

Nonmotorized Vehicles in Ten Asian Cities

Trends, Issues, and Policies



March 1995

Report TWU 20

FILE COPY

The World Bank
Transportation, Water & Urban
Development Department
Transport Division

PADECO Co., Ltd.

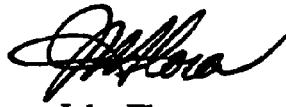
Foreword

One of the most important demographic and social changes in Asia is rapid urbanization. For expanding cities the ability to contribute to macroeconomic performance will largely depend on effective and efficient systems to transport people, goods, services and information. High productivity and rising incomes in urban areas have resulted in pressing demands for motorized forms of mobility; in several Asian countries motorized vehicle populations have been doubling every seven years over the past decades.

The challenge to be confronted in meeting the compelling demand for mobility and accessibility is to define strategies that enhance economic, environmental and social sustainability. Innovative approaches are required to address congestion, automotive pollution and traffic accidents; at the same time mobility of physically or socially disadvantaged people must be improved.

In their strive for modernization many countries neglected the role of traditional transport modes, such as bicycling and walking. However, there is a growing awareness that these low-cost, energy efficient, non-polluting modes have their own role to play in modern transportation systems and an increasing number of industrialized countries are promoting and facilitating their use.

In many Asian cities the role of non-motorized vehicles has not yet been marginalized and there are good opportunities to integrate these modes in more equitable transportation systems. This report identifies a wide variety of factors influencing ownership and use of several types of non-motorized vehicles in various urban settings.



John Flora
Acting Director
Transportation, Water & Urban
Development Department

Acknowledgments

This report was prepared based on a study financed by the World Bank on non-motorized vehicles in Asian cities. It was prepared under the direction of an interdepartmental working group on non-motorized vehicles consisting of John Flora, Paul Gaitink, Peter Midgley, Edward Dotson, Susan Holste, Slobodan Mitric, Richard Scurfield, Peter Ludwig, Richard Barrett, John D. Riverson, Hubert Nove-Josserand, and Shunso Tsukada. Valuable assistance and comments have been provided by them to the authors throughout the study period. The primary authors of this report are Chiaki Kuranami, Bruce P. Winston, and Derek D. Bell of PADECO; additional contributions were made by Yuichiro Motomura and Akio Nakamura. The authors also would like to acknowledge those who provided comments to the earlier drafts, and to extend their gratitude to a number of individuals who contributed at various stages of this study. These included, V. Setty Pendakur, Michael A. Replogle, Tony Hathway, Hirotaka Koike, Walter Hook, Keith Lehrer, Gladys Frame, Cai Jin Xin, S.P. Palaniwami, Fred Wegman, A.D. Pettinga, Wibowo Gunawan, Mohamed I. Kalim, and Teresa Villareal.

The findings, interpretations, and conclusions expressed in this paper are entirely those of the author(s) and should not be attributed in any manner to the World Bank, to its affiliated organizations, or to members of its Board of Executive Directors or the countries they represent. The World Bank does not guarantee the accuracy of the data included in this publication and accepts no responsibility whatsoever for any consequence of their use. The boundaries, colors, denominations, and other information shown on any map in this volume do not imply on the part of the World Bank Group any judgment on the legal status of any territory or the endorsement or acceptance of such boundaries.

CONTENTS

Foreword	<i>i</i>
Acknowledgments	<i>ii</i>
Executive Summary	<i>vii</i>
Introduction	<i>vii</i>
Trends in NMV ownership and use	<i>viii</i>
NMV facilities	<i>ix</i>
Factors influencing NMV ownership and use	<i>x</i>
NMV issues and possible actions by donor agencies	<i>xi</i>
1. Introduction	<i>1</i>
Study background	<i>1</i>
Study approach	<i>2</i>
Structure of report	<i>2</i>
Terminology	<i>5</i>
2. Taxonomy of NMVs	<i>7</i>
Introduction	<i>7</i>
Handcarts	<i>13</i>
Jinrikishas	<i>13</i>
Animal carts and carriages	<i>14</i>
Bicycles	<i>14</i>
Bicycles with trailers	<i>14</i>
Cycle-rickshaws	<i>15</i>
3. NMVs in Case Study Cities	<i>17</i>
Introduction	<i>17</i>
Phnom Penh	<i>17</i>
Hanoi	<i>18</i>
Dhaka	<i>18</i>
Kanpur	<i>19</i>
Shanghai	<i>19</i>
Surabaya	<i>20</i>
Metro Manila	<i>20</i>
Chiang Mai	<i>21</i>
George Town	<i>21</i>
Tokyo	<i>22</i>

4. Analysis of Existing Situation and Trends	23
Ownership and use	23
Levels of service	28
Safety	28
Vehicle acquisition prices	29
Operating and maintenance costs	31
Manufacturing and spare parts sector	32
Registration, licensing, and regulation	33
NMV facilities	35
5. Factors Influencing NMV Ownership and Use	39
Overview of the factors	39
Affordability of NMVs	39
Attractiveness of NMVs compared to other modes	40
City size and urban form	41
Safety of NMV use	41
Risk of NMV theft	42
Social attitudes toward NMVs and other cultural factors	42
Topography	42
Climate	42
Environmental concerns	43
Tourism promotion and recreation	43
Governmental policies	43
Interaction between and among factors	44
6. Issues, Policies, and Possible Actions by Donor Agencies	47
Overview	47
Lack of appropriate facilities	47
NMVs and congestion	50
NMVs and road safety	51
NMV theft	52
Over-regulation of NMVs	53
Lack of compliance with traffic regulations by NMV users	54
Affordability of NMVs for the poor	54
NMVs and economic development	55
NMVs and the environment	56
NMVs and energy	57
NMVs and land use	57
Low priority accorded NMVs	59
Policy biases against NMVs	59
Inappropriate allocation of funds for NMV facility improvement	60
Inappropriate pricing/tax policies in the urban transport sector	61
Lack of data, analytical techniques, and engineering guidelines	62

Box

- 1-1 Topics covered in case studies 6**

Figures

- 1-1 Case study cities 3**
- 2-1 NMVs observed in Asian cities 8, 9**
- 4-1 Comparison of vehicles per population among cities inventoried 26**
- 4-2 Comparison of vehicle composition among cities inventoried 26**
- 4-3 Comparison of NMV and motor vehicle traffic shares 26**

Tables

- 1-1 Socioeconomic characteristics of the study cities 4**
- 2-1 Cycle-rickshaw types by design characteristics and geographic location 10**
- 2-2 Physical dimensions and capacities of NMV types 11**
- 2-3 NMV function by NMV type and geographic location 12**
- 4-1 Number of vehicles per 1000 population 24**
- 4-2 Percent of total vehicles (not incl. handcarts) in terms of ownership 24**
- 4-3 Growth rates of NMVs in selected study cities in recent years 25**
- 4-4 Shares of NMV versus motor vehicle traffic on typical NMV-use roads 25**
- 4-5 Average prices of new vehicles (standard model) 30**
- 4-6 Average annual operating and maintenance costs 32**
- 6-1 Issues, policies, and possible actions by donor agencies 48**



Cycle-rickshaws are popular because passengers can carry goods, especially voluminous ones, with them.

Buses in Dhaka are crowded, infrequent, and have a bad image; therefore, middle-income people prefer cycle-rickshaws.



There are an estimated 200,000 rickshaws or one for every 17 people in Dhaka. Rickshaws account for 80-90% of vehicular traffic in the old part of the city.



EXECUTIVE SUMMARY

INTRODUCTION

i Nonmotorized vehicles (NMVs), such as bicycles, cycle-rickshaws, animal carts, and handcarts, are an essential means of moving passengers and freight in many Asian cities, but their future is threatened by factors such as: (i) increased motorization (including the increased use of motorcycles) and a consequent reduction in street space available for safe NMV use, (ii) exclusion of NMV needs in urban transport planning and investment programs, resulting in inadequate facilities for NMVs, (iii) the general trend toward modernization of Asian cities, which promotes attitudes that NMVs are "backward," (iv) the tendency to believe that NMVs are the cause of urban traffic congestion, and (v) increased trip lengths caused by changes in metropolitan spatial structure. NMVs, however, offer non-polluting, low-cost mobility with renewable energy sources, and they are well suited for short trips in most cities in the region regardless of location or size. Since NMVs are labor-intensive modes of transport and effectively use local technologies and skills, they play an important role in providing job opportunities for many people in developing countries. Encouragement of NMVs, therefore, seems appropriate in urban transport programs designed to achieve objectives related to poverty alleviation, air pollution, congestion management, and sustainable development. This study responds to an urgent need to examine NMV needs and opportunities for their development, to determine the conditions under which NMVs can be competitive relative to other transport modes, and to determine how NMVs can be integrated into urban transport systems.

ii In order to advance understanding of the existing situation concerning ownership and use of NMVs, and NMV issues and policies regarding NMVs, a total of ten cities were selected for inventory. The cities were: Phnom Penh (Cambodia); Hanoi (Vietnam); Dhaka (Bangladesh); Kanpur (India); Shanghai (China); Surabaya (Indonesia); Metro Manila (Philippines); Chiang Mai (Thailand); George Town (Penang, Malaysia); and Tokyo (Japan). A wealth of information on vehicle types, NMV ownership, production, use, regulations, costs and fares, facilities, and issues was compiled for each of these cities. This information was collected through an exhaustive literature survey as well as by visits to the cities. Meetings were held with relevant government officials, traffic police, and local researchers, who provided the study team with both historical information and the latest data on NMVs. This extensive database was supplemented with small-scale field surveys, involving roadside traffic counts and interviews with NMV owners/users, both of which were conducted with assistance from local researchers and consultants. Throughout the study, particular attention was paid to ascertaining the factors that influence ownership and use of nonmotorized vehicles and to identifying NMV issues and policies.

TRENDS IN NMV OWNERSHIP AND USE

iii Within the cities studied, bicycles are the most widely owned NMV except in Dhaka where the number of cycle-rickshaws exceeds the number of bicycles. The cities where bicycle ownership is the highest are Hanoi and Shanghai, with ownership levels of 909 and 865 per 1,000 respectively. Both Tokyo and George Town have over 500 bicycles per 1,000 population, while the remaining cities have bicycle ownership levels below 200 per 1,000. The lowest rates of bicycle ownership were observed in Dhaka and Manila, both about 12 per 1,000. Bicycle growth rates appear to be high in the region, with reliable historical data indicating annual average growth rates in bicycle ownership of 5.3 percent in Kanpur (1983-92) and 14.9 percent in Shanghai (1980-90).

iv The growth of bicycle ownership in the study cities is noteworthy, particularly considering the development of exogenous factors tending to suppress NMV ownership. One such factor is that average trip lengths are increasing in the region as cities decentralize. For example, the average trip length in Kanpur increased from 1.4 km in the late 1970s to 3.6 km by 1987. Longer commuting distances are also becoming more common in Shanghai due to the expansion of the city and relocation of industries and housing.

v In many of the lower-income cities bicycles are used extensively to carry goods. Although Shanghai restricts freight haulage by bicycle, in Phnom Penh, Hanoi, Kanpur, and Surabaya bicycles are used by policemen, in mail delivery service, by persons carrying goods to/from markets, by hawkers, and for goods delivery. Bicycles are also used as taxis in Phnom Penh, although motorcycle taxis are becoming increasingly common. In Tokyo, not a low-income city, bicycles are commonly used by the police and by bank and postal workers.

vi The modal share of bicycle in traffic counts tends to be highly correlated with the proportion of total vehicles that are bicycles. Shanghai, Hanoi, Kanpur, and Tokyo all have a relatively high rate of bicycle ownership and a high proportion of bicycle traffic. However, bicycle ownership in George Town is also comparatively high, with bicycles accounting for nearly half of all vehicles but only about 5 percent of all vehicular traffic. The difference in bicycle trip purposes should be noted. In most NMV-dependent, low-income cities, bicycles tend to be used for the entire trip (e.g., for commuting, shopping). However, the major purpose of bicycle use in middle-income cities such as George Town and Chiang Mai is recreational. In high-income Tokyo, bicycles are increasingly used as a feeder mode to rail stations as well as for shopping and other purposes. The rail feeder modal split of bicycle (and motorcycle) in metropolitan Tokyo increased from 2 percent in 1968 to 10 percent in 1988.

vii Dhaka is by far the most dependent on cycle-rickshaws of all the study cities. The "cycle-rickshaw capital of the world" has about 59 cycle-rickshaws per 1,000 persons, while the ratio in all the other study cities was less than 15. Surabaya, Chiang Mai, and Phnom Penh — all with 14-15 cycle-rickshaws per 100,000 — followed Dhaka in terms of the rate of cycle-rickshaw ownership. George Town and Hanoi also have cycle-rickshaws, with 4-6 per 100,000, while there are few left in Manila (0.65) and none in Tokyo (0). Cycle-rickshaw growth rates vary from negative in Surabaya (-0.7 percent, 1985-92) and George Town (-1.2 percent, 1978-92), two cities where the total number of licenses issued is fixed, to 8.8 percent in Chiang Mai, where the local government has adopted a more accommodating attitude toward the mode.

viii Cycle-rickshaws are primarily used as passenger taxis or for small-scale freight haulage (i.e., up to 200-300 kg). Taxi use is more common than freight transport use in most of the study cities, except in Shanghai where cycle-rickshaws are mainly used as freight carriers. Cycle-rickshaws in most of the study cities are used for a variety of trip purposes including work, shopping, and social trips. They are frequently used for relatively short-distance trips and trips in which passengers are accompanied by freight. In some cities (e.g., Kanpur, Dhaka) cycle-rickshaws are used to transport school children with the vehicles carrying up to eight students in one vehicle. In addition, there are a variety of other types of cycle-rickshaws designated for specific uses such as food and beverage delivery.

ix Kanpur, with 2.4 animal carts per 100,000 population, has the highest rate of ownership of animal-drawn carts of all the study cities, although the number of animal carts in Kanpur has been decreasing at an annual rate of 0.7 percent since 1983. Animal carts in Kanpur are used for both passenger and goods transport. A small number of bullock carts are found in Phnom Penh and George Town. Horse-drawn carriages are found in small numbers in Manila and Surabaya.

NMV FACILITIES

x NMV facilities found in the study cities tend to be either exclusive NMV lanes/paths or NMV parking areas. Exclusive NMV lanes are found to varying degrees in Shanghai, Tokyo, Dhaka, Hanoi, Chiang Mai, Kanpur, and Surabaya:

- Shanghai, one of the most advanced cities in Asia in implementing NMV lanes and paths, had a 91-km NMV network in its urban area as of September 1992. This included NMV-exclusive links (including bridges and tunnels), NMV lanes demarcated with a physical barrier (e.g., a raised concrete median, a temporary barrier), and NMV lanes delineated by lane markings.
- Tokyo and other Japanese cities are relatively advanced in providing bicycle networks, with over 70,000 km nationwide. However, most (93.3 percent) bicycle lanes in Japan are shared bicycle/pedestrian facilities.
- Dhaka, the cycle-rickshaw capital of the world, has provided NMV lanes in three locations. The longest, 1 km in length and 3 m wide, was constructed in the 1980s along the Airport Road. It is separated from the main traffic by a 30 cm-high steel rail fence and sidewalk.
- Two relatively wide streets in Hanoi have physically separated lanes for motorized and nonmotorized traffic in both directions. These lanes are separated by a raised curb, with motorized vehicles to occupy the center lanes and NMVs to travel in the right-hand lanes. However, these lanes are not well used at present.
- Cycle-rickshaw/bicycle lanes have been successfully implemented on a bridge over the Nakhonping River in Chiang Mai. The lanes are separated from motorized traffic by a continuous raised curb, and a pedestrian walkway is separated from the cycle-

rickshaw/bicycle lane by a metal fence. This NMV facility, constructed in 1985, has been very successful in terms of traffic performance and safety.

- Kanpur has no officially designated NMV lanes, but the city authorities have been experimenting with yellow lane markings on certain main streets, effectively separating fast and slow vehicles.
- Surabaya also offers few dedicated facilities, but the 1991 Surabaya Urban Transportation Study recommended that the central business district allow for cycle-rickshaws, perhaps by providing exclusive facilities for access to the CBD as well as for their waiting and circulation within the CBD.

xi Dedicated NMV parking facilities were observed in most of the study cities. Countrywide Japan, the world's leading nation in providing advanced NMV parking areas, has established 8,952 bicycle parking facilities, of which 829 are multistory structures and 35 are fully computerized. Bicycle parking facilities are provided on sidewalks, in residential areas, and at common destinations in Shanghai. Nearly all workplaces in the organized sector in the Indian city of Kanpur provide bicycle parking. Roadside parking space is also available near shopping centers and markets; many of these parking spaces are provided for free, but some parking lots are guarded and charge cyclists at daily or monthly rates. Surabaya provides parking facilities for bicycles and cycle-rickshaws at certain locations, such as the city's night markets, transport terminals, and schools. George Town's city government provides cycle-rickshaw parking stands at several locations in the city. Local governments in Metro Manila have designated curb-side parking areas for cycle-rickshaws, usually in residential areas or along side streets. Bicycle parking facilities are provided at large markets in Phnom Penh and Hanoi.

FACTORS INFLUENCING NMV OWNERSHIP AND USE

xii A wide variety of factors have been identified as potentially having an effect on NMV ownership and use, including: affordability of NMVs; attractiveness of NMVs compared to other modes; city size and urban form; safety of NMV use; risk of NMV theft; social attitudes toward NMVs and other cultural factors; topography; climate; environmental concerns; tourism and recreation; and governmental policies. While there are many variables, no one factor is controlling. Rather, cities with relatively high NMV ownership and use are likely to exhibit a combination of favorable factors. Thus, for example, NMV-dependent Shanghai is a city with relatively low bicycle prices in relation to income, employer subsidies for the purchase of NMVs, relatively poor bus service and a low degree of motorization, a concentrated urban form (at least historically), a bicycle-friendly environment, relatively low risk of NMV theft, favorable social attitudes toward NMV use, and relatively flat terrain.

xiii The single and the most important factor influencing NMV ownership and use is governmental policies at various levels because they affect most of the above examined factors except topography and climate. These policies include:

- unbalanced urban transport planning favoring MVs over NMVs (as in Jakarta and Bangkok, but not in Shanghai);
- low-interest loans and subsidies for the acquisition of NMVs (Shanghai and Kanpur);
- policies promoting (China and Vietnam) or adversely affecting (e.g., Bangladesh's high tariffs on bicycle parts) NMV industries;
- the relative taxes charged MVs and NMVs (e.g., favoring MVs in Bangladesh, but favoring NMVs in China);
- the construction of NMV (network and parking) facilities by the government or by the private sector under public-private cost sharing schemes (Kanpur, Shanghai, and Tokyo);
- investment in mass transit systems, neglecting the complementary potential of NMVs;
- registration and licensing regulations, which may either burden NMVs (as in Surabaya and Jakarta) or may promote NMVs (as with Shanghai's theft-preventing bicycle registration system);
- traffic regulations, which may aid NMVs by promoting a safer environment (as in Shanghai) or may hinder NMVs (as in Dhaka, where NMVs are banned from certain "VIP roads");
- the level of traffic enforcement and education of users (e.g., high in Japan, low in Cambodia); and
- land use policies, which may promote NMVs by concentrating residences and workplaces (e.g., Shanghai's traditional approach) or which may discourage NMV use by decentralizing cities (e.g., Shanghai's current approach of developing satellite towns).

Appropriate governmental policies can be formulated and implemented through urban transport planning, provision of loans and subsidies for NMV acquisition, NMV/MV pricing policies, and provision of NMV facilities.

NMV ISSUES AND POSSIBLE ACTIONS BY DONOR AGENCIES

xiv Major NMV issues have been distilled from the ten case studies prepared during the course of this project. Sixteen issues have been identified, falling into four basic categories: urban transport system issues; regulatory issues; economic, social, and environmental issues; and general NMV planning and policy issues. The following paragraphs summarize possible actions by donor agencies to address major issues.

xv *Assist National and Local Governments through Funding and Technical Assistance for the Provision of Adequate NMV Facilities:* Donor agencies should support the development of improved NMV facilities in cities where NMVs account for a significant share of vehicular traffic. Such

support could take the form of technical assistance and loans to facilitate, among other things, institutional capacity building and the provision of continuous, coherent, direct, attractive, safe, and comfortable NMV networks.

xvi *Support Programs to Improve NMV Safety:* In their urban transport programs, donor agencies should consider supporting measures to improve road safety, including targeted efforts to improve traffic management and enforcement, improve NMV road safety equipment, and establish safety education programs.

xvii *Support Technical Assistance and Loan Programs to Increase NMV Ownership by the Poor:* On both efficiency and equity grounds, donor agencies should consider encouraging local governments to promote NMV ownership among the poorest of the poor. Interventions might include establishing revolving funds offering credit for the purchase of bicycles and cycle-rickshaws, encouraging employers to subsidize employee purchases of bicycles, and promoting the use of bicycles for commuting.

xviii *Assist Local Governments in Adopting Appropriate Policies to Promote NMV Assembly and Manufacturing Industries:* In their programs to assist urban transport and industrial sector projects in NMV-dependent cities in Asia, donor agencies should recognize the vital importance of NMVs in local economies. Donor programs should support NMV use and production; trade policies that unduly restrict the importation of NMV parts should be scrutinized and changes recommended. Donor agencies should also finance a research project to define more accurately the economic impact of NMV industries, including multiplier effects.

xix *Initiate Research on the Economic Impact of NMVs and MVs on the Environment:* In order to devise defensible pricing/tax policies that would require transport system users, particularly MV users, to pay for the environmental costs they impose on others, donor agencies should support research to gauge (1) the magnitude of these environmental costs in economic terms and (2) the extent to which these economic costs can be attributed to particular modes of transport. The output of the research should enable informed judgements with respect to the magnitude and types of taxes to be assessed to cause vehicle users to "internalize" the environmental costs caused by their vehicle use.

xx *Initiate Study to Define the Energy Impact of NMVs:* With the understanding that fuel saving is one (albeit only one) consideration in choosing among alternative urban transport policies, it is recommended that donor agencies initiate studies in order to define more precisely the extent of potential fuel savings from diverting MV travelers to NMVs in Asian cities wherever practical.

xxi *Encourage Planned Urban Development and the Use of NMVs as a Feeder Mode for Public Transport:* In order to promote NMV use and other objectives, donor agencies should support planned urban development policies that reduce commuting distances, although such policies require careful scrutiny in order to avoid possible unintended consequences (e.g., frustrating household residential location preferences). Donor agencies should also consider encouraging local governments in Asia to promote the use of NMVs as a feeder mode for public transport, an approach that has been successfully adopted in Tokyo and other cities in Asia.

xxii *Encourage Local Governments to Increase NMV Priority in Transport and Traffic Planning:* As a general proposition, donor agencies should encourage local governments in Asian cities to accord priority to the movement of persons and goods rather than vehicles. Specifically with respect to NMVs, the urban transport programs of donor agencies should support measures that give NMVs a priority that is commensurate with their importance in moving passengers and freight.

xxiii *Remedy Anti-NMV Biases and Redress Unbalanced Transport Planning:* A previous World Bank technical paper has already suggested a number of actions that donor agencies can take to assure that institutions in recipient countries implement appropriate measures to remedy anti-NMV biases and thereby promote balanced urban transport planning. These measures include (1) giving greater emphasis to policy-based lending that encourages modal diversity, (2) requiring transport projects to include appropriate provisions for nonmotorized modes within the project corridor and provide technical support and training for local professionals in nonmotorized transport planning, (3) working in partnership with and providing support to government and non-government organizations at different levels of government, (4) developing expertise on nonmotorized transport in donor agencies, (5) developing special nonmotorized transport focused training, (6) integrating nonmotorized transport into external activities with other multilateral and bilateral agencies, and (7) developing a new "intellectual technology" in nonmotorized transport to be integrated into mainstream thinking. Clearly, many of these measures are worthy and warrant serious consideration. At the same time, it is important to recognize that the solution to unbalanced planning in favor of MVs is not unbalanced planning in favor of NMVs.

xxiv *Encourage Innovative Financing:* Donor agencies should leverage their investments in NMV and other urban transport facilities by encouraging national and local governments to adopt innovative approaches to financing in the sector.

xxv *Provide Technical Assistance to Encourage Governments in Formulating Appropriate Pricing/Tax Policies and Assist in the Provision of Sustainable Transport Systems:* While measures to increase the price of low-occupancy motorized travel are strongly opposed by motorists, such pricing/tax policies clearly promote urban transport efficiency and should be considered.

xxvi *Assist in Developing Transport Systems Models Incorporating Nonmotorized Modes:* In order to address the failure of the current generation of urban transport models to address NMVs adequately, donor agencies should fund the development of a new generation of models specifically targeted to the requirements of the mixed traffic environments of cities in the developing world, particularly in Asia.



