Community-based Monitoring of Industrial Chemical Pollution in Textile Communities in Bangladesh

Multi-actor Partnership for Improved Due Diligence Implementation in the Textile Sector

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Introduction

This scientific report offers an integrated analysis of environmental pollution, human health impacts, and chemical regulation in textile-producing communities in Ashulia, Dhamsona, Member Bari, Ghoshbag, Jamgora, Molla Bazaar, in Bangladesh. The findings are based on field research carried out by the Environment and Social Development Organization (ESDO) as part of the project 'Multi-actor Partnership for Improved Due Diligence Implementation in the Textile Sector'. The project partners include FEMNET, Südwind, INKOTA, BILS, ESDO and HEJSupport.

The research combined community-based environmental monitoring (CBM), laboratory testing of soil, water, and hair samples, and focus group discussions. The study uncovers significant health issues among residents living near textile factories, including skin diseases, respiratory conditions, and gastrointestinal problems. Other health problems related to harmful chemicals may occur later in life, which include, among others, various types of cancer, reproductive problems, diabetes, neurological and cardiovascular diseases. These issues are linked to exposure to industrial chemicals and inadequate waste management practices. The report further places these findings within the context of global regulatory frameworks, such as the Stockholm, Basel, Rotterdam, and Minamata Conventions, along with Bangladesh's national environmental laws.

Methodology

The research used participatory and scientific methods. ESDO made several field visits in Ashulia, including Ashulia, Dhamsona, Member Bari, Ghoshbag, Jamgora, and Molla Bazaar. In the Ashulia area live approximaltely 317.000 people.

Data collection involved focus group discussions (FGDs), in-depth interviews, and sampling soil, water, and hair for laboratory analysis. The laboratories - Hohenstein Bangladesh, SGS Bangladesh, and the National Institute for Minamata Disease (NIMD, Japan) - performed chemical tests for pollutants like heavy metals, PFAS, phthalates, azo dyes, nonylphenol, octylphenol, and nonylphenol ethoxylates.

Community-based Monitoring (CBM) tools helped record symptoms, health issues, and local environmental observations.

Health Impacts of Identified Chemicals

Industrial chemicals found or expected in textile-related emissions and wastewater have well-documented adverse health effects. The main groups of concern include heavy metals, persistent organic pollutants (POPs), PFAS, azo dyes, Nonylphenol, Octylphenol, and nonylphenol ethoxylates, and plasticizers such as phthalates. The following table summarises the toxicological profiles and key health effects of major contaminants relevant to the Ashulia study.

Chemical Group	Common Compounds / Uses	Major Health Effects
Heavy Metals	Lead, Mercury, Cadmium, Chromium	Neurotoxicity, kidney and liver damage, reproductive toxicity, carcinogenicity, developmental effects
PFAS	PFOA, PFOS, PFHxS	Endocrine disruption, immune suppression, reproductive harm, cancer risk
Azo Dyes	Disperse Blue 1, Direct Black 38	Allergic dermatitis, bladder cancer, respiratory irritation
Phthalates	DEHP, DBP	Hormonal disruption, infertility, asthma, developmental issues
Chlorinated Paraffins	SCCPs, MCCPs	Liver toxicity, thyroid disruption, persistence and bioaccumulation
Alkylphenols and alkylphenol ethoxylates	Nonylphenol, Octylphenol, and Nonylphenol Ethoxylates	Endocrine disruption, reproductive and developmental toxicity, immune system effects, neurotoxicity, liver toxicity

Community Health Findings

The community health findings outlined below are based on field visits, focus group discussions, and community-based monitoring data collected across several industrial zones in Ashulia, known for its textile production. The observations combine local testimonies with on-site environmental inspections, showing how inadequate waste management, air and water pollution, and industrial heat directly affect daily life and health. Each community profile summarises the main environmental challenges and their related health impacts, highlighting exposure patterns that reflect broader structural issues in industrial oversight and urban planning. Communities near garment factories report a high occurrence of respiratory issues, skin problems, and gastrointestinal illnesses. Women and children are identified as particularly vulnerable populations.

