

## TRAVEL CHARACTERISTICS AND MODAL USAGE IN MOTORIZING SOUTHEAST ASIAN CITIES: A CASE STUDY IN YOGYAKARTA

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abstract: Medium-sized cities in Southeast Asian countries are experiencing accelerated process of motorization. With this in mind, the objective of this paper is to analyze the process of motorization and its problems in medium-sized cities in Southeast Asia, based on individual person trip data. Firstly, authors overview the status of motorization in Asian cities and its problems. Secondly, in-depth analysis is made on trip characteristics in Yogyakarta, Indonesia, based on household questionnaire surveys to farther examine the problems arising from mixed traffic of motorized and non-motorized transport modes. In conclusion, it is pointed out that there is a need for establishing traffic management policies to cope with mixed traffic of motorized and non-motorized transport.

### 1. INTRODUCTION

The pace of motorization in fast growing Asian cities is even faster than that of their population growth, and it exceeds the increasing rates of vehicles of many other major cities in the rest of the world. The number of automobiles have been dramatically increasing in Asia, particularly in the fast developing region, such as Bangkok, Kuala Lumpur, Seoul, Manila, Jakarta, etc. Not surprisingly, even in low-income Asian countries where walking and non-motorized vehicles are the predominant travel modes, this is also true, as seen in China where the number of motor vehicles is increasing at the rate of more than 20% annually. The secondary cities are also experiencing the accelerated process of motorization as well. In these cities, the high ownership rates of motorcycles are often observed in many cities, as shown in Table 1.

As a result, the total number of motor vehicles in the countries such as Thailand, the Republic of Korea and China have doubled in the latter part of 1980s. Thus, today, most Asian cities have to cope with much higher rates of motor traffic per road space than their European or North American counterparts. Moreover, the existence of various types of motorized and non-motorized vehicles on roads brings about chaotic traffic conditions, which are further aggravated by inefficient traffic management and inadequate public transport systems. The emergence of automobile-dependent urban pattern is also increasingly conspicuous in many cities due to the absence of, or far from adequate, mass transit systems separated from general traffic. In the course of the automobile-dependent urbanization, the suburbanization of population and economic activities, which has been led by motorization, again naturally causes the acceleration of motorization in spite of inadequate road network.

Against the above background, this study aims: a) to examine the process of motorization in secondary cities in Southeast Asia, b) the problems arising with rapid progress of motorization based on individual-based traffic behavior analysis with particular emphasis on the use of bicycles. As the case study city, Yogyakarta in Indonesia was selected, where a variety of transport modes exists. The use of bicycles is rather popular in Yogyakarta in comparison with other secondary cities and thus, it is understood that it is appropriate to examine the possible problems arising from the mixture of motorized traffic and non-motorized traffic.

Table 1 Ownership Rates of Vehicles in Selected Asian Cities

City	1992 Pop. (mil.)	1991 GNP/cap. US\$	Car-ownership rate (*1) (/000)	Motor-cycle ownership rate (/000)	Bicycle ownership rate (/000)	Data year	Annual rate of increase (%)		
							Car	Motor-cycle	Data year
Jakarta	10.0	610	119	122	35	1990	7.5	4.4	85-90
Surabaya	2.5	610	52	127	n.a.	1991	7.6	4.3	83-87
Yogyakarta (Indonesia)	0.4	610	47	149	129	1987	8.5	5.8	85-87
Shanghai	14.1	370	12	3	445	1988			
Baoding (China)	0.6	370	16	20	564	1988	25.3	28.0	85-90
Delhi	8.8	330	54	88	163	1981	n.a.	n.a.	--
Manila	9.6	730	68	7	n.a.	1989	5.8	9.3	85-89
Bangkok	7.6	1,570	221	131	n.a.	1990	10.1	8.5	85-90
Kuala Lumpur	1.2	2,520	142	102	n.a.	1985	8.4	10.8	83-88
Seoul	11.6	6,330	96	n.a.	n.a.	1989	17.5	n.a.	85-89
Japan	--	26,930	446	144		1990	4.7	4.0	80-90

n.a.: data not available

Note \*1: vehicles of more than 4 wheels

Source: Compiled from Statistical Year Book of each country, Replogle (1992) and other available sources

## 2. OVERVIEW OF TRAFFIC PROBLEMS IN ASIAN CITIES

### Congestion

With the rapid progress of motorization, many Asian cities now suffer from serious traffic problems, such as congestion, accidents, inadequate provision of public services, air and noise pollution, etc. Though it is not easy to compare the degree of traffic congestion of different cities, many Asian cities obviously suffer from critically severe traffic congestion in comparison with western countries. For example, reported inner city average travel speeds in mega-cities in low and middle-income countries in Asia tend to be considerably lower (many are at the level of somewhere between 15 and 20kms/h). Even in China where the level of motorization is still at the low level, the average travel speeds in large cities during the peak period are generally lower than 10km/h due to the chaotic mixture of automobiles and bicycles.

