15.5 Overall Evaluation

At present, analysis of the transport problems in Bogota disclosed that the most serious problem is traffic congestion, which, as measured by traffic speeds, is worst within the Central Business Area in Bogota despite the fact that there are less vehicles per capita. The other problem is public transport served at a low level. There problems are primarily the result of interaction between increasing population levels, increasing urbanization and increasing per capita incomes which have a significant influence on the travel demand for people and freight. Today, problems are widespread throughout Bogota.

By 2020, the population in Bogota is estimated at 11 million including surrounding municipalities, of which 8.65 million are for the Study Area, an increase of almost 1.4 times in the Study Area. At the same time, the urbanization area will be expected to extend to the boundary of Bogota. The urbanization of Bogota is anticipated to spread over surrounding cities. The economic growth will be almost 3.5 times in GRDP. All these contribute to increasing travel demand, anticipated at 1.55 times the present in the whole Study Area. The forecast indicates the high increase rate of private mode (passenger car). Its figure is 2.2 times. These demands must be sustained by road transport.

In general, the transport problem has been simply described by a number of observers as a mismatch between supply and demand of transport infrastructure and service. Problems with urban transport are commonly identified as being associated with or caused by the private car. The improvement of infrastructure may be for car users in a high proportion; these account for a large share of the travel demand. The ratio of public transport passengers at present, however, is remarkably higher (80 % of all motor modes) in Bogota according to PT survey data. In future, the ratio is forecasted at 60 %. Since public transport will be predominant in Bogota in the future, planning in the Master Plan is oriented to public transport.

In the Master Plan, three major projects, namely roads including urban expressways, express busways and railway, are planned by 2020. Road and expressway projects are mainly prepared for the private mode, and the bus and railway projects are for public transport under the conditions for which travel demand is forecasted. The forecast was made taking into account the interactions between the increase of population, growing of economic factors for GRDP, income, and car ownership which directly influence demand.

The service level in travel speed or congestion level from the supply side through the proposed projects in the Master Plan are not sufficient to meet the demand, in spite of improved conditions in the medium years. This is due to the larger constraints in the availability of financial resources as well as the lower capacity to generate revenues from within the transport sector itself. The difficulty is in matching supply and demand. Even increasing the service level to the same level as at the present will need a huge investment. This is not at present being considered.

In order to improve the investment effect of projects under the conditions of restricted funding, travel demand control will be indispensable in the future. Especially, it is important to divert future travel demand from the private mode to the public mode, in order to improve the service level in the whole Study Area. In shifting the private mode to the public mode, the need for adequate public transport service is of major concern, making improvements for poor service level and comfort.

The plans with the introduction of Transport Demand Management(TDM) (which is not easy because the passenger car is thus restricted from free use) is unusable in the Master Plan, because there are too many uncertainties to make plans. Therefore, the Master Plan was made without TDM. The effects of TDM were only examined as a case study in Chapter 16. Its demand reduction effects, shifting traffic demand from private mode to public mode by discouraging ownership and usage of private cars, were estimated seeking better service for the public transport. At the same time, revenue of taxes from car users is also discussed, which will be spent as a new fund for Master Plan projects.

One of the purposes of the demand control policy is to obtain tax revenue as a congestion tax from users for transport funding as well as to avoid future congestion through demand reduction efforts by any action or set of actions. According to the tax revenue estimated in the course of examination of TDM (see Chapter 16), the amount will be close to the total cost of Master Plan Projects. It is necessary to further discuss whether all funds generated by such tax revenue are to be spent for transport purposes.

The Master Plan is formulated on the assumption that future travel demand was forecast on the future socioeconomic framework. The variation of estimated population and/or economic growth affects future travel demand and thus, requires the modification of Master Plan projects. In this situation, the Master Plan must be reviewed in accordance with changes in the socioeconomic framework by using the JICA Transport Model, which is explained in Chapter 4: User's Manual of Urban Transport Planning Manual.

CHAPTER 16
Transport Demand Management (TDM) and Fund Raising

16. TRANSPORT DEMAND MANAGEMENT (TDM) AND FUND RAISING

16.1 Introduction

The comprehensive urban transport Mater Plan in Bogota is formulated in accordance with the future travel demand shown in Chapter 15. In 2020, the traffic volume in the Study Area will rise 1.55 times the present one, of which 2.32 times are for car traffic and 1.35 times are for public transport. In the future, the increase ratio of car traffic volume will be considerably higher than that of the public one.

It is obvious that the road and public transport projects in the Master Plan will be insufficient to meet future traffic volume from the view-point of traffic service level. The Master Plan is not able to maintain the same service level as the present due to the limited budget. If the traffic congestion at the same level as the present will be maintained only by the supply of transport facilities, the investment of the facilities will be huge. Therefore, in order to improve the investment effect of projects, travel demand control will be indispensable in the future. Especially, it is important to divert the future travel demand from the private mode to the public mode to improve the service level in the whole Study Area. Figure 16.1-1 shows the eternal circle of demand and supply as mentioned above.

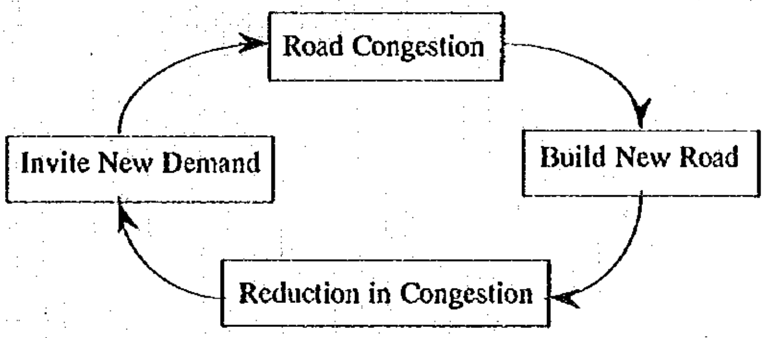


Figure 16.1-1 Eternal Circle of Demand and Supply

Recently, Transport Demand Management (TDM) developed in the United States is examined as a new management system for a strategic approach to avoid traffic congestion. Purposes of the demand control policy are to avoid future congestion through demand reduction efforts by any action or set of actions, and to obtain tax revenue, as a congestion tax from users, for transport funding.

The measures of TDM are composed of growth management, road pricing, auto restricted zones, parking management, fuel tax, alternative work hours, etc. The introduction of TDM, however, is not easy because the passenger car is restricted from freedom of use, though several countries in Europe, Asia and U.S. have introduced or planned implementation. Therefore, it is indeed difficult to obtain a consensus of car owner regarding car use. Especially, the PT survey in the Study revealed that car owners have a very strong propensity to use a car, and that they will use a car whenever and wherever available.

In this chapter, TDM measures in the Master Plan are examined, and its demand reduction effects, shifting traffic demand from the private mode to the public mode by discouraging ownership and use of private cars, are estimated in the light of better public transport service. At the same time, revenue of taxes from car users is also discussed, which will be spent as new funds for Master Plan projects.

Since making the best recommendation among several measures applicable to Bogota is difficult in this report, only case studies were conducted. This is because it is difficult to assay the possibility of introduction of the measure pertinent to Bogota among many alternatives. Further study is necessary to introduce different measures in Bogota. In each Section, problems and effects of each measure introduced were estimated.

Figure 16.1-2 shows the study flow for Transport Demand Management.

