NEW HOUSING DEVELOPMENTS AND MOBILITY PROBLEMS IN JAKARTA METROPOLITAN AREA

Djoko **SASONO**
Graduate Student
Urban Transport Planning Laboratory
Dept of Urban Engineering, Univ. of Tokyo
7-3-1 Hongo, Bunkyo-ku, Tokyo 113, JAPAN
Phone: (03) 5841-6254; Fax: (03) 5841-8527
E-mail: djokosas@ut.t.u-tokyo.ac.jp

Yasunori **MUROMACHI**
Associate Professor
Urban Transport Planning Laboratory
Dept of Urban Engineering, Univ. of Tokyo
7-3-1 Hongo, Bunkyo-ku, Tokyo 113, JAPAN

Noboru **HARATA**
Professor
Urban Transport Planning Laboratory
Dept of Urban Engineering, Univ. of Tokyo
7-3-1 Hongo, Bunkyo-ku, Tokyo 113, JAPAN

Katsutoshi **OHTA**
Professor
Urban Transport Planning Laboratory
Dept of Urban Engineering, Univ. of Tokyo
7-3-1 Hongo, Bunkyo-ku, Tokyo 113, JAPAN

Abstract: Urban development within Jakarta Metropolitan Area (JMA) has created inefficient and undesirable patterns. Sprawled housing areas dominate new urban areas with poor supports of transport system developments, particularly lack of public transport services. On one side, it inevitably causes the acceleration of widely car-oriented communities, and on the other side it deepens mobility problem to public transport dependants. The aim of the research is to investigate the effects of current policies of new housing developments on the increased car oriented communities. This paper presents the result of a household interview survey covering socio-economic characteristics and travel patterns, and then to analyze mode choice for work trips via employing behavioral model, and also to discuss an issue on mobility.

Keywords: Transportation, housing development, travel patterns, mode choice

1 INTRODUCTION: What is the Problem?

Jakarta Metropolitan Area (JMA) begins as a strong centre of national scale socio-economic activities since some decades ago. Huge concentration of activities changed Jakarta to be an attracting magnet and absorbs new migrants from all over Indonesia and in turn abrupt urbanization is unavoidable that then drives spilled-over development to regions surrounding Jakarta. Built-up area expands and performs a conurbation that mainly is dominated by new housing developments and puts JMA as fast growing urban areas. The pattern of housing developments in JMA is not efficient and undesirable. It creates sprawl development without sufficient supports of transport system and eventually accelerates increased car oriented communities in one side and in the other side creates limited mobility to public transport-only dependants, as sufficient connecting services are unavailable to them.

This paper consists of 6 sections. It starts on introduction and is followed by section two describing general figures of the study area as the background for understanding the context. Section three explores the results of data collection via a household interview survey. Section 4 analyses mode choice model for work trips of main workers. The last two sections focus on discussions and end up on conclusions.

2 GENERAL FIGURES OF STUDY AREA

2.1 Characteristics of JABOTABEK

Jakarta Metropolitan Area (JMA), called JABOTABEK, is situated within three provinces and consists of the Jakarta Special Province and BOTABEK (Bogor and Bekasi regions in West Java Province and Tangerang region in Banten Province). JABOTABEK covers an area of 6,864 square kilometres where Jakarta only occupies about 665 square kilometres while Bogor, Tangerang, and Bekasi occupy about 3,433 square kilometres, 1,282 square kilometres, and 1,484 square kilometres respectively.

JABOTABEK's population increased rapidly as the result of abrupt urbanization with the growth rate higher than national level. Following demographic changes, the built-up area expands beyond Jakarta boundaries and creates a conurbation with surrounding sub centres such as Bekasi, Tangerang and Depok, particularly along toll roads and rail network. The conurbation continuously widens by filling up of Jakarta in terms of population density and low price land availability in fringes in which attract new housing development to BOTABEK. Although fringes develop as housing areas, low-income group tends to stay in Jakarta in order to avoid high commuting cost.

Transport system development to new developing sites is poor and it is recognized by lack of a coherent hierarchy on road network. The existing road system throughout most urbanized JABOTABEK has evolved from dirt tracks and paths of former agricultural uses (JICA, 2000). The new major routes within this network have been swamped by ribbon development. The main lines of demand are facilitated by roads with poor alignments of various width' dimensions, indifferent construction as well as frontage access. JICA study also identifies the prominent characteristics of the urbanization in JABOTABEK into three zones (see Figure 1):

a. **High density area (zone up to 20 km from the centre of Jakarta).** Many poor people who cannot afford to commute stay in this zone because they cannot afford the cost of commuting. They live no choice in slum areas and squatters close to their workplaces.

b. **Medium density area (zone between 10 and 30 km).** This zone is the fronts of continuous urban expansion of Jakarta's built-up areas featuring individual housing and small-scale real estates sprawled with the low quality urban infrastructure.

c. **New urban development area (zone between 20 and 50 km).** This area is characterized by real estate development sprawl, or scattered land development with a rush of development permits issued.

2.2 Population and Migration

Population of JABOTABEK increases rapidly since 1960s as the results of abrupt urbanization to this area due to high concentration of activities such as trade, finance, commerce, and industries as seen on Table 1. During the late 1960s up to the mid 1970s the migration pattern was dominated by in-migration to Jakarta from all over Indonesia, mainly from Java and Sumatra as depicted on Figure 2. From the mid 1970s, the pattern changes and the main stream of urbanization shifts from Jakarta to BOTABEK leading to an even more distinct increase of population in BOTABEK. The growth rate of Jakarta's population turns

down and otherwise growth rate of BOTABEK significantly increases. Commuting between Jakarta and BOTABEK increasingly appears of which are Jakarta-oriented working trips.