### Accidents

The high rate of traffic accidents are also commonly observed in the cities of the developing countries. As shown in Table 2, the rates of traffic accidents per vehicles in southeast Asian cities are 4 - 5 times higher than that of USA or Japan. It is noted that, even in the secondary cities, the rates of traffic accidents are as high as large cities. This is partly due

to the high density of vehicles on road space. Yet, it is also true that substantial improvement should be made in the field of the provision of traffic safety equipment, strict and proper enforcement of traffic regulations, safety education and awareness building, etc.

Table 2 Comparison of Traffic Accidents Statistics in Selected Cities

City	Death/ 10,000 vehicles*1	Death/ 100,000 persons	Data year
Jakarta	4.3	10.4	1987
Surabaya	5.1	9.1	1987
Yogyakarta province	5.5	4.6	1990
Baoding (china)	17.8	4.3	1990
Manila	7.6	5.7	1988
Bangkok	4.9	17.1	1990
Seoul	n.a.	12.1	1988
Japan	1.5	9.1	1990
USA	2.3	17.7	1990

n.a. : Data not available

Note \*1: includes motorcycles

Source: Compiled from Statistical Year Book of each country

### Public Transport Services

A majority of the population in the large cities of Asia are dependent on various kinds of public transport services, particularly buses, for their moving (Table 3). Importantly, bus users are affected most by severe traffic congestion, since the fixed-route bus services are much more vulnerable to ever-deteriorating traffic conditions than general traffic. During 1970s, bus priority lanes were introduced in many cities, yet the performance of such lanes are generally poor due to the difficulty of management. The introduction of bus exclusive lanes in the center of roads will be a technically viable option, yet, in many cities, vehicle density on roads seems to be already too high to take such an option without reducing car traffic significantly by way of persuading car users to use buses, which will be very difficult (see Table 3).

### Deterioration of Urban Environment

In the many large cities of Asian, evidence shows that motor vehicles generate more air pollution than other single human activity and contribute significantly to the production of various types of air pollutants. For example, according to the recently conducted study on environmental health risks in Bangkok, air pollution caused by particulate matter and lead which are mainly generated by the emission of motor vehicles, is ranked the highest in environmental health risks. In addition to health risks, cities are also facing the deterioration of amenity, local living conditions and the danger of losing local culture due to invasion of through-traffic into traditional commercial or residential streets. In the developing countries where population and economic activities are concentrating to the primary cities, the promotion of the growth of secondary cities is an urgent issue in national development policy. Thus it is important that rapid motorization should not give danger to the living conditions and local culture of those secondary cities.

As aforementioned, it can be said that serious traffic problems are observed not only in large cities but also in secondary cities in developing countries. Though the most significant

problems vary from city to city, it can be said that fundamental cause of such problems lies in the fact that motorization is occurring in a overwhelming pace in those cities.

Table 3 Modal Share of Transport Modes in Selected Asian Cities

City	1992 Pop. (mil.)	Modal Share (%)						Data Year
		walk	bicycle	rickshaw	motor-cycle	car *1	rail/bus *2	
Shanghai	14.1	38	33	--	--	3	26	1986
Tianjin	9.8	50	41	--	--	--	9	1987
Guangzhou	3.8	38	30	--	--	5	27	1986
Baoding *4 (China)	0.5	17	82	--	--	--	0.4	1991
Delhi	8.8	29	18		13		40	1981
Jaipur	1.6	40	21	9	12		21	1984
Patna (India)	1.1	36	13		17		33	1984
Jakarta	10.0	23	17		13	8	39	1984
Surabaya	2.5	20	25		26	9	20	1984
Yogyakarta *3 (Indonesia)	0.5	12	17	4	42	7	18	1992
Bangkok	7.6	16	--	--	5	19	60	1984
Manila	9.6	8	--	--	--	23	69	1984
Seoul	11.6	12	--	--	--	23	65	1982
Tokyo	25.8	27	15			28	28	1988

