

Imperiling Urban Environment through Varying Air Pollution Rein in Measures and Mass Transit Policies - A Case Study of Lahore

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Abstract-Gargantuan expansion of big cities has increased motor vehicular tremendously. Lahore, a primitive green city is now gripped with swelling motor vehicular air pollution. Mass public transport, a back bone of city transportation network, due to erroneous running significantly contributes toward motor vehicular air pollution. Policy initiatives of the Government to curb motor vehicular air pollution are merely focused upon reduction of air pollution at source by the use of technology and clean fuel programmes. The policies for introduction of mass transit remained imprecise which lead to rise in transportation demand and increase in surfeit emission; Half-baked policies normally stem out to get political popularity which imperils urban environment. The paper highlights inconsistent policy measures and unsound air pollution control strategies adopted in big cities of Pakistan. Furthermore it gives guidance for sustainable mass transit policy measures.

Keywords-PEPA, Mass Transit, NEQs, KCR

I. INTRODUCTION

Urban population is increasing in the World. By 2050, 6.4 billion people, about two-thirds of humanity likely to become urban residents. In 2008, the world crossed a significant point when half of its population started living in urban areas. By 2030 this number will grow to around 5 billion people, and in Africa and Asia urban populations will double between 2000 and 2030 [i].

Gargantuan growth of cities surges usage of motor vehicles tremendously. The plying of these vehicles on the urban roads poses a threat to urban environment. Shanghai Manual [ii] reveals that urban transport represents one of the fastest growing sources of greenhouse gas. According to UNEP [iii], transport is the second largest sector contributing to global carbon dioxide (CO₂) emissions from fossil fuel combustion emissions that contribute to global climate change.

Urban environment can only be protected by taming fastest source of greenhouse gases. A sustainable transportation system with supporting

policies can help to improve urban environment meaningfully. Sustainability is looked at from a threefold perspective, namely, economic, social and environmental. It goes without saying that sustainability is inextricably linked with the transportation system.

II. OVERVIEW OF AIR POLLUTION IN PAKISTAN

Air pollution is one of major environmental issues in Pakistan. Surveys pertain to air quality; show that air pollution level in big cities of Pakistan is either crossed the safe limit or reached at threshold level [iv]. There are two main sources of air pollution in Pakistan. These are stationary sources like industrial pollution and mobile sources which include motor vehicle's Exhaust. Situation of suspended particles and carbon monoxide due to emission of motor vehicles in cities is alarming. Air pollution level is increasing remorselessly in urban environment. Unrelenting level of air pollution put health of urbanites at stake.

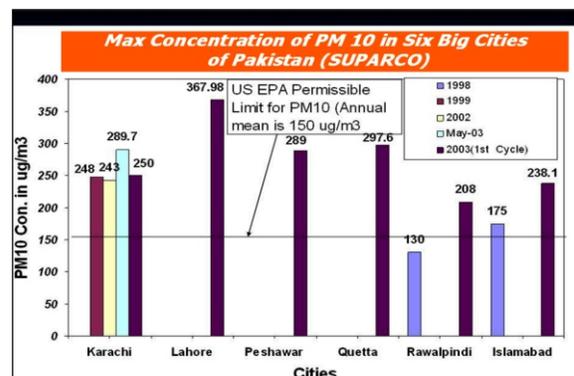


Fig. 1. Air Pollution Level in Major Cities of Pakistan [iv]

Fig. 1. Shows that air pollution situation of Lahore is relatively grimmer as compare to other major cities of Pakistan.

III. MOTOR VEHICLES SITUATION IN PAKISTAN

A. Scenario of Karachi

Karachi is a centralized city where 70 percent of business services and about half of the retail trade is located in central business district. A 50 percent of employment, whole sale trade and transport sector is in CBD [v]. Gigantic expansions of city, spatial fabrication, economic growth and urbanization have increased travel demand. Resultantly causes high growth of vehicles. In 2002, total registered vehicles and cars were growing at twice the growth rate of the population. Vehicles fleet was dominated by cars and motor cycles which account for 92 percent of vehicles as compared to 6 percent for the para-transit vehicles and 2 percent for public transport vehicles. This rapid rise in personal vehicles ownership and lack of economic instrument, such as charged parking and road pricing have led to erroneous congestion especially in central part of city which increases average commute travel time in Karachi by over 45 minutes. [v]

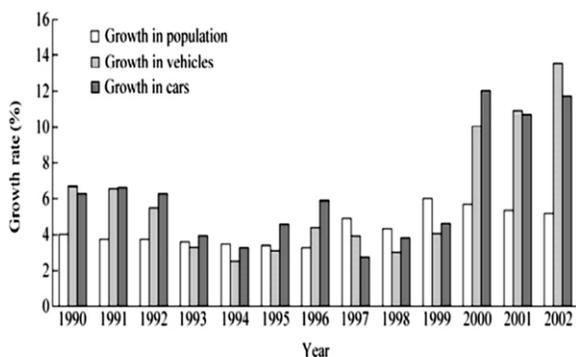


Fig. 2. Growth Trend of Vehicles and Cars Versus Population in Karachi [v]

Fig 2 shows growth of vehicles with growth of population. It indicates that highest growth in vehicles with respect to population is in year 2002 which may be because of increase in travel demand and the absence of planned mass transit system.

