BICYCLES AND CYCLE RICKSHAWS IN ASIAN CITIES: ISSUES AND STRATEGIES

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INTRODUCTION

NMVs -- bicycles, cycle-rickshaws, and carts -- play a vital role in urban transport in much of Asia. NMVs account for 25 to 80 percent of vehicle trips in many Asian cities, more than anywhere else in the world. Ownership of all vehicles, including NMVs, is growing rapidly throughout Asia as incomes increase. However, the future of NMVs in many Asian cities is threatened by growing motorization, loss of street space for safe NMV use, and changes in urban form prompted by motorization. Transport planning and investment in most of Asia has focused principally on the motorized transport sector and has often ignored the needs of non-motorized transport. Without changes in policy, NMV use may decline precipitously in the coming decade, with major negative effects on air pollution, traffic congestion, global warming, energy use, urban sprawl, and the employment and mobility of low income people. [1]

As cities in Japan, the Netherlands, Germany, and several other European nations demonstrate, the modernization of urban transport does not require total motorization, but rather the appropriate integration of walking, NMV modes, and motorized transport. As in European and Japanese cities, where a major share of trips are made by walking and cycling, NMVs have an important role to play in urban transport systems throughout Asia in coming decades.

Transport investment and policy are the primary factors that influence NMV use and can have an effect on the pace and level of motorization. For example, Japan has witnessed major growth of bicycle use despite increased motorization, through policies providing extensive bicycle paths, bicycle parking at rail stations, and high fees for motor vehicle use. Denmark and the Netherlands have reversed the decline of bicycle use through similar policies. China has for several decades offered employee commuter subsidies for those bicycling to work, cultivated a domestic bicycle manufacturing industry, and allocated extensive urban street space to NMV traffic. This strategy reduced the growth of public transport subsidies while meeting most mobility needs. Today, 50 to 80 percent of urban vehicle trips in China are by bicycle and average journey times in China's cities appear to be comparable to those of many other more motorized Asian cities, with much more favorable consequences on the environment, petroleum dependency, transport system costs, and traffic safety.

1. EXTENT OF NMV OWNERSHIP AND USE

Bicycles are the predominant type of private vehicle in many Asian cities. Bicycle ownership in Asia is now more than 400 million and growing rapidly. Bicycle ownership in China increased more than 50 fold between 1952 and 1985, to 170 million[2], with nearly half of them in cities. Since then it has risen to 300 million and is anticipated to grow to 500 million by 2000[3]. In many Chinese cities, bicycle ownership rates are one bicycle per household or more. Between 1980 and 1988, the number of bicycles in Beijing grew more than 12 percent a year to 7.3 million. In India, there are roughly 25 times as many bicycles as motor vehicles and urban bicycle ownership is growing at a fast pace.

The majority of the world's 3.3 million cycle rickshaws and goods tricycles are found in Asia. Despite recurrent efforts made by some local authorities to suppress cycle rickshaws in preference to motorized transport modes, the number and use of these vehicles is growing in many cities in response to otherwise unmet transport needs. The Indian Planning Commission in 1979 estimated that the number of cycle rickshaws in India would increase from 1.3 million in 1979 to 2.2 million by 2001. In Bangladesh, the cycle rickshaw fleet is estimated to grow from two-thirds of a million in 1988 to over one million by 2000.[4] More than three-fourths of Bangladesh's cycle rickshaws are in urban areas. These urban cycle rickshaws each annually account for an average of over 30,000 passenger-miles and nearly 100 ton-miles of goods movements. Together, bicycles, rickshaws, bullock carts and country boats account for about 75 percent of the value added, 80 percent of the employment, and about 40 percent of vehicle assets employed in the transport sector. On secondary roads, non-motorized transport vehicles make up about 85 percent of traffic. [5]

NMVs account for a substantial share of trips made in many Asian cities, ranging as high as 80 percent of vehicular traffic in NMV dependent cities. There is, however, substantial variability, depending on many factors, including topography, income, metropolitan structure, level of motorization, climate, and transport policies. In Indian cities, bicycles typically account for 10 to 30 percent of all person trips (including walking) and for 30 to 50 percent of the traffic on primary urban roads. Walking and cycling account for 60% of total trips and 40% of work related trips in Karachi, Pakistan. In Chinese cities, bicycle use has grown dramatically in recent decades. Bicycles have largely replaced buses as the principal means of urban vehicular transport in Tianjin. Buses are generally slower for the same trip made bicycle. Less pronounced, but similar trends occurred in Shanghai in the 1980s.

