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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

Musa Hassan[1], Muhammad Abdulrahman [2], Salisu Saleh[3]

[1]Department of chemistry, Faculty of Science, Zamfara State University Talata Mafara, Nigeria [2,3]Department of Mathematics, Faculty of Science, Zamfara State University Talata Mafara, Nigeria

Email: abbgusau19@gmail.com

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

INTRODUCTION :

In March 2010, the international humanitarian organization Médecins Sans Frontières (Doctors Without Borders, MSF) uncovered an unprecedented lead poisoning epidemic in several remote villages in Zamfara State, Nigeria. Further investigation revealed that over 17,000 people had been severely poisoned, with an estimated 400-500 children dying due to lead exposure linked to artisanal gold mining and processing in residential areas. In response, a coordinated health and environmental effort was launched to address the crisis. The contamination, stemming from gold mining, resulted in the tragic loss of over 400 children. Socioeconomic, logistical, and security challenges prompted the creation of remediation and medical plans that were adapted to local resources, labor practices, and cultural norms. The main cause was unsafe mining and ore processing. The study assesses the success of soil remediation in eight villages in Zamfara, comparing it to U.S. hazardous waste protocols. An environmental impact assessment was performed to evaluate the remediation's effects and suggest long-term solutions to prevent recurrence. Several international organizations worked alongside Nigerian health authorities and local civil and traditional governments to provide emergency medical, environmental, technical, and public health support. The remediation process, carried out in three phases from May 2010 to July 2013, was based on models from Idaho and the U.S. Environmental Protection Agency.

METHODOLOGY :

Review of literature on the remediation carried out in th towns affected by the disaster which was done in three ways: excavating and evacuating contaminated soil, changing with clean soils or concrete, and disposal of waste material. Site Control plan, excavation plan, and disposal plan. The cleanup of a compound, habitants were required to remove most of their items, including utensils, bedding, and clothing. They were cleaned before being returned into the remediated compounds. During the first phase, sleeping mats and carpets were collected, burned at landfills, and replaced. Areas with surface soil lead concentrations >1,002mg/kg were excavated to meet the USEPA removal threshold of <380mg/kg. Removal was by manual labor using local agricultural equipment's to remove the surface backwards (to prevent re-contamination) from the walls inside, starting at the rear of each house and ending at the main entrance. The interior compound walls were brushed to remove contaminated dust prior to excavation of site. Contaminated cement floors were closed with newly made concrete. The contaminated soils were put into grain sacks, removed by barrow, and trucked to landfills. Excavated surfaces were retested to confirm that removal met or exceeded the cleanup criteria. Area surfaces with concentrations ≥380mg/kg and <1,002mg/kg were not excavated but were capped with at least 8 centimeters of clean soil.

After confirming successful removal of contaminated soils, the clean soil manager supervised the placement of at least 7cm of new soil over the excavated areas. At the discretion of the project manager, unexcavated soils with <380mg/kg lead concentration were covered with clean soil.

Analysis of the efficacy of the remediation this said local governments involved soil lead level which must me at the standard level and blood levels of residents.

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.

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 mean soil lead concentrations in home compounds during the 2010 Phase I emergency response in Daretaa and Yargalmaa were 3,500mg/kg and 4,100mg/kg, respectively. During Phase II in 2011, the values ranged from 780mg/kg to 1,343mg/kg among the five villages, or about 70% lower than Phase I. Mean soil lead levels in Bagegaa in 2011 showed similar concentrations at 1,059mg/kg. However, by 2013, the pre-remediation mean levels in Bagegaa were 650mg/kg or about 39% lower than in 2011. These results suggest premeditation soil lead exposures decreased over time, likely due to both environmental and social factors.

In total, 800 plus residential compounds, 180 common areas, 30 ponds, and the Bagegaa Industrial Area and regional reservoir were remediated. Across the three phases, high percentage of the residential cleanup were accomplished, more than 40,000 m^3 of clean soils were imported as replacement fill and cover. Collectively, an estimated 170 metric tons of lead were removed from the villages and the processing areas. Mean post-remediation soil lead exposures are the average value of all surface soil samples in the villages following placement of clean soils. Phase I remediation addressed 85 residential compounds and 13 common areas in Daretaa, as well as 60 compounds and 10 areas in Yargalmaa. Mean soil lead exposures in the two villages were reduced by 90% to less than 131mg/kg. This allowed 200 plus children under age five years to receive chelation treatment

The processing of lead ore to obtain gold has resulted in large dispersal of lead dust in the affected villages causing widespread ingestion and inhalation of fine lead particles among the residents. 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. The research conducted by multiple agencies in collaboration with Nigerian and Zamfara State Governments found excessive levels of lead in surface water (≤ 210 µg/l0, soil (≤ 606 ppm) and mercury levels in air (≤ 23 micrograms per cubic metre).

The initial environmental health report from the CDC, released before the lead poisoning investigation in 2010, identified soil ingestion as the main source of lead exposure. However, it lacked sufficient data on the amounts of lead in drinking water (both groundwater and surface water). Additionally, the report did not include measurements of lead levels in soil or mercury levels in the air at that time.

Report by JEU [2] revealed the lead concentrations in soil, surface and groundwater as well as mercury levels in air. Clinical investigation report [7] found that blood lead levels of affected children were unprecedented (mean = 119 µm/dl). Further investigation reports revealed that the lead pollution crisis covers at least 47 villages, affecting more than 29,000 plus residents. Consequently, food plantsfor humans and animal consumption are considered very toxic.

CONCLUSION :

"Despite facing significant challenges, considerable remediation and follow-up medical treatments were successfully carried out by tailoring established health and environmental response protocols to suit local conditions and resources. These efforts, along with halting processing activities in the villages, ensuring access to clean drinking water, reducing food supply contamination, natural reduction of soil lead levels, and encouraging behavioral changes, contributed to the overall success.

effected 70–99% decreases in soil lead exposures and > 101µg/dL reductions in blood concentration. The total responsibility for the cleanup were given to the Nigerian federal, state, and local governments. A part of Zamfara State and local government staff was trained to mantain and oversee the remediation and plan sustainable programs to prevent future outbreaks.

A significant drop-in dea rate due to lead poisoning (from 42 percent in 2010 to 1 percent in 2011 among exposed children (0 to 5 years) has been achieved in the state. Gold mining is a paramount source of income and means of survival for the villagers was difficult if not impossible to stop. Sustained To prevent further environmental lead contamination, changes in mining practices are essential. Efforts in this area included relocating ore processing activities, storing ore materials and equipment away from villages, adopting safer ore processing methods that generate less dust, and implementing proper hygiene practices such as removing and washing contaminated clothes, socks, and shoes before returning home after work. The Zamfara lead poisoning crisis unfolded amid increasing environmental pollution and health risks linked to global mineral processing. Rising demand for metals, declining ore quality, and the depletion of accessible reserves have led to widespread exploitation of low-grade ores and legacy waste using hazardous methods that jeopardize the health of workers and communities.

Recommendations :

Engagement from public, private, and community members is essential to ensure complete separation of mining activities and facilities from residential, community, and agricultural areas.
Adherence to proper hygiene practices during and after mining operations.
Model indigenous plant species for sustainable phytoremediation of metal contaminated environment may be identified and selected for propagation at strategic locations. Conduct regular environmental impact assessment's after prolonged periods, education of communities on all harmful effects of mining.

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