Dealing with Vulnerable Road User (VRU) Safety and Mobility in Urban Areas of Bangladesh: A Critical Sustainable Transport Development Challenge

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**ABSTRACT**

With increasing trends in urbanization of developing countries the major cities are facing serious challenges of sustainable transport development. Sustainable transportation strategies are those that can meet the basic mobility needs of all and be sustained into the foreseeable future without any adverse impact on environment and the societal wellbeing. In particular achieving sustainability requires a balanced integration of public mass transit and individual transport, either on foot, by bike, or in a car. Each mode needs to be promoted where it offers the greatest advantage in economic, environmental and social terms.

The greatest challenge thus for transportation professionals is to develop a system for urban transport that meets the basic mobility need 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. In this paper, the mobility and safety issues of the Vulnerable Road Users (VRUs) in the context of sustainable development of urban transport are discussed. Vulnerable Road Users (VRUs) viz. pedestrians, bicyclists, cycle rickshaw occupants and motorcyclists constitute by far the biggest share (around 80%) of urban travel and they accounted for nearly 80 percent of road traffic accidents fatalities in urban areas. The prevailing accident factors, challenges and safety improvement options are also briefly highlighted.
INTRODUCTION

Vulnerable Road Users (VRUs), particularly non-motorized transport (NMT) viz. pedestrians, bicycles and cycle rickshaws play a vital role in urban transport in much of Asia, Bangladesh in particular. They account for around 80 percent of urban travel. Despite their outstanding contribution as travel modes, they are constantly being exposed to significant safety threats. Nearly 80 percent of urban road traffic accident (RTA) fatalities are attributed to these users groups. The purpose of this paper is to discuss the mobility and safety issues in the light of sustainability concept of urban transportation system with particular regard to the situation in Bangladesh.

THE CONTEXT OF SUSTAINABLE TRANSPORT IN URBAN AREAS

It has become increasingly clear that the concept of sustainable transportation calls for a more holistic approach to policy and investment planning to achieve a diverse and balanced mix of transport modes and sensible arrangement of land use that enables conservative use of energy and capital to fulfill mobility needs. Sustainable transportation strategies are those that can meet the basic mobility needs of all and be sustained into the foreseeable future without destruction of the local or planetary resource base. In particular achieving sustainability requires a balanced integration of public mass transit and individual transport, either on foot, by bike, or in a car. Each mode needs to be promoted where it offers the greatest advantage in economic, environmental and social terms. Indeed these three major components of sustainable transport are overlapping in the context of overall sustainable system as shown in Figure 1. The comprehensive sustainability maximizes the benefits in these components (Habib and Iman, 2003) and therefore the sustainable issue in transport has emerged as a vital requirement in many developing countries.

![Figure 1: Scheme of sustainable development: at the confluence of three constituent parts](Source: CTS, 2002)

With particular regards to urban areas, a sustainable transport system must provide mobility and accessibility to all urban residents with safe and environmentally friendly modes of transport. This is a complex and difficult task in the mega-cities of developing countries because the needs of people belonging to various income groups are not only different, but also often conflicting in nature. For example, if a large section of the
population can not afford to use motorized transport – either private vehicles or public buses – they either have to walk or cycle to their place of work (Tiwari, 1999). Thus, pedestrians, cyclists and non-motorized rickshaws are the most critical elements in the sustainable transport system particularly in mixed traffic situation in Bangladesh. Indeed, these non-motorized transport offer low cost private transport, emit no pollution, use renewable energy, emphasize use of labor rather than capital for mobility, and are well suited for short trips in most cities regardless of income, offering an alternative to motorized transport for many short trips. Indeed, they are appropriate elements in strategies dealing with poverty alleviation, air pollution, management of traffic problems and motorization, and the social and economic dimensions of structural adjustment. NMTs have a most important role to play as a complementary mode to public transportation.

