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GREEN CROSS

GAHP

TOP TEN COUNTRIES TURNING THE CORNER ON TOXIC POLLUTION 2014

This document was prepared by Blacksmith Institute for a Pure Earth, GAHP, and Green Cross Switzerland with input and review from a number of experts and volunteers, to whom we are most grateful.

For questions, comments, and feedback, please contact:
Angela Bernhardt
Blacksmith Institute
475 Riverside Drive, 860
New York, NY 10115
+1 212 647 8330
angela@blacksmithinstitute.org

For questions, comments, and feedback, please contact:
Nathalie Gysi
Green Cross Switzerland
Fabrikstrasse 17
8005 Zurich, Switzerland
+41 (0) 43 499 13 10
nathalie.gysi@greencross.ch

Cover photo: A soccer field being remediated in Cinangka, Indonesia *Photo credit: Blacksmith Institute for a Pure Earth*

TABLE OF CONTENTS

LETTER FROM THE GAHP SECRETARIAT

When I first visited Kabwe, Zambia in 2004 I saw a crowd of people gathered around a young man who was sitting on the ground staring blankly at his feet. He had just been pulled out of a hole where he had been digging in mining waste, and it had collapsed around him. His best friend had been killed. They were both teenagers, invincible, and now one of them was dead.

They had been scavenging for lead scrap in the mine tailings near a long-disused lead smelter. Since the early 1900s Kabwe had mined and smelted the lead used in the bullets of the armies of the British Empire through two World Wars and more. At the time, the rich ore near the smelter was one of the largest finds of its kind. But the smelter had closed in the 1990s and the town was now a wreck with 200,000 or more people living from hand to mouth with no industry to sustain them. To make a simple living, people were scavenging wherever they could. There were dozens, maybe a hundred, working over the scrap lead pile that spread for many hectares. Collapses like the one I witnessed were commonplace.

But the problems in Kabwe were much deeper than a collapsed hole in a pile of mining waste. Lead is toxic, an acute neurotoxin that causes permanent brain damage. I checked with other scavengers and the symptoms of lead poisoning were clear: Their hands shook, some could not walk without a strange waddling action; Some had an inability to concentrate for very long, and I saw a blankness in the eyes that was terribly, terribly disturbing. It hurt me deeply to see these young men, well on their way to a certain and early death.

This is what pollution does. It kills people before their time. And along the way it damages both their bodies and their minds. It causes unnecessary misery. It destroys those who cannot get away. It hurts the poor most, trapping them a cycle of bad health and thus crippling their ability to work and provide for their families.

It need not be like this. We know this can be changed because we have done it. The richer countries no longer have these problems. Since the 1950s and 60s, in the U.S. and Europe, a consistent and steady effort has eradicated the worst of our toxic nightmares. Places like Kabwe no longer exist in the North thanks to awareness, regulations, remediation programs, careful controls on industry and mining. In wealthy countries the air is (mostly) clean, the water drinkable, and the soil around us free of toxins. We are all safer for it.

Now is our chance to replicate this success in the rest of the world. Some work has been done, and much more is needed. This report outlines where we see success, and where we see more effort needed in ten countries across all continents. These are stories proving we are on the right track, and moving forward. But we need to do more with industrialization in full swing around the world. Today pollution kills nearly 9 million people while more than 200 million people worldwide suffer from ailments, diseases, sicknesses. This need not be so.

Investments from the international community will serve the poorest well, saving lives, and solving problems permanently. We know how to solve the problem. It is simply a matter of providing communities and governments with the tools to get the job done now.

Join us in bringing effective, low-cost solutions to prevent the terrible damage pollution is causing.

Richard Fuller, President
Blacksmith Institute for a Pure Earth
and Current Secretariat for the Global Alliance on Health and Pollution

ABOUT THE GLOBAL ALLIANCE ON HEALTH AND POLLUTION AND THIS YEAR'S REPORT

This 2014 report is the ninth in an annual series of reports published by Green Cross Switzerland and Blacksmith Institute for a Pure Earth. Joining the publication this year is the Global Alliance on Health and Pollution (GAHP), a collaborative body that facilitates the provision of technical and financial resources to governments and communities to reduce the impacts of pollution on health in low- and middle-income countries.

The "World's Worst Polluted" series of reports has effectively raised global awareness about the extent and the impacts of toxic pollution in low- and middle-income countries. Last year, we looked back to the original top ten list from 2007 and updated the list to name a new top ten worst polluted places. This year we look back to our 2009 report, "12 Cases of Cleanup and Success" for inspiration and highlight the commitment and progress specific countries are making in "turning the corner" on toxic pollution.

This year's ten projects—success stories—showcase how countries are saving lives, improving human health and restoring environments. These projects are the result of extraordinary perseverance, hard work and determined leadership by champions inside government agencies, civil society groups and individual communities.

Children playing on a lead-contaminated soccer field in Cinangka, Indonesia
Photo credit: Blacksmith Institute for a Pure Earth

Solving pollution around the world is a daunting task, but that is why the Global Alliance on Health and Pollution (GAHP) was formed in 2012. GAHP assists nations lacking the resources, infrastructure and environmental engineering expertise to prioritize and implement remediation projects. GAHP also serves as a new mechanism to transfer technology and financial resources from wealthy countries to developing economies.

Members of GAHP include the World Bank, Asian Development Bank, United Nations Development Program, UNEP, UNIDO and about fifteen countries (including Mexico, Peru, Chile, Uruguay, Senegal, Indonesia and the Philippines). Blacksmith Institute for a Pure Earth has been appointed secretariat of GAHP. Learn more at www.gahp.net.

The stories told within this publication are proof that in spite of numerous obstacles and lack of resources, with collaboration and commitment, something can always be done to begin to turn the corner and improve the most polluted environments.

EXECUTIVE SUMMARY

A GLOBAL CRISIS

Pollution Cripples the Health of 200 Million and Chokes Development Potential of Many Nations

Seynabou's Work Killed Five of Her Young Children.

"Pregnant or breast feeding my babies, I never stopped recycling batteries," Seynabou said. Like many others in her village of Thiaroye-Sur-Mer, near Dakar, Senegal, Seynabou made her living recycling used lead-acid batteries by hand. Families there, along with an estimated 20 million more people in other parts of the world, break apart the batteries in their yards and smelt in their homes and yards to extract the valuable but very toxic lead inside.

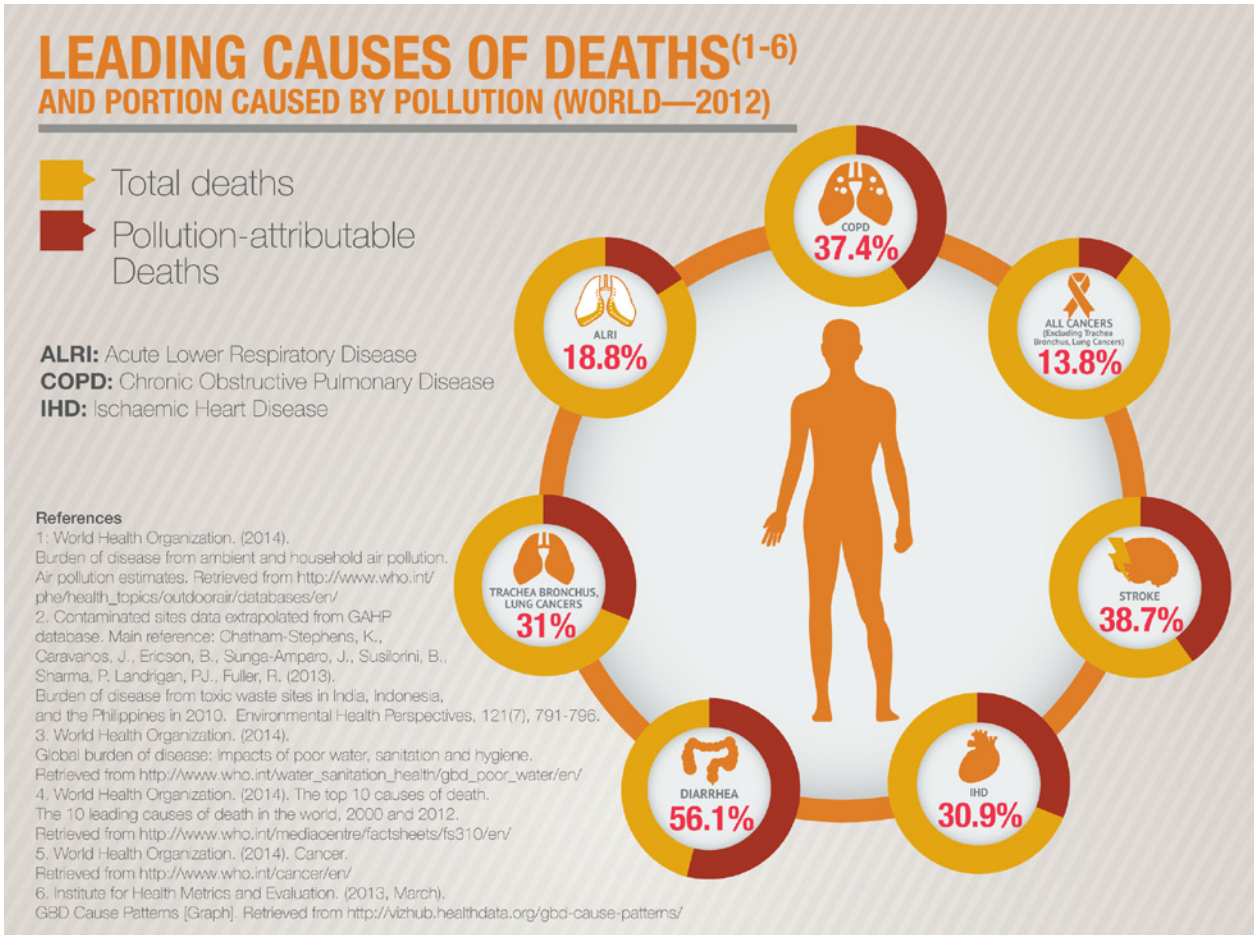
Like many people, Seynabou did not know that lead is a potent neurotoxin. While lower levels can cripple immune systems and even reduce IQ levels, at high exposure levels, lead becomes a lethal poison. Only experts know the growing bodies of young children absorb lead far more readily than adults. Nor is the womb safe; an unborn child will absorb lead present in their mothers' body, leading to permanent mental and physical damage.

Pollution—not disease—is the biggest killer of children in low- and middle-income countries.

Globally, pollution kills more than 8.9 million people each year, most of them children, and nearly all, 8.4 million, in low- and middle-income countries. That's 35% more than deaths from tobacco smoking, almost three times more deaths than malaria and fourteen times more deaths than HIV/AIDs.

The fact that more than one in seven deaths in the world are pollution-related is just a glimpse into the incredible health and economic toll of toxic pollution. Mostly people don't die. Instead, an estimated 200 million peoples' bodies and brains may be damaged, often permanently, by exposure to lead, mercury, chromium, obsolete pesticides and a host of other chemicals at thousands of toxic sites. Pollution can vastly lower life expectancy. In some of the world's worst polluted places, life expectancy can be as low as 45 years.

It is not just people working with these materials who are affected. Far more people are innocent bystanders as toxic particles readily move long distances through air, water and even in the food we eat. Mercury released by artisanal gold mining in Asia or Latin America can end up in tuna and other fish consumed in Europe or North America. Rice growers in ShuiDuiQuan Village, China unknowingly flooded their fields with river water contaminated



with cadmium, lead, arsenic from a nearby copper smelter. The rice plants readily absorbed these dangerous toxins. In 2012, Blacksmith Institute for a Pure Earth, working with local government agencies, remediated polluted soils and identified an alternate irrigation source for a few thousand euros.

Since 1999, Blacksmith Institute for a Pure Earth has worked with local and international partners to complete more than 80 cleanup projects in 21 low- and middle-income countries. Many more are in progress. In 2012 Blacksmith, along with government agencies, international agencies and multilateral funders, formed the Global Alliance on Health and Pollution (GAHP). The alliance is dedicated to addressing the threat of all forms of toxic pollution on a global scale by coordinating resources, launching efforts and applying innovation to fight toxic pollution. As well as educating on all forms of pollution, GAHP assists countries to identifying and assessing toxic pollutant threats, especially for contaminated sites, and creating a process to implement solutions to problems posing the gravest and most immediate risk to human health.

The technology and know-how to clean up or manage pollution at toxic sites already exists. Hand-held detection tools can now instantly pinpoint toxic hotspots. Removal of hazardous pollution can cost as little as $20 a person. However pollution is rarely a top priority because the full health, economic and social impacts are not widely understood.

Pollution is a Tragic and Costly Drain On the Vitality and Potential of Developing Countries

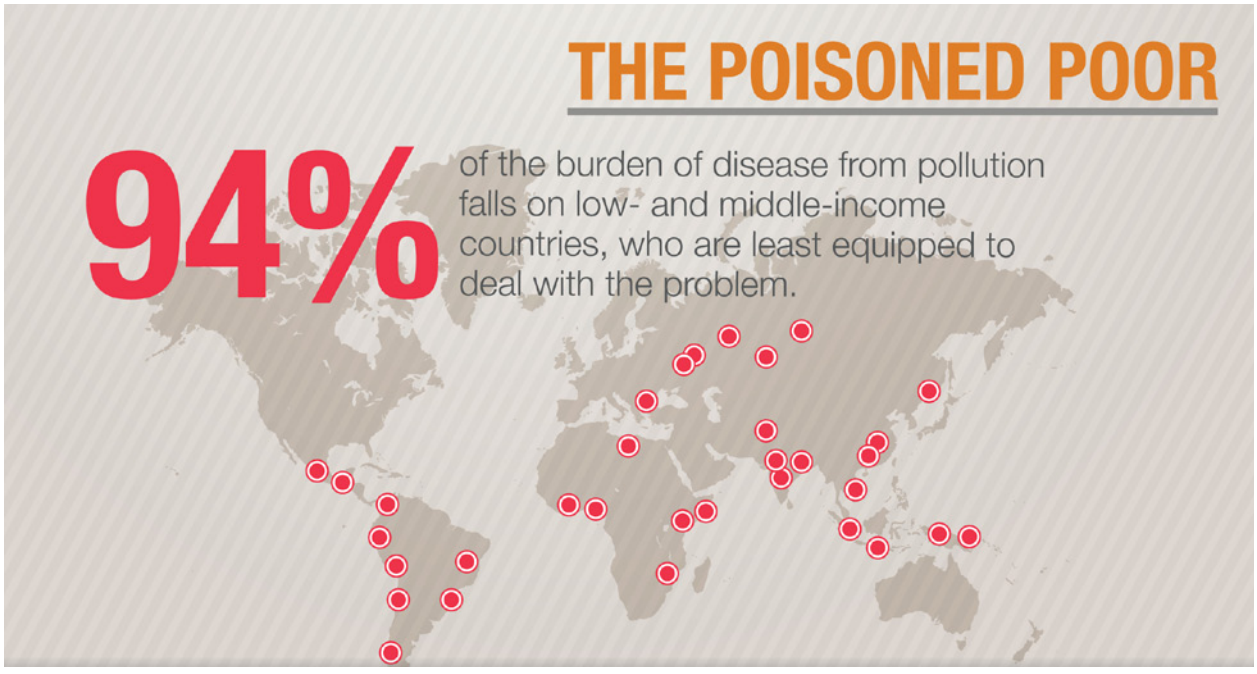
The consequences of this solvable, toxic pollution problem are staggering. People who should lead vigorous productive lives are chronically sick, often unable to work, and become unnecessary burdens on their families and health care systems. Communities and countries suffer both the enormous direct costs of medical services and indirect costs of lost productivity and potential.

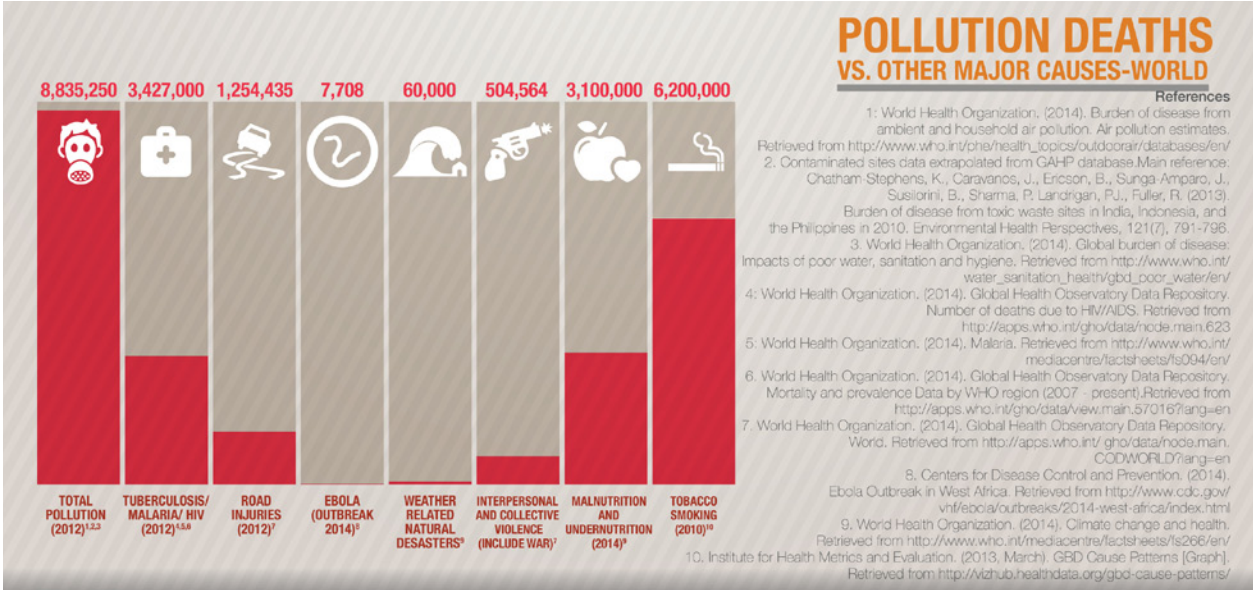
We all know someone from an impoverished background who has accomplished great things in business, as a teacher, artist or leader in government. But what if they had been exposed to some body or brain-damaging toxins when they were young, like millions of kids today? It is unlikely they could have achieved as much. That's the tragic and uncountable cost of pollution.

Children in rural village of Dong Mai in the agricultural heartland of Vietnam will no longer have to pay the hidden cost of pollution. The 2,600 villagers of Dong Mai were once artisans making bronze casts but in recent decades turned to battery recycling and small-scale lead smelting to earn their living. Children and adults had some of the highest levels of lead ever recorded. Many suffer chronic physical and mental illness as a result.

Blacksmith Institute for a Pure Earth, working with international partners and local officials, measured lead contamination in homes and yards in Dong Mai, and covered the highly polluted soil with geotech fabric to block the spread of the toxin. Then a layer of clean soil was placed on top. Levels of lead in the villagers' bodies dropped more than 30% in just three months. The cost: $20 a person for the entire village, including public health testing and education about the hazards of lead.