NMV lanes are being experimented with along main arterials in Kanpur.

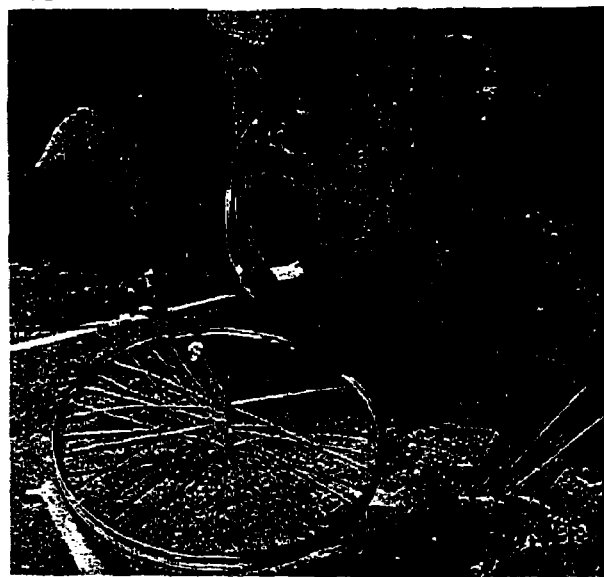
A guarded bicycle parking area near the Kanpur Rail Station. This facility is operated by the private sector on land rented from the city government.



Cycle-rickshaws specially designed for use as school buses in Kanpur. As many as eight children can ride in one vehicle.



The NMV industry provides employment for many people. About 150,000 bicycles are assembled annually in Kanpur.



1

INTRODUCTION

STUDY BACKGROUND

1.1 Nonmotorized vehicles (NMVs), such as bicycles, cycle-rickshaws, animal carts, and handcarts, are an essential means of moving passengers and freight in many Asian cities, but their future is threatened by several factors:

- increased motorization (including the increased use of motorcycles) and a consequent reduction in street space available for safe NMV use;
- exclusion of NMV needs in urban transport planning and investment programs, resulting in inadequate facilities for NMVs;
- the general trend toward modernization of Asian cities, which promotes attitudes that NMVs are "backward;"
- the tendency to believe that NMVs are the cause of urban traffic congestion;
- excessive and often inappropriate regulation of NMV operation, including limitations on NMV ownership and total/partial banning of NMV use; and
- increased trip lengths caused by changes in metropolitan spatial structure.

1.2 NMVs, however, offer non-polluting, low-cost mobility with renewable energy sources, and they are well suited for short trips in most cities in the region regardless of location or size. Since NMVs are labor-intensive modes of transport and effectively use local technologies and skills, they play an important role in providing job opportunities for many people in developing countries. Encouragement of NMVs, therefore, seems appropriate in urban transport programs designed to achieve objectives related to poverty alleviation, air pollution, congestion management, and sustainable development. This study responds to an urgent need to examine NMV needs and opportunities for their development, to determine the conditions under which NMVs can be competitive relative to other transport modes, and to determine how NMVs can be integrated into urban transport systems.

STUDY APPROACH

1.3 In order to advance understanding of the existing situation concerning ownership and use of NMVs, and issues and policies regarding NMVs, a total of ten cities were selected for inventory. The selected cities, shown on a map in Figure 1-1, vary in income, population, motorization, culture, location, and government policy on nonmotorized vehicles. Their respective socioeconomic characteristics are summarized in Table 1-1. The cities were:

1. Phnom Penh (Cambodia);
2. Hanoi (Vietnam);
3. Dhaka (Bangladesh);
4. Kanpur (India);
5. Shanghai (China);
6. Surabaya (Indonesia);
7. Metro Manila (Philippines);
8. Chiang Mai (Thailand);
9. George Town (Penang, Malaysia); and
10. Tokyo (Japan).

1.4 A wealth of information on vehicle types, NMV ownership, production, use, regulations, costs and fares, facilities, and issues was compiled for each of these cities. This information was collected through an exhaustive literature survey as well as by visits to the cities. Meetings were held with relevant government officials, traffic police, and local researchers, who provided the study team with both historical information and the latest data on NMVs. This extensive database was supplemented with small-scale field surveys, involving roadside traffic counts and interviews with NMV owners/users, both of which were conducted with assistance from local researchers and consultants. Throughout the study, particular attention was paid to ascertaining the factors that influence ownership and use of nonmotorized vehicles and to identifying NMV issues and policies. The details of ten case studies are found in the case studies (cf. Box 1-1 for the topics covered in the case studies). This report presents major findings of the case studies and the results of cross-city analysis.

1.5 Several types of nonmotorized vehicles are operated in Asian cities, including bicycles, cycle-rickshaws, carts, and nonmotorized boats. This study, however, concentrated on bicycles, cycle-rickshaws, and carts because these vehicles account for the largest numbers of NMVs used within the studied cities, and therefore pose the most important issues for local policy makers and traffic engineers.

STRUCTURE OF REPORT

1.6 This report includes six sections. Sections 2 to 6 describe major findings from the inventory of NMV needs and opportunities for the ten case study cities:

- Section 2 presents a taxonomy of NMVs observed in case study cities.
- Section 3 describes trends and current levels of ownership and production of both

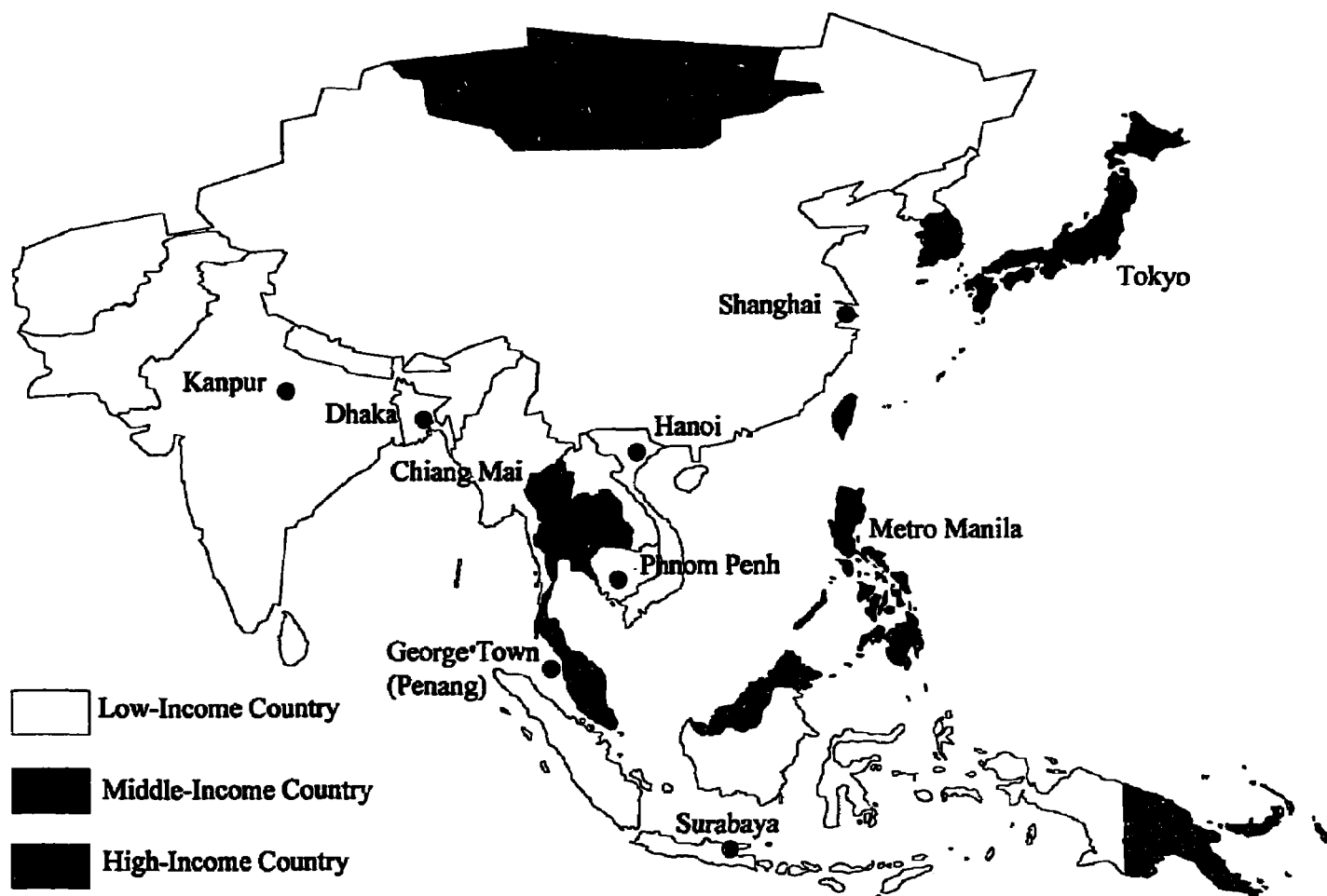


Figure 1-1 Case Study Cities

Table 1-1: Socioeconomic Characteristics of the Study Cities

City	Country GNP/Capita (US\$) 1991 ^a	City Population (million) 1992	City Population Density (pop./km ²) 1992	Energy Use (oil equivalent) 1990 ^b		Country Illiteracy Rate (percentage) 1990 ^c
				kg/capita	GDP output/kg (US\$)	
Phnom Penh	200	0.7 ^d	16,200 ^d	59	2.9	65 ^e
Hanoi	200 ^f	1.1 ^g	25,580 ^g	100	1.4	12
Dhaka	220	3.4 ^h	27,400 ^h	57	3.7	65
Kanpur	330	2.3 ⁱ	7,560 ⁱ	231	1.5	52
Shanghai	370	8.4 ^j	23,470 ^j	598	0.5	27
Surabaya	610	2.7 ^k	9,310 ^k	272	2.2	23
Metro Manila	740	8.4 ^l	13,160 ^l	215	3.3	10
Chiang Mai	1,580	0.2 ^m	2,300 ^m	352	4.2	7
George Town	2,490	0.3 ⁿ	10,250 ⁿ	974	2.4	22
Tokyo	26,920	11.9 ^o	5,450 ^o	3,563	6.7	< 1 ^p

^a The World Bank (1992), *The World Bank Atlas*, 25th Anniversary Edition, pp. 18-19 (except where otherwise noted).

^b *Ibid.*, pp. 26-27.

^c *Ibid.*, pp. 8-9.

^d Estimated from 1990 population of 616,000 and assuming an annual growth rate of 10 percent, according to (1) Ministry of Communications, Transport, and Post, and (2) Asian Development Bank (December 1991), *Economic Report on Cambodia*, p. 2.

^e This figure may be overstated; Cambodia's illiteracy rate was estimated to be 30 percent according to Far Eastern Economic Review (1992), *Asia 1992 Yearbook*, p. 6.

^f This figure is Vietnam's 1990 GNP per capita according to Asian Development Bank (1992), *Asian Development Outlook 1992*, p. 241.

^g United Nations Development Programme (February 1992), National Transportation Sector Review, Volume IX, Urban Transport, UNDP Project VIE/88/040, Socialist Republic of Vietnam, p. 1.

^h Bangladesh Bureau of Statistics.

ⁱ Estimated from 1991 population of 2.2 million and assuming an annual growth rate of 3 percent, according to National Transportation Planning & Research Centre (December 1991), *Comprehensive Traffic and Transportation Studies for Nine Important Cities in Uttar Pradesh*, First Interim Report, Kanpur City, prepared for the Government of Uttar Pradesh, Department of Transport, pp. 2-4 to 2-8.

^j Estimated from 1990 population of 8.2 million and assuming an annual growth rate of 1.5 percent, according to Xu, Kang-Ming (1993), NMT in Shanghai, TRB Preprint Paper No. 931118, p. 2 [citing data from the Fourth National Census].

^k Ministry of Public Works (April 1991), Surabaya Urban Transport Study, Strategic Traffic Model, Directorate General of Bina Marga, in cooperation with Kotamadya Surabaya, Regional Cities Urban Transport Project, p. 7 [citing data from Surabaya Dalam Angka (1988)].

^l National Statistics Office, Metro Manila.

^m These figures correspond to the proposed new municipal area (also the former land use planning area); estimated from 1990 population of 235,549 and forecast 1995 population of 254,947, according to USAID/Thailand (April 1991), Initial Study Findings Report for Chiang Mai Planning Project, Regional Housing and Urban Development Office, Province of Chiang Mai, Department of Technical and Economic Cooperation, Kingdom of Thailand, p. VI-9.

ⁿ Estimated from 1990 population of 254,618 and forecast 2000 population of 283,499 obtained from JICA (September 1987), The Feasibility Study of Computerized Area Traffic Control System in Penang, Malaysia, Technical Report No. 10, Socio-economic Framework for Traffic Projection, for the Government of Malaysia, p. 37.

^o According to population census data.

^p Japan's illiteracy rate is estimated to be 0.3 percent according to Far Eastern Economic Review (1992), p. 6.

nonmotorized and motorized vehicles in each of the case study cities.

- Section 4 presents a cross-city analysis of the existing situation and trends of NMV ownership and use, NMV and motor vehicle (MV) levels of service, safety, costs and prices, NMV industry, regulation and enforcement, and NMV facilities.
- Section 5 analyzes factors influencing NMV ownership and use.
- Section 6 discusses NMV issues, policies, and possible actions by local governments and donor agencies.

TERMINOLOGY

1.7 Throughout this report local terms for nonmotorized vehicles are used to provide some sense of the flavor of the characteristics associated with each type of vehicle in different cities. The English terms "bicycle," "cycle-rickshaw," and "cart" are used as common nouns in the chapters on the various cities, but local names are also used and are shown in *italics*. Cycle-rickshaws are, for example, referred to simply as *rickshaws* in Bangladesh and India, *cyclos* in Cambodia and Vietnam, *becaks* in Indonesia, *pedicabs* in the Philippines, *samlors* in Thailand, and *trishaws* in Malaysia. Horse carriages are called *dokars* in Indonesia and *calesas* in the Philippines.



*Nonmotorized vehicles (NMVs) give way to motorized vehicles.
Shoulder pavement will improve the safety of NMV traffic.*

Box 1-1 Topics Covered in Case Studies*

Background: An overview of socioeconomic characteristics of the study city and the nature of its NMVs is briefly presented with reference to the transport and traffic system of the city.

Vehicle Ownership and Production: This section describes trends and current levels of ownership and production of both nonmotorized and motorized vehicles. Data is presented on both registered and (estimated) unregistered NMVs, trends, and ownership by socioeconomic group. To the extent that information is available, data on the size and characteristics of local NMV manufacturing and assembly industries are provided.

NMV Use: The modal share of NMVs in terms of person trips and traffic is presented in this section. Breakdowns of modal split by trip purpose and trip distance are presented where reliable data is available. This section covers the ways in which each type of NMV is used and the reasons why users prefer to use NMVs instead of alternative modes. Statistics on safety and accidents involving NMVs and on NMV operating characteristics such as travel distances and operating speeds are also summarized. Ways in which NMVs and other modes of urban transport can complement each other are discussed. This section also describes cases where NMVs have been successfully integrated into urban transport systems.

Cost and Fares: Acquisition prices, fares, operating costs, taxes, and duties are shown in this section, which examines influences on the availability and use of NMVs.

NMV Regulation and Enforcement: NMV regulations, such as those pertaining to registration, licensing, and traffic rules and their enforcement, are important factors influencing the ownership and use of NMVs. Some local governments have enacted restrictions or bans on NMV operations, and these are described in this section.

NMV Facilities: The extent and types of NMV lanes and parking facilities are described herein. However, details of recommended design guidelines for NMV facilities (including their physical dimensions) are covered in Part II.

* PADECO Co., Ltd. (June 1993), *Non-Motorized Vehicles in Asian Cities. Part I: Inventory of Needs and Opportunities (Appendices)*, Draft Final Report, The World Bank, Washington, D.C.

2

TAXONOMY OF NMVs

INTRODUCTION

2.1 The results of the NMV inventory showed that NMVs come in a variety of shapes and sizes, and that they are propelled by several physical and mechanical means. However, from a vehicle body and mechanical design standpoint, NMVs observed in Asian cities can be classified into the following eight categories (see also Figure 2-1):

1. handcarts;
2. jinrikishas;
3. animal carts and carriages;
4. bicycles;
5. bicycles with trailers;
6. Type I cycle-rickshaws (pull-type);
7. Type II cycle-rickshaws (push-type); and
8. Type III cycle-rickshaws (bicycles with sidecars).

Within each of these categories, vehicle body and mechanical designs still vary somewhat across cities and regions, especially for handcarts and animal carts and carriages. However, this listing best represents the many different NMVs in Asian cities, and, more importantly, it allows for a more rigorous and comprehensive analysis of NMV performance according to specific NMV design type or "technology." Cycle-rickshaws, three-wheeled single-unit vehicles pedaled like a bicycle, have been classified into three distinct types based on driver orientation and maneuverability (Table 2-1).

2.2 The physical dimensions and effective capacities for each of the eight NMV types are summarized in Table 2-2. Most of these dimensions and capacities are presented in a range of observed values, demonstrating that NMVs within each of these eight NMV types still vary widely. NMVs in cities not inventoried may differ slightly in size or capacity. Nevertheless, it is believed that this table provides a relatively accurate account of NMVs employed in cities throughout Asia.

2.3 NMV function simply refers to whether a particular NMV provides personal, passenger, and/or freight transport service. This is summarized for each of the case study cities in Table 2-3. As discussed earlier and shown in this table, handcarts and animal carts are designed for goods movement while jinrikishas and animal carriages are designed for passenger transport. Bicycles are usually employed for personal transport, but they are also utilized for freight and even passenger

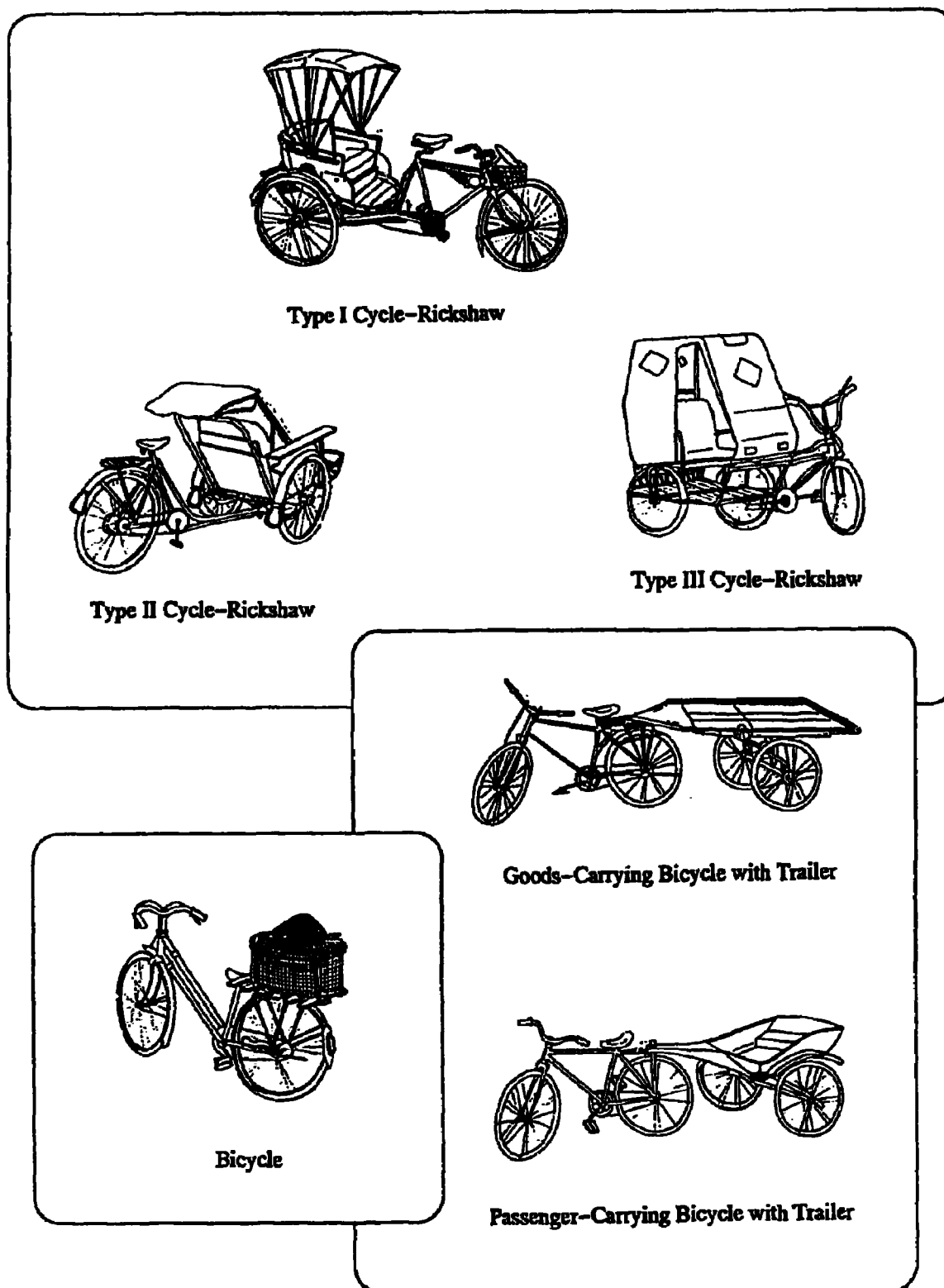


Figure 2-1 : NMVs Observed in Asian Cities

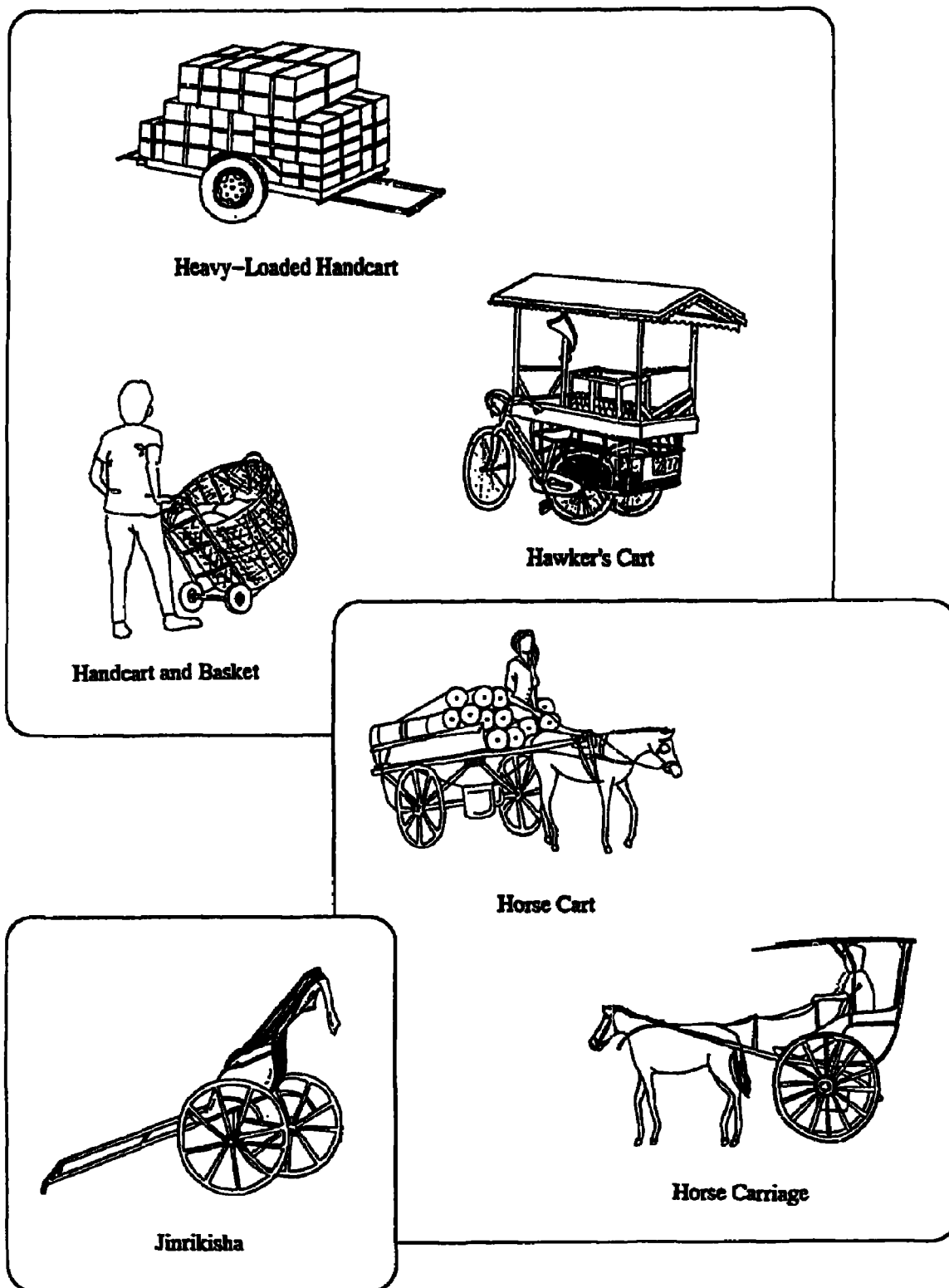


Figure 2-1(continued) : NMVs Observed in Asian Cities

Table 2-1: Cycle-Rickshaw Types by Design Characteristics and Geographic Location

