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Is There a Future for Non-Motorized Public Transport in Asia?

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Abstract: Non-motorized public transport (NMPT), especially three-wheeler cycle rickshaws, has a long history in East Asia; and has long been a major transport planning issue. Policy measures to restrict or eliminate NMPT have already been implemented in many developing cities with mixed success. However given the economic, social and cultural significance of NMPT, its environmental benefits, and the magnitude of its role in sustaining the mobility needs of citizens, it is timely to reconsider the future role of NMPT. Rather than pursuing policies to eliminate NMPT, a better approach may be to integrate motorized and non-motorized vehicles as complementary rather than competitive forces. With this backdrop and given the international significance of the problem, this paper examines the current role and significance of NMPT using Dhaka as a case study, and sets a research agenda for the future of NMPT in a sustainable transport system.

Keywords: Non-Motorized Public Transport, Integration, Sustainability

1. INTRODUCTION

Over the last few decades, most large cities in Asia have been experiencing rapid and imbalanced transport sector development resulting in severe congestion and poor levels of service, especially on urban arterials that act as the network spines of the city. As a result, the urban transport issues of mobility, congestion, safety and environmental aspects are becoming increasingly important as social, political and economic concerns. The most common response at a policy level is to focus on private and public motorized transport modes, and especially on traffic control measures and mass transit systems. Despite their major role in the overall transport system in many cities in Asia, relatively little attention is given to non-motorized transport (NMT) modes (walk, bicycle and cycle-rickshaw). In particular, the paid category of non-motorized public transport (NMPT), notably three-wheeler cycle rickshaws that still have an important role in many Asian cities, are often seen as inefficient and backward; an impediment to progress; and inconsistent with a modern urban image. They are characterized as being 'slow moving', 'congestion creators' and 'inhuman', and policy measures to restrict or eliminate NMPT have already been implemented in many Asian cities

with mixed success. Note that this paper supports the banning of human-pulled rickshaws and specifically excludes them from the category of NMPT.

The continued significance of NMPT in many Asian cities is exemplified by Dhaka, Bangladesh, where despite strong growth in private vehicle ownership and policies generally negative to NMPT, there are an estimated 500,000 cycle rickshaws and rickshaws continue to be the dominant mode for non-walk trips. According to latest available figures of Strategic Transport Plan for Dhaka (STP) (2005), rickshaws have a 40% share of non-walk trips and continue to be crucial for the transport system of Dhaka. Rickshaws are the preferred mode for short trips (which predominate in Dhaka); and are the modal preference by significant social groups (women, elderly and office goers) because of their qualities of security, comfort and reliability. In addition, the rickshaw industry plays a major social function because of the huge workforce involvement; and has a growing role as a freight carrier. The major criticism of the cycle rickshaw as a slow-speed congestion-generating vehicle is valid when considering longer trips on major roads, but for short trips, rickshaws can have a time advantage when walking time, waiting time and transfer penalties involved with motorized public transport (PT) vehicles are taken into account (Bari and Efrogmson 2004). In addition, rickshaws can operate on very narrow streets unsuitable for motorized vehicles; have reduced road space occupancy compared to private automobiles (Human Development Research Centre study 2004); are fuel-free with minimal environmental impact compared to motorized modes; and are an important source of employment for some of the poorest elements of the Dhaka community. NMPT currently plays a key role in the transport system and urban fabric in cities such as Dhaka and this role is expected to continue for some considerable time into the future.

Therefore, given the economic, social and cultural significance of NMPT, its environmental benefits, and the magnitude of its role in sustaining the mobility needs of citizens in many Asian cities, it is timely to reconsider the future role of NMPT in those cities where it is currently a major component of the transport market. Rather than simply ignoring or pursuing policies to eliminate NMPT, a better approach may be to integrate motorized and non-motorized vehicles as complementary rather than competitive forces in meeting the comprehensive urban transport demands. The aim of this research is not to promote reintroduction of widespread NMPT in places where they have already been banned. Instead, the priority is to promote better integration of existing NMPT into a multi-modal transport system. With this backdrop, this paper reports on the initial findings of an ongoing NMPT research program, and sets an agenda for future research into the integration of NMPT in a sustainable transport system. The paper provides an introductory analysis of the current role and significance of NMPT, using Dhaka as a case study, and explores strategic opportunities for the sustainable co-existence of NMPT and motorized modes in a mixed transport system that best meets network performance needs of residents of developing Asian cities.

