Clean Dirt

Assessing the efficacy of lead exposure interventions: results of long-term monitoring and project adaptation in Zamfara, Nigeria

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Responding to the worst lead poisoning outbreak in modern history

>400 children died

>25% mortality rate in children <5 years old

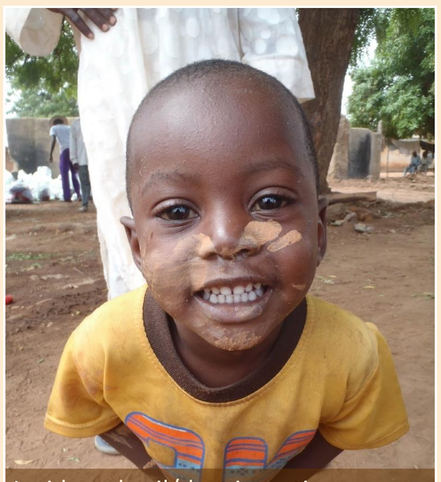
>30,000 people poisoned

- Source of lead exposure: artisanal and small-scale processing of lead-rich gold ore
- Federal, state, and local governments collaborated with international organizations
- Traditional leadership ordered ore processing moved to mining camps (*dabas*)
- Response included soil remediation and chelation treatment
- Remediation involved soil removal and replacement with "clean" backfill soils


Engaging village leadership.


Hand-removal of contaminated soil in homes.


Replacing excavated areas with lead-free "clean" soil.

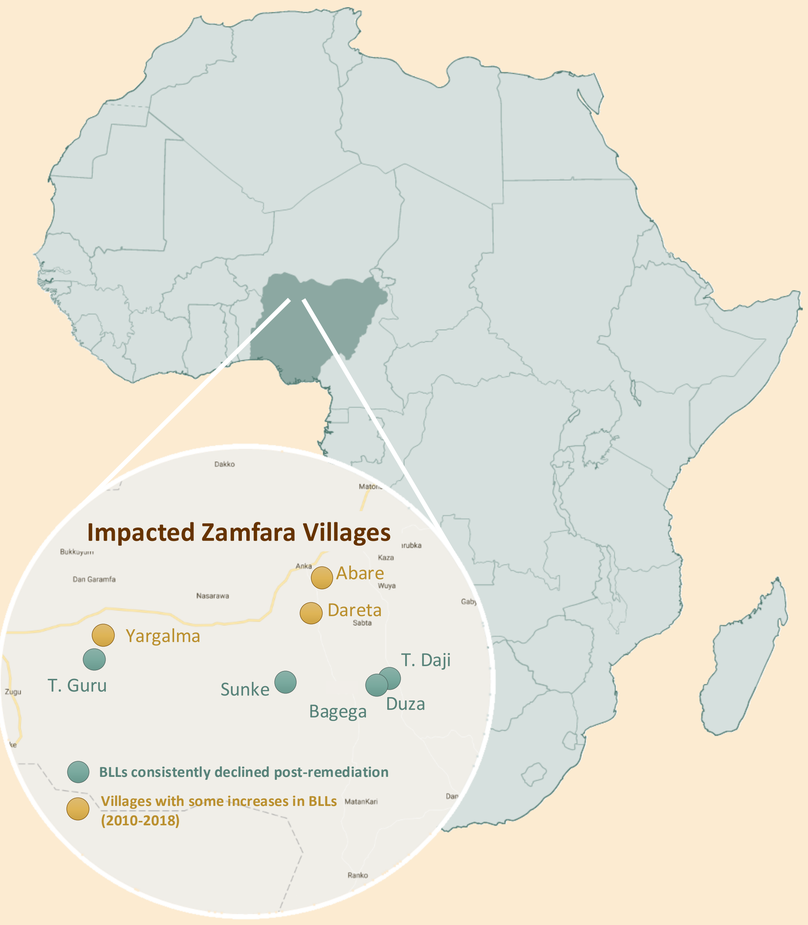

Incidental soil/dust ingestion dominates exposures. Intervention gives children "clean dirt" to eat.

