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

Pollutant	Maximum permissible level					
	24hrs		8hrs		1hr	
	mg/m^3	ppm	mg/m^3	ppm	mg/m^3	ppm
SPM	0.03		0.35		0.5	
SO_2	0.08	0.03	0.12	0.05	0.2	0.08
NO_2	0.01	0.05	0.15	0.08	0.25	0.13
O_3					0.2	0.1

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

Month	Kandy (ppm)	(ppm)
2005 January	0.12	0.016
February	0.08	0.010
April	0.07	0.011
May	0.07	0.005
June	0.06	0.006
July	0.07	0.008
(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

Month	No of Patients	deaths
January	190	5
February	191	4
March	143	
April	140	3
May	178	
June	139	2
July	144	4
August	179	2
September	180	1

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?

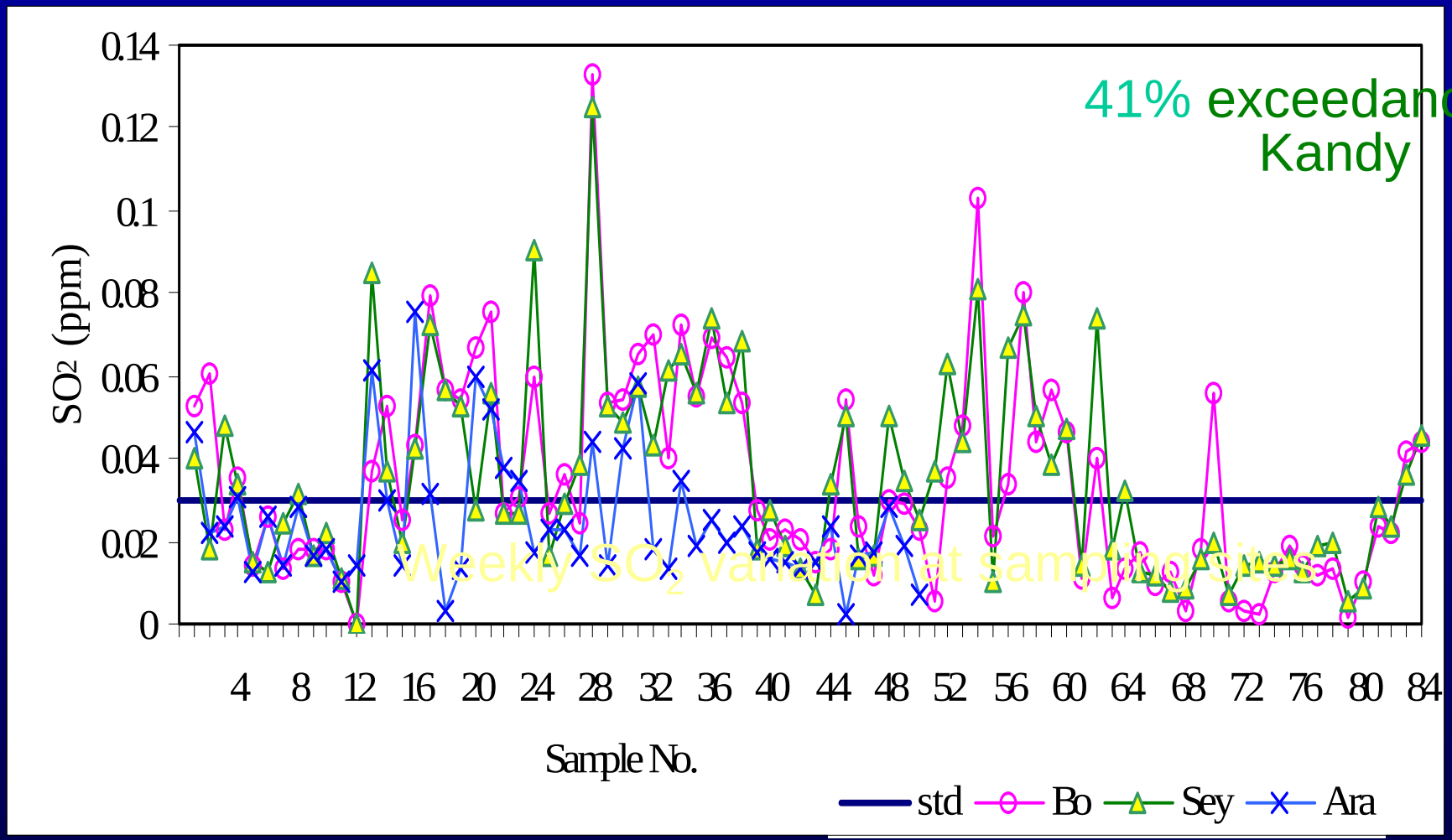
- Geographic location- Situated in a valley. Surrounded by the Hunnasgiriya and Hantane mountain ranges and also a number of hillocks close to town.
- High winds travel over the mountains.