2. EVOLUTION AND CURRENT STATUS OF NMPT IN DHAKA

The original version of the NMPT was 'hand pulled rickshaws', which were first introduced in Japan in around 1870. The concept then spread to countries including China, India, Singapore, the French-Indo-China colonies, South Africa and for a brief time in America and Australia. These vehicles developed into cycle rickshaws and are now also known as trishaws, pedicabs, samlors, cyclos, or becaks (Replogle 1991c).

Even today, NMPTs are a major mode of urban transport system in many developing cities of Asia. Becaks in major Indonesian cities, pedicabs in many cities in Philippines, samloris in most cities in Thailand and cyclos in Cambodia and Vietnam are examples of places in East Asia where NMPTs are plying as a significant public transport mode. Many parts of India (Calcutta in West Bengal, Matheran in Maharashtra, Agra in Uttar Pradesh, Madras in Tamilnadu, states of Kerala, Karnataka and Andhra Pradesh) and Bangladesh also have a large population of cycle-rickshaw as major mode of travel (GTZ 2003). This is especially the case in Bangladesh, where all cities with a population of half a million or more (Dhaka, Chittagong, Rajshahi, Khulna, Comilla and Barisal) have rickshaw as the main mode of transport (STP 2005). Although comprehensive statistics are difficult to obtain, it is estimated that there are currently around 10 million cycle rickshaw pullers in Asia.

In Bangladesh, the NMPT form presently operating is cycle-rickshaws which were introduced first in Europe and Asia. These cycle-rickshaws were developed from the penny-farthing bicycle concept, some of which were made into tricycles and there were attempts to introduce them as rickshaws in both England and Asia around 1886. According to Gallagher (1992), Singapore was the first city to use cycle-rickshaws on a large scale. Calcutta's first cycle-rickshaws appeared around 1930 (Warren 2003) and they soon spread to other towns in the hinterland. They reached what is now Bangladesh in the mid-1930's, and Dhaka by 1938 (Rashid 1978). The cycle rickshaws of Dhaka had their present look by around the 1950's. Since then, the design, technology and operation of rickshaws in Dhaka have showed little change.

This research focuses on NMPT cycle-rickshaws of the type prevalent throughout Bangladesh. These rickshaws have one front wheel and two rear wheels, an average speed of 5 to 12 km/hr over distances of up to 40 km (Replogle 1991c) and capable of carrying two passengers in addition to the driver, or freight loads of up to 250 kg without a passenger (Replogle 1991c), as shown in Figure 1.



Figure 1 Rickshaw usage in Dhaka (Fotosearch 2008)

Dhaka city had only 37 rickshaws in 1941 and 181 rickshaws in 1947 (Banglapedia 2006). The 'official' rickshaw population of Dhaka in 1972-73 had increased to 14,667 which then doubled to 28,703 in 1982-83, and thereafter increased rapidly to reach more than 88,000 by the end of 1986-87 (Gallagher 1992). Rickshaw numbers in Dhaka have continued to grow very rapidly. According to the Institute for Transportation and Development Policy (ITDP) (2005) and STP (2005), the total cycle rickshaw population is now estimated at around 500,000. With an estimated population of more than 12.5 million, this is equivalent to one

rickshaw for every 25 residents in Dhaka. And with annual growth exceeding 4.3%, Dhaka is the world's fastest growing mega-city (BBS 2001). So although official figures for 2008 are not available, it is probable that the number of rickshaws is also continuing to grow at a fast rate.

Rickshaws in Dhaka currently carry around 40% of non-walk trips and also have a major role as freight carriers for personal goods and small consignments. In addition, there are about 5,000 rickshaw vans that are used exclusively for freight carriage (STP 2005). Table 1 shows the modal shares of NMPT, public transport (bus) and private motorized transport over others in last few decades. The trends are shown graphically in Figure 2.

