

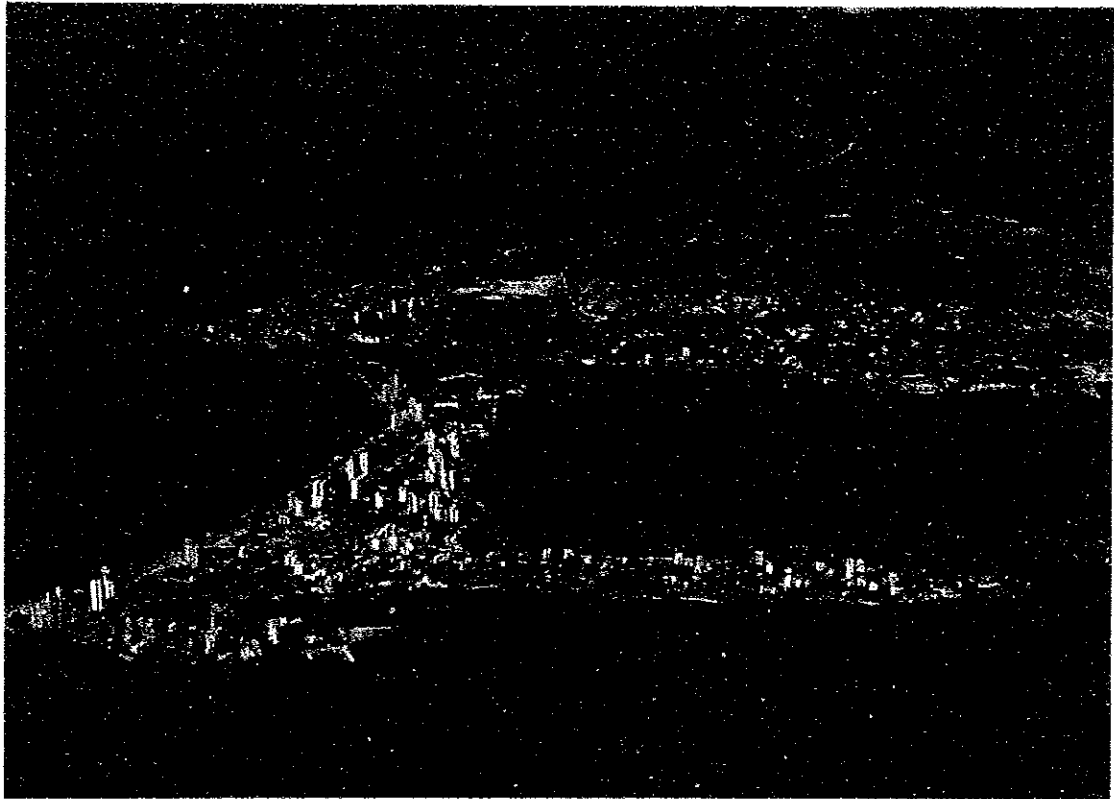


The Urban Transport Study  
in the City of Cartagena de Indias  
of The Republic of Colombia

Final Report

November 1992

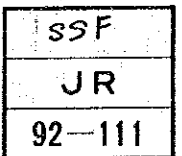
# The Urban Transport Study in the City of Cartagena de Indias of The Republic of Colombia



Final Report

November 1992

Japan International Cooperation Agency



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# **The Urban Transport Study in the City of Cartagena de Indias of The Republic of Colombia**

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**Japan International Cooperation Agency**

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## PREFACE

In response to a request from the Government of the Republic of Colombia, the Government of Japan decided to conduct a study on the Urban Transport Study in the City of Cartagena de Indias of the Republic of Colombia and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Colombia a study team headed by Mr. Takeo SATO, Chodai Co., Ltd., three times between March 1991 and November 1992.

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

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

I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Colombia for their close cooperation extended to the team.

November 1992



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Kensuke Yanagiya  
President  
Japan International Cooperation Agency



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## LIST OF ABBREVIATIONS

JICA	:	JAPAN INTERNATIONAL COOPERATION AGENCY
DNP	:	DEPARTAMENTO NACIONAL DE PLANEACION
EDURBE	:	EMPRESAS DESARROLLO DE URBANO DE BOLIVAR
INTRA	:	INSTITUTE NACIONAL DE TRANSITO
DATT	:	DEPARTAMENTO ADMINISTRATIVO DE TRANSPORTE Y TRANSITO
DANE	:	DEPARTAMENTO ADMINISTRATIVO NACIONAL DE ESTADISTICA
CBD	:	CENTRAL BUSINESS DISTRICT
GDP	:	GROSS DOMESTIC PRODUCT
GRP	:	GROSS REGIONAL PRODUCT
B/C	:	BENEFIT COST RATIO
B-C	:	DIFERENCE BETWEEN BENEFIT AND COST
NPV	:	NET PRESENT VALUE
IRR	:	INTERNAL RATE OF RETURN
VOC	:	VEHICLE OPERATING COST
TTC	:	TRAVEL TIME COST
OD	:	ORIGIN AND DESTNATION
V/C	:	VOLUME CAPACITY RATIO OF TRAFFIC
KT	:	KNOT
hr	:	hour
ha	:	hectare
m <sup>2</sup>	:	square-meter
km <sup>2</sup>	:	square-kilo-meter
\$	:	Colombian Peso
US\$	:	United States Dollar





## CHAPTER 1 INTRODUCTION

### 1.1 Background

1. Cartagena is the capital of Bolivar State and is located about 600 km north of Bogota. During the colonial era, Cartagena developed as a sea port on the Caribbean side. In recent years, it developed as the industrial zone as well as tourism site of the historical city.

2. Its population in 1985 was about 530 thousand and has been growing at a high average rate of about 4.5% annually for a past decade. It is expected to be about 1,200 thousand in the year 2010.

3. Economic growth of Colombia is comparatively steady. GDP (Gross Domestic Products) in 1988 was 11,695 billion pesos and showed average growth rate of about 3.5% per annum for last ten years. The economy of the Study Area in recent years was based primarily on the manufacturing and tourism industries. The value added in Cartagena represented 3.4% of the national total.

4. Urban area of Cartagena has been expanding rapidly in accordance with the population growth of the City. The Central Area, called "Centro", is the major business, commercial, government administrative, residential and tourism district. This area is surrounded by stone walls from the colonial era and still has many of the historical buildings at that period.

5. The residential area is growing along the main roads such as Avenida Pedro de Heredia, Avenida Bolivar, Diagonal 22 and Carretera Troncal de Occidente in a north-west to south-west direction from Centro.

6. Traffic condition in the urban area of the City is not yet in serious condition due to the low car ownership (about 25 thousand vehicles excluding motorcycles in July 1991). The operation of public transportation is demand-oriented and vehicles used are generally very old. More than eighty per cent (80%) of a person trips depend on public bus service. Ten (10) private enterprises operate the public bus services. There are some forty (40) bus routes covering the urban area. Bus facilities such as bus bay, terminal and exclusive bus lane are very few.

7. Due to the small of the road network system and the concentration of the urban activities into the Central area, the traffic tends to concentrate into a few major roads such as Avenida Pedro de Heredia and Diagonal 22 - Carretera Troncal de Occidente. Physical condition of the city urban center surrounded

by the sea, bays, canals and lakes makes it difficult to improve the urban transportation system.

8. Based on the growth of urban population size and socio-economic activity in the Study Area by 2010, the number of person trips is expected to become more than twice that of the present level. This condition will place a severe strain on the current transport network system unless some improvements are introduced.

9. In view of above problems, it is imperative to improve the urban transport system in Cartagena Urban Area. In order to carry out the above program effectively, it is necessary to establish a comprehensive urban transport plan including a future land use plan for the Area.

10. With the above objectives in mind, the Government of Colombia requested the Government of Japan for an assistance to conduct the Masterplan Study on Urban Transport in Cartagena in 1990. In response to this request, the Government of Japan through its implementation agency, the Japan International Cooperation Agency (JICA), began to carry out this study jointly with the Government of Colombia since June 1991.

## 1.2 Objectives of the Study

11. The objectives of the Study are to formulate a transport masterplan including transport policies, a development plan and program for the short and long terms, and a future land use plan in the Study Area, that will effectively serve the present and future transport demands and contribute to urban development in the Cartagena Urban Area (CUA).

### 1.3 Study Area

12. The Study Area covers the present and future urbanized area of the Municipality of Cartagena de Indias, almost equivalent to its administrative territory shown in Figure 1.3-1.

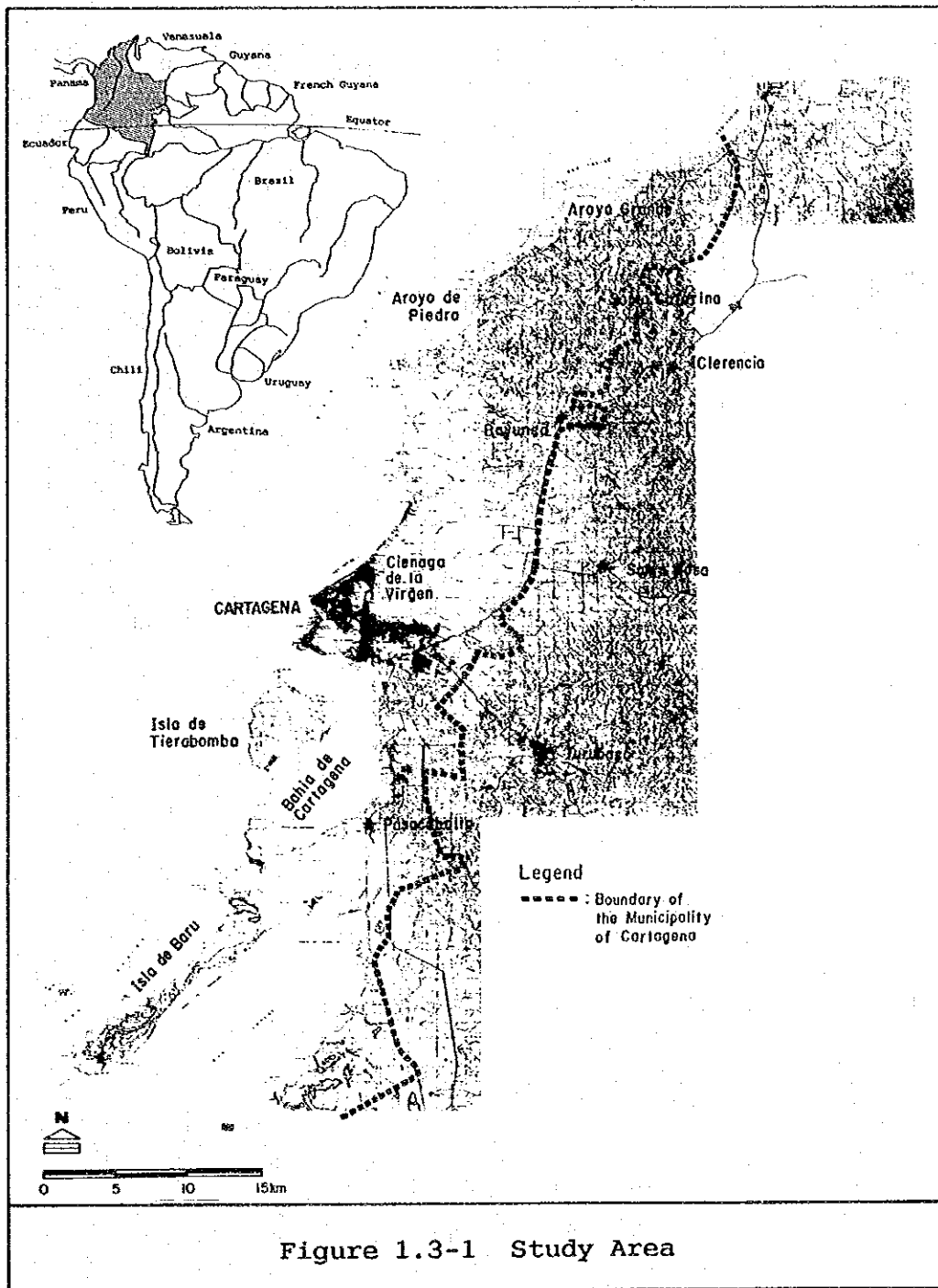
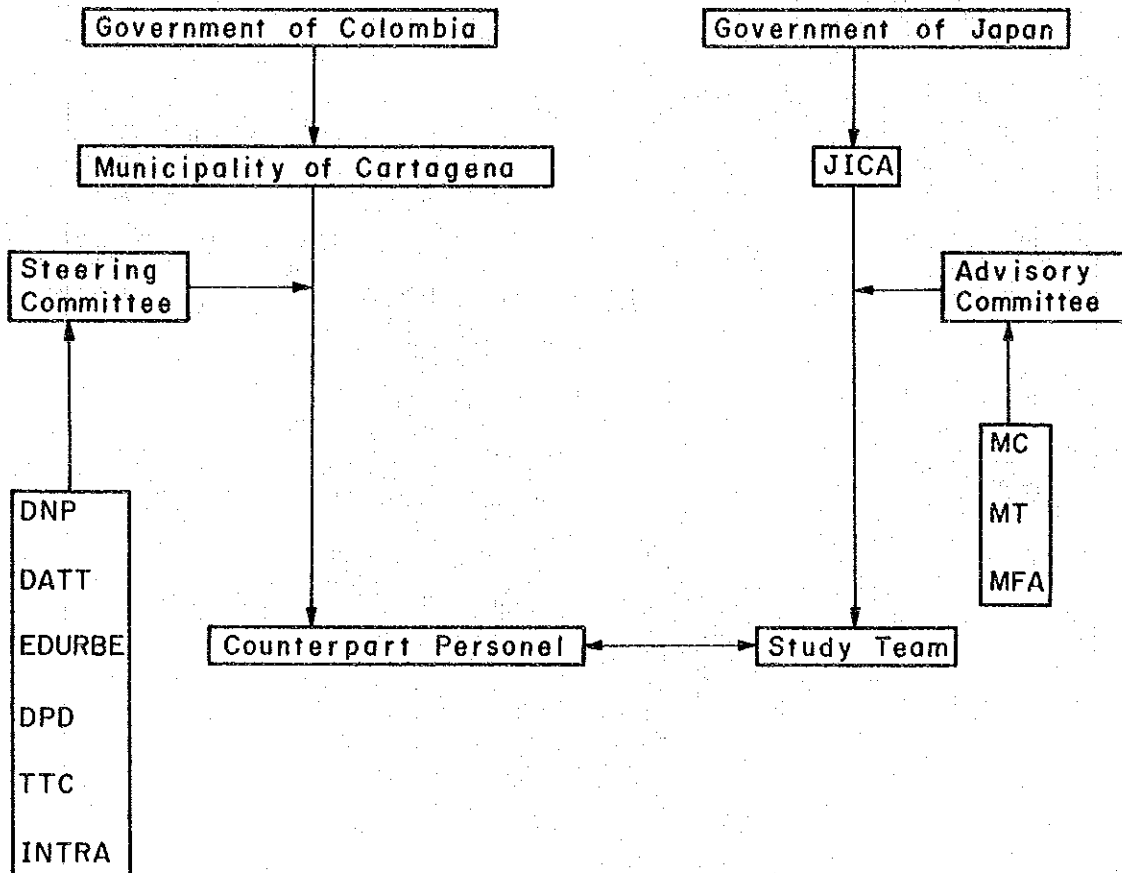


Figure 1.3-1 Study Area

#### 1.4 Study Organization

13. The Study has been carried out in Colombia and Japan jointly by JICA and the Government of Colombia in coordination with other agencies. The organizations involved in the Study are shown in Figure 1.4-1.



