capital of the north.

Tripoli is the second largest city in Lebanon and the capital of Northern Lebanon Governorate. It is located at a distance of about 80 kilometers north of the capital Beirut. The development of Greater Tripoli through carrying out various infrastructure projects will encourage private investments and improve the economical base of the city to assume its future role.

Linked with international routes that go across the border of Syria, Tripoli is the core city of land transport in the area since long years ago due to the merit of its location facing the Mediterranean. In addition, Tripoli has the port that handles the second largest volume of cargo in Lebanon. There is also an airport at the north of the city that is non-operated at the moment but improvement plans for civil operation are under preparation. On the other hand, Tripoli has a high potential in development, as it is an important tourism center with many tourist and historical spots, and moreover, being a main center of financial services in the country.

The transportation system of Greater Tripoli is lacking many facilities as it depends comprehensively on the private cars, and shared-taxi is the most dominant mode for public transportation. With the rapid growth in population, urbanization and motorization in the city, the problem of traffic congestion has imposed itself to be a major issue for concerned authorities, including CDR, MOPWT and Municipalities. Several projects are being implemented or planned such as grade separation, signalization or the Arab Highway, etc. However, there is no integration with city planning or between transport sub-sectors development. In addition, deterioration of the urban environment is expected to increase with the increase in congestion of traffic generated by other development projects.

It was decided that in order to solve the transport problems in the city, a comprehensive master plan meets the city planning needs and integrates the sectors of road network improvement; modern public transport system and measures for traffic demand management should be developed with a time horizon of 2020. That Master Plan should also participate in improving deteriorated environmental conditions in the Study Area.

In response to the request of the Government of Lebanon, the Government of Japan has decided to conduct "The Study on Environmental Friendly Integrated Transportation Plan For Greater Tripoli" (hereinafter referred to as "the Study"), in accordance with the relevant laws and regulations in force in Japan. The Government of Japan has entrusted the Study to the Japan International Cooperation Agency (JICA), which is the official agency responsible for the implementation of technical assistance programs of the Government of Japan, to undertake it in close cooperation with the authorities in Lebanon. JICA has organized and dispatched a Study Team to Lebanon consisting of experts from Katahira & Engineers International to commence the study in October 2000. The Study proceeded for about fourteen months in Lebanon and Japan, and its Final Report is submitted to the Government of Lebanon in December 2001.

OBJECTIVES

1. To formulate an Urban Transportation Master Plan (M/P) for the Greater Tripoli Area to the year 2020, in order to alleviate present traffic congestion and to ensure safe mobility;
2. To formulate a 5-year plan composed of priority projects identified under the M/P;
3. To pursue technology transfer to the Lebanese counterpart personnel in the course of the Study.

THE STUDY AREA

The Master Plan covers the Municipalities of Tripoli, El-Mina, El-Bedaoui, Mejdlaya and Ras-Maska, while the Five-year Improvement Plan covers the Municipalities of Tripoli, El-Mina and El-Bedaoui. In Principal, the Study Area includes the areas west of the Northern Motorway and its corridor in the five Municipalities of Tripoli, El-Mina, El-Bedaoui, Mejdlaya and Ras-Maska, as shown in the location map.



Concentration of Socioeconomic Activities



Continuous Congestion in Central Tripoli

PART 1

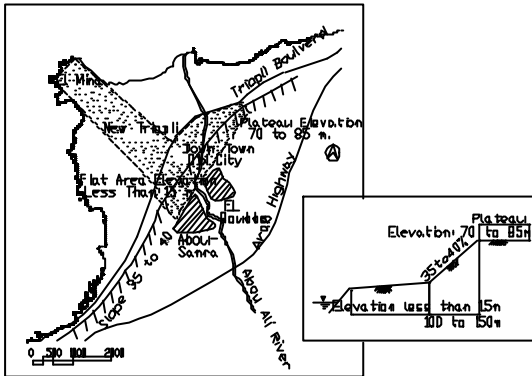
PRESENT AND FUTURE ISSUES

PART 1: PRESENT AND FUTURE ISSUES

1 SOCIOECONOMIC PROFILE

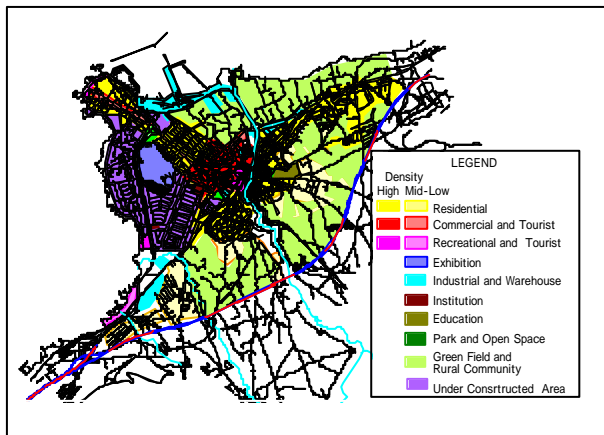
Urban Structure and Present Land Use

- Topographical features in the Study Area have great influence on the urban structure and land use activities. The municipality of Tripoli is divided into high land to the northwest and low land to the southeast. In addition, Abou Ali River lies between its western and eastern sections. High land is composed mainly of the two main urbanized areas of Abou Samra and El-Qoubbe.