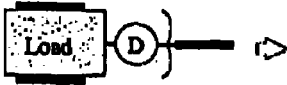
<i>Cycle-Rickshaw Type</i>	<i>Design Characteristics</i>	<i>Plan View Sketch (D = Driver Location)</i>	<i>Geographic Location, City (Local Term for Cycle-Rickshaw)</i>
Type I (Pull-Type)	Driver in Front Load in Back 1 Front Wheel, 2 Rear Wheels		Dhaka (<i>rickshaw</i>) Kanpur (<i>rickshaw</i>) Shanghai (<i>tricycle</i>) Chiang Mai (<i>samlor</i>)
Type II (Push-Type)	Driver in Back Load in Front 2 Front Wheels, 1 Rear Wheel		Phnom Penh (<i>cyclo</i>) Hanoi (<i>cyclo</i>) Surabaya (<i>becak</i>) Chiang Mai (<i>samlor-kin</i>) George Town (<i>trishaw & tricycle</i>)
Type III (Bicycle with Sidecar)	Driver in Left-Center Load in Rear 1 Front Wheel, 2 Rear Wheels		Metro Manila (<i>pedicab</i>)

Table 2-2: Physical Dimensions and Capacities of NMV Types

NMV Type	Physical Dimensions					Effective Capacity		
	Width, W (meters)	Length, L (meters) ^a	Avg. Surface Area Occupied, $A = W \times L$ (m ²) ^b	Height, H (meters) ^c	Weight, Wt (kg) ^d	Number of Wheels	Number of Seated Adult Passen- gers ^e	Maximum Load (kg) ^f
Handcart	0.5-1.5	1.0-4.0	1.0-6.0	0.7-2.0	20-90	2, 3, or 4	0	100-1,500
Jinrikisha	0.9-1.1	2.2-2.6	2.4	1.4-2.1	50-70	2	1 or 2	100-200
Animal Cart or Carriage	1.0-1.5	3.5-5.0	3.5-7.5	1.8-2.5	100-400	2 or 4	2-6	300-1,600
Bicycle	0.6-0.8	1.3-1.9	1.2	1.0-1.2	15-20	2	1	100-250
Bicycle with Trailer	0.9-1.5	2.5-3.0	3.3	1.1-1.2	60-90	4	2 or 4	300-600
Type I Cycle- Rickshaw	0.9-1.2	2.1-2.6	2.5	1.1-1.7	80-90	3	2	250-400
Type II Cycle- Rickshaw	0.9-1.2	2.1-2.6	2.5	1.1-1.5	60-80	3	2	200-350
Type III Cycle- Rickshaw	0.9-1.2	1.4-1.7	1.6	1.0-1.6	40-50	3	2	150-250

^a Lengths for handcarts, jinrikishas, and animal carts and carriages include those of the shafts, persons, and/or animals used to propel the vehicle.

^b Figures for handcarts and animal carts and carriages are presented in a range because their sizes vary significantly and to the extent that use of a single value would be impractical and misleading.

^c Heights do not include driver; ranges in height for jinrikishas and cycle-rickshaws consider non-use and use of each vehicle's fold-down top.

^d Weight is that of the vehicle and does not include that of the driver or animal.

^e This is the passenger design capacity and, except for bicycles, does not include the NMV driver; it should be noted that NMVs were observed carrying passenger loads above their seated design capacities (e.g., cycle-rickshaws carrying two adults and four children).

^f This is the passenger- or freight-load capacity and does not include the weight of the driver, animal, or vehicle.

Table 2-3: NMV Function by NMV Type and Geographic Location^a

<i>NMV Type</i>	<i>Phnom Penh</i>	<i>Hanoi</i>	<i>Dhaka</i>	<i>Kanpur</i>	<i>Shanghai</i>
Handcart	Frt	Frt	Frt	Frt	Frt
Jinrikisha	-	-	-	-	-
Animal Cart or Carriage	Frt (Ox)	Frt (Ox)	Frt (Ox)	Pax (HCrg)/ Frt (Ox)	-
Bicycle	Per/Pax/Frt	Per/Frt	Per	Per	Per
Bicycle with Trailer	Pax/Frt	-	-	-	-
Type I Cycle-Rickshaw	-	-	Pax/Frt	Pax/Frt	Frt
Type II Cycle-Rickshaw	Pax/Frt	Pax/Frt	-	-	-
Type III Cycle-Rickshaw	-	-	-	-	-

^a Note the following acronyms: Frt = Freight, Per = Personal, Pax = Passenger, Ox = Oxcart, HCrg = Horse Carriage, and HCrt = Horse Cart.

Table 2-3 (Continued)

<i>NMV Type</i>	<i>Surabaya</i>	<i>Metro Manila</i>	<i>Chiang Mai</i>	<i>George Town</i>	<i>Tokyo</i>
Handcart	Frt	Frt	Frt	Frt	Frt
Jinrikisha	-	-	-	-	Pax
Animal Cart or Carriage	Pax (HCrg)/ Frt (Ox/HCrt)	Pax (HCrg)	-	Frt (Ox)	-
Bicycle	Per	Per	Per	Per	Per
Bicycle with Trailer	-	-	-	-	-
Type I Cycle-Rickshaw	-	-	Pax/Frt	-	-
Type II Cycle-Rickshaw	Pax/Frt	-	Frt	Pax/Frt	-
Type III Cycle-Rickshaw	-	Pax/Frt	-	-	-

transport in some areas. The remaining NMVs, bicycles with trailers and the three cycle-rickshaw types, provide both passenger and freight transport services in most of the case study cities.

HANDCARTS

2.4 Handcarts are by far the most variable of all NMVs, differing greatly in terms of size, capacity, and use within and between regions. Handcarts are a very labor-intensive mode, often of simple construction with a wooden and/or metal base sometimes equipped with shafts or handles that operators hold onto in order to maneuver the vehicle along the street. For handcarts designed to carry heavy loads, this base is usually supported by four transverse steel rods connected to the axle casing, which contains a steel shaft (i.e., the axle) that connects two pneumatic tires. These carts are often operated by several persons, and some can accommodate loads of up to 1,500 kg. In Dhaka and Kanpur, these carts are sometimes four meters in length and operated by at least four persons. Hawking handcarts are utilized by street vendors to display and transport goods for sale to the general public. These street vendors, or hawkers, usually peddle ready-to-eat food, agricultural produce, locally made goods (e.g., clothing, handbags), cheap merchandise (e.g., tape cassettes, wrist watches), and crafts designed for the tourist market. Often hawking handcarts congregate in specific areas, such as markets and employment centers, and remain stationary throughout the day. There are hundreds of varieties of handcarts, but the two types mentioned above (i.e., heavy-load carts and hawking carts) are the ones most frequently observed in Asian cities. In market areas, dollies and carts that are essentially large baskets on wheels are also commonly used.

JINRIKISHAS

2.5 Jinrikishas, two-wheeled human-drawn carriages designed explicitly for passenger transport, were once used extensively throughout Asia, from about 1870 to 1950.¹ While no longer employed in any of the ten cities (except for a few usually idle ones in the Shimbashi section of Tokyo), they can still be found in significant numbers in Calcutta and in limited numbers at the Star Ferry Terminal in Hong Kong Island's Central District. Jinrikishas are not grouped with handcarts because they have two relatively standard designs, consisting of one- and two-person carriages. Both are equipped with a footrest, fold-down top, and springs. The two wheels, usually pneumatic or made of wood with hard rubber or metal affixed to the rims, are about one meter tall, 50 percent taller than bicycle tires, but have about the same width. The vehicle is drawn by a jinrikisha puller who stands between and holds onto two parallel shafts extending longitudinally from its base. Most jinrikishas in use today have two-person carriages.

2.6 This NMV is particularly labor-intensive because the operator is often required to walk quickly or perhaps run while pulling the jinrikisha to satisfy the travel time requirements of the passenger(s). Because the value of time of the jinrikisha passenger(s) is greater than that of handcart freight, jinrikisha operators generally work under more restricted time constraints than freight handcart operators. However, jinrikisha loads tend to be fairly light compared to those of many handcarts, and this may compensate for pullers' faster walking speeds.

ANIMAL CARTS AND CARRIAGES

2.7 Ox carts, horse carts, and horse carriages comprised the only types of animal carts and carriages observed in the ten cities (the term "ox" includes bullock, buffalo, and any other member of the bovine family used as a draft animal). Ox carts and horse carts, the former of which are often massive in size, are used to move goods. Horse carriages, the most compact of the three, are usually considered by local residents to represent a personalized, comfortable, and upscale mode of public transport. Horse carts and carriages were almost always observed as having one horse per cart or carriage, whereas ox carts commonly had two oxen per cart.

2.8 Most animal carts and carriages have two wheels, although four-wheeled vehicles were observed in some of the cities. These wheels are usually made of wood and are quite tall, similar to jinrikisha wheels at about one meter high or more, but they are at least twice as thick in width. In some cities, such as Hanoi, pneumatic tires are used.² Other animals, such as donkeys, mules, and camels, are known to be used in Asia (e.g., in India, Pakistan, Afghanistan) to draw carts but were not observed in this inventory. In fact, over 300 types of animal carts and carriages used in Asia were identified at a United Nations-sponsored NMV workshop in 1983.³

BICYCLES

2.9 Bicycle design is essentially the same throughout Asia. Bicycles may vary slightly in size and equipped accessories (e.g., gears, hand brakes, lights), but, overall, bicycles are basically a standardized product. Although bicycles with hand brakes and gears are easier to operate than ones without, many of the bicycles operating in the Asian cities surveyed, excluding Tokyo, were not equipped with them. Similarly, most bicycles lacked safety devices such as headlights, reflectors, bells, and locks.

2.10 While bicycles are used in developed countries primarily as a means of personal transport, they are frequently employed in developing Asian countries for goods movement. Bicycles in Hanoi and Shanghai strengthened specifically for that purpose can carry loads up to 250 kg. In Phnom Penh, a limited number of bicycles are still used as a form of public transport, with the passenger sitting on a specially designed seat above the rear tire mud guard. However, these are rapidly disappearing with increased motorcycle ownership and motorcycle taxi service.

BICYCLES WITH TRAILERS

2.11 The so-called "bicycle with trailer," a two-unit bicycle-and-tow-cart observed in Phnom Penh,⁴ is the small-scale NMV version of a tractor-trailer, except that the bicycle with trailer is used to carry passengers in addition to goods.⁵ The bicycle with trailer is considered separate from the bicycle because of its different physical and operating characteristics (e.g., two additional wheels, longer vehicle length, greater width, wider turning radius, longer braking distance). Although the trailer is not permanently attached to the bicycle, thereby enabling the owner to operate the bicycle independent of the trailer or vice versa, the bicycle with trailer should be considered a separate NMV

type for the purpose of designing NMV facilities. The design of intersection geometrics and parking facilities for NMVs, for example, may vary significantly depending on whether bicycles with trailers are to be accommodated.

CYCLE-RICKSHAWS

2.12 Type I or pull-type cycle-rickshaws, found in four of the study cities, have a complicated transmission system with a specially fabricated rear axle. Type I cycle-rickshaws tend to be quite heavy, thus reducing the load that can be carried. The construction of Type II or push-type cycle-rickshaws is relatively easy since a standard bicycle transmission is used, although the steering connection to the front passenger/cargo area is somewhat difficult. Type II cycle-rickshaws, found in five of the study cities, are basically the same size as Type I cycle-rickshaws. This cycle-rickshaw type is the one that was most commonly observed during the inventory. Type III cycle-rickshaws (bicycles with sidecars), observed only in Metro Manila, are the easiest to build, because they are formed by simply welding a sidecar to a bicycle without any mechanical changes in braking or steering methods. Type III cycle-rickshaws are relatively small and light compared to the other two cycle-rickshaw types, principally a consequence of their physical design, which results in a length equal to that of a bicycle to which a sidecar has been attached.

2.13 Chiang Mai has both Type I and Type II cycle-rickshaws: *samlors* (Type I) are used mainly for transporting passengers while *samlor-kins* (Type II) are used for moving freight. In George Town, *trishaws* transport people, and *tricycles* move goods; both are of Type II design. Type III cycle-rickshaws are essentially bicycles with sidecars, in which the driver practically sits next to the passenger(s). This is considered a cycle-rickshaw because the sidecar is permanently welded to the bicycle, unlike the bicycle with trailer discussed earlier.

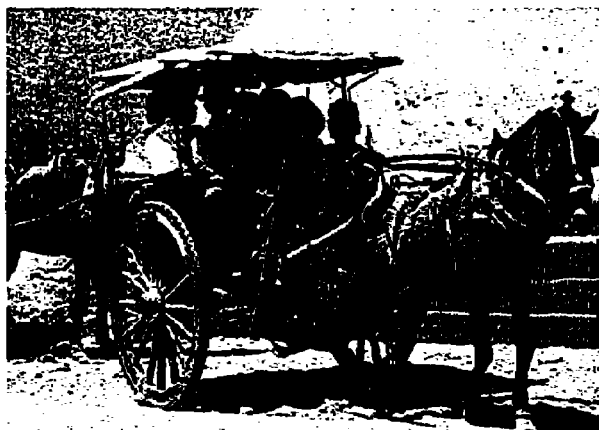
2.14 Although bicycles with trailers resemble Type I cycle-rickshaws in terms of driver and load locations, bicycles with trailers should remain a separate NMV type because of their versatility (i.e., they can be used as a handcart, bicycle, or bicycle with trailer). Further, it is preferable to limit the definition of a cycle-rickshaw to a three-wheeled single-unit vehicle so that its meaning does not become confused (bicycles with trailers have four wheels).

NOTES TO THE TEXT

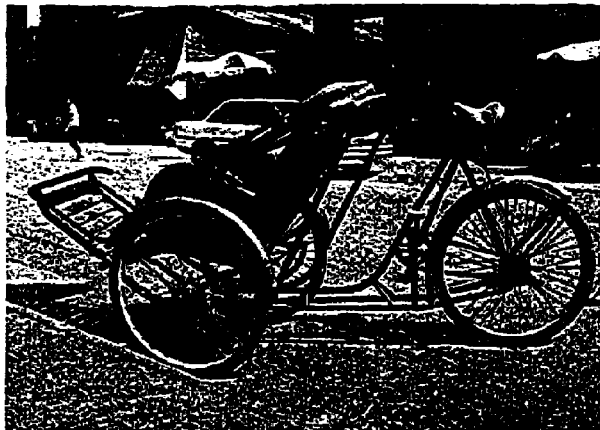
1. See, e.g., Rimmer, Peter (1986), *Rikisha to Rapid Transit*. Pergamon Press, Rushcutters Bay, Australia, pp. 42-59. The word "jinrikisha" comes from the Japanese language; *jin*, person + *riki*, strength + *sha*, vehicle.
2. In Hanoi, animal carts are used in the peripheral area surrounding the city. Animal carts are allowed to operate on the ring road surrounding Hanoi, but they are prohibited from entering the city.
3. ESCAP (1983), *Improvement Potential of Non-Motorized Transport*, United Nations, Economic and Social Commission for Asia and the Pacific (ESCAP), Bangkok, p. 11.

4. Incidentally, this trailer is called a *remorque-kank* in Khmer; *remorquer* means "to tow" in French.
5. According to ESCAP (1983), p. 64, bicycles with trailers are rare in developing countries "except in a few French-speaking countries in West Africa and Indochina." Because bicycles with trailers are widely used in parts of Europe and have great potential to increase a bicycle's load-carrying capacity, this ESCAP report concludes that trailers are not more widely used "because the technology is unknown."

The term "bicycle with trailer" is preferred over "bicycle-trailer" because the latter, without a hyphen, has been commonly used to describe bicycle-holding trailers that are hauled by vans or buses for bicycle shuttle service. See, e.g., Pound, G., and McCuen, A. (1976), "San Diego-Coronado Bay Bridge Bicycle Shuttle Service" in *Proceedings of the Fourth National Seminar on Planning, Design, and Implementation of Bicycle and Pedestrian Facilities*, sponsored by the Metropolitan Association of Urban Designers and Environmental Planners, published by the American Society of Civil Engineers, New York, New York, pp. 326-365.



Horse-drawn wagon (*dokar*) in Surabaya.



Cycle-rickshaw (Type II) in Phnom Penh.



Cycle-rickshaw (Type I) in India.



Animal cart in India.

3

NMVs IN CASE STUDY CITIES

INTRODUCTION

3.1 This section presents brief descriptions of each of the case study cities included in the inventory compiled for the present study. Topics covered in this section include general background information on the cities, the extent of NMV ownership and use, relevant factors influencing NMV ownership and use, and major NMV issues in the cities. The cities are each examined separately, in order of country per capita income according to World Bank data; a more detailed assessment of each study city is presented in the case studies referred to in Box 1-1. Following the city-by-city discussion in this section, cross-city analyses are undertaken in the following three chapters.

PHNOM PENH

3.2 Phnom Penh is the capital city of Cambodia, one of the poorest countries in the world with an estimated per capita income of approximately US\$ 200. The 1992 population of Phnom Penh was 745,000, but the city's average annual population growth rate from 1985 to 1990 was 8.0 percent, and evidence indicates that this rate has increased since 1990. Except for Phnom Penh's four main boulevards, most of the city's roads are unpaved and in very poor condition, which creates an advantage for NMVs, which can be maneuvered more easily than cars, trucks, and buses on damaged streets. Excluding motorcycles, Phnom Penh has only 16 motor vehicles per 1,000 persons, the lowest level of motorization in all of the study cities.

3.3 Approximately half of the vehicles in Phnom Penh are NMVs, with bicycles accounting for 47.1 percent of the city's total vehicle stock and cycle-rickshaws (*cyclos*) for 4.2 percent. The popularity of NMVs in Phnom Penh results primarily from the high demand for low-cost transportation and the city's low level of motorization. Bicycle prices are reasonably low (US\$ 56 for a standard model) and *cyclo* fares are low (US\$ 0.04 per km) because of low labor costs. The city had only 23 buses in 1992. Motorcycles and cars are becoming more numerous, and the national government would like to phase out the use of *cyclos* in Phnom Penh to improve safety and reduce congestion. Early action is required to protect the interests of NMV users and assure improvement of the overall urban transport system.

HANOI

3.4 Hanoi, Vietnam's capital, has an urban population of 1.1 million and a population density of 25,600 persons per km². Vietnam has a low GDP per capita, estimated at US\$ 200, roughly comparable to that of neighboring Cambodia. Hanoi has 1,790 km of paved streets, 75 percent of which are 7-11 meters wide (2-3 lanes). Given the narrow width of Hanoi's roads and the extensive use of two-wheeled vehicles, bus operations are very difficult.

3.5 Hanoi is a heavily NMV-dependent city. The city's estimated one million bicycles and 5,100 cycle-rickshaws (*cyclos*) account for approximately 85 percent of the vehicles in the city. NMVs account for approximately two-thirds of the city's vehicular traffic. Factors contributing to the popularity of NMVs in Hanoi include the presence of a local bicycle industry, which produces bicycles of a reasonably good quality at low prices; household incomes insufficient to purchase motorcycles; government control of ownership of private cars; and a shortage of buses, resulting in a low level of bus service. The mixed traffic condition of NMVs and MVs on Hanoi's streets and the difficulty of enforcing traffic regulations controlling them are seen by city officials, as the major cause of traffic congestion; the recent growth in motorcycle ownership has exacerbated the problem. The improvement of public transport systems has been seen as an important step to improve traffic conditions, but financial constraints as well as an energy shortage make it difficult to upgrade the city's bus service. An appropriate NMV network, traffic management measures, and bus planning are urgently required to improve Hanoi's urban transport system.

DHAKA

3.6 Dhaka, the capital and largest city of Bangladesh, has experienced dramatic population growth over the last three decades. In 1961, the population of Dhaka was just over a half a million; as of 1990, the population of the Dhaka region had increased to about seven million including an estimated one million living in slums and squatter areas. This rapid growth has created immense pressure on the city's already overloaded infrastructure, especially on its transport system.

3.7 Dhaka is another NMV-dependent city, with the city's 200,000 cycle-rickshaws (simply called *rickshaws* locally) accounting for 53.8 percent of the city's total vehicle stock and bicycles 10.7 percent. NMVs also account for 51.8 percent of the vehicles on typical NMV-use roads. The popularity of cycle-rickshaws in Dhaka may be attributed to the high demand for low-cost transportation, a low level of motorization, a low level of bus service, and an abundance of low-cost labor. Cycle-rickshaws, which are used for relatively short-distance trips (2.5 km on average), benefit from the high-density development of the urban area, 27,401 persons per km². The popularity of *rickshaw* use is also supported by the prevailing cultural environment since women in predominantly Muslim Bangladesh prefer not to use crowded buses for reasons of modesty. Several types of specially designed freight *rickshaws* are available for deliveries and for traveling salesmen; their maneuverability on narrow streets leads to their use instead of motorized vehicles. Bicycles are less widely used in Dhaka because of the relatively high price of bicycles in relation to income, the high risk of theft, and the low social status associated with bicycle users.

3.8 The local government tried to eliminate *rickshaws* from the city streets a number of times without success because the issue is highly political. A compromise will have to be reached regarding the roles of NMVs and MVs, and appropriate facilities and management measures need to be introduced.

KANPUR

3.9 Kanpur, originally developed as a British army camp along the Ganges River, had a metropolitan population of 2.2 million in 1991. Located in the Indian state of Uttar Pradesh, Kanpur is the eighth largest metropolis in India and the second largest in northern India, after Delhi. Its population has approximately doubled in the last 20 years, and local government planning studies forecast the metropolitan population to reach four million by 2010. Yet the length of roadway that can be used by automobile traffic in Kanpur is only 225 km, with the remaining streets having a width of less than 3.5 m. Moreover, the use of street-side space by vendors, squatters, and others reduces the effective width of the right-of-way, which exacerbates the city's traffic congestion.