Community	Dominant Environmental Issues	Reported Health Effects
Dokkhin Gazirchat	**1. Poor Waste Management** This refers to **inadequate handling and disposal of solid and liquid wastes**, particularly from nearby textile factories and local households. Industrial waste (e.g., sludge, dye residues, and chemical containers) is often **dumped openly or in drainage canals.** Municipal waste services are either absent or insufficient, leading to **accumulation of garbage and decaying organic material**. Such conditions cause **foul odors, contamination of soil and water**, and proliferation of insects and rodents. **2. Drainage Problems** "Drainage" here means the system (or lack thereof) that removes rainwater and wastewater from the area. In Dokkhin Gazirchat, the **drainage channels are often blocked or poorly designed,** causing **stagnant water and flooding,** especially during monsoon seasons. The stagnant water mixes with **industrial effluents**, making it a breeding ground for mosquitoes and bacteria. **3. Industrial heat** Industrial heat refers to **local thermal stress** caused by industrial activity. Textile factories emit heat and steam from boilers and dyeing units, which increases **ambient temperature in nearby residential zones.** The lack of green spaces and heat reflection from metal roofs and concrete further intensify this effect ("urban heat island"). **In summary:** In Dokkhin Gazirchat, residents are exposed to a **triple burden** of environmental stressors — **chemical waste, flooded or clogged drainage,** and **industrial heat.** Together, these factors degrade local living conditions and contribute to the high rates of **skin, respiratory, and eye problems** documented in the study.	For residents, this directly increases the risk of **skin infections, allergies, and gastrointestinal diseases.** It contributes to **respiratory irritation (from fumes), waterborne diseases (like diarrhea and cholera)**, and worsens overall sanitation. Frequent **skin rashes, eye irritation, allergies, and breathing difficulties** due to prolonged exposure to pollutants and heat stress. For workers and residents, this leads to **fatigue, dehydration, heat-related illness**, and exacerbates **odors and chemical volatilization** from waste.

Palowan Para	Industrial waste and waterlogging Palowan Para is surrounded by small and medium-sized textile units that **discharge untreated or partially treated effluents** into open drains and fields. **Waterlogging** occurs when these effluents mix with rainwater, forming stagnant pools of contaminated water. Residents report that foul-smelling wastewater flows through residential lanes, contaminating shallow wells and hand-pump water.	Itching, **asthma, and gastric problems** are common, indicating exposure to volatile chemicals, microbial contamination, and airborne irritants. The constant dampness also fosters mold and mosquito-borne diseases.
Nayanjholi Khal-Ghosbag	This cluster of communities is directly adjacent to canals receiving textile wastewater. **Waste dumping** of dye residues, plastic fibers, and chemical containers visibly discolors the water and soil. The **canal water is highly polluted,** with chemical foam and strong odors reported during ESDO field visits. **Soil contamination** affects nearby agricultural plots where mustard and vegetables are grown, threatening food safety.	Residents experience **nausea, headaches, diarrhea, and skin diseases**, consistent with chronic exposure to volatile organics, dyes, and heavy metals.
Noyapara	Noyapara lies very close to large textile dyeing and washing facilities, where emissions affect both **air and surface water quality.** **Wastewater** from dyeing operations is often discharged untreated, staining nearby drains and fields. **Air pollution** arises from boiler smoke, textile dust, and volatile solvents used in printing.	**Eczema, contact dermatitis, and asthma** are widespread. The combination of airborne particulates and chemical vapors leads to respiratory irritation, while constant contact with contaminated water contributes to chronic skin conditions.
Molla Bazar	Molla Bazar functions as a local collection point for mixed waste, receiving **solid waste from factories, households, and small workshops.** Waste heaps often contain textile scraps, plastic packaging, and hazardous residues, left exposed to sunlight and rain. Leachate from decomposing and chemically contaminated waste seeps into nearby soil and drainage channels.	Residents report **skin lesions, allergies, and respiratory distress.** The combination of dust, decaying organic matter, and chemical vapors contributes to chronic irritation and heightened vulnerability among children and the elderly

Map of Sample Areas and Factory Locations

Description of the sampling areas

Kathgara Bazar and Nayanjholi Khal–Ghosbag are densely industrialized areas surrounded by numerous textile and garment factories, including Azmat Apparels Ltd., SDS Industries Ltd., Ayesha Clothing Company Ltd., Sterling Apparels Ltd., and Ha-Meem Group.

Residents report that these factories often discharge wastewater early in the morning, when most people are asleep, using privately constructed drainage systems that connect directly to local canals such as Nayanjholi Khal.

This has resulted in strong odors, visible water pollution, and ongoing environmental degradation. Locals also note that in the past, heron birds were commonly seen here, but now they are gone—an indication of the ecological damage.

The untreated or partially treated effluents pose serious risks to both human health and the surrounding ecosystem. With a combined population of 2,112,860 people (According to the 2022 Census) living in Kathgara, Yearpur, and Dhamsona, countless families face daily exposure to polluted water, foul air, and contaminated soil, threatening their health, livelihoods, and future.