--: Data not available

Note \*1: includes taxi; \*2: includes minibus; \*3: survey by authors; \*4: Kubota and Kidokoro (1994)

Source: Compiled from World bank (1991), Replogle (1992), Fouracre and Maunder (1988) and other available sources

### 3. CASE STUDY IN YOGYAKARTA

#### 3.1 Transport Conditions of Yogyakarta

##### Yogyakarta in brief

Yogyakarta is a historical city which is located in the central part of Java Island. As the seat of the Sultan Palace, Yogyakarta holds a special status as the center of Java culture. The world-famous historic Buddhism temple site called Borobudur is also located in the vicinity. Against this background, Yogyakarta has grown as the historical tourism center which attracts tourists world-wide, and at the same time are one of education centers where Gajamada University, one of leading universities in Indonesia and other many colleges are concentrated. Its population was 439.5 thousands in 1990. It covers the area of 32.5km<sup>2</sup> and the average population density was 135 persons/ha in 1990.

##### Vehicle Ownership

The registered numbers of cars and motorcycles are rapidly increasing in Yogyakarta. The number of cars increased 2.6 times in 10 years from 1975 to 1985 while the number of motorcycles increased 2.1 times in the same period. In particular, it is noted that the ownership rate of motorcycles reached as high as 149 per thousand persons in 1987 which is the same level as Japan. Though the ownership rate of cars is still rather low (50 per

thousand persons in 1987), it can be said that the level of motorization is considerably high when the high level of ownership rate of motorcycles is considered. On the other hand, the ownership rate of bicycles had already reached more than 120 per thousand persons in 1975 and it has been stabilized at the high level since then (see Table 4).

Table 4 Registered Number of Vehicles in Yogyakarta City

	Registered number of vehicles								Total length of roads (km)
	cars (*1)		motorcycles		bicycles		becak (*2)		
	No.	/000 persons	No.	/000 persons	No.	/000 persons	No.	/000 persons	
1975	6,658	18	27,150	75	43,968	122	4,712	13	111
1985	17,074	41	57,681	138	53,156	128	5,619	13	210
1987	20,105	47	64,566	149	55,867	129	4,775	11	210

Note \*1: includes vehicles of more than 4 wheels

\*2: Indonesian-style rickshaw

Source: Compiled from the Statistical Yearbook of Yogyakarta

### Public Transport

In 1970s converted pickup type minibuses called *colt* started public transport service within the city. In 1980s, the ordinary city bus service started operation and *colt* was prohibited to operate for intra-city service and converted to inter-city service. At present, publicly-owned DAMRI bus company and 4 private bus companies provide city bus service. The total number of routes was 17 and the total number of buses operated was 368 as of 1992. More than 4,000 *becak*, Indonesian-style rickshaw, are registered in Yogyakarta. They provide not only important services for residents but also for tourists. Yet, the number of *becak* is gradually decreasing recently.

### Road Infrastructure

The total length of roads in the city almost doubled in 10 years from 111km in 1975 to 210km in 1985 and then it reached 230km (219km paved by asphalt) by 1990. It can be said that the provision of road infrastructure was being made steadily in response to the advance of motorization. The construction of a by-pass road of primary national road of central Java which connects Semalan (population: one million) to the northwest and Surakarta (population: 0.5million) to the northeast through the central part of Yogyakarta, was recently completed. By using this by-pass road, through-regional traffic is separated from the city road network. Yet, in the center of the city, the mixture of motorized traffic such as cars and motorcycles and non-motorized traffic such as *becak* and bicycles causes traffic problems, in particular, congestion and traffic safety problems.

