

# Nonmotorized Vehicles in Hanoi and Phnom Penh: Existing Situation and Options for Improvement

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Vietnam and Cambodia, two of the poorest countries in Asia, are currently undergoing accelerated changes in their domestic economies. Vietnam has been moving toward a free-market system since the collapse of communism in the former Soviet Union, and Cambodia experienced an economic surge from the recent presence of 22,000 United Nations personnel involved in a comprehensive peacekeeping mission. A rapid increase in the number and use of motor vehicles (MVs), especially motorbikes, has accompanied these developments and contributed to significant deterioration in traffic safety and congestion. The capital cities of Hanoi and Phnom Penh are major activity centers whose residents traditionally have depended on nonmotorized vehicles (NMVs), especially bicycles and *cyclos* (pedicabs), for performing functions vital to maintaining their livelihoods. Although economic conditions in these countries have encouraged rapid motorization, roadside traffic counts in mid-1992 showed that NMVs still accounted for 50 to 70 percent of all vehicle volumes in these two cities. Local government officials, however, have expressed views hostile toward NMVs, and in Hanoi plans have been made to abolish all NMVs from operating within the city by the year 2004. Officials in Hanoi and Phnom Penh should take a more balanced approach to transport planning by including needs of NMV users with those of MV users. Not only would affordable NMV facility improvements, such as the provision of spatial and temporal separation measures, ensure that all residents, including the poor, maintain reasonable access, but they would probably improve citywide traffic safety and congestion as well.

Vietnam is undergoing significant changes in its economic policies as it moves toward a free-market system, largely encouraged by the collapse of communism in the former Soviet Union and the drastic cuts in aid and subsidized goods that followed. In the case of Hanoi, the capital city of Vietnam, this situation has encouraged the widespread use of nonmotorized vehicles (NMVs) and the recent advent of motorbikes (i.e., small, lightweight motorcycles with typical engine displacements of 50 to 90 cc). Because automobiles are out of the price range of most residents and because services provided by motorized mass transit (e.g., bus, tram) are either inferior or absent, Hanoi residents move around by riding bicycles, *cyclos*, and motorbikes. *Cyclo*, pronounced "seek-low," is the term for pedicab in Hanoi and Phnom Penh (Figures 1 and 2).

Phnom Penh, the capital city of Cambodia, has been experiencing drastic changes since early June 1993 when a 120-member constituent assembly was elected to draft a new constitution; this election was the culmination of a comprehensive peacemaking operation of the United Nations. During the Khmer Rouge regime under Pol Pot during the 1970s, much of Cambodia's formally educated workforce died from overwork, malnutrition, disease, or

execution. This tragedy affects every aspect of Cambodian life, including a shortage of skilled professionals in government agencies, especially those related to city planning. Urban transport planning, policy, and services in Phnom Penh have suffered as a result. NMVs, a source of employment for unskilled workers, are a significant part of the current transport system, and they will likely remain so for many years as the nation recovers and rebuilds.

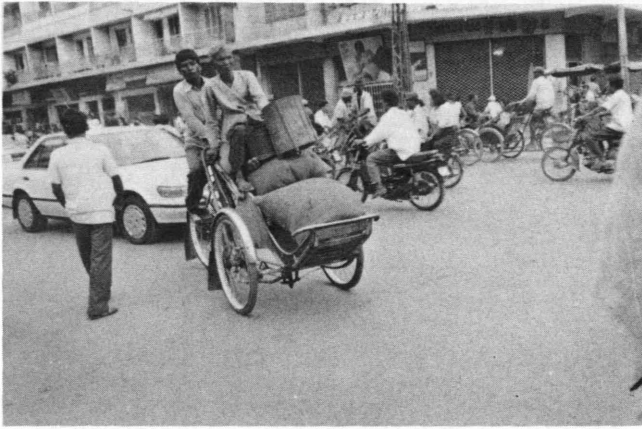
Although NMVs are an important part of the urban transport system and economy in both cities, government officials are planning to limit NMV use in the near future, with the presumption that traffic safety and congestion will improve as a result. In Hanoi, traffic authorities intend to prohibit NMVs from operating by 2004. Similarly, in Phnom Penh officials plan to forbid *cyclo* operations.