Urban Structure and Topography

- There are only compact urban areas and most of the population and facilities are concentrated in few zones, namely the Old City, Central Area and El-Mina. This concentration causes deterioration to the urban environment.
- Environment is deteriorating as green areas are gradually disappearing. Orange orchards became new Tripoli housing areas. The green belt of olive groves is under the same fate.
- The city is facing commercial recession, decrease in tourism industry and adverse health impact due to deteriorated environment and under-developed transport system.



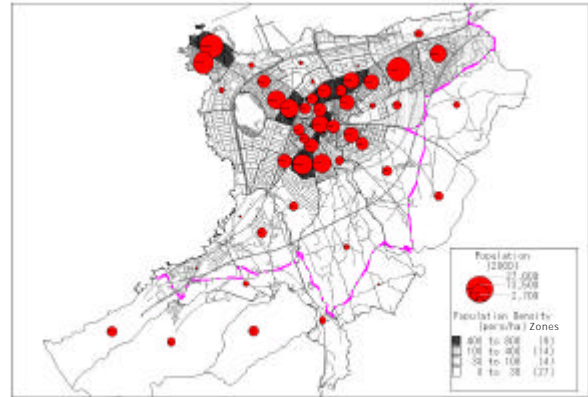
Present Land-use

Present Population Distribution

With the absence of official census data, estimation of population in the Study Area is greatly varied in different studies; between 300,000 and 500,000

inhabitants. Estimation of the Study, which is based on housing units and average occupancy, gives about 1/3 million of population. Main features are:

- Highest density: 684 person/ha
- Average density: 87.2 person/ha
- Number of employees: 120,400
- Number of students: 81,100



Present Population Distribution

Income and Vehicle Ownership

The average household income obtained from the Person Trip Interview survey is about LL 620,000 per month. With high incomes, vehicle ownership is about 1.38 per household. This high rate shows the high dependency on cars as a transport mode.

Vehicle Ownership

| Income LL 1,000/month | No. of Households | Full-time Use Vehicles | Vehicle / Household |
|--------------------------|----------------------|---------------------------|------------------------|
| No Answer | 46 | 26 | 0.57 |
| 0 – 150 | 48 | 8 | 0.17 |
| 151 – 300 | 238 | 86 | 0.36 |
| 301 – 600 | 712 | 376 | 0.53 |
| 601 – 750 | 668 | 486 | 0.73 |
| 751 – 1,500 | 596 | 556 | 0.93 |
| 1,501 and over | 384 | 528 | 1.38 |
| Total | 2,692 | 2,066 | 0.77 |

Socioeconomic Framework

Economic parameters for Tripoli are estimated on population-proportion basis in Lebanon. Growth rates and future sectorial development plans are applied to estimate future population, employees and students.

Future Socioeconomic Parameters for Study Area

| Parameter | 2000 | 2005 | 2010 | 2015 | 2020 |
|-------------|---------|---------|---------|---------|---------|
| GDP (LL B.) | 2,517 | 3,587 | 5,112 | 7,285 | 10,379 |
| Nominal GDP | 2,490 | 3,551 | 5,066 | 7,225 | 10,305 |
| Population | 330,900 | 360,300 | 390,400 | 421,000 | 454,200 |
| Employees | 120,491 | 143,454 | 168,870 | 196,727 | 228,297 |
| Students | 81,122 | 88,689 | 96,257 | 103,824 | 111,391 |

Policy of Urban Development and Reform

The main policy established by concerned agencies for urban development, which is based on the Planning Code of 1971, includes:

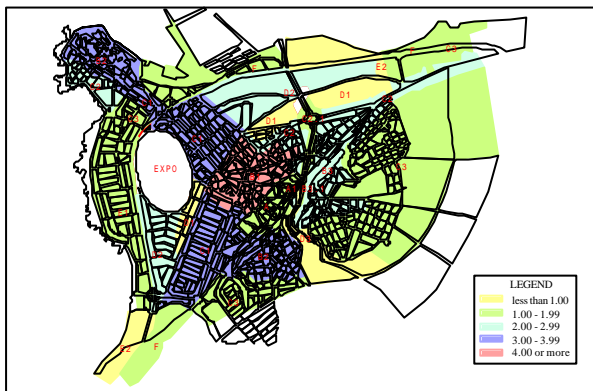
- Improving the environment of populated areas
- Planned functional guidance in new areas.

PART 1: PRESENT AND FUTURE ISSUES

- Preservation of historic heritage
- Well-balanced and spatial arrangement of urban functions.

In addition, and for urban structure development and improvement, the Study established the following fundamental policy for urban reform:

- Development of urban activity for an internationally focal city
- Realization of environmental friendly city
- Providing safety measures, such as emergency roads and open spaces
- Improving the urban structure by strengthening the historical nature of the city
- Improving the urban structure to respond to any drastic increase in population



Basic Floor Area Ratio

Alternative Urban Development Scenarios

In due consideration of existing problems and urban development policies, three urban development scenarios were developed under the Study in order to establish a clear vision and social frame base for the Study Area in the future.

