3) Person trip flow information

- Hourly trip distribution
- Movement pattern by purpose
- Movement pattern by mode
- Parking information

6–1–4 Expansion and Adjustment Procedure

1) Expansion

This Person Trip Survey is a sample survey, therefore, its results are to be expanded by zone. Although the sampling was done by house unit in the sampled area, the expansion factor was calculated by using the collected number of sampled persons, and the total number of persons in each zone.

2) Average Vehicle Occupancy

From the Car Occupancy Survey which was carried out in October 1983, the rate of vehicle occupancy can be calculated. The results of this survey are shown in the following Table 6–1–2.

Table 6–1–2 Vehicle Occupancy Obtained from the Car Occupancy Survey

	Average Occupancy
Passenger Car	2.1 Persons/Vehicle (1)
Taxi	0.9 (2)
Mini Bus	24.8
Large Bus	39.7

Source: Car Occupancy Survey by Study Team.
(1): Including drivers
(2): Excluding drivers

The average occupancy rate of Buses, including Mini Buses and Large Buses, is calculated independently from the Bus Passengers Survey. The average rate is 85.7% of the bus capacity, which averages 37.7 persons/bus. Therefore, 32.2 persons per bus is deduced from this survey. The average occupancy rate for trucks obtained from the Person Trip Survey is 2.05 persons/vehicle. As a result, the average occupancy rates for converting from the person trips to vehicle trips are summarized as follows. (see Table 6–1–3)

Table 6–1–3 Average Vehicle Occupancy

	Average Occupancy
Passenger Car	2.10 Persons/Vehicle
Taxi	0.90
Bus	32.20
Truck	2.05

3) Vacant Taxi Rate

From the results of the Car Occupancy Survey, the rate of vacant taxis is obtained as indicated in Table 6–1–4.

Table 6–1–4 The Rate of Vacant Taxis

Survey date	No. of Taxi	No. of Vacant Taxi	Rate of Vacant Taxi
Oct. 5, 83	935	445	0.476
Oct. 7, 83	3561	1460	0.410
Total	4495	1905	0.424

Source: Car Occupancy Survey

4) Screen Line Adjustment

The OD Table obtained from the Person Trip Survey can be checked for accuracy by comparing it with the results of the Screen Line Survey. If the traffic volume calculated from the OD Table are significantly different from the present traffic flow, the OD Table should be adjusted to represent the existing situation.

The differences between the two survey results may be due to the following causes:

(1) Movement of non-residents in Barranquilla and Soledad are not recorded in the Person Trip Survey.
(2) Vehicle users were not sufficiently included in the Person Trip Survey.
(3) Movements of trucks and trailers for commercial use are not accurately grasped in the Person Trip Survey.
(4) Vacant taxi movements are not well grasped in the Person Trip Survey.
(5) Double counting of trips on the Screen Line is highly possible.

As a result of the comparison of the two survey results, the following adjustment is made. The trips by buses should be multiplied by 1.176, those by taxi by 1.698, and those by trucks should be multiplied by 4.590. The trips by passenger cars can be used readily without modification because results of the Person Trip Survey and Screen Line Survey do not differ significantly, the difference being a mere 2.7%. Traffic volume on the screen line is shown in Table 6–1–5.

Table 6–1–5 Traffic Volume on the Screen Line

	No. of Vehicle (%) Vehicle/day	No. of Person (%) Persons/day
Car	55,335 (33.2)	116,279 (11.0)
Bus	24,695 (14.8)	795,181 (75.3)
Taxi	62,426 (37.4)	85,211 (8.1)
Truck	24,438 (14.6)	59,141 (5.6)
Total	166,894 (100.0)	1,055,812 (100.0)

6–2 Trip Production

6–2–1 Total Trip Production

1) Total Number of Trips

The total number of person trips in the Barranquilla Metropolitan area is estimated to be 2,674,000 trips per average week day. 97% of these i.e., 2,581,000 trips, are made by the residents of Barranquilla and Soledad. Generally a trip is defined by a linked trip, where transfers within a trip are not taken into account. Out of these 163,000 trips representing 6.1% of the total trips are to/from outside the study area. Only 6,000 trips pass through the area from the outside to outside areas.

The survey area of the person trip survey does not include the cities Malambo, Galapa and Puerto Colombia. These cities have many trips outgoing/incoming from/to Barranquilla: 85,000 trips are made by the residents outside the survey area and 78,000 trips by the residents inside the survey area.

2) Number of Trips by Purpose

The composition of trip purpose shows that the "to home" trip is 47.6%, "to school" is 16.6%, "to work" is 14.5%, "private" is 10.7%, "shopping" is 7.5% and "Business" is 3.6%. The three highest percentages combine to make up 78.7% of the total number of trips. These trips constitute a constant daily traffic flow and are considered as the main component of the peak-hour traffic.

The percentage of trips for business purposes is relatively low. In general the percentage of business trips is related to the progress of socio-economic activities in the city. Considering the activity level of the Barranquilla metropolitan region, the actual figure might be slightly higher than the result. The number of trips by purpose is shown in Figure 6–2–1.

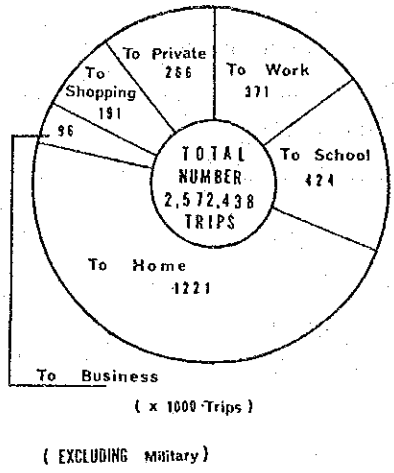


Fig. 6–2–1 Number of Trips by Purpose

3) Number of Trips by Industry

Figure 6–2–2 shows the total number of trips by the personnel whose characteristics can be classified as industry.

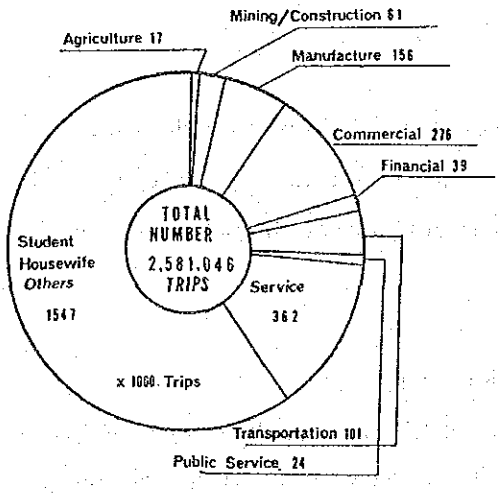
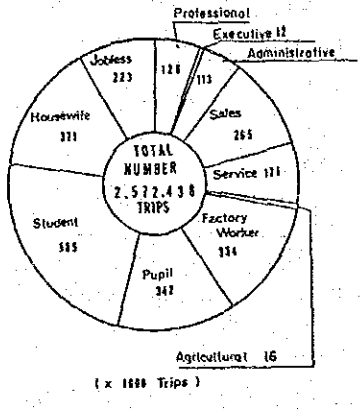


Fig. 6–2–2 Number of Trips by Industry

More than half of the total trips, about 1,547,000 trips (60.3%), are made by non-workers, such as students, housewives and others. The service sector has the largest share with about 362,000 trips (37.3%). Commercial industry has the second largest number with about 276,000 trips.

4) Number of Trips by Occupation

The total number of trips by occupation is shown in Figure 6–2–3. The largest number of trips are made by pupils and students with about 927,000 trips in total, followed by housewives with 367,000 trips per day. Among the 7 categories of occupations, the largest is factory workers with 325,000 trips, followed by sales workers with 259,000 trips.



(EXCLUDING Military)

Fig. 6–2–3 Number of Trips by Occupation

6–2–2 Trip Production Rate

With 2,581,000 trips travelled by a population of 347,000 people (the total number of persons who made a trip), the total trip rate is calculated as 3.04 trips per day. This is called the net trip production rate. The gross trip production rate is calculated as 2.69 trips per day, which is obtained by the total trip production divided by the total population (5 years old and older). Thus, the trip maker ratio, that is, the ratio of persons who travel to the total population, is calculated to be 0.88.

Generally, in this report, the gross trip production rate will be used unless otherwise noted. In large cities throughout the world, the gross trip production rate ranges between 2.0–3.0. The rate tends to increase along with the expansion of the urbanized area reflecting the growth of socio-economic activities.

1) Trip Production Rate by Industry

The trip production rate significantly differs when personal characteristics are classified by industry as shown in Table 6–2–1. It ranges from 2.38 for non-workers to 5.23 for the workers in the transport sector.

Table 6–2–1 Trip Production Rate by Industry

Industry	Trips/Person/Day
1) Agriculture	3.76
2) Mining/Construction	3.23
3) Manufacture	3.03
4) Commerce	3.34
5) Finance	4.00
6) Transport	5.23
7) Public Service	4.04
8) Service	3.01
9) Non-Workers	2.38
TOTAL	2.69

NOTE: "Non-Workers" include students, housewives and jobless workers.

2) *Trip Production Rate by Occupation*

Generally, the trip production rate does not differ much by occupation in the case of Barranquilla. "Administrative" makes 3.69 trip/person, which is the highest and the lowest, 2.11 trip/person, is made by "Jobless" and "Others". (Refer to Table 6–2–2) In the case of Panama City, there is a considerable difference in the production rate by occupation; "Executive" makes 5.84 trips/person while "Housewife" makes only 1.13 trips/person. In Barranquilla, "Administrative" has a low trip production rate for business and private purposes. However, "Housewife" has a high trip production rate for shopping and private purposes. This is why the gross trip production rate becomes a high value.

Table 6–2–2 Trip Production Rate by Occupation

Occupation	Tip/Person/Day
1) Professional	3.64
2) Executive	3.58
3) Administrative	3.69
4) Sales	3.25
5) Service Worker	2.61
6) Agriculture	3.02
7) Factory Worker	3.34
8) Pupil (Elementary)	3.13
9) Student (Highschool College)	2.20
10) Housewife	2.67
11) Jobless	2.28
12) Others	2.11
TOTAL	2.69

3) Trip Production Rate by Car Ownership

The trip production rate by car-ownership is shown in Table 6–2–3. There does not exist a large difference in the trip production rate by car ownership. The trip production rate for car-owners is about 1.2 times that of non car-owners. Only the trip production rate for business purposes shows an obvious difference between them. In the case of Panama, it was 3.39 trips/person for car-owners and 1.94 trips/person for non car-owners.

Table 6–2–3 Trip Production Rate by Ownership

Purpose	No-car	Owner	Total
Work	0.38	0.43	0.39
School	0.43	0.49	0.44
Home	1.25	1.43	1.28
Business	0.08	0.22	0.10
Shopping	0.20	0.20	0.20
Private	0.26	0.35	0.28
TOTAL	2.61	3.12	2.69

6–3 Trip Generation and Attraction

The number of trip generation by zone is almost equal to trip attractions by zone, since the out-going and in-coming (to "home" purpose) trips are counted in terms of all modes and all purposes. The total number of person trips in the Barranquilla Metropolitan Region is 2,674,000 trips per day, of which more than 10% is generated and/or attracted in Centro, i.e. zone 1 as shown in Figure 6–3–1.

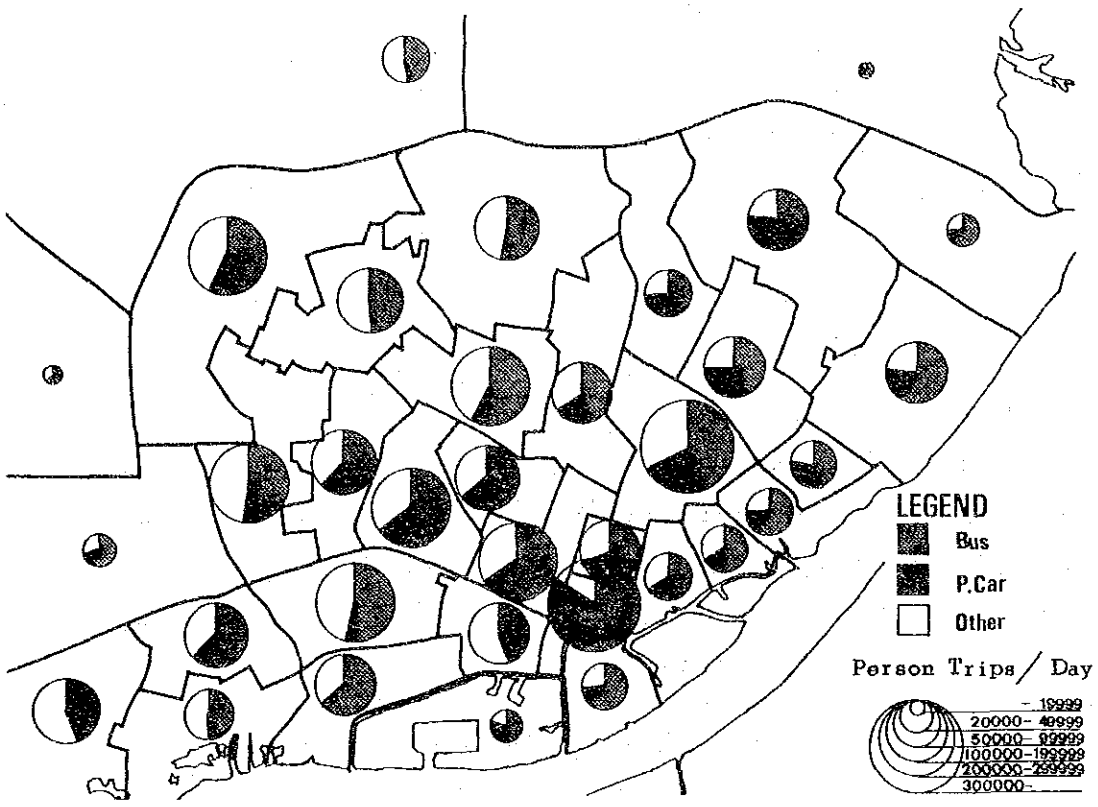


Fig. 6–3–1 Trip Generation/Attraction by Zone

The size of trip generation and/or attraction in a particular zone is largely dependent on the number of residents and the economic activities of the corresponding zone. Therefore, if either one of these is high, the trip generation/attraction will be also high. In the case of Centro, the number of residents makes up only 0.2% of the total population in the study area. Hence, this high percentage share of trip generation/attraction results from an agglomeration of economic activities. Likewise, in other zones, a higher number of trip generation/attraction is found in spite of a relatively lower number of residents. Such is the case of the neighboring zones of Centro such as zones 2 and 10, and the newly developed business and commercial area along Calle 72 such as zones 8 and 9. On the other hand, the south-west areas of Barranquilla such as

Table 6–3–1 Trip Generation and Attraction by Zone

Zone	Trip Generation						Trip Attraction					
	Work	School	Home	Business	Shopping	Private	Work	School	Home	Business	Shopping	Private
1	6,899	2,097	258,064	5,321	6,747	10,553	97,376	8,486	3,053	21,636	97,713	53,591
2	3,354	2,697	81,194	3,219	2,186	4,394	28,563	30,147	6,354	4,014	8,998	17,951
3	1,332	800	21,073	1,764	770	1,138	15,739	535	2,371	2,475	7,552	1,863
4	3,881	4,176	23,256	2,377	2,027	3,116	13,696	5,529	11,590	1,902	1,412	4,673
5	3,939	5,527	21,822	1,210	1,896	3,122	6,546	11,861	14,497	2,462	414	3,235
6	5,146	4,615	14,054	581	1,455	2,943	8,162	3,732	13,973	698	437	2,298
7	7,291	7,577	14,629	871	3,652	3,032	7,091	2,966	20,861	1,118	1,842	3,745
8	14,721	17,565	84,478	7,091	9,351	19,303	29,891	30,812	55,623	7,940	8,461	20,717
9	9,134	8,453	46,129	2,258	5,046	9,780	21,491	5,441	27,798	3,918	9,203	12,989
10	13,132	16,223	74,908	5,656	9,982	12,319	21,266	32,869	49,585	5,036	6,884	18,147
11	12,065	13,477	24,651	2,041	4,402	9,710	5,699	10,897	39,566	1,723	1,640	6,708
12	17,359	21,404	36,857	3,648	5,752	7,427	7,282	22,660	53,033	1,906	1,411	7,452
13	312	115	11,038	1,104	281	222	10,561	245	125	1,736	101	599
14	10,845	11,807	23,205	1,611	9,958	8,564	5,452	9,308	41,236	1,080	4,073	3,669
15	12,839	12,547	9,881	2,834	6,411	7,549	2,082	5,121	41,156	298	915	1,976
16	18,084	26,482	50,862	6,491	12,970	17,927	8,451	24,140	77,737	3,183	7,835	11,712
17	16,844	20,703	45,884	5,063	10,141	11,417	13,448	15,074	59,910	2,859	3,473	15,544
18	15,171	20,074	31,637	4,579	8,447	18,461	6,871	9,123	63,936	2,079	5,553	10,502
19	28,948	33,964	37,962	8,506	15,590	18,939	6,944	23,441	103,154	1,959	3,550	5,991
20	24,100	25,815	46,813	5,663	11,818	16,146	7,770	22,651	80,068	4,017	3,046	13,776
21	20,342	22,382	26,162	1,236	7,918	13,756	3,010	17,068	65,252	647	1,709	3,814
22	33,962	34,355	27,307	1,292	12,711	13,574	5,931	14,980	95,102	1,873	1,852	4,534
23	22,010	23,952	20,177	1,616	11,330	9,299	1,350	13,767	67,011	677	2,936	3,201
24	4,612	9,191	6,728	1,146	2,720	3,901	625	5,504	20,616	276	277	981
25	4,287	6,402	29,334	1,118	2,468	4,241	5,736	15,588	16,342	1,358	3,347	5,467
26	10,834	12,516	41,299	2,174	4,337	7,988	8,137	25,557	33,240	2,237	1,715	8,227
27	13,088	9,422	17,249	3,242	4,174	4,251	9,133	2,971	30,567	1,567	1,997	3,071
28	1,257	1,629	7,201	1,469	1,139	820	6,265	533	4,216	1,276	440	642
29	226	146	8,042	559	91	314	1,362	6,395	193	829	0	820
30	0	0	325	0	0	0	170	0	14	127	1	58
31	3,892	3,428	11,853	789	1,050	893	5,610	4,213	8,096	1,199	355	2,425
32	11,193	13,324	22,872	3,368	4,275	5,834	3,796	15,819	36,234	833	2,260	2,646
33	7,936	12,064	13,375	3,753	5,078	6,785	3,351	5,431	34,192	1,652	2,450	2,199
34	15,552	19,371	41,579	3,574	5,455	8,319	5,636	22,149	48,825	3,635	2,762	9,141
35	21,524	4,788	33,306	8,624	6,052	14,186	11,618	4,075	39,680	15,623	1,066	15,559
Total	396,111	429,088	1,265,206	105,848	197,680	280,223	396,111	429,088	1,265,206	105,848	197,680	280,223

Source: Person Trip Survey

zones 16, 17, 19, 20 and 22 etc. also have large numbers of trip generation/attraction, since they are densely populated, though they do not have many activities. (see Table 6–3–1)

Table 6–3–1 shows the trip attraction by purpose. In the case of "To Work", the trip attraction is relatively higher in the zones with more job opportunities such as Centro and its surroundings zones 2, 3, 4, 10 etc. and the area along Calle 72. As for "To Home", a large number of trip attraction is found in the populated area in the south west part of Barranquilla such as zones 16, 17 18, 19, 22 etc., while the less populated areas such as Centro, the port area etc. have few trip attractions. The trip attraction of "Business" is mainly found in the zones with higher economic activities such as Centro and the area along Calle 72. A considerable number of "Business" trip attractions is also found in zones 20, 34, 16, 17 and 18 due to the dispersed commercial activities and manufacturing industries along the major roads. In the case of "Shopping", the concentration of trip attraction in some specific zones is more outstanding. Centro attracts about half of the total shoppers in the Metropolitan Region. Other commerical zones are found in the neighbouring zones of Centro including Barranquilla, and the area along Calle 72.

6–4 Existing Origin-Destination Pattern

Figure 6–4–1 shows the desire lines of the existing person trips, which have been derived from the Origin-Destination Table.

6–4–1 Total Person Trips (all purpose and all modes) (See Figure 6–4–1)

Generally, the existing O-D pattern shows an outstanding concentration into Centro and its surrounding zones, of which the main flows are those between Centro and the densely populated areas located in the south and south-west parts of Barranquilla. Another concentration can be seen in zone 8 located along Calle 72. This however, is not as heavy as Centro. Although radial type trips are predominent, there exists a significant number of circular type trips among zones 8, 9, 12, 20, 21, etc.

6–4–2 "Work", "Shopping" and "Private" Trips (See Appendix D)

Compared with other purposes, the O-D patterns of these trips are simpler, i.e. the trip concentration to the Centro and its neighbouring zones is more predominent. This is because these districts have about 30% of the total employment in the Metropolitan Region involving most of the major urban functions such as administration, commerce, finance, etc.

Fig. 6–4–1 OD Pattern in 1983 (All Purpose)

6–4–3 "School" Trips (See Appendix D)

The desire lines for "school" trips show a more dispersed pattern, but some concentrations are recognized in the northwest and western areas of Centro. This is because the schools at elementary levels are dispersed over the urbanized area, but the schools at higher levels are rather concentrated in the northwest and western areas of Centro.

6–4–4 "Business" Trips (See Appendix D)

Since the total number of trips for business is less than other purposes, it is difficult to find the characteristics of the trip pattern in relation to the locational pattern of economic activities. Nevertheless, a concentration into Centro is also found in this case.

6–4–5 "Home" Trips (See Appendix D)

The O-D pattern for "Home" is similar to that of the all purpose. This is simply because the number of trips for "Home" makes up almost half of the total number of "all purpose" trips.

6–5 Modal Choice

6–5–1 Existing Modal Choice

In general, a trip is made by using several different modes. In order to define the representative mode used in the trip, a priority is given to each mode. The first priority is given to public transport, the second to vehicles, and the third to personal means. Thus, the order of priority is (1) Bus, (2) Taxi, (3) Passenger car, (4) Truck, (5) Motorcycle, (6) Walk, (7) others.

Buses are used most often by the people in Barranquilla, counting for 1,367,000 trips (53.0%). The mode with the second highest share is by walk, about 25.2% (excluding access to Bus and Taxi). Passenger cars are used for only 10.9% of the total trips. (See Table 6–5–1)

Table 6–5–1 Modal Share

Mode	No. of Trips (x 1000)	%
Passenger Car	282	10.9
Bus	1,367	53.0
Taxi	129	5.0
Truck	107	4.1
Motorcycle	36	1.4
Walk	652	25.2
Others	9	0.4
TOTAL	2,581	100.0

The table also shows that trucks and taxis have small modal shares. They might be underestimated, since in this person trip survey it is difficult to grasp the movements of trucks for cargo transport or of vacant taxi.

6–5–2 Modal Choice by Trip Purpose

Table 6–5–2 and Figure 6–5–1 show the modal choice by trip purpose. These show the importance of public transportation modes and the dependance upon bus transport in the Barranquilla Metropolitan Area. Except for "school" and "business", the modal share of bus is more than half. This high modal share of bus is mainly due to (1) the low income level of the majority, (2) the low rate of vehicle ownership, (3) the concentration of major urban activities in the Central District.

