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Analysis of Efficacy of Soil Remidiation Done in Local Govrments within Zamfara State and Genral Enviromental Impact of the Lead Poisining

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ABSTRACT
Between 2010 and 2013, a coordinated health and environmental response addressed an unprecedented lead poisoning epidemic in Zamfara State, northern Nigeria. The contamination, caused by gold mining, led to the deaths of over 400 children. Socioeconomic, logistical, and security issues necessitated the development of remediation and medical strategies tailored to local resources, labor practices, and cultural customs. The primary cause was unsafe mining and ore processing. The study evaluates the effectiveness of soil remediation in eight villages of Zamfara, comparing it to the USA's hazardous waste protocols. An environmental impact assessment was conducted to assess the outcomes of the remediation and to propose long-term solutions to prevent future occurrences.

KEYWORDS: Remediation, lead poising, mining environmental impact

I. INTRODUCTION

In March 2010, the international medical aid organization, Médecins Sans Frontières (Doctors Without Borders, MSF) found an unprecedented lead poisoning outbreak in a number of dispersed villages in Zamfara State, Nigeria. Subsequent investigation showed that more than 17,000 had been severely poisoned, and approximately 400-500 children are estimated to have died as a result of exposure to lead, a consequence of artisanal gold production and processing in residential zones. As a consequence, a coordinated health and environmental response was initiated to the crisis. Pollution due to gold mining led to the death of more than 400 children. Socioeconomic, logistical, and security considerations led to the development of remediation and medical plans modified on site in accordance with local resources, work force, and cultural expectations. The main cause was unsafe mining and ore processing. The research evaluates the efficacy of soil remediation for eight villages in Zamfara, contrasting it with U.S. hazardous waste treatment guidelines. An environmental impact assessment was carried out in order to assess the impact of remediation and to propose long-term solutions to stop reoccurrence. The International Organizations collaborated together with Nigerian health authorities as well as with local civil and traditional governments to deliver emergency medical, environmental, technical and public health assistance. Remediation work was conducted over 3 phases from May 2010 to July 2013, and was applied using models developed by Idaho and the US Environmental Protection Agency.

II. METHODOLOGY

This includes activities related to excavation and the displacement of soil, the refilling of polluted soil with clean soil or concrete and the safe handling of waste treatment. The groundworks site was managed by a Site Control Plan, an Excavation Plan and a Disposal Plan to safely and fully carry out the remediation work.Residents were asked to temporarily vacate their homes of personal items (i.e., utensils, bedding, and clothing) which were cleaned, before items were returned as part of the decontamination process when the contaminated compounds were fully remediated. During the bedding offstage phase, bedding mats and carpets were dislodged, burned in franchised LFs and then replaced with new ones. Excavations focused on sites with

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surface soil lead concentrations greater than 1,002 mg/kg, in order to meet US Environmental Protection Agency (USEPA) removal criterion of 380 mg/kg. The removal process relied on manual labor and local agricultural tools, following a backward excavation pattern to minimize recontamination. In work, cleaners started at the back of each house, and moved toward the front of the house. Internal walls of the compounds were swept out to dilute contaminated dust prior to soil removal. Contaminated cement floors were sealed by pouring new concrete. Contaminated soils were collected in grain bags, hand transported on wheels by wheelbarrows, and moved by hand in wheelbarrows to dedicated disposal landfills by truck. Post-excavation correlative testing was conducted to confirm that the remediation achieved or exceeded the established safety limit. In cases where soil lead concentrations ranged between 380 mg/kg and 1,002 mg/kg, the soil was not excavated but was instead capped with a minimum of 8 centimeters of clean soil to ensure containment and prevent exposure.

After it has been confirmed that it can be successfully excised, contaminated soils, the clean soil supervisor monitored the deposition of at least 7cm's depth of fresh soil on the excavated locations. Unexcavated soils (lead concentration ≤380 mg/kg) were covered with clean soil (if deemed necessary by the project manager). This report presented the local governments' remediation performance using soil lead concentration as well as local government's soil lead concentration that must be achieved below the permissible standard and the residents' blood lead.

The environmental impact analysis of the affected areas involved a thorough review of investigative findings and literature from 2010 to the present. The information collected primarily includes, but is not limited to, published reports from agencies involved in the Zamfara lead poisoning response. Secondary sources consist of reports from separate investigations on lead poisoning and contamination in Zamfara State, as well as other relevant reviews on the topic. The first environmental health investigation report, published by the CDC in early 2010, confirmed that soil ingestion was the primary source of lead exposure. However, there was a lack of sufficient data on lead levels in drinking water (both groundwater and surface water). Additionally, at that time, the levels of lead in soil and mercury in the air had not been determined.A report by Joint UNEP/OCHA Environment unit revealed the lead concentrations in soil, surface, and groundwater as well as mercury levels in the air. A clinical investigation conducted in late 2010 assessed the blood lead levels of affected children across a wide area of the state, targeting nearly all those impacted. Key activities included the collection and reporting of data from environmental and clinical investigations, as outlined by the investigation sources. These events were meticulously tracked and documented through both written literature and direct communication with some stakeholders involved in the mission. Additional information was gathered directly from community leaders via visits, personal communications, and other contact methods, with their consent. The information collected also includes reports from national and international agencies that participated in the mission.

