

(5) Peak and Off Peak

225. Peak hours are observed at 07:00 hour period (07:00-07:59) as morning rush hour and at 17:00-18:00 hour period (17:00-18:59) as evening rush hour. Peak rates at these time periods are rather low, slightly exceed 8 %, but 70 % of these are to Centro direction in the morning and to residential area direction in the evening. No peak is observed at noon time.

226. Allocation of bus services are not well correlated to hourly passenger movement volume. Roughly speaking, service starts with full size of fleet and decreases gradually (refer to Figure 6.2-10). Long route distances do not respond well to hourly changes of demand.

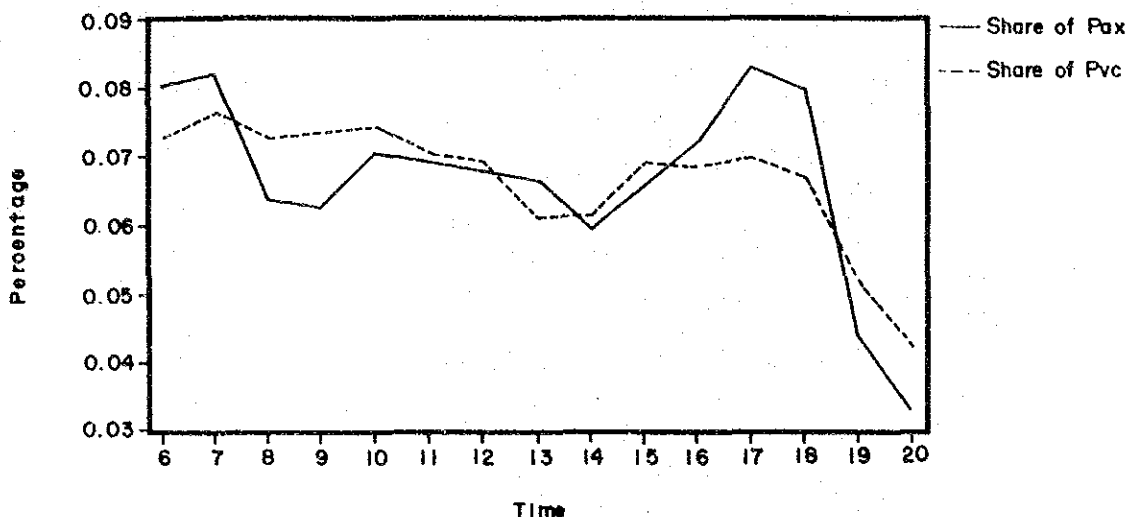


Figure 6.2-10 Hourly Fluctuation Services and Passengers (Mar. 1990, both direction)

6.2.3 Supply

(1) Supplier

227. 100% of bus transport service is provided by private operators. Nineteen operators exist in BMA at this moment (Mar. 1990, A company whose operation is limited completely in Mosqueiro island is not counted). Eleven of nineteens operators serve only for inside at Av. Dr. Freitas. Six of eleven small or medium scale operators operate on one route and four operate on two.

228. Eight of nineteen operators run from outside at Av. Dr. Freitas, while six of them are large scale operators (refer to Table 6.2-3).

Table 6.2-3 Operation Data by Company

Seq. No.	Company Name	Type	Route Length(km)	SVC Times	Passengers (Psn/Day)	Buses Opr.	Buses Owned	Rate at Work	Bus. km	Psn. km
1	Transarsonal	Urban	20.2	218	30160	22	24	0.92	4404	137687
2	Trans B Campos	Urban	25	212	31286	27	30	0.9	5300	131704
3	Belem Lisboa	Trans	32.5	172	42393	40	44	0.91	8840	231161
4	Alcindo Cacela	Urban	21.6	130	28987	24	26	0.92	2808	139266
5	Aero Club	Urban	18.7	282	25192	24	26	0.92	5273	142574
6	Sao Luiz	Urban	22.1	340	51523	35	38	0.92	7514	237478
7	Transpara	Trans	23.1	185	19195	18	20	0.9	4274	130401
8	Rio Guama	Urban	38.5	440	46678	35	38	0.92	8516	238489
9	Esperanca	Trans	60.5	371	55248	54	60	0.9	11248	322684
10	Transbel Rio	Urban	31.2	202	38860	36	41	0.88	3151	141634
11	Transurb	Urban	48.5	246	22385	26	28	0.93	6677	122397
12	D Manoel	Urban	78.4	457	51756	50	56	0.89	12519	228309
13	Monte Cristo	Urban	68.8	680	71267	65	70	0.93	15572	407099
14	Guajara	Urban	95.7	833	73485	55	59	0.93	15939	353561
15	Nova Marambaia	Suburb	276.4	931	109145	97	104	0.93	37289	1151818
16	Perpetuo Socorro	Trans	140.1	904	118525	91	100	0.91	25465	675013
17	Transmab	Suburb	440.6	689	108236	118	127	0.93	27226	1025189
18	Icoaraciense	Suburb	396.9	542	84240	90	94	0.96	25195	785370
19	Forte	Suburb	483.6	1478	205451	180	196	0.92	58423	2009929
	Total		2322.4	9412	1214014	1087	1181	0.92	285632	8611763

Seq. No.	Company Name	Psn/Route. km	Psn/Bus. km	Sales/Bus. km	Profit/Bus. km	Est. Sales (US\$)	Est. Cost (US\$)	Est. Prft (US\$)	Manage. Index
1	Transarsonal	1493	6.85	1.18	0.54	5181	2795	2386	1.9
2	Trans B Campos	1251	5.9	1.01	0.38	5374	3365	2009	1.6
3	Belem Lisboa	1304	4.8	0.82	0.19	7282	5612	1670	1.3
4	Alcindo Cacela	1341	10.32	1.77	1.14	4979	1783	3196	2.8
5	Aero Club	1347	4.78	0.82	0.19	4327	3348	979	1.3
6	Sao Luiz	2331	6.86	1.18	0.54	8851	4770	4081	1.9
7	Transpara	831	4.49	0.77	0.14	3297	2713	584	1.2
8	Rio Guama	1212	5.48	0.94	0.31	8018	5406	2612	1.5
9	Esperanca	913	4.91	0.84	0.21	9490	7140	2350	1.3
10	Transbel Rio	1246	12.33	2.12	1.48	6675	2000	4675	3.3
11	Transurb	462	3.35	0.58	-0.06	3845	4239	-394	0.9
12	D Manoel	660	4.13	0.71	0.08	8891	7947	944	1.1
13	Monte Cristo	1034	4.58	0.79	0.15	12242	9885	2357	1.2
14	Guajara	768	4.61	0.79	0.16	12623	10118	2505	1.2
15	Nova Marambaia	395	2.93	0.5	-0.13	18749	23672	-4923	0.8
16	Perpetuo Socorro	846	4.65	0.8	0.16	20360	16166	4194	1.3
17	Transmab	246	3.98	0.68	0.05	18593	17284	1309	1.1
18	Icoaraciense	212	3.34	0.57	-0.06	14471	15994	-1523	0.9
19	Forte	425	3.52	0.6	-0.03	35292	37088	-1796	1
	Total	523	4.25	0.73	0.1	208542	181323	27219	1.2

229. Each operator has a territory at a terminal end of a route. Operators of suburban routes have large territories and urban route operators have smaller territories (see Figure 6.2-11).

(2) Operation Characteristics

230. Operation characteristics of each route are summed up in Table 6.2-4. A part of the data was provided from operation data of each operator, other data was obtained through field surveys.

231. Almost all routes provide transport service from 5 AM until 11 PM.

232. Route length is defined as round trip length starting from a terminal and returning to the same terminal passing through a central part of Belem. Urban routes show relatively short lengths, an average 22.0 km, and suburban routes show longer, an average 41.4 km. Transitional routes show, similar a figure to routes at inside of Av. Dr. Freitas, 26.8 km. The average length of all routes is 32.1 km and total route length is 1,927 km. Ten (10) local routes are omitted from this table. When the 10 local routes are included, the average lengths of urban, transitional and suburban routes are 21.8 km, 27.8 km and 32.9 km, respectively and the total route length becomes 2,306 km.

233. The average number of operations per day is 120 services, and the total number of operations is 7174 services during survey hours. Urban routes record high frequency and suburban routes show low frequency in general.

234. The average rate in operation is 92%, which is a considerably high figure.

235. Average operating speed of urban, transitional and suburban routes are 18.9, 21.2 and 24.7 km/hour respectively. The fact that even urban routes record high operating speed such as 18.9 km/hour means present road capacities are sufficient to meet road traffic demands.

Table 6.2-4 Operation Data by Route

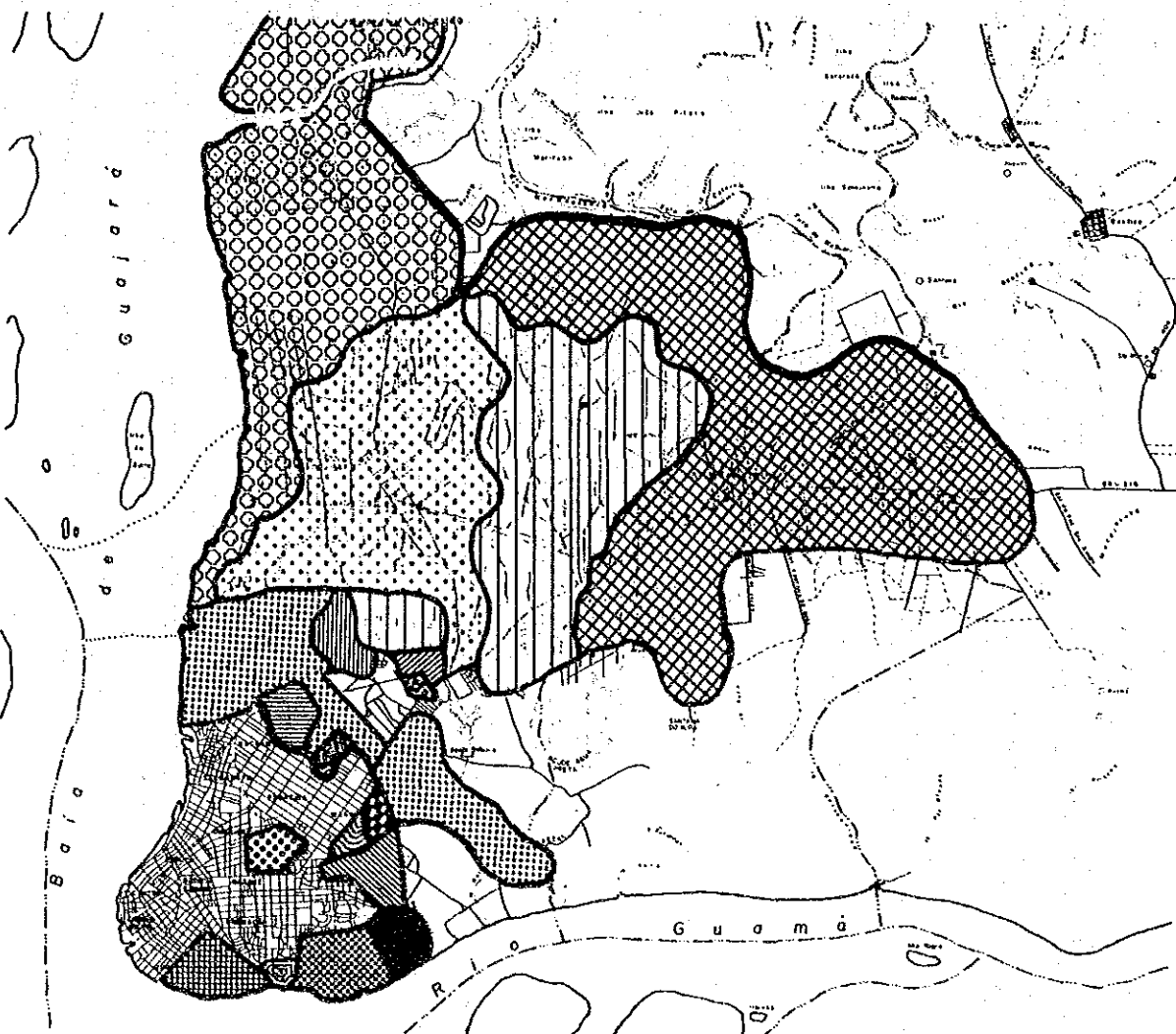
Route Name	Service Hour		Route Length (Km)	Roundtrip Time (Min)	Head (Min)	Buses		Rate at Work	Ope. Spd (Km/Hr)	Sampling		Peak Hr Obs.
	Start	End				Ope.	Owned			Obs. No. (A)	Rate	
Central Area Routes												
Canudos	4.00	23.00	22.1	80	3	35	38	0.92	16.6	30	0.10	07-08
Jurunas Marabala	5.10	23.30	31.0	100	4	30	33	0.91	18.6	30	0.18	06-07
Batista Campos	5.20	23.00	25.0	85	4	27	30	0.90	17.6	30	0.19	07-08
Arsenal	5.00	23.30	20.2	80	5	22	24	0.92	15.2	30	0.15	17-18
Alcindo Cacela	5.20	22.30	21.6	66	6	24	26	0.92	19.6	30	0.20	13-14
Guama Montepio	5.00	23.40	23.1	60	4	19	21	0.90	23.1	30	0.15	07-08
Aero Club	6.00	22.30	18.7	65	4	24	26	0.92	17.3	30	0.11	17-18
Vileta	5.20	23.20	22.7	70	5	20	22	0.91	19.5	30	0.23	18-19
Jurunas Conceicao	5.10	22.40	29.5	100	5	24	27	0.89	17.7	30	0.20	17-18
Tamoios	4.00	23.20	29.9	90	6	23	25	0.92	19.9	30	0.22	06-07
Cremacao II	5.00	24.00	15.5	56	10	18	21	0.86	16.6	30	0.17	07-08
Cremacao I	5.00	24.00	15.7	57	10	18	20	0.90	16.5	30	0.18	07-08
Guama Conselheiro	4.30	23.45	15.4	55	5	16	17	0.94	16.8	30	0.14	07-08
Universidade II	5.00	23.00	19.4	65	5	14	15	0.93	17.9	30	0.21	18-19
UFPA Marabala-Gj	5.00	24.00	18.7	60	6	3	3	1.00	18.7	15	0.29	07-08
N Universitario I	5.00	24.00	18.7	60	6	12	13	0.92	18.7	30	0.20	13-14
N Universitario II	5.00	23.00	19.5	60	5	13	14	0.93	19.5	30	0.19	18-19
Ceasa	3.50	22.20	31.0	75	6	16	18	0.89	24.8	30	0.26	06-07
Universidade I	4.50	23.00	19.4	65	7	13	14	0.93	17.9	15	0.15	18-19
Averages	-	-	22.0	71	6	20	21	0.91	18.6	28	0.17	-
Totals	-	-	417.1	1349	-	371	407	-	-	540	-	-
Transition Area Routes												
Sac Nazare	3.45	24.00	32.5	90	4	40	44	0.91	21.7	30	0.13	07-08
Tavares Bastos	4.30	23.00	31.8	100	5	26	28	0.93	19.1	30	0.16	17-18
Pedreira Nazare	4.30	23.00	27.2	75	4	34	38	0.89	21.8	30	0.15	11-12
P Socorro Teleg	4.30	24.00	33.1	88	5	20	22	0.91	22.6	30	0.28	18-19
P Socorro S Braz	4.00	23.30	33.6	86	5	22	24	0.92	23.4	30	0.29	07-08
Sac Humaita	5.00	24.00	26.5	75	4	22	24	0.92	21.2	30	0.16	07-08
Pedreira L Utinga	5.00	24.00	20.2	70	4	21	23	0.91	17.3	30	0.16	07-08
Djalma Dutra	5.20	23.00	31.2	85	6	18	20	0.90	22.0	30	0.29	16-17
Sac Reduto	5.00	24.00	22.1	60	4	22	23	0.96	22.1	30	0.17	07-08
Telegrafo	5.00	22.30	23.1	65	5	18	20	0.90	21.3	30	0.17	07-08
Marex P Vargas	5.00	23.00	19.5	55	6	11	12	0.92	21.3	15	0.21	17-18
Averages	-	-	26.8	76	5	21	23	0.91	21.2	29	0.19	-
Totals	-	-	300.8	759	-	214	234	-	-	285	-	-
Suburban Area Routes												
Cordeiro de F	4.30	23.15	39.9	102	5	19	21	0.90	23.5	15	0.11	06-07
Guajara Centro	3.30	24.00	49.0	120	8	22	24	0.92	24.5	30	0.24	06-07
C. Nova VI 40 Hs	4.00	24.00	47.0	110	8	22	24	0.92	25.6	30	0.26	06-07
C. Nova V	5.15	23.00	39.9	100	5	18	20	0.90	23.9	30	0.21	06-07
Satelite S Braz	3.30	23.30	42.4	100	6	18	20	0.90	25.4	30	0.26	16-17
C. Nova VIII	5.00	23.00	37.1	100	5	15	16	0.94	22.3	30	0.24	06-07
Marituba Centro	4.00	23.30	49.5	100	10	18	20	0.90	29.7	30	0.36	06-07
Icoaraci Centro	4.00	0.30	57.0	125	12	22	24	0.92	27.4	30	0.30	12-13
Satelite Telegrafo	3.50	23.30	42.4	100	7	18	19	0.95	25.4	30	0.29	06-07
Maguari	4.50	23.00	47.8	110	10	16	17	0.94	26.1	30	0.36	06-07
Bengui S Braz	4.00	23.30	40.4	100	9	15	16	0.94	24.2	30	0.36	06-07
C. Nova IV	5.20	23.20	38.8	100	8	18	20	0.90	23.3	30	0.35	16-17
Bengui telegrafo	3.30	23.20	39.7	98	9	14	15	0.93	24.3	30	0.38	06-07
Icoaraci S Braz	4.00	20.00	47.2	98	12	9	9	1.00	28.9	15	0.16	07-08
BR 316	5.00	21.00	39.5	80	10	15	16	0.94	29.6	15	0.19	16-17
Icoaraci Ver-o-pes	4.00	23.30	52.4	120	18	16	17	0.94	26.2	15	0.26	10-11
Marituba S Braz	3.30	20.00	19.4	83	10	14	15	0.93	14.0	14	0.19	07-08
D Ind Centro	4.20	23.00	49.0	98	12	11	12	0.92	30.0	15	0.35	17-18
Icoaraci P Vargas	4.00	23.00	51.5	118	18	14	15	0.93	26.2	15	0.27	09-10
UNA Conselheiro	5.20	23.00	32.5	95	8	11	12	0.92	20.5	15	0.17	06-07
Souza UNA	5.30	22.10	37.2	100	15	11	12	0.92	22.3	15	0.26	17-18
Souza J. America	5.30	22.00	38.8	100	12	11	12	0.92	23.3	15	0.24	13-14
Jardim Maguari	5.00	23.00	43.1	100	4	16	16	1.00	25.9	15	0.13	06-07
J Seffer P Vargas	5.20	23.00	42.0	100	14	10	11	0.91	25.2	15	0.32	17-18
Souza Satellite	5.00	23.15	45.2	110	12	8	8	1.00	24.7	15	0.35	19-20
J Seffer Ver-o-Pes	5.30	23.00	42.8	98	13	10	11	0.91	26.2	15	0.33	06-07
D Ind S Braz	5.40	21.15	18.2	75	12	9	10	0.90	14.6	13	0.28	06-07
Guajara S. Bras	6.00	20.30	42.3	90	10	9	10	0.90	28.2	13	0.15	06-07
Cordeiro de Farias	5.00	20.30	41.1	110	30	8	8	1.00	22.4	30	0.18	06-07
Bengui Centro	5.30	22.30	28.5	60	10	5	5	1.00	28.5	15	0.14	11-12
Averages	-	-	41.4	100	11	14	15	0.93	24.7	21	0.26	-
Totals	-	-	1241.6	3000	-	422	455	-	-	640	-	-
Whole Routes												
Averages of all	-	-	32.7	85	-	17	18	-	-	24	0.20	-
Totals of all	-	-	1959.5	5108	-	1007	1096	-	-	1465	-	-

Table 6.2-4 Operation Data by Route (continued)

Route Name	No. of Services			No. of Passengers			No. of Passengers/Bus			Pas./.(Bus*Run. Km)		
	Srvy Hrs (B)	Peak Hr (C)	Rate (C/B)	Srvy Hrs (D)	Peak Hr (E)	Ratio (E/D)	Srvy Hrs (F)	Peak Hr (G)	Ratio (G/F)	Survey (H)	Peak Hr (I)	Ratio (I/H)
Central Area Route												
Canudos	310	24	0.08	57312	4845	0.08	185	202	1.09	8.4	9.1	1.09
Jurunas Marabala	168	16	0.10	35107	3359	0.10	209	210	1.00	6.7	6.8	1.00
Batista Campos	159	14	0.09	30137	2514	0.08	190	180	0.95	7.6	7.2	0.95
Arsenal	194	12	0.06	35784	3125	0.09	184	260	1.41	9.1	12.9	1.41
Alcindo Cacela	153	12	0.08	32579	2828	0.09	213	236	1.11	9.9	10.9	1.11
Guama Montepio	203	12	0.06	30426	2574	0.08	150	215	1.43	6.5	9.3	1.43
Aero Club	268	20	0.07	35043	3623	0.10	131	181	1.39	7.0	9.7	1.39
Vileta	130	11	0.08	23164	2502	0.11	178	227	1.28	7.8	10.0	1.28
Jurunas Conceicao	150	11	0.07	26171	2386	0.09	174	217	1.24	5.9	7.4	1.24
Tamoios	135	13	0.10	24750	2389	0.10	183	184	1.00	6.1	6.1	1.00
Cremaçao II	172	14	0.08	19736	2336	0.12	115	167	1.45	7.4	10.8	1.45
Cremaçao I	165	13	0.08	20838	2280	0.11	126	175	1.40	8.0	11.2	1.40
Guama Conselheiro	222	16	0.07	20230	1922	0.10	91	120	1.32	5.9	7.8	1.32
Universidade II	142	9	0.06	22702	1868	0.08	160	208	1.30	8.2	10.7	1.30
UFFa Marabala-Gj	51	4	0.08	4607	520	0.11	90	130	1.44	4.8	7.0	1.44
N Universitario I	150	12	0.08	20701	1999	0.10	138	167	1.21	7.4	8.9	1.21
N Universitario II	158	12	0.08	20507	1939	0.09	130	162	1.24	6.7	8.3	1.24
Ceasa	114	8	0.07	27260	1485	0.05	239	186	0.78	7.7	6.0	0.78
Universidade I	100	8	0.08	12002	1437	0.12	120	180	1.50	6.2	9.3	1.50
Averages	166	13	0.08	26266	2417	0.09	158	190	1.24	7.3	8.9	1.22
Totals	3145	241	-	499056	45931	-	-	-	-	-	-	-
Transition Area Ro												
Sac Nazare	228	20	0.09	42722	3572	0.08	187	179	0.95	5.8	5.5	0.95
Tavares Bastos	186	15	0.08	32125	2907	0.09	173	194	1.12	5.4	6.1	1.12
Pedreira Nazare	203	16	0.08	33102	2919	0.09	163	182	1.12	6.0	6.7	1.12
P Socorro Teleg	106	10	0.09	23793	2636	0.11	224	264	1.17	6.8	8.0	1.17
P Socorro S Braz	104	10	0.10	26390	2514	0.10	254	251	0.99	7.6	7.5	0.99
Sac Humaita	189	17	0.09	31528	2820	0.09	167	166	0.99	6.3	6.3	0.99
Pedreira L Utinga	188	16	0.09	29143	2487	0.09	155	155	1.00	7.7	7.7	1.00
Djalma Dutra	104	4	0.04	22521	1966	0.09	217	492	2.27	6.9	15.8	2.27
Sac Reduto	174	15	0.09	24389	2376	0.10	140	158	1.13	6.3	7.2	1.13
Telegrafo	177	14	0.08	22759	2151	0.09	129	154	1.19	5.6	6.7	1.19
Marex P Vargas	72	7	0.10	9457	994	0.11	131	142	1.08	6.7	7.3	1.08
Averages	150	12	0.08	25521	2377	0.09	175	216	1.21	6.4	7.9	1.23
Totals	1503	124	-	255207	23770	-	-	-	-	-	-	-
Suburban Area Rout												
Cordeiro de F	141	3	0.10	4947	619	0.13	160	206	1.29	4.0	5.2	1.29
Guajara Centro	123	10	0.08	20382	2015	0.10	166	202	1.22	3.4	4.1	1.22
C. Nova VI 40 Hs	116	11	0.09	24311	2466	0.10	210	224	1.07	4.5	4.8	1.07
C. Nova V	140	14	0.10	24741	2766	0.11	177	198	1.12	4.4	5.0	1.12
Satelite S Braz	116	8	0.07	21985	1860	0.08	190	233	1.23	4.5	5.5	1.23
C. Nova VIII	123	11	0.09	24138	2249	0.09	196	204	1.04	5.3	5.5	1.04
Marituba Centro	83	5	0.06	13836	1219	0.09	167	244	1.46	3.4	4.9	1.46
Icoaraci Centro	99	8	0.08	16500	1558	0.09	167	195	1.17	2.9	3.4	1.17
Satelite Telegrafo	104	9	0.09	18944	1936	0.10	182	215	1.18	4.3	5.1	1.18
Maguari	83	6	0.07	17112	1541	0.09	206	257	1.25	4.3	5.4	1.25
Bengui S Braz	83	6	0.07	15099	1384	0.09	182	231	1.27	4.5	5.7	1.27
C. Nova IV	86	8	0.09	15985	1566	0.10	186	198	1.07	4.8	5.1	1.07
Bengui telegrafo	78	6	0.08	13093	1261	0.10	168	210	1.25	4.2	5.3	1.25
Icoaraci S Braz	91	8	0.09	16638	1676	0.10	183	210	1.15	3.9	4.4	1.15
BR 316	79	7	0.09	12743	1175	0.09	161	168	1.04	4.1	4.2	1.04
Icoaraci Ver-o-pes	58	5	0.09	15093	1363	0.09	260	273	1.05	5.0	5.2	1.05
Marituba S Braz	74	7	0.09	13495	1438	0.11	182	205	1.13	9.4	10.6	1.13
D Ind Centro	43	3	0.07	7599	843	0.11	177	281	1.59	3.6	5.7	1.59
Icoaraci P Vargas	55	5	0.09	8873	930	0.10	161	186	1.15	3.1	3.6	1.15
UNA Conselheiro	88	9	0.10	14522	1688	0.12	165	188	1.14	5.1	5.8	1.14
Souza UNA	57	4	0.07	10159	1474	0.15	178	369	2.07	4.8	9.9	2.07
Souza J. America	62	6	0.10	11153	1212	0.11	180	202	1.12	4.6	5.2	1.12
Jardim Maguari	112	9	0.08	18785	1779	0.09	168	198	1.18	3.9	4.6	1.18
J Seffer P Vargas	47	4	0.09	12147	1334	0.11	258	334	1.29	6.2	7.9	1.29
Souza Satelite	43	3	0.07	7858	637	0.08	183	212	1.16	4.0	4.7	1.16
J Seffer Ver-o-Pes	46	4	0.09	7635	844	0.11	166	211	1.27	3.9	4.9	1.27
D Ind S Braz	46	3	0.07	7215	758	0.11	157	253	1.61	8.6	13.9	1.61
Guajara S. Bras	88	7	0.08	10999	1270	0.12	125	181	1.45	3.0	4.3	1.45
Cordeiro de Farias	166	13	0.08	26388	2443	0.09	159	188	1.18	3.9	4.6	1.18
Bengui Centro	106	8	0.08	9216	829	0.09	87	104	1.19	3.1	3.6	1.19
Averages	88	7	-	14720	1472	0.10	177	219	1.25	4.0	5.6	1.39
Totals	2636	210	-	441592	44153	-	-	-	-	-	-	-
Whole Routes												
Averages of all	121	10	-	19931	1898	0.10	171	209	-	5.5	0.5	-
Totals of all	7284	575	-	1195855	113854	-	-	-	-	-	-	-

