Challenges of understanding and combating air pollution in Sri Lanka

• Clean air is essential for life?

• We are concerned about the quality of water we drink

• Did we ever think about the quality of the air we breathe?
Challenges

• Air quality is deteriorating
• This causes immense health problems and the cost of this to the state is phenomenal
• It can affect economy (tourist revenue, investors)
AIR POLLUTANTS

• Criteria pollutants

• 1. NITROGEN DIOXIDE

  2. SULPHUR DIOXIDE

  3. CARBON MONOXIDE

• 4. PARTICLES (DUST, SOOT) - PM10

• 5. OZONE
## Standard values for the ambient air pollutants in Sri Lanka

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Maximum permissible level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>24hrs</td>
</tr>
<tr>
<td></td>
<td>mg/m³</td>
</tr>
<tr>
<td>SPM</td>
<td>0.03</td>
</tr>
<tr>
<td>SO₂</td>
<td>0.08</td>
</tr>
<tr>
<td>NO₂</td>
<td>0.01</td>
</tr>
<tr>
<td>O₃</td>
<td></td>
</tr>
</tbody>
</table>
Why pollution levels are increasing

- Addition of a large number of motor vehicles particularly motor cycles and three wheelers
- Traffic jams
- Burning diesel in thermal power plants
- Poor quality of diesel in Sri Lanka
Air quality (sulphur dioxide levels) of Kandy versus Colombo

<table>
<thead>
<tr>
<th>Month</th>
<th>Kandy (ppm)</th>
<th>(ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005 January</td>
<td>0.12</td>
<td>0.016</td>
</tr>
<tr>
<td>February</td>
<td>0.08</td>
<td>0.010</td>
</tr>
<tr>
<td>April</td>
<td>0.07</td>
<td>0.011</td>
</tr>
<tr>
<td>May</td>
<td>0.07</td>
<td>0.005</td>
</tr>
<tr>
<td>June</td>
<td>0.06</td>
<td>0.006</td>
</tr>
<tr>
<td>July</td>
<td>0.07</td>
<td>0.008</td>
</tr>
</tbody>
</table>

(standard 0.05 ppm)
HEALTH EFFECTS

• OZONE
  • Increased hospital admissions with respiratory problems
  • Exacerbate asthma (susceptible groups)
  • Reduced Lung function
  • Increased mortality

• NITROGEN DIOXIDE
  - Respiratory functions and symptoms of asthma
  - Impaired lung defence (ie. increased infections)
  - Daily mortality
SULPHUR DIOXIDE
- Wheezing and exacerbation of asthma
- Increased respiratory hospital admissions due to asthma
  • Increased mortality

• CARBON MONOXIDE
  - Headaches, nausea
  - Heart disease
Health concerns in Sri Lanka

45% of the total outpatient morbidity in two leading hospitals was due to diseases of the respiratory system.

Diseases of the respiratory system even after excluding diseases of the upper respiratory tract, pneumonia and influenza has ranked as the 2nd leading cause of hospitalisation in Sri Lanka over past 5 years and it has become the 2nd leading cause of death among children aged 5 – 14 years.
## Recorded asthma patients in Kandy hospital in 2003

<table>
<thead>
<tr>
<th>Month</th>
<th>No of Patients</th>
<th>deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>190</td>
<td>5</td>
</tr>
<tr>
<td>February</td>
<td>191</td>
<td>4</td>
</tr>
<tr>
<td>March</td>
<td>143</td>
<td></td>
</tr>
<tr>
<td>April</td>
<td>140</td>
<td>3</td>
</tr>
<tr>
<td>May</td>
<td>178</td>
<td></td>
</tr>
<tr>
<td>June</td>
<td>139</td>
<td>2</td>
</tr>
<tr>
<td>July</td>
<td>144</td>
<td>4</td>
</tr>
<tr>
<td>August</td>
<td>179</td>
<td>2</td>
</tr>
<tr>
<td>September</td>
<td>180</td>
<td>1</td>
</tr>
</tbody>
</table>
Health costs of air pollution

• Health damage due to fine particles (PM10) is estimated as Rs. 32 billion for the city of Colombo alone!!