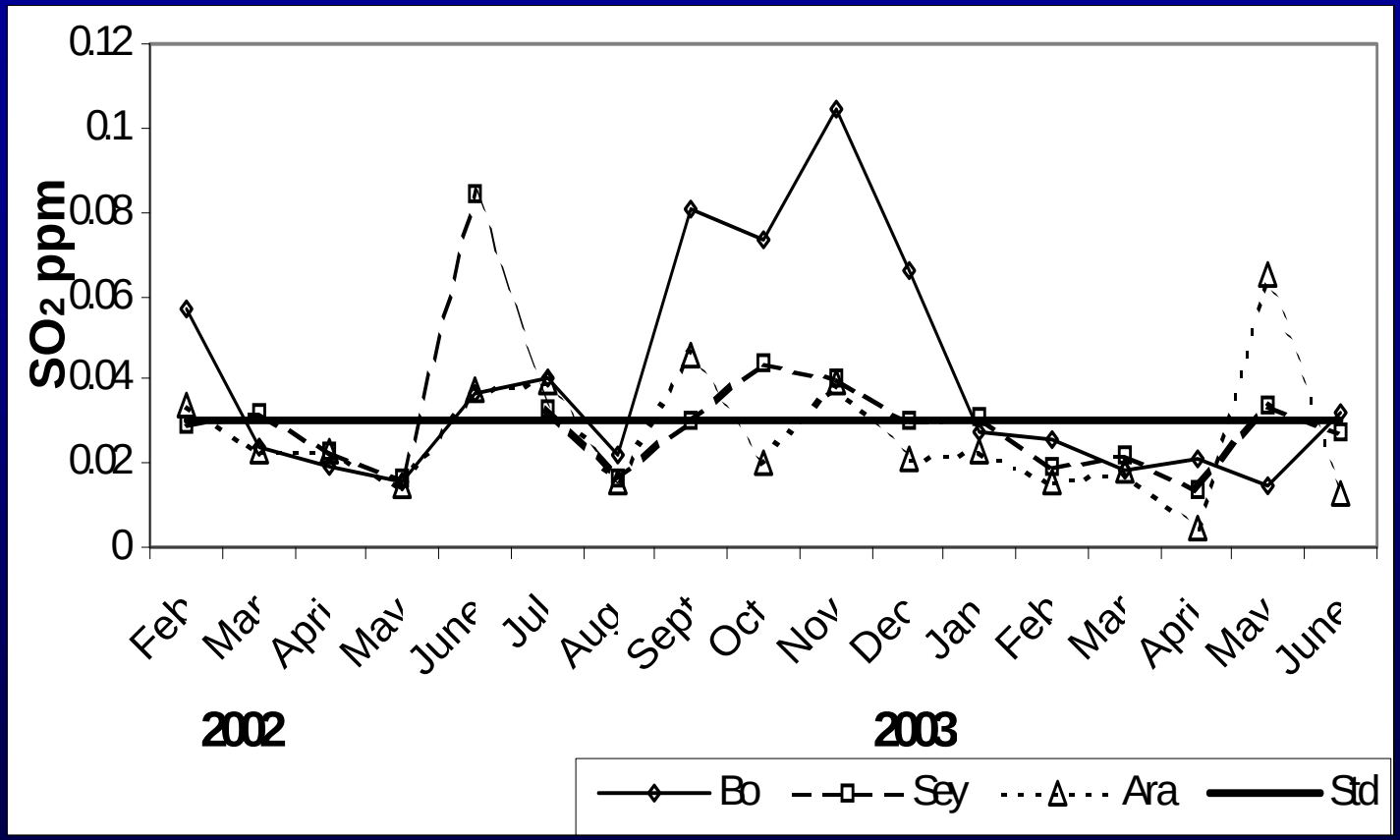
Pollution sources

- 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.