Table 1: Population and Growths in JABOTABEK

AREA	POPULATION (Mil. People)						ANNUAL GROWTH (%)				
	1961	1971	1980	1990	1995	1997	'61-'71	'71-'80	'80-'90	'90-'95	'95-'97
JAKARTA	2.9	4.6	6.5	8.3	9.1	9.8	4.64	3.97	2.41	2.15	2.01
BOTABEK	3.0	3.8	5.4	8.9	11.1	13.8	2.33	4.13	5.07	4.94	12.16
JABOTABEK	5.9	8.4	11.9	17.2	20.2	23.6	3.53	4.05	3.7	3.49	8.42

Source: Soegijoko, 1996; Statistics of Indonesia 1997, 1998; and Statistics of West Java 1997, 1998

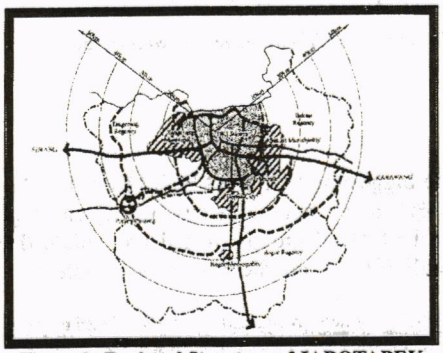

Figure 1: Regional Structure of JABOTABEK
Source: JICA, 2000

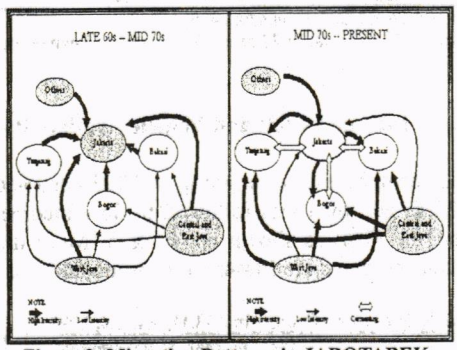

Figure 2: Migration Patterns in JABOTABEK
Source: URDI, 1996

2.3 Transport Condition: vehicles, road development and public transport

Motorised vehicles and roads grew imbalanced. The vehicles increased far above the growth of road length as seen on Tables 2 and 3. Within 5 years, vehicles increased about double of 1990's stands and could not be balanced by road. In Jakarta itself in 1995, road only occupies less than 6% of total area that is far from ideal situation. Motorcycles occupied about a half of vehicles and play an important role as transport mode due to some reasons such as flexible in highly trafficked/congested roads, longer distance between homes and workplaces (as the result of the shift in housing locations), cheaper operating cost than car and even public transport (Sasono *et al*, 2000). Public transport in JABOTABEK is dominated by bus, because rail fails to be the backbone of urban transport due to limited network. The gap of services between regular bus and rail is served mostly by 9-passenger mini bus and play an important role in peripheries of Jakarta where most areas are untouched by other modes (Sasono *et al*, 2000). Although public transport vehicles showed a significant increase (see Table 4), but in total, its capacity still needed an increase by 12% to 19% (or 1,515 regular buses) in order to cope with 1995's demand (MOC, 1996).

Table 2: Motorized Vehicles in JABOTABEK (units)

Category	1990	1995	Av. Growth (%)
Motorcycles	804,186	1,540,825	14.63
Passenger Cars	485,844	849,939	12.02
Goods Vehicles	189,980	320,246	11.36
Buses	169,027	310,128	13.20
TOTAL	1,649,037	3,021,138	13.32

Source: Statistics of Jakarta 1995, 1996 and Jakarta Metropolitan Police, 1996 (Military and diplomatic vehicles were excluded)

Table 3: Road Development in Jakarta (Km)

Category	1990	1995	(1)	(2)	(3)
Pri. Artery	240.16	275.52	2.94	4.55	0.69
Sec. Artery	1,074.91	1,204.66	2.32	13.56	2.05
Local	4,130.20	4,503.13	1.76	19.59	2.96
TOTAL	5,445.27	5,983.31	1.91	37.7	5.7

Source: Statistics of Jakarta 1995, 1996 and MOC, 1996
Note: (1): Average Growth (%); (2): sq km in 1995; (3): % of total land area in 1995

Table 4: Public Transport in JABOTABEK

Category	1990	1995	Av. Growth (%)	1990	1995	Av. Growth (%)
Number of (vehicles)				**Daily Passengers (People)**		
Regular Buses[1]	2,658	6,545	22.63	1,850,640	2,798,883	10.90
Medium Buses[2]	4,350	4,859	2.29	1,470,562	1,348,359	-1.84
Mini Buses[3]	8,751	9,722	2.16	826,815	1,516,176	16.40
Taxis	15,366	17,421	2.78	550,000	863,503	12.34
Bemo[4]	1,080	1,096	0.30	135,000	172,295	6.54
Bajay/Toyoko[5]	14,612	15,112	0.68	325,000	419,163	6.79
TOTAL	46,817	54,755	3.21	5,158,017	7,118,379	8.42
Rail:						
No. of Lines	7	7	0.00	63,574	232,404	38.89
Total Length (km)	188.4	188.4	0.00			

Source: Statistics of Jakarta 1995, 1996
Note: 1) 45 seats; 2) 22 seats; 3) 9 seats; 4) 3-wheel vehicle with route; 5) 3-wheel vehicle without route

2.4 Income Levels and Vehicle Availability

Lower middle-income group in 1995 occupied the biggest portion of JABOTABEK families (37%) and then was followed by low income (34%), upper middle income (22%) and high income (7%) as shown on Table 5. More than a half of all groups owned no vehicle that occurred mostly in low-income group and over a half of lower middle income (see Table 6).