Table 6.2-4 Operation Data by Route (continued)

Route Name	Bus*Km	Psn*Km	Psn/ Route*Km	(Psn*Km) /Psn	(Psn*Km) /(Bus*Km)	Sales/ (Bus*Km)	Profit/ (Bus*Km)	Est. Sale (US\$)	Est. Cost (US\$)	Est. Prft (US\$)	Manage Index
Central Area Route											
Carudos	6851	237478	2593	4.14	34.7	1.38	0.74	9451	4349	5102	2.17
Jurunas Marabala	5208	205074	1132	5.84	39.4	1.11	0.48	5789	3306	2483	1.75
Batista Campos	3975	131704	1205	4.37	33.1	1.25	0.62	4970	2523	2446	1.97
Arsenal	3919	137687	1771	3.85	35.1	1.51	0.87	5801	2488	3413	2.37
Alcindo Cacula	3305	139266	1508	4.27	42.1	1.63	0.99	5373	2098	3275	2.56
Guama Montepio	4689	154338	1317	5.07	32.9	1.07	0.44	5017	2977	2041	1.69
Aero Club	5012	142574	1874	4.07	28.4	1.15	0.52	5779	3181	2597	1.82
Vileta	2951	115474	1020	4.99	39.1	1.29	0.66	3820	1873	1947	2.04
Jurunas Conceicao	4425	117610	887	4.49	26.6	0.98	0.34	4316	2809	1507	1.54
Tamolos	4037	122397	828	4.95	30.3	1.01	0.38	4081	2562	1519	1.59
Cremacao II	2666	70416	1273	3.57	26.4	1.22	0.59	3255	1692	1562	1.92
Cremacao I	2606	71218	1327	3.42	27.3	1.32	0.68	3436	1654	1782	2.08
Guama Conselheiro	3419	84151	1314	4.16	24.6	0.98	0.34	3336	2170	1166	1.54
Universidade II	2755	101017	1170	4.45	36.7	1.36	0.72	3744	1749	1995	2.14
UFFa Marabala-Gj	954	24096	246	5.23	25.3	0.80	0.16	760	605	154	1.25
N Universitario I	2805	88980	1107	4.30	31.7	1.22	0.58	3414	1781	1633	1.92
N Universitario II	3081	81549	1052	3.98	28.5	1.10	0.46	3382	1956	1426	1.73
Ceasa	3534	84240	879	3.09	23.8	1.27	0.64	4495	2243	2252	2.00
Universidade I	1940	57919	619	4.83	29.9	1.02	0.39	1979	1232	748	1.61
Averages	3586	114063	1196	4.34	31.8	1.21	0.57	4331	2276	2055	1.90
Totals	68131	2167188	-	-	-	-	-	82298	43250	39048	-
Transition Area Ro											
Sac Nazare	7410	231161	1315	5.41	31.2	0.95	0.32	7045	4704	2341	1.50
Tavares Bastos	5915	257905	1010	8.03	43.6	0.90	0.26	5298	3755	1543	1.41
Pedreira Nazare	5522	144069	1217	4.35	26.1	0.99	0.35	5459	3505	1954	1.56
P Socorro Teleg	3509	146661	719	6.16	41.8	1.12	0.48	3924	2227	1696	1.76
P Socorro S Braz	3494	163816	785	6.21	46.9	1.25	0.61	4352	2218	2134	1.96
Sac Humaita	5009	155613	1190	4.94	31.1	1.04	0.40	5199	3179	2020	1.64
Pedreira L Utanga	3798	134709	1443	4.62	35.5	1.27	0.63	4806	2411	2395	1.99
Djalma Dutra	3245	123507	722	5.48	38.1	1.14	0.51	3714	2060	1654	1.80
Sac Reduto	3845	116777	1104	4.79	30.4	1.05	0.41	4022	2441	1581	1.65
Telegrafo	4089	130401	985	5.73	31.9	0.92	0.28	3753	2596	1158	1.45
Marex P Vargas	1404	53759	485	5.68	38.3	1.11	0.48	1560	891	668	1.75
Averages	3983	142722	966	5.57	35.1	1.06	0.42	4209	2528	1680	1.66
Totals	39828	1658378	-	-	-	-	-	42086	25284	16802	-
Suburban Area Rout											
Cordeiro de F	5626	279956	124	56.59	49.8	0.15	-0.49	816	3571	-2756	0.23
Guajara Centro	6027	250260	416	12.28	41.5	0.56	-0.08	3361	3826	-465	0.88
C. Nova VI 40 Hs	5452	325711	517	13.40	59.7	0.74	0.10	4009	3461	548	1.16
C. Nova V	5586	278560	620	11.26	49.9	0.73	0.10	4080	3546	534	1.15
Satelite S Braz	4918	209311	519	9.52	42.6	0.74	0.10	3626	3122	503	1.16
C. Nova VIII	4563	255405	651	10.58	56.0	0.87	0.24	3981	2897	1084	1.37
Marituba Centro	4109	235276	280	17.00	57.3	0.56	-0.08	2282	2608	-326	0.87
Icoaraci Centro	5643	286192	289	17.34	50.7	0.48	-0.15	2721	3582	-861	0.76
Satelite Telegrafo	4410	182969	447	9.66	41.5	0.71	0.07	3124	2799	325	1.12
Maguari	3967	173350	358	10.13	43.7	0.71	0.08	2822	2519	303	1.12
Bengui S Braz	3353	132751	374	8.79	39.6	0.74	0.11	2490	2129	361	1.17
C. Nova IV	3337	183436	412	11.48	55.0	0.79	0.16	2636	2118	518	1.24
Bengui telegrafo	3097	116731	330	8.92	37.7	0.70	0.06	2159	1966	193	1.10
Icoaraci S Braz	4295	197188	353	11.85	45.9	0.64	0.00	2744	2727	17	1.01
BR 316	3121	122091	323	9.58	39.1	0.67	0.04	2101	1981	120	1.06
Icoaraci Ver-o-pes	3039	158529	288	10.50	52.2	0.82	0.18	2489	1929	560	1.29
Marituba S Braz	1436	127968	696	9.48	89.1	1.55	0.92	2226	911	1314	2.44
D Ind Centro	2107	86027	155	11.32	40.8	0.59	-0.04	1253	1338	-84	0.94
Icoaraci P Vargas	2833	99052	172	11.16	35.0	0.52	-0.12	1463	1798	-335	0.81
UNA Conselheiro	2860	111756	447	7.70	39.1	0.84	0.20	2395	1816	579	1.32
Souza UNA	2120	91138	273	8.97	43.0	0.79	0.16	1675	1346	329	1.24
Souza J. America	2406	77680	287	6.96	32.3	0.76	0.13	1839	1527	312	1.20
Jardim Maguari	4827	230100	436	12.25	47.7	0.64	0.01	3098	3064	33	1.01
J Seffer P Vargas	1974	138357	289	11.39	70.1	1.01	0.38	2003	1253	750	1.60
Souza Satelite	1944	77680	174	9.89	40.0	0.67	0.03	1296	1234	62	1.05
J Seffer Ver-o-Pes	1969	78569	178	10.29	39.9	0.64	0.00	1259	1250	9	1.01
D Ind S Braz	837	63551	396	8.81	75.9	1.42	0.79	1190	531	658	2.24
Guajara S. Bras	3722	100398	260	9.13	27.0	0.49	-0.15	1814	2363	-549	0.77
Cordeiro de Farias	6823	44409	642	1.68	6.5	0.64	0.00	4352	4331	21	1.00
Bengui Centro	3021	71796	323	7.79	23.8	0.50	-0.13	1520	1918	-398	0.79
Averages	3647	159540	368	10.84	43.7	0.67	0.03	2427	2315	112	1.05
Totals	109421	4786197	-	-	-	-	-	72822	69462	3360	-
Whole Routes											
Averages of all	3623	143529	610	7.20	39.6	0.91	0.27	3287	2300	987	1.43
Totals of all	217379	8611763	-	-	-	-	-	197206	137996	59210	-



- | | | | | | |
|----|--|------------------|----|--|-----------------------|
| 01 | | - TRANSARSENAL | 10 | | - TRANSURB |
| 02 | | - TRANSBCAMPOS | 11 | | - D. MANOEL |
| 03 | | - BELÉM LISBOA | 12 | | - MONTE CRISTO |
| 04 | | - ALCINDO CACELA | 13 | | - GUAJARÁ E RIO GUAMÁ |
| 05 | | - AERO CLUB | 14 | | - NOVA MARAMBAIA |
| 06 | | - S. LUIS | 15 | | - PERPÉTUO SOCORRO |
| 07 | | - TRANSPARÁ | 16 | | - TRANSMARITUBA |
| 08 | | - ESPERANÇA | 17 | | - ICOARACIENSE |
| 09 | | - TRANSBEL RIO | 18 | | - FORTE |



Figure 6.2-11 Territory of the Operaters

(3) Financial Conditions

1) Value of Sales

236. Bus operators' income source is limited only to bus fare. Bus fare in BMA is flat on 14 CR\$ (Aug. 1990).

237. Discount systems are applied for students (50% off from elementary school until university), old age peoples (100% for over 65 years old) and children (100% for less than 6 years old). In addition to these, military persons, policemen and postmen are exempted from payment.

238. Normally there is a book of coupons without discount. But frequent fare adjustments caused by inflation, in actuality, give the coupons discount function because coupons are valid for a month at the purchased price. Observation surveys on a suburban route, Cidade Nova v, and an urban route, Alcindo Cacela show ratios of coupon use passengers to all passengers are 29.5% and 32.2% respectively. Assuming that 30% of passengers use coupon and inflation adjustment rate for bus fare is 40% (result on Aug. 1990), the average discount rate becomes 6%. No pass card system is provided.

2) Operation Costs

239. EMTU developed bus fare settlement methodology in 1984, which is known as "Projeto Tarifa". Estimation of operation costs follows in this method using value in Aug. 1990. Costs are indicated in US dollar using "tourist changing rate" on 22 Aug. 1990, 81.5 CR\$/US\$. Costs are normalized by kilo meter by bus. In order to normalize to this standard, yearly average running kilo meters per bus and operation rate are calculated from Table 6.2-4, which are 82,209 km/year and 0.92.

240. Results obtained are as follows:

Fuel/Oil Costs:	0.0991	us\$/km
Tire Cost :	0.0086	us\$/km
Maintenance Parts Cost:	0.0806	us\$/km
Depreciation Cost:	0.0788	us\$/km
Personnel Expenses:	0.1780	us\$/km
Social Securities and Taxes:	0.1305	us\$/km
Bus Insurance Cost:	0.0345	us\$/km
Opportunity Cost:	0.0248	us\$/km

Total	0.6348	us\$/km

3) Demand and Supply Balance

241. In general, supply corresponds to demands but in the low demand area, even in the central area, supply does not meet to demand (refer to Figure 6.2-12, 6.2-13).

242. Trunk lines have another imbalance phenomenon. Areas with large number of buses are located along Av. Nazare and Av. Gentil Bittencourt, which count around 4,000 bus runs. On the other hand, areas along Av. Almirante Barroso count 2,500 bus runs. Number of passengers along these roads are about the same. Consequently, passengers per a bus is relatively low on the average along Avs. Nazare and Gentil, but relatively high at sections of Av. Almirante Barroso.

4) Financial Condition

243. Managerial index is defined as "estimated amounts of sales" over "estimated cost". Calculated results are summed up in Tables 6.2-3 and 6.2-4. Index by company spreads in the range of 3.3 and 0.8 on the average. (refer to Table 6.2-4). Index by route fluctuates from 2.6 until 0.2 with an average of 1.4. These fluctuation of both indices suggest present bus network has room for improvement.

244. Average values of managerial indices of urban routes is 1.9, an average of 1.1 for suburban routes and 1.7 for transitional routes. These figures correspond to route lengths.

6.2.4 Major Issues

245. Issues on public transportation can be divided into quantity issues and quality issues.

246. Quantity issues are divided into supply to high demand and low demand areas. Bus services from suburban and transitional area finally concentrate into Av. Almirante Barroso/Av. Nazare trunk line section. At present this section provides 2,622 daily service for one way. When 0.056 is applied to peak rate (peak hour rate of bus operation at present), hourly bus service at peak hour becomes 147. Av. Santo Amaro, the most crowded section of bus services in Sao Paulo, provides 453 services at a peak hour. The authority of Sao Paulo (CMTTC) says this figure might be an extreme situation. Belem in the year 1990 has still sufficient capacity to increase bus service frequency to accommodate but this allowance is decreasing year by year. How to prolong the life of trunk line is the most important issue in the public transport field.

247. Supply to low demand area is a universal problem, especially in the city where private companies provide public transport means. Some policy to give an incentive to transport suppliers shall be studied.

248. In Belem there are two transport means. One is a bus and another is a private car. Quality of both transports are substantially different. On the other hand, as described in the previous chapter, a middle income class exists in Belem and is expected to increase. Public transport to respond demand of higher quality becomes necessary.

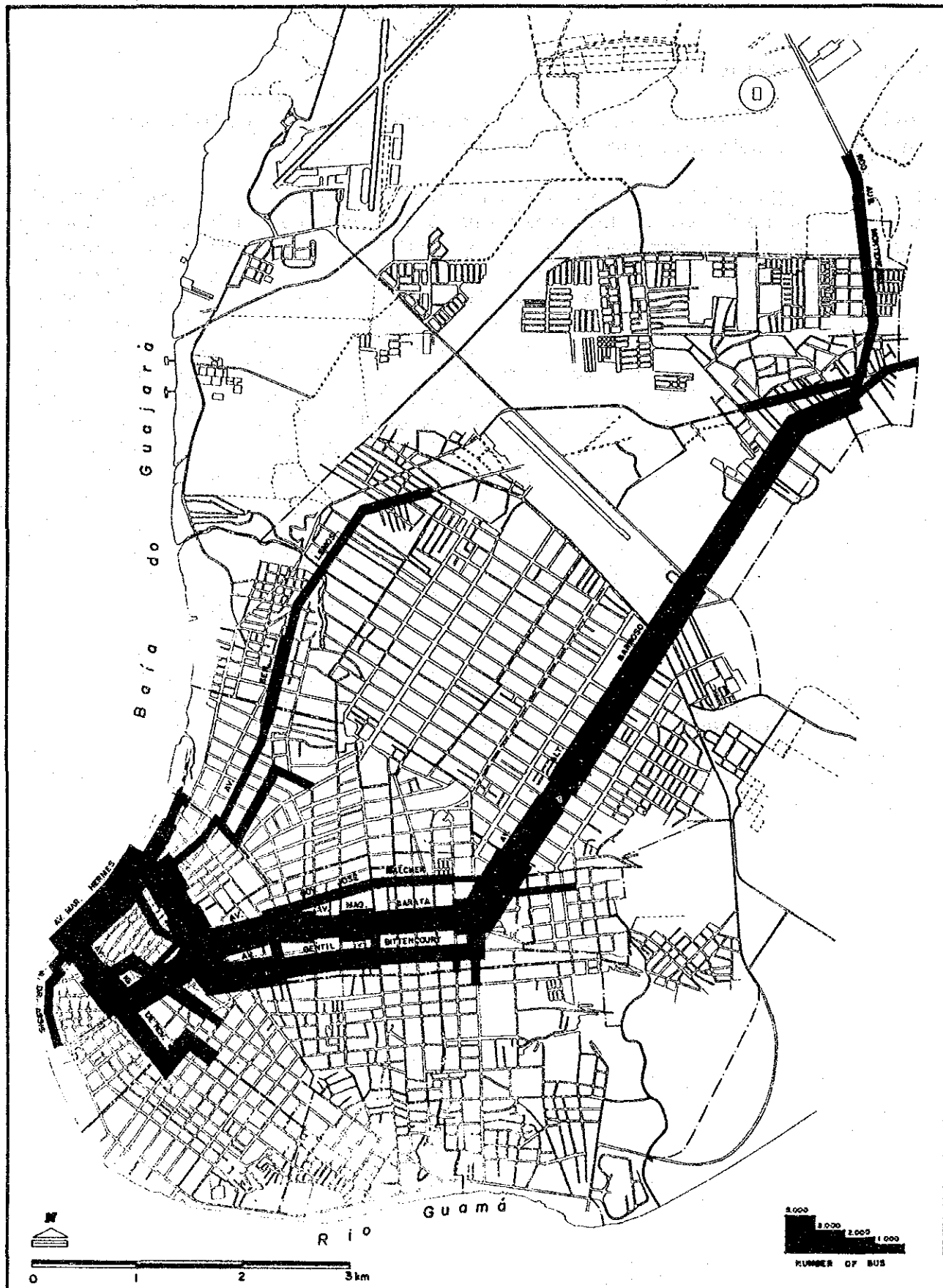


Figure 6.2-12 Number of Buses by Link

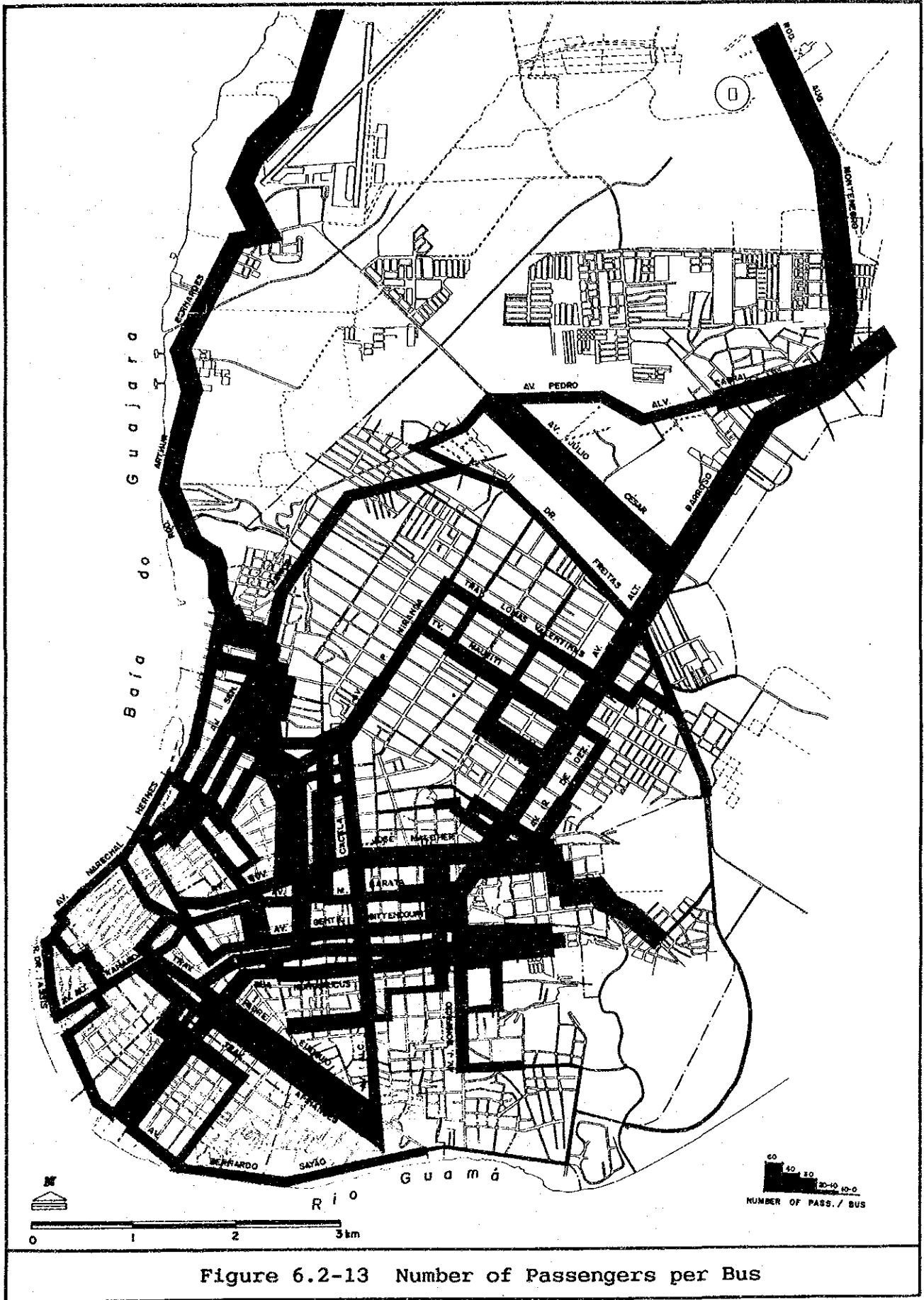


Figure 6.2-13 Number of Passengers per Bus

6.3 Taxi

6.3.1 Demand

(1) Movements

249. Forty thousand (40,000) passengers use taxis in one day and on the average, taxi carries 1.46 passengers.

250. Taxi trips are unevenly distributed. A taxi OD Table for Cidade Velha to Marco Sul covers 74 % of all taxi trips.

251. Table 6.3-1 shows origin and destination of taxi trips. Comercio is the largest origin/destination point. Can, Batista Campos, Umarizal and Sao Braz follow Comercio.