III. RESULTS

XRF results showed 86% of 956 residential compounds tested exceeded the 380mg/kg soil lead remedial action level, 650 compounds were above the 1,002mg/kg excavation criteria, and 312 exceeded 5,002mg/kg. Pre-remediation soil exposures differed by phase of the cleanup. Arithmetic means [soil concentration in home compound exacted] during 2010 Phase I response for Daretaa and Yargalmaa regions were 3,500 and 4,100 mg/kg, respectively. Values for the five villages during Phase II in 2011 varied from 780mg/kg to 1,343mg/kg (about 70% lower than Phase I). Mean soil lead levels in Bagegaa in 2011 showed similar concentrations at 1,059mg/kg. Yet by 2013, the pre-remediation means in Bagegaa were 650mg/kg, or nearly 39% lower than in 2011. These findings indicate that estimates of premeditation soil lead exposures tended to diminish with time coinciding with both environmental and social influence.

A total of 800+ residential clusters, 180 common spaces, 30 ponds and the Bagegaa Industrial Area/regional reservoir were remediated. Across the three phases, high percentage of the residential cleanup were accomplished, more than 40,000 m3 of clean soils were imported as replacement fill and cover. Overall around 170 metric tons of lead were mitigated in the villages and processing environments. Mean post-remediation soil lead exposures are the mean con-If implantation of biomechanical scaffolds is paired with behavioral training and nurturing during the early years of life, these studies indicate a strong capacity for these scaffolds to enhance motor function and raise the chances of healthy adaptation. Phase I remediation targeted 85

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residential structures and 13 common structures in Daretaa, and 60 compounds and 10 structures in Yargalmaa. Average soil lead exposures in the two villages were decreased by 90% and less than 131mg/kg. This enabled more than 200 children up to 5 years of age to be treated by chelation therapy.

The conversion of lead ore for the gold extraction has led to extensive release of lead dust in the contaminated villages that have been dispersed all around across the residential areas, leading to significant inhalation of fine lead particles and ingestion of lead particles by the villagers. Medecin Sans Frontieres (MSF) in March 2010 reported a high number of deaths among children mostly in the age ranging from 0–5 years from these localities. When studies commissioned by several different agencies in partnership with the Governments of the Republic of Nigeria and Zamfara State confirmed the presence of high levels of lead in surface water 210 µg/l0, soil 606 mg/kg), and mercury in air 23 micrograms/m3), then the evidence presented in this report could be used to agree that the concentrations represent serious contamination.

The first environmental health report from the CDC, which came out prior to the 2010 lead poisoning investigation, noted soil ingestion to be the primary pathway exposure. Unfortunately, it did not have sufficient information regarding the concentration of lead in drinking water （groundwater as well as surface water）. Furthermore, the report did not contain measurements of lead in soil or mercury in air levels at that time.

A report by JEU [2] documented the lead concentrations in soil, surface and groundwater as well as mercury concentrations in the air. Clinical investigation report [7] reported unprecedented blood lead levels in affected children (mean 119 µm/dl). Additional reports of investigations indicated that the lead contamination crisis encompasses at least 47 villages and over 29,000 people. Hence, food plants for human and animal food are also highly toxic.

IV. CONCLUSION

Notably, while there are a number of challenges, sufficient remediation and post-treatment medical countermeasures could be made available by modification of existing health and environmental response procedures to suit the local conditions and limitations. In addition to the suspension of production activities in the villages, physical safeguards of drinking water, food contamination, the natural removal of soil lead burdens and abstinence from unhealthy practices have resulted in successful outcomes for this work.

The intervention led to a remarkable reduction in soil lead exposure, ranging from 70% to 99%, and a significant decrease in blood lead levels, exceeding 101 Î¼g/dL. The cleanup was left to the Nigerian federal, state, and local governments(s) respectively. Specifically, a team of Zamfara State staff, including state and local government officials, was trained for onsite management and monitoring of the remediation work in addition to the creation of sustainable ongoing programs to prevent recurrence of disease outbreaks.

Furthermore, significant reduction in dea rate due to lead exposure (from 42% in 2010 to 1% in 2011 for children aged 0–5 years) has been achieved in the state. As gold mine extraction work was the only means of livelihood and survival of the villagers, it was not easy to stop this work. Attempeted to reduce the risk of further environmental lead contamination, mining will need to change. Efforts in this direction included moving the processing of ore away from the proximity of villages, the storage of ore material and equipment away from villages, the use of safer ore processing technologies producing less dust, and the adherence to hygienic practices, such as the washing and/or removal of contaminated clothing, socks, and shoes prior to going home after work. The mining driven lead poisoning epidemic in Zamfara occurred in an era of growing environmental pollutants and corresponding adverse health impacts, stemming from extractive mineral production on a global level. Further expansion of the userspace for metals, degradation of the grade of ores and exhaustion of raw material has resulted in the widespread application of low grade ores (and legacy wastes) subjected to adverse conditions, which can impair the health of workers on duty and the population in general.

Recommendations

1. Community, private, and public engagement is essential for complete severing of mine and associated infrastructure from domestic, communal, and agricultural communities.
2. Safe hygienic behaviour before and after mine work is compliance.
3. Where possible plant native species that could be used as a target in screening metal polluted areas for phytoremediation may be identified and propagated at strategic locations. Carry out periodic environmental impact assessments over the long term and community education

on all detrimental impacts of the mining activities.

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