## 3.2 Main Findings of Household Interview Survey

### Outline of Survey

In order to analyze the present conditions of ownership and use of transport modes at the personal basis, a household interview survey based on questionnaire was conducted. The interview survey was conducted in the following process: 1) the number of samples in each administrative unit<sup>1</sup> was allocated in proportion with its population in Yogyakarta and its vicinity, 2) the surveyors composed of students of the Faculty of Architecture, Gajamada

University<sup>2</sup> were dispatched to typical middle income residential areas of each administrative unit which were selected in advance on map. Selection of sample households at the field was made by interviewers so as to include various income levels within the area. When the household head of the selected house in the field or the household member who can answer instead of the household head, was absent, the other household was contacted instead. 3) The interview was conducted face to face to household heads based on pre-designed questionnaire form. The questionnaire was composed of two parts: the household interview form to ask household characteristics and the individual interview form to ask the transport behavior of each household member. The interview survey was conducted in February to March in 1992.

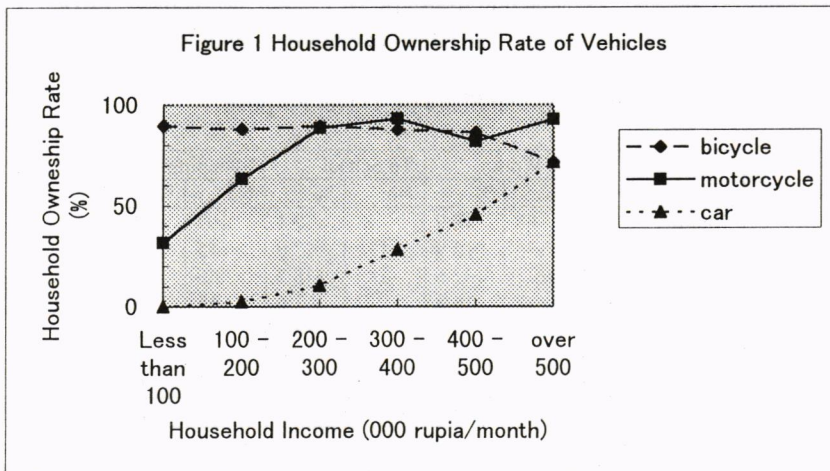
The total number of sample households collected were 193 within the city and 63 in the vicinity, 226 in total. Given the nature of the sampling method in this survey, sample households were not selected randomly on the strict sense and the sample size is not as large as to represent the overall travel characteristics and modal usage of the citizen of Yogyakarta. Yet, sample households are selected to represent middle class people in Yogyakarta who are the main engine of motorization at present and the sample size is also large enough to make simple cross tabulation analysis within the sample group. Thus, it is understood that the results of this home interview survey should reveal the relations of travel characteristics and socio-economic factors behind such travel characteristics in general with the focus on middle class citizens of Yogyakarta.

#### Household Characteristics

The number of household members is typically 4 or 5 in which 66 % of total households fall. As for income level, the average monthly household income of sample households is 265,000 rupia and 32.6% of households are in the income level of 200,000 to 300,000 rupia, 28.9% of households are in 100,000 to 200,000 rupia and 19.6 % of households are in 300,000 to 400,000 rupia. According to the survey conducted in major cities by the Ministry of Housing in 1987, the average monthly household income in medium size cities including Yogyakarta was 180,000 rupia, approximately. Adjusted by the nominal growth rate of GRDP of Yogyakarta during 1987 and 1992 (11% per annum), the average monthly household income is estimated to be 270,000 rupia approximately in 1992. Considering the above, it is judged that the sample households represent generally the average households in Yogyakarta. In fact, as for the question "which social class do you feel that you belong to?", three fourths of sample households answered that they belong to middle class (48.8% to mid-middle class, 18.4% to upper-middle class and 7.9% to lower-middle class).

#### Ownership of Vehicles

Among surveyed households, 87.6% of households own bicycles and 78.0% of households own motorcycles, respectively. On the other hand, only 16.5% of households own cars. As shown in Figure 1, bicycles are owned by most households irrespective of income level. Motorcycles are owned by most households with the income level of more than 200,000 to 300,000 rupia/month. On the other hand, only 10% of households own cars even in the middle income level of over 200,000 - 300,000 rupia/month, though the ownership rate of cars gradually increases in the higher income level. It is noted that, among the households which own cars, 94% of households also own motorcycles.



