Air pollution and Our Health: Setting the agenda

Centre for Science and Environment
New Delhi, February 13, 2013

Burden of Disease
Air pollution among top killers

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From its early stages, CSE's Right to Clean Air campaign used a variety of communication tools — such as this poster — to put out its message to the public. It built support.
Why it has become necessary to talk about air pollution and our health again....
City enveloped in smog, back to pre-CNG

During the first week of November, Delhi went under a thick blanket of smog. The breeze nearly stopped, and the skies turned grey and dank. Cool and calm weather led to fumes settling close to the ground. People held masks, scarves or handkerchiefs to their faces.

The resultant outcry in the smog-hit city had officials stubbornly insisting that this was nothing new and that it happened every year.

The new twist came when the Centre for Science and Environment (CSE), in its latest report, has delivered the shocker. The smog is here to stay. It has also warned that Delhi is in the grip of a multi-pollutant problem, which is not the only thing choking us. Nitrogen oxides...
Winter of 2012-13: Severe and consistent pollution episodes

PM10 and PM2.5

Three major pollution episodes

1) 29 October to 7 November, 2012:
   PM2.5 5 to 9 times higher than the standard. PM10 5 to 7 times the standard. NO2 close to twice the standard.

2) 22 – 27 December 2012:
   Both PM10 and PM2.5 four times the standard. NO2 close to double the standard.

3) 11 January February 2013: PM levels 3 times higher than the standard.
Number of days with critical pollution level skew during winter months

**PM10 classification of daily levels**

**PM2.5 classification of daily levels**

**NO2 classification of daily levels**
Arial raids.......Smoke from Punjab hogged news this year

October 2012: This is NASA image of smoke plume from agricultural burning in neighbouring states
Are there clean cities in India?

Out of 180 cities monitored for SO2, NO2 and PM10 in 2010, only two towns Malapuram and Pathanamthitta in Kerala met the criteria of low pollution (50% below the standard) for all pollutants.
More cities in grip of pollution

-- PM10 monitoring increased from 96 cities in 2005 to 180 cities in 2010.

-- Low polluted cities fallen from 10 to 2. --
Critically polluted cities (1.5 times the standards) increased from 49 to 89 cities.

-- 2005: 75% of cities exceeded the standard.
-- 2010: 78% of cities exceeded the standard.

NO2 monitoring increased from 100 cities to 177 cities
2005: Only 1 city exceeded the standard. 2010: 19 cities
| High | Nalagarh, Nalgonda, Kurnool, Panaji, Dewas, Salem, Parwano, Bhubaneshwar, Kolhapur, Pune, South Suburban, Guntur, Silchar, Vapi, Ujjian, Hyderabad, Kala Amb, Shillong, Coimbatore, Ankleshwar, Patencheru, Lakhimpur, Surat, Nashik, Dimapur, Pathankot/Dera Baba, Aurangabad, Cuttack, Golaghat, Balasore, Vishakhapatnam, Assanora, Dawkii, Ramagundam, Nalbari, Tezpur, Damtai, Solapur, Sagar, Kohima, Nellore, Gulbarga, Tura, Kothagudem, Sangli, Vasco, Kochi |
| Moderate | Sibsagar, Marmagao, Singrauli, Chennai, Tinsukia, Bongaiagon, Daranga, Shimla, Rayagada, Berhampur, Haldia, Trivendrum, Amona, Warangal, Thane, Sambalpur, Mangalore, Kottayam, Kollam, Madurai, Wayanad, Kashipur, Hassan, Mysore, Alappuzha, Kozhikode, Aizwal, Chitooor, Silvassa, Dibrugarh, Curchorem, Puducherry, Tirupati, Daman, Belgaum, Palakkad, Thissur, |
| Low | Malapuram, Pathanamthitta in Kerala |

Source: Based on CPCB air quality data
It is about people......

• Close to half of total urban population breath the air which exceeds the standard of PM10.

• One third of urban population live in cities with PM10 levels classified as critical -- close to Japan’s population.

10% of total urban population breathes the air which exceeds the standard of NO2.

