

# Urban transportation and equity: A case study of Beijing and Karachi

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## Abstract

Development of mega cities of Pakistan and China has greatly been affected by the growth in urbanization and motorization. The uncontrolled rise in urbanization, motorization, exclusionary planning and disproportionate investment in transportation infrastructure has created a socio-economic imbalance, thereby challenging the issue of equity. This paper focuses on a comparative social equity assessment of urban development, characteristics of supply and demand of transportation and infrastructure systems and the impact of existing strategies over equity in the development of urban and transportation system of Beijing and Karachi. The paper concludes by suggesting some strategies for the development of sustainable and equitable urban transportation systems.

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## 1. Introduction

Urban transportation is a pressing concern in mega cities of developing world. Rapid population growth and spatial expansion has led to a sharp increase in demand for urban transportation facilities and services in these cities (ESCAP, 2001). The supply of transportation infrastructure and services, are unable to cope with the travel demand as they are being utilized over and above their design capacity (Pucher et al., 2005). Rapidly increasing motorization has its own pros and cons. An increase of personal vehicles in dense cities can cause serious transport related externalities like growing congestion, air and noise pollution, depletion of non-renewable resources, traffic accidents as well as social inequity.

The role of transportation in human life is significant. An efficient transportation system plays an important role in catering to the daily necessities in the lives of the citizens. This includes access to amenities and services that are central to the lives of all individuals, like employment, education, health services and leisure. Lack of

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affordability and accessibility to adequate transportation system can leave people in social exclusion (Kenyon et al., 2002).

Transportation planning and policies play an important role in providing an ecologically sustainable and equitable transportation system. In the developed world it has been observed that highway development favoring automobiles have been prioritized over public transport (Sánchez et al., 2003) also transportation planning too is mainly based on economic focused transportation infrastructure that benefits premium modes (cars, rapid transit systems, etc.) which have higher speed and longer distance links that “save times” for already mobile persons (Aprodicio, 2004). An exclusionary planning process not consulting the people offers few benefits to poor and brings forth many problems relating to transportation system.

The dense structure of cities in China and Pakistan encourage the use of public transport and non-motorized transport (NMT). These are the most sustainable and affordable modes of transport for low income and urban poor. This would also suffice the requirement of about 10% and 22% of population in China and Pakistan, respectively, that are below poverty line (Aprodicio, 2004). In contrast to compact structure and mixed land use characteristics the cities in both countries following the western model of urban sprawl and modernizing their transportation infrastructure by developing highways, expressways and rapid transit system.

This paper does not negate the importance of modernizing the transportation infrastructure, owing to its importance in the economic development of a city. However such modernization of transportation infrastructure should not compromise on economic priorities, social equity and environmental sustainability. It is being experienced in case cities (Karachi and Beijing) that the planners are undertaking these glamorous projects while completely ignoring the local circumstances, feasibility, demographic facts and long terms effects of these projects. Such development favors a minority of premium modes users over a majority who prefers walking, biking and conventional transit system, hence fails to meet the requirement of sustainable and equitable transportation system.

This paper makes a social equity assessment by comparing urban development, characteristics of supply and demand of transportation and infrastructure systems and impacts of existing strategies over equity in Beijing and Karachi. The paper is organized as follows. Transportation equity is defined in Section 2. In Section 3 methodology is illustrated. In Section 4 we evaluate the urban development. In Section 5 characteristics of supply and demand of transportation infrastructure and transportation system is assessed. In Section 6 impacts of existing strategies in the development of urban and transportation system of case cities is discussed. In Section 7 we suggest some strategies based on the sustainable and equitable urban transportation systems. Finally the paper ends with concluding remarks.

## 2. Transportation equity

“Equity (also called justice and fairness) refers to the distribution of impacts (benefits and costs), and the degree to which that distribution is considered fair and appropriate” (Litman, 2006). An equitable transportation system is one whose costs are paid by those who benefit and does not disproportionately favor or deny transportation improvements to certain demographic populations.

Transportation equity is an important issue to be addressed as it is mostly neglected by transportation planners and researchers. However more recently its importance is being recognized and according to the prediction of executive committee members of the Transportation Research Board “equity will be one of the major themes in transportation policy for the coming decade” (Sánchez et al., 2003).

## 3. Methodology

This paper is based on the case study of mega cities<sup>1</sup> Karachi in Pakistan and Beijing in China and focused to address the important issue of equity in the light of urban and transportation development. Both cities have a population of over 14 million and are experiencing rapid urbanization and motorization. The study has gathered the data from published papers, reports, web sites and statistical year books. The data in this study

<sup>1</sup> Population over 10 million.

is on the population, land area and density, vehicles fleet (private, public and para transit), trip frequency and length, mode split share and transportation infrastructure (road length, public transport operation lines and length, etc.). These data are used to evaluate and compare the urban development, characteristics of supply and demand of transportation and infrastructure system of case cities and figure out its impact on equity. Based on the evaluation and comparison some strategies are suggested for sustainable and equitable transportation system.

#### 4. Urban development in case cities

Urban development can have serious implications on the accessibility, mobility and affordability of lower income and urban poor due to growth pattern of city, processes involved in the transformation of the city and socio-economic dynamics in the political context. A comparative analysis of Beijing and Karachi is being made to see the growth pattern and its implications on low income and urban poor.

##### 4.1. Beijing

Beijing is the capital, political and cultural center of China. The city is famous for its culture and long history. The city has total area of 16,807.8 km<sup>2</sup> and has 10 districts and eight counties under its jurisdiction. The city has an employment density of over 20,000/km<sup>2</sup> in urban areas and Table 1 shows the population, density and land area in these districts and counties.

