Centre for Science and Environment’s Study

Mercury Pollution in Sonbhadra, Uttar Pradesh and its health impacts
Sonbhadra Study

• Mid-2011: Communities in Sonbhadra approached CSE to help them fight pollution from thermal power plants and coal mines in the district

• Banwasi Sewa Ashram (BSA) also approached to test heavy metal, especially mercury, pollution in the district

• CSE decided to do the study in association with BSA
Background

• Singrauli coalfields has one of the largest coal reserves in the country – more than a billion tonnes.

• The coalfields spreads over the Sonbhadra district of Uttar Pradesh and Singrauli district of Madhya Pradesh

• Presently, the maximum thermal power plants are in the Sonbhadra part and coal mining in the Singrauli part.
## Power & coal mining capacity

<table>
<thead>
<tr>
<th>District</th>
<th>Coal mining (million tonnes/year)</th>
<th>Thermal power plant (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sonbhadra, UP</td>
<td>17</td>
<td>9940</td>
</tr>
<tr>
<td>Singrauli, MP</td>
<td>66</td>
<td>3260</td>
</tr>
<tr>
<td>Total</td>
<td>83</td>
<td>13200</td>
</tr>
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</table>
Pollution in Singrauli

• Singrauli is known be a polluted area for a long time.
• In 2009, it was declared as 9th most critically polluted area of the country by MoEF/CPCB.
• A moratorium was put on any new or expansion projects.
• But moratorium was removed in 2010 after UP and MP pollution control boards submitted their 'action plan' to reduce pollution.
Action Plan

• Action plan commits to:
  • 100% flyash utilisation
  • Meet all pollution norms
  • Regular monitoring of pollution

• Most of these were to be done by 2012

• No mention of mercury pollution in action plan
Mercury pollution

• In 1998, Indian Institute of Toxicology Research, Lucknow carried out an extensive epidemiological study involving 1,200 people from Singrauli.

• It found high levels of mercury in humans, water, food items, etc. But this study was never made public; many years later synopsis of the study published by UNEP.

• In 2002-2003, CPCB found mercury in water, milk, food items, air, etc. CPCB was asked by Supreme Court.
Health impacts of Mercury

- Mercury is a neurotoxin and affect the central nervous system.
- Gets bio-concentrated and biomagnified within the food chain.
- Chronic exposure causes tremors, spasms and loss of memory, severe depression, and increased excitability, delirium, hallucination and personality changes.
- Renal damages can also happen
Minamata Disease

• Minamata disease is the first well studied and the most serious mercury poisoning which occurred in Minamata, Japan

• It happened due to consumption of fish and other seafood contaminated with methyl mercury

• Mercury was discharged from a chemical factory in Minamata Bay which contaminated the fish.

• Thousands died and thousands are still suffering
Objective of the Study

• To assess the exposure of the people of Sonbhadra district of Uttar Pradesh to heavy metal pollution especially mercury pollution.

• The study area selected was Dudhi subdivision of Sonbhadra district as it has largest concentration of thermal power plants, coal mines and many other polluting industries.
Methodology

• Primary survey of the area and meeting doctors and local communities in Sonbhadra
• Questionnaire-based health survey conducted
• Based on the above, decided on sampling area and identified affected people
• Sample collection
• Samples were properly preserved and transported to Delhi for testing at PML
• CSE team visited Sonbhadra in May & August 2012
Samples

• 19 human blood and hair and 18 human nail samples
• 23 water samples – 15 drinking water, 3 surface water and 5 effluent
• 7 soil samples, 5 cereal sample and 3 fish samples
• A total of 57 samples collected from the following affected areas – Chilika Daad, Dibulganj, Anpara, Renukut, Shaktinagar, Obra, Khairahi, Kirwani and Kushmaha
Analysis

• All tests conducted using internationally-accepted methodologies – USEPA, AOAC, American Public Health Association, Water Environment Federation etc.

• Heavy metals (lead, cadmium, chromium, arsenic and mercury) tested with AAS

• Methyl mercury analysis done with GC-ECD
Results – Human Samples

• Blood
  • Safe limit (USEPA): 5.8 ppb
  • Mercury found in 84% blood samples
  • Range: 0-113.5 ppb
  • Average: 34.3 ppb (about 6 times the safe limit)
Results – Human Samples

• **Hair:**
  - Safe limit (Health Canada): 6-30 ppm is 'increasing risk' category and more than 30 ppm is 'at risk' category
  - Mercury found in 58% hair samples
  - Range: 0-31.3 ppm
  - Between 6 – 30 ppm mercury levels found in 26% hair samples, 10.5% samples had more than 30 ppm
  - Average: 7.4 ppm *(increasing risk category)*
Results – Drinking water

• Drinking water in study area high in hardness, total dissolved solids, calcium and fluoride – not fit for drinking without treatment

• On top of it, mercury has started contaminating the groundwater

• Mercury found in 20% drinking water samples; Range: 0 – 0.026 ppm

• BIS limit of mercury in drinking water – 0.001 ppm

• Highest concentration found in hand pump at Dibulganj – 0.026 ppm, 26 times higher than the limit
Results – Drinking water

- Fluoride found in 80% drinking water samples
- Range: 0 – 2.1 ppm
- Fluoride problem in the district is well known. The state government had installed filters in hand pumps in 2009 but poor maintenance has done little for the water quality

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Filtered water</th>
<th>Unfiltered water</th>
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<tbody>
<tr>
<td>Hardness (ppm)</td>
<td>389</td>
<td>335</td>
</tr>
<tr>
<td>Calcium (ppm)</td>
<td>80</td>
<td>48</td>
</tr>
<tr>
<td>Fluoride (ppm)</td>
<td>1.8</td>
<td>2.1</td>
</tr>
</tbody>
</table>
Results – Surface water

- **Rihand (GBPS) reservoir** contaminated with mercury.