Dong Mai is one of thousands of toxic "craft" villages in Vietnam that manufacture products in an informal, cottage industry-type setting while growing much of their own food in the same location. Pollution is not just an issue in cities. There are also hundreds of thousands of villages and towns in Asia, Africa and Latin America where children and adults are unknowingly exposed to crippling levels of pollution.





Economic Costs of Pollution Stealing Billions from Fragile Economies

Despite the scale and human toll, pollution receives a fraction of the interest from the global community compared to infectious disease, climate change or other issues. Impacts of pollution are difficult to track because health statistics measure disease, not causes. While wealthy countries have largely forgotten the terrible costs of extreme pollution, developing countries are just beginning to realize the real price they're unnecessarily paying for economic development.

The costs of air pollution in China are estimated to be equal to 10% of its annual GDP. That's an astonishing cost of $924 billion in 2013, more than the GDP of 180 nations including Indonesia, Sweden or Switzerland. Air pollution has a wide range of health impacts—from asthma and impaired lung function to increased levels of cancer and heart attacks.

Although there is little data in low- and middle-income countries, it is likely the costs of air pollution range between 6 and 12% of GDP.

There is even less national data on the impacts and costs of pollution from toxic sites. These "fly under the radar" of public health awareness and action, largely because toxic pollution is unseen. Many affected people may be chronically ill, but it is difficult to determine the cause. For these reasons, little research has been done on the health impacts of chemical pollutants.

First-ever Study Reveals a Unrecognized Global Health Crisis

The very first estimate of the burden of disease resulting from living near toxic waste sites was released in 2013. The study looked at exposures to toxic waste sites in India, Indonesia and the Philippines. [Chatham-Stephens et al 2013]. In these countries more than 8.5 million people were found to be at risk from 373 sites, and suffered a disease burden comparable to outdoor air pollution and malaria. The analysis could not assess health impacts of all the toxic materials in the dumpsites due to lack of data. It's important to note that there are likely tens of thousands of toxic waste sites in these three countries.

Another new study examined the impacts of lead contaminated sites on the intelligence of children in seven Asian countries. Exposure to small amounts of lead is known to result in significant IQ loss. The study [Caravanos et al (2013)] estimated that nearly 200,000 children suffered a 5 point reduction in their IQ on average, with some children losing nearly 15 IQ points. This result is considered a conservative estimate of the actual impact of lead on children in Asia.

The economic impact of a 5 point IQ loss in 600,000 children was estimated to result in $8.7 billion in lost economic productivity annually in the US according to a 2005 study. Another analysis found that minor reductions in lead levels in children results in $17.2 billion annual savings in the US. The economic impacts would vary from country to country but it's absolutely clear the loss is significant.

There is also evidence that individuals with high lead exposures in childhood are more likely to be involved in social violence and criminal activities. Some have linked the declines in violent crime to reductions in lead levels.[1]

The World Health Organization, in conjunction with the World Bank, estimates that environmental risk factors contribute to more than 80% of regularly reported diseases.[2] In fact, it is estimated that up to 37% of a country's total disease burden could be prevented by achieving environmental improvements alone.[3] It is currently estimated that nearly one-fifth of the cancer incidence globally can be blamed

on environmental exposures.[4] This number is disproportionately higher in developing countries.[5]

Low-cost, Effective Local Solutions to Global Pollution

Local sources of pollution can have health impacts thousands of kilometres away. Contaminated air from China and elsewhere can now be measured in other countries. Mercury from unsafe artisanal gold mining and coal plants travel the globe and are found in our fish, while arsenic has been found in our rice.

Tougher pollution regulations alone are not enough. Most countries don't have the enforcement capacity even when pollution reduction has a high priority. They also often lack the resources, technical expertise and trained personnel to effectively deal with the dangers posed by existing or legacy toxic sites. Fortunately, modern pollution solutions are often relatively low-cost: Blacksmith has projects where $20,000 was enough to dramatically reduce the health risks for thousands of people.

Preventing pollution is often a matter of training and education in the use of cleaner technologies. New research shows nearly half the children in Mexico experience lead poisoning at rates where intelligence and behavior is affected. The cause is traditional Mexican pottery that uses lead-based glaze. The lead leaches out of the pottery into food. Blacksmith and FONART in the State of Hidalgo have helped local potters learn to use a new lead-free glaze. Combined with removal of lead-contaminated equipment, soil and pottery, children's lead levels dropped an average of 54% [http://www.pureearth.org/mexico_lead_pottery_mmr/].

Artisanal or small-scale gold mining is the second largest source of mercury pollution in the world. Mercury is an element and neurotoxin similar to lead. Once released it stays in the environment effectively forever. Fish and animals in the Arctic with no direct sources of mercury in the region have high levels of mercury making them dangerous to consume. As a result indigenous peoples of the Arctic have unhealthy levels of mercury in their bodies. One solution is to train miners in mercury-free technologies that increase gold yields. GAHP is now testing mercury-free methodologies successfully used in the Philippines in Indonesia, Bolivia, Mongolia and Peru, with plans to expand to Myanmar and Tanzania.

Contaminated mine tailings present another major problem exposing more than 25 million people to heavy metals. Successful solutions include developing appropriate tailings management systems, monitoring active mines and cleaning heavy metals from land.

The Resource Gap: Work to Be Done

The success stories in this report show that life-saving steps can be made to tackle pollution issues at a relatively low cost. However, a low-income country may only have a few hundred thousand dollars available each year to spend on pollution prevention and clean up—while a high-income country spends many billions of dollars each year despite having already eliminated major pollution problems. This spending disparity in no way reflects the actual need. A low-income country may have thousands of toxic sites as bad or worse than anything high-income countries once had in the 1950s or 1960s, but which now have been turned into productive assets.

Low- and middle-income countries have been largely focused on economic development, education and health. Countries have to tackle many urgent "priorities" and are only able to allot 1 to 2% of their national annual budget, or less into environment and

1 Delaney-Black,Virginia,etal.(2002)"Violence exposure,trauma,and IQ and/or reading deficits among urban children." *Archives of pediatrics & adolescent medicine* 156.3: 280. and " Wright JP, Dietrich KN, Ris MD, Hornung RW, Wessel SD, et al. (2008) Association of Pre-natal and Childhood Blood Lead Concentrations with Criminal Arrests in Early Adulthood. PLoS Med 5(5): e101. doi:10.1371/journal.pmed.005010

2 The World Health Organization, 2013. Available at: http:// www.who.int/gho/phe/en/

3 Pruss-Ustun A., S. Bonjour, and C. Corvalan. 2008. "The impact of the environment on health by country: a meta-synthesis. *Environmental Health* 25;7:7. doi: 10.1186/1476-069X-7-7.

4 Vineis, P. and W. Xun. "The emerging epidemic of environmental cancers in developing countries." Annals of Oncology 20: 205–212, 2009.

5 The World Health Organization, 2013. Available at: http://www. who.int/gho/phe/en/

health. In poorer countries, this results in annual expenditures of perhaps a few hundred thousand dollars, which often has to cover the full range of activities, including salaries, administration, basic equipment and functions such as regulation, monitoring and inspection. Welcome additional resources are sometimes provided by international agencies and organizations.

Compare this to the Netherlands expenditure of 930 million dollars (791 million euros) on air pollution alone in 2012.[6] The United Kingdom spent 22.5 billion dollars on environmental protection in 2010 according to the OECD.[7,8] (This includes waste disposal and waste water treatment.) The U.S. EPA has a budget of around 8 billion dollars annually and a staff of more than 15,000 people. However, every one of the 50 U.S. States has their own environmental protection departments. The California Environmental Protection Agency proposed budget for 2014-15 is 3.6 billion dollars.[9]

Pollution has not been a priority concern in poorer countries in part because pollution is often invisible to the eye and rarely leaves clear fingerprints on its victims. Countries aren't aware of the full costs that pollution steals from its people and economy, despite the hard efforts of a small number of dedicated staff, usually at middle and lower levels in governments. Equally rich countries, multilateral agencies and organizations have 'forgotten' the crippling impacts of pollution and fail make it a priority in their foreign assistance.

There is an incredibly long way to go to rid the world of worst forms of toxic pollution as the richer nations have managed to do. This needs to happen not only for the benefit of low- and middle-income countries, but for every-one. Toxic plumes of pollution readily travel in air and water, sometimes spanning countries and continents. Moreover the health and economic impacts of pollution are not confined to regional or national boundaries.

Fortunately there is the technical expertise, sophisticated equipment and methodology to identify and clean up the worst, the most dangerous sites. The industrialized world has learned over decades how to deal with such sites and has gradually upgraded virtually all of them. The technologies and resources required—at least to deal with the most immediate threats—are clear. However, low- and middle-income countries lack the necessary technical expertise and resources. Nor do many of these countries have the financial resources to address toxic pollution. Thanks to the steadily growing efforts of the partners in the Global Alliance on Health and Pollution (GAHP) this is changing.

The Top Five Components of Successful Projects in the Fight Against Toxic Pollution

Although the countries' efforts and projects profiled in this report cover a diverse range of circumstances, commonalities can be seen that contribute to the success of these endeavors.

6 http://ec.europa.eu/eurostat/statistics-ex-plained/index.php/File:Public_sector_environmental_protection_expenditure_by_environmental_domain,_2012_%28million_EUR%29_YB15.png
7 National Accounts at a Glance 2013 http://www.oecd-ilibrary.org/economics/national-accounts-at-a-glance-2013/general-government-expenditure-by-function-percentage-of-gdp-2010_na_glance-2013-table57-en
8 GDP 2010 http://siteresources.worldbank.org/DATASTATISTICS/Resources/GDP.pdf
9 Governor's Budget Summary – 2014-15 http://www.ebudget.ca.gov/2014-15/pdf/BudgetSummary/EnvironmentalProtection.pdf

1] Forge Partnerships
No single party can effectively deal with any entrenched pollution problem, large or small. Cooperation between all stakeholders is the key to successful remediation efforts. Tackling river pollution in the Philippines would not have been possible without the engagement of fisher folk, local activists, and government officials. Joining hands in tackling toxic pollution problems also benefits all involved in a variety of ways beyond the specific clean-up project.

2] Leverage Financial Resources
Even if all parties are committed to tackling a pollution problem, the financial resources aren't often available to take action. Contributions from international organizations have been critical in tacking legacy uranium mining waste that's contaminating drinking water in Kyrgyzstan for example. Solving pollution problems are not necessarily expensive. Many successful projects prove that making a substantial difference to people's wellbeing, even saving lives, doesn't have to cost beyond $20 per person.

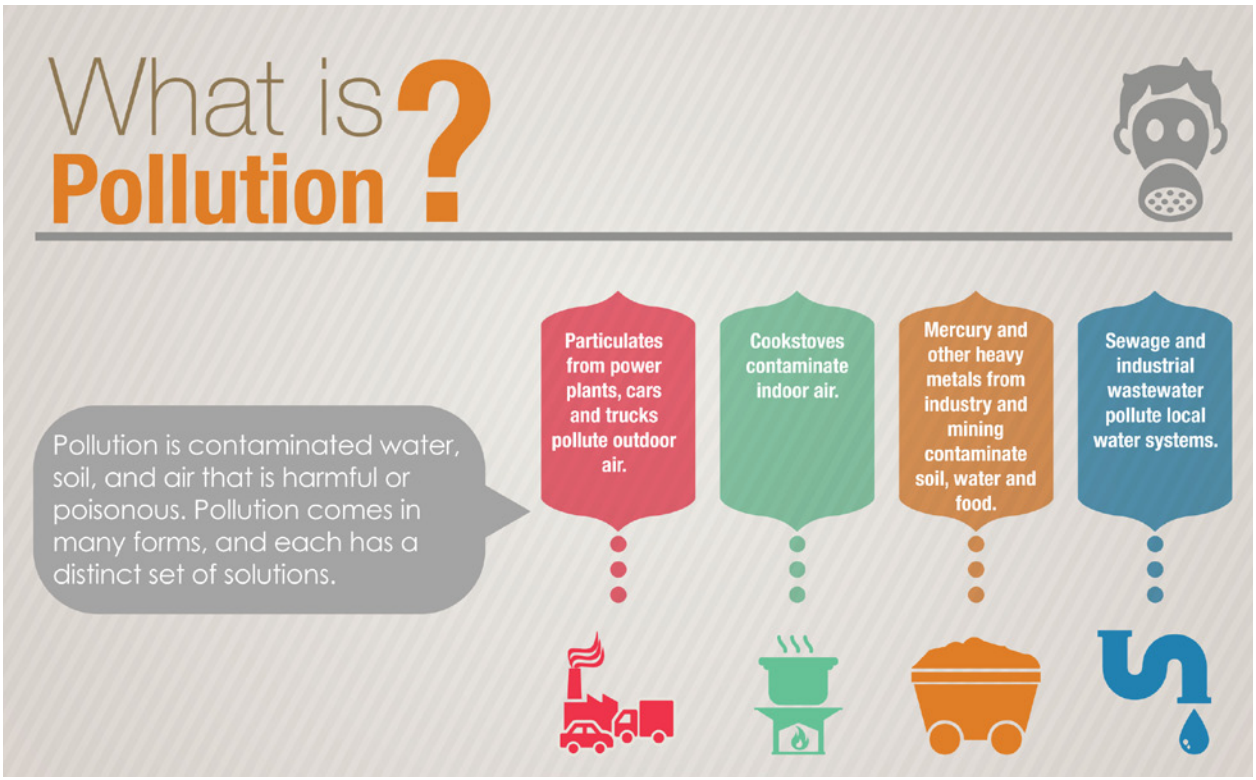
3] Gather Data
Solid information can transform the public's and decision maker's awareness, and provide a benchmark for setting goals and priorities. Research is needed to locate the source or sources of pollution and assess their risk to the local community and environment. The mapping of used-car-battery waste hotspots in Indonesia triggered cleanup of a disposal sites for example. Data from medical examinations reveal the health impacts of toxins. Research is also crucial in monitoring and evaluating the effectiveness of remediation projects.

4] Provide Safer Alternatives
Life-threatening pollution is often the result of people engaged in dangerous and harmful practices unknowingly, out of desperation or both. Burning electronic waste and backyard used-car-battery recycling are common in many countries simply because it provides a 'good' source of income. Real progress in pollution reduction requires safer, alternative and attractive ways to earn an income. In one village, Senegalese women received assistance to set up commercial hydroponics gardens to replace incomes from informal battery recycling that had led to the fatal lead poisoning of their children. Sustainable solutions require coming up with safer alternatives to help improve affected people's lives.

5] Transfer Knowledge and Build Capacity
Successful remediation projects are always dependent on local knowledge of local settings and circumstances. They also often require technological solutions and technical know-how that are not locally available. The establishment of a low-tech electronic waste recycling center in Ghana is replacing the common practice of burning this e-waste to obtain precious metals. Training, funding and some tools came from outside the country, but now local partners are able to continue on their own and serve as a model for others. The international flow of knowledge and technology can be extraordinarily cost-effective and successful in full partnership with local experts.

Ultimately with compassion, commitment and cooperation—pollution can be solved in our lifetime. This has already happened in much of the developed world, and why not the rest of the world?

Pollution especially **harms children** and can cause **birth defects, developmental and neurological disabilities, immune system damage,** and many diseases. It also can severely hamper **economic growth** by degrading **human and natural resources.**



Climate and Biodiversity Expenditures Dwarf Pollution Reduction Funding Despite Co-benefits

In recent years, climate change has deservedly focused the world's attention and resources. Industrialized nations have agreed to provide $10.4 billion in funding for 2015 to help low- and middle-income countries reduce their carbon dioxide (CO_2) emissions and adapt to the impacts of climate change. This is many times greater than the current investment in pollution reduction in these countries. Climate funding is expected to ramp up to $100 billion annually in 2020.[10]

While pollution kills more than 8.4 million people each year globally, the best and most cited estimate for lives lost due to climate change is 5 million in 2010 according to DARA's 2012 Climate Vulnerability Monitor [http://daraint.org/climate-vulnerability-monitor/climate-vulnerability-monitor-2012/].

However the majority of these deaths—at least 4 million—are the result of outdoor and indoor air pollution according to DARA. About 700,000 deaths were attributable to direct climate impacts including deaths caused by heat and cold illnesses, malarial and vector-borne diseases, meningitis and environmental disasters. Extreme heat and drought from climate change likely resulted in food spoilage and shortages that were responsible for around 310,000 deaths from diarrheal illnesses and hunger.

Outdoor air pollution largely stems from burning coal, oil (gasoline and diesel) and natural gas, which are also a main cause of climate change. Any efforts to reduce air pollution have a direct co-benefit of reducing emissions of CO_2, the principle greenhouse gas. Indoor air pollution from the burning of wood and other biomass produces soot or black carbon that is both dangerous to human health and speeds the melting of glaciers, sea ice and polar ice caps by making them darker and decreasing albedo.

At the same time as the climate warms, air pollution will worsen because air flows become more stagnant, especially in the tropics and subtropics. By 2100, more than half of the world's population will experience stationary air masses that will allow soot, dust and ozone to build up, according to new research.[11]

All nations have also agreed to make major investments to halt the dangerous decline of biodiversity, nature's green infrastructure of trees, plants and other organisms. This green infrastructure provides crucial services to humanity—including producing oxygen, cleaning the air and water, holding back floods and reducing impacts of drought—and are vital sources of food and building material.

In 2010, governments agreed on a set of 20 targets known as the Aichi Biodiversity Targets. The estimated cost of implementing those targets is between U.S. $150 billion and U.S. $440 billion per year. Just protecting wetlands would cost approximately U.S. $33 billion per year mainly to acquire land and prevent it being converted to an alternative use.[12]

Similar global investment in pollution reduction and cleaning up toxic sites would not only directly improve the health of tens of millions of people, it would dramatically improve the health of natural ecosystems upon which we all depend. It is impossible to have healthy, properly functioning wetlands, forests or other green infrastructure, if they are exposed to high levels of heavy metals, obsolete pesticides or radioactive waste.

Sustainable Development Goals (SDGs) and Creating Productive Futures

Low-cost, workable solutions to pollution have largely cleaned up the cities of Europe, the U.S. and the developed world. However 94% of the global burden of disease from pollution falls on the poor in low- and middle-income countries. That enormous health, economic and social cost burden cripples their development potential. It's difficult to see how countries can achieve the proposed Sustainable Development Goals (SDGs) without tackling pollution. Doing so requires access to expertise and funding to invest in these low-cost solutions.

With its worst pollution problems in the rear view mirror, the European Union currently spends more than 80 billion euros a year on environmental protection. The United Kingdom, with 63 million people, spends about 19 billion euros. Developing countries generally have a fraction of this to try to cope with far larger pollution problems that are a clear and present danger, and the biggest cause of death in their countries.

This report provides on-the-ground proof of how truly solvable toxic pollution problems are in 10 different countries. All it takes to free people from the crippling impacts of pollution is commitment, cooperation and compassion to marshall the resources to make this happen.