Scenario - 1: Concentrated Urban Development

Development Direction:

- Develop further the existing urban area until its saturation.
- Follow natural Development trend at the planned development areas.

Main Issues:

- The existing urban area has already been developed with high density
- This will further aggravate present situation

Scenario - 2: Enlarged Urban Development

Development Direction:

- No active development of the existing urban area
- Guided development toward the fringe areas of existing urban area

Main Issues:

- The existing urban function will not be improved
- The existing deteriorated urban conditions will expand to its fringe area.

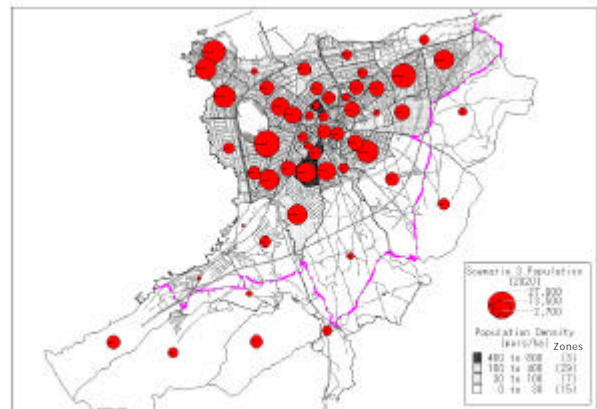
Scenario - 3: Spatial Urban Distribution

Development Direction:

- Controlled development of the existing urban area
- Active development for new planned development areas as self- sustainable communities

Main Issues:

- Strictly controlled development of existing urban areas, with the improvement of urban amenity and preservation of heritage and environment
 - Only tourism facility improvement to be allowed
 - Fewer zones with high population density
- Through comprehensive discussions with all involved parties, mayors and governmental agencies, Scenario - 3 was adopted.

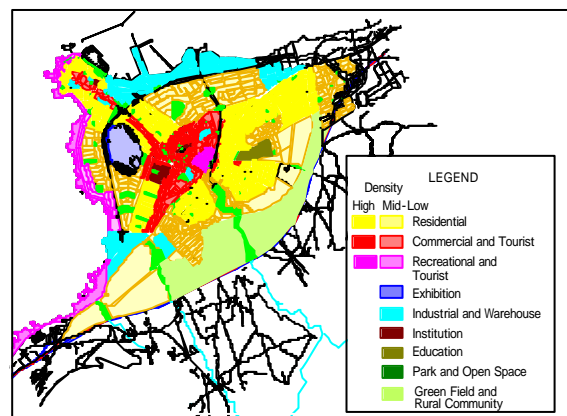


Future Population Distribution (Scenario – 3)

Future Land Use – Year 2020

In 1971, a Master Plan for land use for parts of the Study Area was prepared with a planning code and zoning system. An on-going plan is being prepared and its main concepts are used in the Study to establish a future land use map with the following characteristics and features:

- To move commercial and business functions from central areas to the west
- To improve the environment by the land acquired through re-adjustment schemes
- To develop the Old City as a tourist center
- To carry out environment improvement projects in El-Mina as well
- To develop New Tripoli as a business-oriented area
- To preserve the green belt of olive groves



Future Land Use Plan - 2020

PART 1: PRESENT AND FUTURE ISSUES

2 PRESENT TRANSPORT ISSUES

Urban Transport

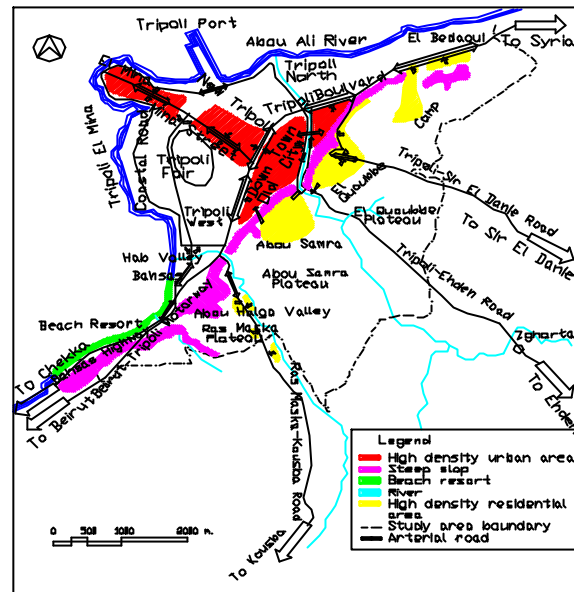
- New urban development projects are in progress in Tripoli is at present. As integration between urban planning and transport planning is not considered, the city is practicing transport and traffic problems.
- The government is planning to construct an Arab Highway, is constructing grade separation structures at two locations, and signaling some intersections without a comprehensive and integrated plan.
- The transport network is not well connected with illegal on-street parking that causes low speeds, high congestion, and high pollution in the Central Area.
- The low accessibility in Tripoli Central Area causes adverse impact on commercial and tourism activities and living environment.