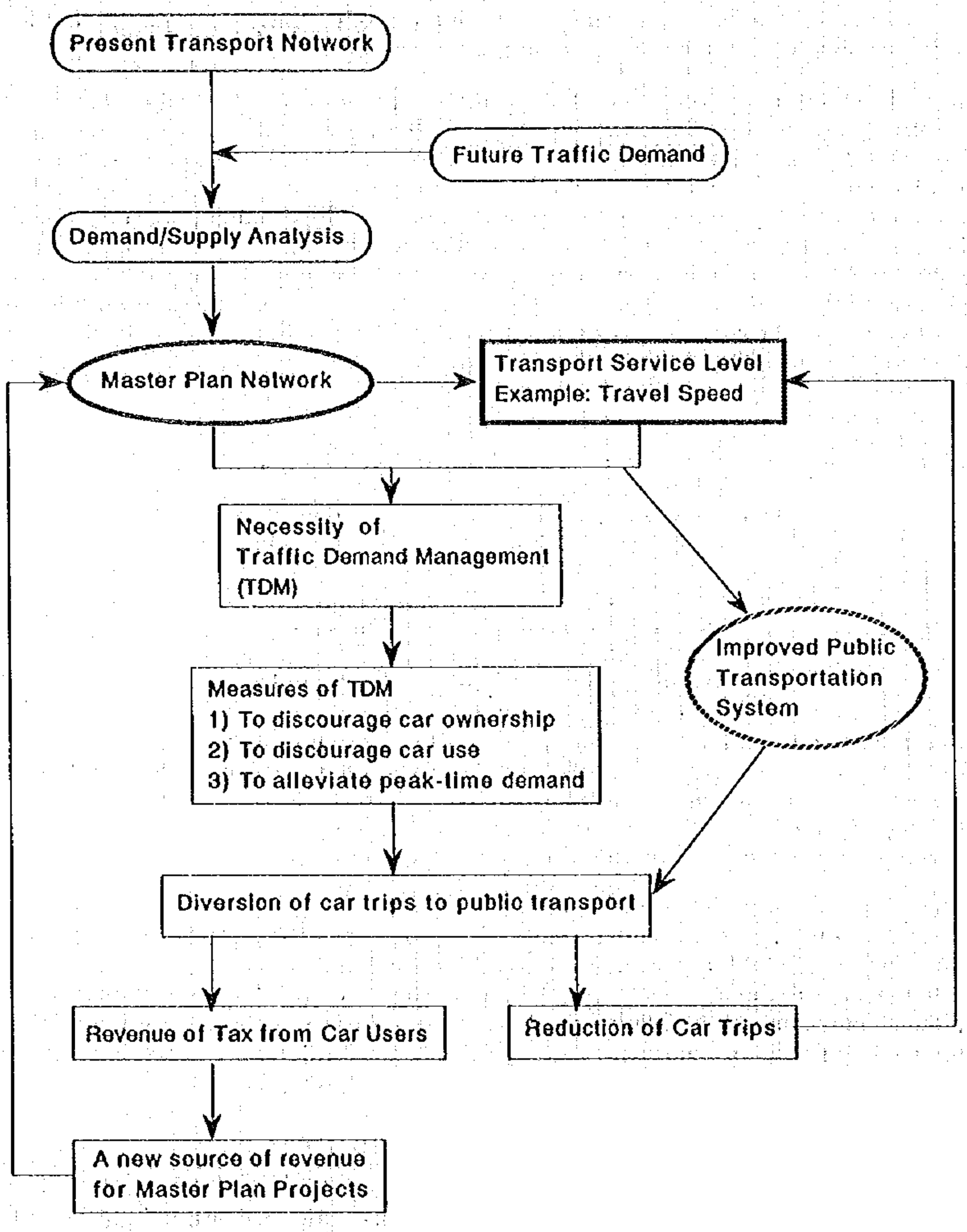


Figure 16.1-2 Study Flowchart for Transport Demand Management

16.2 Measures of TDM

The major measures of TDM are shown below. These are classified into 3 categories: to discourage car ownership, to discourage car use and to alleviate peak-time demand. These measures are to restrict car use or car ownership. These measures have to be introduced under the conditions that the service level of public transport rises sufficiently to encourage car users to shift to public transport. It is because car owners in Bogota have very strong propensity to use a car, i.e., they will use a car whenever and wherever available.

a) To discourage car ownership (A)

- A-1. Planned Car Increase and Limited License Issue
- A-2. High Taxation

b) To discourage car use (B)

- B-1. License-plate Numbering System
- B-2. Road Pricing (Congestion Charge)
- B-3. Area-Licensing (Congestion Charge)
- B-4. HOV Priority System
- B-5. Parking Control
- B-6. Car User Tax

c) To alleviate peak-time demand (C)

- C-1. Staggered Working Time
- C-2. Flex-time System

16.3 Discouraging Car Ownership

16.3.1 Planned Car Increase and Limited License Issue (A-1)

(1) Method

New car acquisition is allowed only to those with a number plate already issued or with a quota.

(2) Cities/Countries where Implemented

Singapore

(3) Application in Bogota

Perhaps this measure is too strong to apply to Bogota.

16.3.2 High Taxation (A-2)

(1) Method

Vehicle ownership is inhibited by high import taxes, purchase taxes, vehicle registration fee and annual licensing fee.

(2) Cities/Countries where Implemented

Hong Kong, Singapore, Seoul(Korea)

(3) Application in Bogota

Among import, purchase, and registration taxes, the purchase tax was examined as high taxation in case study.

In the case study, the diversion of cars by applying the high purchase tax was examined. Table 16.3-1 and Figure 16.3-1 show the examination of high taxation ranged from 50% to 200%, in contrast to 35% at present. When the purchase tax raises from 35% to 50%, car ownership reduces in correspondence to the ratio. And then, car trips decrease (1.4%) as a result of the decrease in motorized households (3%). On the other hand, bus trips rise (0.3%) due to the increase in non-motorized households (2.3%) at the same time. Total trips in the Study Area drop (1.2%) by shifting to the public mode. The tax revenue will be approximately 5,460 billion pesos during 25 years under the reduction of car ownership by high taxation (50%).

The effectiveness for reduction of car trips by the purchase tax in the range from 50% to 100% is somewhat low. When high effect is required for total trips, the purchase tax has to be dramatically increased by 100 % or more. In these cases, it is very difficult to obtain the consensus of car owner.

Although a huge amount of tax revenue will be obtained by the application of the purchase tax, it seems that this measure is hard to introduce in Bogota.

Table 16.3-1 Measure of High Taxation (Purchase Tax)

1) Price of Middle Class Car	(Peso $)	20,000,000	22,222,222	25,925,926	29,629,630	33,333,333	37,037,037	40,740,741	44,444,44
2) PurchaseTax Rate		0.35	0.50	0.75	1.00	1.25	1.50	1.75	2.00
3) Tax	(Peso $)	5,185,185	7,407,407	11,111,111	14,814,815	18,518,519	22,222,222	25,925,926	29,629,630
4) Reduction Rate of Income		1.000	0.969	0.917	0.864	0.812	0.760	0.708	0.656
5) No. of Cars	Vehicles	1,350,000	1,325,000	1,291,000	1,233,000	1,154,000	1,131,000	1,074,000	1,013,000
6) No. of Households									
(1) Non-Motorized	Household	959,915	982,951	1,015,433	1,036,722	1,014,992	1,065,793	1,096,954	1,127,694
(2) Motorized Households	Household	870,123	847,098	814,606	793,317	815,047	764,244	733,085	702,34
7) Ratio									
(1) Non-Motorized	Household	0.525	0.537	0.555	0.567	0.555	0.582	0.599	0.616
(2) Motorized Households	Household	0.475	0.463	0.445	0.433	0.445	0.418	0.401	0.384
8) No. of Trips									
(1) Cars	Persons	4,517,199	4,749,028	4,638,894	4,536,018	4,454,373	4,336,629	4,206,421	4,069,970
(2) Buses	Persons	10,593,650	10,624,695	10,679,008	10,737,707	10,795,551	10,562,144	10,932,562	11,007,956
9) No. of Trips									
(1) Cars	Vehicles	2,901,927	2,860,560	2,794,514	2,732,539	2,701,430	2,612,427	2,533,988	2,451,78
(2) Buses	Vehicles	493,646	495,093	497,624	500,359	503,069	506,158	509,439	512,95
(3) Cars+Buses	Vehicles	3,395,573	3,355,953	3,292,138	3,232,898	3,204,498	3,118,585	3,043,427	2,964,74
10) Decreaseratio of Trips									
(1) Cars		1.000	0.956	0.963	0.942	0.931	0.900	0.873	0.845
(2) Buses		1.000	1.003	1.008	1.014	1.019	1.025	1.032	1.039
(3) Cars+Buses		1.000	0.988	0.970	0.952	0.944	0.918	0.896	0.873
10) Tax Revenue	(Million Pesos $)	0	5,459,894	14,145,993	22,250,581	29,763,472	36,579,074	42,619,168	47,802,58
	(Million US $)	0	5,460	14,146	22,251	29,763	36,579	42,619	47,803
11) Sum Total of Cars Purchased	Vehicles	2,496,506	2,456,952	2,387,136	2,310,668	2,232,260	2,147,033	2,054,853	1,955,560
12) Car Increase Ratio/ year		0.041	0.040	0.039	0.037	0.035	0.033	0.031	0.029