This is why we collect soil and water samples from these locations—to detect the specific pollutants present and understand their impacts on both the environment and the well-being of these vulnerable communities.

Mercury in Human Biomonitoring:
Hair analysis by Minamata Lab in Japan revealed mercury levels exceeding the recommended safety threshold (1.0 ppm) in nine individuals. The highest levels were detected in women and children (up to 2.79 ppm), especially among housewives and students in Ghoshbag. These elevated levels were mainly associated with both dietary intake (such as fish consumption), and occupational textile exposure. The results highlight the importance of combined environmental and human health monitoring. The data also indicates that the food chain in Bangladesh is contaminated by mercury. The textile industry can play an indirect role in this. Mercury is used in the textile production for dyeing, printing, and preservative processes, and can contaminate soil and water. A study on water pollution in the textile industry cites heavy metals, including mercury, among those released in textile-cluster areas such.[1]

2. Revised Interpretation of Heavy Metal Soil Data:
Based on updated thresholds used in Bangladesh, cadmium concentrations in soil (2.1 ppm) are below the national agricultural safety limit of 3 ppm. However, lead levels (114.64 ppm) exceed the standard of 100 ppm. While cadmium has not yet reached dangerous levels, lead remains a serious contaminant.

Additional Contaminants of Concern:
The laboratory analysis also screened for other hazardous substances not yet discussed in detail in this report, including:

- Phthalates (endocrine disruptors, reproductive toxicity)
- Dye and solvent-related compounds: aniline and 2-naphthyl ammonium acetate (both potentially carcinogenic)
- Heavy metals such as arsenic, chromium, and antimony

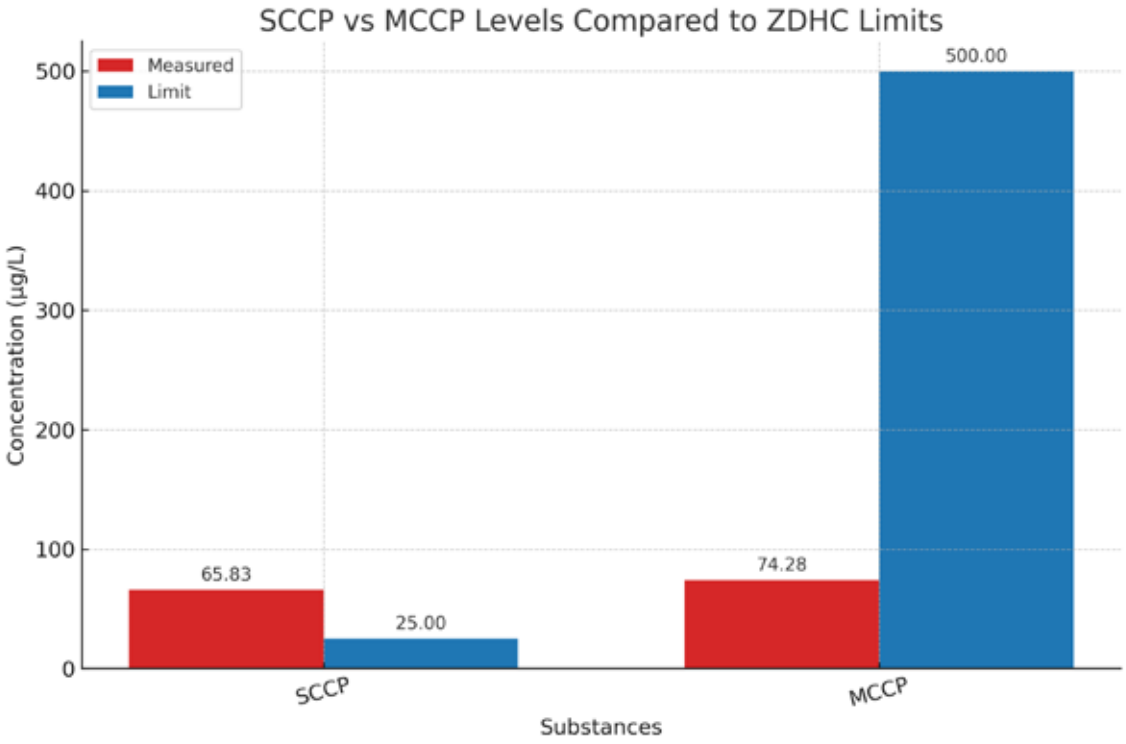
These contaminants are known for their toxicity and should be monitored closely. A detailed breakdown is advised in future updates.

