社会開発調査部報告書

No. 52

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

Municipality of TEHRAN

The Islamic Republic of IRAN

The Study on an Integrated Master Plan for Air Pollution Control in The Greater Tehran Area in The Islamic Republic of Iran

Summary of Final Report

December 1997

JICA LIBRARY
J 1141064 [4]

JAPAN WEATHER ASSOCIATION

ONICO International Corporation

NIES
YR
97-55

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

Municipality of TEHRAN

The Islamic Republic of IRAN

The Study on an Integrated Master Plan for Air Pollution Control in The Greater Tehran Area in The Islamic Republic of Iran

Summary of Final Report

December 1997

JAPAN WEATHER ASSOCIATION

UNICO International Corporation

1141064 [4]

PREFACE

In response to a request from the Government of Islamic Republic of Iran, the Government of Japan decided to conduct a Master plan study on an Integrated Master Plan for Air Pollution Control in The Greater Tehran Area in The Islamic Republic of Iran and entrusted the study to the Japan International Cooperation Agency (JICA)

JICA sent to Iran a study team headed by Dr. Osayuki Yokoyama, Japan Weather Association, associated with UNICO International Corporation, five times between April 1995 and November 1997.

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

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

I wish to express my sincere appreciation to the officials concerned of the Government of The Islamic Republic of Iran for their close Cooperation extended to the team.

December 1997

Kimio Fujita

President

Japan International Cooperation Agency

LETTER of TRANSMITTAL

December 1997

Mr. Kimio FUJITA
President
Japan International Cooperation Agency

Dear Mr. Fujita

It is my great pleasure to submit herewith the Report on the Study on an Integrated Master Plan for Air Pollution Control in the Greater Tehran Area in the Islamic Republic of Iran.

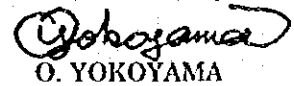
The Study Team which consists of Japan Weather Association (JWA) and UNICO International Corporation (UNICO) conducted surveys and field observations in the Islamic Republic of Iran from March 1995 to December 1997 as per the contract with the Japan International Cooperation Agency.

Based on the findings of these surveys and observations as well as the data and information collected and analyzed in Japan, the Study team held discussions with the Air Quality Control Company belonging to the Municipality of Tehran and other authorities concerned, and has formulated the Integrated Master Plan for air pollution control up to the year 2010.

On behalf of the Study Team, I would like to express my deepest appreciation to the Government of the Islamic Republic of Iran, the Municipality of Tehran, Air Quality Control Company and other authorities concerned for their great cooperation, assistance and the heartfelt hospitality which they extended to the Study Team during our stay in Tehran.

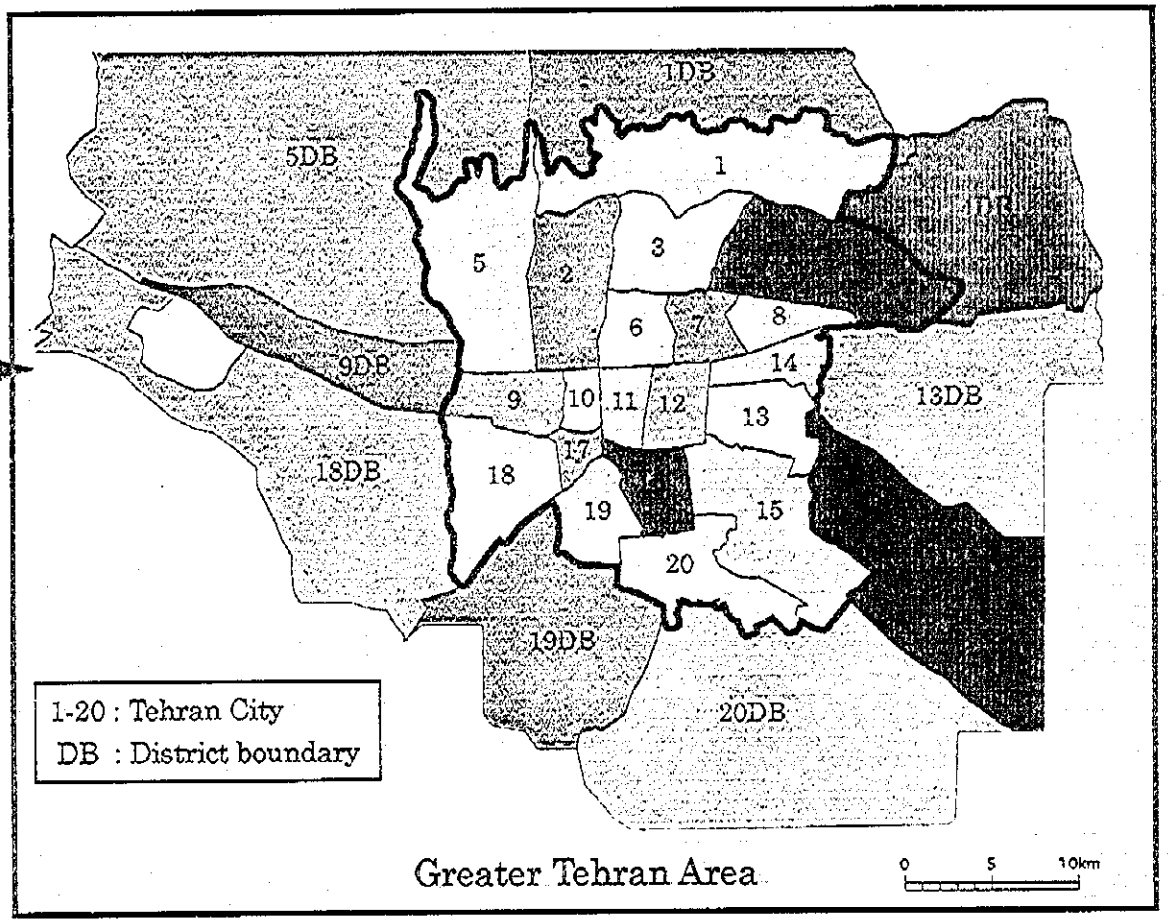
I am also greatly indebted to the Japan International Cooperation Agency, the Advisory Committee of this project, the Environmental Protection Agency, the Ministry of Foreign Affairs and the Embassy of Japan in the Islamic Republic of Iran for giving us valuable suggestions and assistance throughout the project.

Yours faithfully,



O. YOKOYAMA
Leader of the Study Team for
the Study on an Integrated
Master Plan For Air Pollution Control
in the Greater Tehran Area

Location of the Study Site



The Study on an Integrated Master Plan for Air Pollution Control

in the Greater Tehran Area in the Islamic Republic of Iran

-Preface

-Map of the Site

-Executive Summary

Abbreviation

AQCC :	Air Quality Control Company
AIRIC :	Automotive Industries Research and Innovation Centre
CBD :	Central business District
CBI :	Central Bank of Iran
CD :	Chassis Dynamo(Test)
CDM :	Climatological Dispersion Model
CTC :	Chugai Technos Co. Ltd.
CM :	Combustion Modification
CMB :	Chemical Mass Balance
CO :	Carbon mono oxide
CO_2 :	Carbon dioxide
DOE :	Department of Environment
DTT :	Department of Transportation and Traffic of MOT
EPA :	Environmental Protection Agency, USA
FGD :	Flue Gas Desulfurization
FGR :	Flue Gas Recirculation
HC :	Hydrocarbon
HDS :	Hydrodesulfurization
IBRD :	International Bank of Reconstruction and Development
IEA :	International Energy Association
IRIB :	Islamic Republic of Iranian Bank
IRIMO :	Islamic Republic of Iran Meteorological Organization
JICA :	Japan International Cooperation Agency
LNB :	Low NOx burner
LPG :	Liquid Petroleum Gas
Gj :	Giga joule, heat value, G=9 power of 10
GTA :	Greater Tehran Area
JARI :	Japan Automobile Research Institute
JIS :	Japanese Industrial Standard
JWA :	Japan Weather Association
MHUD :	Ministry of Housing and Urban Development
MOE :	Ministry of Energy
MOH :	Ministry of Health
MOI :	Ministry of Industry
MOO :	Ministry of Oil
MOT :	Municipality of Tehran

MTBE : Methyl tertiary butyl ether
NIOC : National Iranian Oil Company
NMHC : Non methane hydrocarbon
NDIR : Non dispersion type infrared gas analyzer
NO_2 : Nitrogen dioxide
NOx : Nitrogen oxides
O_2 : Oxygen
O_3 : Ozone
OECD : Organization for Economic Cooperation and Development
ORSUITO : Organization for Relocation and Systematizing Urban Industrial and Trade Occupation
OSC : Off-stoichiometric combustion
PM10 : Particulate matter less than 10μm of particle size
PPM : Parts per Million, normally used as "ppm"
RIPI : Research Institute of Petroleum Industries
SCEP : Supreme Council for Environment Protection
SCR : Selective Catalytic Reduction
SDC : Senyo Development Co. Ltd
SO_2 : Sulfur dioxide
SOx : Sulfur oxides
SPM : Suspended Particulate Matters
SYNOP : Synoptic station in meteorological measurement
TCTTS : Tehran Comprehensive Transportation and Traffic Studies
THC : Total Hydrocarbon
TSC : Two Stage Combustion
TVTIB : Tehran Vehicle Technical Inspection Bureau
TTCC : Tehran Traffic Control Company
TTTO : Tehran Traffic & Transportation Organization
UBC : United Bus Company
UNICO : Unico International Corporation
WHO : World Health Organization

Executive summary

The objective of the Study is to formulate an integrated master plan for air pollution control based on the research, survey and analysis on socioeconomic activities and air pollution in the Greater Tehran Area which is the area within the administrative boundary of Tehran.

The Study started from April 1st, 1995 covering survey and investigation on Municipal organizations consisting of Air Quality Control Company, Tehran Traffic Control Company, Tehran Comprehensive Transportation & Traffic Studies, the Tehran Transportation and Traffic Organization, the Organization for Relocation and Systematizing Urban Industrial and Trade Occupations and the Tehran Vehicle Technical Inspection Bureau etc. as well as the public organizations in the Central Government such as Department of Environment, Ministry of Oil, Ministry of Industry, Ministry of Energy, Ministry of Health and Iranian Meteorological Organization.

During these investigation, present capabilities and activities including facilities and man-power regarding promotion of environmental counter measures have been verified while and joint observation and measurement work with relevant organizations above have been conducted twice, in September, 1996 and February, 1997 on meteorological conditions, quality of ambient air, inspection of pollutant in flue gas, traffic volume and emission factors for the typical vehicles etc. as shown below.

-Observation of meteorological conditions over the Municipality of Tehran has been conducted for surface meteorology and upper layer meteorology using ultra-sonic anemometers, pyrometers, radiosondes and captive sondes etc..

-Measurement of ambient air quality has been mainly carried out, particularly simplified measurement of SO_2, NOx, CO, VOC, HC etc. because general ambient air quality data

are available mainly in the Department of Environment and partly in the AQCC.

-Measurement of flue gas has been conducted at four targeted model plants, i.e. a refinery plant, cement plant, power station and brick manufacturing plant. Such measurement has been carried out for two days and twice each with an infrared red type flue gas monitor for SOx,NOx,O_2 and CO and with a dust sampling apparatus for dust. Necessary arrangements for measurement and setting-up of sampling nozzles and platforms etc. have been coordinated by supervising Ministries, i.e. the Ministry of Oil, Ministry of Industry and Ministry of Energy.

