Transportation and Environment Studies

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Transportation and Environment Studies

• since 1996, several transportation and environment studies were conducted for Metro Manila wherein 2 were large research and survey projects were funded by Japanese agencies such as JICA and JSPS
  • JICA MMUTIS Project (1996-1999)
  • JSPS Manila Project (1997-2002)

• the JICA and JSPS projects were the main sources of transportation and environment databases, respectively, aside from the transport and environment models that they generated

• the U.P. National Center for Transportation Studies became the repository of MMUTIS transportation database and models in 1999 and the JSPS transport and environment simulation model and air quality data in 2001

• regression models relating road traffic flow parameters and roadside CO, SPM and NO₂ concentration were developed
### Databases on Transportation and Environment

#### MMUTIS Transportation Database
- extensive data on transport network, road and traffic flow, socio-economic, land-use, OD table, public transport routes and person trip in Metro Manila and adjoining areas in 1996

#### MMUTIS Environmental Impact Study
- hourly CO, NO\textsubscript{x}, and SPM concentration, noise level, wind velocity for 6 locations, 5 continuous days per location in Metro Manila (Feb.-April 1997)

#### JSPS Manila Project
- environmental satisfaction survey-Makati and other cities in Metro Manila
- 1998 jeepney engine survey-Quezon City

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### Databases on Transportation and Environment

#### JSPS Manila Project
- Air Pollution Survey Using Filter Badge in Metro Manila:
  - 9 intersections and 5 mid-block roadside sections in March-April 1998
  - hourly traffic volume, traffic speed, signal data for 24 hours for all sites
  - daily NO\textsubscript{x} concentration using filter badge method for 3 days for all 14 sites and 10 open area sites
  - hourly NO\textsubscript{x}, CO, SPM, SO\textsubscript{x} and wind velocity measurement for 3 days using the Horiba Air Pollution Monitoring System at 1 mid-block site and open (park) site
  - hourly noise level: 6 intersections and 2 mid-blocks for 24 hours

#### Impact Study of JBIC Projects in Metro Manila, 2000-2001
- hourly SPM and wind velocity at 5 locations in Metro Manila using the Horiba Air Pollution Monitoring System for 5 days per location in Nov. 2000-January 2001 with traffic flow monitoring using CCTV
- sound level survey at 5 locations in Metro Manila using sound level meters for 1-2 days per location in Nov. 2000-January 2001
Estimation of PM Emissions For Each Traffic Analysis Zone:

$$\text{PM Emissions}_j = \text{travel distance (vehicle-km)} \times \text{share of veh-km}_j \times \text{speed-specific emission factor}_j (g/km) + \text{total stopped time (min)} \times \text{idle emission factor (g/min)}$$

where $j =$ vehicle type

**Methodology for Environmental Assessment**
– Based on MMUTIS (JICA, 1999)

Traffic Assignment – Result of Aggregate Transport Demand Forecast Model or “4-Step Model”
(road network link-level daily traffic volumes and daily average speeds)

Aggregation of Vehicle-Kilometers, Travel Speed and Travel Time
By Traffic Analysis Zone
(zone-level daily traffic volumes, daily average speeds and travel times)

Estimation of PM Emissions Per Zone
Two-Fluid Model for Metro Manila
(estimation of idle time)

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Change in Travel Distance (Vehicle-Kilometers) in Metro Manila and Adjoining Areas for Present and 3 Scenarios in 2015

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</thead>
<tbody>
<tr>
<td><strong>private transport</strong></td>
<td>24</td>
<td>76</td>
<td>43</td>
<td>40</td>
</tr>
<tr>
<td><strong>public transport</strong></td>
<td>10</td>
<td>15</td>
<td>6</td>
<td>5</td>
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</table>

Change in Average Travel Speed (km/h) in Metro Manila and Adjoining Areas for Present and 3 Scenarios in 2015

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<tbody>
<tr>
<td><strong>public transport</strong></td>
<td>28.9</td>
<td>13.5</td>
<td>19.4</td>
<td>19.2</td>
</tr>
<tr>
<td><strong>private transport</strong></td>
<td>30.6</td>
<td>13.1</td>
<td>19.2</td>
<td>20.1</td>
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Transportation Emission Estimation Results, in Metro Manila and Adjoining Areas for Present and 3 Scenarios in 2015 (tons/day)