Table 6–5–2 Modal Choice by Trip Purpose

	Work	School	Business	Private	Shopping	Home	Total
P. Car	15.0	11.0	13.5	8.9	3.9	11.0	10.9
Bus	65.4	41.5	35.8	58.7	59.4	52.2	53.0
Taxi	3.6	1.3	6.6	9.0	3.2	6.0	5.0
Truck	4.5	0.9	34.3	1.7	2.5	3.5	4.1
M/C	2.1	1.0	2.2	1.3	0.6	1.4	1.4
Walk	8.6	44.2	7.0	19.9	30.2	25.6	25.2
Others	0.8	0.1	0.6	0.5	0.2	0.3	0.4
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

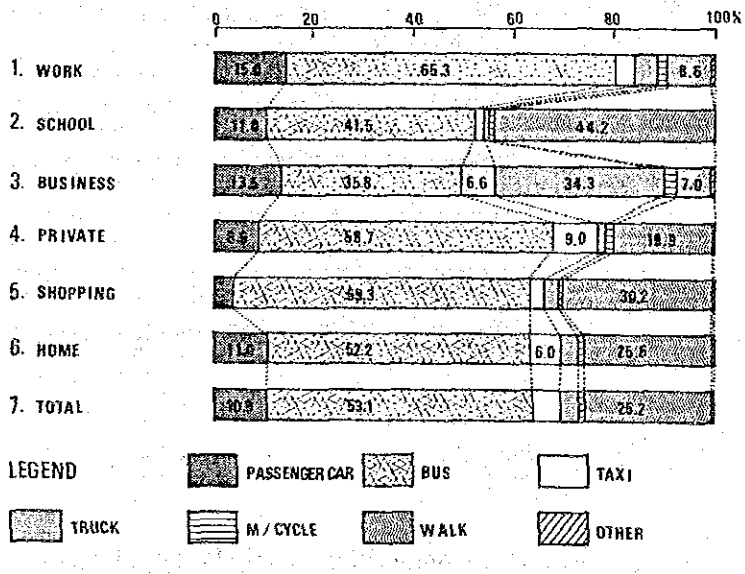


Fig. 6–5–1 Modal Choice by Purpose

With respect to "work" trips, 65.4% of the total person trips are made by bus and 15.0% are made by passenger car. Walking has a very low share, only 8.6%. The "to school" purpose has two important modes, bus and walking, both of them have modal shares of over 40%. Generally, buses are used by students going to high school or university, while walking is the main mode for pupil going to elementary school. "Business" trips are also made by two main modes, bus and trucks, the proportion being about 35% each. The trips by trucks are related to the activities of commercial and manufacturing industries. The passenger car share will grow gradually larger with the growth of activity in Barranquilla. Other trip purposes show similar patterns to the work purpose, which is 50–60% for buses and 20–30% for walking.

The modal choice pattern can be classified into 3 types; (1) work type, (2) school type and (3) business type. However, this pattern is likely to change in the future due to the changes in car ownership and transport services.

6–5–3 Trip Purpose by Transport Mode

Figure 6–5–2 shows the composition of trip purposes by transport mode. It can be seen that each mode is used in a different way and is characterized by a percentage share of the business purpose and private purpose.

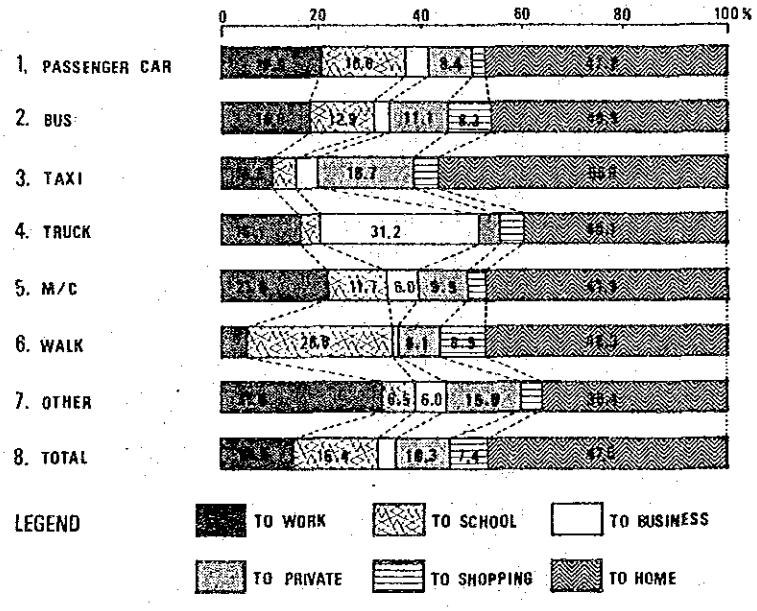


Fig. 6–5–2 Composition of Trip Purpose by Mode

Trucks are used mainly for business, the percentage being 31.2%. Other modes are used less for business; the share being 6% or less. In the case of passenger cars and taxis, their use for business trips is 4.6% and 5.0% respectively. 18.7% of trips by taxi are for private purposes, this proportion being the largest except for "To Home" purposes.

Buses are used uniformly for various purposes except for business and to home purposes. Passenger cars, buses and taxis are used mainly for daily trips such as going to work, school and home, with the percentage share exceeding 70%.

6–6 Other Characteristics

6–6–1 Hourly Variation of Person Trips

1) Hourly Variation of Departure Time

Generally there exists three peaks in terms of the hourly number of trips; 6:00–8:00 in the morning, 12:00–13:00 during the noon time and 17:00–19:00 in the evening. Particularly in the case of buses and passenger cars, the three peaks are well defined. These peaks result from the fact that passenger cars and buses are mainly used for commuting from home to the work place or to school and vice versa.

With regard to trucks, in addition to the three peak hours above, the hourly variations have an additional peak hour from 9:00 to 10:00 a.m. This may be due to business trips which are the main trip purposes of trucks.

On the other hand, for taxis, the hourly variation does not have notable peak hours. This is reflected by the fact that taxis are used for "private" purpose more frequently than for going to work or to school.

2) Hourly Variation of Person Trips to/from CBD

Figure 6–6–1 and Figure 6–6–2 show the hourly fluctuations of person trips to CBD and from CBD.

Regarding the trips to CBD, all the transport modes have two sharp peaks; one is from 7:00 to 9:00 a.m. and the other is from 2:00 p.m. to 3:00 p.m. These peaks are mainly formed by commuting workers. After 4:00 p.m. the number of trips to CBD suddenly decreases to about one tenth of the peak hour volume.

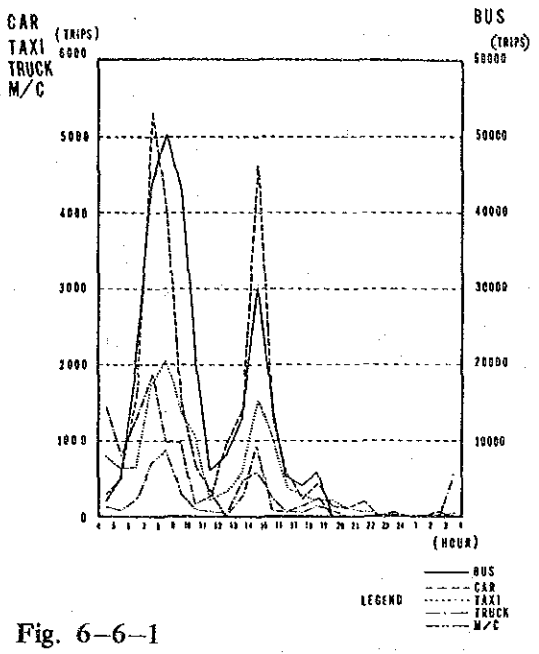


Fig. 6–6–1 Hourly Traffic Distribution to CBD

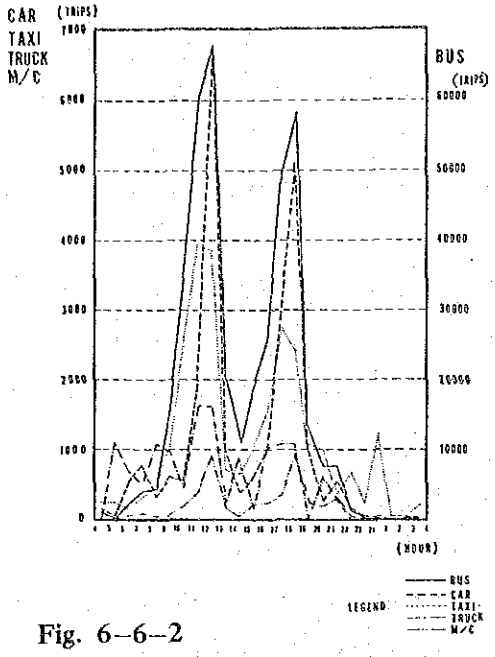


Fig. 6–6–2 Hourly Traffic Distribution from CBD

As for the trips from CBD, peak hours are found at around 11:00 a.m. to 1:00 p.m. and 5:00 p.m. to 7:00 p.m. These peaks are created by the trips to home. It should be noted that in the case of the trips by bus and car, the concentration rate at peak hours is extremely high; in the case of trips to CBD it is about 22% for buses and 34% for cars.

6–6–2 Travel Time Distribution by Trip Purpose

The travel time distribution by trip purpose is shown in Fig. 6–6–3. For any trip purpose, the number of trips decreases in accordance with the increase in the travel time, approaching nearly zero at the travel time of 80 minutes. Among the 6 trip purposes, the trips for school and shopping have the most radical decreasing tendencies by travel time.

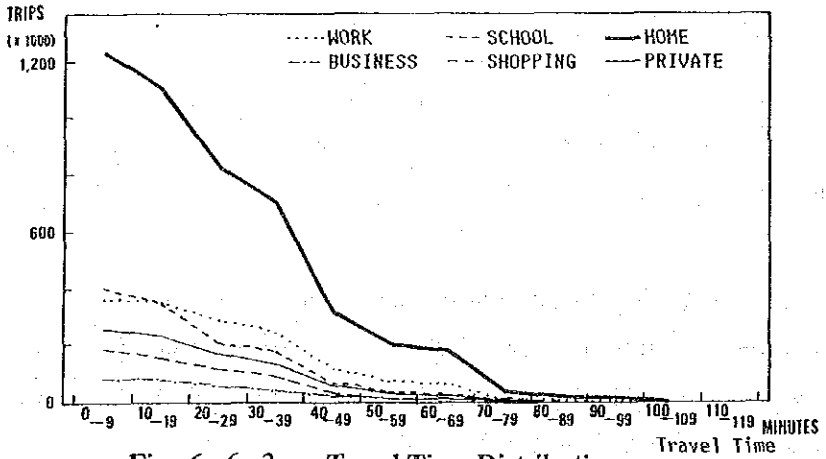


Fig. 6–6–3 Travel Time Distribution

Chapter 7.

EXISTING PUBLIC TRANSPORT SYSTEM

Chapter 7 EXISTING PUBLIC TRANSPORT SYSTEM

7–1 General

The major mode of public transport in Barranquilla is bus. Taxis are also available as a supplementary mode. A total of 61 bus routes are operated by 21 private organizations, using a total of 2,180 buses.

All bus routes are concentrated in the center of the city. These complicated route patterns developed naturally according to the expansion of the city. The expansion of developing neighborhoods on the outskirts of the city encourages the extension of bus routes and the increase in the number of buses. This expansion of bus service areas and increase of the number of bus has made traffic congestion more severe in the Central District.

There are two types of organizations operating bus routes: companies and cooperatives. Previously, many bus owners operated individually, but recently they were asked to integrate with one of the two organizations. Even now, bus companies have many individual bus owners who pay a royalty to use "cupo" which is a bus operation licence from INTRA. Bus operating organizations seem to be undergoing modernization process preferring organizational operations such as the bus compnaies rather than individual operations.

Many bus models are used. For instance, one company operates various models from the 1940's to 1983. Other companies operate more than ten different makes of buses.

Due to the above-mentioned conditions, the maintenance conditions of the buses as well as the maintenance facilities are poor. There is also a shortage of manpower in the individual bus companies. The majority of the buses are Dodge and Chevrolet.

There are three kinds of buses in Barranquilla: the 30 seats or more; the buseta with less than 30 seats; and the microbus, of which there are very few.

Buses can be divided into two types depending on their fares: one is the "corriente" offering cheaper fares due to government subsidy, and the other is the TSS bus operating without sybsidy. During the 1960's, there were three types of buses, each operated under a different subsidized fares, but were subsequently integrated into two kinds.

After the construction of a university outside the circunvalar, busetas were introduced with a higher fare due to non-subsidized operation. At the end of 1981, the TSS bus was introduced. The introduction of the TSS bus had two objectives: One was to promote the renewal of old buses, and the other to slow down the increase in the total amount of subsidies to corriente

buses. Consequently, the introduction of new corriente buses has slowed down. On the other hand, CFT has provided soft loans for the procurement of new buses for TSS.

The Corporación Financiera de Transporte (CFT), a section of MINISTERIO DE Desarrollo Economico (MDE), aims to provide financial resources for public transport businesses. CFT has a master-plan for bus terminals in all major citites of this country. They have completed bus terminals in Bogoá, Cali and some other cities. Barranquilla was also selected as one of these cities, and some studies on site selection of the terminal have been conducted, but have not yet been implemented.

Four taxi companies and about thirty taxi associations exist in Barranquilla operating more than 5,000 registered taxis. Generally, the taxi is considered as a supplemental form of public transport.

Other supplemental form of transport are the ferries on the Magdalena River. Because of poor land transportation, these ferries connect Barranquilla with other small municipalities which are located along the river. However, at present the total number of passengers on the ferry boats is limted.

7–2 Bus Transport Demand and Bus Service

1) Urban Bus Route

There are 61 urban bus routes in the Metropolitan area of Barranquilla. Based on the shape and the service area of each bus route, they are categorized into 4 groups: linear, radial, through and circumferencial routes. According to the categories of the route pattern mentioned above, the 61 urban bus routes are grouped into 18 integrated routes indicated in Table 7–2–1. Major characteristics of the 4 groups are as follows:

(1) Linear route: Connecting the center of the city and the suburban area with a relatively long distance bus route.

(2) Radial Route: Connecting the center and the suburban area with a relatively short distance bus route. Some routes include small circular routes within their service area in the suburbs.

(3) Through Route: Connecting the suburban areas through the central area of the city.

(4) Circular Route: Connecting the center of the city and the areas within the 4 km zone from the center with circular routes.

Table 7–2–1 Integrated Urban Bus Routes

Code of Integrated Routes	Code of Original Bus Routes	Category of Route
I	01, 02, 03, 04, 05	Circular
II	06, 07, 08, 17	Circular
III	08	Linear
IV	21A, 21B	Circular
V	22, 23	Circular
VI	24, 25, 26	Linear (radial)
VII	31, 32, 33, 34, 35, 36	Circular
VIII	37, 38A, 39	Linear (radial)
IX	38B	Linear
X	41, 42	Linear (radial)
XI	47, 48, 49	Through
XII	51, 52, 53, 54	Linear (radial)
XIII	55, 56, 57, 63B	Linear (radial)
XIV	61, 62	Linear (radial)
XV	63A, 71, 72, 73, 74 75, 76, 81, 82	Linear
XVI	64, 65	Linear (radial)
XVII	83, 84, 85, 87A, 87B	Linear
XVIII	96, 97, 98	Linear

(Please see Figure 7–2–1 for the route patterns of the integrated routes, and, also Appendix on the shape of the actual urban bus routes.)

2) Service Area of Urban Buses

The service area of the urban bus routes is shown in the following Figure 7–2–2. The area served by the buses is mainly within the circunvalar. Consequently, some newly built-up areas along this road are not yet serviced. Some areas in the southern part of the city are also not yet serviced. Since the feeder network for bus routes is poor, it is difficult to pinpoint good locations for bus routes.

3) Proposals for Bus Routes

There have been proposals submitted by the bus companies to INTRA which include three types of new routes and the modification of existing routes. There are also two other proposals for the modification of the bus routes currently operating as provisional routes. New bus routes in these proposals are classified into three categories:

(1) Routes to serve areas which currently do not have bus routes.

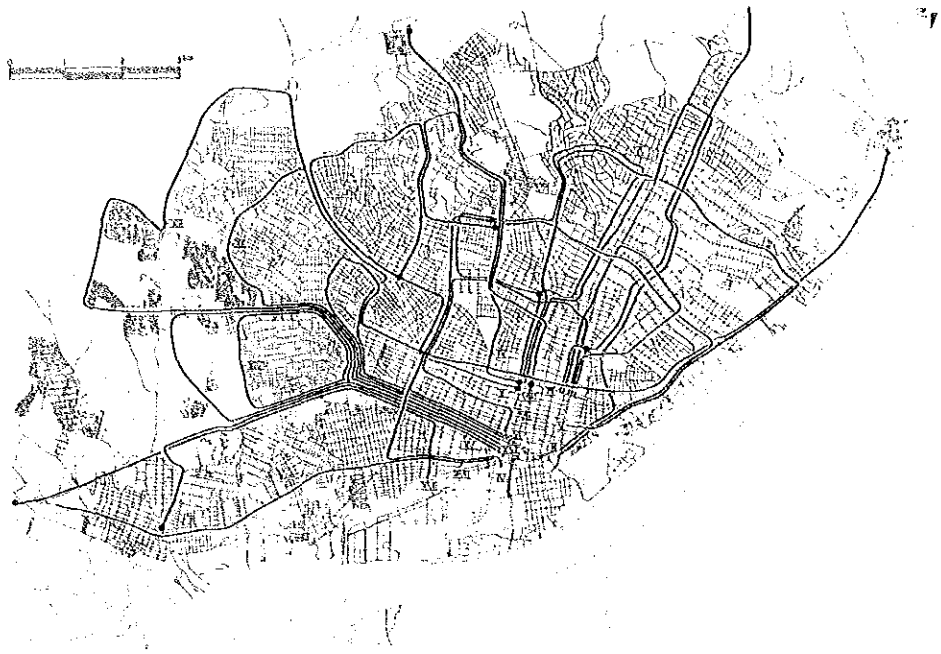


Fig. 7–2–1 Integrated Bus Routes (Present)

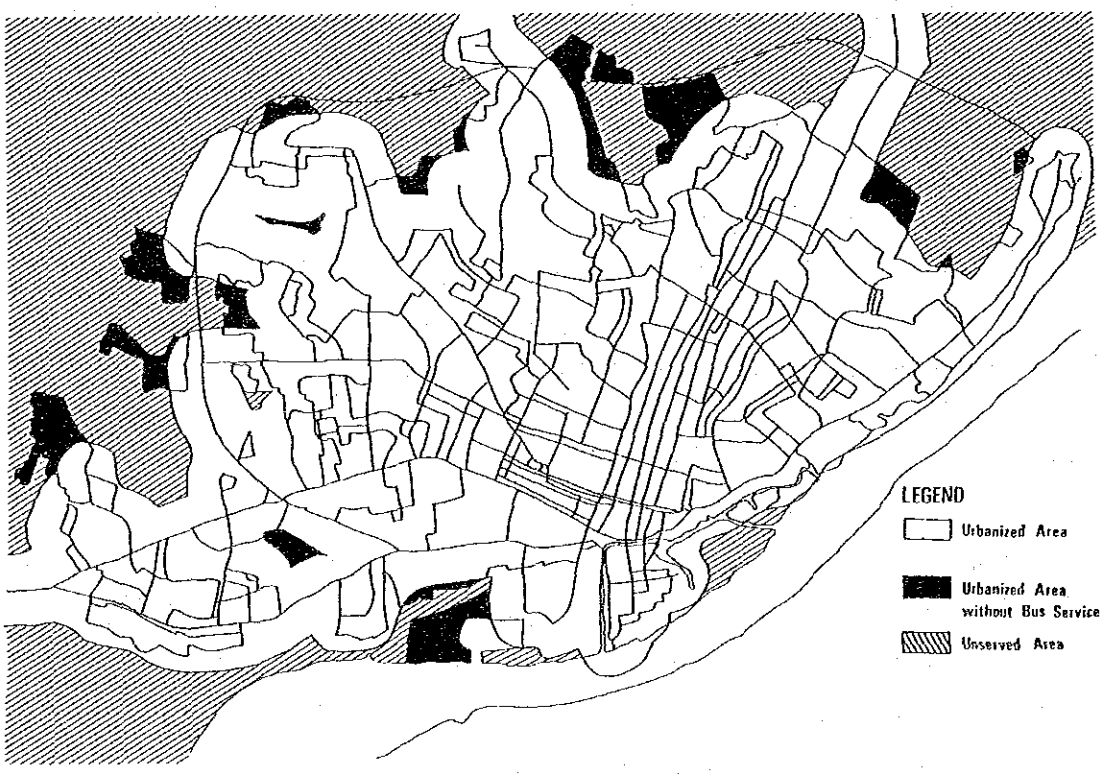


Fig. 7–2–2 Bus Service Area and Urbanized Area

(2) Routes with new route patterns which are considered important for meeting future demands.

(3) Routes which are new for certain companies although similar routes are operated by other companies.

7–2–2 Characteristics of Bus Passenger Trips

1) Characteristics of Bus Passengers

The total number of urban bus users in Barranquilla is about 1,323,000 persons a day which is 71% of the total 1,855,000 person trips of all transportation modes excluding walking trips (hereafter called non-walking-trips).

a. Bus users by occupation

Approximately 335,000 trips, which is 25% of the total bus trips, are made by housewives. This group has the largest share of bus trips classified as bus users by occupations. The second largest share is by the unemployed with 17%, followed by factory workers with 13%, sales men with 12%, and others with 7%.

b. Bus users by industry

Observing the number of bus users classified by industry, the service industry groups has the larges share with 16% of the total number of bus users. The second is the commercial group with 13% and the third is the manufacturing group with 7%. However, users belonging to the non-industrial group make up about 56% of the total bus users.

c. Bus users by car-ownership

83% of the total person trips belong to the non-car owner group. On the other hand, 90% of total bus users belong to the non car owner group.

d. Bus users by trip purpose

The largest share of the trip purposes of the bus users is "home" trip with 47%, "work" trip with 18%, "school" trip with 13%, "shopping" trip with 8%, and "business' trip with 3%. It is noted that the percentage share of "business" trips by bus is relatively smaller than that by other modes. On the other hand, the percentage share of "shopping" trips by bus is higher than that by other modes.

e. Hourly fluctuation of bus users

The bus user peak hour is from 6 to 7 o'clock in the morning which is one hour earlier than the peak hour of total person trips. Other peak hours of bus users are: Between 12 and 1 o'clock in the afternoon and between 5 and 6 o'clock in the evening, similar to the peaks in the passengers using other modes.

The peak ratio of bus users in the morning is 10.8%, 11,7% at noon, and 9.1% in the evening.

2) Bus Passengers Generated by Zone

Approximately 1,382,000 bus passengers are generated in the city. About 21% of the total are generated in the center of the city (zone 001), 9.2% is in zone 111,, 8.1% is in zone 221, 7.9% is in zone 312, 7.1% is in the zone 321, 7.0% is in zone 411, and so on (See Fig. 7–2–3).

The average bus dependence ratio in the city is about 71%. Those zones which have the largest ratio are 222, and 223 each with 86.7T. The zones in the western and southern parts of the city, in general, have a relatively higher bus dependence ratio, greater than 70%, compared with the zones in the northern part of the city, including zone 003 with a dependence ratio between 40 and 60%.