To maximize transportation efficiency and sustainability, transport planning in Asian and other cities will need to focus more closely on stratifying different travel markets by trip length and encouraging different travel modes for various market segments. This essentially needs due cognizance of the needs and crucial role of NMTs. They are remarkably efficient in comparison with other modes of transport and mainly benefits the less well off in society either as users, or as suppliers of services (Habib, 2002). However, the future of NMTs in many Asian cities is threatened by growing motorization, loss of street space for safe NMT 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. Unless Non-Motorized Transport Strategies are adopted to slow or reverse this trend, problems related to traffic safety, air pollution, energy use, traffic congestion, urban sprawl, and the employment and mobility of low income people may spiral out of control, while increasing the speed of global climate change (Replogle, 1991). The high rates of pedestrian, bicycle and motorcycle traffic in LMCs (proportions differ from country to country) result in vulnerable road user fatalities constituting 60-80 per cent of all traffic fatalities (Mohan 1992). This paper examines the safety aspects of non-motorized transport in the urban area of Bangladesh.

**MOBILITY OF VULNERABLE ROAD USER (VRU) IN BANGLADESH**

**Pedestrian:** In Bangladesh, with a low level of motorization, the role of walk mode is quite significant and is highly vulnerable as well. Pedestrians clearly form by far the single largest group of road users in terms of total catered number of trips in urban areas of Bangladesh between 20-60 percent. 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. Indeed the extent of walk mode in urban areas of Bangladesh is much more compared with other Asian mega cities (Hoque, 2000). Walk trip represented up to 40 percent in medium sized cities.

**Cycle Rickshaws:** Cycle rickshaws too cater quite significant proportion of trips (between 25 and 40 per cent) in cities. About 40 per cent of the metropolitan population
are directly or indirectly dependent upon rickshaws. For medium sized cities, almost 60 percent of trips are attributed to cycle rickshaws. As such rickshaws occupy an important position in urban transport scenario and posses some outstanding advantages as well.

**Bicycle:** Despite its outstanding advantages, the usage of bicycle as travel mode in urban areas is however far below the desirable level, accounting for between 2 and 5 percent in metropolitan Dhaka. The bicycle share is however more in medium sized cities, nearly 5 percent.

**Mobility of the Urban Poor:** The mobility issue of the urban poor is particularly important in the context of sustainable urban transport in developing countries. 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.

Under the prevailing socio-economic conditions and even with growing economic affluence and fascination for increased motor vehicle ownership in urban areas. Thus the above characteristics of mixed mode conditions of urban traffic stream will continue to persist 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 and cycling appear to be a major contributor to a sustainable transport strategy. Yet they can still claim to be our most forgotten and neglected road user group. It is the motorist not pedestrian or cyclist who normally receives the attention and greater share of priority. Pedestrians and non-motorized vehicles need protection in the form of facilities by ensuring their safety and convenience.

**VULNERABLE ROAD USER SAFETY IN URBAN AREAS OF BANGLADESH**

**Urban Accidents Statistics**

The distribution of reported road traffic accidents and fatalities in urban and rural areas for the period of 1998-2006 is shown Tables 1 and 2. In the nine year period, at least 11472 accidents occurred in urban areas accounting for 35 percent of total accidents in the country. These accidents resulted in 6519 fatalities and 8471 injuries. Around 25 percent of the total fatalities occurred in urban areas. The data presented in the table shows some possible reporting inconsistencies in the distribution of urban-rural accidents which require further investigation. Aspects of urban accidents are examined in the following sections.
Table 1: Trends of Accidents in Urban and Rural Areas