- DNP : Departamento Nacional de Planeacion  
 DATT : Departamento Administrativo de Transporte y Transito  
 EDURBE: Empresa de Desarrollo Urbano  
 DPD : Departamento de Planeacion Distritales  
 TTC : Terminal de Transporte de Cartagena  
 INTRA : Institute Nacional de Transito
- MC : Ministry of Construction  
 MT : Ministry of Transport  
 MFA : Ministry of Foreign Affairs

Figure 1.4-1 Study Organization

## 1.5 Organization of Cartagena City

14. The organization chart of the Municipality is shown in Figure 1.5-1. The sections marked with asterisk are the major sectors concerned with the Study.

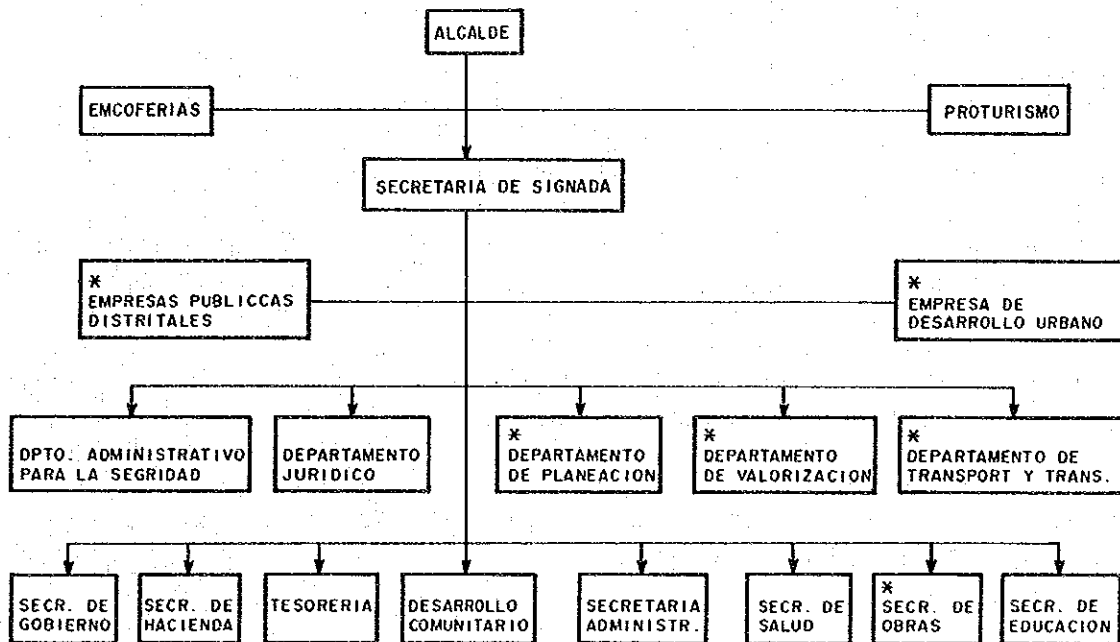


Figure 1.5-1 Organization Chart of the Municipality

15. Departamento de Planeacion is in charge of the control and planning of the land use, environment, sanitation and building schemes of the City. This section is also in charge of the coordination and adjustment of the city projects, and the review and revision of the development master plan. However, such functions are not organized at present.

16. Departamento de Valorizacion is the section involved in the road improvement and construction based on the special taxation on the real estates which will be affected by road construction and improvement. This section prepares the plans to construct the roads or to pave the streets based on the Municipal Development Masterplan and requests from the congress of Comunas (regional unit of the City). The projects are carried out through bank loans and repayments are made by the taxes of valorizacion. This groups carries out only the community road improvement at present, however, it is capable of including the major arterial road construction.

17. Departamento Administrativo de Transit y Transporte (DATT) is in charge of overall transport and traffic matters in the urban area of the City. The responsibility for the management of traffic and transportation in the municipal area was transferred from the State Government to the Municipal Government by the National Law Decreto No.80-87 in January 1987. One year was reserved for the transfer. Its functions are;

- a. driver licensing and education,
- b. vehicle registration and inspection,
- c. investigation and statistics on transport and traffic,
- d. control and sanction for transport companies,
- e. road traffic control and enforcement, and
- f. installation and maintenance of traffic control facilities.

For the enforcement of the traffic regulation and the maintenance of smooth traffic flow, DATT has its own police force (Policia de Transit y Transporte) consisting of some 70 policemen. The budget of DATT is partially funded from the city budget (30 percent of road user tax), as well as licensing and vehicle inspection fees, and fines (traffic violation charge).

18. Secretaria de Obras is the section in charge of public works of the City. Its staff is small and currently its functions are limited to road maintenance.

19. Empresas Publicas Distritales (EE.PP.MM.) is the public corporation for the utility planning, the construction and maintenance of water supply and sewage system in the City. However, it includes the operation and maintenance of the road system, parks and public markets. Its budget is composed of the service charges, city budget (50 % of property tax) and loans from national government agencies and international agencies. For the purpose of the garbage collection, EPM began recently to construct the brick paved community roads.

20. Empresa de Desarrollo Urbano de Bolivar (EDURBE) is the public corporation for the urban development such as residential area development, environmental improvement, tourism development, mass transit improvement, etc. In order to fulfill its duties, EDURBE handles many kinds of functions like road construction, canal/lake improvement, demolition and renewal of the residential area, construction of tourist facilities, promotion of the water transport system etc. The budget of EDURBE is generated from the following sources;

- a. subsidies from central state and municipal governments,
- b. special purpose tax on gasoline: mass transit improvement,
- c. sale of developed land,

- d. wharf rent, and
- e. loans from national government agencies and international agencies.

21. There are three organizations related to the improvement of the road network system in Cartagena, Departamento de Valorizacion, Empresa Desarrollo Urbano and Secretaria de Obras. However, there is no current coordinating section between these organizations for the planning of new road construction or improvement. Departamento de Planeacion should play this role.

22. As for the water transport, there is no authorized organization responsible for the development and maintenance of the system, or for the licensing and control of the operators. EDURBE has intention to develop the water transport system in conjunction with the improvement project of the canals and cienagas. However, in the Bay of Cartagena the port authority is in charge of licensing and inspection for the introduction and operation of the passenger transport.

23. It is clear that the responsibilities for the development of the water transport system without any constraint is necessary for the following areas;

- a. development and maintenance of the navigation channel,
- b. construction and maintenance of the wharves and terminals,
- c. licensing and control of the operators,
- d. vessel registration and inspection, and
- e. operation control and statistics.





## CHAPTER 2 CURRENT SOCIOECONOMIC TREND AND EXISTING LAND USE

### 2.1 Socioeconomic Conditions of Colombia

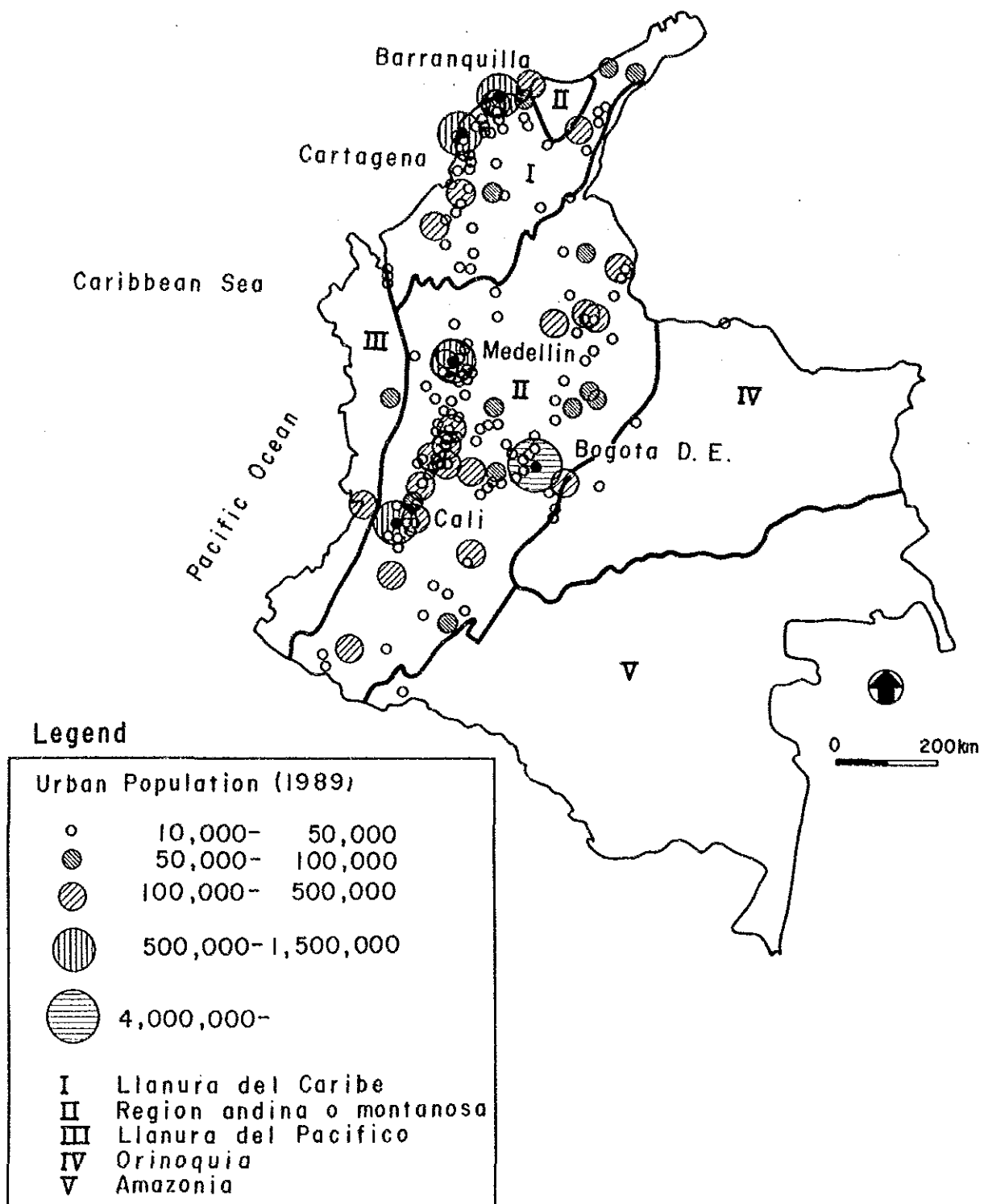
#### 2.1.1 Location and General Aspects

24. The Republic of Colombia, including its maritime territories is situated at the northwestern end of South America, between lat.  $4^{\circ} 13'S$  and lat.  $17^{\circ} 50'N$  and between long.  $66^{\circ} 50'W$  and long.  $84^{\circ} 46'W$ . The total area of the country is 2,070,408 km<sup>2</sup>, of which 1,141,748 km<sup>2</sup> correspond to the continental and insular lands. The continental part is very varied in its topography, from low lands of 0 m above sea level to permanent snow-covered mountain peaks about 5,770 m above sea level.

25. Based on the topography and other natural conditions such as the climate, geological structure and vegetation, the continental area can be divided into 5 natural regions: Andina, Llanura del Caribe, Llanura del Pacifico, Orinoquia and Amazonia (refer to Figure 2.1-1). During the colonial period, the people settled in the Andean high lands and the valleys of high Magdalena and Cauca in the Andina region and in parts of the Caribbean coast in the Llanura del Caribe. Thus, they selected lands good for agriculture and strategically located for international trade. In 1825, just after the Independence War, about 1.2 million people lived around these areas. Colonization of the mountain slope in the Andina region started since the middle of the 19th century. The motive of this process was the necessity of widening the agriculture frontier in order to give food and occupation to the growing population. Coffee growing began in those days.

26. Finally, since the beginning of this century, the Orinogua, Amazonia, Llanura del Pacifico and the southern part of Llanura del Caribe became the objects of settlement. These areas have high humidity and temperature, with very poor soil, and mostly covered by the jungle.

27. Reflecting this settlement history, nearly 3/4 of the total population of the country live in the Andina region and 20% in the Llanura del Caribe. The average population densities are the same at 63 persons per km<sup>2</sup>.



Source; Atlas y Geografia de Colombia

Figure 2.1-1 Natural Regions and Population Distribution

### 2.1.2 Social Conditions

28. In 1990, the total population of Colombia is estimated at 33 million, with 2/3 liveing in urban areas. According to the 1985 Census (revised), the national capital of Santa Fe de Bogota has a population of 4,236 thousand, followed by Medellin (1,480 thousand), Cali(1,429 thousand), Barranquilla(927 thousand) and Cartagena(564 thousand). Colombia is a country in process of accelerated urbanization. While in 1951 38.7% of the population lived in urban areas, in 1985 65.3% of the total became urban population (refer to Table 2.1-1). The rural-urban migration has been caused by the factors such as the difficult economic conditions, lack of adequate public services and deterioration of insecurity in the countryside. The existence of various opportunities such as jobs, education and health in the cities also encouraged this migration to urban centers.

29. Colombia is suffering from socioeconomic problems common throughout the Latin American world. Successive President's administrations of 4-year term have made efforts to cope with the difficulties through their own social and economic policies expressed in the form of the short-term national plans. As described in the following clause, macroeconomic indices of this country have been improved through the second half of 1980s. But social aspects seem to be worsening. The governments' efforts could not catch up with the population growth and the urbanization, and as a result, serious shortages occurred in the fields of public services, health, education and housing. According to a survey carried out by DANE in 1987, 45.6% of the national population live in poverty and 22.8% in misery.

30. This situation has increased social conflicts, and, in 1980s, in addition to the guerrilla war, new types of violence appeared. Violence of the drug trade, terrorism, paramilitarism and general violent crime have become common and daily happenings. Although national policies in a new plan of the present administration are not yet made public, it is expected that the first step towards improvement of these social conditions will be taken by the government with the help of the favorable economic situation.

Table 2.1-1 Population Increase and Urbanization

Year	Population	Average Annual Increase Rate(%)	Percentage of Urban Population
1951	11,548,172	-	28.7
1964	17,484,508	3.24	52.0
1973	22,915,229	3.05	59.4
1985	30,062,200	2.29	65.3

Source: DANE - Population Census

### 2.1.3 Economic Conditions

31. During the first half of 1980s, Colombian economy experienced a low growth (2.2% per annum on average), but since 1986 it sustained a moderate improvement, supported by a favorable trade balance (refer to Table 2,1-2). As the average annual population growth rate is estimated at 2% in 1980s, per capita GDP has steadily been rising. Per capita GDP in 1989 was about 470 thousand pesos. Considering the exchange rate in that year, per capita GDP expressed in the US dollars was a little higher than US\$ 1,000.

Table 2.1-2 GDP Growth Trend

Year	GDP Growth Rate(%)	Per capita GDP <sup>3)</sup> Growth trend(%)
1980 - 1985	2.2	0.1
1986	5.8	3.8
1987	5.4	3.3
1988	4.1	2.0
1989	3.1 1)	1.2
1990	3.7 2)	1.7

Source : DANE

Note : 1) Preliminary

2) DNP projection

3) Study Team calculations based on the estimated population by DANE

32. For the economic growth of Colombia, exports have been an important factor. In the early 1980s, a successive negative growth of exports was the main cause of the stagnant economic situation (refer to Table 2.1-3).

33. The recent sustained economic growth is a result of

diversification in the exported items, that is, the export of oil and other mineral products began to supplement the fluctuating export value of coffee (refer to Table 2.1-4).

34. During the period from the end of 1970s to the beginning of 1980s, the Colombian government invested a huge amount of foreign loans in large-scale mining projects. In recent years these mining projects went into operation one after another.