50% of cities monitored are critically polluted for PM10

...... But 60% of people in monitored cities live in areas with critical PM10 levels

Source: CSE based on CPCB air quality data and Census population data
Non-metro cities have higher levels of PM10

<table>
<thead>
<tr>
<th>Cities with high levels</th>
<th>PM10 annual average in 2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ghaziabad</td>
<td>339</td>
</tr>
<tr>
<td>Gobindgarh</td>
<td>241</td>
</tr>
<tr>
<td>Ludhiana</td>
<td>233</td>
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<tr>
<td>Raipur</td>
<td>203</td>
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<tr>
<td>Lucknow</td>
<td>192</td>
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<tr>
<td>Satna</td>
<td>190</td>
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<tr>
<td>Kanpur</td>
<td>189</td>
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<tr>
<td>Jalandhar</td>
<td>187</td>
</tr>
<tr>
<td>Agra</td>
<td>183</td>
</tr>
<tr>
<td>Jamshedpur</td>
<td>166</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cities with high levels</th>
<th>PM10 annual average in 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ghaziabad</td>
<td>308</td>
</tr>
<tr>
<td>West Singhbhum</td>
<td>302</td>
</tr>
<tr>
<td>Ghaziabad</td>
<td>290</td>
</tr>
<tr>
<td>Raipur</td>
<td>289</td>
</tr>
<tr>
<td>Delhi</td>
<td>261</td>
</tr>
<tr>
<td>Yamunanagar</td>
<td>261</td>
</tr>
<tr>
<td>Usgao</td>
<td>245</td>
</tr>
<tr>
<td>Jharia</td>
<td>237</td>
</tr>
<tr>
<td>Khanna</td>
<td>231</td>
</tr>
<tr>
<td>Alwar</td>
<td>225</td>
</tr>
</tbody>
</table>

Source: Computed from the data provided by the CPCB
Mixed trends in cities

-- PM10: Stabilised in Ahmedabad, Kolkata, Hyderabad, Chennai
— Increased -- Delhi, Bangalore, and Mumbai show a decline in recent years
-- NO2: Stabilised in -- Ahmedabad, Chennai, Hyderabad,
Increasing in Delhi, and Kolkata
South Asia: Very high PM10 levels

Source: Based on WHO air quality database

PM10 in South Asia

Source: Based on WHO air quality database
Delhi has lost its gains. After a short respite pollution curve turns upward.
Ozone exceedance has begun in Jan-Feb
Source: Based on DPCC air quality data

The new danger: ozone

Source: Based on DPCC air quality data

Percentage of days exceeding hourly Ozone standards (Siri Fort, 2008-2010)
Stunning evidences in Delhi

--- Commuters breathe far more harmful particles inside vehicles while traveling compared to the ambient concentration.
-- The PM2.5 concentrations inside vehicles can be 1.5 times higher than the surrounding background air and ultra-fine levels about 8.5 times higher.
-- The short-term peaks during travel can go above 1000 microgramme per cum – nearly 16 times the daily limit. (*University of California, Berkeley research in Delhi*)

Influence of traffic maximum upto 500 meters from roadside. Health Effects Institute estimates that about 55% of Delhi’s population live in that influence zone. (*Health Effects Institute on Delhi*)

Proximity to source matters…..
Mounting global health evidences…..

Numerous studies of varying scale and scope

**Scale of studies** ---- Eg. the Arden Pope study (Journal of American Medical Association 2002) based on American Cancer Society data .....16 years, about 500,000 people in 116 metropolitan areas to arrive at irrefutable findings.

......... a mere increase of 10 microgramme per cum of PM2.5 can increase the risk of lung cancer by 8 per cent, cardiopulmonary deaths by 6 per cent, all deaths by 4 percent.

These findings are equally valid for India .... Human health is same........
India has its own health evidences too.....
Mounting evidences……

More than 72% studies after 1998
Surprise!
Most studies done by doctors themselves……..

Who has done the studies?