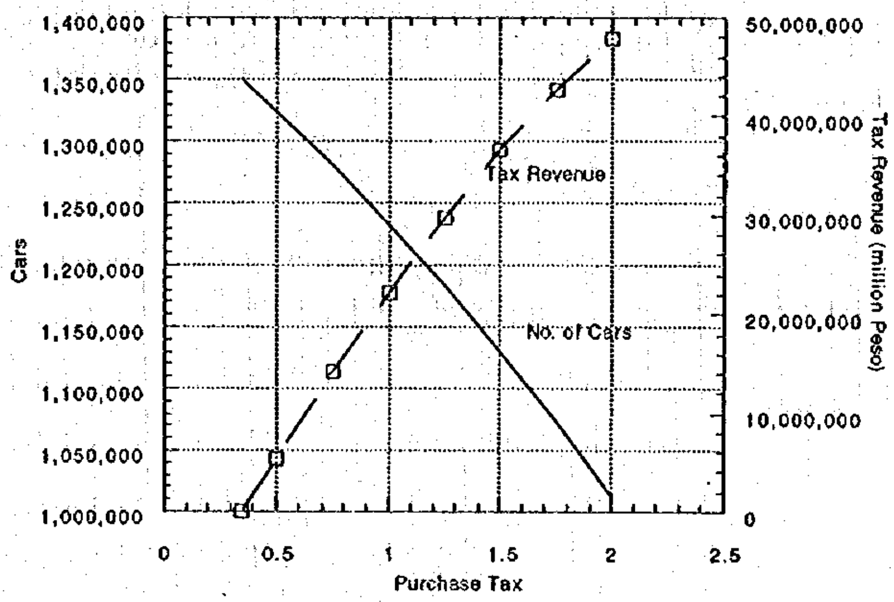


Figure 16.3-1 Relation between Purchase Tax, and Revenue

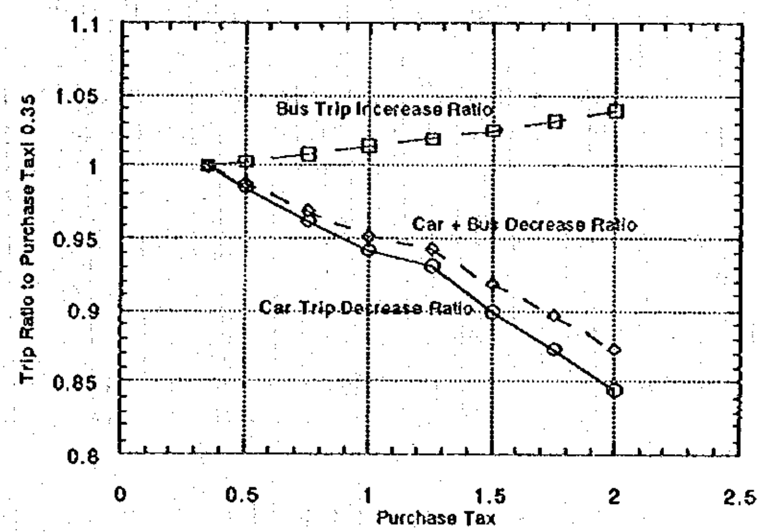


Figure 16.3-2 Relation between Purchase Tax, and Car and Bus Trips

16.4 Discouraging Car Use

16.4.1 License-plate Numbering System (B-1)

(1) Method

Vehicles with odd-numbered plate are not permitted to enter controlled areas on odd-numbered working days and vehicles with even-numbered plate are not permitted to enter on even-numbered days.

(2) Cities/Countries where Implemented

Lagos(Nigeria), Seoul(Korea), Athens(Greek), Mexico city (Mexico)

(3) Application in Bogota

For the first step, the control system is applied to the area surrounded by Calle 100, Av. Ciudad de Quito, Calle 6 and Cra. 7.

the last digit of plate number	not permitted to enter the area on:
1 or 2	Monday
3 or 4	Tuesday
5 or 6	Wednesday
7 or 8	Thursday
9 or 0	Friday

This measure will promote multi-car ownership and will be unfair, by income. In Athens, though the effectiveness of application was apparent at the time of initiation, its effectiveness substantially decreased by the growth of car ownership.

16.4.2 Road Pricing (Congestion Charging) ; (B-2)

By charging car users a "price" that represents the cost they create by using a particular road, car users will react to this cost by 1) accepting it, 2) adopting another mode, 3) going on another route, or 4) foregoing the trip. The intent of road pricing is to "price" highway facilities so that a sufficient supply of highway capacity is provided for those willing to pay the "price".

Road Pricing is classified into 2 categories: one is to charge on a particular road, and the other is to charge on congested area, as described in Chapter 16.4.3.

(1) Method

Vehicles are charged for passing specified streets during peak periods, excluding public and emergency vehicles.

(2) Cities/Countries where Implemented

Several experiments have been adopted in the following countries where advanced equipment (automatic vehicle identification) is used to monitor the vehicle use of congested areas or facilities.

Bergen (Norway, 1986), Oslo (Norway, 1990), Trondheim (Norway, 1991)

Stockholm (Sweden, 1996/1997), Stuttgart (Germany, 1994/1995)

(3) Application in Bogota

1) Route

Avenida. Caracas (Calle 26 - Calle 100), Avenida 7a (Calle 26 - Calle 100)

2) Charging Period

7:00 a.m. - 8:30 p.m.

3) Toll Rate

a) Daily 1,000 pesos
b) Weekly 4,000 pesos
c) Monthly 12,000 pesos

16.4.3 Area Licensing (Congestion Charging); (B-3)

(1) Method

Vehicles are charged for entering congested area during peak periods, excluding public and emergency vehicles.

(2) Cities/Countries where Implemented

Singapore: preparing the introduction of a Electronic Road Pricing system

(3) Application in Bogota

1) Method

Vehicles to enter the restricted area have to buy a license sticker (calcomania) at a supermarket, convenience store, kiosk, etc. and show it on the front window. A vehicle in the area without a valid sticker will be penalized. Vehicles in emergencies and for public-use (except taxis) are excluded.

2) Restricted Area

Restricted area is defined as the area surrounded by Calle 72, Avenida. Caracas, Calle 26 and Avenida. 7, including those boundaries as shown in Figure 16.4-1.

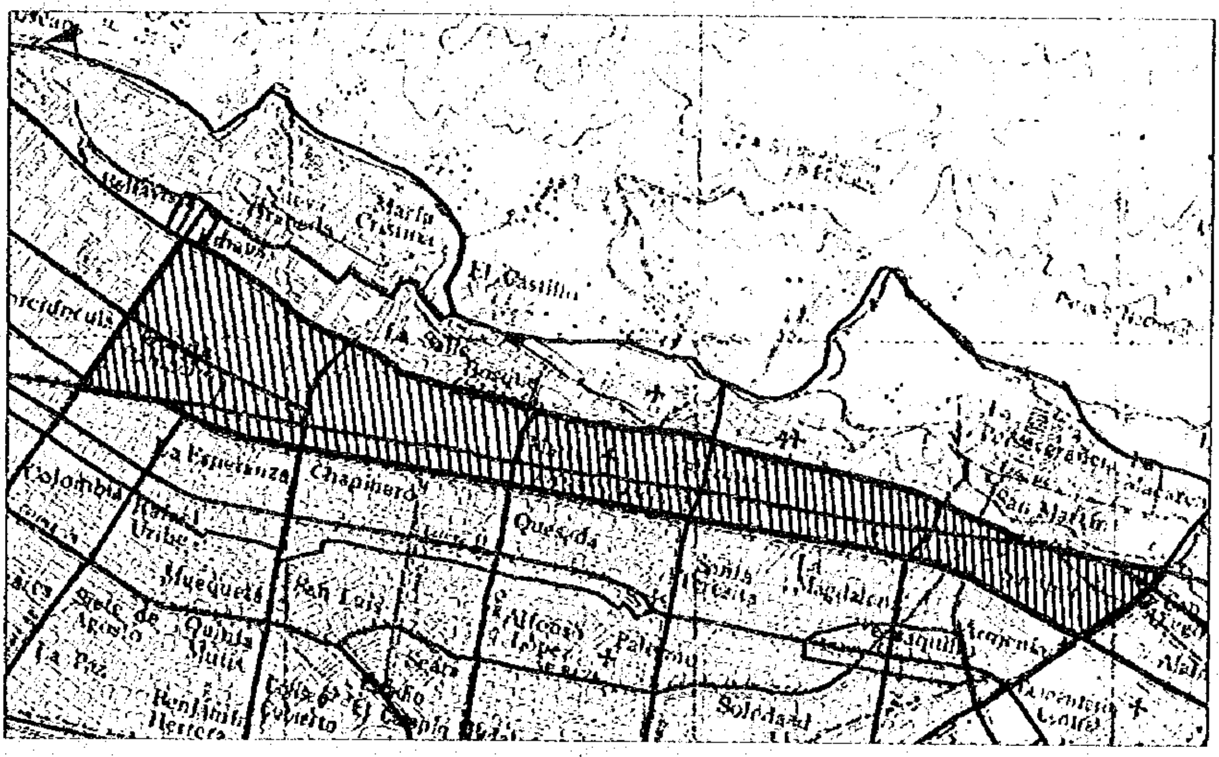


Figure 16.4-1 Restricted Area for Area Licensing

3) Restricted Time- Period

7:00 A.M. - 6:00 P.M.

