6. Urban Transport Administration

6.1 Organization of Transport-related Agencies

1) General

The construction, maintenance and operation of transportation facilities and the management of traffic in the Greater Cairo Region (GCR) are carried out by various organizations under the administrative jurisdiction of the Ministry of Transport (MOT), the Ministry of Development (MOD), the Ministry of Interior (MOI), the Secretariat of Local Government (SLG), and the Governorates of Cairo, Giza and Qaliubiah.

(1) Roads

Three separate administrative bodies are responsible for the construction and operation of roads; Road and Bridge Authority (MOT), Executing Agency for GCR Projects (MOD), and the Directorates of Roads and Transportation in the Governorates.

The Road and Bridge Authority (RBA) undertakes the construction of inter-governorate (inter-city) arterials, while the Executing Agency for GCR projects (EAGCR) undertakes the construction of roads involved in urban or regional development (such as Ring Road). The Governorates are responsible for the construction of intra-governorate roads and the maintenance and operation of all roads that are situated within their respective governorates, including those constructed by the RBA and EAGCR.

Public development companies, such as HCHD and Nasr City Development Co., plan and construct the roads in the new areas that are developed by them, and then hand the roads over to the districts where the development occurs.

(2) Trams and Buses

The Cairo Transport Authority (CTA) and Heliopolis Company for Housing and Development (HCHD - Transport Sector) undertake the construction and operation of the tram systems.

CTA is supervised by Cairo Governorate, and HCHD, in view of the need to maintain coordination with Heliopolis urban development projects, is guided by the MOD.

Buses are operated by the CTA. Here also the CTA is under the supervision of the Cairo Governorate.

(3) Railways

Rail transport systems are managed by the Egyptian National Railways (ENR), which is an authority belonging to MOT.

(4) Regional Metro

The Regional Metro is currently operated by a department within the ENR. Plans are in progress to form an independent department under MOT in the near future; the National Metro Subway Organization (NMSO). The actual construction of subways, however, is currently the responsibility of the National Authority of Tunnels, another MOT authority.

(5) Traffic Management

The Cairo Traffic Police (CTP), which is composed of personnel dispatched from the MOI, carries out the duties of traffic management in each governorate, at the request of the Governorate, but under the technical guidance of MOI. National highways traffic management is enforced by the Central Traffic Department (CTD) of MOI. Fig. 6.1.1 shows the relationships between the executing agencies and supervisory organs described above.

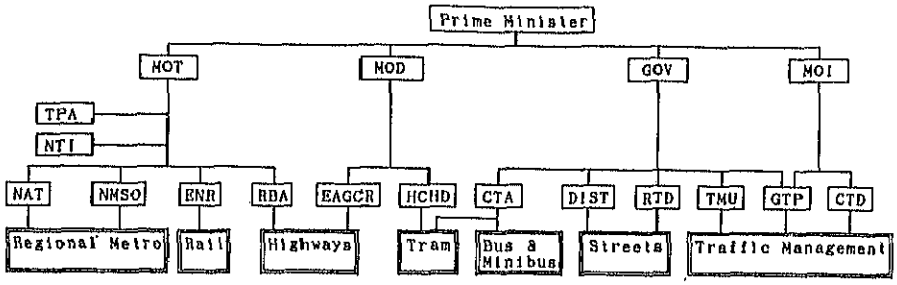


Fig. 6.1.1 Organizations Related to Transportation

2) Executing Agencies

(1) Governorates

The Housing Directorate, Roads and Transport Department, Mechanical and Electrical Department, Traffic Management Unit (found only in Cairo Governorate) and the Traffic Police have the following transportation-related functions, as shown in Fig. 6.1.2 (for Cairo Governorate), and below.

a. Housing Directorate
   Planning and designing related to traffic flow management (Traffic Management Division of the Planning Section).

b. Roads and Transport Department (RTD)
   Construction and maintenance of roads and bridges.

c. Mechanical & Electrical
   Installation of traffic signals, roadway illumination, etc.

d. Traffic Police
   On-site traffic management.

e. Traffic Management Unit
Planning and designing of traffic management system.

f. Town Planning Section
Planning of new roads, new ROW for existing roads, and zoning regulations.

g. Districts (Dist.)
Maintenance and cleaning of roads.

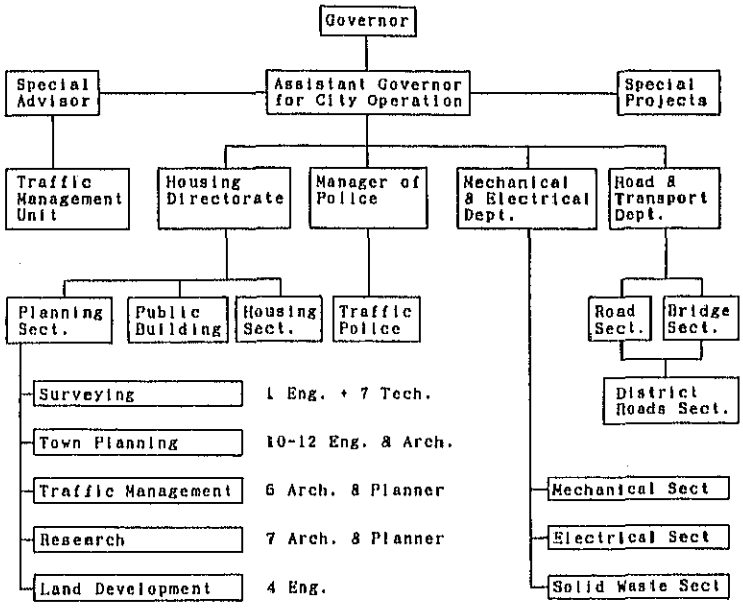


Fig. 6.1.2 Cairo Governorate Organization

All the above agencies, except for the Traffic Management Unit, are at the operational level and are not involved in the formulation of plans that take into account regional or broader-based traffic needs.

Formulating concrete plans for traffic management by the Traffic Police, is done by the Traffic Management Division of the Housing Directorate. However, the division, which is composed of six architects and planners, cannot be said to be functioning effectively, considering their inadequate experience in the field among other factors. In actual practice, the Governor, an adviser or consultant, or the Traffic Police draw up the plans.

The Traffic Management Unit (TMU), within Cairo Governorate has been established to function as a "planning" unit dealing with traffic management. Establishment of the unit was recommended in the World Bank's CBD study report, with a set up that includes sections for traffic planning, parking, traffic design, traffic signals, traffic safety, traffic operations and traffic survey. The TMU is comprehensively concerned with traffic management affairs.

At present, only a manager has been appointed and the unit is at the starting point to develop its staff. The unit is aiming at playing a role for compiling a traffic management plan, design and evaluation, on which operational entities such as housing directorates, and departments for facilities and equipment, parking management and traffic police shall cooperate together.

At the district level, there is the Roads Department, which is responsible for the supervision of construction, operation and maintenance of roads within the district boundaries. These district departments are supervised by the Road and Transport Directorate of the respective governorates.

(2) Cairo Transport Authority

An organization chart of the CTA is given in Fig. 6.1.3. Departments in charge of finance and administration, operations and maintenance, and operations planning come under the chairman and are each supervised by a vice chairman. In addition, there are the Personnel Department in charge of security, legal affairs and public relations, and the Training Department in charge of training planning and training center management.

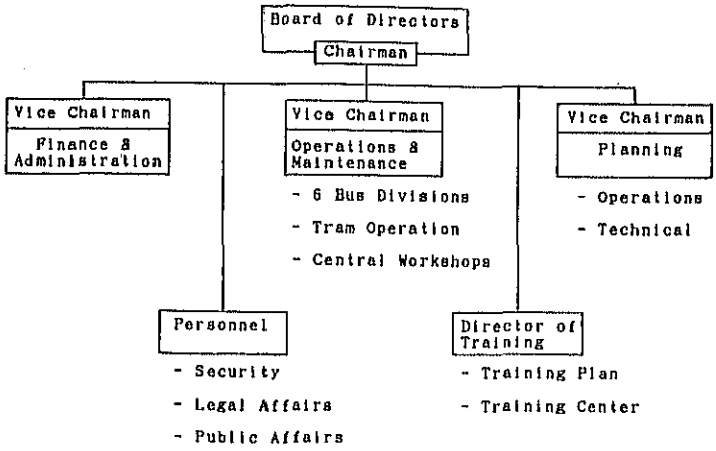


Fig. 6.1.3 Organization of CTA

The CTA is an independent authority and its budget comes directly from the Ministry of Finance. The Governor of Cairo oversees the activities of CTA, and Giza and Qaliubiah Governorates are represented in the CTA's board of directors.

The CTA operates buses, trams, minibuses and river buses in the Greater Cairo Region. In addition the Greater Cairo Bus Co., which runs some bus lines in GCR, is a company within the CTA.

(3) Heliopolis Company for Housing and Development

The Transport Sector and the Housing & Utility Department, the two operating arms of the HCHD, are directly under the chairman (Fig. 6.1.4). The Governor of Cairo is currently acting as chairman of HCHD by the request of the MOD, which supervises the HCHD. About 60% of HCHD personnel are attached to the Transport Sector, indicating the sector's importance within the company. The sector is divided into the Railway & Network Section and Working & Maintenance Section. Concerning the Heliopolis Metro development plan, the sector manager, who is also a member of HCHD board of directors, is in sole charge.

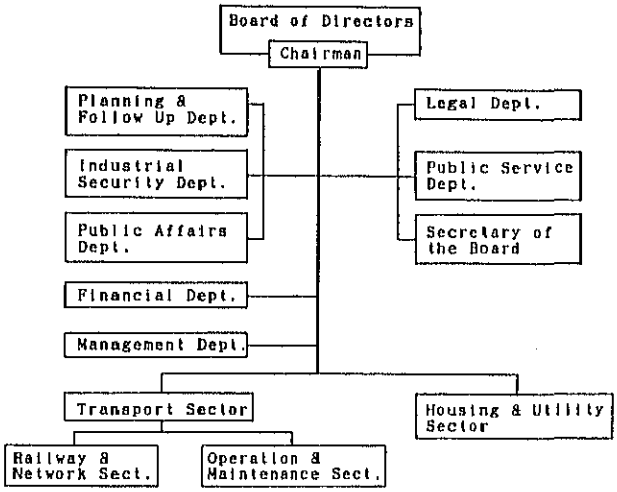


Fig. 6.1.4 Organization of HCHD

The main activity of HCHD is the development of new housing areas in Heliopolis and Nozha areas, through planning, design and construction, and then selling the developed housing. Development also includes the construction of roads, which HCHD then hands over to the districts concerned, for operation and maintenance.

(4) Egyptian National Railways

The two operating arms of the ENR are the Technical Department and Operating & Regions Department (Fig. 6.1.5). The former is in charge of signaling, new construction, and engineering, while the latter is divided into the Operating Division, which is in charge of actual operations, and several regional divisions. In the management sector are the Administration, Finance, Purchasing, and Planning Departments. ENR is an authority belonging to MOT.

At present urban transport activities of the ENR include operation and maintenance of the Regional Metro, Al Marg line, and trains running between the stations of Shubra Al Kheima, Ramses and Giza.

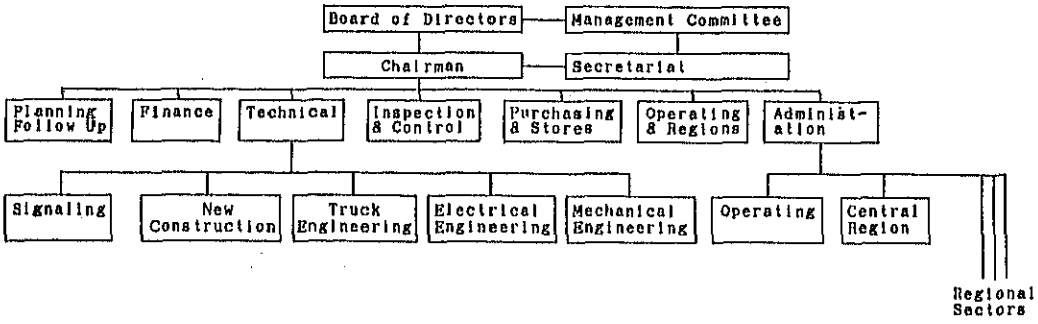


Fig. 6.1.5 Organization of ENR

(5) General Organization for Physical Planning

GOPP is one of the organizations of MOD, and the Master Scheme for GCR was prepared by this organization (Fig. 6.1.6). Managerial sections are directly under the control of the chairman. Regional Planning and Programs Section, and General Research, Studies and Planning Section, the two research arms of the GOPP, are under the control of the two vice chairmen.

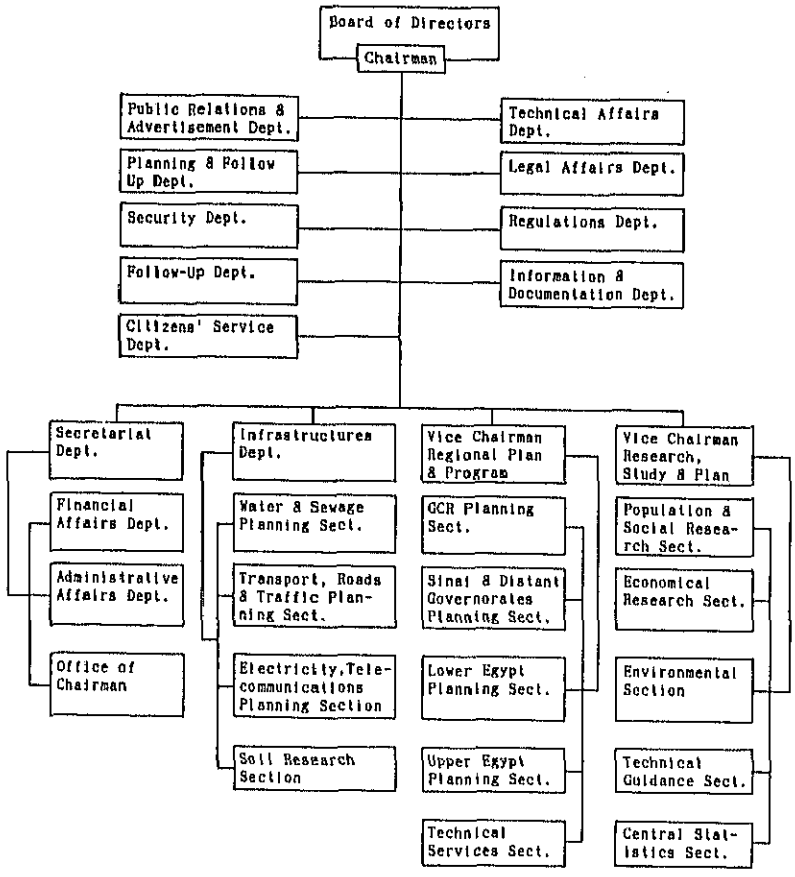


Fig. 6.1.6 Organization of GOPP

(6) Executive Agency for GCR Projects

This is an executing agency belonging to the MOD, which contracts for and supervises construction projects within the GCR. Organization chart is shown in Fig. 6.1.7.

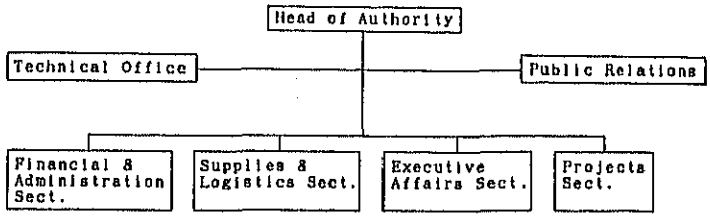


Fig. 6.1.7 Organization of EAGCR

(7) National Authority for Tunnels

NAT was established to construct the subway section of the Regional Metro line, and renewal of the Helwan and Marg lines which the subway connects together. NAT is an authority belonging to the MOT, and is chaired by a chairman and has one vice chairman (Fig. 6.1.8).

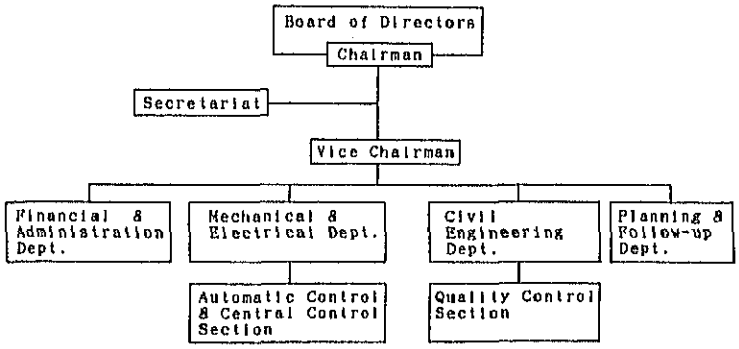


Fig. 6.1.8 Organization of NAT

(8) National Metro Subway Organization

The National Metro Subway Organization (NMSO) is currently part of the ENR and is operating the Helwan - Cairo line. It is expected to be separated from the ENR in the near future. The kind of setup shown below is envisioned for the new organization. Below the director, the Working & Research and Maintenance & Rolling Stock Departments on the operations side, and the Finance and Administration Departments on the management side are provided (Fig. 6.1.9).

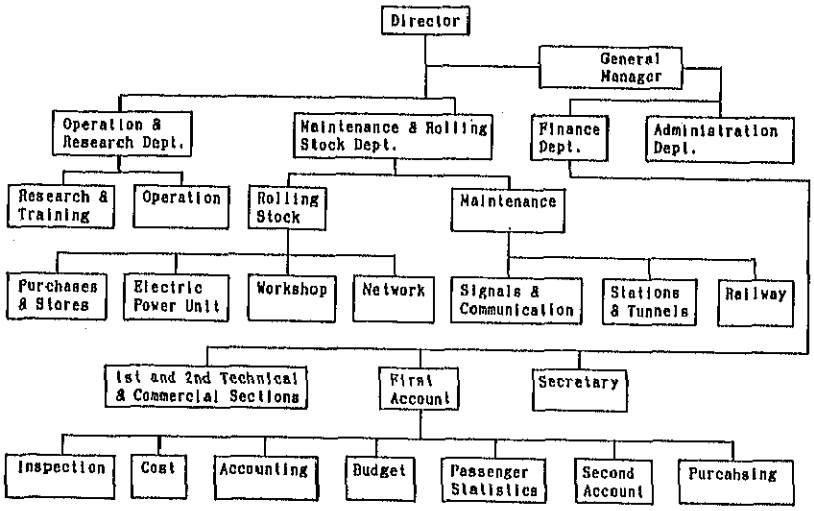


Fig. 6.1.9 Organization of NMSO (Planned)

3) Planning and Research Agencies

(1) The Ministry of Planning

The Ministry of Planning is responsible for the coordination and finalization of the annual capital budget plans of central ministries and governorates, and determining investment priorities within the overall budget allocation determined by the Ministry of Finance. The plan is submitted to the council of governors, the council of ministers and the people's assembly for their approval.

The process goes institutionally through the bottom up approach from the local level to the central. However, the central government, the Ministry of Planning, has the responsibility for giving priority ranking to the submitted projects and interacts with governorates which are responsible for the regional planning within their boundaries. The Ministry of Development is responsible for projects with some governorates or some ministries.

(2) Transport Planning Authority

A part of the MOT, the Transport Planning Authority (TPA) is involved in basic research and studies for the planning of inter-governorate (inter-city) and national transport systems, which are the responsibility of the MOT. Although the TPA conducts research for railway and subway construction, it does not do so from the standpoint of intra-urban transport.

(3) Development Research and Technological Planning Center (DRTPC)

The Center, an autonomous research institution established within the University of Cairo, conducts research on development technologies under consignment from the central government, governorates or private enterprises. There is no permanent research staff; personnel are hired temporarily from among the university teaching and research staff each time there is a consignment.

Following the development of a modal split model for intercity transport jointly with the Massachusetts Institute of Technology, the center has successfully completed a number of transportation-related research under consignment from the MOT. One of the center's most recent study was related to the Regional Metro line, in cooperation with French consultant Sofretu.

(4) National Transport Institute

The National Transport Institute is Egypt's sole educational facility devoted to the provision of general education in traffic engineering and planning. The institute comes under the control of the MOT and is operated by MOT budget, tuition income and research consignment fees. (MOT trainees' tuition is free, but those from other ministries and governorates are charged tuition).

The educational program covers all transport modes in general, and no special emphasis is placed on urban transport in particular. Computer education centering on data processing is also provided.

The faculty consists entirely of persons concurrently serving in other posts at the same time: the director is also a professor at Cairo University, and the professors of the Institute are all involved in transportation-related studies at national universities. In addition, Britain's Overseas Development Agency, which aided the establishment of the institute, has dispatched experts to the institute to act as advisors and instructors.

(5) National Science Academy

The academy provides training programs for ministries and agencies in general at the request of such ministries and agencies. The academy belongs to the Ministry of Education. So far, it has never conducted training in the transportation field, although it has done research in that field, such as the traffic accidents research carried out over a number of years in Cairo. A feature of the academy is that it maintains and manages a store of remote sensing data and that it is equipped to process and manage a large volume of data base material.

4) Implementation Stages of Some Major Projects

Table 6.1.1 lists some of the major transport projects executed recently in GCR, and the agencies responsible during the various stages of the project.

Table 6.1.1 Stages of Major Transport Projects by Agency Involved

Project Name	Planning	Design	Finance	Implementation	Operation	Maintenance
1. Ring Road	MOD	Consultant	MOD	Public Co.	Under Construction	Under Construction
2. Autostrade	MOD	Consultant	MOD	Public Co.	Road & Transport Direct., Cairo Gov.	Road & Transport Direct., Cairo Gov.
3. 6th Oct. Br.	Cairo Gov.	Consultant	Cairo Gov.	Public Co.	Road & Transport Direct., Cairo Gov.	Road & Transport Direct., Cairo Gov.
4. Airport Br.	Cairo Gov.	Consultant	Cairo Gov.	Public Co.	Road & Transport Direct., Cairo Gov.	Road & Transport Direct., Cairo Gov.
5. 26th July Br.	Cairo Gov.	Consultant	Cairo Gov.	Public Co.	Road & Transport Direct., Cairo Gov.	Road & Transport Direct., Cairo Gov.
6. Regional Metro	MOT	French Consultant	Foreign Loan and MOT	NAT and Foreign Company	ENR	ENR
7. Port Said Tram Extension	CTA	CTA	CTA	Public Co.	CTA	CTA
8. Attaba & Opera Multistory Garages	Cairo Gov.	Foreign Loan and Cairo Gov.	Cairo Gov.	Cairo Gov.	Cairo Gov.	Cairo Gov.
9. Minibus	CTA	CTA	CTA	CTA	CTA	CTA
10. Tahrir Sq. Traffic Plan	Cairo Gov.	Consultant	Cairo Gov.	Public Co.	Road & Transport Direct., Cairo Gov.	Road & Transport Direct., Cairo Gov.

Source: Study Team Counterparts Investigation

6.2 Financial Conditions

1) Financing Process in Urban Development

The Governorates, Ministry of Development, and Ministry of Transport are concerned with urban development. There are four kinds of funds for the development; national budget for approved projects, foreign aid, collection of local taxes, and special fund such as fares or tax charged to finance the project.