<table>
<thead>
<tr>
<th>Year</th>
<th>Urban</th>
<th>Rural</th>
</tr>
</thead>
<tbody>
<tr>
<td>1998</td>
<td>1754</td>
<td>1743</td>
</tr>
<tr>
<td>1999</td>
<td>1499</td>
<td>2439</td>
</tr>
<tr>
<td>2000</td>
<td>1504</td>
<td>2451</td>
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<tr>
<td>2001</td>
<td>960</td>
<td>1948</td>
</tr>
<tr>
<td>2002</td>
<td>1366</td>
<td>2557</td>
</tr>
<tr>
<td>2003</td>
<td>1413</td>
<td>2662</td>
</tr>
<tr>
<td>2004</td>
<td>1079</td>
<td>2435</td>
</tr>
<tr>
<td>2005</td>
<td>854</td>
<td>2394</td>
</tr>
<tr>
<td>2006</td>
<td>1043</td>
<td>2418</td>
</tr>
<tr>
<td>Total</td>
<td>11472</td>
<td>21047</td>
</tr>
</tbody>
</table>

Table 2: Trends of Fatalities in Urban and Rural Areas

<table>
<thead>
<tr>
<th>Year</th>
<th>Urban</th>
<th>Rural</th>
</tr>
</thead>
<tbody>
<tr>
<td>1998</td>
<td>795</td>
<td>1534</td>
</tr>
<tr>
<td>1999</td>
<td>733</td>
<td>2152</td>
</tr>
<tr>
<td>2000</td>
<td>775</td>
<td>2276</td>
</tr>
<tr>
<td>2001</td>
<td>593</td>
<td>1785</td>
</tr>
<tr>
<td>2002</td>
<td>752</td>
<td>2283</td>
</tr>
<tr>
<td>2003</td>
<td>826</td>
<td>2476</td>
</tr>
<tr>
<td>2004</td>
<td>697</td>
<td>2416</td>
</tr>
<tr>
<td>2005</td>
<td>580</td>
<td>2321</td>
</tr>
<tr>
<td>2006</td>
<td>768</td>
<td>2313</td>
</tr>
<tr>
<td>Total</td>
<td>6519</td>
<td>19556</td>
</tr>
</tbody>
</table>

Urban Accidents: Metropolitan Vs Non-Metropolitan Areas

A distribution of urban accidents and fatalities by metropolitan and non-metropolitan areas is presented in Table 3. The data shows that urban accidents are concentrated in metropolitan areas. Of the total urban accidents of Bangladesh, 82 percent are metropolitan related accidents which contribute to nearly 75 percent of urban fatalities. It may be mentioned that nearly 30 percent of total accidents and 20 percent of total fatalities are metropolitan related, with 12 percent of the total population of Bangladesh in metropolitan areas.

Table 3: Distribution of Urban Accidents and Fatalities (1998-2006)

<table>
<thead>
<tr>
<th>Locations</th>
<th>Accidents</th>
<th>Percent</th>
<th>Fatalities</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metropolitan</td>
<td>9399</td>
<td>82</td>
<td>4880</td>
<td>75</td>
</tr>
<tr>
<td>Non-Metropolitan (urban)</td>
<td>2073</td>
<td>18</td>
<td>1639</td>
<td>25</td>
</tr>
<tr>
<td>All Urban</td>
<td>11472</td>
<td>100</td>
<td>6519</td>
<td>100</td>
</tr>
</tbody>
</table>

The breakdown of metropolitan accidents by metropolitan cities over the period of 1998 to 2006 is presented in Table 4. There are six declared metropolitan areas in Bangladesh. These are Dhaka, Chittagong, Rajshahi, Khulna, Sylhet and Barishal. It may be seen that, by far the greatest proportions of road traffic accidents and fatalities are in Dhaka, 74 percent and 65 percent respectively (Table 4).

