

Strategies for Safer and Sustainable Urban Transport in Bangladesh

Md. Mazharul Hoque & Jobair Bin Alam

*Department of Civil Engineering, Bangladesh University of Engineering & Technology (BUET)
Dhaka-1000, Bangladesh*

ABSTRACT: The combination of rapid urbanisation and motorization has been a key cause of numerous transport problems in developing cities in Asia. It has resulted in deterioration in accessibility, service levels, safety, comfort, operational efficiency, and the urban environment. This is particularly prevalent in Bangladesh with current urbanisation level at around 24 percent. The rapid urbanisation process, high vehicular population growth and that of the mobility, inadequate transportation facilities and policies, varied traffic mix with over concentration of non-motorised vehicles, absence of dependable public transport system and inadequate traffic management practices and parking facilities have created a significant worsening of traffic and environmental problems in the major urban centres. Urban road accidents are a very serious and growing problem with vast majority of road accident fatalities comprising vulnerable road users particularly pedestrians. The congestion and pollution problems are rapidly spreading to fast growing medium size urban centres as well. The problems of traffic accidents, traffic congestion, emission of noise and pollutants costing the community probably in the order of US\$ 800 million (nearly 2 percent of GDP) each year. The problems have been further aggravated due to severe institutional and professional weaknesses. Traffic management strategy is seen to contribute significantly to solving congestion problems aimed at improved traffic flow as well as improving the urban environment and safety. In this paper characteristics of urban transportation and consequent mobility, safety and environmental effects are discussed with particular reference to the situation of metropolitan Dhaka. Emphasis has been placed on the mobility needs of the urban poor. Key transport issues and possible solution strategies for enhancing mobility, safety and the environment by means of better traffic management measures are further discussed in the light of major themes of the conference.

1 INTRODUCTION

The rapid urbanisation process, high vehicular population growth and that of the mobility, inadequate transportation facilities and policies, varied traffic mix with over concentration of non-motorised vehicles, absence of dependable public transport system and inadequate traffic management practices and parking facilities have created a significant worsening of traffic and environmental problems in the major urban centres. The congestion and pollution problems are rapidly spreading to fast growing medium size urban centres as well. The problems of traffic accidents, traffic congestion, emission of noise and pollutants viz. chemicals, dust, smoke and soot are indeed very great, costing the community probably in the order of US\$800 million (nearly 2

percent of GDP) each year. Indeed, Asian cities rank among the worst polluted urban areas in the world. There is now an ever-increasing urgency for mitigating the complex problem.

In this paper characteristics of urban transportation and consequent mobility, safety and environmental effects are discussed with particular reference to the situation of metropolitan Dhaka. Possible solution strategies for enhancing mobility, safety and the environment by means of better traffic management measures are further discussed in the light of major themes of the conference. At the outset urbanisation characteristics and the congestion and mobility issues are briefly reviewed.

2 URBANISATION CHARACTERISTICS IN BANGLADESH

Bangladesh is a very densely populated and low lying country with the 130 million inhabitants living in an area of 148,000 sq.km i.e. some 900 inhabitants per sq.km. Urbanisation in Bangladesh has been increasing steadily over the last 10 to 20 years with current urbanisation level at around 24 percent. The percentage of people live in urban areas is expected to rise to 30 percent by the year 2010 and to 50 percent by the year 2025. The rate of urbanisation is alarmingly high when compared with other developing countries. The current rate of urban population growth in Bangladesh is found to be the highest in Asia.

The rapid urbanisation is of course a recent phenomenon. During the first four decades of this century, that is, from 1901 to 1940, urban population increased at the rate of 2.2 percent per year. The rate increased about 8.7 percent between 1941 and 1974. Further increase in the rate of urban growth was observed after 1974. Between 1974 and 1981 urban population in the country increased by about 10.6 percent per year. The impact of such rapid growth of urban population has been quite spectacular. In 1961, the urban population was 2.6 million or only 4.8 percent of the total population. The figure reached 22.45 million or 20.2 percent of the total population in 1991 (Jahan, 1997). According to the population census of 2001, the urban population of the country reached 28.8 millions accounting for about 24 percent of the total population. Rural-urban migration is considered to have made the major contribution towards the rapid growth of urban population in Bangladesh. A very high proportion of this urban population is poor. The incidence of urban poverty is nearly 60 percent in Bangladesh and in metropolitan Dhaka 55 percent.