In Senegal, Seynabou no longer breaks open batteries to smelt the lead inside to put food on the table. It was not enough for Blacksmith's technical advisors to train government workers and work with local contractors clean up the village of Thiaroye-Sur-Mer. However lead recycling paid local women very well. To help generate income and put healthy food on the table, Blacksmith Institute for a Pure Earth provided the women with the hydroponic tables and the mineral nutrients solutions necessary to grow crops.

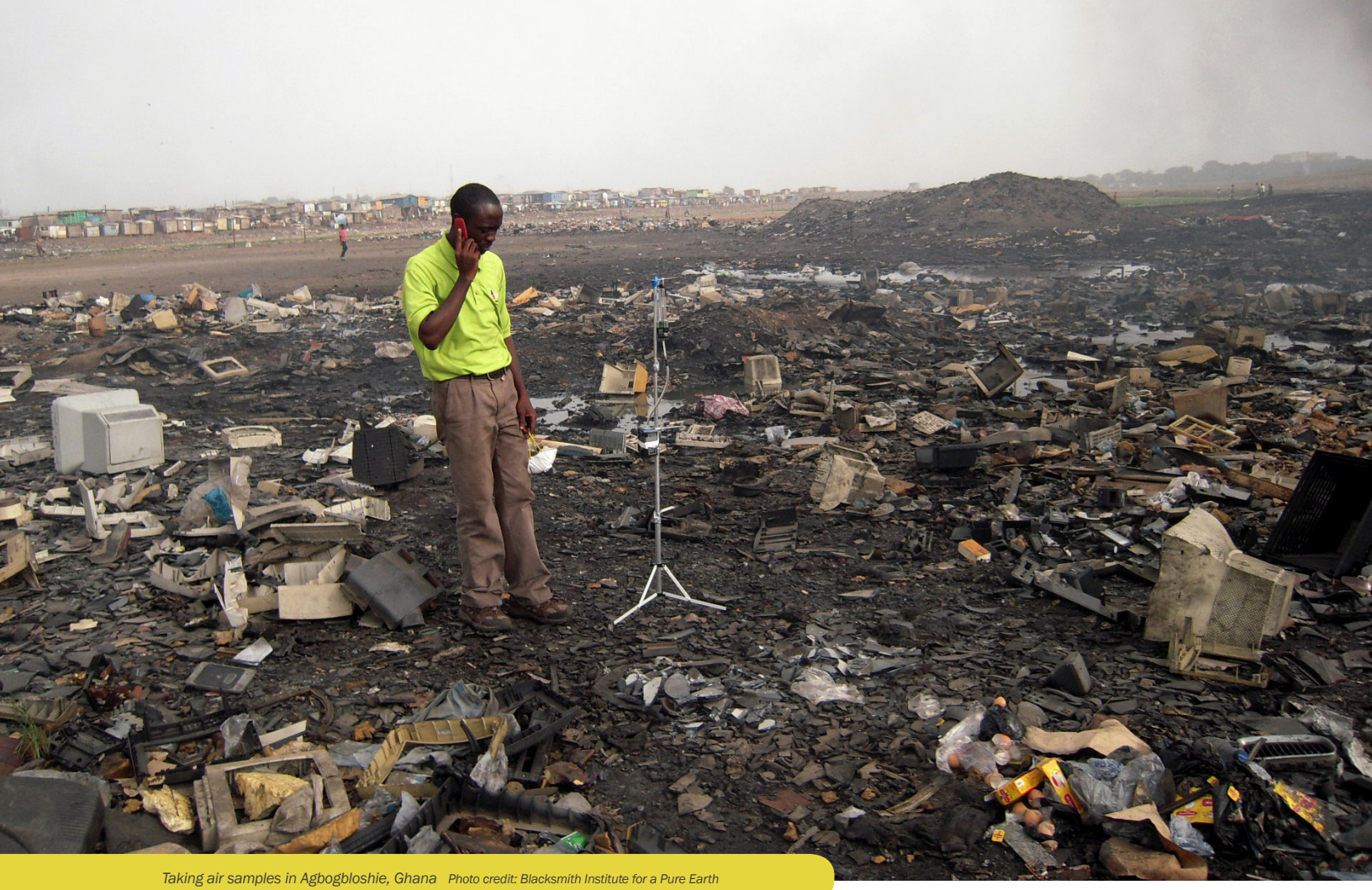
Where once the women dismantled old lead-acid batteries, now stands hydroponic tables growing peanuts, onions, tomatoes, spinach-like leafy greens, beans and legumes and other easy-to-grow fortified foods. Once one of the most toxic places on the planet, Thiaroye-Sur-Mer is now filled with healthy children on the path to a productive future.

10 http://newsroom.unfccc.int/financial-flows/green-climate-fund-exceeds-10billion/
11 http://www.nature.com/news/air-quality-to-suffer-with-global-warming-1.15442
12 http://www.cbd.int/doc/meetings/fin/hlpgar-sp-01/official/hlpgar-sp-01-01-report-en.pdf

THE TOP 10 COUNTRY SUCCESS STORIES*

GHANA
SENEGAL
PERU
URUGUAY
MEXICO
INDONESIA
PHILIPPINES
VIETNAM
FORMER SOVIET UNION
KYRGYZSTAN

*NOT RANKED, LISTED BY REGION



Taking air samples in Agbogbloshie, Ghana *Photo credit: Blacksmith Institute for a Pure Earth*

SUMMARIES

Agbogbloshie, Ghana

Dangerous Burning of Electronic Waste Replaced by Mechanized Recycling

Informal e-waste recycling is an important source of income for the thousands in Agbogbloshie, in the heart of Accra, a city of 2 million. Burning the electronic scrap to recover prized metals, particularly copper, has taken a dreadful toll on the health of recyclers and on the environment. Now wire-stripping machines offer a safer and better way to extract the metals. Plans are already underway to make Agbogbloshie a model for sustainable e-waste recycling in Ghana and Africa.

Thiaroye Sur Mer, Senegal

Replacing Deadly Lead Battery Recycling with Profitable Hydroponic Gardens

Acute lead poisoning, a rare condition requiring prolonged daily exposure to lead, took the lives of 18 young children from Ngagne Diaw in a matter of months. The women of the community had been breaking used lead-acid batteries and smelting the lead to extract it for resale. Lead fumes and dust contaminated the community killing children and impairing the health of others. Project partners and funders, along with the Senegalese government, not only removed lead contamination from the village, but also trained the women in hydroponic agriculture as an alternative to this toxic work.

A toxic hotspot in a neighborhood in Montevideo, Uruguay *Photo credit: Blacksmith Institute for a Pure Earth*

Peru

New Soil Pollution Laws and Remediation Timelines

Peru is mining nation. It is one of the world's top producers of gold, silver, copper and even oil. For decades these extractive industries have operated with little to no environmental regulations leaving behind thousands of contaminated sites in its wake. Peru is beginning to take the necessary steps to ensure its resources boom does not leave the environment and Peruvians with an irreparable toxic legacy. The government recently introduced some of Latin America's first soil quality standards, which will regulate toxic releases from extractive industries and provide a legal framework to begin remediating contaminated sites.

Montevideo, Uruguay

Reclaiming Neighborhoods by Cleaning Up Electronic Waste Toxic Hot Spots

Low-income earners in Montevideo burn electronic trash and electrical cables to obtain copper for resale. By burning e-waste over open pit fires they created "toxic hotspots" in their own communities, sites where contamination from heavy metals and other toxins are so high, it is a danger to human health. The Global Alliance on Health and Pollution

teamed up with the City of Montevideo and successfully identified and remediated some of the worst toxic hotspots of the city.

Mexico City, Mexico

Contaminated Oil Refinery Turned into Urban Park With a Million Visitors a Year

For fifty-eight years, an oil refinery in Mexico City's urban core spewed lead, benzene, and heavy metals into the air, contributing to the capital's former reputation as the most polluted city on the planet. The grounds of the refinery were saturated with toxins meters below surface and the groundwater was contaminated. Working with the corporate sector, universities and industry, the Government of Mexico successfully remediated the area and today, the site is one of Mexico City's most beloved parks.

Bicentennial park is located on the site of a former oil refinery in Azcapotzalco, Mexico
Photo Credit: vladimix, Creative Commons, Some Rights Reserved

Cinangka, Indonesia

Soccer Field Used as an Old Lead-Battery Dump Now Safe for Children

Small scale, informal disposal of used acid-lead batteries contaminated the village of Cinangka.

La Oroya, Peru
Photo credit: Blacksmith Institute for a Pure Earth

Locals dismantled car batteries in backyards, smelted the lead, and dumped the remains at various locations. Soil contamination levels at a local football pitch (soccer field) were 500 times higher than the U.S. safety limit. A project completed in April 2014 safely encapsulated the contaminated soil at the football pitch allowing children to safely use it again. This pilot project proved the feasibility and cost-effectiveness of this method, paving the way to similar, much-needed intervention at additional sites.

Marilao, Meycauayan and Obando River System, Philippines

Cleaning Up with Zeolite and Probiotics Filtering Systems

A major hub for aquaculture, the Marilao, Meycauayan and Obando River System is also badly contaminated by untreated wastewater from used car battery recycling, precious metal refining shops, tanneries and more. Water samples reveal worrying levels of cadmium, copper and lead. A four-year project sponsored by HSBC and carried out by Blacksmith Institute for a Pure Earth is testing innovative water filtering in fishponds,

A boat on the polluted Marilao, Meycauayan and Obando River System in the Philippines
Photo credit: Blacksmith Institute for a Pure Earth

enhancing monitoring of water quality, providing comprehensive training to the fishermen, and expanding education, advocacy and public outreach.

Dong Mai, Vietnam

$20 Per Person Ends Dangerous Lead Poisoning of an Entire Village

At one time the people of Dong Mai were artisans, but in recent decades they turned to battery recycling and small-scale lead smelting to survive. Dong Mai's 2,600 villagers paid a heavy price for this toxic work with high levels of respiratory diseases, and mental illness in the community. Thanks to a technical collaboration and a targeted clean up, the situation is rapidly beginning to turn around. Levels of lead in the villagers have dropped by 30% for an investment of just $20 a person.

Former Soviet Union

Hunting Down Hundreds of Thousands of Tons of Old but Still Toxic Pesticides

Following the collapse of the Soviet Union hundreds of thousands of tons of toxic pesticides were discarded and forgotten. DDT, lindane and other organochlorine-based pesticides were buried at hundreds of largely unrecorded burial sites or left in thousands of abandoned warehouses throughout the region. The pesticides have been leaching toxins into nearby waterways and soil over the last twenty years. A broad partnership including FAO, Green Cross Switzerland and the Tomsk-based NGO Siberian Environmental Agency, WHO, UNEP, International HCH & Pesticides Association, Milieukontakt International, and Blacksmith Institute for a Pure Earth, are working with a local group in Siberia to uncover these toxic sites for remediation.

Mailuu-Suu, Kyrgyzstan

Filters Improve Safety of Water Contaminated by Radionuclides while Children Create an Education Campaign

Long defunct uranium mining operations have left a dangerous legacy in the town of Mailuu-Suu; one of many similar communities across the region. Heavy metals and radionuclides from 23 nearby tailing dumps have migrated into the town's crumbling water system. Immune system disorders have been

Hundreds of thousands of tons of toxic pesticides were discarded and forgotten in the Former Soviet Union
Photo credit: Blacksmith Institute for a Pure Earth

In Mailuu-Suu, Kyrgyzstan, colorful mugs and food sit on neat lace tablecloths in a school's cafeteria, where children were eating food cooked with contaminated water every day Photo credit: Blacksmith Institute for a Pure Earth

found in nearly one in five adolescents. A project to install water filters in schools and kindergartens; measure radiation levels in houses including where needed installation of radiation shields and in very rare cases resettlement of inhabitants; undertake health investigation of risk groups, mainly children and youth; and educate population on risks from the tailing sites, has helped to reduce residents' exposure to these hazardous substances. Water samples from schools where filters were installed showed uranium content 48-65 percent lower than before. Blood tests taken from adolescents 40 days after the installation of the water filters have also shown marked improvement. However, the much-needed expansion of these efforts is currently stalled due to lack of funding.

Honorable Mentions: Booming Economies and a Small Island Nation

China, India, and Madagascar

For China and India, the world's two largest emerging economies, environmental degradation and compromised public health have been the dark side of breakneck economic development. China has recently put in place a strict set of ambitious legal measures to reduce pollution. Meanwhile surveys completed in India with the assistance of Blacksmith Institute for a Pure Earth have helped map the pollution hotspots providing vital information for policy makers and the public.

The Malagasy government recently approached GAHP asking for assistance dealing with sites of contamination scattered throughout the island. Over the last two decades this extremely sensitive environment has come under attack by toxins from activities that include pesticides stockpiling, illegal mining and crude battery recycling.

AGBOGBLOSHIE, GHANA

PROJECT DETAIL
DANGEROUS BURNING OF ELECTRONIC WASTE REPLACED BY MECHANIZED RECYCLING

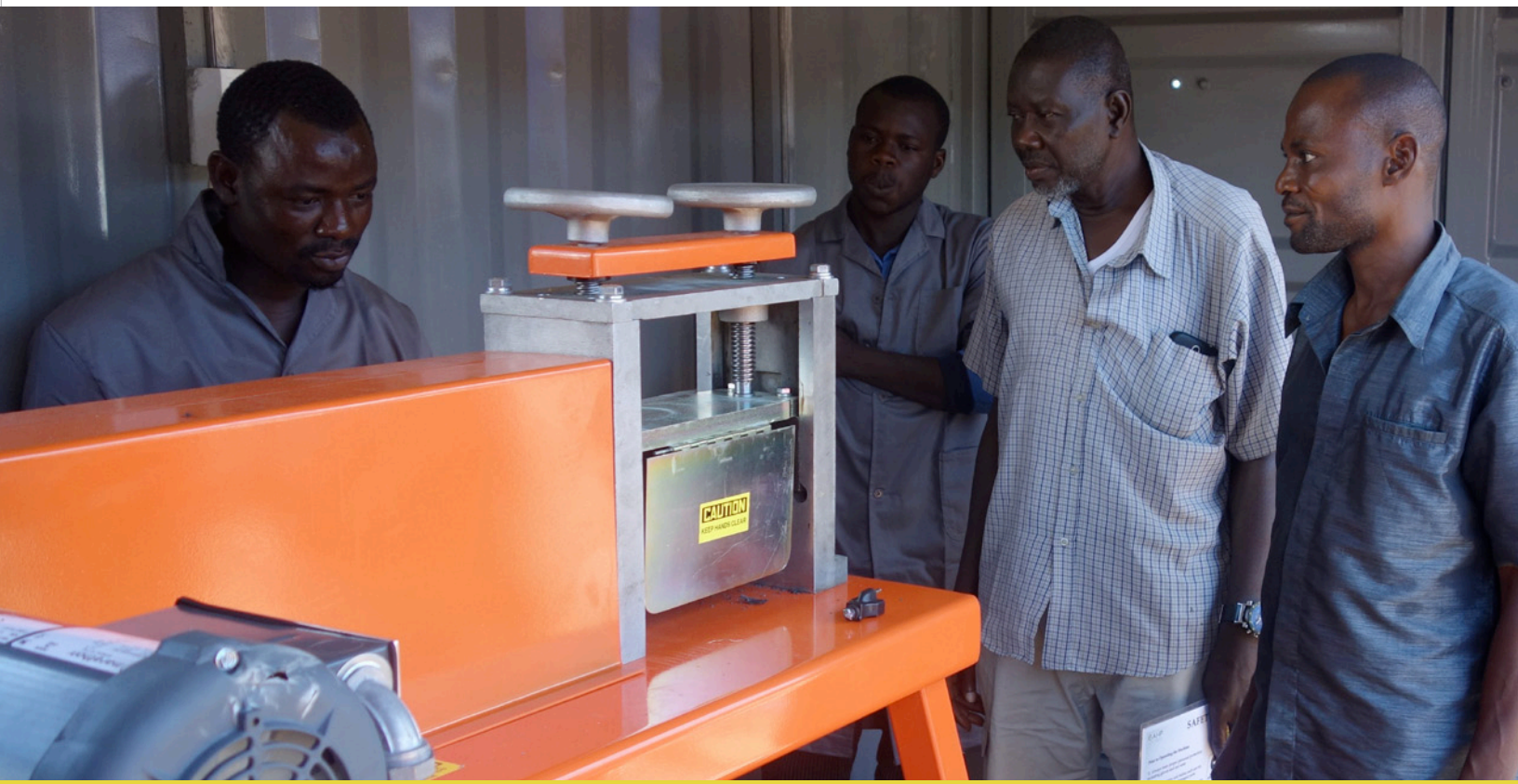
LOCATION	**Ghana**
POLLUTANT	**Heavy metals, particulates, lead, mercury, PCBs, PAH, phalates**
SOURCE	**Burning and dismantling of e-waste**
POPULATION AFFECTED	**50,000—250,000**
HEALTH AND ENVIRONMENTAL IMPACTS	**Air pollution from piles of e-waste lit up to burn off plastic-coated wires; Soil and water pollution with heavy metals from irregular dumping of waste materials**
INTERVENTION	**A mechanized recycling facility that would help eliminating open burning of e-waste.**
OUTCOME	**The goal is to reduce all types of pollution while increasing benefit for recyclers.**
CO-BENEFITS	**Health and income improvement locally. The project can be expanded and be replicated as a model for other e-waste sites in Ghana and beyond.**

The Problem: Countless Piles of Burning Electronic Scrap

Agbogbloshie, Ghana is where some of our electronics go to die and become the widely-known poster child for electronic or e-waste pollution. Now it's on the way to becoming a model of sustainable recycling.

"It's a massive market with just about every sort of recycling that you can imagine going on," says Kira Traore, Program Director for Africa at Blacksmith Institute for a Pure Earth.

Located in the middle of Accra, a city of two million, Agbogbloshie's most defining characteristic is the black, acrid smoke billowing from countless piles of electronic scrap set on fire to recover their inner, prized metals, mostly copper. Once these metals are recovered, the remaining materials are often dumped into unlined pits and waterways.



(Above) E-waste in the recyclers market in Agbogbloshie, Ghana, and, (Below) The new e-waste recycling center in Agbogbloshie, Ghana, is equipped with machines and tools that can safely extract e-waste without burning *Photo credit: Blacksmith Institute for a Pure Earth*

This crude form of recycling has taken a very heavy toll on the health of local recyclers, among them a significant number of children and young people, as well as tens of thousands of others living in nearby informal settlements. Scrapped electronics such as power supply housings, circuit boards and small capacitors often contain toxic materials and recyclers working without any protective gear face the risk of exposure to respiratory diseases and a range of heavy metals, primarily lead.

At long last this is starting to change with a recently launched project introducing modern recycling machinery. The government and local environmental groups have tried addressing the problem in the past. But the current project, will not only make the recovery process safer and more efficient, it also creates a sustainable source of income for local residents.

"We had no doubt that something must be done," says Yaw Amoyaw-Osei, director of the environmental NGO Ghana Advocacy. "This could also act as a kind of sensitization for all decision makers that the Agbogbloshie case is being addressed and that it can be easily replicated."