Table 4: Accidents and Casualties in Metropolitan Areas of Bangladesh (1998-2006)

<table>
<thead>
<tr>
<th>Metropolitan City</th>
<th>Population</th>
<th>Accidents</th>
<th>Fatalities</th>
<th>Casualties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dhaka</td>
<td>9912908</td>
<td>64.0</td>
<td>3047</td>
<td>6935</td>
</tr>
<tr>
<td>Chittagong</td>
<td>3202710</td>
<td>20.7</td>
<td>653</td>
<td>1089</td>
</tr>
<tr>
<td>Rajshahi</td>
<td>1227239</td>
<td>7.9</td>
<td>260</td>
<td>421</td>
</tr>
<tr>
<td>Khulna</td>
<td>646716</td>
<td>4.2</td>
<td>176</td>
<td>303</td>
</tr>
<tr>
<td>Sylhet</td>
<td>285308</td>
<td>1.8</td>
<td>369</td>
<td>588</td>
</tr>
<tr>
<td>Barishal</td>
<td>202242</td>
<td>1.3</td>
<td>46</td>
<td>63</td>
</tr>
<tr>
<td>Total</td>
<td>15477123</td>
<td>100</td>
<td>4551</td>
<td>9399</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Metropolitan City</th>
<th>Population</th>
<th>Accidents</th>
<th>Fatalities</th>
<th>Casualties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dhaka</td>
<td>9912908</td>
<td>64.0</td>
<td>3152</td>
<td>7903</td>
</tr>
<tr>
<td>Chittagong</td>
<td>3202710</td>
<td>20.7</td>
<td>742</td>
<td>1681</td>
</tr>
<tr>
<td>Rajshahi</td>
<td>1227239</td>
<td>7.9</td>
<td>319</td>
<td>727</td>
</tr>
<tr>
<td>Khulna</td>
<td>646716</td>
<td>4.2</td>
<td>190</td>
<td>440</td>
</tr>
<tr>
<td>Sylhet</td>
<td>285308</td>
<td>1.8</td>
<td>426</td>
<td>897</td>
</tr>
<tr>
<td>Barishal</td>
<td>202242</td>
<td>1.3</td>
<td>51</td>
<td>109</td>
</tr>
<tr>
<td>Total</td>
<td>15477123</td>
<td>100</td>
<td>4880</td>
<td>11757</td>
</tr>
</tbody>
</table>

5
Some Striking VRUs Accident Characteristics in Urban Areas

The distribution of road fatalities across road user groups for urban and rural areas is given in Table 5. It can be seen that nearly 80 percent of road fatalities are attributed to VRUs (viz. pedestrian, bicycles, cycle rickshaws and motor cycles) in urban areas with pedestrian being by far the largest user groups in road traffic fatalities. They are also the dominant group in rural fatalities, accounting for 65 percent. Their shares varied markedly between metropolitan cities, 60 to 85 percent.

Table 5: Fatalities by User Groups in Urban and Rural Areas of Bangladesh (1998-2006)

<table>
<thead>
<tr>
<th>User Groups</th>
<th>Urban</th>
<th>Percent</th>
<th>Rural</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pedestrian</td>
<td>4083</td>
<td>63%</td>
<td>8878</td>
<td>46%</td>
</tr>
<tr>
<td>Bicycles and Rickshaws</td>
<td>782</td>
<td>12%</td>
<td>1226</td>
<td>6%</td>
</tr>
<tr>
<td>Motorcycles</td>
<td>207</td>
<td>3%</td>
<td>740</td>
<td>4%</td>
</tr>
<tr>
<td>Baby Taxi/Tempo/Microbus</td>
<td>394</td>
<td>6%</td>
<td>1686</td>
<td>9%</td>
</tr>
<tr>
<td>Car/Jeep/Pickup</td>
<td>136</td>
<td>2%</td>
<td>738</td>
<td>4%</td>
</tr>
<tr>
<td>Buses</td>
<td>436</td>
<td>7%</td>
<td>3669</td>
<td>19%</td>
</tr>
<tr>
<td>Trucks</td>
<td>298</td>
<td>5%</td>
<td>1922</td>
<td>10%</td>
</tr>
<tr>
<td>Others</td>
<td>166</td>
<td>3%</td>
<td>594</td>
<td>3%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>6502</td>
<td>100%</td>
<td>19453</td>
<td>100%</td>
</tr>
</tbody>
</table>

Pedestrians - The Most Vulnerable Road User Group: Analysis of pedestrian accidents yields the following problem characteristics:

- The percentage of pedestrian fatalities has significantly increased from 57 percent in 1998 to 66 percent in 2006 in urban areas. Indeed, the share of pedestrian fatalities in Dhaka is much higher, 80 percent, and there has been a sustained increases of pedestrian fatalities, as revealed in the following data:
  - In 1986-87- pedestrians 43 percent
  - In 1991-92 - pedestrians 67 percent
  - In 1998-99 - pedestrians 69 percent
  - In 2002-03 - pedestrians 76 percent
  - In 2005-06 - pedestrians 80 percent
- In non metropolitan urban areas they accounted for nearly 56 percent.
- Their involvement varied between 43 and 73 percent of the road accident fatalities in the medium seized cities.
- The distribution of pedestrian fatalities was 63 percent day (6 am to 6 pm) and 37 percent at night (6 pm to 6 am) in urban areas of Bangladesh.
- Most of pedestrian fatalities in urban area occur at roadsides, 45 percent which is followed by on road 38 percent and at pedestrian crossing points, 12 percent.
- Further analysis revealed that most of the pedestrians fatalities occur while crossing the road (41%) and is closely followed by walking on the road (39%), and standing on road (14%).
- Studies of road accidents revealed that heavy vehicles such as trucks and buses including minibuses are major contributors to road accidents and are responsible for 61 percent of all urban fatal accidents. This group of vehicles is particularly
over involved in pedestrian accidents accounting for about 72 percent of urban pedestrian fatalities.

**Involvement of Children in Road Accidents:** The national road accidents statistics in Bangladesh revealed a serious threat to the children. The incidence of overall child involvement in road accident fatalities in Bangladesh is found to be very high, about 21% of all fatalities are children below the age of 16 years.

- Of the total child fatalities of road accidents, nearly 82 percent involved as pedestrians with the dominant age group of 5-10 years. Indeed, about one-third of total pedestrian fatalities are children under the age of 15 years. They are the dominant age group of pedestrian fatalities.
- The female child pedestrians are disproportionately higher than the male child pedestrians (44.6% Vs 28.9%).
- The average child fatality involvement in metropolitan area is nearly 18 percent and varied between 16 to 22 percent.
- Children as bicyclist are also quite marked in some metropolitan cities, i.e. Rajshahi and Barishal.
- Child fatalities are predominantly of daytime problem with peak occurrence during 10 am to 12 noon.
- Most of child pedestrian fatalities in urban area occur at roadsides, 42 percent which is followed by on road 40 percent and at pedestrian crossing points, 14 percent.
- As regard to child pedestrian movement, nearly 46 percent of fatalities occurred while walking along the road. Crossing road accounted for nearly 33 percent of child pedestrian fatalities with remaining 16 percent for playing and standing on roads.
- Heavy vehicles such as trucks and buses including minibuses are also major contributors to child fatalities and are responsible for 62.1 percent of urban child fatalities. As regards to child pedestrian fatalities in urban areas, a much higher involvement of these three vehicle type was prevalent, accounting for nearly 69 percent of all urban child pedestrian fatalities.

**Bicycles and Cycle Rickshaws**

As mentioned earlier, cycle rickshaws and bicycles cater for substantial amount of urban travel and hence they are facing serious safety threats as well. Some of the striking accident characteristics are summarized below:

- Around 800 fatalities have been attributed to cycle rickshaws and bicycles in urban areas of Bangladesh during 1998-2006, which represented nearly 12 percent of total urban road deaths.
- On average 30 bicycle deaths and 60 cycle rickshaw deaths each year as reported by the police.
- The predominant types of bicycle accidents are rear end (58%) and head on (21%) and for cycle rickshaw the predominant type of accidents are rear end (70%) and
head on (15%), indicating a serious problem of being hit from behind in the traffic streams and thus merits separating them by traffic segregation.