Table 5: Income Groups in JABOTABEK, 1995

Income Group	% of Total HH	Income Band (Rp.000)
Low (L)	34	< 350
Lower Middle (LM)	37	350 – 1,500
Upper Middle (UM)	22	1,500 – 3,500
High (H)	7	> 3,500

Source: Government of DKI Jakarta, 1996
Note: US$ 1 = Rp. 2,100 (1995)

Table 6: Vehicle Availability in JABOTABEK, 1995

Vehicle Availability	% of Income Group				Total
	L	LM	UM	H	
No vehicle available	81	55	25	10	54.09
1 or more m/cycles, no cars	17	33	23	5	23.40
1 or more cars, no m/cycles	2	9	38	65	16.92
1 or more cars and m/cycles	0	3	14	20	5.59

Source: Government of DKI Jakarta, 1996

2.5 Financial supply for transport system development

Transport system development in JABOTABEK faces difficult financial source. As an example, during 1991-1995, transportation contributed nearly 40% of total revenue of Jakarta, but its allocation was less than 20% of total expenditure in 1991 and even much lesser in 1995 as seen on Table 7. While investment in other infrastructures such as rail and highway that requires tremendous financial sources, is mainly financed by central government.

2.6 Housing Development

2.6.1 Trends of development

The first experience in large-scale housing developments in JABOTABEK began in 1949 when the first new town called Kebayoran Baru was built in Jakarta for 30,000 inhabitants. It then started again in the early 1980s in order to cope with the high demand of housing, especially the spill-over of Jakarta, and intended to avoid unintegrated development and inefficient use of land caused by small-scale housing developments before 1980s. In 1989, the total cumulative houses built by private nationwide were over 400 thousand units where nearly a half was built within JABOTABEK. While in 1997, the cumulative number became

more than 1 million units throughout the country and JABOTABEK shared more than a third where mostly was built within BOTABEK as seen on Table 8. There are recently more than 33 new town-sized housing complexes appearing within BOTABEK with areas of 500 to 33,000 hectares each and with the distances less than 60 kilometers from Jakarta (Sasono *et al*, 2000). Meanwhile due to very expensive and shortage land, the trend of housing developments in Jakarta changed to high-rise buildings as apartments or condominiums equipped with modern facilities for middle and high income groups.

Table 7: Revenue and Expenditure of Transport in Jakarta (US$ Million)

REVENUE	1991	1995	Av. Growth (%)
Regional Taxes	181.9	434.7	24.81
Regional Rev.	5.7	14.4	26.83
Transport Dev't Loan	21.0	32.9	22.80
Total	208.6	482.0	23.69
% of Total Rev.	36.7	38.9	1.53

EXPENDITURE	1991	1995	Av. Growth (%)
Routine	23.1	45.3	18.59
Transport Dev't	80.7	96.2	4.77
Total	103.8	141.5	8.32
% of Total Exp.	18.3	11.4	-10.93

Source: MOC, 1996 Note: US$ 1 = Rp. 2100

Table 8: Cumulative Realization of Housing Development by Private in JABOTABEK, 1987-1997

REGION	1989	1990	1991	1992	1993	1994	1995	1996	1997
JAKARTA	13,767	13,914	13,915	13,915	13,987	13,987	15,195	15,310	15,315
BOTABEK	173,915	201,815	226,165	240,469	245,856	247,022	306,722	341,754	364,463
JABOTABEK	187,682	215,729	240,080	254,384	259,843	261,009	321,917	357,064	379,778
TOTAL INDONESIA	429,267 (651,957)	477,341 (710,436)	515,618 (756,674)	544,206 (801,587)	561,125 (837,707)	636,447 (944,949)	796,594 (1,149,523)	940,534 (1,341,038)	1,046,112 (1,492,689)

Source: *Statistik Pembangunan Perumahan* Indonesia 1989-1997, 1998
Note: ( ) Houses built by private developers and state owned housing enterprise.

2.6.2 Accessibility to new developments

Most of new housing areas in JABOTABEK have poor public transport services, and even within Jakarta. An example, a half of 28 advertised new developments within Jakarta was unlikely well-served by public transport since they have no through route for buses (see Table 9). Further, based on walking distance standard of the World Bank for densely urban areas of the maximum of 500 meters to a bus stop, most new housing areas in Jakarta are well away from a bus route and this figure is much even worse in BOTABEK (MOC, 1996). The study by MOC (1996) further discovers that the level of public transport services to new residential areas is poor due to a reluctance of developers to provide through roads, to provide bus services at a loss in the early phases of occupation, and to permit bus services to serve high income areas. There is also a problem of lack of co-ordination in licensing procedures by traffic/transport authorities involved.

Table 9: Accessibility of Some New Housing Complexes in Jakarta

Distance to Bus Route	< 1.5 km	1.5 to 2.5 km	2.5 to 3.5 km	> 3.5 km
Number of Development	13	12	2	1
No. in which a Through Route is available	5	7	1	1

Source: MOC, 1996

2.6.3 Traffic condition and car traffic through tollgates in adjacent of new housing areas

There is no thorough study conducted in JABOTABEK before to investigate the effects of new development on transport (Sasono *et al*, 2000). There was a survey undertaken in 1995

by Jakarta Traffic and Transport Office (DLLAJ) to measure the average traffic speed on selected routes during morning peak hours. The results revealed that some roads connecting to new housing areas were experienced with slow traffic with average speed in a range of 15 km/hour (MOC, 1996). Other surveys done by DLLAJ in 1993 and JUTSI study in 1995 to investigate traffic composition at 6 cordons connecting the centre of Jakarta to fringes revealed that in 1993 private vehicles dominated the traffic by more than 75% and in 1995 nearly 90% in average. The percentage of 4-wheel passenger cars in average was nearly 55% in 1993 and 51.4% in 1995, and both followed by motorcycles by more than 40%. In heavily trafficked cordons, motorcycle dominated the traffic by over 60%.