• (Study done by Prof. Amal Kumarage, University of Moratuwa)
Air pollution in Kandy

• Why there is a high degree of air pollution in Kandy?

• **Geographic location** - Situated in a valley. Surrounded by the Hunnasgiriya and Hantane mountain ranges and also a number of hillocks close to town.

• High winds travel over the mountains.
Pollution sources

- About 60,000-70,000 vehicles enter the city every day.
- Slow moving private buses which block traffic on both sides of the road.
- Three-wheelers and motor cycles with two stroke engines are highly polluting.
Why high degree of air pollution in Kandy...

• Traffic jams- More pollution when vehicles stop and start
• Not enough roads
• Closed roads such as the one in front of Dalada maligawa
• In February 2002, air pollution levels dropped drastically when the road was reopened for light traffic
Weekly SO₂ variation at sampling sites

41% exceedance

Kandy
Figure 3.22 - Monthly averages of SO$_2$ at Kandy
Variation of Nitrogen Dioxide (NO₂) One Hour Average Concentrations at Colombo Fort Ambient Air Quality monitoring station (1997-2001)

National standard 0.13 ppm

Trend line (Average)

NO₂ Concentration (ppm)

Month

Jan-97  Jul-97  Jan-98  Jul-98  Jan-99  Jul-99  Jan-00  Jul-00  Jan-01  Jul-01

National Stakeholders Forum – Sri Lanka – 12th June 2007
Variation of Sulfur Dioxide (SO₂) One Hour Averages concentrations at Colombo Fort Ambient Air Quality monitoring station

SO₂ Concentration (ppm)

National standard 0.08 ppm

Month

National Stakeholders Forum – Sri Lanka – 12th June 2007
Indoor air pollution

- Kitchen smoke
- Cigarette smoke
- Solvents, sprays, formaldehyde (from adhesives in furniture)
- Radon (from granite)
- Mosquito coils
Chemistry of wood smoke

• Every kg of wood burnt gives

• Carbon monoxide \( 80-370 \) g
• Benzene \( 0.6-4.0 \) g
• Acetic acid \( 1.8-2.4 \) g
• Lead \( 0.1-3.0 \) mg
• Anthracene \( 20-50 \) \( \mu \)g
• Phenanthrene \( 20-3400 \) \( \mu \)g
• Benzo(\( \alpha \))anthracene* \( 400-2000 \) \( \mu \)g
• Dibenzoanthracene* \( 20-2000 \) \( \mu \)g
• Benzo(\( \alpha \))pyrene* \( 400-2000 \) \( \mu \)g
• Benzo(\( \alpha \))pyrene* \( 300-5000 \) \( \mu \)g

*carcinogenic
FINE PARTICLES

Where do they come from?
- Automobile exhaust fumes
- Forest and domestic fires
- Volcanoes
- Indoor cooking using firewood
- Soil and rock debris
- Sea salt
- Industry
Health effects

- Aggravates asthma
- Respiratory problems
- Silicosis and asbestosis
- Heart diseases
- Lead poisoning
- Cancers- from polyaromatic hydrocarbons attached to soot
- Interferes with the cleaning mechanism of lungs (eg. cigarette smoke)
Concentrations of TSP and PM$_{10}$ at Bogambara site
Respiratory health of school children in the Kandy area

- Sample: one set from the Kandy Municipality area, reference set from the Kadugannawa area
- Air pollution monitored using passive samplers
  - The number of episodes of the respiratory symptoms such as cough, common cold, wheezing, shortness of breath, phlegm production and throat irritation were assessed for a period of one year among the selected sample of the study population of children in two areas.
Table No 7. Monthly average SO$_2$ levels in two areas. (24 hour average)

