



Centre for Science and Environment's Study

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

Lucknow, October 19, 2012

# About CSE



- One of India's leading non-profit public interest research institutions
- Set up in 1980 to promote sustainable development
- Works on a wide array of environment and development issues including water and waste management, industrial pollution & regulations, environmental health, food safety, climate change, renewable energy, air pollution and mobility management etc.

# About Pollution Monitoring Laboratory (PML)



- PML was set up in 2000 to monitor environment pollution and food contamination
- Setup as an independent lab to support communities and to investigate issues of public health concern
- Has state of the art equipments (GC-MS, HPLC, AAS etc.) to monitor trace organics and metals, criteria air and water pollutants and other food and environmental samples.

# Key Study and Impacts



- Feb 2001: Endosulfan study in Kasaragod, Kerala
  - 2001: Kerala government suspended the use of endosulfan in the state
  - May, 2011: Supreme Court of India banned the production, sale, exports and use of endosulfan across the country
- Feb 2003: Analysis of pesticide residues in bottled water
  - July 2003: Govt. notifies norms for pesticide residues in bottled water

# Key Study and Impacts



- August 2003 & 2006: Analysis of pesticide residues in carbonated beverages
  - August 2003, The fourth Joint Parliamentary Committee (JPC) was set up to investigate the CSE study
  - Based on JPC recommendations, new food law was enacted replacing the old one and the entire food safety governance structure was changed; the draft pesticide safety rules in parliament
  - August 2008: Union Health Ministry notified rules for maximum levels of pesticides in carbonated water; the first in the world

# Key Study and Impacts



- June 2005: Analysis of blood samples of farmers in the cotton belt of Punjab – *cancer registry established*
- Feb 2009: Fatty acid profile of edible oil and fats in India – *setting-up of transfats standards*
- August 2009: Analysis of lead content in paints – *companies voluntarily agreed to remove lead*
- November 2009, Bhopal contamination – *established that contamination still continues*

# Key Study and Impacts



- Sept 2010: Analysis of antibiotic residues in honey – *advisory issued and standards in the process of notification*
- March 2011: Nutritional analysis of junk food – *UP bans junk food in schools*
- February, 2012: Environmental contamination and chronic kidney disease in Sri Lanka

# 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



District	Coal mining (million tonnes/year)	Thermal power plant (MW)
Sonbhadra, UP	17	9940
Singrauli, MP	66	3260
Total	83	1320

# Pollution in Singrauli



- Singrauli is known to be a polluted area for a long time.
- In 2009, it was finally 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% utilise flyash
  - 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**
- **But what is the present status??**

# 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**



# Pollution in Sonbhadra



- Untreated effluent still being discharged into nallahs meeting the GBPS reservoir :

**Dongiya nallah carrying effluent from Aditya Birla Chemicals**



# 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 as the study was financed by NTPC Ltd it was never made public**
- 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 Dhudhi 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 in range of 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

Parameter	Filtered water	Unfiltered water
Hardness (ppm)	389	335
Calcium (ppm)	80	48
Fluoride (ppm)	1.8	2.1

# 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).
- **These results show that Aditya Birla Chemicals is one of the major sources of pollution of water of Rihand dam.**

# 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 of
- 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**

**0 100 200 KM**

**India's Mission to**

Engage the communities of India with respect and compassion and carry forward the spirit of the 3 E's (Economic, Environmental, and Ethical) to ensure that the world's most vulnerable people are not left behind. The 3 E's are the foundation of our mission and are the key to our success. We are committed to ensuring that the world's most vulnerable people are not left behind.



**Utra**  
 Mercury in bottom soil  
 Range: 0.12 ppm  
 Max: 0.12 ppm  
 Min: 0.00 ppm  
 Maximum mercury level  
 Max: 0.12 ppm  
 Min: 0.00 ppm  
 Soil  
 Mercury: 0.12 ppm

**Quality of the soil**

SAMPLE	STANDARD	SCORE
Soil	0.1 ppm	Central Board of Secondary Education (CBSE)
Water	0.05 ppm	Health Department, Delhi
Soil	no standard	
Water	0.05 ppm	World Health Organization (WHO)
Soil	0.1 ppm	Environment Protection Act, 1986
Soil	no standard	
Water	0.05 ppm	Environment Protection Act, 1986
Soil	0.1 ppm	Central Board of Secondary Education (CBSE)