From 1990 to 1999, the car traffic from and to new housing complexes continuously rose as recorded at tollgates near new housing areas (see Figure 3). The increase was considerably high, particularly during 1990 to 1995. This indicates that car oriented communities are apparently increasing since the penetration of public transport services to these areas is poor.

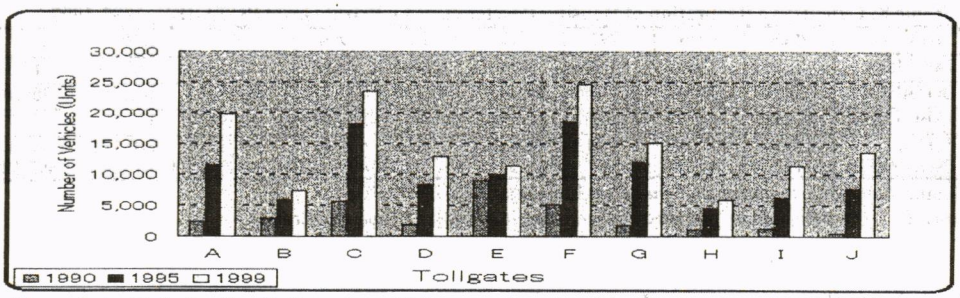

Figure 3: Av. Daily Car Traffic Recorded at Tollgates Adjacent to New Housing Areas in May 1990-1999
Source: *Jasa Marga* Annual Report 1990-1999, 2000
Note: A (Cibubur); B (Cibinong); C (Tangerang); D (Karawaci); E (Tangerang Barat); F (Bekasi Barat); G (Bekasi Timur); H (Bintara); I (Cibitung); J (Cikarang)

2.6.4 Planning requirements

There are some regulations dealing with (large-scale) housing developments issued by some government bodies, but there is no clear rule of thumb of mobility considerations for new site developments, especially dealing with new sites with access to public transport more than walking distance. One of the regulations governs the composition of house types only (Interior Minister Decision No. 1 Year 1987), while another one regulates the ingredients of a housing complex as stated in Planning Guidance for Urban Housing Development (MPW, 1987). The newest regulation is Government Regulation No. 80 Year 1999 regarding *Kawasan Siap Bangun* (KASIBA: Ready-Built Area) and *Lingkungan Siap Bangun* (LISIBA: Ready-Built Site) that applies a maximum area built by developers and its provison of primary and secondary facilities and amenities. Again, mobility aspects are not stated and specified clearly in this regulation.

3 WHAT SURVEY RESULTS SAY

3.1 Samples and locations

Data were collected via a household interview survey in July 2000 at 455 sampled households in 74 selected housing estates within 34 clusters throughout BOTABEK. The samples consist

of 1,785 individuals (about 4 people/HH in average). About 80% of individuals (1,424 people) travel regularly (3 travellers per family in average). All locations were situated within the distances of 14 kilometres to 31 kilometres from the centre of Jakarta (see Figure 4). Most locations have poor access of public transport. More than 95% of locations are more than 500 meters away of regular bus services (45-seat bus) and nearly 60% are more than 500 meters away of mini bus routes (9-seat bus) as seen on Figure 4. The gap between locations to public transport mostly is served by either *ojek* (motorcycle taxi) or *becak*.(3-wheel man-powered rickshaw).

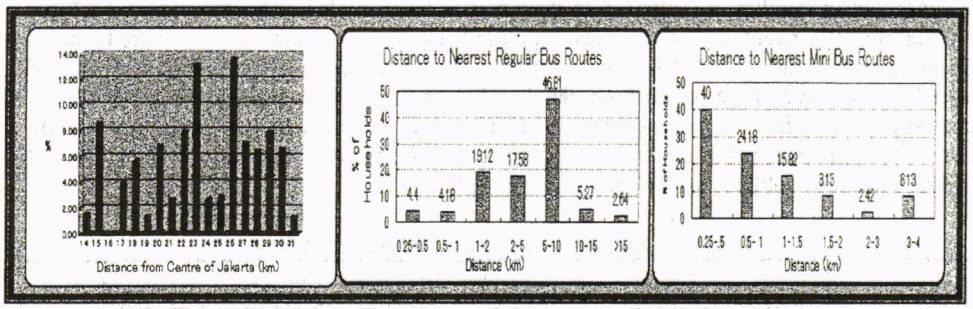

Figure 4: Sample, Location and Distance to Public Transport
Source: HI Survey, 2000

3.3 Family Characteristics: size, income level, vehicle availability, and number of workers

Families with 3, 4 and 5 members together occupy 83.07% while the rest are families with members of 1, 2, 6, 7, 8 and 9 (see Figure 5). Based on family income, 59.12% of families are lower middle income, and is followed by upper middle income (38.24%) and high income (2.64%) as shown on Figure 5. An interesting point noted here is lower income is not caught by the survey. A reason that could be raised up is as expressed by JICA (2000) that is although fringes dominantly developed as housing areas, the low-income group tends to stay in Jakarta in order to avoid high commuting cost.