Table 2.1-3 Contribution of Exports to GDP Growth (%)

Year	GDP Growth rate	Exports of goods <sup>3)</sup> and services	Other <sup>3)</sup> items
1980	4.1	0.9	3.2
1981	2.3	- 2.0	4.3
1982	0.9	- 0.2	1.1
1983	1.6	- 0.1	1.7
1984	3.4	1.4	2.0
1985	3.1	2.0	1.1
1986	5.8	3.2	2.6
1987	5.4	1.4	4.0
1988	4.1	0.0	4.1
1989	3.2 1)	1.6	1.6
1990	3.7 2)	1.8 2)	1.9 2)

Source : DANE

Note : 1) Preliminary

2) FEDESARROLLO projections

3) Study team calculations based on the DANE data

Table 2.1-4 Exports of Goods (US\$ million %)

	1987	1988 1)	1989 1)	1990 2)
Coffee	1633.0(30.4)	1621.1(31.4)	1476.8(23.9)	1414.6(20.0)
Oil	1341.6(24.9)	988.2(19.1)	1398.7(22.7)	1934.5(27.3)
Coal	262.9 (4.9)	304.2 (5.9)	457.0 (7.4)	539.2 (7.6)
Other products	2142.8(39.8)	2254.6(43.6)	2854.2(46.1)	3191.2(45.1)
Total	5380.3(100)	5168.1(100)	6186.7(100)	7079.5(100)

Source : DANE

Note : 1) Provisional

2) Based on the customs house data

35. Colombia, as well as other Latin American countries, fell into foreign debt crisis in the early 1980s, but, comparatively, the amount of foreign debt of the country was not so

large and accelerated. According to a recent document of the Banco de la Republica, as a greater part of the increase of foreign debt was concentrated during the period of 1979-1982, it was clear that repayments of capital would become a heavy burden in the second half of 1980s when the grace periods expired. On the other hand the inaugurations of big projects were expected during the same period, and foreign currency obtained through the export of the products was to be allotted for a part of repayments. Colombia did not adopt a policy of rescheduling like other countries, but a policy of refinancing.

36. After obtaining of a new loan of US\$ 1 billion from consortium banks in 1986, the country received large-scale refinancing loans successively. The reasons which made possible these negotiations are moderate economic growth, exports of coffee and oil, and an impact of devaluation in real terms on the export of nontraditional products. As a loan of US\$ 1.775 billion during the period of 1991-1994 was agreed, the policy of introducing foreign money by refinancing seems to be successful.

## 2.2 Socioeconomic Conditions of the Study Area

### 2.2.1 History of the Study Area

#### (1) 1533-1800

37. Cartagena de Indias was founded in 1533 by Pedro de Heredia. The name "Cartagena" came from the name of the bay which was given by the famous navigator Juan de la Cosa when he entered the bay because it reminded him of Cartagena, Spain. Pedro de Heredia had streets and plazas drawn up and surveyed, lots apportioned for the Church, for the City Hall, and for the first European settlers, and carried out all the formalities required by Spanish law. The city was called Cartagena de Indias, to differentiate it from the other Cartagena in Spain.

38. It became the most important port of trade between the Spanish Kingdom and the American Colonies. After a great fire in 1552, only stone, brick and tile were permitted in construction. But because of its wealth, Cartagena was frequently attacked by pirates. Until around 1800, the population growth was very slow and about 10,000 persons lived in the walled area of only 80 hectares (refer to Figure 2.2-1).

#### (2) 1800-1905

39. Cartagena was a center of the Independence War, and through the beginning of the Republic Age, frequent civil wars, blockades by foreign countries and the cholera epidemic caused

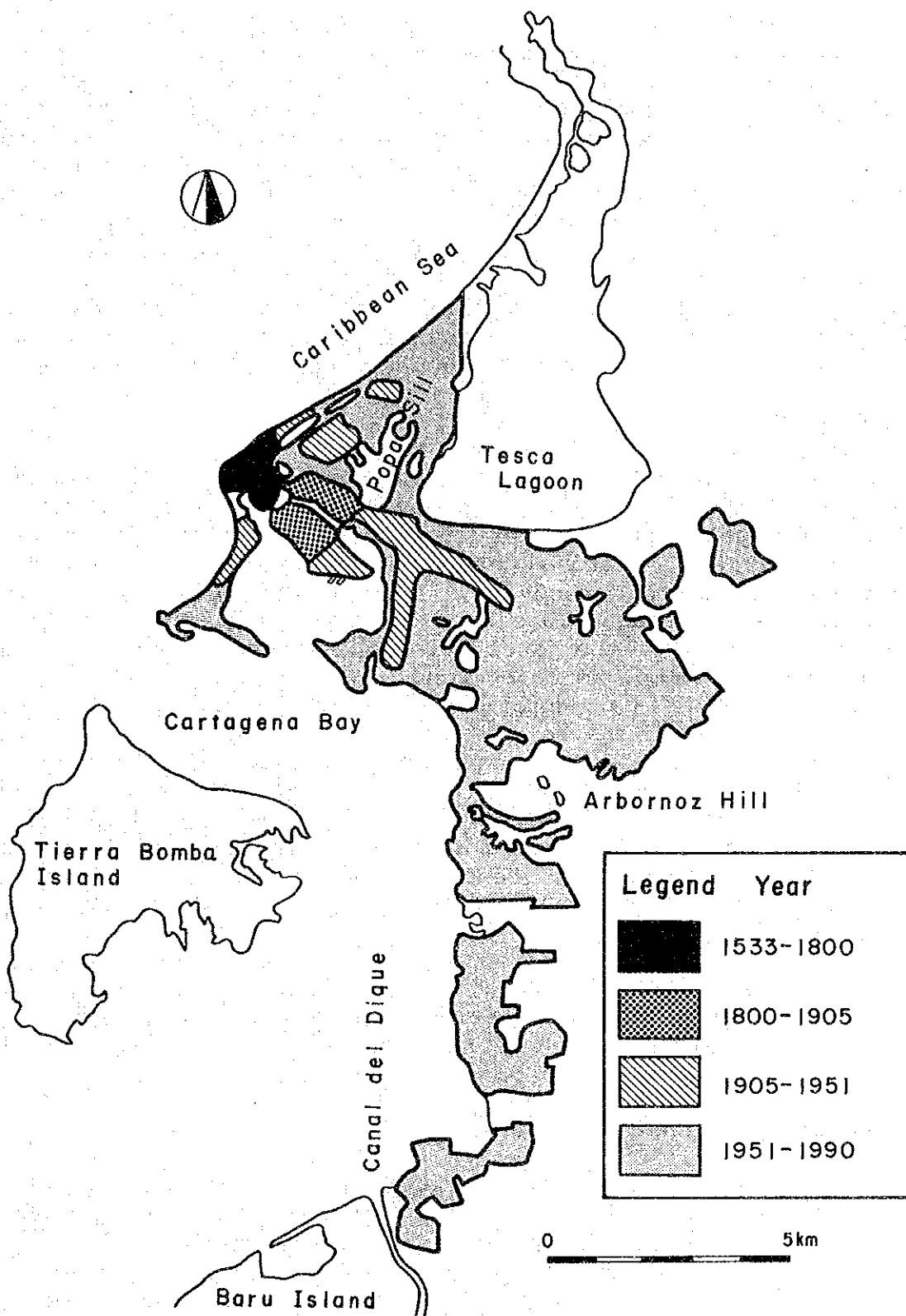


Figure 2.2-1 Urban Evolution of Cartagena

the city to decline and become stagnant. In those days Barranquilla gradually became a strong competitor of trade. In the last quarter of the 19th century, when Rafael Nunez who was born in Cartagena became President of Colombia four times, the city regained some importance. In 1893, a railroad was built from Cartagena to Calamar. At the beginning of the 20th century, public utilities such as water supply and electricity were installed. The island of Manga was developed as an upper-class suburban residential area. Several industries were started. In addition to the three districts of the old urban center, Centro, San Diego and Getsemani, new districts like Pie de la Popa, Espinal and la Quinta appeared along the railroad. The urbanized area reached 170 hectares with a population of 55 thousand.

### (3) 1905-1990

40. During and even after the depression of 1929, economic activity of Cartagena was slow in developing. For example, the creation of a petroleum refinery in Mamonal, appearance of various factories and establishment of trading companies gave an expectation of economic recovery. But the depression destroyed every thing, and Cartagena was kept stagnant till the mid of the 20th century. In 1951 the Canal del Dique was modernized and put into permanent service. A major road was built between Cartagena and Medellin. Thus, Cartagena was linked by land for the first time in its history with the rest of the country. At the end of 1957 an oil refinery of International Petroleum (Colombia) was inaugurated in Mamonal. And with it, a chain of petrochemical industries was formed on the shores of the bay. In those days Bocagrande began to be developed as a tourist zone. The combination of the historic relics, beach, accommodation facilities and the International Convention Center made the tourist industry grow in Cartagena.

41. The economic growth attracted many people from rural areas into the city. The population increased rapidly from a low of 128,877 in 1951 to a high of 660,200 in 1990, a five (5) fold growth.

#### 2.2.2 Demographic Characteristics

42. Population of the Study Area in 1990 is estimated at 660,200, 96% of which (632,900) live in the Urban Area (Comuna 1-33). As for the sex-age structure, the sex ratio is 92.4, and the proportions of population by age-groups are: 0-14 years, 33.2%; 15-64 years, 63.0% and 65 years and over, 3.8% (refer to Table 2.2-1). The sex ratio is a measure giving the number of males per 100 females, and shows that in the Study Area females exceed males. From the data in Table 2.2-2, however, this gap seems to be narrowing.



Table 2.2-1 Population of Study Area and its Sex-age Composition in 1990

Population	Sex ratio	Age composition (%)		
		0-14	15-64	65-
Urban	632,900			
Sub-urban	27,300			
Total	660,200	92.4	33.2	63.0 3.8

Source : Study Team estimates based on the data of DEPLAN, DANE (Encuesta Nacional de Hogares, 1990) and the Home Interview Survey

Table 2.2-2 Sex-age Composition of Population of Cartagena, 1964-1985

Year	Sex ratio	Age composition (%)		
		0-14	15-64	65-
1964	87.8	45.2	52.0	2.8
1973	87.9	41.6	55.3	3.1
1985	92.2	35.8	60.9	3.3

Source : DANE - Censo de Poblacion

Comparison of the two Tables also shows a direction of change in the age composition. The percentage of population aged below 15 years has been decreasing and the proportions of population aged 15-64 years and 65 years and above have been increasing.

43. These trends seem to reflect the facts that while the natural increase rate is declining, many adult males are migrating into the Study Area for job opportunities, education and better living standard.

44. The economic participation of population aged 12 years and above is shown in Table 2.2-3. Economically active population or labor force is 235,570 persons and represents 49.2% of the population aged 12 years and above (working age population). On the other hand, 243,080 persons (50.8%) are not in the labor force and live as students, house wives or without specific activities.

Table 2.2-3 Economic Participation

Economic Category	
Total population (A)	660,200
Population 12 years and over (B)	478,650
Economically active population (C)	235,570
Employed	212,670
Unemployed (D)	22,900
Economically inactive population	243,080
Student	114,970
Household work	112,910
Other inactive	15,200
Crude activity rate (C/A)	35.7(%)
Refined activity rate (C/B)	49.2(%)
Unemployment rate (D/C)	9.7(%)

Source : Study Team estimates

45. The employed persons belong to the three economic sectors as shown in Table 2.2-4. Although the secondary sector occupies nearly 20%, the tertiary sector is prominent. This is explained as follows: although the manufacturing industry is an important attracting power, main factories are equipment intensive and do not absorb much labor force; on the other hand, there are many kinds of informal activities in the tertiary sector.

Table 2.2-4 Employed Persons by Sector

Sector	Employed persons	%
Primary	7,610	3.6
Secondary	40,590	19.1
Tertiary	164,470	77.3
Total	212,670	100.0

### 2.2.3 Economic Activity

46. It is said that the recent economic growth of Cartagena was sparked by the manufacturing industry and by the tourist industry. According to 1988 yearbook of manufacturing industry, the value added in Cartagena represented 3.35% of the national total (refer to Table 2.2-5). Oil refining and chemicals have a very high share of 67.4% and 24.0% respectively. Of the total value added of 77,877 million pesos in Cartagena, 76.5% was generated from oil, chemical and related products. Foods and

beverages are also showing a considerable contribution.

47. Although more recent data are not available, the industrial production has been increasing remarkably as a result of the modernization and expansion of the installed capacity, as well as inauguration of new factories such as chemicals, plastic products and foods in Mamonal.

Table 2.2-5 Manufacturing Industries in Cartagena, 1988

Industrial group	No. of Persons Engaged	Value added (million pesos)	%	Share in the national total (%)
Foods and beverages	2,402	10,906	14.0	1.66
Chemicals	2,644	34,515	44.3	23.99
Chemical Products	352	1,827	2.3	1.14
Oil refining	619	19,996	25.7	67.40
Plastic products	505	3,254	4.2	5.06
Other industries	2,840	7,379	9.5	0.58
Total	9,362	77,877	100.0	3.35

Source : Anuario de Industria Manufacturera

48. There are no data to estimate the size of the tourist industry of Cartagena. According to 1990 National Economic Census, in Bocagrande and Centro zone (traffic zone 1-5) where many tourists visit and stay intensively, there are 3684 tourism-related establishments with about 20 thousand persons engaged (refer to Table 2.2-6). However, this census does not include the informal sectors like street vendors and domestic service workers. From the result of the Household Interview Survey conducted by the Study Team, it is estimated that about 65,000 persons of the tertiary sector are working there. Assuming that half of them are engaged in the tourism-related activities, more than 30,000 persons are employed, and their family members are receiving the benefits from tourism.

Table 2.2-6 Tourism-related<sup>1)</sup> Establishments  
in Tourist Zone

Industrial group	No. of establishment	No. of persons engaged
Wholesale and retail trade	2,713	9,944
Hotels	96	2,409
Restaurants	559	2,792
Transport	166	1,933
Finance	150	2,495
<b>Total</b>	<b>3,684</b>	<b>19,573</b>

Source : Censo Economico Nacional y Multisectorial 1970

Note : 1) It is assumed that these industrial groups derive benefits from tourism.

49. Since the second half of 1989, the tourist industry of Cartagena is facing a crisis caused by the problem of security which brought about the decrease of foreign tourists (refer to Table 2.2-7).

Table 2.2-7 Passenger Movement in Cartagena

Year	Foreign passenger arrived		Subtotal	Colombian passenger arrived by air	Total passenger arrived
	By air	By sea <sup>1)</sup>			
1985	9,650	114,640	124,290	257,088	381,378
1986	16,357	106,470	122,827	271,386	394,213
1987	25,433	101,098	126,531	256,160	382,691
1988r	34,781	81,008	115,789	252,435	368,224
1989r	28,280	50,872	79,152	258,850	338,002
1990p	7,846	4,479	12,325	250,493	262,818

Source : Corporacion Nacional de Turismo and Departamento de Aeronautica Civil y Extranjeria

Note : r revised

p provisional

1) passenger arrived by cruiser

## 2.3 Vehicle Ownership

### 2.3.1 Registered Vehicles

#### (1) Registered System

50. Vehicles in Cartagena are registered in both Departamental de Transito y Transporte (DTT) and Departamento Administrativo de Transito y Transporte (DATT Distrital). In 1990 DATT newly participated in vehicle registration works. In future all vehicle registration works will be transferred from DTT to DATT. The contents of registration is composed of owner address, name, type of vehicle, type of ownership, model year, engine capacity, history of owner transferred, etc. in computer file.

#### (2) Number of Registered Vehicles

51. In July 1991, the number of registered vehicles in the Study Area is approximately 22,700 exclusive of public buses (2,350) and motorcycle (4,985), of which 16,900 are car, 2,900 are taxi and the remaining (2,900) are trucks. The vehicle ownership in terms of number of vehicles per 1,000 inhabitants stands at 34 for all vehicles. Car ownership stays at comparatively low level of 26, that of the urban area is about 27. In contrast, the suburban area has lower car ownership which is only 1.2 (refer to Table 2.3-1).