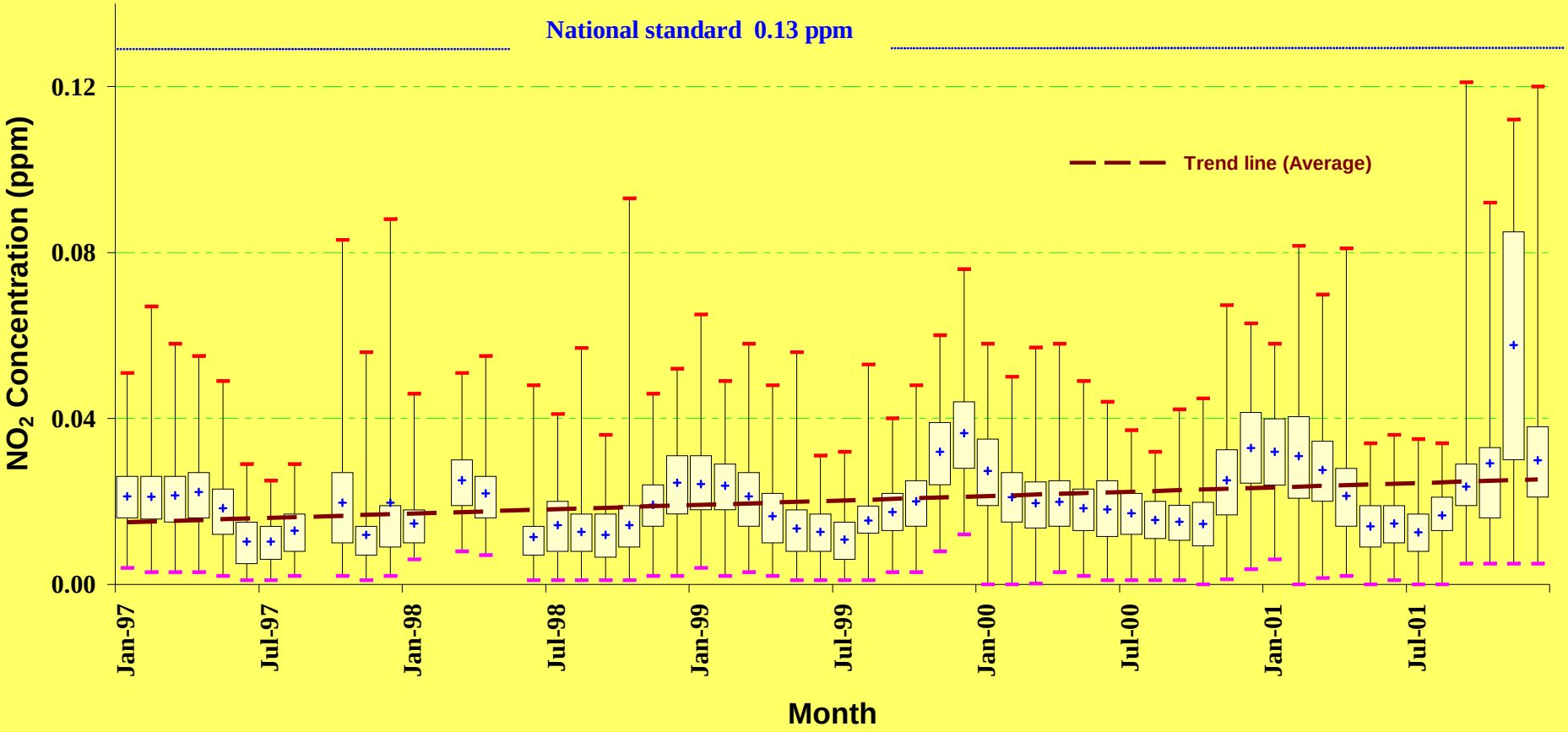
Why high degree of air pollution in Kandy…