Table 1 Trend of Dhaka traffic based on primary non-walking trip share

Travel Mode	Trip Share (%)		
	1994 (DITS)	1998 (DUTP)	2005 (STP)
Private transport and Para-transit	17	13	20
Public Transport	29	40	39
Non-Motorized Public Transport	54	48	41
Total	100	100	100

Source: Derived from DITS 1994, DUTP 1998, STP 2005

Notes: Public Transport – Bus (large, mini, micro),
 Para-transit - Taxi, Auto rickshaw
 Private transport - Car, Motorbike
 Non-Motorized Public Transport - Rickshaw

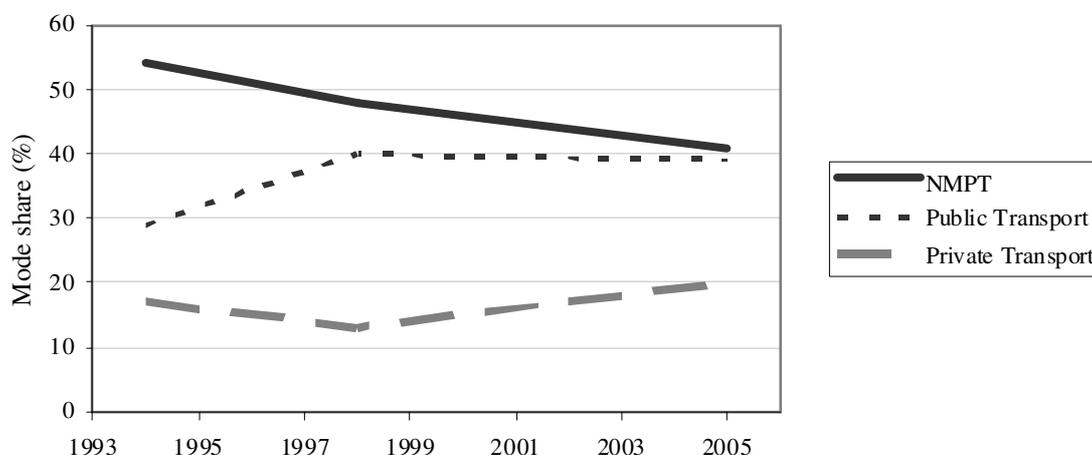


Figure 2 Trend in primary non-walk trip share for Dhaka

These statistics paint a picture of the current market for NMPT usage in Dhaka. Although rickshaw mode share has declined, NMPT is still the most popular mode of transport in Bangladesh, particularly Dhaka, and with strong growth in population and demand for travel, the actual number of trips per day by rickshaw and the number of rickshaws in Dhaka is still growing.

The relentless growth in demand for travel and the rise of private vehicle is also significant. In response to these trends, the recent strategic transport plan for Dhaka (STP 2005) has suggested consideration of mass rapid transit (train) to be introduced as part of the 20 year master plan (2005-2025). A mass transit system would draw mode share from other modes,

but with limited corridors and pick-up/drop-off points, it will require feeder services. So rather than replacing NMPT, it may conversely foster additional NMPT activity use as a way of accessing mass transit stations.

3. NMPT OPERATING CHARACTERISTICS AND SIGNIFICANCE

3.1 Why are rickshaws so popular in Dhaka?

The continued popularity of rickshaws in Dhaka and many similar Asian cities results from a mix of factors. From a user perspective, rickshaws provide affordable door-to-door service; are well-matched to demand in terms of specific trip lengths and types; and can access all parts of the network including very narrow and crowded streets unsuitable for other modes. Table 2 shows the operational characteristics and performance of NMPT in comparison to other transport modes operating in Dhaka.

Table 2 Operational characteristics of transport modes in Dhaka

Travel Mode	Operational Characteristics							
	Route Flexibility	Schedule Flexibility	Ease of Access	Capacity	Service Freq	Speed	User Cost	Dominant Trip Length
Transit								
Metro Train (future)	○	○	○	●	⊙	●	○	●
Bus	○	○	○	●	⊙	●	○	●
Micro bus	○	○	○	⊙	⊙	●	○	⊙/●
Para transit								
Auto rickshaw	⊙	●	⊙	○	○	⊙	⊙	⊙/●
Rickshaw	●	●	●	○	●	○	⊙	○/⊙
Taxi	⊙	●	⊙	⊙	●	●	●	●
Private								
Car	●	●	●	⊙	●	●	●	Mixed
Motorbike	●	●	●	○	●	●	⊙	Mixed
Bicycle	●	●	●	○	●	○	○	○

Source: Adapted from STP (2005)

Legend: ○ Low ⊙ Medium ● High

Compared to other modes, NMPT has a mix of advantages and disadvantages. It is a low speed, low capacity mode, but for many trips these factors are not significant. In Dhaka, the majority of trips are short and local, with average trip lengths around 2.3 km (STP 2005); and the number of people travelling together is generally small. For short trips, NMPT is competitive in terms of overall travel time (when walking, waiting and transit time is taken into account) and is cheaper than travelling by auto-rickshaw, taxi or car. In addition, NMPT has an important role as a business/personal freight carrier over short distances. Transit modes such as existing bus services and future mass transit cater for longer trips on defined routes and are not suited to many older parts of Dhaka with narrow crowded streets. As a result, there is a strong market differentiation with specific modes catering for different travel needs.