Reference [v] Traffic Engineering Bureau of Karachi has carried out two traffic surveys in the city. Result of these surveys show that although trips made by the private vehicles are increasing but buses/mini buses still continue to give over 50 percent of the travel demand.

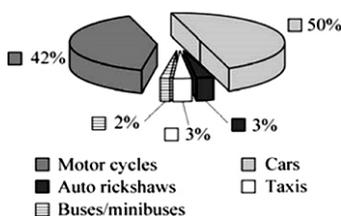


Fig. 3. Share of Passengers Vehicles Fleet in 2003 [v]

In 2007, Karachi was the only mega city in the World without rail base transit system. Karachi circular railway (KCR) which was acted as suburban railway system, started its operation in 1964. KCR proved a reliable alternative to the available public transport for middle class people. But after 1978, heavy subsidies, negligence in maintaining infrastructure and delays in schedule timing, caused declining of rider-ship and popularity. Ultimately, operation of KCR was ceased in 1999 due to heavy losses. Recently, it has been revitalized but no statistics released about passengers ridership.

B. Situation of Rawalpindi

Like other big cities in Pakistan, Rawalpindi is also experiencing high growth of motor vehicles. The growth rate by end of 2008 was 6.05 percent. It is significantly higher than the data of the previous decade (where a progressive rise in vehicles numbers was recorded). However it is in line with growth trends of Pakistan. Statistics of earlier years show that largest growth observed in cars. Growth and modal split of motorized vehicles shown below

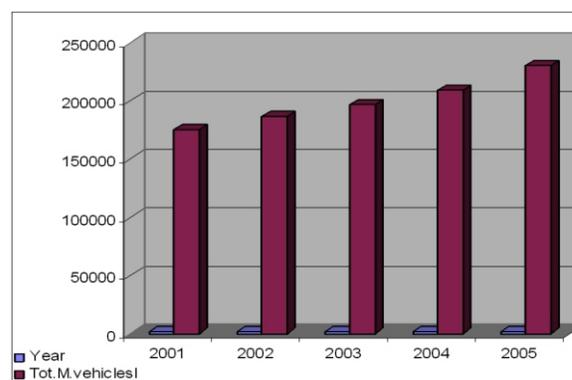


Fig. 4. Growth of Motor Vehicles in Rawalpindi [vi]

Fig. 4 shows growth of motorized vehicles in Rawalpindi. It indicates that rise in number of vehicles is gradual

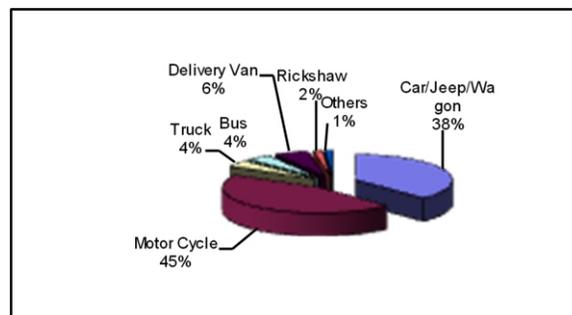


Fig. 5. Modal Share of Vehicles in 2005 [vi]

Fig. 5 shows percent share of key modes in overall volume of traffic.

C. Growth of Vehicles in Case study Area

Motor vehicular air pollution is major source of air pollution in Lahore. Road network, consisting of arterial and collector roads developed in Lahore, is comparable to any other historical city. Present shape of road network in the city is primarily radial which suits for efficient operation and coverage of public transport but due to absence of adequate number of distributors/rings/inter radials, there is unnecessary traffic pressure on primary network. Reference [vii] distribution of overall traffic assigned to the existing road network shows that 35 percent of total traffic is passenger car and jeep, whereas 30 percent constitutes motor cycles. Non-motorized vehicles are 15 percent and public transport is 8 percent of total traffic. Comparative analysis of different studies indicates that overall traffic has increased by 1.5 times with an average annual growth rate of 3.75 percent. Comparison of northern and southern sections of Lahore indicates that growth trends in bicycle and animal driven vehicles in north is steady whereas negative growth of these modes observed in the south.

City experiences high usage of personal vehicles in wake of ailing Public Transport. Growth of traffic at key roads of Lahore highlighted below

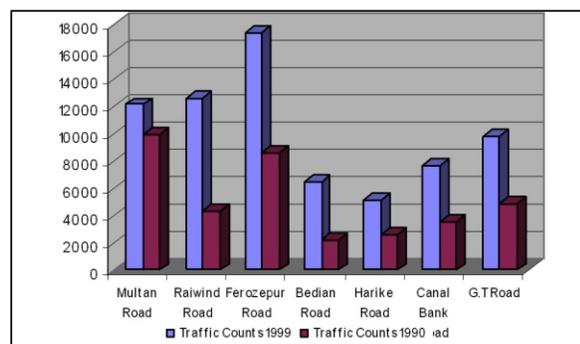


Fig. 6. Traffic Growth at Major Roads of the City Source [vii]

Fig. 6 shows decade growth of vehicles at key roads of Lahore

Mass transit of city comprises upon bus and wagon transit. Due to poor traffic management these vehicles contribute heavily towards air pollution.