- Mercury level 0.01 ppm – 10 times higher than the drinking water standard

- **Obra dam** contaminated with fluoride (1.8 ppm) and Arsenic (0.019 ppm)

- Arsenic was also found in **Renuka river** at Obra (0.008 ppm)
Results – Effluents

- Water of Dongiya nala, which carries the effluent of **Aditya Birla Chemicals (previously Kanoria Chemicals)** had 4370 ppm TDS (Std: 2100 ppm), 4.5 ppm fluoride (Std: 2 ppm) and 0.127 ppm mercury (0.01 ppm).

- The result shows that Aditya Birla Chemicals is still a source of mercury pollution.
Dongiya Nallah
Results – Fish

- Two Rohu (*Labeo Rohita*) and one Malli (*Wallago attu*) fish samples tested
- Methylmercury detected in both Rohu samples and not in Malli
- Highest concentration found in Rohu sample from Shaktinagar – 0.505 ppm, which is twice the safe limit of 0.25 ppm
- Rohu sample collected from Rihand near Dongiya nallah contained 0.447 ppm of methylmercury.
- **Rohu fish of Rihand reservoir not fit for consumption**
Results – Soil

• Mercury found in 100% soil samples in range of 0.42 – 10.09 ppm. No standard for mercury in soil exists

• Highest concentration in soil sample from Rihand dam near Dongiya nallah – 10.09 ppm

• Arsenic also found in all soil samples in the range of 0.52 – 7.67 ppm

• Highest found in Khairahi which is above the 7.2 ppm standard set by the Agency for Toxic Substances and Disease Registry of the US
Results – Cereals

- Mercury was not found in any of the cereal samples.
- Arsenic found in 60% of the samples in the range of 0 – 0.173 ppm; all within the 1.1 ppm limit set by FSSAI.
IITR vs CSE – increasing contamination?

<table>
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<tbody>
<tr>
<td>66% samples exhibited more than 5 ppb blood mercury level</td>
<td>79% samples exhibited more than 15 ppb blood mercury level</td>
</tr>
<tr>
<td>48% samples exhibited more than 1 ppm hair mercury level</td>
<td>26% samples exhibited more than 6 ppm hair mercury level; more than 50% had more than 1 ppm</td>
</tr>
<tr>
<td>15% samples had more than 0.001 ppm of mercury in drinking water</td>
<td>20% samples had more than 0.003 ppm mercury for drinking water</td>
</tr>
</tbody>
</table>
What is the source of mercury?

- Thermal power plant, coal mines and Aditya Birla Chemicals
- CPCB: 0.09 – 0.487 ppm mercury in Singrauli coal
- CSE: 0.15 ppm of mercury in coal from Anpara
- This means the 13200 MW TPPs are releasing between 15-50 tonnes of mercury in a year – detailed survey required
More mercury in future if no action taken

## Industrialisation in Singrauli

<table>
<thead>
<tr>
<th>Sector</th>
<th>Present capacity</th>
<th>Proposed capacity</th>
<th>Players</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal mining (MTPA)</td>
<td>83</td>
<td>50</td>
<td>Northern Coalfields Limited, Mahan Coalfields Limited</td>
</tr>
<tr>
<td>Thermal power plants (MW)</td>
<td>13,200</td>
<td>9,600</td>
<td>Uttar Pradesh Rajya Vidyut Nigam Ltd, NTPC, Lanco, Hindalco</td>
</tr>
</tbody>
</table>

*MTPA: Million tonnes per annum*

*Source: Centre for Science and Environment analysis,*
Health Survey by the State

• According to Annual Health Survey of Uttar Pradesh 2010-11, high incidence of acute illnesses in Sonbhadra -- 30,664 people per 100,000 population – compared to the state average of 12,561 per 100,000 people

• High incidence of chronic illnesses 17,000 per 100,000 population; state average – 8,380 per 100,000
Health Survey by CSE

• 64 random sample – questionnaire-based health survey

• High incidence of vitiligo (skin discolouration), shivers, reduced vision, burning sensation in the limbs and impaired language skills.

• All these are known to be symptoms of mercury exposure.
Recommendations

• Put moratorium on new and expansion project till a mercury control action plan is put in place and implemented.

• Undertake carrying-capacity study to assess how many more industries can the environment sustain

• Mercury standards must be set for TPPs, coal washeries and mining
Recommendations

• Decontamination of the contaminated sites including Aditya Birla Chemicals

• Mercury is present in fish and water. These should be regularly monitored. Advisory must be issued to people not to consume them.

• Treated water must be provided in all hamlets, villages and towns

• People affected by mercury poisoning must be given medical assistance
Pollution in Sonbhadra

• Fly ash dumping in vast open areas is still a common practice: NTPC Shaktinagar fly ash pond
Pollution in Sonbhadra

- Fly ash mixed with water is being discharged into nallahs that drain into the GBPS reservoir or rivers: Fly ash slurry discharged in Renuka river
Recommendations

• Mercury norms developed based on health impacts

• Standards for new power plants:
  • US: Between 0.01 kg per TWh and 1.8 kg per TWh depending on the coal type
  • Canada: Between 3.0 kg per TWh and 15 kg per TWh depending on the coal type