This comparative analysis highlights the market niche that NMPT fills. NMPT provides a personalized, on-demand, door-to-door service with acceptable service quality and comfort, affordable cost, and a sense of privacy and security. It is especially suited to short trips within and between the very densely-settled older parts of Dhaka. With very low levels of car ownership in Dhaka, this makes NMPT the preferred mode of travel for many social groups, especially lower socio-economic groups.

3.2 Socio-Economic Significance

From a broader community perspective, rickshaws make a strong socio-economic contribution in terms of equity and employment; and have a key cultural and economic role in the overall urban system of Dhaka and many other cities. Table 3 summarizes the travel characteristics and modal preferences of different segments of the Dhaka population.

Table 3 Travel characteristics of transport market segments in Dhaka and corresponding mode preferences

Market Segments	Usual Trip Destination	Typical Trip Length	Preferred Mode			
			Car	Bus*	Para-transit^	NMPT
Commuter	Employment centers/ CBD	Long		●	●	
Intra-city working population	Local and regional employment centers/ CBD	Variable (short-long)	●	●	●	●
Student population	Educational institutions	Variable (medium - long)	●	●	●	●
Non-working female &/with pre-school children	Local and regional centers & residential areas	short	●		●	●
Elderly Population	Local and regional centers & residential areas	short	●		●	●
Unemployed	local and regional centers	variable (short - medium)		●	●	●

Source: Adapted from STP (2005)

* Bus includes conventional Bus and proposed mass transit modes

^ Para-transit includes micro-bus, CNG auto-rickshaw and taxi

NMPT is important for all types of short-medium length trips, but also play a special role for vulnerable social groups. Rickshaws are the preferred travel mode by women, children and the elderly due to their safety, security and comfort perspective. In this respect, NMPT plays an import cultural role in providing equity and mobility for these groups. It provides an alternative to over-crowded and poor quality bus services; and an affordable alternative to higher cost taxis and auto rickshaws.

In addition to its social and cultural significance, the rickshaw industry is one of the most important sectors of the Bangladeshi economy. According to Gallagher (1992), rickshaws in Bangladesh contribute 34% of the value added from the transport sector to GDP. Recent research by Ali and Islam (2005) estimated that 6% of Bangladesh's GDP can be accounted

for by rickshaw pulling. In Dhaka alone, around \$300,000 is estimated to transfer between rickshaw pullers and passengers per day (Gallagher, 1992; Ali and Islam, 2005).

This level of activity means that NMPT is a substantial contributor to the employment sector of Bangladesh. It is estimated that there are around two million rickshaw pullers across Bangladesh (Ali and Islam 2005) and that around 14% of the Bangladeshi population relies indirectly on rickshaw pulling for their livelihoods (their families, manufactures, garage owners, painters, repair men) (Wipperman and Sowula 2007). In Dhaka alone, some 20% of the population relies on pulling or indirectly, which amounts to about 2.5 million people (Wipperman and Sowula 2007). This large workforce and its continued growth are attributable to two major factors; a) the unemployment problem in agro-based rural areas and subsequent large urban drift, and b) easy access to jobs in rickshaw industry. As a result, NMPT is woven deeply into Bangladesh society in terms of its employment, cultural and socio-economic contributions, especially amongst the poorest sections of society. In a city like Dhaka, the “hard” transport planning issues associated with NMPT cannot be fully separated from the “soft” socio-economic implications of NMPT policies.

3.3 Sustainability

NMPT also has a growing significance from a sustainability perspective. Although historically, environmental considerations have not underpinned the growth of NMPT in Asia, this is now emerging as a strong factor in its favor.

To a significant degree, the environmental impact of alternatives modes of transport is linked to their fuel use. Table 4 shows the fuel dependence and types of fuel used by transport modes in Dhaka. Cars are the principal contributors to air quality pollutants (SO_x, NO_x and CO) in Dhaka (Hoque, *et al.* 2005); while buses and trucks are significant in the case of SO_x and NO_x emissions and auto rickshaws contribute significantly in the case of SO_x and CO emissions. By contrast, NMPT is fuel-free and has an almost negligible impact on climate change and air quality.

