Transport Sector Dynamics and Its Contribution to Urban Health Burden in a Metropolitan Area

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September 1-2, 2011
Major Policy Issues: Transport Sector

- Public Transport facilities inadequate
- Expensive public transport
- Inadequate road space (encroachment, parking)
- Extreme Congestion and emissions
- Incentives for personal mode of transport
- High Disease Burden
Need to Study Transport Sector?

- Limited network of roads, often narrow, poorly maintained, and unpaved.
- Rapidly increasing ownership and use of private cars and motorcycles.
- Inadequate roadway accommodations for buses and non-motorized transport.
- Primitive or non-existent traffic control and management.
- Extremely high and rapidly rising traffic fatalities, especially among pedestrians and motorcyclists.

- Overcrowded, unreasonably expensive uncomfortable, undependable, slow, uncoordinated, inefficient, and dangerous public transport.

- Extremely high levels of transport-related pollution, noise and green house gas emission especially in large cities.
Why Transport and Health

- Large Indian cities: Dominant Emissions earlier
  - Industrial sources
  - Domestic Burning (Bengal and Bombay Smoke Nuisance Act)
  - Transport for goods movement and public

- Emission scenario: Now
  - Transport
  - Construction & Demolition
  - Refuse Burning
  - Unorganised sector
**Study Area**

- MMR is one of the fastest growing metropolitan regions in India. With geographical spread of about 4,335 sq. km
- MMR comprises eight Municipal Corporations (*Navi Mumbai, Mumbai, Kalyan –Dombivali, Ulhasnagar, Thane, Bhiwandi, Virar-Vasai and Mira-Bhayander*)
- Nine Municipal Councils (*Alibag, Pen, Navghar –Manikpur, Karjat, Khopoli, Matheran, Panvel, Ambernath and Uran*)
- With a population of approx. 19 million (census 2001), it is ranked as the sixth largest metropolitan region in the World

**Land Use Pattern**

- In 1971
  - Forest: 28%
  - Agriculture: 55%
  - Industry: 1%
  - Wetland: 10%
- In 1991
  - Forest: 38%
  - Agriculture: 38%
  - Industry: 3%
  - Wetland: 10%
- In 2011
  - Forest: 24%
  - Agriculture: 37%
  - Industry: 4%
  - Wetland: 3%

**Significance to Study Approach**
- Rapid Urbanization and developmental activities
- High population density
- Employment opportunities leading to infiltration
- Living pattern leading to burden on Environment
City Transformation Goal

- Population growth: linked with two major factors
  - Housing
  - Transport
- Development of sustainable environment along with impact mitigation and transformation of the city.
- Integration of air pollution & climate change based changes during developmental processes.
Population Status for Major Urban Centers

- Although India occupies only 2.4% of the world's land area, it supports over 15% of the world's population.
- Decentralization of economic activities and population by developing other parts of the Mumbai Metropolitan Region would be useful to study the trends in population.
- Mumbai is likely to grow at arithmetic scale provided current policy does not change.
- Other corporations and councils are growing at a faster rate since 2001 and is likely to continue till 2021. Later it will grow at arithmetic rate.

Rest of the corporations > Greater Mumbai Corporation > Municipal Councils
Transport Network of MMR
Mumbai Central and Western part shows high vehicles population, followed by Thane Region.

Percent distribution of category wise Motor vehicles population in MMR region
Emissions estimation includes data collection on vehicle counts, vehicle kilometer traveled, secondary data on vehicle registered, types of vehicles, age of vehicles, fuel used etc.

Vehicle counts at representative major traffic junctions

Estimation of grid-wise road length with major nodes/traffic junctions.

Estimation of VKT (Vehicle Kilometers Traveled) for different categories of vehicles.

Selection of appropriate emission factors from the ARAI vehicle emission study (CPCB, 2008).

Preparation of vehicle emission inventory and Emission growth projections.
<table>
<thead>
<tr>
<th>Region</th>
<th>2 Wheelers</th>
<th>Auto rickshaw</th>
<th>Car Diesel</th>
<th>Car Petrol</th>
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# Factors used for emission load calculation
Source: Air Quality Monitoring Project-Indian Clean Air Programme (ICAP),
The Automotive Research Association of India, 2008
## Category wise Emission Load in MMR (2009)

<table>
<thead>
<tr>
<th>Category wise Emission Load in MMR (2009)</th>
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<th>NOx</th>
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## Category wise Emission Load in MMR (2009) (Contd..)