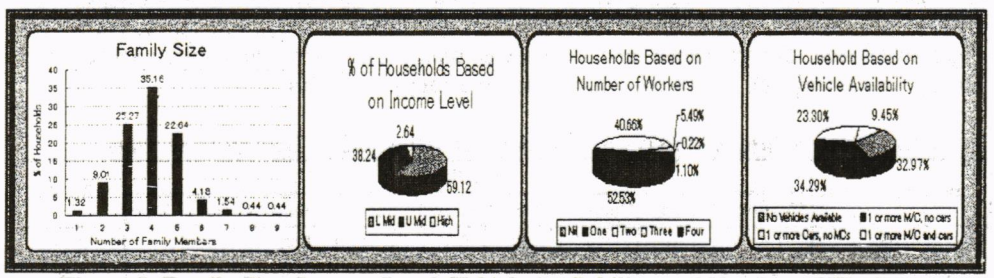

Figure 5: Family Size, Income Level, Vehicle Availability, and Number of Workers
Source: HI Survey, 2000

Families with one worker are dominant (more than a half) as seen on Figure 5. This indicates, within these families, most heads of family are the earning persons. The families with two workers are also dominant at about 41%. Families with workers of three and four share 5.49% and 0.22% respectively; while the rest is families with no worker (1.10%). Nearly one third of

families have no vehicle (32.97%) where mostly is lower middle income, while families with one motorcycle account for 34.29% which mostly are lower middle income. Families with one or more cars no motorcycle occupy 23.30% (mostly upper middle income); and families with one or more cars and motorcycles position at 9.45% (mostly high income).

3.4 Opinions on Locations and Public Transport Services

In general most families are satisfied on their houses based on the attributes as seen on Table 10. Significant percentages of families expressed the dissatisfaction dealing with facilities (20.44%), orientation (13.64%), road network (24.18%), and access to public transport (19.12%). According to the orientation, the dissatisfaction mostly is because the location is far from anywhere. While for road network, the complaint is addressed to narrow and not straight roads. The disappointment on access to public transport mostly is due to limited modes and services, far from public transport, and taking *ojek* first.

Table 10: Satisfaction Levels on Locations (%)

Satisfaction Level	Conditions							Total
	Price	Type	Environment	Facilities	Orientation	Road Network	Access to PT	
Very Satisfied	3.96	2.64	5.05	0.88	1.54	1.76	2.64	2.63
Satisfied	37.58	38.90	45.27	24.40	29.45	27.69	35.60	34.02
Average	53.63	53.63	42.20	54.29	55.38	48.57	42.64	49.89
Unsatisfied	4.62	4.62	7.25	19.56	13.19	21.54	18.46	12.71
Very Unsatisfied	0.22	0.22	0.22	0.88	0.44	2.64	0.66	0.75
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Source: HI Survey, 2000

Private transport users (car users and motorcyclists) who have experience taking public transport mostly testify that public transport is not a promising, encouraging and convincing mode for travel based on all angles of service quality as figured on Table 11. These circumstances make them to stay away from taking public transport. The discouragement is mostly dedicated to inflexible (frequent changes and not straight forward), unsafe (aggressive drivers, old vehicles, and criminal matters), discomfort (hot, smelly, and dirty), crowded, aggressive speed, low frequency and long travel time (traffic jam, unreliable, unnecessary waiting for passengers). On the other hand, most are happy to the fare.

Table 11: Opinions of Private Transport Users on Public Transport Services

Satisfaction Levels	Conditions								Total
	Flexibility	Safety	Comfort	Fare	Crowd	Speed	Frequency	Travel Time	
Very Satisfied	1.61	1.61	1.29	0.32	0.32	0.64	0.96	0.64	0.92
Satisfied	19.94	13.18	7.40	10.93	4.82	7.07	15.43	8.68	10.93
Average	56.27	49.20	45.34	78.46	44.37	56.27	56.59	52.73	54.90
Unsatisfied	21.22	32.48	42.44	9.97	47.91	34.73	25.40	36.66	31.35
Very Unsatisfied	0.96	3.54	3.54	0.32	2.57	1.29	1.61	1.29	1.89
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Source: HI Survey, 2000

Public transport users show the similar situation to their counterpart, private transport users. Some show disappointments of public transport services particularly dealing with low

frequency, unscheduled, unsafe, too crowded, long travel time, aggressive speed, as well as severe effect of traffic jam (see Table 12). Only fare, route coverage and mode choices make them a little bit satisfied.

Table 12: Opinions of Public Transport Users on Public Transport Services

Satisfaction Levels	Conditions										Total
	Fare	Route	Freq.	Sched	Safety	Crowd	Travel Time	Speed	Mode Choice	Traffic Jam	
Very Satisfied	0.88	0.66	1.54	0.44	1.32	0.22	0.22	1.10	1.10	0.22	0.77
Satisfied	15.38	22.42	23.08	16.48	15.16	5.71	12.97	10.99	23.74	3.74	14.97
Average	74.73	66.15	49.45	62.64	48.35	49.23	56.26	62.20	58.90	49.89	57.78
Unsatisfied	8.79	10.55	24.40	20.22	34.29	42.86	30.11	25.05	16.04	39.78	25.21
Very Unsatisfied	0.22	0.22	1.54	0.22	0.88	1.98	0.44	0.66	0.22	6.37	1.27
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Source: HI Survey, 2000

3.5 Characteristics of Travellers

3.5.1 Socio-economic characteristics: age, education and occupation

Most travellers are in ages of 13-20 (24.09%) and 31-40 (21.21%) as shown on Figure 6. Travellers with ages of 4-12, 41-50, 21-30, and >50 occupy 17.77%, 17.35%, 16.43% and 3.16% respectively. Based on education backgrounds, most travellers have a good background of university or college (35.04%) and are followed by high school (33.92%), elementary school (18.12%) and junior high school (12.92%). The biggest percentage of travellers' occupation is student (43.89%), while private employee takes the second by 23.81%. The following positions are civil servant (14.04%), self-owned business (7.72%) and housewives (7.16%). The rest is occupied together by retired, unemployed and armed forces/police 3.38%.