3.10 NMVs account for 51.5 percent of all vehicles owned in Kanpur, with the city's approximately 500,000 bicycles alone accounting for 47.1 percent. The share of NMVs in Kanpur's traffic is 55.7 percent, including bicycles (39.7 percent of the total traffic), cycle-rickshaws (13.3 percent), and carts (2.7 percent). Factors contributing to the popularity of NMVs in Kanpur include the low level of service provided by bus and other motorized public transport modes (e.g., motorized rickshaw); low labor costs, which result in lower costs for NMV acquisition, maintenance, and operation, which in turn result in relatively low fares; the provision of bicycle parking facilities at major destinations; and the *laissez-faire* attitude toward NMVs adopted by the city government. While NMVs have thrived to date in Kanpur's *laissez-faire* environment, the growth of motorized vehicles may eventually lead to the banning of NMVs such as animal carts from the city's main streets, as has happened in other Indian cities. While Kanpur's main streets are wide enough to allow for the coexistence of a mix of modes, it may be necessary to upgrade the city's overall street system if both motorized and nonmotorized modes are to be accommodated in most parts of the city.

SHANGHAI

3.11 Shanghai, one of the three centrally administered cities in China, had a population of 8.2 million in 1990. Including ten adjacent counties, the Shanghai metropolitan area has a population of 12.8 million, the largest in China. Shanghai is a center of business, culture, education, and industry, and it has the busiest shopping district in the country, attracting millions of people daily.

3.12 Like most Chinese cities, Shanghai is now largely dependent on bicycles as a consequence of an explicit national policy to prevent the widespread use of motorcycles and private cars and to implement urban land use strategies that ensure that residences are within reasonable bicycling distance of workplaces. Nearly 96 percent of the vehicles in Shanghai are bicycles, and the 7.1 million bicycles owned by Shanghai residents are equivalent to nearly two bicycles per household. Over 87 percent of all vehicles in traffic in Shanghai are bicycles. One reason that bicycles are popular in Shanghai is that buses are often slow and crowded, while bicycles are faster and more

reliable. Commuting expenses are subsidized by employers, and these subsidies can be used to purchase a bicycle. In addition, residential and employment location patterns allow for relatively short commuting distances, which are well suited for bicycle travel. Other factors promoting bicycle use in Shanghai include a well-developed bicycle industry, low bicycle prices, and the use of pricing policies to control the ownership of motorcycles and private cars.

3.13 Separate networks for MVs and NMVs are planned, and some progress toward implementation has already been achieved. With increasing traffic congestion and changing land use patterns, buses will play a significant role in the near future, and the role of bicycle as a feeder mode to buses will become more important, although the local government envisages bicycle remaining the main mode of transport for the next two decades.

SURABAYA

3.14 Surabaya, Indonesia's second largest city and the capital of East Java, had a population of 2.5 million in 1990. The physical area of the city has expanded rapidly over the last 15 years, as the city sprawls to the south and west. Roads dominate Surabaya's transport infrastructure, but a variety of different kinds of traffic and modes use the city's roads causing conflicts and congestion. Also, there is a lack of traffic signals and controls, which results in a hazardous environment that hinders nonmotorized transport.

3.15 Approximately 45 percent of the vehicles in Surabaya are NMVs, 40.1 percent bicycles, and 4.6 percent cycle-rickshaws. However, nonmotorized vehicles account for only 15.6 percent of the city's vehicular traffic. The role of bicycles in commuter transport has decreased, primarily due to the availability of motorcycles. The role of cycle-rickshaws, known locally as *becaks*, has decreased due to restrictive regulations (e.g., the banning of *becaks* from operating on developed commercial streets). Nevertheless, *becaks* are preferred over motorized public transport for relatively short trips in which passengers are carrying goods. Although the fares are higher, users prefer *becaks* because they provide door-to-door service even within areas with narrow streets.

3.16 Unlike Jakarta, where *becaks* have been banned and confiscated, the local government in Surabaya has a policy of accommodating *becaks* and other NMVs. Nearly 20 years ago, a policy of day- and night-*becaks* (physically distinguishable by color) was implemented to reduce their numbers, and to stabilize operators' incomes. A major urban transport study in 1991 recommended that the *becak* continue to provide feeder services for public transport, direct services in selected inner-city areas, services in outlying areas and special-interest destinations, and services to promote tourism. In addition, a 1992 study formulated a strategy for increasing bicycle use by improving traffic conditions for bicycles in residential areas.

METRO MANILA

3.17 Metro Manila consists of four cities and 13 municipalities, with a total population of approximately 8.4 million. The road length in Metro Manila totals 2,980 km, 85 percent of which is paved. While the main thoroughfares are in relatively good condition, many of the side streets have broken pavement and insufficient drainage. Cycle-rickshaws, known locally as *pedicabs*, are

avored by many for trips along these side streets, because of a lack of pedestrian facilities, especially after heavy rainfall.

3.18 NMVs account for about 13 percent of Metro Manila's vehicle stock, with 12.6 percent bicycles and 0.7 percent *pedicabs*. According to a 1984 person trip survey, NMVs accounted for less than 1 percent of all non-walk trips. However, recent traffic counts at 12 typical NMV-use locations in the city found them accounting for 34 percent of vehicular traffic, with *pedicabs* alone accounting for 19.9 percent of the total.

3.19 Although Manila is confronted with increasing unemployment, an energy shortage, and increasing fuel prices, government officials do not wish to encourage NMVs. Consequently, *pedicabs* are prohibited from operating on major thoroughfares and places already served by motorized transit. Nevertheless, *pedicabs* are expected to continue operating in selected areas, especially in locations near public markets, shopping malls, offices, and schools.

CHIANG MAI

3.20 Chiang Mai, located about 800 km northwest of Bangkok, has a population of 236,000 and a population density of 2,220 persons per km², the lowest of all the cities included in the inventory. Although Chiang Mai's population is only about 4 percent of that of Bangkok, it is the country's second largest city.

3.21 Like many other cities in Thailand, Chiang Mai has become motor vehicle dependent. NMVs account for only 4.8 percent of the city's vehicle stock and 2.2 percent of its vehicular traffic. Bicycle use is not very common because motorcycles are widely available (430 per 1,000 population). *Samlors* have remained in operation despite the increasing number of motorized *tuk-tuks*, which compete directly with *samlors*. *Samlor* passengers use *samlors* for shopping or commuting over relatively short distances. The city government plans to preserve *samlors* by designating existing roads within the old city as NMV routes in order to promote objectives related to pollution, traffic, tourism, and historic preservation.

GEORGE TOWN

3.22 The city of George Town is located in the northeast corner of Penang Island, which is connected to Peninsular Malaysia's mainland by the 13.5-km Penang Bridge. Penang Island had a 1990 population of 568,000 and population density of 1,993 persons per km², respectively. Approximately 45 percent of the island's residents live in George Town, which had a 1990 population and population density of 254,600 persons and 10,024 persons/km², respectively.

3.23 Similar to Chiang Mai, George Town is a motor vehicle dependent city, with NMVs accounting for only 6.5 percent of the vehicles in traffic. Although approximately half of the vehicles in George Town are NMVs, bicycles are used predominantly for recreational purposes and cycle-rickshaws (locally called *trishaws*) have been reduced in importance since the Municipal Council in 1969 decided to prohibit the issuance of new *trishaw* licenses. The city government now plans to ban

trishaws from busy roads. Although certain sectors of society in George Town depend on cycle-rickshaws for shorter, goods-accompanied trips, the long-term role of the *trishaw* in George Town may be only for tourism purposes, particularly considering that younger persons are not interested in becoming cycle-rickshaw drivers since many other employment opportunities are now available in Penang's vibrant economy.

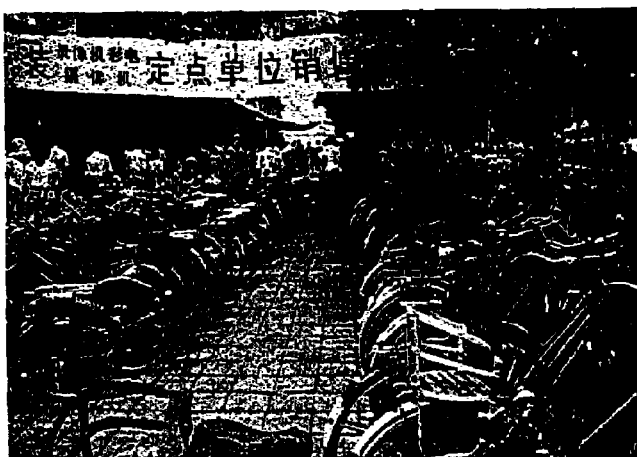
TOKYO

3.24 Tokyo, the capital of Japan, is the most populous city in the country with 11.9 million persons in the city's 23 wards and a population of 31.8 million in the metropolitan region. The estimated income per household in Tokyo was approximately US\$ 60,000 in 1992, by far the greatest of all the study cities. Tokyo has an extensive urban rail system with a total length of 614 km of passenger railways within Tokyo prefecture. The length of roads is 23,419 km, but roads occupy only 7.1 percent of the total land area of the prefecture and 22.4 percent of central Tokyo. Road coverage in Manhattan by comparison is 37.6 percent. The urban toll road network in Tokyo prefecture totals 220 km and is severely congested 16-18 hours per day. Urban streets are generally narrow.

3.25 Approximately 60 percent of all vehicles in Tokyo are bicycles, and bicycles account for 36.1 percent of all person trips in the city. Bicycle use has increased in recent years since bus service levels have deteriorated as a consequence of increased traffic congestion. The national Bicycle Law, enacted in 1980, has encouraged local governments to provide bicycle lanes, paths, and parking facilities near rail stations in order to promote the use of bicycles as a feeder mode for rail service. Other factors contributing to the use of bicycles in Tokyo include the high level of development of the Japanese bicycle industry, low bicycle prices in relation to income, and the use of sidewalks by bicyclists. Many city residents use bicycles for shopping, and high school students use them extensively to commute to school. The respective roles of NMVs and MVs in urban transport are well delineated in Tokyo, where bicycles will remain an important feeder mode to suburban rail.



Cycle-rickshaw waiting stand near bus stop in Surabaya.



Guarded bicycle parking area in Beijing.

4

ANALYSIS OF EXISTING SITUATION AND TRENDS

OWNERSHIP AND USE

4.1 The following data on NMV ownership and use patterns in the ten Asian cities inventoried for the present study is set out in tables and or figures, as shown below:

- ownership of nonmotorized (and motorized) vehicles per 1,000 population (Table 4-1 and Figure 4-1);
- composition of the vehicle stock in each study city in terms of percentage share of total vehicles (Table 4-2 and Figure 4-2);
- annual growth rates of NMVs in recent years for the cities for which reliable data is available (Table 4-3); and
- comparison of NMV and MV traffic shares (Table 4-4 and Figure 4-3).

Salient points with respect to specific NMV modes are presented in the text that follows.

4.2 Bicycles are the most widely owned NMV in the cities studied, except in Dhaka where the number of cycle-rickshaws exceeds the number of bicycles. The cities where bicycle ownership is the highest are Hanoi and Shanghai, with ownership levels of 909 and 865 per 1,000 respectively. Both Tokyo and George Town have over 500 bicycles per 1,000 population, while the remaining cities have bicycle ownership levels below 200 per 1,000. The lowest rates of bicycle ownership were observed in Dhaka and Manila, both about 12 per 1,000. Bicycle growth rates appear to be high in the region, with reliable historical data indicating annual average growth rates in bicycle ownership of 5.3 percent in Kanpur (1983-92) and 14.9 percent in Shanghai (1980-90).

4.3 The growth of bicycle ownership in the study cities is noteworthy, particularly considering the development of exogenous factors tending to suppress NMV ownership. One such factor is that average trip lengths are increasing in the region as cities decentralize. For example, the average trip length in Kanpur increased from 1.4 km in the late 1970s to 3.6 km by 1987. Longer commuting distances are also becoming more common in Shanghai due to the expansion of the city and relocation of industries and housing.

Table 4-1: Number of Vehicles per 1,000 Population

<i>City</i>	<i>Bicycles</i>	<i>Cycle-Rickshaws</i>	<i>Animal Carts</i>	<i>Buses</i>	<i>Motorcycles</i>	<i>Other Motor Vehicles</i>
Phnom Penh	156.25	13.92	0.63	0.03	144.72	16.23
Hanoi	909.09	4.64	0.00	0.15	116.36	44.06
Dhaka	11.76	58.82	0.00	1.41	17.70	20.74
Kanpur	227.27	14.70	2.43	0.38	77.43	93.18
Shanghai	865.37	12.68	0.00	2.44	4.88	17.07
Surabaya	129.63	14.74	0.00	1.04	124.98	52.80
Metro Manila	11.90	0.65	0.03	0.62	7.93	72.97
Chiang Mai	100.00	14.50	0.00	0.17	429.95	135.90
George Town	528.17	6.17	0.02	0.39	308.29	220.76
Tokyo	534.54	0.00	0.00	1.33	123.02	233.61

Source: PADECO Co., Ltd. (June 1993), *Non-Motorized Vehicles in Asian Cities, Part I: Inventory of Needs and Opportunities (Appendices)*, Draft Final Report, The World Bank, Washington, D.C.

Table 4-2: Percent of Total Vehicles (not incl. handcarts) in Terms of Ownership

<i>City</i>	<i>Bicycles (percentage)</i>	<i>Cycle-Rickshaws (percentage)</i>	<i>Animal Carts (percentage)</i>	<i>Buses (percentage)</i>	<i>Motorcycles (percentage)</i>	<i>Other Motor Vehicles (percentage)</i>
Phnom Penh	47.1	4.2	0.2	0.0	43.6	4.9
Hanoi	84.6	0.4	0.0	0.0	10.8	4.1
Dhaka	10.7	53.3	0.0	1.3	16.0	18.8
Kanpur	54.7	3.5	0.6	0.1	18.6	22.4
Shanghai	95.9	1.4	0.0	0.3	0.5	1.9
Surabaya	40.1	4.6	0.0	0.3	38.7	16.3
Metro Manila	12.6	0.7	0.0	0.7	8.4	77.5
Chiang Mai	4.2	0.6	0.0	0.0	72.3	22.9
George Town	49.6	0.6	0.0	0.0	29.0	20.8
Tokyo	59.9	0.0	0.0	0.1	13.8	26.2

Source: PADECO Co., Ltd. (June 1993).

Table 4-3: Growth Rates of NMVs in Selected Study Cities in Recent Years

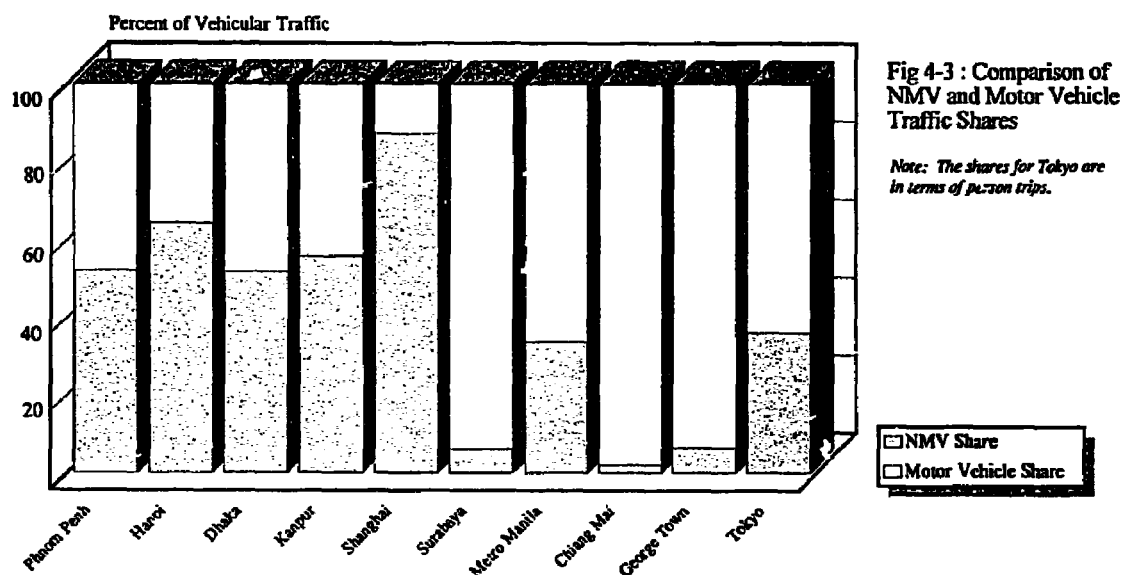
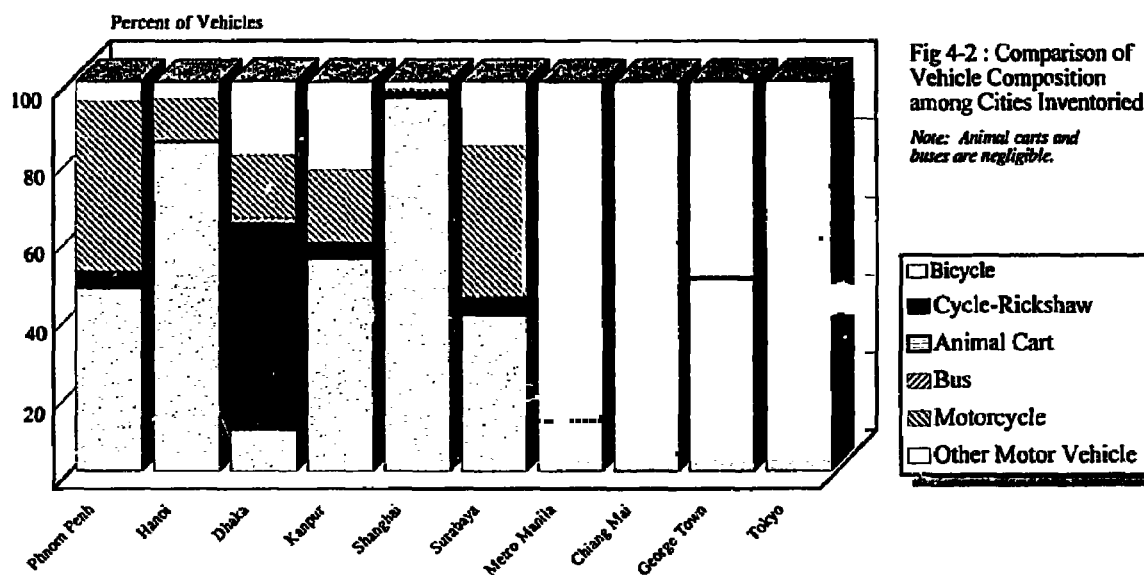
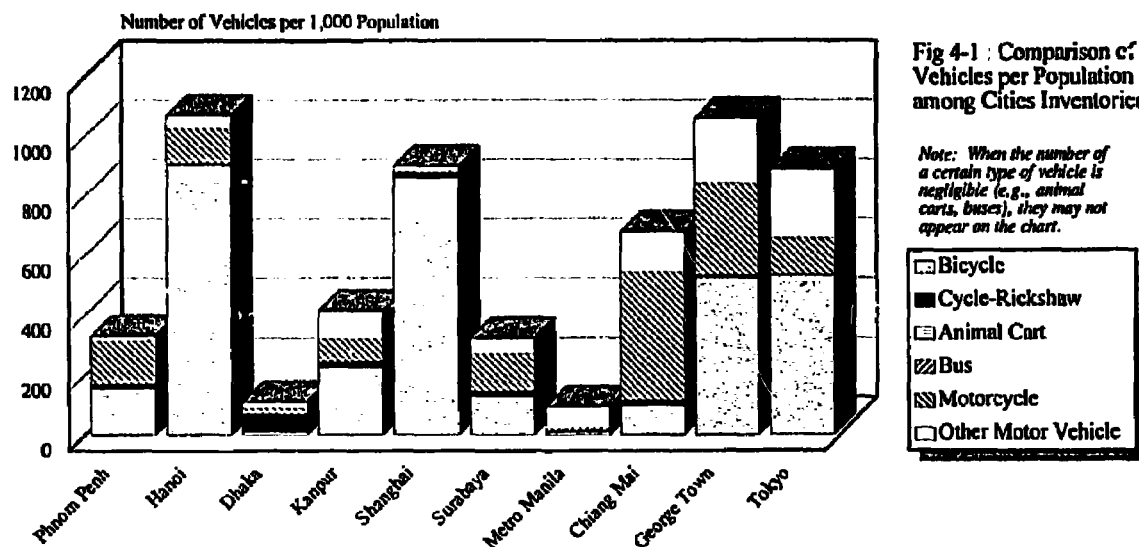
<i>City</i>	<i>Type of NMV</i>	<i>Period</i>	<i>Average Annual Growth Rate (percentage)</i>
Kanpur	Bicycle	1983-92	5.3
Kanpur	Cycle-Rickshaw	1983-92	2.0
Kanpur	Pushcart	1983-92	1.5
Kanpur	Animal Cart	1983-92	-0.7
Shanghai	Bicycle	1980-90	14.9
Shanghai	Other NMVs	1980-90	5.3
Surabaya	Cycle-Rickshaw	1985-92	-0.7
Chiang Mai	Cycle-Rickshaw	1978-92	8.8
George Town	Cycle-Rickshaw	1978-92	-1.2

Source: PADECO Co., Ltd. (June 1993), *Non-Motorized Vehicles in Asian Cities, Part I: Inventory of Needs and Opportunities (Appendices)*, Draft Final Report, The World Bank, Washington, D.C.

Table 4-4: Shares of NMV versus Motor Vehicle Traffic on Typical NMV-Use Roads

<i>City</i>	<i>Nonmotorized Vehicles (excluding pedestrians) (percentage)</i>	<i>Motor Vehicles (percentage)</i>
Phnom Penh	52.1	47.9
Hanoi	64.3	35.7
Dhaka	51.8	48.2
Kanpur	55.7	44.3
Shanghai	87.2	12.8
Surabaya	15.6	84.4
Metro Manila	33.8	66.2
Chiang Mai	2.2	97.8
George Town	6.5	93.5
Tokyo	36.1	63.9

Source: PADECO Co., Ltd. (June 1993).



4.4 In many of the lower-income cities bicycles are used extensively to carry goods. Although Shanghai restricts freight haulage by bicycle, in Phnom Penh, Hanoi, Kanpur, and Surabaya bicycles are used by policemen, in mail delivery service, by persons carrying goods to/from markets, by hawkers, and for goods delivery. Bicycles are also used as taxis in Phnom Penh, although motorcycle taxis are becoming increasingly common. In Tokyo, not a low-income city, bicycles are commonly used by the police and by bank and postal workers.

4.5 The modal share of bicycle in traffic counts tends to be highly correlated with the proportion of total vehicles that are bicycles. Shanghai, Hanoi, Kanpur, and Tokyo all have a relatively high rate of bicycle ownership and a high proportion of bicycle traffic. However, bicycle ownership in George Town is also comparatively high, with bicycles accounting for nearly half of all vehicles but only about 5 percent of all vehicular traffic. The difference in bicycle trip purposes should be noted. In most NMV-dependent, low-income cities, bicycles tend to be used for the entire trip (e.g., for commuting, shopping). However, the major purpose of bicycle use in middle-income cities such as George Town and Chiang Mai is recreational. In high-income Tokyo bicycles are increasingly used as a feeder mode to rail stations as well as for shopping and other purposes. The rail feeder modal split of bicycle (and motorcycle) in metropolitan Tokyo increased from 2 percent in 1968 to 10 percent in 1988.

4.6 Dhaka is by far the most dependent on cycle-rickshaws of all the study cities. The "cycle-rickshaw capital of the world" has about 59 cycle-rickshaws per 1,000 persons, while the ratio in all the other study cities was less than 15. Surabaya, Chiang Mai, and Phnom Penh — all with 14-15 cycle-rickshaws per 100,000 — followed Dhaka in terms of the rate of cycle-rickshaw ownership. George Town and Hanoi also have cycle-rickshaws, with 4-6 per 100,000, while there are few left in Manila (0.65) and none in Tokyo (0). Cycle-rickshaw growth rates vary from negative in Surabaya (-0.7 percent, 1985-92) and George Town (-1.2 percent, 1978-92), two cities where the total number of licenses issued is fixed, to 8.8 percent in Chiang Mai, where the local government has adopted a more accommodating attitude toward the mode.

