

**Project Completion Report**  
**Lead Poisoning Crisis in Nigeria**



Map of Nigeria and Zamfara State



Children gather in a newly remediated area

**Project Details:**

Location	Zamfara, Nigeria
Contaminant	Lead from artisanally-mined ore
Project Duration	June 2010—March 2011
Project Cost	<b>Total: \$2.3 million.</b> UN Central Emergency Relief Fund/UNICEF \$994,290; Blacksmith Institute \$250,675; State of Zamfara and Anka Emirate \$400,000; Terragraphics \$500,000 and Médecins Sans Frontières \$240,000.
Implementing Partners	State Government of Zamfara, Nigerian Government, Blacksmith Institute, Terragraphics, Médecins Sans Frontières (MSF/Doctors Without Borders), World Health Organization, US Centers for Disease Control and Prevention, UNICEF and others

**Performance Metrics:**

Toxin	Lead
Affected Population	More than 71,000
Exposure Standards	10 µg/dl
Levels Prior to Project	As high as 150 µg/dl, and at least 400 confirmed deaths
Levels at Present	Average blood levels have decreased more than 50% in children that received chelation therapy and returned to decontaminated villages.

- **Background and Scope:**

In March 2010, excess childhood death and illness occurring primarily amongst children under five in Zamfara State, Nigeria, was reported by Médecins Sans Frontières (MSF/Doctors Without Borders) to the state health authorities. Investigations led by the US Centers for Disease Control and Prevention (CDC), in collaboration with Federal and Zamfara State authorities, MSF, Blacksmith Institute and the World Health Organization (WHO), revealed that the outbreak was caused by acute lead poisoning associated with artisanal gold ore processing. More than 400 children under the age of five died, and hundreds more were confirmed to be at risk of death or serious acute and long-term irreversible health effects due to extremely high levels of lead. Of the children tested in two villages, 100% exceeded 10 µg/dL (the international standard maximum for lead in blood), with some levels measuring as high as 700 µg/dL.

The source was massive environmental contamination from the informal processing of lead-rich ore to extract gold. Men brought rock ore to the villages, where the women ground it into fine particles. This process resulted in the extensive dispersal of lead-containing dust throughout the villages, including within family compounds.

Seven villages were initially identified for immediate remediation. Seven more villages were later identified for clean up, including Bagega, which alone was double the size of the first seven. In all villages, including in family homes and compounds, soil lead concentrations exceeded 100,000 ppm, far above the internationally accepted standard of 400 ppm for residential areas. Primary exposure routes for children and adults were 1). Incidental ingestion of soil and dusts, 2). Consumption of food contaminated by soil and dust sources, 3). Ingestion of contaminated water, and 4). Inhalation of contaminated dust. Consequently, an estimated 2500 children accumulated life-threatening levels of lead in their blood, with thousands more at risk of permanent brain damage.

- **Solution Implemented:**

In June 2010, Zamfara State and Nigerian Federal health authorities formally requested assistance from WHO, CDC, MSF and the Blacksmith Institute to address this problem. MSF offered chelation therapy, a treatment that removes lead from the body, to children with critical levels of lead. However, in order to prevent recontamination, it was required that treated children not return to a contaminated environment. Environmental assessments indicated that lead exposure could be eliminated by the removal and replacement of topsoil and by thorough cleaning/removal of dust from all interior spaces, homes and compounds.

From June 2010 to March 2011, Blacksmith Institute conducted environmental decontamination in seven villages in collaboration with Terragraphics and local authorities. Local villagers were trained to assist with the clean-up operations,

including cleaning of homes. Contaminated soil was removed to secure landfills and replaced with clean soil. In total, seven villages were remediated, including 282 residential compounds, 107 exterior areas and 23 processing ponds, allowing for MSF to provide chelation treatment for more than 1000 children. The project also removed highly contaminated material from 7 ponds that were used to make bricks for compound repairs. In addition, UNICEF and project partners mobilized the communities and established male and female advocacy programs to raise awareness, facilitate remediation and support prevention of recontamination.

Furthermore, the project trained more than 200 Ministry, village and private personnel, building local capacity to conduct remediation activities, and provided guidance and assistance to the State in how to address mineral processing activities.

○ **Project Performance:**

All soils greater than 1000mg/kg lead were removed and replaced with soils containing less than 100mg/kg lead. Contaminated solids between 400-1000mg/kg were removed or covered with 8cm of clean compacted soil. Post remediation soil lead concentrations are less than 100mg/kg for nearly all exposed soils in remediated villages, both inside and outside compounds. This strategy resulted in a 98% decrease in lead intake and uptake due to incidental ingestion in remediated villages.