Cycle-rickshaw traffic typically accounts for 10 to 20 percent of the traffic on primary urban roads and for 5 to 20 percent of all person trips in Indian and Pakistani cities. These vehicles, along with hand-carts, account for a major share of urban freight movement in Chinese cities. Of all land transportation in Bangladesh, NMVs produced 60 percent of all passenger-km and 36 percent of freight ton-km in 1985. [6] There were estimated to be 200,000 cycle rickshaws in urban areas and another 50,000 in the rural areas in 1982. Urban bicycle rickshaws were estimated to have put in 32,810 passenger miles per vehicles per year and carried 94 ton miles of goods per vehicles per year in Bangladesh.[7] A large portion of cycle rickshaw trips appear

to be of a nature not readily replaceable by overcrowded buses. In a number of Indonesian cities, becaks, also called cycle-rickshaws or pedicabs, play an even greater roles in urban mobility than the bicycle. In Bandung, for example, cycle-rickshaws accounted for 12 percent of all work trips and an even higher share of non-work trips in 1985, while bicycles account for about 6 percent of trips.[8] In Jakarta, where the government is actively suppressing cycle-rickshaws (becaks) through banning and confiscation, these vehicles accounted for 4.6 percent of all trips in 1985, while bicycles held only 2.4 percent mode share.

2. RELATIONSHIP OF INCOME ON BICYCLE USE

Income plays a significant role in influencing transportation choices people have. People with low incomes face extremely limited transport choices. Where there is extensive poverty, it is most important to ensure that the modes used by the poor continue to remain available as travel options. Despite rising incomes in many cities across Asia, the distribution of wealth and income remains skewed in much of the region. Rapid urbanization and economic growth throughout much of Asia has left behind hundreds of millions of people, who continue to live in desperate poverty. Indeed, two-thirds of the poorest of the poor in the world live in India, Bangladesh, Pakistan, and China.

Many low income people in Asian cities cannot afford even subsidized public transport fares and have no choice but to walk or cycle, even for travel distances of 10 to 20 km. For most poor households, walking accounts for the majority of all trips. When incomes are low, the value of time relative to cost for travelers is low as well. Although walking costs nothing, it takes a lot of time for all but short trips. Cycling often offers four or five times greater speed and is cheaper than public transport, once a bicycle is in hand. When a bicycle that will last years costs the equivalent of six or eight months of bus fares, there is good profit for a poor person in having one and using it. Thus, for the poor in Asia, increases in personal mobility are most commonly expressed in expanded use of bicycles. Increased mobility for goods movement and the transportation of children and families is often expressed in greater use of cycle-rickshaws, where these are available, or bus public transportation where this is available. Low income households are forced to spend a higher share of their income on transportation than higher income households. A number of factors contribute to this -- the poor often have to live far away from their jobs to find cheap housing, they often hold multiple part time jobs, and, since their income is so small, a single bus fare represents a larger share of earnings than for others. The poor in general make fewer trips than higher income people and engage in little discretionary travel. Irrespective of city size, the poor will continue for the foreseeable future to be dependent on non-motorized transport modes for mobility in Asian cities.

However, it is not only the poor who use bicycles. The travel time and convenience offered by the bicycle attracts people of all income levels to bicycles in

many cities, particularly where measures have been taken to facilitate cycling. As traffic congestion in Asian cities increases, public transport schedule reliability and average travel speeds both decrease, making bicycles competitive at longer trip lengths due to their flexibility, convenience, and greater reliability.