Health Impacts: Toxic Work

In 2010, nearly 22,000 people died in Ghana as a result of various types of pollution (though not all linked to e-waste recycling)—the same year a little less than 16,000 people died due to HIV. Dangerous exposure to toxic substances is compromising the health of e-waste recyclers in Agbogbloshie and in similar sites across the country.

Both large and small-scale informal recycling of everything from clothing to batteries to electronics is common in many countries. Worldwide, electronic waste or e-waste—defined as anything discarded with a battery or electrical cord or plug—is currently estimated at up to 50 million tons per year and growing. Close to 80 percent of the total is shipped to countries in Asia and Africa.

Ghana alone receives every year nearly 215,000 tons of used consumer electronics, and this amount is expected to double by 2020. About half of these devices are usable, either instantly or after refurbishment. And Ghana itself annually generates additional 129,000 tons of electronic waste, or e-waste.

Much of these discarded electronics arrive in Agbogbloshie in Ghana's capital city of Accra, which is thought to be West Africa's second largest e-waste disposal site. For thousands of poor Ghanaians the valuable materials inside these electronics are a vital source of income.

"Entire buses are being broken down there as well as refrigerators, computers, televisions and cellphones. It's a dirty place—the ground is all covered in oil, and there is lead and other heavy metals in the ground," says Blacksmith's Traore.

"You have all this black smoke that's kind of hovering over the market. You can smell the burnt plastic from all around the market—it's a very pungent smell."

Working or living in this environment is a serious health hazard. A health risk assessment carried out in 2009 found workers in Agbogbloshie suffer adverse health effects with the main symptoms being increased fungal rashes and skin abnormalities. Samples taken from five workers found high levels of aluminum, copper, iron and lead in their blood. Such toxicants, released in the burning process, contaminate or coat tiny particles in the smoke or are found in the soil and readily redistributed by wind or rain. As a result, the pollution affects a wider area including adjacent farmers market, businesses and residential areas.

The Solution: Slashing Pollution With Mechanized Recycling

Efforts to address the growing pollution problem have been going on for several years. Many foreign experts visited to study the problem but few provided practical solutions. In 2010 manual wire-stripping tools like crankers and cutters were introduced, as part of a project supported by Comic Relief. While this is a cleaner method to recover copper from

The new e-waste recycling center in Agbogbloshie, Ghana *Photo credit: Blacksmith Institute for a Pure Earth*

plastic coated cables, it turned out to be more labor intensive and slower—in fact, eight times slower than burning to extract the same amount of copper—and therefore had limited success.

With government fearing bad publicity and local recyclers fearing they'd be shut down, Blacksmith Institute for a Pure Earth worked to build the trust of all parties with a commitment to solve the pollution problem and create a new clean recycling industry.

"We worked hard to find solutions that would work for the local recyclers. Simply banning burning wouldn't help them earn an income. Rather, forbidding burning in Agbogbloshie might push the practice elsewhere, thus expanding the pollution and the number of people affected by it," says Traore.

In January 2014 a pilot project commenced with a series of open community meetings which brought together the various stakeholders—including the local recyclers' association called the Greater Accra Scrap Dealers Association (GASDA), government officials, individual recyclers and local businesses—to discuss the project plans. This was also crucial for improving relations between the informal recyclers and the government.

In parallel, a new, mechanized recycling facility was introduced. Located in a repurposed blue shipping container, four automated wire-stripping units allow workers to strip the plastic coating off the wires in a considerably more efficient, profitable and safer manner. Officially inaugurated in October 2014 it is expected to be able to extract approximately 10 tons of copper per month and employ 50 workers.

Here's how it works: local recyclers bring in the cables and wire they've collected to the centre. For a token amount of money all the plastic is stripped off and the wire bailed. Recyclers get better prices for this cleaner wire. As a bonus the plastics, which previously used to be burned, has become another material they can sell.

Dismantling e-waste in Agbogbloshie, Ghana *Photo credit: Blacksmith Institute for a Pure Earth*

"It's always hard to do something new. People want to see the results of pilot projects. There was a lot of skepticism about this but now we have something to show that worked," says Traore

The project's main objective is to eliminate the open burning altogether, thus slashing the environmental and health risk. "With the recycling equipment that has been installed we believe it's possible," says Amoyaw-Osei.

Eager to achieve this goal, GASDA has set up a task force to discourage e-waste burning. In addition, the Environment Ministry is currently looking at banning burning.

The Next Step: A Replicable Model for Sustainable Recycling

Next, the goal is to scale up the recycling facility so it can process an even larger amount of waste, within an even shorter time, and also increase the number of staff it employs. New machinery would include a shredder, alligator shears and a vertical baler, and GASDA members will receive comprehensive technical and business training as well as health and safety training.

Ultimately, GASDA wants to transform Agbogbloshie from the poster child of e-waste pollution into a model of sustainable recycling: a model that could be replicated in similar sites across Ghana and beyond.

"We're currently working with the National Youth Authority, who are owners of the land at Agbogbloshie, so that what we're doing here can be implemented in other urban centers," says Amoyaw-Osei. "We think our case can be a knowledge transfer center where the Authority can also bring in youth from other areas to train them and give them skills."

But both Amoyaw-Osei and Traore acknowledge that achieving this transformation would require an incredible effort and as much support as they can get. In particular, additional funds will need to be secured to set up the training center and bring the clean e-waste recycling model to other regions.

In its second phase, from October 2014 to June 2015, the project will see the purchase of additional wire-stripping machines and training of workers on the site. A new partnership with GRATIS Foundation, Ghana's largest manufacturer of such machinery, could mean the equipment is produced locally and at a lower cost.

A recent donation will also allow expanding the operations to recycling of plastic casings and sheet metals, and making the dismantling process of various households appliances—from computers to washing machines—safer more efficient.

Cooperation with Ghana's Energy Commission will also assist in setting up a dedicated site for handling refrigerators and air conditioners that require special facilities for removal of hazardous and ozone-depleting substances, as well as safer processing of electronics that contain acid or toxic oils.

In addition, another health assessment is planned to be carried out by the end of 2014, to assess the project's impact on air pollution and the health of workers and local residents.

"Our big dream is to remediate all the contaminated soil in Agbogloshie so it will truly be a clean and sustainable e-waste processing centre," said Traore.

Project Partners

- City University of New York, School of Public Health
- EPA Ghana
- Ghana Health Service
- Ghana, Ministry of Environment
- Greater Accra Scrap Dealers Association (GASDA)
- Green Advocacy Ghana (GreenAd)
- Ghana, National Youth Authority

Funders

- United Nations Industrial Development Organization (UNIDO)
- Comic Relief
- European Commission
- Global Alliance for Health and Pollution (GAHP)
- Blacksmith Institute for a Pure Earth
- Addax & Oryx Foundation

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THIAROYE-SUR-MER, SENEGAL

PROJECT DETAIL
REPLACING DEADLY LEAD RECYCLING WITH PROFITABLE HYDROPONIC GARDENS

LOCATION	**Thiaroye-Sur-Mer, Senegal**
POLLUTANT	**Lead**
SOURCE	**Dismantling lead acid batteries to extract the lead; and smelting the lead for resale**
POPULATION AFFECTED	**10,000**
HEALTH AND ENVIRONMENTAL IMPACTS	**Women and children were inhaling lead dust from the dismantled batteries and smelting; Lead contamination in the soil and water**
INTERVENTION	**Cleaned-up community and provided training hydroponic agriculture, making extracting lead from batteries no longer necessary as a means of income.**
OUTCOME	**Recycling lead acid batteries is no longer practiced in the community.**
CO-BENEFITS	**Health improvement locally. Increase of nutritional foods production. The project can be expanded and be replicated as a model for communities in Senegal and beyond engaged in unofficial labor with toxic materials**

The Problem: Children Dying From Rare Acute Lead Poisoning

Young children in Thiaroye-Sur-Mer, a small community lying on the western most tip of Senegal began mysteriously dying between November 2007 and March 2008. Acute lead poisoning was later determined as the cause of death, a condition seldom seen anywhere and usually requiring daily exposure to lead for months on end.

"Lead contamination is not common in our country," says Aïta Seck, with the Ministry of Environment for Senegal.

To supplement their families' incomes, the women of the village, including the mothers of the deceased children broke apart used lead-acid batteries to extract the lead, and melted it into ingots for resale. No one knew the lead was poisoning the children.

(Above) Cleaning crews went from house-to-house to remove toxic lead dust in Thiaroye-Sur-Mer, Senegal, and, (Below) Women attending a training workshop to learn how to farm with hydroponics in Thiaroye-Sur-Mer, Senegal Photo credits: Blacksmith Institute for a Pure Earth

Women in Senegal didn't know their toxic jobs were poisoning themselves and their families *Photo credit: Blacksmith Institute for a Pure Earth*

"Lead in the soil in Thiaroye-Sur-Mer was off the charts, as high as 220, 000 PPM (parts per million) in the surface layers. In other words the soil was 20% lead. In the U.S. and the E.U., lead concentration in soil more than 400 PPM is considered unsafe," says Kira Traore, Program Director for Africa at Blacksmith Institute for a Pure Earth.

When the tragedy took place, Thiaroye-Sur-Mer was in the midst of a 'lead-rush.' A newly opened nearby lead smelter offered the women $100 for a day's work of collecting lead from batteries and sifting through lead waste. Suddenly the women of Thiaroye-Sur-Mer could earn in one hour what someone working at the market makes in an entire day. The race was on.

With hammers and chisels in hand, and without any protective equipment, the women of Thiaroye-Sur-Mer cracked open old batteries from cars, motorcycles, and solar panels, removed the lead and smelted it in pots and pans over an open fire pit. The work took place at home or near the family compound with the children close by so their mothers could keep an eye on them.

But in breaking apart the disintegrating batteries the lead would escape into the air as a fine red dust. Open pit smelting released the lead in the form of an even finer powder. From there, the powerful neurotoxin which can wreak havoc on the human nervous system made its way into hair, clothing, soil, water, food, and eventually into community members themselves.

"The women did not connect their work with the deaths of the children initially. They understood it as an alternative source of income," says Traore.

Blacksmith Institute for a Pure Earth was

approached by the Senegalese Ministry of the Environment in 2008 to assist with the removing lead contamination in the community at a time when the situation was near epidemic levels. Six years later the contamination has been cleaned up and lead blood levels in children below the age of five has been dramatically reduced.

"The Thiaroye-Sur-Mer project helped in mitigating the amount of lead in the soil and reducing the contamination risks in the population. Furthermore, the community benefited from the project's educational component on the health risks of artisanal lead exploitation," says Mme. Seck.

Health Impacts: Lead Poisoning in the Entire Community

All 10,000 people living in Thiaroye-Sur-Mer were presumed at the time to be at risk of lead poisoning according to the Senegalese government. Lead blood level tests of the siblings and mothers of the deceased children and more than a dozen unrelated community members conducted by the government and the World Health Organization (WHO) revealed lead poisoning in everyone tested. The lead blood levels in some of the children were astronomically high, in some cases as high 150 micrograms per deciliter. Anything above five micrograms per deciliter is considered unsafe in the U.S.

"Windy and dusty conditions in Thiaroye-Sur-Mer had enable the lead dust to move throughout the community. From there it contaminated schools, playgrounds and entire homes," says Traore.

Twenty-seven children in Thiaroye-Sur-Mer tested for blood lead levels showed signs of brain damage from lead poisoning. All but five had to be hospitalized. Lead poisoning can cause damage to the kidneys, liver, brain and cardiovascular system. Long-term side effects of lead poisoning have also been linked to increases in violent behavior.

"When we came into the community, we tested community members and showed them the results on site just so they could see with their own eyes how high their lead blood levels were. This and educating the community on the dangers of lead poisoning really helped the women understand the severity of the situation. The women became determined to act," says Traore of Blacksmith

The Solution: Decontamination, Senegal's First Ever Hazard Waste Removal and Alternative Livelihoods'

Senegal had never conducted a hazard waste removal before and three thousand cubic meters of contaminated soil had to be removed. Technical advisors trained government workers and local contractors on how to adequately and safely remove the contamination. By 2009, the removal project was underway.

"There was some resistance initially to the project because recycling batteries was a income generator and we recognized that. Remediating the contaminated sites and educating community members on the dangers of lead poisoning was how we were able to build trust with the community," says Traore.

The lead contaminated soil was unearthed by a backhoe and locals working in HAZMAT suits. With racks and shovels, they filled up canvass bags with the soil, and placed them in a dump truck. The truck transported the contaminated soil to the municipal dump for containment.

Phase two involved combing over one hundred homes with high-powered vacuum cleaners and scrubbing them with heavy detergents to remove the lead dust.

Presently, lead concentration in the soil in Thiaroye-Sur-Mer is at a level considered safe in the U.S. (400 parts per million). This remarkable turnaround was achieved not only through education and the cleanup, but by also providing alternative livelihoods for the women hydroponic agriculture.

"Senegal has a short rainy season and is dry for most of the year making growing crops in the ground difficult. But with hydroponic tables whatever water you use for your plants stays in the table. This means

the women can grow nutritious, fortified foods year round," says Traore.

Blacksmith Institute for a Pure Earth provided the women with the hydroponic tables and the mineral nutrients solutions necessary to grow crops. The women were also taught how to farm with hydroponics. Where once the women dismantled old lead acid batteries now stands hydroponic tables growing peanuts, onions, tomatoes, spinach-like leafy greens, beans and legumes and other easy-to-grow fortified foods. The produce is either sold at the local market or used to feed their families.

"The women of Thiaroye-Sur-Mer are absolutely committed to change for health of their families. They really rallied with us for this project. We are happy to say Thiaroye Sur Mer no longer recycles batteries. Blood lead levels in children have dropped dramatically and hydroponic growing activities have expanded. We have also developed a great partnership with the government," says Traore.

The Next Step: Expand the Program to the Remaining Sites Contaminated in Senegal

Despite the ban in Senegal on recycling lead acid batteries, several communities continue to dismantle and extract lead from the batteries in the same way women in Thiaroye-Sur-Mer once did. The world's demand for precious metals continues to grow and lead fetches ever-higher prices on the international market. Those still engaged in the crude battery recycling in Senegal are usually completely unaware they are poisoning themselves and their communities.

"We want to build upon the successful ULAB (used lead acid batteries) project to address the remaining small-scale battery recyclers. One goal is to reach all of these areas with educational outreach in order to help change behaviors to protect people from potential lead poisoning," says Traore of Blacksmith.

As in Thiaroye-Sur-Mer, the first step is to build trust with the communities through remediation and education. Blacksmith Institute for a Pure Earth plans to use the model developed in Thiaroye Sur Mer to assist Senegal in cleaning up sites contaminated by POPs/pesticides, many of which are from failed or abandoned large scale agriculture projects and are sitting haphazardly in insecure storage facilities.

"POPs/pesticides sites are a major issue. Under the Africa Stockpile Program most of the pesticides sites in Senegal were identified and assessed, and some were cleaned up. However many more sites remain and need to be cleaned up. This can be done in a very cost-effective way. So we are hoping to bring over some innovative, low-technology, low-cost solutions for remediating soil and cleaning up remaining pesticides stores," says Traore.

Blacksmith hopes to apply the model developed in Thiaroye-Sur-Mer in other parts of African and foster cooperation between neighboring countries in the process. Additional funding will be required expand the project to other parts of Senegal and Africa.

"We are looking at some pilots in Kenya for ULAB recyclers, and integrating South-South training into these is integral for sustainable development and generating cooperation across borders," says Traore.

Project Partners

Senegalese Government
University of Dakar
World Health Organization
Blacksmith Institute for a Pure Earth
Terragraphics
Quality Environmental
Hunter College, City University of New York

Funders

Green Cross Switzerland

Women attending a training workshop to learn how to farm with hydroponics in Thiaroye-Sur-Mer, Senegal *Photo credit: Blacksmith Institute for a Pure Earth*

PERU

PROJECT DETAIL
NEW SOIL POLLUTION LAWS AND REMEDIATION TIMELINES

LOCATION	**Peru**
POLLUTANT	**Lead, arsenic, mercury, cadmium, elemental mercury**
SOURCE	**Mining, mining ore processing, petro-chemical industry, lead smelting**
POPULATION AFFECTED	**30,000,000**
HEALTH AND ENVIRONMENTAL IMPACTS	**Pollutants from mining and other industrial activities have a wide range of human health impacts (brain, liver, kidney, nervous system damage) and severe degrade the natural environment local communities depend on (i.e. contamination of drinking water and food sources).**
INTERVENTION	**Adopting strict regulations on soil contamination**
OUTCOME	**To be determined—regulations only recently adopted**
CO-BENEFITS	**To be determined—regulations only recently adopted**

The Problem: No Legal Framework to Regulate Thousands of Toxic Sites

An astounding quantity of the precious metals comes from Peru. It is Latin America's number one gold producer, second in the world in silver mining, and a leading copper producer. Small, medium, large-scale mining is wide spread throughout the country.

"We are a mining nation. Mining takes place in most of the regions of Peru," says Vilma Morales, a coordinator managing environmental risks and chemicals with Peru's Ministry of the Environment.

Sadly, Peru's wealth of resources has largely been developed without much regulatory oversight. Environmental regulation efforts were first introduced in the 1990s. By then, the impact of mining, oil operations, lead smelting and other industrial operations had left a legacy of

(Above) Mining in the high Andes, Peru *Photo Credit: Matthew Burpee, Creative Commons, Some Rights Reserved*
(Below) Gold mining in the Peruvian Amazon *Photo Credit: Joseph King, Creative Commons, Some Rights Reserved*

environmental liabilities or "pasivos ambientales" across the country. Peru has been steadily increasing regulatory measures to ensure the ongoing resource boom does not cause irreparable harm to the local environment and the population.

Laws regulating air and water pollution have been in existence in Peru for some time now but until recently the country had nothing addressing soil contamination and no soil quality standards. For the first time in the history of Peru contaminating soil with deadly toxins is now illegal. The regulatory mechanisms are in place to require polluters to cleanup whatever toxic mess they have created.

"Before the regulations no one could say a site was contaminated from a legal perspective. This has huge implications," says Sandra Gualtero, Latin America Coordinator for the Blacksmith Institute for a Pure Earth.

Regulations on toxins in soil were introduced in 2013. Now the Peruvian government must undertake the monumental task of mapping out all sites contaminated by mining and other industrial activity and determine what levels of toxins in the soil are acceptable and safe. The government is requiring all businesses and industries to submit the results of the soil sampling by April 2015 and aims to have a complete list in 2015.

Health Impacts: An Environmental State of Emergency Declared

The same year the regulations on soil contamination were introduced, Peru declared a state of environmental emergency for the Amazon region along the Pastaza River.[13] A decade-old oil operation in the region had released dangerously high levels of hydrocarbons into the surrounding environment. The indigenous Quichua and Ashuar peoples hunt and fish in the area.

Peru's small-scale gold miners, often operating illegally, use mercury—a dangerous neurotoxin—to extract gold from mined ore. The miners use small propane blowtorches to boil mercury to remove the gold particles, and in the process mercury contaminates the soil, water and the local food supply (i.e. fish).