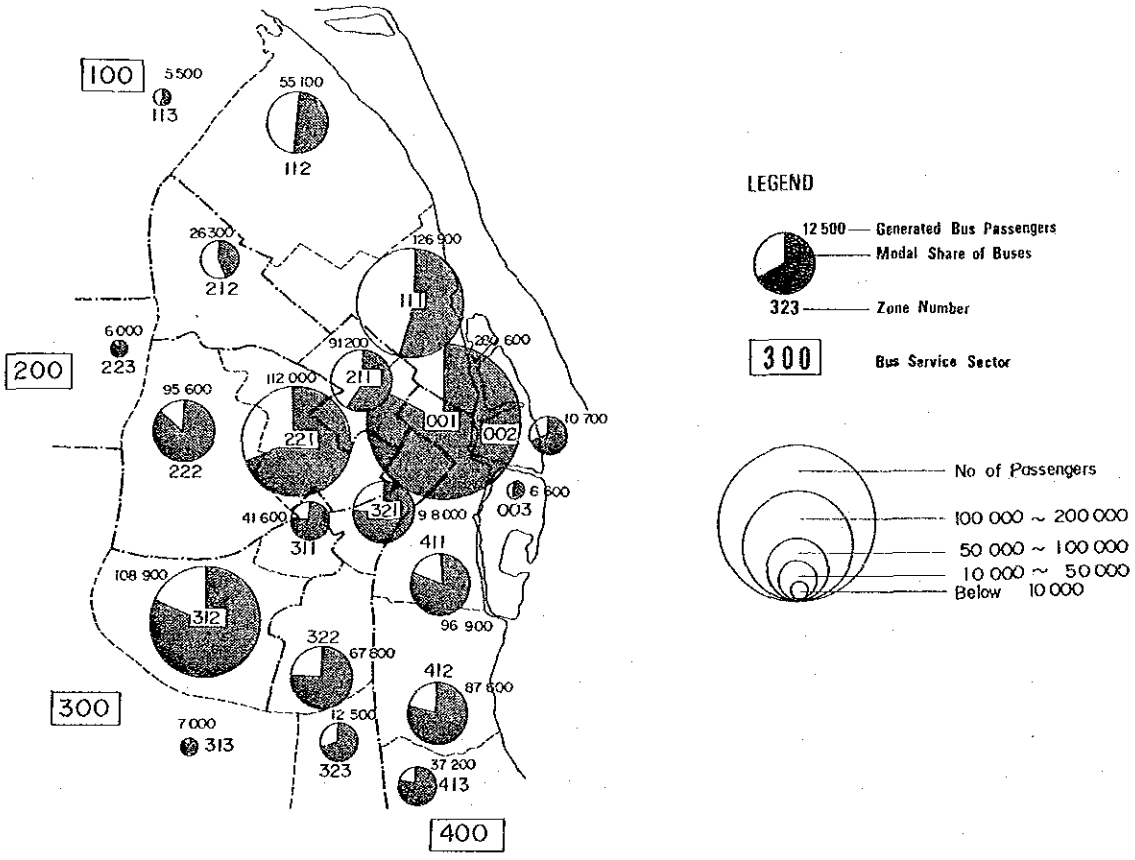


Fig. 7–2–3 Generated Bus Passengers and Bus Dependence Ratio

3) Origin and Destination of Bus Passengers

The following characteristics of bus passengers' activity are identified from the O-D matrix and desire lines of bus passengers;

a. Major flow of bus passengers is between Centro and the south and west parts of the city.

The total number of passengers from Centro to Sectors 220, 310 and 410 is approximately 371,000 which is 28.0% of the total number (1,323,000) of all bus passengers within the city.

Zones 221 and 222, located in Sector 220, are connected to Centro with similar number of passengers (about 65,000 respectively). "Home" and "work" trips are the major trip purposes of passengers in zone 221, and zone 222. Zone 312 in Sector 310 is connected to the Centro closely with about 80,000 trips, and major trip purposes of this passenger flow are the trips for "home" and "work". Zone 411 and 412 in Sector 400 are connected to the Centro with similar numbers of passengers (from 44,000 to 58,000 trips), whose major trip purposes are "home" and "shopping".

b. Inter-sectoral passenger flow

Passenger flow between sectors is not negligible. Although almost all bus routes radiate from the center of the city, major passenger flow between sectors is limited to within the 4 km zone around the center. Almost all the trip purposes of this flow are "home" and "school".

c. Attraction of bus passengers to the industrial sector (Sector 100)

The number of bus passengers commuting from zones 210, 220, 310, and 320 to zone 111 in Sector 100 ranges from 30,000 to 50,000. For passengers from Sector 220 to 111, the "work" trip is the major trip purpose, whereas in Sector 210 the "school" trip is the major trip purpose.

4) Trip Purpose of Bus Passengers

Major zones involving "work" trips are zones 221, 222, 311, and 312, with destination to zones 001, 111, 211, 411, and so on. Zones 002 and 003, (Barranquillita and the free zone area), also are destination zones for bus passengers from almost all parts of the city.

The major destination zones of "school" trips are 001, 111, 211, 221, 321, 412 and so on. The "school" trips are one way because of the location of the schools such as high schools and colleges. The pattern of the "home" trips of bus passengers is similar to that of "all purpose". The "business" trips zones of 111, 211, 221, 312, 322, 411 and 412 are all to zone 001.

This pattern shows that almost all business activities are concentrated in the center. "Private" trips are also concentrated in the center (zone 001) and in some other zones such as zone 111, 211, 312, and 41.

(See Appendix on the distribution of the bus passenger by trip purpose.)

7–2–3 Supply and Demand of Bus Transport

1) Supply of Bus Transport

a. Basic Bus Service Information

The principle data on existing bus service are as follows:

(1)	Number of bus companies	21
(2)	Number of buses under operation	2,180 units
(3)	Number of bus routes for urban service	61
(4)	Total length of bus routes	1,200 kms
	Average length of route	19.7 kms/route
(5)	Total Service Frequency	13,400 trip/day
	Average Service Frequency per route	221.1 trip/day/route

b. Bus Transport Capacity

In this section, bus transport capacity is measured in terms of passenger-kilometers. The total bus transport capacity is estimated at 11,300,000 passenger kms/day. Their distribution by sectors is as follows:

Centro – Sub-sector 110; 1,580,000 psgr. kms
Centro – Sub-sector 210; 1,500,000 psgr. kms
Centro – Sub-sector 220; 1,170,000 psgr. kms
Centro – Sub-sector 310; 1,160,000 psgr. kms
Centro – Sub-sector 310; 2,500,000 psgr. kms
Centro – Sub-sector 410: 2,580,000 psgr. kms

c. Bus Transport Capacity around the Center of the City

In this section, the bus transport capacity is measured in terms of psgr/day at the boundary of the city center. The total bus transport capacity in psgr/day is calculated according to the bus route map and the bus service frequency of each bus route (See Fig. 7–2–4).

Total bus services crossing the boundary of the city center are approximately 32,900 buses, which is equivalent to 1,240,000 passengers/day. On the other hand total number of passengers (demand) is about 900,000 psgr per day at the same boundary. Hence, the bus service supply is exceeding the bus service demand. However, this relationship varies depending upon the direction of the bus routes.

From the center to sector 100 (northern part of the city), the ratio is abut 1.5, toward sector 200 it is 0.7, towards sector 300 it is 1.8 and towards sector 400 it is 1.6.

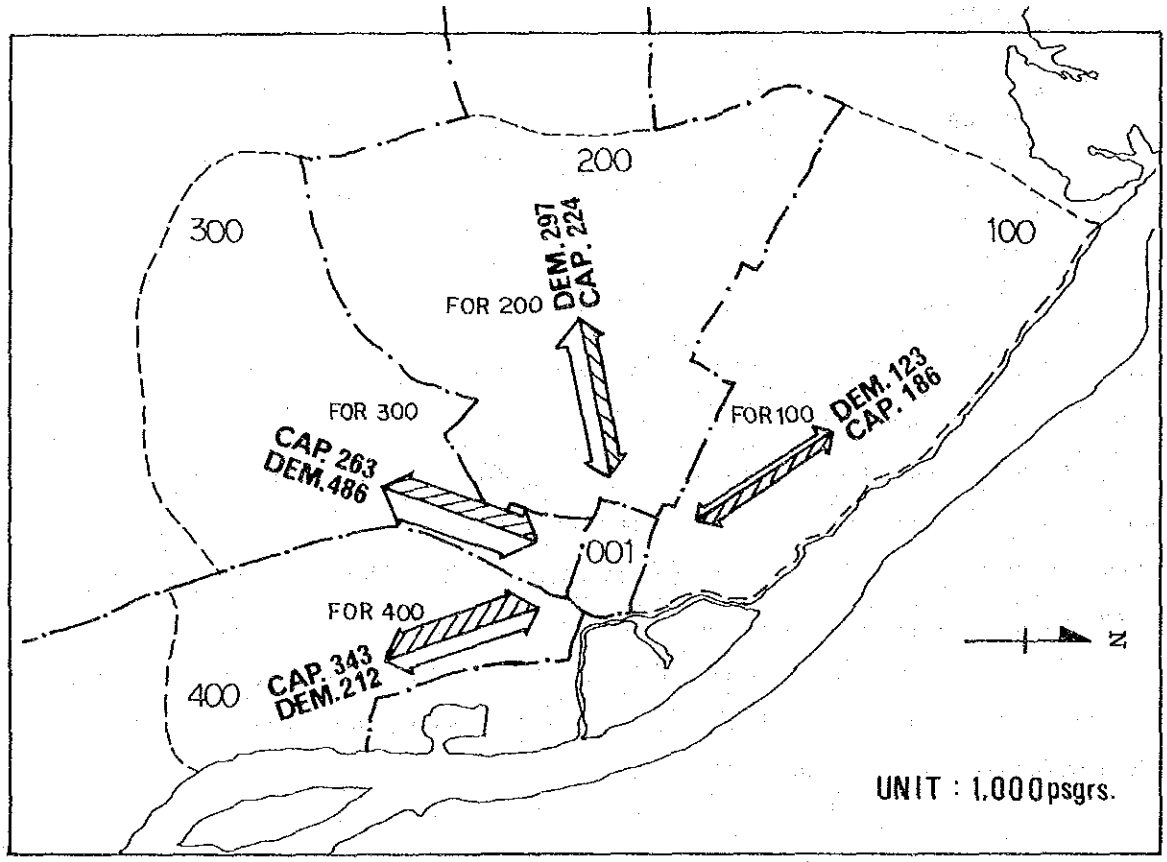


Fig. 7--2--4 Comparison of Bus Transport Capacity and Demand

Table 7–2–2 Comparison of Demand and Supply of Urban Bus Transport at the Boundary of Centro (Zone 001) – 1983 –

(1000 passengers)

Zone	Demand	Capacity	Demand/Capacity
Sector 100			
001 – 110	60.7		
110 – 001	62.8	186.1	1.5
Sub Total	123.0		
001 – 210	45.3		
210 – 001	40.8	224.1	0.7
001 – 220	105.0		
220 – 001	106.2		
Sub Total	297.3		
001 – 310	60.8		
310 – 001	61.2	486.7	1.8
001 – 320	67.9		
320 – 001	73.8		
Sub Total	263.7		
001 – 410	105.6	343.2	1.6
410 – 001	107.3		
Sub Total	212.9		
Total	896.9	1,240.1	1.4

Source: Capacity : Operation Schedule of each bus route.
Demand : OD Matrix of bus passengers, 1983.

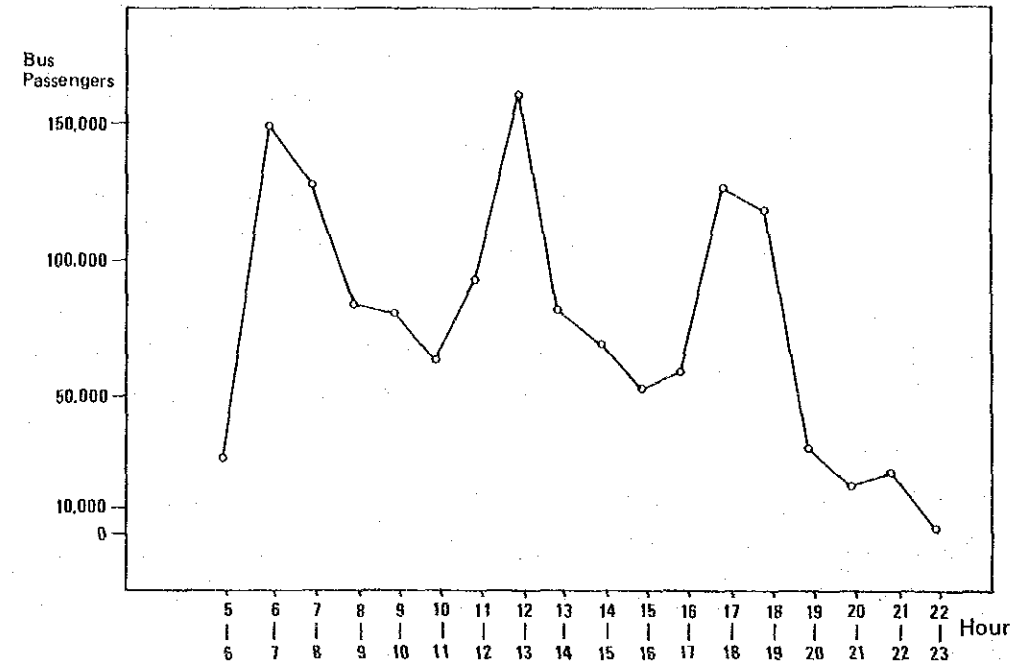
d. Hourly Fluctuation of Bus Transport Capacity

People in Barranquilla including government offices are accustomed to going home for lunch because they have a two hour recess at noon. Consequently, there are three peak periods when road traffic is congested because of commuter activities. The total bus service frequency also fluctuates according to the bus demand (See Fig. 7–2–5).

During the two-hour morning peak from 6 to 8 o'clock, there are about 2,000 bus services; from 11 to 2 o'clock about 3,000 services; and the evening peak hours from 4 to 7 o'clock have about 2,900 services in Barranquilla.

At the same time the hourly fluctuation of the total number of bus passengers has three peaks a day; one is in the morning with 147,000 passengers, the second is at noon with 160,000 passengers and the last is in the evening with 124,000 passengers. However, in comparing the ratios of bus transport demand and two hourly fluctuation graphs, where one is bus service frequency and the other is bus passenger demand, the peaktime/off-peaktime ratios of the graphs are quite different. The ratio of the bus demand is larger than that of the bus service.

In other words, it seems that the transport capacities of the buses are too low to provide good service, especially in the peak periods (See Appendix E).



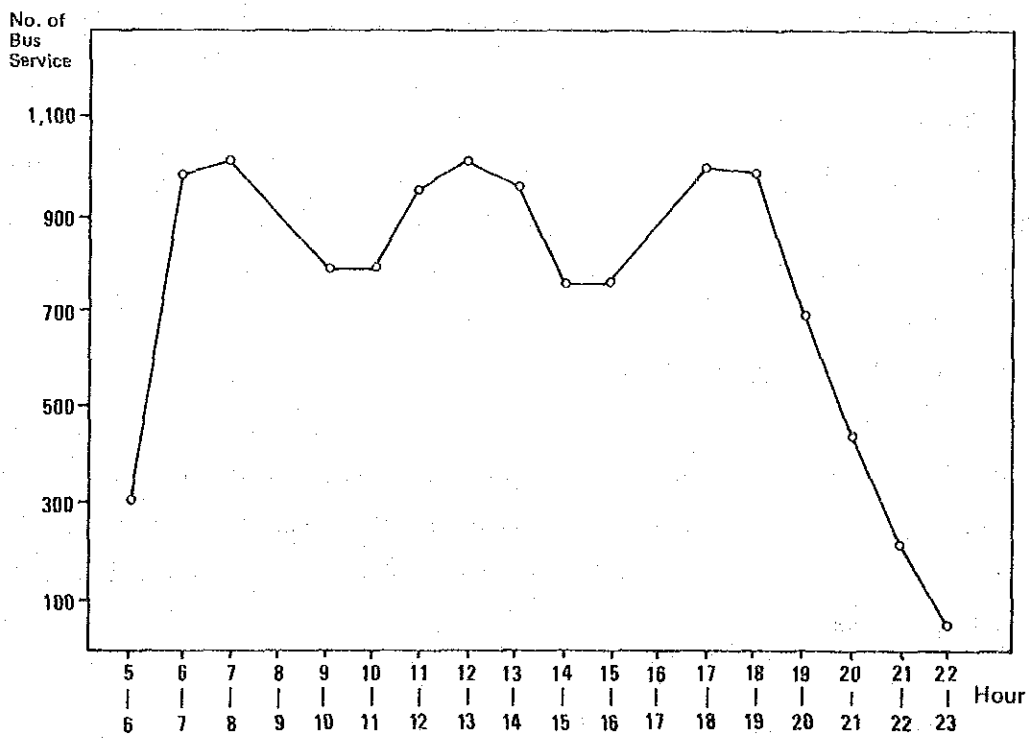


Fig. 7–2–5 Hourly Variation of Number of Bus Passengers

7–3 Bus Traffic

7–3–1 Bus Traffic in the Central Area of the City

The urban bus service, in general, has an advantage of community-to-community service similar to the door-to-door service of the private car. As long as an urban area is relatively small, this advantage of the bus can function well. However, when a city grows to a new scale, this advantage will change to a disadvantage because of the following reasons:

(1) Expansion of the urban area causes an increase in the number of community-wide bus service areas and also expands each service area. Consequently, the number of buses increases and the capacity of each bus expands as well.

(2) This tendency causes an increase in bus traffic at the center of the city where almost all bus routes are concentrated. As this reduces the road capacity in the central area of the city, traffic jams are caused by the bus traffic. Traffic congestion will then spread along the roads into the central area because of the bus traffic. Based on this concept, bus traffic of Barranquilla has been carefully observed and analysed.

These traffic problems in the central area of the city are discussed in Chapter 5. At selected intersections in the center of the city where there is relatively heavy traffic, the degree of bus traffic contribution to the traffic congestion has been observed (See Fig. 7–3–1).

7–3–2 Bus Travel Speed

Bus travel is analyzed not only for bus operation studies but also for the transport study in general. Bus travel time was observed during the bus occupancy ratio survey and the route length was measured on 1/10,000 scale maps based on routes surveyed through the bus company survey. The average bus travel speed by bus route varies between 8.9 and 18.4 km/hour and the average over all routes surveyed is 13.5 km/hour.

Bus travel speed by type of the major road is also analyzed. On arterial roads, the bus travel speed is about 23 km/hr, about 15.8 km/hr in the case of semi-arterial roads, and about 9 km/hr in the case of the major roads in the central area of the city. Average travel speed along major roads is 16.9 km/hr.

7–3–3 Trip Cutting and Passenger Behavior

Bus operators should operate buses along the routes which INTRA designated. However, trip-cutting, which is an action designed to change and/or shorten the route bus, is usually ob-

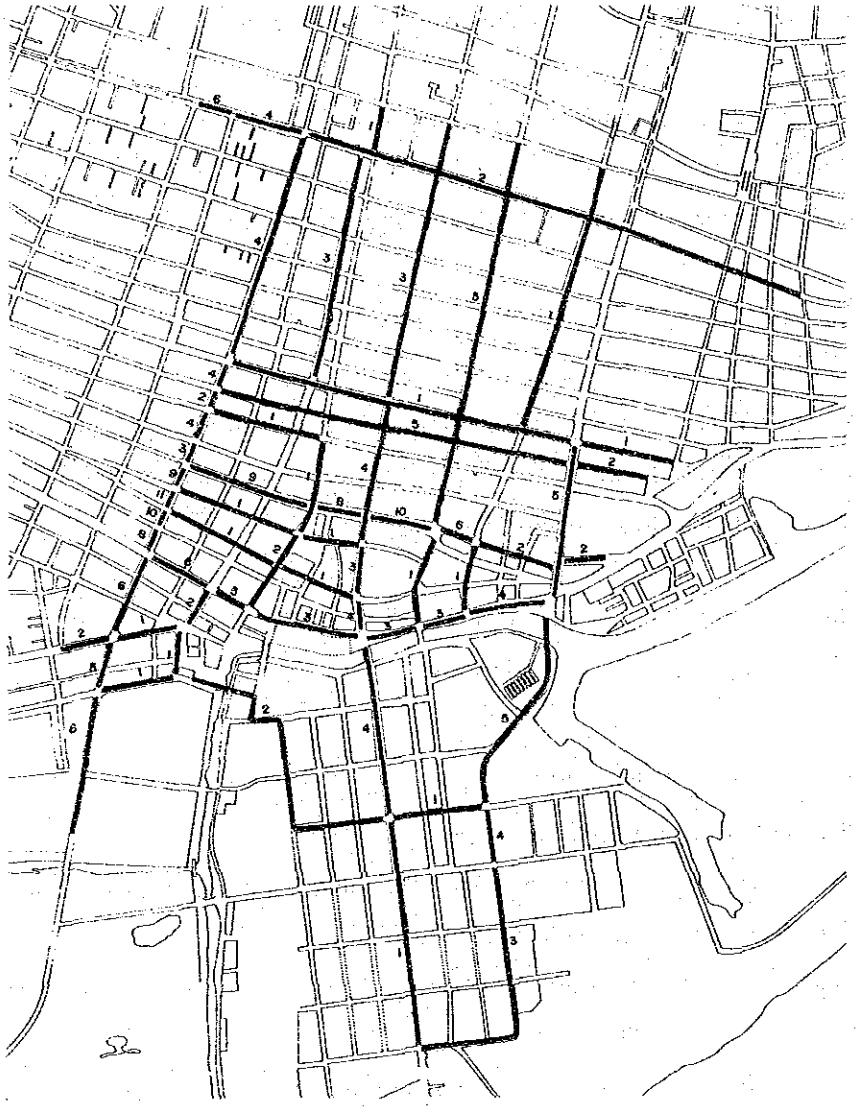


Fig. 7–3–1 Number of Bus Route in Central Area

served by the driver during times when bus demand is low as in early morning or at night. There are three types of trip-cutting.

(1) To neglect service inside Barranquillita before 8:00 a.m. and after 7:00 p.m.

(2) To neglect service in the central area after 6:00 p.m.

(3) To neglect the service in suburban areas in the evening.

The reasons for the first type of trip-cutting are:

(1) To avoid less-effective operation.

(2) To provide higher service frequencies along part of the route with a higher demand.
To avoid the route in Barranquillita, the bus companies transfer bus dispatching points from Barranquillita to the center of the city.

The reasons for the second type of trip-cutting are:

(1) To lessen operation time and cost along routes in the centro area where there is traffic congestion.

(2) To shorten some routes from the southern part of the city by going into the city center.

The reasons for the third type of trip-cutting are:

(1) To avoid operation time and cost along the routes in the suburbs where they can expect less passengers than along major roads.

(2) To avoid dangerous areas where bus drivers have been victimized.

Passengers who wish to go to areas where bus routes have been cut are obliged to use taxis. However, passengers in Centro who want to return to home in the south and west parts of the city have to go to Cra. 38 to catch buses.

Furthermore, passengers walk south along Calle 30 to ensure a seat on the bus. This passenger behavior seems to encourage trip-cutting connecting centro and the south and west parts of the city along Calle 30 and Calle 42.

7–4 Administration and Institutions

There are three institutions involved in the administration of the public transportation system. These are the Instituto Nacional del Transporte (INTRA), Corporación Financiera del Transporte (CFT), and the Instituto Departamental de Tránsito (T.T.).

7–4–1 INTRA's Function

INTRA was established in 1968 as an arm of the Ministry of Public Works in transportation. Branch offices of INTRA have been established in major cities. The functions of INTRA involve the making and implementation of national transport policy. More detailed funcions of INTRA are as follows:

(1) To conduct technical, economic and financial studies for the rationalization of transport equipment, the demand and supply analysis of various aspects of transportation, and the operation cost of public transportation.
(2) To determine the service area for urban, Inter-municipal and inter-departmental buses together with the total volume of necessary equipment and transportation service.
(3) To create a semi-governmental company commissioned to operate transport services if necessary.
(4) To coordinate the various agencies concerned, such as the Ministry of Labour and Social Security, and to promote integrated transport measures such as containerization and palletization.
(5) To isssue licenses such as drivers licenses, bus operation licenses (CUPO) and other transport business licenses and to accept the registration of automobiles.

However, a new decree was issued in 1984 intending to transfer the major functions of INTRA to the city. This decision is a well timed action as almost all major cities in Colombia have projects for improving their urban transport system today.

Barranquilla is also considering to establish a planning section which will include the transportation planning section.

2) Procedure for Issuance of CUPO

There are two kinds of CUPO for bus transportation businesses, the CUPO for route, and the CUPO for the quantity of equipment. The issuance of CUPO by INTRA is based on application by bus companies.

At first, the applicant, such as a bus company, submits a proposal for new routes or for the modification of existing routes to INTRA: The proposals should include the following items:

(1) Items on routes such as location and length of route, bus stops and terminal.
(2) Items on operation such as operation hours, service frequency.
(3) Items on demand and social state of the effected zone.

