

4. Heavy Metal Contamination – Environment

Heavy metals in Cauvery fish, study warns against regular intake. A recent study highlights alarming heavy metal contamination (like lead, mercury, and cadmium) in Cauvery River fish, reflecting a wider Indian problem of river and groundwater pollution from sources like arsenic and fluoride. This contamination, stemming from both industrial and natural sources, causes severe health and environmental damage, prompting solutions ranging from bioremediation and reverse osmosis to government initiatives like the Namami Gange programme.

Contamination in Cauvery River

Key Finding – A recent study published in the journal *Environmental Earth Sciences* reveals alarming levels of heavy metal contamination.

Specific Location – The contamination was identified in fish species sampled from the Cauvery River.

Identified Risks – This pollution poses serious risks to both the local ecosystems and public health, as these metals enter the food chain.

About Heavy Metals

Definition – Heavy metals are naturally occurring elements. They are chemically characterized by having high atomic weights and high densities.

Duality of Metals –

Essential Metals – Some, like iron and zinc, are essential for human and animal health but are required only in trace amounts.

Toxic Metals – Others are highly toxic even at very low concentrations. The most notable examples include lead, mercury, arsenic, and cadmium.

Environmental Pathway

Sedimentation – These pollutants tend to settle in river sediments rather than being washed away.

Bioaccumulation – They are absorbed by aquatic life and bioaccumulate, meaning their concentration increases as they move up the food chain (e.g., from plankton to fish).

Human Exposure – Humans are exposed by consuming contaminated fish and drinking contaminated water.

Sources of Contamination

Anthropogenic (Human-Caused) Sources

Industrial Processes – Activities such as coal mining, smelting (metal extraction), and leather tanning are major contributors. Other sources include various manufacturing and industrial activities.

Natural Sources –

Geological Seepage – Some heavy metals are naturally present in groundwater due to seepage from specific rock formations.

Natural Events – Volcanic activities and forest fires can also release heavy metals into the environment.

Contamination in India's Water Bodies & Food

1. In River Systems

Central Water Commission (CWC) Report – The CWC found that toxic metals—including arsenic, cadmium, chromium, copper, nickel, and lead—were present in concentrations exceeding permissible limits in many rivers.

Affected Rivers – Major rivers like the Ganga, Yamuna, Cauvery, and Arkavati showed significant multi-metal pollution.

Primary Causes – This river pollution is often directly linked to untreated industrial discharge and raw sewage flowing into the water bodies.

2. In Groundwater

Ministry of Jal Shakti Data – The Ministry confirmed that 36,873 rural habitations were affected by heavy metal contamination in their groundwater sources.

Most Common Pollutants – Arsenic and fluoride were identified as the most common and widespread pollutants.

Isolated Pollutants – Cadmium and lead were also found, typically in isolated pockets rather than being widespread.

3. In Food Sources

Fish – Dangerous levels of mercury, lead, and cadmium were found in fish from the Cauvery River and the Kochi backwaters.

Vegetables – A study by EMPRI Karnataka found that vegetables sold in Bengaluru markets also contained heavy metals beyond safe limits.

Impacts of Heavy Metal Contamination

Health Hazards – Can cause severe neurological damage, kidney failure, and bone deformities. They are often carcinogenic, leading to various cancers. In children, exposure can lead to developmental disorders.

Soil Degradation – Reduces soil fertility and harms beneficial microbial activity. This leads to lower crop yields and poorer food quality.

Water Pollution – Leads to the widespread contamination of rivers and groundwater. Triggers bioaccumulation in fish, making them unsafe for consumption and affecting the entire aquatic food chain.

Economic Losses – Directly affects the viability of agriculture and fisheries. Leads to a significant rise in public healthcare costs in contaminated regions.

Ecosystem Imbalance – Disrupts biodiversity by killing off sensitive species. Alters nutrient cycles in the soil and water. Causes comprehensive damage to flora and fauna in affected ecosystems.

Remedies for Heavy Metal Contamination

Scientific and Technological Solutions

Eco-friendly Reduction Methods – Advanced techniques like adsorption, membrane filtration, and photocatalysis are being developed for sustainable water treatment.

Bioremediation – This method uses microorganisms and plants (e.g., the bacterium *Streptomyces Rochei*) to absorb and detoxify metals from soil and water.

Phytoremediation – A low-cost and green solution that involves using specific plants that can extract and store metals from contaminated soil.

Biosorption – This technique utilizes various raw materials—such as agro-waste, plant residue, and algal or microbial biomass—to naturally absorb metals from water.

Reverse Osmosis (RO) – A physical filtration process where water is forced through a series of semi-permeable filters to remove contaminants.

Resin-based Water Treatment – This technology uses ion exchange resins (small, porous beads) that swap undesirable ions (like heavy metals) for harmless ones (like sodium) to purify water.

Project-Based Solutions (Case Study)

KC Valley Project – This initiative in Karnataka used treated wastewater to recharge groundwater aquifers, which successfully helped restore groundwater quality in drought-prone areas.

Community and Environmental Action

Decentralized Water Treatment – Emphasizes local solutions suitable for rural communities, such as sand filtration and activated carbon filters.

Land Remediation – Involves repurposing industrial byproducts, such as steel slag, and applying them to contaminated land to reduce soil toxicity.

Government Initiatives

National Clean Ganga Mission (NCG) and Namami Gange – These flagship programs aim to clean the Ganga River, with a primary focus on **targeting and reducing industrial effluent** discharge.

National Aquifer Mapping & Management Programme (NAQUIM) – A scientific program to map the country's aquifers and **identify zones affected by heavy-metal contamination**.

Lead Control Regulations – The complete ban on leaded petrol (achieved through BS Norms). The Lead Paint Regulations (2016) to control lead in household and commercial paints.

E-waste Management Rules (2022) – These rules are designed to ensure the safe disposal of electronic

waste, thereby curbing the toxic discharges (including heavy metals) that result from improper handling.

Targeted Health Programmes – The National Programme on Prevention & Control of Fluorosis and Arsenicosis is a public health initiative specifically aimed at addressing the two most common groundwater contaminants.

Source – <https://www.thehindu.com/sci-tech/energy-and-environment/heavy-metals-in-cauvery-fish-study-warns-against-regular-intake/article70210960.ece>