3 THE CONTEXT OF URBAN MOBILITY IN DEVELOPING COUNTRIES

3.1 *Mobility Vs Congestion Issues*

In a broad term, mobility is the ability of people and goods to move quickly, easily and cheaply to where they are destined at a speed that represents free flow or comparably high quality conditions (Texas mobility study 2001).

Mobility in this definition is the extent to which a traveller can move freely in both cost and travel speed terms. This definition can be applied to all modes and to persons and goods movement. It can indicate efficiency using per lane-mile, per ton-mile, per vehicle or per person values. A freeway or street corridor that includes HOV lanes, bus priority treatments or a rail transit line will move more persons

than a corridor without these treatments and, hopefully, at a better speed, indicating a high level of mobility.

Indeed mobility definitions and measures should rely on concepts that are understood by the intended audience. Travel time is widely understood and used by professionals and the general public. Thus for the sake of simplicity, mobility is the ability to reach a destination in a time and cost that is satisfactory. Mobility problems can be identified as areas or system parts that do not provide acceptable travel time, characterised as congestion situation. Congestion is thus the inability to reach a destination in satisfactory time due to slow travel speeds. The public simply perceives congestion as bad and mobility as good. Safety is indeed the fundamental requirement of mobility.

The greater challenge thus for transportation professionals is to develop a system of urban transport that meet the basic mobility needs for all urban dwellers at desirable safety and avoiding the unacceptable level of congestion and its consequent overwhelming adverse environmental effects. Indeed the issues of mobility, congestion, safety and environmental aspects are becoming increasingly important and critical in Bangladesh.

3.2 *The Congestion Phenomena*

Congestion is a phenomenon of increased disruption of traffic movement; to the traveller it is immobility. Some of the congestion characteristics include the following:

- ❖ Observed in delays and queuing.
- ❖ Interactions amongst the flow unit of traffic streams.
- ❖ Most visible when demand exceeds the capacity.
- ❖ Measured by speed (peak hour)
- ❖ Congestion is grouped into:
 - Point congestion: Concerned with bottlenecks, i.e. site-specific constrictions, reduced traffic capacity.
 - Network congestion: Area wide phenomena characterised by unstable flow conditions.
 - Link/ Route congestion: Specific to roadway section/ corridor phenomena.

Conceptually, congestion results from increasing disparities between urban transport demands and the supply of transport services (Bovy, 1990). These disparities are depicted in Figure 1. This situation is particularly prevalent in Bangladesh where transport infrastructural developments are unable to keep up with poor general maintenance of vehicles, faulty traffic planning and disregard for traffic regulations.