4) Toll Rate (pesos)

	Daily	Weekly	Monthly
a) Car	1,000	4,500	15,000
b) Taxi	2,000	9,000	30,000
c) Truck	2,000	9,000	30,000

(4) Case Study

In the case study, the alleviation of road congestion by applying road pricing within the above area was examined. Table 16.4-1 and Figure 16.4-2 show that the examination of the road pricing ranged from 1,000 to 3,000 pesos for passenger cars and 2,000 to 4,000 pesos for taxis and trucks. As can be seen, car trips decrease as a result of the increase in the toll rate as shown in Figure 16.4-3. On the other hand, tax revenue for car rises with toll rate of 2,000 pesos and then falls dramatically from 1,400 billion pesos/25 years to 888 billion pesos.

In the case study, road pricing is effective for alleviating the congested area and at the same time collecting the revenue from toll gates. On the other hand, if this system is applied, there is a problem due to the cost of the installation of monitoring devices on the road and in the vehicles, and the creation of an administrative/enforcement structure to collect the revenues.

In the analysis, there is a issue regarding the diversion of car trips from the private mode to the public mode. Since data on diversion is not available in Bogota, the Study Team referred to the data collected from, the Medellin Metro. Figure 16.4-4 shows transport mode before operating the Metro, by car-owning and non car-owning households. According to Figure 16.4-4, approximately 20% of total trips in car-owning households diverted from car use to public transport (Metro) after the Metro began operating.

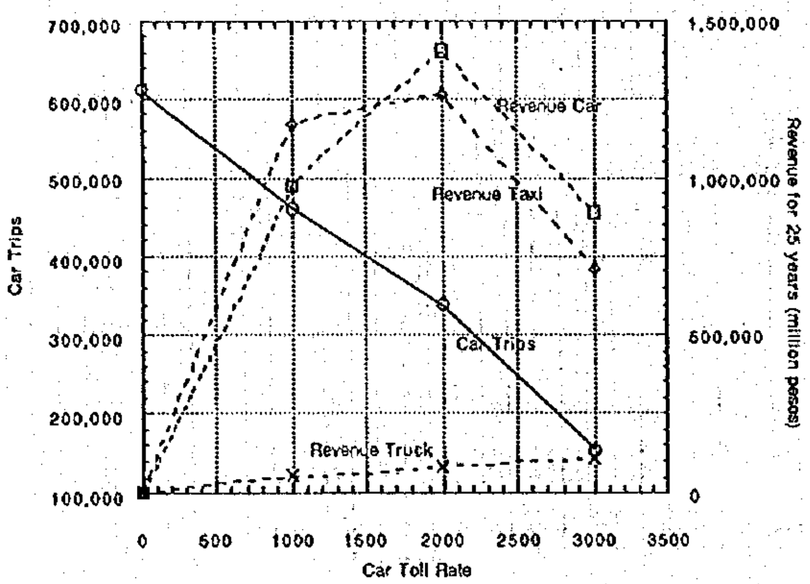


Figure 16.4-2 Relation between Toll Rate, Car Trips and Revenue

Table 16.4-1 Road Pricing (Area Licensing) in Bogota

Toll Rate					
1) Car	pesos/veh/day	0	1000	2000	3000
2) Taxi	pesos/veh/day	0	2000	3000	4000
3) Truck	pesos/veh/day	0	2000	3000	4000
Trips Related Target Area/day					
1) Cars					
Intrazonal Trips	PCU/day	22,487	22,487	22,487	22,487
Internal-External Trips	PCU/day	454,114	437,499	315,834	133,195
Through Traffic	PCU/day	134,064	0	0	0
Total	PCU/day	610,665	459,986	338,321	155,682
2) Taxis					
Intrazonal Trips	PCU/day	12,833	12,833	12,833	12,833
Internal-External Trips	PCU/day	273,806	263,788	190,431	80,309
Through Traffic	PCU/day	62,122	0	0	0
3) Trucks					
Intrazonal Trips	PCU/day	2,065	2,065	2,065	2,065
Internal-External Trips	PCU/day	20,914	20,914	20,914	20,914
Through Traffic	PCU/day	19,970	0	0	0
Diverted Trips					
Cars					
Intrazonal Trips	PCU/day	0	0	0	0
Internal-External Trips	PCU/day	0	16,615	138,280	320,919
Through Traffic	PCU/day	0	134,064	134,064	134,064
Total	PCU/day	0	150,679	272,344	454,983
Diverted Trip Ratio					
Cars					
Intrazonal Trips		0.000	0.000	0.000	0.000
Internal-External Trips		0.000	0.037	0.305	0.707
Through Traffic		0.000	1.000	1.000	1.000
Total		0.000	0.247	0.446	0.745
Tax Revenue					
For a day					
1) Cars	million pesos/day	0	324	468	296
2) Taxis	million pesos/day	0	391	423	238
3) Trucks	million pesos/day	0	18	27	36
For a year					
1) Cars	million pesos/year	0	77,778	112,297	71,037
2) Taxis	million pesos/year	0	93,791	101,563	57,109
3) Trucks	million pesos/year	0	4,330	6,494	8,659
For 25 years					
1) Cars	million pesos/25 years	0	972,220	1,403,707	887,967
2) Taxis	million pesos/25 years	0	1,172,391	1,269,538	713,861
3) Trucks	million pesos/25 years	0	54,119	81,178	108,238
Total	million pesos/25 years	0	2,198,730	2,754,423	1,710,065

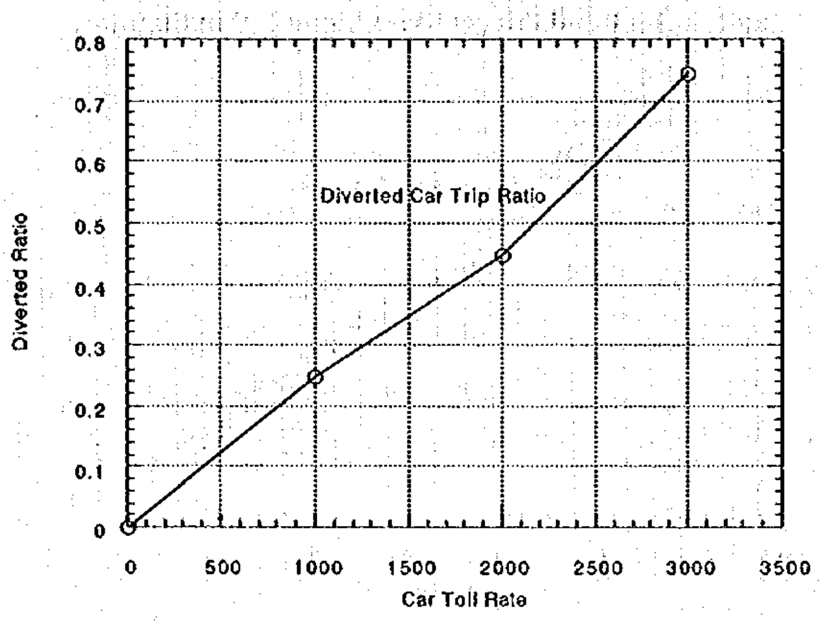


Figure 16.4-3 Relation between Toll Rate and Diverted Car Ratio

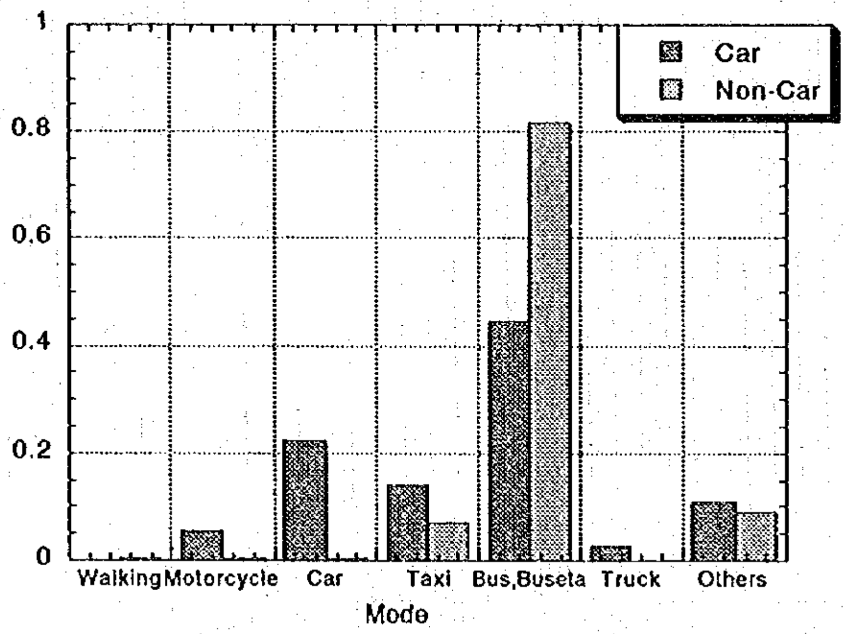


Figure 16.4-4 Transport Mode before Operating of Metro

16.4.4 High Occupancy Vehicle (HOV) Priority System (B-4)

(1) Method

Cars with several passengers (usually more than three) are called "high occupancy vehicles (HOV)" and are given priority to enter a restricted area or pass specified streets during the peak-time period. High occupancy vehicles include buses, vanpools and carpools.