The reforms in China and changes in policies, ideologies and sustainable economic growth have increased urbanization and suburbanization in Beijing. Fig. 1 shows that in 2002 the population of outer suburbs exceeded 1.7 times the population of central area. Further, Table 2 shows that from 1947 to 2004 Beijing has seen 3-fold increase in population and almost 8-fold increases in expansion of urban area.

Beijing is passing through a phase of restructuring in order to make it a modern and beautiful city before the Olympics 2008. To redevelop urban core area the urban poor are being relocated to near suburbs or outer suburbs. Though the relocation is being done with government support but as many have their jobs still in the

Table 1  
Area, population and density at Beijing – 2000

Area	Population	Land area (sq.km)	Density (pers/sq.km)	Urban population (%)
Municipality of Beijing	12,780,000	16,807.80	760	69.2
Urban districts	2,663,000	87.1	30,574	100
Near suburbs	5,373,000	1282.8	4188	86.7
Outer suburbs	2,778,000	6473.8	429	39.1
Counties	1,966,000	8964.1	219	29.9

Source: Beijing Statistical Yearbook, 2001.

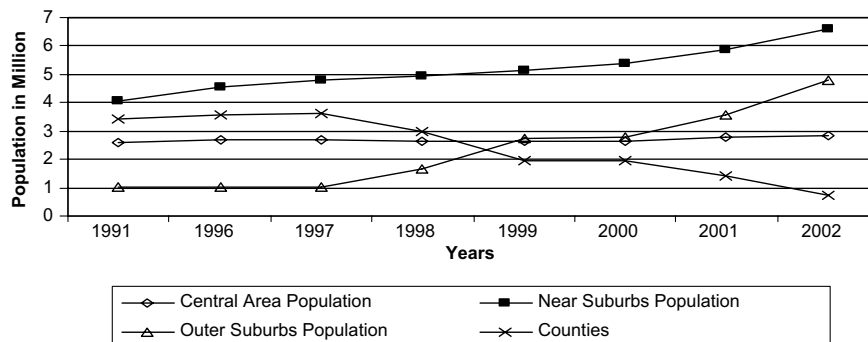


Fig. 1. Trend of suburbanization in Beijing. Source: Beijing Statistical Yearbooks.

Table 2

Trend of population and urban area growth at Beijing

Year	Population (million)	Area (sq.km)
1947 <sup>a</sup>	4	99.8
1980 <sup>a</sup>	9.04	323
1985 <sup>a</sup>	9.81	373
1997 <sup>b</sup>	12.47	488
2004 <sup>b</sup>	14.9	835.01

<sup>a</sup> Lu (1999).<sup>b</sup> Beijing Statistical Yearbooks, 1997 and 2004.

city so they have to bear additional transportation cost while commuting coupled with longer traveling time due to severe traffic jams. Despite the restricted migration policy almost 20% of population in Beijing is floating.

These surplus rural labors come to the city in the search of jobs facing some major problems. Firstly, most of them reside in the urban peripheries which are mostly low density residential areas, though inexpensive but far from jobs markets, making walking and biking use exhaustive for long distances commuting. Secondly, public transport besides affordability problem to poor also offers poor service in suburbs and unable to meet the untraditional work hour's need of them, thereby tends to exclude a transit dependent worker from job opportunities (Sánchez et al., 2003). Thirdly, despite the creation of jobs the employment environment is not able to fulfill the demand. Fourthly, these migrants do not enjoy the benefits for schooling and housing as registered residents do (Hussain, 2003).

#### 4.2. Karachi

Karachi is the industrial, commercial and economic hub of Pakistan. Karachi's population is only 9% of national population but contributes a large proportion to national GDP and federal revenues (Zaidi, 1997). Over 70% of the business services and about half of the retail trade and personal services are located in the Central Business District (CBD). About 50% of the employment in the wholesale trade and transportation sector is in the CBD. Prior to 2001 Karachi was a Municipal Corporation and for administrative purposes the city was divided into five districts. Table 3 shows the population, density and land area of these districts as per 1998 census. However, in August 2001 Local (City) Government Ordinance 2001 was enacted resultantly merging the five districts into one district headed by a mayor and deputy mayor.

Karachi was the first capital of Pakistan and consequently the center of government employment. As a result the population growth rate in Karachi has been phenomenal and estimated to be around 5–6% annually out of which Karachi's natural growth share is 3% and migration share is 2–3% (Zaidi, 1997). Authors (Qureshi and Lu, 2007) collection of data shown in Table 4, indicates that since the emergence of Pakistan the city has seen 35-fold increases in its population and almost 16-fold increases in the spatial expansion.

In Karachi the densification and spatial expansion have occurred with little or no developmental planning. Since 1949 five development plans were prepared for Karachi but never implemented (IUCN, 2004). For example during 1960s in order to speed up industrialization a Greater Karachi Resettlement Plan (GKRP)

Table 3

Area, population and density at Karachi – 1998

Area	Population	Land area (sq.km)	Density (pers/sq.km)	Urban population (%)
Municipality of Karachi	9,856,318	3527	2794	91.6
Karachi East	2,746,014	139	19,756	100
Karachi West	2,105,923	929	2267	91
Karachi South	1,745,038	122	14,304	100
Karachi Central	2,277,931	69	33,014	100
Malir (suburbs)	981,412	2268	433	67

Source: Pakistan Statistical Pocket Book, 2004.

Table 4  
Trend of metropolitan population and area growth at Karachi

Year	Population (million)	Metropolitan area (sq.km)
1947	0.4	233
1981	5.3	1994
1998	9.85	3527
2004	14.0	3566

was proposed with the aim to construct the refugee<sup>2</sup> colonies distant away from the city center with the job creation in the new industrial estate (Sohail, 2000). But unfortunately neither the industrialization took place nor were the houses and jobs provided as planned as a consequence people started settling into the squatter<sup>3</sup> settlements inside and outside the city.