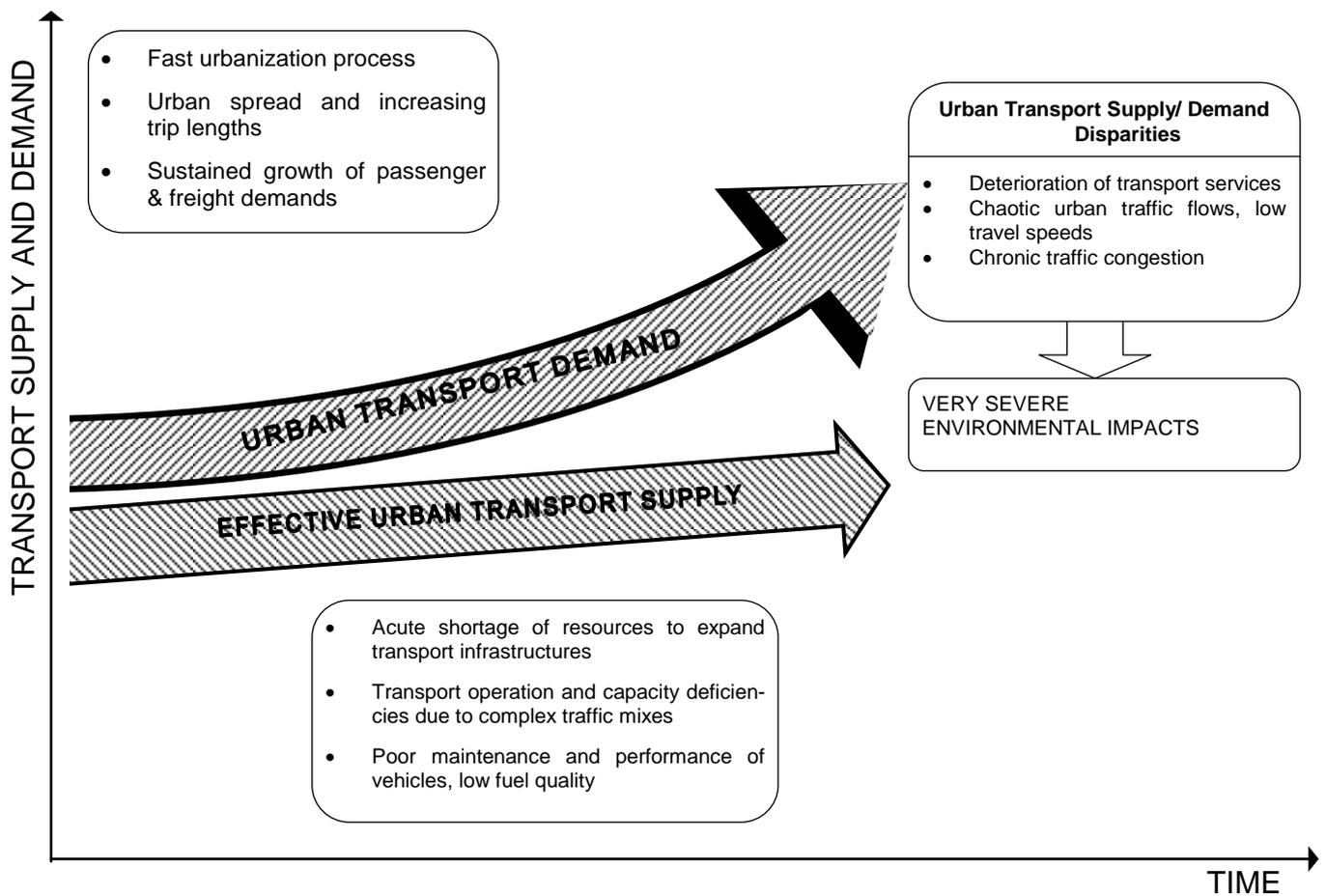


Fig. 1: Increasing supply demand disparities of urban transport in cities of developing countries

3.3 Mobility of the Urban Poor

Replogle (1993) argued that income plays a significant role influencing transportation choices people have. People with low-income face extremely limited transport choices. Where there is extensive poverty, it is vital 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 urbanisation 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 subsidised 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 travellers 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

equivalent of six or eight months of bus fares, there is good profit for a poor person in having on 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.

The issue of mobility of the urban poor in the context of sustainable urban transport in developing countries is available in the published literature. Access to transport is critical for the urban poor, for without it they are literally at risk of physical, economic and social isolation (ADB 2001). The following travel characteristics of urban poor are of particular importance:

- Purpose of trips: the great majority of travel by the urban poor is accessing work and for education.
- Frequency of trips: poor make fewer motorised and shorter trips than average.
- Length of trips: time and effort as well as money limit the range of trips made by the poor.
- Gender differentiated demand: women are much more likely to walk or use cycle-rickshaws and bus.
- Travel mode: mode for the poor is often determined by trip length, for which there may be only one or two possible modes (walking and buses).

4 STRIKING URBAN TRANSPORT CHARACTERISTICS OF BANGLADESH

4.1 Transport Profile of Dhaka – The Mega-City

Dhaka, the capital of Bangladesh, is one of the least motorised mega cities in the world. The following are the brief details of Dhaka:

- Population – 10 Million with a growth rate of 8 percent per annum.
- Dhaka as percent of Bangladesh – 8 percent, and accounts for 33 percent of total urban population
- Poverty incidence – 54 percent (highest in Asian cities)
- Dhaka's contribution to country's GDP – nearly 15 percent
- Road network–3000km (with only 450km primary & secondary/ collector roads)
- Road vehicles nearly 250,000 with huge number of rickshaws (500,000)
- Trip percent catered by Mass Transport – 10 percent.
- Cost of congestion and accidents – Tk. 3,000 crore (US\$ 520 million per annum)
- Air pollution and noise level 4 (in 1-10 scale)
- Urban road accident fatalities – 400 (reported per annum)
- Percent road fatalities who are pedestrians -60 percent
- Non-existent of qualified traffic engineering professionals.