4.7 Cycle-rickshaws are primarily used as passenger taxis or for small-scale freight haulage (i.e., up to 200-300 kg). Taxi use is more common than freight transport use in most of the study cities, except in Shanghai where cycle-rickshaws are mainly used as freight carriers. Cycle-rickshaws in most of the study cities are used for a variety of trip purposes including work, shopping, and social trips. They are frequently used for relatively short-distance trips and trips in which passengers are accompanied by freight. In some cities (e.g., Kanpur, Dhaka) cycle-rickshaws are used to transport school children with the vehicles carrying up to eight students in one vehicle. In addition, there are a variety of other types of cycle-rickshaws designated for specific uses such as food and beverage delivery.

4.8 Kanpur, with 2.4 animal carts per 100,000 population, has the highest rate of ownership of animal-drawn carts of all the study cities, although the number of animal carts in Kanpur has been decreasing at an annual rate of 0.7 percent since 1983. Animal carts in Kanpur are used for both passenger and goods transport. A small number of bullock carts are found in Phnom Penh and George Town. Horse-drawn carriages are found in small numbers in Manila and Surabaya.

4.9 Many hawker's carts are observed in low- and middle-income cities such as Dhaka, Kanpur, Surabaya, and George Town. In Dhaka, two-wheeled pushcarts operated by several persons are still used for larger scale freight haulage. Handcarts are widely used for waste removal and numerous other purposes, especially in the low-income cities.

LEVELS OF SERVICE

4.10 Service levels for both NMVs and motorized vehicles in the study cities suffer from persistent congestion. Consider, for example, that in central Shanghai average travel speeds of NMVs and MVs are estimated at 14.3 kph and 6.7 kph, respectively. City officials report that between 1985 and 1990 area-wide traffic speeds have decreased by 8.4 percent, from 19.1 kph to 17.5 kph.

4.11 Although travel speed data is not readily available for the other study cities with mixed traffic environments, it is apparent that service levels have been degraded as a consequence of the sharing of road space among different types of vehicles. In Kanpur the city's diverse motorized and nonmotorized modes share the same street and highway system, which covers only 13.0 percent of the city's total area. Motorized and nonmotorized vehicles do battle on the city's streets, as both NMV operators and MV drivers engage in aggressive behavior toward the other, a situation hardly conducive to promoting overall urban transport system efficiency, much less basic social harmony. During peak hours some intersections near Old Dhaka are completely choked for at least 30 minutes with a mixture of pedestrians, animals, and vehicles (both motorized and nonmotorized) flowing in from all approach roads.

4.12 Congestion in such cases is often the result of:

- a lack of appropriate NMV facilities;
- ineffective police enforcement; and
- the lack of compliance with traffic regulations.

The policy implications of these findings are addressed in section 6 of this volume.

4.13 In addition to congestion, the level of service (broadly defined) for NMVs is degraded in certain cities by theft. In Dhaka, for example, the perception of a high probability of bicycle theft has depressed bicycle ownership levels. Similarly in Surabaya, the theft of cycle-rickshaws is reported to be a serious problem, although there is a dearth of formal data on the subject, a reflection of the poor relationship between cycle-rickshaw operators/owners and the police.

SAFETY

4.14 Although conventions vary for reporting accident data, NMVs were found to be a relatively unimportant cause of traffic accidents in each of the eight study cities for which reasonably reliable data was available. Excluding pedestrians, the number of accidents attributed to NMVs was 1.1 percent in Metro Manila, 2.6 percent in Kanpur, 7.8 percent in Phnom Penh (5.6 percent attributed to bicycles and 2.2 percent to cycle-rickshaws), and 11.0 percent in Hanoi. In Japan (including all

cities), 10.3 percent of all fatalities and 17.2 percent of all injuries are sustained by bicyclists, although police reports indicate that 77.9 percent of all bicyclists injured were not responsible for the accidents causing their injuries. In NMV-dependent Shanghai, 26.5 percent of all accidents involved collisions between a motor vehicle and a bicycle. Reported data in Dhaka indicates that only 3.9 percent of all traffic accident injuries and 3.8 percent of all fatalities were cycle-rickshaw drivers.

4.15 The share of accidents attributable to NMVs was found to be significantly less than the modal split of NMVs in vehicular traffic in every city for which data was available. In Phnom Penh, for example, considering accident rates and peak-hour traffic compositions, motorcycles are 4.7 and 12.5 times more likely to be involved in an accident than bicycles and cycle-rickshaws, respectively; autos, with even a higher accident rate than motorcycles in Phnom Penh, are 5.8 and 15.6 times more likely to be in an accident than bicycles and cycle-rickshaws, respectively.

4.16 While NMVs were found to be a relatively unimportant cause of traffic accidents in the study cities, urban transport officials in several cities expressed the view that NMVs have a significant adverse impact on road safety. The most striking case is perhaps Hanoi, where bicyclists are perceived by officials to cause 50-90 percent of all traffic accidents, in direct contravention of the statistics gathered by the Hanoi Bureau of Traffic, which indicate that motorcyclists cause more than half of the accidents in the city.

4.17 Even though the impact of NMVs on road safety is less than perceived by urban transport officials, there is still substantial scope for improving the safety of NMVs in the study cities. Not only is there a lack of traffic management measures clearly allocating street space between motorized and nonmotorized modes, but NMVs in low-income cities in the region often lack basic safety devices such as rear-view mirrors, lights, and reflectors. In Shanghai, for example, dynamo lights are attached to only 1 percent of all bicycles; such lights are not inexpensive by local standards (about US\$ 5), and bicyclists do not like the extra drag created by their use, nor do they appreciate the high risk of theft of such lights. In contrast, in Japan nearly 100 percent of the bicycles are equipped with lights, but the rate of use of these lights at night is only 25 percent.

VEHICLE ACQUISITION PRICES

4.18 Table 4-5 presents data on the purchase cost of standard-model bicycles, cycle-rickshaws, motorcycles, and automobiles in the study cities. The data on motorized vehicles is shown for comparison purposes. The study cities generally fall into two categories in terms of bicycle prices stated in terms of United States dollars¹. The cities with relatively low bicycle prices include five of the six in low-income countries as designated by the World Bank; prices of standard-model bicycles in this city grouping vary from US\$ 36 in Hanoi to US\$ 61 in Dhaka. The cities with comparatively high bicycle prices include all cities in the sample in middle- or high-income countries as designated by the Bank, and Surabaya, which is located in a country considered upper lower income. Generally, the price of a motorcycle in the cities inventoried is 7 (Manila) to 39 (Hanoi) times the cost of a bicycle, although in Chiang Mai the price ratio is only 2 to 1. The price of an automobile in the study cities is 75 (Tokyo) to 833 (Hanoi) times the price of a bicycle.

Table 4-5: Average Prices of New Vehicles (Standard Model)

Units: 1992 US\$

City	Bicycle	Cycle-Rickshaw	Pushcart	Animal Cart	Motorized Rickshaw	Motorcycle	Car
Phnom Penh	40	61	24	88	-	1,690	25,100
Hanoi	36	43	-	-	-	1,660	35,800
Dhaka	61	181	-	-	-	-	-
Kanpur	53	128	53	298	2,500	1,200	6,400
Shanghai	60	-	-	-	-	2,380	34,000
Surabaya	138	150	170	1,230	-	1,480	24,600
Manila	176	255	-	-	1,880	1,760	31,300
Chiang Mai	178	790	-	-	5,940	1,520	19,800
George Town	180	-	-	-	-	2,000	16,000
Tokyo	160	-	-	-	-	1,800	12,000

Source: PADECO Co., Ltd. (June 1993), *Non-Motorized Vehicles in Asian Cities, Part I: Inventory of Needs and Opportunities (Appendices)*, Draft Final Report, The World Bank, Washington, D.C.

4.19 The affordability of a bicycle is a function of price in relation to income. In the relatively wealthy cities of George Town and Tokyo a new standard-model bicycle consumes only 26 percent and 3 percent of the average monthly household income, respectively. In the poorer countries, even though bicycle prices are lower in terms of United States dollars, the price of a new standard-model bicycle consumes greater percentages of average monthly household incomes, as high as 86 percent in Hanoi and 96 percent in Phnom Penh. However, even in cities where the price of new standard-model bicycles is high in relation to income, the affordability of bicycles for those with comparatively low incomes is enhanced by the availability of economy models as well as the availability of used bicycles for sale. For example, in Hanoi a new bicycle can be purchased for as little as US\$ 14, or only 34 percent of the average monthly household income, and a used bicycle can be purchased for US\$ 9, or 22 percent of average monthly household income.

4.20 The affordability of bicycles in two cities is enhanced by the availability of credit and subsidies to finance bicycle purchases. Employers in Shanghai commonly provide employees with commuter subsidies of up to US\$ 3 per month, which can be used by bicyclists to purchase a new bicycle or maintain an existing one. While employees in Kanpur do not receive commuting subsidies, private and government organizations offer low-interest loans for the purchase of bicycles and motorcycles. However, at least in Bangladesh, relatively high taxes on bicycles have made them less affordable. Customs duties and sales taxes on NMVs have been increasing in recent years, and in 1990 the import duty on bicycles and other nonmotorized vehicles was 150 percent, while the rate for motorcycles and trucks (completely built up) was 50 percent, and that for motor cars was 50-300 percent.

4.21 Cycle-rickshaw prices vary more among cities than bicycle prices, with the lowest cycle-rickshaw prices in Hanoi (US\$43 for a standard model) and Phnom Penh (US\$ 61) and the highest in Manila (US\$ 255) and Chiang Mai (US\$ 790). Cycle-rickshaws tend to be considerably cheaper than motorized rickshaws, with the price ratio of nonmotorized to motorized rickshaws ranging from 5 percent in Kanpur to 14 percent in Metro Manila. Nevertheless, the price of cycle-rickshaws is sufficiently high to cause many drivers to rent rather than own their vehicles. The proportion of cycle-rickshaw drivers owning their own vehicles is 10 percent in Dhaka, 20 percent in Kanpur, 22 percent in George Town, 35 percent in Chiang Mai, and 60 percent in Surabaya.

4.22 Ownership of cycle-rickshaws can be quite lucrative. Rental fees are on the order of US\$ 0.32 per day in Hanoi, US\$ 0.35-0.50 per day (i.e., one 12-hour shift) in Surabaya, and US\$ 1.20-2.60 in Metro Manila. The time required to recover a cycle-rickshaw's capital cost has been estimated to range from six months (Dhaka) to one year (Surabaya), implying that the cycle-rickshaw business is lucrative even though the owner pays for maintenance, repairs, licensing, storage, and loan repayment.

4.23 None of the study cities has implemented a successful scheme to provide low-cost credit to drivers wishing to purchase cycle-rickshaws. Government loans in Bangladesh can be used to purchase public transport vehicles, both motorized and nonmotorized, but these loans are primarily for use by individuals in rural areas to purchase motorized taxis and buses. Although bank loans are not generally available for the purchase of NMVs in Surabaya, some usurers offer loans at interest rates of 5-10 percent per month to finance the purchase of a *becak*.

OPERATING AND MAINTENANCE COSTS

4.24 Table 4-6 presents annual average operating and maintenance costs for bicycles, cycle-rickshaws, motorcycles, and automobiles in the seven study cities for which data were available. The annual average operating and maintenance for bicycles generally ranges from US\$ 15 (Kanpur) to US\$ 20 (George Town and Tokyo), but was as low as US\$ 3 in Phnom Penh, perhaps reflecting underinvestment in maintenance of the city's bicycle stock. Annual average operating and maintenance costs for cycle-rickshaws in the study cities were generally in the range of US\$ 30 (Surabaya) to US\$ 42 (George Town), although substantially lower costs were cited in Phnom Penh (US\$ 5) and substantially higher costs in Kanpur (US \$ 85). The cost of operating and maintaining motorized vehicles is substantially higher than for nonmotorized vehicles, with annual recurrent costs for motorcycles ranging from US\$ 147 (Manila) to US\$ 406 (Tokyo) and annual recurrent costs for automobiles ranging from US\$ 600 (Phnom Penh) to US\$ 2,600 (Tokyo).

4.25 Licensing/registration fees constitute an additional cost of NMV use in several of the study cities. A modest annual bicycle registration fee of US\$ 0.75 is charged in Shanghai and George Town, while a one-time registration charge of US\$ 4.00 is assessed bicycle owners in Tokyo. Annual registration fees charged cycle-rickshaw owners in the study cities include US\$ 1.89-2.83 in Shanghai, US\$ 6.65-12.00 in George Town, US\$ 6.80-11.40 in Metro Manila, and US\$ 56.25 in Kanpur. In addition, cycle-rickshaw operators in Kanpur pay US\$ 5.74 per year for a driver's license. Registration fees for pushcarts and animal carts range from US\$ 6-12 in George Town to

Table 4-6: Average Annual Operating and Maintenance Costs

Units: 1992 US\$

<i>City</i>	<i>Bicycle</i>	<i>Cycle-Rickshaw</i>	<i>Motorcycle</i>	<i>Automobile</i>
Phnom Penh	3	5	174	600
Kanpur	15	85	349	1,000
Surabaya	20	30	183	820
Manila	16	31	147	1,130
Chiang Mai	16	32	239	1,280
George Town	20	42	380	2,230
Tokyo	23	-	400	2,600

Source: PADECO Co., Ltd. (June 1993), *Non-Motorized Vehicles in Asian Cities, Part I: Inventory of Needs and Opportunities (Appendices)*, Draft Final Report, The World Bank, Washington, D.C.

US\$ 20.25-40.25 in Kanpur. More details on registration and licensing of vehicles and drivers in the study cities are presented in a later section.

4.26 Relatively low parking fees for NMVs were found at certain locations (e.g., near railway stations, in market areas) in Hanoi, Kanpur, and Shanghai; in Tokyo, fees of up to US\$ 30 per month are charged for spaces in multistory or underground parking facilities near major railway stations. NMVs are not charged parking fees in any of the other study cities.

4.27 Cycle-rickshaw fares, which are typically negotiated, tend to exceed bus fares, by ratios of as little as 4:1 in George Town to as high as 20:1 in Surabaya based on typical trip lengths by the respective modes. The ratio of cycle-rickshaw to bus fares tends to increase with trip length, reflecting the comparative advantage of cycle-rickshaws for short trips and buses for long trips. One reason bus fares remain low is the political strength of bus patrons, who in certain cities (e.g., Dhaka) have violently protested fare increases. While cycle-rickshaw fares tend to exceed bus fares, cycle-rickshaw fares tend to be cheaper than motorized rickshaw fares, for example by ratios of 1.7-2.5 in Kanpur.

MANUFACTURING AND SPARE PARTS SECTOR

4.28 Significant NMV manufacturing and/or spare parts sectors were found in several of the study cities. The largest was in Shanghai, where the bicycle manufacturer's association consisting of four bicycle factories and ten bicycle parts manufacturers, employs 28,000. "Forever" and "Phoenix" bicycles, with production facilities located in Shanghai, are two of the largest manufacturers in the world. They produce 7.4 million bicycles annually, about one-sixth of the total national production of bicycles. Bicycle manufacturers in Shanghai also export about one million units annually, mostly to countries in Asia and Europe.

4.29 After China, Japan has the largest bicycle industry of all countries included in the study. Although Japan produced 8.0 million bicycles in 1990, up from 6.6 million in 1981, production was

largely centered in regional cities outside of Tokyo, the Japanese city included in the inventory. While Japanese bicycle exports have decreased from 1.1 million in 1981 to 0.2 million in 1990, the monetary value of exported parts has increased from 16 billion yen in 1971 to 115 billion yen in 1990.

4.30 Outside of China and Japan, significant NMV manufacturing and/or parts sectors were found in Hanoi, Dhaka, Kanpur, and Phnom Penh. Hanoi accounts for approximately half of Vietnam's bicycle production, which decreased to 120,000 bicycles in 1991 from 286,000 in 1988, as bicycle owners choose to keep their current bicycles for longer periods of time. Dhaka has 200-250 cycle-rickshaw assembly shops, most of them family-run enterprises. In addition, 20 bicycle component firms are operating in Dhaka with an average staff of 10-50 employees, except for one company that employs over 200. Although bicycles are not manufactured in Kanpur, the city has 150 bicycle assembly shops, each assembling 1-10 bicycles per day depending on the demand. In addition, there are about 100 cycle-rickshaw manufacturers/assemblers in Kanpur, with each producing about 1-5 cycle-rickshaws per day. Phnom Penh produces bicycle trailers as well as bicycle tires and inner tubes.

4.31 Considering the benefits of NMV production (i.e., increased employment, low NMV prices; see chapter 6), it is clearly desirable for countries with significant numbers of NMVs to promote NMV manufacturing industries. Given that tariffs create inefficiencies and increase the cost of NMVs in the domestic market, the identification of appropriate strategies for promoting NMV production is an important issue.

REGISTRATION, LICENSING, AND REGULATION

4.32 NMV regulations generally relate either to the registration and licensing of vehicles and/or drivers or to the use of the vehicles in traffic. Each type of regulation is considered below, along with a discussion of related issues. In all cities, the development of policies toward competing modes in the urban transport sector, both motorized and nonmotorized, is hindered by the lack of a rigorous approach to determining the extent to which particular modes should be promoted.

4.33 Registration and licensing regulations in the study cities are outlined below, for cycle-rickshaws, bicycles, and carts:

- Cycle-rickshaws are required to be registered in Dhaka, Surabaya, Manila, George Town, Hanoi, and Kanpur. The number of cycle-rickshaws is controlled in the first three of these cities, which however have had problems in implementing their registration regulations. In Dhaka, both genuine and counterfeit registration certificates are available on the black market at lower costs than those issued by the city government. In Surabaya, it is estimated that approximately 15 percent of the cycle-rickshaws are unlicensed, while in Manila it is estimated that only approximately one-third are licensed.
- Cycle-rickshaw operators are required to be registered in Dhaka, Manila, Chiang Mai, and George Town. Cycle-rickshaw operators must be at least 18 years old in all cities, but in Dhaka this regulation is not strictly enforced. In Manila, operators must obtain insurance for

third-party liability, pass a health examination, and provide a certificate of police clearance. George Town also requires a health examination as well as traffic and riding tests at the discretion of the registrar.

- Shanghai requires that bicycles be registered at the Public Security Bureau and their owners pay an annual registration fee. This system has proven useful not only for the city government to effectively collect road user taxes, but also for the bicyclists to protect their vehicles from theft and subsequent resale. In Japan, police departments instruct bicycle shop owners to encourage customers to register their bicycles to prevent theft, but the number of non-registered bicycles has increased in recent years.
- Carts of all kinds must be registered in George Town.

4.34 NMV registration and licensing requirements can be justified when they are based on legitimate safety or security concerns, when they are used as a means for collecting road user taxes, or when they provide important data for urban transport planning. However, the regulatory process can be abused, as in Jakarta where the authorities seized 100,000 cycle-rickshaws, over one-third of which were dumped into the sea.

4.35 Traffic regulations specifically governing NMVs have been enacted in most of the study cities. These include rules controlling the movement of NMV traffic, or alternatively rules banning traffic, either at specific times or at all times. Traffic regulations affecting NMVs should be formulated with the aim of promoting the overall efficiency of the urban transport system, not merely to promote the flow of MV traffic.

4.36 Specific rules controlling the movement of NMV traffic are found in cities as diverse as Phnom Penh and Tokyo, where regulations require NMV users to stay on the extreme right- or left-hand side of the road. However, enforcement of such regulations is poor; in Phnom Penh traffic regulations are universally ignored, while in Tokyo most bicyclists prefer to use pedestrian facilities, even though often such facilities are not officially designated for bicycle use. Additional regulations in Tokyo, included in Japan's Road Traffic Act of 1960, include prohibitions on riding "double" (i.e., with two persons on a bicycle) and driving in parallel with another bicycle. Metro Manila does not allow more than two passengers to ride in cycle-rickshaws. Shanghai, with its NMV modal share of 87.2 percent, has the most comprehensive set of regulations governing the movement of NMV traffic. Among other requirements, the rules mandate that bicyclists signal turning movements, dismount and walk the bicycle at certain times (e.g., when crossing more than four motor vehicle lanes), and sit on the seat/saddle at all times when riding. Also, the Shanghai NMV regulations include prohibitions against right turns and parking at certain locations.

4.37 Regulations banning NMVs at all times of day from certain areas are found in Hanoi, where animal carts are prohibited from entering the central city; Dhaka, which bans NMVs from certain "VIP roads"; Shanghai, where NMVs are restricted full-time on certain links (e.g., on Waibaidu crossing Suzhou Creek); Surabaya, where cycle-rickshaws have been prohibited from operating on streets in developed commercial areas since the mid-1970s; Metro Manila, where cycle-rickshaws are banned on streets permitting a maximum speed greater than 40 kph and where one municipality (Makati) bans horse carts; and Tokyo, where bicycles are restricted from entering certain intersections

for safety reasons. In Dhaka and Surabaya, however, NMVs are permitted to cross certain major roads. Enforcement problems with bans on NMVs throughout the day are not common, although in Surabaya some cycle-rickshaws still use short sections of main streets where they are prohibited, particularly at minor intersections.

4.38 Regulations prohibiting NMVs at certain times of day are also found in Dhaka, where carts are restricted from major roads during the morning peak; Shanghai, which has enacted temporal restrictions on NMVs on several streets (e.g., on Nanjong Donglu Road, where NMVs are prohibited during the off-peak, from 8 AM - 4 PM); and Surabaya, which in 1974-75 instituted a policy of day- and night-*becaks*, allowing two-thirds of all cycle-rickshaws to operate in the daytime and one-third at night. The Surabaya policy, initially implemented with the support of cycle-rickshaw operators as a measure to stabilize operator incomes, is no longer strictly enforced and day-*becaks* and night-*becaks* are seen mixed on Surabaya's streets.

4.39 A problem in Dhaka and Surabaya, the two cities with traffic regulations targeting cycle-rickshaws in particular, is that no clear guidelines have been established to determine warrants for implementing bans. One consequence is strong political opposition, manifested in Dhaka by riots organized by drivers, owners, and users. In general, if regulations restricting NMVs are to be enacted they should be accompanied by the implementation of alternative NMV facilities, as in the case of Shanghai, which is implementing an extensive NMV network.

4.40 In contrast to most of the study cities, Kanpur and Chiang Mai have few or no restrictions on the use of NMVs in traffic. In NMV-dependent Kanpur, all types of NMVs have become well accepted and the city government has basically adopted a *laissez-faire* attitude toward them, leaving the private sector to respond to travel needs. In MV-dependent Chiang Mai, there are few clear policies on informal public transport modes, both motorized and nonmotorized.

NMV FACILITIES

4.41 NMV facilities found in the study cities tend to be either exclusive NMV lanes/paths or NMV parking areas. Exclusive NMV lanes are found to varying degrees in Shanghai, Tokyo, Dhaka, Hanoi, Chiang Mai, Kanpur and Surabaya:

- Shanghai, one of the most advanced city in Asia in implementing NMV lanes and paths, had a 91-km NMV network in its urban area as of September 1992. This included NMV-exclusive links (including bridges and tunnels), NMV lanes demarcated with a physical barrier (e.g., a raised concrete median, a temporary barrier), and NMV lanes delineated by lane markings. Shanghai embarked upon its NMV network strategy by preparing an initial plan in 1985, which was implemented by 1989. In 1991, the World Bank provided a loan to assist Shanghai in the preparation of an action program that will provide an additional 19.4 km of four-lane bicycle roads. Worthy of particular note, Shanghai has a contra-flow bicycle lane on two roads, with the lanes separated only by painted markings; the scheme is self-enforcing because contraflow bicyclists and motor vehicle drivers are clearly aware of the potential danger of crossing the dividing line (i.e., a head-on collision). Also worthy of mention, Shanghai operates bicycle-only streets during the peak period.

- Tokyo and other Japanese cities are relatively advanced in providing bicycle networks, with over 70,000 km nationwide. However, most (93.3 percent) bicycle lanes in Japan are shared bicycle/pedestrian facilities.
- Dhaka, the cycle-rickshaw capital of the world, has provided NMV lanes in three locations. The longest, 1 km in length and 3 m wide, was constructed in the 1980s along the Airport Road. It is separated from the main traffic by a 30 cm-high steel rail fence and sidewalk.
- Two relatively wide streets in Hanoi have physically separated lanes for motorized and nonmotorized traffic in both directions. These lanes are separated by a raised curb, with motorized vehicles to occupy the center lanes and NMVs to travel in the right-hand lanes. However, these lanes are not well used at present.
- Cycle-rickshaw/bicycle lanes have been successfully implemented on a bridge over the Nakhonping River in Chiang Mai. The lanes are separated from motorized traffic by a continuous raised curb, and a pedestrian walkway is separated from the cycle-rickshaw/bicycle lane by a metal fence. This NMV facility, constructed in 1985, has been very successful in terms of traffic performance and safety.