As mentioned above, bicycles and motorcycles are owned in many of households. As for the question “how much did you pay to purchase each vehicle?”, two thirds of owners of bicycles answered that they paid less than 100,000 rupia. This amount is less than one third of average monthly household income, which is understood not to be a big amount. In fact, in most cases, bicycles were purchased in cash. In case of motorcycles, the purchasers paid about 1.4 million rupia on average, which is 5.3 times bigger than the average monthly household income and considerably high. Yet, about 80% of owners purchased motorcycles in cash and hire purchase is not common (18%). On the other hand, the percentages of purchase of used vehicles were considerably high both in bicycles (28.6%) and motorcycles (39.0%). It is also noted that more than 70% of both of bicycles (77.4%) and motorcycles (71.8%) are used by more than two persons. As for the frequency of use, most of bicycles are used “almost everyday” (65.7%) or “3 to 4 times a week” (15.1%). Motorcycles are even more frequently used: 90% are for “almost everyday” use.

### Travel Modes

In the individual questionnaire form, travel modes used for daily commuting as well as daily shopping were asked to answer. In the case of travel “to work”, motorcycles have the biggest share (37.6%), followed by cars (16.5%). As for the travel “to school”, the biggest share also goes to motorcycles (38.7%), though only 3.6% of respondents use cars (Table 5): that is, about a half of respondents use motorcycles or cars for commuting purpose. This fact clearly illustrates the considerable advance of motorization even in a secondary city like Yogyakarta. Yet, bicycles are used by 27.0% of respondents for travel “to school” and 15.9% for travel “to work”. 18.9% of respondents walk for travel “to work” and 12.1% for “to school”. Thus, it should be noted that more than one third of respondents rely on non-motorized transport (walk or bicycles) for commuting travel.

As for the use of buses, though only 9.4% of respondents use buses for travel “to work”, rather high percentage of respondents use for travel “to school” (18.0%). 152 persons among 164 respondents who answered that they use buses, answered that they walk to bus stop. Bicycles (9 respondents) and *becak* (3 respondents) are seldom used for feeder travel to buses. Cycle and ride (to bus) are rarely observed for daily travel. As for the daily shopping travel, walking is the most popular mode (38.8%), followed by bicycles (19.9%),

though motorcycles are also considerably used (16.7%). *Becak* is used for the travel to shopping particularly because they have the advantage of carrying luggage.

Table 5 Modal Share by Travel Purpose

	To Work		To School		Shopping	
	No.	%	No.	%	No.	%
Walking	88	18.9	58	12.1	107	38.8
Bicycle	74	15.9	129	27.0	55	19.9
Motorcycle	175	37.6	185	38.7	46	16.7
Car	77	16.5	17	3.6	15	5.4
Bus	44	9.4	86	18.0	34	12.3
<i>Becak</i>	7	1.5	3	0.6	17	6.2
Others	1	0.2	0	0	2	0.7
Total	466	100	478	100	276	100