3. EMPLOYMENT GENERATION BY NMVS

Direct manufacturing accounts for only a small share of the large amount of total employment related to non-motorized transport. Additional people are employed servicing and repairing NMV fleets, mostly through small informal sector businesses. Throughout Asia, NMVs form the foundation for a large informal sector providing goods or services on the street or transporting people and goods on a for-hire basis.

In Dhaka, Bangladesh, for example, about 380,000 people are directly employed as cycle-rickshaw pullers, and another 80,000 are employed in ancillary services related to cycle-rickshaws, together accounting for nearly one-fourth of all employment in metropolitan Dhaka. In all of Bangladesh, cycle-rickshaws in 1988 were estimated to provide employment for over one million people and ancillary employment to another 250,000, representing about 3.5 percent of the nation's recognized labor force.[9] Together, motorized and non-motorized public transport services provided direct employment to 28,000 people in Patna, India, in the mid-1980s. When indirect employment linkages were considered, 42,000 jobs and the livelihoods of nearly 150,000 were dependent on the public transport sector in Patna. The non-motorized portion of this sector accounts for the larger share of this and is especially vital in providing employment for unskilled low income workers. A 100,000 rupee (US$ 8,000 at 1984 exchange rates; US$ 5,000 at 1991 rates) investment in a conventional bus system in Patna, India, was estimated to produce two new direct jobs. If invested in the motorized auto-rickshaw system, six direct jobs were created. The same sum was estimated to create 75 jobs if invested in cycle-rickshaw transport.[10] Promotion of the NMT sector can stimulate substantial employment growth and microenterprise development, especially in low income cities, particularly benefitting the poor. Where cycle-rickshaws are declining, frequently due to regulatory suppression, taxes, licensing requirements, bans, and even confiscation, hundreds of thousands of low income people are threatened with loss of employment.

4. NMV FACILITIES

Several Asian cities are noteworthy for their cycle networks, including Tianjin, China, and Pune, India, which has been working to develop its cycle network for a number of years. Officially dedicated NMV facilities are rather common in Chinese cities, but not widely found elsewhere in Asia. Instead, where NMVs make up a major portion of traffic flows, they frequently define NMV "lanes" through their physical presence in large numbers. However, especially where NMV lanes are not well defined by physical separation, extensive mixing of NMV and MV traffic often

fosters poor traffic discipline among all modes, which exacerbates traffic congestion and safety problems.

Motorized modes are heavier, faster, and often accorded higher social status than NMVs. When street space is scarce, NMVs are vulnerable to displacement from mixed traffic streets unless they are present in sufficient numbers to assert an almost continuous claim to their share of road space. A key function of bicycle or NMV facilities is to protect the legitimacy and safety of NMVs in the transport system where it would otherwise be threatened by motorized traffic. In many NMV dependent cities, bicycle networks can best be preserved by keeping cars and motorcycles out of many existing streets in neighborhoods. Creation of "environmental districts" -- motor vehicle restricted and traffic calmed areas -- can be a most effective strategy for supporting use of NMVs, walking and public transport. Such districts are increasingly common in many affluent cities in Europe and Japan. In some cities, extensive alley systems offer opportunities for creating NMV networks while improving traffic management, as in a World Bank project in Shanghai.

The rapid growth of bicycle traffic in Chinese cities in the 1980s has led to serious traffic congestion problems in many cities. Peak hour flows at many main intersections in Beijing and Tianjin exceed 15,000, with 29,000 per peak hour observed at one main junction in Beijing. [11] As a result, interest in assessment of the capacity of bicycle facilities has been a serious matter for Chinese planners. In Beijing, China, practical saturation capacity of a separated bike tracks has been estimated at 0.5 bicycles per second per meter width, or 1800 bicycles per hour per meter width. Cycle rickshaws typically require 1.5 to 3.0 times the capacity of a single bicycle, depending on size and weight.[12] Mixed traffic streets typical of Beijing, China, show a saturation capacity of about 0.37 bicycles per second per meter width, or 1330 bicycles per hour per meter width. Separation of motorized and non-motorized traffic at intersection approaches with fences is becoming increasingly common in China as a traffic safety measure. Recent studies indicate that this strategy likely increases motorized traffic capacity of intersections without diminishing bicycle traffic capacity.[13]