4.42 Kanpur has no officially designated NMV lanes, but the city authorities have been experimenting with yellow lane markings on certain main streets, effectively separating fast and slow vehicles. In addition, the ongoing state-sponsored Comprehensive Traffic and Transportation Study in Kanpur has recommended provision of additional lanes for bicycles waiting at crossings in the short term, permanent segregation of bicycles and cycle-rickshaws in the medium term, and the development of route networks for bicyclists in the long term.

4.43 Surabaya also offers few dedicated facilities, but the 1991 Surabaya Urban Transportation Study recommended that the central business district allow for cycle-rickshaws, perhaps by providing exclusive facilities for access to the CBD as well as for their waiting and circulation within the CBD. Similarly, a 1992 study by the International Institute for Energy Conservation proposed that special lanes for cycle-rickshaws and NMVs such as pushcarts be provided in Surabaya.

4.44 Dedicated NMV parking facilities were observed in most of the study cities:

- Countrywide Japan, the world's leading nation in providing advanced NMV parking areas, has established 8,952 bicycle parking facilities, of which 829 are multistory structures and 35 are fully computerized.
- Bicycle parking facilities are provided on sidewalks, in residential areas, and at common destinations in Shanghai.
- Nearly all workplaces in the organized sector in the Indian city of Kanpur provide bicycle parking. Capacities of bicycle parking facilities in Kanpur range from 50 at small offices, to 500 at railway stations, and up to 1,000 at large factories; the total capacity of such workplace parking facilities in the city has been estimated on the order of 200,000. Roadside parking space is also available near shopping centers and markets; many of these parking spaces are

provided for free, but some parking lots are guarded and charge cyclists at daily or monthly rates.

- Surabaya provides parking facilities for bicycles and cycle-rickshaws at certain locations, such as the city's night markets, transport terminals, and schools.
- George Town's city government provides cycle-rickshaw parking stands at several locations in the city.
- Local governments in Metro Manila have designated curb-side parking areas for cycle-rickshaws, usually in residential areas or along side streets.
- Bicycle parking facilities are provided at large markets in Phnom Penh and Hanoi.

NOTES TO THE TEXT

1. The exchange rates used were for 1992, the year in which the data was collected.

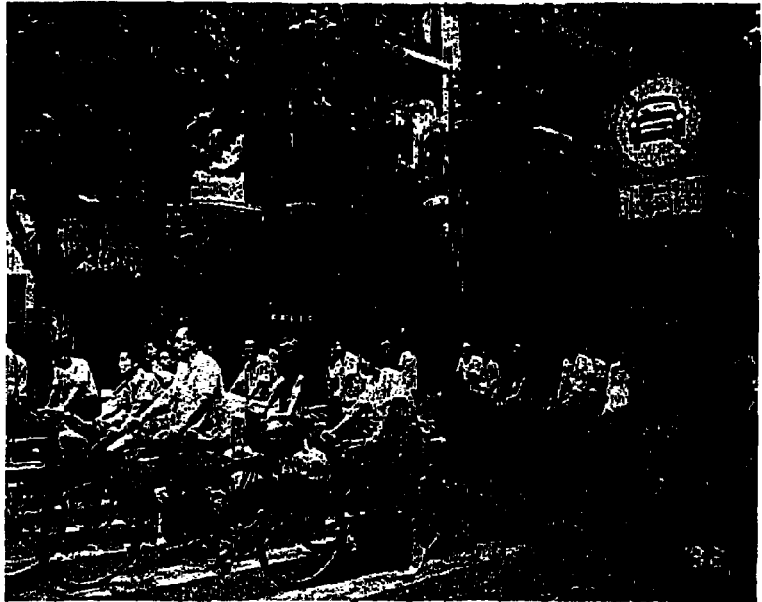
A guardrail separates nonmotorized and motorized vehicles.



Bicycle-only path in Shanghai.



Contra-flow bicycle lanes are being implemented in Shanghai. These types of lanes can be provided at low cost and are an effective traffic management method.



Narrow streets make up an extensive bicycle-only network in Shanghai (motorized vehicles are restricted during morning and afternoon peak hours).



Along busy streets in shopping areas, bicycle restrictions are implemented during store hours (bicycle lanes become pedestrian lanes during shopping hours).

5

FACTORS INFLUENCING NMV OWNERSHIP AND USE

OVERVIEW OF THE FACTORS

5.1 Based on the analysis of existing situation and trends of NMVs in the study cities (Chapter 4), this chapter examines factors influencing NMV ownership and use. A wide variety of factors may be identified as potentially having an effect on NMV ownership and use, including:

- affordability of NMVs;
- attractiveness of NMVs compared to other modes;
- city size and urban form;
- safety of NMV use;
- risk of NMV theft;
- social attitudes toward NMVs and other cultural factors;
- topography;
- climate;
- environmental concerns;
- tourism and recreation; and
- governmental policies.

Each of these factors is examined below; because of the difficulty of drawing statistically significant conclusions from what is after all a relatively small sample size (10 study cities), the discussion is necessarily qualitative and occasionally cites examples from other cities. It is important to recognize that the various factors are interrelated and no one factor is controlling. The final section of this chapter briefly addresses interactive effects between and among factors.

AFFORDABILITY OF NMVS

5.2 One important factor affecting the ownership of NMVs is their affordability, which can be defined in terms of costs relative to income. Factors that in turn affect affordability include the following:

- the distribution of income, which affects the number of individuals or households that can afford an NMV;

- the availability of economy and used models, which may widen the range of households that can afford an NMV (as in Hanoi, Kanpur, and Shanghai, but not in Dhaka);
- the degree of development of the local NMV industry, which may result in comparatively low average prices for NMVs (as in Shanghai, Hanoi, and Kanpur) and may secondarily create employment for persons who themselves may then be able to purchase an NMV;
- low labor costs (as in many of the study cities), which result in lower costs for NMV (particularly cycle-rickshaw) operation, which in turn results in relatively low fares;
- the availability of low-interest loans and subsidies for the purchase of NMVs (as in Shanghai and Kanpur), which effectively reduces the price of an NMV to the potential buyer; and
- the prevalence of high tariffs and other taxes on NMVs (as in Bangladesh), which adversely affect NMV ownership and use by increasing the price of NMVs to users and/or degrading the quality of NMVs offered for sale on the local market.

ATTRACTIVENESS OF NMVs COMPARED TO OTHER MODES

5.3 The attractiveness of NMVs relative to competing modes is another important factor affecting the ownership and use of NMVs. The NMV share of the vehicle stock and the modal split of NMVs may be expected to increase when:

- bus service is poor, as in Phnom Penh (a city with only 23 buses), Hanoi (with only one bus for every 6,875 residents), Kanpur (with only 80 buses used for intracity service, each averaging only 71 km per day), and Shanghai (where travel by bicycle is faster than travel by bus);
- where the ownership of motorcycles and automobiles is low, as a consequence of low incomes and/or high tariffs and other taxes on MVs (as in Phnom Penh, Hanoi, and Shanghai, but not in Chiang Mai);
- where good NMV facilities are available, as in Shanghai (which has made substantial progress in the implementation of separate networks for NMVs and MVs), Kanpur (with the provision of bicycle parking facilities at major destinations), and Tokyo (with its advanced bicycle parking facilities); and
- when there is a high degree of integration between NMVs and public transport (as in Japan, where the national Bicycle Law has encouraged local governments to provide bicycle lanes, paths, and parking facilities near rail stations in order to promote the use of bicycles as a feeder mode for rail service).

CITY SIZE AND URBAN FORM

5.4 No conclusive evidence was found to support the hypothesis that the ownership and use of NMVs is related (or inversely related) to a city's size or the extent of urban decentralization. Although trip distances increase as cities grow and spread out, and human- or livestock-powered vehicles are necessarily less competitive for longer trips, determining factors are usually other than city size and urban form. For example, relatively compact Hanoi has been termed a "paradise" for bicycles,¹ but the city travelers use NMVs because of the poor bus service and high costs of owning MVs. While NMVs have largely disappeared from the streets of the large, sprawling city of Bangkok, the main reason for their disappearance in the Thai capital is a rapid increase in MV ownership and the resulting lack of safe space for NMV use. On the other hand, NMVs can continue to play a role in large, decentralized cities; in the Tokyo megalopolis, for example, approximately one-quarter of all rail feeder trips are made by bicycle. Shanghai is another city where NMVs will continue to play a role in the urban transport system regardless of changes in urban form. Consequently, NMV ownership and use is not clearly related to city size or urban form.

5.5 High-density development, however, can positively contribute to the use of NMVs. The cities or areas inventoried with high NMV use are characterized by high-density development (e.g., Shanghai, Hanoi, Kanpur, Old Dhaka, and Japanese cities). Concentrated development encourages shorter trip lengths, which makes NMVs more competitive to use than MVs.

SAFETY OF NMV USE

5.6 NMVs may be termed "vulnerable road users"² because they are often the victim of aggressive driving by motorists, especially in bicycle-hostile street environments where slow and fast modes are inadequately separated. The extent of NMV ownership and use appears directly related to the quality of the bicycling environment and inversely related to accident risk. In Shanghai, a city that offers a relatively safe, user-friendly bicycling environment, 95.9 percent of all vehicles owned and 87.2 percent of all vehicles in traffic are bicycles. In contrast, bicycles in Surabaya and Chiang Mai were found to account for less than 6 and less than 1 percent of all vehicles in traffic, respectively, a consequence of unsafe conditions for bicyclists in the two cities.

5.7 One may hypothesize a "vicious circle" by which decreasing bicycle use and increasing motorization result in degradations in the quality of the bicycling environment and increases in accident risk, leading to further decreases in bicycle use. Bicycles "rule the road" in bicycle-dependent cities such as Shanghai and Hanoi, and consequently bicyclists in these cities are confronted with comparatively minor conflicts with motorized modes. With continued motorization and consequent degradation of the safety of the bicycling environment, substantial decreases in bicycle use in these cities may be expected unless effectively counteracted by policies to improve the bicycling environment.

RISK OF NMV THEFT

5.8 Although there is a dearth of formal data on NMV thefts, the possibility of NMV theft was found to represent a barrier to NMV ownership in certain of the study cities (e.g., Dhaka, Surabaya). Even in low-income cities where the statistical probability of theft is relatively low, the perception of the risk of losing a major investment in an instant likely deters many from owning NMVs. A survey of bicyclists and non-bicyclists in ten low-income neighborhoods in Delhi in 1985 found that while only 1 percent of the bicyclists reported having a bicycle stolen, theft was seen as a significant deterrent to bicycle ownership by the non-bicyclists.³ However, in Japan bicycle theft is rather common but does not significantly suppress the ownership and use of bicycles because bicycle prices are rather low in relation to incomes.

SOCIAL ATTITUDES TOWARD NMVs AND OTHER CULTURAL FACTORS

5.9 Local social attitudes can have a significant impact on the ownership and use of NMVs. For example, the prevalence of NMVs can be influenced by the status of their use. In Bangladesh, most bicycle owners are middle-income persons because more affluent individuals prefer to travel by other means, even by foot, than to lower their status by using a bicycle. While poorer and less well-educated bicyclists in Bangladesh have been found to use their bicycles every day, wealthier and better educated bicyclists are more likely to use their bicycles only occasionally.⁴ The extent of NMV ownership and use can also be influenced by attitudes related to gender. Female bicycle riders are much more common in China and Vietnam than on the Indian subcontinent or in Indonesia, where traditional clothing styles and cultural norms make it difficult for women to use bicycles. On the other hand, females commonly use cycle-rickshaws in the predominantly Muslim city of Dhaka, where *purdah* (the social seclusion of women) makes it difficult for women to share crowded buses with the predominantly male passengers.

TOPOGRAPHY

5.10 Not surprisingly, NMVs tend to be more prevalent in flat cities than in hilly ones. It is difficult to illustrate this common-sense point from the study cities, since all were selected because of their predominantly level terrain. However, to illustrate the point, consider Myanmar, with hilly and MV-dependent Yangon, and flat and NMV-dependent Mandalay, the latter which has been dubbed "a city of bicycles." Of course, bicycles can thrive in mountainous countries and even in hilly cities, if there are sufficiently large expanses with relatively level topography. For example, against a backdrop of hilly terrain, bicycles are widely used in the relatively flat city center of Semarang, Indonesia.

CLIMATE

5.11 There are no clear relationships between NMV use and ownership and climate. In certain of the study cities (e.g., Manila), hot and rainy climates were found to deter bicycle ownership and use but increase the use of cycle-rickshaws. However, bicycles were found to predominate in other study

cities with similar climates (e.g., Hanoi). And bicycles have become increasingly popular in the rainy North American cities of Seattle and Vancouver,⁵ which have an average of 160 days per year of measurable precipitation. NMV users in cities where occasional rain is expected are often prepared with a plastic sheet or raincoat; if they are not prepared, they take temporary shelter until the rain stops.

ENVIRONMENTAL CONCERNS

5.12 Evidence from outside of Asia indicates that, at least at certain levels of development, bicycle ownership and use may be related to the environmental consciousness of a community or country. The Netherlands, one of the world's leading countries in environmental policy,⁶ has 14 million bicycles compared to 15 million people and only 5.5 million motor vehicles; 29 percent of all trips in Holland are made by bicycle, and the modal split for commuting trips in certain towns is approximately 70 percent.⁷ Evidence also indicates that North American cities where bicycle use is prevalent (e.g., Toronto, Vancouver, Seattle, Santa Monica) are among the environmentally conscious.⁸

TOURISM PROMOTION AND RECREATION

5.13 Tourism promotion and recreation are two additional factors contributing to NMV ownership and use. In George Town, bicycles account for nearly half of all vehicles but only about 5 percent of all vehicular traffic because they are used primarily for recreational purposes. Cycle-rickshaws (*trishaws*) have been preserved in George Town largely because of their nature as a tourism asset on an island that derives 15 percent of its GDP from tourism. Although local government officials in the historic city of Chiang Mai have indicated their desire to see cycle-rickshaws (*samlors*) promoted for tourism purposes, tourists currently account for only about 2 percent of all cycle-rickshaw passengers in Chiang Mai.

GOVERNMENTAL POLICIES

5.14 The single and the most important factor influencing NMV ownership and use is governmental policies at various levels because they affect most of the above examined factors except topography and climate. These policies include:

- unbalanced urban transport planning favoring MVs over NMVs (as in Jakarta and Bangkok, but not in Shanghai);
- low-interest loans and subsidies for the acquisition of NMVs (Shanghai and Kanpur);
- policies promoting (China and Vietnam) or adversely affecting (e.g., Bangladesh's high tariffs on bicycle parts) NMV industries;

- the relative taxes charged MVs and NMVs (e.g., favoring MVs in Bangladesh, but favoring NMVs in China);
- the construction of NMV (network and parking) facilities by the government or by the private sector under public-private cost sharing schemes (Kanpur, Shanghai, and Tokyo);
- investment in mass transit systems, neglecting the complementary potential of NMVs;
- registration and licensing regulations, which may either burden NMVs (as in Surabaya and Jakarta) or may promote NMVs (as with Shanghai's theft-preventing bicycle registration system);
- traffic regulations, which may aid NMVs by promoting a safer environment (as in Shanghai) or may hinder NMVs (as in Dhaka, where NMVs are banned from certain "VIP roads");
- the level of traffic enforcement and education of users (e.g., high in Japan, low in Cambodia); and
- land use policies, which may promote NMVs by concentrating residences and workplaces (e.g., Shanghai's traditional approach) or which may discourage NMV use by decentralizing cities (e.g., Shanghai's current approach of developing satellite towns).

Appropriate governmental policies can be formulated and implemented through urban transport planning, provision of loans and subsidies for NMV acquisition, NMV/MV pricing policies, and provision of NMV facilities.

INTERACTION BETWEEN AND AMONG FACTORS

5.15 Many of the factors affecting NMV use and ownership outlined in this section are interrelated. A few examples will suffice to illustrate this point:

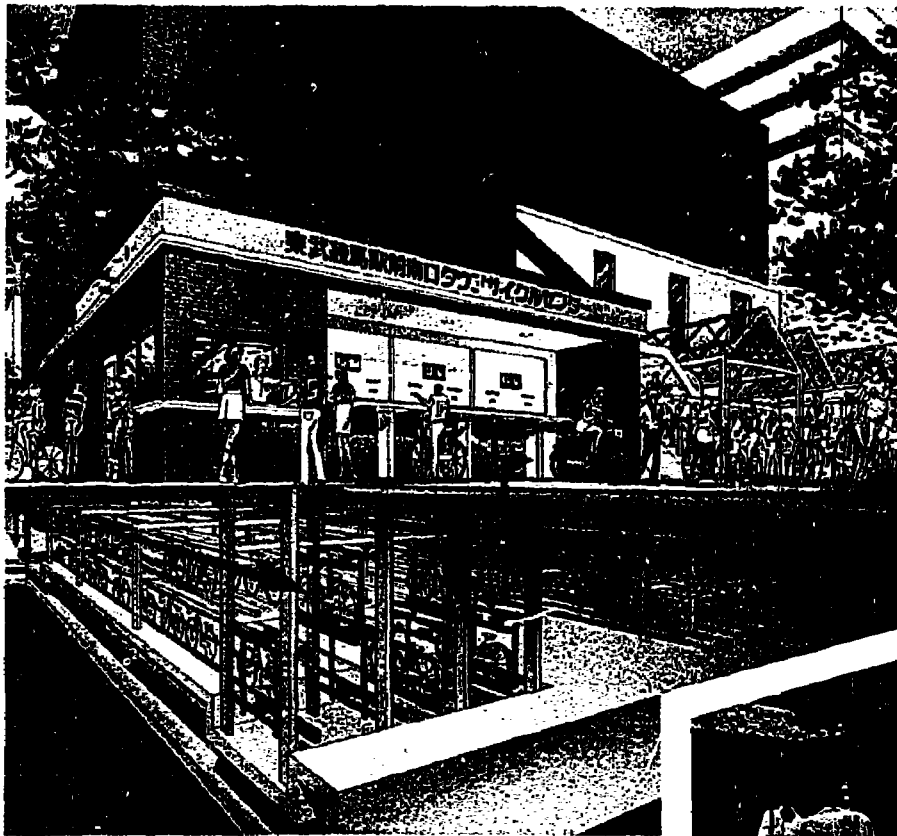
- the affordability of NMVs is related to the availability of governmental policies providing low-interest loans and subsidies for the acquisition of NMVs;
- the attractiveness of NMVs is related to the extent to which governments provide good NMV facilities;
- the attractiveness of NMVs also depends on motorization rates, which in turn are related to tax levels among other factors; and
- the safety of NMV use is related to the modal split of NMVs, which in turn is related to most other factors considered above.

5.16 While there are many variables, no one factor is controlling. Rather, cities with relatively high NMV ownership and use are likely to exhibit a combination of favorable factors. Thus, for

example, NMV-dependent Shanghai is a city with relatively low bicycle prices in relation to income, employer subsidies for the purchase of NMVs, relatively poor bus service and a low degree of motorization, a concentrated urban form (at least historically), a bicycle-friendly environment, relatively low risk of NMV theft, favorable social attitudes toward NMV use, and relatively flat terrain. The following chapter provides a detailed discussion of NMV policies and possible actions by local government and donor agencies in relation to major issues (e.g., NMVs and congestion).

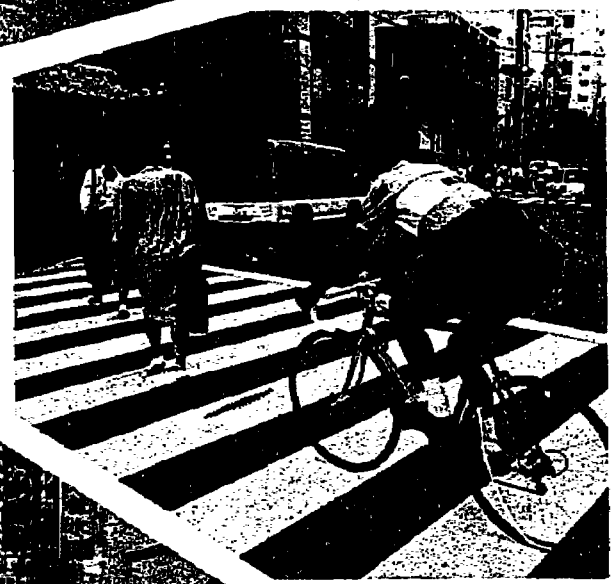
NOTES TO THE TEXT

1. Heierli, Urs (1993), *Environmental Limits to Motorization: Non-motorised Transport in Developed and Developing Countries*, SKAT, Swiss Centre for Development Cooperation in Technology and Management, p. 134.
2. *Ibid.*, p. 56 [citing Mohan, Dinesh (1991), "The Vulnerable Road Users," paper presented at the International Conference on Traffic Safety, New Delhi, published in *Journal of Traffic Medicine*, Vol. 18, No. 4, 1990].
3. Hathaway, A.G. (1990), "Travel Requirements of the Poor," presented at the Transportation Research Board Annual Meeting, Washington, D.C.
4. Gallagher, Robert (June 1991), *The Rickshaws of Bangladesh*, privately published.
5. See, e.g., Dornfield, Mike (September 1992), Seattle Advisory Board: How It Works, paper presented at The Bicycle: Global Perspectives conference, Montreal, 13-17 September 1992, pp. 432-33; Adam, Ian, Planning Vancouver's Bicycle Network, paper presented at The Bicycle: Global Perspectives Conference, Montreal, 13-17 pp. 33-37.
6. Consider, for example, that the Netherlands has adopted a new strategy for environmental policy in the 1990s, investing six billion guilders (about US\$ 11 billion) per year to reduce automotive emissions, through reduced car use and urban environmental traffic management.
7. Welleman, A.G. (Ton) (September 1992), The National Bicycle Policy and the Role of the Bicycle in the Urban Transport System in *Still More Bikes Behind the Dikes: reader on Policy and Research for Bicycle Facilities in the Netherlands*, Centre for Research and Contract Standardization in Civil and Traffic Engineering (CROW), p. 9.
8. See, e.g., Egan, Daniel (September 1992), Toronto's Bay Street Urban Clearway: A Bicycle and Bus Success Story, paper presented at The Bicycle: Global Perspectives Conference, Montreal, September 1992, 13-17, pp. 146-48; Dornfield, Mike, Seattle Advisory Board: How It Works, pp. 432-33; Adam, Ian, Planning Vancouver's Bicycle Network, pp. 33-37; Snyder, Ryan, The Santa Monica Master Plan, pp. 251-54.



A drawing of the computerized rent-a-cycle facility in Nerima, Tokyo. This facility has been in operation since 1989 and is open daily from 4:00 a.m. to 1:20 a.m. (This drawing was provided courtesy of Japan Sun-Cycle Co., Ltd.)

Riding bicycles on pedestrian facilities is allowed in certain areas, further promoting bicycle use in Japan.



Illegal bicycle parking in front of rail stations is a problem for many local governments in Japan, not to mention pedestrians (this photo was provided courtesy of the Tokyo Prefectural Government).



6

ISSUES, POLICIES, AND POSSIBLE ACTIONS BY DONOR AGENCIES

OVERVIEW

6.1 This chapter assesses major NMV issues as distilled from the ten case studies prepared during the course of this project. Sixteen issues have been identified, falling into four basic categories:

- urban transport system issues;
- regulatory issues;
- economic, social, and environmental issues; and
- general NMV planning and policy issues.