(4) Items affecting competing bus routes and road traffic.

(5) Items on financial and technical capacities of bus operation.

Items in proposals for the modification of routes are more limited than those for new routes which mainly take into account the usage.

INTRA publicizes the proposals three times after receiving the application. If there are no objections, a CUPO will be issued to the applicant. If there are objections, a decision is made by higher ranking agencies such as INTRA Bogotá, and the courts.

INTRA assesses proposals based on the following items:

(1) Category of the company.

(2) Equipment age.

(3) Availability of equipment for immediate use.

(4) Experience of the company.

(5) Service schedule and programs for vehicle use.

Those activities will be implemented by the city according to the new decree.

7–4–2 CFT

CFT, a semi-public agency, was established in 1964 under the auspices of the Ministry of Economic Development. The major functions of CFT are as follows:

(1) To promote and finance land transport development.

(2) To administer subsidies to Corriente buses.

(3) To carry out studies on transport terminals.

CFT has twenty loan systems: Two systems for bus procurement, two related to the construction of bus facilities, four for the procurement of parts for vehicles including buses, five for taxis and seven for other transportation businesses. Some of the major loan systems are explained below:

1) Urban Bus Replacement Program

This loan was established in 1982 for the purpose of replacing old buses. At the same time, this system restrains borrowers from uring old buses for publis service. The loan is limited to 73% of the procurement cost or 2,560,000 pesos per bus, payable within 60 months at an annual interest rate of 26%.

2) Loans for terminal construction and special projects

One of the two loan systems mentioned here is for construction of company terminals which includes parking space, maintenance shops, offices, etc. The other is for special projects which are not identified as specific to the project, although it could be used for special projects such as the construction of a common passenger terminal.

3) Loans for vehicle parts and repairs

There are four kinds of loan systems in this category; three for procurement of parts, such as body, engine and spare parts, and the fourth for vehicle repair.

7–4–3 Bus Transportation Subsidy

Subsidies related to bus transportation are divided into three categories:

(1) Subsidies for bus users.

(2) Subsidies for bus companies.

(3) Subsidies for bus drivers.

The first category of subsidies was started in 1958. According to Law 18, students could obtain tickets from their school to supplement their bus fare, this system, however, was cancelled in 1966. According to the same law, all company employers were obligated to pay the transport expenses of their employees, and this system is still in effect at present.

The second category of subsidies was started in 1966. According to Decree 424, buses and busetas could get subsidies as vehicles for public use. The subsidies were given to the companies as a "BONUS" which is one kind of evidence of debt. This decision was followed by a rapid increase of the fuel price in 1966, and in 1971, the payment system was changed from the indirect way of using the "BONUS" to a direct payment to the companies.

The third category of subsidies was started in 1975. This was a subsidy for bus drivers which started at 300 pesos. This system is still in existence to this day.

In 1983, INTRA decided to slow down the increase in corriente buses under Decree 490. Approvals for new corriente buses were not stopped, but the applicants for new corriente buses were required to obtain approvals from three ministries connected with bus operations (Refer to Fig. 7–4–1). The amount of subsidy in 1983 was 2.36 pesos per passenger determined from

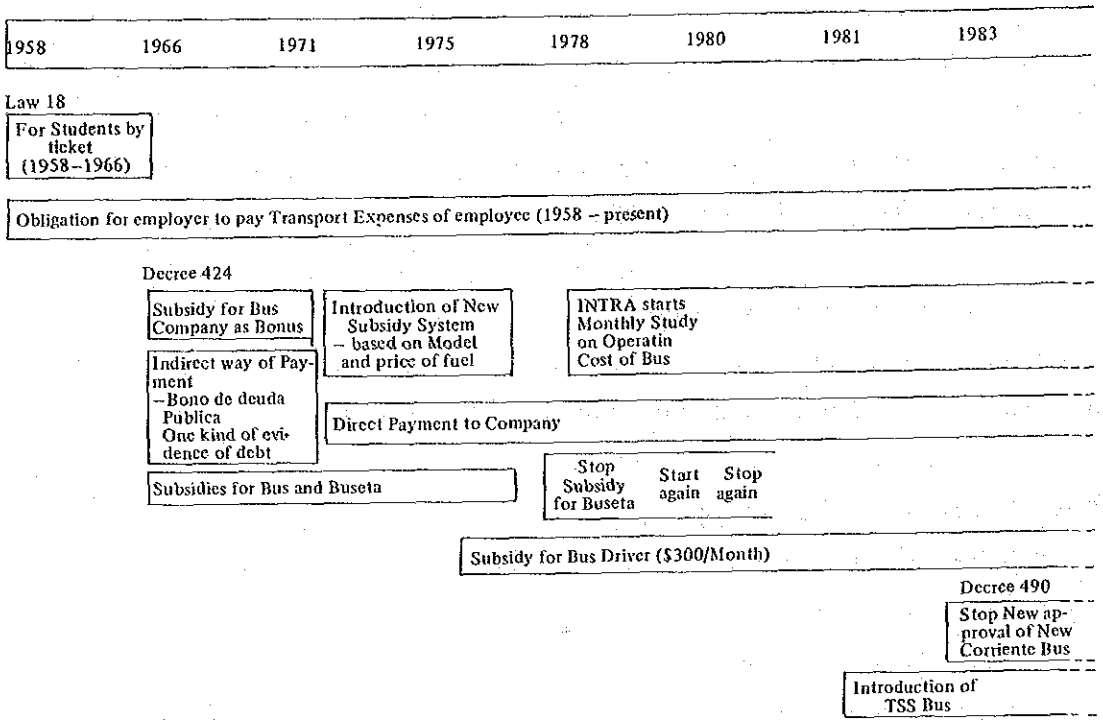


Fig. 7–4–1 History of Subsidies Related to Bus Transportation

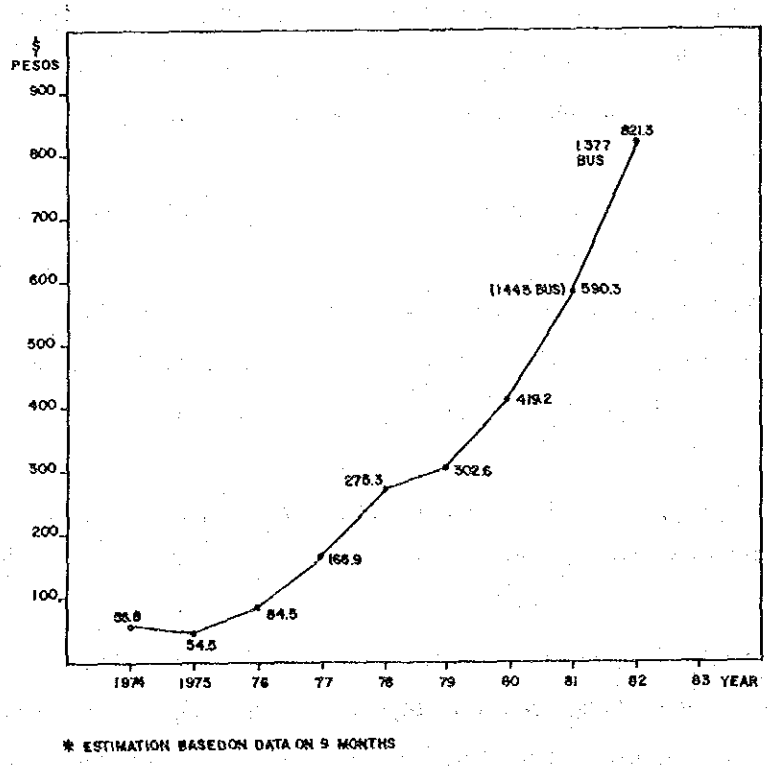


Fig. 7–4–2 Increase of Subsidy for "Corriente" Buses

INTRA's survey. In Barranquilla 19 bus companies receive subsidies today. The total amount of subsidies given to those companies over a period of 10 years has recently increased sharply (Refer to Fig. 7–4–2).

2) Bus Renewal Project

More than 50% of buses in the Barranquilla bus fleet are over 10 years old. Due to poor maintenance facilities and insufficient manpower of the bus companies, the mechanical and passenger service conditions of the buses are extremely poor. About 15% of the total bus fleet is inactive due to the need for repairs. The government is desirous to renew old buses, and in 1981, the executive committee of INTRA approved a bus renewal project, using three strategies:

(1) Introduction of TSS buses decided in 1981.

(2) Granting CFT loans to procure new buses.

(3) Making it difficult to increase corriente buses on Decrease corriente buses on Decree 490, 1983.

Since 1981, 391 TSS buses were introduced in Barranquilla. This is about 18% of the total city bus fleet.

7–5 Bus Operation

7–5–1 Bus Fleets

1) Bus Statistics

The bus statistics mentioned here are based on the Bus Company Survey which was conducted at the end of 1983.

The number of buses run by individual bus companies is regulated by INTRA: This regulation is included in the bus operation permit which is called "CUPO", and which determines the maximum and minimum number of buses. Consequently, the number of buses in individual companies is usually somewhere between the maximum and minimum, with some exeptions.

The present bus fleets maintained by bus companies in Barranquilla are shown in Table 7–5–1.

Table 7–5–1 Total Number of Bus/Buseta in Barranquilla 1983

	Bus		Buseta		Total	
	Max.	Min.	Max.	Min.	Max.	Min.
No. of Buses in CUPO	2,208	1,699	240	190	2,448	1,889
No. of Buses owned by companies	1,892		279		2,180	

* Including nine mini-buses

The distribution of the number of bus units by company is shown in Fig. 7–5–1. The largest company in terms of the number of buses is COOCHOFAL(1) with 238 bus units, and the smallest is SOTRAUSQUE(12) with 53 bus units. The average number of buses for each of the twenty-one (21) companies is 104.

Some companies such as FLOTA ROJA, TRANS. LOLAYA, and TRASALFA have a smaller number of buses than those designated in CUPO, because incentives for the utilization of a lower number of buses are adopted for these companies. On the other hand, there are companies which use more bus units than designated by CUPO. These intend to up-grade from their present category to a higher one. These categories are used by INTRA to evaluate bus companies.

Only 12.8% of the total number of buses are Busetas. 34.8% of the Busetas (97 units) are under COOLITORAL, which has no buses. 28.3% of the Busetas (79 units) are under SOBUSA which is ranked second of all companies in the city.

Buses are divided into two categories: Corriente and TSS buses. Only 18.0% of the total number of buses are TSS buses. TRANSDIAZ has 60 TSS buses, the highest number, followed by TRANSURBAR with 52 units. SODETRAUSQUE has 53 corriente buses which signifies that all buses owned by this company are subsidized. On the other hand, COOLITORAL has no ocrriente buses which signfifies that this company has no subsidized buses.

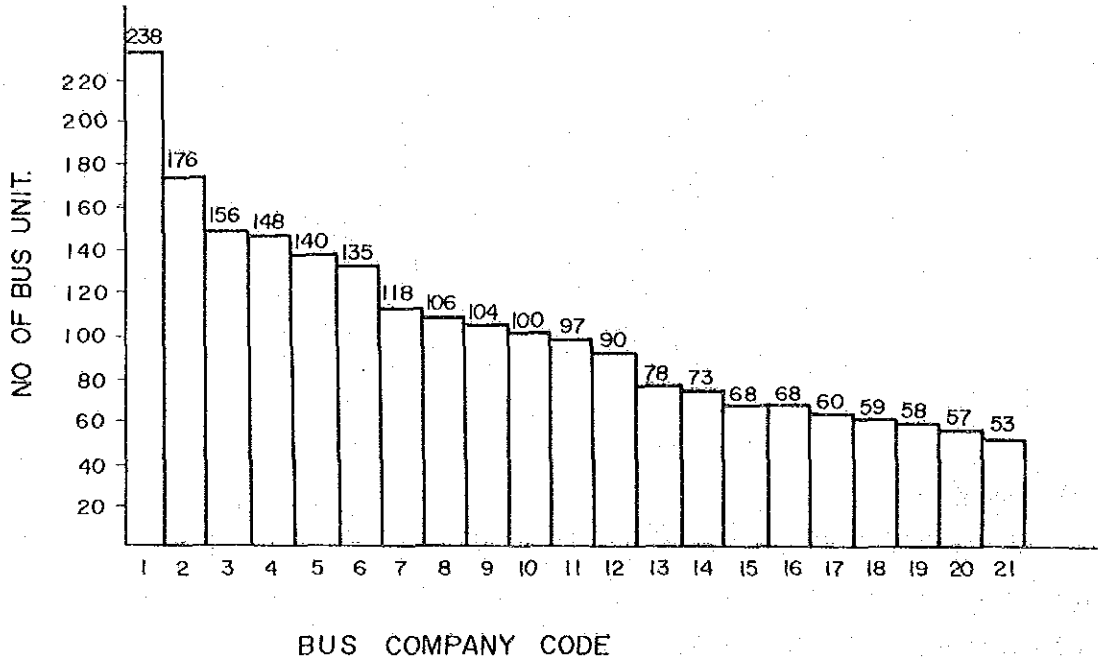


Fig. 7–5–1 Number of Bus Units by Company

2) Bus Capacities

Bus capacity is defined as the number of seats on the bus. However, the actual bus transport capacity per vehicle includes the number of passengers without seats.

A bus is defined as having more than 30 seats, and a Buseta has between 20 and 30 seats. However, there are some Busetas which have more than 30 seats. The seating capacity of abus, in general, varies from 21 to 60 seats per bus. Buses from 41 to 45 seats constitute the largest number of buses (671 units), or 30.8% of the total and buses from 46 to 50 seats constitute the second largest number of buses (535 units). Busetas with 26 to 30 seats constitute approximately 84% of the total number of busetas. The average capacity of all buses including Busetas in Barranquilla is 42.5 seats. Figure 7–5–2 shows the bus fleet by class of capacity.

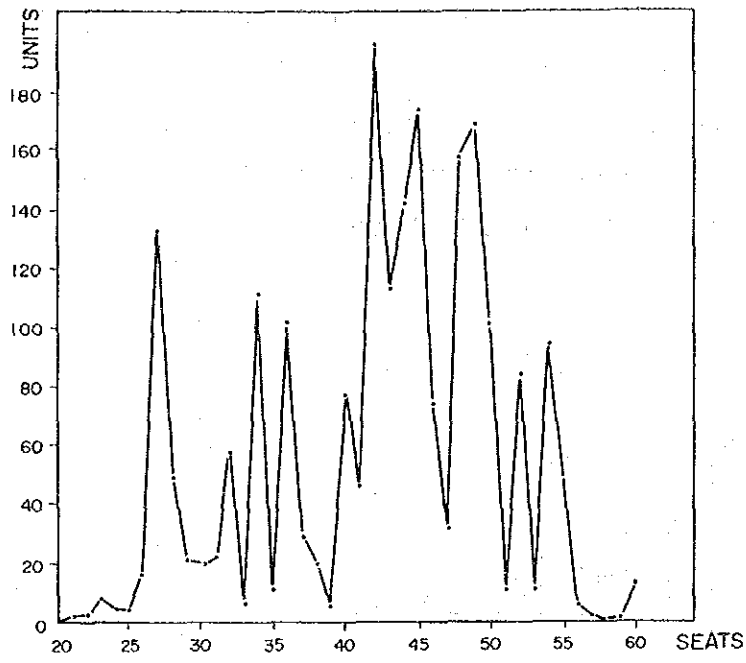


Fig. 7–5–2 Bus Fleet by Class of Capacity

3) Bus Models

Bus models in Barranquilla range from the 1940's to 1983. The largest number of all buses, 25.8%, are 1980 to 1983 models, followed by 21.5% which are 1975 to 1979 models. 1982 bus models with 297 units rank highest among the number of buses for model by year, 1970 models are second, 1981 third, 1965 fourth, 1976 fifth, and 1977 sixth (Refer to Fig. 7–5–3).

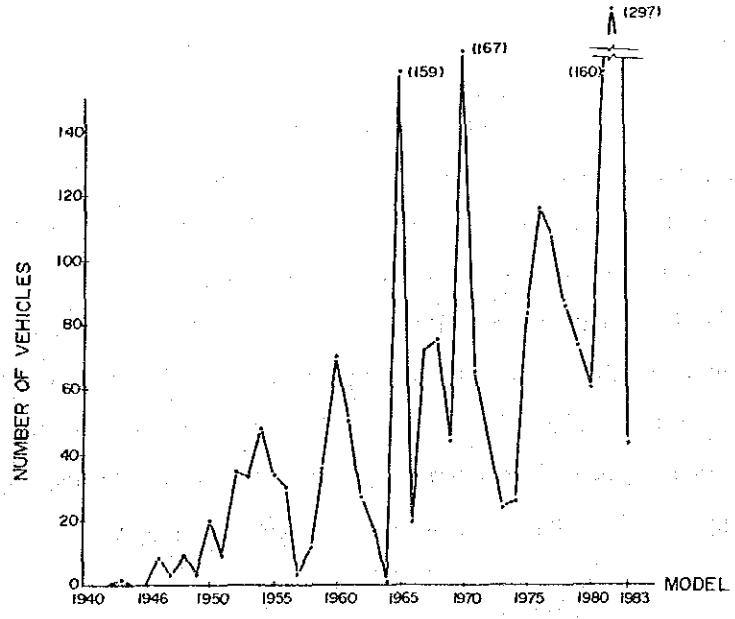


Fig. 7–5–3 Bus Fleet by Model

4) Bus Manufacturers

Buses used in Barranquilla are manufactured by 16 different manufacturers. The majority of the manufacturers are: Ford, Dodge, and Chevrolet. The share of the three top manufacturers is 26.0%, 40.1%, and 25.1% respectively, and the total share of these three companies is 91.2%. Additionally, there are six other companies from the USA, five from Western Equope, and two from Eastern Europe. Between 1970–1980, many Dodge buses were introduced when Dodge operated its factory in Bogotá. As of 1981, the factory ownership transferred from Dodge to Chevrolet with the result that Chevrolets have been introduced. Figure 7–5–4 shows the bus fleet composition by car-manufacturer.

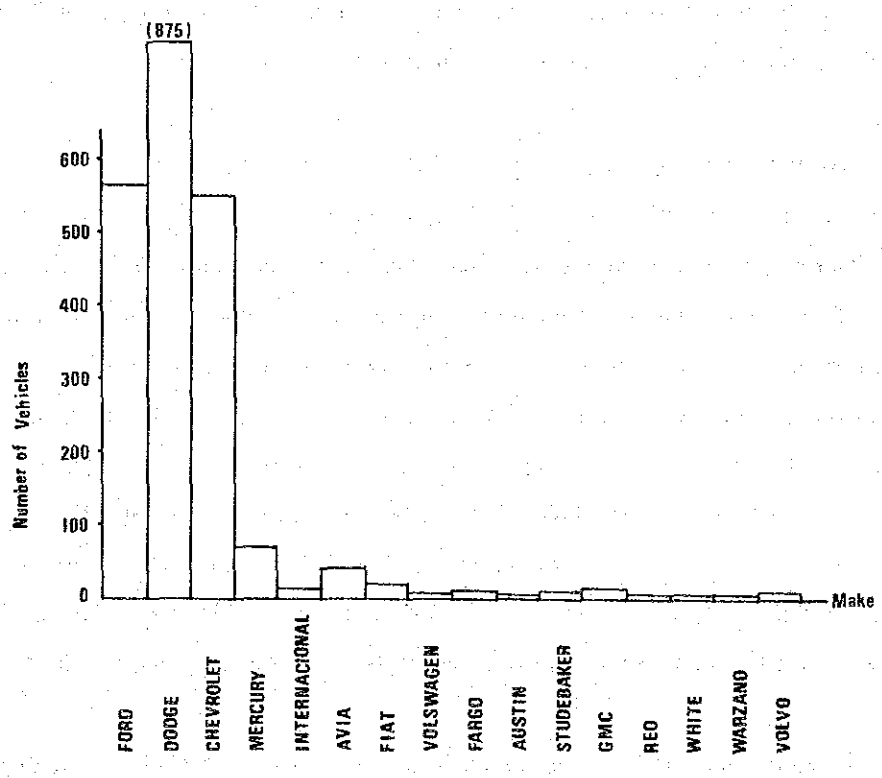


Fig. 7–5–4 Bus Fleet by Car-Make

7–5–2 Bus Operation Control System

The purpose for bus operation control of bus companies is to bring about the following:

(1) Maintain regular and constant operation.

(2) Reduce non-passenger service distances.

(3) To give incentives to bus drivers to ensure more boarded passengers.

In order to maintain regular and constant operation, all bus companies introduced dispatchers at terminals and intermediate controllers along the bus routes. Each bus driver is given the exact time when he should pass the intermediate control points and when he must return to the terminal. An intermediate controller along the route records the time when the bus passes his check-point. When the driver returns to the terminal, the dispatcher records his arrival time together with his departure and intermediate times. Those records will be used to evaluate his work performance which will determine salary increases.

To reduce non-passenger service distances there are two kinds of strategies: the Cuña system and route-cutting. With the Cuña system, the bus driver keeps the bus at his home overnight. Almost all bus companies have their terminal in Barranquillita, but the natural tendency of bus passengers is to proceed from suburban areas to the central area in the morning and travel in the opposite direction in the evening. If the buses are kept in the terminals at night and begin to serve passengers in the morning, the buses must be sent from the terminals to the suburban areas with few passengers. In the evening, a similar problem occurs. Consequently, the bus companies allow the drivers to keep the buses at their homes located in the suburbs. The drivers can then serve passengers from the area around thier homes and proceed for the Centro in the morning.

Route-cutting occurs when the driver skips parts of his route during slack periods when there are few passengers, such as in Barranquillita in the morning and late in the evening.

In addition to the strategies mentioned above which result in picking up more passengers, companies have introduced a percentage incentive system to the drivers salary. Salaries consist of fixed and percentage portions. The percentage portion is determined by the number of passengers the driver picks up. Consequently, drivers make an effort to pick up more passengers and waste less time along those routes with few passengers. According to the drivers survey, about 65% of drivers get a salary consisting of a fixed portion and a percentage.

7–5–3 Bus Maintenance

1) Inactive Bus Fleet

Of the 2,180 total units, 15% are inactive. Reasons for inactive buses are indicated in Table 7–5–2 which follows:

Table 7–5–2 Reasons for Inactive Buses

Reasons	Percentage
Reparis:	
Major	8.6%
Minor	60.0%
Special	7.4%
Very OLd and Lack of Parts	4.0%
No driver	20.0%
Total Inactive (326 Units)	100%

According to the statistics of bus fleets by model, approximately 50% of the total number of buses are more than 10 years old. Each bus company also has buses from approximately six different manufacturers. Since some companies may have so many different types of buses, the maintenance and procurement of spare parts for buses become a serious problem.

2) Driver's Interest in Maintenance

During the driver's survey, the driver's interest in pre-operation–inspection of vehicles was considered. The results of the survey are summarized below:

(1) Almost all the drivers inspect the oil and water. Only 15% check the fan belt.

(2) Effectiveness of brakes and brake oil are checked by about 70% and 40% of drivers respectively. Effectiveness of the hand brake is checked by few drivers.

(3) Direction of head light beam is checked by about 50% of the drivers. Brake lights, however, are checked by only 40%.

(4) Condition and cleaning of rear exit door is checked by 30% of the drivers. Very few drivers, however, check the windows.

(5) Tires are checked by 80% of the drivers.

(6) Steering condition is checked by 50% of the drivers.

Almost all the drivers are interested in those parts of the vehicle which are directly related to driving and which can be observed from the outside, but only a few drivers are interested in the bus interior and passenger comfort.

3) Maintenance Capacity of the Bus Company

To evaluate the maintenance capacity of each company, the various activities related to vehicle maintenance are divided into three levels.

(1) Light work including repairs not requiring special tools and equipment, or trained manpower.

(2) Medium work including maintenance work requiring ordinary tools and equipment, but needing skilled mnapower.

(3) Heavy work including maintenance work requiring specialized tools and equipment, with trained and experienced manpower.

The above classifications were based on maintenance work classified for the estimation of the maintenance cost in INTRA's study in Barranquilla.