(1) Funds for Governorate

Local taxes, which are the governorates' direct source of revenue, consist of those levied uniformly by all Governorates in accordance with the Local Government Act and those levied variously by the Governorates in accordance with their own legislation. The two together, however, are insufficient for covering personnel expenses and other current account expenditures required by the governorates, and subsidies from the central government are also relied upon. Such subsidies amount to about the same as local tax revenues. Thus, the Governorates are unable to use any of their local tax revenues for investment purposes.

Transportation investment made by the Governorates are financed by the following funds as shown in Fig. 6.2.1: those received from the Ministry of Finance (MOF) through the National Investment Bank (NIB) in accordance with approved plans; loans

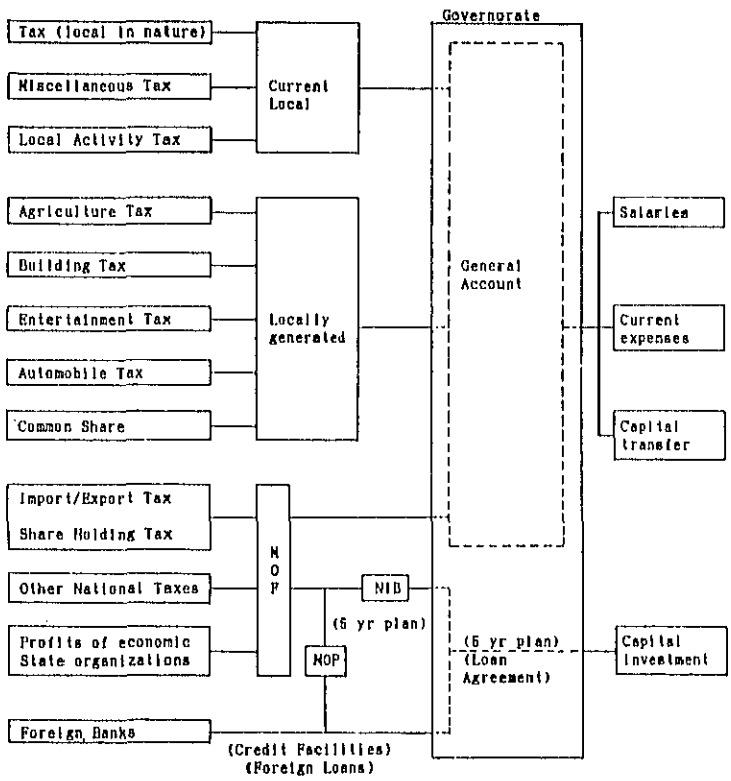


Fig. 6.2.1 Funds for Capital Investement in Cairo Governorate

and grants from foreign aid organizations; and funds originating in the gasoline tax, received from the Secretariat of Local Government.

(2) Foreign Aid

As a rule, an agreement is signed between the executing organization and the foreign organization providing the aid, subject to the approval of the Ministry of Planning. Based on this agreement, funds are made available to the executing organization, which duly repays its borrowings at a later date.

(3) Special Funds

Special funds created specifically for transportation investment include the road special fund, which is based on the 2 pt/lit levied as part of the gasoline tax. First, 30% of the total revenue is turned over to the RBA of the MOT for road investment. The remaining 70% is allocated to the Governorates in accordance with the apportionment schedule determined by SLG. The road special fund is to be used only for road construction and maintenance, and may not be used for traffic management process such as the installation of signals and road markings.

As shown in Table 6.2.1, road special funds totaled 42.2 million LE on a nationwide basis in 1987/88, corresponding to more than half of the 79.3 million LE allocated for road investment from the general account under the five-year plan. The three Governorates in the Greater Cairo Region received about 25% of the total, indicating that the money is being dispersed over a wide area. Taking into consideration the fact that MOD and RBA also have road investment in the Greater Cairo, special funds correspond to only about 10% of road investment made in the GCR on the basis of other sources.

Table 6.2.1 Road Investement Fund of Governorate

(unit: million LE)

Fund	Special Fund	5 Year Plan	Total
Governorates			
Cairo	7.0	32.0	39.0
Giza	2.0	6.8	8.8
Qaliubiah	1.5	3.6	5.1
Egypt Total	42.2	79.3	121.5

(4) Toll System

Fares are charged on railways, trams and buses. In order to maintain the public benefit of these facilities, the establishment and revision of fares require the approval of either the Cairo Governor (trams and buses) or the Minister of Transport (railways). Where a revision is thought to create an impact that

exceeds the bounds of administrative judgment, it requires the consent of the popular councils as well.

By law (Decree No. 164; 1984), tolls may be set for "distinguished roads" constructed by the RBA, in accordance with the standards given in Table 6.2.2 below. At present tolls are charged on the Cairo-Alexandria road and the Hamdi Tunnel crossing the Suez Canal. When tolls are to be charged on roads managed by organizations other than the RBA, a decree to that effect must be proposed by the supervisory organ concerned and passed by the councils.

Table 6.2.2 Tolls for Distinguished Roads

(unit: LE)

Vehicle Type	The Whole Road	Part of the Road
Private Car or Taxi	1.0	0.5
Pickup or Semi-Lorry	2.0	1.0
Bus	2.0	1.0
Truck or Lorry	3.0	1.5
Heavy Duty Truck	5.0	2.5

2) Budget Allocation in 2nd 5-Year Plan

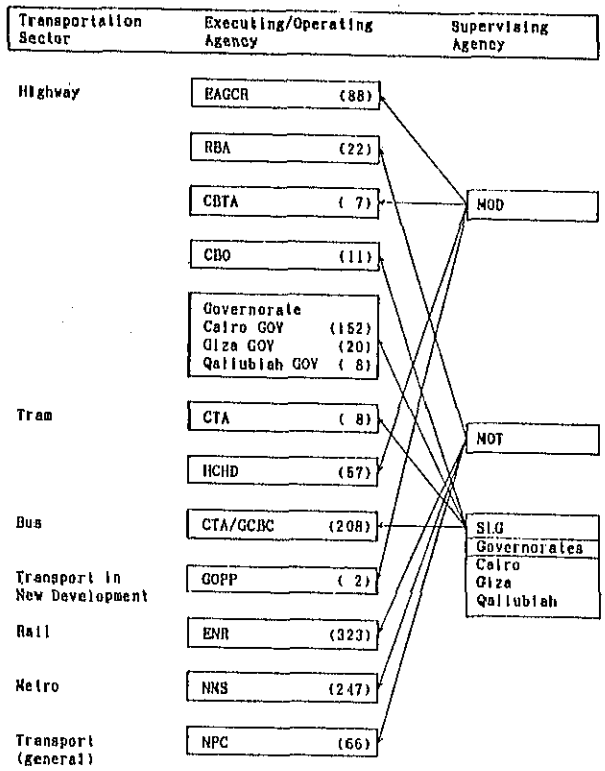
The flow of investments for transportation projects in the Greater Cairo Region in the 2nd five year plan (1987/88 - 1991/92) is shown in Fig. 6.2.2, by transport sector. 53% of the investments were for railway projects, and 41% for road and bus. Investments are listed in the plan under the following three classifications, with each classification having roughly 1/3rd of the amount;

a. Replacement and renovation
b. Completion of on-going projects
c. Expansion and new projects

Total investments on transport sector in GCR in the new five year plan were 1,219 million LE, an amount which is 31% of the total investments in the transport sector on the national level.

3) Financial Conditions of Public Transport Agencies in GCMR

Governmental agencies operating the public transport services are all facing difficult conditions. The reasons for this is the national policy of maintaining low fares, and over staffing. The performance and financial conditions of the CTA and HCHD are analyzed hereafter, to the extent of the data available to the Study Team.



Note: Parenthesized figure is the amount of fund for transportation projects in the Five-Year Plan (1987/88-1991/92), in million LE at 1986/87 prices.

Fig. 6.2.2 Current Flow of Investement Funds in GCMR

(1) Cairo Transport Authority

a. Performance of the CTA

The key indicators of the CTA are summarized in Table 6.2.3.

The bus fleet is in the range of 2,300 to 2,500 vehicles, with an operation rate of about 75 percent. This rate is relatively low compared with standards in the developed countries.

The running distance for each bus per annum shows a stable figure of around 67,000 km/year. The daily running distance is estimated as 245 km/day with the assumption of 75% operation. This figure seems to be reasonable. With the assumption of twelve hours operation per day, average vehicle speed is estimated as 20.4 km/hr, which is considered to be good.

The number of yearly passengers per bus decreased during the period from 1982 to 1985, as can be easily observed from the decreasing trend of bus passengers and stable trend of number of buses. In 1986, however the number increased, and also at the same time the yearly number of passengers per bus made an upward turnaround.

Table 6.2.3 CTA Key Indicators of Performance, 1981-1986

Indicators	Year				
	1982	1983	1984	1985	1986
Total Passengers (millions)	962	918	906	905	1,084
Buses	836	799	791	790	972
Trams	113	106	103	103	102
River Buses	13	13	12	12	10
No. of Buses					
Total	2,259	2,382	2,512	2,555	2,350
Available for service	1,676	1,683	1,800	1,972	1,776
Rate of operation (%)	74	71	72	77	75
Ave. km/bus/year (1000)	67.7	67.0	67.5	69.5	67.0
Passenger trips/bus/day	1,661	1,479	1,440	1,338	1,513
Manning ratio/bus	18.2	17.9	16.6	15.3	18.1
Drivers	3.8	3.5	3.5	3.5	4.2
Conductors	4.3	4.4	4.1	4.1	4.0
Inspectors	0.7	0.7	0.7	0.8	0.9
Mechanics	3.9	3.7	3.6	3.7	4.0
Administrators	5.0	5.2	5.3	5.0	5.0
Total Employees (1000)	41.1	42.6	41.7	39.1	42.5

Source: CTA

The number of employees fluctuated along the line of 41,000 persons during the last five years. Manning ratios for drivers, conductors, and inspectors were 4.2, 4.0, and 0.9 employees per bus respectively in 1986. These figures are reasonable given that each bus comprises a crew of two men (driver and conductor) with two shifts. However, manning ratios of 4.0 mechanics and 5.0 administrative staff are very high.

b. Analysis of the CTA Finances

- Balance Sheets

The CTA financial sheet is shown in Table 6.2.4. Total assets were 370.5 million LE as of June 30th, 1986. Total liabi-

Table 6.2.4 Summary of CTA Balance Sheet, 1984-1986

Items	Year		
	1984	1985	1986
Current Assets	144.8	148.9	234.8
Other Assets	32.4	32.4	37.5
Fixed Assets	231.8	251.8	236.8
Accumulated Depreciation	-105.6	-129.8	-138.6
Total Assets	303.4	302.8	370.5
Current Liabilities	59.3	61.7	46.8
Foreign Loans	47.9	30.3	
Government Loans	294.5	333.3	302.9
Reserves	32.9	32.9	19.7
Capital	16.5	16.5	142.1
Deficit	-147.7	-171.9	-141.0
Total Liabilities	303.4	302.8	370.5

Source: CTA financial statements

lities and capital amounted to 511.5 million LE as of the same date, thus creating an accumulated deficit of 141 million LE. The deficit amount however, improved somewhat from 171.9 million LE in the previous year, decreasing by 30.9 million LE.

Of the total liabilities and capital, 302.9 million LE was owed to government and foreign loans, with the major portion probably being governmental loan.

The capital has greatly increased from 16.5 million LE as of June 30th, 1985 to 142.1 million LE in June 30th, 1986. No significant changes are observed in the other items.

- Financial Performance

Against the revenue increases during the 1981-1986 period, the CTA performance continued to weaken. As shown in Table 6.2.5, operating losses increased from 35.7 million LE in 1981 to 97.5 million LE in 1986.

Table 6.2.5 CTA Financial Performance, 1981-1986

(unit: million LE)

Items	Year						Increase Rate
	1981	1982	1983	1984	1985	1986	
Revenue	36.1	52.6	54.9	55.2	57.0	69.0	13.8
Direct Expenses	45.3	59.0	58.8	64.6	76.2	92.5	15.3
Fixed Expenses	8.3	8.7	11.9	13.5	14.5	28.2	27.7
Interest	2.8	4.6	4.2	21.9	20.3	31.2	62.0
Depreciation	15.4	20.8	24.3	27.9	24.1	14.6	-1.0
Net Loss	35.7	44.5	44.3	72.7	78.1	97.5	22.2
Subsidy Requirements	53.3	54.3	80.9	75.7	92.8	NA	--
Direct Expenses Coverage (percent)	80.0	89.0	93.0	85.0	75.0	75.0	-17.8
Total Expenses Coverage (percent)	50.0	56.0	55.0	43.0	42.0	41.0	-3.9

Source: IBRD

The annual increase in interest was significant at 62.0%, followed by the fixed expenses which showed an annual increase of 27.7%. In spite of a fairly good increase in the rate of revenue of 13.8% annually, owing to the higher rates of increase of cost items, the net loss showed a higher increase rate of 22.2% annually.

The most important indicator is the total expense coverage, which showed a relatively small decrease of 9 percentage points, from 50% in 1981 to 41% in 1986 (Table 6.2.5).

- Operating Costs and Sales

Operating costs per km were obtained by dividing the operating costs by the total running distance (Table 6.2.6).

Table 6.2.6 Operating Costs and Sales

Items	CTA Bus	Tram
Costs		
Fuel, Oil	0.0346	0.1365
Tyres	0.0382	---
Maintenance	0.0065	0.0045
Interest	0.0961	0.1141
Depreciation	0.2085	0.7226
Tax, Insurance	0.0052	0.0008
Personnel		
Direct	0.4073	1.3697
Administration	0.1985	0.3689
Total	0.9949	2.7171
Sales	0.5028	0.6836

Source: CTA monthly report

The figures show that the depreciation of the tram was extremely high, but the reason for this was not clear. Direct personnel costs were high, with the tram costs double its sales figure. When including administrative personnel costs, sales of the buses also were surpassed. Managerial indices of buses and trams are 198 and 387 respectively.

(2) HCHD - Transport Sector

a. Performance of the HCHD

The key indicators of HCHD's Transport Sector are summarized in Table 6.2.7, for the financial years of 1984/85, 1985/86 and 1987/88. The figures in the table show that the number of passengers decreased in 1985/86 compared to the previous fiscal year, however began to increase thereafter.

The average number of tram units for the three years is about 220 per year, with an operation rate of about 70%.

The daily running distance shows a stable figure of around 200 km.

The number of employees fluctuated along the line of 2,900 persons during the last four years. Manning ratios for all categories did not differ during the same period. The ratios for drivers, conductors, and inspectors were 1.0, 2.6, and 0.4. per unit respectively. The ratios for drivers and conductors may seem low, when considering that there are two work shifts, but if ratios were calculated per train, and assuming three units per train then the values for the three categories would triple to 3.0, 7.8, and 1.2.

Table 6.2.7 HCHD Indicators of Performance, 1984-1988

Indicators	Year			
	1984/85	1985/86	1986/87	1987/88
Total Passengers (millions)	91	76	80	83
No. of Units				
Ave. Scheduled operation/day	225	217	NA	224
Actual available ave./day	154	160		151
Rate of Operation (%)	68	74		67
Ave. km/unit/day	206	194		198
Ave. trip/unit/day	8.1	9.7		7.6
Passenger trips/unit/day	1,613	1,302		1,502
Manning ratios/unit (%)	12.6	13.1		13.1
Drivers	1.0	1.0		1.0
Conductors	2.6	2.6		2.6
Inspectors	0.4	0.4		0.4
Signalers	0.9	0.9		0.9
Mechanics	2.1	2.2		2.2
Maintenance	2.2	2.3		2.3
Tracks engineering	2.4	2.5		2.6
Administrators	1.1	1.1		1.1
Total Employees (1000)	2.8	2.8		2.9

Source: HCHD - Transport Sector - Statistics Section
Note : Data for 1986/87 not available

b. Analysis of the HCHD Finances

- Financial Performance

Against the revenue increases during the 1985-1988 period, the HCHD performance continued to weaken. As shown in Table 6.2.8, the deficit increased from 16.6 to 28.33 million LE during the same period.

From the table it is clear that the Transport Sector cannot cover its own wages, and that the rate of increase of expenditures is higher than the rate of increase in revenue. More detailed explanation of the expenditures of HCHD is presented in Chapter 9 of this Report.

Table 6.2.8 HCHD Financial Performance, 1985-1988

(unit: million LE)

Items	Year		
	1985/86	1986/87	1987/88
Revenue	9.88	9.75	10.48
Expenditures	26.45	32.05	38.81
- Wages	10.70	11.53	12.27
- Goods	4.76	5.46	5.47
- Services	0.62	0.59	0.62
- Transferred Expenses	6.88	7.87	9.46
- Current Transfers	3.49	6.60	10.99
Surplus/Deficit	-16.57	-22.30	-28.33

Source: HCHD Transport Sector, Accounting Section

6.3 Legislative System of of Urban Renewal

Law 577/1954 (Expropriation for Public Purpose) empowers the project authority to acquire lands and structures occupying the project area if the project has a public purpose. Expropriations are needed for implementation of ordinary public projects such as projects for transportation, utilities or urban facilities. As for renewing existing districts, Law No. 3 (Urban Planning Law) provides the process for reconstruction of new residential area and also the expropriation for the project.

Expropriation is done through the process shown in Fig. 6.3.1, where the governorate is entrusted with execution by the ministry concerned with the project.

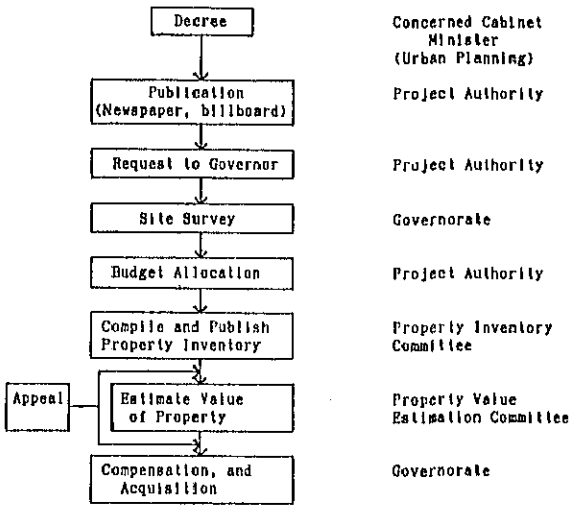


Fig. 6.3.1 Process of Property Expropriation

The governorate plays an important role in promoting expropriations since it can prepare substitute homes as well as having detailed information about properties in the project area.

Two committees are organized by Governor's decree, one for preparing inventory of properties to be expropriated and the second for estimating the compensation for the properties. Members of the committees are an under secretary as chairman, and engineers from the governorate department of housing, development, physical planning, land acquisition and planning project, all from governorate.

Compensation takes two forms; payment, or provision of substitute home. Land and building owners are compensated by payment of a sum estimated based on prices on the date of the decision of the expropriation. For those who live in the expropriated buildings as tenants, substitute homes are provided for their purchase with 30 years repayment period and at no interest.

Cairo Governorate and a number of public companies have begun the execution of a development plan on an area of 6.3 ha in Torgoman, adjacent to the CBD. The development plan involves the total clearance of the existing buildings, most of which have an average of 3 to 4 stories and in poor conditions. They will be replaced by modern commercial and office buildings. Compensations were carried out in accordance with Law 577/1954 and a large part of the area has already been cleared, which is at present being used temporarily as a car park. Appropriations were borne by the Cairo Governorate and the public companies concerned. The project is now temporarily suspended, postponing further demolition and the selling of plots for development; this is due to some policy and zoning issues that are being resolved at present.

In executing the Regional Metro project, the National Authority for Tunnels (NAT) needed to re-locate the Sayedah Zeinab sta. from the former place. Through the process above, Cairo Governorate was asked to expropriate the land and a hundred households. The station, new alignment and flyover to access the terminal have been constructed upon the expropriated land.

PART II
FORECAST AND PLAN

7. Demographic Framework and Land Use Plan

7.1 Future Urban Structure

The Greater Cairo Region Transportation Masterplan has been prepared on the basis of the urban development strategy presented in the Master Scheme. A summary of the Master Scheme is presented in sections 1 and 2 of this chapter.

The Greater Cairo Region Long Range Urban Development Scheme - Master Scheme was prepared by the GOPP, in cooperation with OTUI and IAURIF of France during the period of 1981 to 1984. In 1986, two additional reports were prepared outlining plans for implementation of the homogeneous sectors and the urban development of East Cairo.

The Master Scheme supersedes the Master Plan for Cairo which was prepared in 1970, approved in 1974, but which required updating to correspond to the socio-economic change occurring after the cessation of the war in 1973 and introduction of economic open-door policy. The Master Scheme identifies the urban development scheme for the Greater Cairo Region up to the year 2000.

1) Future Urban Scheme

(1) Master Scheme Objectives

The Master Scheme has adopted a number of objectives with the purpose of increasing economic growth and improving the living environment. The principal objectives are as follows:

a. Protection of agricultural land located north and west of the region from the steady unplanned urbanization, in the form of informal housing, taking place.

b. Improvement of industrial location policy; to control industrial pollution which has become a serious problem in areas as Helwan, prohibit industrial activity on agricultural land, and introduce industries near new settlements and satellite cities.

c. Improvement of transport efficiency through urban planning to reduce transport demand, and organization of public transport services to reduce private car use.

d. Deconcentration of the Greater Cairo agglomeration, by limiting urban expansion of the city beyond its present limits, and by accommodating roughly 40% of the growth expected by year 2000 into new communities.

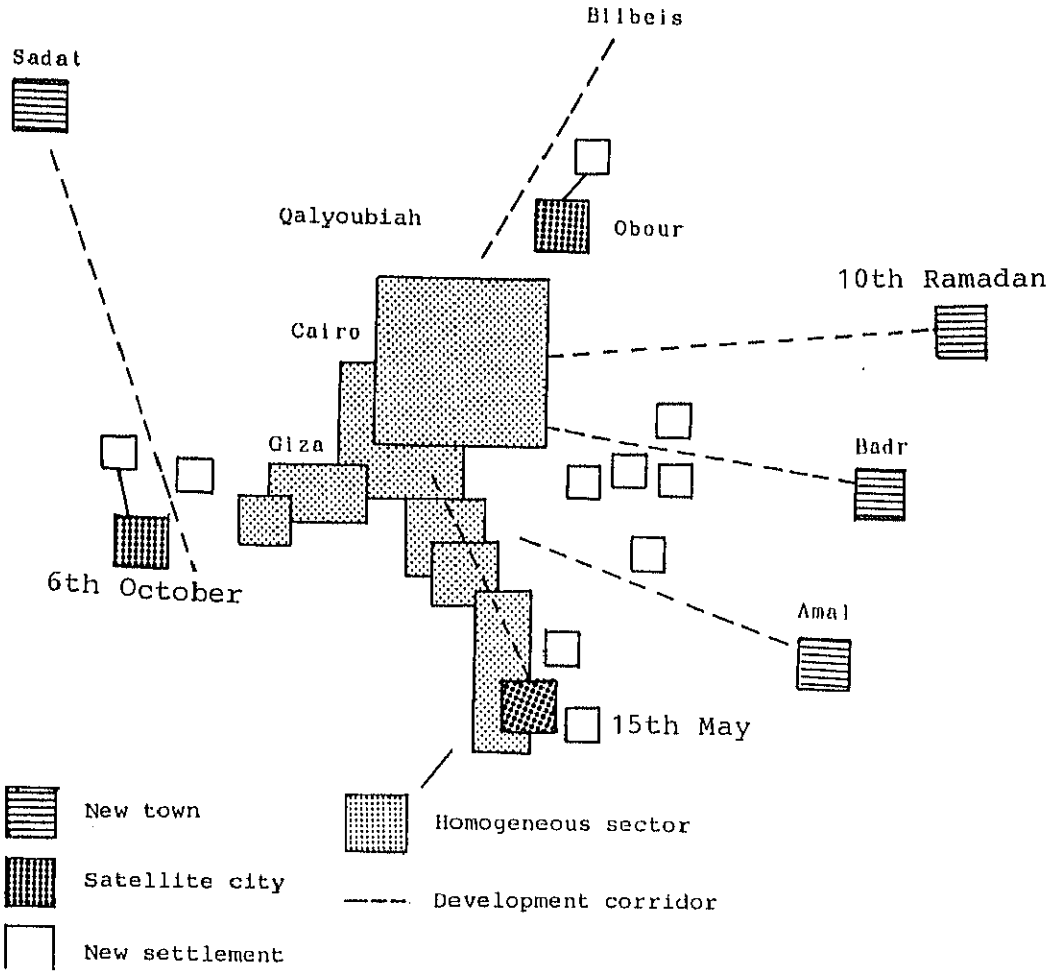
e. Provision of low and medium income dwellings with necessary services in new communities as an alternative to informal housing construction.