Geographical Mapping of Contamination:
Sampling was conducted across several highly industrialized zones in Ashulia, including Dhamsona, Ashulia, Ghoshbag, Member Bari, Jamgora, and Mollar Bazaar. Contaminated media included river water, canal water, mainstream water, groundwater from community wells, and agricultural soils from mustard and vegetable fields. A visual map or tabular matrix of contaminant locations is provided to enhance environmental justice visibility.

These zones exclusively host textile and garment industries, with no other types of industrial operations present, further emphasizing the direct connection between textile activities and recorded environmental contamination.

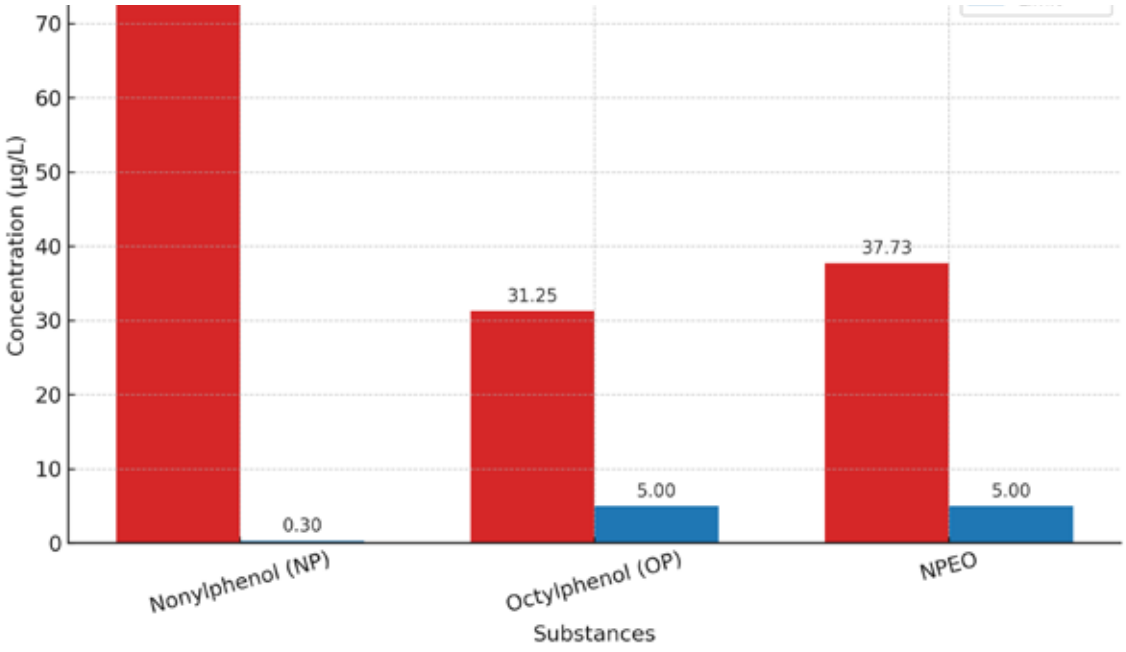
1 Sakamoto, Maiko, Tofayel Ahmed, Salma Begum, and Hamidul Huq. 2019. „Water Pollution and the Textile Industry in Bangladesh: Flawed Corporate Practices or Restrictive Opportunities?“ Sustainability 11, no. 7: 1951. https://doi.org/10.3390/su11071951

SCCPs and MCCPs



The detected concentration of Short-Chain Chlorinated Paraffins (SCCPs) was **65.83 µg/L**—almost **three times higher** than the ZDHC wastewater limit of **25 µg/L**—indicating serious non-compliance and environmental risk.2 Middle-Chain Chlorinated Paraffins (MCCPs), at **74.28 µg/L**, remain well below the limit of **500 µg/L** but still warrant monitoring due to their potential environmental and regulatory concerns.