Table 2.3-1 Number of Registered Vehicles in the Study Area

Area		No. of Vehicles	Ownership Veh/1000
Car	Urban	16,912	26.7
	Suburban	32	1.2
	Total	16,944	25.7
Taxi		2,872	
Truck		2,902	
Total		22,718	34.4

52. Figure 2.3-1 shows annual change of registered vehicles in the Study Area. For about a decade since 1981, the highest increase ratio recorded in taxi (5.33 times), followed by 3.3 for car and 2.19 for truck. The annual average increase rate for car since 1981 is 13 %. During first 5 years this rate shows 14 % higher than 12 % for second 5 years. This trend is also shown in taxi and truck.

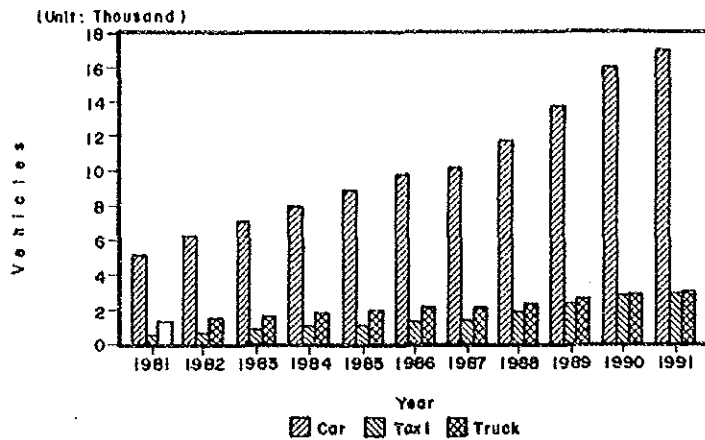


Figure 2.3-1 Annual Change of Registered Vehicles

53. Accumulative rate distribution of registered vehicles by model year is shown in Figure 2.3-2. Approximately 35 % of the total of buses and trucks are the models before 1970, in contrast to some 15 % for car and taxi. As for the models before 1980, about 80 and 70 % are shared by trucks and buses, respectively. On the other hand, about 40 % of the total of cars and taxis are 1980s models.

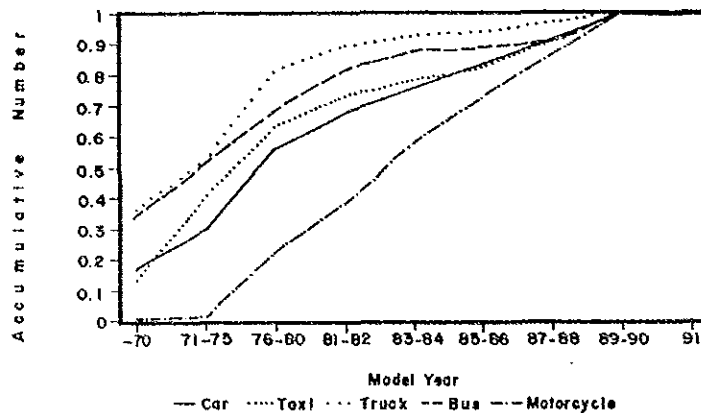


Figure 2.3-2 Accumulative Rate Distribution of Vehicles by Model Year

### (3) Number of Cars by Zone

54. Number of the registered cars by integrated traffic zone is shown in Figure 2.3-3. As can be noted, car owners concentrate into a few zones such as Bocagrande, Centro and Manga (zones 1, 2 and 5). The combined share of these 3 zones is about 54 %. Those of other zones in the urban area fluctuate from 1 to 9 %. While those of suburban zones are 0.1 % or less.

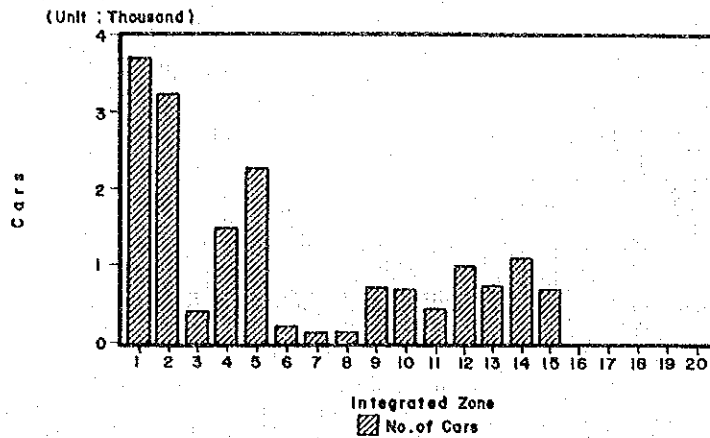


Figure 2.3-3 Registered Cars by Integrated Zone

### 2.3.2 Structure of Car Ownership

#### (1) Motorized Household Characteristics

55. Table 2.3-2 shows the summary of car ownership in the Study Area. According to the Table, total number of registered car is approximately 17,000. The percentage of motorized household owning cars is 10 %.

Table 2.3-2 Motorized Households in the Study Area

Items	Households	Ratio
Non-Motorized Households	114,045	0.899
Motorized (1-Car)	10,674	0.084
Motorized (Multi-Car)	2,186	0.017
Sub-total (Motorized)	12,860	0.101
Total Households	126,905	1.000
<hr/>		
Number of Registered Cars	16,944	
No. of Cars by 2-car	2.87	
Car Ownership (/1000 ps.)	25.7	

Source: Study Team survey results

56. The relationship between household income level and car ownership is shown in Figure 2.3-4. The percentage of car ownership categorized into non-car, one-car and multiple-cars by household income level is shown in Figure 2.3-5 and 2.3-6. The rate of motorized households increases as the income level of the households increases.

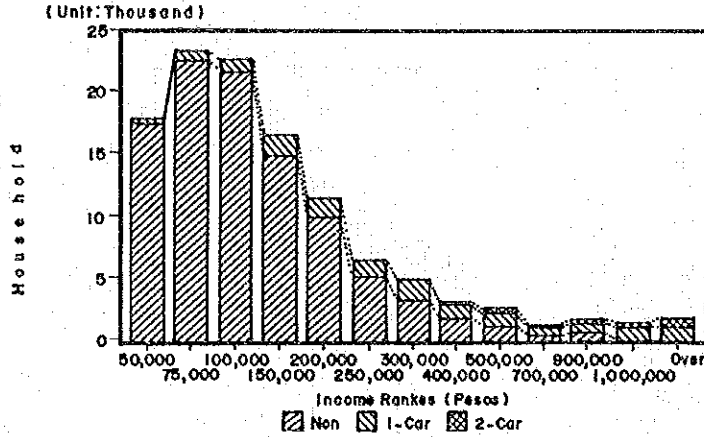


Figure 2.3-4 Motorized Households by Income Level

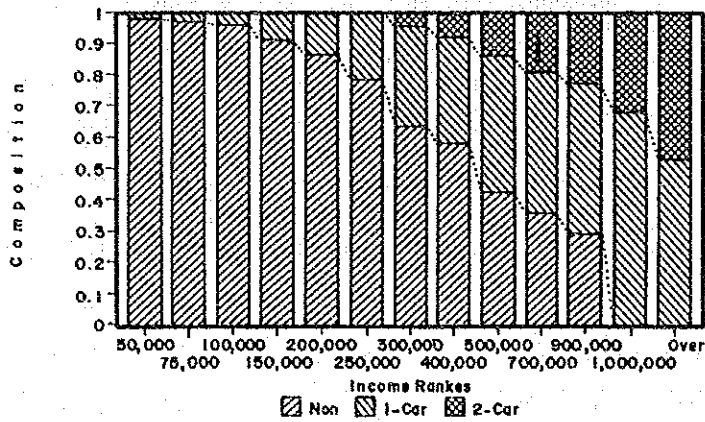


Figure 2.3-5 Accumulative Percentage of Car Ownership

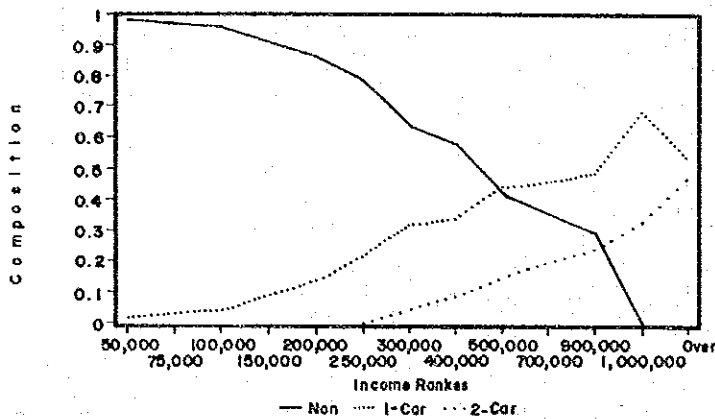


Figure 2.3-6 Car ownership Ratio by Income Level

57. Figure 2.3-7 shows the relationship between the average household income and "Estrato" value which represents the level of social/economic class of the area in range from 1 to 6. It can be seen to have a good relationship between the income level and the value of "Estrato".



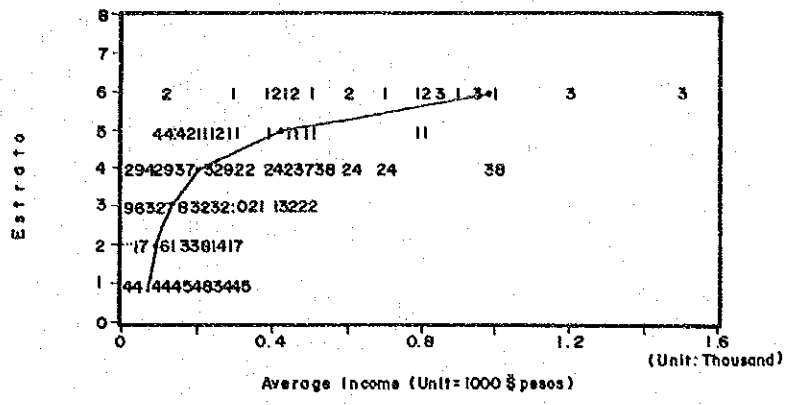


Figure 2.3-7 Relationship between Income and Estrato

## 2.4 Physical Situation of the Study Area

### 2.4.1 Urban Scale of the Study Area

58. Cartagena metropolitan area is one of the major urban areas along the Caribbean coastal region. Table 2.4-1 shows the urban scale of the major cities in Colombia.

Table 2.4-1 Profile of the Major Cities in Colombia

Name	Area (km <sup>2</sup> )	Population 1985	Pop. Density (psn/km <sup>2</sup> )
Bogota	1,587	4,236,490	2,669
Medellin	358	1,480,382	4,135
Cali	564	1,429,026	2,534
Barranquilla	514	927,233	1,804
Cartagena	606	563,949	931
Cucuta	1,176	388,397	330
Pereira	604	357,585	592
Ibague	1,498	314,954	210

Source: DANE

### 2.4.2 Location of the Study Area

59. The capital city of the State of Bolivar, Cartagena is situated at latitude 10° 26'N and longitude 75° 33'W. The Study Area stretches long from north to south with Caribbean sea forming its western boundary, while the eastern boundary is surrounded by the municipalities of Sta. Catalina, Sta. Rosa, Turbaco and Turbana.

60. Two national road, Carretera Mar (to Barranquilla) and Carretera Troncal (to Medellin) connect Cartagena with the principal cities of other regions through the road network. The International Airport is located at north-east fringe of the urban area along the Cienaga de La Virgen. It connects the City with other major cities including international routes to USA and Europe.

61. Port of Cartagena is the important primary sea port on the Atlantic coast. As the industrial city Cartagena exports the industrial products through the private owned wharves of the industrial zone (refer to Table 2.4-2).

Table 2.4-2 Cargo Movement (thousand ton)

Year	1970	1975	1980	1985	1987	1988	1989	1990
<b>Colombia (Commercial)</b>								
Total	3,127	3,220	5,315	5,049	5,097	5,126	5,046	5,576
Import	1,656	1,592	3,464	3,255	3,132	3,525	3,272	3,228
Export	943	1,297	1,470	1,310	1,330	1,431	1,660	2,273
Others	528	331	381	484	635	260	114	75
<b>Colombia (Private)</b>								
Total	-	-	-	-	8,824	10,199	8,171	8,760
Import	-	-	-	-	1,226	1,227	1,342	1,363
Export	-	-	-	-	5,149	4,788	4,860	5,964
Others	-	-	-	-	2,409	4,184	1,969	1,433
<b>Cartagena (Commercial)</b>								
Total	-	313	746	919	817	890	863	915
Import	-	170	555	651	447	507	438	448
Export	-	143	191	264	353	369	410	460
Others	-	-	-	4	17	14	14	7
<b>Cartagena (Private)</b>								
Total	-	-	-	-	7,502	8,782	6,817	7,134
Import	-	-	-	-	639	518	760	643
Export	-	-	-	-	4,646	4,304	4,316	5,305
Others	-	-	-	-	2,217	3,960	1,741	1,186

Source: Colpuertos

Note: Commercial means cargoes flow through public wharves and Private means cargoes flow through private wharves.

### 2.4.3 Natural Conditions of the Study Area

62. The Study Area is classified into two parts in accordance with its topographic characteristics, "continental area" located in the eastern part and "islands area" located in the western part of the Study Area. Islands area consists of two major islands, Baru and Tierra Bomba, which cover about 6% of the total Study Area.

63. The land of the Study Area is generally flat except the northern part which is hilly topography less than 100m high above sea level. The vegetal cover of "continental area" is represented by meadow forest, which is now used as cattle raising farms or ranches. While in the "island area" meadow forest is fringed by the narrow belts of mangroves.

64. Climate condition of Cartagena is categorized as tropical zone, characterized as hot and relatively humid. Rainfall was 1378 mm per annum in 1989. There are two seasons; "rainy season" from May to November and "dry season" from December to April.

Maximum absolute temperature was 40 °C and minimum one was 12 °C. (refer to Table 2.4-3)

Table 2.4-3 Meteorological Observation Data in Cartagena.

Month	Temperature (°C)			Humidity (%)	Rainfall (mm)	Wind Velocity Max.(m/s)
	Max.	Min.	Average			
Jan.	40.0	16.0	26.8	79	5	17.0
Feb.	38.0	16.0	26.8	77	1	19.6
Mar.	38.0	16.0	27.2	77	1.3	16.5
Apr.	38.0	16.5	27.7	79	23.8	18.0
May	40.0	17.0	28.3	81	81.3	15.4
Jun.	38.0	15.0	28.4	81	100.6	21.1
Jul.	39.0	15.0	28.3	80	82.8	19.6
Aug.	38.0	15.0	28.2	81	107.3	22.1
Sep.	38.0	14.0	28.2	82	124.6	20.1
Oct.	39.0	14.0	27.8	82	204.7	24.9
Nov.	40.0	16.0	27.8	82	115.8	14.8
Dec.	39.0	12.0	27.3	80	33.7	39.3

Note: source; HIMAT

Temperature, humidity and rainfall are the average from 1943 to 1989. Wind velocity is the average of maximum records from 1980 to 1989.

65. As for the winds, the north-east are predominant and the north are of less frequency year around. From August to November the south and the south-west winds are more frequent.

## 2.5 Existing Land Use

### 2.5.1 Methodology

66. The Study Area stretches from north to south along the Caribbean for about 70km long. An urbanized area is formed in the central part of the Area.

67. For the urban area, two types of maps are available; 1:5,000 block maps(1989, DANE), and a 1:20,000 general map (1981, SADEC, S.A.). Maps which cover the whole Study Area are 1:25,000 general maps(1976, IGAC) and a 1:100,000 outline map(showing administrative boundaries, rough contour lines and location of the urbanized area).

68. No existing land use map of the study Area can be found. As for the future land use, "Cartagena Development Plan, 1989-2010" includes a detailed land use plan for the urban area and rough plans for the sub-urban areas.