- Most of the accidents are taking place during day time, 6 am to 6 pm, (83% bicycle and 71% cycle rickshaw).
- The age profile of the bicycle victims are 0-15 years 19 percent; 16-30 years 45 percent; 31-45 years 24 percent and above 45 years 12 percent.
- For the cycle rickshaw the age profile of the victims are 0-15 years 9 percent; 16-30 years 45 percent; 31-45 years 35 percent and above 45 years 12 percent. These data indicate that most of the bicycle victims are young and middle age people, nearly 70 percent.
- Nearly 70 percent of the fatalities involving bicycles and cycle rickshaws occurred on roadway sections with 30 percent at intersections. This again demonstrates the need for separate facilities for their protection.

UNDERSTANDING OF THE PROBLEMS AND FACTORS INVOLVED

In the preceding sections, the road accident characteristics of non-motorized vulnerable road users’ in urban areas are highlighted in an effort to discuss the need for their safety improvements. By and large, countermeasures, that are intended to improve the safety situation of traffic participants, can have an infrastructural character, a legal character or an educational character. The choice what type of countermeasure will be most fruitful to tackle a particular problem and the decision how to work it out a practice, must depend on a thorough understanding of the identified problem and what causes them (Schagen et. al. 1991).

Traditionally this understanding is achieved through systematic investigation and scientific research on road traffic accident which results from failure in the interaction of human, the vehicle and the road environment- the three elements which produce the road traffic system. Indeed, an accident is defined as a ‘rare, random, multifactor event always preceded by a situation in which one or more persons have failed to cope with their environment. One useful approach to road safety analysis is to consider these three components with three distinct phases in an accident viz. pre-crash, in-crash, and after crash and is known as the Haddon Matrix (Haddon 1980, Ogden 1996) as shown in Table 7. This provides a useful framework for the crash analysis and prevention program in the way to formulate effective countermeasures. Each of the nine elements of the matrix represents a possible focus for road safety and shows typical countermeasures applicable to each cell of the matrix relating to the roadway, vehicle and road user.

Table 7: The Haddon Countermeasure Matrix (Haddon 1980, Ogden 1996)

<table>
<thead>
<tr>
<th>Element</th>
<th>Before Crash</th>
<th>In Crash</th>
<th>After Crash</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human</td>
<td>Training; Education; Behaviour (e.g. drink driving) Attitudes; Conspicuous clothing on pedestrians and cyclists</td>
<td>In-vehicle restraints fitted and worn</td>
<td>Emergency medical services</td>
</tr>
<tr>
<td>Vehicle</td>
<td>Primary safety (e.g. braking, roadworthiness, visibility) Speed; Exposure</td>
<td>Secondary safety (e.g. impact protection)</td>
<td>Salvage</td>
</tr>
</tbody>
</table>
The challenge in road safety therefore is to identify what is common about the causal chain of events involving human, vehicle and road factors across a range of accidents and to apply measures which will “break” the chain for a number of accidents. Understanding of these casual factors operating at the same time is extremely important in the context of overall road safety strategy. It was this understanding of the problem which prompted industrialized countries to be successful in reducing the carnage on their roads and it is worth learning lesson from their experiences (Mohan 1991 & 2006). Importantly, accident remedial and preventive measures should by and large be implemented based on local research on road safety issues in a specific country of concern. However, with a few notable exceptions, relatively little research had been undertaken in many developing countries, Bangladesh in particular. Many important lessons of the past thirty years could be summarized as follows (Mohan 1991 & 2006).

- Accident rates have a disproportionate relationship with average speeds. That is, all else remaining the same, if average speeds of vehicles are increased by 10 percent, the number of accidental deaths will go up by much more than 10 percent.
- Road users must be provided automatic protection: vehicles much be designed to keep occupants safe in crashes at moderate speeds, physical separation of different road users (pedestrian, slow traffic and fast traffic), road designs must force correct road behaviour including low speeds (e.g. speed breakers) etc.
- All safety features requiring an action by the road user (e.g. use of helmets and seat belts) must be enforced by laws.
- An accident is the result of a large number of factors operating at the same time and “human error” is just one of them. So exhorting drivers to behave better has very little effect.