The rationale behind these proposed restrictions is understandable when considering that (a) NMVs are commonly misperceived as being responsible for most traffic accidents, (b) NMVs are relatively slow vehicles, and (c) NMVs outnumber motor vehicles (MVs) on the city streets. However, plans to prohibit NMV operations may not resolve traffic safety or congestion problems; in fact, they may be self-defeating. NMVs are well suited for short trips, and they can be more efficient than MVs in terms of productive passenger capacity (e.g., passengers per hour per meter of lane width) (1). NMVs also effectively use local technologies and play an important role in providing job opportunities for many people. Consequently, NMV facility planning should be integrated into the urban transport planning process.

## SOCIOECONOMIC CHARACTERISTICS

Hanoi had a 1992 urban population of 1.1 million and a population density of 25,600 residents per square kilometer (66,300 per square mile). Although the proportion of Vietnam's workforce in agriculture is a relatively high 72 percent, rural migration to Hanoi is estimated at fewer than 10,000 persons a year (2,p.7). Vietnam had an annual gross nation product (GNP) per capita of U.S. \$200 in 1990 (3,p.241).

The 1992 urban population of Phnom Penh was approximately 745,000, corresponding to a population density of 16,200 inhabitants per square kilometer (42,000 per square mile). In contrast to Hanoi, the population of Phnom Penh increases by an additional 100,000 during the dry season as farm workers migrate to the city to seek temporary employment. With 81 percent of Cambodia's work force in agriculture, this trend may continue for



**FIGURE 1** Cyclo used for passenger and goods movement in Phnom Penh (photograph courtesy of D.D. Bell).

many years (2). In 1991, Cambodia had an annual GNP per capita of U.S. \$200, the same as that of Vietnam (4,p.18).

### TRANSPORT INFRASTRUCTURE

In general, the transportation infrastructure is poor throughout Vietnam but especially in the north. Of 105 000 km (65,200 mi) of roads nationwide, about 12 000 km (7,500 mi), or 11 percent, is paved (5,p.84). Many of the roads and bridges were damaged during the country's past three wars (i.e., with China, Cambodia, and the United States) and have yet to be repaired or reconstructed. Hanoi has 385 streets, of which most are paved and 75 percent are 7 to 11 m (23 to 36 ft) wide. The total length of paved streets in the urban area of Hanoi is estimated to be 1790 km (1,112 mi). There is one main ring road that surrounds the city, but it can carry only one lane of traffic in each direction. Bus operations are rather difficult given the narrow width of Hanoi's roads and the extensive use of two-wheeled vehicles.



**FIGURE 2** Congested street in Hanoi filled with bicycles and cyclos (note bicycle tire maintenance hawker on the sidewalk) (photograph courtesy of C. Kuranami).

Roads throughout Cambodia and within Phnom Penh are in desperate need of repair. All of Cambodia's national roads were originally paved with asphalt materials but suffered serious damage during the 1970s and 1980s. Today only 2600 km (1,620 mi)—8 percent of all roads in the country—is paved, and widths range from 4 to 7 m (13 to 23 feet). In Phnom Penh, 188 km (117 mi) out of the city's 488 km (303 mi) of roads is paved. Many of these unpaved roads are in poor condition, and some are impassable for large MVs. This creates an advantage for NMVs and motorbikes, which can be maneuvered more easily than automobiles, trucks, and buses on damaged streets.

Interestingly, Hanoi and Phnom Penh have nearly the same urbanized area and paved road length. However, the paved road supply per population is quite different: 1.7 km (1.1 mi) per 10,000 population in Hanoi, and 2.5 km (1.6 mi) per 10,000 population in Phnom Penh.

### VEHICLE OWNERSHIP

#### Hanoi

Although bicycles have not been registered in Hanoi since 1975, estimates by various government officials place their number at about 1 million (Table 1), equivalent to a bicycle ownership level of 0.91 per person. Consequently, bicycles make up about 85 percent of all vehicles in the city, and, after combining them with motorbikes, the number of two-wheeled vehicles represents over 95 percent of all vehicles.

Although some motorbikes in Hanoi are used for public transit services, most units are privately owned for personal use. The motorbike ownership level is 0.12 vehicle per person. Because a significant portion of the number of automobiles are owned by the government for official use, Hanoi's nongovernment automobile ownership level is likely below the calculated 0.03 vehicle per person. Hanoi does not have any metered taxicabs.

Cyclos, used for passenger or freight transport, or both, account for less than 0.5 percent of all vehicles. Ox carts, prohibited within the city of Hanoi, are produced and used in the surrounding rural areas for goods movement.

Xelams (which are three-wheeled motorized taxis) account for the majority of motor vehicle public transit trips in Hanoi. Xelams resemble the tuk-tuks of Thailand except that the passenger area of the xelam is slightly larger, with two longitudinal bench seats capable of holding 6 to 10 passengers, who must enter from the rear of the vehicle.