Due to the non implementation of development plans and the subsequent influx of migrants within and outside the country, made the city suffered from a chronic shortage of dwelling units, water supply, electricity and public transport, etc. The shortage of dwelling units has been largely responsible for the emergence of large number of squatter settlements in the city. About 50% of the total population resides in these squatter settlements (GTZ, 2004). It is also evident that the socio-economic and the environmental conditions in these settlements are dismal. Residents who live in the inner city slums are exposed to air and noise pollution whereas those living in peripheral slums are captive riders of limited and low level public transport service and lack accessibility to jobs and other socio-economic needs.

The comparison of urban development process in Karachi and Beijing shows some important differences and similarities between the two cities.

- Both cities have high urban densities (refer Tables 1 and 3) with city centers as main place of work.
- Economic and industrial growth gave boost to the rapid urbanization in both cities.
- The rapid urbanization and industrialization in both cities are changing the landscape and now becoming the part of urban sprawl. The main consequences of the modernization are the sharply decrease of arable land and increase of per capita land use for urban construction.
- Karachi's population is growing much faster than Beijing as in Pakistan there is no restriction or policy for migration. This stimulates migration in Karachi not only from Pakistan but also from other countries as over one million people from Bangladesh, Afghanistan and Burma have migrated to Karachi during 1980s (Zaidi, 1997). Whereas urbanization and population growth in Beijing is steady and controlled mainly due to China's restricted migration (HOKOU SYSTEM) and one child policy.
- Beijing has planned eviction. Evicted people get better housing, services and amenities but with accessibility and affordability tradeoff (Aprodicio, 2004). Whereas in Karachi the evicted people besides accessibility and affordability problems also have inadequate housing and services problems.

## 5. Characteristics of supply and demand of transportation and infrastructure system in case cities

### 5.1. Development of transportation infrastructure in case cities

The urban transportation system of Karachi and Beijing is mainly road based. Though Karachi has railway system known as Karachi Circular Railway System (KCR) but its share in mode split is almost negligible. Table 5 shows that Karachi road network in 2004 was 7400 km with 0.5 m/capita length of road.

In contrast, Beijing does have a good mass rapid transit system but despite heavy investment its share in mode split is almost 5%. In 2004 Beijing road network was 14,557 km with 1 m/capita length of road (Table 5). The limited road space in both cities coupled with the absence of essential support functions, acute increase in

<sup>2</sup> People migrated at the time of Independence from India.

<sup>3</sup> An indicator of poverty.

Table 5  
Road network of case cities in 2004

Cities	Total length (km)	Road density (km/km <sup>2</sup> )	Per capita length of road
Karachi	7,400	2.07	0.5 m/capita
Beijing	14,557	0.87	1 m/capita

personal vehicles ownership and use have placed tremendous pressure on urban transportation system. In order to mitigate the traffic problems like ever increasing congestion both cities are modernizing their transportation infrastructure by developing mass rapid transit system, expressways including elevated expressways.

Table 6 gives the details of the urban transportation project executed and to be executed in Karachi. Construction of Lyari Expressway and Northern By Pass costs US\$ 88 million whereas elevated expressway and rail based transit system will cost US\$ 225 and US\$ 569 million, respectively. Moreover for fiscal year 2005–2006 city government has approved US\$ 100 million for construction of roads, bridges, flyovers, under passes and other infrastructure projects. (<http://www.businessrecorder.com/index.php?id=289653&currPageNo=1&query=&search=&term=&supDate=2005-07-05>). It can be seen in Fig. 2 that transportation infrastructure in Karachi is mainly benefiting the high to middle class.

Table 7 shows that the improvement of urban transportation infrastructure in Beijing from 1996 to 2003 had cost US\$ 15.13 billion. Besides this before year 2008 Beijing also planned to expend US\$ 8 billion on construction of municipal railways to reach to the total length of 300 km and US\$ 4 billion on the construction of

Table 6  
Details of urban transport projects in Karachi

Projects	Length (km)	Cost (million US\$)	Mode	Status
Lyari expressway	32.1	83	Road	In progress
Northern by pass	57	5	Road	Near completion
Elevated expressway	24	225	Road	MOU signed
Corridor 1 of MRT	15.2	569	Rail	MOU signed