Road Network Characteristics

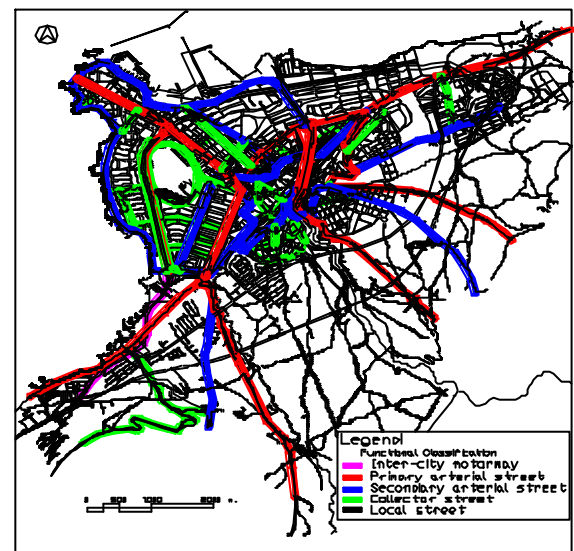
- The network is greatly influenced by topography; with two rivers and slopes of plateaus that compose physical constraints for well-planned network. The network has no direct connections between zones with low accessibility for plateaus.
- Length of roads in the Study Area, according to the functional classification is 3.61 km of motorways, 129.02 km of primary arterials, 29.15 km of secondary arterials and 26.62 km of district and other roads.
- The network features the concentration of all road classes (international, inter-regional inter-urban and urban street) and many radial arterials on Tripoli Boulevard that handles the highest traffic volumes in the Study Area.
- Alignments of roads in plateau areas are generally satisfactory except for some sections that have substandard vertical alignment. Pavements in flat plain areas are in fair condition, but in the plateau area rehabilitation is required
- There are too many narrow roads at old areas with high population density; such as Tripoli Central Area and Old City, and at El Mina that cause low road density. New areas have many well-formed roads but with almost same standards; functional hierarchy is not well achieved.

Level of Service

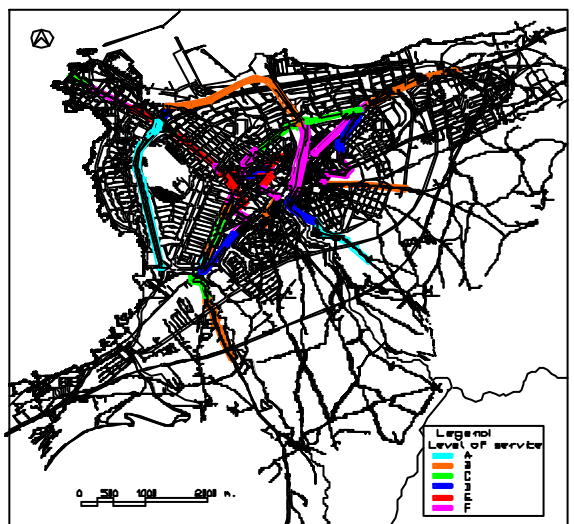
- The level-of-service is very low at old and densely developed areas with narrow roads. Also, the improvement or widening of roads is not possible due to roadside development and buildings.
- There are many multi-leg and irregular-shaped intersections with short intervals that cause traffic delay and low level-of-service.
- At most intersections of Central Tripoli and El Mina, low level-of-service (Flow/Saturation Flow) is found. The lowest level-of-service belongs to intersections along Tripoli Boulevard.
- Drivers' behavior, especially taxi-service drivers, is decreasing the level-of-service.



Existing Road Network Characteristic

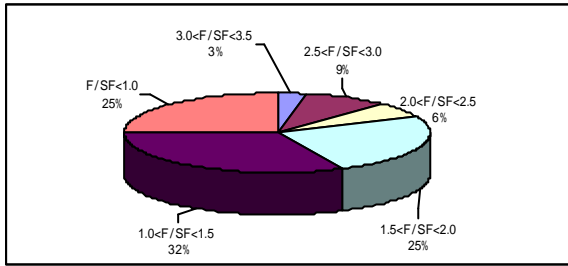


Functional Classification of Road Network



Level of Service

PART 1: PRESENT AND FUTURE ISSUES



Flow/Saturation Flow at Intersections

Travel Speed

- Most of the streets in newly developed areas have speeds over 30 km/hr
- Most of the streets in central areas have speeds less than 20 km/hr
- High speeds are observed on roads outside the built-up areas.

Traffic Volumes on Major Roads

| Road Name | Veh./day |
|-----------------------------|---------------|
| Tripoli Boulevard | 35,000-40,000 |
| El-Mina Street | 18,000-24,000 |
| Tripoli – Sir El-Danie Road | 7,000 |
| Tripoli – Ehden Road | 12,000 |
| Ras Maska – Kousba Road | 12,000 |
| Beirut – Tripoli Motorway | 30,000 |

- Most of taxi drivers are lacking appropriate traffic education and manner. The sudden stopping of taxis to load/unload passengers cause obstacles to traffic flow and may cause traffic accidents.
- The taxi fleet is composed mostly of very old cars that deteriorate environment. Survey results show over-supply of taxis that occupy road space for long time.