Here, it should be noted that nearly 65 percent of World's urban poor live in 5 Asian countries- Bangladesh, China, India, Indonesia, Pakistan.

4.2 Walking and Rickshaw – Dominant Travel Modes

Based on data overview from the home interview and O-D (origin-destination) surveys it is revealed that pedestrian is by far the largest identifiable groups (see Table 1). It can be seen that over 60 percent of all link trips in Dhaka involve walking alone, followed by rickshaws 13 percent. Of the remaining trips some 11 percent include a walking component. Equivalent trip studies in medium sized cities showed walking representing 20-40 percent of trips. If person trips by vehicle are considered, present modal split reveals that rickshaw comprises the highest with 35 percent. Indeed the extent of walk mode in urban areas of Bangladesh is much more compared with other Asian mega cities (Hoque 2000):

- Tokyo : walk and bicycle 25 percent
- Bangkok : walk 16 percent and other non-motorised transport 8 percent
- Jakarta : walk 13 percent and other non-motorised transport 12 percent

- Delhi : walk and cycle 44 percent and other non-motorised transport 6 percent
- Lahore : walk 12 percent and other non-motorised transport 5 percent
- Singapore : walk 12 percent and other non-motorised transport 4 percent
- Hong Kong : walk 13 percent

Pedestrians thus clearly form by far the single largest group of road users in terms of total catered number of trips in urban areas of Bangladesh. This is particularly prevalent (about 65 percent) for short trips up to one mile. Walking as primary mode of travel is dominant in all age groups and income classes. It is most prevalent for low income groups, nearly 80 percent. This characteristic will continue to grow in the future as a large part of the urban population would hardly afford any kind of motorised or non-motorised transport of their own. Indeed walking appears to be a major contributor to a sustainable transport strategy. Yet pedestrian can still claim to be our most forgotten and neglected road user group. It is the motorist not pedestrian who normally receives the attention and greater share of priority. Pedestrians need protection in the form of facilities by ensuring their safety and convenience.

Table 1: Metro – Dhaka: Person Trip by Mode, 1999

Mode	No. of Person Trips		Ave. Trip Length per Day (km)	Passenger-km	
	000/day	%		000/day	%
Car	576	4.0 (10.5)	10.4	5,990	11.9
Bus	1,482	10.2 (27.0)	13.5	20,007	39.8
Auto-rickshaw	845	5.8 (15.2)	12.8	10,816	21.6
Rickshaw	1,927	13.3 (35.0)	4.3	8,286	16.5
Others	675	4.7 (12.3)	7.5	5,066	10.1
Subtotal	5,505	38.0 (100.0)	9.1	50,165	100.0
Walk	9,000	62.0	1.0	9,000	15.0
Total	14,505	100.0	4.1	59,165	100.0

* Figures in bracket are subtotal percentage

4.3 Level of Bus and Minibus use

Although their contribution as travel modes has recently been enhanced, their patronage share remains much low, accounting for around 10 percent. The bus fleet grows at very low growth rate of only 2 percent. The present bus transport mode has not been able to perform satisfactorily and efficiently. Long waiting, delay on plying, overcrowding, lack of comfort and long walking distance from the trip origin are some of the common problems.

4.4 Level of Bicycle use

It is highly expected that cycling mode should be able to play its effective part in meeting the transport demands. The most outstanding advantage of the bicycle is its availability for door-to-door trips and flexibility of use. However, the usage of bicycle as travel mode in urban areas is far below the desirable level, accounting for nearly 1 percent in metropolitan Dhaka. The bicycle share is however more in medium sized cities, nearly 5 percent.

4.5 Traffic Congestion

In spite of the low level of motorization, Dhaka suffers from serious traffic congestion largely due to the absolute lack of roads, deficient road network configuration and inefficient traffic management (JBIC 2000). Conflict in the use of road space by pedestrians, rickshaw, bus, car auto-rickshaw, and others is visible everywhere in Dhaka and their movements are not properly segregated nor managed. Poor parking facilities and management, unorganised roadside activities and lack of public transportation and pedestrian facilities among others contribute to the problem. The low awareness level of drivers and pedestrians to traffic rules and regulations, as well as insufficient and poor enforcement capacity of traffic police, further aggravates the situation.