Environmental Health Intervention Goals

1. REDUCE exposures via remediation of contaminated soils
2. FACILITATE medical treatment program
3. ESTABLISH technical capacity for response

Remedial Effectiveness Evaluation (REE) Objectives

1. ASSESS project efficacy in reducing exposures and BLLs
2. IDENTIFY intervention needs
3. INCREASE project sustainability



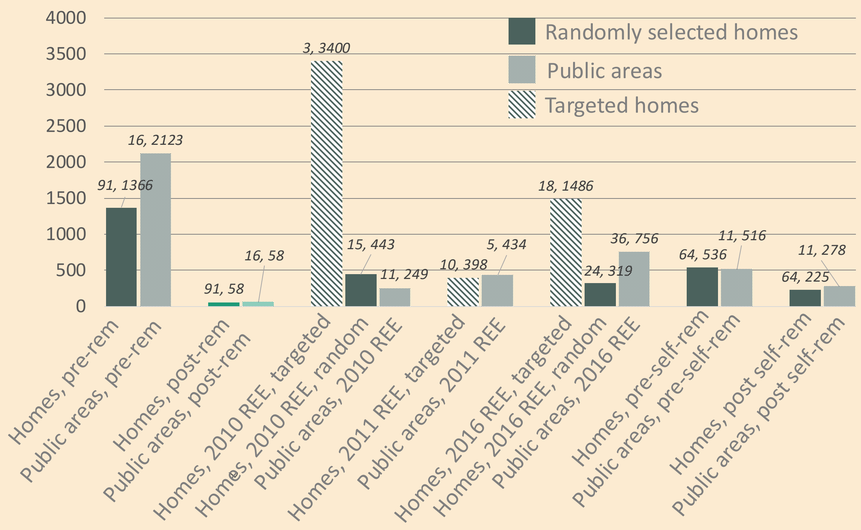
Assessing the efficacy of the remediation

- Data collected before, during, and after remediation (2010-2018)
- Assessed areas with portable x-ray fluorescent spectrometer (PXRF)
- Evaluated 2 subsets of homes through interviews and sampling:
  - i) targeted homes of children not responding to chelation treatment
  - ii) randomly selected homes
- Held dialogues with families and multiple levels of leadership
- Applied retrospective social impact assessment (SIA) to analyze interview results


Outside Abare village, Zamfara.

Developing and modifying a locally-led Institutional Controls Program (ICP)

PXRF in-situ soil sampling



PXRF results for Dareta village over a 9-year period (mg/kg) with counts and geometric means above each bar. Statistically significant differences were found between most time periods – detailed ANOVA results included in forthcoming publication.

Key take-aways

- Two villages had significant soil recontamination
- Moderate (400-1000 mg/kg) Pb found in homes where mining tools were stored
- Severe (>5000 mg/kg) Pb found in homes where processing had resumed
- SIA showed intentional and unintentional project impacts and influence of social factors on project sustainability
- Self-remediation and routine monitoring were effective in reducing exposures
- Modifications to the ICP resulted in increased project sustainability

Conclusions

- REEs are a vital tool for improving project efficacy and sustainability
- The environmental health response substantially reduced soil lead exposures in all villages and recontamination is being managed with the ICP
- BLLs subsequently declined in all villages as a result of successful ICP (data not shown)
- Support of the ICP will be needed for as long as artisanal mining continues in the region
- Including periodic evaluations during and after interventions is essential for long-term project success


PXRF soil testing in a home.


Discussing project successes and challenges with leadership.

Acronyms

BLL – Blood lead levels
ICP – Institutional controls program
MSF – Medecins Sans Frontieres (Doctors Without Borders)
PRXF – Portable x-ray fluorescent spectrometer
REE – Remedial effectiveness evaluation
Pb – Lead
TIFO – TerraGraphics International Foundation

Acknowledgments

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Additional project resources

Project update: *Climate change, conflict, and resource extraction in Zamfara*

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