Three pollutants, when compare with WHO standards indicate alarming echelon of air pollution in Lahore.

TABLE I
AIR POLLUTION SITUATION IN LAHORE [viii]

Name of Spot	NOX PPb	PM ₁₀ (µg/m ³)	CO ppm
WHO Standards	75	150	9
Yateem Khana Chowk	175	1123	3
Chearing Cross	328	1100	5.2
Bank Square	208	1050	19
Qurtaba Chowk	105	1030	22

Table I shows that there is a high gap between WHO permitted limits and observed level of air pollution in Lahore. Moreover, relatively high gap observed in values of Pm₁₀.

Despite a modest growth of 26 during 2000-2003, mass transit couldn't reduce pollution level in Lahore significantly. Pollution level at only one point where these buses have largely been induced, reflects no letup in pollution scenario.

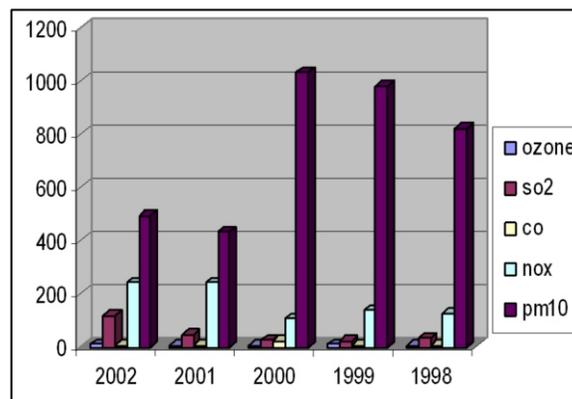


Fig. 7. Air Pollution Level at Qurtaba Chowk [viii]

A comprehensive study on Transportation system in Lahore concluded that with existing network and do nothing situation average velocity in 2010 may decrease and PCU/h will increase alarmingly [ix].

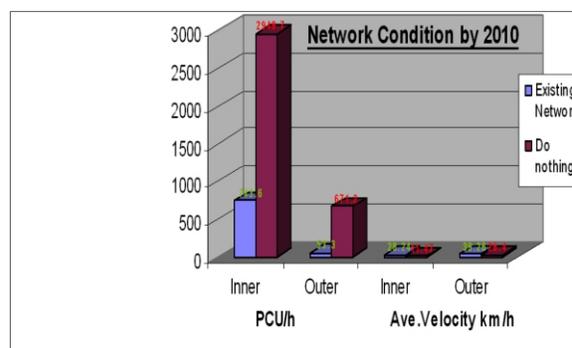


Fig. 8. Network Condition by Year 2010 [ix][adopted]

Fig. 9 shows pcu/h on inner and out network of Lahore in light of do nothing scenario.

To reduce vehicular emission management strategies for bus transit is imperative for city. Lesson from other cities of Asia suggest that construction of flyovers and modernized infrastructure does not guaranteed reduction in congestion and air pollution.

Trying to solve traffic congestion by building infrastructure simply does not work. Cities like Bangkok and Manila tried to solve their rather serious and economically costly traffic congestion problem by building flyovers, expressways and rail based mass transit systems along main corridor routes. For people

in these cities, traffic congestion remains a daily commuting nightmare [x].

IV. REMEDIAL INITIATIVES BY GOVERNMENT OF PAKISTAN

The Government of Pakistan has made significant progress in planning and responding the environmental challenges over the last two decades. National Conservation Strategy (NCS) 1992 was a major step taken by the Government of the Pakistan in terms of enacting environmental policy and practice.

A. *National Conservation Policy 1992* [xi]

The objective of NCS is to identify key environmental issues and their prioritization. NCS has 68 specific programs in 14 core theme areas. The core theme areas set out for priority implementation are

- Maintaining soils in crop lands
- Increasing irrigation efficiency
- Protecting watersheds
- Supporting forestry and plantations
- Restoring range lands and improving livestock
- Protecting water-bodies and sustaining fisheries
- Conserving bio-diversity
- Increasing energy efficiency
- Developing and deploying renewables
- Preventing and abating pollution
- Managing urban waste
- Supporting institutions for common resources

integrating population and environment programs
Program related to air pollution include shifting of industry, large manufacturing units, setting up vehicles tune up centers and compressed natural gas stations. Due to economic and technical constraints and lack of potential only limited success has been achieved in resolving industry related programs. However, progress regarding setting up of tune up centers and CNG stations is significant.