-In addition to the above flue gas measurement, an Inventory of stationary emission sources in the MOT has been prepared through delivery of investigation sheets and interviews in cooperation with AQCC covering data on names of emission source, address, annual consumption of fuel, dimensions of stacks of combustion facilities and annual production amounts.

-Investigation and measurement for mobile vehicle has been conducted for investigations of traffic volume, fields driving test and Chassis dynamo test(CD test). These work has been jointly worked with Tehran Traffic Control Company(TTCC), the Tehran Transportation and Traffic Organization(TTTO), the Tehran Comprehensive Transportation and Traffic Studies(TCTTS), the Ministry of Industry, and the Automotive Industries Research and Innovation Center(AIRIC).

-A simulation model has been developed and validated using the full geographical data and dimensions on roads, location of stationary sources and meteorological data, all of which have been provided by the relevant organizations and finalized through the case studies and discussions with working groups of this study.

On the basis of the analysis of these data, present conditions of air pollution in the Municipality of Tehran and future air pollution has been projected followed by proposed

countermeasures for these projections and concrete preventive policies and measures corresponding to the roles of the Central Government, the Municipality of Tehran, enterprises and/or individual personnel.

The analysis of observed and collected data reveals that air pollution in GTA, especially for CO, is alarming. Eighty percent of the pollution is being caused by vehicular emission and 20% by stationary sources including households sources, and it's status will become worse in the year 2010, when the yearly average concentration of CO, NOx, SO_2 and SPM in ambient air will reach about 26ppm, 0.3ppm,0.2ppm,200 $\mu g/m^3$ respectively at the maximum value.

Such situations are deemed attributable to lack of environmental management systems in the public organizations, the aging structure of vehicle fleets, lack of mindset for saving of energy among industries and individuals, delayed technology development in industry, and unsatisfactory policies for fuel pricing, inconsistent foreign exchange rate systems and import restrictions. They, however, are out of the scope of the study, and therefore, are not to be commented in this report.

Measures for air pollution reduction in the GTA will be classified into three categories, e.g. ①establishment of environmental management systems in the central government and MOT, ②measures for vehicular emission sources and ③those for stationary sources;

(1) Establishment of environmental management systems in the central government and MOT

In the central government and municipal level, three key environmental activity are needed such as an emission inventory, monitoring and inspection, and environmental laws/regulations including environmental audit systems for reduction of air pollution in GTA, as will be described below and summarized in Fig. 6.1.1-1.

1) Organization of environmental management

2) Plan of environmental laws and regulations

3) Analysis of present air pollution caused by vehicles and stationary sources facilitating policy making

4) Study of environmental management systems in foreign countries

5) Establishment of environment management systems

6) Regional & wide area monitoring system including meteorological observation

7) Establishment of systems for monitoring and inspection for emission sources

8) Establishment of inventory systems

9) Improvement and research of analytical technologies for analyzing air polluting substances

10) Preparation of emission reduction guidelines

11) Research in health impacts and economic loss due to air pollution

12) Support of the private sector in reduction of air pollution

13) Research and development in energy conservation

14) Man-power development for environmental protection

15) Promotion of technical cooperation with foreign countries

(2) Management of vehicular sources

As the management system for vehicle emission reduction needs a wide range of activities to be conducted by the central government and municipality, therefore, roles of the parties of these activities is required to be defined.

1) Monitoring of transportation and traffic volume in the GTA

2) Improvement of traffic regulations and monitoring of traffic conditions

3) Execution of vehicle inspection

4) Determination of traveling modes and operation of chassie dynamo tests

5) Expansion of vehicle maintenance capacity

6) Improvement of vehicle manufacturing technology

7) Research and development in vehicle emission reduction technology targeting in-use vehicles

8) Research and development in urban planning

9) National programs for vehicle fuel renovation

10) Research and development in the energy economy

11) Promotion and coordination of introduction of foreign technology for emission reduction

(3) Management of stationary sources

At this moment in GTA, relocation of factories is being promoted on the basis of the Clean City 80 Program. Though only a few polluting emission sources have been found in GTA, in view of future economic development, light industries such as agro-based food processing, plastic and packaging as well as mechatronic industries are predicted to expand. It is therefore recommended for future development of stationary emission sources to implement following activities.

1) Improvement of emission inventory systems

2) Improvement of monitoring and inspection systems

3) Preparation of air pollution reduction guidelines through a manufacturing sector study as well as promotion of development of industrial technology

4) Promotion of activities for dissemination of technology and information among manufacturing sub-sectors on saving of energy including cleaner production technologies which are being used worldwide.

5) Improvement of combustion technology and promotion of import of technology and related equipment

6) Development of man-power relating to the key technologies described above and management of pollution control

7) Dissemination and demonstration of model facilities for air pollution technology

8) Rehabilitation of regional inspection laboratories in GTA

9) Enforcement of emission standard regulations for flue gas

10) Promotion of technical cooperation with overseas organizations

Among these environmental activities, urgent, essential and strategic countermeasures for reduction of air pollution are proposed as shown in the Table.

Table: Summary of countermeasure for air pollution control for Greater Tehran Area

No.	Countermeasure	Implemetation period 1/	Project cost (US$1000)	xpected amount of pollutants to be reduced(ton)			
				CO	SOx	NOx	Cost(US$/ton) 2/
1	Air pollution control management						
1-1.	Establishment of inventory system	1998	283		12699.3	4774.9	59.27
1-2.	Ambient air monitoring system	1999	522				
1-3.	Municipal environment research and promotion Center (establishment)	2003	24,630		5079.72	2864.94	
1-4.	Expansion of monitoring stations	1999, 2003, 2007	2,750		2539.86	1909.96	
2	Vehicular sources						
2-1.	Enhancement of public transport system	2003	231,150	124,021	1,251	5,942	1863.8
2-2.	Strengthening of I/M programme	1998	25,300	165,000			153.33
2-3.	Enforcement of emission standard	1998	354	41,340	500		8.56
2-4.	Establishment of I/M training course	2000	1050	82,680			12.7
2-5.	Establishment of vehicle engineering center	2001	8,520	110,000	500	10,000	77.45
2-6.	Improvement of main parts of car manufacture	2000	5,560	220,000			25.27
2-7.	Introduction of catalytic converter	2005	148,780	110,000		30,000	1352.55
2-8.	Desulfurization of diesel oil	1999	44780		6,000		7463.33
2-9.	Construction of MTBE plant	2007	139,980	145,000			965.38
2-10.	Implementation of scrappage programme	1999, 2001, 2008	53,560	152,000			352.37
2-11.	Promotion of public awareness	1998	400	24804.12			
3	Stationary source						
3.1	Improvement of regional inspection lab.	1999, 2003	990		10159.4	3819.92	97.45
3-2.	Investigation and preparation of master plan on manufacturing sub-sector in GTA	1998	1,310		25398.6	11459.8	51.58
	1) Sub-sectoral study 2) Measure for saving of energy 3) Introduction of cleaner production technology 4) Nox reduction measure		114 1820 190 340				
3-3.	Construction of de-sulfur plant	2005	976,490		153,000		6382.29
3-4	Fuel conversion to natural gas	2005	3,140		200,000	40,000	16

Remarks: 1/ Operation start-up
2/ Per ton of targeted pollutants

Chapter 1

Introduction

1. Introduction

Greater Tehran area with a current population of over eight millions and an area of approximately 2300 square km is suffering from life-threatening atmospheric pollution, arising from the rapid urbanization during the last few decades. Recently, there are more than 1.4 million vehicles and some 300 thousand industrial factories and offices in Tehran. Although there are few inventory data available in Tehran, some observed data reveal that concentration of CO, SO_2 and SPM (PM10) in the ambient air in Tehran very often are well over the WHO standard.

Against these background, the Government of Japan, in response to the request of the Government of Islamic Republic of Iran, decided to carry out a study on an integrated master plan for air pollution control in the Greater Tehran Area in the Islamic Republic of Iran and dispatched the Study Team through the Japan International Cooperation Agency (hereinafter referred to as 'JICA'). The Study Team headed by Dr. Osayuki Yokoyama visited Iran four times from March 30, 1995 to February 12, 1997 for investigations relating to the environmental situations in Tehran and two periods for observations and measurement work in the study area.

During the survey, the Team exchanged views and had a series of discussions with the Municipality of Tehran and relevant organizations in the central Government and authorities concerned in the Government of Islamic Republic of Iran concerning the Study and conducted the observation, measurement and investigation on meteorological, ambient air, emission from stationary sources and indicative parameters on the vehicle sectors, preparation of an inventory of stationary sources and development of a simulation model in 1st and 2nd site survey during the study period.

This Final Report has been prepared through the analysis in Japan on the basis of observation and measurement work conducted twice. And major strategic countermeasures for reduction of pollution in GTA mainly caused by vehicle emission

presented as the Draft Final Report for discussions and collection of comments of the officials concerned.

Chapter 2

Outline of social and economic situation relating to the air pollution

2. Outline of social and economic situation relating to the air pollution

2.1 Outline of the Islamic Republic of Iran

2.1.1 Outline of the Islamic Republic of Iran

Iran is located on the upland vast plateau bounded by southeast mountains, borders Turkmenistan, the Caspian Sea, Azerbaijan and Armenia in the north, Turkey and Iraq in the west, the Persian Gulf and the Sea of Oman in the south and Pakistan and Afghanistan in the east.

The Iranian southern coastline bordering the Persian Gulf is the longest coastline among the Persian Gulf countries, and along the opposite bank of this politically important sea region, there are Kuwait, Saudi Arabia, Bahrain, Qatar, United Arab Emirates and Oman.

Iranian plateau bounded by two large mountains, Alborz and Zagros, has an area of some 1,648,195 sq. km, two thirds of which consist of mountainous plateaus and/or deserts.

While Alborz mountain strides over from Turkey to the Caucasus region, stretches to the north of Afghanistan and is allied with Hindukushi mountains, the other Zagros mountains start from Turkey , and stretches to south and southeast.

Almost all people living on the plateau stay in the mountainous, hill or valley.

The inner land consists of huge deserts, Kavir desert in the north and Lot desert in the south. In the peripheries of these deserts, there are several traditional cities which has been developed through intensive development of water pumping and storage technology.

As for climate of Iran, there are four seasons similar to close in Japan, spring from the middle of march to the end of June when flower bud grows in the trees and wheat becomes fresh green , summer from the end of June to the end of the September when it is the best for the fruits, autumn from the end of September to the middle of December which is the best season for maples, winter from the end of December to the middle of March when temperature becomes below zero in the northern parts of Iran as in Hokkaido in Japan, but its climatic condition varies so much that the temperature in the southern Persian Gulf coastline parts of Iran rises to 15-20degrees as in Okinawa in Japan.

Total area	1,648,195 sq. km
Population	55.8million (1991census) 60.0million(1996 census)
Towns with populations in excess of 500,000	Tehran: 6,475 Shiraz: 965 Mashhad: 1,759 Ahwaz: 724 Isfahan: 1,127 Qom: 681 Tabriz: 1,088 Bakhtaran: 624
Climate	Continental with high temperature,
Weather in Tehran	Hottest month: July; 22-37℃ Coldest month: January; minus 3-7℃ Driest month: July; 3mm rainfall Wettest month: January; 46mmrainfall
Official language	Persian
Measures	Metric system
Calendar	-The Iranian New Year: March 21, -31 days x 6 months, 30 days x 5 months, 29 days in 12th month (Iran1375=March 1996)
Currency	Rial, IR10=1 toman, IR3,000=US$1
Time	3.5 hours ahead of GMT
Public holidays	New Year: March 21-24,

2.2 Outline of environmental sector of Iran

2.2.1 Organization in Iran

The Islamic Republic of Iran was founded in 1979 through the Islamic Revolution. Since the end of the Iran- Iraq War (1980-1988), the Government of Iran has been engaged enthusiastically in reconstruction. During the decade after the end of the War, recovery has been underway in all sectors. The organization of the Government of Iran is shown in Fig. 2.2.1-1.