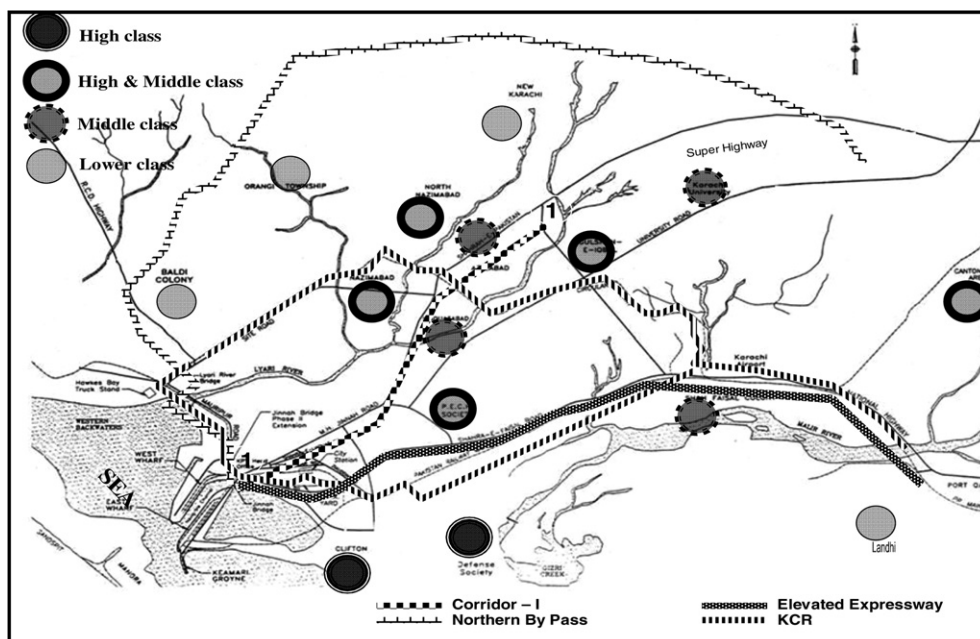


Fig. 2. Urban transportation infrastructure in Karachi benefiting high and middle class.



Table 7  
Improvements of urban transport projects in Beijing

Projects	Increase in length (km)		Percentage increase	Remarks
	1996	2003		
Urban roads	3665	3786	3.3	14.1 billion US\$ was spent on road infrastructure during 1996–2003
Urban expressways	114	501	339.5	
Metropolitan roads	11,682	14,452	23.7	1.03 billion US\$ was spent on rail infrastructure in 2003
Metro rail system	41.6	114	174	

roads to reach to the total length of 15,400 km including 890 km of expressways (<http://strategis.ic.gc.ca/epic/internet/inimr-ri.nsf/en/gr125057e.html>). Such investments in transportation infrastructures do not meet the travel need of poor.

### 5.2. Motorization

The increased urbanization, motorization and economic growth put a tremendous pressure on infrastructure demand. Rising incomes stimulates car ownership and use and limit the use of non-motorized transport (NMT) and transit (Lave, 1992). Motorization is strongly correlated with the country's per capita gross domestic product (GDP). Fig. 3 shows the exponential increase in vehicles and automobiles in China and rather slow increase in Pakistan are strongly correlated with the GDP per capita.

The increase in income, residents' living standard and travel distance stimulates the desire for more comfortable, convenient and flexible personal vehicles (automobiles and motorcycles). Fig. 4 shows the growth trend of total registered vehicles, automobiles and motorcycles of both cities from 1997 to 2005. In Beijing total vehicles, automobiles and motorcycles are growing at an annual rate of 15.7%, 20.5% and 1%, respectively, whereas in Karachi following the above order the same are growing at an annual rate of 4.6%, 6.5% and 5.1%, respectively. Influence of restricted policy on new registration on motorcycles in Beijing is visible as its share is drastically decreasing, whereas in Karachi the share of automobiles and motorcycles is nearly reaching the same. However in 2005 the share of personal vehicles in Beijing and Karachi was 73% and 92%, respectively.

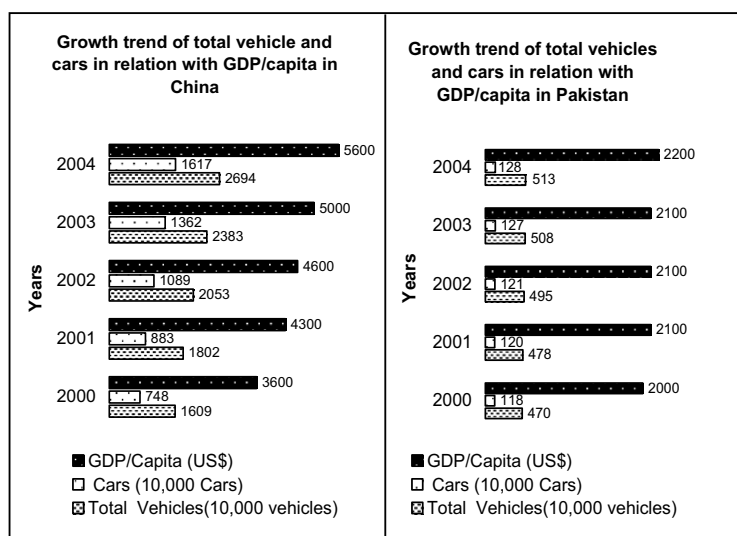


Fig. 3. Growth trend of vehicles and cars in relation with GDP/capita. Source: China Statistical Yearbooks and Pakistan Statistical Pocketbook.

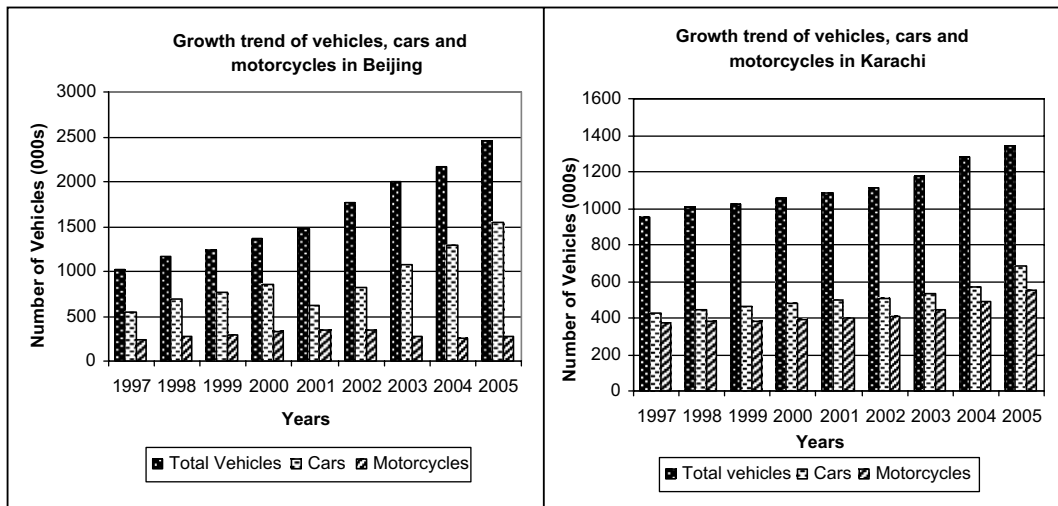


Fig. 4. Growth trend of total vehicles and personal vehicles (cars and motorcycles). *Source:* Beijing Statistical Yearbooks and District Regional Transportation authority Karachi.