"Some miners know working with mercury is not good for their health, but use it anyway because they are dependent on the income from gold mining," says Sandra Gualtero, Latin America Coordinator for the Blacksmith Institute for a Pure Earth.

The miners are not the only ones at risk of mercury poisoning. The Carnegie Institute of Science found 78% population in Puerto Maldonado, the capital of the state of Madre de Dios in southeastern Peru, had dangerously high mercury levels.[14] Puerto Maldonado is far removed from where mining takes place in the state.

"There is a big bioaccumulation issue with mercury. Fish in a river contaminated by mercury from mining are caught and consumed by the local population living far from mining operations. They still are at risk of mercury poisoning," says Gualtero.

Mercury poisoning hits pregnant women and children hardest. Developing fetuses, infants and young children can suffer brain damage. High levels of mercury can cause damage to the heart, lungs, kidneys and immune system. According to the same Carnegie study, indigenous communities living in the areas of Madre de Dios where mining is taking place have mercury levels five times higher than what the World Health Organization considers to be safe.

"The government in engaged in a scoping process to understand how many contaminated sites exist in Peru. Each mining operation and any other industrial activity is a potential generator of soil contamination," says Morales.

According to the Peruvian government's preliminary assessment on the number of toxic sites, many are assumed to be "legacy sites" meaning they are the toxic legacy leftover from an industrial project no longer in operation. Toxic waste had either been mismanaged, inappropriately disposed of or the operations themselves had been improperly shut down.

Mining town in the Peruvian Andes *Photo Credit: Frank_am_Main, Creative Commons, Some Rights Reserved*

The Solution: World Class Soil Quality Standards

Peru's new soil quality regulations set standards on allowable levels for twenty-one pollutants such as lead, or arsenic, and what levels are dangerous to the environment and human health. This provides a much-needed legal framework for regulation and controlling hazardous materials and aids in implementing decontamination plans.

Few countries in Latin America have soil quality standards. Peru's regulations will undoubtedly serve as an example for other countries in the region to follow.

Each government ministry is equipped with its own 'environmental section' and these sections are responsible for enforcing soil quality standards and evaluating contaminated sites in their own sectors. For example, the Energy and Mining Ministry is responsible for implementing the soil regulations in the mining sector.

The Environment Ministry sets out the rules and guidelines on how to deal with sector specific contamination. and has established a fairly straightforward, step-by-step process. The first task for each ministry is to identify toxic sites resulting from their sector's activities, then determine the extent of the contamination and identify what contaminants are in the ground—and finally remediate the area.

Before these regulations were adopted, the government held public consultations and heard

13 http://www.huffingtonpost.com/2013/03/26/peru-oil-contamination-emergency_n_2955630.html?utm_hp_ref=green
14 http://globalecology.stanford.edu/research/CAMEP/Findings.html

Mining town in the Peruvian Andes *Photo Credit: Frank_am_Main, Creative Commons, Some Rights Reserved*

both praise and criticism for the soil quality standards.

"People did ask how it was possible to create soil quality standards if we did not know what was in the soil before these areas became contaminated. For this, the regulation also establishes baseline levels of soil composition or "niveles de fondo"; taking soil samples from areas near contaminated sites," says Morales. The guidance documents (Guias) provide further information on how to proceed in these cases.

Using these baseline levels as the standard and with other legislative tools in the regulations, the Environment Ministry and the relevant government authorities can now determine when a mine or industrial operation has exceeded safe levels, and legally force the involved parties to remediate the area.

The Next Step: Tracking Down Peru's Contaminated Sites

This year is set to be a big year for the new soil regulations. The Environment Ministry hopes to make great progress in tracking down and identifying Peru's contaminated sites. The new regulations also guide the evaluation of contaminated sites and the design and implemention of decontamination projects.

"Knowing where contaminated sites are in Peru and knowing what contaminants are in those sites will help with remediation and the enforcement of the new regulations," says Morales.

The work ahead includes training local government professionals on contamination and the new regulations, as well as expanding the capacity of the local, regional and private laboratories will all enhance the effectiveness of the regulations.

"These remediation projects will contribute to cleaner environments for people, especially mothers and young children," says Gualtero.

Criticism of Changes in Environmental Governance

Changes to the decision-making authority of the Environment Ministry inacted in 2014 by the Peruvian government transfers authority of mining-related and other environmental land use decisions from the Environment Ministry to the Council of Ministers, representing a broad range of interests. This change has led to broad criticism from environmental groups.

However, this change does not negate, weaken or impact these important soil standards that have been in development since 2006. These new national requirements to measure the soil, map contaminates, submit remediation plans have to potential to create a major shift in the environmental health of Peru.

Many developing nations are faced with balancing the needs of economic growth and environmental protection. Although the changes in land-use policy can be seen as a rollback of environmental progress, the new soil regulations are clearly a win. For the first time in the history of Peru, contaminating soil with deadly toxins is now illegal. The regulatory mechanisms are in place to require polluters to submit remediation plans, which will be reviewed for approval, and cleanup whatever toxic mess they have created by 2018. It will likely take a few years to begin to evaluate the impact of the new regulations and assess the progress of the implementation. The world will be watching with great interest.

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MONTEVIDEO, URUGUAY

PROJECT DETAIL
RECLAIMING NEIGHBORHOODS BY CLEANING UP ELECTRONIC WASTE TOXIC HOT SPOTS

LOCATION	**Montevideo, Uruguay**
POLLUTANT	**Lead, arsenic, mercury, cadmium, elemental mercury**
SOURCE	**Burning and dismantling of e-waste**
POPULATION AFFECTED	**15,000**
HEALTH AND ENVIRONMENTAL IMPACTS	**Air pollution from piles of e-waste lit up to burn off plastic-coated wires; Soil pollution with heavy metals from irregular dumping of waste materials water and food sources).**
INTERVENTION	**Locating toxic hotspots in the community; remediating contaminated sites.**
OUTCOME	**The goal is to remove contamination without having to relocate entire communities.**
CO-BENEFITS	**Government has the tools and know-how to tackle other toxic sites in Montevideo and in the surrounding; Government is also willing to share knowledge with other cities in Uruguay.**

The Problem: Montevideo's Toxic Hotspots

Breathing in toxic smoke from burning piles of electronic trash and electrical cables is just part of life in some informal settlements in the sprawling city of Montevideo, Uruguay. Copper and other metals recovered from the burning can fetch a good price, but the price is widespread contamination of the community by lead and other toxic compounds.

Officials in Montevideo were aware of the health risks but lacked the equipment, expertise and resources to tackle what first appeared to be a major problem. They asked the Global Alliance on Health and Pollution (GAHP) to assist them to locate and cleanup the contaminated spots in the area of Cuenca del Arroyo Pantanoso.

In less than two years, most of these toxic hotspots had been cleaned up, the health of local people has

(Above and below) Toxic hotspots in a neighborhood in Montevideo, Uruguay *Photo credits: Blacksmith Institute for a Pure Earth*

improved and the communities are delighted to have safe places for their children to play.

“Their gratitude and the happy faces of the children will be something I’ll always remember,” said Hugo Gonzalez, a geologist with the City of Montevideo’s environmental lab team.

“The GAHP project brought together people from different government services, who all worked very well together. We really adopted a ‘Yes We Can’ attitude and tackled the problem faster than most government projects tend to take,” says Enrique Ruzo, architect and adviser to the City of Montevideo.

This remarkably successful project was the result of excellent cooperation between different government authorities in partnership with the Blacksmith Institute for a Pure Earth and GAHP. The project began in early 2013 with the training of city workers to identify the “toxic hot spots” in Cuenca del Arroyo Pantanoso in need of clean up.

Health Impacts: Unsafe Levels of Lead in Children and Pregnant Women’s Blood

City of Montevideo health care workers screened people living in Cuenca del Arroyo Pantanoso for blood lead levels before and during the cleanup. During the screening they discovered a one-year old child with a blood lead level six times higher than what is considered safe in the U.S. “Children at that age spend a lot of time crawling on the ground and putting things in their mouths and can inadvertently ingest lead particles,” says Lorena Aosta, part of the City of Montevideo’s environmental lab team.

The team tested an additional two hundred fifty people from the community and discovered that many suffered from high levels of lead in their blood. Ninety percent of those tested were children and the other ten percent were pregnant women. Children are usually the ones hit hardest by lead poisoning, which can cause brain damage. Lead can have more than forty different human health impacts including kidney and liver damage. Studies also show links between lead poisoning and violent behavior.

“After the screenings, we visited the homes of those who tested positive for lead poisoning to see if the possible source of the lead was in their homes. No source in the homes was found,” says Maria Jose Moll, a doctor with the City of Montevideo’s health department.

Lead particles released by burning the electronic waste (e-waste) can disperse quickly and settle as a fine dust. These particles get caught in clothing and hair and are absorbed through the skin. This aggressive neurotoxin can also be inhaled and ingested.

The Solution: Locating and Removing Toxic Hotspots

The trust of the community had to be gained before removing any contaminated soil. The people of Cuenca del Arroyo Pantanoso were worried the clean up of the hotspots meant they were going to lose their homes. In 2000, entire communities in a different area of Montevideo had been forced to move in order to protect them from legacy industrial toxic contamination.

“A lot of work was done within the communities to create trust when we came in to do the remediation,” says Hugo Gonzalez, the geologist with the City of Montevideo.

Blacksmith Institute for a Pure Earth and the environmental lab team held frequent meetings with community members to teach about the risks of lead poisoning and to inform the community on the progress of the cleanup. Local clinics with local doctors were equipped with the necessary tools to test blood for lead poisoning. Slowly but surely, mothers brought their children to the clinics of their own accord to get tested.

“On the health side, we invited people to get their blood lead levels tested before and during the remediation, and we found this really helped people

understand why the cleanup was necessary," says Maria Jose Moll.

To move the project along quickly, GAHP provided a handheld XRF (X-Ray fluorescent) scanner that is capable of detecting contamination in soil within thirty seconds. Without the XRF, soil samples would have had to been sent off to a lab for analysis, taking hours or even days to get back the results.

"Having the technology to do a rapid evaluation made a big difference," says Gonzalez.

Using the XRF, workers were able to determine which sites were in need of remediation almost immediately. Priority was given to the hotspots close to where people were living. The contaminated soil from toxic hotspots was removed and transported to a landfill.

The Next Step: Expand to Other Cities; Educate on the Dangers of E-waste

By the end of 2014, the toxic hotspots of Cuenca del Arroyo Pantanoso had been eliminated. The City of Montevideo will continue to monitor the lead blood levels in the community to ensure they fall to even safer levels.

"We have the tools now to locate toxic hotspots quickly and determine what pollutants are in the ground and how to clean them up at a low cost. It is a story we'd like to tell to other cities in Uruguay," says Ruzo.

Unfortunately, despite the clear success and newly acquired expertise, Montevideo does not have the funds to clean up the rest of the hotspots. "There are not enough resources. We are worried how we can keep going in 2015," said Amalia LaBorde, Blacksmith Institute/GAHP program coordinator for Uruguay.

In addition to the environmental remediation tasks, the Montevideo team wants to address the source of the e-waste problem in their city. "E-waste is a large complex issue. We need to work on the root causes of this contamination and this will require a multidisciplinary approach," says Ruzo. Some people are dependent on selling the copper to survive. In other cases, those burning the e-waste in the community are outsiders who do not even live there. The City of Montevideo wants to begin to uncover where this e-waste is coming from, who is buying it and where it is being sold.

Project Partners

- Intendencia de Montevideo (City of Montevideo)
- Blacksmith Institute for a Pure Earth
- Unidad Pediatrica Ambiental—Hospital de Clinicas, Facultad de Medicina, Universidad de la Republica (Uruguay)

Funders

- European Commission
- Global Alliance on Health and Pollution (GAHP)
- UNIDO

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MEXICO CITY, MEXICO

PROJECT DETAIL
CONTAMINATED OIL REFINERY TURNED IN TO URBAN PARK WITH ONE MILLION VISITORS A YEAR

LOCATION	**Mexico City, Mexico**
POLLUTANT	**Heavy metals, lead, benzene, methyl tertiary butyl ether (MTBE) and more**
SOURCE	**Obsolete, abandoned oil refinery**
POPULATION AFFECTED	**Entire population of Mexico City at the time (approx. 9 million)**
HEALTH AND ENVIRONMENTAL IMPACTS	**Pollution of groundwater, air quality decline,**
INTERVENTION	**Site remediation; treating contaminated groundwater and soil, removing hazardous waste, constructing a barrier to contain future effects of contamination.**
OUTCOME	**The site has been successfully remediated and converted into a park enjoyed by over million visitors each year.**
PARTNERS	**Mexican Petroleum Institute, National Polytechnic Institute, National Autonomous University of Mexico, Universidad Autónoma del Carmen, Autonomous University of Coahuila, Autonomous University of Nuevo León, Autonomous University of Puebla, Autonomous University of San Luis Potosi, Agricultural Technological Institute of Oaxaca, Technological Institute of Ciudad Madero, Graduate College Campus Puebla, Center for Research and Advanced Studies of the IPN, University of Waterloo (Canada), Environmental Züblin (Mexico), Züblin Umwelttechnik GMBH (Germany), Remediation Service International (USA), SERPOL (France).**

The Problem: A Legacy of Contamination from An Abandoned Oil Refinery

In Azcapotzalco, an urban area of Mexico City, lies "*Parque Bicentenario*" or Bicentennial Park. Opened in 2010, the park attracts well over one million visitors annually and is a popular gathering place for young and old alike. A visitor today enjoying the park's orchid greenhouses and unique water gardens would find it hard to believe this was once the site of one of Mexico's oldest and heavily polluting oil refineries.

Bicentennial Park is perhaps Mexico's greatest toxic cleanup success story. For fifty-eight years the oil refinery severely contaminated the area with hazardous compounds such as benzene, toluene, ethylbenzene, xylene (BTEX), lead, methyl tertiary butyl ether (MTBE), and other materials. On-site investigations conducted by the Government of

(Above and below) Bicentennial park is located on the site of a former oil refinery in Azcapotzalco, Mexico *Photo Credits: vladimix, Creative Commons, Some Rights Reserved*

Mexico, national oil company PEMEX, universities and other corporations between 2000 and 2008 found that the soil was saturated with a mix of these toxic chemicals to an average depth of 3.5 meters. In some cases, the contamination was discovered nine meters below ground. At those depths, toxins could easily make their way into the groundwater.

"The environmental conditions around the refinery deteriorated as its output increased. Emissions increased dramatically at the site affecting the health of the population around the site and overall air quality in Mexico City," an official of the Mexican government recalls.

When the refinery opened in 1933, Azcapotzalco was agricultural land on the outskirts of Mexico City. Over time, as the city grew into a world metropolis, Azcapotzalco and the refinery became part of the city. By the late 1980s pollution from the refinery had reached the surrounding residential areas and became a major contributor to the poor air quality Mexico City was once famous for. In 1991, the refinery was closed.

"When a new subway line was being built in the street near the refinery the problems became apparent. Also the quality of life for people around the refinery began to decline sharply," a Mexican government official said.

With this abandoned fifty-five hectare area sitting in Mexico City's urban core, there was a desire by the public and the government to do something beneficial with the area. Developers likely would have paid millions to construct towering buildings in the vast area, but it was decided to set the area aside as a green space for the public. The Mexican government then took it upon itself to cleanup the area in what has become a model remediation of a heavily contaminated site.

"There were doubts about whether it was possible to do this work in Mexico and whether Mexico had the necessary expertise to do so. For other major projects in Mexico, this has now become a benchmark," an Mexican government official said.

Health impacts: A Chemical Cocktail of Carcinogens and Neurotoxins

Mexico City was named "the most polluted city on the planet" by the United Nations in 1992. The city's horrific air quality was to blame. The city is situated in a large valley and pollution from factories, cars, and Azcapotzalco's refinery simply sat on top of the city unable to escape. One thousand people died and another 35, 000 were hospitalized annually at that time due to the poor air quality.[15]

"There was a time in Mexico City the air pollution felt like it was thick enough to walk on," Daniel Estrada, Program Coordinator in Mexico for the Blacksmith Institute for a Pure Earth said.

The oil refinery itself was emitting a combination of carcinogens and neurotoxins into the air which would then settle on the ground and into the water. Prolonged exposure to carcinogenic xylene (BTEX) can cause damage to the liver and kidneys, while long-term exposure to benzene can lead to cancer. MTBE, a possible carcinogen, can contaminate groundwater and give it a foul odor and taste.

"The population of Azcapotzalco was more affected by air pollution from the refinery as heavier particulates fell close to the refinery and higher concentrations of pollutants were found near the source. The polluted water was not used to drink, but it remained as a concern," said Estrada.

Lead poisoning has been a major issue in Mexico for decades with the main sources of lead arising from the petro-chemical industry, industrial mining and traditional lead-glazed ceramics. There are at least forty different health impacts of lead poisoning ranging from kidney and liver damage to impeding neurological development particularly in children.[16] Eighty million Mexicans—seventy per cent of the population—are estimated to have blood lead levels higher than what the World Health Organization (WHO) considers safe. Nearly half of all children (0 to 4 years of age) in Mexico are believed to be at risk of mild mental retardation caused by lead poisoning.

The Solution: Full Scale Remediation On Site

Extensive environmental and human health impact studies were conducted first to determine which areas of the old refinery sites were the most contaminated and then prioritized for the cleanup. This involved putting together a unique working group from academia, government and corporate partners.

"The model, involving universities and private companies, led to a sharing of field experience and expertise in remediation... a benefit to society was achieved by generating and accumulating knowledge which now can be transferred to others. This is one aspect of the significance of this project," a Mexican government official said.

A number of remediation techniques had to be employed on site to combat such extensive contamination over a the fifty-five hectare area. Four aerobic water treatment plants were established on site and used natural minerals such as zeolites to remove contamination from groundwater. A technique called bioventing involving indigenous microorganisms was implemented to break down oil contamination in the soil. In fact, 150,000 liters of fuel were pumped from the site and sent off to another refinery for refining and consumption.

In total 1.1 million cubic meters of soil and 412, 000 cubic meters of water were treated during the course of the remediation project. Another 532 square meters of contaminated soil was safely encapsulated. Hazardous materials that could not be remediated were removed and shipped to a landfill.

As an extra precautionary measure, a massive 1.1 kilometer long and six meter tall impermeable barrier was sunk 2.5 meters in the ground between the worst contaminated sections and a deep lying water aquifer. This is designed to prevent any remaining contaminants from getting into Mexico City's water distribution system.

The surrounding community initially had its doubts and misgivings abut the effectiveness of the project but this was overcome through community engagement during remediation itself. At community meetings, remediation techniques were explained and the concerns of the community heard.

The Next Step: Remediate Other Contaminated Oil Industry and Mining Sites

The successful remediation of the old oil refining site in Azcapotzalco created a paradigm shift in Mexico. Environmental authorities and polluting industries have an empowered approach towards cleanup efforts and the government is ready and eager to tackle more toxic sites.