69. Based on the above-mentioned situation, the following surveys are carried out for the land use and related matters.

a. Existing Land Use

a-1 Urban Area (Traffic Zone 1-40, Comuna 1-33)

- Determine the limits of urbanized area, consulting the 1:5,000 block maps and the aerial photographs
- Mark large-scale facilities, except residential use, facility groups (for example, commercial zone, industrial zones and etc) and open spaces
- Distinguish the following types of land uses on the 1:20,000 general map by using different colors

- (a) Commercial areas
- (b) Commercial / residential mixed areas
- (c) Institutional areas
- (d) Industrial areas
- (e) Industrial / residential mixed areas
- (f) Parks / open spaces
- (g) Special project areas
- (h) Residential areas (include all types of urban land uses except above-distinguished areas)
- (i) Agricultural/unused land

- Compute the areas for the different use categories by traffic zone with the use of a planimeter

a-2 Sub-Urban Area (Traffic Zone 41-47)

- Delineate the boundaries of urbanized areas and settlements on the 1:25,000 general map
- Mark large-scale facilities, facility groups and open spaces
- Distinguish the following land uses on the 1:100,000 general map (prepared by reducing the 1:25,000 general maps of IGAC)

- (a) Built-up areas
- (b) Industrial zones
- (c) Tourism zones
- (d) Agricultural/unused land

- Compute the areas for the different use categories by traffic zone with the use of a planimeter

b. Land Use Plan

- Copy the land use plan map of "Cartagena Development Plan, 1989-2010" on the 1:5,000 block maps (urban area) and on the 1:100,000 general map(sub-urban area)

- Compute the areas for the different use categories by traffic zone with the use of a planimeter
- Collect the documents explaining the contents of the plan

c. Existing Projects

- Collect the information about development projects

d. Systems Related to Urban Development

- Study the legal and administrative systems, for example, the Urban Reform Law (Law No.9 of 1989), Land Readjustment, Valorization, etc.

e. Population Distribution

- Estimate the population in 1970 by traffic zone based on the House Survey conducted by the Municipality of Cartagena

f. Employment Distribution

- Estimate the employment in 1990 by traffic zone based on the National Economic Census and the National Household Survey, which are both conducted by DANE

2.5.2 Present Land Use

70. Built-up areas cover 54 km<sup>2</sup>, 8.7 % of the whole Study Area (609 km<sup>2</sup>), and are concentrated in Traffic zones 1-40 and 44. The recent economic activity of Cartagena has been supported by the industrial activity of the Mamonal and other industrial zones and the tourism to the beach and the historical properties in Centro. Reflecting this situation, land use areas of the industrial and tourism activities are as much as 11.9 km<sup>2</sup> and 4.5 km<sup>2</sup>, respectively (refer to Table 2.5-1, 2.5-2 and Figure 2.5-1).

71. High-quality residential areas were developed first in Manga and then in Castillogrande and Crespo. On the other hand, the economic growth of the city has attracted a large number of people from rural areas. Many of the migrants invaded public and private lands located along water side and on the hillside. These marginal residential areas extend on the shore of Virgen Lagoon and on the slope of Popa Hill.

72. Among institutional land uses, transport facility areas such as Crespo Airport, Maritime Terminal and the future container terminal and military areas such as Navy Base and Navy school

are outstanding.

73. As for nonurban land uses, the suburban Area is mostly covered by pastures. Farmlands are developed near the settlements, and crops like maize, yam and cassava are cultivated. In Baru Island the shrimp culture is prospering and vast ponds are constructed.

Table 2.5-1 General Land Use Areas by Traffic Zone

(km <sup>2</sup> )						
Zone no.	Zone name	Zone area	General built-up area	Industrial zone 1)	Tourism zone 2)	Agricultural/unused land
1-40	U. Area	54.0	34.2	5.1	3.0	11.7
41	A. Grande	121.1	0.3			120.8
42	P. Canoas	111.9	0.9			111.0
43	Bayunca	109.8	0.7			109.1
44	Mamonal	116.6	0.7	6.8		109.1
45	T. Bomba	20.0	0.6		0.1	19.3
46	Sta. Ana	60.5	0.3		0.4	59.8
47	Baru	15.2	0.3		1.0	13.9
41-47	SU. Area	555.1	3.8	6.8	1.5	543.0
Study Area	total	609.1	38.0	11.9	4.5	554.7

Source: Study Team calculations with the use of a planimeter

Note: 1) Industrial zone of the Urban Area is assumed to be industrial area and industrial/residential area.

2) Tourism zone of the Urban Area is assumed to be Laguito, Bocagrande, Centro and commercial/residential area of Marbella.

Table 2.5-2 Urban Land Use Areas by Traffic Zone

(ha)

Zone no.	Zone name	Zone area	Residen- tial	Commer- cial/ residen- tial	Commer- cial	Indus- trial/ residen- tial	Indus- trial	Institu- tional	Parks/ open spaces	Vacant lot for special project	Agricul- tural/ unused land
1	Laguito	18.4		14.4	4.0						
2	C. grande	38.1	31.1					5.0	2.0		
3	B' grande	111.6		37.5	28.4			29.8	15.9		
4	Centro	117.1		74.3	10.4			5.2	27.2		
5	Marbella	310.4	61.0	55.0				120.6	15.8		58.0
6	Comuna 3	67.7	64.8					2.9			
7	Comuna 4	105.1	84.1								21.0
8	Comuna 5	95.0	69.3								25.7
9	Comuna 6	121.0	111.3					9.7			
10	Comuna 7	159.6	25.2	37.0				1.0	11.2	27.6	57.6
11	P. d. Papa	51.3	31.0	19.7					0.6		
12	Manga	152.4	89.2	3.0	1.0		7.2	44.4	7.6		
13	Comuna 9	87.4	27.2	44.6	12.8			2.8			
14	Comuna10	74.1	40.7	12.6							20.8
15	Comuna11	80.9	54.5								26.4
16	Comuna12	94.3	80.9	13.4							
17	Comuna13	72.2	72.2								
18	Comuna14	127.8	108.2								19.6
19	Comuna15	57.4	49.0						4.6		3.8
20	Comuna16	270.9	163.3								107.6
21	Comuna17	106.9	76.3								30.6
22	Comuna18	100.5	86.1						0.4		14.0
23	Comuna19	79.8	48.8					4.6	23.0		3.4
24	N. Bosque	89.2	72.8					2.8			13.6
25	V. Sandra	89.8	62.3	20.8	0.4			6.3			
26	Comuna21	117.6	105.4					11.4			0.8
27	Comuna22	90.0	46.9	17.6				2.9			22.6
28	Comuna23	69.3	64.2	2.7				2.4			
29	Comuna24	83.5	59.3					3.4			20.8
30	Bosque	206.8	55.8	2.8		63.2	72.4	1.6			11.0
31	M' nillo	68.8						68.8			
32	Ceballos	342.0	170.8				32.2	49.8	0.8		88.4
33	A. Barato	622.8	40.4				330.2	5.0			247.2
34	Comuna27	86.9	67.7					10.0	9.2		
35	Comuna28	44.0	44.0								
36	Comuna29	77.5	77.5								
37	Comuna30	90.4	69.0					21.4			
38	Comuna31	435.4	150.6		6.8			10.9	6.9		260.2
39	Comuna32	178.9	139.1					16.2			29.6
40	Comuna33	206.7	122.4								84.3
Urban area total		5399.5	2722.4	355.4	63.8	63.2	442.0	432.9	125.2	27.6	1167.0



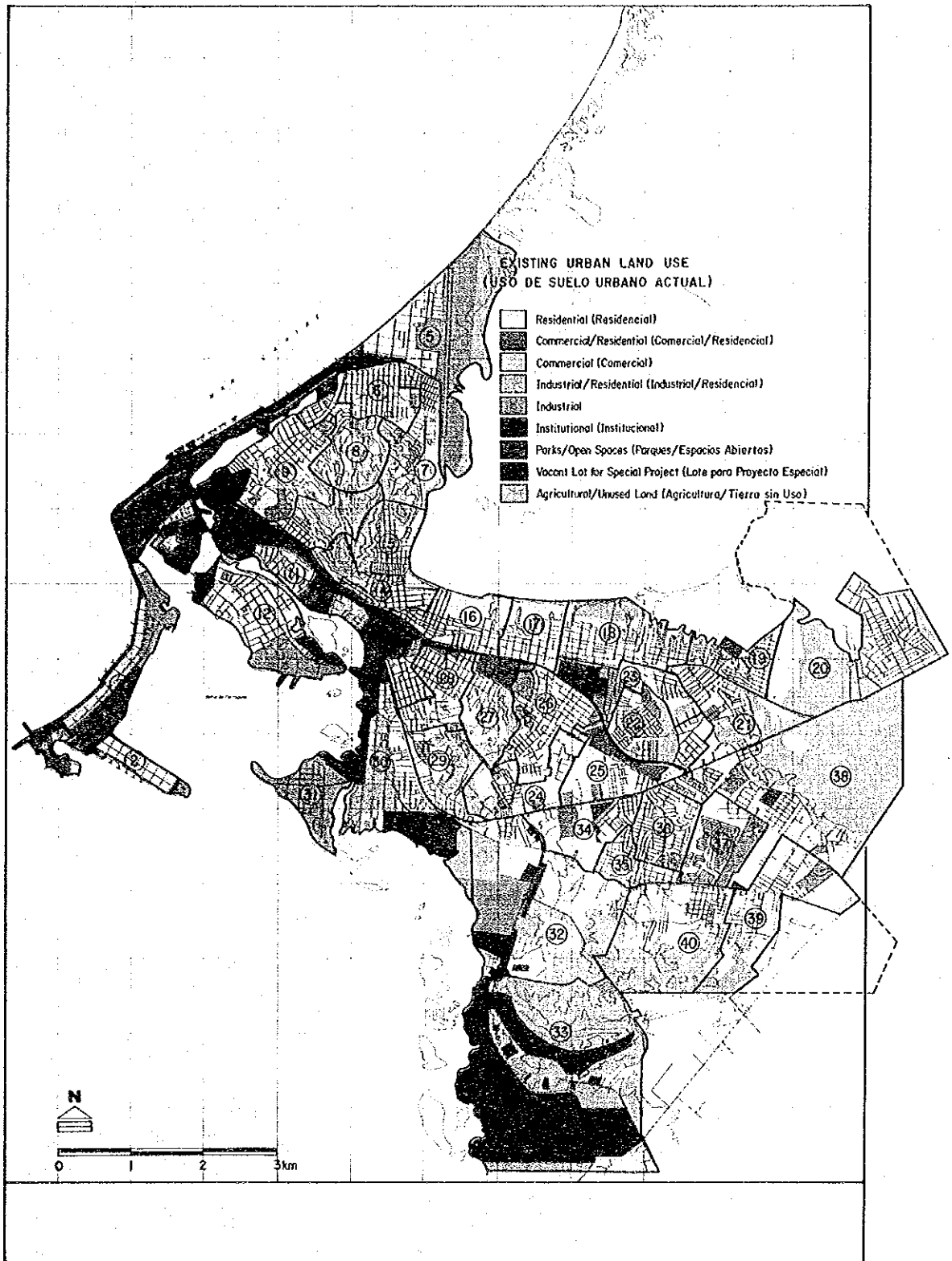


Figure 2.5-1 Urban Land Use

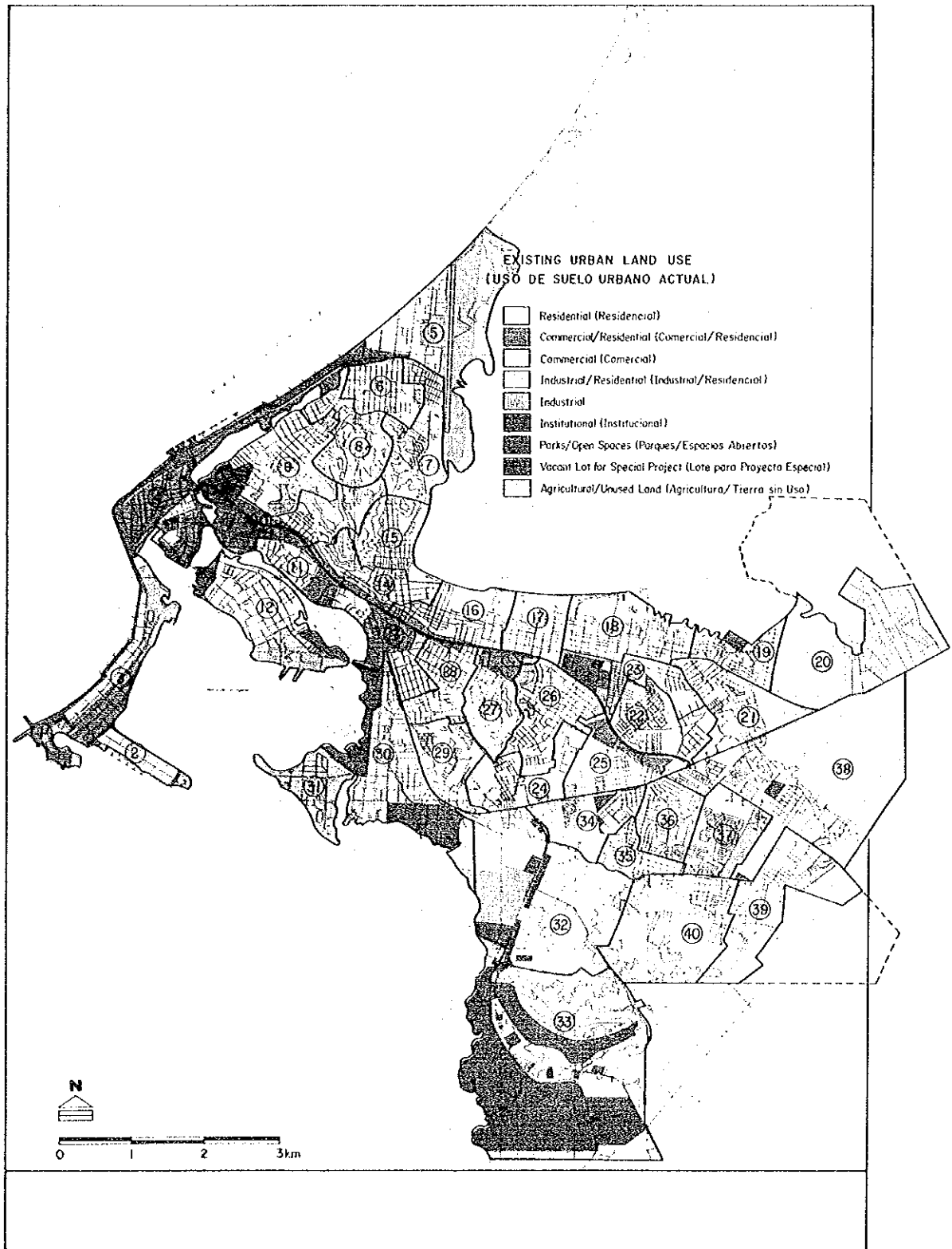


Figure 2.5-1 Urban Land Use



### 2.5.3 Population Distribution

74. Based on the number of houses counted by DEPLAN and the average number of persons per house obtained by 1985 Population Census, the organization estimates the total population of the Urban Area in 1990 at 632,900. But there is no authorized data for population distribution. Population by traffic zone is estimated as follows (refer to Table 2.5-3):

- a. Obtain the average number of household members for each traffic zone by the tabulation of 1990 National Household Survey original data.
- b. Assume the average number of persons per house for each traffic zone by applying the average number of household per house in the Urban Area ( $5.9/5.25=1.124$ ).
- c. Obtain the population of each traffic zone by multiplying the number of houses (DEPLAN data) by the average number of persons per house.

75. As for the Sub-urban Area, the original data of "I Municipal Census of Population and House of Cartagena and its corregimientos (1989)" are tabulated. The result is shown in Table 2.5-3. While 632,900 (96%) live in the Urban Area of 5,400 ha, only 27,300 (4%) in the Sub-urban Area of 55,500 ha.

76. Table 2.5-4 shows population densities of traffic zones in the Urban Area.

77. The average gross density of the whole Urban Area is 117.2 persons per hectare; The highest one is 330.4 persons per hectare of Laguito, where many apartment houses are erected.