Only 160 buses out of 480 units in Hanoi are operational, corresponding to one bus for every 7,000 residents. Most of the buses are not in working condition because there is a shortage of parts to repair them. This situation contributes to the general perception that bus service is poor and unreliable. Tram service was recently terminated because of a lack of spare parts.

#### Phnom Penh

In Phnom Penh, bicycles account for 47 percent of all vehicles in the city. Although their number is considered to be increasing, bicycle ownership is a low 0.17 unit per person. There are still a few hundred bicycles being used for public transport in Phnom Penh, but they are quickly disappearing. Bicycles and motorbikes

TABLE 1 Vehicles by Type in Hanoi and Phnom Penh

| Vehicle Type  | Hanoi <sup>a</sup> |         | Phnom Penh <sup>b</sup> |         |
|---------------|--------------------|---------|-------------------------|---------|
|               | Number             | Percent | Number                  | Percent |
| Bicycle       | 1,000,000          | 84.6    | 125,000                 | 47.1    |
| Cyclo         | 5,100              | 0.4     | 11,136                  | 4.2     |
| Oxcart        | 0                  | —       | 500                     | 0.2     |
| Motorbike     | 128,000            | 10.8    | 115,775                 | 43.6    |
| Xelam         | 1,667              | 0.1     | 0                       | —       |
| Auto Rickshaw | 0                  | —       | 100                     | 0.0     |
| Automobile    | 35,000             | 3.0     | 11,049                  | 8.6     |
| Truck         | 11,800             | 1.0     | 1,937                   | 0.7     |
| Bus           | 160                | 0.0     | 23                      | 0.0     |
| Total         | 1,180,860          | 100.0   | 265,520                 | 100.0   |

<sup>a</sup>As of June 30, 1991, according to the Ministry of Transport, Communication, and Post.

<sup>b</sup>As of May 31, 1992, according to the Department of Roads and Bridges.

combined make up more than 90 percent of all vehicles. The number of cyclos is slightly higher than that of automobiles, but trucks outnumber oxcarts by about 4 to 1.

With only one bus for every 32,000 people, Phnom Penh is essentially a city without bus service. Consequently, the city's public transport system is largely based on the cyclo, which outnumber all other forms of public transit in the city with one for every 70 residents. Most cyclos are found in poor residential areas of Phnom Penh and near work places. Very few can be seen in agricultural areas where population densities are low. Motorbike taxis are the most popular form of motorized public transit. Like Hanoi, there are no automobile taxis.

When Phnom Penh, like all of the Cambodia, was closed to the rest of the world (except China) during the late 1970s, MV use basically disappeared. Although firm data are unavailable, casual observations over the past few years indicate that MV ownership and use, especially that pertaining to motorbikes, has rapidly expanded in Phnom Penh. The city's traffic environment, previously dominated by bicycles and cyclos with fewer motor vehicles, will

soon be inundated with motorbikes. As of June 1992, the numbers of motorbikes and automobiles in Phnom Penh were nearly even with the number of bicycles and cyclos, respectively.

Phnom Penh has a small number of three-wheeled motor vehicles called auto rickshaws. Interestingly, these vehicles have two wheels and a wooden cart in front of the driver (single wheel in rear), and a small engine between the driver and the wooden cart powers the front axle. These auto rickshaws are produced locally and used to transport freight.

#### NMV USE

##### Modal Split

In Hanoi, bicycles are the main mode of transport during the peak period and clearly dominate all other forms of transport (Table 2). However, it is important to note that the 36 percent MV share observed in a 1991 survey (not including pedestrians) in Hanoi's

TABLE 2 Pedestrian and Vehicle Volumes in Hanoi and Phnom Penh

| Mode                 | Hanoi <sup>a</sup> |         | Phnom Penh <sup>b</sup> |         |
|----------------------|--------------------|---------|-------------------------|---------|
|                      | Number             | Percent | Number                  | Percent |
| Pedestrian           | 582                | 7.1     | 242                     | 5.1     |
| Handcart             | 0                  | —       | 6                       | 0.1     |
| Bicycle              | 4,578              | 55.8    | 1,237                   | 25.9    |
| Cyclo                | 321                | 3.9     | 1,116                   | 23.4    |
| Motorbike            | 2,377              | 29.0    | 1,721                   | 36.1    |
| Xelam                | 49                 | 0.6     | 0                       | —       |
| Auto Rickshaw        | 0                  | —       | 9                       | 0.2     |
| Automobile and Truck | 230                | 2.8     | 434                     | 9.1     |
| Bus                  | 66                 | 0.8     | 8                       | 0.2     |
| Total                | 8,203              | 100.0   | 4,773                   | 100.0   |

<sup>a</sup>Survey was conducted by the principal author at two locations on a major thoroughfare during the evening peak hour (4:15 p.m. to 5:15 p.m.) on June 30, 1992.