According to a government official, one of the toughest environmental issues to address is contaminated mining sites. Mines owned by international companies usually leave behind a trail of pollution and community disintegration, which result in complex, intertwined environmental and social problems. Mexico currently lacks the financial and technical resources to create a cost-effective way to deal with multiple toxic sites covering large areas.

Project Partners

- PEMEX
- Mexican Petroleum Institute
- National Polytechnic Institute
- National Autonomous University of Mexico
- Universidad Autónoma del Carmen
- Autonomous University of Coahuila
- Autonomous University of Nuevo León
- Autonomous University of Puebla
- Autonomous University of San Luis Potosi
- Agricultural Technological Institute of Oaxaca
- Technological Institute of Ciudad Madero
- Graduate College Campus Puebla
- Center for Research and Advanced Studies of the IPN
- University of Waterloo (Canada)
- Environmental Züblin (Mexico)
- Züblin Umwelttechnik GMBH (Germany)
- Remediation Service International (USA)
- SERPOL (France)

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CINANGKA, INDONESIA

PROJECT DETAIL
SOCCER FIELD USED AS AN OLD LEAD BATTERY DUMP NOW SAFE FOR CHILDREN

LOCATION	**Cinangka, Indonesia**
POLLUTANT	**Lead**
SOURCE	**Informal dismantling of used lead-acid batteries**
POPULATION AFFECTED	**12,500**
HEALTH AND ENVIRONMENTAL IMPACTS	**Soil contamination and air pollution**
INTERVENTION	**Isolation and containment of contaminated soil**
OUTCOME	**Rehabilitation of the main football field in the village, dramatically reducing children's exposure to the hazardous waste**
CO-BENEFITS	**Engaging a wide range of key stakeholders; proving the feasibility of the in-situ encapsulation strategy**

The Problem: Battery Recycling was Contaminating the Community

Old car batteries have become both a major source of income and a serious health hazard for the residents of Cinangka, a village 45 kilometers southwest from Jakarta, Indonesia. An informal industry of used lead-acid batteries recycling emerged in the 1990s after the country's three battery disposal factories could not handle the volume of imported batteries. Employees then took batteries home to make extra income. But by crudely dismantling the batteries in their backyards and homes they inadvertently contaminated Cinangka with lead, a powerful neurotoxin.

"People didn't know what exactly the impacts were—they only felt they could not breathe, that there is something weird about the air they are inhaling," says Budi Susilorini, the local project coordinator for Blacksmith Institute for a Pure Earth.

(Above) Broken battery casings in Cinangka, Indonesia, and, (Below) Remediation begins on the contaminated soccer field in Cinangka, Indonesia
Photo credits: Blacksmith Institute for a Pure Earth

Residents of Cinangka broke down the used lead-acid batteries (ULABs) with axes or knives and dumped the inner contents into a one-meter deep wells surrounded by bricks and cement. Acid water was poured over the pile and coal placed on top. Then it was set on fire with a blowtorch. Eventually, they would recover liquid lead and produce ingots that could be sold back to the formal recycling industry.

The workers made efforts to hide their operations. Not only did they conceal the disposal activities with fences and concrete walls, they also waited for the sun to set so the black smoke could not be seen. While invisible to outsiders, the recyclers—using only minimal protection gear or none at all—could not escape the health impacts.

The waste from the smelting activities in the area was collected and then disposed of in shallow pits and surface dumps across the village including around the local football field and the adjacent ravine. This football pitch has been a favorite spot for many of the thousand students attending Cinangka's main primary school located merely one hundred meters away. Over the years, a large number of the young boys and girls have been exposed to the hazardous substances lying under their bare feet while playing on the field.

Unaware of the impacts, these informal smelting operations were carried out with no supervision or monitoring of health or environmental standards. And yet some people in the community gradually came to realize the smelting affected the environment and their lives.

"They complained to the sub-district office and to the village office. But when the authorities tried to ban ULAB smelting they faced fierce opposition. Even the village office was burnt down," said Susilorini.

Blacksmith launched a cleanup project in 2013 on one of the worst sites of contamination; Cinangka's football field. The cleanup was successfully completed last year, and proved beyond doubt that remediation is feasible in the village and in other areas with toxic sites. The project has managed to shift how local residents, as well as decision makers perceive the problem.

"We have been able to raise stakeholder awareness on the issue and convince the government to prioritize tackling the hazardous waste," says Susilorini. "We explained to them that mismanagement of hazardous waste isn't only fatal in terms of public health but it is also very expensive, becoming a burden on the government."

Health impacts: Children had Dangerously High Blood Lead Levels

Investigations found numerous soil contamination spots in Cinangka where lead levels were greater than 200,000 parts per million (ppm). The U.S. Environmental Protection Agency's upper limit for lead in soil in residential areas is 400 ppm. Subsequent blood samples from 40 schoolchildren from the three nearby elementary schools found lead at an average of 36.62 microgram per deciliter. The World Health Organization's standard is 10 microgram per deciliter.

"I saw the children of the owner of the ULAB smelter who also suffered mental and physical disabilities," says Susilorini. "Some try to deny that these disabilities were caused by the ULAB smelting activities. For them it was fate they would be born with disabilities. And that's why we really need an epidemiological study that could prove the correlation."

Lead poisoning, from either soil contamination or air pollution can have dire health impacts, perhaps most tragically, when pregnant women are exposed to it. Blood tests taken in 2013 found lead levels increased in some children, particularly those living near ULAB smelters still active. And samples from workers in both the formal and informal ULAB processing industries had disturbing results with mean lead concentrations at more than 6 times higher than the World Health Organization safety level.

Usually, smelting workers would be in Cinangka for six months, or maximum a year, and they would then return to their home villages. Some of those we talked to, says Susilorini, mentioned they have heard former workers got sick after they had left, but they did not link it to the ULAB recycling operations. "When they learned that lead levels in blood could be related to the smelting activity they were surprised, and then they become more open to us," Susilorini said.

A map of the soil contamination around Cinangka was first produced by local NGO called KPPB.

Surveyors identified close to seventy ULAB hotspots including smelters and collection points, and the overall volume of contaminated soil is estimated at more than 2500 cubic meters. "KPPB had the information but nobody cared about this until the partnership with Blacksmith Institute for a Pure Earth Institute was formed," says Susilorini

The Solution: Providing a Successful Remediation Example

The local population had made attempts to cleanup the contamination. In some cases bamboo would be planted at the site as a remediation method, in others the dump site would be covered with a layer of clean dirt fill. However these makeshift disposal sites were eroded by rain and wind exposing battery casing fragments and internal battery insulation materials.

Using KPPB's ULAB hotspot map, Blacksmith conducted site assessments to investigate the environmental impacts, estimate the population at risk and health implications beginning in September 2011. The result was a list of the top ten sites with the highest lead concentration in soil and largest population at risk. The football field was ultimately selected for the pilot remediation project because no culprits could be identified for contaminating the area.

"We suspected the football field was the dump site for the ULAB recycling because there were piles of car battery separators, and if you stepped on the pitch it was bouncy—it looked like soil but it was not stable," said Susilorini.

The remediation activities at the site took place between September 2013 and March 2014. In line with the U.S. Environmental Protection Agency's standards, an encapsulation strategy was employed to isolate the contaminated soil. The football field was dug out to a depth of six meters and the deep pit was then lined with layers of clay to prevent future exposure to the lead waste and the contaminated soil put back. It was then covered with two meters of clean soil. It's now safe to use and the children have returned to playing there again.

The Next Step: Achieving a Sustainable Solution

Formal lead smelting operations in Cinangka largely ceased in the early 2000s after a ban was imposed on used lead-acid battery (ULAB) import into Indonesia. But the pollution remains to this day, as does informal ULAB recycling. Compared to other sources of income such as farming or rubber plantations, lead smelting has been perceived as easier and more profitable, even if it is illegal.

"Now that the governments are aware of the issues that arise from mismanagement of hazardous waste we can make recommendations for policy reforms," Susilorini says. "They have started allocating funds in the national budget for the cleanup of contaminated sites. Sustainable urban planning needs to tackle the sources of soil contamination and site remediation should also be incorporated in the process."

With Susilorini's leadership, the project partners are examining how to establish safe ULAB recycling efforts in Indonesia. "One solution could be to shut down the informal recycling altogether and try to encourage them to switch into collection of used car batteries, but this would be difficult because they earn more from the smelting operations," says Susilorini.

"It's a learning experience not only for us, KPPB and the government, but it is really a success for us already," says Susilorini.

Project partners

- KPBB
- Ministry of Environment—Indonesia
- BPPT
- Regency of Bogor
- Ministry of Health—Indonesia

Funders

- CLSA
- UNEP
- SAICM
- European Commission
- UNIDO

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PHILIPPINES

PROJECT DETAIL
CLEANING UP WITH ZEOLITE AND PROBIOTICS FILTERING SYSTEMS IN MARILAO, MEYCAUYAN AND OBANDO RIVER SYSTEM

LOCATION	**Marilao, Meycauayan and Obando River System—Philippines**
POLLUTANT	**Heavy metals**
SOURCE	**Untreated waste water discharged by a range of registered and unregistered local industries**
POPULATION AFFECTED	**161,000**
HEALTH AND ENVIRONMENTAL IMPACTS	**Extensive aquaculture industry affected by the water pollution, with risk to fishing communities and to the health of hundreds of thousands of consumers**
INTERVENTION	**Testing filtration technologies to improve water quality in fishponds; Monitoring water quality and developing a database; Training and capacity building for the fishing communities to engage them in rehabilitation projects; Education and public outreach for the different stakeholders.**
OUTCOME	**Ongoing project: the first part of the remediation experiment has recently been completed; other project components are underway.**
FUNDER	**HSBC Water Programme**

The Problem: If the Fish Could Talk

Local fishermen along the Marilao, Meycauayan and Obando River System (MMORS) in the Bulacan province of the Philippines are fishing in troubled waters. The fifty-two-kilometer long network of waterways is home to a thriving aquaculture industry with thousands of hectares of fishponds. But it has also become a toxic soup of untreated wastewater from numerous formal and informal industries along the riverbanks.

"When you go along the river, it's black. If you see it you'll instantly say it's very polluted," says Larah Ibañez, Philippines Coordinator for the Blacksmith Institute for a Pure Earth. "And it smells even if you don't open the windows," says Ibañez.

Local elders described the rivers of Marilao, Meycauayan and Obando as once clean body of

(Above) Marilao government workers collecting waste from the Mariloa section of the river system, and, (Below) The Marilao, Meycauayan and Obando River System in the Philippines
Photo credits: Blacksmith Institute for a Pure Earth

water with an abundance of fish and other aquatic life. Rapid urban development, guided by little planning has taken a serious toll on the health of this river system.

Effluent—containing heavy metals from used lead-acid battery recycling facilities, gold smelting shops, tanneries and other operations close to the river system—is discharged into the river feeding directly into Manila Bay. Not surprisingly the river system's fishponds have pollution levels well above the Philippines' national standards. The contamination is a serious economic and health problem for fishermen and thousands of consumers.

For the local fishing communities, MMORS' extensive fish farming industry provides a vital source of income. The aquaculture industry in Bulacan registers around U.S. $80-100 million in revenue per year from sales of milkfish, locally named Bangús, its number one seller. The fish, which contain a variety of dangerous toxins, are sold at urban centers in the area and are very popular. With so much at stake, the Bulacan government, fishing communities and Blacksmith Institute for a Pure Earth are hard at work to mitigate the effects of the pollution in this important river system.

Health impacts: A Toxic Cocktail of Health Risks

Over one hundred toxins with the potential of endangering the health of nearly five million people have been recorded in MMORS waterways by the project partners in the country. The worrying state of the river system landed MMORS on the "dirty thirty" list of the world's worst polluted sites in Blacksmith's 2007 annual report.

A water analysis of the river system in 2014 found high levels of cadmium, copper, lead, zinc and other toxic substances that have grave effects on physical, mental and cognitive developments in people. Lead poisoning can cause poor muscle coordination, nerve damage, higher blood pressure, and problems with hearing and seeing in adults. Children exposed to high levels of lead can suffer brain damage, anemia, liver and kidney damage, hearing loss, hyperactivity and even death.

Small-scale gold mining, mining and ore processing, used lead-acid battery recycling, and other large-scale industries along river basins are likely the most significant primary environmental hazard in the Philippines. Open dump sites, livestock farms, refining precious metals for local jewelry production and homes along the rivers have exacerbated the contamination in MMORS as well.

The Solution: An Elaborate Response to a Complex Problem

Despite limited resources, ongoing efforts involving multiple stakeholders are turning the tables in the fight against pollution in the MMORS. The river system was designated a Water Quality Management Area in 2008 with its own governing board and a ten-year action plan to guide the river rehabilitation efforts. In addition, an innovative project with the support of HSBC's Water Programme that began in May 2013 has the aim of reducing the health risk posed by pollution in the river system.

"When we talk to the fisher folk, some don't believe the river system can be cleaned up. But from the overall feedback we get from them in the training, they certainly appreciate the efforts and attention that organizations like Blacksmith Institute give to them," says Ibañez. "Government agencies are also very appreciative of the work we do."

The four-year *Protecting Livelihoods, Human, and Ecosystem Health* project has many components because it takes multiple solutions to confront pollution problems with so many different sources. The project also builds upon a previous 2008 project where Blacksmith and its local partners mapped out pollution sources and identified heavy metal contamination hotspots in MMORS.

Filtration systems using zeolite help clean the water in the ponds and prevent heavy metals from accumulating in fish. Probiotics are broadcast directly into the fishponds to help build the immune system of the fish to help them survive in this kind of environment. A mobile environmental

monitoring laboratory—the first of its kind in the Philippines—is doing on-site analysis of key water quality parameters including levels of heavy metals. These data are incorporated into a database with the government's environmental department water quality monitoring of MMORS. A comprehensive water quality database will help assess the performance of the filtration technologies and give decision makers a clearer picture of the river system's health when creating further remediation plans.

The wide range of training activities underway in MMORS complements the progress made in better data collection on contamination in the river system. Training fishermen and their local organization in strategic planning, organizational management, and policy development, enhances their own capacity to deal with pollution in the river system both in the long and short term.

All stakeholders as well as policy makers are given hands-on learning experiences to raise awareness about the issue and mobilizing them for cleanup actions in the river system.

For those who have lived and worked in the MMORS for most of their lives the state of the river system appears dire. But the relentless efforts to improve things have managed to convince the most important stakeholders that the situation can be improved.

The Next Step: Stemming the Tide of Unregulated Pollution

"Ultimately, we still believe that at MMORS the best solution is controlling pollution at source," says Ibañez. "Even though we keep on cleaning, if the sources keep on loading untreated waste water and other waste, nothing will happen."

The informal, unregulated sector is responsible for the bulk of the pollution in the river system, and the key obstacle is the lack of monitoring and information on the location and extent of their effluent discharges into the river.

"The Governor of Bulacan is particularly interested in finally coming up with something big to clean up the river," she says. The governor would especially like to have support and funding for dredging in the critical parts of the river and to beautify the riverbanks.

"He told us that once that's done and he can show the people that the river is visibly improving and the pollution problem is solvable, then he can impose stricter policies on the polluting industries," Ibañez says.

Project Partners

- HSBC Water Programme
- Province of Bulacan
- Blacksmith Institute for a Pure Earth

Funders

- HSBC Water Programme
- Green Cross Switzerland

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DONG MAI, VIETNAM

PROJECT DETAIL
$20 PER PERSON ENDS DANGEROUS LEAD POISONING OF AN ENTIRE VILLAGE

LOCATION	**Dong Mai, Vietnam**
POLLUTANT	**Lead**
SOURCE	**Dismantling lead acid batteries to extract the lead; and smelting the lead for resell**
POPULATION AFFECTED	**2,600**
HEALTH AND ENVIRONMENTAL IMPACTS	**Population inhaling and ingesting lead dust from the dismantled batteries and smelting; Lead contamination in the soil and water**
INTERVENTION	**Capping of residential soils; Home and yard cleanup/remediation**
OUTCOME	**30% decline in blood lead levels in the local population within 6 months**
CO-BENEFITS	**Increased awareness of health impacts of lead poisoning and how to reduce exposure; nearby commercial lead smelting operation adopted safer practices at the work place.**

The Problem: Epidemic of Severe Lead Poisoning Eliminated at Cost of $20 a Person

Half of the of the world's 11 million tons of lead that goes into batteries, cables and electronics every year comes from recycled sources. One of those sources are industrial 'craft villages' like Dong Mai in the agricultural heartland of Vietnam. Unaware of the hazards, residents of Dong Mai broke apart used car and truck lead-acid batteries by hand and smelted the lead in their backyards. Children and adults there had some of the highest blood lead levels ever recorded. Many are suffering chronic illness as a result.

"I have stomach aches frequently and I have to visit many hospitals for check ups," said Bùi Văn Lòng, a former Dong Mai lead recycler.

(Above) In Vietnam, educational flyers are distributed house-to-house to inform villagers about the dangers of lead, and, (Below) Remediation crews clean up some of the worst contaminated homes in Dong Mai, Vietnam Photo credits: Blacksmith Institute for a Pure Earth

Community meetings are held in Dong Mai to educate villagers about the dangers of lead and to answer questions
Photo Credit: Blacksmith Institute for a Pure Earth

There was a time the people of Dong Mai were artisans making bronze casts, but in recent decades, turned to battery recycling and small-scale lead smelting to survive and prosper. However, the 2,600 villagers of Dong Mai are paying a heavy price for this toxic work with high levels of respiratory, and mental illness in the community, and greatly shortened life spans [Noguchi 2013].

"For over 30 years, lead recycling facilities without any pollution control measures had operated and freely released lead dust which settles on soil and surfaces in the village. In 2003, Dong Mai village had been listed as a most seriously polluted site needing to be solved promptly," a representative of the Vietnamese government said.

In 2010 the Department of Natural Resources and Environment for the local province of Hung Yen, determined that the lead concentrations in soil was 32-36 times higher than the acceptable limits. Health assessments of the villagers showed that the people engaged in lead recycling activities had high lead concentration in their blood. That prompted the local government to move most of the lead recycling to an industrial area outside of the village. However the lead contamination inside the village remained. Additional studies by Vietnam National Institute of Occupational and Environmental Health revealed that some young children had dangerously high levels of lead.

"There had long been talk about cleaning up the village but technical challenges and spending millions of dollars to remediate the site was too much for local government," said Bret Ericson Director of Operations at the Blacksmith Institute for a Pure Earth.

Thanks to a technical collaboration and a targeted

clean up by Blacksmith, local and international partners, the situation rapidly improved. The first site assessment was done on 19 April 2013, the project designed, and funding identified. All major remedial work was completed by February 2014, less than a year later. Levels of lead in the villagers have dropped by 30%, within 6 months of the intervention, for an investment of just $20 a person.

Health Impacts: Lead—A Powerful Neurotoxin the Body Cannot Breakdown

Lead is a potent neurotoxin with a wide range of impacts from headaches and stomach pain to lowered IQ, behavioral problems and anemia. Exposure is usually via fumes or dust. Lead moves readily throughout the body and levels build up as villagers are exposed day after day. Lead does not breakdown.