The DUTP project performance assessment report (2007) concluded that banning rickshaws on some corridors in Dhaka had led to an increase in the number of mini-buses operating as a stop-and-go service that passengers could request to stop at any point along the corridor. This added considerably to air pollution and congestion, on top of the general emissions generated by the introduction of private vehicles, replacing fuel-free modes like rickshaw.

The contribution of NMT in achieving transport sustainability is tenable, especially in developing cities of Asia, such as Dhaka, where trip lengths are primarily short and where NMPT already has a large and in some cases dominant share in the overall traffic composition. Kubota and Kidokoro (1996) emphasized this dimension stating that, though the number of motorized vehicles will inevitably increase in most Asian cities, they cannot be treated as a separate alternative to non-motorized transport. Rather, both of them, including public transport, should be treated together for balanced system development. World Bank-GEF (2003) also recommended a modal shift in developing countries to NMT and low emission, less polluting vehicles like NMPT to achieve transport sustainability and reduce climate change effects.

Table 4 Fuel use by transport modes in Dhaka

Mode	Type		Fuel Usage			
	Motorized	Non-motorized	Fuel Dependent			Fuel Free
			Petrol/Diesel	Natural Gas	Gas-Fuel/Gas-Diesel	
Passenger						
Metro Train (future)	●		●			
Bus	●		●		●	
Micro bus	●		●		●	
Auto rickshaw	●			●		
NMPT (Rickshaw)		●				●
Taxi	●		●		●	
Car/Jeep	●		●		●	
Motorbike	●		●			
Bicycle		●				●
Freight						
Truck	●		●			
Rickshaw van		●				●
Pushcart		●				●

Source: Adapted from STP (2005)

3.4 Levels of Impact

It is clear from above analysis that the implications of NMPT rickshaw in the city system of Dhaka are all pervading. More noteworthy is that such impacts exist at different levels of this system – individual micro-level to nationwide macro level. The role contribution of NMPT begins from individual stage (serving rickshaw pullers and passengers); expands to facilitate local functional movement (intra-neighborhood connectivity) and city wide network connectivity (inter-neighborhood connectivity); and has substantial citywide and nationwide economic effects, both direct and indirect (by large scale equity improvement, employment generation, ecology enhancement and financial growth). This reinforces the utility of rickshaw at various policy levels and further demonstrates its role significance.

4. NMPT AND RICKSHAW POLICY

Given the benefits of NMPT it might be expected that the general policy environment for NMT in Asia would have been supportive. In fact, the opposite has been the case, with transport strategies and policies mostly being neutral, or more often in the case of NMPT, negative. Many developing cities in Asia have imposed constraints on NMTs including cycle-rickshaws and bicycles claiming that they "cause congestion". The efforts have usually involved removal of NMPT from roads, or restriction on their registration and licensing, or a combination of both.

4.1 Some policy change initiatives and their end results

Manila banned NMPT initially in 1950's but some of them re-emerged in the 1990's. Bangkok banned them in 1960 and Karachi in 1962. Jakarta followed the trend in 1988, then lifted the ban briefly in 1998 before reversal. New Delhi followed suit during the early 1980's and also put restriction on the number of cycle-rickshaw registrations as well as licensing.

Transport statistics suggest none of these cities that imposed NMPT bans were able to solve their transport problems by doing so. In most cases the situation became even worse. From the modal shares of different vehicles, it appears that NMPT was replaced by higher pollution generating vehicles like motorcycles and motorized three-wheelers. The modal share of motorcycles or motorized three-wheeler in some Asian cities accounts for 35-70% of the total vehicles (World Resource Institute, 1996; Bari and Efroymsen, 2007), which is more or less similar to that of rickshaws in Dhaka. The average travel speeds in most NMPT free cities are also generally lower than that of Dhaka (Bari 2003). Some governments' policy decision to ban NMPT may also be driven by the desire to boost domestic car manufacture, even though the employment gained from this will not always offset the employment lost from any decline in non-motorized transport, and despite the pollution increase and foreign expenditure required for oil importation (Whitelegg and Williams 2005).