78. In order to get residential density, semi-gross population density is calculated. Habitable area is considered to be "residential", "commercial/residential", "commercial" and "industrial/residential" of urban land use category. The semi-gross population densities of upper-class residential areas of Castillogrande and Manga are 164.3 persons per hectare and 106.0 persons per hectare, respectively. Medium-class residential areas such as Comuna 18, Comuna 20 and Comuna 22 have a semi-gross population density of around 200 persons per hectare. Lower-class residential areas formed at the foot of Popa Hill and along the south edge of Tesca Lagoon shows very high densities, especially 373.3 persons per hectare of Comuna 15. The historical area of Centro, where medium- to upper-class people are living has a density of about 300 persons per hectare.

Table 2.5-3 Population of the Study Area in 1990

	Zone no.	Zone name	Average persons /household *1	Average persons /house (e) *2 (A)	Number of houses *3 (B)	Population (e) (A)*(B)	Comuna, Barrio, Corregimiento
Urban Area	1	Laguito	3.17	3.57	1,705	6,080	(C 1) El Laguito
	2	C, grande	4.83	5.43	940	5,110	(C 1) Castillogrande
	3	B' grande	3.89	4.38	2,035	8,910	(C 1) Bocagrande, Base Naval
	4	Centro	4.47	5.03	5,037	25,320	(C 2) Centro, San Diego, Getsemani, Matuna
	5	Marbella	4.17	4.69	1,612	7,560	(C 3) Cabrero, Marbella, Crespo, B. Militar
	6	Comuna 3	6.00	6.75	2,361	15,940	Comuna 3
	7	Comuna 4	5.90	6.64	3,601	23,890	Comuna 4
	8	Comuna 5	5.84	6.57	3,202	21,040	Comuna 5
	9	Comuna 6	5.57	6.27	3,123	19,570	Comuna 6
	10	Comuna 7	5.38	6.05	2,179	13,190	Comuna 7
	11	P. d. Popa	4.40	4.95	2,189	10,840	(C 8) Pie De La Popa
	12	Manga	4.40	4.95	1,996	9,880	(C 8) Manga
	13	Comuna 9	5.22	5.87	2,569	15,090	Comuna 9
	14	Comuna10	5.50	6.19	2,282	14,120	Comuna10
	15	Comuna11	5.20	5.85	2,168	12,680	Comuna11
	16	Comuna12	4.55	5.12	4,099	20,980	Comuna12
	17	Comuna13	5.00	5.63	2,727	15,340	Comuna13
	18	Comuna14	6.21	6.99	3,893	27,120	Comuna14
	19	Comuna15	6.47	7.28	2,513	18,290	Comuna15
	20	Comuna16	5.33	6.00	3,542	21,240	Comuna16
	21	Comuna17	4.53	5.10	3,146	16,030	Comuna17
	22	Comuna18	5.27	5.93	2,821	16,730	Comuna18
	23	Comuna19	6.25	7.03	2,010	14,130	Comuna19
	24	N. Bosque	4.55	5.12	3,126	16,000	(G20) N. Bosque, Alcañis, Los Caramares
	25	V. Sandra	4.40	4.95	2,453	12,140	(G20) Barrios except Zone24
	26	Comuna21	5.54	6.23	3,525	21,970	Comuna21
	27	Comuna22	5.24	5.90	2,142	12,630	Comuna22
	28	Comuna23	4.75	5.34	1,869	9,990	Comuna23
	29	Comuna24	5.36	6.03	2,722	16,410	Comuna24
	30	Bosque	5.89	6.63	3,366	22,290	(G25) Barrios except Isla De Manzanillo
	31	M'nillo	4.33	4.87	180	880	(G25) Isla De Manzanillo
	32	Ceballos	5.05	5.68	3,387	19,240	(G26) Barrios except Zone33
	33	A. Barato	4.63	5.21	1,138	5,930	(G26) A'noz, M' lla, Gloria, A. B' to, P' carpa
	34	Comuna27	4.59	5.16	4,081	21,070	Comuna27
	35	Comuna28	5.50	6.19	1,778	11,000	Comuna28
	36	Comuna29	5.82	6.55	2,955	19,350	Comuna29
	37	Comuna30	6.39	7.19	2,724	19,580	Comuna30
	38	Comuna31	5.54	6.23	3,635	22,650	Comuna31
	39	Comuna32	5.48	6.17	3,718	22,910	Comuna32
	40	Comuna33	6.44	7.25	2,730	19,780	Comuna33
	U. A. Total	5.25	5.90	107,269	632,900		
Sub Urban Area	41	A. Grande				1,600	Arroyo Grande
	42	P. Canoas				6,540	Ayo Piedra, Boquilla, P' zuela, Pta Canoas
	43	Bayunca				6,120	Bayunca
	44	Mazonal				5,440	Pasacaballos
	45	T. Bomba				4,550	Bocachica, Tierra Bomba, Cano de Loro
	46	Sta. Ana				1,700	Santa Ana, Baru(p)
	47	Baru				1,350	Baru(p)
	S. U. A. Total				27,300		
Study Area Total					660,200		

\*1 DANE-Encuesta Nacional de Hogares, 1990 septiembre

\*2 Estimated by Study Team applying the ratio of 5.9/5.25 to the average number of persons per household

\*3 DEPLAN

Table 2.5-4 Population Density by Traffic Zone (Urban Area)

(psn/ha)						
Zone no.	Zone name	Zone area (ha)	Habit-able area (ha)	Popula-tion	Gross popula-tion density	Semigross popula-tion density
1	Laguito	18.4	18.4	6,080	330.4	330.4
2	C,grande	38.1	31.1	5,110	134.1	164.3
3	B'grande	111.6	65.9	8,910	79.8	135.2
4	Centro	117.1	84.7	25,320	216.2	298.9
5	Marbella	310.4	116.0	7,560	24.4	65.2
6	Comuna 3	67.7	64.8	15,940	235.5	246.0
7	Comuna 4	105.1	84.1	23,890	227.3	284.1
8	Comuna 5	95.0	69.3	21,040	221.5	303.6
9	Comuna 6	121.0	111.3	19,570	161.7	175.8
10	Comuna 7	159.6	62.2	13,190	82.6	212.1
11	P.d.Popa	51.3	50.7	10,840	211.3	213.8
12	Manga	152.4	93.2	9,880	64.8	106.0
13	Comuna 9	87.4	84.6	15,090	172.7	178.4
14	Comuna10	74.1	53.3	14,120	190.6	264.9
15	Comuna11	80.9	54.5	12,680	156.7	232.7
16	Comuna12	94.3	94.3	20,980	222.5	222.5
17	Comuna13	72.2	72.2	15,340	212.5	212.5
18	Comuna14	127.8	108.2	27,120	212.2	250.6
19	Comuna15	57.4	49.0	18,290	318.6	373.3
20	Comuna16	270.9	163.3	21,240	78.4	130.1
21	Comuna17	106.9	76.3	16,030	150.0	210.1
22	Comuna18	100.5	86.1	16,730	166.5	194.3
23	Comuna19	79.8	48.8	14,130	177.1	289.5
24	N.Bosque	89.2	72.8	16,000	179.4	219.8
25	V.Sandra	89.8	83.5	12,140	135.2	145.4
26	Comuna21	117.6	105.4	21,970	186.8	208.4
27	Comuna22	90.0	64.5	12,630	140.3	195.8
28	Comuna23	69.3	66.9	9,990	144.2	149.3
29	Comuna24	83.5	59.3	16,410	196.5	276.7
30	Bosque	206.8	121.8	22,290	107.8	183.0
31	M'nillo	68.8	-	880	12.8	-
32	Ceballos	342.0	170.8	19,240	56.3	112.6
33	A.Barato	622.8	40.4	5,930	9.5	146.8
34	Comuna27	86.9	67.7	21,070	242.5	311.2
35	Comuna28	44.0	44.0	11,000	250.0	250.0
36	Comuna29	77.5	77.5	19,350	249.7	249.7
37	Comuna30	90.4	69.0	19,580	216.6	283.8
38	Comuna31	435.4	157.4	22,650	52.0	143.9
39	Comuna32	178.9	139.1	22,910	128.1	164.7
40	Comuna33	206.7	122.4	19,780	95.7	161.6
Urban area total		5399.5	3204.8	632,900	117.2	197.5

## 2.6 Land Use Plan/Control

79. At present, the Urban Reform Law (Law No.9 of 1989) is a basic law for the local governments to make urban development plan and to implement development projects. Based on this law, Cartagena has already prepared the Cartagena Development Plan 1989-2010. In this plan a detailed use zoning is designated for the Urban Area and for Mamonal district. The classification of use zone is as follows:

- a. Residential zone
  - a-1 High density
  - a-2 Medium high density
  - a-3 Medium density
  - a-4 Minimum norm
- b. Commercial zone
  - b-1 General commercial
  - b-2 Heavy commercial
  - b-3 Community commercial
- c. Industrial zone
  - c-1 Light industrial
  - c-2 Medium industrial
  - c-3 Heavy industrial
- d. Institutional zone
- e. Tourism zone
- f. Historical zone
- g. Recreational and sports zone
- h. Integrated project zone
- i. Special activity zone
- j. Special Treatment zone
- k. Conservation zone

80. Areas by use zone for the Urban Area are shown in Table 2.6-1. According to the Table, 51% of the total area, 2,761 hectares, are designated as the residential zone. The industrial zone is 643 hectares (11.9%) and the tourism zone is 256 hectares (4.7%). There are some unique zones such as the integrated project zone, special activity zone and special treatment zone. The integrated project zone is designated to the Navy Base,

Maritime Terminal, Crespo Airport and Chambak area as urban renewal sites for complex development.

81. The special activity zone is for the bus terminal, truck terminal and other large-scale commercial facilities and designated to the east suburbs of the city. The special treatment zone is to devise some measures for the extension of low quality residential areas. The conservation zone is designated to Popa Hill, Arborno Hill and Tesca Lagoon totaled to 525 hectares. In addition to the area shown in Table 2.6-1, the heavy industrial zone is designated to the Mamonal industrial area.

## **2.7 Existing Issues on Land Use**

82. The urban area of Cartagena was being developed along the main development spin of Av. Pedro de Heredia from Centro in direction of south-east due to the topographical condition of the Area. Therefore specific land use zones such as CBD or touristic zone where the traffic concentrates are located on the western edge of the Study Area. Residential areas have developed in the north-east and south-east directions occupying the suitable land for living. There are a few land use areas of business, commercial, administrative and educational functions outside the Centro. Traffic should concentrate into the main corridor of Av. Pedro de Heredia connecting the residential areas to Centro.

83. There are several ideas to improve this concentration of the functions of Centro. The proposal for the relocation of navy base, port facility and airport and redistribution of several functions of the Centro to those areas will relieve to some extents the existing congestion. However, those areas located near Centro and those effect on traffic seem to be limited. Taking into consideration the future population size, it is more desirable to establish the sub-core center of the urban functions at more remote areas such as Bayunca or Pasacaballo.



Table 2.6-1 Use Zoning Areas by Traffic Zone (Urban Area)

(ha)

Zone no.	Zone area	Residen- tial	Commer- cial	Indus- trial	Institi- tional	Tourisa/ historic	Recrea- tional	Integrat- ed project	Special activity	Special treat- ment	Conser- vation
1	18.4					18.4					
2	38.1				5.0	31.1	2.0				
3	111.6		3.0		3.4	76.3	2.5	26.4			
4	117.1		6.2			83.7	27.2				
5	310.4					130.3	1.5	178.6			
6	67.7	63.7			2.9		1.1				
7	105.1	84.1									21.0
8	95.0	46.2									48.8
9	121.0	101.3	5.6		5.6						8.5
10	159.6	46.7	11.6		2.7		28.9	12.1			57.6
11	51.3	47.4					3.9				
12	152.4	95.0	3.2		1.3		4.7	39.5	8.7		
13	87.4	53.5	25.6		2.8		5.5				
14	74.1	49.6	3.7								20.8
15	80.9	54.5									26.4
16	94.3	82.4	8.4				3.5				
17	72.2	64.6	7.6								
18	127.8	110.8	6.3				10.7				
19	57.4	53.9	1.7				1.8				
20	270.9	89.7							12.0	90.3	78.9
21	106.9	99.4	7.5								
22	100.5	96.0	4.5								
23	79.8	52.2			4.6		23.0				
24	89.2	84.2	2.2		2.8						
25	89.8	74.3	9.2		6.3						
26	117.6	101.4	4.8		11.4						
27	90.0	84.9	2.2		2.9						
28	69.3	65.5	3.8								
29	83.5	75.9	4.2		3.4						
30	206.8	67.1	18.0	121.7							
31	68.8				68.8						
32	342.0	190.1	34.2	60.5	49.8					7.4	
33	622.8			460.8							162.0
34	86.9	66.7	1.0		10.0		9.2				
35	44.0	44.0									
36	77.5	77.5									
37	90.4	69.0			21.4						
38	435.4	200.8	7.2		10.9				156.4	60.1	
39	178.9	125.2	5.7		10.2						37.8
40	206.7	143.4									63.3
<b>Total</b>	<b>5,399.5</b>	<b>2761.0</b>	<b>187.4</b>	<b>643.0</b>	<b>226.2</b>	<b>339.8</b>	<b>125.5</b>	<b>256.6</b>	<b>177.1</b>	<b>157.8</b>	<b>525.1</b>

Note : \* Including nondesignated land of 58.0 ha. adjacent to the airport

## CHAPTER 3 EXISTING ROAD TRAFFIC CONDITIONS

### 3.1 General

84. The transportation in Cartagena refers primarily to land transportation mainly. Water transportation serves only for the passenger traffic between the islands and city center in spite of the circumstances of the central urban area being surrounded by bay, canals and lakes.

85. In this chapter, existing road network and traffic conditions are reviewed based on the information provided and the results of surveys carried out by the Study Team.

### 3.2 Road Network

86. The road network in the Study area was reviewed to identify the road network characteristics such as road composition and road configuration, and road inventory such as length and lanes.

87. Road organizations for the administration of different road types as state and municipal highway are responsible for planning, construction and maintenance. There are mentioned in Section 1.5.

#### 3.2.1 Road Configuration

88. The road network in Cartagena is composed of a few radial arterial roads, collector roads and local roads to the arterial and collector roads under the geographical restriction. The major traffic corridor between Centro (down town) and residential area runs in quite narrow belt surrounded by Ciénaga de Tesca (swamp) in the northern side and Bahía de Cartagena (the Bay of Cartagena) in the southern side. The circumferential road is not in Cartagena because of the above reason. Figure 3.2-1 shows the existing road network.

89. There are two major roads connecting with the neighboring major cities. One is the national road (Highway Traversal 54) connecting between Barranquilla by way of Santa Catalina. The other is the national road linked to Calle 31 (Av. Don Pedro de Heredia) in the urban area, and connecting with Medellín by way of Turbaco. Av. Don Pedro de Heredia penetrates the urban area in the east-west direction and terminates in Centro. This road is most important for the road traffic.

## (1) Urban Area

90. The road network is composed of the following main roads;

- Av. Don Pedro de Heredia playing an important role in carrying east-west traffic, penetrating the urban area in the east-west direction,
- Av. San Martín and Av. Sucre running in Bocagrande, under the one-way traffic regulation system,
- Av. Santander connecting between the Cartagena airport and Bocagrande running by the sea shore,
- Diagonal 22 and 30 (Carretera a Mamonal) connecting with the Mamonal industrial area,
- Av. Campo Alegre and Av. Alfonso Araujo connecting Centro with Manga Island, and
- Carretera Troncal de Occidente, extension section of Traversal 54, linking between Diagonal 22 and Traversal 54.

91. At present, there are few roads serving for the east-west traffic. These are Av. Don Pedro de Heredia and Av. Alfonso Araujo. The heavy traffic volume flows in the east-west direction in which the urban area in Cartagena is developed. The demand of traffic and the capacity of roads in this direction is currently balanced.