(2) Master Scheme Concepts

The Master Scheme proposes that the future urban scheme be based on the following five concepts;

a. Homogeneous Sectors
b. New Settlements
c. Development Corridors
d. Urban Region
e. Discouragement of urban expansion on agricultural land

Fig. 7.1.1. shows a schematic representation of the concepts stated above. The concepts are explained in Table 7.1.1.



Source: Master Scheme, 1984, GOPP

Fig. 7.1.1 Master Scheme Urban Development Concepts

Table 7.1.1 Master Scheme Concepts

Concept	Objective	Application
Homogeneous Sector	The existing urban space shall be organized into self sufficient sectors. While each sector should provide living, public services and employment opportunities, sectors must also be specialized in terms of activity, such as governmental sectors, business sectors, etc.	-Sector population shall be 1 to 2 million. -Minimum 80% of labor force shall be employed within the sector. -At least one main service center in each sector. -Local transport system within sector has priority to links between sectors. -Provision of barriers between sectors. -16 homogeneuos sectors.
New Settlement	New settlements in desert areas shall be constructed as an alternative to informal housing and to arrest the continuous growth of the agglomeration.	-New settlement max. population is 250,000. -Development mainly by private financing. -Construction cost similar to informal housing cost. -Close to employment opportunity. -10 new settlements.
Development Corridor	Construction of new towns around Cairo shall lead to creation of development corridors.	-Locating new settlements along the development corridors.
Urban Region	This concept calls for the balance between increased autonomy of the new independent communities on the one hand, and the need for integration on the regional level within a regional socio-economic framework.	-Establish hierarchy among communities to supply various service levels. -Regional planning of roads and utility networks.
Preserve Agricultural Land	Arrest urban development in agricultural areas.	-Prohibit the construction of new roads on the periphery of the urban front. -Ring road sections through agricultural area shall be free from any local intersections and branchings, with links only at main agglomeration entrances.

2) Homogeneous Sectors

The Master Scheme envisions the establishment of 16 homogeneous sectors in the Greater Cairo Region, five of which are considered to be "protection sectors" where no urban development is planned. The sectors are shown in Fig. 7.1.2.

The increase in population estimated by the Master Scheme, and highlights of the development plan by sector are described in Table 7.1.2.

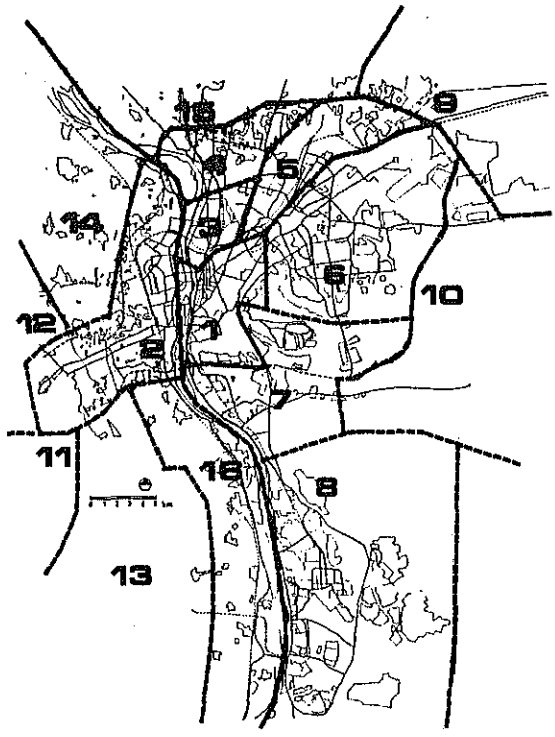


Fig. 7.1.2 Homogeneous Sectors

Sectors 11 and 13 are not described in the table as there are no development plans for them in the Master Scheme. Fig. 7.1.3 shows the locations of the proposed service centers.

The Master Scheme estimates that during the period of 1985 to 2000 the population in the Greater Cairo Region will increase by about 7.0 million persons, of whom 2.5 million will be living in new communities. The Master Scheme predicted a GCR population of 10.66 million in 1985. However, the 1986 census showed a GCR population of 10.74 million which meant that the Master Scheme had overestimated its figures. Furthermore the forecast GCR population in 2000 of 17.66 million in the Master Scheme is higher than CAPMAS forecast of 16.5 million.

One of the indicators to evaluate the soundness of homogeneous sector concept is the rate of inner trips to total trips generated in each homogeneous sector.

Table 7.1.3 shows the OD tables by homogeneous sector base. Seven of nine homogeneous sectors show a rate of around 70% or more of inner trips to total trips. Zones 1, 6 and 7 show an inner trip rate of around 60%. Zone 1 is the center of Cairo city. Communication with other zones is active due to the nature of the zone. Zone 6 is the Heliopolis - Nasr City - Al Nozha area. This area is strongly connected with zone 5, Mataria, which is the reason of low independency. Zone 7, Maadi, is strongly connected with Cairo center through Corniche road.

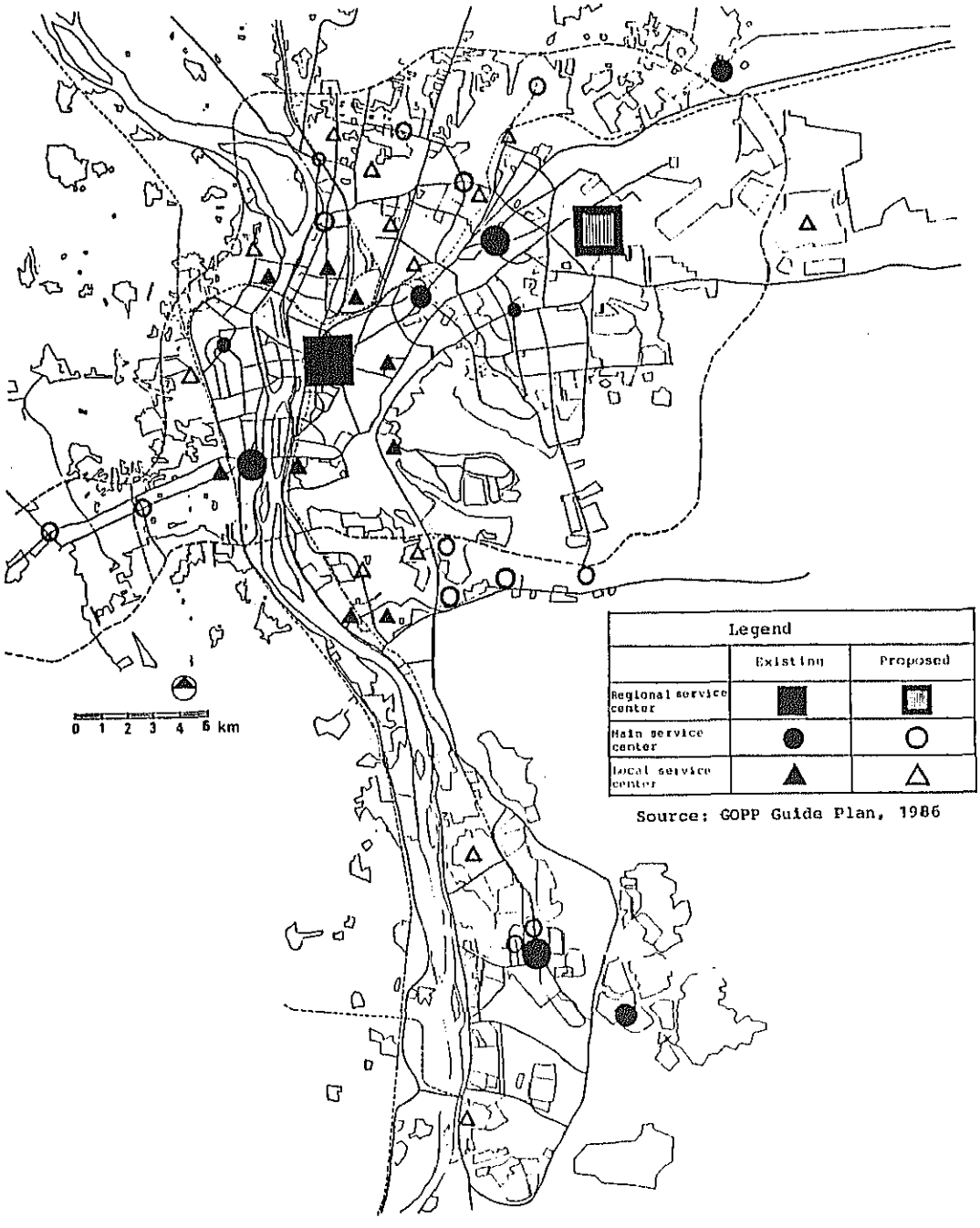


Fig. 7.1.3 Future Service Centers Distribution by Homogeneous Sectors

Table 7.1.2 Homogeneous Sectors Development Plans

Sector No.	Population Increase 1985-2000	Present Conditions	Development Plan
(1)	15,000	City center & potential redevelopment of slums	-Redevelopment of areas in poor condition. -Proper utilization of Fustat plateau area and removal of slums that have developed there. -Relocation of workshops and other activities having negative environmental impact. -No additional main or local service centers required. -Tramway improvements, priority for public transport and pedestrians, traffic management and street beautification.
(2)	820,000	Giza residential & business area	-Development of vacant lots, redevelopment of little used plots, and upgrading of informal housing areas. -Relocation of small industries within the urban fabric to utilize vacated spaces for much needed public facilities. -Creation of two new main service centers along Ahram st. and King Faisal st. to increase job opportunities. -Implementation of Ring Road west arc, east-west roads parallel to Ahram st., and upgrading of Rod Al Farag br. Giza connection. -An East-west regional public line is proposed.
(3)	115,000	Very active small scale industries & dense medium income residences	-Creation of a main service center at the site of the Rod Al Farag wholesale market after its removal. -Redevelopment of ill-conditioned residential areas, old workshops and slums. -Redevelopment of existing industrial area to remedy excessive pollution and ensure working opportunities for inhabitants. -Implementation of Rod Al Farag br. approaches, Sekket Al Wayli, and two roads in Sharabiya.
(4)	340,000	Industries & informal development on arable land	-Organization of existing urbanized area which developed in the past 20 years on agricultural land. -Redevelopment of polluting industries and utilization of land freed by aging industries for making public facilities. -Redevelopment of slum areas. -Creation of two main service centers to make up for present lack of such centers and 2 local service centers. -Implementation of Shubra Al Kheima proposed road network, Ring Road and Alexandria Agricultural Road deviation to Corniche.
(5)	485,000	Mainly residences & agricultural land in the north	-Development of 2 main service centers in Bahtim and Al Marg and 3 local service centers. -Control and organization of urban development on arable land. -Preparation of urban action plan for Al Marg area. -Construction of Ring Road, north regional primary road, north-south secondary road, metro crossings and improvement of primary and secondary roads.
(6)	560,000	Medium & high income residences & governmental, businesses, commerce & light industry	-Development of a regional center on the Almaza airbase site, in addition to two existing main service centers in Roxi and Nasr City. -Development of desert land to the east and conversion of some military camps for civilian use. -Continuation of Nasr City development towards the Ring Road. -Construction of north-south artery from Qatamiah rd. to Ring Road's northern section, and along east-west public transport system.
(7)	945,000	Medium & high income residences & industry along Tourah Corniche	-Two strategies proposed; Establishment of an east-west public transport line crossing Maadi (high cost), and improvement of present conditions by implementation of a few road projects (low cost). -Construction of 4 new main service centers between Ring Road's southern section and Qatamiah Road, east of the Autostrade at locations of ongoing housing development projects. -Continuation of industrial activity expansion along Qatamiah Road to provide jobs.
(8)	490,000	Heavy industry & residences	-Continuation of residential development west of Autostrade in 15th May City (pop. in yr. 2000 is 210000) and proposed new settlements numbers 8 & 9. -Proposed construction of two new main service centers, adjacent to the main service center in Helwan. -Development of pollution control measures for the heavy industries in the area. -Connection of Autostrade to Corniche by feeder roads.

Table 7.1.2 (cont...)

(9)	725,000	Low income housing at Al Salam & Haiksteb military camp and housing	-Construction of Obour satellite city with estimated population of 240,000 by year 2000, and new settlement number 10. -Development of area between Dar Al Salam and the Airport to create job opportunities and industrial activities along Anshas plateau. -Development of existing main service center at Al Salam, and construction of Obour city.
(10)	975,000	Vacant desert land	-Construction of 5 new settlements of about 1.0 million population with main and local service center along Ring Road's eastern arc.
(12)	750,000	6th October & New Giza Cities	-Completion of 6th Oct. city (pop. 250,000 in yr. 2000) and two new settlements 6 & 7 (New Giza) (pop. 750,000 in yr. 2000). -Implementation of Ring Road western section and necessary infrastructure (roads, water & sewage).
(14)	280,000	Rural villages with informal exapnsion	-Protection of agricultural land and development of agricultural activties.
(15)	350,000	Agriculture & rural housing	-Maintaining of agricultural land and investment only for improving agricultural productivity and rural population living standards. -Stopping expansion of activities along Alexandria Agricultural Rd. -Banning of connections between Ring Road's northern sec. and agricultural villages except at Alexandria and Ismailia Agricultural Rds.
(16)	150,000	Rural development & some industries	-Protection of agricultural land and development of agricultural-based industries only.

Table 7.1.3 OD Matrix of Homogeneous Sectors, 1987

(unit: thousands)

Sec. No.	Sector Name	1	2	3	4	5	6	7	8	9	Total	Inner Trip Rate
1	Cairo Center	1,906	402	249	46	242	183	144	54	33	3,257	58.5%
2	Giza	403	2,053	63	12	41	67	40	29	5	2,713	75.7%
3	Shubra	245	62	1,135	57	67	60	10	34	3	1,673	67.9%
4	Shubra Al Kheima	46	12	57	658	24	20	3	5	0.3	825	79.8%
5	Mataria	238	42	67	25	1,442	242	16	12	15	2,099	68.7%
6	Heliopolis - Nasr City	186	71	59	19	239	755	18	8	12	1,367	55.2%
7	Maadi - Qatamiah Road	145	41	10	2	16	18	443	30	1	707	62.7%
8	Helwan	54	29	33	5	12	8	31	541	3	716	75.6%
9	Al Salam - Al Obour - Haiksteb	34	5	4	0.3	16	11	1	3	199	272	73.1%
	Total	3,255	2,716	1,677	825	2,098	1,365	706	715	271	13,629	
	Inner Trip Rate	58.5%	75.6%	67.7%	79.8%	68.7%	55.3%	62.8%	75.6%	73.4%		

Considering those circumstances it may be said that the independence of homogeneous sectors are well maintained. Homogeneous sectors do not correspond well to Kisms, or in other words, PT zones. PT zone 30 is located within the two homogeneous sectors 1 and 7. Technically, the PT zone can not be divided into two subzones corresponding to two homogeneous sectors. Consequently, in this calculation, PT zone 30 is double counted in homogeneous sectors 1 and 7. This is one of the reasons for the strong connection between those two sectors.

The OD Matrix in the year 2000 has similar features to the 1987 OD Matrix (Table 7.1.4). Only one remarkable difference is that the inner trip rate for homogeneous sector No. 3, Shubra, will become closer to that of the CBD. Not all sectors can achieve the target of 70% inner trip rate but when the target is

lowered to 60%, it can be cleared by most sectors. Conclusively, the concept of homogeneous sector is sustained.

Table 7.1.4 OD Matrix of Homogeneous Sectors, 2000

(unit: thousands)

Sec. No.	Sector Name	1	2	3	4	5	6	7	8	9	Total	Inner Trip Rate
1	Cairo Center	1,976	525	298	121	302	272	199	51	28	3,772	52.4%
2	Giza	525	3,558	91	45	78	134	96	52	9	4,587	77.6%
3	Shubra	299	91	1,023	127	90	92	31	19	8	1,781	57.4%
4	Shubra Al Kheima	120	44	130	1,241	65	65	15	7	4	1,691	73.4%
5	Mataria	301	78	89	64	1,972	381	33	16	35	2,971	66.4%
6	Heliopolis - Nasr City	276	133	92	65	378	1,461	49	18	32	2,503	58.4%
7	Maadi - Qatamiah Road	202	94	31	15	33	49	775	42	6	1,247	62.1%
8	Helwan	50	52	19	7	16	18	43	1,039	2	1,247	83.3%
9	Al Salam - Al Obour - Haiksteb	27	9	9	4	36	31	6	2	394	519	76.0%
	Total	3,777	4,585	1,781	1,690	2,969	2,504	1,247	1,247	519	20,318	
	Inner Trip Rate	52.3%	77.6%	57.5%	73.4%	66.4%	58.3%	62.1%	83.3%	76.0%		

3) Satellite Cities and New Settlements

The development in GCMR up to the present may be characterized by the following:

a. Most of the urban development occurs on agricultural land in the form of informal housing.
b. The development occurs along the outskirts of the urban agglomeration.

The Master Scheme's program to construct new self-sufficient communities separated from Cairo and Giza but well connected to it stems from the need to protect agricultural land, limit development by informal housing where inhabitants living conditions are very poor, decentralize Cairo by moving new development away from it, and finally to accommodate around 2.5 million of the 7.0 million GCR population increase it estimates during the period 1985 to 2000.

As shown in Fig. 7.1.1, the Master Scheme originally called for the construction of 10 new settlements and 3 satellite cities within the GCR, and four new towns around it. At present there are plans to construct only 7 of these new settlements. Plans for settlements numbers 4, 9, & 10 have been suspended.

6th October and 15th May Cities are already inhabited and construction work is continuing there. However, to date, no construction work has started on the 7 new settlements.

The new settlements, with a population capacity of 250,000 each, shall be constructed through private investments with the aim of attracting investments equal to the amount currently spent in the construction of informal housing.

4) Future Land Use

Fig. 7.1.4 has been produced from the land use map of the Master Scheme. As seen in the figure, it is clear that an attempt is made to restrict urban expansion within the boundaries of the Ring Road.

The delay in the construction of the Ring Road's northern and western sections may defeat this purpose so it is considered urgent to physically identify the Ring Road's route along these sections. Furthermore, after the Ring Road construction strong measures will be necessary to prevent urban expansion along and beyond its northern and western sections in addition to those discussed in the Master Scheme, such as the construction of a green belt.

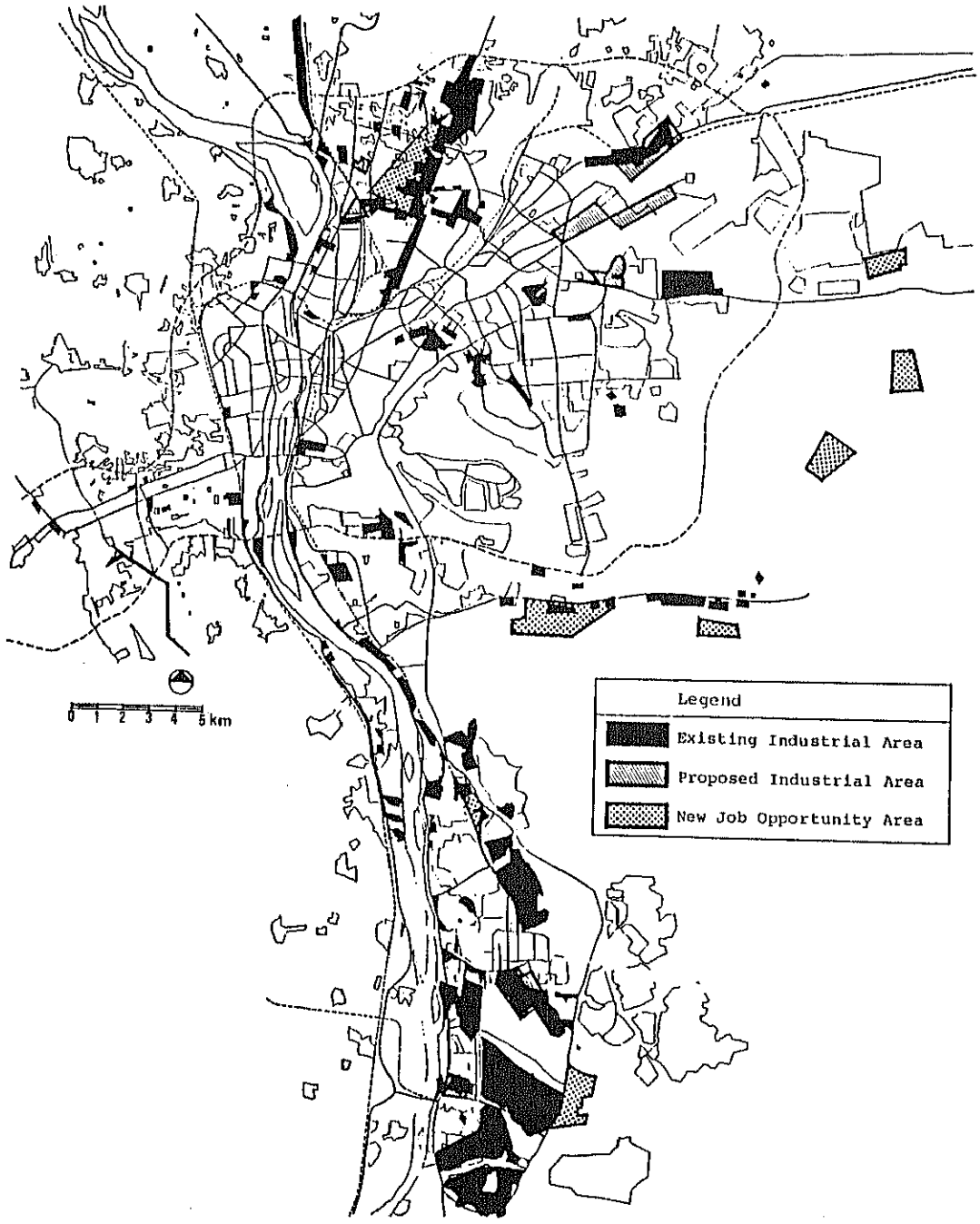
Urbanization on the desert land shall be east of the Ring Road's eastern arc on 4 new settlements, another settlement east of Helwan, and development along the Autostrade and Qatamiah Roads. Not shown on the map two new settlements are also planned near 6th October City.