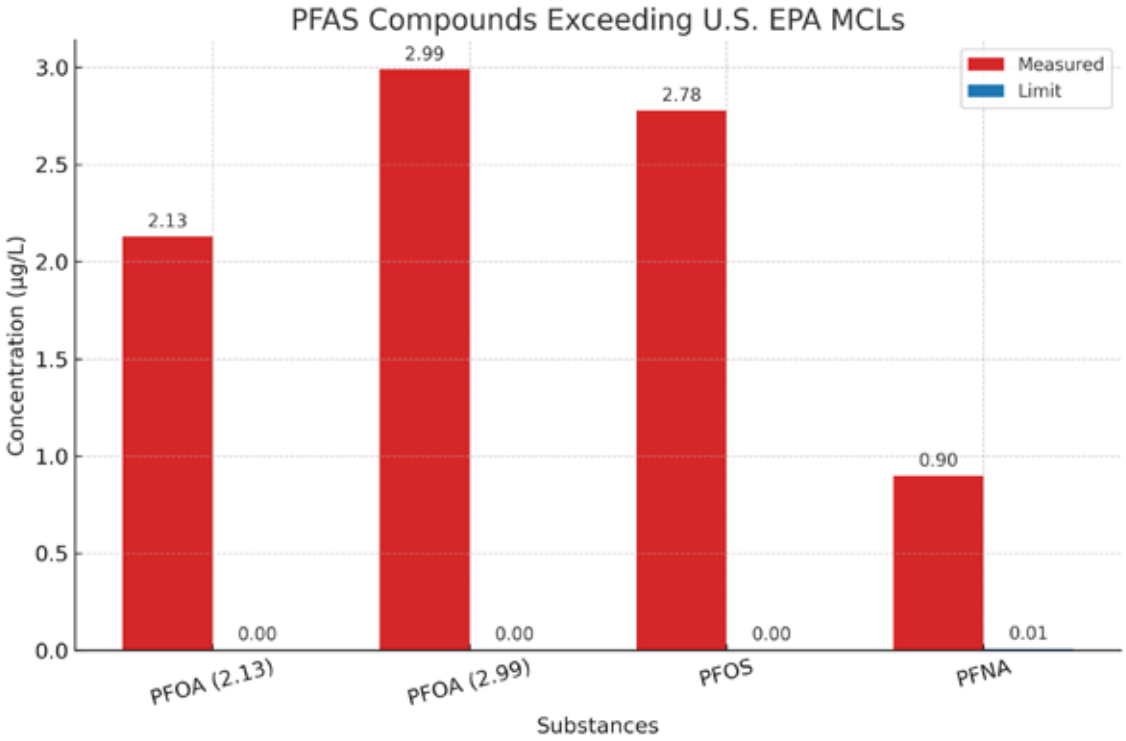
Nonylphenol, Octylphenol and Nonylphenol Ethoxylates



2 ZDHC Wastewater Guidelines v2.x: SCCPs = 25 µg/L; MCCPs = 500 µg/L; NP/OP/NPEO = 5 µg/L.

Measured levels of **Nonylphenol (NP)**, **Octylphenol (OP)**, and **Nonylphenol Ethoxylates (NPEO)** were significantly above regulatory thresholds. NP was **76.43 µg/L**—**255 times** over the EU drinking water limit of **0.3 µg/L**.[3] OP and NPEO were **31.25 µg/L** and **37.73 µg/L**, exceeding the ZDHC limit of **5 µg/L** by more than **six** and **seven times**, respectively. These endocrine-disrupting substances pose high risks to health and the environment.