92. As for local roads to connect arterial and collector roads in the residential area, the road conditions such as alignment, width and pavement are not enough to serve vehicles and public buses. There are many local roads which are not linked between arterial/collector roads, and which are long in terms of length. It is difficult to steer vehicles and operate public buses on these roads.

## (2) Sub-urban Area

93. The road network is coarse and poor in both quantity and quality in the sub-urban area where the population is equivalent to 4% of the total and the land space is equivalent to 90% of the total. As before-mentioned, there are the two paved national roads to serve to the neighboring cities, which have 2 lanes. The other roads are poorly developed, connecting only to small towns. Those roads have unpaved surfaces and are not sufficient for running vehicles (refer to Figure 3.2-1).

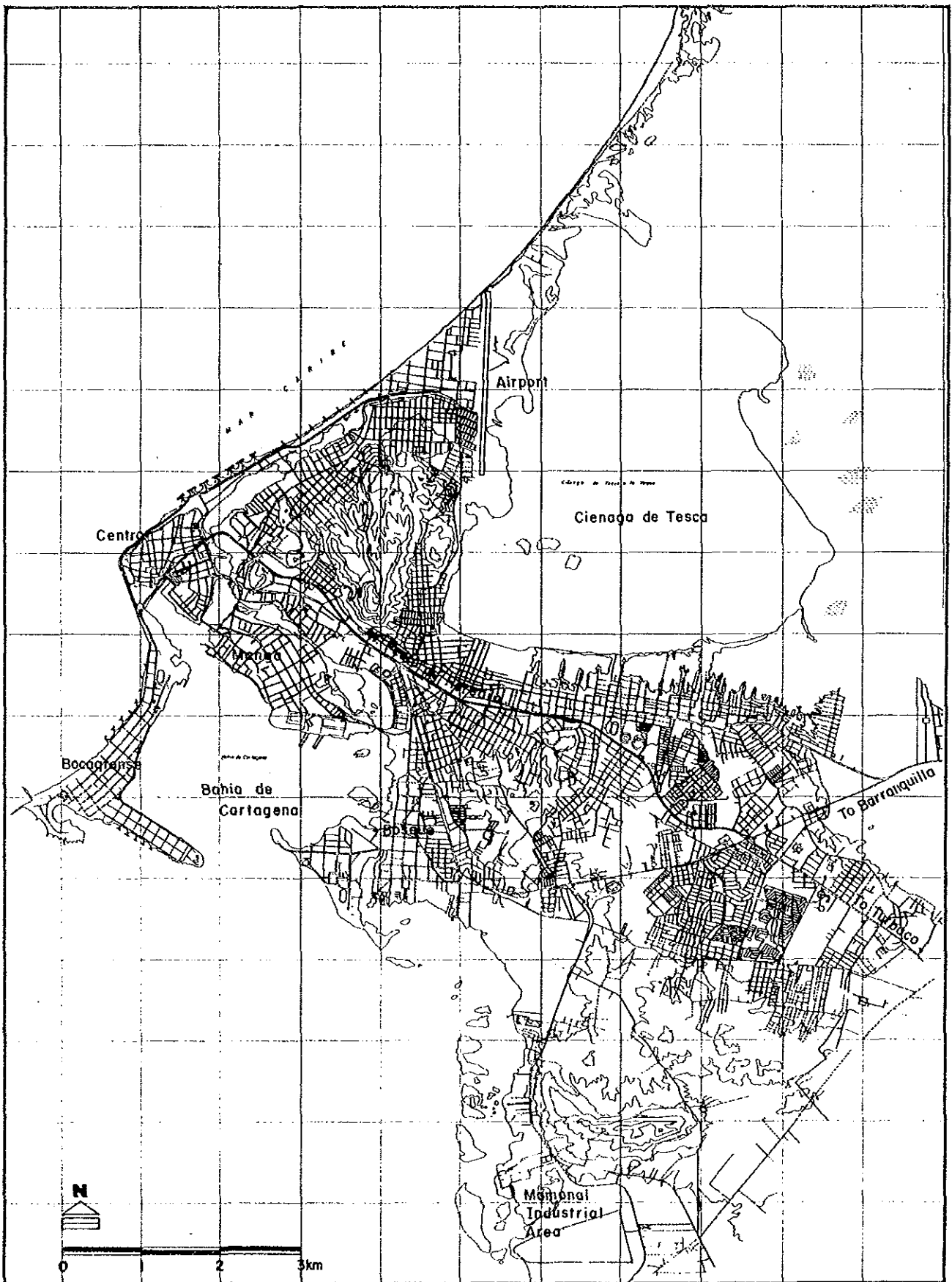


Figure 3.2-1(1) Existing Road Network (Urban Area)

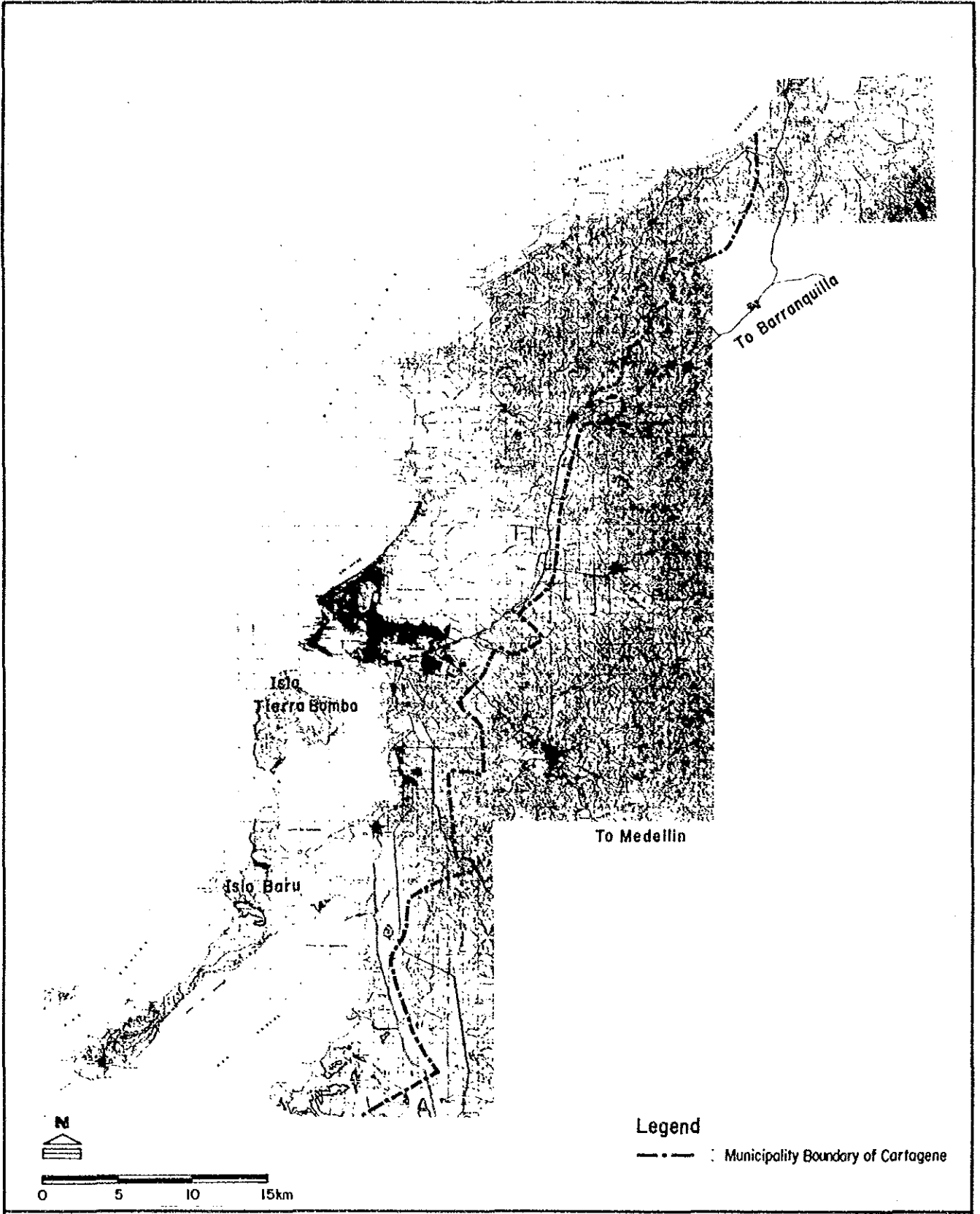


Figure 3.2-1(2) Existing Road Network (Sub-Urban Area)

### 3.2.2 Road Inventory

94. At present, it is estimated that the total road length with more than two lanes in the urban area of the Study Area is approximately 90 km. The main local roads are included in this length as well as the roads which function as arterial and collector roads.

95. Table 3.2-1 shows the road inventory of urban area in Cartagena. The road length with two lanes is approximately 57 km, equivalent to 65% of the total. Three to four (3-4) lanes and five (5) or more lanes roads are 27 km (30%) and 5km (5%) in length respectively. In the urban area, two lane roads are predominant.

Table 3.2-1 Road Inventory of Urban Area in Cartagena

	No. of Lanes	Road Length		Median		Sidewalk		Shoulder with Plant	
		Km	(%)	Km	(%)	Km	(%)	Km	(%)
1	7 - 8	1.10	( 1.2 )	1.10	( 1.2 )	1.10	( 1.2 )	1.10	( 1.2 )
2	5 - 6	3.60	( 4.1 )	3.60	( 4.1 )	3.60	( 4.1 )	3.40	( 3.8 )
3	3 - 4	27.18	( 30.7 )	20.18	( 22.8 )	25.93	( 29.3 )	20.20	( 22.8 )
4	2	56.71	( 64.0 )	0.00	( 0.0 )	39.31	( 44.4 )	38.22	( 43.1 )
Total		88.59	(100.0)	24.88	(28.1)	69.94	(78.9)	62.92	(71.0)

96. Figure 3.2-2 illustrates the number of lanes on the roads. Av. Don Pedro de Heredia which is a main road in Cartagena has 6 or 7 lanes exclusive of some segments which are 4 lanes. Av. San Martin and Av. Santander which connect between the airport and Bocagrande (Tourist area), have 4 lanes. The remaining main roads, namely Diagonal 22 and Carretera Troncal de Occidente, have 4 lanes. As seen, the main roads in the urban area have almost 4 or more lanes.

97. Approximately 95% of the 4 lane roads length have sidewalks. The ratio of sidewalk length on two lane roads to their total length is approximately 70%. Roads with 6 or more lanes have both sidewalk and median. Four (4) lanes roads also show the high ratio of median installation (75%), with 2 lane roads having none.

98. The conditions of the road surface are shown in Table 3.2-2 and Figure 3.2-3. The surfaces are classified into 3 types; asphalt, concrete and unpaved. The concrete surfaced roads have a high ratio (72% of the total), followed by 20% for asphalt and 8% for unpaved. Most of the unpaved roads are recorded on 2 lane roads (96%).

Table 3.2-2 Length of Paved Roads

	No. of Lanes	Length of Paved Road		
		Asphalt Km (%)	Concrete Km (%)	Unpaved Km (%)
1	7 - 8	0.00 ( 0.0 )	1.10 ( 1.2 )	0.00 ( 0.0 )
2	5 - 6	0.00 ( 0.0 )	3.60 ( 4.1 )	0.00 ( 0.0 )
3	3 - 4	10.55 ( 11.9 )	15.73 ( 17.8 )	0.90 ( 1.0 )
4	2	7.12 ( 8.0 )	42.79 ( 48.3 )	6.80 ( 7.7 )
	Total	17.67 ( 19.9 )	63.22 ( 71.4 )	7.70 ( 8.7 )

99. The conditions of pavement are shown in Table 3.2-3 and Figure 3.2-4, in which the pavement are classified into 3 levels; good, regular and bad. The more the number of lanes are, the better the conditions of road surface are. The bad condition roads concentrate on the 2 lanes roads. The figure shows that Av. Don Pedro de Heredia has good surface condition and the other main roads are also maintained in good condition exclusive of Av. Carretera Troncal de Occidente being in regular condition.

Table 3.2-3 Conditions of Road Surface

	No. of Lanes	Conditions of Road Surface		
		Good Km (%)	Regular Km (%)	Bad Km (%)
1	7 - 8	1.10 ( 1.2 )	0.00 ( 0.0 )	0.00 ( 0.0 )
2	5 - 6	3.60 ( 4.1 )	0.00 ( 0.0 )	0.00 ( 0.0 )
3	3 - 4	22.33 ( 25.2 )	3.95 ( 4.5 )	0.90 ( 1.0 )
4	2	46.55 ( 52.5 )	3.71 ( 4.2 )	6.45 ( 7.3 )
	Total	73.58 ( 83.1 )	7.66 ( 8.6 )	7.35 ( 8.3 )



Figure 3.2-2 Number of Lanes on Roads in the Urban Area







Figure 3.2-3 Paved Type of Road Surface in the Urban Area





Figure 3.2-4 Pavement Conditions on Roads in the Urban Area



### 3.2.3 Road Classification

100. The roads in a road network have their own functional features, no matter whether explicitly or implicitly. The roads in urban and suburban areas are broadly classified into four categories from the view point of traffic features. They are trunk road, major arterial road, collector road and local road.

101. In Cartagena, the planning and designing roads can be classified jurisdictionally into the following 10 classifications under the City Act No. 420 dated on January 2, 1990, taking into account the road function as shown in Table 3.2-4.

Table 3.2-4 Classification of Road

Classification	Service
V-1.	Sub-Regional Area
V-2.	Penetration of the City
V-3.	Penetration of the Sector of the City
V-4.	Penetration of the Barrios of the City
V-5.	Secondary of the Barrios
V-6.	Secondary of the local of the Barrios
V-7.	Secondary of the local
V-8.-10.	Local Service

102. Standard of the cross section by road classification is shown in Table 3.2-5, which are regulated in the City Act No. 477 dated January 2, 1990.

103. According to the City Act No. 426 dated on January 2, 1990, the cross sections of the existing roads in the Study Area are planned as a part of the future road network. Av. Don Pedro de Heredia is planned as the classification of V-2. Av. Carretera a Mamonal and Av. Santander are classified into the categories of V-2A and V-2B, respectively, in which the accompaniment "A" and "B" mean minor change of design figures in the cross section from the original figures. In the category of V-3, Diagonal 22 - Carretera de Occidente, Av. Bolivar and Carretera de Torices are classified in the future road network.

Table 3.2-5 Design of the Cross Section by Road Classification

Road Classification	Right of Way		Side-Walk		Median	Total
	Right	Left	Shoulder	Median		
V-1 Subregional	7.30	7.30	3.00	3.00	20.00	46.60
V-2	10.50	10.50	3.00	0.00	2.00	29.00
V-2A	7.00	7.00	3.00	0.00	2.00	22.00
V-3	14.00	-	3.00	0.00	0.00	20.00
V-4	10.50	-	3.00	0.00	0.00	16.50
V-5	7.00	-	3.00	0.00	0.00	13.00
V-6	6.00	-	3.00	0.00	0.00	12.00

### 3.3 Road Traffic

#### 3.3.1 Traffic Survey

104. The traffic surveys were carried out to obtain comprehensive travel characteristic data and information necessary for the transport masterplan in Cartagena. As for the travel information in Cartagena, there are data for the person trip survey which was conducted in 1983 by EDURBE as part of a study for introduction of water transport system. These data have become much different from the present conditions after about a decade. Therefore, the survey aimed to collect new comprehensive trip information.