This rapid rise in personal vehicles ownership and use is the result of favorable transportation infrastructure and policies for automobiles. In Karachi according to State Bank of Pakistan the banks have loaned and financed US\$ 0.37 billion during the last half of 2004 for automobiles which is 2.5 times higher than the loans released for house purchase and construction (<http://www.dawn.com/2005/04/25/eb12.htm>).

Lack of management with no financial constraints rather favorable leasing policy besides other negative externalities of transport has led to enormous congestion in different parts of both cities and resultantly increasing the average traveling time. As per one estimate the average travel time for work trips in Karachi is approximately over 45 min (<http://www.asiaweek.com/asiaweek/features/asiacities/ac1999/data/karachi.html>) whereas in Beijing more than an hour is required to commute to work (Peng, 2005). Moreover in Beijing the intensity of congestion can be seen from the declining trend of vehicles speed which has reduced from 45 km/h in 1994 to 10 km/h in 2005 especially between second and third ring road of Beijing which is now extending beyond fourth ring road and along major radial and arterial roads (World Bank, 2006).

### 5.3. Trip intensity and mode split

The average number of trips for each resident per day reflects the trip demand intensity, and the total number of trips is a basic indicator which measures the load capacity of urban transportation system. Whereas the mode split is influenced by the characteristics and service level of each transportation mode, city's land uses pattern and management policies. Table 8 shows that in Karachi, though the total number of motorized trips generated increased but the trip per person decreased by 38% between year 1976 and year 2004 along with 10.3% decrease in the share of public transport and 14.3% increase in the share of private/para transit whereas the share of walk/bike has no statistical data. The alarming law and order situation, absence of NMT environment and bad transportation system are some of the reasons for declining trip per person.

Table 8  
Trip intensity and mode split characteristics

Year	Cities	Total trips/per/day	Total daily trip (millions)	Mode split (%)			
				Walk	Bike	Public transport	Private/para transit
1976	Karachi	1.62	7.59	–	–	58	42
2004	Karachi	1	13.6	–	–	52	48
1986	Beijing	1.61	15.93	–	58	32	10
2003	Beijing	2.81	41.95	–	39	26	35



There was a time in Karachi when walking and cycling used to have a share of 60% in mode split and 40% out of them were related to work trips (Replogle, 1992). Though walk/bike are most preferred modes for low income and urban poor but presently in Karachi there share as modes is almost negligible and perhaps not considered as significant urban transportation modes.

The low income and urban poor who mostly dependent on NMT modes beside expose to air and noise pollution are also the largest group of victims of road accidents as almost 600 persons die in road accidents every year in Karachi among them over 50% are pedestrians (<http://www.urckarachi.org/fandf%20September%202003.htm>).

Public transport share in 2004 is though decreasing but still maintains over 50% of the mode share, indicating that in the absence of NMT modes the low income group has no other options except to opt for depleted public transport that has not only failed to cope up with increasing travel demand because of its low capacity and low level of service but its popularity and speed is also substantially been reducing due to disproportionate investment in transportation infrastructure.

Trip demand in Beijing is increasing as Table 8 shows that the average number of trips per person per day in 2003 has increased 74.5% once compared with that in 1986; moreover the demand for trip quality is also raised. Walking and biking are the traditional and primary means of mode whereas public transport is the second most preferred mode in China but their share in mode split is decreasing over the years. The share of biking and public transport in 2003 have decreased 32.7% and 18.7%, respectively, whereas an increase of 250% in private/para transit. There are obvious reasons for the declining share of the walking/biking and public transit. Firstly because of the rapid motorization and urbanization the urban transport policies and investments are largely auto oriented. Secondly, the increasing urban sprawl tends to increase the travel distances and travel time as housing and employment opportunities grow further apart reducing the significance of short and medium length trips associated with walking, cycling and busing. Thirdly, the rapid economic growth has brought in higher desire for convenience, flexibility and quickness. This desire is increasing the numbers of cars in Beijing with phenomenal pace. Fourthly, mixed traffic flow causing safety and environmental problems to NMT users coupled with substantial reduction in the speed of the buses.

#### 5.4. Public transport network

With respect to number of public transport operation lines, line length and buses in operations of the case cities Table 9 shows that the public transport network of Beijing is very well developed and much ahead of Karachi. However the succeeding paragraph will discuss the public transport system of case cities in detail.

The urban public transport system in Karachi is mainly road based and the share of Karachi Circular Railway (KCR) is almost negligible as the system ceased its operation in 1999 due to heavy losses, however recently the system has partially been revitalized. This road based public transport system is mostly in the hands of private sector with very little public sector involvement. Fig. 4 shows that buses/minibuses constitute only 2% of the total passenger vehicles fleet but it serves more than half of the passenger demand (Table 8). Nevertheless it receives no preferential treatment in terms of dedicated lanes or traffic management.