B. *Pakistan Environmental Protection Act (PEPA) 1997* [xii]

The Existing laws relevant to motor vehicular air pollution listed below

- Pakistan Penal Code 1860 (Section 278)
- West Pakistan motor vehicles ordinance 1965
- Motor vehicles rules 1969
- City Development Act 1973
- Constitution of Islamic Republic of Pakistan (Article 9 and concurrent list-24)
- Pakistan Environment Protection Act 1997
- National Highway Safety Ordinance 2000
- Punjab Local Government Ordinance, 2001

Among all above PEPA is comprehensive and closely associated with urban issues. It paves the way for establishment of federal and provincial environment protection agencies and approval of National Environmental Quality Standards (NEQS). Sections of Pakistan Environmental Protection Act

relevant to urban air pollution summarized below

Section 3 establishes the Pakistan Environmental Protection Council. ("Council").Section 4 enumerates its functions including those of approval of National Environmental Quality Standards and power to direct the Pakistan Environment Protection Agency(Established under section 5 as the implementation organ for this legislation with specified task listed under section 6) or any Government Agency to, inter alia, prepare and implement environmental protection projects.

The Agency's tasks under section 6 include preparation, revision and establishment of the NEQS (with council's Approval), enforcement of NEQS and establishment of standards for quality of ambient air, water and land, after consultation with Provincial Environmental Protection Agency (Provincial Agency) concerned. While agency can set different standards for discharge of emissions from different sources and for different areas and conditions(section 6(1)(g)(i), if such standards are less stringent than the NEQS, prior approval of Council has to be obtained

Section 7 empowers agency to undertake its functions whereas section 8 establishes and empowers Provincial Agencies for the same purpose

Section 11 expressly prohibits any emission of any effluent or waste or air pollutant or noise in excess of NEQS or, where applicable, the standards established under section 6(1) g(i).Contravention leads to levying by the Federal Government of pollution charge calculated and collected as per prescribed procedure. The specific extension of same standard to motor vehicles takes place in section 15 which further says that in order to maintain this standard, the agency may direct any motor vehicles or class of vehicles to install prescribed pollution control devices or other equipment or undergo testing or maintenance use a particular fuel, which motor vehicles or class of vehicles shall be prohibited from operating till such direction has been complied with

Penalties for contravention or failure to comply with provisions of section 11 and section 15: punishable with fine of up to Rs.100000 with an additional fine of up to Rs. 1000 per day for any continuing offence or failure to comply with. Any monetary benefit as result of the commission of the offence may also be recovered through a commensurate fine. Repeated contraventions may also lead to ,inter alia ,imprisonment up to two years

Prohibitions of certain discharges or emissions.

Section 15 : regulation of motor vehicles

Section 17 : penalties (extend to Rs. 100000/- with an additional fine of Rs. 1000/- every day)

C. National Environmental Action Plan[xiii]

For long time National Conservation Strategy remained defacto environmental policy of Pakistan. All actions to address environmental degradation and to promote sustainable utilization of natural resources were taken under fourteen core areas. The course of action was followed under National Environmental Action Program (NEAP) which approved in 2001. Thus narrowing down focus of government policy to four core areas namely, clean air, clean water, waste management and reservation management. A comprehensive program launched to support implementation of NEAP. The main objective of NEAP is to safeguard health and to promote sustainable livelihood by enhancing quality of life of people. It targeted to establish bridge between government agencies and civil society.

1) Components of Plan

The NEAP component plan targeted three sources of air pollution in collaboration with UNDP Pakistan. These include pollution caused by industry, indoor burning and vehicular emission. The program adopted six pronged approach by focusing on environmental governance, ecosystem management, energy conservation, dry land management and grass root initiatives.

2) Pollution Control

The purpose of the program is to improve human health by curtailing industrial pollution, vehicular pollution, indoor pollution and quality of drinking water. Sub-objectives of program are

1. Capacity enhancement of industry and EPAs to cut short industrial pollution.
2. Decrease greenhouse gases emission and vehicular emission to improve environment.
3. Enhance technical capacity of Town Municipal Administrations to bring improvement in health, education and income generation of poor.
4. Protection of drinking water in urban and rural areas.
5. Improvement in health and environmental conditions of households.

3) Fraction of Pollution Control Program

Pollution control program is further divided into secondary programs. Details of these secondary programs are as under

Industrial Pollution

Target of this program is to get clean production, improve environmental management and institutional capacity building for small and medium-sized enterprises and development at regional level.

Vehicular Pollution

Motor vehicles contribute 90% of total emitted hydrocarbons (HC), aldehydes and carbon monoxide (CO). Furthermore 75% of sulphur dioxides (SO_x) and nitrogen oxides (NO_x) generate through motor vehicles. The main focus of program is to help reduce pollution caused by automobile emissions.

Water Quality Protection

In the year 2000, contamination of ground water caused an outbreak of bone deformity disease. The outbreak required a vigorous monitoring especially about drinking water. The program thus primarily focused upon strengthening institutional capacities to develop program related to issues of drinking water.