### Car Diesel Emissions (T/y)

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**Category wise Emission Load in MMR (2009) (Contd..)**

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<tr>
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<td>13.2</td>
<td>476.5</td>
<td>--</td>
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<td>794.1</td>
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VKT (Vehicle Kilometers Traveled) for different categories of vehicles was estimated using primary method (actual vehicle counting) for Greater Mumbai and secondary method for rest of the MMR.

The highest VKT share is by Cars Petrol- 27%, Car Diesel-18%, 3 Wheelers-20%, Taxies-14%, 2 Wheelers-13% and HDDV-8%. Projected VKT estimation for Greater Mumbai upto 2050
### Congestion Impact in Mumbai City

<table>
<thead>
<tr>
<th>Sr.</th>
<th>Fuel</th>
<th>Type</th>
<th>From</th>
<th>To</th>
<th>Km</th>
<th>Litre</th>
<th>Minute</th>
<th>Engine size (L)</th>
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<tbody>
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<td>Bandra</td>
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<td>22</td>
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<td></td>
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<td>Worli</td>
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<tr>
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<td>Chembur</td>
<td>Worli</td>
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<td>Hajiali</td>
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<td>Peak Traffic</td>
<td>CST</td>
<td>Parel</td>
<td>6</td>
<td>2.5</td>
<td>30</td>
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</tr>
</tbody>
</table>

The key findings of the test show that both fuel and journey time increase in peak traffic. Emissions increase by 33% to 75%.

Whereas travel time increase by 5min to 30min for the same route.

Denser traffic condition leads to higher emissions, slow moving traffic (stop-start vehicle movement), increased journey times and higher vehicle operating costs.
In MMR region, the convenient mode of transport is train (85%) followed by Bus (10%) and 5% other viz. autorikshaw, walking and motor bike.

Minimum Distance travel in MMR region include 10-30 km and time required is 1-2 hours.

They do not face congestion situation similar to Mumbai.

Large scale heavy duty vehicle movements hamper general traffic and also create unsafe situation.
Travel Pattern: Mumbai Region

- Low and Middle income group category people travel mainly by train (68%), Bus (22%) and 8% by other mode of transport like auto rickshaw and walk.

- High income group people prefer to travel by cars (42%), train (28%), 20% bus and 10% motorbike and other mode of transport.

- The survey also indicated that most number of people use dual mode transport like train and bus.

- 69% of High Income group people normally travel up to 20 Km and it takes around 30-40 minutes approx. Low group traveling more than 10-15 kms in 45 minutes to 1 hour.
- Highest VKT by personal mode: 61%
- Next are taxies and Autos : 32%

- Most of he HC emissions from three wheelers
- The highest pollutants from 2 wheelers: Panvel, Thane, Mumbai and Ulhasnagar

- Highest Occupancy on the road : Cars
- Highest movement of people : Buses
Impact of Diesel Price Increase

- For 1 km of travel a car consumes nearly 5 times more energy than a 52 seater bus with an average load factor of 82%.
- The car occupying 38 times more space compare to a bus for a km of a travel.
- The emission from a 2 wheeler equivalent to a bus could add 27% more pollution
  
- As per new bus fare cost is Rs 3-4 per Km and for a two wheeler it works out to be less than one rupee/Km

- Recent Report shows that passenger loads have come down in Mumbai after last fare increase.
- The congestion due to increased private vehicles have led to increase of about 15-18% emission [mainly gaseous pollution]
- Price Increase is anti poor as also against environment
Projected Emission Loads from 2010 to 2050 for Different Pollutants
Projected Emission Load Different Pollutant at MMR Region (T/Yr)
Scenario of CO$_2$ and other Emissions Reduction: Control Options

- Mumbai and Delhi as two mega cities
- Pattern of vehicle types and use is different
- Analysis of CO$_2$ emission reduction from this sectors based on
  - Synchronization of signals
  - Fuel Shift
  - Preference of Public transport
Mumbai City

Number of Vehicles

- 2 Wheelers
- 3 Wheelers
- Buses
- 4 Wheelers

% Passenger kilometers

- 2 Wheelers
- 3 Wheelers
- Buses
- 4 Wheelers

CO2 Emission

- 2W
- 3W
- CD
- CP
- BusCNG
- BusDiesel
- HDDV
- Taxi CNG

Percent VKT Share of Vehicles: 2007-08

CO2 Emission Load (T/yr)