- 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

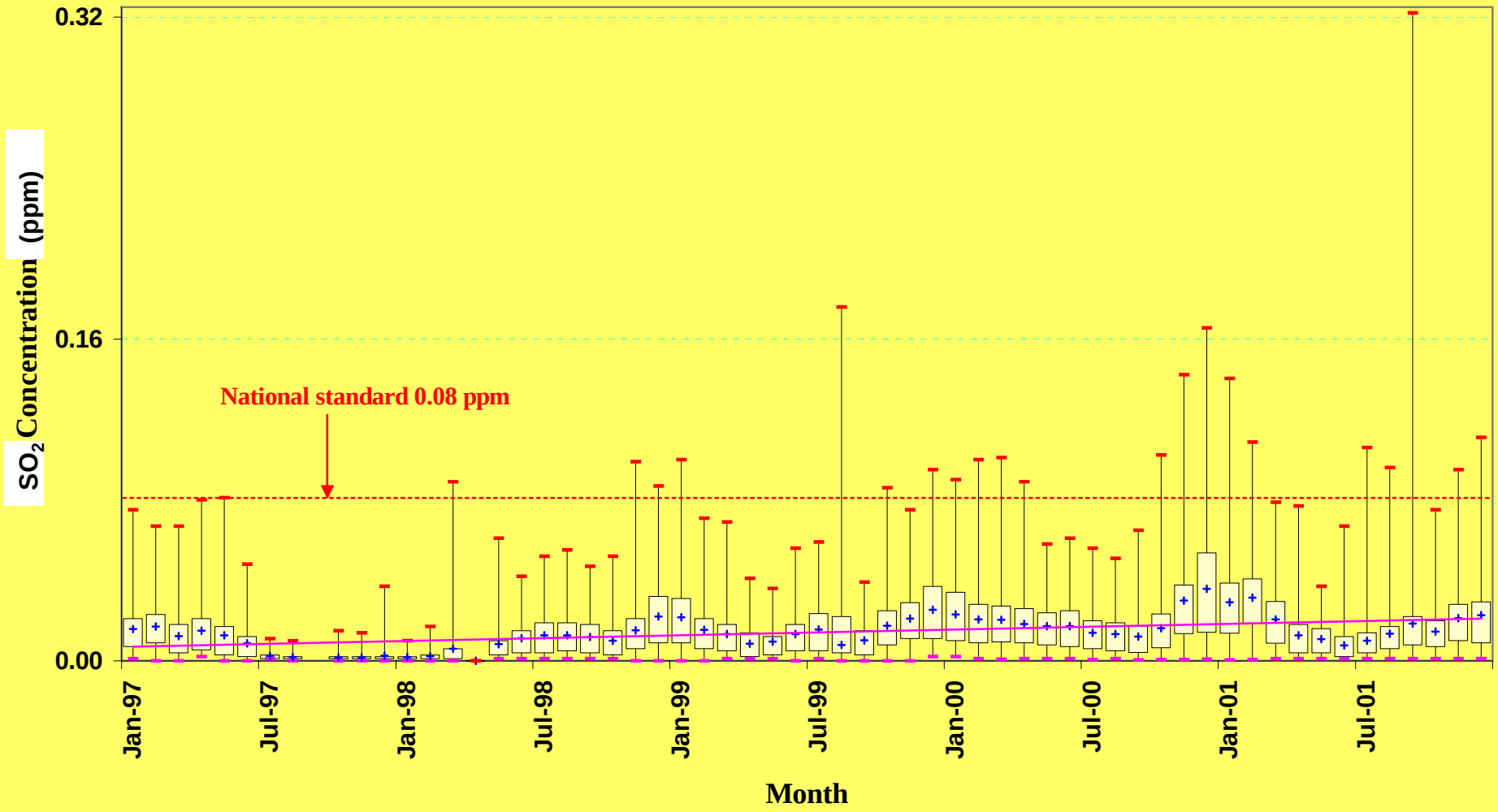

41% exceedance
Kandy
Weekly SO_2 variation at sampling sites
SO_2 (ppm)
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
4 8 12 16 20 24 28 32 36 40 44 48 52 56 60 64 68 72 76 80 84
Sample No.
std
Bo
Sey
Ara