Indoor Pollution

The focus area is to curtail indoor pollution in order to bring improvement in health and environmental condition

Hazardous Waste Management

The program includes measures relate to capacity building to prevent generation of wastes and improvement of contaminated sites. This includes hospital waste management. Despite NEAP regarding environmental issues and institutional frame work, the Government is cognizant of the fact that further efforts and actions need to bring actual improvement in state of environment and natural resources.

D. National Environmental Policy 2005

The National Environmental Policy aims to protect environment was announced in 2005. It focused on improvement of quality of life through protection; conservation and restoration of environment. The policy introduces a new paradigm to integrate environmental consideration in decision making. Guidance on sectoral and cross sectoral areas with highlighted instruments of implementation and monitoring made policy more open and smooth for implementation and capacity building of government institutes.

Sectoral Guidelines

Sectoral guidelines cover nine areas of environmental management and strategies, these include

Water Supply and Management

Air Quality and Noise

Waste Management

Forestry

Biodiversity and protected areas

Climate change and Ozone Depletion

Energy Efficiency and Renewables

Agriculture and Live Stock

Multilateral environmental agreements

Cross Sectoral Guidelines

Cross sectoral Guidelines cover sectors where sustainability is reliant upon environmental regulations. These include

- Poverty and Environment
- Population and Environment
- Gender and Environment
- Health and Environment
- Trade and Environment
- Environment and local Governance
- Natural Disaster Management

E. Ambient Air Quality Improvement Program

Government is quite concerned about degradation of air quality especially in major cities and has taken some significant measures to

Establish National Environmental Quality Standards and review motor vehicles examination system in country.

Devise a phase out plan of lead and sulphur by providing clean fuels.

Through incentive measures 150000 petrol vehicles converted to CNG and efforts have been made to convert diesel engine to CNG fuel. Fifteen tune up stations set up and revolving loan of US \$ 3million reserved to encourage establishment of more tune up stations.

Safe guard environment at federal and provincial level a special squad of traffic police constituted.

Steps for enforcement of industrial emission standards.

Clean Fuels Program

Clean fuels program tailored to convert vehicles on clean fuels. Under umbrella of this program 0.2 million cars have made to switch over to CNG fuel. With assistance of Canadian International Development Agency (CIDA), rickshaws have been converted to CNG on experimental basis in several parts of country.

V. INITIATIVES TAKEN BY GOVERNMENT OF THE PUNJAB TO CURB AIR POLLUTION

Efforts of Government to curb air pollution remained focused on shifting obnoxious industries outside municipal limits and penalizing high polluted vehicles. However, after realizing gravity of situation and financial support from National Government, Government of the Punjab has taken key steps towards environmental conservation. Detail of initiatives taken by Government of the Punjab for protection of urban environment is given below

A. Ban on Two Stroke Rickshaws

After establishing fact that two-stroke rickshaws

are major contributor to air and noise pollution, the Punjab Government put ban on issuance of fitness certificates on two-stroke motor cab rickshaw after 1st January 2005 .It was announced to phase out two-stroke rickshaw from major cities of the Punjab, namely, Lahore, Multan, Gujranwala, Faisalabad and Rawalpindi by 31st December 2007. Furthermore, a ban has been imposed on induction of two-stroke rickshaw as public service vehicle with effect from 31st July 2005 in major cities of Punjab. Accordingly directions issued to manufacturers M/s Saigals Qingqi private limited and M/s Sohrab industries private limited to stop manufacturing of two-stroke motor cycle rickshaws by 31st December 2007.

B. Chief Minister's Green Fund Program

Under this program incentives have been provided to prospective owners of four-stroke CNG rickshaw. This program initiated through Bank of Punjab from 15th Jun 2005. This scheme provides interest free loan to prospective buyers to purchase four-stroke CNG rickshaw. Only on payment of 10-25 percent of total cost, rickshaw hands over to owner and remaining amount will be collected in easy installments.

C. Modern Vehicle Testing Station

Government is planning to set up modern vehicle testing stations and strengthening of institutions of motor vehicles examination. In this context Secretary Transport directed by the chief minister to finalize matter in light of recommendations of ENERCON and concerned institutes.

D. Motor Transport Management Information System

A project called motor transport management information system for integrated computerization of MVE (motor vehicles examination), Fitness certificate /route permit and emission control motoring is to be started in near future. The prime objective of program is to get coordination among four departments, namely, traffic police, Excise and Taxation, Transport and Environment Protection by bringing them online through wireless system.

E. Establishment of An Urban Unit In Planning and Development Department

The Govt. of the Punjab has established the urban sector policy and management unit to make strategic interventions which improve urban environment, standards and quality of life. This urban unit with assistance of World Bank will launch an integrated traffic management system pilot project on Ferozepur road at cost of Rs. 550 million. The project would be implemented on 16 Km stretch between Mozang chungu and Khaira distributary. The work on project will commence from mozang chungu side. Under this project service lanes will improve, bus stops will

redesign and separate lanes for more than 500 buses to ply will introduce. Signals on roads will be computerized and equipped with cameras and traffic will control through newly recruited trained policemen. According to Director of Urban Unit the World Bank consultants are of the view that road is capable of taking traffic load and problems can solve by better coordination between departments and agencies responsible for traffic management. [x]

F. Ban on Old Poorly Maintained Wagons

Govt. of the Punjab after obtaining expert technical opinion that conversion of old wagons to CNG is not possible imposed a ban on old wagons. Subsequently model condition of 10 years imposed w.e.f 30th Jun 2006.