Carpooling involves the use of an employee's private vehicle to carry one to five fellow employees to work, either using one car and sharing expenses, or rotating vehicle use so that no money changes hands.

There are two type of HOV facilities; concurrent flow HOV lanes and counterflow. Concurrent flow HOV lanes on surface streets are the most widely applied HOV priority project, found in at least 30 American cities. Most applications have occurred along curb lanes of downtown streets using a minimum of signing and marking. On the other hand, most counterflow applications have occurred on one-way streets, although a few projects have applied the counterflow concept to two-way surface streets, either on the opposite side of a median, or as a reversible center lane.

Concurrent flow HOV lanes usually operate during one of the following time periods:

a) AM peak hour period
b) PM peak hour period
c) Both AM and PM peak hour period
d) Daylight hours (e.g., 7 AM - 6 PM)

On the other hand, most downtown counterflow lanes operate with permanent 24-hour restrictions.

HOV facilities can induce commuters to shift to higher-occupancy travel modes to reduce vehicular demand in peak periods, and consequently reduce traffic congestion, energy consumption and air polluting emissions.

(2) Cities/Countries where Implemented

Seoul (Korea), Manila (Philippines), Los Angeles (US), Houston (US), Toronto (Canada)

(3) Application in Bogota

This system will be applicable combined with other TDM measures such as road pricing and area licensing by exempting HOVs from tolls. Present occupancy of a car is 1.5 persons on average. If this system succeeds in raising the rate to 2.0 passengers, for example, traffic demand will decrease by 25%.

16.4.5 Parking Management (B-5)

(1) Method

Parking management is widely considered effective as a tool of TDM. The parking management program is basically any plan by which parking space is provided, controlled, regulated, or restricted in any manner. Parking management actions can be categorized into six major categories: on-street parking, off-street parking, fringe and corridor parking, pricing, enforcement and adjudication, and marketing.

Research has shown that when parking at employment sites is free or provided at very low cost (i.e., subsidized by a person's employer) people generally drive to work alone rather than use carpools or transit.

An increase in parking charges will encourage car users to share rides, use public transport to reduce an individual's costs, or find a cheaper place to park. If the parking charge in commercial parking lots is not directly regulated, a municipal tax may provide an indirect means of increasing charges at those parking lots.

(2) Cities/Countries where Implemented

a) Restriction of long-time roadside parking for working purpose:
   Helsinki(Finland), Prague(Czech Republic)

b) Inhibition of parking Facilities Construction in CBD
   Montreal(Canada), Zurich(Switzerland)

c) Underground Parking Facility Construction by BOT
   France, Italy

(3) Application in Bogota

a) Additional surcharge (for example, of 500 pesos/park) is imposed on vehicles parking in "Zonas Azules" and off-street parking facilities with a capacity of more than 5 lots in CBD.

b) Long-term parking for working purpose is prohibited in "Zonas Azules". No car is allowed to park for over 3 hours.

(4) Case Study in Bogota

In the case study, the alleviation of road congestion by applying parking management within the central area was examined. The surcharge is charged on the parking lots in the same area as the central area where road pricing is charged, in Figure 16.4-1. The surcharge was charged only on the "to work" purpose trips of private cars during 7 hours.

Table 16.4-2 and Figure 16.4-5 show the examination of parking management in the range of surcharged rates from 500 pesos to 3,000 for car. As can be seen, car trips decrease as a result of the increase in the surcharged rates. For instance, if a parking rate of 1,000 pesos is surcharged on car trips related to the area, 8.6 % of total trips related to the area divert from car mode to public mode (see Figure 16.4-6). At the same time, the revenue of the rates will be approximately 480 billion pesos during 25 years.

However, there are several potential problems that must be addressed in considering this action:

a) Business companies may oppose the increase of surcharge rates as limiting their ability to attract employees or customers.
b) Garage owners and users probably will oppose the increase charge.
c) Residents of nearby neighborhoods in the central area where parking management will be done may object to the increase rates if car users shift to parking on their streets.
d) Car users who work in the parking restricted areas will oppose the increase rates.

Table 16.4-2 Parking Management Measure

Toll Rate						
1) Car	pesos/veh/day	0	500	1000	2000	3000
Trips Related Target Area/day						
1) Cars						
Intrazonal Trips	PCU/day	22,487	22,487	22,487	22,487	22,487
Internal-External Trips	PCU/day	454,114	453,827	437,499	315,834	133,195
Through Traffic	PCU/day	134,064	34	0	0	0
Total		610,665	476,348	459,986	338,321	155,682
Diverted Trips						
Cars						
Intrazonal Trips	PCU/day	0	0	0	0	0
Internal-External Trips	PCU/day	0	100	5,815	48,398	112,322
Through Traffic	PCU/day	0	46,911	46,922	46,922	46,922
Total		0	47,011	52,738	95,320	159,244
Diverted Trip Ratio						
Cars						
Intrazonal Trips		0.000	0.000	0.000	0.000	0.000
Internal-External Trips		0.000	0.000	0.013	0.107	0.247
Through Traffic		0.000	0.350	0.350	0.350	0.350
Total		0.000	0.077	0.086	0.156	0.261
Tax Revenue from Cars						
1) Cars	million pesos/day	0	83	161	237	163
1) Cars	million pesos/year	0	20,005	38,639	56,838	39,232
1) Cars	million pesos/25 years	0	250,065	482,985	710,474	490,398

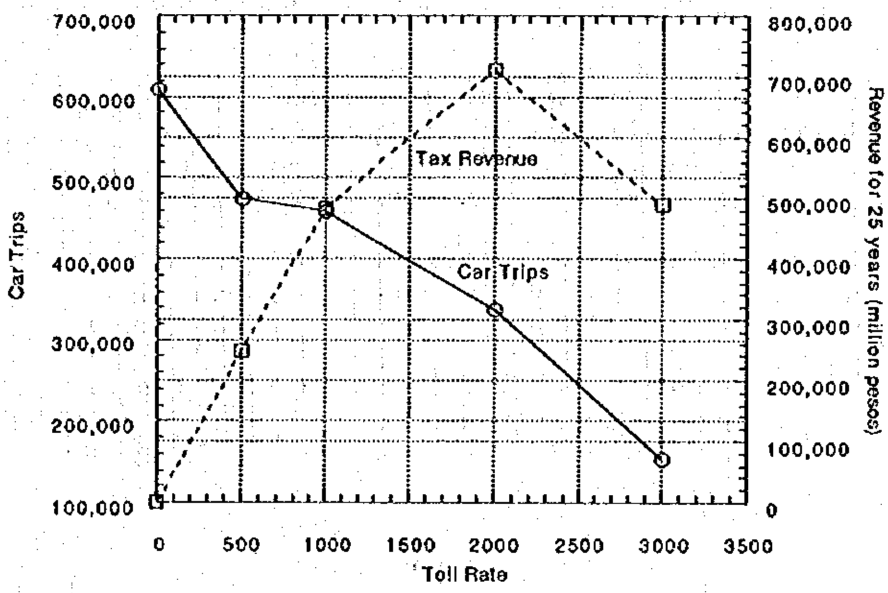


Figure 16.4-5 Relation between Parking Charge, Tax Revenue and Car trips

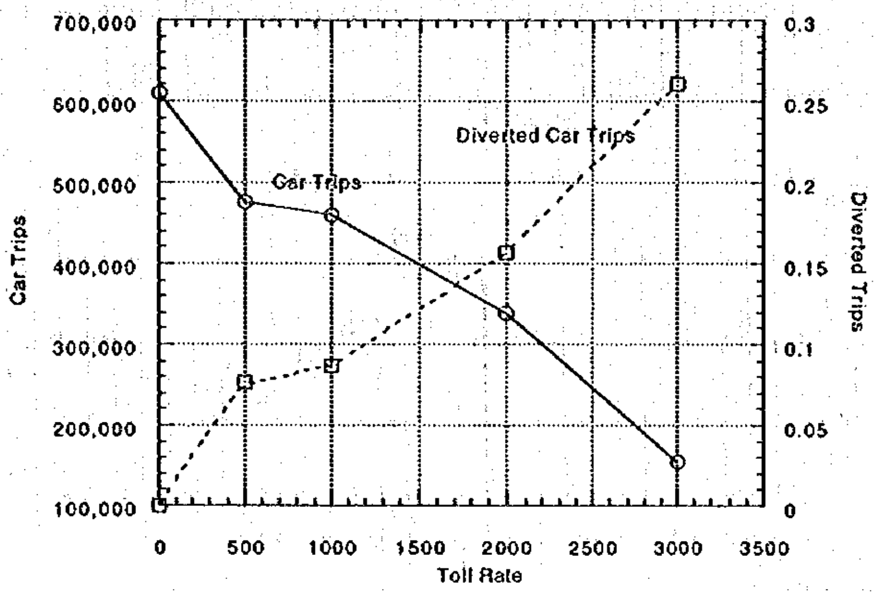


Figure 16.4-6 Relation between Parking Charge, Car Trip and Diverted Car Trips

16.4.6 Car Use Tax (B-6)

(1) Method

Vehicle use is restrained through user taxes imposed on fuel, tires, spare parts, etc., thus adding to the operating cost in relation to the distance traveled. Fuel taxes are an effective means of alleviating traffic congestion by shifting to public mode through increasing of operating costs, and generating revenue for transport improvements.