The capacity of different types of rights-of-way to move people at different speeds has been the subject of some debate in recent years. Proper analysis of transport modal efficiency must differentiate based on trip length, cost, and function. For a given amount of road or corridor space, the most efficient modes of transportation are generally rail or bus modes operating on their own dedicated rights-of-way. The least efficient use of road space is low occupancy automobiles. Bicycles fall in between this range, with road space utilization approaching that of buses in mixed traffic. Motorcycles, scooters, and other two-wheeled motorized vehicles are in between automobiles and bicycles in their road space utilization.[14] Further research is needed to develop better models of facility capacity under different modal mixes and conditions.

The function of modes and distribution of trip lengths that must be accommodated within travel corridors is an important consideration in evaluating how scarce road space should be most efficiently allocated. If a large share of traffic is of short to moderate trip length, rail modes are not likely to be cost-effective or practical to accommodate these trips. If a large share of traffic is of long trip length, bicycles and walking are not likely to be the most efficient or practical modes. If resources are unavailable to provide bus transportation sufficient to meet demand, bicycles may be more efficient than an overburdened public transport system, even for longer trips. In most travel corridors travel demand is in fact composed of a spectrum of trip lengths, some short, some long. Thus, it is uncommon for a single mode of transport to be the most efficient for a corridor. Rather, a combination of modes need to be accommodated in a complementary fashion to meet the needs of diverse travel markets, recognizing limitations on road space, affordability of transport modes in the community, and the required speed and distance of trips made in the corridor. Where road space is most scarce, traffic management should be the first step in dealing with traffic congestion problems. This can include turn restrictions at intersections, introduction of one-way street systems, improved traffic signalization, and management of encroachments on transportation rights-of-way. These steps can all affect the relative efficiency of different modes in using road space.

5. INTEGRATION OF BICYCLES WITH PUBLIC TRANSPORT

Bicycles are not a substitute for public transport. Instead, these are complementary and partially overlapping modes of transport. Each has unique strengths and weaknesses. In combination, they offer a strong potential competitor to private motorized transport for many types of trips. To reduce long-distance bicycle commuting and free up congested road space, the Chinese have been establishing bicycle-subway and bicycle-bus exchange hubs, which have been very popular in Beijing and other cities.[15] Bicycle access to railways is also important in India, where hundreds or thousands of bicycles can be seen parked at some stations.

Bicycle access expands the potential market area of high-speed public transport services at low cost. This is one of the most valuable potential functions of NMVs in megacities, where average trips lengths are long. Integration of bicycles with public transport is also an important strategy for sustaining non-motorized and public transport mode shares in rapidly motorizing cities with mixed traffic systems, for reintegrating NMVs into motor vehicle dependent cities, and for dealing with network capacity saturation in NMV dependent cities.

In Western Europe and Japan today, the fastest growing and predominant access mode to suburban railways is the bicycle, accounting for one-fourth to one-half of access trips to stations. [16] Adequate supporting infrastructure, including secure parking at station entrances and safe access routes, is essential to this intermodal integration. Between 1975 and 1981, the number of bicycles parked at Japanese rail stations quadrupled to 1.25 million. By the end of the 1980s, more than two million bicycles

were used daily to access suburban railway stations in Japan. Use is heaviest in the lower density suburban fringe areas of large cities, where 15 to 45 percent of rail station access is by bicycle. Japanese and European transportation policy and investment has encouraged bike-and-ride system development. In Japan, more than 730,000 new bicycle parking spaces were built at rail stations between 1978 and 1981, supported by national subsidies available to both public and private sector parking developers. By 1981, there were 636 garages at Japanese rail stations accommodating more than 500 bicycles, with 5,456 other station parking garages of lower capacity. By 1989, total parking capacity had grown to 8,735 bicycle parking garages with a total capacity of 2.77 million bicycles.[17] An increasing number of these facilities are computerized or automated multi-story structures providing very high density parking.[18]