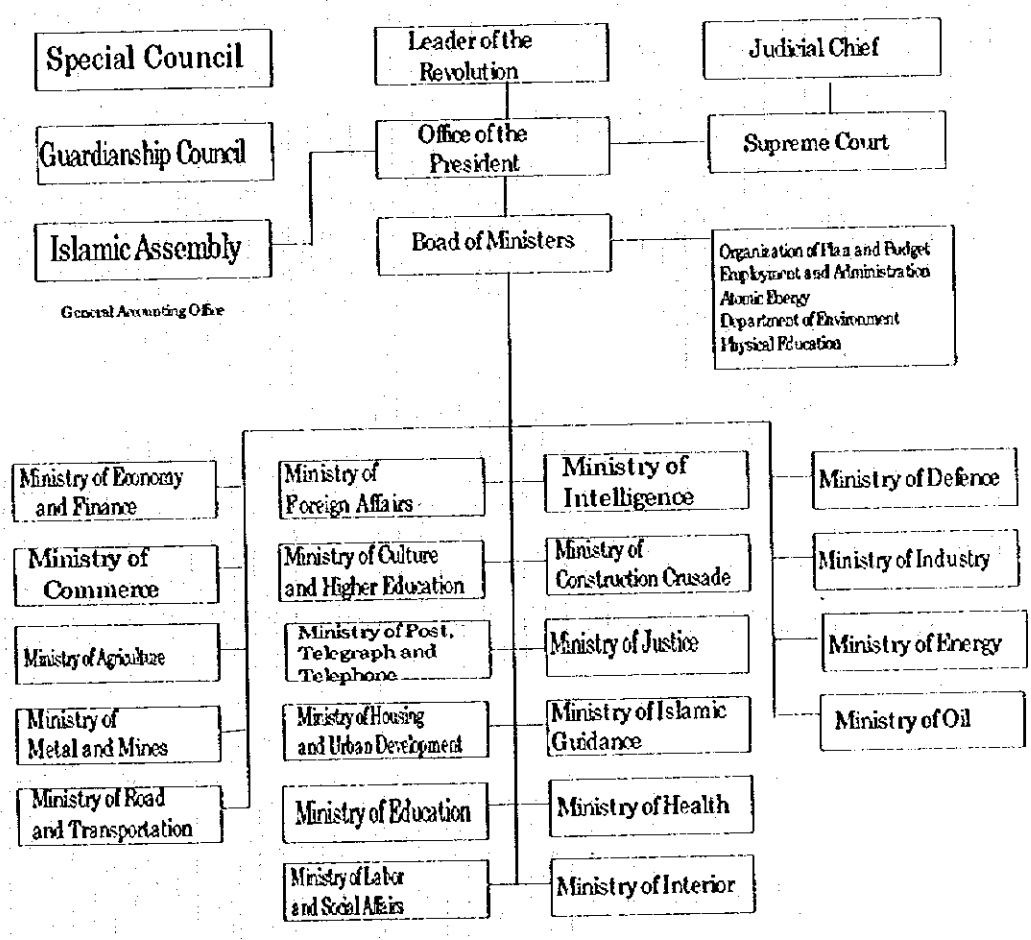


Fig.2.2.1-1 Institutions of Islamic Republic of Iran

Fundamental environmental policy is discussed and determined by the High Council which has 10 members including the President, and a bill is sent to the Diet and considered for approval. The Department of Environment is responsible for environmental policy making. Concerning air pollution, the Air Pollution Control Act was enacted in 1996, but neither the environmental standard nor emission standard has been decided yet as of March 1997. Instead of Iran's own environmental standard, the following WHO standard is used. Also, DOE is responsible for air monitoring all over Iran, on-site inspection of emission of pollutants from industries, environmental research, education and other matters. The organization of DOE is given in Fig. 2.2.1-2.

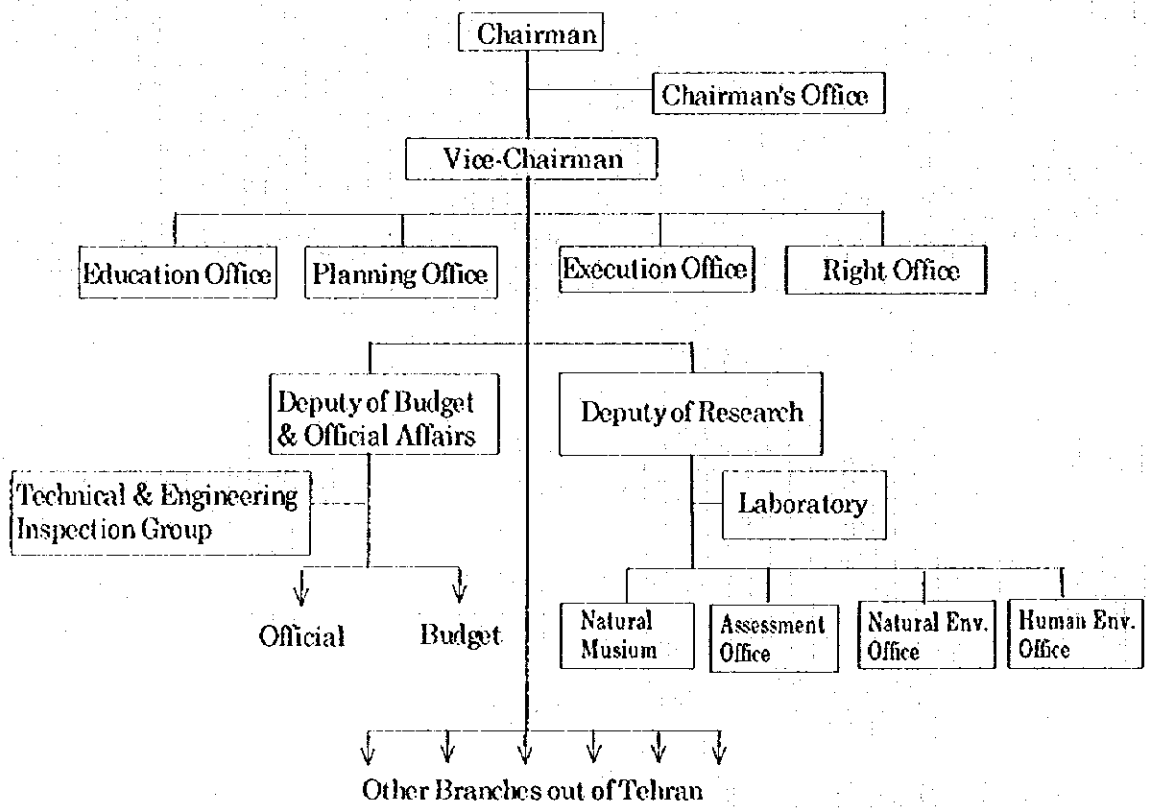


Fig.2.2.1-2 Department of Environment (1991)

As shown in Fig. 2.2.1-1, there are several ministries relating to environmental matters such as the Ministry of Health, Ministry of Industry and Ministry of Oil . For this JICA project, the following organizations have cooperated:

Ministry of Health (MOH): Air pollution concentration in Tehran is watched at 10 stations of MOH. Three stations among them are international watch stations of GEMS/WMO. the watched pollutants are SO_2 and smoke.

Ministry of Industry (MOI): All industries are under the supervision of MOI including the automobile industry. As the emission standard has not been decided yet in Iran, the ECE 15.04 standard is used. Iran Khodoro Co., biggest automobile manufacturer in Iran and other manufacturers, are making an engine satisfying this emission standard. MOI is not responsible for maintenance of cars.

Industrial emission control is supervised by DOE and is not under the jurisdiction of MOI.

Islamic Republic of Iran Meteorological Organization (IRIMO): Meteorological observations are being made at the Meherabad International Airport and other 4 stations belonging to MOT and many other observatories in Iran, covering atmospheric pressure, wind direction and speed, insolation, cloud amount, temperature, humidity, visibility and so on. Corporation of IRIMO for this project is most important.

Ministry of Oil (MOO): The Ministry of Oil supervises and controls all matters concerning oil. Quality of gasoline, gas oil, heavy oil and price of oil are key elements for environmental problems. Fundamentally, though quality of gasoline and gas oil for automobiles is good in Tehran, introduction of enriched and oxiginated gasoline seems necessarily in the future.

2.2.2 Law and regulation relating to air pollution

(1) Clean Air Act

The current air pollution law (Clean Air Act: A plan for the control of Air Pollution) was enacted by the Iranian Parliament on 4/23/1995 (see appendix of the main report), although it has not been completely implemented yet. This law consists of 36 articles and classifies the air pollution sources into the following three groups:

A) Motor vehicles

B) Factories, workshops and power plants

C) Business, domestic and miscellaneous sources.

Regulations on emission standards or permitted concentration will be prepared later by DOE with cooperation of related agencies (the Municipality of Tehran, the Ministry of Industry, the Ministry of Oil) and will be approved by the Supreme Council on the Environmental Protection Affairs. This act refers to Article 50 of the Constitution of Islamic Republic of Iran, which declares environmental conservation as a public duty and prohibits polluting activities.

Main responsibility for enforcing the Clean Air Act is held by the Department of Environment (DOE), which is expected to prepare relevant regulations based on this law and to propose the standards to the Supreme Council of Environment. The Department of Environment is directly under supervision of the President of Republic, and the head of DOE is Vice President and a member of the Council of Ministers. Fig. 2.2.2-1 shows the organization chart of Department of Environment.

In this law, as mentioned before, air pollution sources are classified into three categories of Vehicles, Industry, and Residential/ Commercial sources.