G. Induction of Dedicated CNG Buses

Government the Punjab decided to recommend Federal Government to allow duty-free import of 4000 dedicated CNG buses (exempt import duty for two years). Further Government will provide subsidy or financial support to operator of CNG buses by sharing 20 percent of cost.

V. MASS TRANSIT DEVELOPMENT IN PAKISTAN

After British rule little attention has paid on the development of mass transit infrastructure. Except Karachi Circular Railway, urban mass transit system of the country comprised on bus transit only. But with the growing demand of the public transport Govt. initiated different studies for introduction of railways and bus rapid transit. Different studies and development of mass transit are as under.

A. Karachi Mass Transit Study (KMTS)

Karachi mass transit study was commissioned in 1987 in amid of growing motor vehicles and declining progress trend in the share of mass transit system. The objective of Karachi mass transit study was development of programs for improvement of public transport system. After initial study it realized that Karachi needed mass transit system to fulfill growing demand. Furthermore project on build operate transfer basis was feasible. To undertake transport relevant mega project 'Karachi Mass Transit Authority' created under auspices of Government of Sindh. The mandate of the Authority was to develop and undertake implementation of mega projects. The plan prepared by Karachi Mass Transit Authority outlined five corridors of high demand in 1990. The routes identified by Karachi Mass Transit Authority revised in light of the directive of Ministry of Environment and Heritage Foundation. After deliberation and agreed on priority corridor I, Government invited Expression of Interest. Agreements were also signed but construction could

not start on Priority-I (15.2 Km). The project could not gain its financial close to start physical construction. The deadline set for the system to become operational was the end of year 2000. There were some political reason and irrational decision about choice of the mode. The study concluded that inclusion of light rail transit was not feasible. Despite the fact, decision makers decided to move forward with option of rail transit. Consequently, no investment received as consultant of project was given his consent that rail not feasible at that time. Salient points of the whole study were as under

It recommended immediate action to address deficiencies of buses and minibuses

It identified transit way technology for city of Karachi (Transit ways give exclusive ways for public transport)

It called construction of 87 transit way after tested computerized network transit way alignment of 190 Km in four alternative area wide networks. The entire 87 Km should need to in place by the year 2001.

It addressed the need for year 2000 and serves requirements upto 2010.

Inclusion of light rail transit was not feasible

B. Bus Rapid Transit System in Karachi

Karachi mass transit study concluded that introduction of light rail transit was not a feasible option as bus ways could perform best, cost least and have adequate capacity. Light rail is relatively costly with very high capital cost and high fares.

A rail line will impose 2.5 times the cost per ride of the same route as bus-way [xiv]

In light of the results of Karachi mass transit study a new project called Karachi Mega City Sustainable Development Project with help of Asian development Bank is being launched. The Asian Development bank has allocated US \$223 for bus rapid transit system. The system would facilitate transportation of at least 20000 passengers on persons per hour per direction basis. The project consists on construction of eleven corridors which may build in four tranche of Mega City Project. Under tranche-1, the entire three corridor project is planned to complete within a record period of 24 month. Detail of three corridors under tranche-1 (plan to undertake in 2008) is as under

Corridors Under Tranche-1

Route I (32 Km)

Surjani Town to Quaid's Mausoleum

Route II (14 Km)

Quaid's Mausoleum to Karachi University

Route III (4 Km)

Orangi Town extension

Corridors Under Tranche-2

Route IV (21.5 Km)

Nagan chowrangi to Landhi

Route V & VI (2.7 Km)

- Rashidabad extension and Upmore extension
- Corridors Under Tranche-3
- Route VII (4.7 Km)
- Gulistan-i-Jauhar to University road
- Route VIII (10.4 Km)
- KDA to Metropole via shahrah-i-Faisal
- Route IX (2.3 Km)
- From shahra-i-Quaidin
- Route X (18 Km)
- Korangi to shahra-i-Faisal
- Route XI (4.8 Km)
- In Defense Housing Authority

Buses plying under BRTS will environment friendly dedicated CNG buses with capacity of 160 passengers. Budget allocated for all three phases of tranche-1 is US \$ 223 million. BRT system in Karachi is likely to incur a construction cost of about US \$ 2.57 million per Km including cost of stations, all equipment and cost of buses.