The bus companies survey includes maintenance facilities, equipment, tools, and manpower of each company. According to that information, the level of maintenance of each company is classified by sectors of vehicle parts. Of the twenty-one bus operating organizations, six companies have no maintenance capacity. Three companies, SOBUSA*, TRASATLANTICO, and TRANSDIAZ, have maintenance capacity for all sectors of vehicle parts which need maintenance. However, almost all the mechanics of these companies work on a contract basis (See Appendix E for additional information related to bus maintenance).

7–5–4 Financial Costs/Benefits of Bus Operation

1) Financial Costs/Benefits by bus route

The purpose of this analysis is to determine the cost/benefit relationship for selected bus routes as indicators of bus operation conditions in the city.

Passengers on the buses of 16 bus routes were surveyed during the bus travel time survey. Service frequency and route length of each bus route were also surveyed at the time of the bus company survey. Operation costs of buses are surveyed by INTRA monthly. Bus fare was 4.50 peso/person on corriente buses and 11.0 peso/person on TSS buses when the surveys were conducted. Methodology of the analysis is indicated in Fig. 7–5–5, and described below.

(1) Estimation of operation kilometrage per route.

(2) Estimation of total operation cost based on INTRA's information, including the adjustment in operation costs of busetas.

(3) Estimation of total number of passengers per route.

(4) Estimation of total fare income per day, per route including adjustments in the bus fare of busetas.

(5) Calculation of income/cost ratio.

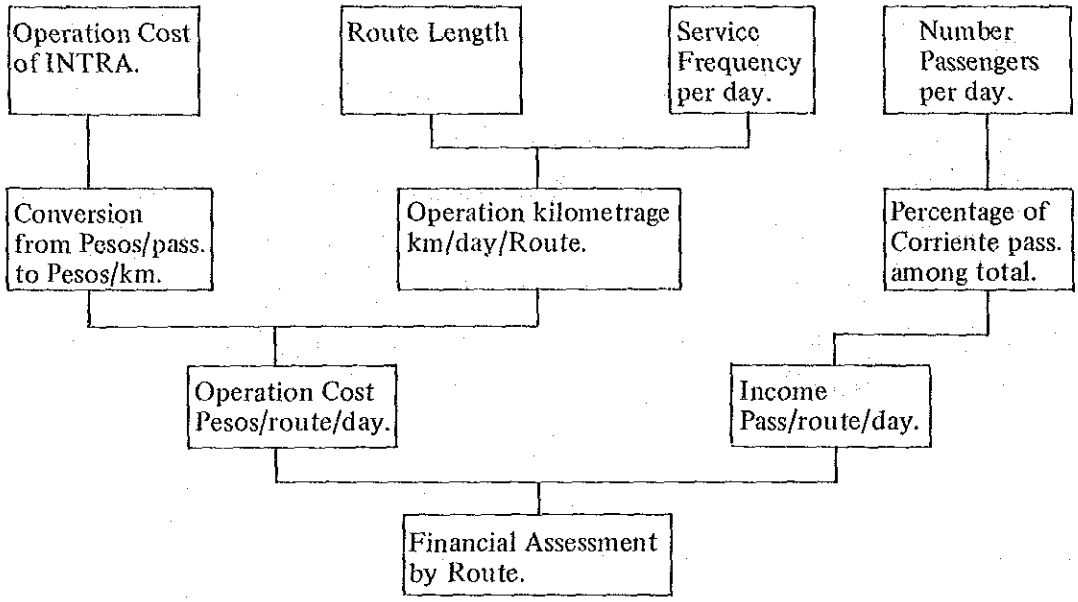


Fig. 7–5–5 Flow Chart of Financial Analysis by Bus Route

It was noted that some of the routes serving the northern part of the city generally have bettern income/cost ratios than others. This can be explained as follows:

(1) The operation cost of busetas is about 62.5% that of the buses. Consequently, only those routes using busetas have a high cost/benefit ratio.

(2) TSS bus fares are almost double those of Corriente buses. Consequently, those routes with a higher TSS bus share which serve the northern part of the city have low cost/benefit ratios.

(3) Routes serving the western and southern part of the city, use Corriente buses (80–100%) of total number of buses). Consequently, the ratios are generally bad.

For routes using Corriente buses, subsidies are availables which are almost equal to the bus fares collected from the passengers. Considering this subsidy as an addition to the actual fare income, almost all bus routes surveyed have a relatively good income/cost ratio except for one route which uses TSS buses and has a ratio of less than one.

7–5–5 Inventory of Urban Bus Terminals

The terminals mentioned here refer to the bus company facilities and not to the passenger terminals. Usually a terminal includes parking space, garage, gas station, and office as well as fulfills other functions such as bus storage, dispatching, maintenance and management of bus operations.

13 of the 21 bus companies in Barranquilla have terminal facilities which vary from 1,300 m^2, in the case of smallest, to 1.8 ha. for the largest. The total area of these terminals combined is 73,500 m^2. Seven terminals are located in Barranquillita. The other terminals are scattered in the western and southern parts of the city (See Fig. 7–5–6, and Table 7–5–3).

The other three companies which have no terminals, COOLITORAL, FLOTA ANGULO, and EMBUSA, have facilities with maintenance shops and offices. But they do not dispatch their buses from those facilities.

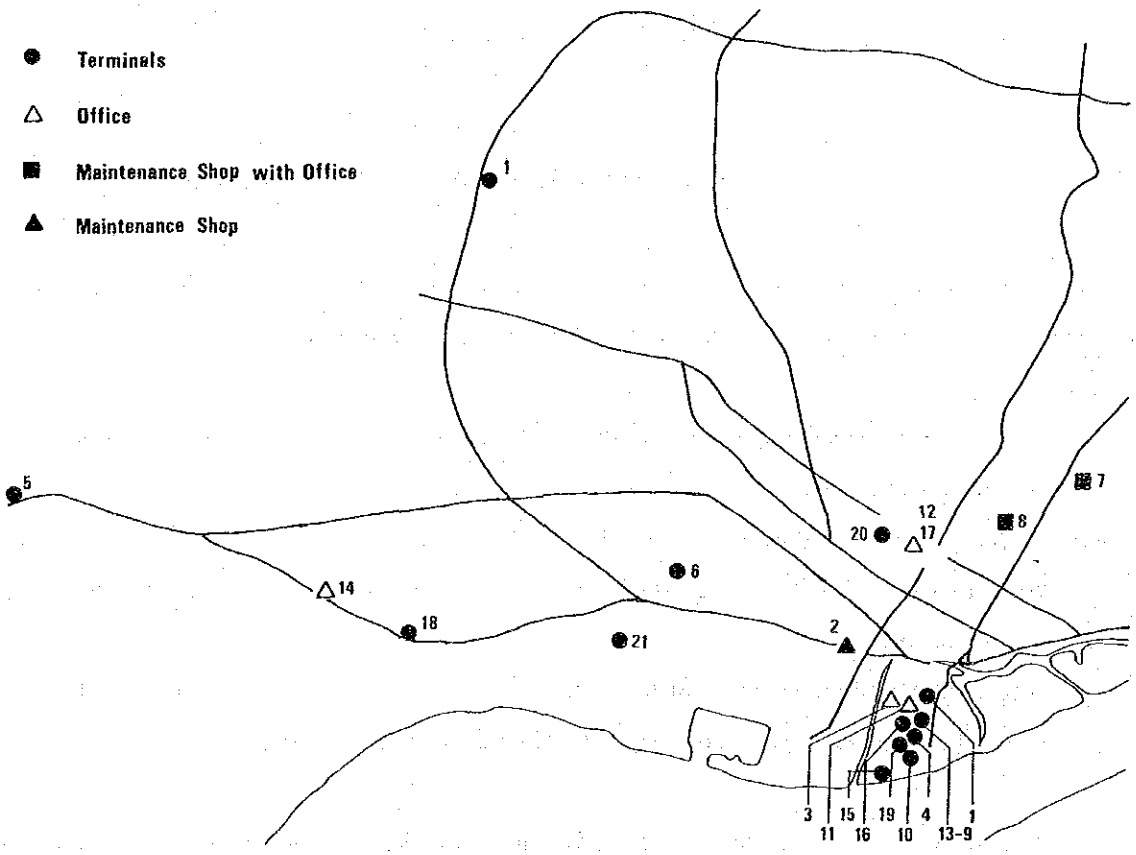


Fig. 7–5–6 Distribution of Urban Bus Facilities

Table 7–5–3 Facilities in Bus Company Terminals

(Units: m^2)

Facility Bus Company	Total Area of Terminal	Parking Area	Gas Station	Floor Area Office	Workshop	Parts Shop	Cafeteria	Others
1. Coochofal	800	–	30	100	–	18	–	8
2. Coolitoral	–	–	–	180	1,000	60	–	60
3. Cootransnorte	–	–	–	28	2,800	4	–	–
4. Cootrantico	3,600	3,476	4	78	–	–	42	–
5. Cootrasol	18,000	17,864	–	30	36	45	–	25
6. Cootratlantico	3,000	500	210	769	1,500	15	–	6
7. Embusa Ltda	–	–	–	84	432	–	–	–
8. Flota Angulo Ltda	–	–	10	100	200	20	–	–
9. Flota Roja Ltda	1,300	666	100	150	324	60	–	–
10. Sobusa S.A.	10,000	5,000	500	400	1,100	400	200	2,400
11. Sodetrans Ltda	–	–	–	40	–	–	–	–
12. Sotrausque Ltda	–	–	–	32	–	–	–	–
13. Transdiaz S.A.	9,800	9,047	90	306	410	40	60	–
14. Transmecar Ltda	–	–	–	18	–	–	–	–
15. Transp. Atlántico	3,300	–	–	400	2,200	–	40	–
16. Transp. Lolaya Ltda	6,400	3,000	1,200	50	1,650	150	–	–
17. Transp. Monterrey Ltda	–	–	–	60	–	–	–	–
18. Transoledad S en C.	2,400	900	876	24	660	–	–	–
19. Transubar Ltda	2,500	1,000	3	40	–	15	50	30
20. Trasalfa Sc. A	2,400	2,310	–	30	60	–	–	–
21. Trasalianco S.A.	10,000	9,200	400	–	–	–	–	400

7–6 Other Public Transport

7–6–1 Inter-regional Bus Service

1) Origin and Destination of inter-regional bus routes

The inter-regional public transportation that affects road traffic in Barranquilla are the long distance buses such as interdepartmental and intermunicipal buses.

The interdepartmental bus connects Barranquilla as a capital city of the Atlántico Department and the capitals of other Departments such as Antioquia ,Cundinamarca, Bolivar, etc. Bus service which serve outside Barranquilla city but inside the Atlántico Department are called the inter-municipal bus services)

There are 62 bus routes for interdepartmental service which have Barranquilla as their origin or destination with a total of 681 services per day (See Fig. 7–6–1).

There are 31 bus routes for intermunicipal service from Barranquilla with 721 services per day (See Fig. 7–6–2).

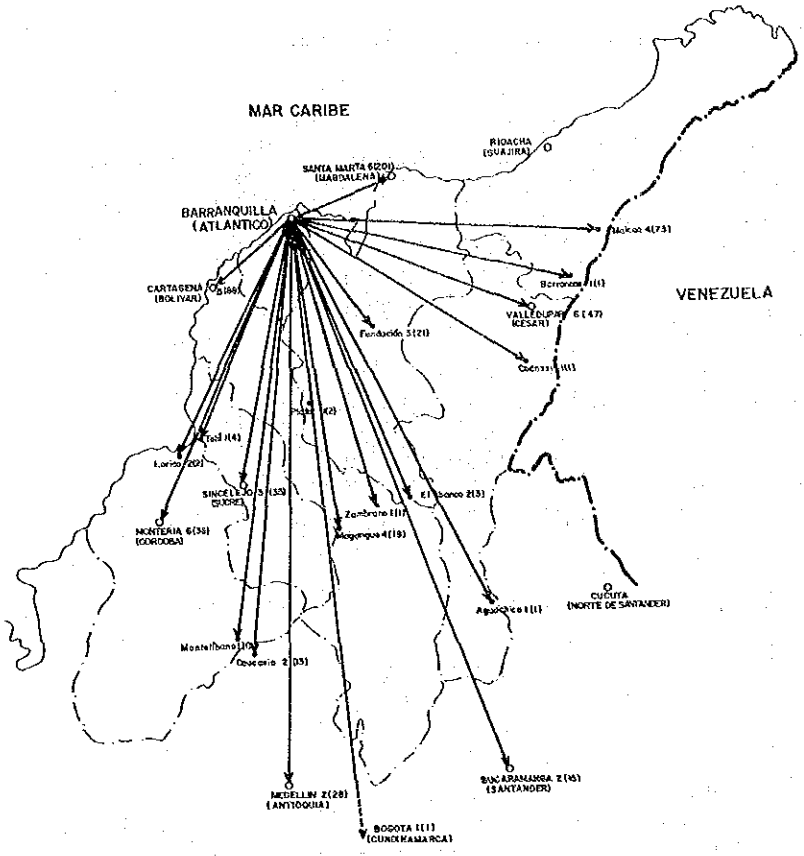


Fig. 7–6–1 Interdepartmental Bus Services from Barranquilla

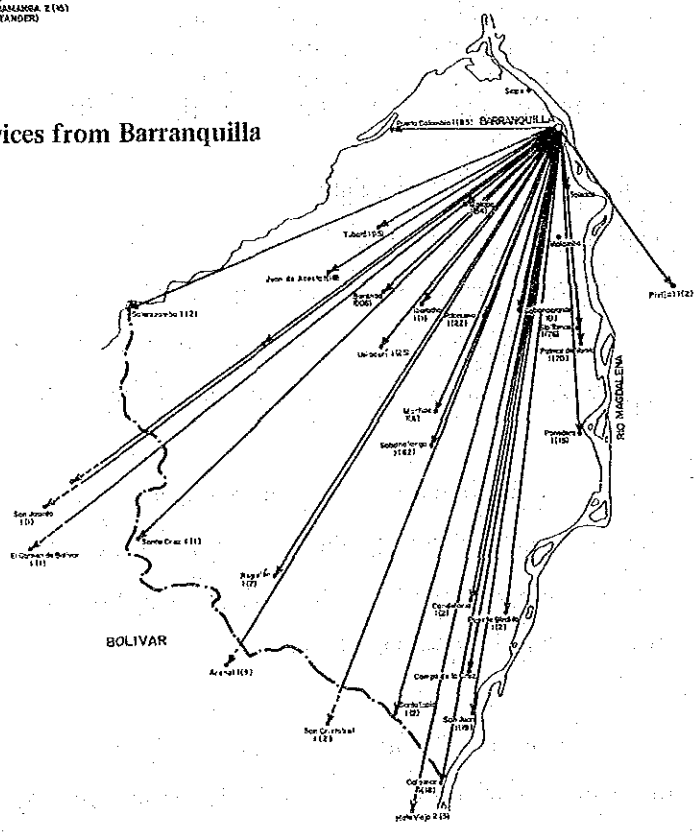


Fig. 7–6–2 Intermunicipal Bus Services in the Atlántico Department

2) Passenger Flow of Inter-regional Buses

a. Origins of inter-regional bus passengers

Major origins of the passengers for intermunicipal bus service are in the southern parts of Barranquilla city including Malambo, and Sabanagrande and the total number of passengers is approximately 50,000 per day. This is about half of the total number of the passengers entering and exiting the city. The southwest area of the department including Baranoa and Sabanalarga is the second major passenger origin of these bus services.

One of the major origins of the interdepartment bus passengers is the Magdalena Department including Santa Marta from where about 46% of the total number of the interdepartment bus passengers commute to Barranquilla. From the western part of the Atlantico Department including Cartagena, about 34% of the total interdepartment bus passengers visit the city.

b. Destination of the Inter-regional Bus Passenger

About 25 to 28% of both intermunicipal and interdepartment bus passengers have as their destination the central area and about 42 to 48% of the inter-regional bus passengers have their destination within a 4 km zone around the center. Consequently, about 70 to 74% of total number of the inter-regional bus passengers have their destination within a 4 km zone of the city center (Refer to Fig. 7–6–3).

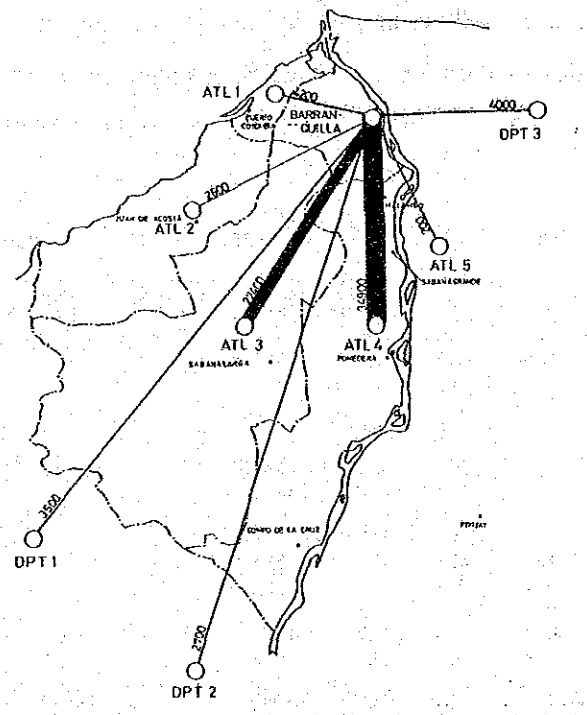


Fig. 7–6–3 Pattern of Inter-regional Bus Passengers

c. Trip purpose of inter-regional bus passengers

The composition of the inter-regional bus passenger's trip purpose is as follows (Refer to Table 7–6–1):

Table 7–6–1 Trip Purpose of the Inter-regional Bus Passengers

Trip Purpose	Intermunicipal bus	Interdepartment bus
To Home	46 %	39 %
To Work	25 %	14 %
Private	15 %	28 %
Business	2 %	13 %
To School	6 %	2 %
To Shopping	5 %	4 %

The intermunicipal bus passengers include a larger share of "To Work" and "To School" trips than the composition of the interdepartment bus passenger trips. "Private" and "business" passengers on the former bus services have less of a share than that of the latter. In other words, intermunicipal bus use is similar to the urban bus use.

3) Inventory of the terminal facilities at inter-regional bus companies

The terminal facilities of the interdepartmental bus companies are loated in the central areas of the city (See Table 7–6–2). Inthemunicipal bus companies have no terminal facilities in Barranquilla.

Table 7–6–2 Terminal Facilities of Interdepartmental Bus Companies

Transport Company	Maintenance Shop, m²	Parking m²	Office m²	Baggage Warehouse m²	Waiting Room m²	Ante Room for Driver m²	Dormitory m²	Service Station m²	Total Area
Brasillia	–	2,922.0	952.0	15.0	860.0	–	–	–	4,749.0
Expreso *1 Cartagena	–	–	21.3	–	125.6	–	–	–	146.9
Cooliber-tador *2	–	235.12	27.0	27.0	279.0	–	–	–	569.02
Copertran	–	–	36.45	96.4	39.44	–	3,000.0	3,000.0	6,172.29
Cosite Linda	–	–	21.3	–	125.6	–	–	–	146.9
Cootracequa	–	–	40.9	11.25	52.7	–	–	–	104.85
La Costena	506.3	216.0	89.1	11.1	54.5	–	–	–	876.95
La Velox *3	–	209.7	51.75	–	–	–	–	–	161.45
Rapido Ochoa	–	209.3	101	48.7	112.4	–	–	–	471.65
Torcoroma *2	–	235.12	27.0	27.9	279.0	–	–	–	569.02
Unitransco *3 co	–	116.4	75.3	16.9	58.5	–	–	–	267.1
Total	506.3	4,043.6	1,443.4	255.2	1,986.7		3,000.0	3,000.0	14,236.1

Note: *1, *2: Two companies use the same terminal
*3 : Two companies use the same terminal but they have their own space separetely in the terminal.

7–6–2 Taxi Service

Taxi services in Barranquilla are operated by 4 companies and 6 societies. The number of taxi units belonging to the companies is 5,251 units and to the societies is approximately 1,700 units. A total of about 7,000 taxis are operated in the city.

The models of the taxi fleet belonging to the four companies vary from 1940 models to 1983. The proportion of 1955 and 56 models is more than 30%. With respect to the taxi fleet as classified by car-producers. Chevrolet has the highest share followed by Dodge and Ford (See Fig. 7–6–5, Fig. 7–6–6).

The total number of taxi passengers is approximately 129,000 a day in Barranquilla. This is about 6.7% of the total person trips excluding walking trips. The trip purpose composition of taxi passengers is as follows. About 57% is for "To Home", 19% "Private", and 11% "To Work". Taxi passengers use taxis more frequently "To Home", "For Private Purposes" and "For Business" than urban bus users, and less frequently "To Work", "To School" and "To Shopping". The locations of taxi stations which were setup by the taxi societies are scattered throughout the northern part of the city (See Fig. 7–6–7).