PFAS

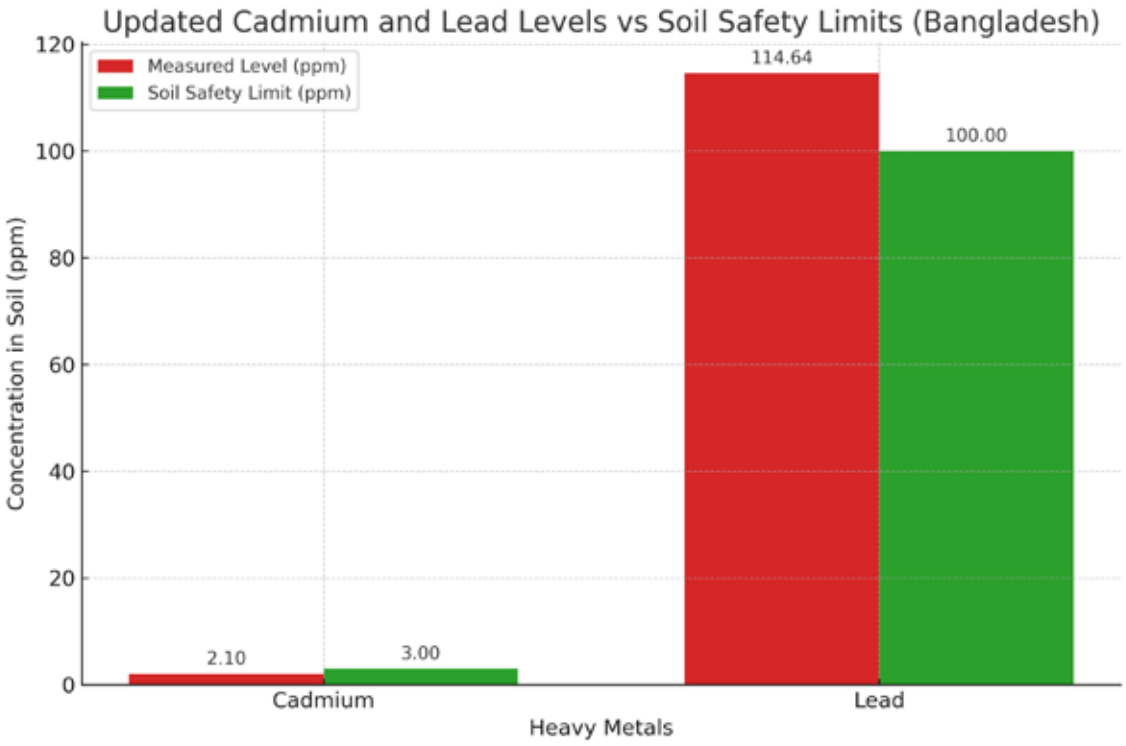


The sample revealed **severe exceedances** of U.S. EPA drinking water limits for key PFAS compounds[4]. **PFOA** was found at **2.13 µg/L** and **2.99 µg/L**—over **500 to 700 times** the regulatory limit of **0.004 µg/L**. **PFOS** (**2.78 µg/L**) exceeded the same limit by **695 times**, while **PFNA** (**0.9 µg/L**) was **90 times** over the **0.01 µg/L** limit. These findings highlight **urgent contamination risks** and the need for **regulatory enforcement**.

3 EU Drinking Water Directive (Directive (EU) 2020/2184): Nonylphenol parametric value = 0.3 µg/L.

4 PFAS Drinking Water Standards (U.S. EPA, April 2024): Final MCLs – PFOA and PFOS = 4 ppt (0.004 µg/L); PFNA, PFHxS, and HF-PO-DA (GenX) = 10 ppt (0.01 µg/L); 2025 revisions under review.

Cadmium and Lead



Soil testing in Ashulia revealed cadmium levels at 2.1 ppm, which approach the national agricultural safety threshold of 3.0 ppm in Bangladesh.[5] In contrast, lead was detected at 114.64 ppm, which exceeds the national safety limit of 100 ppm, indicating a clear case of contamination.

Although cadmium levels do not currently exceed regulatory limits, their presence in agricultural soil still requires close monitoring because of their toxicity, persistence, and potential to bioaccumulate in food crops. In contrast, lead levels are well above permissible thresholds, raising serious concerns about neurodevelopmental toxicity, especially in children, and chronic health risks for affected communities.

These findings underscore the importance of soil remediation, particularly in food-producing areas, and highlight the need for preventive measures to obstruct further industrial deposition of toxic metals into the environment.

Global and National Chemical Regulation Frameworks

The chemicals identified in Ashulia fall under several international and national regulatory instruments aimed at protecting human health and the environment. Bangladesh, as a Party to key multilateral environmental agreements, has obligations to control persistent and hazardous substances. The following table summarizes the relevant frameworks.

5 Bangladesh agricultural soil thresholds: Cadmium = 3.0 ppm (no exceedance at 2.1 ppm); Lead = 100 ppm (exceedance at 114.64 ppm).

Framework	Scope / Key Provisions	Relevance
Stockholm Convention on POPs	Eliminates or restricts persistent organic pollutants, including certain PFAS[6], SCCPs, and PCBs	PFAS and chlorinated paraffins from textile effluents are regulated POPs
Basel Convention	Controls transboundary movement and disposal of hazardous waste	Improper waste disposal from factories may contravene Basel principles
Rotterdam Convention	Requires prior informed consent for export of hazardous chemicals	Trade of hazardous chemicals also used in textiles and textile production
Minamata Convention	Controls mercury emissions and use	Mercury contamination in dyes and wastewater is addressed
Bangladesh Environment Conservation Act (1995)	National legal basis for pollution control and environmental clearance	Applies to textile factories and industrial effluents
Bangladesh Air Pollution (Control) Rules, 2022	Sets emission standards and mandates air monitoring	Addresses airborne industrial pollutants in Dhaka region

Discussion

The combined findings from community mapping, CBM data, and laboratory analysis reveal significant overlaps between observed health conditions and known toxicological effects of chemicals used in textile production. The testing of chemicals in soil, water and human hair shows high level of pollution, mainly due to the textile industry nearby. The lack of adequate waste treatment and poor industrial oversight amplify exposure risks for nearby residents. Although Bangladesh has comprehensive environmental laws, enforcement remains weak. The results emphasize the need for integrating community-generated data into national reporting under international conventions such as the Stockholm Convention and multistakeholder agreements such as the Global Framework on Chemicals (GFC). Persistent organic pollutants, endocrine disruptors, and heavy metals pose long-term risks, requiring urgent remediation and stronger policy coherence across sectors.