The organization chrt of DOE

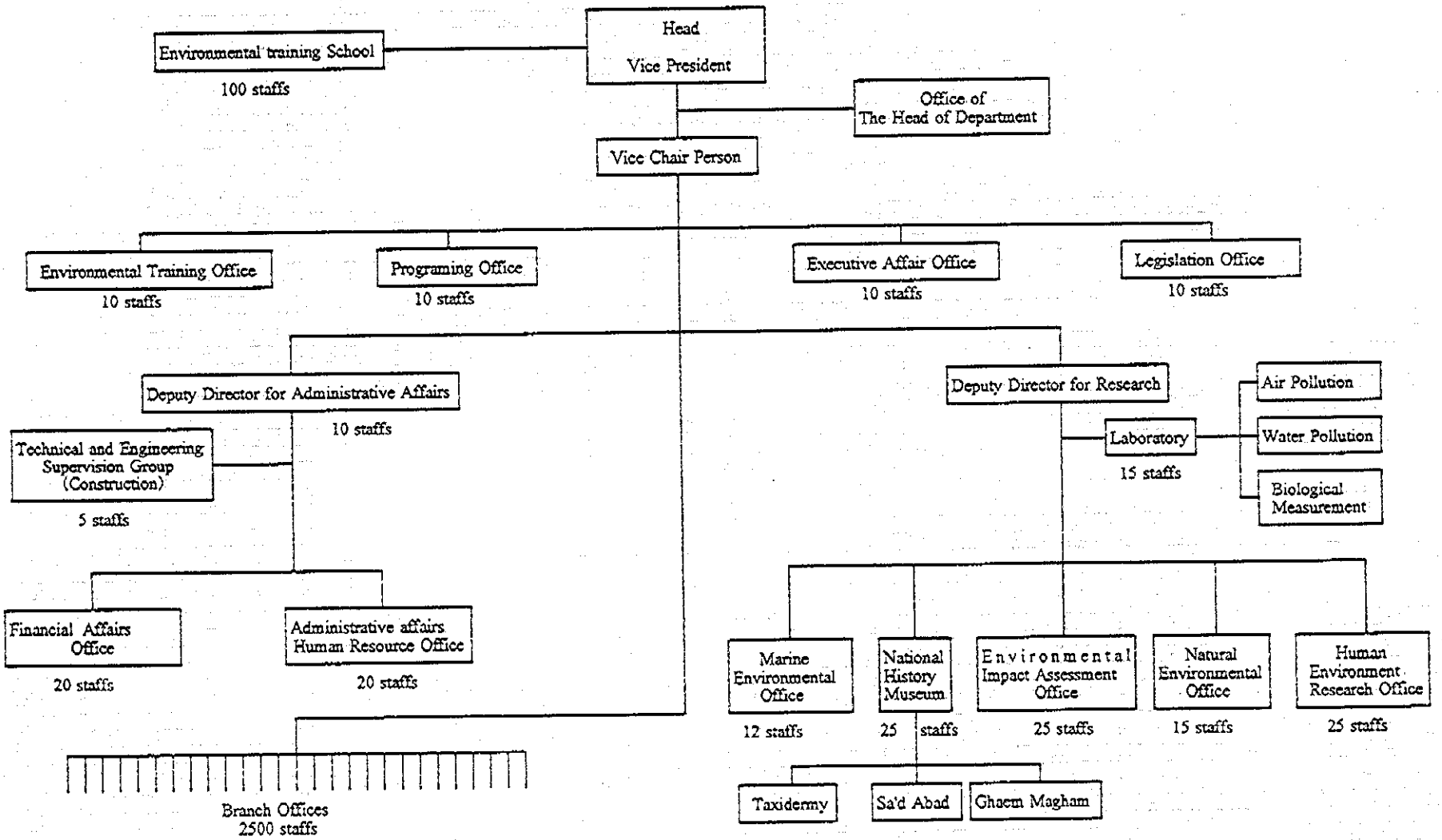


Fig 2.2.2-1 The organization chart of Department of Environment

(2) The standard for vehicle emission

For vehicles, the Department of Environment together with the Ministry of Industry is required to submit the emission standards to the Supreme Council of Environment. The approved standard for new vehicles is ECE 15.04. For in-use vehicles, the standards are set forth by the Inspection and Maintenance (I/M) program presented by AQCC and MOI and approved by DOE. The current idle emission levels of CO and HC are 6.5 % and 700 ppm respectively. These newly accepted limits which are considerably higher than those used previously by the Tehran Vehicle Technical Inspection Bureau (TVTIB, 5.0% and 500 ppm respectively), have been adopted based on a earlier research by AQCC, in order to lay a realistic ground for an effective I/M program. The levels for CO and HC are supposed to be reduced in five years to 4 % and 400 ppm respectively.

(3) The standard for industrial emission

Through the Clean Air Act clearly states that emissions from industries and households are not allowed to exceed the standard, as a practical matter, there is no emission standard for industrial activities or households. Since two years ago, it has been mandatory for all major industries to prepare Environmental Impact Assessment in the initial stage of development.

(4) The countermeasures

According to The Clean Air Act, Municipalities together with the police force are responsible for regulating urban transportation planning including establishment of traffic restricted zones. In addition, urgent countermeasures should be taken in case of serious air incidences, based on notification to a committee of representatives of Ministry of Interior, IRIB, DOE, the Municipality, Meteorological Organization, and Ministry of Health.

(5) The national ambient air quality standards

Mainly based upon the USEPA standards, the current national ambient air quality standards were determined as follows (see Table 2.2.2-1):

Table 2.2.2-1 Ambient Air Quality Standard in Iran

Air Pollutant	Duration for Evaluation	Air Quality Standard 1	Air Quality Standard 2
CO	Max Conc. 8 hours average	9 ppm	9 ppm
SO2	24 hours average	0.14 ppm	0.1 ppm
HC(NMHC)	3 Hours average, 6-9 a.m.	0.24 ppm	0.24 ppm
NO2	Annual average	0.05 ppm	0.05 ppm
SPM	24 hours average	260 $\mu g/m^3$	150 $\mu g/m^3$

Note: Air Quality standards 1 and 2 are applied to the proper area according to the local conditions.

(6) Present situation of legislation and implementation

One of the problems of the environmental legislative system in Iran is centralization of authorities on DOE, which is responsible for enforcement of the Clean Air Act. Actually, however, many other relevant bodies are involved in decision making and implementation. Review and reconsideration of the current system is necessary for air pollution regulation. At present, DOE is not capable enough to carry out a variety of environmental management activities by itself: legislation, implementation and enforcement on a national scale. For the time being, however, a very important necessity seems to be establishment of comprehensive and realistic emission standards covering different sectors. This is obviously a prerequisite for enforcement of any air pollution regulation at present or in future.

2.3 City planning and land use

2.3.1 Outline of MOT's Master Plan

The Municipality of Tehran designs a Master Plan for the land use and city planning of Tehran, which follows the policy established by the High Council of Architecture and Urban Planning that convened in September and October, 1991.

The outline of the Plan is as follows:

- The area for land use is limited to 707.51 km^2.
- The population within the above-mentioned area should not exceed 7.65 millions in the final stage of the Plan.
- Tehran City's 613 km^2 will be divided into five zones and 22 districts.

  Figure 2.3.1-1 shows the MOT's conception of the five zones and 22 districts.
- Industrialization in Tehran will be restricted and 20,000 polluting factories will be moved outside of the city.
- The development and redevelopment project of Tehran will be implemented according to the order previously set forth for each district.
- The activities of construction, reconstruction and destruction of buildings are limited by various regulations before MOT makes a concrete urban plan, and otherwise permissions or certifications of MOT is necessary.

Given the above-mentioned basic ideas, the High Council has taken the initiative to make a Master Plan. It has also made an inclusive, far-reaching plan dealing with Tehran's environment, traffic and transportation, city planning and the system of administration called the Strategic Plan of Tehran. In this plan, six major goals have been set for 2001. The following is an outline of the Strategic Plan of Tehran made by MOT:

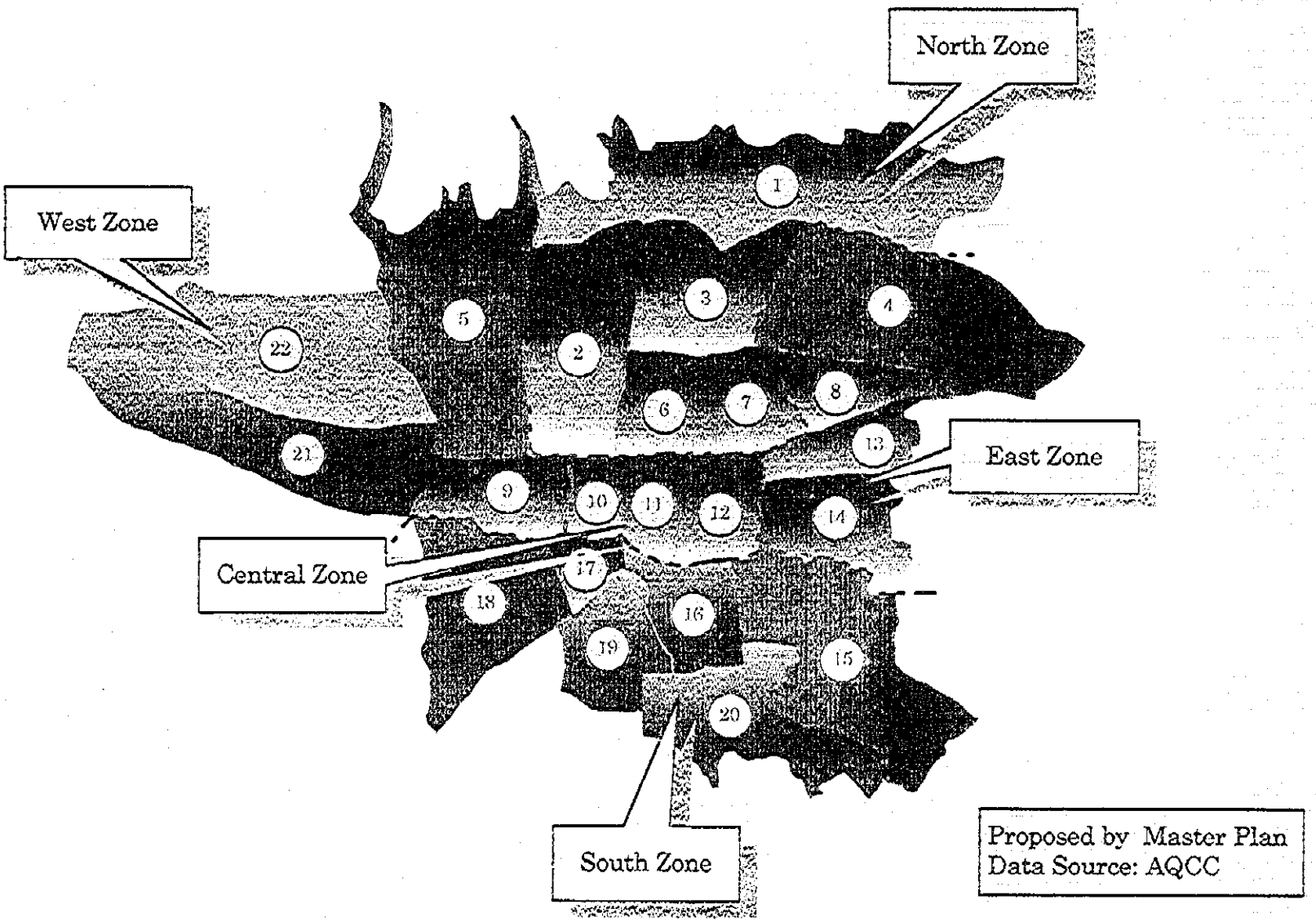


Fig.2.3.1-1 The concept of 5 zone and 22 districts of MOT

(1) Clean City 80

Clean City 80 aims to reduce pollution such as air, noise, water, sewage, soil and wastes. Given these objectives, comprehensive improvement and consolidation of various systems are necessary. The main objectives are as follows:

1). Air and noise

- Encouragement to utilize public transportation and expansion of the restricted area in the central part of Tehran for the purpose of reducing vehicular pollution.
- Conversion of fuels of vehicles such as taxis, public mini-buses and passenger cars to LPG.
- Establishment of industrial zones in order to relocate air-polluting factories.
- Establishment of an inspection and maintenance system for vehicles in order to control vehicle emissions.
- Reduction and control of vehicular noise by introducing effective methods and regulations.

2). Water and sewage

A mandatory system should be introduced requiring every factory and facility to be equipped with sewage disposal tanks. Also development of sewage disposal technology should be discussed.

3). Soil and city waste

The aim is to reduce municipal wastes and study the feasibility of a separation system in collecting waste. In addition, those who create waste should be obligated to see to their disposal, and countermeasures against soil pollution should be established.

4). Education, research and environmental regulations

Basic guidelines for education, research and environmental regulations against air pollution are as follows:

-Legitimization of vehicle emission standards

-Discussion on the necessity of an environmental impact assessment when implementing projects.

-Follow-up of the relocation of polluting industries.

-Sensitization of business corporations and the general public to the environmental issues in order to facilitate the implementation of environmental reforms.