Table 6.3-1 Origin and Destination of Taxi Trips

Zone No.	Zone Name	Origin	Destination	Total
01	Cidade Velha	985	1,168	2,153
02	Comercio	4,548	3,741	8,289
03	Batista Campos	3,072	2,878	5,950
04	Jurunas	949	910	1,859
05	Reduto	1,314	1,433	2,747
0601	Nazare	1,354	1,166	2,525
0602	Can	3,240	3,475	6,715
07	Cremacao	815	694	1,509
08	Condor	629	689	1,350
09	Umarizal	2,250	2,786	5,338
10	Fatima	394	424	818
1101	Sao Braz	2,443	2,063	4,506
1102	Rodoviaro	560	341	901
12	Guama	1,870	2,246	4,116
13	Telegrafo	798	865	1,663
14	Sacramenta	327	493	820
1501	Pedreira-Sul	908	1,295	2,203
1502	Pedreira-Norte	162	130	292
16	Marco-Sul	1,741	1,832	3,573
Total		28,661	28,661	-

(2) Users Characteristics

252. About 5 % of trips use taxi when household income is equal to or more than 40,000 CZNS\$ per month (As of March 1990). No increase of taxi utilization rate is observed in noted event that household income level is more than 40,000 CZNS\$ per month. Decrease of bus utilization rate in inverse proportion to increase of household income, and is compensated with increase of private car utilization rate. (refer to Table 6.3-2)

253. Taxi utilization rates vary in relation to trip purpose. "To go home" shows the highest, 3.8 %. "For private matter", "to go work" and "for business use" follow with 3.0 %, 2.9 %, and 2.5 % respectively.

Table 6.3-2 Taxi User Characteristics

Mode	Household Income Group (in thousand CZN\$)					
	-39.9	40.0-49.9	50.0-69.9	70.0-99.9	100-149.9	150-
Taxi	38,762	6,386	8,073	10,387	6,785	6,966
	0.02	0.05	0.04	0.05	0.05	0.05
Others	141,465	19,665	34,250	48,678	33,827	45,224
	0.06	0.15	0.18	0.23	0.27	0.32
Bus	2,023,656	105,606	149,269	157,013	84,083	88,439
	0.92	0.80	0.78	0.73	0.67	0.63
Total	2,203,883	131,657	191,592	216,078	124,695	140,629

6.3.2 Supply

(1) Number of Taxis at work

254. DETRAN is the administrative authority of taxi operation, however, taxi licenses are issued by Municipalities. A taxi license is renewed once a year. Numbers of renewed licenses in 1989 from the Belem Municipality and from Ananindeua were around 6300 and 2850, respectively. The sum of these two figures, 9150, represents the number of taxis in BMA.

255. Holding a taxi license in BMA represents some sort of property right, therefore license holders who have no operating vehicle at sometime tend to maintain that right. Hence the number of operating taxis is considered smaller than the number of licenses renewed.

256. INMETRO is a national institution which examines and authorizes accuracy of various kinds of meters used in about 4000 taxis in 1989. Some taxis use faulty meters, in violation of national regulations which require annual verification. Other taxis come to INMETRO more than once a year to change their fare meters. Meter verification might be a more reliable means of counting operating taxis than the number of licenses renewed.

257. There are two syndicates in the taxi trade, one is for taxi owners and another for drivers. The former is composed of 4071 taxi owners, although very few taxi owners in Ananindeua join this syndicate. Additionally, not all of taxi owners in Belem join the syndicate.

258. In the synthesis of the above information, it is assumed that there are around 4500 taxis operating in Belem. Applying the same ratio of operating taxis to renewal licenses, it appears that there are around 2000 taxis operating in Ananindeua, however, road side observations suggest that this number might be overestimated.

(2) Operation Characteristics

259. In order to clarify operation characteristics of taxis, 19 taxi drivers of whom 9 drivers use vehicles equipped with a radio transmitter/receiver were randomly picked and requested to record their operations on real time basis from 7 AM to 7 PM on 10 weekdays during Jan. 16 and 29, 1990. Following is the information developed from that survey.

1) Classification of Taxi

260. There are two types of taxis in BMA. One is that which is equipped with a radio transmitter/receiver set and another has no communication aids. The former is the familiar "radio taxi", and is smaller in number at this moment. Additionally, there are 50 airport taxis in operation, however, airport taxis are excluded from this section due to being exclusively used for shuttle between an airport and the city.

2) Total Run (Total Travel Distance)

261. Any business area, amusement district or a place that generates rather large traffic is expected to have a taxi stop (see Figure 6.3-1). Some taxis run about to find a customer but it is also common to park and wait for a customer at a taxi stop. An average run in length of "radio taxi", 138 km/day is larger than that of conventional one, 123 km/day. This fact suggests that "radio taxi" responds to requests of customers by phone (see Table 6.3-3).

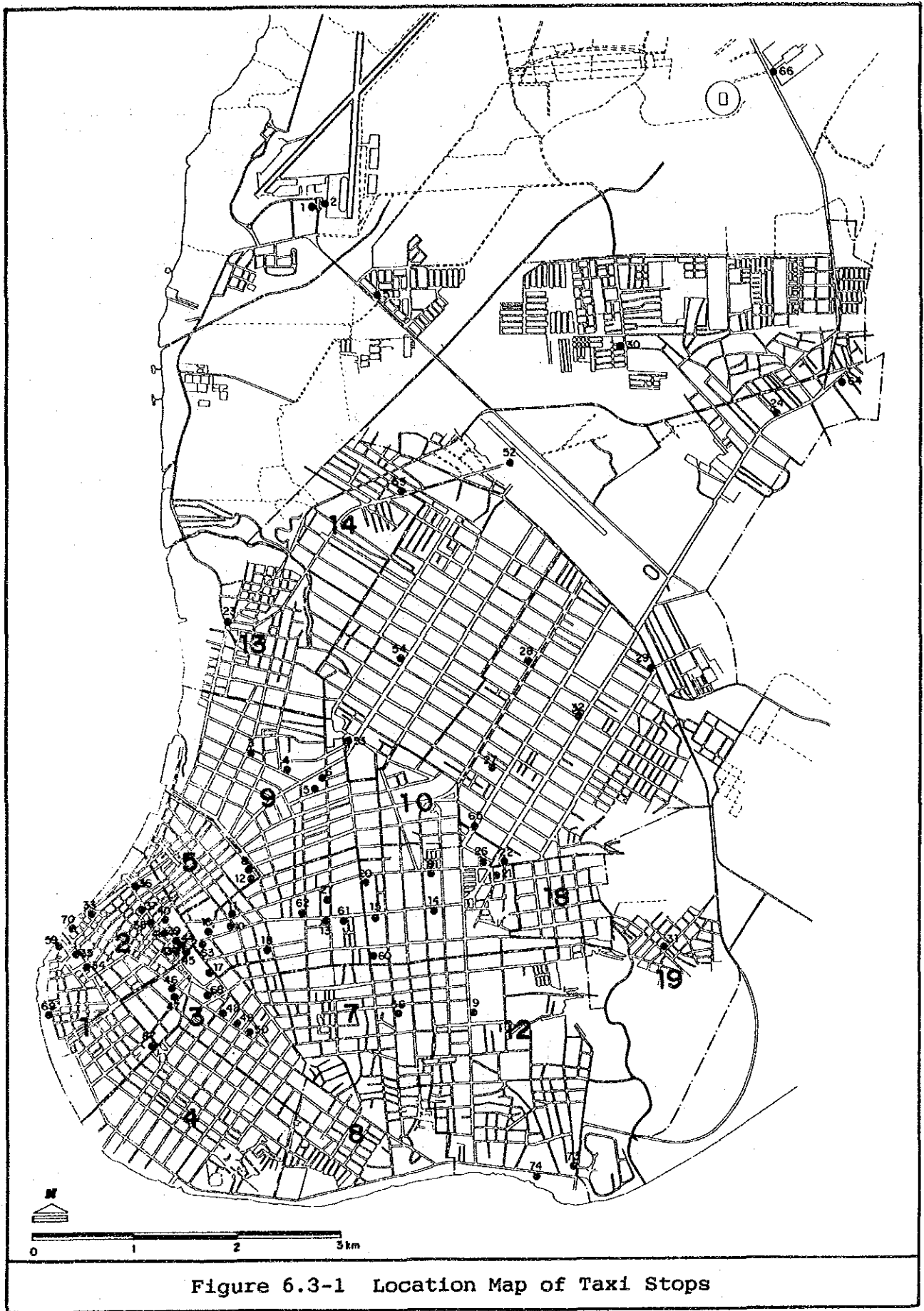


Figure 6.3-1 Location Map of Taxi Stops

Table 6.3-3 Taxi Operation Data

Type of Taxi	Total Run (km)	Pay Run (km)	Rate of Pay Run	Total Run (hr)	Pay Run (hr)	Rate of Pay Run
Radio Taxi	11,450	6,048		989.12	264.41	
Convention Taxi	138	73	0.53	11.55	3.11	0.27
Radio Taxi	10,010	4,957		986.54	274.47	
Convention Taxi	123	60	0.52	12.02	3.21	0.28
Total	21,460	11,005		1,976.06	539.2	
	130	67	0.52	11.58	3.16	0.27

Type of Taxi	Sales (CZN)	Sales/ Total km	Sales/ Pay km	No. of Passenger	No. of Trips	Passenger/ Trips
Radio Taxi	65,803			2,083	1,253	1.66
Convention Taxi	793	5.75	10.88	208	125	1.66
Radio Taxi	52,868			1,644	1,012	1.62
Convention Taxi	645	5.28	10.67	183	112	1.63
Total	118,671			3,727	2,265	1.65
	719	5.53	10.78	196	119	1.65

3) Pay Run

262. Pay run in length of "radio taxi" which is 73 km/day is superior to that of conventional taxi, 60 km/day.

263. An average run in frequency is 14 runs per day. Difference between "radio taxi" and conventional taxi is small, "radio taxi" 13.7, conventional taxi 14.2.

264. Against similar number of frequency of runs of both, the distance of pay runs shows significant difference. "Radio taxi" travels 5 km per run on the average but conventional taxi travel only 3.7 km. This difference indicates that passengers who call a taxi by phone travel longer in general.

4) Zones Passengers boarded and off

265. Destinations and origins of taxi trips are discussed in the previous section. Taxi trips concentrate in several zones, especially those of Comercio, Nazare and Sao Braz locate on line. These facts suggest possibility of introduction of para-transit services. The possibility of introduction of para-transit services will be discussed in Chapter 12.

5) Number of Passengers in a Cab.

266. The average number of passengers transported per trip was observed at 1.46 at the screen line, however, the result of the taxi survey was 1.64.

6.3.3 Financial Condition

(1) Sales in Amount

267. The taxi fare rate in Jan. 1990 was 7.60 CZN\$ per km (6 AM - 10 PM on weekdays including Saturday) and 9.12 CZN\$ per km (10 PM - 6 AM on weekdays and all day Sunday). Exception is outside of Belem city area, where the fare rate of 9.12 CZN\$ per km which is the normally applied rate.

268. Sales in amount reported by taxi drivers are normalized by pay km. The average of those is 10.83 CZN\$/km, which exceeds the taxi fare rate of 9.12 CZN\$/km (note: these two figures are for Jan. 1990). This fact shows that taxi drivers reported their sales at actual receipt base.

269. Sales in amount by total run km is 5.53 CZN\$/km, which is equivalent to 45.24 CR\$/km (0.5141 US\$/km) in fare rate on Oct. 1990 (Authorized tariff is 62.17 CR\$/km).

(2) Operation Costs

270. Operation cost data were collected through interviews with those 19 taxi drivers. Based on these interviews, but adjusted by price in Oct. 1990, operation costs are estimated. Costs are indicated in US dollar using "tourist changing rate" on 20 Oct. 1990, 88 CR\$/US\$. Hundred thirty (130) km/day of total run and twenty five (25) days operation in a month are applied to estimate unit costs. Results are summarized as follows:

Samples:	Type of cars:	OPALA, DEL REY, SANTANA, CHEVETTE, CORCEL II, FUSCA:	2 vehicles each
		MONZA, FIAT, BRASILIA, ESCORT, MARAJÓ, PASSAT:	1 vehicles each.
	Type of Motor:	Alcohol	16 units
		Gasoline	3 units
Fuel:	Alcohol:	Consumption rate in average	7.43 km/liter
		Price	0.4782 us\$/liter
	Gasoline:	Consumption rate in average	8.83 km/liter
		Price	0.6365 us\$/liter
	Unit cost (mixed)		0.0691 us\$/km

Lubrication: Unit cost	0.0032 us\$/km
Tire: Unit cost (mixed)	0.0094 us\$/km
Maintenance: Maintenance unit cost	0.0281 us\$/km
Depreciation: Unit cost (information source: taxi driver interview)	0.0235 us\$/km
Opportunity Cost: Unit cost	0.1759 us\$/km
Taxes, License Expenses, Insurance: Unit cost	0.0011 us\$/km
Grand Total: Unit cost	0.3092 us\$/km

(3) Managerial Index

271. Operating cost in total is 0.3092 us\$/km and sales in amount is 0.5141 us\$/km. The managerial index defined as sales amounts per km over operating costs per km becomes 1.6625.

272. Assume 130 km/day running and 25 work days/month, taxi owner driver income becomes 9 times of "salario minimo".

(4) Major Issues

273. The taxi is the only existing transport to provide high quality public transport service at present. From this point of view the taxi is very important transport mode at present and might be more in future. Administration of taxis, however, is poor since as mentioned before, even the number of taxis at present is not clear. Updating of registration records of taxi owners and vehicles, issue/cancel of taxi licenses and taxi driver licenses, and training/control of taxi drivers are minimum requirements for administration.

274. Taxi business is sustained, in Belem, by individuals, who possess one or a few vehicles and drive by themselves or rent these to no-car-own taxi drivers. This type of business is not easy to control or to maintain some level of service by an administration authority. In addition, in the case of accident they do not have enough capability to compensate for damages. Taxi companies composed of taxi owners shall be organized.

7. Present Person Trip Characteristics

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Present Person Trip Characteristics ▼



98 1 12

7.1 Introduction

275. In the Study for making the transportation masterplan in Belem, Person Trip Survey was planned and carried out to obtain detailed information on travel characteristics. There are travel information and socioeconomic data by GEIPOT's study in 1980 and population census in 1980. These data have become much different from the present conditions during a decade. Therefore, the survey aimed to collect new comprehensive trip information and socioeconomic data. As Person Trip Survey only covers the residents of the Study Area on a sampling basis, it is supplemented by a number of surveys such as Cordon Line Survey and Screen Line Survey.

276. Person Trip Survey was conducted through home interviews in which interviewers directly visited homes selected from the registered residence list of CELPA for collecting the consumed electrical power charge. A random sample of 21,266 households (91,597 persons interviewed), equivalent to a sample rate of 7.2 % of total population (6 years old or above), was collected from the Study Area which was divided into a total of 64 traffic zones. The zoning system has sub-zones, in which traffic zones are divided into 2-4 sub-zones to be available for trip movement of bus passengers, totaling 82 zones.

277. The Person Trip Survey was commenced on March 6, 1990 and completed by the end of April, 1990. The selected household members were interviewed in accordance with the questionnaire form which include socioeconomic indicators and trip information.

278. The contents of the survey were as follows;

- a. social indicators: age, sex, occupation and working address
- b. economic indicators: total number of families and of members in residence, number of vehicles owned, monthly family gross income and home ownership
- c. trip information: origin, destination, departure time, trip duration, trip purpose, transport mode, bus route number and type of parking lot.

7.2 Person Trip Characteristics

7.2.1 Total Number of Trips

(1) Total Number of Trips

279. The total number of trips per day in the Study Area in 1990 is approximately 2.89 millions, of which 2.87 million trips are made by residents in the Study Area, and 20 thousands by non-residents who are not dwelling in the Study Area. Since trips by residents in the Study Area have a 99% share, it seems to indicate that the Study Area is closed area from the traffic point of view. Summarized in Figure 7.2-1 are trips of residents and non-residents according to internal and external trips.

280. Out of the total trips made by the resident, 2.85 million trips, equivalent to 99 % to the total, are made within the Study Area. On the other hand, 18 thousand trips (0.6%) travel passing through the boundary of the Study Area. As for the non-residents, 95% of the total are trips between internal and external places of the Study Area, and the remaining (5%) is external-external trips.

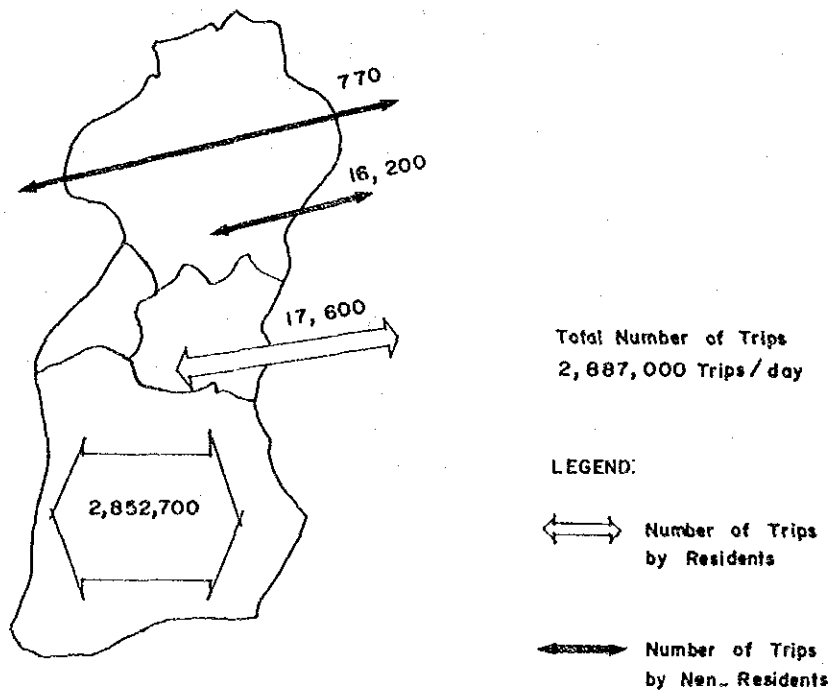


Figure 7.2-1 Total Number of Trips in the Study Area

(2) Trip Composition by Purpose

281. As can be seen from Figure 7.2-2(A), which shows the trip purposes made by all modes, the composition of "to home" trip purpose is highest (41%), followed by 21% for "private/others", 18% for "to work", 15% for "to school" and 5% for "business". On the other hand, Figure 7.2-2(B) shows the composition of purpose by mode of road transportation (excluding walking, bicycle and boat). As seen, the share of school trips decrease, while the other purpose trips somewhat increase.

282. Almost half of the trips are "to home" which means that there are many home-based trips, and that there are many outgoing trips with one destination.

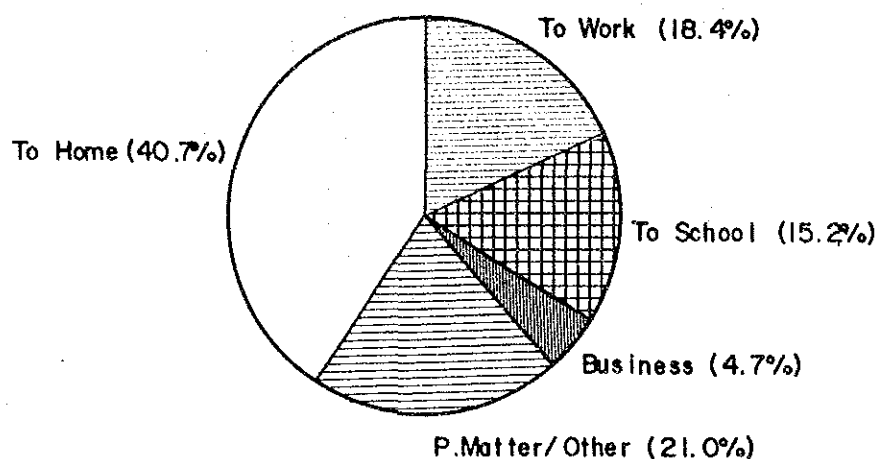


Figure 7.2-2(A) Composition of Trip Purposes (All Mode)

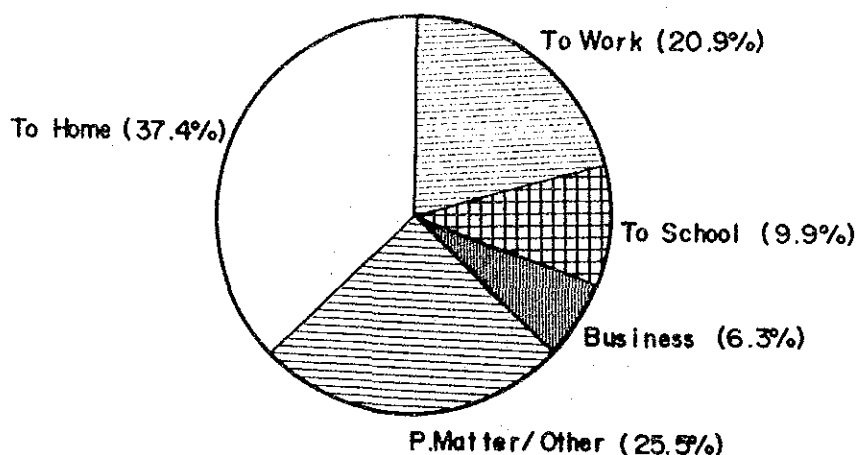


Figure 7.2-2(B) Composition of Trip Purposes
(Excluding Boat, Walking and Bicycle)

(3) Trip Composition by Mode

283. Trip modes are summarized in Figure 7.2-3(A). The figure shows a breakdown of all trips in a day. As can be seen, about 13% are car, bus 54%, taxi 1%, truck 3%, and walking and bicycle 30%. The share by motorcycle is as low as 0.3%. As for the trip composition of road transportation excluding walking, bicycle and boat (refer to Figure 7.2-3(B)), bus transport (76%) is predominant over other transports.

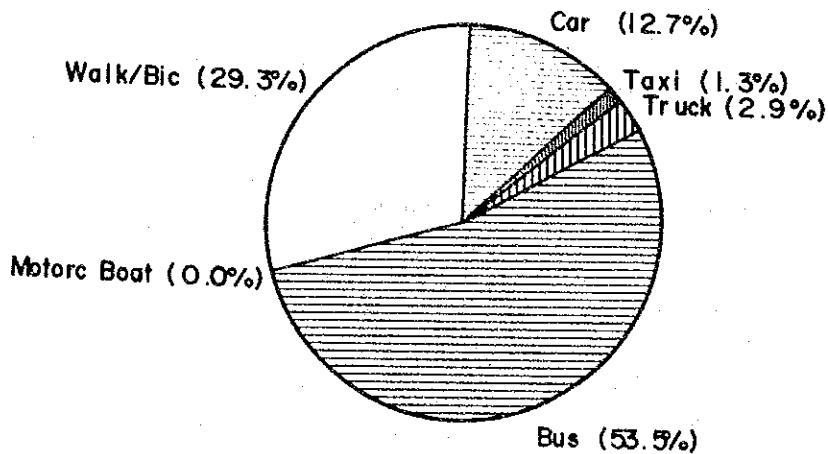


Figure 7.2-3(A) Composition of Modes (All Mode)

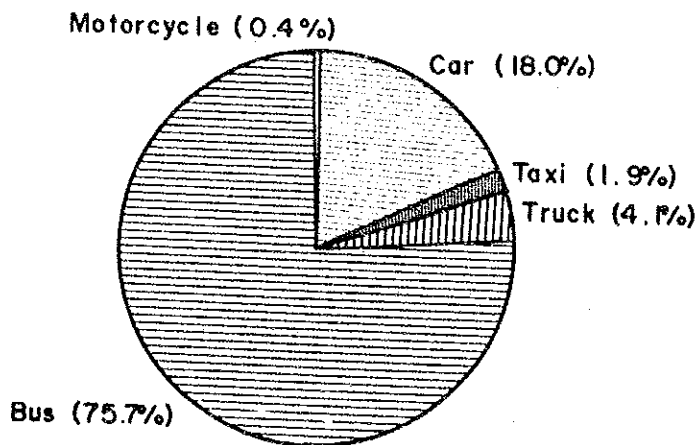


Figure 7.2-3(B) Composition of Modes
(Excluding Boat, Walking and Bicycle)

7.2.2 Trip Production Rate

284. The concept of trip production rate in terms of number of trips per person (6 years or above) in a day, involves two facets: one is gross rate which is for all the person not related to whether trip is made or not, and the other is net rate which is only for the person who makes a trip. In this report, gross rate is taken as the trip production rate taking into account making travel demand model.