Source: CSE
Emerging evidences in Indian cities

Studies in large number of cities

Now studies on smaller cities as well

Post 2000......studies in small cities and towns as well

<table>
<thead>
<tr>
<th>Year</th>
<th>Metropolitan</th>
<th>Small cities and towns</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980-89</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>1990-99</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>2000-09</td>
<td>30</td>
<td>31</td>
</tr>
<tr>
<td>2010-12</td>
<td>10</td>
<td>20</td>
</tr>
</tbody>
</table>
Interesting …. About 60% studies have focused on exposure to traffic pollution…specially those occupationally exposed………..

Source: CSE
Studies have responded to the emerging concerns in air quality...

-- **Early years**: Primary focus on SPM, SO2, and little on NOX – nearly 60%

-- **Subsequent years**: A wider pollutant basket: VOCs, PM2.5, PAH etc

-- Benzene and its impacts in more than 10% of studies since 2000.

-- VOCs and PAHs in a few studies since 2000.

-- But very little on ozone – only one in Delhi.....

Source: CSE
Studies looking at a more diverse health end points….

Predictably respiratory health symptoms dominate....

Broadens to other health end points – cardiovascular, eye disorders, cellular changes, cancer, premature deaths....

<table>
<thead>
<tr>
<th>Effects studied</th>
<th>No. of studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respiratory</td>
<td>43</td>
</tr>
<tr>
<td>Cardio</td>
<td>7</td>
</tr>
<tr>
<td>Cancer Related</td>
<td>6</td>
</tr>
<tr>
<td>Eye related</td>
<td>4</td>
</tr>
<tr>
<td>Cytogenetic</td>
<td>6</td>
</tr>
<tr>
<td>Mortality</td>
<td>3</td>
</tr>
<tr>
<td>Others</td>
<td>8</td>
</tr>
</tbody>
</table>

Source: CSE
**Diabetes:** First large-scale population-based study links diabetes with air pollution. Increase in insulin resistance in lab test ... and an increase in markers of inflammation (which may contribute to insulin resistance) after particulate exposure.

Strong and consistent association between diabetes prevalence and PM2.5 concentrations. For every 10 μg/m3 increase in PM2.5 exposure, there was a 1 percent increase in diabetes prevalence. Counties with highest versus the lowest levels of PM2.5 pollution had a more than 20% increase in diabetes, which remained after controlling for diabetes risk factors. (Diabetes Care 2011)

**Heart:**

Acute Effects of Fine Particulate Air Pollution on Cardiac Arrhythmia: Conclusion: PM2.5 exposure within approximately 60 min was associated with increased PVC counts in healthy individuals. (He F et al 2011 The APACR Study. Environ Health Perspect)

**Blood pressure**

Traffic-related Air Pollution and Blood Pressure in Elderly Subjects With Coronary Artery Disease: Found positive associations of systolic and diastolic BP with air pollutants. The strongest associations were with organic carbon, multiday average exposures, ect. (Delfino, Ralph J.a et al 2010,, Epidemiology, May 2010)

**Effect on foetus:** Studies have shown damaging impact of PAH on even fetus

Source: CSE
India’s unique public health challenge

• The Asiawide review of existing studies show that the estimated health effects are similar to those found in the extensive studies in western countries.

• But the risk in south Asia could be more serious. Science has yet to assess our unique risk factors

• Extremely high levels of particulates and pollution cocktail -- the problem of exposure to multiple pollutants

• Impact of poverty: Socio economic variables are not included in health studies to influence public policy. Sporadic studies elsewhere show poor are more susceptible

Understand risk transition

• Double burden of disease. Modern or community risks increasing

• This has important implication for environmental monitoring strategies

Source: CSE
The vulnerable children, poor, elderly, city dwellers...
Children more susceptible -- low breathing zone; time spent outdoors; immature immunity; developing organs.............