Future industrial land use area within the urban area has been maintained at the present levels, while it has been increased along the Ring Road southern and eastern sections, surrounding the new Obour City, adjacent to 6th October City and in Nozha south of the airport. No new land has been allocated for agricultural activity. Fig. 7.1.5 shows the present and future industrial and job opportunity areas. Most of the future job opportunity areas will be related to industrial and service activities.

The Master Scheme encourages the increase of commercial activity in Giza, in an attempt to make up for the lack of job opportunities there. Commercial centers are also located in each new settlement.

The Master Scheme suggests that present governmental and military lands be converted to civilian use should the military activities be transferred to locations outside the city (such as the military city of Haiksteb). However the future land use map continues to show large areas north and east of the city reserved for military activity.

Along the eastern arc of the Ring Road there are plans for five new settlements and a green belt which will be irrigated by the treated sewage produced by these settlements.



Source: GOPP Guide Plan, 1986

Fig. 7.1.5 Future Industrial Area and Job Opportunity Area

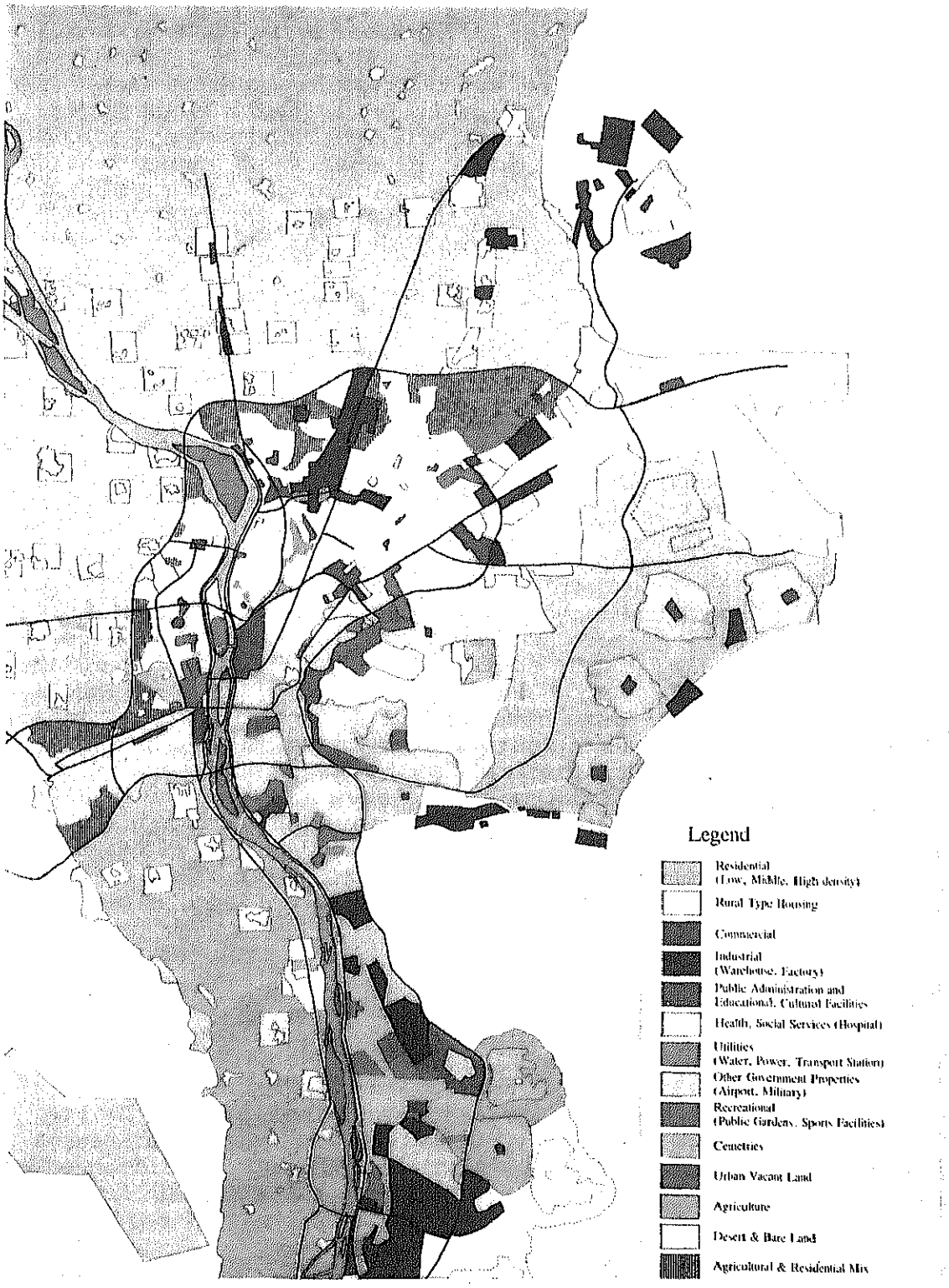


Fig. 7.1.4 Future Land Use

7.2 Demographic Framework

Demographic indices such as population, number of workers, and number of students, which serve as basic data for forecasting future transport demand, are forecast for the year 2000. Population forecasts are made in order of the largest region to the smallest; for Egypt, GCR, governorates, and kisms (zones), on the basis of the 1986 census (preliminary report) and the 1976 census. The 1966 and 1960 census data are also referred to when necessary.

1) Population

(1) Nationwide

According to the 1986 census, Egypt has a total population of 48.21 million (excluding overseas residents numbering 2.25 million). While the average annual growth between 1960 and 1976 was 2.2%, the rate accelerated to 2.7% in the 10 year period between 1976 and 1986.

In the early 1980's, the Egyptian government conducted a study on the country's population dynamics in order to analyze and forecast such factors as birth rate, mortality rate, life table, and fertility rate. Based on these data, the Central Agency for Public Mobilization and Statistics (CAPMAS) projected that the population of Egypt would reach 67.74 million in the year 2000, which means that average annual growth between 1986 and 2000 will be 2.5%. Since this projection was made before the 1986 census results were published, it is likely to be adjusted in the future. However, it still remains the official figure released by the government at this stage, and since all projects will be planned in line with this forecast population, the Study will also consider it as a given condition.

(2) GCR and GCMR

The Arab Republic of Egypt is divided into 26 governorates. The future population of each governorate is forecast separately by extrapolating the current population to the year 2000 on the basis of the average annual growth rate shown in the past 10 year period. The values thus obtained are adjusted so that their aggregate corresponds to the national population discussed above. The combined population of the three governorates of Cairo, Giza, and Qaliubiah, which contain the Greater Cairo Region (GCR), is predicted to rise from 12.27 million in 1986 to 18.0 million in 2000.

While the entire Cairo Governorate is included in the GCR, the Giza and Qaliubiah Governorates are divided into those areas falling within the GCR and those areas falling outside the GCR. The method for forecasting the populations of the former areas is the same as the method for forecasting population at the governorate level. In other words, the current populations of these two areas are extrapolated to the year 2000 on the basis of past

trends, and the values thus obtained are adjusted so that their total corresponds to the governorate's total population.

A simple application of past trends for forecasting the future population of the Greater Cairo Metropolitan Region (GCMR) would be injudicious. This is because population growth in the GCMR has been decelerating sharply during the past decade. In particular, annual growth in the Cairo Governorate, which accounts for roughly 70% of the GCMR population, dropped steeply from 3.54% during 1960-1966 to 2.23% during 1966-1976, and further to 1.78% during 1976-1986. These last two rates are lower than the rate of natural increase of 2.24%. Although population growth in the GCMR as a whole between 1976 and 1986 was 2.57%, it may well decline below the natural increase rate if growth in the Cairo Governorate peaks out.

Population growth at a rate below the natural increase rate means that there are more out-migrants than in-migrants. The net outward migration of population in the GCMR indicates the deterioration of the metropolitan economy, which serves as the motive force of the national economy, and is not a desirable condition by any means. Thus, administrative measures should be taken to prevent this condition. In this forecast, therefore, it is assumed that the growth of the GCMR population will slow down but will at least maintain the natural increase rate. Accordingly, the following growth rates are established:

1986 - 1991: 2.46%
1991 - 1996: 2.35%
1996 - 2001: 2.24%

Based on the foregoing, the population of the GCR and that of the GCMR are forecast for the year 2000 as shown in Table 7.2.1. The population of the former will swell from 10.74 million in 1986 to 16.02 million in 2000 at an annual rate of 2.9%, which is 0.4 percentage points higher than the national average. As a result, the GCR's share of the national population will rise from 22.2% in 1986 to 23.6% in 2000. Roughly 12 million, which corresponds to 75% of the GCR's population, will reside in the

Table 7.2.1 Future Population of GCR/GCMR

		1986	2000
GCR	Cairo	6,052,836	7,388,000
	Giza	3,183,358	5,809,000
	Qaliubiah	1,506,697	2,818,000
	Total	10,742,891	16,015,000
GCMR	Cairo	6,052,836	7,388,000
	Giza	1,870,508	3,108,000
	Qaliubiah	710,794	1,500,000
	Total	8,634,138	11,996,000

GCMR, and the remaining 4 million or so will live outside the GCMR, in rural areas and the new settlements and cities to be developed in accordance with the Master Scheme. The population of the GCMR, to which this Masterplan Study pertains, will expand by around 1.4 times by the year 2000.

(3) Kisms

There are 42 kisms in the GCMR, ranging from long-established urban areas with a population density of more than 700 persons per hectare to newly-developed residential areas with a density of less than 50 persons per hectare. It is therefore necessary, when forecasting future population by kism, to take into account how many more inhabitants a kism can accept (capacity), in addition to past trends. Capacity depends on the area of land that will be urbanized in the future and the maximum population density that is considered acceptable. On the other hand, it is also necessary to establish a minimum population density for kisms in the CBD, where population has been declining in recent decades. Based on the land use plan discussed in the preceding section and the future goals set forth in the GOPP's Master Scheme, the area of land that will be urbanized by the year 2000 and the maximum (or minimum) population density are established as shown in Table 7.2.2.

The following logistic curves are used to forecast kism-based population in the year 2000. The parameters are determined separately for each kism based on past census data.

Population increase zones:

$$P = \frac{Pmax}{1 + Exp\ (\ at+b\ )}$$

Population decrease zones:

$$P = \frac{Pmin}{1 - Exp\ (\ at+b\ )}$$

Where P = Population in year t
t = Year (1900 = 0)
a, b = Parameters

The values obtained from the above models are adjusted so that the aggregate of the populations of kisms in a given governorate corresponds to the GCMR population in that governorate.

Table 7.2.2 shows population and density in year 1986 and in 2000 and population change of each zone is illustrated in Fig. 7.2.1 where a zone with a white inner circle shows population increase and a black inner circle, decrease.

Table 7.2.2 Maximum/Minimum Population Density Set Up and Population Projection

Zone No.	Zone Name	Maximum Density (pax/Ha)	Minimum Density (pax/Ha)	Future Urbanized Area (Ha)	Population 1986	Population 2000	Net Density 1986	Net Density 2000
1	Awal Shubra Al Kheima	1,200		194	367,209	731,167	844	1,163
2	Thani Shubra Al Kheima	1,000		280	343,585	768,833	511	808
3	Al Marg	600		210	116,681	206,321	212	271
4	Al Salam	600		382	139,073	266,592	88	136
5	Ain Shams	800		52	366,768	550,595	494	693
6	Mataria	1,000		20	437,968	559,773	759	937
7	Nozha	400		740	126,583	163,374	164	108
8	Masr Al Gadida	400		44	125,192	118,946	214	189
9	Nasr City	400		671	166,176	460,389	83	173
10	Al Zeitoun	800			326,501	375,678	578	665
11	Hadaek Al Kobba	1,000			338,641	352,650	847	882
12	Al Zawia Al Hamra	1,000			300,263	331,568	853	942
13	Sharabiya	1,200			295,599	327,262	1,019	1,128
14	Shubra		600		108,333	89,207	1,083	892
15	Al Sahel		600		399,942	351,851	980	862
16	Rod Al Farag		600	8	230,505	192,517	998	805
17	Al Wayli	600		38	112,596	164,497	366	475
18	Manshiet Nasser	600		177	130,240	173,581	851	527
19	Al Zaher		400		83,816	69,846	548	457
20	Bab Al Shaaria		600		79,562	63,223	874	696
21	Gamalia		600	6	89,841	78,846	702	590
22	Al Darb Al Ahmar		600	14	105,208	92,143	751	599
23	Azbakiah		300		45,373	35,038	605	467
24	Moski		600		43,201	37,305	708	609
25	Abdin		400		65,090	52,301	576	463
26	Boulaq		500		123,376	99,989	667	540
27	Zamalek		200		21,716	23,832	157	173
28	Qasr Al Nile		200		17,204	14,996	265	231
29	Sayedah Zeinab		400		198,838	159,608	656	527
30	Al Khalifah	400		163	163,897	128,786	254	159
31	Masr Al Qadima	400		158	254,651	208,253	353	289
32	Basatin	600		16	450,143	608,351	405	547
33	Maadi	400		431	89,269	193,506	120	165
34	15th May	400			24,060	152,304	22	140
35	Helwan	600		296	425,677	615,504	273	394
36	Al Tebbin	600		36	50,853	81,369	157	226
37	Embaba	1,500		20	480,027	497,923	1,348	1,399
38	Agouza	600			180,646	217,437	426	513
39	Dokki	400			106,789	113,786	283	302
40	Giza	800		221	257,033	307,400	599	717
41	Boulaq Al Dakrour	1,000		527	585,078	1,265,230	479	724
42	Al Ahram	800		757	260,935	698,224	363	473
44	Al Obour, NS10				0	100,000	0	400
45	NS1, 2, 4				0	500,000	0	600
46	NS3, 5				0	200,000	0	400
47	6th Oct., NS6, 7				0	200,000	0	400
	Total			5,461	8,634,138	13,000,001	395	453

Zones with a significant population increase are Shubra Al Kheima (zones 1 and 2) in Qaliubiah Governorate; Nasr City (9), Al Salam (4), 15th May (34) in Cairo Governorate; and Boulak Al Dakrour (41) and Ahram (42) in Giza Governorate. All of these zones are located on the fringe of GCMR.

Twenty-six zones out of 42 will have population increase of 6.5 million in total, resulting in 1.57 times the present population while the other 16 zones will lose their population from 2.13 million to 1.79 million and the total will be 0.84 times the present.

Fig. 7.2.1 clearly shows that the major population increase will occur in zones adjacent to agricultural land except such zones as Nasr City and 15th May which are adjacent to desert land. Therefore despite the Master Scheme's objective of stopping urbanization north and west of GCMR, past trends indicate that informal housing and laisser faire development by private sector will continue to expand along the agricultural land in those areas.

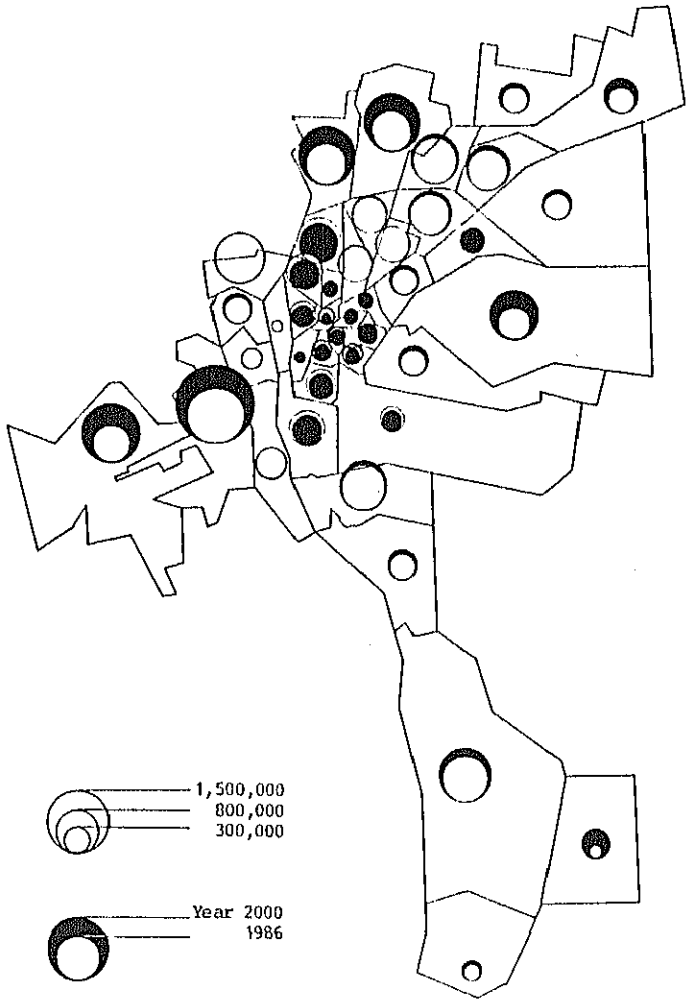
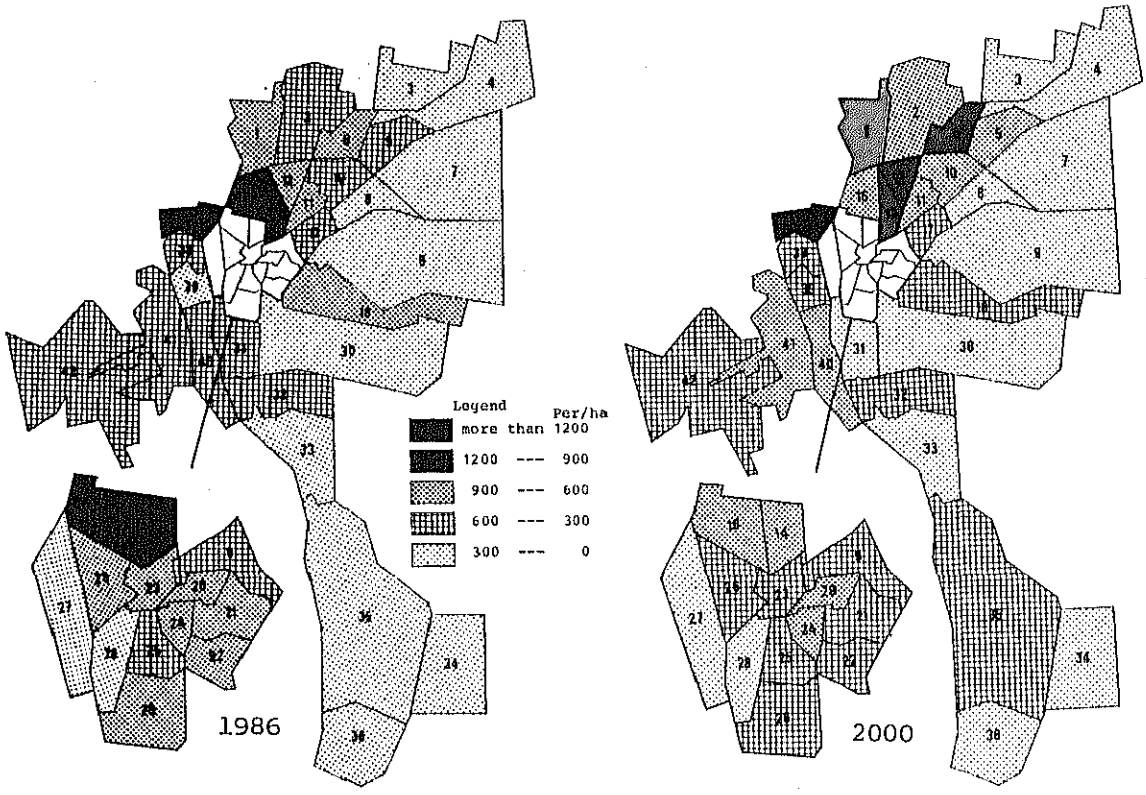


Fig. 7.2.1 Population Distribution in 1986 and 2000

A more realistic approach would be to prepare a comprehensive urban development plan for such outskirt areas with the objectives of containing urban development within the outer Ring Road and securing orderly and controlled urban expansion. The suggestion of this approach stems from the present urgent need to take some action, either to arrest the continuing informal development or to control and organize the inevitable urban development along the agricultural land.

Fig. 7.2.2 compares net population density distribution (Population/built-up area) by zone in the years 1987 and 2000. The densities will exceed 900 person/ha in Qaliubiah and Giza Governorates and northern part of Cairo Governorate while the densities in the central area will become lower.



Source: National Census, 1986, CAPMAS, and JICA Study Team

Fig. 7.2.2 Net Population Density in 1986 and 2000

(4) Population Aged Six Years or Older

Since the transport demand forecast involves persons not younger than six years of age, the population for the year 2000 given above is multiplied by the ratio of the current population accounted for by persons aged six years or over. The ratio differs slightly from kism to kism, but the average is 85%.

2) Worker Population and Employee Population

In this forecast, worker population denotes the number of laborers counted at the kism of residence and employee population denotes the number of laborers counted at the kism of employment. Worker population corresponds to the concept of nighttime population and employee population corresponds to the concept of daytime population.

(1) Worker Population

According to census data, participation rate (the rate of workers to productive-age population) in the GCMR, which stood at 29.8% in 1976, fell slightly to 28.8% in 1986. There are two factors, however that appear to indicate a future rise in the participation rate. One is the relative increase of working-age population owing to the decline of overall population growth. The other is the increased entry of women into the job market. Based on the projection published by CAPMAS concerning participation rate by age and by sex, the participation rate in the GCMR is forecast to reach 31.8% in the year 2000. This rate is applied to the population of each kism separately to obtain the future worker populations of individual kisms.

(2) Employee Population

The employee population of the GCMR is at present 2.71 million, calculated by adding the number of employees residing in the region (2.66 million) and the net (inflow minus outflow) number of employees residing outside the region (0.05 million). In the year 2000, resident employees will number 3.9 million and non-resident employees, 0.1 million (obtained on the basis of the growth rate for the GCR population living outside the GCMR), giving a total employee population of 4 million, or 1.48 times the current level.

As shown in Table 7.2.3, the primary industry sector accounts for only a very small proportion of the GCMR's employee population, while the ratio of employees of the secondary industry sector to those in the tertiary industry sector is roughly 1:2. In the year 2000, the share accounted for by the primary industry sector is assumed to remain unchanged, whereas the secondary industry sector ratio is assumed to decline slightly and therefore the tertiary industry sector ratio, to rise slightly. When the population of a metropolitan area increases, the general tendency is for the tertiary industry population to increase at a faster pace than the secondary industry population. However, since the Egyptian government plans to develop industrial land actively in the metropolitan region in line with its second Five-Year Plan, which emphasizes the manufacturing sector, the shares of the employee population accounted for by the secon-

Table 7.2.3 Composition of Employees by Industry in 1987 and 2000

	Primary	Secondary	Tertiary	Total
Employee (1000)				
1987	81,200	980,000	1,645,800	2,707,000
2000	120,000	1,400,000	2,480,000	4,000,000
(Increase)	38,800	420,000	834,200	1,293,000
Share (%)				
1976	2.3	37.7	60.0	100.0
1987	3.2	36.0	60.8	100.0
2000	3.0	35.0	62.0	100.0

dary and tertiary industry sectors are considered to remain more or less unchanged.