With the persistence of very serious problems these lessons deserve priority attention in road safety policies and actions in developing countries, particularly less motorized countries like Bangladesh.

Importantly, the following main reasons for accidents and injuries involving Vulnerable Road Users are still prevalent in many developing countries as revealed from the published literature (e.g. Mohan 1991). These are also observed in the situation of Bangladesh.

- Road design, transportation policy and vehicle safety standards are not appropriate to our traffic conditions and policy makers give inadequate importance to safety.
- Public transport has been neglected, forcing people to use unsafe vehicles like motorcycles and scooters.
- Fast velocity vehicles are being encouraged.
• No importance given to provide facilities and road space to pedestrians and slow vehicles. The latter are forced to mingle with motor vehicles.
• Vehicle safety standards are inadequate, with hazardous front ends of motor vehicles
• Haphazard and unreliable emergency care arrangements.
• Inadequate research and investigation on road accidents safety problems

Observational studies of accidents in the context of Bangladesh have documented varied factors. Typically the principal contributory factors of accidents prevalent in urban areas are (Binnie partners 1994; Haworth 1995; Hoque 2006):

• Mix traffic with a variety of vehicle characteristics and speeds,
• Failure to obey mandatory traffic regulations,
• Conflicting use of roads
• Illegal and inconsiderate driving practices
• Adverse roadway and roadside environment
• Pedestrian and vehicle conflicts
• Failure to enforce traffic safety laws
• Inadequacy of police inspection and sanctions
• Inadequate and unsatisfactory of education of road users
• Poor detailed design of junctions and road sections
• Failure to give way and non-compliance of traffic rules
• Lack of lane disciplines
• Non-wearing of motorcycle helmets
• Failure to slow down approaching intersections
• Excessive speeding, overloading, dangerous overtaking,
• Hazardous front ends of motor vehicles

Figure 2 depicts some prevailing typical road safety hazards. The other major issues of concern for urban accidents in Bangladesh are defective and road unworthy motor vehicles, drivers’ incompetency, underreporting of accidents, low level awareness of the safety problems, absence of safety policies to protect poor and most vulnerable people and inadequacy of safety research and investigation. Countermeasures and pragmatic policies need to be developed taking cognizance of the above factors and issues in mitigating the safety problem of vulnerable population groups.
THE CHALLENGES AND SAFETY IMPROVEMENT OPTIONS

In view of the above facts, the safety of VRUs in urban planning and traffic management still posits a challenge to transport planners and practitioners’ because of the multi-dimensional aspects of accidents involving them.

As demonstrated pedestrian-vehicle conflicts are clearly the greatest safety problem in urban areas with significant involvement of trucks and buses coupled with road and road environmental hazards and therefore presents a major challenge for traffic safety professionals. Bicycle and cycle rickshaws are also facing serious threats. To reduce and prevent such road accidents and casualties would require implementation of effective and coordinated safety policy and actions which require significant improvements in the relevant sectors viz. better enforcement, better roads, enhanced vehicle safety standards and improved public education programs.

A fairly more common and perhaps the most important characteristic in developing countries is that there has been very little systematic safety consideration given in the planning, design and operation of roadways. TRL Guide (1991) noted that "highway
design standards in many developing countries tend to be either outdated and no longer relevant or else simply too direct a translation from overseas without appropriate modification for the particular needs of the developing country. These standards usually ignore pedestrians, other non-motorized traffic and motor cycles. There is a severe lack of priority and attention given to vulnerable road user movements despite this group of road users dominating travel patterns as well casualty types (Silcock and TRL 1996). The safety of the vulnerable road users must be sufficiently catered for in the urban planning, road safety engineering strategies and principles which are vital to sustainable safety strategies. This in essence requires shifting road safety paradigm placing greater emphasis on building road safety into the system by fixing and improved roadway and road environmental conditions. Vulnerable road users particularly pedestrians and cyclists must be provided with automatic protection.

