



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



District	Coal mining (million tonnes/ year)	Thermal power plant (MW)
Sonbhadra, UP	17	9940
Singrauli, MP	66	3260
Total	83	13200

Pollution in Singrauli



- Singrauli is known to 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

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).
- **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**

0 100 200 KM

India's Nitrate in

Exposure: the concentration of nitrate in drinking water and groundwater and heavy metal content in soil & agricultural produce. There are data on nitrate pollution in drinking water from only a few states. The following table provides information on nitrate and heavy metal content in drinking water in some states. High nitrate levels in drinking water may increase the risk of cancer and other health problems.



Uttar Pradesh
Meerut
 Maximum nitrate level
 Groundwater: 10.00 ppm
 Soil: 10.00 ppm
 Maximum nitrate level
 Groundwater: 10.00 ppm
 Soil: 10.00 ppm
 Nitrate
 Maximum: 10.00 ppm

Mean of the data

SAMPLE	STANDARD	SCORE
Soil	10.00 ppm	Drinking Water Enforcement Protection Agency (DWPE)
Soil	10.00 ppm	Health Department, Canada
Soil	no standard	
Water	10.00 ppm	World Health Organization (WHO)
Water	10.00 ppm	Environment Protection Act, 1986
Soil	no standard	

Mean of Mean of the data

Soil	10.00 ppm	Environmental and Standard Authority of India (ESAI)
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MADHYA PRADESH
 Singrauli

UTTAR PRADESH
 Sonbhadra

Dehri
 Maximum nitrate level
 Groundwater: 10.00 ppm
 Soil: 10.00 ppm
 Maximum nitrate level
 Groundwater: 10.00 ppm
 Soil: 10.00 ppm
 Drinking water
 Maximum: 10.00 ppm
 Soil
 Maximum: 10.00 ppm

Angra
 Soil
 Maximum: 10.00 ppm
 Drinking water
 Maximum: 10.00 ppm

Amraoti
 Soil
 Maximum: 10.00 ppm

Kanpur
 Soil
 Maximum: 10.00 ppm

Khatola - Ghosi
 Maximum nitrate level
 Groundwater: 10.00 ppm
 Soil: 10.00 ppm
 Maximum nitrate level
 Groundwater: 10.00 ppm
 Soil: 10.00 ppm
 Soil
 Maximum: 10.00 ppm

Chh. Ma. Das
 Maximum nitrate level
 Groundwater: 10.00 ppm
 Soil: 10.00 ppm
 Soil
 Maximum: 10.00 ppm

SINGRAULI

Meerut

Dehri

Angra

Amraoti

DIDHINAGAR

GHPS (New Bahadurpur)
 Maximum nitrate level
 Soil: 10.00 ppm

SINGRAULI

Dehri
 Maximum nitrate level
 Groundwater: 10.00 ppm

GHPS (New Bahadurpur)
 Maximum nitrate level
 Groundwater: 10.00 ppm

GHPS (New Bahadurpur)
 Maximum nitrate level
 Groundwater: 10.00 ppm

LEGEND

- Point 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



- 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**