In European countries, the fuel taxes have been introduced as an environment tax which is a mean of conservation and alleviating global warming due to fossil fuels consumption.

In many debates on raising the gasoline tax, opponents often claim that a gasoline tax increase will have a serious economic impact on a region's or state's economy. This impact is described in terms of jobs lost and reduced economic competitiveness.

(2) Cities/Countries where Implemented

Seoul (Korea), Finland, Netherlands, Sweden, Norway

(3) Application in Bogota

Fuel tax should be raised high enough to discourage car owners to use a car, and to raise funds to develop mass transit facilities.

Table 16.4-3 Gasoline Consumption Tax in Bogota

Fuel Type	As of June, 1996	
	$ / gallon	Tax Rate(%)
Regular Gasoline	1,028	13
Super Gasoline	1,375	13
Diesel	1,028	13

(4) Case Study in Bogota

In the case study, the alleviation of road congestion by applying the fuel tax in Bogota was examined. Table 16.4-4 and Figure 16.4-7 show the examination of a surtax on gasoline in a range from 20% to 60%, in contrast to 13% at present. As can be seen, car trips decrease as a result of an increase in the surtax rates. For instance, if a tax rate of 20% is charged on gasoline, 3 % of car trips in the whole Study Area divert from the car mode to public mode (see Figure 16.4-8). At the same time, the revenue of the rates will be approximately 590 billion pesos during 25 years.

Fuel taxes are an effective means of generating revenue for transport improvements. The reliability of the revenue stream makes them attractive as a basis for issuing bonds which provide financing for construction projects. In Bogota, the tax rate at present is as low as 13%, in contrast to 38% for U.S.A., 200% for U.K, 206% for Germany and 87% for Japan.

Table 16.4-4 Measure of TDM for Car User Tax (Fuel Tax)

1) Gasoline Tax Rate	(%)	13	20	30	40	50	60
2) Gasoline Price	Peso/gallon	1028	1,092	1,183	1,274	1,365	1,456
3) Tax Revenue	Million Peso/day	0.0	133	322	512	702	891
(No-diverted Car)	Million Peso/year	0.0	48,471	117,677	186,884	256,091	325,297
	Million Peso/25year	0.0	605,886	1,470,968	2,336,051	3,201,133	4,066,216
4) Tax Revenue	Million Peso/day	0.0	129	311	492	671	848
(Diverted Car)	Million Peso/year	0.0	46,996	113,647	179,682	244,995	309,459
	Million Peso/25year	0.0	587,448	1,420,584	2,246,031	3,062,433	3,868,238
5) Car Trips (PCU)	PCU/day	3,094,858	3,000,687	2,988,860	2,975,607	2,960,772	2,944,184
6) Diverted Car Trips	PCU/day	0	94,181	106,008	119,261	134,096	150,684
7) Before Total PCU (Car+Bus)	PCU/day	3,621,369	3,621,369	3,621,369	3,621,369	3,621,369	3,621,369
8) After Total PCU (Car+Bus)	PCU/day	3,621,369	3,534,529	3,523,624	3,511,404	3,497,725	3,482,430
9) After/Before		1.000	0.976	0.973	0.970	0.966	0.962
10) Decrease Ratio of Car Trips		1.000	0.970	0.966	0.961	0.957	0.951

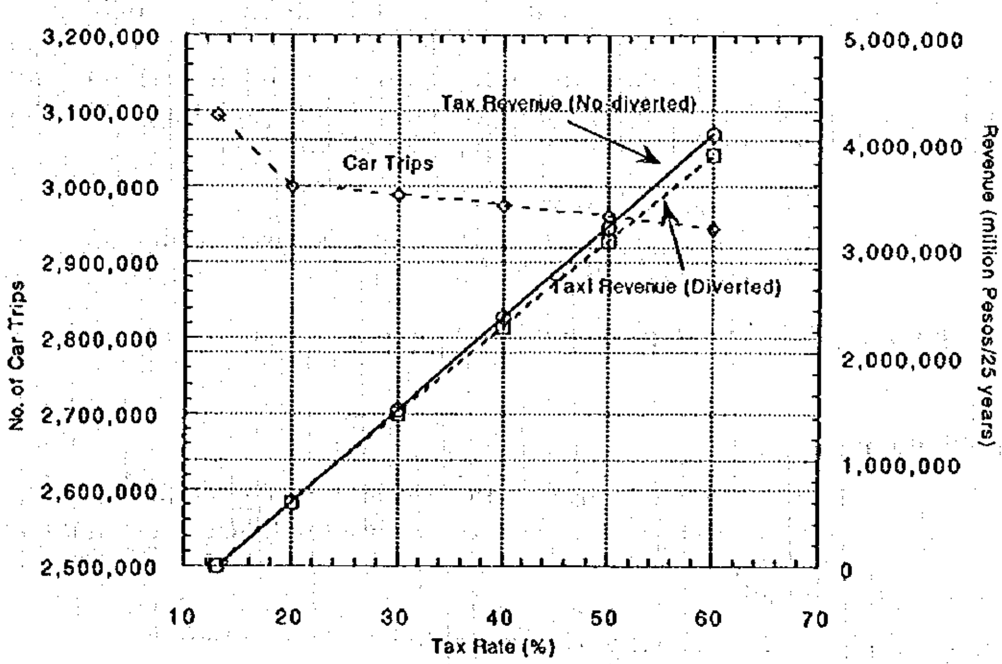


Figure 16.4-7 Relation between Tax Rate, Revenue and Diverted Car Trips

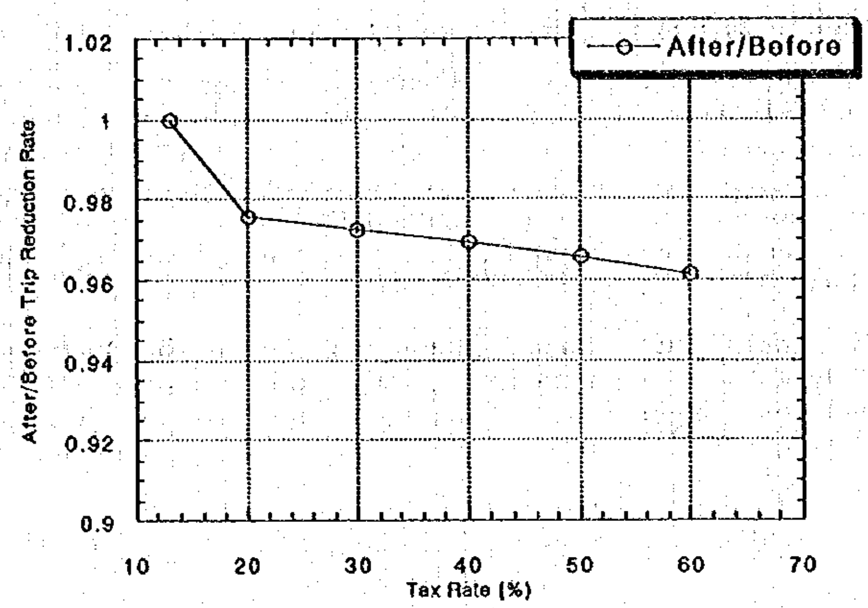


Figure 16.4-8 Relation between Tax Rate and Trip Reduction Rate

16.5 Alleviating Peak-time Demand

16.5.1 Staggered Working Time (C-1)

(1) Method

Commuting traffic demand can be diversified evenly between 7:00 - 10:00 A.M. by assigning starting times of work according to business category. Spreading the demand for travel over a wider band of time through "alternative work hours" programs is another demand management technique. By spreading demand, an existing bus fleet and road network can serve more commuters with smaller additional investment in peak capacity. There are three methods of spreading commuter travel demand: staggered hours, flex-time and a compressed work week.