**MADHYA PRADESH**  
 Singrauli

**UTTAR PRADESH**  
 Sonbhadra

**Dehri**  
 Mercury in bottom soil  
 Range: 0.12 ppm  
 Max: 0.12 ppm  
 Min: 0.00 ppm  
 Maximum mercury level  
 Max: 0.12 ppm  
 Min: 0.00 ppm  
 Drinking water  
 Mercury: 0.05 ppm  
 Soil  
 Mercury: 0.12 ppm

**Angra**  
 Soil  
 Mercury: 0.12 ppm  
 Drinking water  
 Mercury: 0.05 ppm  
 Soil  
 Mercury: 0.12 ppm

**Haridwar**  
 Soil  
 Mercury: 0.12 ppm

**Karnal**  
 Soil  
 Mercury: 0.12 ppm

**Khatola - Karnal**  
 Mercury in bottom soil  
 Range: 0.12 ppm  
 Max: 0.12 ppm  
 Min: 0.00 ppm  
 Maximum mercury level  
 Max: 0.12 ppm  
 Min: 0.00 ppm  
 Soil  
 Mercury: 0.12 ppm

**Chh. Ma. Das**  
 Mercury in bottom soil  
 Range: 0.12 ppm  
 Max: 0.12 ppm  
 Min: 0.00 ppm  
 Maximum mercury level  
 Max: 0.12 ppm  
 Min: 0.00 ppm  
 Soil  
 Mercury: 0.12 ppm

**SINGRAULI**

**Aligarh**

**Amroha**

**SEWA**  
 Mercury in bottom soil  
 Range: 0.12 ppm  
 Max: 0.12 ppm  
 Min: 0.00 ppm  
 Maximum mercury level  
 Max: 0.12 ppm  
 Min: 0.00 ppm  
 Soil  
 Mercury: 0.12 ppm

**SIRSA**

**Dehra Doon**  
 Mercury in bottom soil  
 Range: 0.12 ppm  
 Max: 0.12 ppm  
 Min: 0.00 ppm  
 Maximum mercury level  
 Max: 0.12 ppm  
 Min: 0.00 ppm  
 Soil  
 Mercury: 0.12 ppm

**SEWA (New Delhi)**  
 Mercury in bottom soil  
 Range: 0.12 ppm  
 Max: 0.12 ppm  
 Min: 0.00 ppm  
 Maximum mercury level  
 Max: 0.12 ppm  
 Min: 0.00 ppm  
 Soil  
 Mercury: 0.12 ppm

**SEWA (New Delhi)**  
 Mercury in bottom soil  
 Range: 0.12 ppm  
 Max: 0.12 ppm  
 Min: 0.00 ppm  
 Maximum mercury level  
 Max: 0.12 ppm  
 Min: 0.00 ppm  
 Soil  
 Mercury: 0.12 ppm

**LEGEND**

- Plant samples
- Water
- Soil
- Soil sites
- Industry
- Thermal Power Plants (TPP)





# IITR vs CSE – increasing contamination



IITR Study, 1998	CSE Study, 2012
66% samples exhibited more than 5 ppb blood mercury level	79% samples exhibited more than 15 ppb blood mercury level
48% samples exhibited more than 1 ppm hair mercury level	26% samples exhibited more than 6 ppm hair mercury level; more than 50% had more than 1 ppm
15% samples had more than 0.001 ppm of mercury in drinking water	20% samples had more than 0.003 ppm mercury for drinking water

# 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

Sector	Present capacity	Proposed capacity	Players
Coal mining (MTPA)	83	50	Northern Coalfields Limited, Mahan Coalfields Limited
Thermal power plants (MW)	13,200	9,600	Uttar Pradesh Rajya Vidyut Nigam Ltd NTPC, Lanco, Hindalco

*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



- 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.**
- **They indicate the beginning of mercury poisoning**
- **Take action now!!!!!!**

# Recommendations



- Put moratorium on new and expansion project till a mercury control action plan is put in place.
- Undertake regional impact assessment to assess how many more industries can the environment sustain
- Mercury standards must be set for TPPs, coal washeries and mining
- Aditya Birla Chemicals must be penalised and asked to stop mercury discharge and decontaminate its site

# Recommendations



- 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 and the polluting industries should pay for it
- People affected by mercury poisoning must be given medical assistance