<sup>b</sup>Survey was performed by a local consultant on a major thoroughfare during the morning peak hour (6:30 a.m. to 7:30 a.m.) on May 24 and 25, 1992.

Ba Dinh and Dong Da districts (one location in each district) is greater than the 27 percent share observed from average daily traffic counts of 1 year before in the same two districts (four locations in the Ba Dinh District and five locations in the Dong Da District) (6,p.21). This finding suggests that MVs, namely motorbikes, have been increasing in number and use in Hanoi, although such a comparison between the two surveys may be influenced by the various time segments involved (i.e., the 1992 survey was a peak-hour count and the 1991 survey was a daily count). Cyclos, which represent less than 0.5 percent of all vehicles in Hanoi, accounted for 4 percent of all vehicles observed in the roadside peak-hour traffic counts. This corresponds to a very high cyclo utilization rate.

Although the bicycle ownership level in Phnom Penh is higher than that for motorbikes, roadside traffic counts indicate that there are more motorbikes than bicycles on the city's streets today (Table 2). As shown earlier, 47 and 44 percent of all vehicles in Phnom Penh are bicycles and motorbikes, respectively. Yet recent roadside traffic counts during the morning peak hour demonstrate that bicycles made up 27 percent of vehicular traffic and motorbikes accounted for 38 percent. Although cyclos make up only 4 percent of the total number of vehicles in Phnom Penh, they are the most highly used vehicles, accounting for 25 percent of all observed vehicular traffic.

### Impact of Rainy Weather

During brief yet heavy rainstorms, many streets in Hanoi and Phnom Penh become flooded. However, traffic continues and people still ride bicycles, cyclos, and motorbikes during the rain showers. In terms of travel behavior, rainy weather has little impact. Pedestrians walk in the rain at a normal pace without umbrellas. One can sometimes observe a cyclo carrying a passenger with his or her stalled motorbike, presumably because the spark plugs became wet and the engine could not refire. This is an ironic situation in which the NMV performs better than the MV—a motorbike in this case—in terms of performance and reliability.

### NMVs and Tourism

NMVs are considered important for the development of tourism in Hanoi and Phnom Penh because many tourists prefer to rent bicycles or hire cyclos in which they then travel around the city. This is true except during the peak periods when riding a bicycle in heavily congested conditions can be dangerous for inexperienced riders. Advantages of cyclos are that they can operate on narrow streets where cars and buses may not be able to go, they move slowly and allow one to view one's surroundings more easily than in a speeding car, and they enable one to easily keep one's bearings and know where one is in the city. With an increase in tourism, there is great potential for the increased use of cyclos by tourists visiting Hanoi or Phnom Penh.

### SAFETY AND ACCIDENTS

Although most government officials in Hanoi complain that bicyclists account for 50 to 90 percent of all traffic accidents, statistics gathered from the Hanoi Bureau of Traffic Police (Table 3) suggest otherwise. According to these figures, bicycles and cyclos combined were responsible for only 11 percent of all reported traffic accidents in 1991 even though they make up about 60 percent of all vehicles plus pedestrians observed in traffic. Motorbikes were the leading cause of accidents, responsible for 61 percent of the total, far exceeding their traffic composition rate of 29 percent.

The figures shown for Phnom Penh are the number of vehicles by type damaged in traffic accidents, according to the Phnom Penh Police Commissariat. Bicycles and cyclos combined represented fewer than 10 percent of all damaged (involved) vehicles even though they make up slightly more than 49 percent of all vehicles plus pedestrians observed in traffic. As in Hanoi, motorbikes accounted for the majority of involved vehicles at 71 percent, much higher than their traffic share of 36 percent.