-Promotion of public awareness of urban environmental issues

(2) A City Free from Traffic Congestion 80

The guidelines for management and improvement of traffic in the city are indicated here:

1). Traffic and transportation management

The aims of this plan are to implement countermeasures for reducing the number and distance of vehicular trips and to establish a traffic and transportation management system. The plan also proposes legislation concerning parking regulations.

2). Improvement and development of public transportation facilities

The aim of this plan is to work out effective ways to encourage people to use public buses and mini-buses instead of private cars and to improve the present conditions and service of taxi fleets through feasibility studies.

3). Improvement of highways and urban roads

This plan proposes alterations of the current road construction plans taking the priority of road linkage into consideration in networking the roads. For safety measures for pedestrians, the plan proposes the design of pedestrian conscious roads as well as introduction of necessary equipment.

4). Affiliated organizations and the implementation of traffic regulations.

A proposal is made that the various organizations related to transportation should be in contact with each other in order to update and optimize traffic regulations and services as well as to thus improve traffic conditions.

5). Raising public awareness and education on traffic.

Planning and implementation of seminars, conferences and traffic training sessions are encouraged. It is also proposed that legislation be made concerning vehicle traffics for better traffic conditions and transportation facilities.

(3) Green City 80

This plan proposes to expand and maintain MOT's "green" space, and suggests the necessity of land use for MOT's preservation and maintenance of environment and green space, its proper distribution within the city and the securing of water sources. For this purpose, raising public awareness of the necessity of green spaces and preparing regulations for their maintenance and preservation are crucial.

The goals of this plan are to improve parks according to the standards for a green space, to harmonize the green space with surrounding buildings, and to achieve better urban environment by means of its creation.

(4) A City with Rich Civilization Culture 80

1). Expansion of cultural facilities.

This plan suggests the expansion of facilities relating to culture, art, religion, education and recreation, and proposes further improvement of welfare and the way of spending leisure time.

2). Promotion of cultural activities.

The aim of this plan is to raise the standard of public mental health by encouraging people to use cultural facilities actively. The plan also proposes that young people be encouraged to participate in public events as well as cultural and social activities, and that the general public raise their public awareness of culture.

(5) Dynamic City 80

The aim of this plan is to further develop the existing policy and administrative system by improvement of administrative efficiency and citizen's participation in government activities. By reforming the administration and information network, the measures taken by the administration will improve and thus be able to meet various public needs promptly. It also proposes that opportunities for direct dialogue between the mayor and citizens be provided.

(6) Traditional and Modern City 80

This plan proposes plans for urban renovation, legislation for land use and security measures.

1). Urban renovation

The aim of this plan is to improve the city's traffic networks by constructing highways, trunk roads, parking places and traffic terminals in the suburban areas. The plan proposes a study of urban renovation through promotion of dispersion of municipal organizations and public service facilities. The city's renovation, based on the master plan, proposes that each district in the city represents a different feature, i.e. the north district being the municipal office area, the south the regional recreational area, the west the sports and recreational area and the east the industrial-commercial area.

As for public services, the aim of this plan is to render necessary services in accordance with needs of the population of each district, as well as to locate necessary facilities including shopping centers, sports/recreation facilities, cultural facilities, parking places and green spaces.

2). Preparation of legislation for the purpose of urban planning

This plan states that revision of laws to control disorderly development is necessary, as well as to establish an organization to supervise promotion and implementation of city plans. The plan also proposes that the government control the construction of high-rise buildings and discordant buildings.

3). Urban security measures

These measures include river improvement, measures to accommodate pedestrians (installation of sidewalks) and promotion of building-related earthquake precautions.

Chapter 3

Present situation of air pollution in GTA

3. Present situation of air pollution in GTA

3.1 Overview

(1) SO_2

Annual variation of SO_2 is characterized by high concentration in winter, and comparatively low concentration in the warm seasons, because of more consumption of fossil fuel in winter. And concentration at Bazar is always higher than that at Fatemi. As for the diurnal variation, the peak is recorded around 9:00 through the year. In summer and autumn, the second peak is observed around 22:00. Holiday sink of concentration is recognized only in autumn. These variations depend on source activities and weather. The wind direction does not seem important for variations of the concentrations, but breezy or calm conditions contribute to the high concentration.

(2) NO

The NO concentration is high in autumn and winter, and low in spring and summer. In contrast to SO_2, the concentration at Fatemi is almost twice as high as that at Bazar in each month through the year, perhaps because of the difference in traffic volume. The diurnal variation shows a distinct half day cycle with two peaks, the first one appearing around 9:00 and the second around 22:00. The peak time may be determined by traffic activities and atmospheric stability. Holiday sink of concentration is seen in autumn at both stations, and also the values at Fatemi in August and November show typical drops. High concentration is observed under the conditions of northwesterlies and weak wind.

(3) NO_2

The NO_2 concentration is high in winter and low in early summer, but the annual range is narrow compared to NO. There is no particular difference among the stations in the annual variation, except the concentration at Fatemi which has the second peak in April. Compared to NO, the diurnal range is not wide, and the half-day cycle is recognized only at Bazar. Notably the diurnal curve at Fatemi almost through the year shows the minimum concentration in the early morning and becomes flat in the afternoon. It is not easy to

explain these features of the diurnal variation, because NO_2 is produced by oxidation of NO. The 7-day variation of each season is almost flat, while the day of the week does not have an important influence on the concentrations. The wind direction does not affect the concentrations, while the wind speed does. For example, calm or breezy conditions are conducive to high concentration.

(4) CO

While the annual concentration of CO is almost constant, the concentration in summer is slightly higher. The diurnal variation shows a half-day cycle through the year, especially summer and autumn curves are characterized by distinct two peaks in the morning and in the late evening. CO shows the most typical variation depending on the day of the week. Friday is distinguished from the other days by its distinct drop of concentration. Wind influence on the concentration is seen clearly at Fatemi, where the high concentration corresponds to northwesterlies or northeasterlies and weak wind.

(5) O_3

The O_3 concentration at Bazar is high in summer and low in winter. Diurnal change has one peak in the afternoon. Such variations are explained by the dependence of O_3 concentration on the intensity of solar radiation, because O_3 is produced by photochemical reaction. There are no distinct relationships between O_3 and the day of the week. On the other hand, southerlies and strong wind correspond to the high concentration. However, they are not considered the necessary conditions for high concentration and not related to photochemical reaction directly, but such winds are supposed to appear with strong solar radiation simultaneously.

(6) THC (Total Hydrocarbon)

The THC concentration is almost constant through the year except in late summer when it becomes somewhat higher. Similarly to CO, the diurnal variation shows a half-day cycle through the year, especially the summer and autumn curves are characterized by distinct two peaks in the morning and in the late evening. The 7-day variation in each season is almost

negligible, but in summer and autumn, a drop on Friday is recognized. Concerning the wind influence, the high concentration corresponds to northwesterlies or northeasterlies and weak wind.

(7) PM10

The PM10 concentration is high in autumn and low in spring, and the concentrations at Bazar are higher than those at Fatemi almost through the year. The diurnal variation in each season shows a half-day cycle with two peaks in the morning and in the night, while the peak time is somewhat random especially at Bazar. The concentration clearly drops on Friday in summer and autumn. The wind direction is not related to the concentration. On the other hand, PM10 reduces with the increase of wind speed up to 4 - 5 m/s. When the wind is stronger than this level, the concentration increases in proportion to the wind speed. It is supposed that particles originated in natural sources such as soil will increase when the wind speed exceed 5 m/s.

3.2 Present activities for air pollution in the central government and MOT

3.2.1 Monitoring

It is not clearly stated which organization is responsible for ambient air quality monitoring pursuant to the Clean Air Act. Perhaps for this reason, many organizations are involved in ambient air monitoring activities. While DOE claims to be legally the only responsible body, the Municipality of Tehran is also involved in monitoring, referring to its responsibility for the well-being of citizens. These two organizations are equipped with real time monitoring stations, while other organizations like the Ministry of Health or Ministry of Oil have some discontinuous monitoring stations. Among these organizations, the Ministry of Health has the longest air quality record for TSP and SO_2. Table 3.2.1-1 lists ambient air monitoring stations in Tehran, while Fig.3.2.1-1 illustrates their locations in the Greater Tehran Area.

Table3.2.1-1 Air pollution monitoring station in Tehran(Location and detail information)

Managing Organization	Location of the station	Measured pollutants	Year stating Meas.
AQCC	Fatemi St./Valleye-asr	NOX, SO_2, CO, O_3, THC, PM10	Sep. 1995
AQCC	Bazar Square	NOX, SO_2, CO, O_3, THC, PM10	Oct. 1995
AQCC	Nikoughhadam St.(AQCC Bldg.)	NOX, SO_2, CO, O_3, THC, NMHC	Jul. 1997
AQCC	Mobile(movable station on truck)	NOX, SO_2, CO, O_3, THC, PM10	Oct. 1995
DOE	Ostad Nejatollahee(DOE Bldg.)	NOX,SO_2, CO, O_3,THC,NMHC, SPM	May 1993
DOE	Azadi Square	NOX,SO_2, CO, O_3,THC,NMHC, SPM	Jun. 1993
DOE	Gholhak Area	NOX,SO_2, CO, O_3,THC,NMHC, SPM	Jul. 1993
DOE	Tajrish area	NOX,SO_2, CO, THC,NMHC, SPM	Nov. 1994
DOE	Farhang Saraye Bahman	NOX,SO_2, CO, THC,NMHC, SPM	Dec. 1994
DOE	EmanKhomaini Mosque(Haram)	NOX,SO_2, CO,THC,NMHC	(1995)
DOE	Piruzi Area	Intermittent SO_2, CO, Dust	1991
DOE	Narmak Area	Intermittent SO_2, CO, Dust	1991
DOE	Keshavars Boulevard	Intermittent SO_2, CO, Dust	1991
DOE	Emam Khomani Square	SO_2,	?
DOE	Enghelab square	NOX,SO_2, CO	1991
MOH	Shariati Street	Intermittent SO_2,TSP, Smoke	1973
MOH	East Shoush street	Intermittent SO_2,TSP, Smoke	1976
MOH	Seyed Jamate/Asad Abadi street	Intermittent SO_2,TSP, Smoke	1976
RIPI	Tehran Refinery	NOX,SO_2, CO, O_3, THC, Smoke	1969
NIOC(RIPI)	NIOC Bldg.Courtyard/Hafez St.	NOX,SO_2, CO,THC, Smoke	1994

Abbreviations AQCC: Air Quality Control Company

DOE: Department of Environment

MOH: Ministry of Health

RIPI: Research Institute of Petroleum Industry

NIOC: National Iranian Oil Company

Notes: PM10 and SPM are mass concentration but based on different particle size separation.

For Dust and Smoke, relative concentration is listed.

Most of the available monitoring stations in Tehran are roadside stations. Therefore, their monitoring data may not be appropriate as the materials for assessment of the pollutants influence on environment and public health in Tehran. It is therefore necessary to select site carefully for development of the ambient air monitoring network. The most important monitoring stations in Tehran belong to DOE and AQCC.