Where total or partial NMPT bans have been made in Asian cities, the expected benefits in congestion reduction have not always been achieved and many of these initiatives have failed and lead to subsequent decision reversal. Where such bans persist, the sense of dissatisfaction often prevails. For example, even long after the ban, about 70% of residents in the low income neighborhoods of New Delhi and Jakarta favor reintroduction of NMPT (GTZ 2003).

4.2 Rickshaw policy in Dhaka

In Bangladesh over recent decades, NMVs including NMPT have been discouraged compared to motorized transport. The government approach to NMPT has gone through the stages of a) a neutral stance in the hope that NMPT would disappear; b) a negative stance with initiatives implemented quickly and in an uncoordinated way to discourage NMPT without recognizing its broader significance and making arrangement for better alternatives; and c) after failure of these policies to resolve the issue, now looking for some new approach. The current comparative policy standing of government towards various modes operating in Dhaka is presented in Table 5.

Table 5 Government policy towards transport services at operation in Dhaka city

Travel Mode	Type		Government Policy		
	Motorized	Non-motorized	Supportive [^]	Restrictive *	Negative**
Passenger					
Metro Train	●		●		
Bus	●		●		
Micro-bus	●		●		
CNG Auto rickshaw	●			●	
Taxi	●	●		●	
Car/Jeep	●		●		
Motorbike	●		●		
NMPT (Rickshaw)		●			●
Bicycle		●			●
Freight					
Truck	●		●		
Rickshaw van		●			●

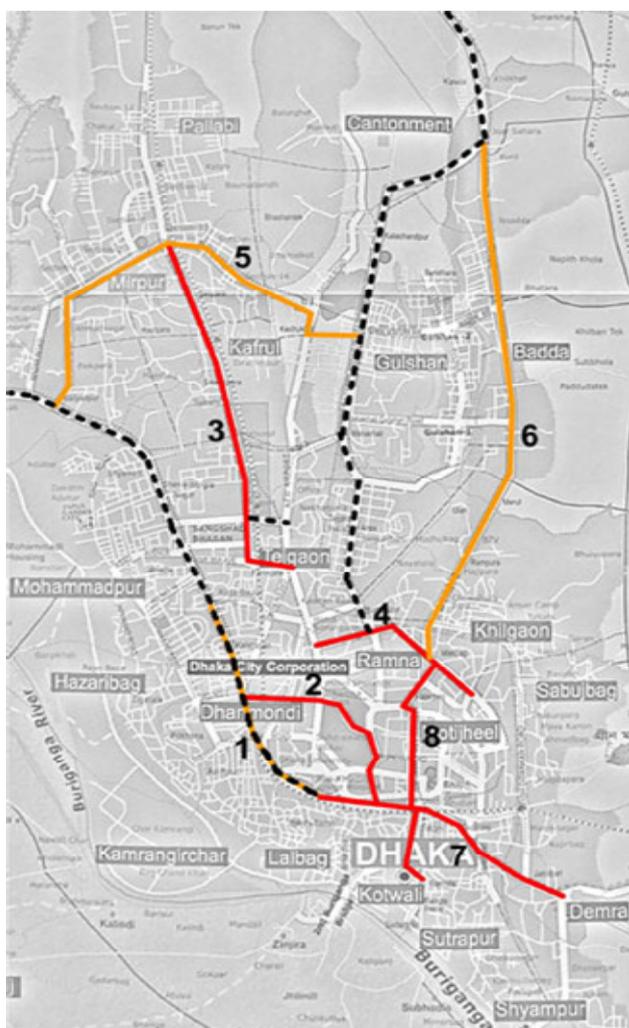
Source: Adapted from STP (2005)

[^] Infrastructure design, finance and regulatory support *Restricted in terms of total fleet number

** Non-cooperation regarding infrastructure design, finance and regulatory support.

In April 1987, the government of Dhaka announced plans to completely ban pedicabs from the city on safety grounds, although at the time, they employed more than 100,000 people (Replogle 1991b). This ban did not materialize due to political reasons and public opposition, but has been followed by restricted registration as well as licensing for NMPT in 1989 and high taxation on spare parts. Such restrictive measures are still in practice. Replogle (1991a) and Gallagher (1992) emphasized the NMT unfriendly situation stating that 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. The policy has also tended to hold back technical innovation in NMV design and materials that have been occurring in neighboring countries. At the same time, low taxes on motor vehicle imports tend to foster economically inefficient choices.