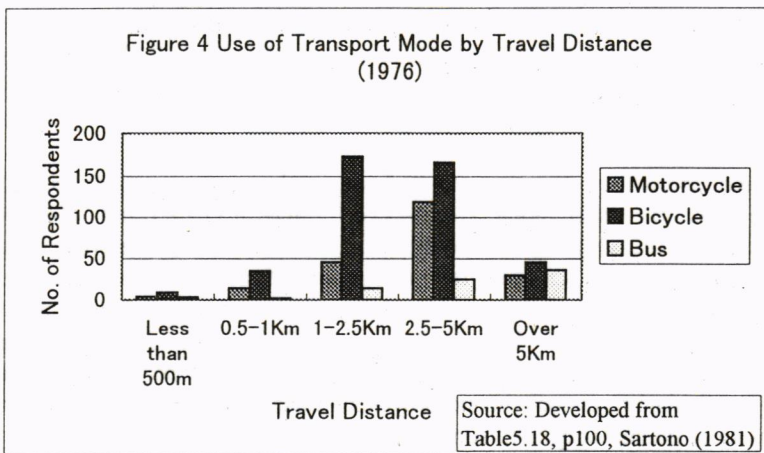
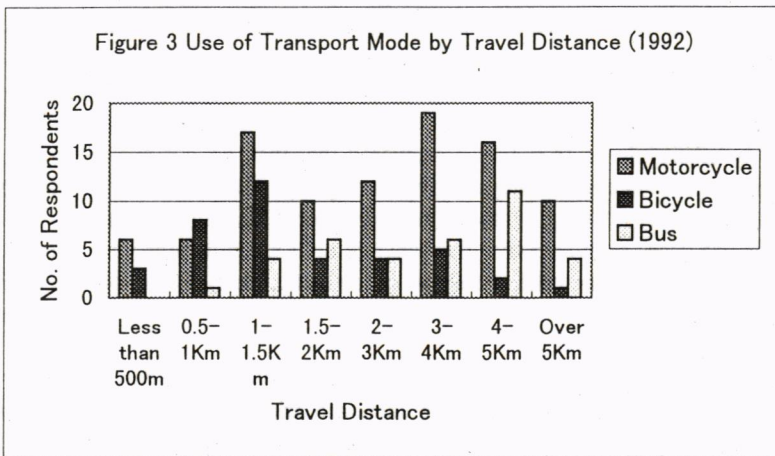
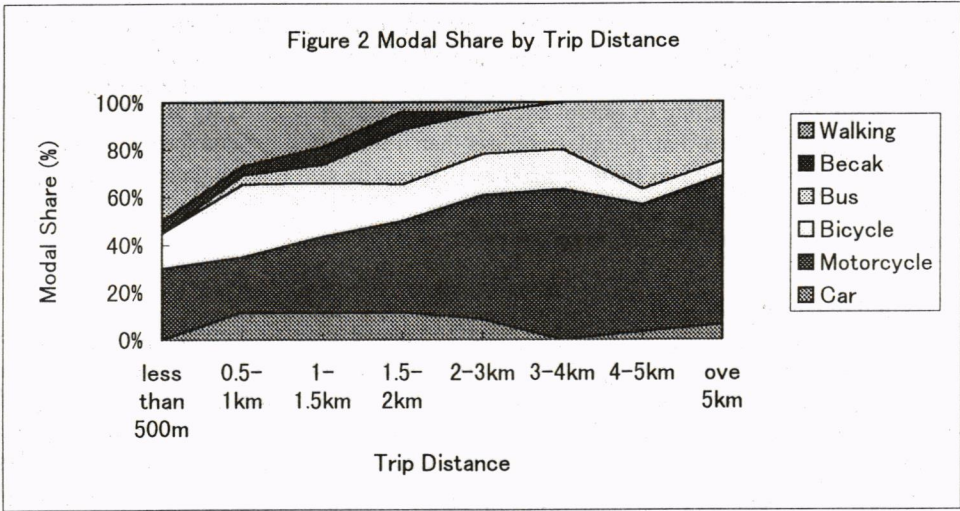
The Gajamada University conducted the survey on the use of travel modes in Yogyakarta in 1972. According to this survey, the most popular mode was bicycles (37.8%), followed by walking (24.1%), motorcycles (20.4%) and *becak* (8.6%) in the case of commuting to work, and, in the case of commuting to school, bicycles (43.4%), motorcycles (21.6%), walking (20.5%) and *becak* (12.6%). The direct comparison of the results between two surveys is not appropriate because of difference in the basis of survey. Yet, at least, it can be pointed out that the share of non-motorized modes rapidly decreased and, in particular, the most popular mode has changed from bicycles to motorcycles in the past 20 years.

#### Travel Distance and Travel Mode

Each respondent was asked to mark their normal travel routes for daily commuting and shopping travel on the attached map of Yogyakarta. The modal share by travel distance is shown in Figure 2. As shown in the Figure, there was clear difference in modal share corresponding to the distance of travel. Walking takes the biggest share for the travel of less than 500m, bicycles take the biggest for 500m to 1km and motorcycles for over 1km. The use of buses increase for the travel of over 1.5km and a considerable number of respondents (36.1% of total) use buses for the travel of 4 - 5km, though, it still does not reach the level of motorcycle use (53.3% of total) even in that bracket of travel distance. There is no clear pattern in the use of cars observed from the survey results, partly because the number of respondents who use cars itself is small. Yet, it is noted that the share of cars are rather irrespective of travel distance, which suggests that cars are used even for short distance only if available.

Figure 3 shows the comparison of numbers of users of motorcycles, bicycles and buses by travel distance. It is obvious that motorcycles are used irrespective of travel distance. On the other hand, bicycle users suddenly decrease for the travel of over 1.5km, while bus users gradually increase after 1km. This fact strongly suggests that bicycles and buses complement each other in different distances of travel: bicycles for short-distance travel and buses for long-distance travel. In 1976, Gajamada University conducted the home interview survey to 750 households on the travel mode and travel distance in Yogyakarta (Figure 4). When compared with the result of this survey, it can be said that the use of bicycles for long distance (over 5 km) decreased, while the use of motorcycles for short distance (less than 2.5 km) increased to a considerable extent, which, it is believed, reflects the rapid progress of motorization in this period.