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<tbody>
<tr>
<td>CO</td>
<td>841.5</td>
<td>2,372.1 (+182%)</td>
<td>1,286.1 (+53%)</td>
<td>1,161.6 (+38%)</td>
</tr>
<tr>
<td>NO&lt;sub&gt;x&lt;/sub&gt;</td>
<td>145.7</td>
<td>613.7 (+321%)</td>
<td>232.2 (+59%)</td>
<td>201.4 (+38%)</td>
</tr>
<tr>
<td>SO&lt;sub&gt;x&lt;/sub&gt;</td>
<td>1.3</td>
<td>6.9 (+430%)</td>
<td>2.2 (+69%)</td>
<td>1.9 (+46%)</td>
</tr>
<tr>
<td>PM</td>
<td>9.5</td>
<td>49.0 (+416%)</td>
<td>15.5 (+63%)</td>
<td>13.1 (+38%)</td>
</tr>
</tbody>
</table>

Source: JICA (1999)

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Total PM Emissions Per Zone (32-Zone System) For the Present Situation and 3 Scenarios in 2015

Source: JICA (1999)
Impact Analysis of Metropolitan Policies for Development and Environmental Conservation in the Philippines (JSPS Manila Project)

• a micro-scale simulation system for the transportation environment has been developed for Metro Manila by the JSPS Manila Project (2002)

• using the system, the assessment of the impacts on traffic and the transportation environment of the improvement in driver behavior, vehicle performance and implementation of various transportation policies are conducted

![Snapshot of simulation network](image)

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Inputs and Policies for Simulation

• absence of emission factors as a function of speed in Metro Manila

• use of the emission factors developed for Metro Manila by the ADB-VECP Project and extrapolated based on the Tokyo Metropolitan Government Environmental Conservation Bureau’s speed-specific emission factors

• study area: Makati City central business district (Makati CBD)

• network has 462 nodes, 1,243 links and total road length of 341.85 km. and 23 zones

• O-D traffic flow obtained from Metro Manila Urban Transportation Integration Study (MMUTIS)

<table>
<thead>
<tr>
<th>Transportation Policy</th>
<th>Simulation System Settings</th>
</tr>
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<tbody>
<tr>
<td>Installation of SPM filters in buses and jeepneys</td>
<td>Reduction of jeepney and bus emission factors by 80%</td>
</tr>
<tr>
<td>Motor vehicle inspection and maintenance</td>
<td>Setting of emission factors similar to Tokyo</td>
</tr>
<tr>
<td>Exclusive bus and jeepney lanes</td>
<td>Assignment of the outermost lane as exclusive lanes</td>
</tr>
<tr>
<td>CBD Entry regulation</td>
<td>Reduction of OD flows to the Makati CBD by 20%</td>
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Impact of Transportation Policies on Traffic Flow and the Transportation Environment

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Impact of Transportation Policies on SPM emission (roadside PM concentration)

- Base Conditions
- Exclusive bus and jeepney lanes
- Installation of SPM filters
- Entry regulation
- Automobile inspection

Morning peak off-peak (installation of SPM filter)
Off-peak (exclusive bus/jeepney lane)
Off-peak (automobile inspection)
Issues and Recommendations

• there is a need to improve Metro Manila emissions inventories especially from transportation using transportation demand forecast models such as the one used in MMUTIS
  → MMUTIS Environmental Impact Study total emissions calculation
    – good starting point

• micro-scale models such as the transportation and environment simulation model developed by the JSPS Manila Project is recommended to be expanded for application to larger transportation networks in Metro Manila and other areas to simulate policies that require microscopic analysis

• these macroscopic and microscopic models can be improved significantly if the inputs such as update local emission factors and vehicle fleet data are available
  → develop emission factors for a wide range of vehicle and operating characteristics
  → improve database of vehicles to include basic vehicle fleet data such as annual mileage and engine age

Thank you.