Pathways of Lead Exposure in the Philippines

Part 1 of a two-part series on lead contamination in the Philippines

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Abstract

A growing body of Filipino-led research is building a compelling evidence base showing that lead contamination reaches across the Philippine environment — in rivers, urban soils, school dust, port waters, aquaculture farms, and consumer products. This article surveys the pathways through which Filipinos encounter lead, drawing on more than a dozen local studies spanning two decades of investigation. Despite the establishment of lead paint regulations in 2013, the threat remains pervasive, multi-pathway, and under-recognised. This is Part 1 of a two-part series; Part 2 examines the health impacts on Filipino children and the growing advocacy response.

2025 Volcano Art Prize (VAP) entry

Artist: Paula Jacobe, Age: 10

Title: Painted Lion

Lead-Safety Message: Thankfully, since the Philippines banned lead in children's paints in 2013, the EcoWaste Coalition and UN/WHO Lead Paint Alliance has achieved a government ban on decorative (house) paints with lead - phased in from 2013 to 2016 - and a ban on lead-containing industrial paints by December 31, 2019.

Description of Work: Lead free children's paints painting of a lion stencil.

https://volcanoartprize.com/portfolio-item/painted-lion/

Introduction: Pathways of Lead Exposure in the Philippines

Lead exposure affects one in every three children globally, with the vast majority living in low- and middle-income countries (Rees, Fuller and UNICEF, 2020). The World Bank estimates that children under five have lost 765 million IQ points to lead exposure, at a cost of US$1.4 trillion worldwide (ARNEC and Vital Strategies, 2025). These are not abstract statistics. They represent permanently diminished futures for hundreds of millions of children.

The Philippines is no exception. Despite enacting Administrative Order 2013-24, which established a

90 parts per million (ppm) limit on lead in new residential paint sold, the country's lead problem extends far beyond a single product. Lead enters Filipino lives through water, soil, dust, imported goods, and the food chain — pathways that regulations have barely begun to address. In Asia, only the Philippines and Bhutan have recently initiated efforts to monitor lead in children; most countries in the region have no active monitoring at all (ARNEC and Vital Strategies, 2025).

What makes the Philippine story both troubling and hopeful is the work of local researchers. Across the archipelago, Filipino scientists — from established university faculty to senior high school students — are systematically mapping where lead lurks. Their studies, many conducted with limited resources, form an evidence base that demands attention. This article traces their findings, pathway by pathway.

Water: From River Source to Coastline

The Angat River is the lifeblood of Metro Manila. Its dam supplies 500 million gallons daily, meeting 97 per cent of the capital's water needs (Santos, Venturina and Violago, 2024). When Santos, Venturina and Violago (2024) assessed arsenic and lead concentrations in the Angat River Network at Banga II, Plaridel, Bulacan, they found levels within the permissible limits set by the World Health Organization (WHO), the United States Environmental Protection Agency (EPA), and the Philippine Department of Environment and Natural Resources (DENR). The river, they concluded, still meets Class B/C safety standards for its intended usage.

But the reassurance is qualified. Sediment samples showed monthly variation, with detectable levels of both lead and arsenic appearing in February, possibly linked to nearby construction activity involving paints and welding materials. The researchers emphasised that continuous monitoring is essential, particularly given the rapid urbanisation and industrialisation surrounding the river network.

2025 Volcano Art Prize (VAP) entry

Artist: Prince, Age: 8

Title: Rizal Monument

Lead-Safety Message: Rizal Monument in Manila includes a sculpture of Philippines national hero Jose Rizal, that was cast, in 1912, from molten bronze containing possibly up to 20% lead. Occupational exposure to lead fumes back then would have been massive and would certainly have contributed to the early death of the bronze workers.