When forecasting the employee population of each kism, the job opportunities available at present are assumed to remain available in the future, so that only the portion that constitutes an increase in the GCMR's employee population is assigned to the kisms. The number of employees to be assigned is 38,800 in the primary industry sector, 420,000 in the secondary, and 834,000 in the tertiary.

a. Primary Sector

The primary sector in GCMR consists mainly of agriculture with negligible volume of fishery and quarrying industry. As the increase of the primary sector employees is not significant, they are distributed in the same pattern as the current primary sector employees distribution.

b. Secondary Sector

The secondary sector is divided into two categories; manufacturing and construction. In 1987, the former occupied about two thirds of employees and the latter, one third. As the manufacturing sector has been slightly expanding its share in the past twenty years according to the census data, it is reasonable to assume that the shares of manufacturing and construction sectors will be 70% and 30% respectively in year 2000. This means an increase of 317,520 employees for the manufacturing sector and 102,480 employees for the construction sector (Table 7.2.4).

Table 7.2.4 Composition of Secondary Industry in 1987 and 2000

	1987	2000	Increase
Employee (1000)			
Manufacture	662,480	980,000	317,520
Construction	317,520	420,000	102,480
Total	980,000	1,400,000	420,000
Share (%)			
Manufacture	67.6	70.0	2.4
Construction	32.4	30.0	-2.4
Total	100.0	100.0	

In GCMR at present, about 662,000 employees are working in an industrial area of 3475 ha, excluding small scale cottage industry. Their working density is 190 employees/ha. According to the future land use plan of GOPP as explained in the previous section, development areas totaling about 840 ha are allotted to new industrial area and main job opportunity area where industrial sector is not specified (Fig. 7.1.5 and Table 7.2.5). Adopting the above mentioned working density, these new development areas are envisaged to absorb 159,600 employees, about half

Table 7.2.5 Development of New Service Center and Working Opportunity

Zone	Existing Service Area	Future Scheme: Regional S.Center	Future Scheme: Main S.C.	Future Scheme: Local S.C.	Area Increase (ha): Industrial Area	Area Increase (ha): Major Job Opp. Area
1 Awal Shubra Al Kheima	●		○	○		40
2 Thany Shubra Al Kheima			○	○	100	
3 Al Marg			○			
4 Al Salam			●	◖		
5 Ain Shams				◖		100
6 Mataria			◖			
7 Nozha	◖	○				100
8 Masr Al Gadida	◖		●			80
9 Nasr City	●		●	○○○		
10 Al Zeitoun			◖	○		
11 Hadaek Al Kobba				○		
12 Al Zawia Al Hamra				○		
13 Sharabiah				●		
14 Shubra						
15 Al Sahel			○	●		
16 Rod Al Farag						
17 Al Wayli	●		●			
18 Manshiet Nasser						
19 Al Zaher						
20 Bab Al Sharia	●*	●				
21 Gamalia				●		
22 Al Darb Al Ahmar						
23 Azbakia	●*	●				
24 Moski	●*	●				
25 Abdin	●*	●				
26 Boulaq	●*	●				
27 Zamalek						
28 Qasr Al Nile	●*	●				
29 Salyedah Zeinab						
30 Al Khalifah				●		
31 Masr Al Qadima				●		
32 Basatien			○◖ ◖	○○		
33 Maadi	●		○◖ ◖	●●	150	
34 15 th May			●			
35 Helwan	●		●○○	○	30	60
36 Al Tebbin				○	150	30
37 Embaba				●○		
38 Agouza	●		●			
39 Dokki	●					
40 Giza	●		●			
41 Boulaq Al Dakrour			●	●○		
42 Al Ahram	●		●			

Legend
● Existing service center
○ New service center
* Located in CORPS
◖ Part of existing service center
◖ Part of new service center

of future employee increase. The other half, 157,900 employees, will be distributed to each kism proportionally to the present number of employees in the industrial sector.

The increment of 102,480 construction sector employees, will be distributed according to the same pattern of the present distribution.

c. Tertiary Sector

The ratios of tertiary industry employees working in a certain kism to the resident population in the same kism varies significantly according to the nature of the kism; for every 1000 persons there were 636 employees in CBD, 242 employees in kisms with service center function, and 80 employees in other kisms in year 1987 (Table 7.2.6).

Table 7.2.6 Employees in Service Sector per 1000 Population

1	CBD Area	636 Employee/1000 Pop.
2	Zones with Service Center	242
3	Zones other than 1 and 2	80
4	GCMR Average	162

It can be assumed that population increase of each kism will result in an increase in jobs opportunity in the tertiary sector at the rate of minimum 80 persons per 1000 population, which is the average employee rate in kisms with no service center function. About 350,000 tertiary sector job opportunities will accrue together with a population increase of 4,400,000 by the year 2000.

On the other hand, the demand for tertiary sector cannot be completely explained by the resident population because the tertiary sector in CBD and service center serves not only the residents in the kism but those of a wider area.

Population and employee densities in the three kisms (Abdin, Moski, and Qasr Al Nile) located entirely within CORPS are compared in Table 7.2.7. It is expected that the decrease in population of 110,000 in these three kisms and other kisms surrounding the CBD will be replaced by an increase of 158,800 employees which corresponds to a population decrease of 144% (25.7/17.8).

Table 7.2.7 Resident and Employee Per-Capita Floor Area in CORPS Zones

Zone	Resident	Employee
Abdin	25.7	28.1
Moski	18.8	13.2
Qasr Al Nile	42.9	14.1
Average	25.7	17.8

The remaining tertiary sector employees are distributed to other kisms where new service centers will be located according to the following volumes:

Regional Center	50,000 employees
Main Service Center	20,000 employees
Local Center	10,000 employees

Half of these volumes will be allocated to existing service centers by type of sector.

d. Results

In GCMR, including 6th October City and new settlements, there will be 3.83 million workers and 4 million employees in

year 2000, with the net inflow of 0.17 million workers from outside of GCMR. Fig. 7.2.3 shows workers to employees ratio in 1987 and 2000. From the figure, tendency of dispersion of working place is clearly identified.

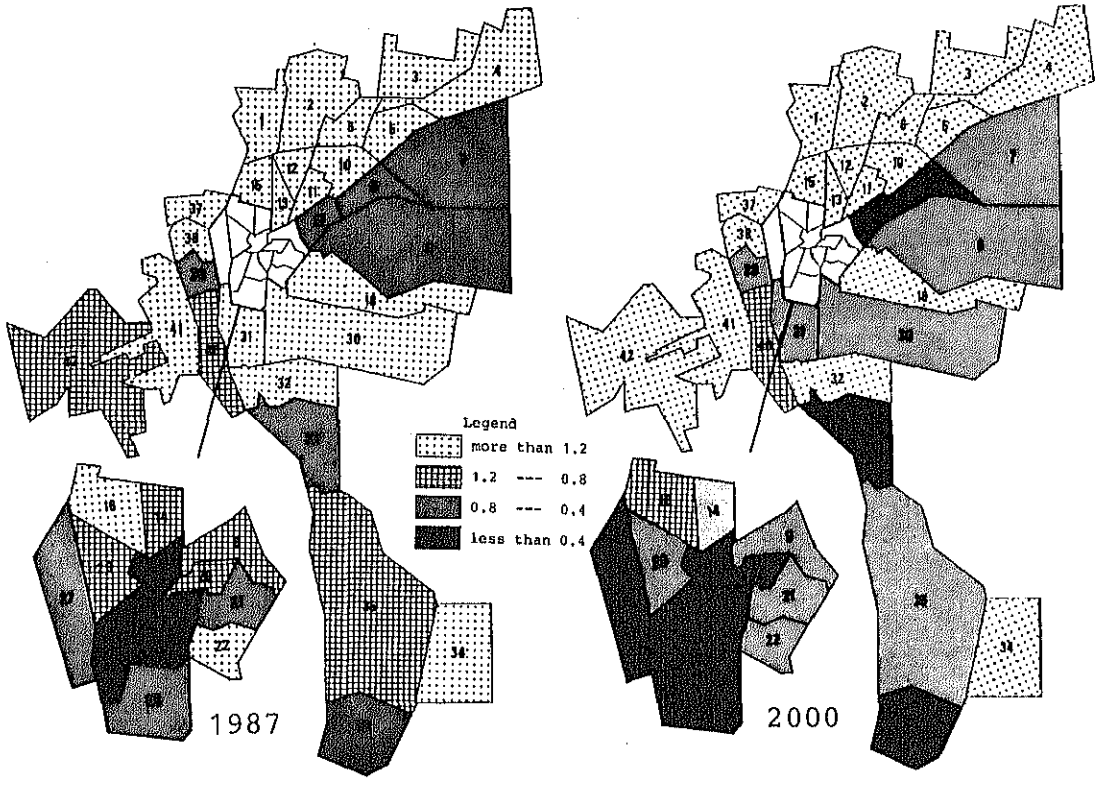


Fig. 7.2.3 Worker to Employee Ratio

3) Students

Future student distribution was forecast for both cases of living-place base and studying-place base. Number of students at living place was estimated by multiplying the present student population rate by the future population of each kism. The shortening of study period of primary school from the current six years to five years is taken into account here because the Government has already declared it.

Total number of students at living place estimated above is distributed, in principle, according to the present pattern of student distribution at studying place. However, to such kisms with rapid population increase as Shubra Al Kheima, Nasr City, Helwan and Boulak Al Dakrour, more students than the present share are assigned, considering the development of new facilities for higher education.

4) Car Ownership

(1) Car Ownership in Egypt

In general, the increase of car ownership in a given society can be explained by the growth of income in that society. In Egypt, the number of cars owned rose by four times during the decade from 1975 to 1985, when the nation's economic growth was particularly rapid. The relationship between passenger car ownership rate and per capita gross domestic product (GDP), which is used here as the substitute variable for income, is shown in Fig. 7.2.4. A strong correlation is observed between the two variables. This relationship can be expressed mathematically by the following equation:

$$Y = 0.0391X - 17.67 \quad (R = 0.982)$$

where Y = Number of passenger cars owned per 1,000 persons
X = Per capita GDP (1987 prices)
R = Correlation coefficient

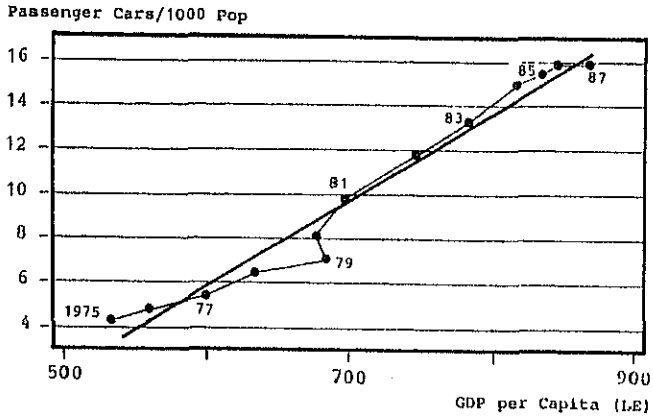


Fig. 7.2.4 Correlation of Car Ownership and GDP Per Capita

While the Egyptian economy grew sharply at an average annual rate of 7.1% during the 10 year period from 1976 to 1986, average annual GDP growth of 5.8% is targeted under the Second Five-Year Development Plan (1987/88 - 1991/92). If this target is achieved, and if the economy continues to grow in the following years up to the year 2000 at an assumed rate of 5%, Egypt's GDP in 2000 will rise to about LE 84,000 million (1987 prices), or about twice the current level. Since the nation's population is forecast to increase to 67,743 thousand (excluding overseas residents) at the end of this century, per capita GDP in the year 2000 will be 1,239 LE, or 1.43 times the present value (Table 7.2.8).

Applying the above-mentioned equation to the figures just cited, the number of passenger cars owned per 1,000 persons is

Table 7.2.8 Increase of Passenger Cars in Egypt

Year	GDP (million LE)	Population (1000)	GDP/Cap. (LE)	Cars/ 1000 Pop.	Pass. Cars
1990	51,115	53,127	962	19.98	1,061,326
1995	65,790	59,991	1,097	25.24	1,514,285
2000	83,967	67,743	1,239	30.83	2,088,613

Note: GDP is shown at 1987 constant price

forecast to increase from 16 vehicles in 1987 to 31 in the year 2000; and the total number of passenger cars owned, to 2,088,000 vehicles, an increase of 2.8 times from the present level.

The 1983 National Transport Study (Phase III, Volume 5, pages 5.74-5.76) uses the same method to forecast national car ownership in the year 2000. The NTS projects that the number of passenger cars owned will expand to 2,445,000 vehicles if GDP grows at a rate of 5% annually. Both these figures exceed the forecast values given above. This is because the economy did not expand as rapidly as predicted between 1982, the base year of NTS's projection, and 1987. In addition, NTS's forecast does not take into account the fact that the growth of passenger car sales has slowed down in recent years owing to the tightening of import restrictions from 1985.

(2) Car Ownership in the Greater Cairo Region (GCR)

Historically, about two-thirds of passenger cars owned in Egypt tend to be concentrated in the GCR (Table 7.2.9). While the GCR concentration ratio was 62.7% in 1987, the ratio is assumed to rise to 65% by the year 2000 in consideration of the fact that the GCR's share of the national population is forecast to expand, albeit slightly, from here on. Thus, the number of passenger cars owned in the GCR is forecast to increase from around 500,000 vehicles in 1987 to 1,357,000 in 2000.

(3) Car Ownership by Zone

The relationship between the car ownership rate (number of car-owning households vs. total number of households) and average household income for a given zone can be expressed as follows:

$$P = 95.0 / 1 + 58.81 \text{ EXP } (-0.0105X (1 + Y))$$

Where P = Car ownership rate (%)
X = Average household income (LE/month)
Y = Zone coefficient expressing factors other than household income

The above equation is illustrated in Fig. 7.2.5. The zone coefficient (variable Y) is applied to those zones where a large gap exists between the theoretical value (the value obtained from the equation) and the actual value (car ownership rate).

Table 7.2.9 Forecast of Passenger Car

Year	Egypt	GCR	% of GCR
1975	155959	98683	63.3%
1976	178196	113817	63.9%
1977	210924	137932	65.4%
1978	249127	162515	65.2%
1979	289189	191672	66.3%
1980	330112	221946	67.2%
1981	408758	266436	65.2%
1982	509414	313558	61.6%
1983	593038	359301	60.6%
1984	685717	414713	60.5%
1985	727248	469364	64.5%
1986	766563	486309	63.4%
1987	789363	495123	62.7%
1990	1061326	668635	63.0%
1995	1514285	969142	64.0%
2000	2088613	1357598	65.0%

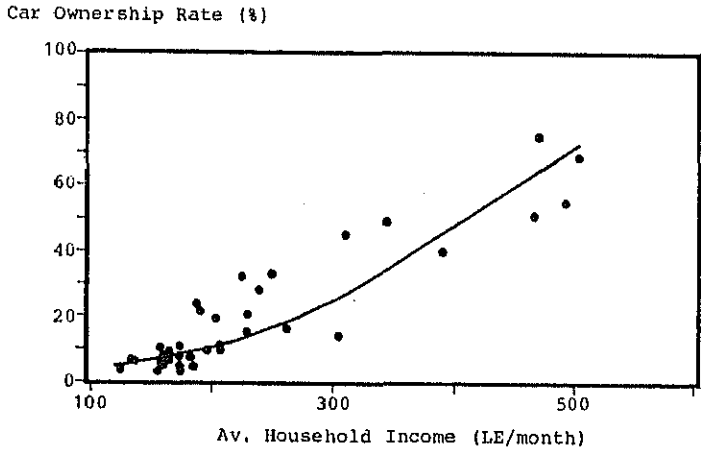


Fig. 7.2.5 Relationship of Income and Car Ownership Rate

According to the results of the PT survey, average household income in the GCMR was 217 LE per month in 1987, with the amount ranging widely from zone to zone, from 50 LE to more than 1,000 LE. Since the government has published no official projection on future household income, the average household income in the GCMR is assumed to grow at the same rate as the national economy, 5.8% between 1988 and 1992, and 5% thereafter. Household income in each zone is also assumed to grow at the same rate as the national economy, with no consideration given to any possible widening or shrinking of income gaps between zones.

At present, passenger cars owned by ordinary households number roughly 413,000 vehicles; this number is forecast to increase to 1,034,000 in the year 2000. Vehicles owned by government agencies and private corporations are added to these figures and the totals are shown in Table 7.2.9.

The rate of increase in CBD and surrounding zones, where the population will decrease in the future, is predicted to be only 1.2-1.5 times between 1987 and 2000, while 2-3 times is forecast for such zones as Nasr City, Zeitoun, Ain Shams, Wayli, Al Basatin, Maadi, Boulaq Al Dakrour, and Al Ahram, where the population increase will be sharp and where the existing ownership rate is already high.

While the average ownership rate is currently 18%, this is expected to rise to 30.7% in the year 2000. In other words, roughly one out of three households will own a passenger car. At present, about 10% of the households owning a passenger car own two or more. In calculating the number of passenger cars owned from the ownership rate, the ratio of households with more than one car is assumed to remain the same hereafter, and all such households are assumed to own no more than two cars, since the number of those households actually owning three or more cars is negligible. Fig. 7.2.6 shows the ownership rate by zone.

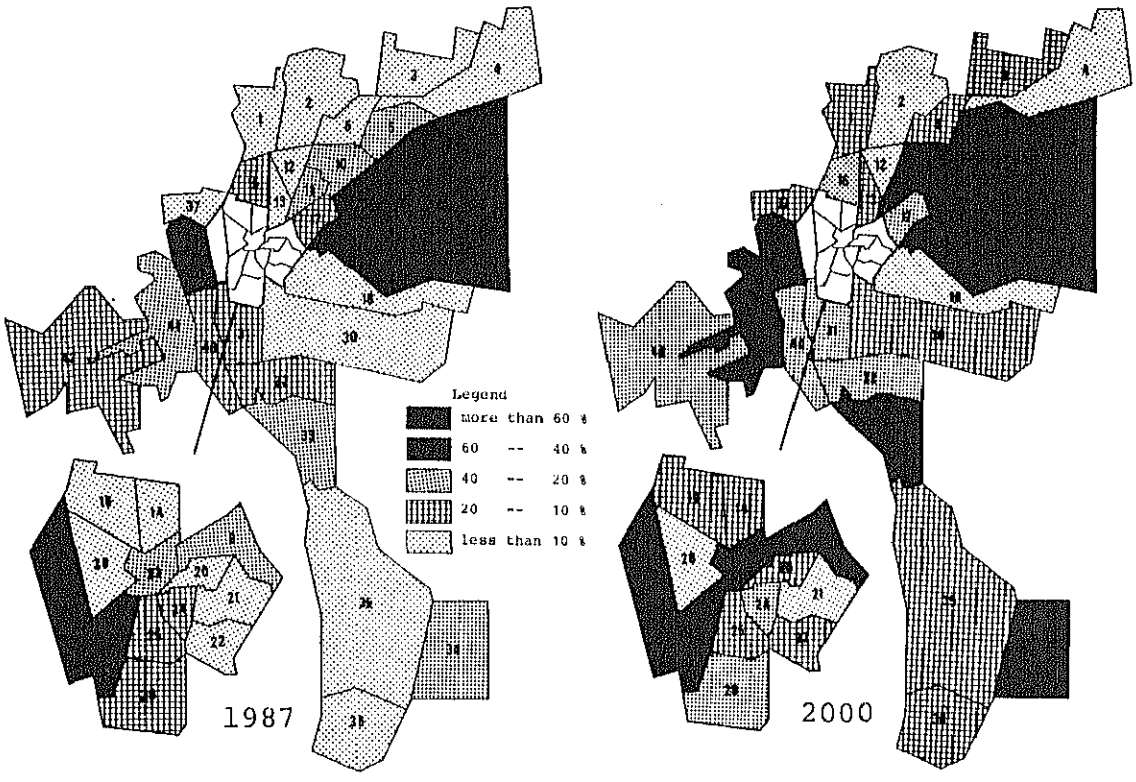


Fig. 7.2.6 Car Ownership Rate by Zone in 1987 and 2000

7.3 Socio-Economic Indices

Socio-economic indices discussed in Chapter 7.2, are summarized in Table 7.3.1. In addition socio-economic indices in 1978 are attached as Table 7.3.2.