105. The following various types of traffic surveys were planned and conducted in the Study.

- Vehicle OD Survey
- Cordon Line Survey
- Screen Line Survey
- Traffic Volume Counts at selected intersections/road sections
- Traffic Volume Survey on Transport Facilities
- Household Characteristic Survey

106. In this Study, Vehicle OD Trip Survey was carried out instead of Person Trip Survey. This is because the survey volume of Vehicle OD Trip Survey is smaller than that of Person Trip Survey, and the vehicle OD survey method such as questionnaire items and interview method is simpler than that of Person Trip Survey. However, by Vehicle OD Trip Survey, it is difficult to collect information on the travel of non-motorized households, and to arrive at the relationship between private and public modes. Therefore, several surveys, including Household Characteristic Survey and Public Transport Survey, were planned and conducted in this Study to supplement the above information.

107. The information from such transport facilities as the cargo terminal located at the sea port and the airport is useful for estimating the trip movement of trucks and cargo.

(1) Traffic Survey Procedures

108. In order to obtain detailed information on travel characteristics of vehicles of the Study Area, Vehicle OD Trip Survey accompanied by Cordon Line Survey and Screen Line Survey was carried out in the period of July and August, 1991.

109. Vehicle OD Trip Survey was conducted through home interviews in which interviewers directly visited homes selected from the vehicle registration list in Departamental de Transito y Transporte. A random sample of 2,300 vehicle owners, equivalent to a sample rate of 10% of the total owners, was collected from the Study Area.

110. Cordon Line Survey was carried out on the cordon line which surrounds the boundary of the Study Area. The interview to the passengers on board and traffic count passing through the cordon line were carried out on July 30, 1991 on the two (2) roadsides. Screen Line Survey was carried out on July 31, 1991. Traffic volume passing through the screen line was approximately 66,000 veh./day in both directions.

111. The other surveys, Traffic Volume Counts, Traffic Volume Survey on Transport Facilities and Household Characteristic Survey, were carried out during the period from the end of July to the middle of August, 1991.

112. Summarized in Table 3.3-1 is the outline of the traffic surveys. The details of surveys are presented in the following sections.

(2) Vehicle OD Trip Survey

113. The purpose of Vehicle OD Trip Survey is to obtain detailed information on travel characteristics of vehicles in the Study Area. The survey covers the movement of a person who uses owned vehicle in terms of trip purpose, origin and destination of a trip, and departure and arrival times, etc. It also covers the household characteristics including occupation, income and frequency of vehicle usage, etc. However, since Vehicle OD Trip Survey only covers the vehicle owners of the survey area on a sampling basis, it is supplemented by several surveys such as Cordon Line and Screen Line Surveys.

114. The data base of Vehicle OD Trip Survey gives, among



others, the following output:

- a. Trip generation/ attraction level and characteristics
- b. Distribution and flow of vehicle trips
- c. Socioeconomic characteristics of vehicle owned households

115. The data also provides input information for various demand forecast models.

Table 3.3-1 Summary of Traffic Surveys

Surveys	No. of Locations /Samples	Type of Vehicles	Survey Items	Survey Period
1 Vehicle OD Survey	1600 300 300	Car Taxi Truck	Interview	-
2 Cordon Line Survey	2	Car Taxi Truck Bus Colectivo Inter.Bus	Interview /Counting	24 hours for Counting 14 hours for Interview
3 Screen Line Survey	3	Car Taxi Truck Bus Colectivo Inter.Bus	Counting	24 hours
4 Traffic Volume Survey 1) Road sections	15	Car Taxi Truck Bus Colectivo Inter.Bus	Counting	3 locations for 24 hours 12 locations for 14 hours
2) Intersections	11	Car Taxi Truck All Buses	Counting	14 hours
5 Traffic Volume Survey on Transport Facilities - Airport - Cargo Terminal - Public Market	3	Car Taxi Truck	Interview /Counting	14 hours
6 Household Characteristic Survey	400	Persons	Interview	-

### 1) Zoning

116. The traffic zoning system in the Study Area refers to the zoning system of an administrative district composed of 'Comuna' and 'Barrio' which is divided into 33 zones in the urban area, and composed of 16 'Corregimientos' in the suburban area. This zoning system based on the administrative district is useful for collection of socioeconomic data and registered vehicles by each zone.

117. The total number of traffic zones in the Study Area is 47. The urban area was divided into smaller zones of 40 traffic zones, while the suburban area was divided into wider zones of 7. The zoning is shown in Figure 3.3-1. Zones inside the urban area were set to be relatively small to obtain more detailed information of trip characteristics in the Study Area. As for the suburban area, the future development plans were taken into account when dividing and/or integrating the 'Corregimientos' zones.

118. The outside of the Study Area was divided into 2 traffic zones. This is because there are the neighbor cities and towns along the two national roads; one is in the direction to Barranquilla, and the other is for Medellin. This situation of the outside is taken into consideration for zoning.

## 2) Sampling of Vehicles

119. The vehicles in Cartagena are now registered in both Departamental de Transito y Transporte (DTT) and Departamento Administrativo de Transito y Transporte (DATT Distrital). DTT has responsibility for the vehicle registration up to the year 1990 when DATT commenced the registration works for all types of vehicles. In the near future, the registration works will be transferred from DTT to DATT.

120. The total number of registered vehicles excluding motorcycles in 1991 in the Study Area is approximately 22,700, of which 17,000 are cars, 2,900 are taxis and the remaining 3,100 are trucks. The registered vehicles in the urban area stand at 99% of the total and the portion in the suburban area is only 1%. From this data, it seems to indicate that the urban traffic movement is mainly inside of urban area.

121. The number of collected samples was approximately 2,300 vehicle owners from the registered vehicle list, equivalent to a sample rate of 10% of the total registered vehicles. The vehicle owners shown in Table 3.3-2 were randomly surveyed in relation to the registered vehicles of traffic zone by type of vehicle.

Table 3.3-2 Number of Registered Vehicles and Sampled Vehicles

Type	No. of Registered	No. of Samples	Sampling Rate (%)
Car	16,944	1,681	9.9
Taxi	2,872	302	10.5
Truck	2,902	310	10.7
Total	22,718	2,293	10.1

### 3) Questionnaire

122. The three (3) type questionnaire forms for this interview survey were prepared according to the type of vehicles; Car, Taxi and Truck, because the type of ownership, trip pattern, and number of trips, etc., are different by type of vehicle.

#### i) Passenger Car

123. The items of questionnaire involved car owner characteristics and trip information. The car owner characteristics aim to identify the socioeconomic characteristics of car owner. The trip information in the questionnaire aims to collect information about the trips made by car owner in a previous day before the interview.

- a) Car Owner Characteristics
  - Form of Ownership
  - Occupation
  - Number of Vehicles owned
  - Frequency of Vehicle Use per week
  - Monthly Family Gross Income

- b) Trip Information
  - Origin/Destination
  - Departure/Arrival Time
  - Trip Purpose
  - Parking Place
  - Number of Passengers accompanied

#### ii) Truck

124. The questionnaire items included company information and trip information. The company information reflected the company characteristics.

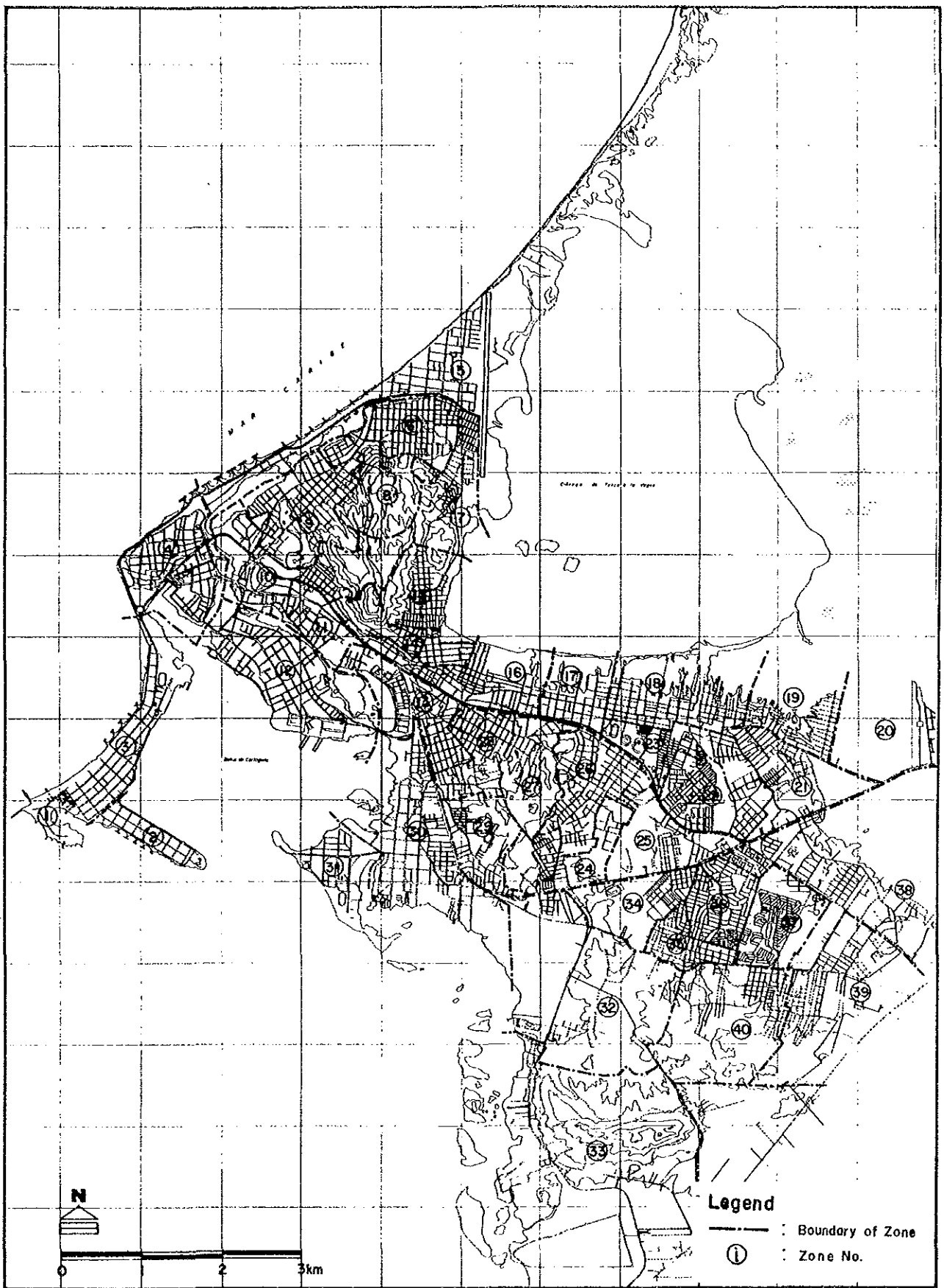


Figure 3.3-1(1) Traffic Zoning System (Urban Area)

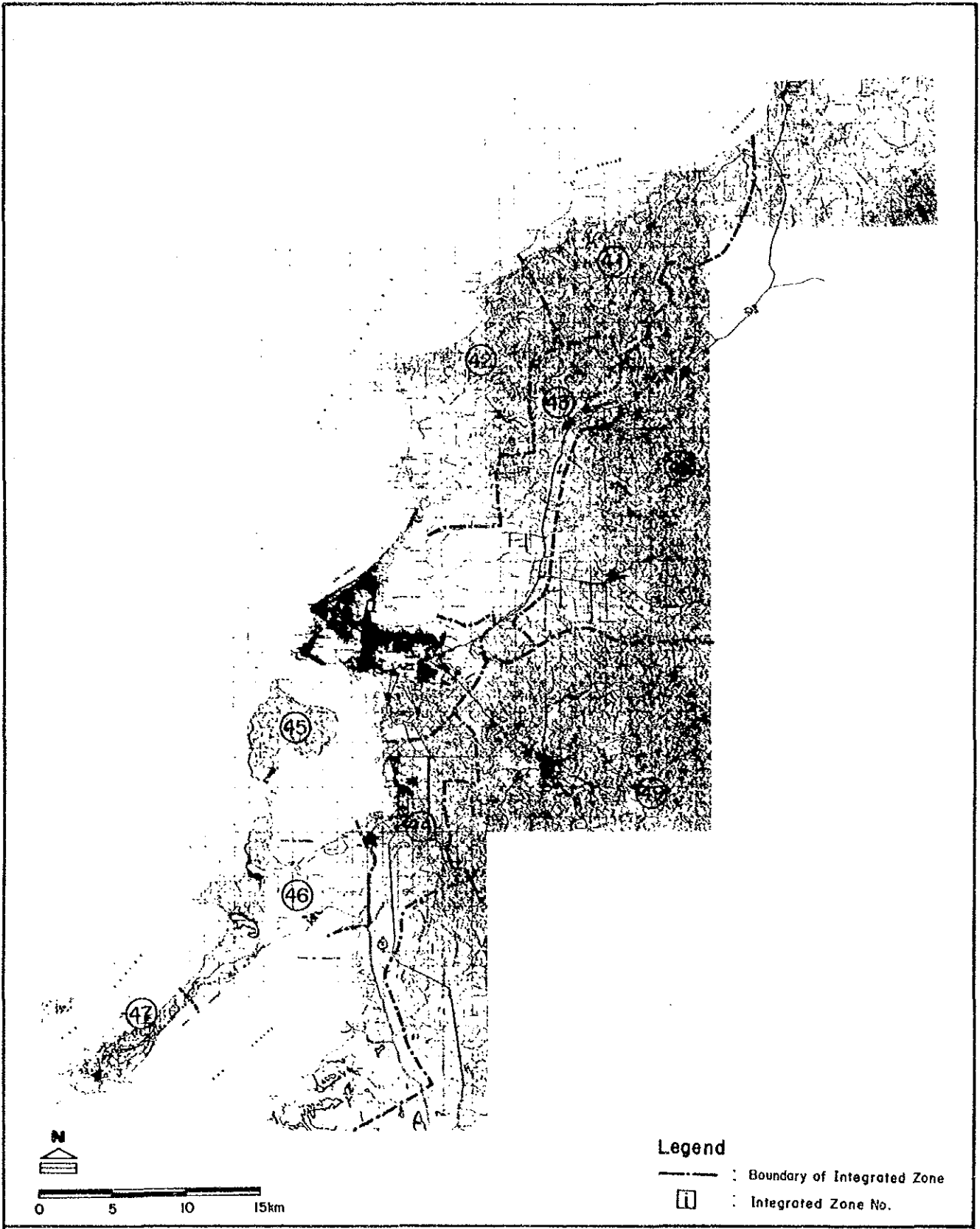


Figure 3.3-1(2) Traffic Zoning System (Sub-Urban Area)

- a) Company Information
  - Type of Business
  - Number of Employees
  - Number of Vehicles owned by Company

- b) Trip Information
  - Origin/Destination
  - Departure/Arrival Time
  - Parking Place
  - Number of Passengers accompanied
  - Commodity Type of Freight
  - Weight of Freight

iii) Taxi

125. The elements in the questionnaire included taxi driver information and trip information. The taxi driver information aims to identify the taxi association and the driver's characteristics.

- a) Taxi Driver Information
  - Type of Driver (Owner or Employee)
  - Number of Vehicles owned (in case of owner driver)
  - Working Period (daytime or nighttime)
- b) Trip Information
  - Origin/Destination
  - Departure/Arrival Time
  - Number of Passengers accompanied

4) Survey Method

126. Vehicle OD Trip Survey was conducted by the home interview method in which interviewer visits homes and collects questionnaires. In order to get the cooperation of inhabitants dwelling in the Study Area, prior to the commencement of the survey, the public relations activities through mass media of TVs and news papers were done. All the surveyors wore the same designed hat as a uniform to be noticeable. Vehicle OD Trip Survey was commenced at the beginning of August, 1991 and completed at the end of August, 1991.

(3) Cordon Line Survey

127. Cordon Line Survey consists of roadside interview and traffic volume count which are conducted simultaneously at cordon line survey stations. The roadside interview is done to obtain OD data of vehicles and passengers, both those registered or dwelling outside the Study Area who travel to/from the Study Area. Traffic