According to these figures, NMVs perform significantly better than MVs in terms of accident avoidance and safety in Hanoi and Phnom Penh. Although the number of responsible or damaged

TABLE 3 Vehicles Responsible for or Involved in Traffic Accidents in Hanoi and Phnom Penh, 1991

| Vehicle       | Hanoi <sup>a</sup> |         | Phnom Penh <sup>b</sup> |         |
|---------------|--------------------|---------|-------------------------|---------|
|               | Number             | Percent | Number                  | Percent |
| Bicycle       | 48                 | 11.0    | 20                      | 7.5     |
| Cyclo         | 0 <sup>c</sup>     | —       | 5                       | 1.9     |
| Motorbike     | 265                | 60.6    | 190                     | 71.4    |
| Xelam         | 21                 | 4.8     | 0                       | —       |
| Automobile    | 13                 | 3.0     | 51                      | 6.7     |
| Truck and Bus | 90                 | 20.6    | 0                       | —       |
| Total         | 437                | 100.0   | 266                     | 100.0   |

<sup>a</sup>These figures correspond to vehicles deemed responsible for traffic accidents in 1991, according to the Hanoi Bureau of Traffic Police.

<sup>b</sup>These figures correspond to vehicles reported damaged from traffic accidents in 1991, according to the Traffic Police Direction of the Phnom Penh Police Commissariat.

<sup>c</sup>The 48 accidents listed above for bicycles include those for cyclos.

vehicles reported in these tables is probably far lower than the total number of accidents that actually occurred in these cities in 1991, there is no reason to believe that any one of these modes should be singled out as having a different share of responsibility for unreported accidents, which most likely involve minor or no injuries. Usually traffic police in these cities report an accident only if injuries are considered serious or if the parties involved cannot agree on a settlement.

One important issue regarding traffic safety in Phnom Penh is that many of the current residents migrated to the city from rural areas in recent years and still do not understand the dangers associated with high-volume traffic. Many have little knowledge about or little regard for traffic safety. Although some attempts have been made to educate the public, such as a traffic safety campaign with weekly announcements on TV and other uses of mass media, people generally ignore them.

## COSTS

### Acquisition Prices

NMVs in Hanoi and Phnom Penh are, for the most part, produced locally and are very inexpensive compared with MVs. Although the average price for a new bicycle in Hanoi is 400,000 dong (U.S. \$36, according to the exchange rate in June 1992), a secondhand one costs about 100,000 dong (U.S. \$9). The average costs for new and secondhand bicycles in Phnom Penh are about 48,000 and 30,000 riel (U.S. \$38 and \$24), respectively.

In contrast, new motorbikes and automobiles are imported and subject to import duties, which average 100 percent. New motorbikes cost about 18,500,000 dong (U.S. \$1,680) in Hanoi and 1,435,000 riel (U.S. \$1,150) in Phnom Penh. Secondhand motorbikes cost about half in both cities. Automobiles are far beyond the range of affordability for the majority.

### Annual Registration Fees

In Hanoi, so-called traffic fees were introduced in November 1991. Although bicycles are exempt, cyclo owners are required to pay 4,000 dong/month (U.S. \$0.36), equivalent to U.S. \$4.36/year. This is more than twice the fee imposed on a 50-cc motorbike, 1,500 dong/month (U.S. \$0.14), or only U.S. \$1.64/year. It appears that the authorities are discouraging cyclo use and encouraging motorbike use through discriminatory pricing methods. Likewise, oxcarts in the urban periphery are charged a relatively high 10,000 dong/month (U.S. \$0.91) or nearly U.S. \$11/year. The rate for automobiles is exactly twice this.

Vehicle registration fees were also introduced in Cambodia in 1991. Bicycles and oxcarts are exempt, but cyclo owners are required to pay 500 riel/year (U.S. \$0.40), almost equal to the monthly rate in Hanoi. Motorbike owners pay two to four times this fee, depending on engine displacement, and car owners pay about 20 times as much. It appears that the registration fees in Phnom Penh are based on the ability of owners to pay, not on the desired side effects as in Hanoi.

### Rental Fees

In Hanoi, cyclo drivers typically own their vehicles. One exception is if they work for a hotel, from which they then rent the

hotel-owned cyclo; however this is uncommon. On average, a cyclo driver earns about 10,000 to 50,000 dong/day (U.S. \$1 to \$5).

Most cyclo drivers in Phnom Penh rent their vehicles for about 400 riel/day (U.S. \$0.32), and their average daily incomes are about 2,500 to 3,750 riel (U.S. \$2 to \$3). Considering that the annual GNP per capita in Vietnam and Cambodia is U.S. \$200, cyclo drivers in Hanoi and Phnom Penh earn above-average incomes. In fact, in 1992 cyclo drivers in Phnom Penh made about 10 times the fixed monthly salary of government employees. From this perspective, it is evident that cyclos are an important part of the local economy.