In line with the recommendations of the Dhaka Urban Transport Project (DUTP) (1998) and the National Land Transport Policy (2004), Dhaka City Corporation (the city government) has adopted a plan to phase out cycle-rickshaws from eight major roads of Dhaka (Figure 3), comprising a total of 120 km.



No.	Name of the Corridor	NMT Phase out time (Target time)
1.	Mirpur Road (Kalabagan-Azimpur)	31-8-2004
2.	New Elephant Road/ Bhasani Road (Science Lab-Shahbagh-Matshabhaban-Press Club-College Road)	31-8-2004
3.	Rokeya Sarani (Mirpur 10-Taltala-Agargaon-Farmgate)	31-5-2005
4.	New Eskaton Road/Circular Road (Bangla Motor-Moghbarar-Mouchak-Malibagh-Rajarbagh)	31-7-2005
5.	Technical (Technical-Mirpur 1-Mirpur 2-Kachukhet-Banani)	30-9-2005
6.	Progati Sarani /DIT Road (Kuril-Baridhara-Badda-Rampura-Malibagh-Mouchak)	30-11-2005
7.	Zahir Raihan Sarani/Hatkhola (Azimpur-Fulbari-Tikatuli-Saidabad)	30-12-2005
8.	North-South Road/English Road (Malibagh-Kakrail-Purana Palton-Zero Point-Fulbaria)	31-7-2006

----- Already made rickshaw free under World Bank DUTP

Figure 3 Existing and proposed rickshaw-free corridors in Dhaka

The objective being to make space for motorized transport and improve traffic flow, while at the same time, creating some separate routes for NMVs including NMPT rickshaws (Manchetti 2005).

The World Bank originally supported this plan (Hummel 2008), but observing the severe negative socio-economic implications of such policy measures on the population and the marginal improvement in traffic conditions, the World Bank in early 2005 reversed its patronage for rickshaw restriction from major roads in Dhaka. This policy reversal is also evident in the DUTP project performance assessment report (DUTP 2007), which admitted that such rickshaw restriction measures had been ineffective, stating that the banning of rickshaws from certain intersections and corridors had a negative impact on rickshaw drivers and some users.

It appears that, while generally well-intentioned, policy initiatives to restrict or ban rickshaw access in Dhaka have failed because they have focused on expected benefits to private motorized vehicles and not on broader mobility needs. For some trips, for instance trips that cross major corridors on which rickshaws are banned, accessibility has declined and adequate alternatives and traffic management measures have not been put into place to manage new traffic movements and the interaction of motorized and non-motorized vehicles. In addition, these policies have not sufficiently taken into account the severe social disruption caused by restricting NMPT by implementing programs to mitigate the impact on the rickshaw industry and its dependents.

5. WHAT IS THE FUTURE FOR NMPT?

This research paper has used the example of rickshaws in Dhaka to focus attention on and critically analyzed the role that NMPT plays in the overall transport and urban system. The findings clearly indicate that in cities such as Dhaka where NMPT is currently a major component of the transport system, NMPT is woven deeply into the urban fabric and can make an effective and functional contribution towards a sustainable transport system.

However with its functional constraints of speed and capacity, NMPT is not a substitute for motorized public transport. Instead, they are complementary and partially overlapping modes. Each has unique strengths and weaknesses. In combination, they offer strong potential competition to private motorized transport for variable trip dimensions in developing cities of Asia. Therefore more attention should be paid to issues such as the integration of motorized and non-motorized modes, for example by encouraging bicycle and cycle-rickshaw as access modes to express transit services for longer distance trips; and to improving traffic management measures to address congestion where motorized and non-motorized modes interact. For Dhaka, it should also be noted that rickshaws as NMPT are not the only cause of congestion, and that replacement of rickshaws with motorized transport may have a detrimental impact, especially from road space occupancy and environmental perspectives.

In Western Europe, Japan and the Americas, walking and cycling are being actively encouraged as measures to reduce congestion, improve public health and promote a more sustainable urban system. This includes policy and infrastructure initiatives to better integrate NMT and motorized modes, and NMT and PT. The Bogotá approach is considered by many researchers like Hidalgo (2002), Bari (2003) and Joewono and Kubota (2005) as a highly successful, sustainable urban development model that demonstrates how NMVs, pedestrian

mobility and public transport facilities could be integrated for the development of sustainable transport system and is worthy of exploring to cities like Dhaka (Bari 2003). Likewise the integration lessons from Delft, Netherlands incorporating motorized modes, NMV (bicycle), pedestrians, mass public transit and water transport within an integrated transport network; and the plan for Tama New Town in Tokyo, which provides for pedestrian and bicycle access to town centers and railway stations completely segregated from vehicular road traffic (World Bank 2002), are also relevant to MT-NMT integration possibilities for Dhaka and other cities in developing countries.