6 perfluorooctane sulfonic acid (PFOS) and its derivatives, perfluorooctanoic acid (PFOA) and its salts and related compounds, and perfluorohexane sulfonic acid (PFHxS) and its salts and related compounds

Recommendations

1. Strengthen enforcement of the Environment Conservation Rules (2023)[7] and Air Pollution Control Rules (2022)[8].

Bangladesh has developed a legal framework to address industrial pollution, yet enforcement remains inconsistent and under-resourced. Strengthening enforcement requires increasing the capacity of the Department of Environment (DoE) for regular inspections, compliance monitoring, and public reporting of violations. Independent environmental audits of textile factories should be mandated, and non-compliant facilities should face proportionate penalties. Additionally, the government should ensure that effluent treatment plants (ETPs) and air-emission controls are functioning continuously—not only during inspections—and that sampling protocols follow ISO and WHO standards. Real-time disclosure of ETP performance data could further improve compliance transparency.

2. Integrate CBM health data into national monitoring and reporting under international conventions.

CBM initiatives have proven valuable in generating local, (gender) disaggregated data that reflect real community exposure. These datasets should be institutionalized within Bangladesh's national environmental monitoring system and linked to obligations under the Stockholm, Basel, Rotterdam, and Minamata Conventions, as well as GFC and the UNEP Global Chemicals Outlook process. Establishing formal channels between community networks and national focal points would enable bottom-up reporting of pollution events, strengthen public accountability, and improve the accuracy of periodic reports to international bodies. Training programs and digital tools could help harmonize CBM data collection with national indicators.

3. Promote substitution of hazardous textile chemicals with safer alternatives consistent with EU REACH and ZDHC frameworks.

Transitioning from hazardous chemicals such as PFAS, chlorinated paraffins, azo dyes, and phthalates is essential for aligning Bangladesh's textile industry with international markets and sustainability goals. The government, in collaboration with industry associations, should develop a *National Roadmap for Safer Chemistry in Textiles*, promoting cleaner production technologies and providing incentives for companies that adopt non-toxic substitutes. Alignment with the ZDHC Manufacturing Restricted Substances List (MRSL) and the EU REACH Candidate List would enhance market access, reduce occupational risks, and improve environmental outcomes. Support for SMEs through training, subsidies, and technical assistance is critical to enable this transition. ZDHC collects data on harmful chemicals in wastewater and inventories of textile production facilities. The data should be shared with affected communities and local and national authorities, to avoid high costs for double testing and instead benefit from synergies. Data related to health and environment cannot be kept confidential, according to the Dubai Declaration.

4. Establish a national Pollutant Release and Transfer Register (PRTR) for transparency and accountability.

A PRTR system would require industries to report annually on the quantities of pollutants released to air, water, and soil, as well as those transferred for treatment or disposal, including the locations of the releases. Such a register would support the "right to know" for communities and improve data-driven

7 https://www.scribd.com/document/710795071/Enviroment-Conservation-Rules-2023-En

8 https://doe.portal.gov.bd/sites/default/files/files/doe.portal.gov.bd/page/0b2ef93a_ba06_48d9_b8dd_ca1e779e8f41/Air%20Pollution%20(Control)%20Rules%202022.pdf

policymaking. It should be designed in line with UNECE and OECD PRTR guidance, integrated with existing environmental clearance procedures, and accessible online to ensure transparency. The register could also serve as an early-warning mechanism for chemical hotspots, guiding enforcement and remediation priorities.

5. Expand occupational and community health surveillance in industrial zones.

Given the high prevalence of respiratory, dermatological, and gastrointestinal diseases in Ashulia and similar areas, there is an urgent need for systematic health surveillance. Collaboration between the Ministry of Health, DoE, and local health centers should establish long-term monitoring programs that track exposure-related diseases among both workers and residents. Mobile health units and digital reporting systems could help collect data more efficiently. Partnerships with universities and medical institutes would enable biomonitoring of mercury, PFAS, and heavy metals in blood and hair samples, providing early detection of chronic exposure.