## FARES

### Public Transport

In Hanoi, all passenger transport options for a 2-km (1.2-mi) trip cost about 2,000 dong (U.S. \$0.18). For trip lengths less than 1.5 km (0.9 mi), cyclos and xelams are cheapest, charging about 1,000 dong/km (U.S. \$0.15/mi). When trip lengths exceed 2 km (1.2 mi), the 50- to 70-cc motorbike and bus have the least expensive fares—1,500 dong (U.S. \$0.14) and 2,000 dong (U.S. \$0.18), respectively—because they have flat rates controlled by the city government. Motorbikes or motorcycles with engine displacements greater than 70 cc charge a flat rate of 2,000 dong (U.S. \$0.18). Because the availability of motorbikes for public transit is far greater than that for buses, motorbikes are widely patronized.

In Phnom Penh, buses are the cheapest form of public transit at 5 riel/km (U.S. \$0.006/mi), but because of their usual unavailability people must choose other modes. Cyclos, in some cases capable of carrying up to six or more passengers and always readily accessible, are the most frequently used public transit vehicle, charging at least 10 times the bus fare. This fare increases according to the number of passengers, but as with all forms of informal public transit in Phnom Penh (and Hanoi), rates are negotiable. Motorbike tax fares average 70 riel/km (U.S. \$0.09/mi), slightly higher than those for cyclos.

### Freight Transport

In Hanoi, freight transport is handled mainly by bicycles, cyclos, small tractors, and trucks. Occasionally xelams are used. Bicycles hauling goods are a common sight in Hanoi, but usually the bicyclists are hauling their own goods to and from the market. Most bicycles are equipped with a flat metal brace anchored above the rear fender. This brace can be used as a platform to support large straw baskets and other vessels for transporting goods. People carry all sorts of cargo, mostly agricultural products, in these containers. Specially reinforced bicycles can carry loads of up to 250 kg (550 lb).

Cyclos are used in Hanoi for transporting agricultural products in addition to carrying much heavier loads, especially when distributing goods between warehouses and retail outlets. One can observe cyclos transporting as many as five full metal kegs, a dozen coat racks, two or three rolls of carpet, a few bed mattresses, or long pieces of timber. In transporting these heavier loads, which can amount to as much as 350 kg (770 lb), cyclos compete with small tractors and sometimes with xelams. Govern-

ment officials estimate that cyclos charge about 10,000 dong/ton-km (U.S. \$1.33/ton-mi). Trucks normally handle loads that exceed the capacities of cyclos, small tractors, and xelams.

Besides carrying passengers, cyclos in Phnom Penh are also used to deliver goods to stores and from the river port to distribution points such as shops, markets, and warehouses. Traffic authorities estimate that cyclos charge about 5,000 riel/ton-km (U.S. \$5.85/ton-mi). In many cases, people employ bicycles or handcarts to deliver goods over relatively short distances. Bicycles are commonly utilized to transport agricultural products whereas handcarts carry mainly firewood and other bulky objects. The use of oxcarts can be observed in the urban periphery, seldom within the city itself. As with passenger transport fares, fees for goods movement in Phnom Penh and Hanoi are negotiable.

## NMV REGULATIONS

As mentioned earlier, oxcarts are prohibited from operating within the city of Hanoi. Occasionally they can be seen on the main ring road, but they do not penetrate the city. Some streets in Hanoi do not allow truck, bus, or tractor traffic, but all roads are open to bicycles and cyclos, both of which are expected to follow the same basic traffic rules as MVs.

In Phnom Penh, 62 traffic regulations were approved by the local government on August 31, 1991 (7,p.1). One of these regulations calls for NMVs to operate on the far righthand side of the road with motorbikes and not to occupy the lanes near the centerline (as in Vietnam, vehicles in Cambodia travel on the righthand side of the road). The lefthand lanes are supposed to be used only by automobiles, trucks, and buses. However, like all other traffic regulations, there is little enforcement and very little public knowledge or understanding of the restriction. Therefore, this and other traffic rules constantly are being violated.

## NMV FACILITIES

Two relatively wide streets in Hanoi have physically separated lanes for motorized and nonmotorized traffic in both directions for a total length of about 2 km (1.2 mi). These lanes are separated by a raised curb, with MVs to occupy the center lanes and NMVs to travel in the righthand lanes. While motorized traffic stays in its designated area, NMVs can be found operating in both lanes. This is the case even when traffic in the NMV lanes is light. There is no enforcement of these lanes to ensure that traffic remains separated.