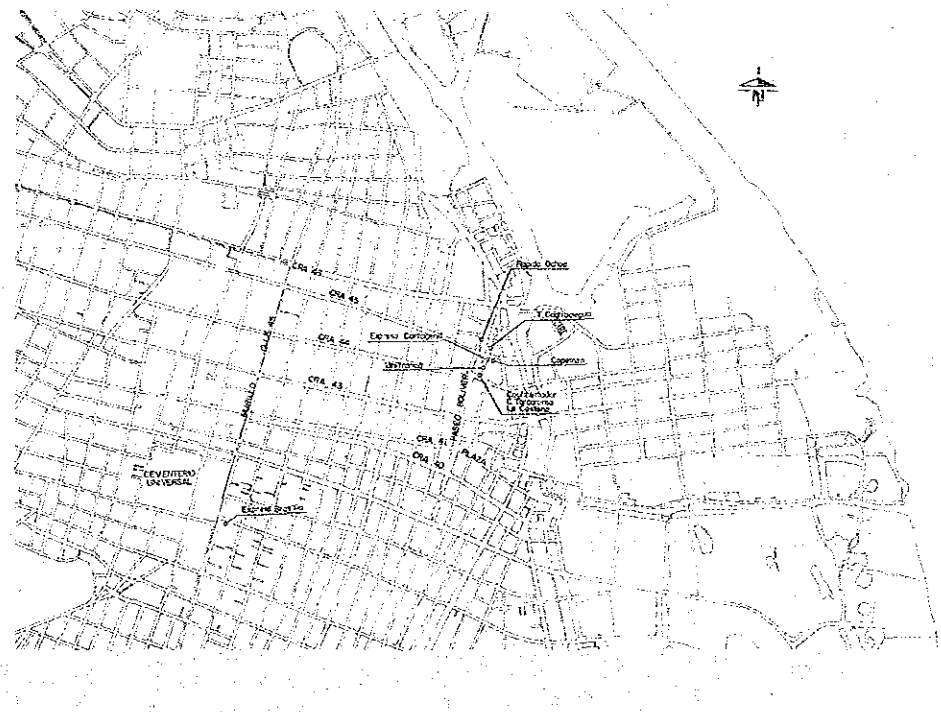


Fig. 7–6–4 Location of Interdepartmental Bus Companies

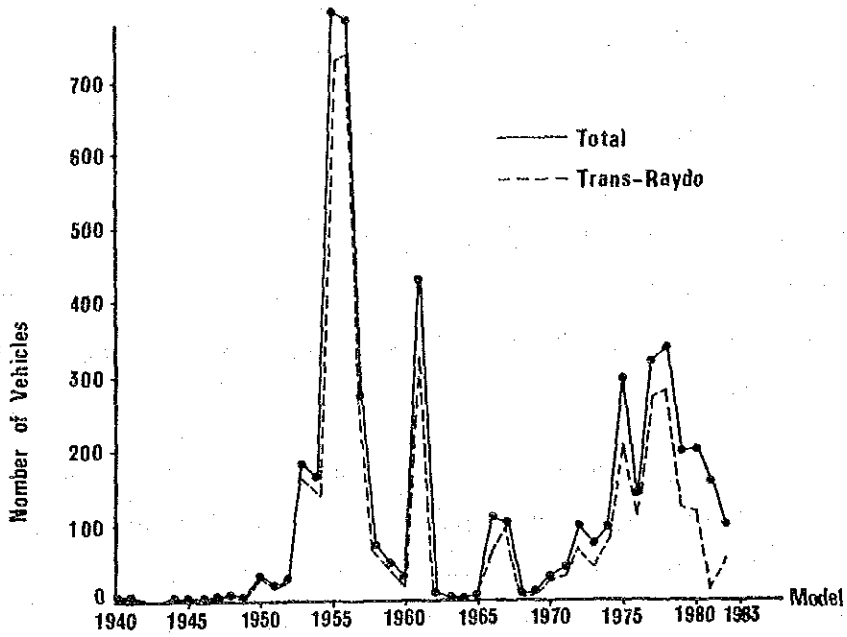


Fig. 7–6–5 Number of Taxi by Model

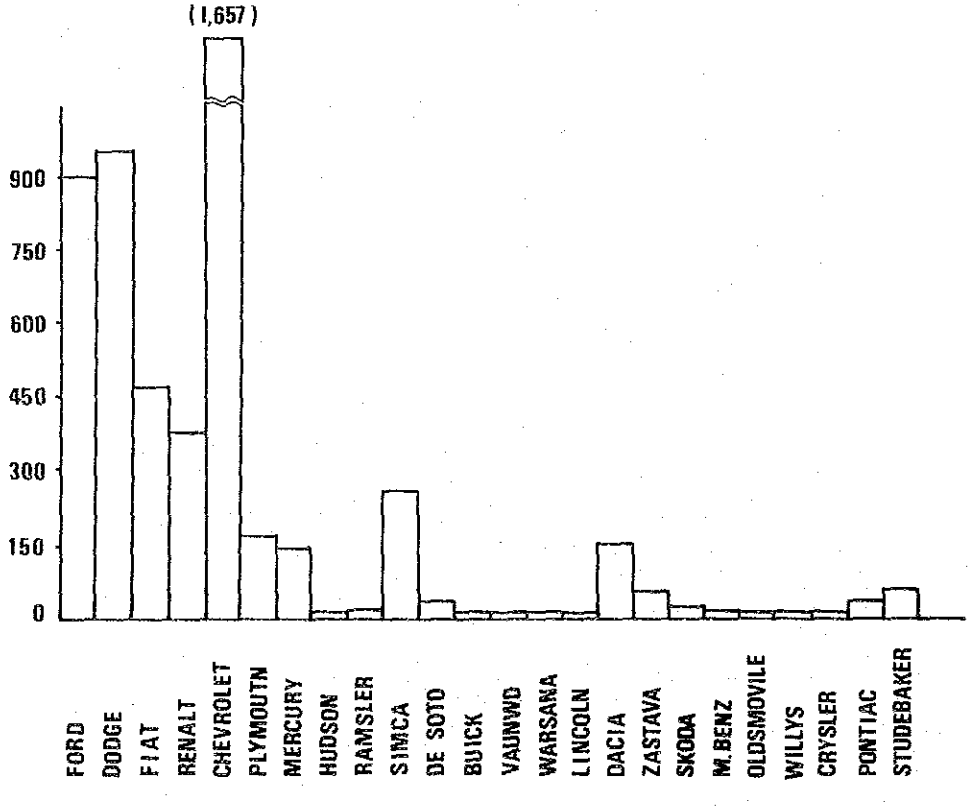


Fig. 7–6–6 Number of Taxi by Car Make

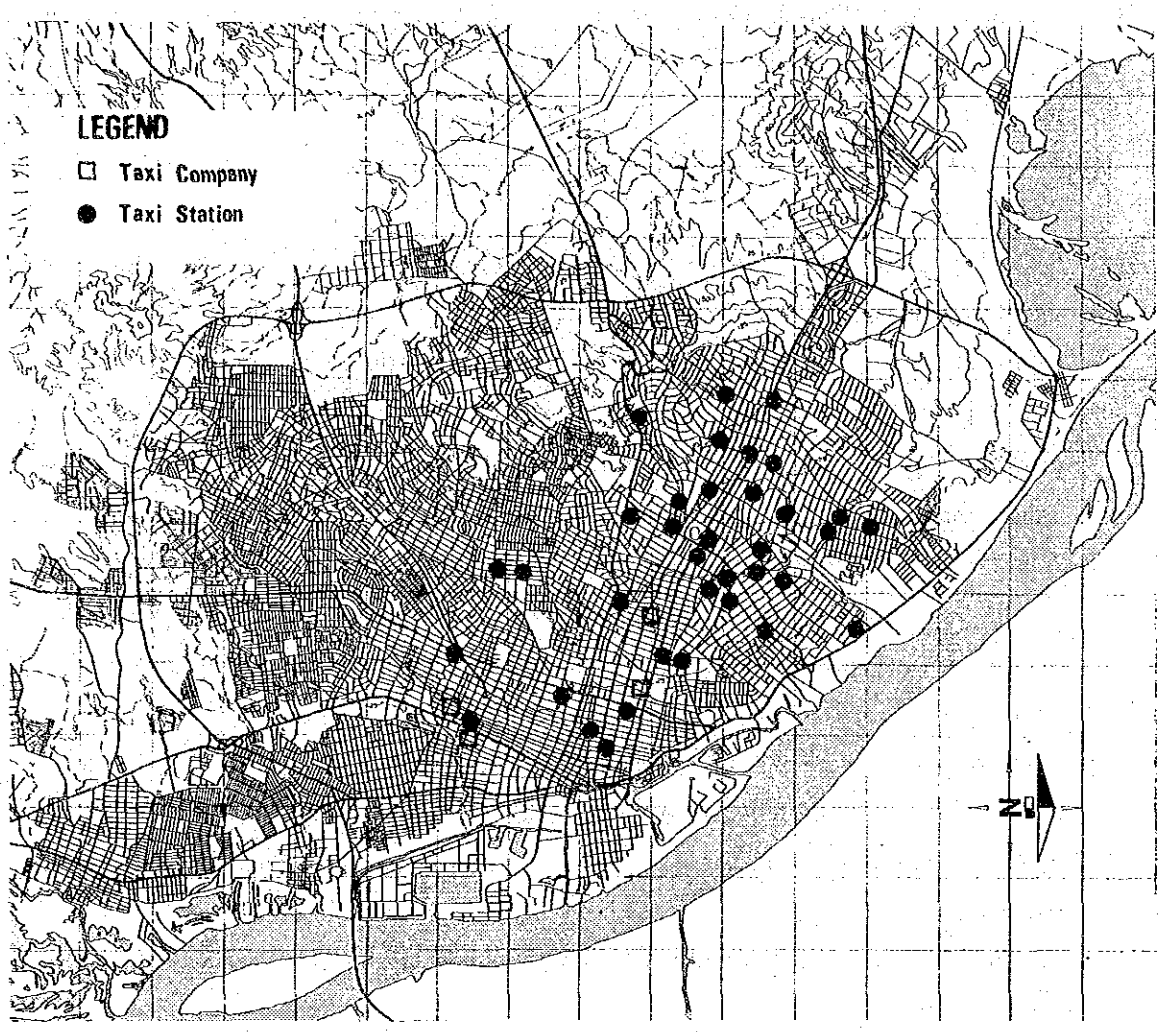


Fig. 7–6–7 Location of Taxi Company and Taxi Station

7–7 Existing Problems of Public Transport System

The following problems are identified by analysis of the present state of public transportation in Barranquilla;

(1) In newly developed city suburbs, there are some areas with insufficient bus services.

Some areas along the circumference road and southern parts of the city have few bus routes.

Some new bus services should be considered for the above-mentioned areas in the near future.

(2) The major flow of urban bus passengers is radial. Passenger flow between sectors is small but significant. The total number of passengers from centro to the suburbs is approximately 550,000 and the number of passengers moving between sectors is approximately 53,000. The necessity for circumferencial bus routes will be more significant in the near future.

(3) Several sections of the roads in the centro area are already congested due to poor traffic signal system and the high proportion of buses. Some major roads in and around the centro area such as Calle 30, Cra. 38, Paseo Bolfvar and so on, are already congested during peak hours. Not only the improvement of the traffic signal system but also improvement of the bus routes and improvement of road intersections in the area, should be considered in the near future.

(4) A large number of passengers change buses at bus stops in the centro. Approximately 40% of all passengers who use bus stops in centro, change bus routes. However, terminal facilities for urban bus passengers do not exist in centro at present. The necessity of such facilities will be acute in the near future.

(5) There is some similarity of passenger activity between urban and interminicipal buses. Some of the interminucipal bus routes which serve areas relatively closer to the city, might be reconsidered in the near future as an urban service depending on passenger characteristics.

(6) The hourly variation pattern of urban bus passengers is not sequenced with the bus service frequency.

Urban bus demand varies significantly in peak and off-peak hours. However, the bus supply does not vary as much as the demand. This is because the urban bus service frequency is designated by INTRA. Consideration of optimum occupancy ratio at peak hours is and will be necessary to supply better urban bus service levels.

(7) Passenger facilities for urban and intermunicipal buses have not been provided. All urban and intermunicipal buses pick up passengers at the road side without any passenger facilities. This kind of passenger bus service affects the overall road traffic flow. To run a safer service, add convenience for passengers and ensure smoother traffic flow, passenger facilities such as passenger terminals and bus stops along major routes should be considered.

(8) The bus maintenance level is poor in Barranquilla. Better bus maintenance systems create more stable and safer bus service in general. Policies and systems to improve the maintenance level of buses in Barranquilla should be considered in the near future.

PART Ⅱ: FORECAST AND PLAN

INTRODUCTION OF THE PART II

As identified in Part I, various problems exist in terms of urban structure and urban transport. These problems are expected to become bigger and more complex in the future due to the rapid expansion of the urbanized area in the Barranquilla Metropolitan Region.

The existing problems are summarized as follows:

1) Land Use and Urban Structural Problems

(1) Concentration of various urban functions in the Central District

Major administrative, financial, commercial and transportational activities are highly concentrated in the Central District, consequently, they became the main causes of traffic congestion.

(2) Mingling of various activities in the Central District

The market area and the bus operation centers are located close to the business district. Other various activities such as small industries, shops, street vendors and residences are intermingled of each other, creating traffic confusion in the Central District.

(3) Deterioration of environmental conditions in the Central District

This can be best illustrated as follows:

a. Vacant buildings are increasing in number.
b. Permanent settlements of squatters can be observed.
c. Disorderly conversion of building use is found.
d. Contamination of Caño Ahuyama contributing to poor sanitation and probably causing health problems.

(4) Disorderly development and sprawl of built-up area

Disorderly development of residential urbanization has been made by squatters in the southwest part of Barranquilla. In addition, a sprawl of built-up areas outside of Circunvalar is being promoted by private developers.

In order to expand the residential areas in an orderly fashion, it is necessary to prepare a master land use plan as a guideline for future housing developments.

2) Urban Transport Problems

(1) Traffic congestion in the Central District

The Central District is suffering from a chronic traffic congestion particularly during three peak daily periods: morning, noon and evening.

This is mainly due to the following reasons:

a. The classification of the roads and streets is not obvious, therefore, an orderly utilization of road network is difficult.

b. The traffic capacity of arterial roads is not sufficient.

c. There exist several factors for the disturbances of traffic flow: indiscriminate crossing by pedestrians, illegal road-side parking, flooding by Arroyo system, etc.

d. The traffic management system, particularly for buses, is not properly considered.

(2) There exists a significant imbalance between the transport demand and the supply of buses. More specifically, during the peak hours, buses are overcrowded and bus passengers are forced to wait for the next bus.

(3) Although many bus passengers transfer from one route to another in the Central District, terminal facilities are not available.

(4) The road maintenance is not adequately carried out.

(5) In the newly developed residential areas along Circunvalar, some districts have no bus service.

(6) A high occurrence of traffic accidents can be seen at many intersections. This is mainly due to inadequate traffic safety facilities, improper traffic management and the lack of morality for traffic safety.

As will be explained in Chapter 8, the population size of the study area has been projected to grow from about 1.2 million in 1983 to 2.0 million in the year 2000. The GRDP of Atlántico is expected to grow about 2.5 times the present value in the year 2000. In accordance with economic and income growths, vehicle ownership in the year 2000 will also increase to 1.64 times the present ownership. Based on the existing situation, and the future projections, the following problems can be anticipated.

(1) Disorderly expansion of urbanized area.

(2) Deterioration of environmental conditions in the Central District.

(3) Increased traffic congestion in the Central District.

(4) Increase of traffic demand in both direcitons along radial and circumferential roads.

(5) Increase of traffic accidents.

3) Planning Needs

In order to cope with the existing and foreseeable problems mentioned above, the following planning needs can be identified.

- By dispersing some of the urban funcitons to a peripheral area of Barranquilla, the excessive congestion in the Central District can be lessened. Simultaneously, it will help the residents by creating new job opportunities at locations adjacent to the residential areas.

- The central area should be renewed and reorganized so it can function as a center of the Metropolitan Region. This can be accomplished through intensificaiton of the business functions and the improvement in the level of commercial functions.

- Prevention of the disorderly expansion of built-up areas is also important. It is, therefore, necessary to define the area for urbanization and land use for the year 2000.

- It is necessary to improve the environmental conditions in the Central District of Barranquilla by undertaking various countermeasures as a part of urban renewal. Such countermeasures include but are not limited to, dredging of the canal, beautification of the landscape of the sorrounding area, provision of green spaces, open spaces and pedestrian ways etc.

For these purposes the land use plan of Barranquilla Metropolitan Region is envisioned as follows:

(1) The urbanized area will mainly expand to the northwest and the south, outside the Circunvalar.

(2) Formation of an industrial belt along the Magdalena River by expanding the existing industries, and establishing new industrial parks near the airport and Malambo.

(3) With respect to business and commercial activities, in addition to the existing centers, such as the Central District of Barranquilla, the commercial area along Calle 72 and the administrative center of Soledad, two new sub-centers are planned in the sub-urban area; one is located at the area adjacent to Soledad 2000 in the south, the other near the construction site of Universidad Atlántico in the northwest.
Multiple activity areas will be created along the arterial roads mainly for commerce, services and small industries.

(4) The Central District will function as an administrative, business and commercial center of the Metropolitan Region after its renewal and redevelopment.

On the basis of the above changes in land use, transport problems have been identified and quantified. As a result, the following can be anticipated:

- In terms of person trips, the total transport demand in the year 2000 is forecasted to be 1.84 times the present level.

  Car ownership rate in the Study Area is also increasing, therefore, the growth rate of traffic on roads and streets is predicted to be much higher.

- Particularly in the directions to the south for Soledad and Malambo or to the northwest for Puerto Colombia, the transport demand will be immensely increased, mainly due to the many housing development projects and the formation of sub-centers. From 1983 to 2000, in the south and northwest directions, the respective demand will increase by 2.7 and 3.8 times the present level.

- In the Central District of Barranquilla, the growth rate of transport demand is relatively low; about 1.3 times the existing level in terms of person trips, however, the incremental number of person trips with origin or destination in the Central District will be significantly large; about 250,000 additional trips are expected. This increase will make traffic congestion more serious.

- On the other hand, the present arterial road network system is still premature, and each road is not effectively utilized.

- In addition, bus routes are operated by private companies without coordination and are concentrated in the profitable routes with destinations in the Central District as a shuttle service. The Central District is already overcrowed with buses particularly during the peak hours. Without some rearrangement of bus routes, it will be difficult to increase the capacity of bus transport.

In order to solve the problems described above, various countermeasures should be taken, such as improvement of transport facilities including roads and streets, development of public transport, improvement of traffic management, etc. Uncoordinated use of one or another countermeasure may not be effective. Rather, a comprehensive and systematic approach should be taken to cope with all the above problems.

The countermeasures planned in this study are classified into those for the short term and those for the long term. The short term plans are those to be undertaken within about 5 years from now. These countermeasures will neither require a large amount of investment, nor a long period of time. The long term plans are those to be undertaken as a target for the year 2000. Both plans should be consistent in terms of basic policy, and well coordinated with each other.

Chapter 8.

SOCIO-ECONOMIC FRAMEWORK AND LAND USE PLAN

Chapter 8 SOCIOECONOMIC FRAMEWORK AND LAND USE PLAN

8-1 Development Policy

8-1-1 Formulation and Execution

Development policies of the Republic of Colombia are executed in accordance with regional development plans prepared by the respective regions based on guidelines from the national development plan formulated by the DNP. Section policies are executed by government ministries and agencies, as well as their auxiliary organs and local bureaus, and departmental and municipal government divisions.

There are two development plans at present:

(1) National Development Plan 1983-1986 (Plan Nacional de Desarrollo 1983-1986)

(2) Atlantic Coast Development Plan 1983-1986 (Plan de Desarrollo de la Costa Atlantica 1983-1986)

8-1-2 National Development Plan 1983-1986

1) Basic Objectives

The basic objectives of the Plan are as follows:

(1) Social Equity

This objective aims to achieve a more balanced development among regions with different levels of development, and at the same time to improve the income distribution by creating more job opportunities for low-income groups.

(2) Economic Recovery and Revitalization

This aims not only to recover from the recent economic recession, but also to enable the economy to grow more dynamically by stimulating the economically-depressed industries. Boosted by intensive investment in infrastructural facilities and numerous housing development projects in urban areas, the construction industry is expected to become the leading sector.

(3) Consolidation of the Economy

This objective is to strengthen the national economy and to improve the financial conditions of both the private and public sectors. This also includes the improvement of the balance of payments, the promotion of reinvestment and the development of new industries.

2) Major Production Sector Policies

(1) Agriculture

The agricultural sector is expected to grow at an annual rate of 4% hereafter, and exports of agricultural products are expected to expand at an annual rate of 10% or more. Investments will focus on the improvement of irrigation systems, the Integrated Rural Development Plan (Desarrollo Rural Integrado), the National Nutrition Program (Programa Nacional de Alimentacion y Nutricion) and the construction of a food distribution center. To expand exports, the implementation of selective protective measures for agricultural products and the expansion of export promotion financing have been proposed.

(2) Manufacturing

The three biggest objectives of this sector are as follows:

- Recovery of the domestic market
- Substitution of imported products
- Expansion of exports

It is important to promote movements to purchase domestically produced products, both in the public and private sectors. In relation to the expectation that the construction industry will act as the leading sector, it is necessary to provide some sort of incentive measures to the construction materials industry. Cooperation between the agricultural and industrial sectors is a basic policy for fostering the growths of both sectors.

(3) Mining and Fuel

The substitution of hydrocarbon with coal should be promoted. It is important to study the possibility of creating new industries that utilize surplus natural gas available along the Atlantic coast. A drastic reduction in oil imports could be realized by increasing the drilling of new oil wells. An investment of 450 billion pesos will be made for the construction of 21 power plants that will go into operation by 1995.

(4) Transportation and Communication

The principal goal for this sector is to establish national road, air and telecommunication networks. Investments will focus on improving transportation conditions in outlying areas and in expanding telephone networks in rural areas.

(5) Tourism

Attracting tourists from abroad will be promoted so that tourism will represent at least 10% of international current revenue. Domestic tourism will be encouraged with projections of participation by 20% of the population.

3) Major Commercial Sector Policies

(1) International Trade

Simultaneously with the application of selective protective measures to domestically-produced products, financing to promote exports will be expanded. The Free Zone's function as an export base will be strengthened. Transportation to and from the Caribbean countries, the Latin American countries and the Andes Group countries will be improved.

(2) Domestic Trade

The control of contraband trade will be strengthened, and sales tax on domestic products, which compete with smuggled goods, will be adjusted. The system of financing capital investments and the stimulation of commerce will be improved.

4) Main Social Sector Policies

(1) Housing

During the period, 442,000 units of housing (400,000 in urban areas and 42,000 in rural areas) will be constructed. The supply of low-cost housing will be expanded and loans to low-cost housing purchasers will be increased.

(2) Employment and Social Security

Jobs for an average of about 280,000 persons will be created annually through housing construction projects. Social security for workers in the informal and agricultural sectors and self-employed persons will be substantially expanded.

(3) Education

A national education system (System Nacional de Educacion) which links together the various organizations and organs dealing with education will be established. Opportunities to receive higher education will be offered to 200,000 persons through universities opened to the general public and through educational radio/TV programs.

(4) Health Insurance

Coverage by the national health insurance program will be expanded from 50% of the total population to 75%. By ensuring adequate supplies of housing, drinking water and food, the disease and death rates will be decreased.

(5) Public Security

Concurrent with the reorganization and strengthening of the various organs such as the Ministry of Justice, the public prosecutors office and the police department, simplification and speeding up of legal and court processes will be vigorously pursued.

5) Monetary Measures

(1) Basic Policy

Basic monetary policies are established as follows:

- Control of current expenditure, rationalization of foreign currency use, and foreign currency investment in basic development sectors.
- Clarification of decision-making rights concerning local expenditures.
- Promotion of public investments in businesses which lead to new job opportunities and greater domestic products demand.
- Stabilization of public utilities rates, correction of differences in such rates between regions, and reviewing the possibility of having the higher-income bracket bear a greater share of costs.
- Healthy investment plans taking into account the ability to pay back foreign debts.

(2) Policy Framework

The amount of public investments at the national level during the period of the Plan is expected to increase 7% annually in real terms, and will amount to 1,589 billion pesos. Current revenue will reach 1,640 billion pesos and current expenditure, 750 billion pesos, so that current account surplus will amount to 890 billion pesos. Of this 52% will be applied to departmental and municipal current expenditure (national treasury disbursements for education and health insurance, transfer of sales tax to municipalities, etc.) and 48% will be applied to expenditures of state-run enterprises.

(3) Special Investment Programs

Of the total investment of 1,589 billion pesos, special investments which characterize the present Plan are as follows:

– Urban housing development	515.2 billion pesos
– Restoration of guerrilla area	68.2
– Study of agricultural technique	23.1
– Land improvement	43.4
– Scientific and technological development	11.6
– Education by correspondence and TV/radio	15.2
– New health insurance investments	24.5

8–1–3 Atlantic Coast Development Plan 1983–1986

1) Basic Objectives

Development objectives of the Plan are as follows:

(1) Stimulation of the regional economy

(2) Expansion of the agricultural frontier

(3) Stimulation, diversification and stabilization of regional industries

(4) Integration of mining and energy developments into the regional economy

(5) Maximizing the advantages of being a coastal region

(6) Commitment of human resources for regional development

(7) Identification and response to basic needs

2) Major Policies by Sector

(1) Agriculture

The imrpovement of existing irrigation systems and the provision of new irrigation facilities in areas of high potential will be promoted. A central wholesale market will be established for improving the distribution process, and at the same time a storage center will be constructed in the department of Magdalena and in the southern part of the Atlantico department. Fertilization, improved seeds, machinery and agrobiology will be utilized for raising productivity. Moreover, efforts will be made to foster the agro-industries and to implement appropriate financial policies.

(2) Fishery

The system of investigating marine resources will be strengthened. Efforts will be made to develop a technology for harnessing ocean energy and to probe for submarine mineral ore resources. It is necessary to foster the framing of marine engineers and experts within a short period of time. A commercial fish cultivation industry of appropriate size will be realized.

(3) Forestry

Ways to make use of trees that would be submerged by water as a result of power resource development projects will be developed. Afforestation will be promoted in Sierra Nevada and central Magdalena.

(4) Mining

Existing projects concerning coal, nickel, natural gas and rock salt will be continued. A policy of promoting the participation of the private sector in mining projects will be carried out. In order to promote the use of natural gas, supply pipeline networks in major cities will be improved. 10% of the coal fund will be allotted to expanding the electric power division of this region in order to lower electric power rates.