The existing public transport system is not capable of meeting the increasing travel demand primarily because of infrequency of buses, limited hours of services and shortage of routes and vehicles. Table 10 shows that the number of vehicles and lines in operation are much lower than the actual demand. Out of 403 lines only 219 are functionally operating. Moreover the deficiency in vehicle fleet is due to the fact that majority of Karachi's urban public transport (69%) is comprised of low capacity (27/32 passengers carrying capacity) mini buses/coaches. Due to this deficiency in fleet the ratio of available seat capacity on public transport to

Table 9  
Public transport network of Beijing and Karachi in 2004

Cities	Public transport operation line		Public transport operation line length		Vehicles in operation	
	Buses (Nos.)	Rail (Nos.)	Buses (km)	Rail (km)	Buses (Nos.)	Para transit (Nos.)
Karachi	403	2	750	84	20,209	78,811 (Taxis and auto rickshaws)
Beijing	599	4	17,206	114	20,014	62,283 (Taxis)

Table 10

Road based public transport fleet and routes

Modes	Vehicles in operation	Operation lines (Nos.)	
		Classified	Operative
Buses	6388	110	48 (44%)
Mini buses/coaches	13,821	293	171 (58%)
Total	20,209	403	219 (54%)

population in Karachi is 1:40 as compared to 1:12 and 1:8 in Mumbai and Hong Kong, respectively ([www.cleanairnet.org/asia/1412/articles-59041\\_karachi2.ppt](http://www.cleanairnet.org/asia/1412/articles-59041_karachi2.ppt)) (See Fig. 5).

Fig. 6 shows that this deficiency compels the commuters to travel in overcrowded buses, minibuses and coaches exposing themselves to serious hazards by traveling on footboards, roof-tops and even on rear guards of the vehicles. Despite being the only city of Pakistan which has a traffic planning agency the traffic management is chaotic because of low technology, non availability of bus stops, bus terminals and depots, non observance and implementation of rules and regulations, un-regulated parking and lack of provision of basic road furniture like directional signage, guide lines and traffic signals.

Karachi Circular Railway (KCR) started its operation in 1964 and used to serve as a cheap, reliable and an alternative mode of public transport. Until 1978, nearly 0.3 million commuters traveled on the KCR every day (Sohail, 2000). The local train service was very popular with the commuter's, and the majority of them were low paid employees, daily wages earners, semi and non-skilled workers seeking lively-hood on daily basis. The fare structure suited their budget and they were also safe from the hassles of traveling by overcrowded buses and mini buses, etc. Besides the low income class the system was also very popular and convenient for middle and lower-middle income urbanites. But unfortunately the system was ceased in 1999 as the system was suffering heavy losses due to negligence in maintaining the infrastructure and stations.

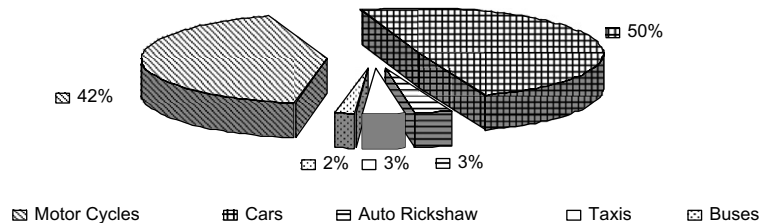


Fig. 5. Share of passenger vehicles fleet in Karachi – 2004.



Fig. 6. A daily routine scene of traveling on foot boards, roof tops and rear guards of public transport.

Moreover the reliability of the system was also doubtful because of the 23 at grade crossings which obstructed the circular railway trains from arriving on time. However the system has great potential to serve the city in an affordable manner.

In contrast to Karachi the public transport system of Beijing is much more highly developed and managed. Beijing bus system has seen a rapid development. In 2004 the total number of buses in operation has reached to 20,014 as compared to 3927 in 1995 whereas the routes in operation has reached to 599 as compared to 246 during the same period, an increase of 409.6% and 143.5%, respectively. Similarly the mass rapid transit system of Beijing has reached to 114 km in 2003 as compared to 41.6 km in 1996, an increase of 174%.

Moreover by year 2008 a modern urban public transportation system will be developed by building 13 municipal railway lines totaling approximately 300 km, large capacity bus rapid transit (BRT) covering 60 km, and a quick bus and tram transportation network covering 350 km (<http://strategis.ic.gc.ca/epic/interface/inimr-ri.nsf/en/gr125057e.html>).

The local government hopes to increase the mode split share of public transport from 27% to 60%, with municipal railway and large capacity BRT taking up to 40% of the total public transport (Peng, 2005).

### 5.5. Affordability of public transport

Affordability reflects the financial expenses required to meet one's basic needs and services. Based on household survey of Beijing and Karachi carried out in 2002, the affordability of public transport of both the cities have been calculated. The calculation assumed that each household has two earning members and each member carried out 60 trips (40 work related trips and 20 other trips). It is also assumed that travel expenses are only incurred by earning members. Table 11 shows that as per 2002 household survey an average income group and bottom quintile group (BQ) of Karachi have spent 5.24% and 2.8%, respectively, of their monthly discretionary income on transportation whereas in Beijing the average income group and bottom quintile group spent 2.4% and 2.27%, respectively.

The low transportation expenses in Beijing supports the heavy reliance of residents on walking and biking, whereas in Karachi low income groups are the residents of peripheral slums and employed in informal sector and mainly work at homes, thereby fewer trips are made by public transit. The increasing urban sprawl makes the walking and biking trips impossible. In order to meet the basic needs and job requirements residents of these areas have to rely on public transit. Table 11 also shows that if all the 120 trips/household are to be made by public transport (without taking into account the transfer) then bottom quintile group of Karachi and Beijing have to spend 17% and 24.5% of their discretionary income on public transit. Moreover this expenditure only incurs by the earning members and not on the other members of household. Despite the fact that the bus fare in Beijing and Karachi is quite cheap even then bottom quintile group will have to spend a higher share of their discretionary income on transportation. It can be well worked out that how difficult it would be for low income and urban poor to afford metro as in Beijing a one way metro trip costs US\$ 0.375 and if that trip requires a transfer then costs US\$ 0.625 which is 3–5 times higher than average bus fare.