(1) Trip Production Rate by Age Group and by Sex

285. The trip production rate in the Study Area is 2.25, and the outgoing rate is 65 %. The trip production rate by sex is 2.66 for male, and 1.90 for female as shown in Table 7.2-1, which shows the trip production rate by age group and by sex. As for the trip production by age group, the males between aged 25 and 59 years old exceed 3.0, while the females (20- 44 years) stand at 2.2 - 2.5, which figures are considerably higher than that of other age groups of females.

Table 7.2-1 Trip Production Rate by Sex and Age

Age Rank	Male	Female	Total
5 - 9	1.562	1.564	1.563
10 - 14	1.776	1.716	1.745
15 - 19	2.311	1.967	2.126
20 - 24	2.915	2.163	2.511
25 - 29	3.220	2.312	2.732
30 - 34	3.486	2.405	2.899
35 - 39	3.410	2.221	2.767
40 - 44	3.788	2.046	2.853
45 - 49	3.372	1.763	2.508
50 - 54	3.118	1.632	2.299
55 - 59	3.397	1.416	2.318
60 - 64	2.358	1.194	1.706
65 - 69	1.891	1.055	1.431
70 -	1.229	0.708	0.904
Total	2.655	1.896	2.248

(2) Trip Production Rate by Occupation and by Purpose

286. Trip production rate by occupation is shown in Figure 7.2-4. The production rate for workers exclusive of agriculture is roughly 3.0 - 4.0 trips per day and a low rates are found among unemployed, retired and housewives. Agriculture workers and students stand in between.

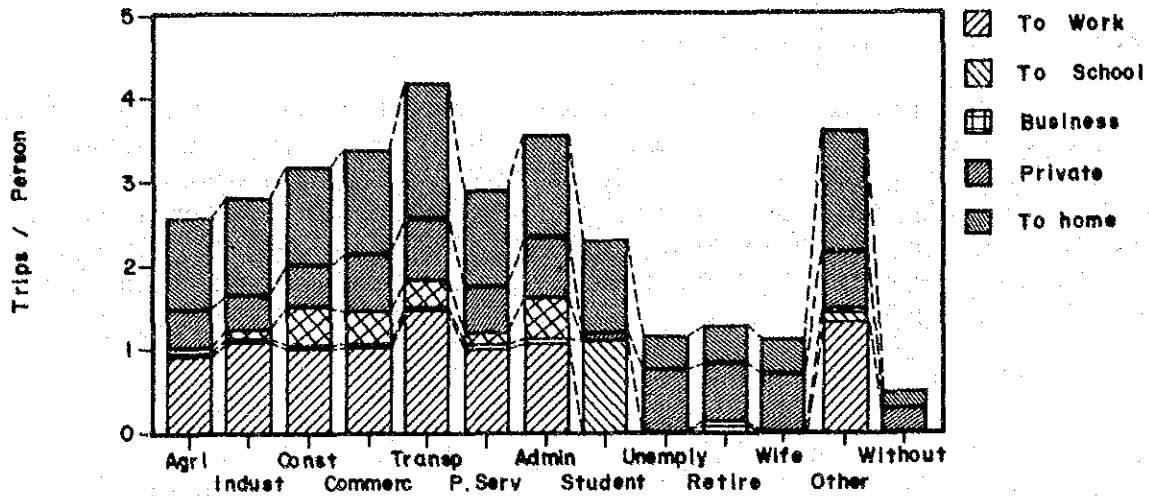


Figure 7.2-4 Trip Production Rate by Occupation

287. As for the production rate by purpose according to occupation, there are difference between working and non-working persons. The "to work" and "to home" purposes are predominant for workers, while the "private/others" and "to home" purposes are higher for non-workers.

(3) Trip Production Rate by Household Income Level

288. Figure 7.2-5 shows the trip production rate by household income level. As can be seen, the higher the household income level is, the higher the trip production rate is. The purpose of composition shows that the every trip purpose becomes higher in the similar proportion, corresponding to increase of the income level.

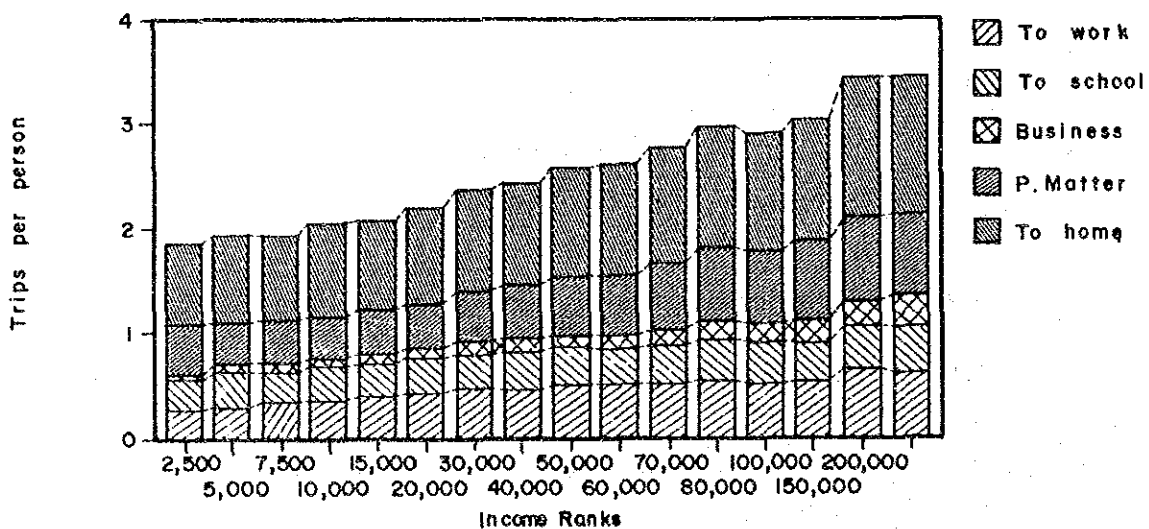


Figure 7.2-5 Trip Production Rate by Household Income Level

(4) Trip Production by Vehicle Ownership

289. Figure 7.2-6 compares trip production rate by motorized and non-motorized households classified into 4 categories: non-car owning, car owning, motorcycle owning and car/motorcycle owning. The trip production rate is 2.99 for car owning household and for household owning car and motorcycle, respectively, while it is 2.08 for non-motorized household. Only motorcycle owning household is close to non-motorized household in the production rate. This shows that the trip production rate has close relationship to whether the household owns the car or not.

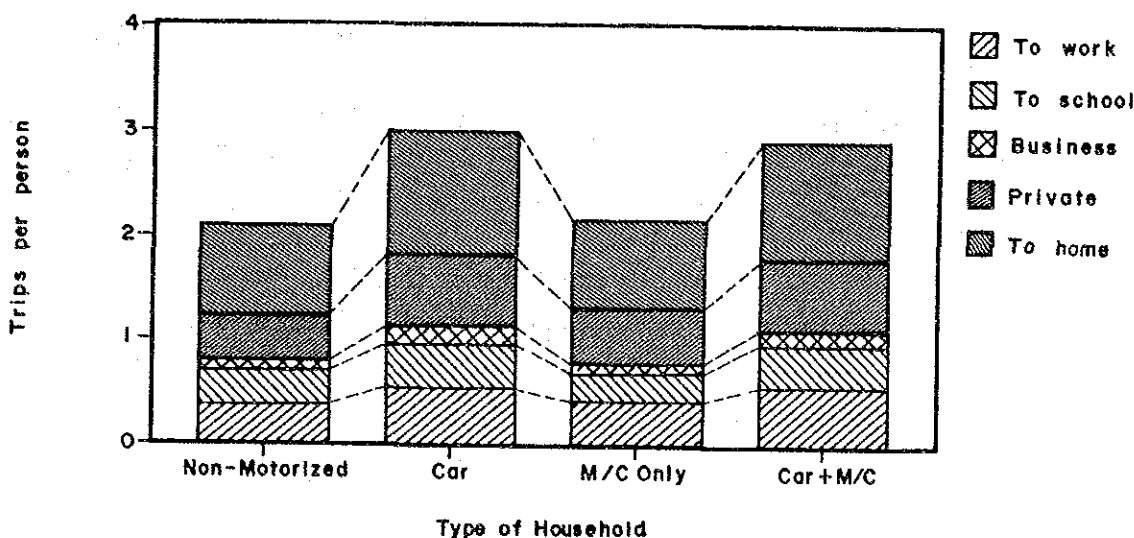


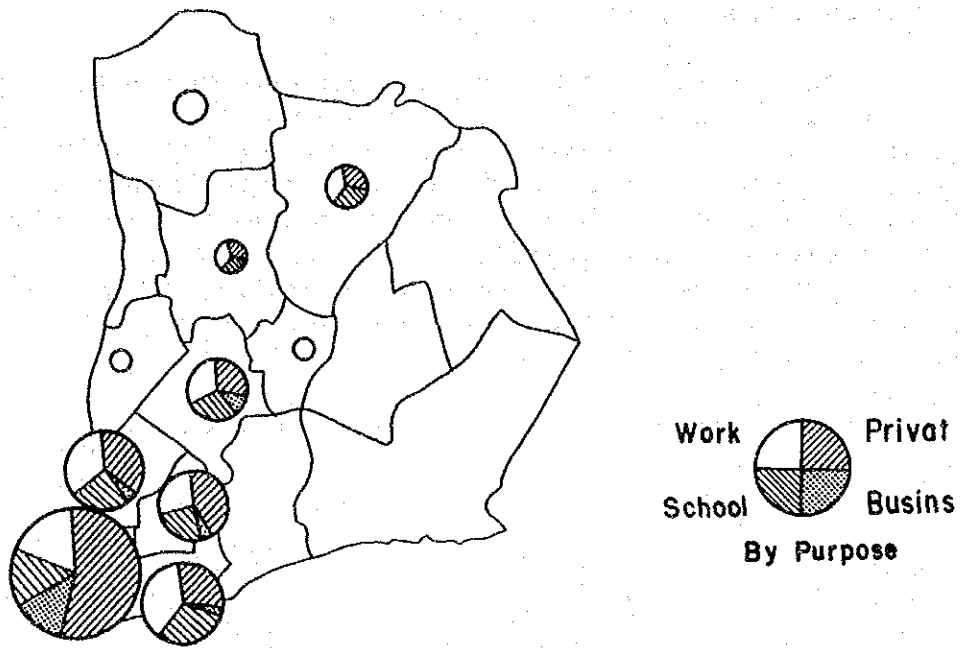
Figure 7.2-6 Trip Production Rate by Vehicle Ownership

7.2.3 Trip Generation and Attraction

(1) Trip Generation and Attraction by Purpose and Zone

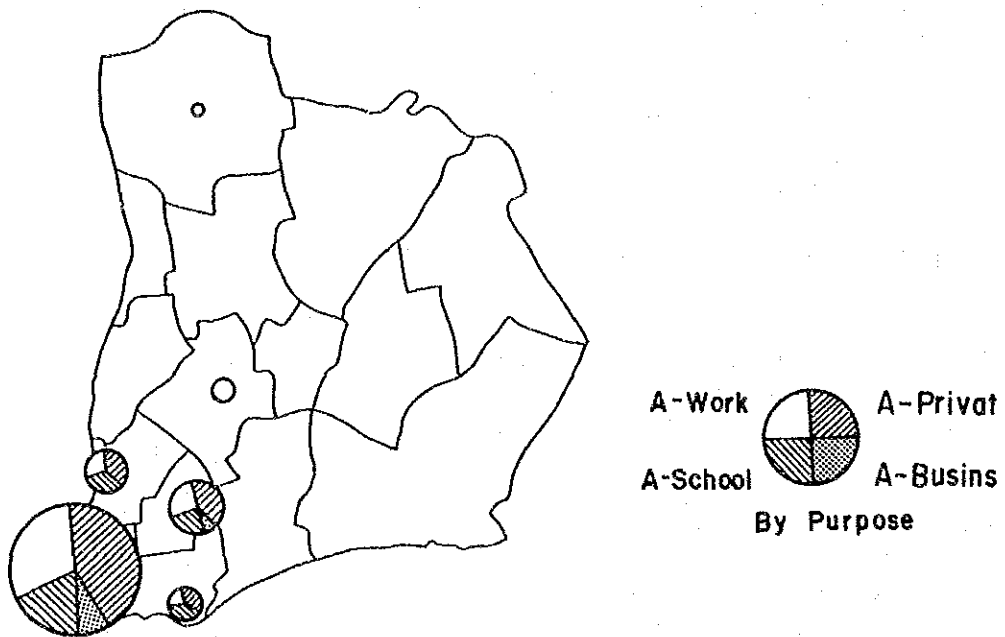
290. Trip generation and attraction by trip purpose according to the integrated zone are shown in Figures 7.2-7 and 7.2-8. Looking at a integrated zone whose numbers of generation and attraction trips are higher, both of those of zone No.1 stand at approximately 750 thousands. The zones with other large numbers of generation and attraction trips are 2, 3, 4 and 5 (refer to Figure 7.2-16 for zone number).

291. As for "to work" trip purpose, trip attraction rate in the zone No.1 is dramatically higher than the others, while trip generation rate is considerably lower than the average rate. This is because this zone is the business activity center and there are many workers concentrated into this zone. The "school" and "business" purpose trips are in the same situation as that of the "to work" trips.



Trip Generation (1990)

Figure 7.2-7 Trip Generation by Purpose

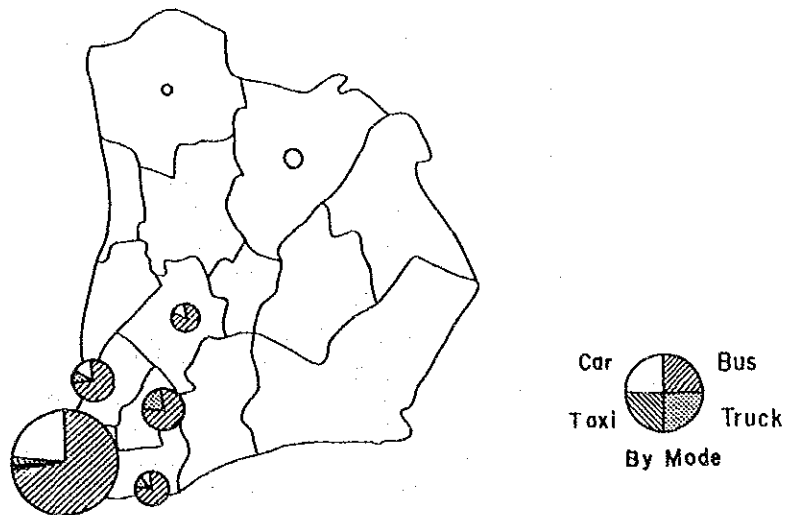


Trip Attraction (1990)

Figure 7.2-8 Trip Attraction by Purpose

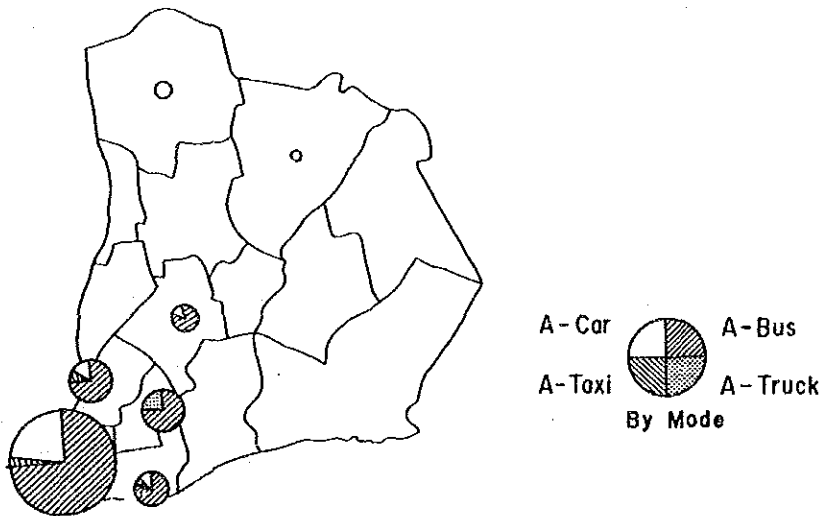
(2) Trip Generation and Attraction by Mode

292. Figures 7.2-9 and 7.2-10 show trip generation and attraction by zone and transportation mode. In zones 1,3,4 and 5, the composition of travel modes of car and taxi in the trip generation and attraction are high. The public transportation (bus), however, is almost constant in the share by zone. This indicates that bus is used by residents as a major transportation in each zone, and is not necessarily related to urban and rural areas.



Trip Generation (1990)

Figure 7.2-9 Trip Generation by Mode



Trip Attraction (1990)

Figure 7.2-10 Trip Attraction by Mode

(3) Hourly Trips Generation by Purpose

293. The hourly number of trips by purpose is shown in Figures 7.2-11, 7.2-12, which show the hourly fluctuation of trips at the departure time. As can be seen, the morning and evening peak hour ratios are approximately 13% and 10%, occurring between 7:00 a.m and 8:00 a.m, and between 6:00 p.m and 7:00 p.m, respectively. At noon, the generation trips also rise due to return to home.

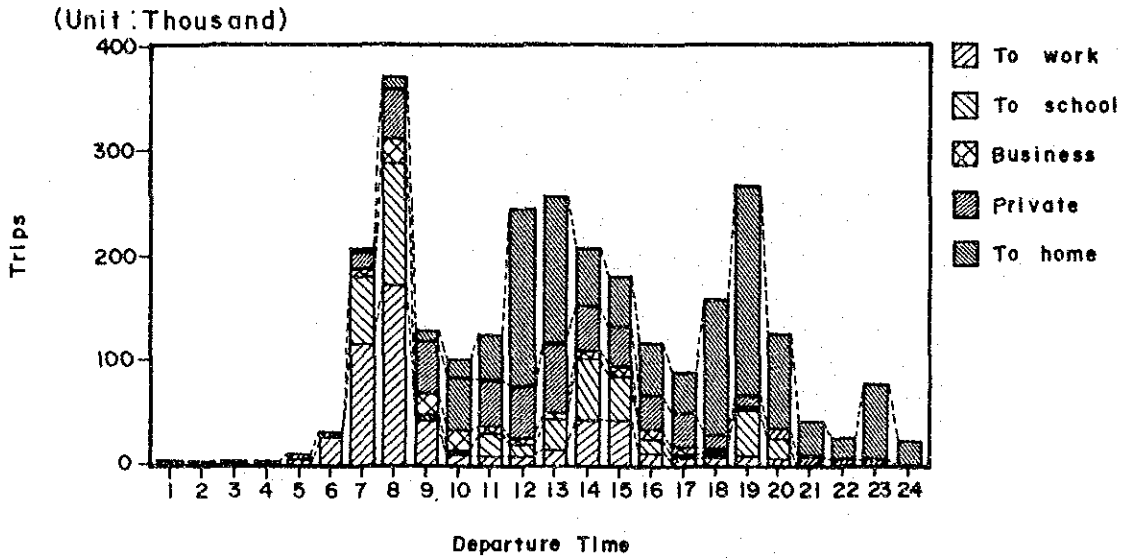


Figure 7.2-11 Hourly Trip distribution by Purpose

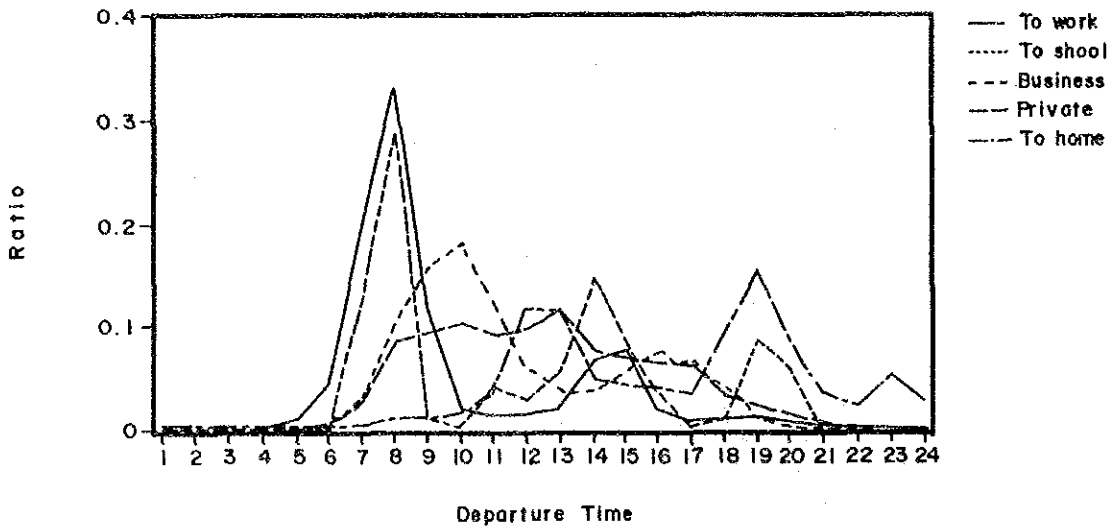


Figure 7.2-12 Hourly Trip Distribution Ratio by Purpose

294. The peak hour percentage for "to work" trip rises by 32% in the morning from 7:00 a.m and 8:00 a.m. And also, the hourly trip ratio in the afternoon from 1:00 p.m to 3:00 p.m is considerably higher due to the fact that workers come back to office. The "to school" trip fluctuation indicates the same pattern as that of the "to work". The peak hour ratio of "to school" is 27%, in contrast to 32% in the "to work". The "to home" trip peak occurs twice: from 11:00 a.m to 12:00 a.m and 6:00 p.m to 7:00 p.m, as mentioned above. The "business" trip starts around 6:00 a.m and ends around 4:00 p.m.

295. Figure 7.2-13 shows the hourly fluctuation of moving trips by purpose. The figures are counted in the entire time period from departure and arrival. It shows moving trips at specific time frames in the Study Area. Examination with the hourly trip distribution rate in Figure 7.2-11, indicates that after the peak hour, there still remains unfinished trips.

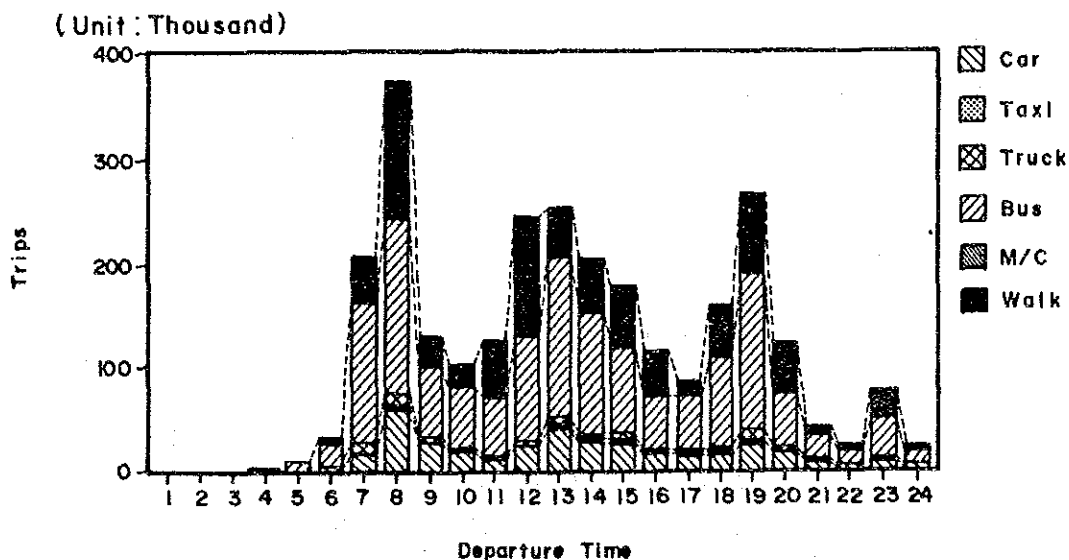


Figure 7.2-13 Hourly Distribution of Moving Trips

(4) Hourly Trips Generation by Mode

296. The hourly number of trips by transportation mode are shown in Figures 7.2-14 and 7.2-15. These figures show the hourly trip distribution under "departure time". As seen, the trip patterns of hourly distribution by the mode are nearly same throughout the day, exclusive of that of the noon in which the peak period of walking occurs one hour ahead in comparison with that of bus and car. It seems that this difference relates to trip distance and travel time by mode.