For each issue, recommended policies at the local level as well as possible actions by donor agencies are discussed. For example, an issue (number fifteen in the following discussion) is inappropriate pricing/tax policies in the urban transport sector, particularly with respect to differences between MVs and NMVs; the associated policy recommendation at the local level is to revise pricing/tax policies to reflect costs occasioned by vehicle use, while the possible actions by donor agencies are to provide technical assistance to encourage governments in developing appropriate pricing/tax policies for private vehicles and assist in the provision of sustainable transport systems. Table 6-1 lists the 16 issues, associated policy recommendations, and possible actions by donor agencies; more detailed discussion follows.

ISSUE 1: LACK OF APPROPRIATE FACILITIES

6.2 Facilities for NMVs are inadequate in most of the study cities. For example, in Phnom Penh, where all vehicles share the same road space, regulations require NMVs to occupy the far right-hand lane; however, without physical distinctions between lanes, many vehicles weave between and among lanes as they overtake slower-moving vehicles. Hanoi has physically separated lanes for motorized and nonmotorized traffic, with the lanes separated by a raised curb; however, the physically separated lanes are relatively ineffective because they do not provide continuous travel paths. Dhaka has NMV lanes, but only at three locations; Dhaka also has *rickshaw* waiting areas along certain road segments, but these facilities are not clearly marked and their capacities are insufficient to meet the demand. Surabaya offers few NMV-dedicated facilities, mainly parking facilities for bicycles at certain places, such as the city's night markets, transport terminals, and schools. Metro Manila also offers few NMV facilities, except for faded yellow-striped lanes for bicycles on a small number of city streets and *pedicab* terminals designated by local governments in residential areas or along side streets. Although

Table 6-1: Issues, Policies, and Possible Actions by Donor Agencies

<i>Issue</i>	<i>Recommended Policies at the Local Level</i>	<i>Possible Actions by Donor Agencies</i>
<i>Urban Transport System Issues</i>		
1. Lack of Appropriate Facilities	• Develop appropriate facilities for NMVs	• Assist national and local governments by funding and technical assistance for the provision of adequate NMV facilities
2. NMVs and Congestion	• Improve public transport • Provide adequate bicycle parking facilities	• Provide loans and technical assistance for NMV facilities to alleviate illegal parking and congestion by NMVs
3. NMVs and Road Safety	• Improve traffic management and enforcement • Establish safety education programs • Improve NMV safety equipment	• Support programs to improve NMV safety
4. NMV Theft	• Provide secure parking for NMVs • Register NMVs to reduce theft	• Encourage anti-theft programs
<i>Regulatory Issues</i>		
5. Over-Regulation of NMVs	• Limit the regulation of NMVs to safety- and security-related concerns	• Require the deregulation of NMVs
6. Lack of Compliance with Traffic Regulation by NMV Users	• Review traffic laws and regulations, improve traffic enforcement and traffic education	• Support the efforts of local governments to review traffic-related laws and regulations, improve traffic enforcement and traffic education
<i>Economic, Social, and Environmental Issues</i>		
7. Affordability of NMVs for the Poor	• Supply credit and offer targeted subsidies for the purchase of NMVs • Reduce tariffs on NMVs	• Support technical assistance and loan programs to increase NMV ownership by the poor
8. NMVs and Economic Development	• Promote NMV use, assembly and manufacturing	• Assist local governments in adopting appropriate policies to promote NMV assembly and manufacturing industries
9. NMVs and the Environment	• Implement pricing/tax policies that reflect environmental costs occasioned by vehicle use	• Initiate research on the economic impact of NMVs and MVs on the environment

Table 6-1: Issues, Policies, and Possible Actions by Donor Agencies (Continued)

<i>Issue</i>		<i>Recommended Policies at the Local Level</i>	<i>Possible Actions by Donor Agencies</i>
10.	NMVs and Energy	Consider the fuel-saving quality of NMVs	Initiate research on the energy impacts of NMVs
11.	NMVs and Land Use	- Adopt land use policies that can reduce commuting distance - If land use planning policies are ineffective, promote intermodal integration between NMVs and public transport	Encourage planned urban development and the use of NMVs as a feeder mode for public transport
<i>General NMV Planning and Policy Issues</i>			
12.	Low Priority Accorded NMVs	Increase priority of NMVs in transport and traffic planning	Encourage local governments to increase NMV priority in transport and traffic planning
13.	Policy Biases Against NMVs	- Implement institutional measures to address biases against NMVs - Incorporate NMVs in the urban transport planning process	Remedy anti-NMV biases and redress unbalanced transport planning
14.	Inappropriate Allocation of Funds for NMV Facility Improvement	- Consider low-cost solutions - Adopt innovative approaches to financing	Encourage innovative financing
15.	Inappropriate Pricing/Tax Policies in the Urban Transport Sector	Revise pricing/tax policies to reflect costs occasioned by vehicle use	Provide technical assistance to governments in formulating appropriate pricing/tax policies and assist in the provision of sustainable transport systems
16.	Lack of Data, Analytical Techniques, and Engineering Guidelines	Improve data, analytical techniques, and engineering guidelines	- Require local governments to improve NMV data collection systems - Assist in developing transport systems models incorporating nonmotorized modes - Implement NMV pilot studies

Note: More detailed discussion of each issue, recommended policies at the local level, and possible actions by donor agencies are provided in the text.

Chiang Mai has successfully implemented a *samlor*/bicycle lane on Nakhonping Bridge traversing the Ping River, dual-use motorcycle and bicycle lanes implemented several years ago were discontinuous, poorly maintained, and are now used mostly for parking by cars and trucks. George Town offers only a limited number of *trishaw* parking stands.

6.3 Recommended Policy at the Local Level - *Develop Appropriate Facilities for NMVs:* A few of the study cities provide examples of how adequate facilities for NMVs can be developed. Shanghai, perhaps one of the leading cities in Asia in providing NMV facilities, founded upon basically traffic management measures, had a 91-km NMV network in its urban area as of September 1992. This included NMV-exclusive links (including bridges and tunnels), NMV lanes demarcated with a physical barrier (e.g., a raised concrete median, a temporary barrier), and NMV lanes delineated by lane markings. Japanese cities are also very advanced in providing bicycle lanes, with over 70,000 km nationwide; however, most bicycle lanes in Japan (93.3 percent) are shared bicycle/pedestrian facilities. An important feature of the Shanghai and Japanese examples is that the network provided is reasonably continuous, offering a relatively direct and convenient path between trip ends. Also worthy of note is the experience of Kanpur, where traffic authorities are experimenting with yellow lane markings on certain main streets, effectively separating fast- and slow-moving vehicles. Such low-cost solutions may be particularly appropriate for cities with limited financial resources. Lane markings, however, may not work without disciplined traffic or strict enforcement, or both. In Lima (Peru) lane markings turned out to be a complete failure; the bicycle lanes were used for parking by MVs.

6.4 Possible Action by Donor Agencies - *Assist National and Local Governments by Funding and Technical Assistance for the Provision of Adequate NMV Facilities:* Donor agencies should support the development of improved NMV facilities in cities where NMVs account for a significant share of vehicular traffic. Such support could take the form of technical assistance and loans to facilitate, among other things, institutional capacity building and the provision of continuous, coherent, direct, attractive, safe, and comfortable NMV network must also be considered.¹

ISSUE 2: NMVS AND CONGESTION

6.5 In certain NMV-dependent cities NMV congestion on city streets is itself a major concern. In Shanghai, where 87 percent of all vehicles in traffic are NMVs, bicycles are seen as a less efficient user of the city's increasingly scarce road space than buses. In Hanoi, where 64 percent of all vehicles in traffic are NMVs, local government officials have calculated the "interruption" of NMVs and certain motorized vehicles to traffic in terms of the road area taken up by one bus passenger. Although perhaps overstated, Hanoi authorities have estimated that a bicycle rider and a cycle-rickshaw (*cyclo*) passenger require an area 16 and 20 times larger than that required for one bus passenger, respectively. A congestion problem of a different sort is found in Tokyo, where illegal bicycle parking is a pervasive problem. Because the demand for bicycle parking at rail stations in Japan's urban areas far exceeds the supply, many people illegally park their bicycles within the vicinity of stations. In some areas, particularly on pedestrian sidewalks surrounding rail stations, the overabundance of illegally parked bicycles is a serious hindrance to pedestrian traffic flow.

6.6 Recommended Policies at the Local Level - Improve Public Transport: In NMV-dependent cities such as Shanghai and Hanoi, where a preponderance of bicycles has overwhelmed the capacity of the urban street system (particularly on main streets), public transport services should be upgraded by giving a higher priority to buses. In terms of persons per hour per meter lanewidth, buses provide a capacity of 2,700 in mixed traffic and 5,200 on a busway; comparable figures for NMVs are 1,330 for a bicycle in mixed traffic, 1,800 for a bicycle on a separated facility, and only 420-1,200 for a cycle-rickshaw in mixed traffic and 560-1,600 for a cycle-rickshaw on a separated facility. In certain large cities where buses are insufficient to provide sufficient capacity (e.g., Bangkok), an off-street public transport system may be required to provide additional capacity. Estimated capacities in terms of persons per hour per meter lanewidth equivalent for light rail, suburban rail, and rapid rail are 3,600, 4,000, and 9,000, respectively.² An alternative for addressing the problem of NMV congestion, limiting the numbers of NMVs through regulation, is not recommended. Such a policy unduly constrains NMV use. When urban transport alternatives are properly priced, free markets can most efficiently allocate resources among modes, motorized and nonmotorized.

6.7 Provide Adequate Bicycle Parking Facilities: Japan, which has the most serious bicycle parking problem in the region, enacted the Law for the Promotion of Bicycle Parking Facilities in 1980 to address the problem of illegal bicycle parking. Since passage of this national law, more than a third of all local governments in Japan have enacted ordinances to address problems with illegal bicycle parking. Typically, these ordinances require landowners with property near rail stations to provide land for bicycle parking, call for the impounding of illegally parked bicycles, or both. Similar approaches could be considered in other cities in the region with serious illegal bicycle parking problems.

6.8 Possible Action by Donor Agencies - Provide Loans and Technical Assistance for NMV Facilities to Alleviate Illegal Parking and Congestion by NMVs: In cities where NMVs are approaching the saturation point in terms of NMV parking space and urban street capacity, donor agencies should provide loans and technical assistance for public transport projects. Improving bus services would be the first priority in most cities, perhaps later followed by mass rapid transit investments in the largest cities with the most severe congestion problems. Whatever improvements are made in public transport, consideration should also be given to improvements in NMV parking facilities and networks.

ISSUE 3: NMVs AND ROAD SAFETY

6.9 As noted, NMVs were found to be a relatively unimportant cause of traffic accidents in each of the eight study cities for which reasonably reliable data were available. In each of these cities, the share of accidents attributable to NMVs is significantly less than the modal split of NMVs in vehicular traffic. Even though the impact of NMVs on road safety is relatively low and substantially less than that perceived by urban transport officials, there is still substantial scope for improving the safety of NMVs in Asian cities, particularly considering that a significant portion of accident victims are NMV users. The issue must be considered an important one, given the alarming rates of deaths from traffic accidents in Asian cities.

6.10 Recommended Policies at the Local Level - *Improve Traffic Management and Enforcement:* As noted, traffic management and enforcement measures are required to reduce conflicts between NMVs and MVs so that traffic flows are improved and congestion reduced. Such measures could also improve safety because they clearly allocate road space between MVs and NMVs and increase compliance with traffic regulations. Worth noting here is the case of Shanghai, which records traffic violations on bicycle driving licenses and requires repeated violators to attend a two-day training program on safe bicycle riding. Another instructive case is that of Japan, where prefectures compete against each other to reduce the incidence of road traffic accidents and fatalities.

6.11 *Establish Safety Education Programs:* The low educational background of NMV operators creates safety problems in certain low-income cities in the region. However, safety education programs can be beneficial, as the Japanese experience demonstrates. The bicycle law in Japan requires schools to teach children bicycle safety, which is usually done as part of health and physical education classes, in which the traffic police teach young children how to check a bicycle for safety and operate a bicycle in traffic. In cities where many NMV operators have limited educational backgrounds or are simply unfamiliar with urban driving conditions and levels of traffic (e.g., Phnom Penh and Kanpur), more general public education campaigns perhaps accompanied by special NMV safety "seminars" could be considered.

6.12 *Improve NMV Safety Equipment:* NMVs in low-income cities in the region often lack basic safety devices such as rear-view mirrors, lights, and reflectors. Local governments should consider implementing policies to induce NMV owners to provide at least the most basic of safety devices, through the provision of financial incentives for doing so, through regulations requiring basic safety features (as has been implemented in George Town, for example), or through some combined "carrot and stick" approach.

6.13 Possible Action by Donor Agencies - *Support Programs to Improve NMV Safety:* In their urban transport programs, donor agencies should consider supporting measures to improve road safety, including targeted efforts to improve traffic management and enforcement, improve NMV road safety equipment, and establish safety education programs.

ISSUE 4: NMV THEFT

6.14 Although there is little formal data on NMV thefts, the possible theft of NMVs was found to represent a barrier to NMV ownership in some of the study cities (e.g., Dhaka and Surabaya). Even in low-income cities in which the statistical probability of NMV thefts is not high, the perception of the risk of losing a major investment in an instant likely deters many from owning NMVs.

6.15 Recommended Policies at the Local Level - *Provide Secure Parking for NMVs:* One approach to combating the perceived or actual problem of NMV thefts is to provide secure parking for NMVs. Japan is the world's leading nation in providing advanced NMV parking areas, as described in Chapter 4. The Netherlands is experimenting with the *Ficarro*, a bicycle parking carousel that is secure against bicycle theft and that reportedly can cover its own costs even with a small number of bicycles, at least under Dutch conditions. Lower-technology solutions were also

found in some of the study cities (e.g., extensive guarded bicycle parking facilities in Kanpur and Shanghai).

6.16 Register NMVs to Reduce Theft: Another approach to addressing the NMV security issue, whether it be perceived or actual, is to implement a comprehensive system of bicycle registration. The bicycle registration system in Shanghai, which requires that registration cards be attached to bicycles at all times, has proven effective in reducing bicycle thefts in China's largest city. Also instructive is the experience of Denmark, where bicycle thefts in Copenhagen decreased by 23 percent after the introduction of a nationwide computerized bicycle theft register in June 1990.³ However, NMV registration is costly and should be introduced only after carefully assessing its cost-effectiveness.

6.17 Possible Action by Donor Agencies - Encourage Anti-Theft Programs: In cities where NMV theft is seen as a deterrent to NMV ownership and use, donor agencies should consider encouraging local governments to promote the development of NMV parking facilities and NMV registration programs. As explained later, parking facilities may make excellent candidates for concession projects.

ISSUE 5: OVER-REGULATION OF NMVs

6.18 There are a number of examples of how government regulatory policies have reduced the supply and use of NMVs in Asian cities:

- In Jakarta, authorities seized 100,000 cycle-rickshaws, over one-third of which were dumped into the sea. A similar policy, albeit on a lesser scale, was implemented in Delhi in the late 1980s.
- In Dhaka, NMVs have been banned from certain "VIP Roads," and it is likely that NMV-restricted areas will be extended in the near future. However, no clear guidelines have been established for determining the areas where cycle-rickshaws are to be prohibited.
- In Surabaya, the government enacted a policy of day- and night-*becaks* (i.e., cycle-rickshaws) to reduce the number operating at any given time. This regulatory system was implemented with the support of the operators and resulted in a stabilization of operator incomes. It nevertheless has resulted in a reduction in the availability of NMV transport services to local residents.
- In George Town (Malaysia), the city council in 1969 stopped issuing new cycle-rickshaw licenses and prohibited transfers except to cycle-rickshaw drivers registered before 1969. The number of cycle-rickshaw registrations has decreased 38 percent since that time, a surprisingly small decline considering that no new licenses have been issued in more than two decades.

6.19 Recommended Policy at the Local Level - Limit the Regulation of NMVs to Safety- and Security-Related Concerns: The urban transport sector in general, and NMVs in particular, would

benefit by substantially less regulation by local authorities in Asian cities. Kanpur, a city with a half million bicycles and over 30,000 cycle-rickshaws, presents a good example of how NMVs can thrive in a laissez-faire environment in which the private sector is free to respond to the travel needs of the city's residents. Of course, in Kanpur and elsewhere certain regulatory policies can play a useful role in promoting NMVs, particularly with respect to the allocation of street space, safety, and security.

6.20 Possible Action by Donor Agencies - *Require the Deregulation of NMVs*: Cities with overly restrictive NMV regulations should be required to revise or abolish these regulations as a condition for receiving donor support in the urban transport sector. The World Bank's success in promoting the deregulation of the public transport sector in a number of Asian cities can provide a model for this effort.⁴

ISSUE 6: LACK OF COMPLIANCE WITH TRAFFIC REGULATIONS BY NMV USERS

6.21 A lack of compliance with traffic regulations by NMV users was found to be a serious problem in many of the study cities. One problem is that traffic laws in many Asian cities, which often date back to colonial times, need updating to reflect current conditions. Another problem is that the police force allocated to traffic duties is typically understaffed and inadequately trained. Finally, system users are often unfamiliar with existing traffic regulations⁵ and need to be educated.

6.22 Recommended Policies at the Local Level - *Review Traffic-Related Laws and Regulations, and Improve Traffic Enforcement and Traffic Education*: A variety of measures are recommended in order to increase compliance with traffic regulations by NMVs. Reflecting the problems set forth in the issue statement, these measures include revision of traffic laws, strengthening of traffic police, and education of system users (e.g., with billboards or decals, as used in Beijing and Lucknow, India, respectively).

6.23 Possible Action by Donor Agencies - *Support the Efforts of Local Governments to Review Traffic-Related Laws and Regulations, and to Improve Traffic Enforcement and Traffic Education*: In their urban transport programs, donor agencies should provide technical assistance and funding to review national and local regulations, improve traffic enforcement, and upgrade traffic education.

ISSUE 7: AFFORDABILITY OF NMVs FOR THE POOR

6.24 One barrier to the purchase of NMVs in some study cities is their affordability, defined in terms of price relative to income. The price of a new standard-model bicycle consumes as much as 96 percent of average monthly income in Phnom Penh. Affordability tends to be a particular barrier to NMV ownership for those with below average incomes, the availability of lower-priced economy and used models notwithstanding. Moreover, in certain countries such as Bangladesh, the affordability barrier is exacerbated by relatively high tariffs on NMV parts, which result in higher acquisition prices. Although loans are generally available to the more affluent to purchase an automobile or motorcycle, loans are rarely available to the poor to purchase a bicycle for personal mobility or a cycle-rickshaw to establish a small transport business.

6.25 Recommended Policies at the Local Level - Supply Credit and Offer Targeted Subsidies for the Purchase of NMVs: The affordability barrier to bicycle ownership has been addressed in three study cities. In Kanpur, private and government organizations offer low-interest loans for the purchase of bicycles. In Shanghai, employers provide commuters with subsidies of up to US\$ 3 per month, which bicyclists can apply to the purchase of a new bicycle or the maintenance of one they already own. And, in Bangladesh, credit has been issued by various government agencies to *rickshaw* cooperatives on a limited basis, with the Government financing the purchase of 3,300 *rickshaws* per year countrywide.

6.26 Bicycle subsidies would seem to be justified to the extent that they result in savings in spending on transport facilities or in subsidies to public transport operators. A Dutch study found that the incremental cost of travel by bicycle is approximately one-twelfth of that of travel by car, principally because of the difference in facility costs. An Indian study concluded that the operating subsidy for the bus operator in Delhi in 1985 (on the order of US\$ 150 million) would have been sufficient to provide a bicycle for every household below the poverty level.⁶ Subsidies for the purchase of cycle-*rickshaws* would also seem to be easily justified given the return on investment in these vehicles; in Surabaya, for example, the return on investment in a new *becak* is significantly greater than 100 percent, which is not inconsistent with the high interest rates of 5-10 percent per month charged by certain usurers. However, to achieve their objectives, loans must be targeted at *rickshaw* drivers and not existing owners.⁷

6.27 Reduce Tariffs on NMVs: In some countries, the affordability of NMVs is adversely affected by high tariffs, intended to benefit the local manufacturing industry. Even if high tariffs lead to increased local production, such a policy distorts free competition, resulting in unnecessarily high prices for locally produced bicycles. The price of a bicycle in Bangladesh, for example, is twice that in the neighboring Indian state of West Bengal.⁸ Because there is little evidence that such tariffs have led to increased local production of NMVs, the case for their removal is unambiguous.

6.28 Possible Action by Donor Agencies - Support Technical Assistance and Loan Programs to Increase NMV Ownership by the Poor: On both efficiency and equity grounds, donor agencies should consider encouraging local governments to promote NMV ownership among the poorest of the poor. Interventions might include establishing revolving funds offering credit for the purchase of bicycles and cycle-*rickshaws*,⁹ encouraging employers to subsidize employee purchases of bicycles, and promoting the use of bicycles for commuting.

ISSUE 8: NMVs AND ECONOMIC DEVELOPMENT

6.29 NMVs play an important role in the local economy in many of the study cities. The *rickshaw* industry in Dhaka - including drivers, repair persons, owners, mechanics in assembly shops, and retailers in components shops - directly provides 23 percent of the city's employment. Similarly, approximately 20 percent of the jobs in Kanpur are in the NMV sector, which includes all employment related to bicycles, *rickshaws*, animal carts, and handcarts. The NMV sector is also an important employer in Shanghai and Hanoi - two large bicycle manufacturing centers. To the extent that MVs replace NMVs in these cities, local economies will drastically change with consequent dislocation effects (e.g., loss of employment in the NMV industry). Nevertheless, the inventory of

Asian cities conducted for this recent study found that local governments often underestimate the economic impact of the NMV sector.

6.30 Recommended Policy at the Local Level - *Promote NMV Use, Assembly, and Manufacturing.* Consistent with overall economic efficiency considerations, cities with high levels of NMV ownership should promote NMV use, assembly, and manufacturing. NMV use can be promoted with a variety of measures specified elsewhere in this chapter (e.g., improving facilities, providing potential users with access to credit). NMV assembly and manufacturing can be encouraged by providing credit and technical assistance to NMV assembly and manufacturing enterprises, identifying potential export markets for NMVs,¹⁰ and technology transfer between and among nations with large numbers of NMVs.¹¹ However, it is not advisable to promote NMV assembly and manufacturing through high tariffs on NMV parts, a policy that merely increases prices for users. A bicycle consists of over one thousand parts, and even in technically sophisticated Holland, large factories import two-thirds of their parts.¹² An attempt by the Government of Bangladesh to produce complete bicycles has proven unsuccessful, with output only 10 percent of factory capacity.¹³

6.31 Possible Action by Donor Agencies - *Assist Local Governments in Adopting Appropriate Policies to Promote NMV Assembly and Manufacturing Industries.* In their programs to assist urban transport and industrial sector projects in NMV-dependent cities in Asia, donor agencies should recognize the vital importance of NMVs in local economies. Donor programs should support NMV use and production; trade policies that unduly restrict the importation of NMV parts should be scrutinized and changes recommended. Donor agencies should also finance a research project to define more accurately the economic impact of NMV industries, including multiplier effects.

ISSUE 9: NMVs AND THE ENVIRONMENT

6.32 To the extent that use of NMVs reduces the number of motorized trips, NMVs will have a positive impact on local air quality and noise environments. NMVs also can help to substantially reduce other adverse environmental impacts (e.g., visual intrusion and community severance). On the other hand, NMVs are not without adverse environmental impacts (e.g., the bicycle parking problem observed in Japan).

6.33 Recommended Policy at the Local Level - *Implement Pricing/Tax Policies That Reflect Environmental Costs Occasioned by Vehicle Use.* As recommended under issue 15, pricing/taxing policies should reflect all costs engendered by vehicle use, including environmental costs. The problem of formulating technically defensible pricing/tax policies that would accurately reflect environmental externalities remains an obstacle to implementation. One study in the Dutch city of Groningen estimated a total environmental cost of 7.8 million guilders (US\$ 4.3 million) if the modal share of bicycles in the city were to be reduced from 50 percent to 5 percent;¹⁴ more work of this sort is required, however.