C. Development of Mass Transit in Lahore

Govt. policies about mass transit system remained inconsistent and vague. During 1970's, for only two million people, a sufficient fleet of double decker buses (which were less polluted, low fuelled and high transit capabilities) were available and government endured to focus on the development bus transit. In later years rather than expanding role of mob carrying transit government relied on tiny fleet of Bus transit (each comprise on 75 seats). To cope with the growing demand of transport, government had allowed to operate privately owned (15 seater) wagons. These wagons with low transit capabilities had caused a huge damage to environment of city. Furthermore, that transit system, being an uncomfortable, less transit capable, highly overloaded forced people to have their own riding. Thus results in uncontrollable rise of Para transit. By counting high vehicular emission and growing concern about congestion in city, the Government redefined its role. Incentives to bus transit operators were introduced and a ban imposed on allotment of routes to wagon transit. The developed situation, again swapped the Government policy of bus transit but that time in private control. Government policy had been focusing merely on single mode since long, despite feasibility and scope of other mass transit system. Master Plan for Greater Lahore asserted the need of circular railway around city, keeping in view the future spiralling demand of motor vehicles and environmental concerns. But the Govt. did not pay heed to the assertion, even after expiry of planning period. In 1991, a comprehensive study on transportation system of Lahore was carried out with cooperation of Japanese International Cooperation Agency (JICA). It was again asserted in the report that Light Rail Transit (LRT) and Heavy Rail Transit (HRT) were highly feasible for city. Introduction of LRT not only would save energy but also helped in maintaining the environmental balance.

Furthermore, growing motor vehicles and increasing congestion had forced the Government to reconsider the option to introduce of rail transit in the city. In connection to it, in 2007, the Government had hired a Hong Kong based company to carry out feasibility study of light transit in Lahore.

D. Lahore Light Rail Mass Transit (LLRMT)

LLRMT was a two-phased 97 Km long project. MVA Asia have proposed four rail lines in the city to share traffic burden. Funding for the project was committed by the Asian Development Bank (ADB). Proposed capacity of LLRMT is to move 35000 passengers per hour in city. Two phases of the project have been proposed. In phase I, two tracks have to be built, a north- south bound route (called as green line) and an east- west bound route (called as orange line). The proposed length of the green line is 27 Km. Out of which 11.6 Km long green line route be under ground while 15.4 Km long would be overhead. Twelve underground and ten overhead stations have to be built on green line route. The cost of the green line is US \$ 2.4 billion (US \$ 88 million/Km). Initially, the project has planned to finish by 2012 but finally, the completion year for the green line set as 2011. It has been estimated that 227000 people will benefited from the green line. The Authority has selected green line route from Shadra to Hamza Town via Ravi Road, Lower Mall, The Mall Road, Fatima Jinnah Road, Qartaba Chowk and Ferozpur Road Area. Passengers of LLRMT would be charged Rs.125/- to 140/- to travel from one end to other.



Fig. 9. Route Map of LLRMT Priority Line [xv]

Fig. 10 shows underground and elevated corridors of priority line to be completed by the year 2010.

The route of the orange line has been planned from Pakistan mint to sabzazar via Shahnoor, Awan Town, Hinjarwal, Niazbeg Thokar etc. The total length of orange line is 27 Km. Out of which 6.9 Km long track would be under ground while 20.2 Km long would be overhead. Six underground and twenty overhead stations have planned to develop. The total cost of orange line was US \$ 1.9 billion (US \$70.37 million per Km) and completion year set as 2015. About 245000 people annually would benefit from orange line. Completion of the phase II is set as 2020. Two more tracks have to be built. Routes of these tracks are called as blue line and purple line respectively. The blue line 24 Km long have planned to start from Chouburji and end at college road. Whereas purple line 19 Km long will start from Bhatti Chowk and end at Allama Iqbal International Airport. Train stations on elevated routes would be designed like overhead bridges while underground routes would have two entrance ways and two exit ways.

Due to change of government and allegation of corruption, LLRMT project could not be initiated, despite availability funding from Asian Development Bank.

Government of the Punjab (GoPb), recently negotiated the project with Chinese investor company "NORNICO" who showed willingness to provide 85% of the contract amount. According to the contract NORINCO has to design and build LRMTS; whereas LTC to engage an operator for subsequent operation of the system. The previously carried out feasibility and initiation of the project, was put at stake by a chaotic construction of a flyover at Kalma Chowk Lahore. The flyover has been located on the green line proposed LRMTS.

Reference [xvi] Fate of this project is under risk, as GoPb has constructed a flyover at Kalma Chowk. Semi Government Consultant Company was responsible for the design & construction of the Kalma Chowk flyover. LRMTS Green Line alignment and design had been completely ignored. The construction had been done on ad-hoc basis due to inability of the Consultant to understand and incorporate the complex LRMTS Green Line (GL) alignment and station design. The most serious problem is the location of flyover pillars which incurs re-design of the GL underground Kalma Chowk station.

Another similar mistaken action, has now subjected the construction of green line to another review. The situation is further made worst by the recently started construction of Canal / Muslim Town/ Wahdat road junction flyover. This will have the same impact on GL Cana station as did the Kalma Chowk flyover. Future LRMTS Green Line would need another review and re-design effort by some International Consultant [xvi].