Table 7.3.1 Socio-Economic Indices in 2000

Zone No.	Zone Name	Pop. Over 6 (pers)	STUDENT		EMPLOYEE			Household Income (LE/M)	AREA (ha)	Car Ownership (%)
			RES. (pers)	SCHOOL (pers)	1 and 2 (pers)	3 (pers)	TOTAL (PERS)			
1	Awal Shubra Al Kheima	588,906	202,466	170,379	51,858	80,757	132,615	218	629	16.5
2	Thany Shubra Al Kheima	594,632	203,433	166,359	82,584	76,500	159,084	172	952	14.3
3	Al Marg	162,654	55,066	45,897	7,741	32,312	40,053	184	760	8.4
4	Al Salam	213,403	49,126	40,785	12,065	29,260	41,325	241	1,954	29.8
5	Ain Shams	447,024	159,250	136,290	43,584	44,542	88,126	266	794	6.1
6	Matarla	452,002	167,199	151,900	31,640	51,206	82,846	226	597	17.8
7	Nozha	143,848	50,925	44,809	42,709	75,142	117,851	677	1,510	79.2
8	Masr Al Gadida	108,792	31,351	81,859	60,204	84,239	144,443	706	629	93.4
9	Nasr City	383,580	141,547	110,937	69,131	128,350	197,481	715	2,665	92.0
10	Al Zeitoun	320,890	108,942	112,132	29,993	54,999	84,992	336	565	15.9
11	Hadaek Al Kobba	303,247	99,017	94,568	22,709	37,359	60,068	323	400	19.4
12	Al Zavia Al Hamra	273,179	96,925	88,962	22,160	29,733	51,893	216	352	37.1
13	Sharabiah	280,924	97,263	86,788	15,295	22,962	38,257	242	290	20.7
14	Shubra	80,369	21,791	58,031	18,673	36,895	55,568	256	100	23.4
15	Al Sahel	313,226	101,000	112,373	23,641	98,568	122,209	321	408	31.4
16	Rod Al Farag	172,096	49,113	56,026	7,109	49,257	56,366	246	239	17.5
17	Al Wayli	148,931	42,257	142,978	39,066	90,634	129,700	424	346	80.5
18	Manshiet Nasser	131,516	36,380	32,386	9,195	9,897	19,092	244	330	48.1
19	Al Zaher	64,435	21,912	34,310	11,978	23,135	35,113	314	153	7.7
20	Bab Al Sharia	56,802	13,593	19,630	21,300	35,308	56,608	240	91	20.3
21	Gamalia	70,002	19,060	24,574	15,075	33,900	48,975	256	134	40.2
22	Al Darb Al Ahmar	82,286	21,718	24,646	12,663	22,308	34,971	236	154	19.6
23	Azbakia	32,221	8,065	29,023	34,827	89,098	123,925	265	75	6.1
24	Moski	33,565	10,024	10,719	29,331	53,956	83,287	271	61	21.5
25	Abdin	48,558	14,494	20,327	26,996	70,030	97,026	287	113	30.3
26	Boulaq	86,205	20,341	23,483	17,621	53,767	71,388	224	185	25.2
27	Zamalek	22,191	5,436	20,116	4,838	13,661	18,499	1,474	138	95.0
28	Qasr Al Nile	13,959	3,658	21,723	35,180	107,039	142,219	442	65	39.0
29	Saiyedah Zeinab	143,364	37,196	69,526	28,414	92,134	120,548	289	303	24.8
30	Al Khalifah	111,703	32,326	41,346	21,910	45,970	67,880	190	809	10.6
31	Masr Al Qadima	181,922	51,662	73,545	23,152	74,834	97,986	319	721	31.0
32	Basatien	482,514	163,246	132,637	35,845	61,393	97,238	243	1,112	13.7
33	Maadi	166,584	50,832	59,120	66,915	82,253	149,168	549	1,173	86.1
34	15 th May	111,974	36,790	27,253	4,173	22,711	26,884	351	1,089	17.4
35	Helwan	492,956	163,925	149,133	139,449	87,876	227,325	230	1,561	12.4
36	Al Tebbin	64,123	22,231	21,199	62,222	18,079	80,301	187	360	10.3
37	Embaba	405,702	132,921	138,170	35,459	56,253	91,712	228	356	18.2
38	Agouza	189,845	67,295	57,959	7,855	37,452	45,307	656	424	92.2
39	Dokki	102,245	31,546	57,917	20,809	63,455	84,264	488	377	48.1
40	Giza	259,521	78,149	122,643	30,213	76,349	106,562	219	429	9.2
41	Boulaq Al Dakrour	1,027,009	341,136	261,633	26,711	106,624	133,335	283	1,748	11.4
42	Al Ahram	551,309	165,194	139,997	48,858	79,932	128,790	367	1,476	51.4
44	Al Obour,NS10	83,817	26,850	18,021	8,685	7,991	16,676	200	250	11.6
45	NS1,2,4	419,084	134,250	90,107	48,424	39,955	88,379	250	833	18.1
46	NS3,5	167,634	53,700	36,043	22,370	15,982	38,352	250	500	18.1
47	6 OCT,NS6,7	167,634	53,700	36,043	49,370	15,940	65,310	200	500	11.6
	Total	10,758,383	3,494,301	3,494,302	1,480,000	2,519,997	3,999,997		28,710	

Source: Study Team estimates

Table 7.3.2 Socio-Economic Indices in 1987

Zone No.	Zone Name	Pop. Over 6 (PERS)	STUDENT		EMPLOYEE			Household Income (LE/M)	AREA (ha)	Car Ownership (%)
			RES. (pers)	SCHOOL (pers)	1 and 2 (pers)	3 (pers)	TOTAL (pers)			
1	Avat Shubra Al Kheima	307,718	112,992	100,921	33,772	27,103	60,875	156.4	435	6.4
2	Thany Shubra At Kheima	285,105	101,090	87,234	46,204	18,021	64,225	123.4	672	4.1
3	Al Marg	96,461	34,648	26,497	5,597	5,452	11,049	132.2	770	6.9
4	Al Salam	116,741	28,776	22,992	8,719	4,391	13,110	173.1	1,994	5.3
5	Ain Shams	318,920	117,348	86,415	14,955	25,391	40,346	190.5	585	22.5
6	Mataria	378,758	145,479	116,831	23,594	32,136	55,730	162.2	1,572	6.9
7	Nozha	113,261	42,332	31,354	13,766	33,383	47,149	485.9	577	81.7
8	Masr Al Gadida	113,681	35,612	78,015	30,464	55,653	86,117	506.4	550	58.6
9	Nasr City	151,248	56,498	46,189	49,345	66,374	115,719	513.3	742	72.3
10	Al Zeitoun	282,911	102,548	97,897	23,145	31,365	54,510	241.1	565	29.6
11	Hadaek Al Kobba	291,727	104,287	79,383	17,138	26,541	43,679	231.5	400	21.5
12	Al Zawia Al Hamra	253,393	97,153	70,731	16,964	17,646	34,610	154.8	308	3.0
13	Sharabiah	259,903	96,351	63,773	11,428	15,703	27,131	173.7	153	7.4
14	Shubra	95,377	28,693	55,262	14,272	22,773	37,045	183.5	100	7.8
15	Al Sahel	350,819	123,069	103,837	18,045	37,589	55,634	230.3	352	16.7
16	Rod Al Farag	201,526	63,605	51,929	5,363	20,777	26,140	176.4	290	9.5
17	Al Wayli	106,967	31,438	134,347	28,982	78,836	107,818	303.9	408	15.0
18	Manshiet Nasser	103,543	31,432	23,818	6,816	6,595	13,411	175.0	231	3.4
19	At Zaher	75,221	28,380	32,682	9,299	12,733	22,082	225.5	153	33.8
20	Bab At Sharia	68,797	18,208	18,669	17,197	13,173	30,370	172.1	91	7.7
21	Gamalia	74,557	23,251	23,405	11,802	20,751	32,553	183.7	128	4.8
22	Al Darb Al Ahmar	90,389	26,867	23,081	10,103	12,770	22,873	169.1	140	7.5
23	Azbakia	40,383	11,372	27,479	26,637	72,017	98,654	189.9	75	25.7
24	Moski	37,517	12,576	8,509	23,119	40,118	63,237	194.4	61	10.7
25	Abdin	58,323	19,452	19,462	20,541	50,619	71,160	205.7	185	10.2
26	Boulaq	101,993	27,696	22,372	13,660	26,743	40,403	160.4	113	5.2
27	Zamalek	20,402	5,456	19,064	3,488	14,136	17,624	1,057.3	138	86.1
28	Qasr Al Nile	15,724	4,446	20,426	25,903	96,569	122,472	317.2	65	48.3
29	Saiyedah Zeinab	173,432	49,694	65,909	21,785	64,660	86,445	267.2	303	11.8
30	Al Khalifah	139,554	44,916	38,703	15,939	14,456	30,395	136.4	646	6.8
31	Masr Al Qadima	219,884	68,723	70,283	17,118	35,081	52,199	228.6	721	15.8
32	Basatien	380,936	135,273	68,365	26,785	19,273	46,058	174.3	742	11.3
33	Maadi	81,995	25,314	52,775	24,073	24,472	48,545	394.2	1,112	41.3
34	15 th May	18,873	6,706	7,119	2,903	2,477	5,380	251.8	1,561	35.6
35	Helwan	353,178	125,038	114,184	94,015	33,539	127,554	165.0	1,089	9.7
36	Al Tebbin	41,539	15,630	18,525	16,434	5,780	22,214	134.4	324	0.0
37	Embaba	404,389	142,101	125,401	27,279	40,561	67,840	163.8	356	6.9
38	Agouza	160,484	60,449	37,436	5,738	24,864	30,602	470.7	424	52.8
39	Dokki	95,919	31,782	54,977	14,905	64,201	79,106	350.0	377	51.4
40	Giza	220,351	72,117	116,440	22,521	63,311	85,832	157.2	429	10.9
41	Boulaq Al Dakrour	501,321	174,088	96,742	19,516	34,219	53,735	203.1	1,221	20.1
42	Al Ahram	219,748	68,757	84,863	35,923	35,761	71,684	263.5	719	17.0
	Total	7,422,888	2,551,643	2,444,296	875,252	1,348,063	2,223,315		21,877	

Source: PT Survey

8 Traffic Demand Forecast and Transportation Cost Estimate

8.1 Forecast Procedure

Except in special cases, the usual four-step forecast method is used to project future traffic demand. That is, the volume of road traffic and the number of railway passengers between stations are obtained by undertaking the tasks entailed in each of the following steps:

Step 1	Trip generation/attraction
Step 2	Trip distribution
Step 3	Modal split
Step 4	Traffic assignment

The overall flow of the procedure is shown in Fig. 8.1.1. A brief explanation will be given here of the special problems that existed in the Study and how they were dealt with.

1) Forecast by Passenger Car Ownership

The results of the PT survey indicate that there is a significant difference between car-owning households and non-car-owning households with respect to trip production rate, trip generation/attraction, and modal preference. Therefore, separate forecasts are made for car-owning households and non-car-owning households on each of these three aspects.

2) Sample Size

The sampling rate in the PT survey was about 0.8%. At the same time, under Kism-based zoning there are 42 zones (excluding new settlements in the suburbs), or 1,764 (42 x 42) possible zone pairs. Because of these factors, it is necessary to keep the OD table as simple as possible in order to ensure a fair degree of reliability in the forecast. Therefore, trip purposes are grouped into the five categories of "commuting to work", "commuting to school", "returning home", "shopping" and "others". Modes of transport are likewise grouped into the five categories of "walking or two-wheeled vehicle", "passenger car", "taxi", "railway" and "bus". Future OD tables based on trip purpose/mode of transport combinations are avoided in order to prevent a decline in reliability.

3) Combined Use of Model Method and Present Pattern Method

The factors cited above also make it difficult to develop a distribution model by mode of transport for forecasting future OD trips by mode of transport. Therefore, the gravity model is used to forecast the overall volume (all purposes/all modes) of OD trips, and the present pattern method is used to forecast the volume of OD trips using passenger cars. The volume of OD trips by public transportation is then obtained by subtracting the latter from the former. This process is followed separately for car-owning households and non-car-owning households.

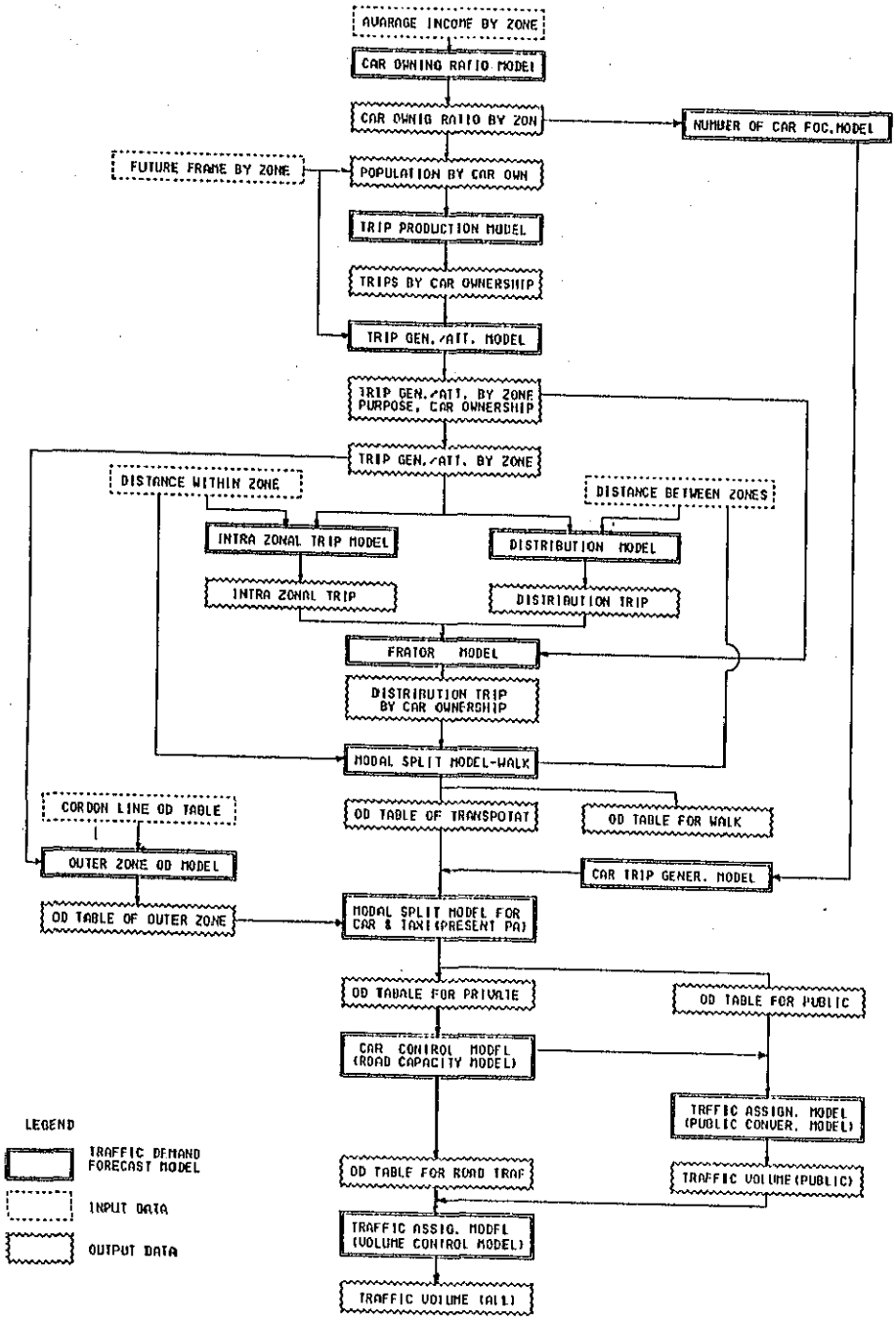


Fig. 8.1.1 Demand Forecast Procedure

Another reason for adopting the above procedure is that no factors justifying a split between passenger car trips and public transportation trips could be found despite strenuous efforts to do so through analysis of current data. All that can be said is that at present there is an extremely strong preference for passenger cars, and that individuals use the passenger car whenever possible regardless of the destination, cost or traveling time.

4) Disaggregate Model for Separating Railway and Bus Passengers

An interview survey on trip purpose, origin and destination, access and egress modes, traveling time and other matters was conducted against randomly selected passengers traveling between Mubarak Sta. and Sadat Sta. on the Regional Metro, which opened in November 1987. At the same time, a similar survey was conducted against the passengers of buses serving the route that is in competition with the Regional Metro. Based on the results of the two surveys, a disaggregate modal split model was developed to divide public transport users into railway users and bus users.

The assignment of public transportation trips was made by dividing the total number of OD trips into five parts and assigning each part one by one. This method was taken because of the limitation placed on the transport capacity of rail systems: it allows another route to be searched for if the preceding assignment to the minimum time route on the railway results in an excess of trips over capacity in any one section of the route. After searching for the minimum time route on the bus and railway networks, the travel times and fares of the two routes are obtained. Then, based on the modal split model mentioned above, the passenger shares of buses and railways are obtained, and trips are assigned to the respective networks accordingly.

5) External Trips

The four-step forecast method was applied to internal trips made by residents of the Study Area (GCMR). For trips made into the Study Area by non-residents, which account for 4% of the total, a simple forecast method using the growth rate was adopted. In this case, the geometric average between the population growth rate of the GCMR and that of non-GCMR zones was used as the growth rate.

6) New Towns and Settlements

There are plans to establish new towns and settlements in the desert regions surrounding the GCMR, and the population framework for the year 2000 assumes that these regions will have a population of one million. However, as there are many uncertain factors concerning the realization of these plans, the base case for forecasting future traffic demand disregards the population prediction of one million, and the influence of new towns and settlements on traffic demand is dealt with separately.

8.2 Total Number of Trips

The per capita trip production rate of the GCMR population aged six years or over is considered to remain unchanged in the future. At present, car-owning households produce 3.1 trips per person and non-car owning households, 1.6 trips, or a total average of 1.87. Since the ratio of car-owning households to the total will rise from the current 18.0% to 30.7% in the year 2000, the average trip production rate will rise to 2.06. In other words, the increase of passenger cars will cause a gain in mobility of 1.1 times (2.06/1.87).

Trips originating and ending in the GCMR will increase by 1.6 times from 13.4 million per day in 1987 to 22.2 million in 2000 due to the 1.47 times increase in population and 1.1 times rise in mobility. At the same time, trips originating or ending outside the GCMR and through trips will increase by 1.4 times and 1.2 times respectively (Fig. 8.2.1, Table 8.2.1).

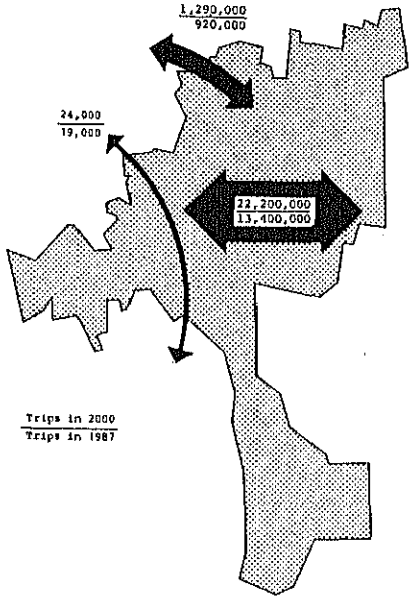


Fig. 8.2.1 Total Trips in 1987 and 2000

Table 8.2.1 Major Indicators of Transport Demand

	(A) 1987	(B) 2000	(B)/(A)
1 Population (1000)	8856	13000	1.47
2 GDP/Capita (LE at 1987 price)	869	1239	1.43
3 Passenger Car (1000)			
Total	495	1358	2.74
Owned by Family	413	1034	2.50
Ownership Rate (car/1000 pop)	46.6	79.5	1.71
Car Owning Family Rate (%)	18.0	30.7	1.71
4 Trips			
Trip Rate	1.87	2.06	1.10
Total Trip (1000)	13456	22171	1.65

By trip purpose, the largest share of internal trips in the year 2000 will be accounted for by returning-home traffic (48.0%), followed by commuting to work (21.0%), commuting to school (16.3%), others (business, social, leisure and other purposes; 11.0%), and shopping (3.6%). The order will thus remain the same as in 1987, but a significant development will be the rise in the share of commuting-to-work trips from 19.2% to 21.0% (Fig. 8.2.2). Commuting to work traffic accounts for most of the traffic during peak hours and constitutes the most critical element in transportation planning. It should be noted that the increased share of such trips in the future will create a major burden on the transport network.

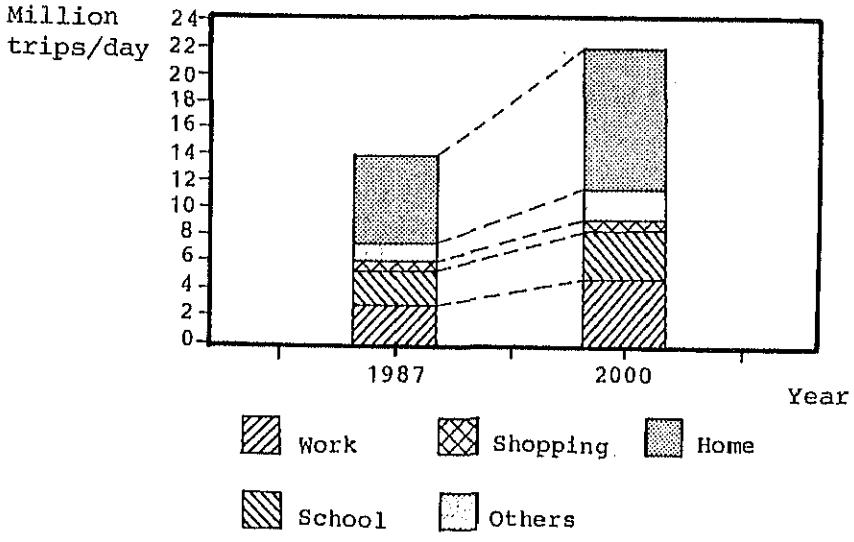


Fig. 8.2.2 Distribution of Internal Trips by Trip Purpose

8.3 Trip Generation and Attraction

A linear model which has as its explanatory variables the population indices determined for the future socio-economic framework is used to forecast trip generation and attraction in each zone. The linear models developed on the basis of the results of the Person-Trip Survey are shown in Table 8.3.1. Forecasts at this stage are still based on passenger car ownership.

Table 8.3.1 Trip Generation/Attraction Model

Trip Purpose	Car Owner	Equation	Correlation Coefficient
Work	Own	$G_C = -171 + 0.6537P_C$	0.992
		$A_C = -2790 + 0.6365E_3 + 23772F_1 + 541F_2$	0.969
	Non	$G_N = 3649 + 0.2721P_N$	0.992
		$A_N = 664 + 0.7968E_T - 6626F_1 - 16568F_2$	0.990
School	Own	$G_C = -402 + 1.1551S_C + 10016F_1 + 6749F_2$	0.992
		$A_C = 2272 + 0.0829P_C + 0.1156E_3 + 22780F_1 - 50402F_2$	0.962
	Non	$G_N = 9 + 0.9249S_N + 942F_1 - 3831F_2$	0.997
		$A_N = -877 + 0.8798S_T - 0.0185E_T - 14133F_1 + 32042F_2$	0.990
Shopping	Own	$G_C = -376 + 0.0910P_C + 0.0011E_3 + 6472F_1 + 4098F_2$	0.962
		$A_C = -655 + 0.0269P_C + 0.0614E_3 + 21364F_1$	0.968
	Non	$G_N = 3063 + 0.0476P_N - 0.0458E_1 + 15847F_1 + 6302F_2$	0.944
		$A_N = 3202 + 0.0316P_N + 0.0107E_T + 15726F_1$	0.915
Others	Own	$G_C = -3436 + 0.3304P_C + 0.0964E_T + 18623F_1 + 12766F_2$	0.974
		$A_C = -2352 + 0.1510P_C + 0.2462E_3 + 60842F_1 - 30500F_2$	0.948
	Non	$G_A = -1207 + 0.0883P_N + 0.0911E_1 + 17048F_1 + 13397F_2$	0.946
		$A_A = 1374 + 0.0245S_T + 0.2788E_T + 13875F_1$	0.943

Note P_C: Car-owning-population
P_N: Non-car-owning-population
S_C: Car-owning student
S_N: Non-car-owning student
S_T: Number of student at studying place
E_1: Number of employee (1st & 2nd industry)
E_3: Number of employe (3rd industry)
E_T: Number of employee (total)
F_1, F_2: Adjustment coefficient

F1 and F2 are dummy variables that express special characteristics related to land use or urban functions not fully explained by population, number of students, number of workers or other demographic factors. Zones to which the dummy variables are applied are those that attract a larger number of trips than their population indices warrant--such as zones containing a business center, university, government offices, or hospital.

While the forecasts are made by trip purpose, the linear model is not applied to "returning home" trips. These are calculated by assuming that the number of returning-home trips attracted to a given zone is the same as the total number of home-based trips generated in that zone, and that the number of returning-

home trips generated in a given zone is equivalent to 92-96% (the current ratio is applied) of the total number of trips attracted to that zone.

The values for total trip generation and total trip attraction (all purposes and all zones combined) obtained from the linear model are both adjusted so as to correspond to the value for total trip production given in the preceding section.

The forecast figures are compared with the current figures in Table 8.3.2 and Fig. 8.3.1. In order to emphasize the generation/attraction characteristics of the zones, returning-home trips are not included in the table or the figure. If returning-home trips were included, generation and attraction in a given zone would be more or less equal and would be close to the sum of the corresponding figures for that zone shown in the table.