Since the beginning of operation of these monitoring stations, AQCC has tried to make air quality data open to citizens and other institutions. On the contrary, DOE has

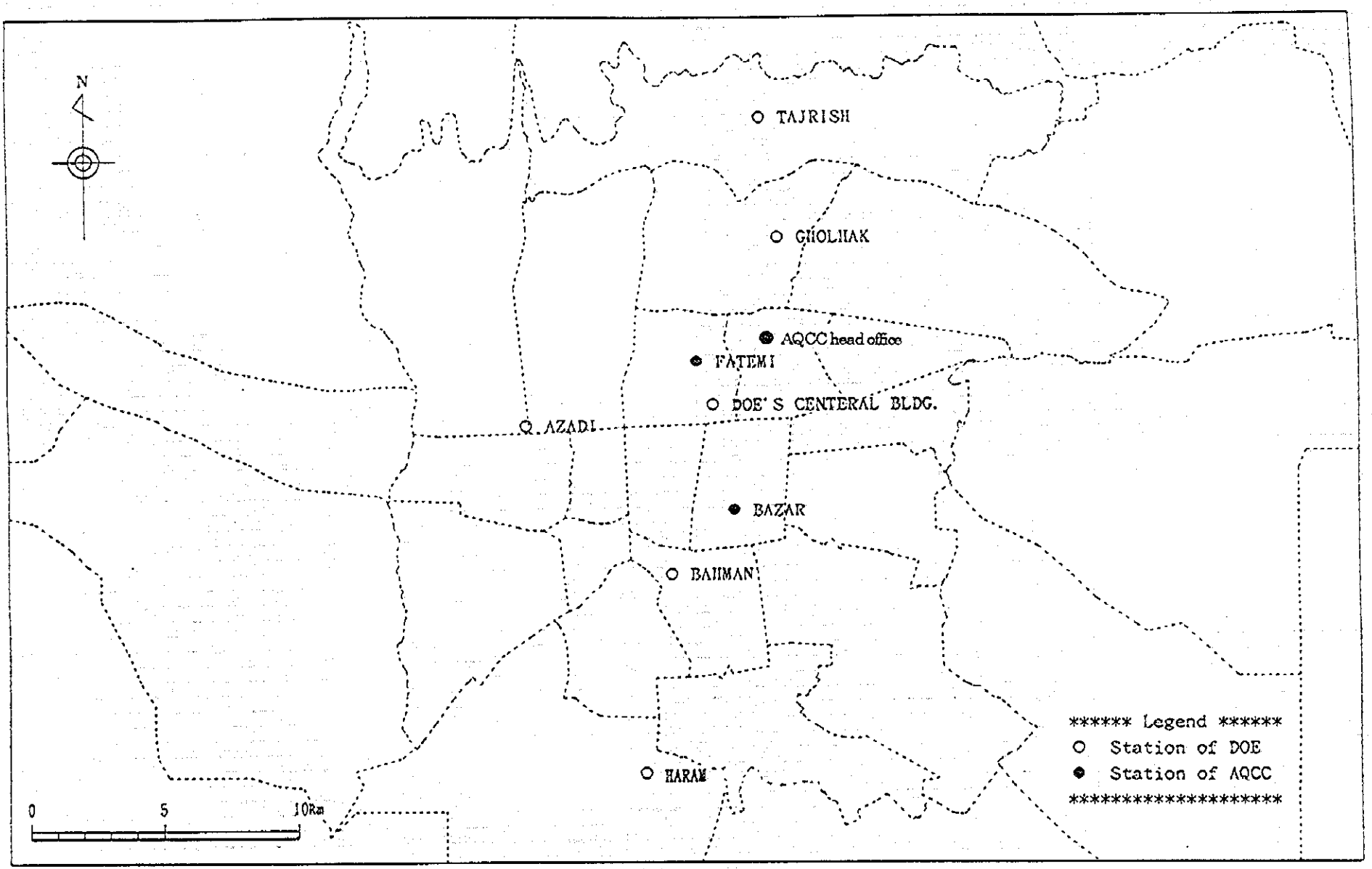


Fig. 3.2.1-1 Location of air pollution monitoring (continuous and real-time) station in Tehran (DOE and AQCC)

adopted a completely different strategy so that its data have been regarded strictly confidential. Since public awareness is one of the most important objectives of air quality monitoring, this policy of DOE certainly needs to be corrected in future. In addition, the inadequate number of stations in Tehran strongly necessitates exchange of data among interested bodies in order to take the best advantage of available resources.

It is difficult to evaluate the quality of data gathered at the ambient air monitoring stations in Tehran. Regardless of the organizations, difficulties in purchasing spare parts and calibration materials prevent them from getting high quality data. In addition, in some cases, shortage of well-trained service and maintenance staff make the task more difficult.

3.3 Present situation of sub-sector relating to the air pollution

3.3.1 Transportation and traffic

(1) The number of vehicles and the traffic volume

While some statistics of MOT are available, the numbers of registered vehicles and in-use vehicles vary depending on a source of data. According to AQCC, the following numbers (Table 3.3.1-1 and Table 3.3.1-2) are most reliable.

Table. 3.3.1-1 Numbers of registered vehicles classified by car type and age

	Passenger Car	Van	Mini Bus	Bus	Mini Truck	Truck	Total
1967-1971	83,970	25,992	2,743	5,679	1,823	13,514	133,721
1972-1976	225,020	76,109	5,010	2,920	1,230	12,768	323,057
1977-1981	199,269	52,286	4,643	2,947	219	13,758	273,122
1982-1986	98,979	33,627	1,450	1,586	57	10,880	146,579
1987-1991	46,487	13,068	3,893	852	50	6,945	71,295
1991	4,375	-----	3,265	1,330	160	5,422	14,542
1992	230,398	15,056	3,786	1,331	552	32,704	283,827
1993	73,168	-----	-----	-----	-----	-----	73,168
1994	56,877	-----	-----	-----	-----	-----	56,877
Total	1,018,543	216,138	24,790	16,645	4,081	95,991	1,376,188

Source : The center for Computer Service, Municipality of Tehran

Though there is a slight difference in numbers between Table 3.3.1-1 and Table 3.3.1-2 because of different classification of vehicles, the total numbers of vehicles are almost equal.

Figure 3.3.1-1 shows the number of vehicles in each district in accordance with Table 3.3.1-2, illustrating that the districts 1 to 5 in the north part of the city, and the districts 14 and 15 in the southeast part of the city have a large number of vehicles, because these districts are heavily populated residential areas.

Table 3.3.1-3 shows the number of trips within each district, the average number of trips per head and the number of vehicles. Figure 3.3.1-2 illustrates the number of trips within each district. The number of trips in the districts, where the populations are large, is relatively high, as compared with the number of trips in

less populated.

The government offices of Tehran and places of business are concentrated in districts 10, 11 and 12. Fleets of vehicles heading for the center of the city, especially from the north and the southeast contribute to the increased volume of traffic.

Table 3.3.1-2 Distribution of vehicle fleet in Municipality of Teheran

Type / District	Bicycle	Motor Cycle	Passenger Car	Taxi *	Van	MiniBus	Bus	Mini Truck	Truck	Other	Total
1	9,063	6,098	52,465	1,676	3,428	1,012	459	177	339	1,073	75,790
2	15,537	9,933	72,215	2,720	4,957	763	595	235	894	1,038	108,887
3	13,066	5,670	58,698	946	3,001	495	421	61	162	669	83,189
4	15,401	19,331	66,479	3,558	9,526	2,080	1,978	707	1,510	1,660	122,230
5	11,372	10,031	52,304	2,424	5,911	1,680	1,431	365	1,269	1,858	88,645
6	9,619	6,338	49,394	951	2,644	203	356	226	429	738	70,898
7	8,482	12,060	34,416	2,332	2,871	555	1,066	294	495	1,032	63,603
8	8,405	14,834	38,641	2,605	5,099	782	574	106	681	1,528	73,255
9	7,728	9,971	23,763	2,079	3,690	928	1,103	270	1,139	1,086	51,757
10	5,461	15,274	21,222	2,007	3,409	671	673	114	543	509	49,883
11	5,620	13,091	19,724	2,051	2,445	367	726	345	315	312	44,996
12	6,986	18,671	17,420	1,646	3,666	463	753	286	556	1,039	51,486
13	5,764	10,730	21,753	1,177	1,794	329	1,249	200	185	446	43,627
14	9,948	30,885	34,314	4,105	5,714	747	1,632	404	844	1,195	89,788
15	10,092	34,335	30,330	3,040	9,905	2,606	1,554	746	1,689	1,667	95,964
16	5,908	16,247	15,849	1,300	4,597	1,110	520	172	778	821	47,302
17	5,424	16,522	16,263	1,812	4,337	889	546	205	675	1,225	47,898
18	6,909	14,194	16,015	1,259	5,844	1,050	612	629	872	636	48,020
19	3,467	10,927	12,016	847	4,048	371	388	220	679	1,360	34,323
20	11,163	16,505	19,549	2,514	6,023	1,073	854	438	2,005	714	60,838
Total	175,415	291,647	672,830	41,049	92,909	18,174	17,490	6,200	16,059	20,606	1,352,379

Data Source: AQCC, based on 1994
Note : Taxi includes Private and Agencies cars

Table 3.3.1-3 Distribution of trips and statistics in MOT

District No.	Number of Trips (Passenger Cars)	Number of Trips (All kind of Cars)
1	189,078	525,939
2	293,644	822,182
3	175,112	488,372
4	357,744	999,284
5	240,645	676,208
6	179,051	503,292
7	167,592	470,125
8	198,747	558,140
9	146,822	410,018
10	148,612	417,531
11	124,620	344,544
12	121,038	341,324
13	101,701	287,657
14	219,158	617,174
15	261,773	738,462
16	136,079	377,818
17	132,498	370,304
18	139,660	387,478
19	117,099	326,297
20	155,774	438,998
Total	3,606,446	10,101,145
Average	180,322	505,057

Data Source: AQCC, based on 1994

District No.	Number of Vehicle (All kind of Cars)	Population (Estimate of 1994)	Number of trips of each person	Population / Number of Cars
1	75,790	269,000	2.0	3.5
2	108,887	383,000	2.1	3.5
3	83,189	241,000	2.0	2.9
4	122,230	593,000	1.7	4.9
5	88,645	425,000	1.6	4.8
6	70,898	270,000	1.9	3.8
7	63,603	302,000	1.6	4.7
8	73,255	368,000	1.5	5.0
9	51,757	263,000	1.6	5.1
10	49,883	318,000	1.3	6.4
11	44,996	256,000	1.3	5.7
12	51,486	265,000	1.3	5.1
13	43,627	201,000	1.4	4.6
14	89,788	435,000	1.4	4.8
15	95,964	613,000	1.2	6.4
16	47,302	346,000	1.1	7.3
17	47,898	355,000	1.0	7.4
18	48,020	369,000	1.1	7.7
19	34,323	273,000	1.2	8.0
20	60,838	366,000	1.2	6.0
Total	1,352,379	6,912,000	-	-
Average	-	-	1.5	5.1