E. Metro Bus Lahore (Bus Rapid Transit System)

In 2011 the Government of Punjab appointed "Ulasim", a Turkish based company of the Istanbul Metropolitan Municipality, for preparing the preliminary design of Metro Bus System (MBS). The Metro bus operates on 27 Km long corridor starting from Gajjumata to Shahdara. The corridor has the following salient features

It operates in centre of the road at 10 m wide dedicated corridor

There are twenty seven (27) bus stations each after 1 Km with two curb-side platforms serving opposite bound Buses.

Each Platform can accommodate simultaneous stopping of three articulated buses.

Corridor from Qaddafi Stadium to Data Darbar (8.3 Km's) made elevated to avoid conflict of Metro buses with normal traffic in the congested areas..

Metrobus system now operates with 64 articulated buses.

The maximum speed of the Metrobus is 50 Km/h with headway of 2-3 minutes.

Intelligent System is equipped with Automated Fare Collection (AFC) System, Bus Scheduling System (BSS), Vehicle Tracking System (VTS), Passenger Information System (PIS)

LRMTS network, which was developed by JICA based on identification of potential mass transit corridors and their priority of implementation, built primarily on forecasted passenger demand, has identified the following four lines:

- 1) *Green Line* - Ferozepur Road/Mall Road/Ravi Road/Shahdara
- 2) *Orange Line* - Raiwind Road/Multan Road/Mcleod Road/ Railway Station/GT Road
- 3) *Blue Line* - Township/Gulberg Boulevard/Jail Road
- 4) *Purple Line* - Bhatti Gate/Allama Iqbal Road/Airport

An international group have submitted to Transport Department an unsolicited bid to build and operate a monorail system along the Green Line alignment on BOT basis. The technical specifications of the proposed systems have been scrutinized and now confirmed. But no decision yet taken regarding 'monorail' system in Lahore.

A Korean group of investors have also expressed interest in providing BRT system along the Green and Orange lines corridors on BOT basis. Government has requested the Korean investors to prepare detailed feasibility study which covers detail of technology, financing and implementation plan for the two BRT lines along both Green & Orange Lines corridors.

The imprecise stance of Government finally lasted when it decided to extend the metro bus project along

orange and blue lines in Lahore. But rather than to focus on its extension and completion, Govt. decided to introduce it in other big cities of Punjab without assessing its impact on environment and overall transportation of the city. The work on Metro bus of the twin city (Rawalpindi-Islamabad) has been started. The transit system of Lahore which is being run on only one corridor is now turned into a half-baked scheme which could have crucial connectivity problem with existing public transport. Furthermore, there require a root rationalization of all routes in wake of Metro bus. In 2014, the Government again intends to introduce the rail transit along orange line already as proposed by LLRMT feasibility with cooperation of a Chinese company.

The inconsistent behaviour of the Government leads to increase transport demand sharply. The transport demand recently estimated by Japanese International Co-operation Agency (JICA) is 12 million trips, which includes 4 million short walking trips and 8 million motorized trips, on a usual weekday. The number of vehicles registered in Lahore increased sharply from 95 vehicles in 2001 to 238 vehicles in 2008; per 1000 population [xvii].

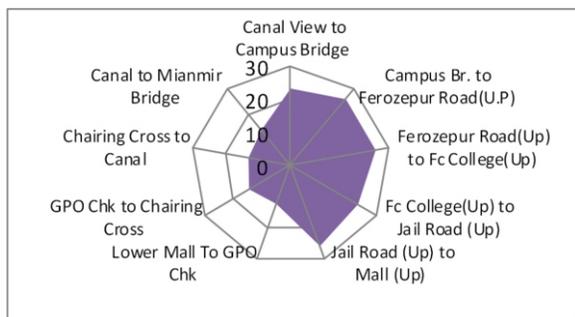


Fig. 10. Percentage of Surfeit Emission due to Erroneous Running of Mass Transit in Lahore

Furthermore, the existing mass transit due to erroneous running generates up to 26% additional emission at different corridors of Lahore [xviii]. Surfeit emission at different corridors of Lahore highlighted in Fig. 10.

F. Results and Discussion

The growth of motor vehicles in big cities of Pakistan particularly in Lahore is unprecedented which has led to pollute environment.

Policy and initiatives taken by the Federal Government to curb urban air pollution has focused upon reduction of motor vehicular emission at source by the use of technology and clean fuel programs. It rarely focused upon control of air pollution through mass transit system.

Government policy for introduction of mass

transit remained imprecise which has increased transportation demand and up surged surfeit emission due to erroneous running of existing mass transit system.

The Planned Metro bus expansion has put to stagnation as the Govt. finally decided to introduce rail transit at orange line. Incongruously, it decided to extend its operation to other big cities of Punjab.

Routes alignment or rationalization of public transport needs to be carried out in the wake of metro bus operation. Up to 26% surfeit emission resulted due to erroneous running of existing mass transit.

The construction of the green line would need another review and re-design effort by some International consultant due to disorder construction of two flyovers as finally decision for rail transit has taken.

Inconsistent policies of governments towards mass transit system have jeopardized fragile environment of the city.

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