"Health checking of the villagers showed that the people engaged in lead recycling activities had high lead concentration in blood. According to a study conducted by Vietnam National Institute of Occupational and Environmental Health in 2006, environment was found contaminated with high lead concentration and elevated urine lead in children," a representative of the Vietnamese government said.

Lead smelting in Dong Mai, one of the many toxic craft villages across Vietnam Photo Credit: Blacksmith Institute for a Pure Earth

Complicating matters is the fact that Dong Mai is located in a tourist region. No one wanted to call attention to the extent of the lead contamination.

The Solution: Local Champion Builds Bridges to Make Cleanup a Reality

"Solving local pollution problems is often more about building relationships with officials and local people than about technology," said Ericson. This is especially true for an organization based in the US. Resources were another challenge—a full remediation of Dong Mai would cost more than $10 million.

"At the beginning, with the limited financial sources of the project, we did not think that we can mobilize the active participation of the villagers, local authorities and very difficult to convince the authorities to gain their political support," a representative of the Vietnamese government said. Following years of discussions, officials working with Blacksmith experts agreed that a cleanup that sharply reduced public exposure to the lead contamination would be practical, cost-effective way to improve the health of villagers.

"Once decided, local officials were very effective in making the clean up happen," he said.

In less than a year, the work was done. Villagers' blood lead levels fell 30% and will go lower still, all for a cost of just $60,000 including educational materials and public health testing.

"None of this would have happened without Madam To," said Ericson. A former official in Vietnam's environmental agency, Madam To had both the much-needed connections and respect within government. Equally important Madam To worked with Blacksmith to involve the villagers in the proposed clean up plan. Each family received a 20-page booklet describing the whole of the project, a laminated pamphlet offering tips for mitigating exposure including the proper method for cleaning a contaminated home.

Using a handheld X-ray Florescence (XRF) analyzer

provided by Blacksmith, hundreds of measurements were made to find the 'toxic hotspots'—homes and gardens with the highest levels of lead contamination. Some homes had lead levels ten times higher than the US Environmental Protection Agency (EPA) standard. One home was fifty times higher.

Blacksmith staff wearing protective equipment and using High Efficiency Particulate Air (HEPA) vacuums, cleaned the interiors of thirty-nine homes to remove lead contamination in the form of a fine dust. These cleanings were also used as demonstrations for community members who then cleaned their own homes.

"There was a lot of enthusiasm in the community. Our education workshops had over 90% participation from the village. This speaks to the quality of work done by the University of Washington and CECoD in designing and carrying out the education component." said Ericson.

Gardens and yards with heavily contaminated soils posed an even greater challenge. Removing the soil and shipping it to a landfill would have cost USD $400 per cubic meter. Given the scope this would have been prohibitively expensive.

Instead, the contaminated soil was covered with five centimeters of sand and then a geotextile layer. A further twenty centimeters of compacted clean soil, pavers (bricks), or concrete was then placed on top. All soil lead levels are now a fraction of what they were.

Going beyond the initial scope of the remediation, more than 50 residents remediated their own yards, and community members and district authorities pooled resources to pave three main roads in 2014. The new roads will drastically reduce dust creation and therefore exposures. Empowered with the knowledge to act, the community committed resources that exceeded the initial project investment.

Another of the project's big co-benefits has been greatly increased awareness in Dong Mai of the health impacts of lead poisoning and how to reduce exposure to lead. A nearby commercial lead smelting operation decided to build changing and showering facilities for its workers to prevent them from bringing lead dust home in their clothes.

"The owner was initially uninterested but realized we were there to improve the health of the villagers not close the smelter," says Ericson of Blacksmith.

Blacksmith co-financed 60% of the construction and the private facility is covering the remainder.

"The close collaboration of international experts and local experts help to strengthen the technical capacity for local and young experts from CECoD, CECT, Hung Yen DoNRE and Van Lam district Environment Division who participated in the project, especially through the technical guidelines prepared/provided by Blacksmith and training on site for investigation implementation and intervention deployment," said a representative of the Vietnamese government.

Next Steps: Replicate and Expand the Successful Project Across Vietnam

Based on the success of Dong Mai, Blacksmith Institute for a Pure Earth has been asked by the Vietnamese Environment Administration (VEA) to replicate the effort elsewhere. The thousands of craft villages in the country recycling precious metals are like decentralized factories—hundreds of families operating in different regions but all involved in the same industry. In some villages scrap metal comes in from Hanoi in the morning and is shipped out in the evening as clean ingots to China.

"This project [in Dong Mai] is very significant as it directly create benefits to the communities (the villagers). Besides, the close collaboration of international experts and local experts is very significant for learning international experiences that is useful and appropriate to be copied in Vietnam," a representative of the Vietnamese government said.

Some fifty villages have already been identified in Vietnam where contamination from heavy metals, including hexavalant chromium and cadmium, exists. A workshop, supported by the National Institute of Environmental Health Sciences (NIEHS-USA), was held in November 2014 to review the risks and propose solutions.

A focus on cost effective implementation is crucial given the scale of the issue in Vietnam. In Dong Mai, in situ encapsulation, cost sharing on construction, and training of community members in house cleaning were just a few of the cost saving measures implemented. Blacksmith was able to utilize the Marilyn S. Broad Foundation's contribution of USD $10,000 to leverage other donations. The result was unusually fast implementation in Dong Mai which helped overcome community skepticism, build support with stakeholders, and cultivate enthusiasm in the national government.

There is great enthusiasm within VEA now to replicate this work. The November NIEHS workshop will further help to maintain that enthusiasm. Future projects would capitalize on the capacity developed in Dong Mai and be implemented even more effectively.

Project Partners

The project was directed by Blacksmith Institute and implemented by:

- Centre for Environment and Community Development (CECoD), an NGO belonging to Vietnam Association of Nature and Environment Preservation (VANEP)
- Centre for Environmental Consultancy and Technology Transfer (CECT), a public service institution under Vietnam Environment Administration (VEA)
- Ministry of Natural Resources and Environment (MoNRE) as prime environment authority in Vietnam
- Hung Yen province Department of Natural Resources and Environment (Hung Yen DoNRE) as highest provincial level of environmental authority,
- Environmental Division of Van Lam District People's Committee as local environmental authority and the Chi Dao Commune Committee of Communist Party
- Environmental Division of Van Lam District People's Committee as local environmental authority and the Chi Dao Commune Committee of Communist Party

Funders

- International Lead Management Center (ILMC)
- University of Washington (UW)
- Marilyn S. Broad Foundation
- European Commission
- Green Cross Switzerland

FORMER SOVIET UNION

PROJECT DETAIL
HUNTING DOWN HUNDREDS OF THOUSANDS OF TONS OF OLD BUT STILL TOXIC PESTICIDES

LOCATION	**Area of the Former Soviet Union**
POLLUTANT	**Obsolete pesticides (DDT)**
SOURCE	**Abandoned pesticide warehouses and waste dumps**
POPULATION AFFECTED	**Unknown but likely millions**
HEALTH AND ENVIRONMENTAL IMPACTS	**Cancer, birth defects, diabetes, immune system impairment**
INTERVENTION	**Training in identification; risk assessment and management**
OUTCOME	**Thousands of tons removed or encapsulated**
CO-BENEFITS	**Improved human and environmental health, reduced risk of long distance contamination**

The Problem: Hazardous Toxins Dumped and Forgotten

Following the collapse of the Soviet Union hundreds of thousands of tons of toxic pesticides were discarded. DDT, lindane and other organochlorine-based pesticides were buried at hundreds of largely unrecorded burial sites or left in thousands of abandoned warehouses. They and their toxic by-products (metabolites) are extremely long-lasting, remaining dangerous for many decades and result in transboundary pollution in countries thousands of kilometers away.

"The health impacts from these obsolete stockpiles of pesticides in the region is not easy to prove. However many, many studies document serious health and environmental impacts of chronic exposure even at low levels of exposure," says Stephan Robinson of Green Cross Switzerland.

(Above) Toxic pesticides were stored at hundreds of largely unrecorded burial sites or left in abandoned warehouses throughout the Former Soviet Union Photo credit: Blacksmith Institute for a Pure Earth
(Below) Repackaging of obsolete pesticides in Azerbaijan in the Former Soviet Union Photo credit: Ministry of Agriculture, Republic of Azerbaijan

During the Soviet era, cotton production and forestry were largely huge monocultures dependent on enormous doses of pesticides to remain productive and fight insect outbreaks. “The 5 year-plans used at the time meant stockpiling huge inventories,” said Robinson. With the ban of DDT in the 1970s, large stocks had to be eliminated. And more than 20 years after the end of the Soviet Union, many of the containers and warehouses housing these pesticides have crumbled and the toxins are getting into local waterways and soil. There are only incomplete records of where these pesticide dumpsites are so the extent of the contamination is also unknown.

DDT, lindane, and other organochlorine-based pesticides cause cancer, birth defects, damage developing brains and nervous systems and more. They are banned or heavily restricted under 2004 Stockholm Convention on Persistent Organic Pesticides.

In 2012, a local group in Tomsk coordinated by the NGO Siberian Environmental Agency asked for international help to locate and identify the contents of the dumpsites and explore ways to clean up sites in the western Siberian region of Tomsk Oblast. “Based on old records Tomsk Oblast has 20,000 to 30,000 tons of DDT unaccounted for,” said Robinson. Since then, Green Cross Switzerland, Blacksmith Institute for a Pure Earth and other partners have trained local authorities to develop systematic approaches in line with international best practices as propagated by FAO to finally deal with this major health and environmental risk.

Health Impacts: Pesticide Exposure Affecting Multiple Generations

DDT was first linked to infertility and thinning of eggshells of birds in the 1960s. Later researchers determined DDT and its metabolite DDE, caused birth defects, increases in breast cancer and diabetes. More recently studies show transgenerational impacts: children and grandchildren who have never been exposed suffer obesity kidney, ovarian and other diseases as a result of their parents’ and grandparents’ exposure [http://www.ehjournal.net/content/13/1/62].

DDT is still allowed for use in malaria control in Africa, India and few other regions. The quantities are small, estimated to be less than 4,000 tons per year [http://www.environmentalhealthnews.org/ehs/news/ddt-only-as-last-resort]. Although malaria and other vector-borne disease are presently recurring in parts of Central Asia, DDT is not seen as an option for diseases control. Green Cross Switzerland manages a project with UNEP, the World Health Organization, and Milieukontakt International that showed that non-chemical vector-control methods like release of mosquito fish into water reservoirs, use of bednets and environmental management are as effective for vector-control as indoor residual spraying of pyrethroids, a DDT alternative often used today, without having the negative effect of resistance building.

Lindane and DDT share similar characteristics, both being Persistent Organic Pollutants (POPs) which hardly de-grade in the environment. Lindane is a pesticide shown to damage to reproductive and immune systems. It is in terms of volumes the biggest challenge in the disposal of obsolete pesticides today, forming about 80 % of the total volume of POPs chemicals. Like DDT, lindane also bioconcentrates so that even very low exposures build up in fish, birds, mammals and other organisms to potentially dangerous levels. It is also very long-lasting and readily travels through water and air [http://www.epa.gov/ttnatw01/hlthef/lindane.html]. Again like DDT, lindane is found in the Arctic and other regions where it was never used.

The Solution: Detective Work Unmasking Toxic Sites

As a result of the training done in 2012 in Tomsk, a legacy site with 15,000 tons of both DDT and badly contaminated soil was discovered in a small town. Environmental impacts were considerable. The clean up work is planned for 2015, and Tomsk has a controlled landfill capable of storing this toxic material.

Another dozen previously unknown sites were identified using a kind of detective work including interviews with old forest workers and local villagers, says Robinson.

"The local authorities understand the scope of the problem and are ready to take action," said Robinson.

Tomsk has very good scientific and technical resources and was chosen to host a Green Cross and Blacksmith training seminar in October 2014. Experts from various former Soviet Union countries learned how to do rapid site assessments, and determine what risks are exerted by dumpsites. Up to 90% of such sites nearly always contain mixtures of pesticides and other chemicals. Identifying these chemicals is difficult but essential to minimize the risks when transporting and destroying harmful toxins in a later phase.

Disposal or destruction can be extremely costly but there are low-tech solutions that can contain the contamination and minimize risks.

The Next Steps: Hunting Down the Remaining Pesticide Dumps

The winter of 2015 is being used to find more of these long-forgotten legacy sites and in the spring, assessments will be made to determine what they contain and what risks they pose. Sites will be prioritized for remediation according to the risk posed to health and the environment.

"The key to all of this has been the strong relationships the Tomsk group has with local authorities and their willingness to address the issue," said Robinson.

Cleaning up or safely containing these old toxic pesticides is important not just for the health of the local population and the environment. Since some of these chemicals easily move long distances in the air and water, action in Tomsk and other parts of the former Soviet Union will also protect the health of many millions of people around the world.

"There are huge stockpiles of these pesticides in other parts of the world. The key is finding a feasible and cost-effective solution to reduce their risks," Robinson said.

The disposal and clean-up approach varies depending on the types and toxicity of the pesticides and the condition of the stored/landfilled materials. Options can include e.g. digging out old pesticides, repackaging them into UN-certified plastic or steel drums and taking them to a special hazardous waste incinerator in a Western country; immobilization in-situ; clean-up with thermal desorption; or bioremediation of soil or other solutions. For each site, its own site-specific remediation strategy needs to be developed based on the inventory data, remediation aims, available technologies, community views, available funds, etc.

Since 2009, in partnership with FAO, UNEP and other partners like Milieukontakt International and IHPA, Green Cross Switzerland has organized the training of 126 experts from 12 countries in a variety of subjects related to the management of obsolete pesticides. In Azerbaijan and Belarus, 218 tons of old pesticides had been packed into UN-certified drums by 2012. In December 2013, 17.15 tons of DDT have been repacked in Kyrgyzstan. Another approximate 180 tons of DDT are expected to be packed up and properly disposed of by 2015 2015 in Central Asia and the Caucasus regions.

Project Partners

- Green Cross Switzerland
- Tomsk authorities and NGO Siberian Environmental Agency
- Blacksmith Institute for a Pure Earth
- Milieukontakt International
- International HCH & Pesticides Association (IHPA)
- FAO
- UNEP
- WHO

Funders

- GEF
- FAO
- UNEP
- WHO
- GFATM
- Green Cross Switzerland

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MAILUU-SUU, KYRGYZSTAN

PROJECT DETAIL

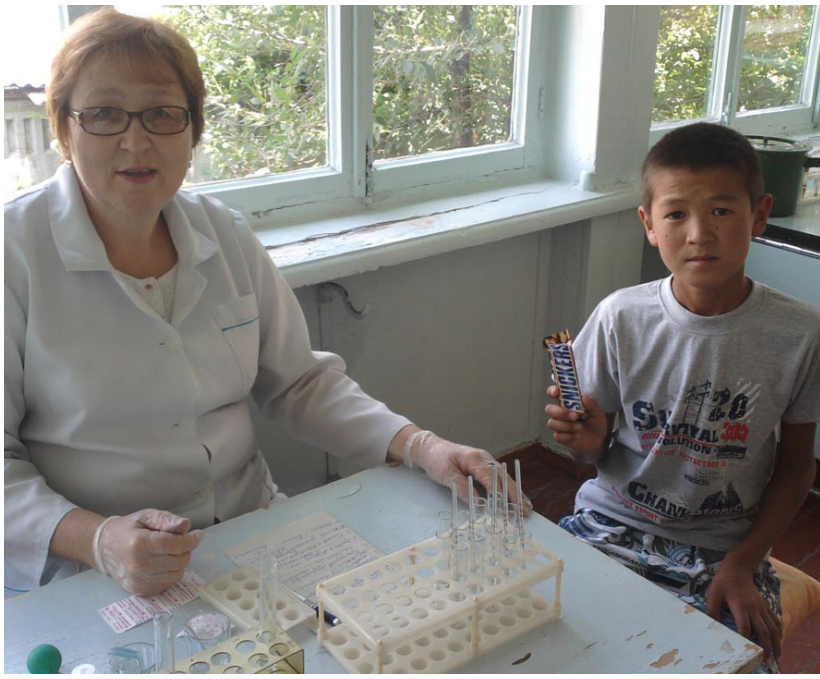
FILTERS IMPROVE SAFETY OF WATER CONTAMINATED BY RADIONUCLIDES WHILE CHILDREN CREATE AN EDUCATION CAMPAIGN

LOCATION	**Mailuu-Suu, Kyrgyzstan**
POLLUTANT	**Uranium, other radionuclides, heavy metals**
SOURCE	**Abandoned uranium mining tailings**
POPULATION AFFECTED	**25,000**
HEALTH AND ENVIRONMENTAL IMPACTS	**Depressed immune system in adolescents; higher occurrence of cancer than in the rest of the country.**
INTERVENTION	**Installing water filters in schools and kindergartens; measurement of radiation levels in houses, where needed installation of radiation shields and in very rare cases resettlement of inhabitants; health investigation of risk groups, mainly children and youth; education and public outreach activities.**
OUTCOME	**Significant reduction in exposure to contamination in water and onsite**
CO-BENEFITS	**Launched a successful community education program with ten days of workshops attended by 40 school teachers, 20 school children, and 224 college students.**

The Problem: A Radioactive Legacy

For a visitor it is an idyllic scene with streams gushing down yellow sandstone ridges peppered with sparse vegetation. For the former Soviet Union, however, the area around the town of Mailuu-Suu in southern Kyrgyzstan was one of the largest reservoirs of prized uranium ore just waiting to be extracted. The collapse of the USSR left the impoverished town with a dreadful inheritance in the form of heavy metal and radioactive mining waste leaching into a decades-old, crumbling drinking water infrastructure.

"There are mountains of radioactive waste. People go there and let their cattle graze," says Petr Sharov, Blacksmith Institute's Russia and Central Asia coordinator. "Radiation is invisible so people don't realize it's dangerous, but it does impact your health."



(Above) A child gets tested in Mailuu-Suu, Kyrgyzstan, where residents live with the toxic legacy of uranium mines, and, (Below) Children created dioramas and put on plays to illustrate the dangers of radiation contamination in their community in Mailuu-Suu, Kyrgyzstan Photo credits: Blacksmith Institute for a Pure Earth

Water filters, which are supposed to last for three years, have to be changed after just nine months in Mailuu-Suu, Kyrgyzstan, because of the high level of contamination Photo credit: Blacksmith Institute for a Pure Earth

Blood tests were taken from school children in 2011 revealed worrying rates of immune system disorders including impaired thyroid gland function, making them more susceptible to diseases. About 18 percent of the tested adolescents had thrombocytopenia (sharply reduced blood platelet levels) leading to malaise, fatigue, and general weakness. Local health officials blamed this on their exposure to radiation.

However, projects backed by Blacksmith Institute for Pure Earth and Green Cross Switzerland involving installation of water filters, measurement of radioactivity levels in homes, installation of radiation shields where needed (with resettlement of inhabitants in very rare cases), health investigation of risk groups (mainly children and youth) and enlistment of the enthusiastic efforts of local children, has helped to greatly reduce local residents' exposure to these hazardous substances.