The main benefit of staggered work hours is the relief of traffic congestion. By adopting earlier or later hours than near-by companies, a company allows its employees to avoid the worst periods of traffic congestion and transit crowding.

(2) Cities/Countries where Implemented

No data available.

(3) Application in Bogota

Maximum effect to be obtained through this system can be estimated theoretically. However, it seems to have less feasibility as a practical implementation in Bogota.

(4) Case Study in Bogota

In the case study, based on hourly trip distribution by arrival time in the entire Study Area and the centro area referred to in the PT survey data, the effectiveness of alternative work hours is examined.

Figure 16.5-1 and Figure 16.5-2 show hourly trip distribution by arrival time of trip destination according to trip purposes and trip modes, respectively. In those figures, the upper side shows the distribution in the whole Study area, and the lower is for the central business area. The peak hour trip rate all day in the central area is approximately 20% between 7:00 a.m. and 8:00 a.m., while the whole Study Area is recorded at 13% in the same period. As for the "to work" purpose, approximately 12 % of all trips in the central area are concentrated in the peak hour, in contrast to 7 % in the whole area.

As for trip mode, approximately 9.6% of all modes (in PCU) arrive by car between 7:00 a.m. and 8:00 a.m. within the central area, while 5.1 % applies to the whole Study Area. In the morning peak hour, the car traffic volume ratio in PCU is remarkably higher. If the car volume ratio can be reduced by the measure of the Staggered Working Time, traffic congestion within the central area will be alleviated. For instance, by the Staggered Working Time the car trip ratio will be reduced by half of the present ratio in the central area, and the trips in the area will fall to 75% in the morning peak hour.

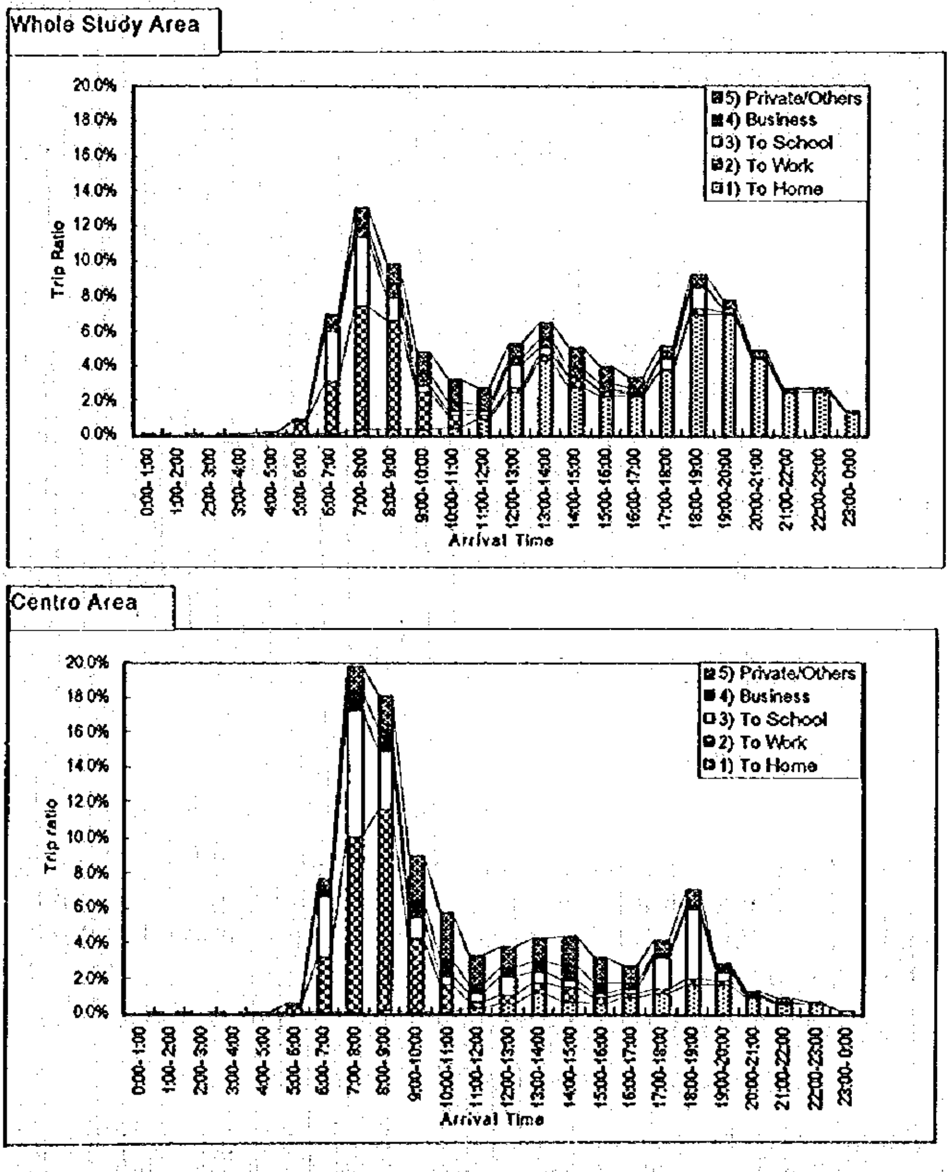
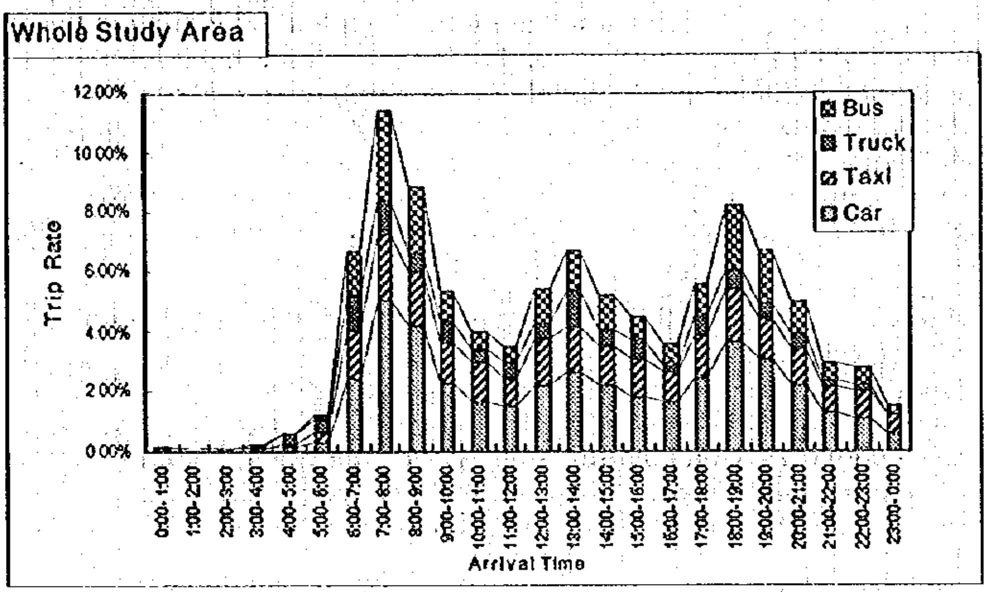


Figure 16.5-1 Hourly Trip Distribution by Arrival Time According to Trip Purposes



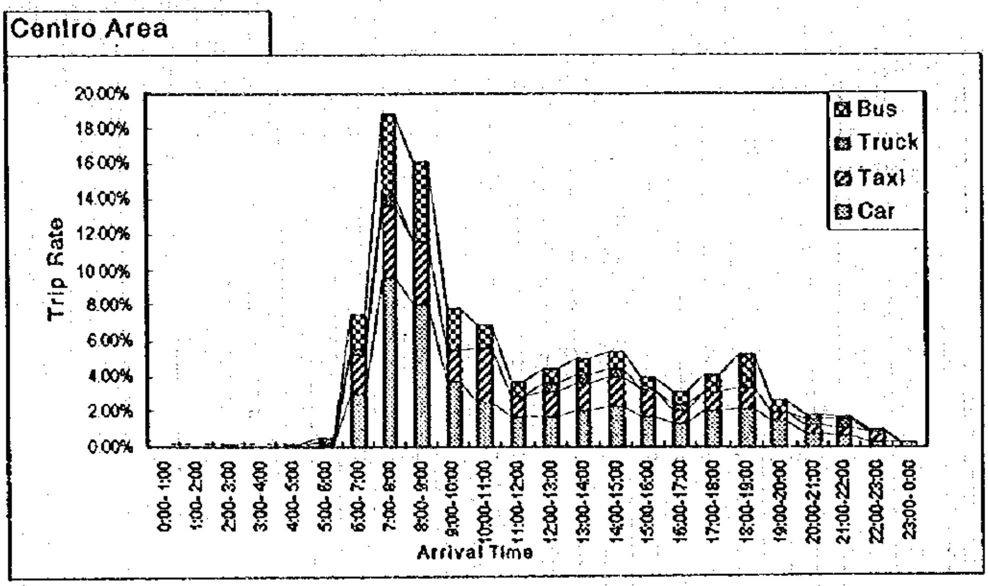


Figure 16.5-2 Hourly Trip Distribution by Arrival Time According to Trip Modes

16.5.2 Flex-time System (C-2)

(1) Method

Working time is flexible. One can start to work anytime at his work place as long as he works for specified hours and keeps the core time. Flex-time works well for office workers who work independently and can exercise a certain amount of discretion over the scheduling of their work.