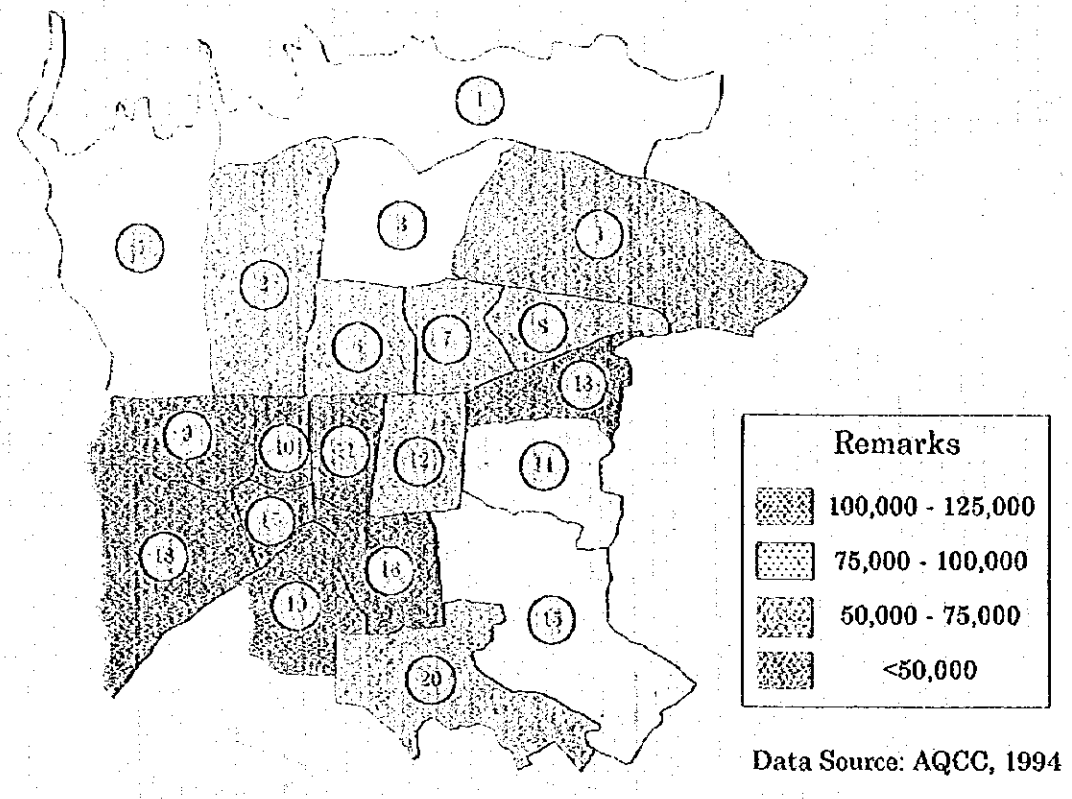


Fig. 3.3.1-1 Distribution of vehicle fleet in MOT

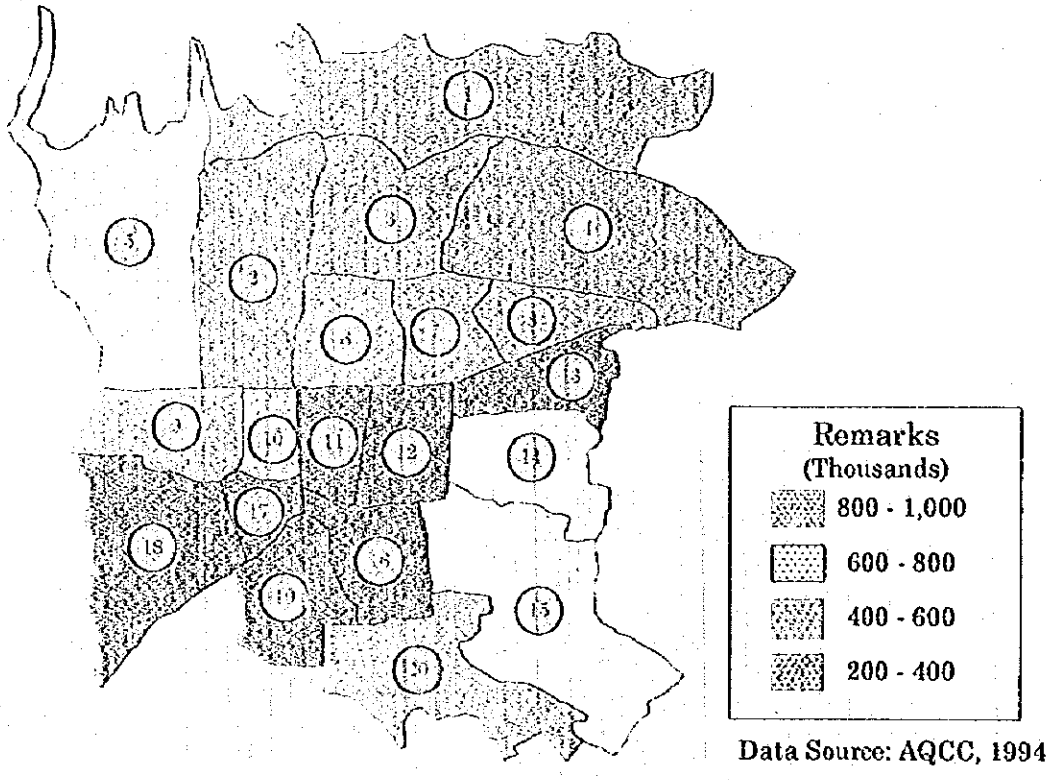
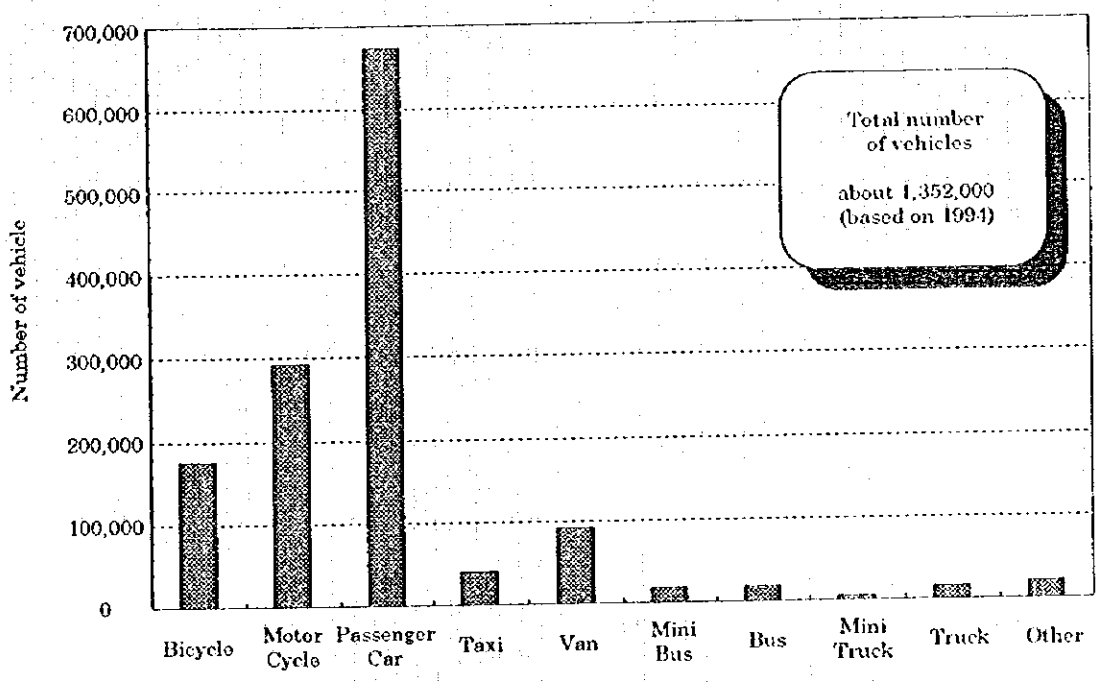


Fig. 3.3.1-2 Distribution of trips in MOT

Figure 3.3.1-3 shows the number of vehicles of each type. Passenger cars prominently number as many as 670,000 (50%) and motorcycles 300,000 (22%). The number of buses, mini-buses and taxis categorized as public transportation totaled 77,000 (5.6 %).



Note: Recent private passenger cars number goes up to 790,000 in 1997
Data Source : AQCC

Fig. 3.3.1-3 Distribution of vehicle classified by type

(2) Age of vehicle

Figure 3.3.1-4 shows the number of vehicles in MOT classified according to the age. Vehicles aged from 16 to 22 form a large part of the total and the average age is 15.9.

Paykan, the national cars, holds 50 % share, of which vehicles aged 10 years or more hold an average of more than 60 % share, and the vehicles aged less than 10 years drop to 35 %.

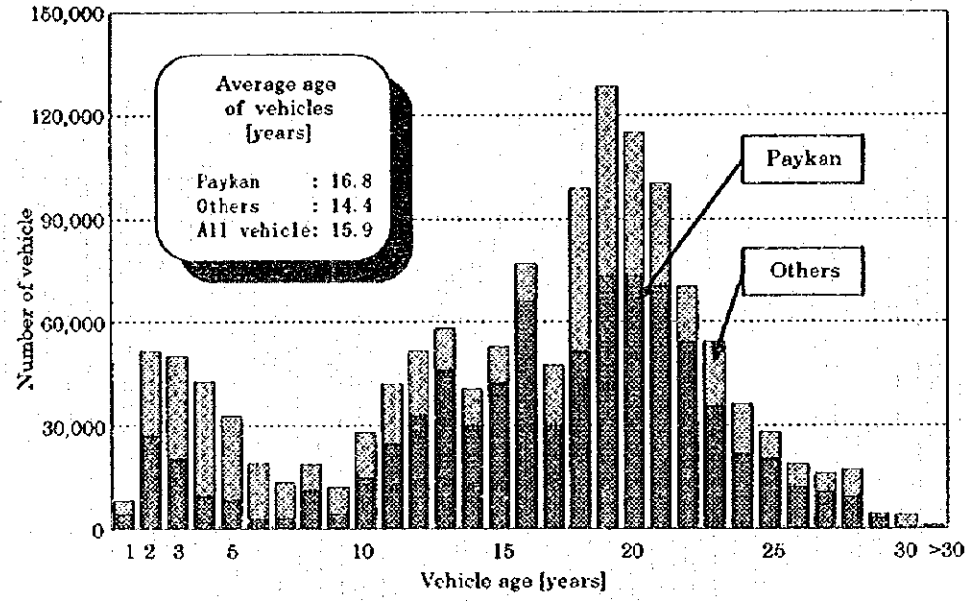
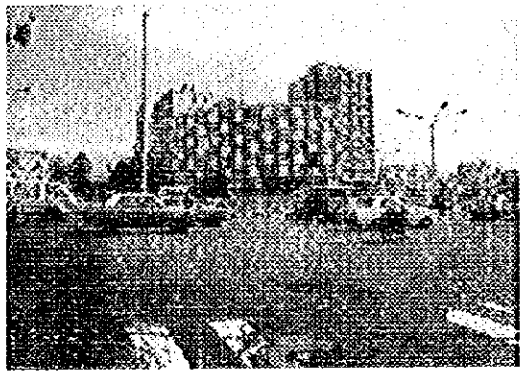


Fig. 3.3.1-4 Distribution of vehicle age

(3) Traffic control and surveillance center and traffic signal system

The Traffic Control and Surveillance Center controls the network of roads, setting TV cameras at 50 main intersections, monitoring 18 screens and remote-controlling them in the center. Traffic information is aired on the radio every 15 minutes by the center and urgent information like traffic accidents and other emergencies are reported through radio to the proper authorities, like police and UBC.



Traffic signals can be controlled on the basis of collected information using traffic volume measuring sensors (16 spots) and built-in sensors on roads called AADT system. To meet heavy traffic conditions on streets and at intersections, however, police officers often control the lighting system of signals or control traffic directly. Currently, the TTCC Signal Division is studying to automate and optimize the lighting system of traffic signals. As TTTO also plans to improve facilities at intersections, the situations will hopefully be better in future.

(4) Parking

The City has a large number of public and private parking facilities, besides park and rides and terminals. Figure 3.3.1-5 shows where parking places are located in the main part of the city. According to the Parking and Parkometer Bureau belonging to TTTO, the number of parking places is 252 and the total area is 53ha, holding over 20,000 vehicles, so that 2 % of all the vehicles registered at the municipality can find parking places in the City.

The parking fees vary depending on types of vehicles or parking duration as shown in Table 3.3.1-4.