**Effects of air pollution on the respiratory health of children:** Respiratory symptoms in 32% of children in Delhi, in contrast to only 18.2% of the rural children. (Delhi (2010) IIT Guwahati; CNCI Kolkata NEWS Kolkata & Health Canada)

**Air pollution lung function of children in Delhi,** Lung function reduced in 43.5% school children in Delhi as compared to 25.7% of control group. PM10 blamed for lung function deficits. (Delhi (2010): IIT Guwahati; CNCI Kolkata NEWS Kolkata & Health Canada)

**Attention-deficit hyperactivity disorder (ADHD) in children chronically exposed to high level of vehicular pollution** (2010): (IIT Guwahati; CNCI Kolkata; NEWS Kolkata; & Health Canada)

**The impact of atmospheric pollution on vitamin D status of infants and toddlers:** Delhi (2002): St. Stephens Hospital, Delhi;
The endpoint of the toxic risk is cancer

-- In India over 700,000 new cases and 300,000 people are set to die every year, estimates the National Cancer Control Programme (NCCP).

-- NCCP’s forecast -- by 2026, more than 1.4 million people will be falling in the grip of the disease.

-- NCCP has listed greater exposure to environmental carcinogens as one of the most important reasons.

-- Mitigation strategy must reduce environmental risk from all factors – and air pollution is an important factor.
Then came the shockers .................
December 2012

Globally air pollution related deaths have increased by 300 per cent since 2000. About 65 per cent of these deaths occur in Asia.

Air pollution ranked among the top 10 killers in the world

Two-thirds of the death burden from outdoor air pollution occurs in developing Asia

How about India? Don’t know yet…….
Cancer risk of diesel

The WHO/International Agency on Cancer Research reclassify diesel emissions as class 1 carcinogen, -- same class as tobacco for its strong link with lung cancer.

But India is dieselising very rapidly

Source: MP Walsh
June 2012

Toxicity (unit risk x emissions in cubic metre per kilometre)

- Euro 0
- Euro II
- Euro III
- Euro IV
- Diesel car with particulate trap

Comparison of new vehicles

Source: MP Walsh
CSE asked the Delhiites:

-- Has city’s air quality worsened?
-- What are the dominant sources of air pollution in the city and in their vicinity?
-- Frequency and type of respiratory ailments in their family
-- Are they aware of the pollution episodes?
-- Are they aware of the release of the Global Burden of disease report?
-- Do they know that the WHO-IARC has reclassified diesel emissions as class 1 carcinogen?
-- The key mitigation strategies they support

Majority have complained of multiple symptoms this winter.
What have Delhites said?

-- 64% have said air pollution is worsening. 26% -- it has remained the same.

-- 79% blame growing number of vehicles.

-- 77% say vehicles are closest source of pollution around their residences, offices

-- 74% say air pollution cause respiratory problems and respiratory symptoms. Report increased in frequency this winter. About 14% have said this has increased school absenteeism amongst children

-- Close to half say that doctors mention air pollution as one of the causal factors

-- Close to one third of the respondents have said that they are aware of the new Global Burden of disease estimates

-- 26% of Delhiites know that the WHO and International Agency on Cancer Research have reclassified diesel emissions as class 1 carcinogen, -- same class as tobacco for its strong link with lung cancer.
Response to individual mitigation strategies

-- Strong support for public transport walking and cycling. (64% and 70%)

-- 47% support reduction in car numbers.

-- 62% want restraint on diesel cars and SUVs on dirty diesel.

-- Support for clean fuel in power plants

-- 66% say reduce dependence on gen sets.
We have enough evidences to act and influence...

12th five year plan: Urban areas to meet the air quality standards by 2017.

The 12th plan highlights need for epidemiological studies

Planning Commission working on environment performance index to incentives states for environmental performance through budgetary allocation.

National Health Research Policy: will this address health concerns related to air pollution?

Clean Air Action Plan in cities….
India cannot afford to ignore health evidences anymore

Make National Ambient Air Quality Standards legally binding: The national air quality planning and city action plans need a roadmap for each source of pollution and aggressive measures. Impose penalty on cities if air quality standards are violated.

Account for health cost in decision making: Valuation of acute and chronic illnesses must be linked to decision on air pollution control measures.


Strengthen implementation plans for critically polluted areas

Need public information system on daily air quality with health advisories and implement smog alert and pollution emergencies measures

Control and cut explosive increase in vehicle numbers by scaling up public transport, non-motorised transport, compact city planning and car restraint measures
Let us manage the health risk transition well…. 

The cost of inaction is very high 

We cannot afford to wait.................
Let us begin the discussion....