6. Foster cross-sectoral partnerships between government, NGOs, and industry for sustainable pollution management.

Effective chemical and waste governance requires collaboration across institutions and sectors. Establishing a *Textile Environmental Stewardship Platform* would provide a mechanism for joint decision-making, bringing together government agencies, local authorities, industry representatives, NGOs, and affected communities. Such a platform could coordinate policy implementation, share technical knowledge, and mobilize funding for green technologies. International cooperation—especially with the EU, Japan, and donor agencies—could further support technology transfer, remediation projects, and pilot programs for zero-discharge production.

Additional Cross-Cutting Actions

Adopt Extended Producer Responsibility (EPR) mechanisms for the textile sector to ensure producers remain accountable for chemical and waste impacts throughout the product lifecycle. Exporting countries and regions, such as the EU, that develop an EPR scheme should ensure that a certain percentage of the fees is earmarked for the production countries and waste-receiving countries in the Global South.

Integrate pollution prevention into urban and land-use planning to prevent new factories from being established near schools, agricultural land, or residential areas.

Enhance public access to information and justice by applying the principles of the Aarhus Convention, even though Bangladesh is not yet a Party, to promote participatory environmental governance.

Form an inter-ministerial Chemicals and Health Task Force to ensure policy coherence among trade, industry, health, and environment sectors.

Conclusion

Industrial pollution in Bangladesh's textile sector has clear impacts on community health and environmental quality. The findings in this report strengthen global evidence linking hazardous chemical exposure to skin, respiratory, and reproductive health problems and other diseases that may occur

later in life, such as cancers, neurological and fertility impairment or cardiovascular diseases. Effective enforcement of international chemical agreements, alongside strong national laws and community participation through CBM, is vital to protect public health and create a toxic-free textile industry in Bangladesh.

The findings of this study show clear, scientifically significant evidence that industrial activities in Bangladesh's textile sector are contaminating the environment and endangering human health. Elevated levels of PFAS, SCCPs, nonylphenols, and heavy metals, especially lead, indicate ongoing breaches of both national and international safety standards. These results support earlier global research that identifies textile manufacturing as a major source of hazardous chemical exposure, connecting local pollution to global supply chains.

The health data collected through community-based monitoring show a consistent pattern of respiratory, dermatological, and gastrointestinal illnesses among residents living near textile clusters. The strong alignment between observed symptoms and the known toxicological profiles of identified substances indicates that the health impacts are not accidental but directly linked to chemical-intensive industrial processes and lenient pollution control. Vulnerable groups, particularly women and children, face increased exposure risks via air, water, and food pathways.

From a policy perspective, the study highlights a significant implementation gap: Bangladesh has ratified major multilateral environmental agreements (MEAs)—including the Stockholm, Basel, Rotterdam, and Minamata Conventions—yet enforcement remains inadequate. Regulatory provisions exist under the Environment Conservation Rules (2023) and Air Pollution (Control) Rules (2022), but monitoring, transparency, and accountability mechanisms are weak. The lack of a comprehensive Pollutant Release and Transfer Register (PRTR) and limited disclosure from factories impede effective public oversight.

The data also illustrate the vital role of community-based environmental monitoring (CBM) as a supplementary tool to official regulatory systems. CBM not only provides local evidence on pollution and health but also empowers communities to take part in environmental governance, bridging the information gap between affected populations and policymakers. Incorporating CBM data into national reports under MEAs could significantly enhance Bangladesh's compliance and promote environmental justice.

In conclusion, the Ashulia case exemplifies the urgent need for systemic transformation of the textile industry toward toxic-free, circular, and transparent production. This requires coordinated action at multiple levels:

Scientific and technical: continuous monitoring of PFAS, chlorinated paraffins, phthalates, and heavy metals using standardized laboratory methods;

Policy and regulatory: strengthen enforcement of environmental laws, adopt a national PRTR, and align with EU REACH and ZDHC frameworks for safer chemistry, and force industry initiatives to publicly disclose collected data relevant to human health and the environment;

Community and social: empowering residents through awareness, health surveillance, and participatory monitoring.

International cooperation: leveraging MEAs and donor partnerships to support remediation, technology transfer, and capacity-building.

Sustainable transformation of Bangladesh's textile sector relies on closing the enforcement gap, investing in cleaner production methods, and institutionalising community participation. The evidence from this study provides a strong foundation for both national policy reform and global advocacy for a toxic-free textile future.

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