0.12
0.1
0.08
0.06
0.04
0.02
0
SO2 ppm
Feb
Mar
Apri
May
June
Jul
Aug
Sept
Oct
Nov
Dec
Jan
Feb
Mar
Apri
May
June
2002
2003
Bo
Sey
Ara
Std

Variation of Nitrogen Dioxide (NO_2) One Hour Average Concentrations at Colombo Fort Ambient Air Quality monitoring station(1997-2001)



Variation of Sulfur Dioxide (SO_2) One Hour Averages concentrations at Colombo Fort Ambient Air Quality monitoring station



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 μg**
- **Phenanthrene** — **20-3400 μg**
- **Benzo(α)anthracene*** — **400-2000 μg**
- **Dibenzoanthracene*** — **20-2000 μg**
- **Benzofluoroanthracene*** — **400-2000 μg**
- **Benzo(α)pyrene*** — **300-5000 μg**
- ***carcinogenic**

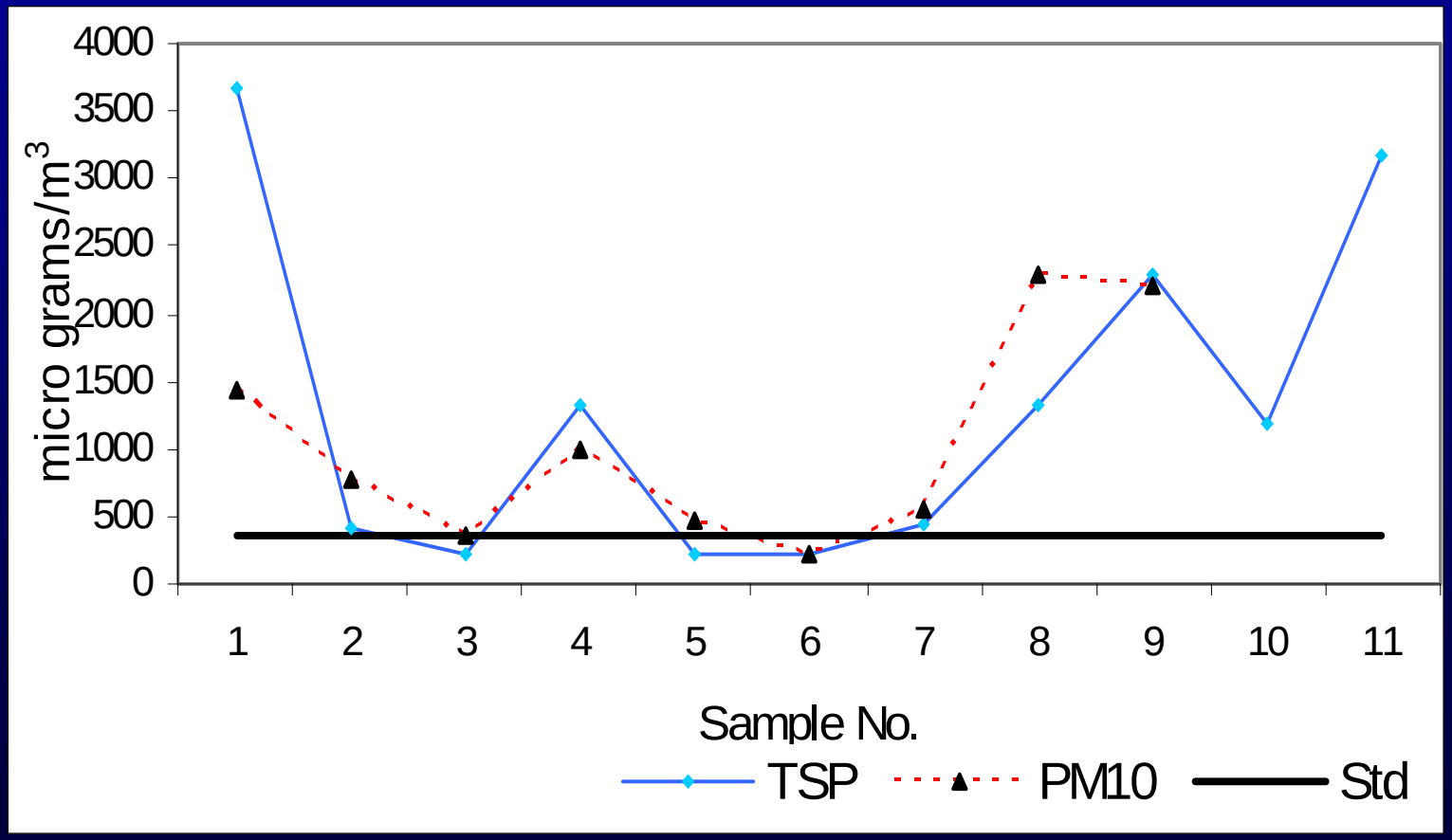
FINE PARTICLES

- 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

- **(O.A.Ileperuma and W.I. Siritunga (2006)**
- **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.

Health and Air pollution

Table No 7. Monthly average SO_2 levels in two areas. (24 hour average)

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