In Phnom Penh, all vehicles share the same roadways. As mentioned earlier, a regulation requires all NMVs to occupy the far righthand lane, but this does not occur in practice. Currently there are no physical distinctions between these lanes, and often there is no striping on the streets. As a result, many vehicles make weaving movements when overtaking and passing slower-moving vehicles.

## LOCAL GOVERNMENT ATTITUDES AND POLICIES

### Hanoi

Government officials in Hanoi are now trying to transform the traffic system from nonmotorized to motorized, namely, from bi-

cycle and cyclo to bus and xelam. The most frequent argument is that high bicycle and cyclo use slows down motorized traffic and results in an underutilization of the capacity of Hanoi's streets. Motorized transport other than motorbikes cannot develop in line with its potential capacity, and this actually serves to reinforce NMV and motorbike use.

Officials at the Hanoi Office of Transport and Urban Public Works have calculated the "interruption" of NMVs and certain MVs to traffic in terms of the road area taken up by one bus passenger. On the basis of these figures, officials argue that greater bus and xelam patronage, through a change in mode choice, would reduce the number of vehicles on the streets and consequently reduce traffic congestion. Currently, city government officials are appealing to the national government to allow a competitive policy for buses. Since the local government does not have funds to compensate for city bus operating losses, it is constantly losing money and thereby fueling inflation.

Officials expect the speedy development of MVs to displace NMVs by the end of 1997. At that time they expect bus and xelam service to be superior to that of NMVs, and subsequently they plan to abolish all NMVs within the city of Hanoi by 2004 after "gradually moving all bicycles out of the city." With these future changes in mind, government officials want to inform the public that NMVs are limited in their activities and should be required to obey certain traffic rules and regulations; for example, operators of NMVs used for passenger transport should be organized and belong to an association or cooperative.

### Phnom Penh

In Phnom Penh, government authorities would like to phase out the use of cyclos over the next few years. Their rationale is that cyclos are unsafe for passengers because they sit in front of the driver and the driving behavior of the operator is generally poor. However, exposed to the possibility of a different cyclo design, such as that found in Bangladesh, India, and parts of Thailand, where pedicab passengers are seated behind the driver, the same government officials said that such an option would require consideration and may be acceptable.

Passenger safety, however, is not the only issue. Some officials argue, like those in Hanoi, that cyclos slow down motorized traffic and that cyclo drivers do not obey traffic rules. Other disadvantages cited by government officials include the disorganization of cyclo drivers, incidents in which cyclo drivers are intoxicated or discourteous, and the difficulty in controlling fares. However, in December 1993, the Cambodian Conductors' Association (CCA) was established with private donations to provide drivers of cyclos and motorbike taxis with cheap meals and accommodations if homeless; the CCA also aims to educate its member drivers about traffic regulations (8,p.4). Clearly, this is a step in the right direction.

## OPTIONS FOR IMPROVEMENT

### General

Although bus service in Hanoi needs to be improved, abolishing NMVs from operating in the city may not be the answer. Such a declaration would likely cause many social problems because peo-



ple who could not afford motorbikes would suddenly be dependent on transit with all the associated limitations and inconveniences. For example, how would someone carry a large basket of fruit or live fowl on board a crowded bus or xelam, or while hanging onto the back of a motorbike? All of these situations are very difficult, thus requiring a change in distribution methods that could better be achieved through the implementation of a comprehensive long-term transport plan that considers NMVs and MVs. Any rule prohibiting NMVs would also have to be strictly enforced if it is to be followed.

Officials in Phnom Penh also want to encourage bus use, but many residents of Phnom Penh also carry bulky commodities with them when they travel, making bus transport particularly inconvenient. Furthermore, the general population does not understand the purpose of urban mass transit, which has a bad reputation because its users generally are considered to have low status in the community.

Instead of discouraging and abolishing NMVs from the streets of Hanoi and Phnom Penh, government officials should consider a plan that would both improve bus service and meet the needs of NMV users. This could be accomplished by incorporating NMV facility planning into the conventional urban transport planning process, thereby providing a framework to supply basic NMV facilities. Early action is required to protect the interests of NMV users and ensure improvement of the overall urban transport system.

### NMV Facility Planning

It is recognized that motorization is both a by-product of and an impetus for economic development and growth, but burdening NMV users, who are disproportionately represented by the poor, by restricting their mobility through NMV regulations seems counterproductive. The needs of both MV and NMV users should be met, and this requires the simultaneous planning of both MV and NMV facilities. Such comprehensive planning enables close integration between transport services, such as bicycle- or cyclo-to-bus, as well as an understanding of the patronage each mode receives and the dynamics of competition and complementarity among modes.