School Trips

- School buses in service are mostly large-sized that cause traffic congestion near schools.
- It is noticed that all schools have almost the same in/out time, which cause congestion at that time.
- There are no off-street parking areas near schools that can be identified for school buses.



On-street Taxi Parking

City Bus Service

- There is no city-bus service in the Study Area. Buses, which are parked on street in the Central Area, are used only for inter-city trips to other municipalities and to Beirut.
- There is no official authority based in Tripoli to handle public transport operation. In addition, there are no enough fund resources or a capable organization to operate an efficient bus system.
- The existing transport system can be considered as a car dominated transport system.

A well-planned city bus service can provide an environmental friendly public transport mode that can integrate with other modes for a more efficient transport system.

Taxi Service

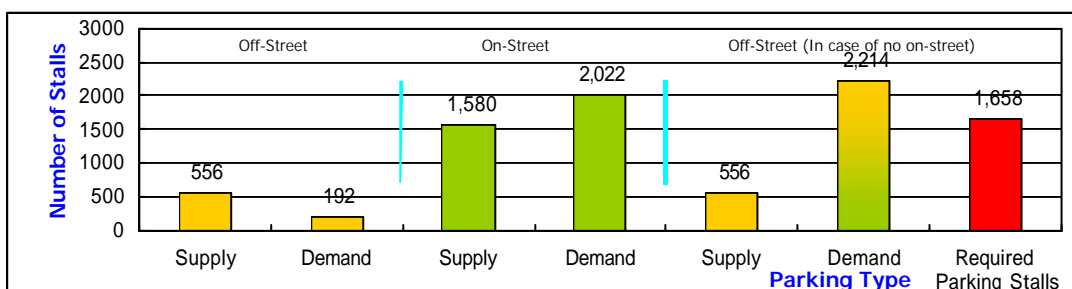
- With the absence of city bus service, taxi service is the most dominated public transport system for intra- and inter-city trips.
- There are no designated off-street spaces to be used as taxi terminals. The on-street parking of taxis, especially at intersections, is a major traffic problem in the Central Area.

Traffic Management

- There is no control or parking policy for the on-street parking even at intersection approaches.
- Single, double and triple parking are the main cause of traffic congestion in central areas.
- There is no plans for off-street parking facilities as well as for taxi stands and bus terminals.
- The one-way system is the only applied measure of traffic management. Signalization is under progress to improve traffic flow conditions.

Problem Identification

- The malfunction of the road network and extensive illegal on-street parking in central Tripoli result in heavy traffic congestion and deterioration of urban environment.
- The low level of service of streets and intersections causes increase in traffic cost and travel time.
- With low accessibility levels, tourism and commercial activities are badly affected.
- In new development areas, low consideration is given to the road and transport system.
- Transport projects are implemented individually without due coordination or integration with others.



Parking Demand and Supply in Surveyed Areas (2000)

PART 1: PRESENT AND FUTURE ISSUES

3 TRANSPORT DEMAND FORECAST

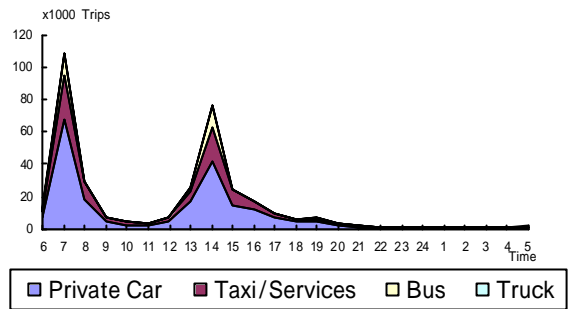
Present Transport Pattern

To study the present transport pattern and existing problems as well as to forecast the future demand, the following surveys were conducted in the Study Area:

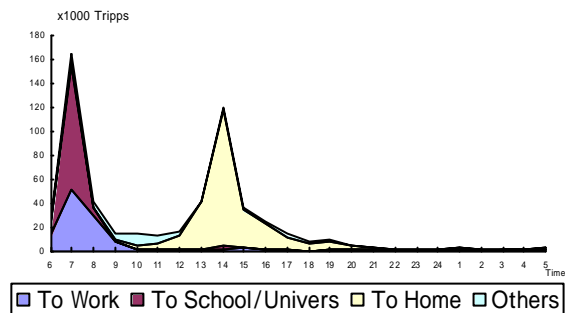
- Person-Trip
- Commodity Movement
- Cordon Line
- Screen Line
- Intersection Traffic Volume
- Public Transport
- Travel Speed
- Parking
- School Trips

Person Trip Characteristics

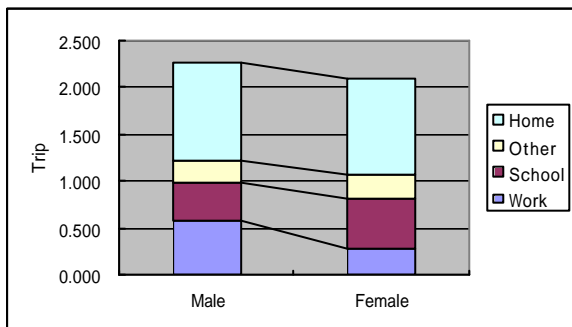
The population over 6 years old, which is 297,840 inhabitant, produces a total of 694,423 trip/day, with an average of 2.332 trip/person/day. Average generated trips by males is 2.424 trip/day and for females 2.240 trip/day. Major trip purposes are those for work and school trips. Person trips by mode are distributed between all modes and the highest vehicular share is for taxi trips.