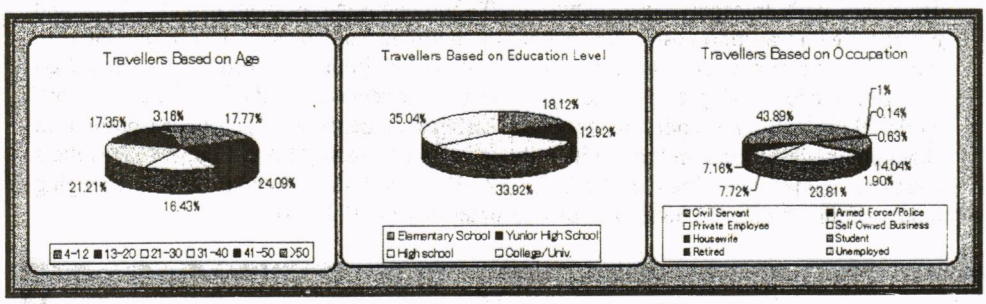

Figure 6: Age, Education and Occupation of Travellers
Source: HI Survey, 2000

3.5.2 Travel characteristics

a. **Trip purpose, mode used, travel distance and travel time**. Going to work and school are the main trip purposes and take 45.01% 44.10% respectively, while shopping trip and other purposes such as visit families share 9.90% 0.98% respectively as shown on the Figure 7. According to modes used for travel, nearly 60% of travellers use public transport

(see Figure 7), while travellers driving cars and motorcycles position as the second (15.38%) and the third (13.97%). Travellers walking and cycling account for a significant amount of 8.92% and 1.83% respectively. Travellers use *ojek* or *becak* contributes a significant percentage of 2.88%.

More than a half of travellers travel more than 10 kilometres as depicted on Figure 7. In particular, it is found that travellers with the distance over 30 km are relatively high nearly one fifth of trip makers. According to time consumed for travel, travellers with travel time of 30 minutes or less occupy nearly 40%, while travellers with travel time between a half hour and one hour account for more than 30% (see Figure 7). More than a quarter of travellers spend an hour to two hours travelling and only 5.41% of travellers consume more than two hour for the trips.

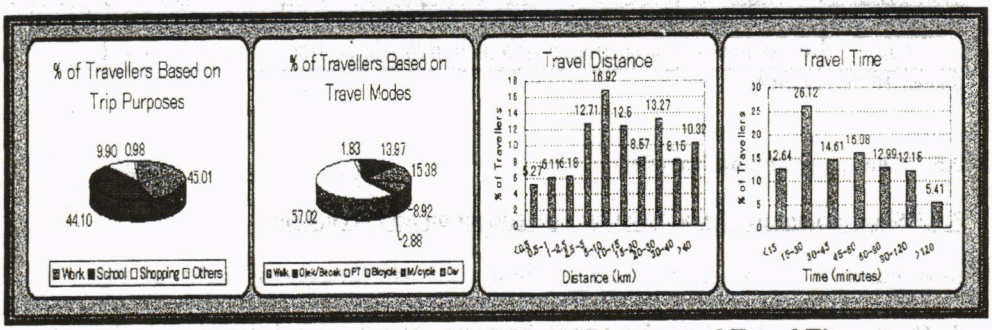

Figure 7: Trip Purposes, Modes Used, Travel Distance and Travel Time
Source: HI Survey, 2000

b. **Travel cost, change modes and origin/destination**. More than three quarters of travellers spend 100 thousand Rupiah per month or less for transport as shown on Figure 8, while travellers with transport cost between 100-200 thousand Rupiah account for 14.33%. Travellers with transport costs between 200-300 thousand Rupiah reveal 3.79% and travellers with transport cost between 300-500 thousand Rupiah share 4.21%, and the rest, travellers with transport cost more than 500 thousand Rupiah, record 2.11%. Based on changing modes, taking two modes or more is experienced wholly in public transport, while taking only one mode, mostly occurs on private transport. The biggest portion on changing modes occurs on those with only one change (44.80%) (see Figure 8. Travellers changing modes two times account for 32.23% and followed by travellers changing modes of three times (15.38%), and of four times or more (7.59%).

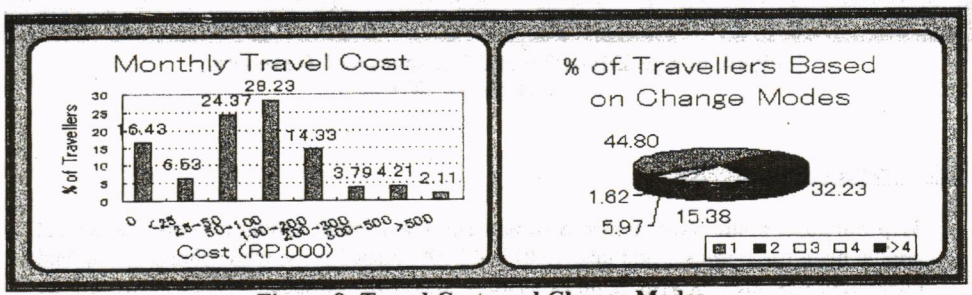

Figure 8: Travel Costs and Change Modes
Source: HI Survey, 2000 (US$ 1 = Rp.7,500, July 2000)

Internal trips within each origin show a dominant share in daily activities. In total, internal trips reveal more than 70% of travellers (see Table 13). For example, internal trips within Bekasi take nearly three quarters of travellers originated from Bekasi. It also happens within Tangerang. More than 75% travellers originated from Tangerang. While internal trips within Bogor take a share of nearly 60% of travellers originated from Bogor. In overall, Bekasi contributes the biggest origin of travellers (43.75%) and is followed by Tangerang (38.76%) and Bogor (17.49%). Trips to Jakarta somehow also show a significant number as represented by more than a quarter of travellers. This evidence convinces that commuting traffic within JMA relatively high.