### NMV Network and Routing

Just as NMV planning should be performed in conjunction with the planning for other transport modes, the NMV network should be prepared in conjunction with design of the overall transport network. This NMV network should consist of continuous NMV routes that are consistent with NMV operators/users' origin-destination pairs. Similarly, these routes should provide a relatively direct and convenient path between trip ends and not be circuitous or "spotty" in nature. When generating an NMV plan, the responsible agency should consider both spatial and temporal separation measures.

### Spatial Separation Measures

The two types of NMV facilities recommended here are NMV lanes (a) delineated by pavement markings and (b) designated by

barriers. With the first type, NMVs and MVs are provided separate lanes of travel, but there is no physical barrier to prevent an MV from encroaching in the NMV lane or vice versa. As a result, the use of NMV lanes with pavement markings will be effective if motorists and NMV operators are well disciplined and stay within their respective lanes.

The simplest pavement marking is a single, solid line of bright color, and it should be used consistently throughout the city for this purpose; the color (e.g., white or yellow) should be determined by local authorities, consistent with prevailing color schemes used in traffic control. It is recommended that road paint be used for lane markings and repainting be performed whenever necessary and financially feasible. This type of lane striping has been successfully implemented in the Indian city of Kanpur, with NMVs and MVs naturally separating along this inherently perceived boundary (9).

However, if traffic violation rates significantly reduce the practical capacity or safety, or both, of such lanes, it may be necessary to upgrade the facility by installing steel railing, vertical posts, raised curb, or another form of physical barrier. This technique of NMV facility planning, to initially designate NMV lanes with pavement markings, ensures that the potentially most cost-effective solution is implemented, and if indeed effective, these NMV lanes should satisfy the transport needs of NMV operators or users and improve traffic flow and road safety.

With the second type of NMV lane, MVs are physically prevented from encroaching on the NMV facility. These NMV lanes should perform better in terms of traffic flow because of the reduction in friction from physically separating slow- and fast-moving vehicles. However well-designed NMV lanes delineated by pavement markings may outperform poorly designed NMV lanes designated by barriers.

The major drawback with physically separated lanes is that generally they are more expensive to provide initially than striped NMV lanes. However, they may be more cost-effective when considering the potentially lower maintenance costs, fewer accidents, and improved traffic flow. Furthermore, the installation of barriers, such as steel railing, is a low-technology solution that can utilize local labor and materials.

As mentioned earlier, the physically separated NMV facility on a section of road in Hanoi does not effectively prevent NMVs from occupying MV lanes. This failure should be interpreted not as an example demonstrating the difficulty of accommodating NMVs, but as a good example of poor planning (and poor enforcement). Often NMV facilities are implemented where there is space available and in disjointed segments, not where they are needed. This practice should be discontinued in favor of the comprehensive planning process described herein.

### Temporal Separation Measures

Temporal separation measures, such as access restrictions, can be very effective in improving overall traffic safety and congestion in the city. Access restrictions can vary by vehicle and by time of day for any given road facility.

In Shanghai, vehicle access restrictions have been successfully implemented to prohibit MV access to certain roads during morning and afternoon peak periods of travel (10). Such roadways become temporary NMV paths during MV-prohibited hours and are

likely to function more effectively and efficiently than spatially separated lanes.

This type of separation is recommended for corridors with high NMV use where MVs can travel adjacent streets without major inconvenience. If adopted, access restrictions must be well defined and made known to NMV and MV operators through the installation of visible and legible road signs. Movable barriers, such as drums or concrete blocks, may also be utilized to prevent MV access from side streets or driveways.

## CONCLUSIONS

NMVs, which account for a majority of the vehicles observed on the streets of Hanoi and Phnom Penh, are important not only in meeting travel needs, but also in contributing to the livelihoods of many of the cities' residents. However, prevailing biases of local governments toward NMVs may result in the prohibition of NMV use in the near future. Consequently, this conflict should be resolved through an emphasis on balanced transport planning, which includes the needs of MV and NMV users when drafting an urban transport plan. NMVs, in fact, often perform better than MVs in terms of traffic safety and efficiency.

It is important to also recognize that a critical issue concerning transport improvements in Hanoi and Phnom Penh is that funding constraints have severely limited action to date. This could be remedied with appropriate transport infrastructure planning and development projects funded by international aid organizations. When providing funds for such projects, these organizations should take appropriate measures to remedy anti-NMV biases and thereby promote balanced transport planning.

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*Any errors in fact or judgment are the responsibility of the authors.*