As for the routes which are frequently used by each travel mode, not only buses and cars but also motorcycles and bicycles tend to concentrate on several arterial roads, which causes the problem of mixed traffic. The average trip length is rather short: 2.7 km for commuting to work, 2.8 km for commuting to school and 1.4 km for shopping. As for travel time, a half of respondents answered that it took only less than 15 minutes for commuting travel, and most of the rest answered less than 30 minutes. It can be said that, in general, commuting time is not long and rather in good conditions, at least, in terms of time consumption in secondary cities in Indonesia such as Yogyakarta.

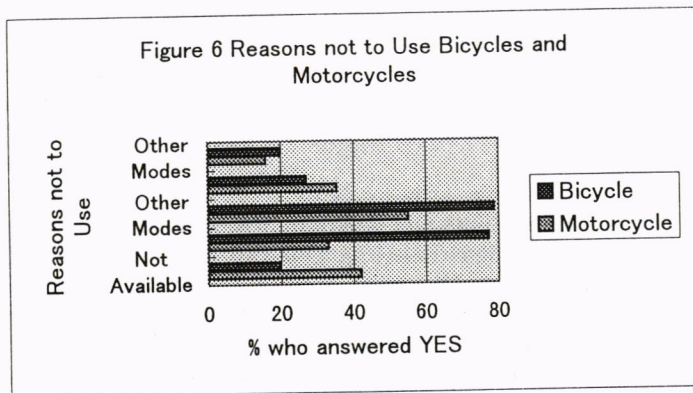
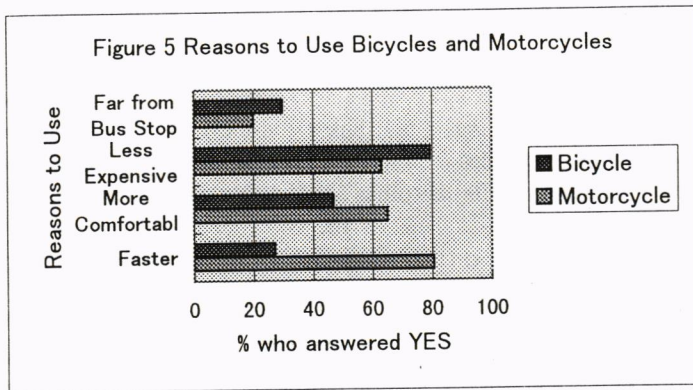
#### Perception to Bicycle and Motorcycle Use

The findings of the home interview survey described above show that owning motorcycles is commonly observed except for the lowest income group though owning cars is relatively limited to higher income class. At the same time, it is also true that the ownership rate of bicycles is high and they are frequently used. Though bicycles tend to be used in a limited purpose in comparison with before, people in Yogyakarta looks rather favorable to bicycles according to the questions about the perception to bicycles in this survey. Almost all respondents feel that "bicycles are good for health" (95.6%), while many respondents answered that "they do not feel tired when riding bicycles" (62.9%). In addition, not so many respondents feel that "bicycles are expensive" (21.1%). A rather small part of respondents answered that "they worry about safety" (11.4%). Yet, it is noted that many respondents answered that "they worry about theft" (46.0%). It is also remarked that a large part of respondents answered that "they feel inconvenience at the time of rain" (55.0%). Yet, the majority of bicycle users (61.8%) answered that they do not change to the other travel mode and they manage to use bicycles by wearing raincoats or waiting for rain to stop, etc. On the other hand, 20.7% of bicycle users answered that they change to the other mode and 17.5% of users answered that they change only when it rains very hard. Among bicycle users who change to the other transport mode at the time of rain, 44.2% change to walk and 25.5% to buses.

In order to examine the reasons to choose motorcycles and bicycles in comparison to other modes, both the motorcycle users and bicycle users are asked to answer "yes" or "no" to given several reasons (Figure 5 and 6). As for the reasons to use motorcycles, many respondents answered "yes" to the following reasons: "faster than other modes" (65.1%), "more comfortable than other modes" (63.3%) and "less expensive than other modes" (63.3%), while, as for bicycle users, "less expensive than other modes" (79.5%) seems the only important reason. When it is compared with bicycles, it is obvious that motorcycles are popular because it is a convenient mode.