4.6 Urban Road Safety

In urban areas of Bangladesh pedestrians represent often up to 70 percent of the total road accident fatalities. Their involvement varied between 43 and 73 percent of the road accident fatalities in the medium sized cities. Current statistics revealed a deteriorating situation in metropolitan Dhaka. For example, pedestrians as a proportion of road accident deaths increased from 43 percent in 1986-1987 to 67 percent in 1991-1992. In most recent years (1996-1998) the number of pedestrian casualties (fatalities and injuries) has increased markedly, from 433 in 1966 to 588 in 1998, an increase of about 29 percent. Pedestrians now make up approximately 63 percent of road accident fatalities and 32 percent of injuries and are involved in about 20 percent of all reported accidents. Indeed, with fatal accidents, 70 percent were pedestrian motorised vehicle collisions. The seriousness of the pedestrian accident problem of Bangladesh is clearly evident from the comparative data on pedestrian's involvement in fatal and injury accidents for numerous countries in the Asia and Pacific region. Overall, Hong Kong, China had the highest share of pedestrian deaths (two thirds of all fatal accidents) followed by Dhaka, Bangladesh (63 percent), Pakistan (50 percent), Republic of Korea (48 percent), Sri Lanka (45 percent), Fiji (43 percent) and Papua New Guinea (33 percent). Further details

about road safety problems and interventions could be seen in Hoque (2000) and Hoque et al (2001).

4.7 Traffic Induced Pollution

Dhaka has become one of the most polluted cities in the world. The environment of the city has been deteriorating rapidly during the last couple of years. Now a days, complaints about headache, eye and skin irritation as well as breathing problem are very common among the users of the roadways of the city. The situation is expected to worsen further with increase of population and economic development. The conditions are severely harmful for the children and the elderly people.

To make the city environmentally sustainable it is required to assess the level of air pollution and develop policies to control the emission of the pollutants as soon as possible. In the roads of Dhaka city the concentration of Oxides of Nitrogen (NO_x), Oxides of Sulphur (SO_x), Carbon Mono-oxide (CO) and Suspended Particulate Matter (SPM) are 500, 1200, 7500 and 2500 $\mu\text{g}/\text{m}^3$ respectively which far exceeds the acceptable limit set by WHO.

Contribution of motor vehicles in air pollution is summarised in Table 2. The relative contribution of different types of vehicles is shown in Figures 2, 3 and 4.

Car is the principal contributor of SO_x , NO_x and CO emission in the city. The contributions from bus and truck are significant in the case of SO_x and NO_x emission. Auto-rickshaws contribute significantly in the case of SO_x and CO emission.

Table 2: Pollutant Emission from Motor Vehicles.

Pollutant	Emission Ton/Day	Percentage of Total Emission
SO_x	5.43	55
NO_x	21.57	70
CO	215.34	60

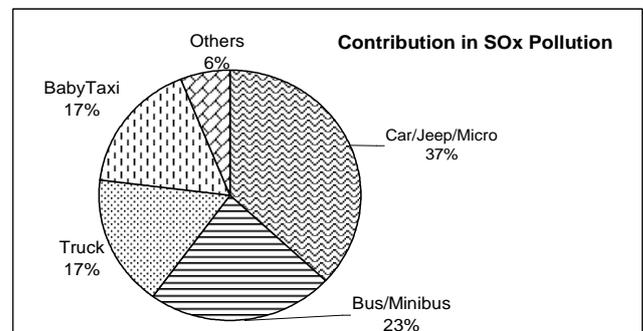


Figure. 2. SO_x emission by vehicle type

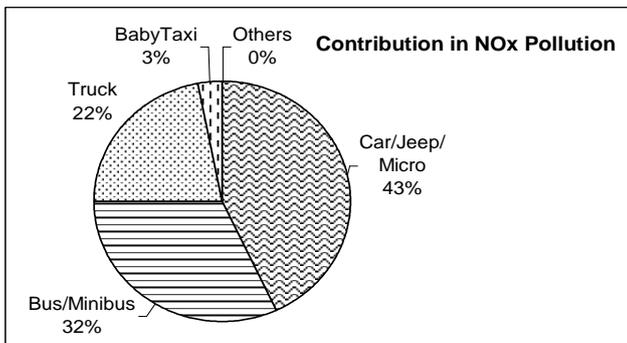


Figure. 3. NOx emission by vehicle types.