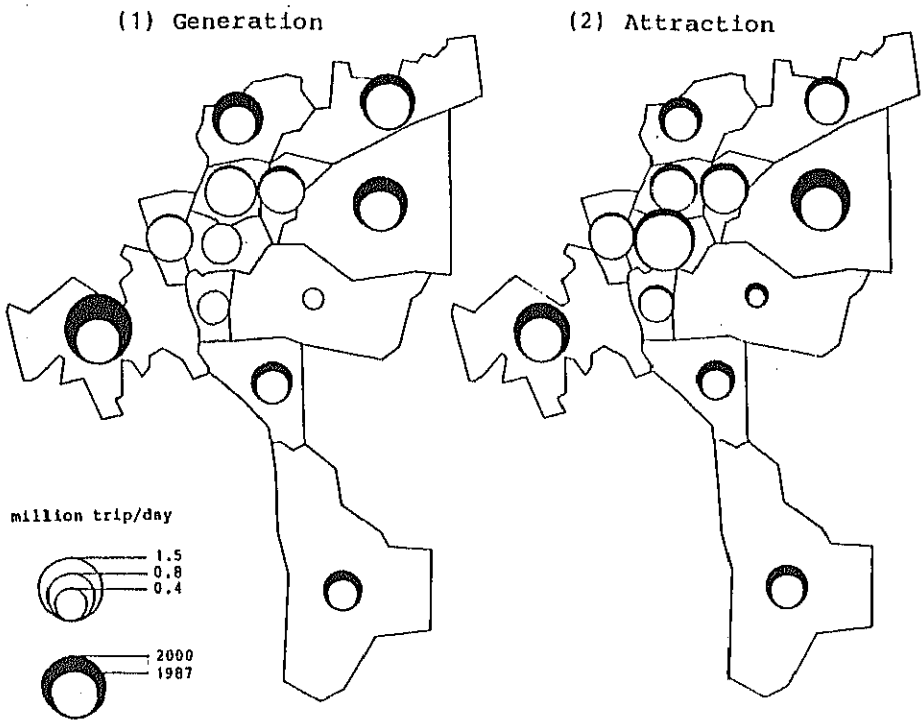


Fig. 8.3.1 Trip Generation and Attraction in 1987 and 2000

Since overall trip generation in a zone is more or less proportionate to the zone's population, those zones, where a sharp increase in population is forecast, also expect to see a sharp increase in the number of trips generated. Zones where trip generation will increase by more than two times in the year 2000 are: Awal Shubra Al Kheima (2.05 times), Thani Shubra Al Kheima (2.02 times), Nasr City (2.44 times), Maadi (2.65 times), 15th May and the surrounding new settlements (6.65 times), Boulaq Al Dakrour (2.6 times), and Al Ahram (2.9 times). Conversely, trip generation will decline in many of the zones in the CBD (zones 20-29), where nighttime population is predicted to decrease.

Table 8.3.2 Future Trip Generation and Attraction

Zone No.	Zone Name	Generation		Attraction	
		1987	2000	1987	2000
1	Awal Shubra Al Kheima	243,604	499,625	202,757	353,284
2	Thani Shubra Al Kheima	259,258	524,175	241,555	426,900
3	Al Marg	79,568	143,051	45,331	108,043
4	Al Salam	81,695	156,648	43,970	103,008
5	Ain Shams	293,695	518,991	190,180	306,775
6	Mataria	360,744	448,909	264,262	323,480
7	Nozha	220,219	293,388	199,414	359,550
8	Masr Al Gadida	176,205	204,489	312,380	552,808
9	Nasr City	270,924	661,214	304,102	694,051
10	Al Zeitoun	328,341	449,743	261,100	358,225
11	Hadaek Al Kobba	270,364	341,608	156,136	192,765
12	Al Zawia Al Hamra	205,655	223,925	123,878	144,616
13	Sharabiya	215,198	246,918	111,271	132,076
14	Shubra	77,740	73,206	120,777	136,618
15	Al Sahel	304,537	322,944	199,991	312,968
16	Rod Al Farag	173,747	166,119	113,092	158,477
17	Al Wayli	148,415	203,894	366,594	415,121
18	Manshiet Nasser	78,048	97,901	45,982	52,852
19	Al Zaher	80,659	87,762	68,104	86,657
20	Bab Al Shaaria	54,019	52,041	59,682	97,533
21	Gamalia	60,733	60,086	73,035	94,380
22	Al Darb Al Ahmar	71,065	69,607	58,371	72,482
23	Azbakiah	49,526	53,294	178,347	215,792
24	Moski	69,865	73,689	160,394	203,000
25	Abdin	57,825	57,396	128,713	167,679
26	Boulaq	77,922	72,465	85,613	133,848
27	Zamalek	29,811	34,233	49,716	47,933
28	Qasr Al Nile	94,269	102,443	296,086	368,349
29	Sayedah Zeinab	159,711	156,173	215,659	263,024
30	Al Khalifah	110,393	97,920	82,952	136,310
31	Masr Al Qadima	227,870	228,418	214,932	298,751
32	Basatin	295,993	428,230	159,748	297,477
33	Maadi	87,403	231,351	120,145	297,874
34	15th May	21,399	142,324	17,951	83,678
35	Helwan	270,193	430,503	299,241	511,716
36	Al Tebbin	38,331	65,171	44,825	91,716
37	Embaba	328,071	348,964	243,687	259,874
38	Agouza	250,881	338,162	175,029	261,733
39	Dokki	166,985	202,917	278,001	327,021
40	Giza	208,878	262,974	341,246	401,482
41	Boulaq Al Dakrour	413,712	1,077,092	221,260	588,736
42	Al Ahram	189,263	548,185	185,898	339,749
44	Al Obour, NS10	0	70,643	0	37,605
45	NS1, 2, 4	0	363,441	0	197,321
46	NS3, 5	0	146,670	0	80,555
47	6th Oct., NS6, 7	0	143,640	0	95,728
	Total	7,202,734	11,522,542	7,061,407	11,189,620

Trip attraction will show a large increase in zones with a steep rise in population, zones where a new urban core (regional center, main center, local center) will be established, and zones where industrial development is planned. Zones where trip attraction will increase by more than two times in the year 2000 are: Al Marg (2.38 times), Al Salam (2.34 times), Nasr City (2.28 times), Maadi (2.48 times), 15th May (4.66 times), Al Tebbin (2.05 times), and Boulaq Al Dakrour (2.66 times).

The ratio of trip attraction to trip generation is defined as the trip satisfaction rate within a zone. Even if a zone has a trip satisfaction rate of 1.0, there is actually a large number of vehicles moving out of the zone and an equal number of vehicles flowing into the zone. However, if the achievement of "closed" zones in terms of traffic demand is considered desirable for mitigating traffic congestion, it would at least be necessary to secure a trip satisfaction rate of more than 1.0.

In 1987, 18 out of the 42 zones had a trip satisfaction rate of over 1.0. All these zones contain a commercial, business or industrial centers. They are: Masr Al Gadida, Nasr City, Shubra, Al Wayli, Bab Al Shaaria, Al Gamalia, Azbakiah, Al Moski, Abdin, Boulaq, Zamalek, Qasr Al Nile, Sayedah Zeinab, Maadi, Helwan, Tebbin, Dokki, and Giza.

In the year 2000, in addition to the above 18, the following four zones will have a trip satisfaction rate of over 1.0: Nozha, Al Darb Al Ahmar, Al Khalifah, and Masr Al Gadida.

Fig. 8.3.2 shows trip generation and attraction by purpose in the year 2000 (returning-home trips are again excluded). The proportion of trips generated for "commuting to work" is nearly the same in all zones, as are trips for "shopping" purposes. The share of "other purpose" trips (business, leisure, social, etc.) is large in the CBD and Heliopolis (Masr Al Gadida, Nozha), while the share of "commuting to school" trips is large in suburban zones.

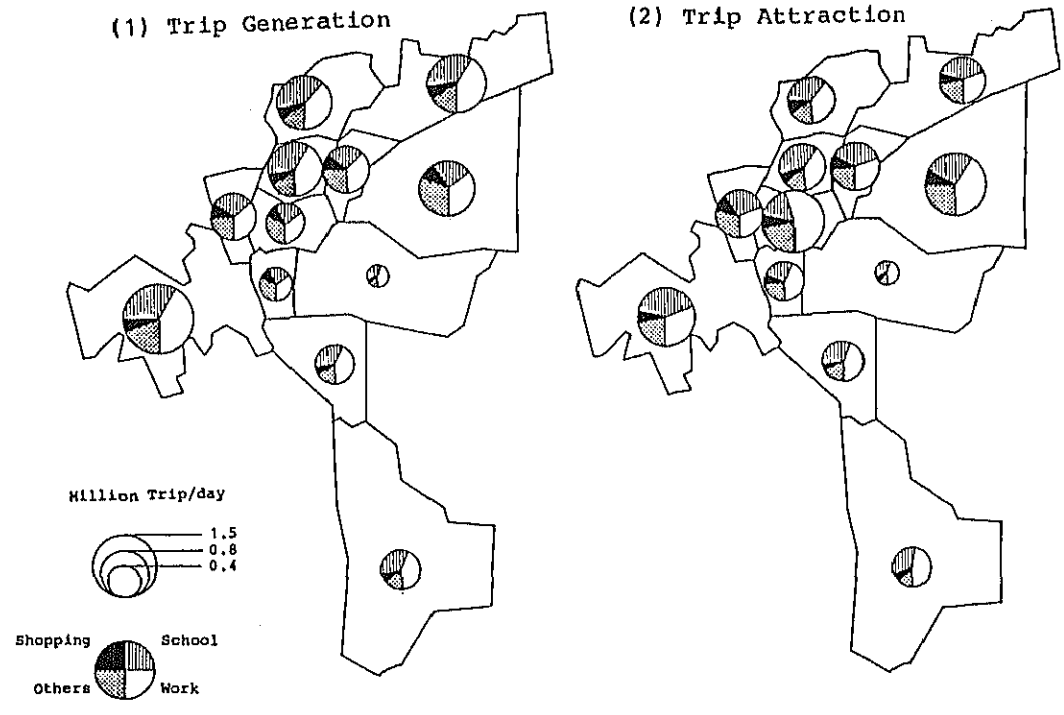


Fig. 8.3.2 Trip Generation and Attraction by Purpose in 2000

On the attraction side, the ratio of "commuting to work" trips is high in the CBD, Maadi, Helwan and Heliopolis, where employment opportunity is high. On the other hand, "commuting to school" trips account for a large proportion of trip attraction in Al Marg and Helwan zones, and all the zones in the Giza and Qaliubiah Governorates.

8.4 Trip Distribution

After having reviewed the suitability of various models for calculating inter-zonal trips, the Voorhees type gravity model was selected. The equation for the model is as follows:

$$Tij = Gij \frac{Aj \times Dij^{\alpha}}{\sum_{k} (Ak \times Dik)^{d}}$$

Where Tij = O-D trip volume between zones i and j

Gi = Trip generation in zone i (excluding intra-zonal trips)

Aj = Trip attraction in zone j (excluding intra-zonal trips)

Dij = Distance by road between zones i and j (km)

d = Parameter

The results of the analysis indicate that distance is an important factor when the destination zone (zone j) is located in the outlying area of a city and is not important when the destination zone is at a city center. Therefore, separate parameters are used for the two areas (α = -1.876 in outlying areas and α = -1.058 in central areas).

For intra-zonal trips, the following log-linear model is applied:

$$Tii = K \; Gi^{\alpha} \; Ai^{\beta} \; Li^{\gamma} \; F1^{\delta} \; F2^{\delta}$$

Where Tii = Intra-zonal trips in zone i
Gi = Trip generation in zone i
Ai = O-D trip volume in zone i
Li = Average traveling distance in zone i (km)
F1, F2 = Adjustment coefficients corresponding to zone characteristics
$K, \alpha, \beta, \gamma, \delta, \varepsilon$ = Parameters

Trip Purpose	Parameter						Multiple Correlation Coefficient
	k	α	β	γ	δ	ε	
Work	0.0121	-0.1659	1.1121	0.1696	0.9268	-0.0036	0.934
School	0.1554	0.1618	1.1234	0.0073	0.3323	0.6716	0.976
Shopping	0.0069	0.0483	1.0218	0.4739	0.0500	0.5970	0.975
Others	0.0564	0.2194	0.8166	0.3685	0.6805	0.3691	0.966

The OD trip volumes thus calculated from the models are iterated based on the Fratar method in order to achieve harmony

with the trip generation and attraction volumes given in the preceding section.

An OD table for all trips regardless of purpose is shown by integrated zone for the year 2000 in Table 8.4.1. Fig. 8.4.1 gives the desire line charts for inter-zonal trips in 1987 and 2000.

Table 8.4.1 Integrated Origin - Destination Table for Year 2000 (All Purpose, Mode)

	1	2	3	4	5	6	7	8	9	10	11
1	1240553	44679	64810	42192	129653	6034	78810	17473	15431	7166	22982
2	44859	1244119	273219	155650	56545	8666	87401	22037	19826	10280	22839
3	64904	270892	1460991	224372	91615	25805	132911	31741	49305	17793	56879
4	42076	153143	223438	1002668	89049	19129	132516	31159	23986	13352	39337
5	127271	56954	92446	88551	1023361	16479	193824	40769	30954	19474	40407
6	5956	8613	25376	19096	16455	156345	46402	25301	18546	3623	9273
7	78959	88296	131175	131220	193432	45637	778123	98950	96950	27244	127470
8	17646	22420	31817	31170	40485	24812	99368	363679	76437	14962	36568
9	15394	19947	49145	23442	30810	18886	97632	78538	697824	42416	28808
10	7253	10467	18018	12948	19314	3735	26959	14732	42836	1038523	19570
11	23352	23190	57492	38875	39877	9385	128069	36359	29524	19754	1000737
12	21423	23898	76154	42832	50669	21969	178480	108600	66117	32416	186232
13	1958	6027	14339	5585	4450	832	8369	2599	2918	2410	3786
14	5785	14353	104697	22250	15662	4553	40714	11903	13093	9524	13850
15	3358	4631	14654	8827	9483	2324	20730	9085	10347	7261	12699
16	1544	1573	2534	5986	3108	356	3050	1521	2984	750	2334
17	4998	17290	16572	7614	9970	2445	12480	4922	5673	1258	5580
18	14977	8503	8542	5647	6998	919	10119	4399	693	480	4461
19	40268	14128	19523	17147	32672	1027	34286	6497	3964	4271	16667
20	6386	6699	10889	16759	14223	4368	25655	9471	5799	24870	48008
TOTAL	1768920	2039822	2695831	1902831	1877831	373706	2135898	919735	1213207	1297827	1698487

	12	13	14	15	16	17	18	19	20	TOTAL
1	21191	1895	5538	3259	1489	5014	14449	40268	6261	1769147
2	23331	5832	13697	4477	1518	16729	8128	13889	6616	2039658
3	75987	14265	104468	14655	2469	16660	8521	19408	11238	2694879
4	42966	5683	22468	9061	5922	7483	5465	16953	16686	1902540
5	50901	4471	15615	9548	3077	9927	6822	32729	14339	1877919
6	21953	812	4495	2272	364	2215	892	1010	4514	373513
7	179692	8506	41787	21042	3148	12103	9791	34282	26818	2134625
8	108673	2655	12154	9219	1553	5071	4401	6583	9978	919651
9	65162	2867	12952	10157	3000	5727	642	3967	5916	1213232
10	32434	2405	9598	7253	762	1254	454	4320	25365	1298200
11	184248	3864	13913	12854	2383	5388	4243	16547	48485	1698539
12	2186891	3160	10689	24820	3861	4350	3719	15101	72797	3134178
13	3182	45348	1401	856	24	24	23	24	48	104203
14	11001	1439	486239	2571	48	47	47	48	97	757921
15	25249	857	2540	98085	24	23	23	23	49	230272
16	3846	24	50	24	0	94	552	1458	1202	32990
17	4461	24	48	24	94	0	78	820	1276	95627
18	3981	23	47	23	583	85	0	174	1320	71974
19	15504	24	48	24	1515	890	170	0	3328	211953
20	73161	49	98	50	1227	1222	1254	3220	3084	256492
TOTAL	3133814	104203	757845	230274	33061	94306	69674	210824	259417	22817513

Integrated Zones

1	Shubra Al Kheima	6	Khalifah	11	Agouza	16	East Cairo, South Sinai
2	East	7	Central	12	Ahram	17	Sharkia, North Sinai
3	Masr Al Gadida	8	South	13	Obour, NS 10	18	Delta
4	Zeitoun	9	Maadi	14	NS 1,2,3,4,5	19	Western Region
5	North	10	Helwan	15	6th Oct., NS 6,7	20	Upper Egypt

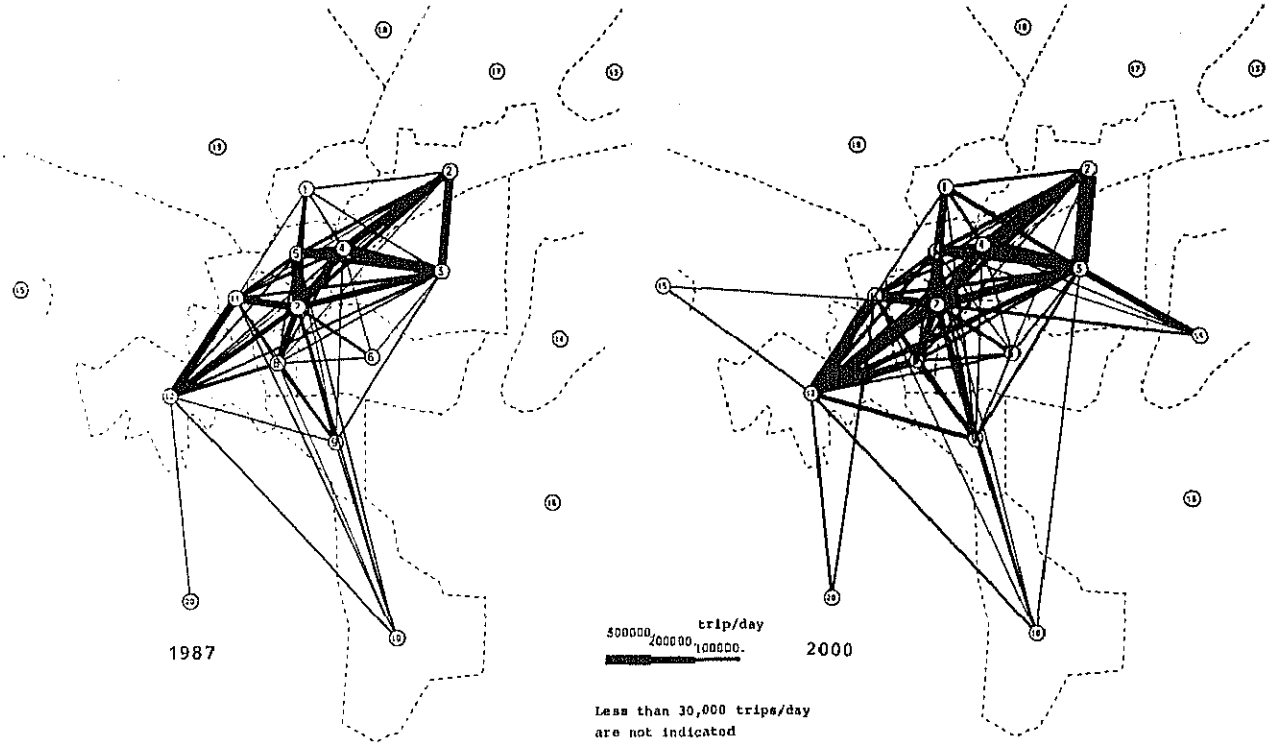


Fig. 8.4.1 Change in Origin-Destination Trip Structure in 2000

In the year 2000, intra-zonal trips will total 12.8 million, or 56.2% of the total number of trips. Since the ratio was 54.8% in 1987, the average intra-zonal trip rate will rise slightly. When calculated from the O-D table based on 42 zones, the average intra-zonal trip rate rises from 45.6% in 1987 to 47.1% in 2000.

Future inter-zonal trips will show a tendency to increase further in the zone pairs that already stand out as having a significantly high volume of O-D trips. Inter-zonal trips of more than 200,000 will be seen in the following 12 zone pairs in the year 2000.

(1)	Masr Al Gadida(3) - East(2)	544,000 trips/day
(2)	Zeitoun(4) - Masr Al Gadida(3)	448,000 trips/day
(3)	Central(7) - North(5)	387,000 trips/day
(4)	Ahram(12) - Agouza(11)	370,000 trips/day
(5)	Ahram(12) - Central(7)	358,000 trips/day
(6)	Zeitoun(4) - East(2)	309,000 trips/day
(7)	Central(7) - Masr Al Gadida(3)	264,000 trips/day
(8)	Central(7) - Zeitoun(4)	264,000 trips/day
(9)	Nozha(5) - Shubra Al Kheima(1)	260,000 trips/day
(10)	Agouza(11) - Central(7)	256,000 trips/day
(11)	Ahram(12) - South(8)	217,000 trips/day
(12)	Masr Al Gadida(3) - New Settlement(14)	209,000 trips/day

Traffic demand along the northeast -- southwest corridor (Al Marg/Ain Shams -- CBD -- Giza) will continue to be conspicuously high in the future. Traffic between Al Marg/Ain Shams and

Heliopolis/Nasr City, and traffic between Shubra Al Kheima and the CBD will increase by close to two times. In addition, if new settlements to the east of Nasr City are established, traffic demand corresponding to 200,000 trips will be generated between these settlements and Heliopolis.

To calculate the strength of linkage between zones, the following equation is used to define inter-zonal linkage intensity:

$$IZLI(ij) = Tij \; / \; (\; Gi \times Aj \; / \; T \;)$$

Where IZLI(ij) = Linkage intensity between zones i and j
Tij = Trips from zone i to zone j
Gi = Trip generation in zone i (excluding intra-zonal trips)
Aj = Trip attraction in zone j (excluding intra-zonal trips)
T = Total number of trips (Gi = Aj)

In other words, if trips generated in zone i are assumed to be distributed in accordance with the relative attraction power (Aj/T) of zone j, the number of trips from zone i to zone j should correspond to GiAj/T. The ratio between this value and the actual number of trips moving from zone i to j (Tij) indicates the strength of linkage between zones i and j.

Fig. 8.4.2 shows the zone pairs with a linkage intensity of over 3.0 at present and in the year 2000. The figure also shows the changes in inter-zonal linkage intensity that are expected between now and 2000 (CBD and adjoining zones are integrated).