Table 13: Origins and Destinations

Origins	Destinations									
	C Jkt	W Jkt	N Jkt	S Jkt	E Jkt	Bekasi	Tangerang	Bogor	Others	Total
Bekasi	3.72	0.70	1.05	1.40	4.49	31.81	0.07	0.28	0.21	43.75
Tangerang	3.79	0.98	0.35	3.23	0.28	0.07	29.14	0.56	0.35	38.76
Bogor	1.26	0.70	0.21	2.18	1.69	0.42	0.63	10.39	0.00	17.49
Total	8.78	2.39	1.62	6.81	6.46	32.30	29.85	11.24	0.56	100.00

Source: HI Survey, 2000 Note: C (Central); W (West); N (North); S (South); E (East); Jkt (Jakarta)

4 MODE CHOICE ANALYSIS FOR WORK TRIPS

4.1 Model Estimation

The analysis for mode choice employs a multinomial logit model (MNL). The choice of MNL for modeling is based on some reasons, that is, not only suits to the data available, also can represent a wider range of policy variables, as well as can treat multimodal problems without difficulty (Ben-Akiva and Lerman, 1985).

The analysis is based on 293 samples of heads of family that have two or more alternatively mode choices for their travel to work. The modes available are car, motorcycle and public transport. Motorcycle as a choice is a reality that many people use it as found from the survey with a significant percentage. Sample frequencies of the chosen mode are as follows: Car (47.78%), motorcycle (M/C) (39.93%) and public transport (PT) (12.29%). Some variables have been tested and based on the t-statistic values obtained, some satisfied the statistical requirements and some others did not. The final variables used in the model are shown in Table 14.

4.2 Model Interpretation

4.2.1 Statistical performance

All estimated parameters are significantly different to zero at 90 percents confidence level. The likelihood ratio of the model was also calculated against the log likelihood for constant only [L(c)]. This resulted a much higher value compared to the tabulated χ^2 at the 99 percents confidence level ($\chi^2_{6,0.01} = 16.81$) that means a good fit statistically.

The constants to car and motorcycle show positive values as predicted that mean people tend to drive to work or take motorcycle than public transport. The constant value of car that is much higher than motorcycle value gives a sign that car greatly more attractive than

motorcycle as a mode for travel to work. There is a possible reason in which even though M/C is more flexible and cheaper than car, but car is more comfortable and safer compared to M/C in the trafficked roads where these service quality factors of road were not included in the model.

Table 14: The Result of Analysis on Mode Choice Model for Work Trips

VARIABLES	ESTIMATE	t-statistic
Constant to Car	3.1514	3.0837
Constant to M/C	0.0763	1.5813
In Vehicle Time (mnt)	-0.0270	-2.2313
Out of Vehicle/Travel Distance (mnt/km)	-1.9048	-3.0464
Travel Cost/Household Income (Rp.000/Rp.000)	-244.1680	-2.1794
No. of Cars available in the Household [Car]	1.1712	3.2788
Dummy, =1 if Working Place is in Jakarta; =0 otherwise [Car and M/C]	3.0734	3.7337
No. of Observations		293
Initial Log Likelihood, L(0)		-220.9300
Log Likelihood-Constant Only, L(c)		-111.4660
Final Log Likelihood, L(β)		-80.2822
Likelihood Ratio, -2{L(0)-L(β)}		281.2956
Likelihood Ratio, -2{L(c)-L(β)}		62.3676
Likelihood Index, rho-squared (ρ^2)		0.6366
Adjusted rho-squared (ρ^{-2})		0.6049

Source: Calculation

4.2.2 Policy variables

Three main policy variables to be analysed in the model, that is, in-vehicle-time (IVT), out-of-vehicle-time (OVT) associated with travel distance, and travel cost associated with family income. IVT and OVT convince as important variables to mode choice model for work trip because work trip as a compulsory trip is more time considering related decision. Hence IVT and OVT take place as sensitive determinants in conducting work trip.

The model estimates a trade-off of 3.44 OVT minute that is equal to a minute of IVT. It is also estimated that the value of in-vehicle-time is equal to Rp. 180/minute or Rp. 10,800/hour (US$1.44; US$1= Rp.7,500 in July 2000) and the value of out-of-vehicle-time is equal to Rp. 620/minute or Rp. 37,200/hour (US$4.96).

The calculation of aggregate direct elasticities is presented on Table 15 below.

Table 15: Aggregate Direct Elasticities

MODE	IVT	OVT	TC
CAR	-0.4544	-0.0761	-0.4923
M/C	-1.1511	-0.2454	-0.4036
PT	-1.8184	-2.0903	-1.0133

Source: Calculation

From Table 15, for car, travel cost (TC) has the greatest elasticity followed by IVT and OVT. While for motorcycle, IVT shows the greatest elasticity compared to other two variables of TC and OVT. For public transport, OVT provides the greatest elasticity followed by IVT and TC. All these conclude that for car, TC is relatively more sensitive that other two policy

variables. Motorcycle shows that IVT is relatively more sensitive that TC and OVT, while for public transport, OVT is relatively more sensitive than IVT and TC.

4.2.3 Trip Characteristics and socio-economic variables

Four variables related to trip characteristics and socio-economic variables are travel distance (associated with OVT), family income (associated with travel cost), car availability and workplaces. The estimated value for car availability and workplace are as predicted. The positive sign of those two is supported by empirical evidence that increasing car ownership gives an increased preference for driving, while for workplace, a positive value means either car or motorcycle is the better mode choice compared to public transport due to insufficient capacity and poor service quality of public transport as well as congested road network. Further, people with good socio-economic level tend to use private transport to avoid undesired PT services such frequently changes, long stranded for a seat and even within congested roads etc., also public transport cannot be hoped as satisfactorily mode to work. People with better income would choose to spend more money in their own car, particularly for long distance working trip in order to minimize the disappointment to public transport services and severe traffic condition.