<table>
<thead>
<tr>
<th>Month</th>
<th>SO2 concentration in KMC area (ppm)</th>
<th>SO2 concentration in Yatinuwara (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>September 2004</td>
<td>0.0769</td>
<td>0.0131</td>
</tr>
<tr>
<td>October 2004</td>
<td>0.0609</td>
<td>0.0147</td>
</tr>
<tr>
<td>November 2004</td>
<td>0.0426</td>
<td>0.0111</td>
</tr>
<tr>
<td>December 2004</td>
<td>0.0513</td>
<td>0.0163</td>
</tr>
<tr>
<td>January 2005</td>
<td>0.1249</td>
<td>0.0171</td>
</tr>
<tr>
<td>February 2005</td>
<td>0.0810</td>
<td>0.0182</td>
</tr>
<tr>
<td>March 2005</td>
<td>0.0593</td>
<td>0.0142</td>
</tr>
<tr>
<td>April 2005</td>
<td>0.0754</td>
<td>0.0153</td>
</tr>
<tr>
<td>May 2005</td>
<td>0.0722</td>
<td>0.0126</td>
</tr>
<tr>
<td>June 2005</td>
<td>0.0593</td>
<td>0.0138</td>
</tr>
<tr>
<td>July 2005</td>
<td>0.0744</td>
<td>0.0146</td>
</tr>
<tr>
<td>August 2005</td>
<td>0.0683</td>
<td>0.0175</td>
</tr>
<tr>
<td>Average</td>
<td><strong>0.0705</strong></td>
<td><strong>0.0148</strong></td>
</tr>
</tbody>
</table>

The above table shows that the
Table No 8. Monthly average Ozone (O₃) levels in two areas (one hour average).

<table>
<thead>
<tr>
<th>Month</th>
<th>O₃ concentration in KMC area (ppm)</th>
<th>O₃ concentration in Yatinuwara (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>September 2004</td>
<td>0.0619</td>
<td>0.0169</td>
</tr>
<tr>
<td>October 2004</td>
<td>0.0428</td>
<td>0.0143</td>
</tr>
<tr>
<td>November 2004</td>
<td>0.0714</td>
<td>0.0181</td>
</tr>
<tr>
<td>December 2004</td>
<td>0.0522</td>
<td>0.0324</td>
</tr>
<tr>
<td>January 2005</td>
<td>0.0423</td>
<td>0.0218</td>
</tr>
<tr>
<td>February 2005</td>
<td>0.0612</td>
<td>0.0249</td>
</tr>
<tr>
<td>March 2005</td>
<td>0.0529</td>
<td>0.0316</td>
</tr>
<tr>
<td>April 2005</td>
<td>0.0813</td>
<td>0.0213</td>
</tr>
<tr>
<td>May 2005</td>
<td>0.0975</td>
<td>0.0129</td>
</tr>
<tr>
<td>June 2005</td>
<td>0.0624</td>
<td>0.0146</td>
</tr>
<tr>
<td>July 2005</td>
<td>0.0427</td>
<td>0.0161</td>
</tr>
<tr>
<td>August 2005</td>
<td>0.0569</td>
<td>0.0182</td>
</tr>
<tr>
<td>Average</td>
<td><strong>0.0604</strong></td>
<td><strong>0.0202</strong></td>
</tr>
</tbody>
</table>

Thus, the average O₃ levels in KMC area is about 3 times than that of Yatinuwara.
Results

• Air pollution was about one-fifths lower in the rural area
• Health problems were 50% lower in the rural area
COPD

- Group of disorders where lung function decline over the time.
- Two most common forms of this are,
  - **Chronic bronchities** – Excessive production of mucous
    - Swelling of bronchial wall
  - **Emphysema** – Ruptured alveoli
    - Loss of Natural elasticity of lung
    - Loss of the ability to absorb $O_2$ & release $CO_2$
COPD (Chronic Obstructive Pulmonary Disorder)

Enlarged view of air sacs (alveoli)

Emphysema: weakened and collapsed air sacs with excess mucus

Normal healthy air sacs
Course of action

• Strictly enforce emission testing for all vehicles including CTB buses, lorries, vans etc.
• Limit the import of three wheelers and motorbikes which are the worst polluters
• Improve quality of diesel
Costs of Failure

- A sick population and increased health costs:
  - COPD amongst children, lost school days due to asthma, heart problems for the elderly and cancer
- Loss of tourist revenue and eventually the world heritage status for Kandy!
Course of action

- One-way traffic has considerably lessened the air pollution in some areas of the Colombo city
- Kandy is not that lucky - Dalada Veediya still remains closed
THANK YOU