(2) Cities/Countries where Implemented

Partly applied in some business sectors in many countries.

(3) Application in Bogota

This system is considered effective to diversify commuting time and decrease peak-time traffic demand. However, the applicable business sector will be limited.

16.6 Case Study for Application of Car Use Tax and Road Pricing

In the above-sections, each measure of TDM was examined to evaluate the effect of the measures in terms of diversion of car trips to public transport and tax revenue generated. In this section, the traffic assignment was conducted according to the 2020 year's OD table, with TDM, and on the 2020 year Master Plan network, to ascertain the effectiveness of TDM.

The 2020 year's OD table was used in considering the measures of both the gasoline tax as a Car User Tax and Area Licensing as Road Pricing. 50% gasoline tax and 1,000 and 2,000 pesos of toll rate are applied in this case study. Table 16.6-1 shows their effects in terms of travel speed and the congestion length ratio of the total (travel speed 10 km/h or less). The congestion length is represented in PCU-km and Person-km. Four assignment cases which are composed of the 2020 OD table with TDM and 2010 and 2020 networks were conducted.

As can be seen, the travel speeds in case 6 (toll rate 2000 pesos) and in case 4 (1,000 pesos) raise the speed to an average 21.4 km/h and 20.5 km/h, respectively, in contrast to 20.0 km/h in case 2 without TDM. In case 6, travel speed rises by 7% of case 2. The congestion length in PCU-km is reduced by 73% and 88% of that in case 2.

It seems that the application of Area Licensing with Gasoline tax will be effective in case of toll rate of $2,000 pesos.

Table 16.6-1 Effectiveness of TDM (Area Licensing and Gasoline Tax)

	OD table (Year)	Network (Year)	Gasoline Tax (%)	Toll Rate ($pesos)	Travel Speed (km/h)	Travel Speed 10 km/h or less PCU-Km (Ratio to Total)	Person-Km (Ratio to Total)
Case-1	2010	2010		-	28.0	5.54%	6.97%
Case-2	2020	2020		-	20.0	14.14%	12.15%
Case-3	2020	2010	50%	1,000	11.0	38.45%	36.12%
Case-4	2020	2020	50%	1,000	20.5	12.46%	10.87%
Case-5	2020	2010	50%	2,000	11.6	35.00%	32.83%
Case-6	2020	2020	50%	2,000	21.4	10.87%	9.76%
Case-3/Case-1		2010	50%	1,000	0.39	6.94	5.18
Case-5/Case-1		2010	50%	2,000	0.41	6.32	4.71
Case-4/Case-2		2020	50%	1,000	1.03	0.88	0.89
Case-6/Case-2		2020	50%	2,000	1.07	0.77	0.80

16.7 Summary of TDM

It is difficult to recommend measures pertinent to Bogota among so many measures, based on the preceding multiple examination. In each section, problems and effects of each measure introduced were estimated and stated. It is necessary to conduct further study for the introduction of the measures in Bogota. Summaries by section are shown in Figure 16.7-1.

As can be seen, the application of measures at the same time will be difficult. Especially, the municipal government of Bogota has no jurisdiction over the car purchase tax. Road Pricing, Parking Control and Fuel Tax are governed by the municipality. Road Pricing and Parking Control in the same area will be not acceptable by car users. The most acceptable measures are a combination of Fuel tax, Road Pricing and Parking Control (applied to different areas in the Road Pricing area). Table 16.7-1 shows the summary of Tax Revenue which totals approximately 9,300 billion pesos for 25 years. The amount will be close to the total cost of the Master Plan Projects. The funds generated by such tax revenue must be spent for transport purposes.

Table 16.7-1 Summary of Tax Revenue of TDM

Items	Tax Rate / Toll Rate	Tax Revenue Million Peso for 25 years	Car Trip Decrease Ratio	Remark
Purchase Tax	50%	5,459,894	0.986	Whole Area
Fuel Tax	20%	587,448	0.970	Whole Area
Area Licensing	2000 pesos	2,754,423	0.554	Central Area
Parking Control	1000 pesos	482,985	0.914	Central Area
Total		9,284,750		

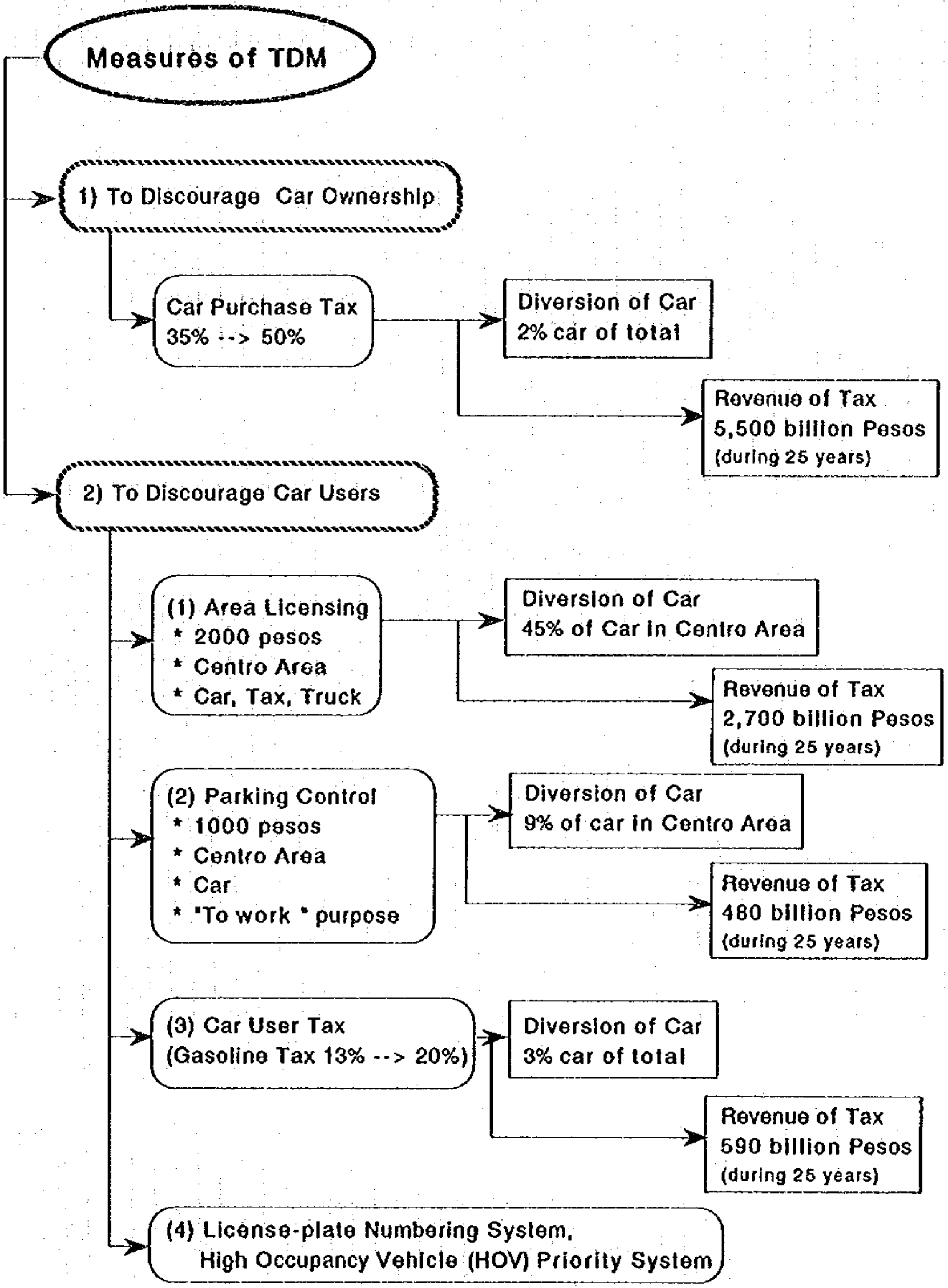


Figure 16.7-1 Traffic and Financial Impact by TDM