4.3 Modal Share Estimation

Via sample enumeration approach for aggregation, the model estimates current modal share as follows: Car occupies 45.87%, motorcycle takes 35.62% and public transport shares 18.51%. This result demonstrates that private transport (car and motorcycle) reveals the dominant modes used for work trips from new housing areas, while public transport only plays less than one-fifth.

This evidence conforms that the poor public transport services to new residential areas have driven enormously the use of private transport, particularly car. The use of private transport seems to increase if public transport remains unchanged and even worse in service quality and coverage. Hence car-oriented communities will no doubt build up significantly. In this situation, motorcycle could be a captive mode, as a transition mode. Its users are in the position to switch to public transport if there is a significant improvement on public transport service quality and coverage, but inversely, they would move to car if public transport fails to improve its performance, especially if the family income increases.

5 DISCUSSIONS

Mobility issue becomes apparent in JABOTABEK. The facts obviously indicates that the population of JABOTABEK will continue to increase, particularly in BOTABEK as well as the demand for housing and urban movements. Since the effort to facilitate urban movements is limited, particularly the provision of public transport services, in turn, rapid increase in population and sprawled developments all together sign that mobility issue is in a serious stage, particularly within BOTABEK Records on housing development show that BOTABEK up to 1997 has already facilitated more than 350 thousand new houses that means BOTABEK has absorbed millions of people that most of them are potentially regular travellers to be accommodated in transport network.

It is indicated that there have been planning problems in JABOTABEK in conjunction with land allocation and for rapid development of housing (Yuniarto, 1993). There is a gap between housing policy and spatial planning policy and in turn produces spatial problems. Further Yuniarto (1993) identifies 3 main problems that is, first, a gap between the plan and its implementation, particularly the distribution of increasing population and the response to the national housing policy. Second, local government is unable to direct housing developments to the designated areas in spatial plan. Third, as the consequence of first and second problems, the difficulty in provision of necessary urban infrastructures to the new residential areas of which the dwellers are vulnerable to increasing transport costs and environmental problems mostly in low-cost housing areas. Also in practice, the criteria set for location assessment of housing developments are more oriented to the land problem than to spatial planning. Hence it is understood that all of those have contributed in creating inefficient and undesirable patterns of urban development in JABOTABEK. Housing development, as national policy, that should be closely co-ordinated within the local spatial plan, in practice has not occurred. Thus urban sprawled and ribbon development is inevitable. This actually costs enormously high to communities (TRB, 1998 and Duany *et al*, 2000).

Sprawled housing developments in BOTABEK have conformed lessening capacity and distribution of transport system that then impose unnecessary transport costs. The facts show that imbalance growths between motorised vehicles and road network development as well as increased vehicles ownerships indicate the lining up cars on the road network. From site observation, it is found that most radial roads connecting to new housing areas are experienced severe bumping-to-bumping traffic, during morning/afternoon rush hours. On the other hand, as facts, disability of public transport to increase its capacity, and factually even reduction on its capacity, has given no hope to those with no vehicle for bettering quality of services for their mobility needs. In fact, this group is reasonably dominant in JABOTABEK. Conducting travel, especially necessary trips would be full of 'mores', that is, tougher (competing for a seat), riskier (safety issue), more difficult (less services), more time consuming (stranded and many transfers) and of course more costly (higher transport cost).

Public transport users expose to the difficulty to travel. The survey witnesses that most new residential areas are far enough from public transport routes, beyond a reasonable walking distance of 500 meters (as recorded 95.60% of travellers are 500 meters or more away from regular bus routes and 35.82% of travellers are 500 meters or more away from mini bus services), the additional sacrifice must be, no choice, swallowed either taking *ojek* or *becak* or unpleasant walk. These figures demonstrate how difficult for public transport dependants to travel. Some evidence also reveals that within a reasonably short distance travel, they must change more than twice. The more frequent changes of modes mean at least more stranded, more time spent, and more out-pocket money for ticket.

Car oriented communities are building up. The shift of housing locations towards fringes of Jakarta with poor transport system developments has imposed enormous effects in increased private transport use and neglected public transport dependants (Sasono *et al*, 2000). From the facts, motorisation level during 1991 to 1995 apparently increased significantly as indicated by high growth rates of passenger cars and motorcycles far above the population growth. This indicates that car-oriented communities in JABOTABEK are increasingly building up following the disability of public transport service improvements. Some facts strengthen this argument on increased car oriented developments as shown by increased car traffic in new housing areas as recorded at tollgates in adjacent new site developments. Further evidence reveals that based on mode choice analysis, modal share estimation for working trips from

new housing areas shows the domination of private transport use that car takes the biggest share. Another evidence supports that public transport is not a promising mode for travel as expressed by private transport and public transport users. It is further exacerbated by many locations of new housing areas having bad orientation, bad road network as well as poor access to public transport. This means car-oriented societies would be greatly stronger in the future as facts say that most housing developments are built mostly well away from public transport routes and also many developers reluctant to provide through roads for public transport services, particularly in high income housing areas, and also not intentionally to provide bus services at a loss in the early phases of occupation. The problem on lack of co-ordination in licensing procedures by traffic/transport authorities involved is also deepened the mobility problem.

It can be summed up that current housing developments impose disbenefit mostly to those with no access to vehicle because they are severely hit by mobility difficulty and embark on paying unnecessarily additional cost for their activity. Whilst for those with an access to a vehicle, current situation places them as the beneficiaries in gaining better opportunities available in JABOTABEK.

6 CONCLUSIONS

Based on discussions on previous sections, it can be summarized some conclusions as follows:

a. Housing developments in JABOTABEK has resulted inefficient and undesirable sprawled development patterns with poor support of transport system.

b. Facts show that such developments have pushed a mobility problem up to public transport dependants and even have swiftly encouraged car-oriented communities. This is clearly proved by the evidence on the result of the estimated modal share of work trips of main workers from new housing areas.

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