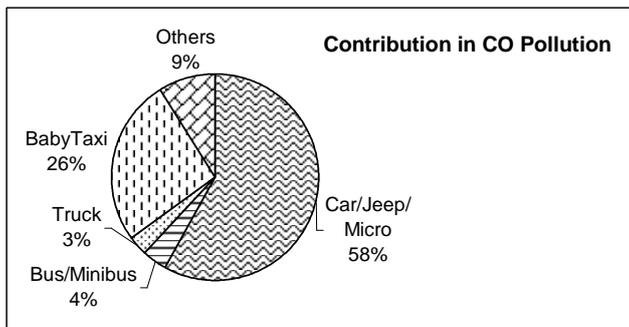


Figure. 4. CO emission by vehicle types.

4.8 Severe Institutional Weaknesses

Traffic planning and management seriously suffers from a lack of a strong, professional traffic management agency with well defined powers and responsibilities, fragmentation of responsibilities between agencies and of inter-agency co-ordination, low levels of staffing and lack of professional capacity as well as lack of trained traffic police for the effective enforcement of traffic regulations.

5 KEY URBAN TRANSPORT ISSUES AND STRATEGIES

In the light of the facts and discussions presented in the previous sections, the following key issues and strategies are outlined towards addressing the urban transport problem in order to achieve sustainability and safety.

5.1 Some Key Issues

Alarming growth:

- Economic growth coupled with increasing disposal income and urbanisation causing increased transportation demand and number of vehicles.
- Motor vehicle growth rate of 8 to 10% causing considerable congestion and safety problems.
- Vehicle fleets may be doubled in around 7 years with persistent high number of NMV.
- Well-planned and well co-ordinated approaches are required to cope with future increases.

Directions for the Future: Travel options available in developing countries are defined by a combination

of technology, form of operation and management measures which can provide priority over other traffic (ADB 2001). These options include walking, non-motorised transport, paratransit, minibus and bus, sub-urban rail and MRT (busway, light-rail transit/tramway, and metros).

- Walking as travel mode would dominate as the largest single group in cities, particularly for the poor.
- The dependence on non-motorised modes will persist in foreseeable future. Bicycles should be treated as an integral part of the urban transport system by providing adequate bicycle facilities (e.g., bicycle paths) with proper design. Policy should also favour affordability of bicycles by poorer sections of the community.
- Measures to separate non-motorised to motorised traffic should be given increased priority.
- Priorities are needed to significantly increase the fleet, frequency and operating conditions of bus transportation.
- Interventions should heavily rely on traffic management and non-capital intensive measures.

5.2 Traffic Management Strategies

Traffic management in urban areas is being used to provide controls on congestion by introducing improved traffic flow and lane occupancy and to restrict access to certain areas at peak periods. An effective management strategy may include: re-routing through traffic, traffic calming measures, improving the geometric layout of junctions, improving public transport infrastructure, measures to improve facilities for pedestrians and cyclists. When adopted sensibly, traffic management measures could be a useful tool in improving the environment and encouraging walking and cycling. It is clear that environmental issues cannot be addressed in isolation and need to be integrated with various technical, social, political and economic aspects. Efficient transportation systems and control of future urban development form a vital link in improving the urban environment and sustaining development. There are clear relationships between traffic congestion and environmental pollution. Improvements in traffic systems will result in better environment. There is a wide range of technical solutions available to help reduce pollution from vehicular traffic. In the industrialised countries, many of these solutions are being examined by motor vehicle manufacturers in response to the legislative pressures from national governments, who wish to see environmental protection measures implemented. The available technologies for reducing energy consumption and improving energy efficiency can be conveniently classified into five groups, namely: engine technology, alternative fuels, vehicle design, public transport and traffic management. Reducing environmental impacts through planning pol-

icies and traffic management are particularly important and demands greater attention in developing countries like Bangladesh.