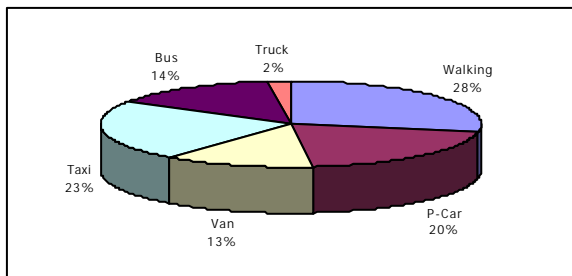
Generated Trips by Time and Mode



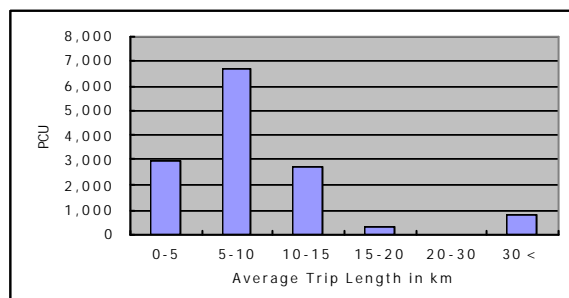
Generated Trips by Time and Purpose



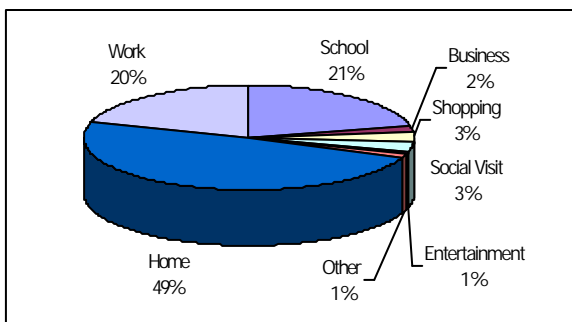
Trip Purpose by Gender



Person Trip Composition by Transport Mode



Person Trip Length Distribution



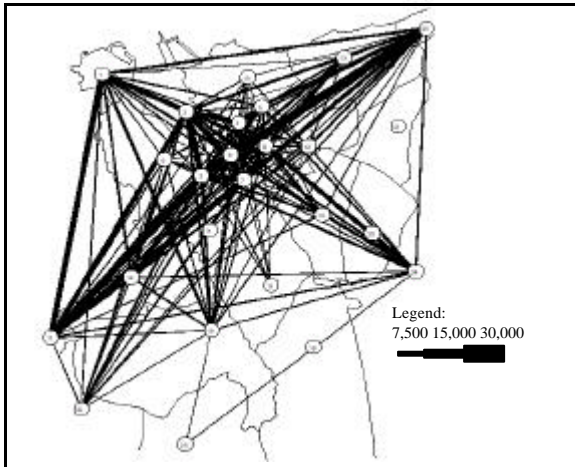
Person Trip Generation by Purpose

The average vehicle ownership of 0.77 vehicle/household is relatively high and most of the vehicles are old with more than 16 years in service.

| Vehicle Age | | Vehicle % |
|--------------------|--|-----------|
| Less than 5 years | | 4.6 |
| 6 – 10 years | | 10.0 |
| 11 – 15 years | | 26.6 |
| More than 16 years | | 58.8 |
| Total | | 100.0 |

PART 1: PRESENT AND FUTURE ISSUES

The desire line chart of the present trip pattern shows concentration of all trips through the city center as most of the socioeconomic activities exist in central zones.