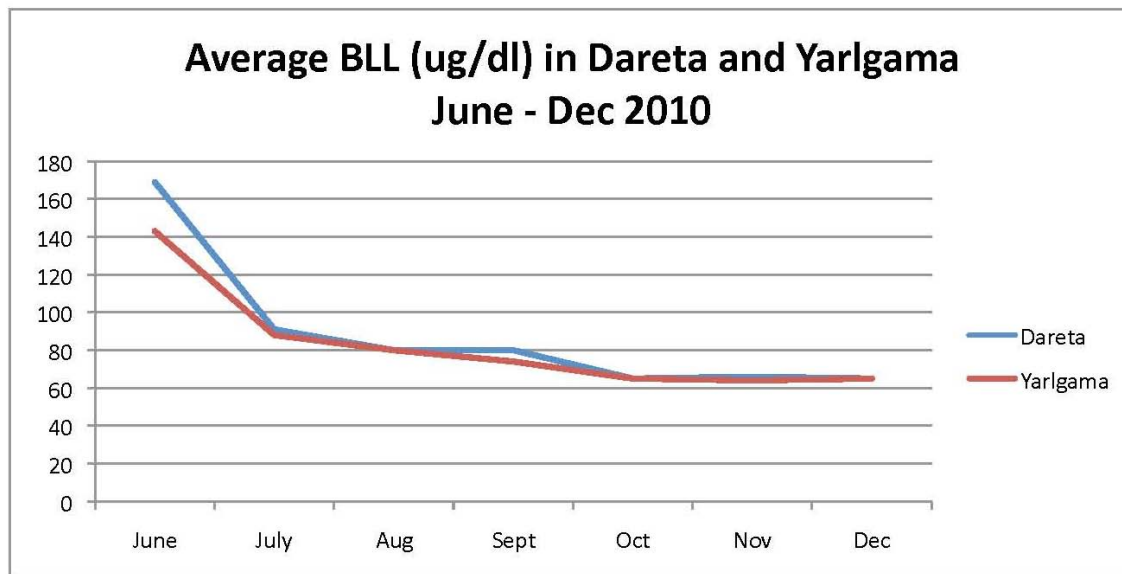
Table D. Pre-Remediation Pb Levels (mg/kg) in Compounds in 5 CERF villages.  
(A compound was placed into a category based on the maximum reading in the compound.)

	<400	400-999	1000-4999	5000-24999	25000-100000	>100000
<b>Abare</b>	18	17	29	4	8	17
<b>T. Guru</b>	2	4	14	12	0	1
<b>Sunke</b>	7	7	34	10	22	0
<b>T Daji</b>	2	8	35	20	6	3
<b>Duza</b>	9	6	17	2	6	0
<b>TOTALS</b>	38	42	129	48	42	21

Table A. Remediation Statistics for Villages – Compounds, Exteriors, and Rooms

Village	No. cmpds	No. cmpds remediated	No. exteriors remediated (not incl. ponds)	No. ponds remediated	No. rooms concreted
Tungar Guru	33	31	8	1	30
Sunke	80	73	28	10	64
Abare	93	75	21	0	103
Tungar Daji	79	72	17	10	118
Duza	40	31	33	2	15
Dareta (Phase I)	98	89	N/A	4	N/A
Yargalma (Phase I)	64	59	N/A	3	N/A
CERF Totals	320	282	107	23	330
Grand Total	482	430		30	

Figure 8. Average Blood Lead Levels (BLL) in Phase 1 Villages as of January 2011



○ **Outcomes**

This project had several significant results:

1. All seven remediated villages now have markedly reduced lead exposures and reduced risk of mortality and significant adverse health effects.
2. As a direct result of remediation, MSF was able to provide clinical services to several hundred families and chelation therapy for more than 1000 children under the age of five. These children were returned to clean homes without risk of recontamination.
3. Villagers are increasingly aware of the dangers of artisanal mining and the measures required to protect their families.

4. Zamfara and local entities now have the capacity to undertake future cleanup activities. Zamfara State and local staff have been trained to manage and supervise remediation programs and activities. Several hundred villagers and local suppliers were trained and acquired experience in implementing remediation protocols.
5. The Zamfara Ministry of Environment established a new agency to undertake remediation and regulate artisanal mining and processing.

○ **Follow Up:**

During the remediation, a total of 114 villages were identified that were processing the lead ore. Of 73 villages that were visited, 43 villages had children with blood lead levels exceeding the 10µg/dL limit. At least 7 more villages, including Bagega and its industrial area urgently need emergency remediation.

Additional remediation activities will be required to address contamination in the other villages, as well as contaminated water. Source control, best practices for artisanal mining and facilities to support responsible mining need to be developed. In addition, follow up investigations to assess effectiveness of applied measures and remediation should be conducted.



Lead-contaminated dirt is removed from a family compound in Sunke village. © Photographer Shawn Baldwin/Bloomberg