- 2007
- 2010
- 2015
- 2020
- 2025
- 2030

SIM-16-2009
Mumbai

- **Synchronization of traffic signals** (20% improvement in 2012 and 40% improvement in 2017)

- **CNG/LPG to commercial** (all 3 and 4-wheelers) - 25% conversion in 2012 and 40% in 2017 – Taxi & 3W already converted to CNG

- **Improvement of public transport**: as per existing plan for the city (VKT of cars, 2-wheelers and buses) Incorporated city specific proposals on public transport with respect to Metro/mono rail, BRT, large buses contingent etc. leading to percentage shift in VKT and off road personal transport: 10% shift in VKT – in 2012 and 20% shift in VKT in 2017
Other Policies and measures

- Enhancement of knowledgebase and capacity building

- Improving access and reducing transport demand
  - Integrate land use and transport planning

- Using less fuel per passenger or freight kilometre
  - Fiscal and control measures
  - Priority to good public transport
  - Promoting use of NMT modes

- Implement fuel economy standards for new vehicles
  - Fuel efficiency standards
  - Emission standards
  - Fuel quality standards

- Reducing emissions from in-use vehicles
  - Inspection and Certification
  - Retrofit programme
Health Status and Linkages with Transport Sector

- Difficult to apportion health to a sector
- Problems of sources emissions, locations and exposures
- Methodology need to be evolved
- Population staying close to roads
- Understand exposure in a given situation and microenvironment
- Understand how much comes from transport sector
- Types of diseases,
- Background area: cohorts and control
Mumbai Case

- The number of air polluting industrial units in the year 2002 was 181 which drastically declined to less than 40 by 2007.

- It is witnessed that most of the air pollution in the city currently can be attributed to transport and construction sector.

- Of many pollutants, NOx and CO can be mainly attributed to transport sector, whereas PM contributions come from construction, refuse burning, resuspended dust and other combustion processes.

- Most of the future illnesses due to air pollution would majorly come from transport sector, not only due to its higher contribution but also due to toxics emissions.
Health Issues: Mumbai

- In recent times, City doctors are baffled with the increasing number of patients with respiratory ailments requiring hospitalisation.

- The study shows around 25-30% increase in cases of upper respiratory ailments.

- 2-4% of these patients required urgent hospitalisation. In some cases, it has been found that the lungs are severely damaged.
Economic Assessment

- Environmental Pollution Research Centre at KEM Hospital in Mumbai data analysed
- Study to establish respiratory diseases and air pollution using logistic regression to investigate the link between air pollution and morbidity impacts. The monetary burden of morbidity was estimated through the cost of illness approach.
- PM and NOx emerged as the critical pollutants for a range of health impacts,
- The study developed the concentration-response coefficients for these health impacts.

The total monetary burden of these impacts, including personal burden, government expenditure and societal cost, is estimated at INR 4522.96 million or US$ 113.08 million for a 50-µg/m3 increase in PM10,

INR 8723.59 million or US$ 218.10 million for a similar increase in NO2.
• Appropriate policies to exploit the railways for Air Pollution reduction potential.

• China and India have currently less than five cars per 100 head of population, the US has around 90 and the UK 50. If India and china alone go ahead with fossil-fuelled cars the way the West did, the situation can be very daunting.
Policy Options

• Railways offer efficient transport
  – social equity,
  – low environmental impact
  – positive economic growth,
  – sustainable mobility and an improved quality of life.

• Fuel shift along with reduction of vehicle kilometers traveled [bio diesel, hydrogen, renewables etc or any new development]

• Public transport use of all categories.

• Lower cost of Fuel for public transport or other fare reduction options
Conclusions

• Of many issues which can be addressed there are plenty of them for easy implementation such as improvement in vehicle technology, reduction in rate of vehicle growth, other mode of transport (buses, metro, rail, waterways etc), land use etc.

• Awareness about economic benefits in terms of reduced health burden

• Transport sector local alternatives

• Reduction in fare and improvement of public transport for the sole purpose of improving health
Acknowledgement

Mumbai Transformation Support Unit
All India Institute of Local Self Government

Dr. Shalini Tandon
Ms. Abba Elizabeth
Ms. Rupam Anand
Mr. Niranjan Kolekar
Mr. Prachi Nimkar