Present Desire Line Chart

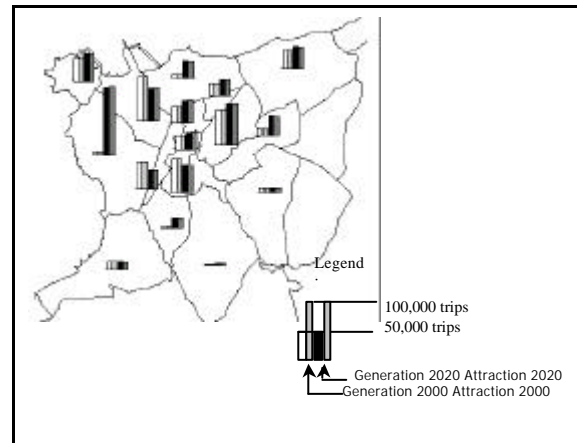
Present and Future Vehicular Trips

| Vehicle Category | 2000 | 2020 | 2020/2000 |
|-----------------------|---------|---------|-----------|
| Internal Trips | 176,418 | 270,732 | 1.535 |
| Passenger Car | 125,688 | 181,817 | 1.447 |
| Taxi | 33,466 | 44,283 | 1.323 |
| Bus | 8,626 | 11,204 | 1.299 |
| Truck | 8,638 | 33,428 | 3.870 |
| External Trips | 105,712 | 143,670 | 1.359 |
| Passenger Car | 79,275 | 110,812 | 1.398 |
| Taxi | 18,846 | 24,721 | 1.312 |
| Bus | 2,771 | 3,317 | 1.197 |
| Truck | 4,820 | 4,820 | 1.000 |
| Total | 282,130 | 428,233 | 1.518 |
| Passenger Car | 204,963 | 292,629 | 1.428 |
| Taxi | 52,312 | 69,004 | 1.319 |
| Bus | 11,397 | 14,521 | 1.274 |
| Truck | 13,458 | 52,079 | 3.870 |

Future Demand Forecast

The four-step forecast method is applied in this Study through the use of JICA STRADA models. Based on the present OD matrices estimated through the collected person-trip data and established socio-economic framework, future generated and attracted trips were forecasted by applying multiple linear regression models.

Generated and attracted trips were distributed on zonal basis to produce future OD matrices that were assigned on the road network in order to identify the magnitude of potential transport problems in the future and to establish the required transport improvement components of the Master Plan projects up to the target year 2020.



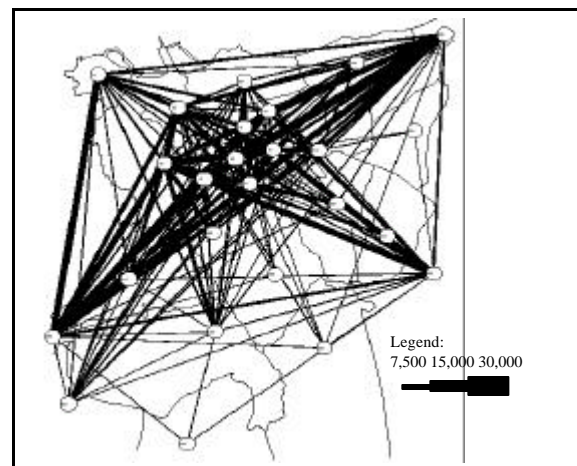
Present and Future Generated and Attracted Trips

Generated and Attracted Trips

The newly developed areas will generate a considerably high trip rates. Generation pattern from zones in the Central Area of the city is expected to change due to tendency in land-use changes from mostly residential areas to more business and commercial activities.

Person Trips by Trip Purpose and Mode

| Trip | 2000 | | 2020 | |
|---------------------|----------------|--------------|----------------|--------------|
| | Trips | % | Trips | % |
| Trip purpose | | | | |
| To Work | 137,169 | 19.8 | 231,016 | 23.6 |
| To School | 146,949 | 21.2 | 221,833 | 22.7 |
| Others | 79,100 | 11.4 | 102,449 | 10.5 |
| To home | 331,205 | 47.7 | 423,566 | 43.2 |
| Mode | | | | |
| Walking | 193,587 | 27.9 | 265,507 | 27.1 |
| Pass. Car | 228,494 | 32.9 | 330,535 | 33.8 |
| Bus | 97,641 | 14.1 | 129,150 | 13.2 |
| Taxi | 161,324 | 23.2 | 209,514 | 21.4 |
| Truck | 13,377 | 1.9 | 43,958 | 4.5 |
| Total | 694,423 | 100.0 | 978,864 | 100.0 |



Future Desire Line Chart

Assigned Traffic Volume - 2000

The highest daily traffic volumes are those on the expressway to Beirut with a little more than 40,000 vehicles and followed by volumes on the northern highway to Syria with a little less than 40,000 vehicles. Streets in the newly developed areas provide higher travel speed when compared with streets in the densely populated Central Area.

PART 1: PRESENT AND FUTURE ISSUES

Tripoli Boulevard, which is the main arterial in Central Tripoli, shows low average speed and level of service "F" for a length of about 1.3 kilometer.

**Assigned Traffic Volume - 2020
(Do Nothing Case)**

The northern highway to Syria accommodates high daily traffic volumes of more than 60,000 vehicles and the speed is less than 20 km/hr on all the segments. On the expressway to Beirut, volumes are a little lower than 60,000 vehicles and speeds are still over 30 km/hr. Almost all of the streets in the central and northern areas well as roads connecting the Study Area with other neighboring municipalities have speeds less than 20 km/hr. Speeds higher than 30 km/hr exist on the expressway to Beirut and coastal road in the municipality of El-Mina. The resulted average high speeds and low congestion degrees are due to suburban and rural roads in the Study Area.