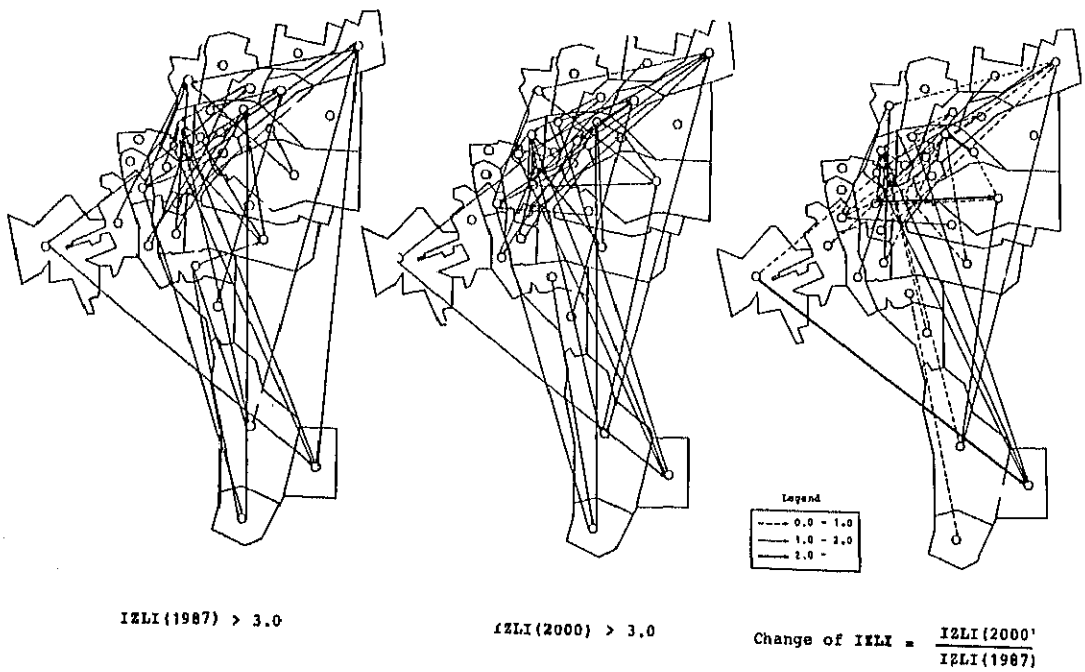


Fig. 8.4.2 Change in Inter-zonal Linkage Intensity (IZLI)

Although the general tendency is for inter-zonal linkage intensity to be high between adjacent zones and from a residential zone to a central business district, this tendency does not hold true in the GCMR. On the contrary, strong linkage is found between zone pairs that are located quite a distance apart and between zone pairs in which the destination zone is not necessarily a business center. This indicates that distance does not have much influence on trip distribution in the GCMR, which covers a relatively small area (nearly all of the urbanized area can be covered by a radius of 10 km with Attaba sq. as the center).

Between 1987 and 2000, inter-zonal linkage intensity will strengthen from Masr Al Gadida to Al Zeitoun, from Zamalek to Nasr City, and from Al Ahram to 15th May. However, the overall trend will be for linkage intensity between zones to weaken and average out.

8.5 Modal Split

1) Forecast Method and Model

The procedure used here for forecasting the modal split of future transport demand follows the binary choice method as shown in Fig. 8.5.1. However, when breaking down trips made by modes, other than walking or two-wheeler, into passenger car, taxi and public transportation, trips using the first two are estimated individually, and the remainder is allocated to public transportation. To separate public transportation demand into buses and rail transit, a modal share curve which has as its explanatory variables the travel times and fares incurred when the respective modes are used, was developed. The models are described briefly below.

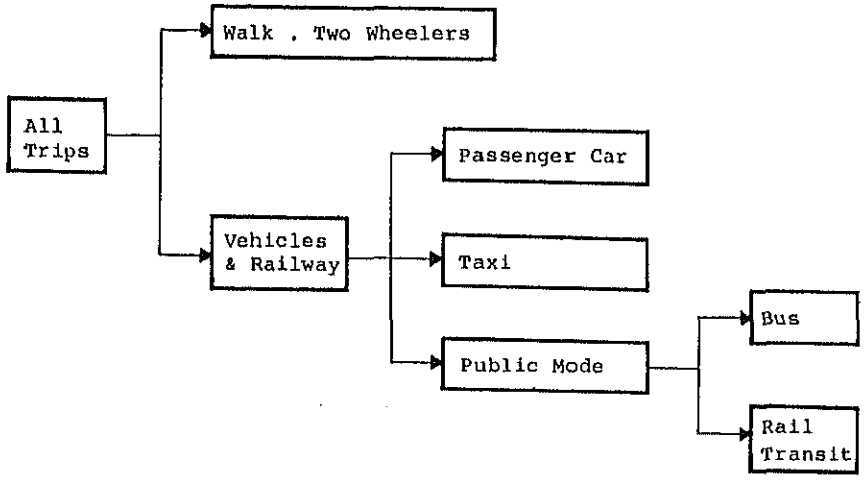


Fig. 8.5.1 Procedure of Modal Split

(1) Walking/Two-Wheeler Split Model

The share of trips made by walking or two-wheeler is estimated in accordance with the equation given below. Since walking or two-wheel vehicles are rarely used for distances exceeding 7 km, zone pairs that are more than 7 km apart are assumed to have no walking/two-wheeler trips.

$$W = K + \alpha Dij + \beta Dij$$

Where W = Modal share of walking/wheelers (%)
Dij = Distance between zones (km)
K, α, β = Parameters

(2) Trips by Passenger Car

The present pattern method is used to estimate trips by passenger car. The generation volume of such trips is obtained from the forecast number of cars owned in individual zones, while the attraction volume is obtained by applying the growth rate for

total generation volume to the current pattern of attraction. However, in order to take into consideration the urban center concept (GOPP Master Scheme) proposed for the future, trip generation in zones that will contain a center is adjusted so that the rate of increase is higher than average.

The generation volume of trips by passenger car is estimated using the following equation:

- Car-owning households:

$$Tc = -4944 + 4.232\ Nc \quad (r = 0.957)$$

Where Tc = Passenger car trips generated
Nc = Number of passenger cars owned

- Non-car-owning households:

$$Pn = 19.0 + 0.286\ P \quad (r = 0.962)$$

Where Pn = Share of passenger car trips generated (%)
P = Passenger car ownership rate (%)

(3) Trips by Taxi

First, the generation and attraction volumes of travel by taxi are estimated by applying the rate at which the number of taxis is expected to increase (assumed to be similar to the rate at which trips by modes other than walking or two-wheeler are expected to increase). Then, a future O-D table for taxi passengers is compiled by applying the present pattern method.

(4) Bus/Railway Split Model

To apportion public transportation travel between buses and rail transit, the following logit model was developed:

$$P = 1 / (1 + \mathrm{Exp}(0.127 - 0.041\ dT - 0.060\ dC))$$

Where P = Share of railway passengers
dT = Time difference (travel time by minutes on bus minus travel time on railway)
dC = Cost difference (bus fare minus railway fare; piaster)

The parameters are determined in accordance with the results of the February 1988 interview surveys conducted on passengers of the Regional Metro and passengers of the bus and minibus lines that serve routes competitive to the Regional Metro.

Fig. 8.5.2 shows the sample distribution by cost and time difference calculated from the alternative modes assumed. In terms of cost, there is a difference of 30 pt. for bus users and

there is no difference of cost for metro users. In other words, the bus users use bus because of low fare. In terms of time, distribution curves are not clearly separated but it is observed that metro users use metro when traveling time is less than that of bus, and bus users prefer to use buses even when the traveling time is longer. The time difference is affected by that bus stations are located close to the trip origin and/or destination and that access is needed to metro stations. Using these distribution data, the parameters of the aforementioned model were determined.

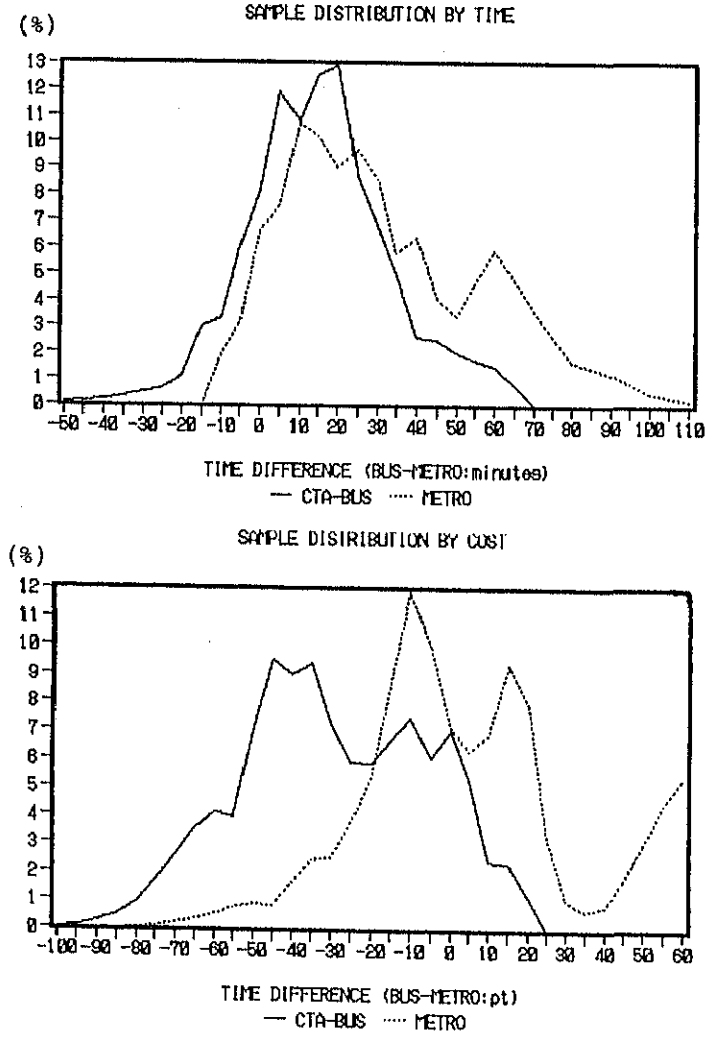


Fig. 8.5.2 Regional Metro/Bus Passengers Distribution by Cost/Time Difference

To obtain the differences in travel time and fare between buses and railways, it is necessary to search for the bus and railway routes that are expected to be used in each O-D pair. In this forecast, the minimum-time route is searched for on the bus and railway networks. This means that trip assignment is completed in conjunction with the modal split process as far as bus and rail transit are concerned (Fig. 8.5.3).

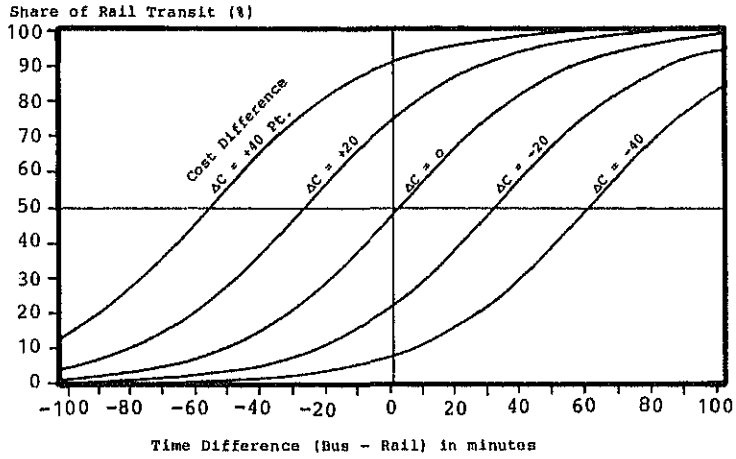


Fig. 8.5.3 Modal Split Model for Bus and Rail Transit

2) Forecast Results

When the O-D trip volume for the year 2000 is divided by mode of transport in accordance with the above procedures, the modal shares will be as shown in Table 8.5.1 and Fig. 8.5.4. Walking and two-wheelers currently account for 35.6% of all trips, but this share will decline to 30.8% in 2000 owing to the higher increases predicted for other modes of travel. Since people walk or ride a two-wheeler mostly for short distances, 87.7% of such trips are intra-zonal trips. When trips on foot or by two-wheeler are excluded, the intra-zonal trip rate given in the preceding section on trip distribution declines to 23.9% in 1987 and 29.2% in 2000 (42 zone basis).

Table 8.5.1 Modal Share in Year 1987 and 2000

Mode	1987		2000		2000/1987
	Trip	%	Trip	%	
Walk/Two Wheelers	4,928,626	35.6	6,834,176	30.8	1.4
Private Car	4,100,191	29.6	9,194,467	41.5	2.2
Taxi	633,154	4.6	848,513	3.8	1.3
Public Mode	4,194,318	30.3	5,293,515	23.9	1.3
Total	13,856,289	100.0	22,170,671	100.0	1.6

When grouping passenger cars and taxis as private modes of transport, the ratio between private and public transportation was more or less equal at 53:47 in 1987. The balance strengthens in favor of private transportation in the year 2000 at 66:34--in other words, private modes will account for two-thirds of all trips in the future.

Fig. 8.5.5 shows the distributions of trips by public and private modes of travel in the form of a desire line chart. Although public transportation demand will increase slightly

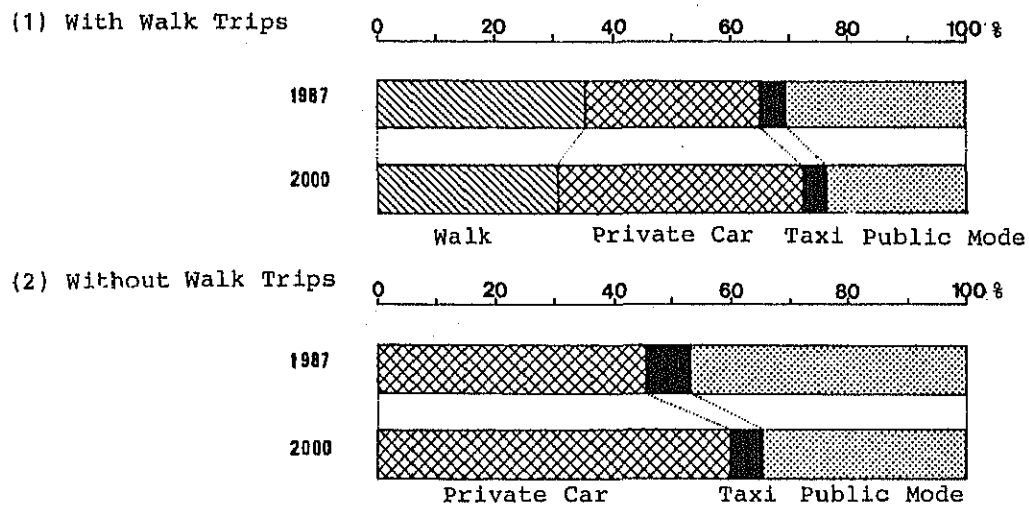


Fig. 8.5.4 Change in Model Share from 1987 to 2000

between Shubra Al Kheima and Central (1-7), between East and Masr Al Gadida (2-3), and between Shubra Al Kheima and East (1-2), all other areas will show no conspicuous increase. In contrast to this, demand for private transport will increase substantially in all zone pairs. In particular, since the population and passenger car ownership in such zones as Masr Al Gadida (3), Ahram (12), and Maadi (9) are expected to rise dramatically, O-D trips involving these zones will increase sharply.

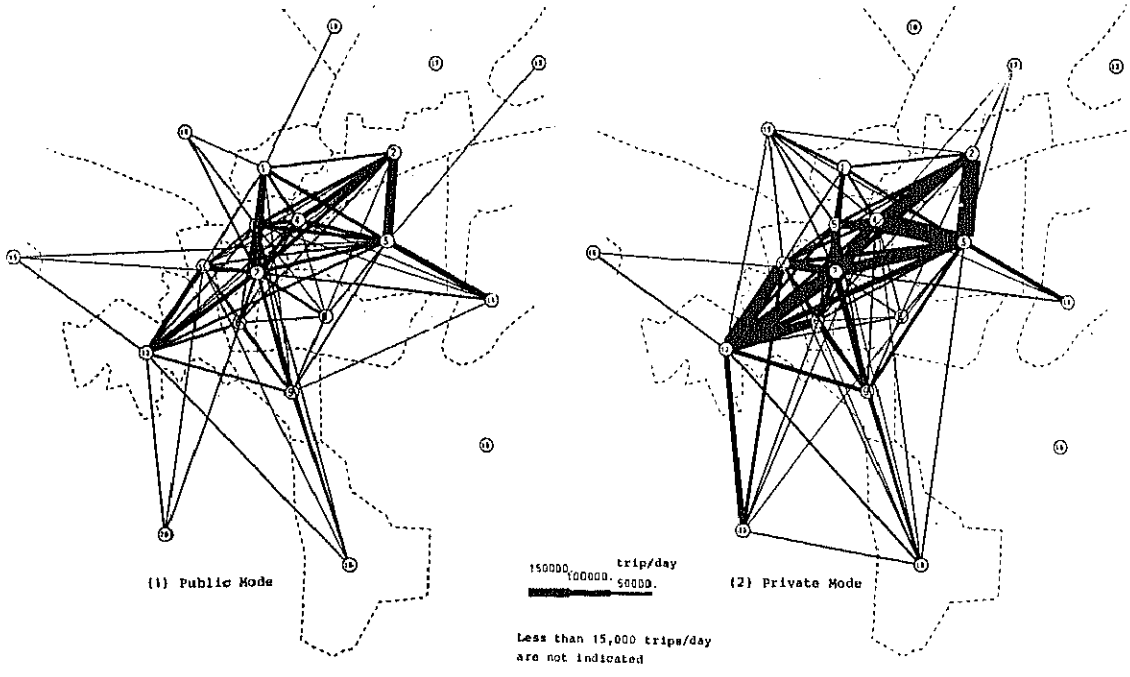


Fig. 8.5.5 Desire Line Chart of Trips in 2000 by Private and Public Mode

No significant development between the present and the year 2000 is found with respect to trip length regardless of the mode of transport, as shown in Fig. 8.5.6. The overall average will increase marginally from 5.28 km in 1987 to 5.34 km in 2000. Since the population of outlying areas will expand in the future, the length of trips to the CBD will tend to increase. This, however, is expected to be offset by the tendency for trips to the CBD to decline concurrently with the establishment of new urban cores throughout the GCMR. This is understood to be the reason why the average trip length will not change appreciably in the future.

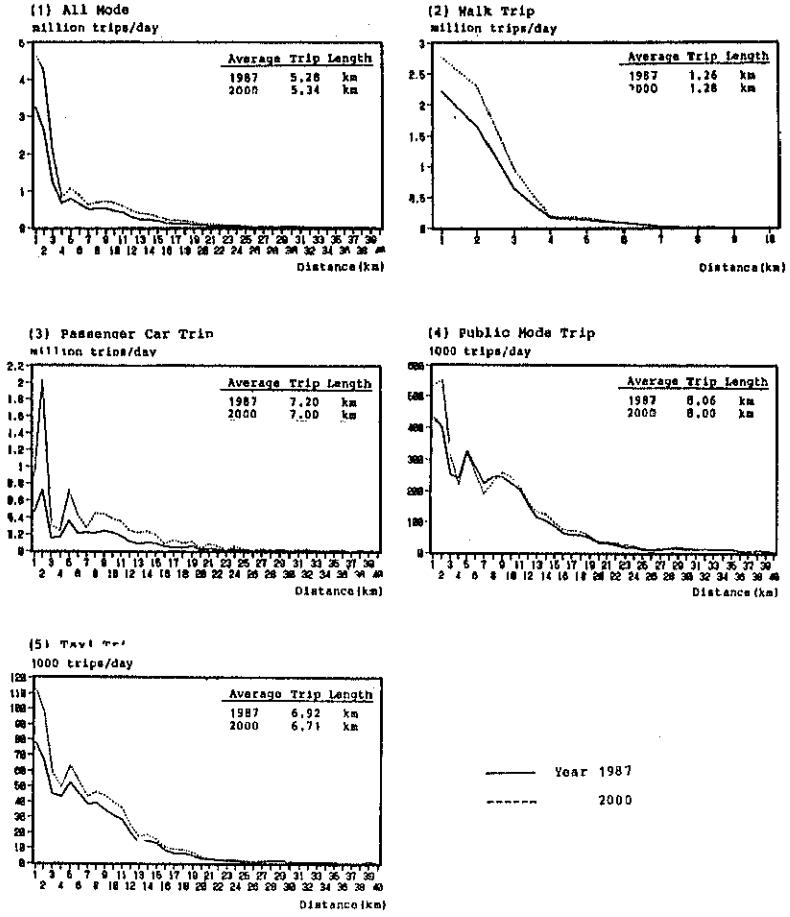


Fig. 8.5.6 Trip Length Distribution by Mode in 1987 and 2000

8.6 Traffic Assignment

OD trips subject to assignment to the transportation networks are inter-zonal OD trips by passenger car, taxi or public transportation. As mentioned in the preceding section, the assignment of public transportation demand is completed in conjunction with the modal split process.

The assignment of inter-zonal trips by passenger car or taxi to the road network is undertaken in accordance with the multi-step minimum-time route method, which takes into consideration the capacity of each link (or section) of roadway. Where a toll road is planned, there is a search for the minimum-distance route to take into account the road users' resistance to paying toll.

All OD trips to be assigned are converted into passenger-car units. Since the conversion involves different types of vehicles, the average number of passengers per vehicle and the passenger-car equivalent depends on the weighted average of each vehicle type. To obtain the weight, the current composition of traffic is applied. Table 8.6.1 gives the average number of passengers per vehicle and the passenger-car equivalent used in the calculations for trip assignment.

Table 8.6.1 Passenger Car Equivalent

Vehicle Type	Ave. pax number	PCU
Passenger Car	2.99	1.06
Taxi	1.02	1.00
Bus, Mini/Microbus	18.69	1.68

Each link of roadway consists of data concerning nodes (intersections) at both ends, distance and the QV curve. The QV curve establishes the relationship between traffic volume (Q) on a link of roadway and the speed (V) at which travel is possible at that volume.

The QV curve is determined in the following manner: (1) First, the basic capacity of the link is obtained, given a standard capacity of 2,000 vehicles per lane per hour; the basic capacity is then adjusted by taking into consideration specific conditions applicable to the link, such as road specifications and the number of signalized intersections, to obtain hourly capacity; (2) next, hourly capacity is converted into daily capacity, Qo, by applying the peak hour ratio and the heavier direction traffic ratio; (3) speed, Vo, that corresponds to daily capacity Qo, is established by taking into account such factors as road specifications and roadside environment; (4) assuming that a speed of 1.2 times Vo is possible when the road is empty, this is given as the maximum speed (Vmax); and (5)

when volume exceeds capacity Qo, speed declines, and when volume reaches the level of 1.5 times Qo, travel speed falls to the minimum level (Vmin = 5 km/hour). Fig. 8.6.1 shows the general pattern of QV curve schematically.

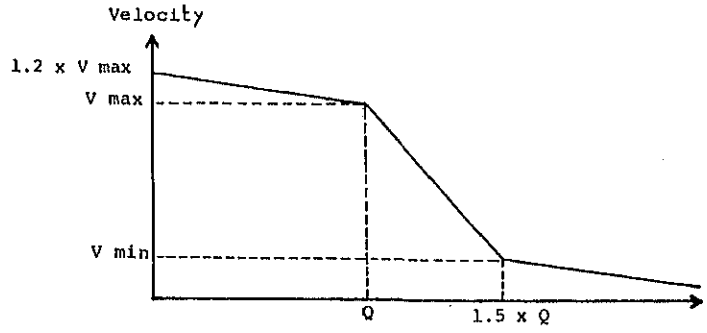


Fig. 8.6.1 Q-V Curve (Traffic Volume and Velocity)

Before trips can be assigned, the rail and road networks to which the assignment will be made must be established. Since the determination of the future transportation network transcends the bounds of traffic demand forecast and touches the area of planning, traffic assignment will be discussed in a later chapter.