Description of Work: Pen and coloured textas on paper.

https://volcanoartprize.com/portfolio-item/rizal-monument/

Elsewhere, the picture is less encouraging. At the Port of Mukas in Kolambugan, Lanao del Norte, Jimenez et al. (2018) found average lead concentrations of 0.18 mg/L in seawater — 3.6 times the DENR's allowable limit of 0.05 mg/L for marine waters with beneficial usage. The sources were visible: ships being salvaged and repainted using lead-containing materials, welding operations, and residual contamination from leaded petrol. Children were observed swimming near the port, directly exposed to contaminated water. Lead concentrations were detected in fish, macroinvertebrates, and water samples from the coastal lagoon of Manila Bay as well (Jimenez et al., 2018).

In Dumaguete City, Balbon et al. (2024) examined the Banica River downstream of a former municipal landfill in Barangay Candau-ay. Lead concentrations were below 0.003 mg/L at all three sampling stations — within safe limits. However, pH levels had shifted from non-acidic in 1994 to neutral in 2023, suggesting gradual environmental change linked to the deteriorating landfill. The researchers recommended longitudinal monitoring and remediation, including trash segregation, physical barriers between the river and landfill, and microbial remediation.

The water pathway illustrates a critical point: even where individual measurements fall within regulatory limits, the cumulative and chronic nature of lead exposure means that 'safe' readings today are no guarantee against contamination tomorrow. As Collin et al. (2022) note in their global review, lead can persist in environmental systems for extraordinary periods, making ongoing vigilance essential.

Soil: The Ground Beneath Their Feet

Children play in soil. They fall in it, dig in it, and put their hands in their mouths afterwards. In the Philippines, the soil they touch may carry a legacy of decades of leaded petrol vehicle emissions, industrial discharge, and flooding.

Alberto et al. (2006) measured lead levels in urban soils across six cities in the central Philippines. Lead was detected at all 30 sampling sites, with concentrations ranging from 1.5 to 251 mg/kg. Five of six cities showed elevated levels exceeding 25 mg/kg, with San Fernando City recording the highest average at 73.9 mg/kg. One site in San Fernando surpassed the WHO permissible limit of 100 mg/kg. The primary source was vehicular emissions — diesel trucks, buses, and jeepneys — a legacy of the era before the Philippines phased out leaded petrol. The researchers noted that children, who are more predisposed to lead toxicity than adults, face particular risk from contaminated urban soils.

Perhaps the most striking Philippine soil study comes from Ostrea et al. (2015), who investigated lead exposure in 150 children aged six to seven in Bulacan province. Every single soil sample tested positive for lead, with a median concentration of 27.06 mg/kg. River water was also universally contaminated, with a median of 70.00 parts per billion. The critical finding was the mechanism: flooding. The Bulacan region is flood-prone, and when rivers overflow, they deposit lead-contaminated alluvial and riparian soils across communities. The researchers found significant correlations between soil lead levels and lead concentrations in children's hair, concluding that 'alluvial and riparian soils from polluted rivers are important sources of lead exposure in children' (Ostrea et al., 2015, p. 5086).

Globally, lead can persist in soil for up to 2,000 years (Collin et al., 2022). This means that contamination from decades-old sources — leaded petrol, industrial waste, deteriorating lead paint — remains biologically active in Philippine soils today. Root vegetables such as carrots and sweet potatoes may accumulate the highest concentrations, while leafy greens like lettuce absorb lead from the soil as well (Collin et al., 2022). For communities growing food in urban or peri-urban areas near historical contamination sources, the soil pathway represents an ongoing, invisible risk.

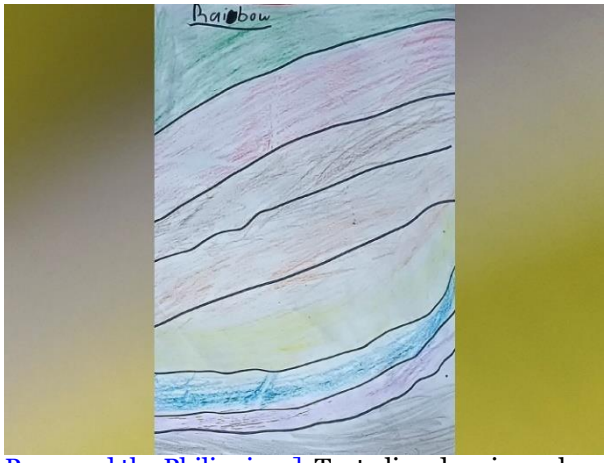
Dust: The Pathway You Cannot See

Lead dust is arguably the most insidious exposure pathway. It is invisible, settles on surfaces children touch daily, and can be ingested through normal hand-to-mouth behaviour. In the Philippines, the

evidence from school environments is alarming.