Traffic Assignment Results

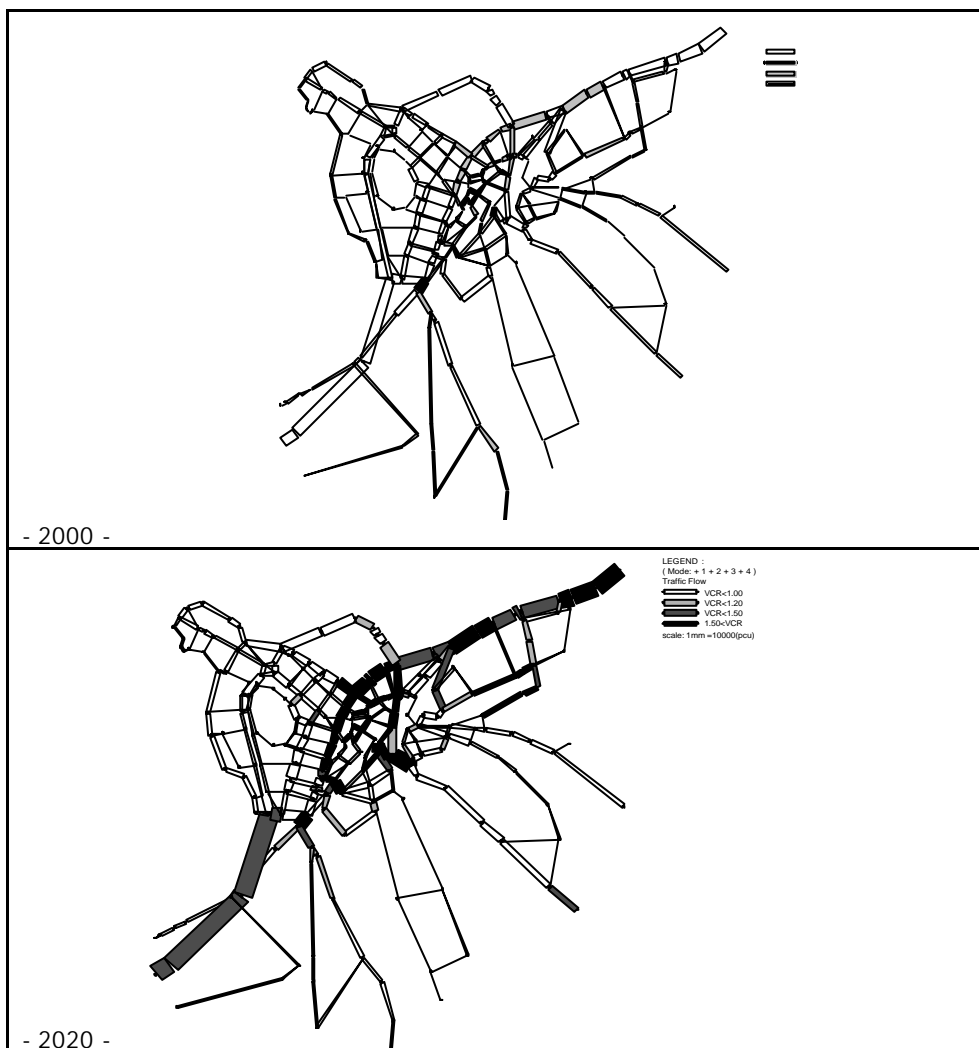
| Year | PCU- Kms | PCU-Hours | Average Congestion Rate | Av. Travel Speed (km/h) |
|------|-----------|-----------|-------------------------|-------------------------|
| 200C | 1,402,912 | 25,652 | 0.384 | 54.7 |
| 200E | 1,991,996 | 42,419 | 0.545 | 46.9 |
| 201C | 2,137,628 | 47,041 | 0.585 | 45.4 |
| 202C | 2,391,839 | 56,385 | 0.655 | 42.2 |

Road Lengths by Traffic Congestion Degree (Km)

| Congestion Degree | 2000 | 2005 | 2010 | 2020 |
|-------------------|-------|-------|-------|-------|
| >0.5 | 90.2 | 66.3 | 60.8 | 56.8 |
| 0.5-0.8 | 24.8 | 33.1 | 34.7 | 31.3 |
| 0.8-1.0 | 9.8 | 10.7 | 11.7 | 12.9 |
| 1.0-1.2 | 5.6 | 12.9 | 14.1 | 10.8 |
| 1.2-1.5 | 0.1 | 4.2 | 5.9 | 11.7 |
| >=1.5 | 0.2 | 3.5 | 3.5 | 7.2 |
| Total | 130.7 | 130.7 | 130.7 | 130.7 |

Problem Identification

- From 2000 to 2020, the average travel speed will decrease from 54.7 to 42.2 km/hr and the average volume/capacity congestion rate will increase from 0.384 to 0.655 on the whole road network, which will cause huge increase in traffic cost.
- Tripoli Boulevard will face severe traffic congestion in the future that will negatively affect the urban environment
- Most of the streets in the central Area will be subject to high congestion rates over 1.5 with heavy traffic volumes and congestion. Decreasing accessibility will produce adverse impact on commercial and tourism activities.



Present and Future Assigned Traffic – "Do Nothing" Case