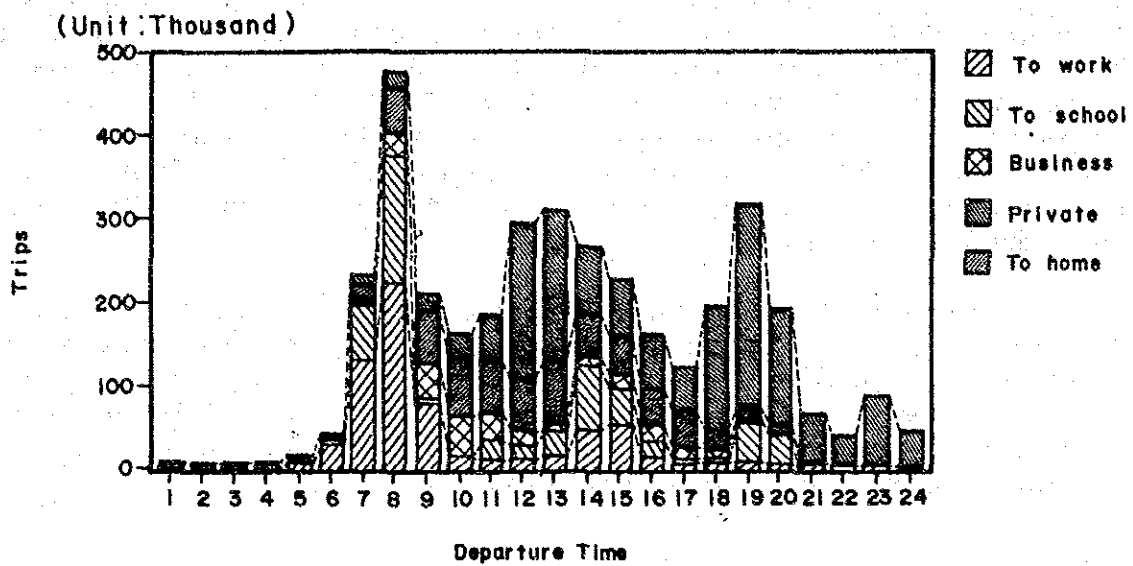


Figure 7.2-14 Hourly Trip Distribution by Mode

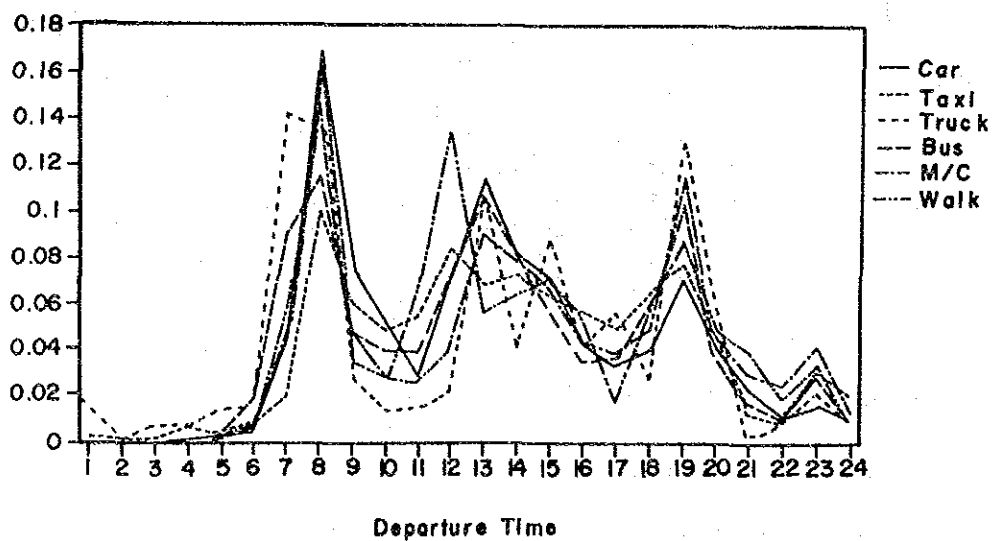


Figure 7.2-15 Hourly Trip Distribution Ratio by Mode

7.2.4 Trip Distribution

(1) Trip Distribution by Purpose

297. Trip distribution by all modes and purposes is shown in Figure 7.2-16 by desire line charts. In this figure, the two-directional movement between each pair of zone blocks is drawn by a straight line whose width is proportional to the number of trips between zone blocks. As can be seen, there are large movements within the central area which is composed of zone Nos.1, 2, 3 and 4, and between Zone No. 1 and its surrounding suburban area composed of Zone Nos.5, 9, 11, 12, 13 and 14. In conclusion, strong desire lines concentrate to Zone No.1 from every place.

298. The desire lines by purpose are shown in Figures 7.2-17. The desire line for "to work" trips shows that there is heavy traffic between the business area (Zone No.1) and every other area. The "to school" trips also show the same desire pattern as that of "to work" desire line. These "to school" trips can be considered as movement of students of high school or higher level, since a large part of the primary and secondary school pupils attend on foot (it means short distance trip) and are probably excluded from this figure due to the movements within the integrated zone.

299. The "business" and "private/other" trips show that long distance trips are noticeable, especially trips between the business area (Zone No.1) and the areas outside the Study Area, compared with the "to work" trip.

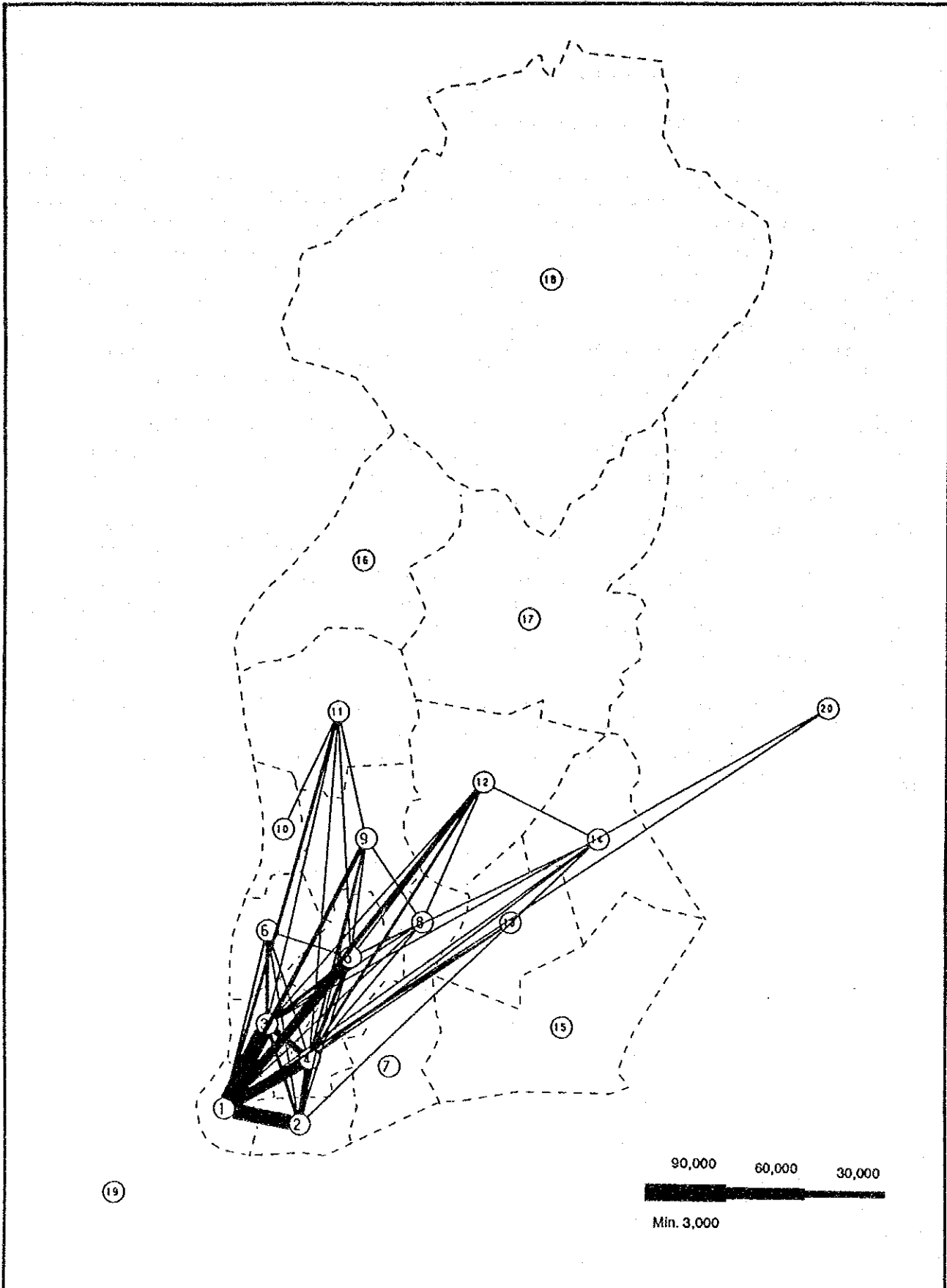


Figure 7.2-16 Trip Distribution by All Mode and Purpose

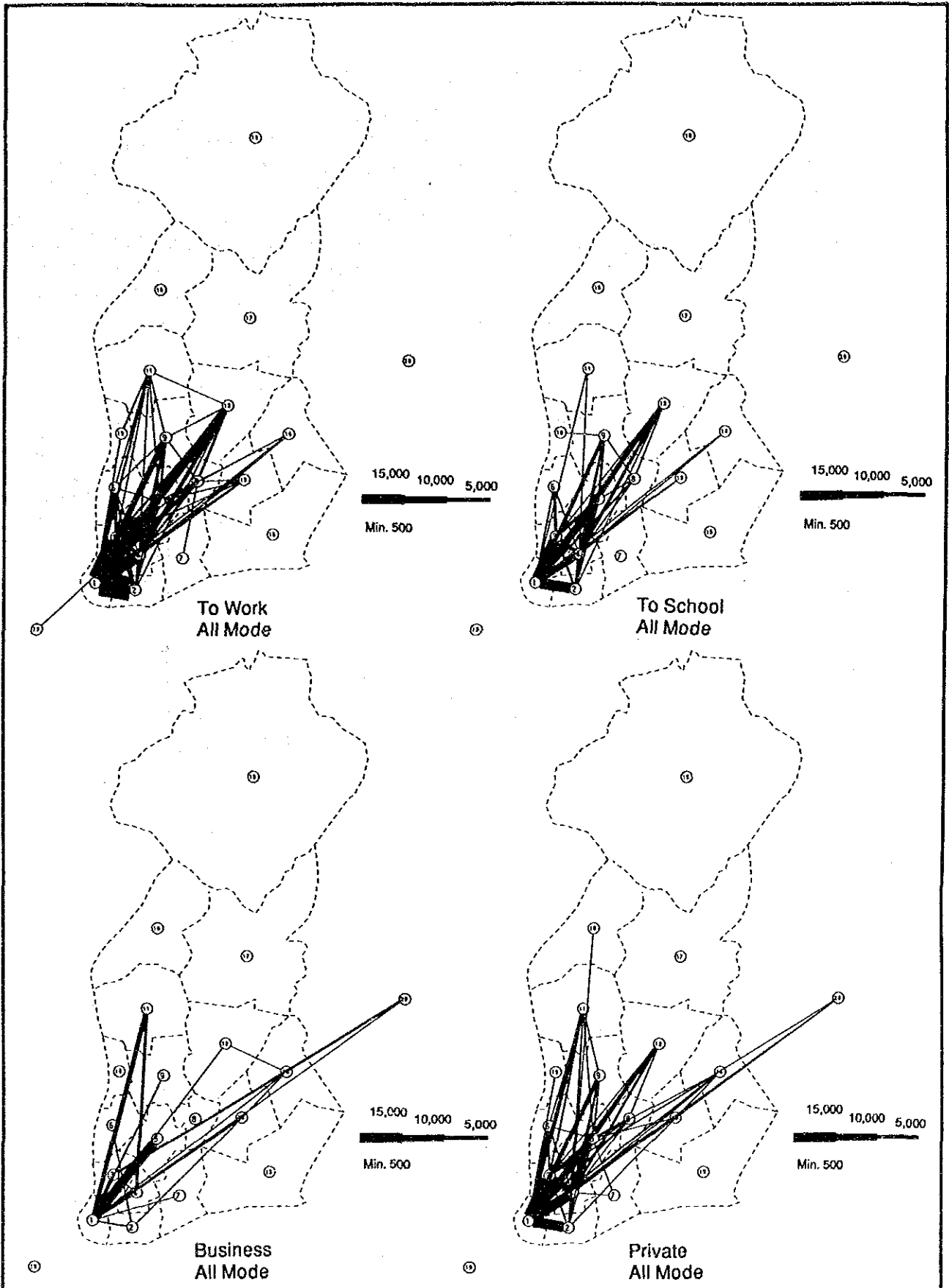


Figure 7.2-17 Trip Distribution by Purpose

(2) Travel Time by Purpose

300. Travel time distribution by purpose is shown in Figure 7.2-18. The travel time of the "to work" trip does not have a peak and remains stable for 35 minutes and decreases gradually thereafter. The "business" and "private" trip times also show a similar pattern as that of "to work" trip. Approximately 70-80 % of the total trips have travel time within 35 minutes. On the other hand, the travel time of the "to school" has a peak around 5-10 minutes and its accumulative percentage reaches to 60 % by 15 minutes, in contrast to 32 % for the "to work".

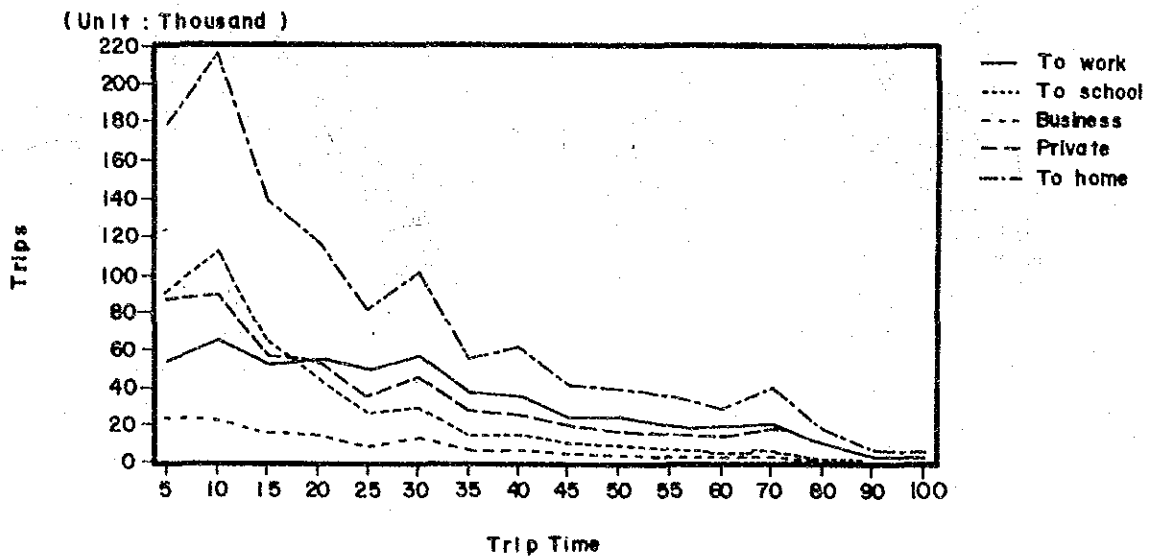


Figure 7.2-18 Travel Time by Purpose

7.2.5 Trip Production and Distribution by Mode

(1) Modal Share of Trip by Purpose

301. The trip composition of modes according to trip purpose is shown in Figure 7.2-19. The share of "to work" trip by bus accounts for about 60%, and "to school" trip is predominant on foot at 54%. The "business" trip is well shared by car and bus into 54% and 35%, respectively. The trip composition of purpose by mode is also shown in Figure 7.2-20. Car, taxi and bus are used by trips with the purpose of "to work", "private/others" and "to home", while walking has relatively high percentage of "to school", compared to car and bus.

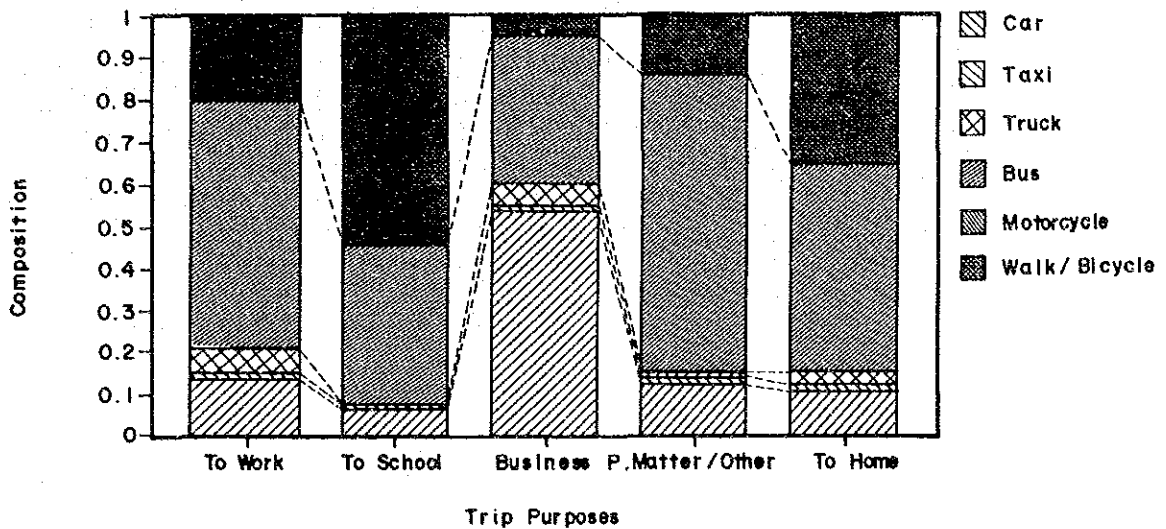


Figure 7.2-19 Composition of Modes by Purpose

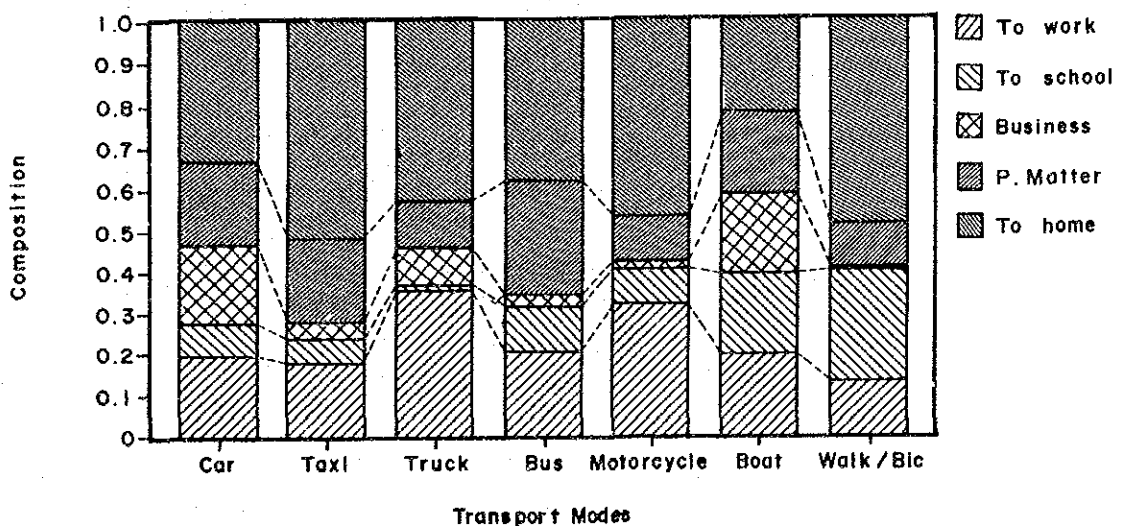


Figure 7.2-20 Composition of Trip Purpose by Mode

(2) Trip Distribution by Mode

302. The desire lines by mode show in Figures 7.2-21. As can be seen, the bus trips cover the whole Study Area with heavy traffic, while the car desire lines connect only central area (Zone No.1, 2, 3, 4 and 5) with strong desire line. The desire line for taxi shows that taxi is mainly used within the central area (Zone No.1, 2, 3 and 4). The truck is different from other modes in trip movement. It shows the connection between the inside and outside of the Study Area toward the city boundary of Ananindeua along BR-316 Road and also, between the central area and Zone No.6 which has petroleum tank terminal, airport and army base.

(3) Travel Time by Mode

303. Travel time distribution by mode is shown in Figure 7.2-22. The average travel time by car mode is approximately 27 minutes. The travel time for bus passengers is somewhat longer (37 minutes) than that by car. Approximately 80% of the total trips for bus passengers have a travel time within 50 minutes, in contrast to 30 minutes for car. On the other hand, the travel time of walking mode has a peak around 5-10 minutes and its accumulative percentage reaches to 83% for 15 minutes duration.