Table 11  
Affordability of public transit in Beijing and Karachi

Cities	Discretionary monthly income of an urban household in (US\$)		Amount spent on transportation by an household in year 2002 (%)		Average one way bus fare without transfer in (US\$)	Amount required to spend on public transport based on 120 trips/household for avg bus fare in (US\$)		Percentage share of discretionary income on transportation	
	(a)		(b)			(d)		(e)	
	Avg	BQ	Avg	BQ	(c)	(d) = (c) × 120		(e) = (d)/(a) × 100	
						Avg	BQ	Avg	BQ
Karachi	180	92	5.24	2.8	0.13	18	18	9	17.34
Beijing	126	61	2.4	2.27	0.125	15	15	12	24.5

## 6. Impacts of existing strategies over equity

Analysis of urban development and trend of supply and demand in transportation and infrastructure system shows that modernization in case cities are taking place over equity. Some of the strategies which are affecting equity and its associated consequences are:

- Forced evictions of urban poor from city centers to the remote locations have limited their accessibility and affordability to urban infrastructure and services. Moreover the services and transportation system in these areas are scarce, thereby making low income and urban poor to devote a major share of their income and time as compared to urban residents. The forced evictions situation is more severe in Karachi and that is why the city has such a large number of squatter settlements.
- Absence of public participation and community impact assessment. People who have to be relocated to make room for these mega projects are neither consulted nor taken into the confidence. Moreover, the planners while undertaking these marvelous development completely ignore the social, economic and environmental impacts of these developments on the community.
- Land compensation policies lack enforcement. As the land in urban fringe areas is cheaper this stimulates developers to acquire the land from local residents. The poor residents tend to sell their property to have economic benefits. Generally the compensation they get is far below the legal standards.
- Disproportionate investment in modernization of transportation infrastructure does not meet the travel behavior of low income and urban poor. Furthermore, such infrastructure is unlikely to ease traffic congestion as they are de-linked from social and environmental land use planning. In Beijing despite the phenomenal ownership and use of private automobiles the walking, biking and busing system have a significant share of approximately 60% in mode split. Similarly in Karachi the road based public transport accounts for 52% of the share. Instead of facilitating and encouraging these modes which are being used by the majority of population the transport planners and local city governments interested in evolution of a transportation infrastructure that benefits a small segment of population over a large segment.
- Encouraging and facilitating the ownership and use of personal vehicles by booming auto industries, building expressways and lucrative leasing policy. This explosion of personal vehicles have disproportionate social, environmental and energy related negative impacts on low income and urban poor. Socially this cause social divide and excites the desire to have one even by resorting to unfair means. Environmentally they have to bear disproportionate share of traffic related air and noise pollution. High automobiles use induces high level of energy consumption especially of petroleum products. The recent price hike in petroleum products have significant impacts on low income and urban poor as it not only increases the public transport fare but also make the other goods and services expensive.
- Ignorance of importance of most sustainable and affordable modes (walking and biking) in urban transportation priorities. Absence of policies and planning, security and safety hazards, encroached/ill maintained footpaths for pedestrians and absence of right of ways for cyclists are the major barriers in using these sustainable and affordable modes in Karachi whereas in Beijing though the right of ways do available for pedestrians and cyclists but these right of ways are being shared with rapidly increasing motorized transport and exposing the users not only to environmental pollution but also to the safety hazards.

## 7. Suggested policies to enhance sustainable and equitable urban transportation system

After evaluating the urban development, characteristics of supply and demand in transportation and infrastructure system and impacts of existing strategies on equity, this section proposes some policies for equitable and sustainable urban transportation in case cities.

### 7.1. *Change the urban form and land use pattern*

In both cities large proportion of activities are carried out in CBD with mismatch in jobs and residence. In order to avoid the overdevelopment of CBD, there is a need to decentralize the urban functions on the prin-

ciples of smart growth which requires balance between jobs and residence and connection of sub centers through multi modal traffic trip structure.

### *7.2. Integrate transportation and land use planning*

Due to the lack of integrated transport and land use planning, development projects are made and implemented without carrying out the economic, social and environment impact studies. The haphazard land use and suburbanization also created a spatial mismatch between jobs location (being concentrated in CBD) and residential location (in suburbs) making it difficult for public transportation to serve efficiently. The equitable and sustainable urban development needs an urban transportation system and land use pattern that can keep a balance between transport supply and demand which is not possible without integrating comprehensive transportation planning and master plan.

### *7.3. Encourage public participation and community impact assessment*

Carry out community impact assessment for every transportation development project, and make it the basis of issuing contractual authorization. This will help in understanding the social, economic and environmental impacts of these projects on affected communities and in decision making.

### *7.4. Promote public transport and development based on transit oriented development (TOD)*

The recent efforts to ease traffic congestion, by building wider roads, flyovers, elevated expressways, are unlikely to ease traffic congestion in the long run. Sustainable and equitable development of urban transportation needs to place a priority on the development of integrated urban transportation system with the public transport as the core. Moreover TOD which prefers a mixed community of compact layout and facilitate use of public transport, cycling and walking can play a significant role in urban land development while restricting the unreasonable usage of personal cars.