The hills and ridges that surround Mailuu-Suu hold 23 radioactive tailings dumps with a total volume of nearly 2 million cubic metres, as well as 0.8 million cubic meters of rock waste in 13 dumps. Some of these are signposted and fenced off, but not all, and local herders often pasture their cattle nearby.

The region is prone to seismic activity and a number of these radioactive dumps stand perilously close to the Mailuu-Suu river that supplies drinking and irrigation water to the town of 23,000 people and to other towns downstream, across the border, in Uzbekistan and Tajikistan.

Floods and landslides prompted the World Bank fund the relocation of a number of the tailings piles that have been exposed, but this is a largely interim solution.

The potential risk of large-scale water contamination

remains real and grave. Heavy metals and radionuclides have already been detected in the town of Mailuu-Suu's tap water, and there were several incidents of tailings slipping into the river over the last decades.

Health impacts: Cancerous Water

Central Asia has 34 large abandoned uranium tailing sites—the result of Soviet military enterprises. Much of today's pollution problems in Kyrgyzstan—including toxic pollutants like cadmium, mercury, arsenic, lead and others—are the result of decades of a large Soviet-era mining industry. Today, there are seven major radioactive tailing sites across the country, and the tailings next to Mailuu-Suu are but one example.

Uranium is known to be carcinogenic and mutagenic. Because it is a heavy metal, it can also cause damage to kidneys, liver and the cardiac tissue. In Mailuu-Suu, a 1999 study by the Institute of Oncology and Radioecology found twice as many residents suffer from some form of cancer than in the rest of the country. In 2005, there were 114 cancer cases registered in the town.

"The uranium mining plant was shut down in the late 1970s, but it took several more years until the health effects on the exposed population became evident," says Nemat Mambetov, director of the Health Ministry's Epidemiology Control Center in Mailuu-Suu.

"In the 1980s-1990s we saw an increase in recorded occurrences of radioactive-related illnesses—for example, various cancer types, pathology of pregnancy and childbirth, and congenital malformations," says Mambetov Radioactive particles and heavy metals reach the city's water supply mainly due to heavily eroded pipeline infrastructure. Constructed in the early 1950s and poorly maintained today, the water supply system often delivers poor quality water to taps.

"During summertime the water looks clear and normal," says Indira Zhakipova, the project's local coordinator. "But in spring and in autumn the water is brown due to silt, soil sediments, organic material and the old pipes. So residents fill up big buckets and leave them for two-three days before they use the water."

In 2011, blood tests were taken from school children shortly after a major flood hit the town, containing runoff from the polluted river and tailings dumps. "This was the first such study conducted in Mailuu-Suu in 20 years, focusing on the new generation growing up in this tragic reality," says Zhakipova.

The results showed worrying rates of immune system declines such as thrombocytopenia in 18 percent of the tested adolescents, as well as impaired thyroid gland function making them more susceptible to diseases. Local health officials attribute this to exposure to radiation.

A 2012 study monitoring uranium traces found uranium content in the tap water in Mailuu-Suu River exceeded national public health standards up to 30 times and more, depending on the season. Uranium content was also detected in human teeth at 48.1mg/kg in children's deciduous teeth, and 68.7mg/kg in elderly people. High concentrations were also found in beef and milk.

The Interim Solution: Filters and Workshops

The situation in Mailuu-Suu is undoubtedly difficult, but tireless work in recent years has slowly begun what could eventually be a real transformation. A project, initiated in 2008 by Blacksmith Institute for a Pure Earth, with the support of Green Cross Switzerland, has helped evaluate the extent of the hazard and worked to mitigate it by fitting water filters.

The project was designed to target children, the most sensitive part of the community, says Sharov, and therefore they chose to install filters in schools and kindergartens.

"The local government is of course aware of the problem and since we worked with them before, they were very supportive," says Sharov.

Water filters have been installed in schools and hospitals to protect children and the most vulnerable residents in Mailuu-Suu, Kyrgyzstan
Photo credit: Blacksmith Institute for a Pure Earth

In addition, radiation levels were measured in houses where tailing materials had been used for their construction. Where radiation levels of concern were measured, radiation shielding was installed. Four families had to be relocated to other homes as it was impossible to sufficiently lower radiation levels with simple measures.

Medical examinations were done twice on 48 adolescents and 56 adults in August and in September 2012, and blood analyses were done three times in June, August, and October 2012 (42 adolescents, 36 adults). Based on the results, persons received individual treatments.

Yet, shortage of funds saw the suspension of that project. Later, Blacksmith and Green Cross Switzerland reinvested in a second phase of the project in 2012-2013, which saw filter cartridges replaced and the project expanded to include engaging with pupils, educators and the community to raise awareness to the risk.

“We explained to the school children the radiation risk when they go near the tailings dumps, but they were not afraid. For them that’s the only thing they know,” says Zhakipova.

“But what really surprised me was to see the children so open-minded, so active, so eager to participate in the different activities we organized,” she adds.

Activities in schools were devised with the aim of introducing basic radiation hygiene techniques such as aggressive hand washing, sweeping away dust, use of water filters and shredding meat and vegetables before storage in order to allow more thorough washing and removal of radioactive of contaminants.

“We were not sure that the schools would allow us to fit the filters, and we were also worried that only few pupils would show up to the seminars, but the cooperation we have seen and pupils’ high turnout refuted all our doubts,” says Mambetov.

“With children, if you can engage with them, make it interesting, and then they educate their parents too,” says Sharov. Education activities are also really cheap, and they have a lot of impact, he adds. And the young pupils were not the only ones keen to take part. Responding to requests from local activists, the education program was greatly expanded to an overall of ten days of workshops attended by 40 school teachers, 20 school children, and 224 college students.

At the conclusion of the project, water samples from schools where filters were installed showed uranium content 48-65 percent lower than before. Blood tests taken from adolescents 40 days after the installation of the water filters have also shown marked improvement.

“For such project to work, you need someone who is a local champion who could go there, steer things and coordinate the project. We have a good local scientist, Igor Hodjamberdiev, who studied the problem in Mailuu-Suu and came up with this solution,” Sharov explains.

“At the same time you need support—so once we had

Blacksmith Institute and Green Cross Switzerland on board then it was done."

The Next Step: Fixing the Water Infrastructure

Initially, the project was intended to encompass three sites, but the funding was only enough to survey the two other sites—Khaidarken and Sumsar-Shekaftar. Results of the environmental monitoring showed high levels of contamination in both sites. And since the problems are similar, the approach, which proved successful in Mailuu-Suu, would also be similar, says Sharov.

"I think we did the best we could with the available funding," says Sharov. The schools and kindergartens with water filters in Mailuu-Suu were equipped with a total of 39 cartridges which they can replace on their own.

But this is only a short-term solution, especially considering the contamination levels in the river water. In fact, already by spring 2015 they are expected to run out of cartridges.

"People in Mailuu-Suu are happy to see that children get clean water in school," says Zhakipova. "But some say that the same children then go home and use contaminated water."

"We are currently assessing the option of addressing the entire water supply because that would be a long term solution," says Sharov. "We are still calculating, but it would be very expensive. The government doesn't have the resources to do this."

Project Partners

- Green Cross Switzerland
- Blacksmith Institute for a Pure Earth

Funders

- Green Cross Switzerland
- Blacksmith Institute for a Pure Earth

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Children created dioramas and put on plays to illustrate the dangers of radiation contamination in their community in Mailuu-Suu, Kyrgyzstan
Photo credit: Blacksmith Institute for a Pure Earth

HONORABLE MENTIONS

BOOMING ECONOMIES AND A SMALL ISLAND NATION
CHINA AND INDIA INVEST, AND MADAGASCAR TAKES ITS FIRST STEPS

Many low- and middle-income countries are at various stages in addressing their pollution problems. Here we briefly feature three countries, China, India, and Madagascar, which have acknowledged the need for action and are taking different steps based on their particular circumstances.

For China and India, the world's two largest emerging economies, environmental degradation and compromised public health have been the dark side of breakneck economic development. China has recently put in place a strict set of ambitious legal measures to reduce pollution. Meanwhile surveys completed in India with the assistance of Pure Earth have helped map the country's pollution hotspots providing vital information for policymakers and the public.

In Madagascar, a global biodiversity oasis, the government is taking the first steps in identifying the prevalence of contamination throughout the island, the 48th country to do so until now.

China

China's rapid economic growth over the past three decades has come at a devastating environmental and public health cost. Along with lifting nearly half a billion people out of poverty, air pollution alone is killing around 300,000 people each year according to Chinese government statistics. China is home to 16 of the world's 20 cities with the worst air pollution mainly due to heavy industry, metal smelters, and coal-fired power plants. The cost of air pollution stands at billions of dollars in lost productivity and healthcare expenses each year.

However a new set of measures have been recently introduced to tackle the root causes of air pollution. Among the measures is reducing coal power plant emissions; cleaner fuel standards, encouraging a switch to electric vehicles; and restricting the construction of power plants and other energy intensive industries near residential areas. Additional policy changes include publicizing air quality information, capping regional coal consumption, and the closure of inefficient coal-fired industrial boilers.

(Above) Nanhua, China, and, (Below) Children in Hunan, China, looking at an educational poster *Photo credit: Blacksmith Institute for a Pure Earth*

Another major health and environmental issue in China is water and soil pollution mainly from mining, smelting and industrial chemical manufacturing. High levels of cadmium, mercury, lead and other heavy metals have been found in lakes, rivers, agricultural soils and in cities. This heavy metal contamination is a serious threat to China's biodiversity, food safety, public health and agriculture. It is believed to be causing the loss of up to 12 million tons of food each year. According to data from China's Ministry of Land Resources, over 10 percent of the country's cultivated land is contaminated with heavy metals.

The latest Five-Year-Plan requires a reduction of 15 percent of emissions of lead, mercury, chromium, cadmium and arsenic below 2007 levels in 'priority areas'. In other, 'non-priority areas,' these emissions

Polluted water in Ranipet, India *Photo credit: Blacksmith Institute for a Pure Earth*

will be capped at 2007 levels. A comprehensive system for the control of heavy metal pollution is expected to be fully operational this year.

China also introduced a new Environmental Protection Law[17] in January 2015, considered far more stringent and includes provisions for public education. There is still a long way to go, but these and other measures reflect the government's determination to stem and eventually reverse the tide of costly and lethal pollution.

India

Like China, India's ongoing rapid industrialization is resulting serious pollution impacts on environment and health. The city of New Delhi has the worst air pollution of any city in the world according to World Health Organization. India records more than 627,000 deaths as a result of air pollution and reduced lifespans.[18] This year India is expected to announce new standards for power plants to reduce emissions by 50 percent.[19]

Equally challenging is widespread water and soil pollution. The city of Kandur on the River Ganges is India's fifth most polluted city. Three hundred fifty leather tanning facilities spew untreated effluents containing mercury, arsenic, hexavalent chromium and other toxins into the river and the groundwater. A single pilot project in 2007 by Blacksmith Institute for a Pure Earth has shown simple bioremediation of the groundwater can begin to reverse a situation that at one time looked quite hopeless.

Grappling with toxic contamination in India is a monumental task. The country is both one of the world's biggest economic producers, and one of the most populated places on earth. Industry can be hostile to efforts intended to prevent and clean up toxic sites. Local governments can be reluctant to

admit there is a pollution problem in the first place.

After over a decade of work in India, Blacksmith Institute for a Pure Earth has located more the four hundred contaminated sites through the Toxic Sites Identification Program or TSIP. One hundred of the four hundred sites were determined to be dangerous to human health. The data is crucial for India to begin addressing widespread contamination across the country.

Blacksmith Institute for a Pure Earth is also spearheading an exciting new initiative in India called the Indian Alliance on Health and Pollution or IAHP. In collaboration with the New Delhi-based Council on Energy, Water and Environment and Public Health Foundation India, IAHP will work with governments and local communities to raise awareness about the dangers of contamination and support the advancement of policies, regulations and actions that seek to tackle pollution problems. The official launch date of IAHP is set for late winter 2015.

Madagascar: Toxic Sites Destroying the World's Biodiversity Hotspot

From lemurs to Madagascar flying fox, ninety per cent of the creatures living on this island in the Indian Ocean cannot be found any place else in the world. Over the last two decades this extremely sensitive environment has come under attack by toxins from activities that include pesticides stockpiling, illegal mining and crude battery recycling.

"Pollution of air, water and soil has grown rapidly in Madagascar since 1990," says Marthe Delphine Rahelimalala of the Madagascar Ministry of the Environment.

"People in Madagascar do not know that are exposed to hazardous contamination if not informed by the appropriate authorities or experts in the field," says Rahelimalala.

The Malagasy government recently approached GAHP (Global Alliance for Healthy and Planet) asking for assistance dealing with sites of contamination scattered throughout the island. The first hurdle is locate where the majority of toxic sites are, and what toxins are causing contamination.

Blacksmith has located and investigated over 3,200 contaminated sites in forty-seven countries as part of its Toxic Sites Identification Program or TSIP. The same program will now be implemented in Madagascar.

"We will prioritize identifying toxic sites in Madagascar we believe have the biggest human health impacts. This way the Malagasy government can prioritize what sites it will clean up first," Kira Traore Program Coordinator for Africa at the Blacksmith Institute for a Pure Earth, which currently serves as the Secretariat for GAHP.

Remediation of Madagascar's toxic sites will be the next logical step but that will depend on the country's ability to find additional funding.

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APPENDIX 1

REPORT METHODOLOGY

Country Selection Process

The selection process for the 2014 top ten countries began with the formation of a list of low- and middle-income countries with known toxic pollution problems that impact human health, using the same criteria for inclusion in the Toxic Sites Inventory Program (i.e per capita income level, level of industrialization, etc). Existing data in the TSIP database, prior inclusion in a World's Worst Polluted report, and peer-reviewed literature served as a basis for determining this list.

Countries were selected for consideration according to the following criteria:

Minimum requirements:

—*At least one* successful pollution mitigation story with credible and measurable results for affected populations;

—*At least one* of the following in development or in place: TSIP (or a national equivalent), National Pollution Action Plan or pilot remediation/clean up or other pollution intervention project or a national equivalent

—Signatory of one or more of the chemicals conventions (BRS&M)

Additional scoring criteria:

—Development of a national program for remediation

—Development of a national action plan for one or more types of pollution

—Number of successful stories or projects completed

—Number of large-scale unattended problems

Country Case Studies

Blacksmith Institute for a Pure Earth contacted all GAHP country members, and several other countries not involved with GAHP, inviting them to participate in the creation of the report. Those who responded positively were invited to help develop the focus and content of the case studies. Those on the ranking list were likewise invited to provide input on the content of relevant areas of the report.

We assumed case studies may not have been possible for each country that makes the list, for a variety of reasons. Thus, an "honorable mention" section is an alternate way to highlight countries which have made good progress but for which relationships with the government are not well-established, and thus their input cannot be easily solicited.

Key Considerations

- **Geographical spread**. The country case studies selected should be spread across different regions (i.e. two in Asia, two in Africa, etc) in order to show differences in approaches and the breadth of expertise and capacity.

- **Thematic spread**. The case studies should cover a range of thematic pollution issues, meaning the report may have a broader focus on all types of pollution (air—indoor and outdoor—water/sanitation and contaminated sites).

APPENDIX 2

GLOBAL ALLIANCE ON HEALTH AND POLLUTION MEMBERS

Based on current development priorities and agendas, key stakeholders who have taken concrete action, shown leadership and/or are interested in resolving the issues of toxic pollution are invited to participate in the GAHP. The roles and responsibilities of GAHP members will vary from organization to organization, depending on the mandate and modus operandi of each. There are no financial requirements to join GAHP.

Broadly, it is expected that GAHP members will contribute one or more of the following:

- Sharing knowledge and experience that may be pertinent to GAHP objectives;
- Promoting the issue of legacy pollution at appropriate occasions and venues (conferences, meetings, seminars);
- Providing technical assistance, as may be needed, in activities supported by GAHP;
- Exploring options for mobilizing financial assistance for clean-up projects in low-income countries and for dealing with emergencies;
- Actively participate in the GAHP annual meeting, the Executive Committee and/or Technical Advisory Group.

GAHP Members:

- Asian Development Bank (ADB)
- Basel Convention Regional Centre for the South American Region
- Blacksmith Institute for a Pure Earth (GAHP Secretariat)
- Children's Environmental Health Center of the Icahn School of Medicine at Mount Sinai
- Cyrus R. Vance Center for International Justice
- Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
- Earth Institute, Columbia University
- European Commission
- Federal Ministry of Environment, Nigeria
- Fundación Chile
- Ghana Environmental Protection Agency
- Harvard School of Public Health
- Intendencia de Montevideo, Government of Uruguay
- Inter American Development Bank (BID)
- Komite Penghapusan Bensin Bertimbel (KPBB—Indonesian NGO)
- La Agencia de Protección Ambiental de la Ciudad de Buenos Aires, Government of Argentina
- Ministry of Health, Government of the Republic of Tajikistan
- Ministry of Environment, Government of Cameroon
- Ministry of Environment, Government of Indonesia
- Ministry of Environment, Ecology and Forests, Government of Madagascar
- Ministry of Environment, Government of Mali
- Ministry of Environment, Government of Mexico (SEMARNAT)
- Ministry of Environment, Government of Perú (MINAM)
- Department of Environment and Natural Resources, Government of the Philippines (DENR)
- Ministry of Environment, Government of Senegal
- Ministry of Health, Government of Senegal
- Ministry of Environment and Forest Resources, Government of Togo
- Ministry of Environment, Government of Uruguay, DINAMA
- Suez Canal University
- United Nations Development Programme (UNDP)
- United Nations Environment Program (UNEP)
- United Nations Industrial Development Organization (UNIDO)
- World Bank (WB)

GAHP Observers:

World Health Organization
Green Cross Switzerland

About Blacksmith Institute for a Pure Earth

Blacksmith Institute for a Pure Earth is a New York based non-profit dedicated to solving toxic pollution problems that threaten human health in low- and middle-income countries. Since its inception in 1999, Blacksmith has completed 80 environmental remediation projects in 20 countries, improving the lives of millions of people, especially children, who are most at risk from pollution.

About Green Cross Switzerland

Green Cross Switzerland facilitates overcoming consequential damages caused by industrial and military disasters and the cleanup of contaminated sites from the period of the Cold War. Central issues are the improvement of the living quality of people affected by chemical, radioactive and other types of contamination, as well as the promotion of a sustainable development in the spirit of cooperation instead of confrontation. This includes the involvement of all stakeholder groups affected by a problem.

About GAHP

GAHP is a collaborative body that facilitates the provision of technical and financial resources to governments and communities to reduce the impacts of pollution on health in low- and middle-income countries.

Blacksmith Institute for a Pure Earth
475 Riverside Drive, 860
New York, NY 10115 USA
+212 647 8330

Green Cross Switzerland
Fabrikstrasse 17
8005 Zurich
Switzerland
+41 (0) 43 499 13 10

GAHP
475 Riverside Drive, 860
New York, NY 10115
USA
+212 647 8330