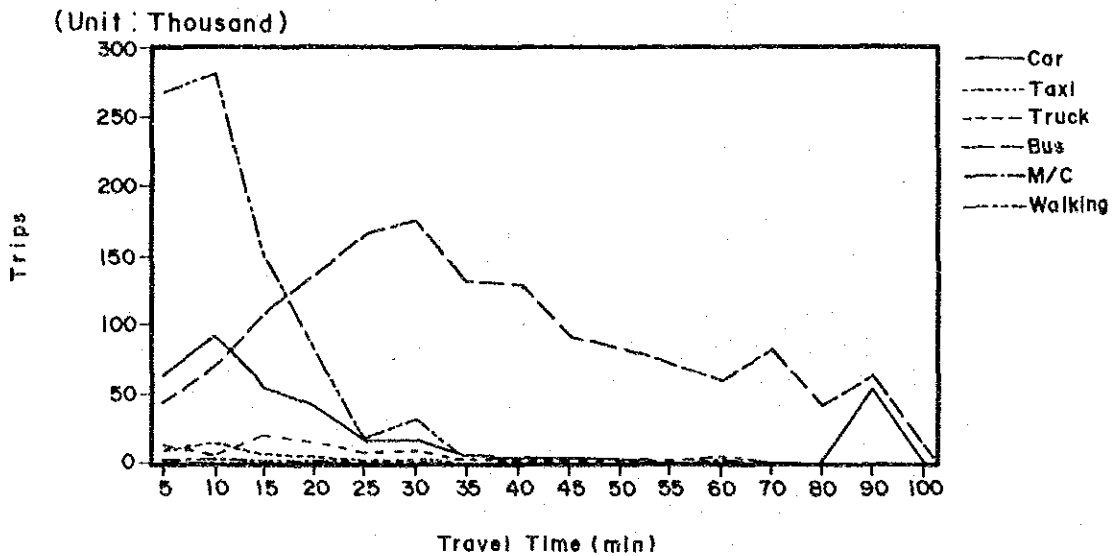


Figure 7.2-22 Travel Time by Mode

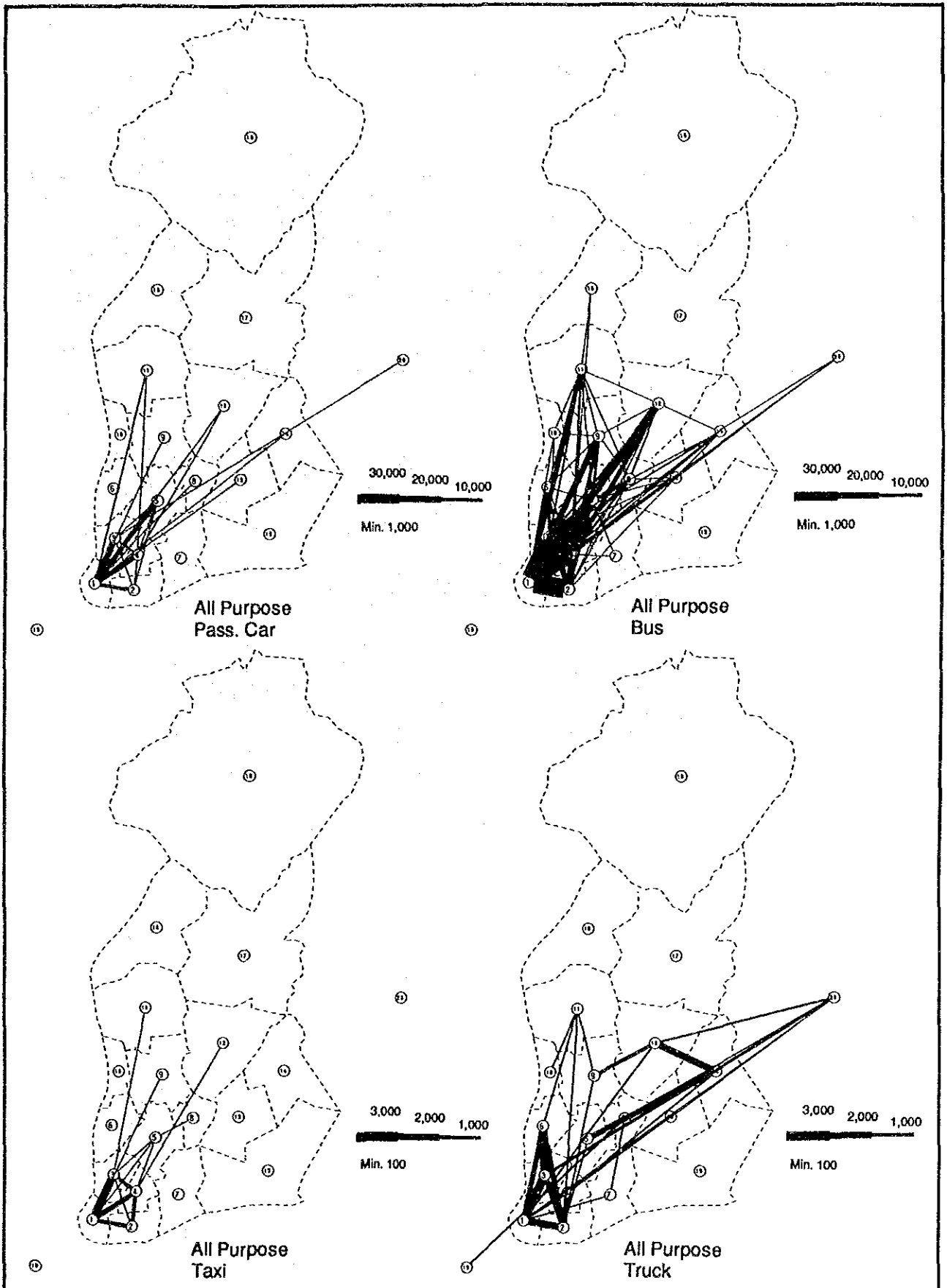


Figure 7.2-21 Trip Distribution by Mode

7.2.6 Household Trip Characteristics

(1) Modal Share by Motorized Household

304. The trip composition of mode used by non-motorized and motorized households is shown in Figure 7.2-23. In this figure, the motorized household is classified into 3 categories: car owning, motorcycle owning and car/motorcycle owning. The car owning household mainly uses a car (43% of the total modes) and bus (34%), while the transportation of non-motorized household is supported by bus (90% of the total modes exclusive of walking). As for the motorcycle owning, the motorcycle modal share is somewhat higher (20%) than that of non-motorcycle owning.

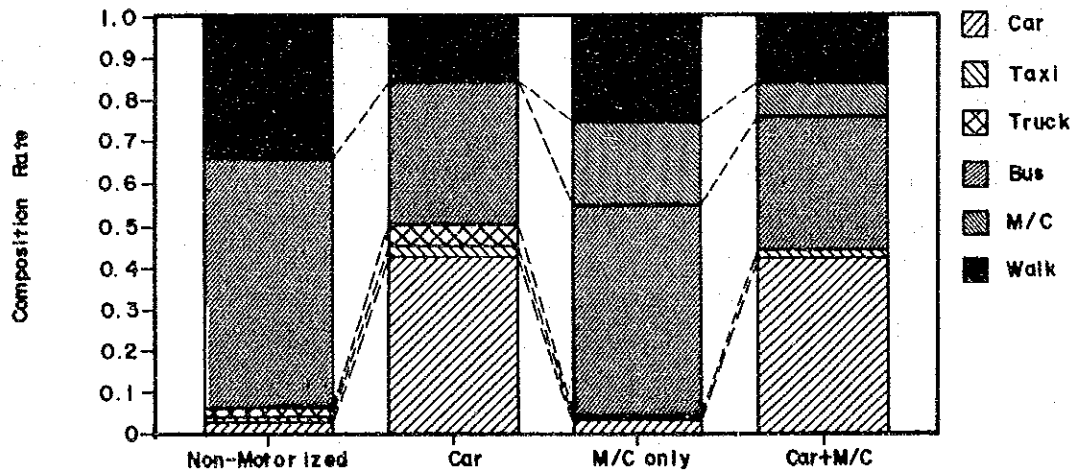


Figure 7.2-23 Trip Composition of Mode by Car Ownership

(2) Trip Composition of Mode by Household Income Level

305. The trip composition rate of mode by household income level is shown in Figure 7.2-24. The relationship between travel mode used and income level is found from this figure. The higher the household income level, the higher the share of car, and the lower the walking share. As for bus, the middle income levels between 15,000 NCZ and 70,000 NCZ are higher users than the others. This trend is based on the relationship between the household income and car ownership.

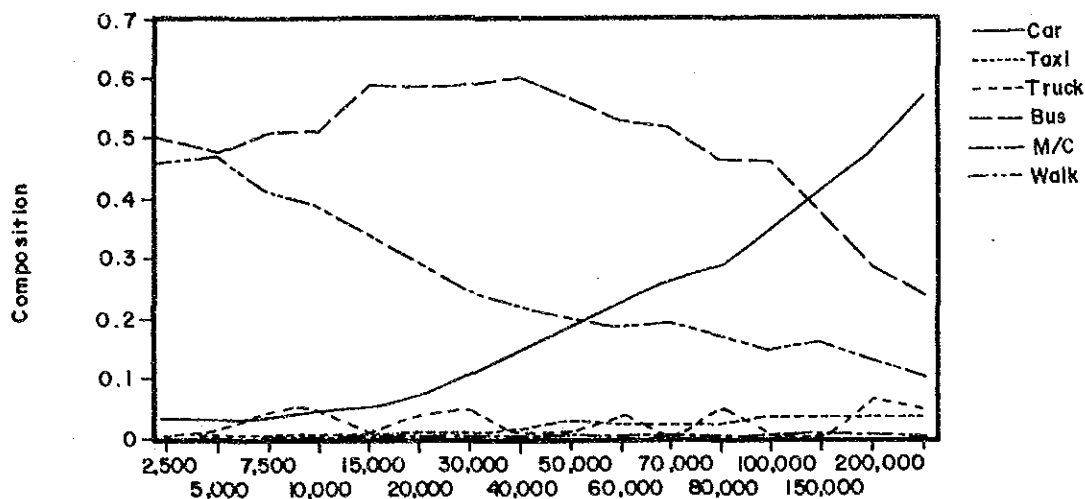
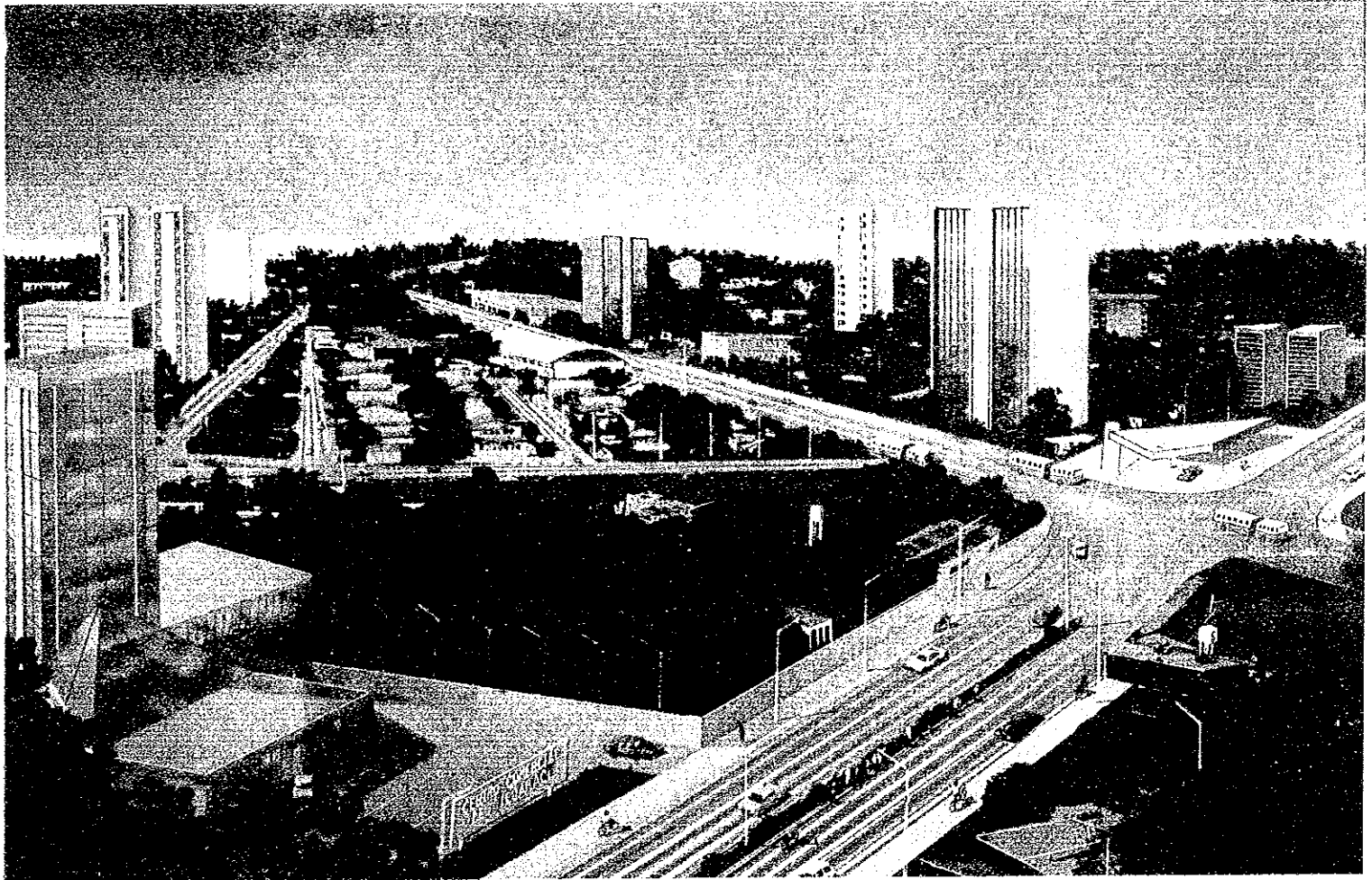


Figure 7.2-24 Trip Composition of Modes by Income level

8. Socioeconomic Framework and Land Use Plan

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8.1 Future Prospect and Development Policy

8.1.1 Future Prospect of National Economy and Development Scenario for Para

306. The Brazilian Government is making efforts to improve its economic situation by bringing into force a set of measures called the New Brazil Plan. Negotiations with international financial institutions for the reduction of foreign debts and the introduction of new investment funds are under way, restraining inflation and cutting the public expenditures. The future situation of Brazilian economy largely depends on the results of the efforts.

307. At present the new Brazilian economic policies seem to be evaluated in the international financial society, and it is expected that the agreement on the reduction and rescheduling of the debt will be reached between the Brazilian government and the lending agencies. Official development assistance from the developed countries and international lending agencies will be resumed. New investments from the private banks, however, will not be easily obtained. During the period of restructuring the national economy, especially 1990-1992, the growth rate will remain at low level.

308. After this period, the national economy will be strengthened to receive the foreign investments and to develop the domestic production activities supported by a recuperation of the world economy. In the beginning of 21th century, the world economy will be expanded because of a wider agreement between the industrialized countries and the developing countries. Brazil will enjoy a relatively high economic growth affected by the world economy.

309. Under such future prospects of the national economy, a development scenario for the State of Para is assumed as follows:

- a. 1990-1995 (period of integration of its economy to the national projects)
Introducing such national prospects as mining and energy development, to absorb the surplus population of the rest of the country and to form the basis for economic growth.
- b. 1996-2000 (period of strengthening of internal socio-economic structure)
Based on the economic growth resulting from the full-scale operation of national projects introduced during

the previous period, to make investments in social infrastructures and to enlarge opportunities for income growth.

c. 2001-2010 (period of ecological and cultural restriction)

Due to increasing ecological and cultural problems, losing the characteristics of frontier area, the Area will begin to receive less investment and in-migration and its socioeconomic structure will be stabilized.

8.1.2 Future Economy of Study Area

310. The largest national projects ever introduced or to be introduced in Para state are located in the hinterland of BMR, bringing only the indirect effects on the economy of the Study Area. Increases in commercial sales, in-migration, utilization of port facilities and the inflow of collected taxes from the interior to the capital are expected as a result of these activities.

311. In spite of accelerated growth of several urban cores in Para, Belem will still remain as the major commercial and service center of the State, intensifying its function as supplier of more sophisticated goods and services for other cities in the State.

312. In the primary sector, the agriculture and livestock will be forced to decline in the process of diversion of farm land to urbanized area. However, there are some possibilities for agricultural production to be initiated in the island area as alternatives to imports from other states. Fisheries will continue to expand from now on.

313. The secondary sector will maintain the existing structure. In due time, industries oriented to the local and state market will become important. This means that the degree of interrelation between the Study Area and the rest of the State will rise in accordance with the scenario described in 8.1.1, especially after 2000. The accumulation of economic activities in Belem, the infrastructure installed in the two industrial estates and the port services will be important location advantages, which will continue to attract industrial establishment.

314. The number of medium and small scale industries are supposed to increase, but the introduction of large scale industries will be difficult because of the scarcity of natural resources, high land prices, and environmental restrictions in metropolitan region. Due to the channel navigation condition, it

is impossible to more large scale ships in the port of Belem, creating difficult in the transportation of manufactured goods. It is mainly for these reasons that no big change will occur in industrial structure of the Study Area.

315. The tertiary sector will accompany the growth of local consumer market, activated by the demand for more sophisticated goods and services by the rest of the Para State, when the historical role of the Study Area in the urban hierarchy of the cities in Para is take into consideration. These activated effects will increase in due course of time, resulting in the upgrading of interrelationship among various parts of the economic space in the State.

316. The expansion of the tertiary sector will occur not only in the formal sector but also in the informal sector which will continue to play its historical role to absorb a part of labor forces not incorporated in organized labor market.

8.1.3 Urbanization Trends

(1) Expansion of Urban Space

317. The Expansion of the urban space in the Study Area will happen with the creation, within a determined space, of the great diversification of uses and topologies, which are: Residential (invasions, residential estates, etc.), Commercial and services (retail, wholesale, business and services), Industrial and Institutional. This integration of various functions in a determined urban space will be kept, except in the cases of single land use like: the administrative center, industrial districts and residential estates (in its initial stage).

318. In the residential land use the expansion of the urban space should be mainly done through housing for low and medium income residents, especially in the expansion area. These low income housing developments will be adjacent to high standard housing developments already in existence, mainly in the non-planned area.

319. In the areas of natural occupancy, already consolidated until 1990, a repetition of the process of accumulation which occurred in the 1st Patrimonial League will happen, by the subdivision of urban lots and expansion of the existing real estates.

320. In the planned residential areas, existing until 1990, accumulation of the urban space and increase of new functions will happen in the urban space.

(2) The Transfer of Urban Occupancy

321. In a first half of the Study period (from 1990 to 2000), the expansion of the urban space will occur following the traditional vectors of growth, which remain consolidated (BR-316 Road, Augusto Montenegro Road and Coqueiro Road). Other vectors of significant importance may follow with improvements in the same period (extension of 1o de Dezembro, PA-150 and link road between Icoaraci and Freitas(Contorno das Bases)).

322. Despite the definition of the tendencies for urban growth, its speed will depend on some factors such as: the change in the socioeconomic picture of the country, the improvement of conditions which create jobs in a determined area and the development or construction of urban infrastructure by the public sectors. Therefore, within the forecasted picture, the changes in the land use of the Study Area for the next 20 years are the following:

- a. Population accumulation of the urban land in the limitative polygonals by BR-316, Coqueiro Road and Augusto Montenegro Road with the occupancy on the boundary of the main axles, spearheaded by greater commercial use, services, deposits and small industries.
- b. Population accumulation on the northerly side of BR-316 Road, in the vicinity of the urban area of the Cohab residential estate, Industrial District of Ananindeua and Marituba Town.
- c. Land occupancy in the Icoaraci-Guajara area between the Cohab residential estate and Maguari River.
- d. Occupancy of the areas which are still free and progressive population accumulation in the limited polygonal by Augusto Montenegro Road, military areas, Arthur Bernardes Road and the State Administrative Center.
- e. Occupancy of the areas which are still free, and progressive accumulation in the surroundings of the axle of Augusto Montenegro Road starting from Coqueiro Road until the Icoaraci Village and Maguari River.
- f. Population accumulation in the surroundings of Ananindeua and Icoaraci industrial districts.
- g. PA-150 Road (a new vector of growth after 2000): With the implementation of PA-150 Road and with the lack of available land for the urban occupancy in the tradi-

tional area of growth of Belem Metropolitan Region the occupancy process on the right border of BR-316 Road starting from the institutional areas of COSAMPA until PA-150 Road should begin.

323. The expansion of the urban space, except for the intervention by the public sector, will keep on happening in a disorganized way, which will create some difficulties for its integration with the main existing road network. This discontinuity of urban occupancy is one of the factors which makes it difficult to implement the basic infrastructure (water, drainage, road network and public transport) in the expansion areas.

(3) Residential Land Use

324. The high income class, residing in condominium type buildings, should remain within the boundaries of the 1st Patrimonial League (Central area), more particularly in the areas (bairros) near Central Business District, such as Nazare, Batista Campos, Umarizal, Jurunas (close to Batista Campos).

325. The average income class should be placed inside and outside the 1st Patrimonial League, in a direct relation between the income level and closeness to the center and quality of land. The new residential enterprises designated for the superior stratum of this segment should be especially located in the areas (bairros) of Jurunas, Marco and Sao Braz, in condominium type of buildings.

326. The low and average income class should be partially transferred to the outside of the 1st Patrimonial League. Due to the land values, especially in the areas of urban improvements and the rise in the cost of urban land, an intra-urban migration of the population of low income towards the expansion area has been noticed.

327. There appears to be a tendency of increase of the degree of social segregation in the 1st Patrimonial League, which may lead to a gradual elitism of this area.

328. The areas inside the 1st Patrimonial League should receive more vertical construction in terms of residential use, defined in the Law of Use and Occupancy of the Urban Land as H-6 and H-7 zones, which permit higher rates of density and vertical construction.

(4) Land Use for Commercial and Services

329. For the CBD it is forecasted that land use for commercial and service will consolidate in certain patterns, with the following observations:

- a. Maintenance of the businesses designated for the low (Ver-o-Peso and close areas) and medium income class;
- b. Bank services, with headquarters remaining in the CBD, while agencies and service stations will spread around the city. The center of decision of the Comercio area will follow the same pattern.
- c. Other services (offices and notary's office etc.) directly linked to the existing activities at the CBD;
- d. Large number of informal activities; and
- e. Consolidation of the expansion of the CBD towards Sao Braz especially by the occupancy along the corridors of Av. Padre Eutiquio and Av. Nazare, by large size shops.

330. For the pericenter it is forecasted:

- a. The expansion of the high income business in some areas of the pericenter (Bras de Aguiar, Serzedelo Correa);
- b. Tendency for the specialization in some areas (electronic products, specific services, banks etc.)

331. For the rest of the 1st Patrimonial League:

Development of business and services will be forecasted along some important corridors such as Pedro Miranda, Padre Eutiquio, Senador Lemos, Nazare, Jose Bonifacio. Some areas of greater concentration like Sao Braz, Entroncamento and Icoaraci and some important commercial centers of local extension will be noticed.

332. For the expansion area, the following activities are expected:

- a. In the expansion area, gradual development of business and services of local extension, with greater concentration in the corridors and in some specific areas;
- b. Retail business of large size (shopping centers and department stores) will tend to develop outside the CBD, close to the 1st Patrimonial League and in the interior.

333. It is anticipated that wholesale and big sized retail business will be concentrated near the Port of Belem and along the corridor of BR-316, Augusto Montenegro and Coqueiro Road.

(5) Industrial Land Use

334. The large-scale industries will tend to locate primarily in the expansion area, especially in the corridor of BR-316 and Augusto Montenegro and secondarily in the industrial districts.

335. The industries of average size will tend to locate in the inside of the 1st Patrimonial League as well as in the expansion area (in this case, the same as the large-scale industries).

336. The small-scale industries will also tend to locate in the whole urban space of the Study Area, but outside of the industrial districts.

337. Small and average size industries will keep on locating in mixed land use areas (residential, commercial etc).

338. The industrial districts will keep on having a slow growth, because of some disadvantages related to other areas of the Metropolitan Region of Belem, especially by:

- a. Unreliability of bus transport services;
- b. Necessity to lower the high electrical energy costs which increase the operation costs of the enterprises;
- c. Lack or poor maintenance of the road network causing problems to transportation.

(6) Institutional Land Use

339. Some central institutional areas, especially military areas are under consideration to be urbanized.

340. The item above together with the relocation of Julio Cesar Airport will make it possible to connect the corridors of Av. Duque de Caxias and Av. Pedro Miranda with the expansion area.

341. Val-de-Cans International Airport should have improvements (expansion and modernization).

342. The Port of Belem should also have improvements, especially permanent dredging operation.

343. The small ports located on the river-front of Central area should also keep on operating (due to the lack of other available places and to its economic importance).

344. With the effective operation of the State Administrative Center, there should occur a considerable increase of urban activities for the areas, with the attraction of functions and the consequent change in the urban space.

8.1.4 Basic Policies for Development

345. In order to create the multi-core urban structure in the Study Area and lessen the transport demand pressure on the transport network between the suburban area and the central area, the following basic policies for urban development should be realized;

(1) Legislation of Land Use

1) Concerning Land Use Law of Belem:

- a. Establish restrictions on the establishment of large and average size facilities of industrial plants in the 1st Patrimonial League including the pollution generating small sized industries.
- b. Stimulate, through the Law of occupancy and land use, the opening of industries in selected areas, near the sub centers of Ananindeua and Icoaraci.

2) Establish a law that controls the occupancy and land use in the Municipality of Ananindeua, compatible with the Study Team's proposals.

(2) Other Elements of Institutional Matters

- 1) Define the territorial boundaries between the municipalities of Belem and Ananindeua.
- 2) Support to the improvement of the administrative structure of the Municipality of Ananindeua.
- 3) Create an organization for planning and coordination of metropolitan matters.

4) Define the urban land instruments such as:

- a. Land reserve funds
- b. Exchange of interests*, etc.

(3) Economic Matters

- 1) Create loan system by official institutions of credit to micro or small employers located outside the 1st Patrimonial League.
- 2) Restrict official credit to industries located in the 1st Patrimonial League.
- 3) Stimulate the ceramic art craft in Icoaraci throughout available credit, export assistance, marketing and official advertisement, etc.
- 4) Realization of the study for the "Implementation of the Agriculture Belt".

(4) Infrastructure and Equipments

- 1) Improve infrastructure and urban equipments at the regional, metropolitan and district levels, preferably in the sub-centers of Icoaraci and Ananindeua.
- 2) Transfer the bus terminal from Sao Bras to the surroundings of Ananindeua Sub-center.
- 3) Effective improvement of the State Administrative Center and the Guajara Metropolitan Park.
- 4) Improve the infrastructure in the areas of commercial accumulation of the 1st Patrimonial League and also in Entroncamento, Icoaraci and Ananindeua.
- 5) Improve the infrastructure of the Icoaraci Fluvial Shore in order to stimulate the recreational activity.