### *7.5. Prioritize road based public transport*

Rapid transit system can not mitigate surface congestion and no where in the world that such transit system has eliminated the surface congestion at its own. Buses besides preferred by the most indigent segment still remain a very important mode of any large urban transportation system and carries invariably larger traffic load but despite that do not get the preferential treatment in investment, dedicated lanes and traffic management. What is required is to prioritize these buses by increasing their speed through dedicated lanes, priority at signals and by providing environmentally friendly buses coupled with reliability and quality.

### *7.6. Improved traffic management*

An inefficient traffic management places an unnecessary burden on the transportation infrastructure. Like in case cities the parking management is ineffective and lacks parking spaces, allowing the cars to park on the main roads and collector streets this besides causing enormous congestion also taking over the cyclists right of way (especially in Beijing). Whereas in Karachi due to lack of enforcement and lack of availability of bus terminals the buses/minibuses are parked on the roads affecting the normal mobility of the road and destroy the overall environment. Moreover buses speed is reducing substantially as they are stucked in the congested roads because of their fixed route structure and travelers have to devote a considerable time in traveling. In order to mitigate the urban transportation problems there is a need for making and implementing comprehensive traffic regulations with advanced transportation engineering technology.

### *7.7. Utilize the existing transportation resources in an optimal way*

The transportation resources in Karachi and Beijing are scarce. With the increasing travel demand it is necessary to make optimal use of existing transportation resources. For example Karachi has a very good circular

railway system which had been serving the transportation system in an affordable and efficient manner but due to reasons mentioned above the operation of the system was to be ceased. However the system still has the great potential to serve the transportation system efficiently but need rectification. It is estimated that complete rehabilitation of the system by Pakistan Railways need an investment of 0.092 billion US\$ and that too would be recovered within 30 years by offering a very reasonable and affordable fare of US\$ 0.1–0.13 per trip. In contrast if the same project is constructed on Built Operate Transfer (BOT) basis the cost of one trip would be US\$ 0.27–0.33 (Aprodicio, 2004) which is beyond the affordability of urban poor even if subsidized.

#### *7.8. Subsidize transport fare for low income groups*

The technologically advanced modes and infrastructures (rail based mass transit and bus rapid transit) though very efficient being high capacity and sustainable from energy and environmental point of view but are usually been developed by private consortium and the costs of these projects tend to be significantly higher and have to offer higher fare for quality operation and service. The most indigent segment of the society cannot afford to pay the cost of these premium modes. Without a major government subsidy, the fare will be much higher than that of bus transport, which is beyond the affordability of indigent segment. A sustainable funding source must be identified and the system must be subsidised by the government to make its fares comparable with other modes of public transport.

#### *7.9. Provide people-friendly continuous bicycle and pedestrian roads*

The main focus of road system planning is on motorized traffic, whereas adequate attention has not yet been paid to uninterrupted passage space for bicyclists and pedestrians. Cycling lanes have not formed a network; pedestrian passage space is not continuous, either. There is no sufficient green time at intersections, where safety islands used by pedestrians to wait for crossing opportunities are rather rare. Signal control is completely configured according to the concept of priority for motorized traffic, therefore aggravating the traffic environment of non-motorized traffic users. The traffic management should also pay more attention to bicyclists and pedestrian walkers.

#### *7.10. Need to reverse motorization trend by providing NMT infrastructure and environment*

Transportation policies and planning have a great impact as they are one of the driving force for the selection of mode. At one time NMT modes had a share of 60% in the mode split of Karachi but the ignorance and absence of NMT infrastructure and environment mainly due to planning and policies have made these modes unpopular as transport modes. In Beijing too the share of these modes is drastically decreasing despite having the separate right of ways. These rights of ways are being invaded either by stationary cars or moving cars thereby making NMT modes unsafe for users. In order to avoid no return situation policy makers, regulation authorities and planners should realize that NMT modes are the primary means of mode and still preferred and used by the multi class in Beijing whereas in Karachi a large segment of population is poor and welcome these modes as urban transport modes if provided with an infrastructure and environments which are best suited to them.

#### *7.11. Impose financial constraints to manage personal vehicles use*

Despite the rapid economic and personal vehicles growth in case cities, majority of the population still do not own one and rely on walking, biking and busing system. With the current favorable automobiles policies the mobility needs of the low income and urban poor would be seriously hampered if the rapidly increasing personal vehicles are not properly managed through congestion pricing, area licensing scheme, cordon pricing and high parking fee, etc., as efficiently been implemented in Singapore, Hong Kong and in London. These pricing schemes become justified and equitable once the transportation need can be met through better alternative and sustainable transport modes for example Beijing does have a well developed public transport system including busing system with walking and biking are still preferred across demographic groups.



## 8. Conclusion

Beijing and Karachi are passing through a rapid phase of urbanization and motorization. The increase of personal vehicles in both cities are causing serious transport related externalities like growing congestion, transport related air and noise pollution, depletion of non-renewable resources, traffic accidents as well as social inequity. In order to mitigate these negative externalities of transportation both cities are developing automobile oriented and technologically advance transportation system offering few benefits to the low income and urban poor.

Moreover due to lack of integrated transport and land use planning, development projects are made and implemented without carrying out the social and environment impact studies. Due to the increasing urban sprawl poor communities are being dispersed, fragmented and pushed farther away from city centers and work places, thus pushing them into slums which are poorly serviced by public transport and make NMT modes exhaustive. While less than 12% of residents in case cities own personal vehicle and despite the fact that majority of population is unable to afford the fare of even cheap busing system for regular commuting, the planning and development is geared to benefits the elite at the expense of the needs of the poor. As majority of population in the case cities rely on walking, biking and busing and in order to avoid no return situation this study suggested a series of strategies for the development of sustainable and equitable transportation system in Beijing and Karachi.

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