On the other hand, as for the reasons not to use motorcycles, many respondents answered "yes" to the reasons "the other mode is more comfortable" (55.2%) and "there are no motorcycles available" (42.3%). On the other hand, for bicycles, the reasons "the other mode is more comfortable" (78.9%) and "the other mode is faster" (77.4%) were chosen as main reasons not to use. On the other hand, in the case of motorcycles, higher percentage of respondents answered "yes" to "there is a danger to ride" as the reason not to use, in comparison to bicycles. In sum, it can be said that, when the motorcycle and the bicycle are compared, people tend to choose the motorcycle because of its convenience though they worry about safety of the motorcycle to some extent.

In addition, as for the question “what things do you feel uncomfortable when you are riding the bicycle?” (respondents are asked to choose up to two items from the given list of items), rather high percentages of respondents selected “when roads are congested with cars” (22.2%), “when roads are congested with buses” (21.2%), followed by “when roads are filled with vehicle emission gas” (9.9%), “when there are many obstacles on roads” (9.6%), and “when they have to travel on artery roads” (6.5%). Judging from those answers, it is understood that bicycle users are conscious of the problem of mixture with motor vehicles.



#### 4. CONCLUSION

In this paper the discussion was made on the travel characteristics in secondary cities in Indonesia as Yogyakarta as a case study city. The main findings are summarized as below:

- (a) Motorization is rapidly progressing in not only large cities but also in secondary cities in Southeast Asia. In particular, the owning of motorcycles is commonly observed in the average households.
- (b) On the other hand, non-motorized transport modes also play a considerable role.

- Particularly, it is noted that bicycles still play an important role in Yogyakarta, though motorcycles have taken over the status of prime transport mode.
- (c) As the result, the mixture of traffic of motorized and non-motorized transport modes causes various problems, particularly on traffic safety.
  - (d) Judging from the result of perception of respondents of the home interview survey, people in Yogyakarta are rather favorable to bicycles, yet they tend to choose motorcycles rather than bicycles if available. Thus, it is understood that the shift from bicycles to motorcycles will more and more proceed along with the increase of income. As the result, furthermore, the use of non-motorized transport becomes more troublesome due to mixture of traffic on roads, which will, again, accelerate the shift to motorized transport, because non-motorized traffic is naturally more affected by the problem of traffic safety.
  - (e) The survey results strongly suggest that buses and bicycles complement each other in terms of travel distance: bicycles for short distance trip and buses for long distance trip in the case of Yogyakarta. On the other hand, motorcycles and cars tend to be used irrespective of travel distance. Thus, if the ownership rate of motorcycles or cars continue to increase, the use of them will increase most likely irrespective of travel distance, rather than act complementarily with bicycles and buses.

As clearly shown in the above discussion, secondary cities in Southeast Asia are presently at the cross road of whether they will accept the full-motorization dependent society or they seek the society depending on a variety of transport modes including non-motorized transport. During the course of authors' interview to the local government officers, there seems no strong concern on the danger of environmental degradation or destruction of community and local culture which might be caused by rapid progress of motorization without proper management. It seems that these cities are rather in the direction to the acceptance of full-motorization dependent society.

It is believed to be an important issue to create secondary cities distinct from large cities based on local culture in Southeast Asian countries where the over-concentration to primary cities is causing serious urban problems and, thus, decentralization of social and economic development is one of the most important issues in national development. Furthermore, it is also understood that depending fully on motorcycles or cars may not be appropriate in secondary cities such as Yogyakarta, when concerns on environmental problems and energy savings are considered, in particular, in secondary cities where average travel distance is rather short and a majority of travel demand be possibly able to be met by non-motorized transport. Thus, it is concluded that it is important to create better traffic management systems to allow the coexistence of motorized and non-motorized transport modes.

Note:

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<sup>1</sup> Sample households are allocated to each administrative units (26 traffic zone used in 1990 person trip survey) in proportion to the population of each traffic zone. The population of each traffic zone was 20,000 – 30,000 on average in 1990. About 10 samples were allocated in one traffic zone on average.

<sup>2</sup> The survey team was supervised by Dr. A. Djunaedi, Senior Lecturer, Department of Architecture, Gadjah Mada University

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