* Exchange of interests:

This means the negotiation or exchange of interests between the municipality and a construction company. For instance, the company wants to build a 30-story apartment building at a place where the Municipality only allows 20 stories, so the company makes an agreement to allow 30 stories in exchange of something of interest for the Municipality, which can be a residence complex or any other improvement for the Government, without any monetary payment, with the location and interest established by the Government. The above example is only one way of negotiating the "Solo Criado". There are other forms of negotiating land occupancy.

8.2 Socioeconomic Framework

8.2.1 Gross Regional Product (GRP)

(1) Assumption of Economic Growth Rate of Brazil and Para

346. Based on the prospect of Brazilian economy described in 8.1.1, the economic growth rate of Brazil is assumed as follows;

- a. During the period of 1990-95, the shock of the New Economic Plan will remain in the first half(1990-92) and the recovery process will be accelerated in the last half(1993-95). The economic growth rate will be limited to 2.3-2.5% per annum.
- b. The Brazilian economy will enter a new developing period in 1996-2000. The effects of foreign and domestic investments will activate the socioeconomic conditions of the country. The annual growth rate will rise to 5.0-6.0%.
- c. After 2001, as a new economic force in the world trade, Brazil will extend its exports and imports among the growing world economy. The growth rate is expected to reach 6.0-7.0% per annum.

347. For the development of Para in accordance with the above scenario, a target growth rate is set up for each period corresponding to the optimistic case of the national economic growth (refer to Table 8.2-1).

Table 8.2-1 Future Economic Growth Rate of Brazil and Para (%)

Period	Brazil	Para
1990-1995	2.3-2.5	5.0
1996-2000	5.0-6.0	9.0
2001-2010	6.0-7.0	8.5

(2) Future Projection of GRP

348. The future economic growth of the Study Area is assumed to be lower than that of Para and higher than that of Brazil, based on the past trend and the future prospect of the Area.

349. The sector growth rate is determined by considering the future growth possibilities of each sector and the future needs of absorption of labor force with a certain increase in income distribution. The assumed growth rates by sector are shown in Table 8.2-2.

Table 8.2-2 Future Sector Growth Rate of the Study Area's GRP(%)

Sector	1990-1995	1996-2000	2001-2010
Primary	-2.0	-2.0	-2.2
Secondary	2.9	5.9	4.7
Tertiary	4.4	8.2	7.4
Total	4.0	7.6	6.8

350. Applying these growth rates, the future GRP is forecast. Table 8.2-3 shows the forecast results.

Table 8.2-3 Future GRP of Study Area (thousand US\$, %)

Sector	1989	1995	2000	2010
Primary	10,702	9,476	8,562	6,850
Secondary	951,378	1,130,711	1,506,022	2,383,955
Tertiary	2,454,476	3,179,885	4,714,548	9,635,717
Total	3,416,556	4,320,072	6,229,132	12,026,522

8.2.2 Population

(1) Projection of Natural Increase Rate

351. The natural increase rate in the Study Area is declining at a considerably rapid pace, and is estimated to have become lower than the national average in 1989/1990. However, it is difficult to consider that this rapid decline will continue for a long time and that the natural increase rate of the Study Area will go down to a level far below the national average. According to a long-term population projection of Brazil by IBGE (1980-2025), the population increase rate will gradually slow down from 2.01% in 1989/90 to 1.34% in 2009/10.

352. Assuming that the natural increase rate of the Study Area will recover to the national average level of 1.60% in 1999/2000, an annual average rate is adopted for each period as shown in the following Table 8.2-4.

Table 8.2-4 Future Natural Increase Rate (%)

Period	Natural Increase Rate
1990/95	1.75
1995/00	1.63
2000/10	1.57

353. Figure 8.2-1 shows a locus of the change in the natural increase rate.

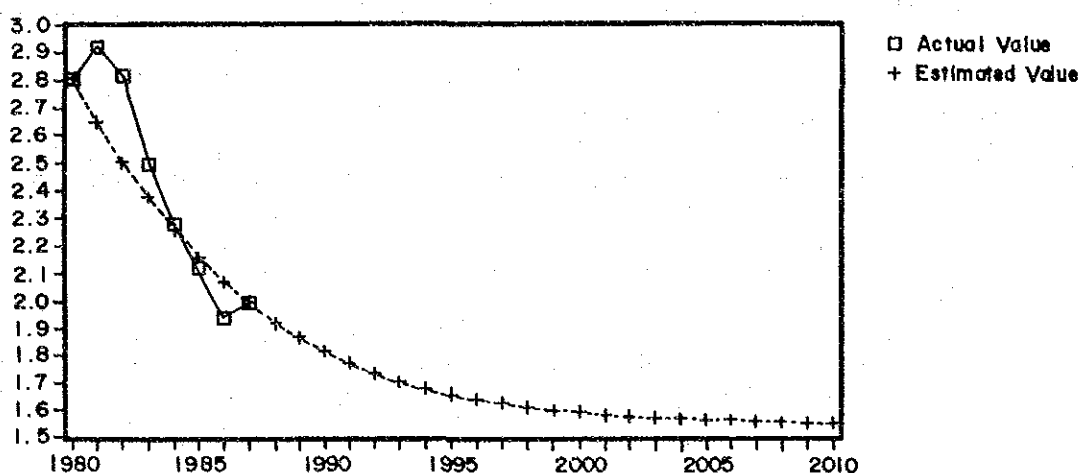


Figure 8.2-1 Projection of Natural Increase Rate

(2) Alternatives of Future Net In-migration Rate

354. The future population growth in the Study Area will be affected by the in-migration. As the capital city of Para, Belem has attracted people from the rest of the State. Furthermore, the difference in the economic growth between Para and Brazil has generated an in-migration from the other States not only to the project sites but also to Belem.

355. It is not easy to get a direct relationship between the size of net in-migration to the Study Area and its economic growth. However, the position of Belem in Para will decline gradually due to the more rapid economic growth of the rest of the State brought about by the large-scale development projects.

356. Considering the above mentioned facts, alternatives of future net in-migration rates are set up in relation to the socio-economic position of the Study Area within Para (refer to Table 8.2-5).

Table 8.2-5 Alternatives of Future Change in Position of Study Area

C a s e	R e m a r k s
Case 1	Future socioeconomic relationships between the Study Area and Para and between Para and Brazil will be almost the same as in the late 1980s.
Case 2	Corresponding to the economic growth of Para outside the Study Area, the position of Belem in Para will suffer a rapid decline.
Case 3	The position of Belem in Para will gradually decrease, but Belem will continue to attract people as a great core of the tertiary sector activities supported by an organized structure of interrelationship among development points and urban cores.

357. The net in-migration rates by case is assumed to be as shown in Table 8.2-6.

Table 8.2-6 Future Net In-migration Rate by Case

	Case 1	Case 2	Case 3
1990/95	1.45	1.25	1.35
1995/00	1.45	0.89	1.17
2000/10	1.45	0.38	0.92

(3) Future Population of Study Area by Case

358. The assumed population increase rates by each case are shown in Table 8.2-7.

Table 8.2-7 Population Increase Rates by Case (%)

		1990/85	1995/00	2000/10
Case 1	N.I. Rate	1.74	1.63	1.57
	I.M. Rate	1.45	1.45	1.45
	P.I. Rate	3.19	3.08	3.02
Case 2	N.I. Rate	1.74	1.63	1.57
	I.M. Rate	1.25	0.89	0.38
	P.I. Rate	2.99	2.52	1.95
Case 3	N.I. Rate	1.74	1.63	1.57
	I.M. Rate	1.35	1.17	0.92
	P.I. Rate	3.09	2.80	2.49

359. Applying the population increase rates shown above, the future population of the Study Area is forecasted by case (refer to Table 8.2-8).

Table 8.2-8 Future Population of Study Area by Case
(thousand)

	1990	1995	2000	2010
Case 1	1,419	1,660	1,932	2,602
Case 2	1,419	1,644	1,862	2,259
Case 3	1,419	1,652	1,897	2,425

360. The differences of future population changes by case are shown visually in Figure 8.2-2.

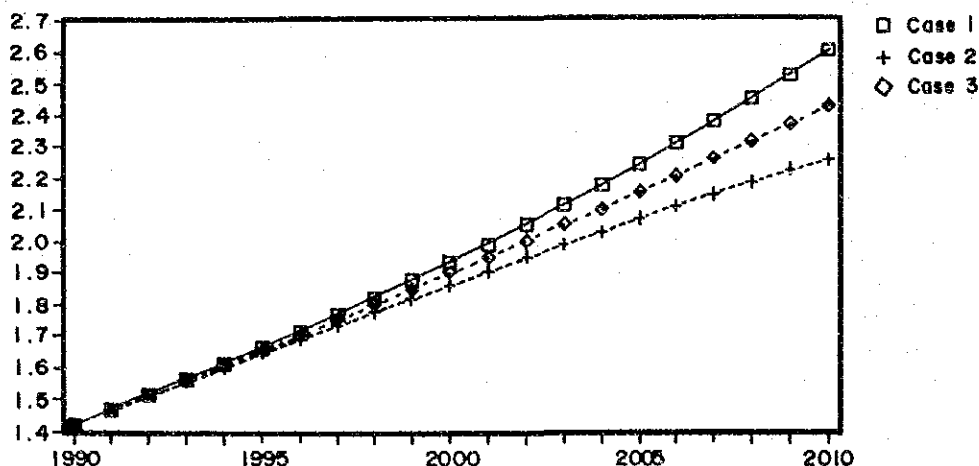


Figure 8.2-2 Population Projection by Case

361. Case 1 assumes that the future net in-migration rate will be constant at the level of 1.45 % realized in the last two years of 1980s. The large scale development projects are expected to be implemented outside the Study Area within Para and the project sites and their surrounding areas will attract more people from the rural areas. Therefore, the net in-migration to the Study Area will certainly decrease. On the other hand, Case 2 assumes that the net in-migration rate will be 0 in 2009/2010. This means that the Study Area will become a closed city.

362. Both Cases 1 and 2 are the extreme cases which will perhaps not occur in the Study Area. Accordingly, Case 3 is employed as the most probable case for further study analyses.

8.2.3 Employment

363. Future projection of employment is made from both sides of labor force, supply and demand. Labor force supply depends on population growth, while labor force demand depends on economic growth.

(1) Labor Force Supply

364. The crude activity rate will rise in the future proportionately as the percentage of working age population goes up. The Study ELETRONORTE forecasts that the crude activity rate of Amazonia will rise from 37.2 % in 1990 to 40.3 % in 1995, 44.4 % in 2000 and 51.0 % in 2010.

365. Supposing that the crude activity rate of the Study Area will change in accordance with the above mentioned upward trend of Amazonia, the future crude activity rate is forecasted as follows: 41.3 % in 1995, 45.5 % in 2000 and 52.2 % in 2010.

366. Labor force supply in the future is calculated by applying these crude activity rates to the projected population by case (see Table 8.2-9).

Table 8.2-9 Future Labor Force Supply
in Study Area (thousand)

Case	1990	1995	2000	2010
Population	1,419	1,652	1,897	2,425
C.A.R.(%)	38.1	41.3	45.5	52.2
Labor Force	541	682	863	1,266

C.A.R.: crude activity rate

(2) Labor Force Demand

367. Results of the Person Trip Survey of the resident employed population working inside and outside the Study Area were shown in Table 2.3-1.

368. Assuming that these ratios were the same in 1989, labor productivity and employment by sector are estimated (refer to Table 8.2-10).

Table 8.2-10 Labor Productivity and Employment by Sector, 1989

Sector	GRP (US\$ 1000)	Labor Productivity (US\$/person)	Employment in Study Area	Resident Employed Population
Primary	10,702	1,811	5,908	6,959
Secondary	951,378	12,218	77,870	79,785
Tertiary	2,454,476	6,480	378,750	384,518
Total	3,416,556		462,528	471,262

369. In accordance with the sector growth rates and GRP described in 8.2.1, future labor force demand is forecast as in Table 8.2-11.

Table 8.2-11 Future Labor Force Demand in Study Area by Sector (Unit: Thousand)

Sector	1989	1995	2000	2010
Primary	6	5	5	3
Secondary	78	93	116	155
Tertiary	379	491	677	1,044
Total	463	589	798	1,202

(3) Supply / Demand Balance

370. If labor force demand outside the Study Area (within commutable distance area) will occur at the same rate as in 1990, future labor force demand in the Study Area and its vicinity can be forecasted as in Table 8.2-12.

Table 8.2-12 Total Future Labor Force Demand in Study Area and its Vicinity (Thousand)

Sector	1995	2000	2010
Primary	6	6	4
Secondary	95	118	159
Tertiary	498	688	1,060
Total	599	812	1,223

Future employed population in the Study Area is determined by the supply / demand balance through the unemployment rate.

371. In 1995, the unemployment rate will be forced to rise to about 12%. Table 8.2-13 shows the labor force supply and demand balance in the population projection.

Table 8.2-13 Labor Force Supply / Demand Balance
(Thousand, %)

Year	Labor Force Supply (A)	Labor Force Demand (B)	Supply/demand Gap (C=B-A)	Unemployment Rate(C/A)
1995	682	599	-83	12.2
2000	863	812	-51	5.9
2010	1,266	1,223	-43	3.4

372. Table 8.2-14 shows the employed population by sector.

Table 8.2-14 Employed Population by Sector, 1990-2010 (Thousand)

Category	Sector	1990	1995	2000	2010
Resident Employed Population	Primary	7	6	6	4
	Secondary	80	95	118	159
	Tertiary	407	498	688	1,060
	Total	494	599	812	1,223
Working in Study Area	Primary	6	5	5	3
	Secondary	78	93	116	155
	Tertiary	401	491	677	1,044
	Total	485	589	798	1,202
Working Outside	Primary	1	1	1	1
	Secondary	2	2	2	4
	Tertiary	6	7	11	16
	Total	9	10	14	21

8.2.4 Income

373. The absolute amount of household income in real terms will rise in proportion to the increase of the per capita GRP, on condition that the ratio of income distributed to the value added will not change (refer to Table 8.2-15).

Table 8.2-15 Projection of GRP per Capita

	1990	1995	2000	2010
GRP (US\$ 1,000)	3,553,218	4,320,072	6,229,132	12,026,522
Population (1,000)	1,419	1,652	1,897	2,425
Per capita (US\$/p)	2,504	2,615	3,284	4,959
Growth Ratio (1990=1)	1.00	1.04	1.31	1.98

From Table 8.2-15, it can be expected that the future average household income will be doubled in 2010.

374. As for the income distribution pattern, the following cases should be considered. One case is that the distribution pattern will be the same as the present one. In this case, all income groups will gain an income increase in proportion to their average income. Another case is that labor force participation (employment) of lower income groups will rise more sharply than higher income groups and as a result the composition of income distribution gained by employed population from lower income groups will increase. Another case is that higher income groups will gain more.

375. Considering that lower income groups are suffering more from unemployment (see Table 8.2-16) and that employment opportunities for youths of lower income groups will increase as education spreads, the second case above-mentioned might be acceptable if unemployment rate will go down in future.

Table 8.2-16 Ratio of Employed to Total Population by monthly Income Quintile Group

Monthly Income Quintile Group	Percentage of Households No	Ratio of Employed to Total Pop. (%)
I	22.7	27.4
II	29.2	32.4
III	12.0	35.5
IV	19.3	38.2
V	16.8	39.5

source: Person Trip Survey, 1990 by Study Team

376. Assuming that the ratio of employed to the total population of each monthly income quintile group will be the same (50.4%) in 2010, and that the average income of workers belonging to lower income groups will increase more sharply than higher income groups, a future income distribution by monthly income quintile groups is obtained (see Table 8.2-17).

Table 8.2-17 Future Household Income Distribution

Monthly Income Quintile Group	Percentage of Households No	Composition of Income Dist.(%)
I	20	7.1
II	20	10.0
III	20	13.2
IV	20	18.0
V	20	51.7

8.2.5 Vehicle Ownership

377. Vehicle registration is managed by DETRAN in the Study Area. The number of vehicle registered has been recorded in every year since 1901. Due to the vehicle registration system the total number of the vehicles now operated is not apparent. At the end of 1989, the total numbers of registered vehicles are as follows;

passenger car	:	106,814	(75.9%)
truck	:	23,362	(16.6%)
bus	:	3,166	(2.3%)
motorcycle	:	7,354	(5.2%)
Total	:	140,696	(100.0%)

378. However, when deducting certain vehicles (older than 13 years for passenger vehicles, 10 years for others), the total numbers of vehicles active are supposed to be as follows;

passenger car	:	76,431	(77.6%)
truck	:	13,950	(14.2%)
bus	:	1,981	(2.0%)
motorcycle	:	6,142	(6.2%)
Total	:	98,504	(100.0%)

379. The number of vehicles for which the owners paid the vehicle tax (IPVA) in 1989 was 86,656 by DETRAN. This number is the same level with the number estimated above taking into consideration the existence of vehicles excluded from tax (older than 15 years and/or government use). Therefore, hereinafter, the vehicle number in operation is estimated using the vehicle number registered in every year (excluding older than 13 years for passenger car, and 10 years for others).

380. The vehicle ownership per 1,000 persons in 1989 is very low compared with those of other cities even in 1981 (refer to Table 8.2-18).

Table 8.2-18 Comparison of Vehicle Ownership
(passenger car per 1,000 persons)

City	Population	Vehicle Ownership
Belem	1,383,000	55.2 (at 1989)
Sao Paulo	12,250,000	187.5 (at 1981)
Recife	2,220,000	89.6 (at 1981)
Salvador	1,880,000	85.5 (at 1981)
P. Alegre	2,318,000	155.0 (at 1981)

source: Estudo da Demanda de Transportes Urbanos
no Brasil, MT/GEIPOT/EBTU 1985

381. Table 8.2-19 shows the relationship among the population, GRP (Para State) and the vehicle number operated above mentioned between 1975 and 1989. Due to the economic recession of the Area in '80s, the growth rate of annual vehicle number registered decreased in this period and the number of operated vehicles is in same level as for last several years.

Table 8.2-19 Number of Vehicle Registered

year	Population	GRP	Pass.Car	Truck	M/cycle	Bus	Total
1975	809.5	810.1	23,666	6,146	1,038	665	31,515
76	844.3	947.4	30,264	6,908	1,074	750	38,996
77	880.6	1,058.7	35,358	7,620	1,135	851	44,964
78	918.5	1,230.9	40,454	8,331	1,211	1,008	51,004
79	958.0	1,459.5	47,447	9,340	1,447	1,163	59,397
80	999.2	1,533.2	54,854	9,942	1,588	1,293	67,677
81	1,037.7	1,359.2	60,401	10,347	1,909	1,387	74,044
82	1,077.7	1,350.6	65,728	10,836	2,321	1,502	80,387
83	1,119.2	1,276.4	71,076	11,091	3,300	1,614	87,081
84	1,162.3	1,224.4	74,992	11,167	3,852	1,681	91,692
85	1,207.2	1,512.8	77,845	11,817	4,370	1,749	95,781
86	1,248.9	1,796.4	80,589	12,632	5,000	1,700	99,921
87	1,292.2	1,967.0	79,044	13,373	5,677	1,861	99,955
88	1,336.9	1,993.2	78,111	13,920	6,034	1,971	100,036
89	1,383.2	1,971.0	76,431	13,950	6,142	1,981	98,504

Note: Population, unit x 1,000 persons, estimated using the number of 1970, 1980 and 1990 data.

GRP, unit x million US\$

Numbers of vehicle operated are the estimation by Study Team.

382. From 1975 to 1985, the vehicle number increased at 11.8 percent per annum. However, in the recent four years, the rate was only 0.7 percent per annum. In order to analyze the past increase tendency, the regression model with the variables of population size and GRP of Para state was examined. The results shows that the major variable is population size. (refer to Table 8.2-20)

Table 8.2-20 Regression Model of Operated Vehicles

Type of Vehicle	a	b	c	r
Passenger car	-921828.0	140797.3	434.3931	0.998
Truck	-84468.8	11558.27	1981.531	0.998
Motor Cycle	-75958.0	12612.50	-1237.16	0.962
Bus	-16457.1	2626.566	-62.6743	0.990

note: $Z = a + b \cdot \ln X + c \cdot \ln Y$

where,

Z: annual vehicle number operated

X: population size in Study Area (1000 persons)

Y: GRP of Para State (million US\$)

a, b, c: constant

383. The income increase by GRP growth seems not to directly relate to the expansion of vehicle ownership because of the gap of high vehicle price and low income level of the majority of the residents in the Study Area. Therefore, the future vehicle ownership of the Study Area is forecasted to stay at a relatively lower level than other cities in Brazil.

384. The Table 8.2-21 shows the results of future vehicle ownership forecasted using the regression model above shown.

Table 8.2-21 Future Car Ownership

year	Pass.Car	Truck	M/Cycle	Bus	Total	Rate/1000 Persons
1989	76,431	13,950	6,142	1,981	98,504	71.2
1995	105,562	16,788	7,750	2,511	128,611	77.9
2000	121,198	19,239	9,958	2,847	153,242	80.8
2005	139,308	21,437	10,090	3,158	174,029	80.8
2010	156,128	23,579	11,080	3,439	194,226	80.1

385. Taking into consideration the possibilities of a substantial reduction in cost of vehicles, and income distribution improvement, the vehicle ownership alternative of 1.5 times of the above forecasted is examined to analyze the influence for the future road network.

8.3 Land Use Plan

8.3.1 Objectives of land use Plan

386. The objectives of land use plan are to show a desirable physical structure of the Study Area and to lay a basic quantitative foundation for transport planning. The increase of resident population is assumed approximately 1 million persons during the coming 20 years, while the increase of employed population is about 730 thousand persons.

387. In accordance with the development policies described in 8.1.4, the land use plan shows the designation of residential, commercial/services, industrial and institutional areas, with a proposed control system.