(5) Manufacturing

The following measures will be affected to strengthen the competitiveness of regional products:

- Tighter restrictions will be on foregin products sold in the Free Zone, designated piers and airports. Tighter restrictions on foreign capital will also be imposed, as well as enforcement of laws to prohibit smuggling.
- Protection of domestic industries through selective customs barrier

Public investments will focus on the region's industries which are superior compared to those of other regions (ie., construction materials, food, chemicals, textiles, etc.). Feasibility studies will be conducted on the possibility of creating the following new industries:

- Methanol, artificial fertilizers, chlorine, soda, aluminum nitrate
- Agro-industries (alcohol, fats and oil, enriched fertilizers, dairy products, vegetable protein, etc.)

An industrial park will be planned, packaged together with public services, financial institutions, technical guidance facilities and employment support. This will function as the nucleus of regional development. The financial and labor policies for the Free Zone will be restudied and special incentive measures will be strengthened.

(6) Education

The encouragement of engineers and experts in the manufacturing and construction fields will be continued as before, while those for the agricultural, fishery and mining fields will also be encouraged. Opportunities to receive higher education will be expanded through universities opened to the general public and educational TV/radio programs.

(7) Health Insurance

Fundamental facilities for health insurance-related activities will be improved, and efforts will be made to prevent environmental pollution that may accompany development.

(8) Housing

Low-cost housing that require no down payments will be made available in large quantities so that lower-income families will be preferentially provided with housing. Furthermore, redevelopment of urban areas and housing developments in rural areas will be promoted.

(9) Transportation and Communication

A scheme of improving the transregional road network by relating them to production activities and of utilizing major rivers as transportation routes will be reviewed. Existing

harbor facilities will be streamlined and made more efficient. Piers for containers will be constructed in Cartagena and Santa Marta. The communication network will be improved, emphasizing investments in regions which lack means of communication and raising the efficiency of existing facilities.

(10) Electric Power

Power generation costs will be reduced by implementing the Sinu hydraulic power plant project, and power rates will be lowered to the national level. Moreover, the capacity of the existing thermal power plants will be expanded and the network of power transmission lines and service lines will be improved.

(11) Tourism

Basic tourist facilities will be improved using the urban development fund. Special incentive measures will be established to promote the maintenance and repair of properties in historically important districts. Capable personnel for the tourist industry will be fostered, and steps to raise the quality of travel agencies will be strengthened.

(12) Commerce

Export-oriented enterprises located in the Free Zone and industrial park will receive preferential treatment with regard to financing and employment. The organization of street vendors will be encounraged, and their appropriate locations will be studied.

3) Land Use Policy

In order to carry out the above-mentioned policies, the following guidelines will be adopted with regard to land use and regional development preparation:

(1) Promotion of the Use of Undeveloped Sections

For example, exploitation of new mines, improvement of areas that are easily flooded, afforestation of highly eroded land.

(2) Stimulation of Semi-developed Sections

For example, restoration and construction of irrigation systems, intensification of the livestock industry and partial switch-over to crop-raising.

(3) Reinforcement of Highly Productive Sections

For example, regulations on urban expansion, decreasing the distance between a producing region and its market.

(4) Control of Highly Integrated Urban Areas

For example, raising the city inhabitants' standard of living, restriction of population expasnion into areas of high agricultural potential.

(5) Reinforcement of the Transit Function of Central Communities

For example, decreasing the distance between a production region and a consumer-oriented region, improvement of fundamental city infrastructure.

(6) Unification of Troubled Areas

For example, raising the standard of living of informal sector inhabitants.

(7) Formation of a Regional System Adapted to a Rational Implementation of Policies

For example, encouraging national budget allocations to regional governments, unification and coordination of the activities of local agencies and the activities of private-sector organizations.

(8) Organizational and Administrative Measures Necessary for Strengthening the Regional Structure

For example, encouraging the development of residents' organizations by occupation and by region, reinforces the regional autonomy.

4) Investment Plan

The total amount to be invested between 1983 and 1986 is 397.1 billion pesos, of which nearly one third is earmarked for electric power. Of the 18.5 billion pesos of investments for the primary industries, nearly 11 billion pesos will be used for improving irrigation systems, and about 2 billion pesos is planned for improving the central wholesale market (Gran Central de Abastos). Of the 57.6 billion pesos for industrial investments, about 46 billion pesos will be used for constructing an urea-ammonia factory in Guajira, and, for Barranquilla, 1 billion pesos is proposed for the airport free zone and 2 billion pesos for a Land Rover assembly factory. The cost of moving and expanding the University of Atlantico campus, 2.2 billion pesos, is included in the educational investment of 11.3 billion pesos. The amount of transportation and communication-related investments will be 66.0 billion pesos, of which only 270 million pesos will be allocated to Barranquilla and nearby areas, for improving Barranquilla city intersections and other projects (See Table 8–1–1).

Table 8–1–1 Investment by Sector 1983 – 1986

(In million pesos)

Sector	Investment	Percentage
Primary Industry	18,474.0	4.7
Manufacturing Industries	57,610.0	14.5
Education	11,310.4	2.8
Health, Sanitation	37,190.0	9.4
Housing	78,790.0	19.8
Transportation, Communication	65,994.0	16.6
Electricity	123,487.0	31.1
Tourism	4,238.0	1.1
Total	397,093.4	100.0

8–2 Socioeconomic Framework

8–2–1 Population

Population forecasts are made on the basis of the following assumptions:

(1) Population will continue to concentrate in the urban areas during the coming two decades, but population in rural areas will increase as well.

(2) Population growth in the Study Area will tend to slow down due to a decline in the birth rate resulting from the spread of education and the promotion of family planning programs.

Population forecasts for the Barranquilla-Soledad district are normally available from two sources: DNP (Departament Nacional de Planeacion) and PIDAMB (Plan Integral de Desarrollo Urbano del Area Metropolitana del Barranquilla). Table 8–2–1 shows the forecast given by DNP. If the 1983 forecast is compared with the 1983 population estimate made from person trip surveys, the value given by DNP is slightly lower.

Table 8–2–1 Population Projection by DNP

(x 1000)

	1964[1)]	1973[1)]	1983[2)]	1990[2)]	2000[2)]
Barranquilla and Soledad	536.1	772.1	1,074.0 (1,108.0)[3)]	1,333.0	1,705.0
Rest of Atlántico	180.6	256.8	305.1	332.3	364.9
Atlántico	717.4	1,028.9	1,379.3	1,665.3	2,069.9

Source: 1): Population Census adjusted DANE
2): Dinamica Demografía y Proyecciones de Población del País, Los Territorios Nacionales, El Distrito Especial de Bogotá, Departamentos y Las 30 Principales Ciudades Sep. 1982, DNP.
3): Person Trip Survey in 1983.

The alternative population projections for the Barranquilla-Soledad district are presented in Table 8–2–2. The highest values are given by PIDAMB and the lowest, by DNP. The middle values are obtained by modifyng the growth rate given by DNP based on past conditions and applying the modified rate to the 1983 population estimate made from person trip surveys.

Table 8–2–2 Population Projection for Barranquilla and Soledad

(in thousands)

		1964[1]	1973[1]	1983	1990	2000	Average Annual Growth Rate (%) '64-'73	'73-'83	'83-'90	'90-'00
Barranquilla and Soledad	H[3]				1,440.4	2,003.5			3.8%	3.35%
(% share to Atlántico)	M[4]	536.8	772.1	1,108.0[2]	1,409.7	1,875.3	4.1%	3.7%	3.5%	2.9%
	L[5]	(74.8%)	(75.%)	(75.4%)	1,330.0	1,705.0			3.1%	2.5%
Rest of Atlántico	H[6]			371.7	471.8	626.1		3.7%	3.5%	2.9%
	M[6]	108.6	256.8	362.2	429.5	514.1	4.0%	3.5%	2.5%	1.8%
	L[5]			305.1	332.3	364.9		1.7%	1.2%	0.9%
Atlántico	H[6]			1,479.7	1,912.2	2,629.6		3.7%	3.7%	3.2%
	M[6]	717.4	1,028.9	1,470.2	1,839.2	2,389.4	4.1%	3.6%	3.25%	2.65%
	L[5]			1,413.1	1,665.0	2,070.0		3.0%	2.4%	2.2%

Source: 1: Population Census Adjusted
2: Person Trip Survey in 1983
3: Estimated by PIDAMB
4: Estimated by modifying the growth rates of DNP
5: Estimated by DNP
6: Estimated by Study Team

Legend: H; High Estimates
M; Medium Estimates
L; Low Estimates

According to the Table, population forecasts for the year 2000 in the Barranquilla-Soledad district ranges from 1.7 million to 2.0 million. In veiw of the declining tendency of the growth rate during 1973 to 2000, the middle values seem to be the most probable.

Based on the medium estimates, the population in Malambo, Galapa, and Puerto Colombia is projected as shown in Table 8–2–3. As elaborated in Chapter 2, the population growth of these satellite cities of Barranquilla during the past decade is tremendously high.

Table 8–2–3 Population Projection for Malambo, Galapa, Pto. Colombia

(in thousands)

		1964	1973	1983	1990	2000	Average Annual Growth Rate (%) '64-'73	'73-'83	'83-'90	'90-'00
B/Q & Soledad	1)	536.8	772.1	1,108.0	1,409.7	1,875.3	4.1%	3.7%	3.5%	2.9%
Malambo, Galapa Pto. Colombia	H				148.1	219.2			7.0%	4.0%
	M	24.0	36.8	92.2	124.6	167.5	4.9%	9.6%	4.4%	3.0%
	L[2)]				106.2	129.5			2.0%	2.0%
Outside of Study Area in Atlántico	L[				281.4	294.9			0.6%	0.5%
	M	156.6	220.0	270.0	304.9	346.6	3.8%	2.1%	1.8%	1.3%
	H				323.3	384.6			2.6%	2.5%
Atlántico	1)	717.4	1,028.0	1,470.2	1,839.2	2,389.4	4.1%	4.1%	3.25%	2.65%

Note: 1: The medium value in Table 8–2–2 was applied.
2: Estimated by Empresa de Obras Sanitarias del Atlántico "EMPOTLAN", Feb. 1984

Legend: H; High Estimates
M; Medium Estimates
L; Low Estimates

For the years from 1983 to 2000, the table presents three alternatives projections; however, the medium figures by EMPOTLAN (Empresa de Obras Sanitarias del Atlántico) seem to be the most likely ones, considering the following factors:

(1) The satellite cities are expected to grow with a high growth rate at least by 1985, since lots of housing development programs have been approved.

(2) The rapid growth will incur various problems such as shortages in water supply, electricity, transport, etc. and other social facilities. These problems may discourage the rapid expansion of the urbanized area.

(3) The outside of the Study area will also have a relevant development, taking the past trend into account.

As a consequence, the population in the Study Area is likely to grow from 1.2 million in 1983 to 1.53 million in 1990 and 2.04 million in 2000 as shown in Table 8–2–4.

Table 8–2–4 Population Projection in Study Area

(in thousand)

	1983	1990	2000
Barranquilla and Soledad	1,108.0	1,409.7	1,875.3
Malambo, Galapa, Puerto Colombia	92.2	124.6	167.5
Total Study Area	1,200.2	1,534.3	2,042.8

8–2–2 Gross Regional Domestic Product (GRDP) of Atlántico

1) Gross Domestic Product (GDP) of Colombia

The progress of real GDP (in 1975 prices) between 1970 and 1982 can be regressed with a straight line and GDP in the future will most likely continue this past tendency in view of the fact that an immediate recovery of the global economy, and hence that of the Colombian economy, might be difficult. However, from a planning stand-point, it is preferable to expect a higher growth as a target. Therefore, it is assumed that a growth of 4.5% will be realized in 1986, which is the final year of the National Development Plan, and that the same kind of growth will be maintained up to the year 2000. (GDP) projections are not included in the National Development Plan. However, the Plan anticipates high growths of 4% in the agricultural sector and 1 to 2 percentage points higher than GDP in the industrial sector. Hence, based on discussions with the DNP personnel in charge of policy planning, 4.5% is established as the growth rate.

The above assumptions indicate the following. The stagnant economic condition of the early 1980s will be corrected through current and future development plans and that by 1990 the economy will recover to the level of the 1970s. The economy will continue to grow thereafter, and by the year 2000 it will have grown to twice the scale of 1983 (See Fig. 8–2–1).

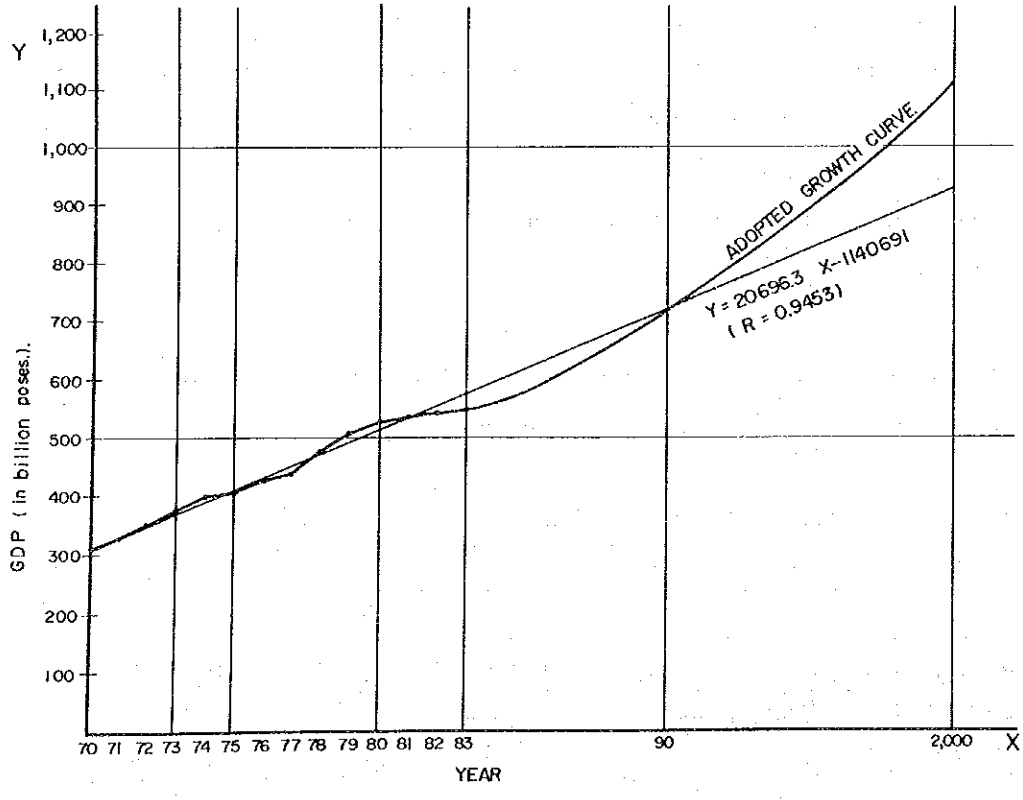


Fig. 8–2–1 Projected Growth Curve of GDP in Future

2) GRDP of Atlántico

Per-capita GRDP of Atlántico in 1983 was 1.064 times greater than per-capita GDP of Colombia. Assuming that this ratio does not change in the future, Atlántico's GRDP as a percentage of the GDP of Colombia will grow from 5.69% in 1983 to 6.24% in 1990 and to 6.98% in the year 2000.

Table 8–2–5 shows the GRDP projection for Atlántico. The department's economy will grow at an average annual rate of 5.5% (1983–1990, 5.4%; 1990–2000, 5.7%) to reach a scale 2.5 times greater than the present, in the year 2000. Moreover, per-capita GRDP will be 1.5 times the current level.

Table 8–2–5 Projection of Future GRDP of Atlantico by Three Sectors of Economic Activity at 1975 Constant Prices

	GRDP (million Pesos)			Ave. Annual Growth (%)	
	1983	1990	2000	1983–1990	1990–2000
Primary	2,100	2,760	4,090	4.0	4.0
Secondary	10,030	13,440	21,060	4.3	4.6
Tertiary	19,030	28,720	52,870	6.1	6.3
Total	31,160	44,920	78,020	5.4	6.7

The primary industries are assumed to show the average annual growth indicated by the National Development Plan, ie. 4.0%. The secondary industries will recover gradually as the department's leading economic sector and will realize an average annual growth of 4.5% during the period. The tertiary industries, which are expected to play a leading role in meeting the sharp increase in job demand anticipated in the future, are expected to show an average annual growth of 6.2% during the period.

8–2–3 Employment

1) Labor Supply

The ratio of working age population (persons 12 years of age or older) to total population, will increase in the future for the folloing two reasons:

(1) The proporation of children will decrease due to a decline in the birth and death rates.

(2) Most of the people moving into the area for work or education will be in the working age population.

The participation rate (ratio of labor force population to working age population) showed an upward tendency during the past 10 years. As for the future, a decrease in the participation rate can be expected from a greater can be expected from a greater ratio of women seeking employment. Taking into account past tendencies, a slight growth is expected. Hence, the activity rate, the ratio of labor force population to total population will also increase.

As shown in Table 8–2–6, labor force in the Study Area will increase from 400,000 in 1983 to 550,000 in 1990 and 770,000 in the year 2000.

Table 8–2–6 Projected Labor Force in Study Area

(in thousands)

	1983			1990			2000 (3)		
	B/Q & Soledad (1)	Malambo, Galapa & Pto. Col. (2)	Study Area	B/Q & Soledad	Malambo, Galapa & Pto. Col.	Study Area	B/Q & Soledad	Malambo, Galapa & Pto. Col.	Study Area
Total Population	1,108.0	92.2	1,200.2	1,409.7	124.6	1,534.3	1,875.3	167.5	2,042.8
Working Age	7 6.5	64.6	851.1	1,074.2	95.0	1,169.2	1,483.4	132.5	1,615.9
Labor Force	372.1	27.7	399.8	511.3	41.3	552.6	712.0	58.3	770.3
Participation Rate (%)	47.3	43.0	47.0	47.6	43.5	47.2	48.9	44.0	47.6
Activity Rate (%) (Gross)	33.6	30.0	33.3	36.3	32.2	36.0	38.0	34.8	37.6

Source: (1) Person Trip Survey 1983.
(2) Estimated by the Study Team by using the information of Departamento Administrativo Nacional de Estadisticas - DAME 1983 and Encuesta en el sitio 1982.
(3) Projected by the Study Team.

2) Labor Demand

The labor productivity of each sector in 1983, obtained from the GRDP and working population of each sector, was 56,000 pesos per person in the primary industries, 109,000 pesos per person in the secondary industries and 69,000 pesos per person in the tertiary industries (in 1975 prices). Future rise in the labor productivity is assumed to be as follows:

(1) Primary Industries

1983 – 1990 Assuming that the degree of contribution to the secotr's growth rate of 4% of will be 30%, an annual rise of 1.2% (30% is the actual figure recorded between 1973 and 1983) is expected.

1990 -- 2000 Assuming that the degree of contribution to the sector's growth of 4% will be 50%, an annual rise of 2.0% is expected.

(2) Secondary Industries

1983 – 2000 It is assumed that the average annual rise of 0.9% in the labor productivity of the manufacturing in dustries in recent years will be maintained up to the year 2000.

(3) Tertiary Industries

1983 – 1990 Hardly any rise in labor productivity can be expected due to the recent heavy influx of workers into this sector (especially street vendors).

1990 – 2000 A gradual rise to 70% the level of the secondary industry in 1980 is expected.

Future labor demand in Atlántico is estimated by applying the labor productivity of each sector obtained as described above to the GRDP of each sector (Refer to Table 8–2–7).

Table 8–2–7 Future Working Population by Sector and Area

		1983	1990	2000
Atlántico	Primary	37,300 (9.2)	45,000 (7.9)	54,700 (6.7)
	Secondary	92,200 (22.8)	116,100 (20.3)	166,300 (20.3)
	Tertiary	275,300 (68.0)	410,300 (71.8)	596,400 (73.0)
	Total	404,800 (100.0)	571,400 (100.0)	817,400 (100.0)
Study Area	Primary	8,000 (2.4)	8,800 (1.8)	9,500 (1.3)
	Secondary	80,800 (23.8)	101,400 (20.8)	147,400 (20.7)
	Tertiary	250,000 (73.8)	378,300 (77.4)	555,100 (78,0)
	Total	339,500 (100.0)	488,500 (100.0)	712,000 (100.0)
Rest of Atlántico	Primary	29,300 (44,9)	39,200 (43.7)	45,200 (42.9)
	Secondary	11,400 (17.4)	14,700 (17.7)	18,900 (17.9)
	Tertiary	24,600 (37.7)	32,000 (38,6)	41,300 (39.2)
	Total	65,300 (100.0)	82,900 (100.0)	105,400 (100.0)

Note: Figures in parentheses show percentage distribution by sector for each year.

3) Working Population in the Study Area

The ratio of working population living in the Study Area to the total working population of Atlántico rose from 81.2% in 1973 to 83.9% in 1983. This trend is forecasted to continue in the future, with the ratio rising to 85.5% in 1990 and 87.1% in the year 2000. By sector, the following trends are expected:

By sector, the following trends are expected:

(1) The importance of the secondary and tertiary industries will increase outside the Study Area in the Department of Atlántico as well.

(2) Agricultural activities in the Study area will be affected to some extent by urbanization, but since good agricultural land is scarce near the urban areas, there will be no decline in the farming population. In fact, the growth of suburban agricultural industries such as poultry raising will lead to an increase in the faming population.

(3) The tertiary industries will continue to concentrate in the Study Area in the future.

(4) The secondary industries will account for an even greater share in the Study Area, due to the developments of the Malambo industrial park and the airport free zone, and the stimulation of construction activities.

Taking the above trends into consideration, labor demand (working population) in the Department of Atlántico is divided into labor demand in the Study Area and labor demand in areas outside the Study Area.

Working population in the Study Area will reach 489,000 in 1990 and 712,000 in the year 2000. Comparing these with the labor force figures given in Table 8–2–6, the employment rate will gradually improve to 88.4% in 1990 and 92.4% in the year 2000, from 84.9% in 1983.

4) Number of Employment

Figures given in Table 8–2–7 are the forecasted number of working population living in the Study Area which means that those who live in the Study Area but work outside the Area are included but those who live outside the Area but work in the Area are not included.

As of 1983, the number of persons employed in the Study Area is 347,000, which is 1.022 times greater than the resident working population. By sector, the secondary and tertiary industries show surplus inflow and the primary industries show surplus outflow to areas outside the Study Area for work.

Assuming that the above tendency will remain unchanged in the future, the number of persons employed in the Study Area is forecasted as shown in Table 8–2–8.

Table 8–2–8 Future Employment by Sector in Study Area

	1983		1990		2000	
Primary	6,900	(2.0)	7,600	(1.5)	8,200	(1.1)
Secondary	82,300	(23.7)	103,200	(20.7)	150,000	(20.6)
Tertiary	257,900	(74.3)	388,600	(77.8)	569,700	(78.3)
Total	347,100	(100.0)	499,400	(100.0)	727,900	(100.0)

Note: Figures in parenthesis show percentage distribution by sector.

8–2–4 Future Vehicle Ownership

As already mentioned in Chapter 2, the total number of vehicles registrated in Barranquilla has grown with an annual growth rate ranging from 5 to 8% during the last few years.

The per capita GRDP is expected to increase in the future as shown in the previous section. It is obvious from the experiences in other cities that vehicle ownership is likely to increase along with the income growth.

The future vehicle ownership can be estimated by verious methods. In this study the following approaches are undertaken. For statistical reasons, vehicle ownership is firstly estimated for Atlántico then, the owner ship in the study area is estimated.

(1) Average Annual Growth Rate

The average annual growth rate in the past is applied to the future. The annual growth rate of the private cars during the period from 1977 to 1982 was 6.53%. By using this grwoth rate, the number of vehicles for the year 2000 is estimated to be 2.73 times that in 1983.

(2) Time Series Regression Model

After examining various forms, it is found that the following formula has the highest conformity to the past trend.

$$N = 26657 \cdot (1.06322)^{t} \qquad (r = 0.990)$$

where N : Number of private vehicles

t : Year (t = 0: 1976)

r : Correlation coefficient

From above formula, the number of vehicles for the year 2000 is estimated to be 2.64 times that in 1983.

