



SILENT THREATS: UNSEEN CHEMICALS IN THE ENVIRONMENT AND THEIR IMPACT ON HUMAN HEALTH

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ABSTRACT

Environmental toxins, which are invisible and frequently disregarded, are quietly causing a global public health emergency. Synthetic chemicals and persistent organic pollutants (POPs) are found in the air, water, soil, and food chains in everything from domestic goods to industrial effluents. The sources, routes, and health impacts of invisible substances in the environment are examined in this research. It investigates their link to long-term conditions such cancer, neurodevelopmental abnormalities, endocrine disruption, and reproductive problems. In order to lessen the subtle but serious risks to human health, the study promotes stricter environmental regulations and increased public awareness.

KEYWORDS: Environmental toxins, synthetic chemicals, organic pollutants, neurodevelopmental abnormalities, endocrine disruption, persistent pollutants, chemical exposure.

1. INTRODUCTION

The modern environment is increasingly burdened with chemical contaminants, many of which are invisible to the naked eye. These substances, ranging from pesticides to plasticizers, accumulate silently in ecosystems and bio magnify through the food chain. While technological advances and industrial growth have improved human life, they have also led to unintended health consequences due to chemical exposure.

According to the World Health Organization.^[1] more than 1.6 million deaths annually are attributable to toxic environmental chemicals. The silent nature of exposure without immediate symptoms makes them particularly dangerous and often underreported.

2. Major Sources of Environmental Chemicals

2.1 Industrial and Agricultural Sources

- **Pesticides and herbicides** such as DDT, glyphosate
- **Heavy metals** like mercury, lead, cadmium from mining and manufacturing
- **Volatile organic compounds (VOCs)** from paints, fuels, and solvents

2.2 Domestic Sources

2.3 Environmental Persistence

Many of these chemicals are **non-biodegradable**, remain in the environment for decades, and can travel long distances through air and water.^[2]

3. Pathways of Human Exposure

- **Inhalation:** Indoor and outdoor air pollution
- **Ingestion:** Contaminated food and water
- **Dermal absorption:** Through cosmetics and handling of treated materials

A study by showed that nearly every individual worldwide.^[3] carries detectable levels of synthetic chemicals in their blood, including newborns through placental transfer.

4. Health Effects of Unseen Environmental Chemicals

4.1 Endocrine Disruption

Chemicals like BPA, dioxins, and phthalates mimic or block hormones, disrupting:

- Puberty and reproductive development
- Thyroid function
- Insulin regulation

4.2 Cancer

Long-term exposure to carcinogens⁵ such as benzene, arsenic, and polychlorinated biphenyls⁶ (PCBs) increases the risk of

- Leukemia
- Liver cancer
- Breast and prostate cancers

4.3 Neurodevelopmental Disorders

Prenatal and early-life exposure to chemicals like lead and organophosphates⁴ is linked with:

- Autism Spectrum Disorders (ASD)
- Attention-Deficit/Hyperactivity Disorder (ADHD)
- Lower IQ scores

4.4 Reproductive Health

Chemical pollutants have been associated with:

- Infertility
- Miscarriages
- Hormonal imbalances
- Birth defects

5. Case Studies and Global Examples

5.1 Minamata Disease (Japan)

Mercury poisoning from industrial waste caused severe neurological damage and birth defects in residents consuming contaminated fish.

5.2 Bhopal Gas Tragedy (India)

A chemical leak of methyl isocyanate killed thousands and left long-term health consequences for survivors.

5.3 Flint Water Crisis (USA)

Lead-contaminated drinking water led to widespread developmental and behavioral disorders in children.

6. Mitigation Strategies

6.1 Policy and Regulation

- Strengthening laws like **REACH** (EU), **TSCA** (USA), and **BIS guidelines** (India)
- Banning persistent organic pollutants (POPs)

6.2 Public Health Measures

- Regular health surveillance
- Chemical monitoring in air, water, and food
- Promoting green chemistry and safer alternatives

6.3 Awareness and Education

Empowering the public with knowledge to reduce exposure (e.g., avoiding plastic containers, reading product labels)

6.4 India has launched several government schemes and policies aimed at reducing environmental pollution and promoting sustainable development. Below is a list of major government schemes and initiatives to control and reduce environmental pollution

6.4.a National Clean Air Programme (NCAP) – 2019

- **Objective:** Reduce air pollution levels by 20–30% by 2024 (compared to 2017).
- **Focus:** 131 non-attainment cities.

- **Strategy:** Public transport promotion, dust control, industrial and vehicle emission checks.

6.4.b Swachh Bharat Abhiyan (Clean India Mission) – 2014

- **Objective:** Eliminate open defecation and improve solid waste management.
- **Impact:** Reduces water and soil pollution caused by human waste.

6.4.c Namami Gange Programme – 2014

- **Objective:** Rejuvenate the River Ganga and reduce water pollution.
- **Actions:** Sewage treatment, river cleaning, effluent monitoring.

6.4.d National Electric Mobility Mission Plan (NEMMP) – 2013

- **Objective:** Promote electric vehicles to reduce vehicular pollution.
- **Supported by:** FAME India Scheme.

6.4.e FAME India Scheme – 2015 (Updated FAME II – 2019)

- **Objective:** Subsidies for electric vehicles including scooters, buses, and rickshaws.

6.4.f Environment Protection Programme (EPP)

- **Focus:** Monitoring and control of air, water, and noise pollution.
- **Includes:** National Air Monitoring Programme (NAMP).

6.4.g National River Conservation Plan (NRCP)

- **Goal:** Reduce pollution in rivers like the Yamuna, Godavari, and others.
- **Activities:** STPs, sanitation, public awareness.

6.4. h Ujjwala Yojana – 2016

- **Objective:** Provide LPG connections to reduce indoor air pollution.
- **Target:** Low-income rural households.

6.4.i Perform, Achieve, and Trade (PAT) Scheme

- **Goal:** Reduce industrial energy use and emissions.
- **Approach:** Market-based trading of energy-saving certificates.

6.4.j National Afforestation Programme (NAP)

- **Objective:** Increase forest cover, reduce carbon dioxide, and improve ecology.
- **Implemented by:** State Forest Departments, MoEFCC.

6.4. k Graded Response Action Plan (GRAP) – Delhi NCR

- **Aim:** Tackle severe air pollution in Delhi NCR.
- **Measures:** Ban diesel generators, construction limits, odd-even rule.

6.4.l Bio-Energy and Waste to Energy Programme

- **Objective:** Use organic, agricultural, and municipal waste for energy production.
- **Promoted by:** Ministry of New and Renewable Energy (MNRE).

6.4.m State Pollution Control Boards (SPCBs)

- **Role:** Implement and enforce pollution control at the state level.
- **Monitors:** Industrial pollution, emissions, and compliance.

7. CONCLUSION

The growing presence of invisible yet harmful chemicals in our environment poses a serious threat to public health and ecological balance. These pollutants, often persistent and bioaccumulative, silently infiltrate human systems through air, water, food, and even household products, leading to severe health consequences such as hormonal disruptions, cancer, and neurodevelopmental disorders.

Case studies like Minamata, Bhopal, and Flint demonstrate the long-term dangers of unchecked chemical exposure. However, the crisis is not insurmountable. Through effective policy implementation, technological innovation, and public awareness, chemical pollution can be significantly reduced.

India's proactive stance, as seen in programs like the National Clean Air Programme, Swachh Bharat Mission, and Ujjwala Yojana, reflects a growing commitment to environmental health. Continued investment in green chemistry, stricter regulation, and individual responsibility will be crucial in ensuring a safer, healthier future for all.

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