Under the prevailing socio-economic context and for mitigating complex urban traffic and transportation problems in Bangladesh traffic management elements requiring urgent attention include the following. Further details on these elements can be seen in Hoque et al (2002).

- Managing pedestrian travel (including augmentation of various pedestrian facilities).
- Managing non motorised traffic (particularly bicycle rickshaws for passenger and freight transport).
- Promoting bicycle as an important travel mode (particularly for low initial and operating costs).
- Improving mass transit system application (examine various MRT options).
- Urban truck management policy (efficient urban road freight distribution).
- Enhancement of traffic engineering transport planning and management practices.
- Traffic regulation (e.g. one way street, turning and entry restrictions, pricing) & information systems.
- Develop a cadre of competent professionals supported by research and investigation.
- Create a city traffic management authority with improved governance and strong commitment.
- Low-cost improvement measures (hierarchy of roads, missing road links, spot improvements).
- Traffic control centre (use of IT for trip planning by making aware of traffic conditions).
- Proper land use planning and regulation (control future developments and growth).
- Enforcement and institutional strengthening with road user awareness development program.
- Expansion of existing transport infrastructure (construction of Bypass/ Freeways).
- Development of appropriate design guidance (establishment of good design practice).
- Urban road safety improvements (road safety programs including community road safety).

5.3 Strategies for Road Safety

The safety situation is very severe by international standards. Pedestrian-vehicle conflicts are clearly the greatest problem with significant involvement of trucks and buses. There is specific need for road environmental improvements aimed at correcting the most common deficiencies. Strategies required to prevent pedestrian-vehicle conflicts includes:

- For road environment improvement:
 - Wider application of traffic engineering approaches.
 - Both accident prevention and accident reduction strategies.

- Systematic implementation of road safety audit.
- Priorities for principles like traffic segregation, channelisation, speed reduction and other self-enforcing measures.
- Implementation required at the places of black-spots identified by systematic accident investigation.
- Strategies should offer cost-effective results.
- Preparation of road traffic safety action plan.

6 CONCLUDING REMARKS

The prerequisite for economic activity is the mobility of the inhabitants which is catered for by providing the transportation system. Mobility and safety as well as sustainability are the fundamental requirements for any transportation system which should be built in the planning, design, construction and operation stages of the system. The major pitfalls and factors inhibiting mobility and the development of a safe and sustainable transport system for the urban areas of Bangladesh. are discussed in this paper with particular emphasis on Dhaka metropolitan area. In alleviating the continued worsening urban traffic problems, key issues in consideration of future growth and directions, together with strategies encompassing various traffic management approaches are summarised. The paper in particular focuses on the elements requiring immediate attention. Institutional strengthening with strong political and professional commitment is required as a matter of due urgency.

REFERENCES

- Asian Development Bank (ADB), Urban Transport Policy Paper, Finalise Draft, ADB, Manila, June 2001
- Bovy, Ph.H. (1990), Transport and the environment; a tentative overview of issues in cities of developed and developing countries, CODAU-V, conference proceedings, Sao Paulo, September, 1990.
- Hoque, M.M.(2000), Road planning and engineering for promoting pedestrian safety in Bangladesh, 10th REAAA conference, Tokyo, September 2000.
- Hoque, M.M., McDonald, M. & Hall, R.D. (2001), Road safety improvements in developing countries: priority issues and options, 20th ARRB conference proceedings, ARRB Transport Research, Melbourne. March 2001.
- Hoque, M.M., Ahsan, H.M & Alam, J.B (2002), Traffic congestion and safety in Dhaka city: some contemporary issues and options, Key note paper (in preparation) for the seminar on Traffic Problems in Dhaka, ASCE Local Chapter (Bangladesh), Dhaka.
- Jahan, S. (1997), Planning for urban poverty reduction: an integrated approach, The Journal of Local Government, Dhaka, July 1997.
- Japan Bank for International Co-operation (JBIC) (2000), Study of the improvement of transportation and environment in Dhaka, Dhaka.

Replogle, M. (1993), Bicycle and cycle rickshaws in Asian cities, 6th conference on urban transport in developing countries, CODATU-VI, Tunis, 1993.

Texas Mobility Study (2001) Texas A & M University System, USA (<http://mobility.tamu.edu>).