Bike-and-ride strategies offer opportunities for increased public transport system efficiency when factored into public transport network and operations design. With expanded station catchment areas, inter-station spacing can be greater, creating higher line-haul public transport speeds and efficiency in equipment utilization, with a level of service comparable to that obtained with denser station spacing relying on pedestrian access. In the long-run, increased inter-station and inter-line spacing may permit public transport networks to concentrate more frequent service on fewer lines for the same size vehicle fleet, reducing average waiting time for public transport services and increasing efficiency in use of rights-of-way. This is particularly important in megacities where average trip lengths are long and resources for express public transport service provision are insufficient to meet demand. In cities where public transport services are inadequate to meet demand, it may be productive to shift some less efficient short distance public transport trips to NMVs, allowing concentration of public transport resources on longer trips, with bike-and-ride access systems expanding market catchment areas.

6. REGULATIONS AND POLICIES INFLUENCING NMV USE

Regulations and policies, including taxes and import duties, fuel taxes, vehicle registration and licensing fees, and credit financing systems for vehicle purchase, all have a major influence on the cost and availability of various transport modes. Frequently in Asia and other parts of the world, regulations and policies have been used to discourage or suppress the use of NMVs, especially cycle-rickshaws, while fostering motorization of transport.

In some Asian countries, import duties are structured to favor motorized transport. In Bangladesh, for example, the trend over the past two decades has been towards encouraging motorized public transport, discouraging imports of bicycles and their components to protect local bicycle manufacturers, and offering concessions to affluent private motor vehicle buyers. In 1989, Bangladesh taxed imported bicycles and most bicycle components at 150 percent, while buses, mini-buses, and trucks were taxed only 20 percent, baby-taxis at 5 percent, small-engine automobiles (850

cc or less) at 50 percent, jeeps and station wagons at 30 percent, and motorcycles at 20 percent. While such taxes are intended to protect domestic bicycle producers, two-thirds of bicycle components needed in Bangladesh must be imported, raising significantly the costs of bicycle and cycle-rickshaw ownership and operation. Smuggling of bicycles and their components from India is widespread, but this alleviates only part of the regulatory cost burden on end users.[19] Such stiff protectionist policies aimed at aiding domestic NMV producers impose a high cost on cyclists and cycle-rickshaw users while often failing to create viable industries. When combined with low taxes on motor vehicle imports, such policies foster economically inefficient choices.

Vehicle licensing is commonly used to raise revenue, to ensure vehicle safety, and to regulate vehicle use. In many cities, however, it has been used to try to suppress cycle-rickshaws and other informal sector public transport services, such as jeepnies, jitneys, motorized auto-rickshaws, and pirate taxis. In Karachi, cycle-rickshaws were banned in 1960 and replaced by auto-rickshaws, which in turn were subjected to restrictions on new registrations from 1986 onwards. In Manila, the motorized tricycles which replaced cycle rickshaws in the 1950s were later banned from main roads, and now operate mostly on smaller roads as feeder services. [20] Only in Singapore have restrictions been placed on private motor vehicle registrations, beginning in 1990, although such vehicles are the least efficient users of road space in Asian cities. In a number of cities in India, Indonesia, and Bangladesh, restrictions have been placed on the number of cycle-rickshaw registrations that will be permitted, often freezing registrations at a fixed level for many years. Restrictions on licenses create a lucrative black market in duplicate or falsified licenses. It also makes cycle-rickshaw drivers and owners vulnerable to extortion and abuse from local police, who can threaten to seize their vehicle, causing at a minimum, loss of a full day's pay and at worst, loss of livelihood. Indeed, Jakarta authorities have seized some 100,000 cycle-rickshaws in the past five years, dumping at least 35,000 into Jakarta Bay, as they seek the complete elimination of these vehicles from the city. In Delhi, thousands more cycle-rickshaws have been siezed and destroyed recently.