Priorities must be placed on the principles like traffic segregation to provide facilities and road space for the most vulnerable users particularly pedestrians and non-motorized vehicles, force correct road user behaviour (self enforcing measures) via channelization, speed reduction measures etc. Vulnerable road users are much more susceptible to accidents when vehicle speeds are high and can even suffer fatal injuries in accidents with motor vehicles at moderate speeds (Mohan 1991). Thus the most critical and effective measure which should be immediately adopted in every country is to reduce speeds particularly in urban areas. This measure alone will greatly reduce the overall number of road deaths as shown by experience all over the world (the number of fatalities was reduced by 32% in urban areas after a speed limits of 50 km/h were enacted and strictly enforced in Hungary) (Ross Silcock and TRL 1996).

Importantly, safety measures relating to road environment improvements, which have low capital cost and can be implemented quickly to obtain large safety benefits, should be given the highest priority. Indeed, the greatest importance was also placed on the safety of the VRUs at the International Conference on Traffic Safety held in New Delhi in 1991. Most effective measures to reduce VRU injuries through road design and traffic control methods were recommended in the New Delhi Declaration which include provision of bicycle lanes and pedestrian pathways separated from motorized traffic and improving the urban environment by traffic calming techniques and pedestrianisation. Policies which change priorities in favor of VRUs and commitment at the highest level to systematically implement the recommendations are urgently needed.

It is also important to note that the substantial scope and opportunities exist for improving vulnerable road users safety by sustained introduction of newly developed road safety approaches viz. safe community program and road safety audit – a new accident prevention tool

**Community based road safety strategies**: The idea behind the safe community programs is to address all kinds of safety and prevent injuries in all areas, addressing all ages, environments and situations and involving non-government and governmental community sectors. The program can be introduced at the local levels by promoting wider public participation and awareness, as well as making necessary changes in
behavior and the environments. The community itself by virtue of its expertise, enthusiasm, resources and networks can greatly enhance existing programs and even devise new ways of tackling safety problems. About 30 to 40 percent of accidents and injuries could be reduced through such programs. The Safe Community interventions are particularly effective in controlling road traffic accidents. (Hoque, 2002)

**Road Safety Audit:** The concept of road safety audit as an accident prevention tool is a relatively new and highly cost effective approach to improve road safety. Safety Audit refers to the formal process of reviewing road projects specifically to identify potential or existing safety hazards in order to allow for timely proactive correction especially for pedestrians and other vulnerable road users whose safety needs are often neglected in traditional transport planning and design. Safety checking or safety auditing offer opportunities to create safer roads for vulnerable road users. The elements that could be checked at various stages of audit for VRUs are described in ADP 1996. Which merit urgent attention for systematic implementation in urban areas to protect vulnerable road users form accidents and injuries.

**CONCLUDING COMMENTS**

It is concerning to note that everyday about 3,000 people die and 30,000 people are seriously injured on the worlds roads and over 85 percent of the deaths, 90 percent of all children killed and 90 percent of the disabilities adjusted life years lost from road traffic injuries are in low and middle income countries (Nantulya and Reich, 2002). Poor people in developing countries have the highest burden of injuries and fatalities due to road traffic crashes. The problem is increasing at a fast rate in developing countries due to rapid motorization and other factors. The road traffic injuries in these countries mostly affect the productive and vulnerable population groups. Therefore, the sustainable urban transport policies and strategies need to recognize this growing problem as a public health crisis and devise appropriate policy responses in mitigating such immense human distress through pragmatic measures and strategies. In view of this context, safety of VRUs (viz. pedestrian, children, bicyclist and cycle rickshaws) poses a serious challenge to urban transportation planning and management. In this paper an attempt has been made towards contributing mobility and safety characteristics in urban areas of Bangladesh. The safety improvement options, various engineering measures, particularly physical and road environmental, are also discussed.

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