The above table shows that the

Table No 8. Monthly average Ozone (O_3) levels in two areas (one hour average).

Month	O_3 concentration in KMC area (ppm)	O_3 concentration in Yatinuwara (ppm)
September 2004	0.0619	0.0169
October 2004	0.0428	0.0143
November 2004	0.0714	0.0181
December 2004	0.0522	0.0324
January 2005	0.0423	0.0218
February 2005	0.0612	0.0249
March 2005	0.0529	0.0316
April 2005	0.0813	0.0213
May 2005	0.0975	0.0129
June 2005	0.0624	0.0146
July 2005	0.0427	0.0161
August 2005	0.0569	0.0182
Average	**0.0604**	**0.0202**

Thus, the average O_3 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

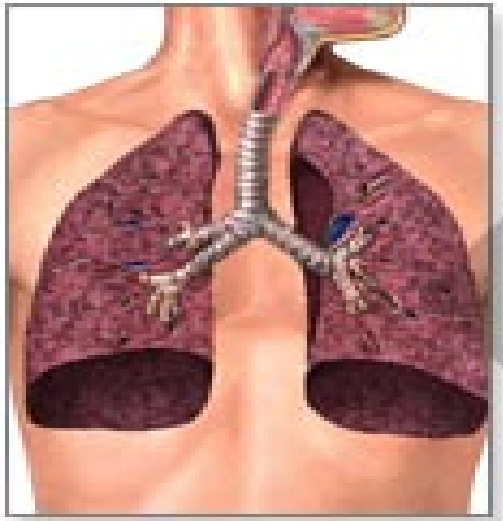
  Swelling of bronchial wall

  Emphysema – Ruptured alveoli

  Loss of Natural elasticity of lung

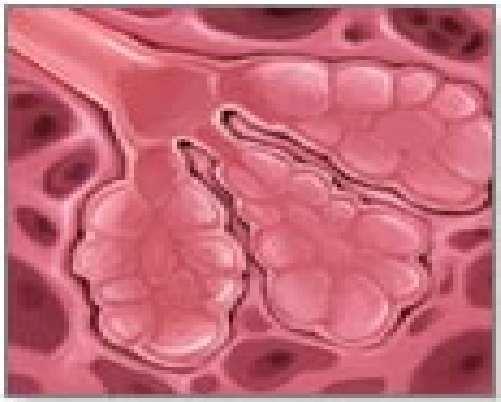
  Loss of the ability to absorb O_2 & release CO_2

COPD (Chronic Obstructive Pulmonary Disorder)



Enlarged view of air sacs (alveoli)

Emphysema: weakened and collapsed air sacs with excess mucus



Normal healthy air sacs

A.D.A.M.

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