Table 3.3.1-4 Parking fee in different area

Parking fee in Restricted Area (No Roof)

Type	Entrance	Hourly Fee (6 a.m to 8 p.m)	Hourly Fee (8 p.m to 6 a.m)
Private, Van	500	250	100
Mini bus	600	250	100
Bus-Truck	1,000	300	150
Large truck	1,500	500	300
Motor Cycle	150	100	50

Parking fee out of Restricted Area (No Roof)

Type	Entrance	Hourly Fee (6 a.m to 8 p.m)	Hourly Fee (8 p.m to 6 a.m)
Private, Van	500	250	100
Mini bus	600	250	100
Bus-Truck and Large Truck	1,000	300	150
Motor Cycle	150	100	50

Parking fee out of Restricted Area (with Roof)

Type	Entrance	Hourly Fee (6 a.m to 8 p.m)	Hourly Fee (8 p.m to 6 a.m)
Private, Van	700	300	150
Motor Cycle	200	150	100

Parking fee in Restricted Area (with Roof)

Type	Entrance	Hourly Fee (6 a.m to 8 p.m)	Hourly Fee (8 p.m to 6 a.m)
Private, Van	700	300	150
Motor Cycle	200	150	100

Data Source: TTTO, 1996

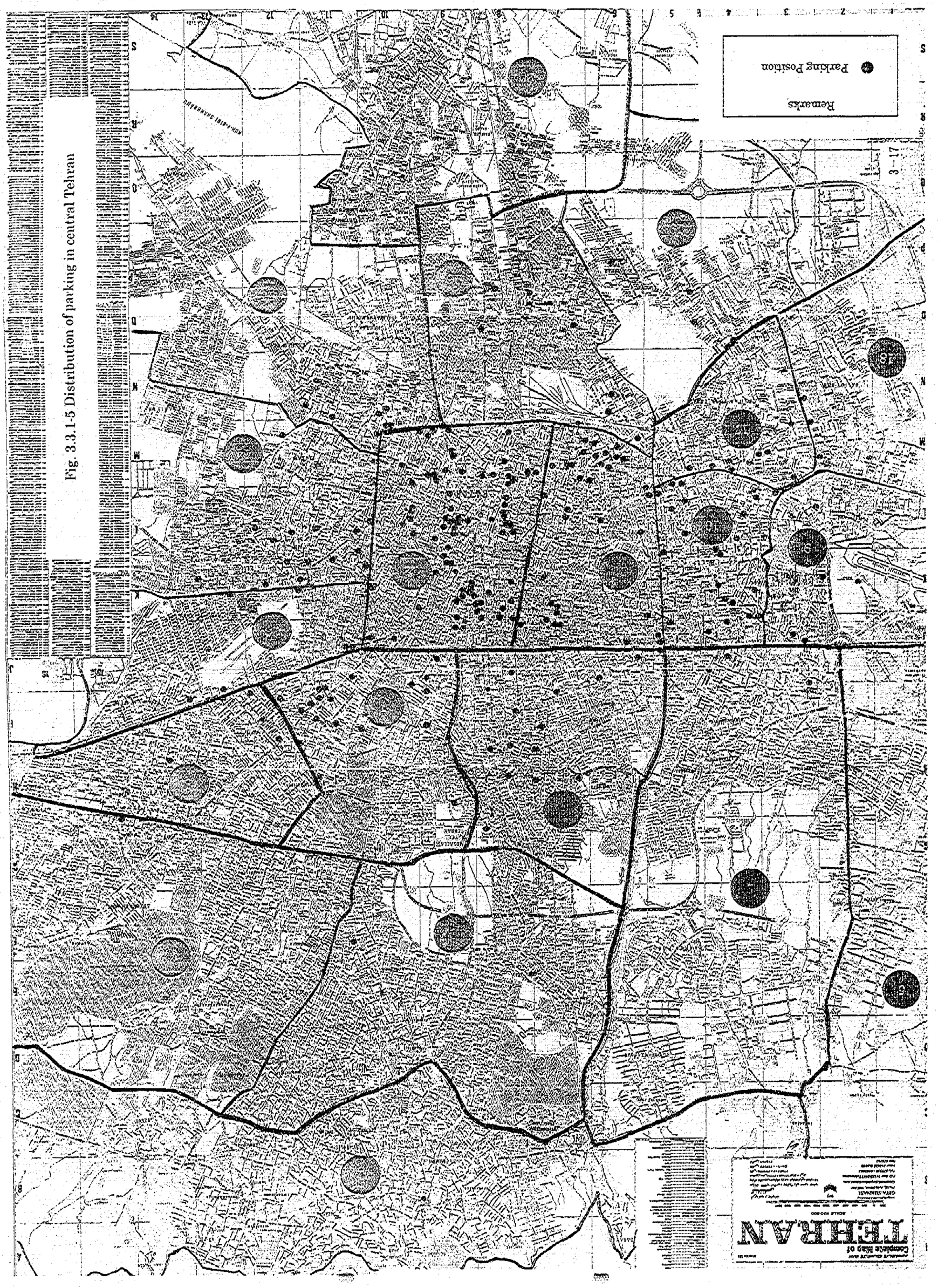
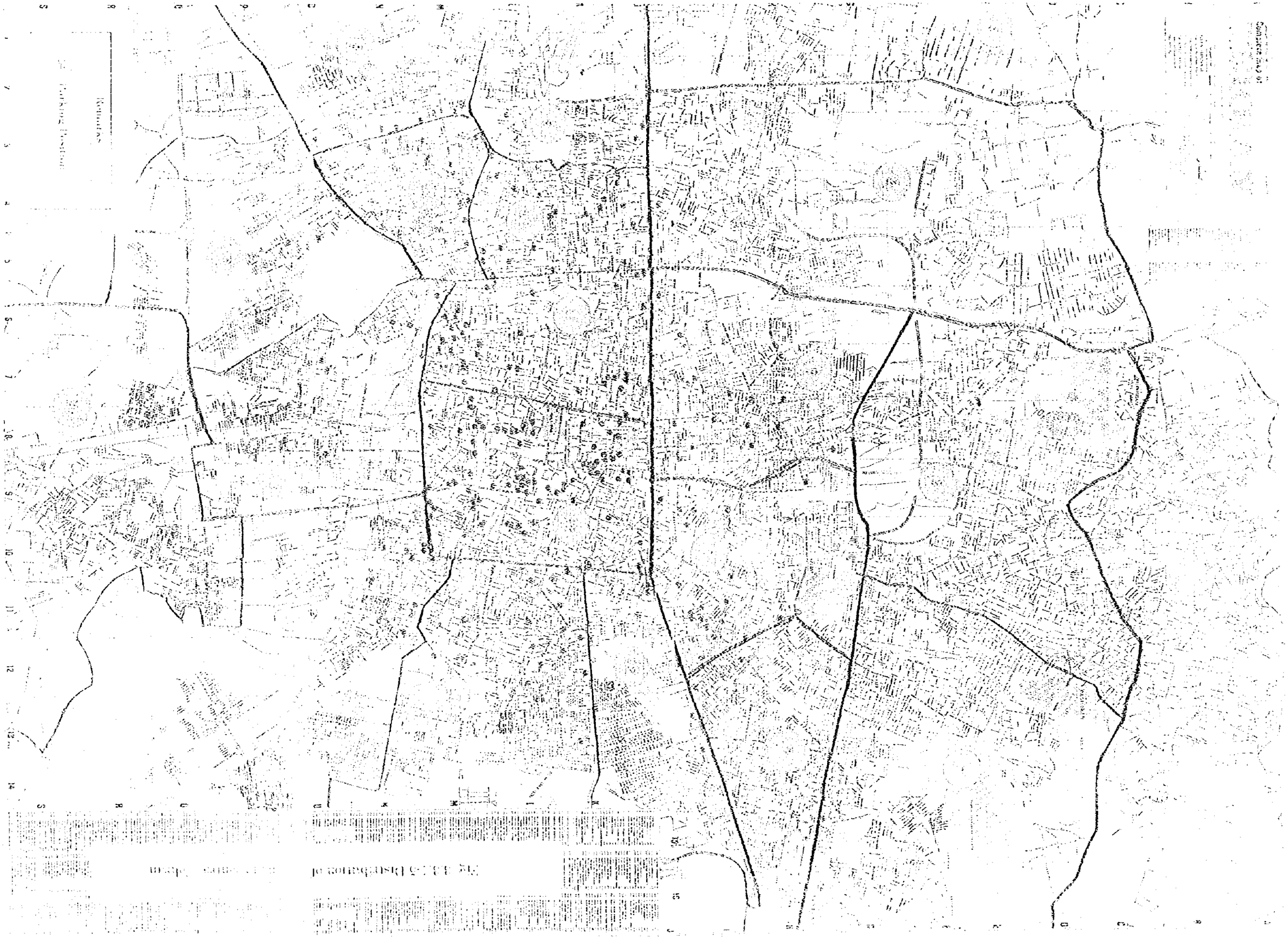


Fig. 3.3.1-5 Distribution of parking in central Tehran



3.3.2 Factory and enterprise

Table 3.3.2-1 and Fig 3.3.2-1 show the sector-wise number of the industrial units and workers in GTA districts in 1994. The manufacturing industries in GTA account for 40% of the energy consumption and 25% of the number of workshops both in the manufacturing sector of total Iran, causing a great deal of environmental pollution as well as heavy congestion of the city. Hence, tighter environmental control by the manufacturing industries in addition to control of mobile sources is a most urgent task to be faced by MOT.

The manufacturing sector in this report is classified based on the following international code of ISIC (International Standards of Industrial Classification).

31 Food Products
32 Textile Products
33 Wood Products
34 Paper Products
35 Industrial Chemicals
36 Nonmetal Products
37 Iron & Steel
38 Machinery Products
39 Other Industries

(1) Problems of the manufacturing sectors in GTA

Among the industries classified above, the following industries have been considered unsuitable in residential areas by MOT:

31 Butchery and meat processing
32 Tannery and processing
33 Wood chemical processing
35 Chemical manufacturing
36 Brick manufacturing and processing
37 Metal melting and foundry
38 Chemicals handling machinery

(2) Countermeasure for the problem

In order to plan and implement countermeasures, AQCC was established in 1993, and ORSUITO in 1990 as MOT's affiliate organizations dedicated to environmental control. The major step taken by MOT was to relocate polluting industries to the suburbs of GTA by providing them with the alternative sites (industrial estates).

There are 4 industrial estates under the control of MOT and 8 under MOI in the outskirts of GTA, as shown in Fig 3.2.4-1, site preparation of which is now under progress and where, in the near future, some of the relocated workshops will start operation.

Table 3.3.2-1 : Sectorwise number of industrial units and workers in GTA

Industrial Code / Sector	Workshop Size (No of Workers)				Total Number Unit	Total Number Worker
	Small	Medium		Large		
	1-10	11-50	51-100	100<		
31 Food	6,703	182	21	20	6,926	42,399
32 Rextile	24,195	527	21	36	24,779	99,400
33 Wood	4,063	49	0	2	4,114	9,920
34 Paper	2,229	171	13	23	2,436	17,899
35 Chemicals	2,623	247	33	48	2,951	42,311
36 Nonmetal	1,454	218	19	29	1,720	24,748
37 Iron	887	60	3	13	963	11,121
38 Machinery	18,307	683	72	105	19,167	120,490
39 Others	7,795	126	6	7	7,934	23,512
(Total)	68,256	2,263	188	283	70,990	391,800

(Source) AQCC (INTR632E)

Fig 3.3.2-1 : Total number of industrial units and workers in GTA