Ona (2010) collected 108 dust samples from six elementary schools in Tarlac City. Every single sample contained lead. Concentrations ranged from 158.3 to 287.8 µg/ft² — all substantially exceeding the US EPA's maximum exposure limit of 40 µg/ft² for floors. In other words, the dust on the floors of these Philippine classrooms contained four to seven times the amount of lead considered safe by US standards 16 years ago, and contained 32 to 56 times the US EPA (2024) Dust Lead Action Level (DLAL) of 5 µg/ft² for floors, following lead removal activities, effective 13 January 2025. The contamination showed minimal variation across the six schools, suggesting a systemic rather than localised problem.

The implications are sobering. Filipino schoolchildren spend hours each day in these environments, sitting on floors, handling materials, eating lunches. Ona (2010) concluded that 'schoolchildren in Tarlac City, Philippines are at risk of exposure to the hazards of lead dust' and called for policy interventions to address lead pollution in school environments.



2025 Volcano Art Prize (VAP) entry

Artist: Ella Mae Castro, Age: 4

Title: Dusty Rainbow

Lead-Safety Message: When there's too much heavy metal dust and smog in the air in Manila, the rainbow is greyer and less vivid. Lucky for me, Pure Earth has collaborated with local governments to include blood lead testing in to local health programs in the Philippines.

Description of Work: Message from Pure Earth's *Mitigating Lead Exposure in Low- and Middle-Income Countries - A Project to Reduce Lead Exposure in 7 Countries* [Colombia, Egypt, Ghana, India, Indonesia, Peru, and the Philippines]. Texta line drawing coloured in with pencils.

https://volcanoartprize.com/portfolio-item/dusty-rainbow/

Climate change may be making this worse. Research into the intersection of climate and lead exposure has found that warmer temperatures increase the mobilisation of lead dust inside homes, heightening children's exposure during hotter months (ARNEC and Vital Strategies, 2025). In a country experiencing rising temperatures and increasingly extreme weather, the dust pathway is not static — it is growing.

Products and the Food Chain: Lead at the Point of Purchase

In October 2025, the Philippine environmental group EcoWaste Coalition released laboratory results that should have made national headlines. Of 20 imported spray paint samples tested, all contained lead exceeding the country's legal 90 ppm limit. Twelve of the twenty exceeded 10,000 ppm. A counterfeit yellow Bosny Spray paint topped the list at 116,000 ppm — more than 1,200 times the legal limit for new residential paint sold. Most disturbingly, 13 of the paints displayed 'No Pb' labels, falsely claiming to be lead-free (EcoWaste Coalition, 2025).

The paints were mostly marked as manufactured in China or Thailand. The EcoWaste Coalition's findings illustrate a critical enforcement gap: the Philippines has the regulation, but imported products continue to enter the market in flagrant violation of it. As the ARNEC factsheet notes, around 52 per cent of countries worldwide still do not have confirmed legal controls on lead in paint, and even where regulations exist, enforcement is often lacking for local small-scale manufacturers and imported goods (ARNEC and Vital Strategies, 2025).

Lead also enters the food chain. Collin et al. (2022) document how lead bioaccumulates in plants, with root vegetables absorbing the highest concentrations and lead persisting in affected soils for millennia. Odunlami et al. (2024), studying trees and fruits grown near mechanic workshops in Nigeria, found that lead concentrations exceeded WHO/FAO limits in 83 per cent of samples — a pattern with direct relevance to Philippine communities near similar informal industrial sites. In Manila Bay, heavy metal contamination has been detected in aquaculture resources, raising concerns about lead entering the diet through seafood (Jimenez et al., 2018).