8.3.2 Future Land Use

(1) Residential area

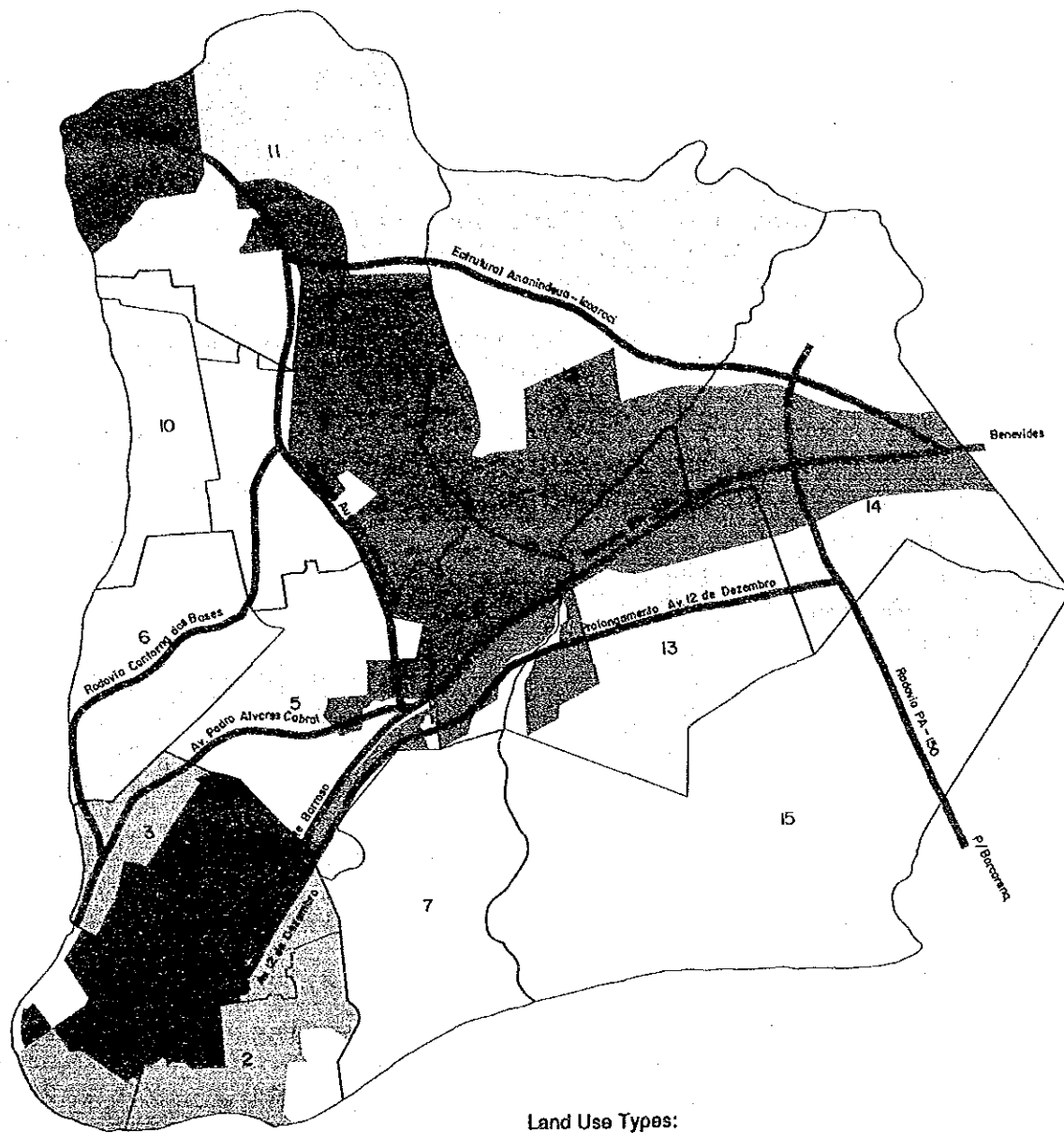
388. There are five types of human settlements for the future. The Table 8.3-1 shows the definition of characteristics of each settlement type, based on the criteria of population density, building types and social classifications of residents. They are as follows;

- Type-A: High-rise high-densely settlement in Central area
- Type-B: Low-rise high-densely settlement in Central area
- Type-C: Medium-density settlement in Outskirts area
- Type-D: Low-density settlement in Outskirts area
- Type-E: Settlement within special areas
 - (E1) Settlement in "Historical conservation area"
 - (E2) Settlement adjacent to "Environmental reservation area for water reservoir"

Table 8.3-1 Designation of development typology for settlement

Types	Population density	Predominant building types	Social classifications
Type-A:	High-density	High-rise apartments	High to medium
Type-B:	High-density	Low-rise attached	Medium to low
Type-C:	Medium-density	Low-rise apartments	Medium
Type-D:	Low-density	Detached houses	Medium to low
Type-E:	Low-density	-	-

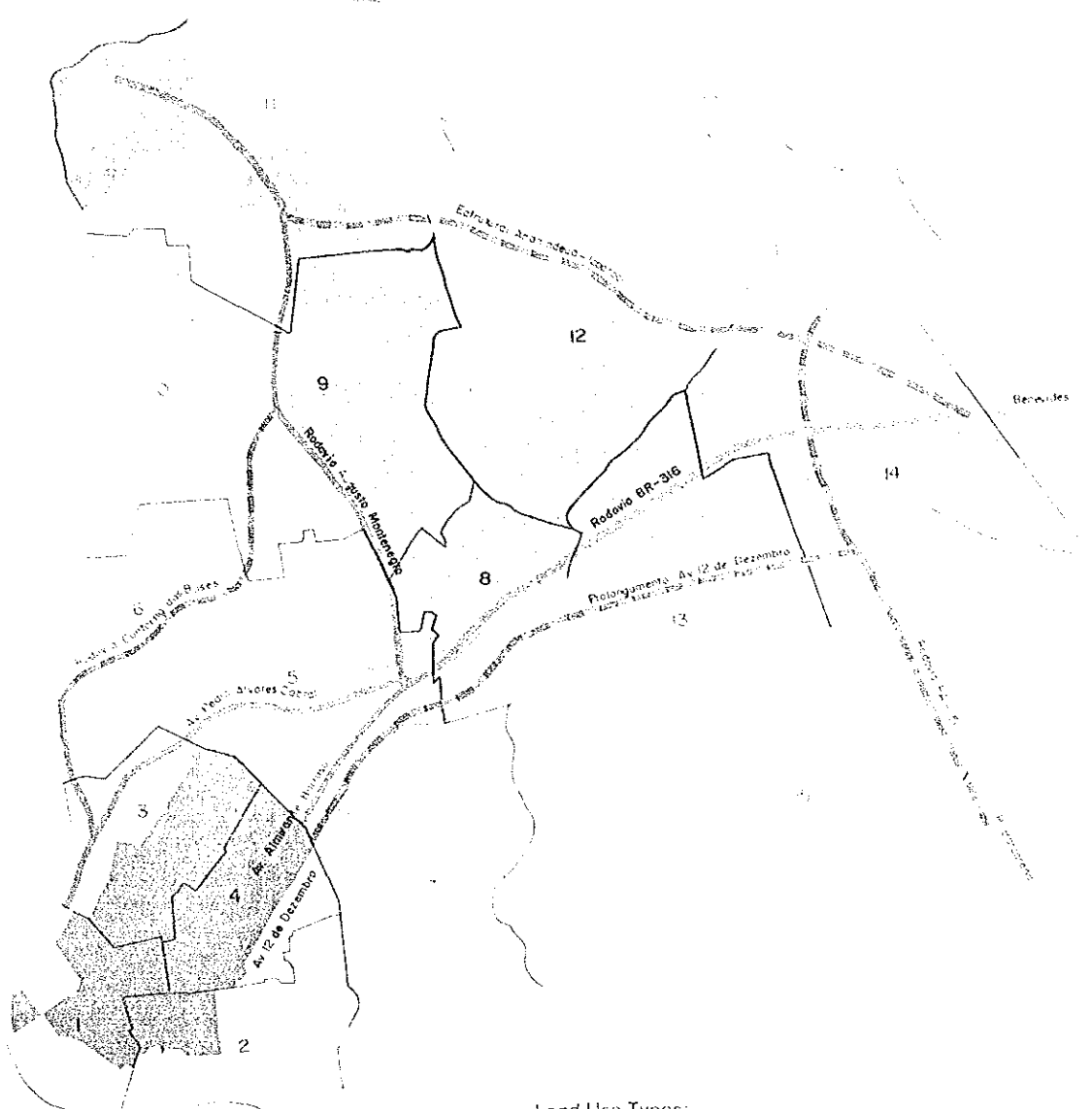
389. Figure 8.3-1 and Table 8.3-2 show the allocation for each settlement type in the Study Area, to create the future residential area. Total habitable land in future is designated 27,641 ha, and it comprises 44% of the whole Study Area.









- Land Use Types:**
- Type-A: High-risen Settlement within Central Area
 - Type-B: High-densely Settlement within Central Area
 - Type-C: Medium-densely Settlement in Outskirts Area
 - Type-D: Low-densely Settlement in Outskirts Area
 - Type-E1: Settlement within Historical Conservation Area
 - Type-E2: Settlement beside Environmental Reservation Area for Water Reservoir



Figure 8.3-1 Residential Land Use Plan



- Land Use Types:
-  Type-A: High-risen Settlement within Central Area
 -  Type-B: High-densely Settlement within Central Area
 -  Type-C: Medium-densely Settlement in Outskirts Area
 -  Type-D: Low-densely Settlement in Outskirts Area
 -  Type-E: Settlement within Historical Conservation Area
 -  Type-E: Settlement beside Environmental Reservation Area for Water Reservoir

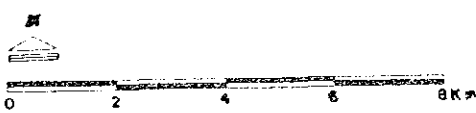


Figure 8.3-1 Residential Land Use Plan

Table 8.3-2 Allocation of residential area by blocks (Unit:ha)

Blocks	Type-A	Type-B	Type-C	Type-D	Type-E	Total
Block A	1,850	1,641	-	-	37	3,528
Block B	-	-	1,367	14	180	1,561
Block C	-	-	2,662	2,542	539	5,743
Block D	-	-	3,321	6,175	-	9,496
Block E	-	-	-	7,313	-	7,313
Total	1,850	1,641	7,350	16,044	756	27,641
(%)	6.7	5.9	26.6	58.1	2.7	100%

Note: The total area of 27,641ha represents the habitable land in the Study Area, which excludes the zones of Industrial, Institutional and Rural.

390. The breakdown of the residential area allocation by integrated zone is shown in Table 8.3-3.

Table 8.3-3 Allocation of residential area by integrated zones

Zones	Type-A	Type-B	Type-C	Type-D	Type-E	Total
1. Centro	497	274	-	-	37	808
2. Guama	197	733	-	-	-	930
3. Sacramento	577	426	-	-	-	1,003
4. Marco	579	208	-	-	-	787
5. Marambaia	-	-	954	-	180	1,134
6. Aeroporto	-	-	413	-	-	413
7. Embrapa	-	-	-	14	-	14
8. Guanabara	-	-	528	-	247	775
9. Bengui	-	-	1,478	777	-	2,255
10. Pratinha	-	-	-	545	-	545
11. Icoaraci	-	-	1,056	1,511	-	2,567
12. Cidade Nova	-	-	1,133	2,782	-	3,915
13. J. Seffer	-	-	656	1,220	292	2,168
14. Ananindeua	-	-	1,132	1,213	-	2,345
15. Aura	-	-	-	669	-	669
16. Outeiro	-	-	-	2,158	-	2,158
17. Ilhas	-	-	-	-	-	-
18. Mosqueiro	-	-	-	5,155	-	5,155
Total	1,850	1,641	7,350	16,044	756	27,641

Notes: Block A= zones 1 to 4.
 Block B= zones 5 to 7.
 Block C= zones 8,9,10 and 13.
 Block D= zones 11,12,14 and 15.
 Block E= zones 16 to 18.
 (unit:ha)

1) Settlement Type Allocation in Central Area

391. The domain of Type-A settlement covers from "Centro" to "Marco" via "Sao Braz", along Nazare street. This area is the most developed urban environment. At the present time population density is not so high in the Study Area, however it is necessary to promote more high-density high-rise urban complexes within these areas. At this time, these areas are corresponding to zones of Commercial/Services, Mixed use M-1, Habitational H-6 and H-7 in the current Development Control Plan (DCP).

392. Type-B covers the outer areas of above-mentioned Type-A area. The topographical condition is lowland facing Guajara Bay and Guama River. Currently the population density is the highest in the Study Area, reaching 227 persons/ha (net density). Therefore population increase is not expected to be so high compared with Type-A areas in the future. At this time, these area are corresponding to Habitational zone of H-4 in the current DCP.

393. "Cidade Velha" is the oldest district in the City of Belem. At the western edge of this bairro, there are concentrated many old and valuable buildings. For the purpose of conservation of historical environment so as to protect the cultural heritages of Belem, it is necessary to control the development activities within this area. These areas are corresponding to Habitational zones H-2 and H-3 in the current DCP. (It means a limited population density of 110 to 170 persons/ha in cases of minimum and maximum standards. Type-E1)

394. The Table 8.3-4 shows the breakdowns of three types of settlement to each traffic zone in Central area.

Table 8.3-4 Zonal allocation of settlement types (unit:ha)

Traffic Zones	Habitable land	Settlement types			Corresponding bairros
		Type-A	Type-B	Type-E1	
Zone 1	117	14	66	37	Cidade Velha
Zone 2	95	95	-	-	Comercio
Zone 3	143	143	-	-	Batista Campos
Zone 4	229	21	208	-	Jurunas
Zone 5	73	73	-	-	Reduto
Zone 6	151	151	-	-	Nazare
(I. zone 1)	808	497	274	37	
Zone 7	148	148	-	-	Cremacao
Zone 8	172	-	172	-	Condor
Zone 12	372	49	323	-	Guama
Zone 19	238	-	238	-	Terra Firme
Zone 20	0	-	-	-	Guama (UFPA)*
(I. zone 2)	930	197	733	-	
Zone 9	247	176	71	-	Umarizal
Zone 13	234	26	208	-	Telegrafo
Zone 14	147	-	147	-	Sacramenta
Zone 15	375	375	-	-	Pedreira
(I. zone 3)	1,003	577	426	-	
Zone 10	63	63	-	-	Fatima
Zone 11	167	161	6	-	Sao Bras
Zone 16	288	202	86	-	Marco (southern)
Zone 17	199	153	46	-	Marco (northern)
Zone 18	70	-	70	-	Canudos
(I. zone 4)	787	579	208	-	
Total	3,528	1,850	1,641	37	(18 bairros)

Note: *UFPA= Federal University of Para

2) Settlement Types Allocation of Outskirts Area

395. Table 8.3-5 shows the zonal allocation of Type-C settlement. The domain of this type covers the triangle zone linking three focal areas, such as "Entroncamento", "Ananindeua" and "Icoaraci". After 1970's, rapid urban expansion evolved along BR-316 and Rd. Augusto Montenegro, and numbers of residential estates were constructed in these axles.

Table 8.3-5 Zonal allocation of settlement (ha)

Zones	Area			Total
	Type-C	Type-D	Type-E2	
Zone 5	954		180	1134
Zone 6	413			413
Zone 7		14		14
Zone 8	528		247	775
Zone 9	1478	777		2255
Zone 10		545		545
Zone 11	1056	1511		2567
Zone 12	1133	2782		3915
Zone 13	656	1220	292	2168
Zone 14	1132	1213		2345
Zone 15		669		669
Zone 16		2158		2158
Zone 17				0
Zone 18		5155		5155
Total	7350	16044	719	24113

396. Table 8.3-5 also shows the zonal allocation of Type-D settlement. This type covers the outer areas of Type-C in the continental area and western parts of islands of Outeiro and Mosqueiro.

397. Table 8.3-5 also shows the zonal allocation of Type-E2 settlement. This type means the settlement adjacent to environmental preservation area for water reservoir, located along to BR-316, on the left side from "Marco" to "Entroncamento". For the purpose to preserve the environment of water reservoir from the pollution of human activity, limited development is expected in the future.

(2) Commercial and Services Area

398. Table 8.3-6 shows the present distribution of companies in the Study Area. There is a strong concentration in Central area (blocks A1 and A2). Wholesale shows 65.8%, retail 71.3%, services 79.5% and average of the three kind of tertiary industry is 73.3%.

Table 8.3-6 Present distribution of commercial and services

Blocks	Number of companies				Composition (%)			
	Wholesale	Retails	Services	Total	Who.	Ret.	Ser.	Tot.
Block A1	634	4238	2830	7702	32.9	31.5	40.5	34.4
Block A2	633	5357	2722	8712	32.9	39.8	39.0	38.9
Block B	201	1235	571	2007	10.4	9.1	8.2	9.0
Block C	181	990	390	1561	9.4	7.4	5.6	7.0
Block D	260	1438	429	2127	13.5	10.7	6.1	9.5
Block E	6	166	21	193	0.3	1.2	0.3	0.9
missing	11	43	23	77	0.6	0.3	0.3	0.3
Total	1926	13467	6986	22379	100%	100%	100%	100%

Source: SEICON data, 1989

399. Proposed land use policies recommended that the new urban center system be introduced in the Metropolitan Region of Belem in the future, for the purpose of decentralization of urban center. This hierarchical system is considered as follows:

- a. Repromotion of the CBD
Designation of 550ha in the mid-central area for rejuvenating the Central Business District of Metropolitan Region of Belem, also the core city of the State of Para.
- b. Promotion of the metropolitan sub-center
Designation of 380ha in the center of Ananindeua Municipality to support the CBD.
- c. Promotion of the local centers in the Study Area
Designation of two areas, the center of Icoaraci (220ha) and Entroncament (130ha), to support the district community activities.

(3) Industrial Area

400. Total area of 1,598ha (2.6% of Study Area) is occupied for industrial land use. The principle areas are concentrated in the following specific zones (refer to Table 8.3-7):

- a. In the Central area, there are numerous small-scale factories located in the commercial and residential

- areas, so called "mixed-use".
- b. In coastal area along to the Guajara bay, there are largescale factories with jetties for exclusive use.
- c. There are two medium-scale industrial estates under implementation: industrial districts of Icoaraci and Ananindeua. The organization in charge of these estates is the "Company of Industrial Districts of Para (CDI-Pa)".

Table 8.3-7 Present situation of industrial area and work-place

Areas	Area (ha)	No. of work-place 1990(persons)	
Central area	61	46893	58.9%
Guajara bay-front	284	1772)	
Icoaraci (IDI)	357	6609)	15.7
Ananindeua (IDA)	619	4130)	
Other areas	277	20277	25.4
Total	1598	79681	100%

401. As shown in Figure 8.3-2 no new industrial area is added to the present ones. In connection with the formation of urban sub-centers two (2) industrial districts are expected to become in full operation.

(4) Institutional Area

402. As shown in Table 8.3-8, 6,831 ha or 11% of the Study Area is designated occupied as institutional areas. Those are concentrated in Block B of "Transition area".

Table 8.3-8 Distribution of institutional area

Blocks	Designated area (ha)	Percentage of total area
Block A	185	5.0%
Block B	3,287	67.6
Block C	498	7.7
Block D	2,024	12.6
Block E	837	2.6
Total	6,831	11.0%

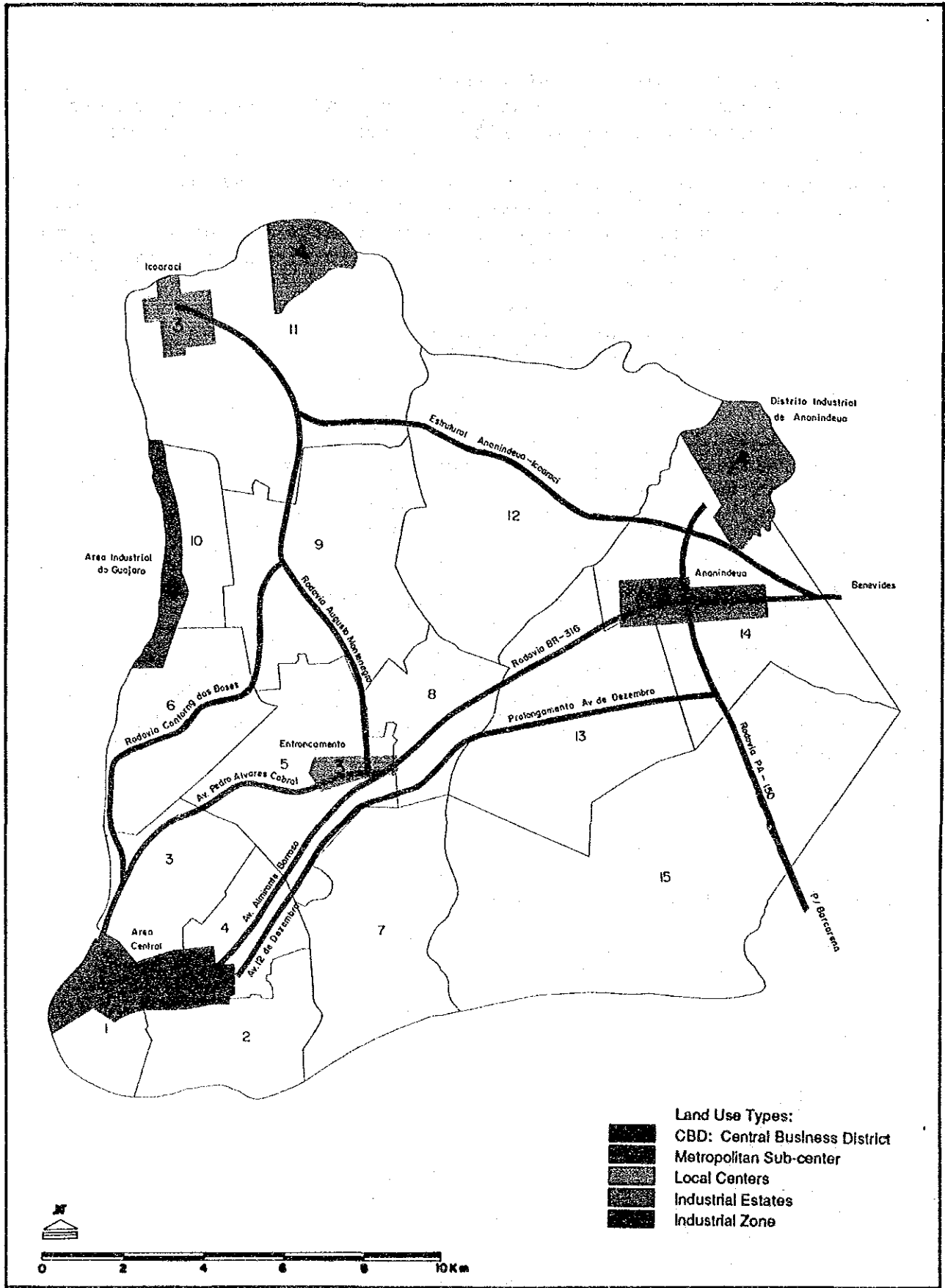


Figure 8.3-2 Urban Center and Industrial Land Use Plan

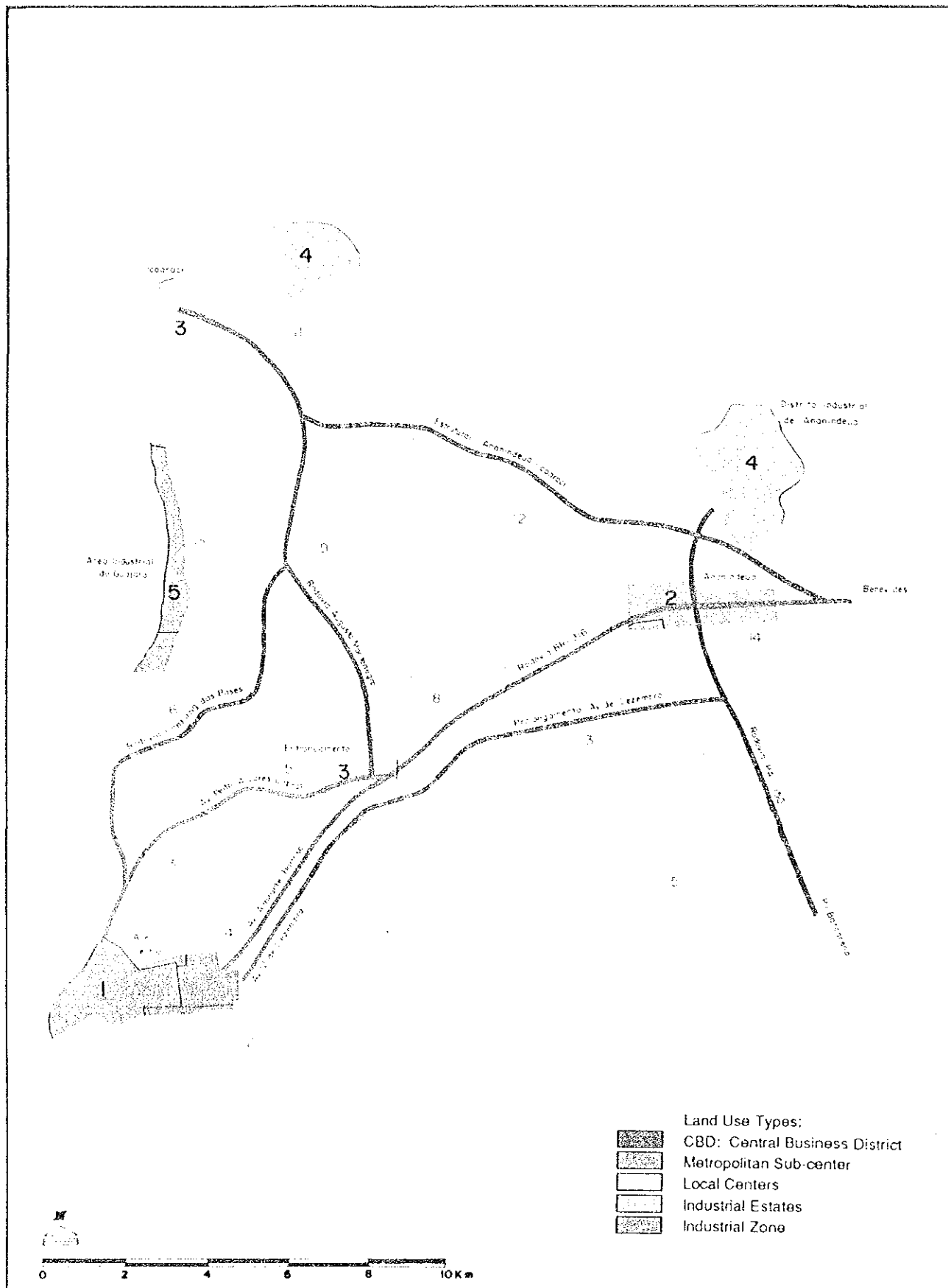


Figure 8.3-2 Urban Center and Industrial Land Use Plan