(3) Regression with GRDP

By examining the relationship between vehicle ownership and per capita GRDP in Atlántico, the following formula is obtained.

$$N = 0.00000132X^{1.5649} \qquad (r = 0.520)$$

where X : per capita GRDP in Atlántico

Since the correlation coefficient is extremely low, this method cannot be applied.

(4) Logistic Curve

By examining the time series data for vehicle ownership, the following logistic curve is obtained as the best fit.

$$V = \frac{200}{1 + 7.7116\, e^{-0.03562t}} \qquad (r = 0.948)$$

where V : Vehicle Ownership Rate (vehicles/1000 population)

3 : exponential

t : year (t = 0: 1976)

The above curve shows that the vehicle ownership in the year 2000 will be 1.64 times that in 1983. When this growth rate is expressed in terms of the growth rate of the number of vehicles, the growth rate during the years from 1983 to 2000 is found to be 2.66.

The above results show that the estimated growth rates by different approaches are fairly close to each other except for the case of regression with GRDP. However cases (1) and (2) are merely based on the past trend of vehicle registration, while the case (4) takes into consideration the future population growth and the ceiling of vehicle ownership. Hence, case (4) i.e. the logistic curve method is adopted for forecasting. Consequently vehicle ownership in the year 2000 for the study area is obtained as follows.

Table 8–2–9 Vehicle Ownership in 2000

	1983	2000	Growth Rate
No. of Private Vehicles in Atlántico	41,900	111,600	2.66
Population in Atlántico (in thousand)	1,470.2	2,389.4	1.63
Vehicle Ownership in Atlántico (veh/1000 person)	28.5	46.7	1.64
Composition Rate of Vehicle Owners in Barranquilla and Soledad	14.8%	24.3%	1.64

8–3 Land Use Plan

8–3–1 Background of the Barranquilla Land Use Plan and Relationship to the Study

The land use plan proposed by a consultant group (Drs. Aurora Pachon and Gabriel Galvis) was approved by the Barranquilla Metropolitan Committee in August 1982 as a basic concept. The plan includes land use proposal for 1990 and urbanization in the year 2000.

The land use plan prepared under this Study is based on the above plan but also takes into consideration the recent direction of urbanization, the socioeconomic framework for the year 2000, and the area of land for urbanization.

Based on the land use plan thus prepared, population and employment in 1990 and 2000 are assigned to each zone and used in making traffic demand forecasts.

8–3–2 Land Use Plan Themes

There are the following problems concerning land use in the metropolitan area of Barranquilla:

(1) Concentration of various functions in Centro
(2) Environmental deterioration of Centro
(3) Haphazard expansion of urbanization
(4) Unorganized location of various functions

In order to resolve these problems, the following points can be listed as themes to be considered when preparing land use plans:

(1) Relocation of some of the functions located in the central district to surrounding areas
(2) Renewal of the central district
(3) Decreasing the distance between work place and residence by creating a nucleus in the surrounding areas
(4) Formation of compact urban areas
(5) Appropriate location of distribution and production facilities

8–3–3 Long-term Development Pattern

1) External Conditions Relating to Land Use Patterns

a. Rio Magdalena

Various river facilities will continue to remain in the future, such as wharves for the exclusive use of factories along Via 40 and the port of Barranquilla. The role of the river in contributing to the growth and development of this city should be appreciated.

b. Department of Magdalena

Magdalena is situated on the other side of Rio Magdalena, and the Pumarejo bridge connects the department to Barranquilla. It has many natural surface water features, and should be preserved as a natural park site. It is, therefore, undesirable to expand the urbanized area in this direction.

c. Puerto Colombia

Cemeteries, universities and colleges, sports clubs, high-class residential districts, etc. are located along the Puerto Colombia Road. Although the pressure of urbanization is not strong at present, some housing development projects have been approved for this area. The Department of Atlántico has initiated a study on the development of resorts along the coastal areas. In veiw of such a situation, this area should be developed as a middle- and upper-class housing area with recreational and cultural facilities.

d. Western Area

Urbanization is not quite noticeable in the Juan Mina and Galapa directions. There are however, some motels and factories along the Algodón Road. In this zone, there are several arroyo flowing toward the sea in the north from the hills in the south. If urbanizaiton continues without any appropriate drainage system, it is feared that new arroyo problems will occur as in the built-up area of Barranquilla. This is one of the important reasons why an axial development plan is being proposed for the Pachon-Galvis project.

e. Malambo

Many projects such as housing, industrial and distribution projects are now under way around the airport. There is no public land use plan nor a public facilities improvement plan to act as guideline for such urbanization, with the result that public services such as water supply and sewage disposal are unable to keep up with demand. The current airport cpacity is said to be sufficient even for future demand, so that there no plans for airport expansion.

Because of the fast pace of development, the Pachon-Galvis project needs to be revised with respect to the 1990 urbanization zone. It is important to develop this plan from the view-

point of strengthening local land use restrictions and creating district centers.

2) Axial Development Pattern

Based on the background, issues and external conditions of the Plan as discussed above, the "north-south axial development pattern" was selected as the long-term development pattern. The advantages of this development pattern are as follows:

(1) Efficient use of existing road network
(2) Efficient use of new traffic routes
(3) Compatibility with the locations of exisitng or planned facilities servicing major areas such as airport, Malambo industrial park, Gran Central de Abastos, University of Atlántico, coastal recreation center developments, etc.
(4) Investments in public facilities such as drainage facilities, are economically feasible.

8–3–4 Land Use Plan

1) Residential Area

New residential areas will be formed in the suthern and northwestern suburbs, and will extend up to Arroyo de Lean to the west. All vacant land inside the Circunvalar will be converted into housing areas by 1990, thus completing all existing housing projects. Between 1990 and 2000, idle land within the urbanization zone outside the Circunvalar will be converted into residential areas.

There is a difference of 100 to 400 persons/hectare in the population density of housing zones, depending upon the type of house. The population density is, however, generally higher in the south than in the northwest, so that houses in the south will be a mixture including small detached houses. A group of medium- and high-rise model apartments will be introduced into the central district, where population is decreasing.

2) Industrial Zone

The location of industrial zones will basically follow the existing pattern. However, a new site will be encouraged toward Malambo along Calle 30, and another will also be formed between the free zone adjacent to the airport and the Gran Central de Abastos. Thus, the total area of major industrial zones will increase from about 320 hectares in 1983 to abut 1,100 hectares in the year 2000.

Table 8–3–1 Existing and Future Site Area and Employment of Main Industrial Zones

	1983		2000	
	Area (ha)	Employment	Area (ha)	Employment
Vía 40	230	11,700	380	17,400
Calle 30	90	7,600	160	10,800
Industrial Park in Soledad	–	–	220	5,600
Industrial Park in Malambo	–	–	340	8,500
Total	320	19,300	1,100	42,300

Of the future total industrial area of 1,100 hectares, 540 hectares will be provided by the idle land inside the existing industrial zones (along Vía 40 and Calle 30), while 560 hectares will be contributed by the new industrial parks planned in Soledad and Malambo.

Employee density in the industrial zones is currently 50 persons/hectare along Vía 40, and 84 persons/hectare along Calle 30. The factories to be sited in the idle land in the existing industrial zones are assumed to start at a lower density than those of existing factories. Consequently, the average employee density will eventually show a slight reduction in the existing industrial zones in the future. The planned employee density in the new industrial parks is proposed to be 25 persons/hectare. The employee density of the factories recently sited along Calle 30 and in Soledad ranges from 23 to 40 persons/hectare, however, the 25 persons/hectare is adopted to allow for future growth and in order not to deteriorate the environmental conditions.

3) Land for Large-scale Facilities (Refer to Fig. 8–3–1)

(1) Airport Free Zone (Zona Franca Aeroportuaria)

The Free Zone Public Corp. (Zona Franca Industrial y Commercial de Barranquilla) is now pushing this project under the supervision of the Economic Development Ministry (Ministerio de Desarrollo Economico). The plan consists of the development of a group of industrial facilities and a group of warehouse facilities. According to the Ministry, the warehouse facilities component will be the core of this project. In addition, an investment of 1.0 billion pesos is scheduled under the 1983–1986 Atlántico Coast Development Plan, however, the implementation has not yet started. The planned site is along Calle 30 adjacent to the airport and occupies about 100 hectares in total.

(2) Gran Central de Abastos

The Gran Central de Abastos del Caribe S.A. is now implementing this project, using the Urban Development Fund (Fondo Financiero de Desarrollo Urbano) and construction is scheduled to be completed in 1986. Some of the wholesalers located in Barranquilla will

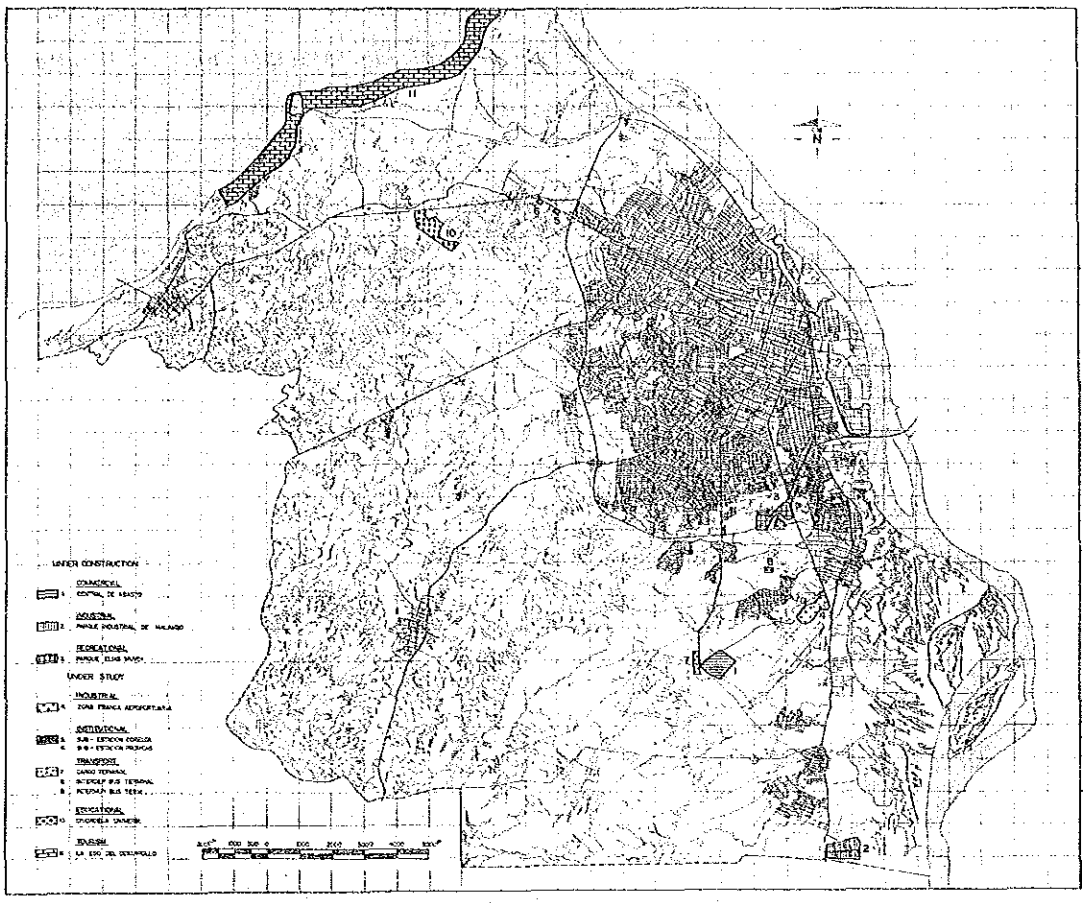


Fig. 8–3–1 Development Project of Large Scale Facilities

be transferred to this central market, which will mainly deal in perishable food. The total amount of investments will be 2.2 billion pesos; the total land area will be about 35 hectares, and the site will be to the west of the airport, at the end of the Calle 45 extension.

(3) Cargo Terminal

The cargo terminal project is proposed by the Study. The terminal will be constructed next to the Gran Central de Abastos and will occupy an area of about 29 hectares. It is expected to function as a depot for intercity cargo as well as a collection and distribution center for intracity cargo.

(4) Bus Terminal

The bus terminal project proposed under this Study will also take into consideration out-of-town buses. Out-of-town buses are divided into interdepartment and intradepartment buses. The plan is to construct separate bus terminals for the two types, in view of the difference in their type of service and the timing of the project's implementation. The interdepartment terminal will be constructed in the south subcenter and the intradepartment terminal in Barranquilla. The area of land required will be about 3 hectares.

(5) Relocation of University

This is a project for the relocation and expansion of the University of Atlántico campus to accommodate 15,000–20,000 students and 1,000 professors and staff members. The first phase, consisting of the construction of a sports field, is now under way and is expected to be completed in 1989. It is expected that the total investment of 2.2 billion pesos will be covered by an international loan (as per the Atlántic Coast Development Plan), but this has not yet been finalized. The site is situated along the Puerto Colombia road and covers an area of about 40 hectares.

(6) Expansion of Military Land

An air force base is situated adjacent to the Barranquilla airport, covering the Atlántic coast area and the northern zones of Colombia. There is a plan to expand this base to accommodate 2,000 military personnel and 1,000 family members, within the next five years. In addition to the military facilities, facilities for administration, training, and maintenance and repair, as well as residential and recreational zones, will be constructed. The total land area required will be 15 hectares.

(7) Caribbean Coast Recreation Center

This project is now under study by the public works division of the Department of Atlántico and is not yet definitely planned. As a recreation center for citizens living near Barranquilla, it should include rest and overnight accommodations, a sports field, enter-

tainment facilities, and so forth. The coastal road is now being improved by the department.

4) Centers and Subcenters

In order to mitigate the burden placed on the Centro District and to promote the public benefit, the following centers and subcenters are planned:

(1) Metropolitan Center

Major Functions: Business headquarters, administrative headquarters, high-level commerce, high-level culture, Gran Central de Abastos, international trade fair hall, interdepartment bus terminal (central station of rail transit system)

Service Area : Metropolitan area of Barranquilla

Population : 2.0 million

Employment : 150,000

Area : 450 hectares

(2) Metropolitan Subcenters

Major Functions: High-level commerce, branch offices of foreign firms, cultural center hotels, high-class restaurants, new type restaurants

Service Area : Metropolitan area of Barranquilla

Population : 2.0 million

Employment : 50,000

Area : 150 hectares

(3) Municipal Centers (Soledad and Malambo)

Major Functions: Municipal administrative agencies, local commerce, chapels, markets

Service Area : The city (old Soledad urban area and vicinity)

Population : 100,000 – 150,000

Employment : 15,000 – 10,000

Area : 45 – 60 hectares

(4) Suburban District Centers (south and northwest suburban areas)

Major Functions: Suburban shopping centers, recreation facilities (outdoor and indoor), branch offices of business firms, sales offices, local administrative offices, local culture centers

Service Area : New urban area in western Soledad (south) and northwest Barranquilla and part of Puerto Colombia (northwest)

Population : 250,000 (south) and 170,000 (northwest)

Employment : 35,000 (south) and 20,000 (northwest)

Area : 100 hectares (south) and 60 hectares (northwest)

(5) District Centers in Built-up Area

Major Functions: Supermarkets, specialty stores, branch offices of financial institutions such as banks, service establishments such as barbershops, middle-class restaurants, movie theaters

Service Area : Nearby housing area in built-up area of Barranquilla

Population : 100,000 – 150,000 per center

Employment : About 10,000 per center

Area : About 20 hectares per center

5) Land Area by Use

The land area by use in the year 2000 will be as shown in Table 8–3–2 below. The land use plan for the year 2000 is shown in Fig. 8–3–2.

Table 8–3–2 Area by Use in the Year 2000

Use	Area (ha.)
Metropolitan Service Facilities	1,610
Industrial	1,560
Commercial and Business	1,060
Residential and Others	11,170
Total	15,400

Excluding Puerto Colombia, Galapa and Juan Mina

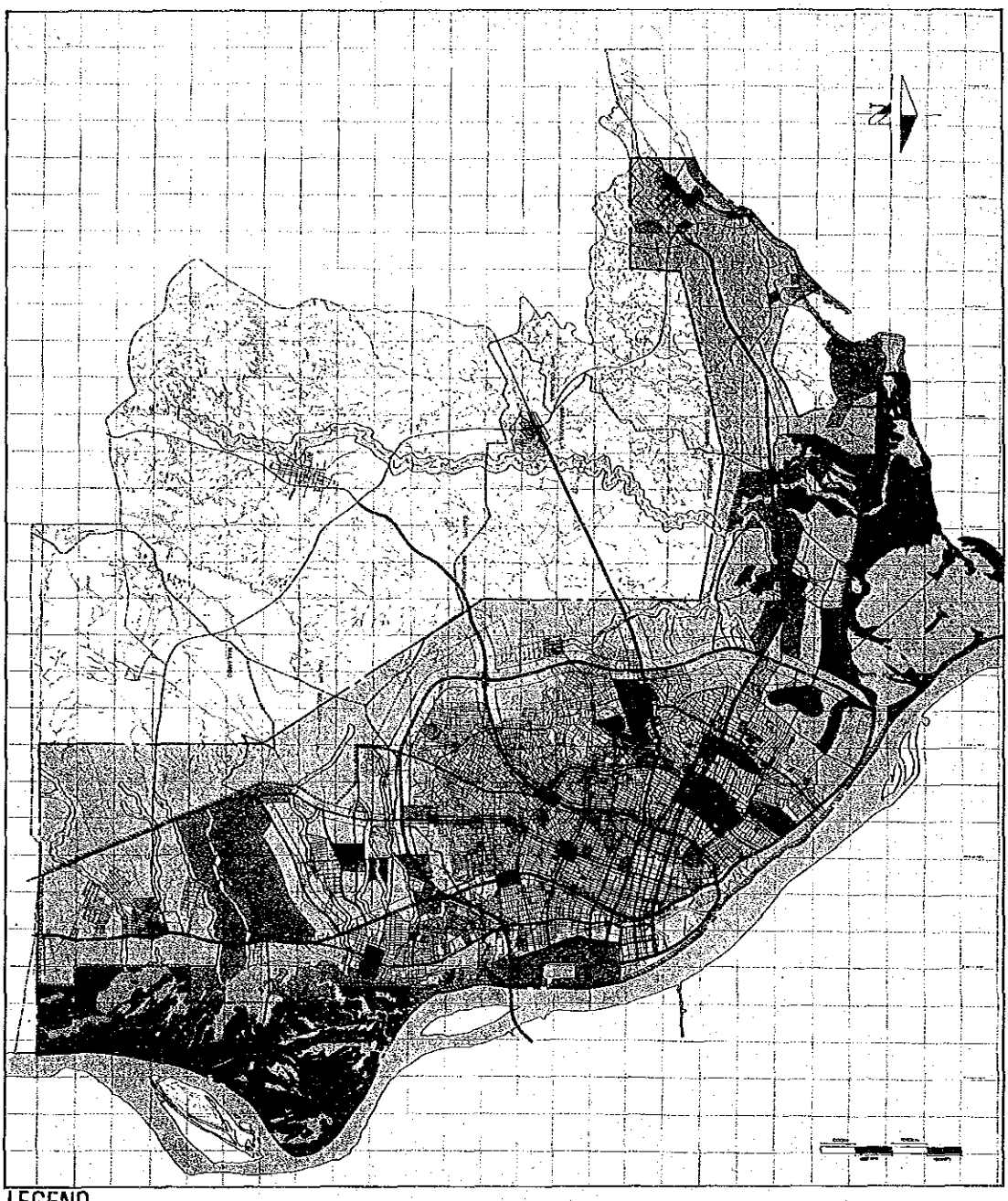


Fig. 8–3–2 Land Use Plan for the Year 2000

8–4 Population and Employment Distribution Plans

8–4–1 Work Premises

1) Zoning

For the purpose of making traffic demand forecasts, the Study Area is divided into 82 zones. Population and employment distributions are first made for the following 7 zone groups and then for each of the zones (See Fig. 8–4–1).

(1) Central District (zone 1–14, 19)
(2) Barranquilla built-up area (zones 15–18, 20–50, 52, 53, 55, 60, 62–64)
(3) Soledad built-up area (zones 74–77)
(4) Southwest suburbs (zones 51, 54, 56–59, 70, 71)
(5) Northwest suburbs (zones 61, 65–69)
(6) South suburbs (zones 72, 73, 78)
(7) Outer area (zones 79, 82–84)

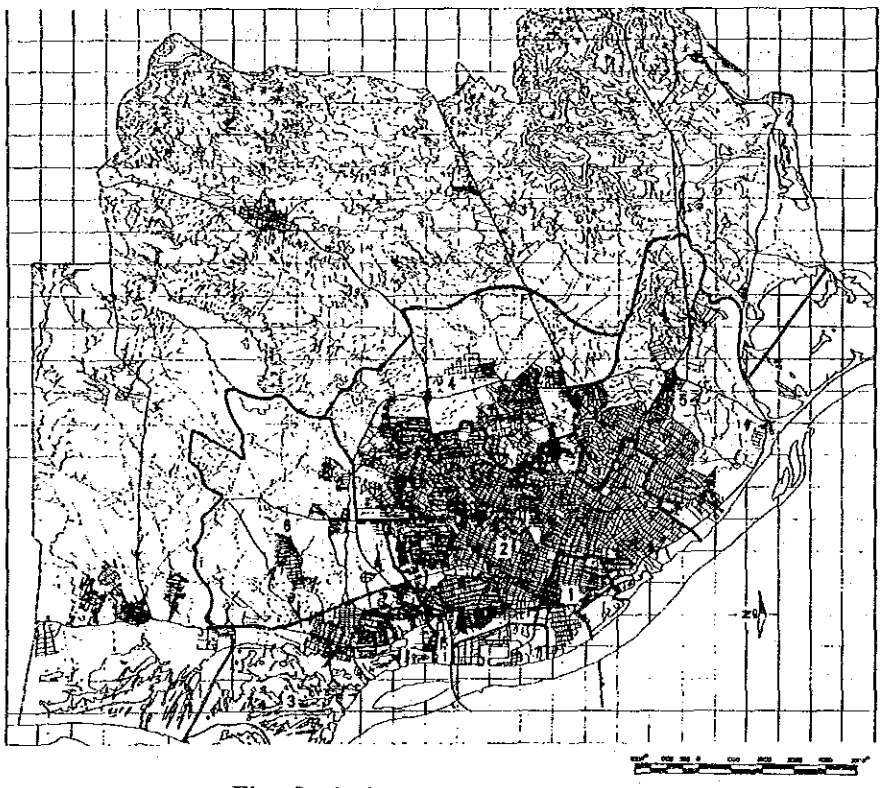


Fig. 8–4–1 Zone Groups

2) Distribution Framework

The distribution framework is the Study Area population and employment forecasted in section of this report 8–2, as shown in the Table 8–4–1.

Table 8–4–1 Future Total Population and Employment of the Study Area

(in thousand)

	1983	1990	2000
Population	1,200.2	1,534.3	2,042.8
Employment	347.1	499.4	727.9
Primary	6.9	7.6	8.2
Secondary	82.3	103.2	150.0
Tertiary	257.9	388.6	569.7

8–4–2 Population Distribution Plan

1) Distribution Policy

Basic distribution policies for each zone group are as follows:

(1) Central District

a. Middle- and high-class residential areas will be constructed in Barranquilla, covering about 50 hectares of land with a population density of 400 persons/hectare, to house about 20,000 persons.

b. Squatter areas will be removed.

c. The central area will be reserved for commercial, business and transportation facilities.

d. Other commercial and residential areas will be left to develop naturally.

(2) Barranquilla Built-up Area

The present trend of moderate population increase will be maintained.

(3) Soledad Built-up Area

The present trend of moderate population increase will be maintained.

(4) Southwest Suburbs

a. The sloping vacant land along Cra. 38 will be maintained as natural green zone.

b. Population increase will be maintained in the remaining areas inside the Circunvalar.

c. Areas outside the Circunvalar will be developed to accommodate a population of 200 persons/hectare.

(5) Northwest Suburbs

a. The current coal mining area will be gradually converted into a housing area by the year 2000.