7. FORMULATION OF A NON-MOTORIZED TRANSPORT STRATEGY (NMTS)

The experience of Asian cities with non-motorized transport points out the importance of NMVs in urban transport and the multiple problems they face. Because NMVs are a desirable complement to motorized transport modes, explicit policy support is needed to preserve and expand their potential role. Such support can benefit the environment, the poor, and both local and national economic efficiency and performance. Such support can best be provided within the framework of a Non-Motorized Transport Strategy (NMTS), whether for a city, a country, a region, or for an international development agency. While some elements described below are

undertaken in transport sector and project appraisal studies today, many aspects related to NMVs are often neglected.

A NMTS should identify the extent, pattern, and current trends related to non-motorized transport availability and use, including variations based on income, cost, trip length, and other factors. It should assess the overall pattern of travel demand for different modes of transport for low, moderate, and high income groups to identify particular trip lengths where modal options are limited to inefficient transportation choices. A key focus should be on road safety problems, particularly those facing pedestrians and bicyclists. Road safety improvements offer a potential for widespread social and economic benefits in terms popular with all classes of society.

An urban NMTS should identify key traffic congestion locations and gather data on the composition and attributes of traffic flows, their trip length distribution and pattern, and the extent of encroachment on the transportation right-of-way by non-transportation activities and uses. This information should be used to identify opportunities for improved traffic management in congested locations, including separation or channelization of different modes within the right-of-way or on parallel routes to separate slow and fast traffic, improvement of intersection design and operation to reduce tuming movement conflicts and delays, using turn prohibitions, one-way systems, grade separations, traffic signalization, and grade separated under and over passes, where appropriate. It should consider restriction of private motor vehicle traffic in congested areas by limiting peak hour entry or by creating automobile restricted areas, streets, or traffic cells, which discourage short trips by private motor vehicles. It should consider pricing changes for public and private transport to influence travel demand. Where poor traffic discipline or encroachments are problems, stepped up enforcement, public education, and advertising campaigns and the provision of low cost off-street market areas should be considered.

An urban NMTS should identify and evaluate opportunities for shifting longer distance trips made by private motorized and non-motorized vehicles to bike-and-ride systems, with express public transport operating on reserved rights-of-way. It should identify strategies for reducing average trip length in the long run through changes in land use patterns and the distribution of housing, markets and shops, and employment both in relationship to each other and the public transport system. It should identify appropriate networks for NMV use to strengthen their utility for short to moderate length trips within cities and evaluate the appropriateness of shifting long walk trips and short public transport trips to NMVs.

Barriers to the NMV manufacture and ownership and strategies for overcoming these should be identified as part of NMTS work. These may include NMV-related trade barriers, local NMV industry structure and performance, affordability of NMVs to the population, credit systems for NMV purchase, and licensing and registration requirements. Regulatory policies inhibiting NMV use should be identified along with strategies for influencing them, including changes in traffic regulations, parking policies, and licensing requirements.

8. CONCLUSIONS

The transportation systems of many Asian cities are at a crossroads. If they continue on their present path of rapid and uncontrolled motorization, they may face very high long-term economic and environmental costs with diminishing benefits. If they instead follow the models of China, Japan, and the Netherlands, they may be able to stabilize or increase the appropriate use of non-motorized vehicles with large positive long-term economic and environmental consequences.

NMVs offer no panacea to growing problems of traffic congestion, air pollution, energy use, global warming, and regional economic development, but they should be seen as a potentially important element in addressing these problems. As we enter the 21st century, instead of declining, NMVs may play a growing role in urban transport systems world-wide.

ACKNOWLEDGEMENTS

The author would like to acknowledge the support of the World Bank and to thank its staff, and especially Peter Midgley, the Senior Urban Planner responsible for managing the Asia Urban Transport Sector Study, for their assistance in preparing the study from which this paper was drawn. Gracious thanks are also due to Setty Pendakur, Professor of Community and Regional Planning at the University of British Columbia, and Marcia Lowe, Senior Researcher at the Worldwatch Institute, for their comments on early drafts of the study.

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