However, these are examples of integration between motorized public transport and private NMVs. The scenario is somewhat different for Dhaka where integration demands are predominantly between motorized transport and NMPT (rickshaws). Therefore, while taking lessons from the successful integration instances elsewhere, it is necessary for Dhaka and similar Asian cities to devise a functional and indigenous integration mechanism that is contextual to the traffic characteristics and travel demand while facilitating the majority of the transport users.

It follows that if we accept that there is an ongoing role for NMPT in the transport system of many developing cities as this paper has argued, then there are several key questions that arise:

- what is the optimum role of NMPT in a sustainable transport system?
- how can NMPT and motorized vehicles co-exist more efficiently and safely in a mixed traffic environment?
- how do we rationally attain that place, starting from the current state of the transport system? What plans and policies need to be in place?
- what are the external factors (social, cultural, political, financial) to deal with while making this transition?

No research has so far addressed these key issues in an integrated fashion. This paper as a first step in a research program that will look into these largely unexplored aspects of this hotly contested issue. In particular, it will focus on developing suitable mechanisms for functional integration of NMPT (rickshaw) with motorized vehicles in the ever increasing traffic volume of Bangladesh, with Dhaka as a central focus.

6. CONCLUDING REMARKS

Many cities in Asia are approaching a decision point about the future nature of their transport system and the future role of NMPT. In particular, those cities where NMPT already has a large and in some cases dominant role in the transport market are faced with the decision to (a) ignore NMPT, perhaps in the hope that it will eventually disappear; (b) actively discourage it through policy measures to ban or restrict NMPT; or (c) accept that NMPT is a valid and sustainable component of the system and work towards better integration of motorized and non-motorized modes.

This paper has delineated the directions in which the transport systems of many developing cities are heading, and has investigated the degrees and patterns of NMPT contribution to the overall transport system of Bangladesh, with Dhaka as a central focus. Facts and figures have clearly demonstrated the crucial place NMPT currently holds as a primary mode of travel for

many citizens covering important market segments and mobility needs. It has also highlighted the travel utility, economic role, extent of workforce involvement, population dependence, eco-friendly nature, equity contribution and freight usage of rickshaws. Over time, socially and environmentally sustainable alternatives to NMPT will evolve, but for many cities such as Dhaka, the transition is likely to be a very long one. This paper argues that in the meantime, the preferred approach is to accept the importance of NMPT and actively work towards integrating motorized and non-motorized transport modes.

Having established the present contribution of NMPT and its integration with the overall transport system as a priority, three broad areas of future research emerge:

- 1. Better Integration** – this involves better integration of NMT and motorized modes, and between NMPT and motorized PT. Traffic management measures aimed at improving traffic flow in a mixed traffic environment of NMPT and motorized modes have not always been based on sound research and have a very mixed (mostly unsuccessful) track record. In addition, little research attention has been devoted to approaches towards coordinating NMPT with motorized PT modes by physical infrastructure and operational integration measures. Since NMPT and PT are in most instances complementary not competing modes, this should be a subject of focus and priority. Improved integration would facilitate harmonious transfers between modes and reduce functional discrepancy between arterial and feeder traffic.
- 2. Better Technology** – in many cities, NMPT technology has not changed for decades. Therefore there is scope to introduce locally suitable technological innovations that ease driver operation and improve operating efficiency and comfort. Some programs have been successful in introducing improved rickshaw design in India and Indonesia (Utz and Petersen 2003) but there has been little or no recent innovation in Bangladesh and many other countries.
- 3. A Supportive Policy Environment** – last but not the least, comprehensive attention to NMPT as part of a national strategy and policy framework and local planning mechanism for implementation. And more crucially, policies and regulations that encourage and facilitate initiatives towards efficient integration, technological innovation and appropriate traffic management measures for NMPT operations.

This ongoing research will take a holistic approach to exploring opportunities and developing suitable mechanisms (management, infrastructure, technology, regulation) for better integration of NMPT and other modes. The aim is to achieve a sustainable co-existence of NMPT and motorized modes in a mixed transport system that best meets the mobility and network performance needs of residents of developing Asian cities.

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