6.34 Possible Action by Donor Agencies - *Initiate Research on the Economic Impact of NMVs and MVs on the Environment:* In order to devise defensible pricing/tax policies that would require transport system users, particularly MV users, to pay for the environmental costs they impose on others, donor agencies should support research to gauge (1) the magnitude of these environmental costs in economic terms and (2) the extent to which these economic costs can be attributed to particular modes of transport. The output of the research should enable informed judgements with respect to the magnitude and types of taxes to be assessed to cause vehicle users to "internalize" the environmental costs caused by their vehicle use.

ISSUE 10: NMVs AND ENERGY

6.35 NMVs do not use fossil fuel for their operation. Data from 1985 show that the transport sector used only 13 percent of the oil consumed in China, where NMVs predominate for short- and moderate-length trips, but 35 percent elsewhere in Asia, where mixed traffic is the norm.¹⁵ NMVs will reduce fuel consumption to the extent that their use reduces the number of motorized trips. Energy-dependent countries, therefore, should seriously consider an increased role of NMVs in the transport sector. One study concluded that bicycles consume only 22 kilocalories/passenger-km, compared with 60 for walking, 575 for bus, and 1,160 for single-occupancy automobile;¹⁶ moreover, not only is the energy used by bicyclists and pedestrians substantially less than that consumed by MVs, it is renewable.

6.36 Recommended Policy at the Local Level - *Consider the Fuel-Saving Quality of NMVs:* Further research is required to assess the energy implication of NMVs in Asian cities. After the conclusion of such research, decision makers choosing among alternative urban transport policies should consider the energy efficiency of NMVs in contrast to MVs, especially in countries that are large oil importers. Nevertheless, it is important for urban transport policymakers to understand that energy efficiency is but one of many considerations and that the policy that maximizes economic efficiency and some other objectives may often be the one that favors modes that are more energy intensive than NMVs (e.g., bus). That said, better-balanced transport systems with less reliance on private cars would not only consume less energy but also reduce dependence on foreign exchange.

6.37 Possible Action by Donor Agencies - *Initiate Study to Define the Energy Impact of NMVs:* With the understanding that fuel saving is one (albeit only one) consideration in choosing among alternative urban transport policies, it is recommended that donor agencies initiate studies in order to define more precisely the extent of potential fuel savings from diverting MV travelers to NMVs in Asian cities wherever practical.

ISSUE 11: NMVs AND LAND USE

6.38 NMVs, which by definition are either human- or livestock-powered, are most competitive for short trips. However, evidence indicates that the average commuting distance in several of the study cities has been increasing as the cities become more decentralized. The 1992 World Bank technical paper, *Non-Motorized Vehicles in Asian Cities*, included a box featuring Kanpur as a walking and cycling city. On the basis of data from the 1970s, the box indicated an average trip length of 1.4 km

in Kanpur; however, by 1987 the average trip length in Kanpur had increased to 3.6 km, principally a consequence of industrial expansion radiating to the southwest of the city.

6.39 Another case is Shanghai, a city where nearly 90 percent of all trips are made by NMVs, but where changes in land use have begun to alter commuting patterns. Longer commuting distances are becoming more common in Shanghai because of the expansion of the city and relocation of industries and housing. Many households will relocate to satellite towns now under construction at a rate of 80,000 dwelling units per year. The result will be a dramatic increase in the demand for public transport, with the role of the bicycle changing from a door-to-door mode of transport to bus-feeder mode.

6.40 **Recommended Policies at the Local Level - Adopt Land Use Policies That Can Reduce Commuting Distance:** A number of land use policies may be considered to address the growing trend toward decentralization and its consequent impact on commuting patterns, which will result in more travel by motorized modes. One such policy is the one traditionally followed in Shanghai, where employers have provided their employees with housing as part of the fringe benefits provided by enterprises, and the location of areas for worker housing has been based on two principles: (1) housing is to be located in close proximity to enterprises; and (2) residential areas are to be designed to minimize travel distances to shops, schools, and recreation centers.¹⁷ These arrangements are, however, becoming less effective than previously because of recent liberalization trends in the Chinese labor market. Where the choice of residence is up to employees rather than employers, mixed land use patterns integrating attractive living and working environments can serve as an incentive to NMV use. Another instructive example is Singapore, which has implemented a low-income housing program that locates residences close to workplaces, which thereby reduces trip lengths and increases the use of nonmotorized modes. A third instructive case is Karachi, where the so-called Metroville program enables individuals to build residences near their workplaces.¹⁸

6.41 **If Land Use Planning Policies Are Ineffective, Promote Intermodal Integration Between NMVs and Public Transport:** If land use policies are ineffective in reducing commuting distances and the demand for motorized transport increases, then policies to promote intermodal integration between bicycles and public transport can have positive effects. In Tokyo, one of the largest cities in the region and world, about 10 percent of all train and subway riders use the bicycle to travel to and/or from the station.¹⁹ Use of the bicycle as a feeder mode for bus is also prevalent in India; guarded bicycle parking facilities are provided at the Kanpur rail station on land rented from the city government by a private operator. A caveat to the encouragement of the use of the bicycle as a feeder mode for public transport is the potential for the problem of illegal bicycle parking that afflicts Tokyo and other major cities throughout Japan. Since the passage of the Bicycle Law in 1980, over one-third of all local governments in Japan have enacted local ordinances to address this problem (e.g., requiring property owners near rail stations to provide land for bicycle parking and impounding illegally parked bicycles).

6.42 **Possible Action by Donor Agencies - Encourage Planned Urban Development and the Use of NMVs as a Feeder Mode for Public Transport:** In order to promote NMV use and other objectives, donor agencies should support planned urban development policies that reduce commuting distances, although such policies require careful scrutiny in order to avoid possible unintended consequences (e.g., frustrating household residential location preferences). Donor agencies should

also consider encouraging local governments in Asia to promote the use of NMVs as a feeder mode for public transport, an approach that has been successfully adopted in Tokyo and other cities in Asia.

ISSUE 12: LOW PRIORITY ACCORDED NMVS

6.43 A case can be made for giving priority to the movement of persons and goods rather than vehicles.²⁰ Preliminary studies suggest that the least efficient modes in terms of capacities measured by person-throughput are low-occupancy automobiles, whereas the most efficient modes are rail and bus. Bicycle tends to fall in the middle of the range, whereas cycle-rickshaws are less efficient.²¹ The efficiency of NMVs is greatest for short trips; in large, low-income cities, NMVs are arguably the most efficient modes for trips of up to ten kilometers.²² Nevertheless, in most Asian cities a disproportionately high allocation of street space has been accorded to relatively inefficient low-occupancy automobiles compared with that allocated to NMVs.

6.44 **Recommended Policy at the Local Level - Increase Priority of NMVs in Transport and Traffic Planning:** It is recommended that NMV-priority schemes be considered in NMV-dependent cities where MVs are accorded greater priority than NMVs. The provision of NMV lanes and paths, as discussed earlier, is one kind of solution. Other NMV priority schemes are possible. Beijing, for example, has implemented bicycle-priority traffic signals, which include bicycle detection loops. Preliminary findings indicate that a 15 percent reduction in delays for bicycles (and a 24 percent reduction in delays for car traffic) can be achieved with this system.²³ Netherlands Railways gives higher priority at station entrances to bicycle users than to bus riders, taxi passengers, and private cars.²⁴

6.45 **Possible Action by Donor Agencies - Encourage Local Governments to Increase NMV Priority in Transport and Traffic Planning:** As a general proposition, donor agencies should encourage local governments in Asian cities to accord priority to the movement of persons and goods rather than vehicles. Specifically with respect to NMVs, the urban transport programs of donor agencies should support measures that give NMVs a priority that is commensurate with their importance in moving passengers and freight.

ISSUE 13: POLICY BIASES AGAINST NMVS

6.46 In several of the study cities it was apparent that policymakers were biased against NMVs. Hanoi, a city with an NMV mode share of 64 percent in 1992, plans to abolish NMVs by 2004 after "gradually moving all bicycles out of the city." Dhaka, a city where the NMV mode share was 52 percent in 1992, has repeatedly attempted to eliminate or reduce the number of cycle-rickshaws, but without success. Many localities in Metro Manila would like to see cycle-rickshaws eliminated, because of their perceived impact on congestion and safety, as well as the "degrading" nature of work required of the operator. Guangzhou is particularly opposed NMVs with policies designed to get rid of them altogether. Even in Shanghai, it is required that bicycles be pushed across bridges.

6.47 The consequence of anti-NMV biases is unbalanced transport planning, which results in accommodating the needs of motorists at the expense of NMV operators and users. Such unbalanced

planning can actually lead to a deterioration of traffic conditions for both MVs and NMVs. Consequently, it is in the best interest of all road users, motorized or nonmotorized, for NMV facilities to be planned in conjunction with those for MVs.

6.48 Recommended Policies at the Local Level - *Implement Institutional Measures to Address Biases Against NMVs:* Anti-NMV biases should be counteracted with a host of institutional measures, ranging from national-level implementation of transport pricing and credit policies that do not discourage NMV use, to the training of local personnel in comprehensive urban transport planning (i.e., encompassing both MVs and NMVs) and the upgrading of local data collection on NMVs. Also, wherever possible, the views of NMV users should be taken into account in NMV planning.

6.49 *Incorporate NMVs in the Urban Transport Planning Process:* Urban transport planning in Asian cities has been heavily weighted toward motorized transport. This approach whereby nearly all energies and resources have been devoted to motorized modes must be rejected in light of the unique and vital role that NMVs play in Asia, where in many cities they account for a significant proportion of all vehicle trips, and where they contribute in important ways to achievement of non-transport goals. On the other hand, NMVs should not be promoted merely because they are NMVs. Rather, the case for NMVs, if it is to be made, must be based on a careful consideration of a city's transport system (present and future, both supply and demand) and the impacts that the system has upon larger systems of which it is a part. In other words, the goal should not be to promote NMVs because they are "greener" than other modes,²⁵ but because they have a useful role to play in particular cities in the region.

6.50 Possible Actions by Donor Agencies - *Remedy Anti-NMV Biases and Redress Unbalanced Transport Planning:* A previous World Bank technical paper has already suggested a number of actions that donor agencies can take to assure that institutions in recipient countries implement appropriate measures to remedy anti-NMV biases and thereby promote balanced urban transport planning.²⁶ These measures include (1) giving greater emphasis to policy-based lending that encourages modal diversity, (2) requiring transport projects to include appropriate provisions for nonmotorized modes within the project corridor and provide technical support and training for local professionals in nonmotorized transport planning, (3) working in partnership with and providing support to government and non-government organizations at different levels of government, (4) developing expertise on nonmotorized transport in donor agencies, (5) developing special nonmotorized transport focused training, (6) integrating nonmotorized transport into external activities with other multilateral and bilateral agencies, and (7) developing a new "intellectual technology" in nonmotorized transport to be integrated into mainstream thinking. Clearly, many of these measures are worthy and warrant serious consideration. At the same time, it is important to recognize that the solution to unbalanced planning in favor of MVs is not unbalanced planning in favor of NMVs.

ISSUE 14: INAPPROPRIATE ALLOCATION OF FUNDS FOR NMV FACILITY IMPROVEMENT

6.51 Most cities in the region devote between 15 and 25 percent of their annual expenditures to their transport systems. However, over the last decade, traffic in most Asian cities has increased at a faster rate than has investment in the urban transport infrastructure. And with developing countries

already strapped for revenues, the search for financing for urban transport infrastructure, either for MVs or NMVs, is not easy.²⁷ In most cases, both national and local governments have shown neither the willingness nor the ability to address urban transport needs by generating additional revenues from the sector, from increased prices or reduced subsidies.

6.52 Recommended Policies at the Local Level - Consider Low-Cost Solutions: In light of the budgetary constraints confronting most local governments in the region, careful consideration should be given to low-cost solutions to traffic problems. As noted, traffic authorities in Kanpur are experimenting with yellow lane markings on certain main streets, effectively separating fast- and slow-moving vehicles. The success of the Kanpur experiment suggests that the prime emphasis should be on simple traffic management approaches such as signing and marking rather than the construction of facilities.

6.53 Adopt Innovative Approaches to Financing: A number of innovative approaches are available for the financing of facilities for NMVs and other urban transport modes. One approach, discussed earlier, involves the proper pricing of urban transport. An instructive case is that of Shanghai, where a highway maintenance fee (a tax on vehicle use), bicycle registration fees, and vehicle utilization taxes raise approximately two-thirds of the funds spent on urban transport investment.²⁸ A second approach involves a combination of public-private involvement to finance NMV infrastructure. In Kanpur, as cited earlier, the city government has rented public land near rail stations to private operators of bicycle parking facilities. In Japan, many local governments have met their legally mandated responsibilities to provide bicycle parking by requiring landowners within close proximity to rail stations to contribute by dedicating a portion of their land for bicycle parking. A third approach generates revenues from advertising, e.g., the sale of space at kiosks along bikeways or on NMVs (cycle-rickshaws) themselves. Another innovative financing scheme involves the use of concessions and build, operate, and transfer (BOT) schemes, in which a franchise or license agreement is negotiated with the public sector by a private group responsible for the design, finance, construction, and supervision of the facility. The approach in the urban transport sector in Asia to date has been limited to highway and mass transit projects, but could conceivably apply to revenue-generating NMV facilities such as large parking structures.

6.54 Possible Action by Donor Agencies - Encourage Innovative Financing: Donor agencies should leverage their investments in NMV and other urban transport facilities by encouraging national and local governments to adopt innovative approaches to financing in the sector.

ISSUE 15: INAPPROPRIATE PRICING/TAX POLICIES IN THE URBAN TRANSPORT SECTOR

6.55 Taxes (e.g., purchase taxes, fuel taxes, parts taxes) charged to MVs are not commensurate with the costs MVs impose on others (e.g., congestion, environmental damage).²⁹ Use of MVs tends to result in higher external costs than does use of NMVs. Bicycles, for example, are likely to impose significantly lower costs on others per passenger-kilometer than are low-occupancy automobiles and most other MVs, except for perhaps buses. Nevertheless, in certain countries customs duties and sales tax rates on bicycles are higher than on some MVs. In Bangladesh, for example, the import duty on bicycles (and other NMVs) was 150 percent, whereas the rate for motorcycles and trucks (CBU) was

50 percent, and that for motor cars was 50 to 300 percent. In other countries (e.g., Cambodia), MVs are subsidized through the pricing of fuel at below market prices.

6.56 Recommended Policy at the Local Level - *Revise Pricing/Tax Policies To Reflect Costs Occasioned by Vehicle Use:* The recommended policy is to assess higher levies on automobiles relative to NMVs, both in absolute terms and measured in terms of charges per passenger- and ton-kilometers. Consider, for example, the case of Singapore, which instituted an area licensing scheme in its central business district in 1975 that is now being upgraded to full road pricing, to be extended over the entire island. Other measures implemented in Singapore include import duties, additional registration fees, bonuses for scrapping old cars, and a quota system for the maximum number of cars that can be registered.³⁰ Also worth noting, Hong Kong in 1983 became the first city to test the technical, economic, and administrative feasibility of electronic road pricing (ERP). Although found effective for reducing congestion by time-of-day and location, the system was abandoned after two years primarily because of adverse reactions by motorists.³¹ Proposals for road pricing schemes in Bangkok, Kuala Lumpur, and Jakarta were also unpopular and never implemented.

6.57 Possible Actions by Donor Agencies - *Provide Technical Assistance to Encourage Governments in Formulating Appropriate Pricing/Tax Policies and Assist in the Provision of Sustainable Transport Systems:* While measures to increase the price of low-occupancy motorized travel are strongly opposed by motorists, such pricing/tax policies clearly promote urban transport efficiency and should be considered.

ISSUE 16: LACK OF DATA, ANALYTICAL TECHNIQUES, AND ENGINEERING GUIDELINES

The efforts of the present study notwithstanding, there is a dearth of data on NMVs in Asian cities. Such data is required to prepare urban transportation plans that will adequately meet the needs of NMV users. Similarly, there is a lack of proper analytical techniques with which to address NMVs. The majority of analyses of urban transport problems in Asian cities rely on the "tried and trusted methods" that have been developed and tested on transport networks in metropolitan areas located in developed countries, where NMVs are generally insignificant. Finally, at least until this study, there has been a lack of engineering guidelines for NMV planning in Asian cities.

6.58 Recommended Policy at the Local Level - *Improve Data, Analytical Techniques, and Engineering Guidelines:* NMV-related surveys that would need to be undertaken would include an NMV facilities inventory; an NMV traffic volume survey; an NMV speed and travel time survey; a household survey; an NMV operators' survey; a road accident inventory; an inventory of NMV transport costs and fares; an inventory of traffic regulations, enforcement, and education programs relating to NMVs; and an outer cordon survey. Regarding analytical techniques, there is an urgent need to develop a transportation network model capable of reflecting both motorized and nonmotorized transport modes by adjusting link characteristics such as link capacity and speed-volume relationships. Alternatively, in certain circumstances it may be acceptable to model motorized and nonmotorized modes separately, with explicit interacting relationships between the models to assure consistency. Finally, it would be helpful to refine the engineering guidelines developed during the course of this study through pilot studies in selected cities.

6.59 Possible Actions by Donor Agencies - Require Local Governments to Improve NMV Data Collection Systems: As a part of urban transport sector programs, local governments should be encouraged to upgrade their systems for the collection of data on NMVs. The technical guidelines presented in the second volume of this study could provide the "blueprint" for such programs.

6.60 Assist in Developing Transport Systems Models Incorporating Nonmotorized Modes: In order to address the failure of the current generation of urban transport models to address NMVs adequately, donor agencies should fund the development of a new generation of models specifically targeted to the requirements of the mixed traffic environments of cities in the developing world, particularly in Asia.

6.61 Implement NMV Pilot Studies: As called for by the World Bank document "Urban Transport in Asia - An Operational Strategy for the 1990s," an attempt has been made to prepare technical guidelines for urban transport planning involving the management of NMVs in mixed traffic urban environments using experience in such measures from Japan, China, and the Netherlands. However, as also called for by the same World Bank document, it is necessary to undertake pilot studies in Asian cities in order to demonstrate the application of these guidelines in real-world Asian cities. Some of the concepts are new and others may need refinement. Further, because the approach of incorporating NMVs in urban transport planning process has been neglected, it is necessary to provide technical support to interested local planners and policymakers. Once a "critical mass" of demonstrated successes has been achieved in the region, it is expected that the concepts recommended in the guidelines will be widely adopted without significant further support required from donor agencies.

NOTES TO THE TEXT

1. C.R.O.W., Sign up for the Bike: Design Manual for a Cycle-friendly Infrastructure, prepared by Center for Research and Contract Standardization in Civil and Traffic Engineering (C.R.O.W.), the Netherlands, August 1993, p. 24.
2. The figures in this paragraph are drawn from Replogle, M. *Non-Motorized Vehicles in Asian Cities*. Technical Paper 162. Asia Technical Department Series, The World Bank, Washington, D.C., 1992; and PADECO Co., Ltd. *Non-Motorized Vehicles in Asian Cities, Part II: Technical Guidelines*. Draft Final Report. The World Bank, Washington, D.C., June 1993.
3. Balslev, Jens, Bicycle Theft Prevention in Denmark, paper presented at The Bicycle: Global Perspectives Conference, Montreal, 13-17 September 1992, pp. 292-95.
4. Replogle, Michael (1992), p. 54.
5. Surveys taken by the Central Road Research Institute of India found that 50 percent of driving license holders had no knowledge of traffic rules and 63 percent admitted that they did not observe the rules of the road. World Bank, Asia Technical Department, Infrastructure Division (June 1991), *Urban Transport in Asia: An Operational Strategy for the 1990s*, p. 46.

6. Hathaway, A.G. (January 1990), Travel Requirements for the Urban Poor, presented at the Transportation Research Board Annual Meeting. It must be recognized, of course, that the option of subsidizing a public bus system is at least arguably a straw man alternative.
7. A review of the Bangladesh program found that in many cases the policy of "loans only to non-owners" has not been followed. Gallagher, Robert (June 1991), *The Rickshaws of Bangladesh*, Chapter 15.
8. Heierli, Urs (1993), *Environmental Limits to Motorization: Non-motorised Transport in Developed and Developing Countries*, SKAT, Swiss Centre for Development Cooperation in Technology and Management, p. 119.
9. Such program has been implemented by the World Bank in Peru.
10. Bicycle manufacturing has been identified as an excellent opportunity for promoting "South-South" trade. UNCTAD/GATT (1985), *Bicycles and Components: A Pilot Survey of Opportunities for Trade Among Developing Nations*, Geneva.
11. See Replogle, Michael (1992), p. 51.
12. Heierli, Urs (1993), pp. 11 and 148 [citing van Balen, Peter, Toruney, Hein, and Vermeulen, Ruud (September 1991), Organisation of bicycle manufacturing; a model of phased development, *AT Source Magazine*, Vol. 19, No. 3].
13. *Ibid.* p. 147 (citing Wiemer, Hans-Jurgen, Production of Bicycles and Bicycle Parts (Bangladesh), African Asian Bureau, undated, p. 39).
14. Krommendijk, Erna (1988), Bicycle and environment in the city: a quantification of some environmental effects of a bicycle-oriented traffic policy in Groningen, Groningen, Professor H.C. van Hall Institut.
15. Replogle, M. (1992), p. 22. The comparable figures for more MV-dependent regions were 40 per cent for Latin America and Africa, and 62 per cent for the United States.
16. Gallagher, R. *The Rickshaws of Bangladesh*, June 1991.
17. Powills, M., Hamburg, J.R., and Vance, J.H. (January 1991), Transportation Planning for Bicycles in Shanghai, Paper Prepared for the 70th Annual TRB Meeting, p. 7.
18. Lowe, M. D., (January 1991), Policy Goals for the World's Pedestrians and Cyclists, Paper Presented at the 70th Annual TRB Meeting (citing W. Owen (1987), *Transportation and World Development*, Johns Hopkins University Press).
19. The comparable figure is 30-40 percent in the Netherlands, and 20 percent in Germany. Heierli, Urs (1993), p. 104.
20. See, e.g., World Bank (1986), *Urban Transport: A World Bank Policy Study*, Chapter 3.
21. PADECO Co., Ltd. (1993)

22. Replogle, M. (1992), p. 47.
23. Wood, K., Bretherton, R.D., and Ren, E.L. (1988), Bicycle Scoot in Beijing China, *Planning Transport Research and Computation*, pp. 29-38.
24. Bekker, M.E. (September 1992), Bicycle Parking 21: Toward a Policy for Future Bicycle Facilities at the Stations of Netherlands Railways, in Centre for Contract Standardization in Civil and Traffic Engineering, in *Still More Bikes Behind the Dikes: Reader on Policy and Research for Bicycle Facilities in the Netherlands*, pp. 69-82.
25. Many authors have adopted this approach in recent years, particularly in Europe. See, e.g., Tolley, R. (1990, ed.), *The Greening of Urban Transport: Planning for Walking & Cycling in Western Cities*, Belhaven Press, pp. 64-73.
26. Replogle, Michael (1992), pp. 50-54.
27. See Gutman, Jeffrey S., Financing Urban Transport: Constraints and Options for Developing Countries, International Union of Public Transport Conference, Singapore, October 11-13, 1988, p. 1.
28. World Bank, Asia Technical Department, Infrastructure Division (June 1991), p. 52 (citing World Bank (April 1991), China, Shanghai Metropolitan Transport Project, Staff Appraisal Report).
29. See PADECO Co., Ltd. (December 1990), *The Survey of Urban Transport Costs and Fares in the SEATAC Region, Phase I*, Final Report, prepared for the Southeast Asian Agency for Regional Transport and Communications Development (SEATAC), Chapter 3; PADECO Co., Ltd. (December 1990), *The Survey of Urban Transport Costs and Fares in the SEATAC Region, Phase II*, Final Report, prepared for the Southeast Asian Agency for Regional Transport and Communications Development (SEATAC), Chapter 3; and Winston, B.P. and Laoha-unya, S., Assessment of the Optimality of the Current Modal Split in Bangkok, (September 1992), Proceedings of Seminar C, Transport Policy and its Implementation, *Planning Transport Research and Computation (PTRC) XXth Summer Annual Meeting*, Manchester, U.K.
30. See The World Bank, Asia Technical Department, Infrastructure Division (June 1991), p. 31.
31. *Ibid.*