Beyond paint and food, the global picture reveals lead exposure from sources that may also affect the Philippines: used lead-acid batteries recycled informally, contaminated spices, traditional cookware and ceramics, cosmetics such as kohl and sindoor, cigarettes and electronic waste (Lead Elimination, n.d.). With 85 per cent of global lead production going into batteries and the number of vehicles in low- and middle-income countries tripling between 2000 and 2018, the demand for lead — and the risk of informal, unregulated recycling — continues to grow (ARNEC and Vital Strategies, 2025).

Conclusion: Mapping the Invisible

The research surveyed in this article paints a picture that cannot be ignored. Lead reaches Filipinos through their water, their soil, the dust in their children's classrooms, the paint on their walls, and the food on their tables. No single pathway tells the whole story; it is the accumulation across all of them that makes lead exposure in the Philippines a systemic public health challenge.

Existing regulations limiting lead in new residential paint sold should be expanded to include all types of new paint sold. (For comparison, the Australian Poisons Standard (NDPSC, 2024) required nearly all paint types sold in Australia to contain less than 0.009% lead by 1st October 2021; anti-corrosion paint was limited to 0.009% lead since 1st October 2023; and marine anti-fouling paint will be limited to 0.009% lead by 1st October 2029.) And it needs to be investigated as to whether enforcement of existing regulations in the Philippines is adequate. Spray paint products labelled 'lead-free' contain more than a thousand times the legal limit for new residential paint sold. Monitoring of blood lead levels in children is nascent at best. The legacy of leaded petrol persists in urban soils decades after phase-out, and climate change threatens to mobilise stored contamination through floods and rising temperatures.

2025 Volcano Art Prize (VAP) entry

Artist: Paulo Castro, Age: 6

Title: Happy Family

Lead-Safety Message: My family will be happy for life if my parents take me to Philippines General Hospital for a blood lead test to find out if I should be treated for lead poisoning. EDTA in food can lower my blood lead level and supercharge my learning at home and at school.

Description of Work: Message from Pure Earth's *Mitigating Lead Exposure in the Philippines: Integrating Lead Detection Into National and Local Health Systems*, and www.leadtox.blog by Dr Ulrich Mack. Texta drawings on coloured paper, cut-out and glued to paper.

https://volcanoartprize.com/portfolio-item/happy-family/

Yet the very existence of this evidence base is cause for optimism. Filipino researchers — from Mapua University engineers testing the Angat River, to Silliman University high school students sampling the Banica River, to Tarlac State University faculty swabbing classroom floors — are doing the foundational work that makes action possible. What gets measured gets managed, and these scientists are measuring.

Their work aligns with the LEAD Group's global vision of a lead-safe world by 2041. Every study, every dataset, every published finding brings that goal closer. The Philippines is not merely a country with a lead problem; it is a country whose researchers are actively building the case for change.

In Part 2 of this series, we examine what these exposure pathways mean for Filipino children's health — and what communities, researchers, and advocates are doing about it.

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2025 Volcano Art Prize (VAP) entry

Artist: James Brando, Age: 4

Title: Masked Man

Lead-Safety Message: My city of Manila is ranked the 11th worst city in the world for air pollution. Wearing a mask protects me from some of the air pollution and from COVID19 too. If my parents take me to the local health program, I could get a blood lead test and then they'd know if I need to start lead detox with oral EDTA.

Description of Work: Message from Pure Earth's https://www.pureearth.org/philippines/ - *Working to Solve Pollution in the Philippines Since 2008; Progress in Blood Lead Level (BLL) Testing in the Philippines (2021-Present)* and www.leadtox.blog by Dr Ulrich Mack. "Lead" pencil drawing with lead-free pencil.

https://volcanoartprize.com/portfolio-item/masked-man/