Mercury Contamination Risk Assessment in Artisanal Small-Scale Gold Mining Sites in Uke and Environs, Nasarawa State

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LCUPG/001668

Being a Ph.D. Thesis Submitted to the Department of Biological Sciences, Faculty of Natural and Applied Sciences, Lead City University, Ibadan, Oyo State, Nigeria

In Partial Fulfilments of the Requirements for the Award of the Doctor of Philosophy (Ph.D.) in Environmental Management and Toxicology

2023

Certification

This is to certify that **Davies, Henry Olapade** with Matriculation number **LCU/PG/001668** carried out this research work titled "**Mercury Contamination Risk Assessment in Artisanal Small-Scale Gold Mining Sites in Uke and Environs, Nasarawa State**" in the Department of Biological Sciences, Faculty of Natural and Applied Sciences, Lead City University, Ibadan, Oyo State, for the award of Doctor of Philosophy (Ph.D.) Degree in Environmental Management and Toxicology and that this has not been previously submitted.

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(Head of Department)	

Dedication

This research work is done to glorify the Almighty God and dedicated to my family.

Acknowledgement

My primary appreciation is directed to the Management of Lead City University for providing an enabling learning platform to undergo this program.

Bountiful appreciation goes to my Thesis supervisor, Dr. Omotayo Sindiku, for painstakingly scrutinizing the project in line with conventional standards and also committed to the prompt completion of this research work.

Furthermore, my sincere appreciation to the Head of Department and all the staff in the Department of Biological Sciences, Lead City University Ibadan for their sincere input and participation during the period of the research work. The various contributions are all acknowledged and I pray that God will support you all in the hour of need.

Finally, my ultimate thanks to my family for your prayers and support always during the program. All glory be to God for all his favour, blesssings and guidance throughout this process.

Even though the above -mentioned institutions and persons have assisted in the process of this research work, l alone stand responsible for the errors, if any found in the work.

Abstract

The main focus of this research was to investigate the environmental effects of the use of mercury, a potent neurotoxicant, by artisanal miners processing gold at Uke mining sites in Nassarawa State. The research adopted multidisciplinary research approach involving analytical, quantitative and geospatial methods. The samples analyzed for both seasons includes, 10 fish samples,39 water samples, 24 plants samples, 20 soil (wastes) tailing samples,20 agricultural soil samples and 3 river sediments. The mercury concentration was measured using Direct Mercury Analyser (DMA80) and USEPA 7473 standard method. Moreover, remote sensing technique was adopted to process satellite imageries to extract NDVI values and Land use cover for the area. Results showed concentrations of mercury in fish within WHO allowable human consumption limit of 0.5 mg/kg, with bioaccumulation order within the organs as follows; gills>liver>intestine >muscle>bone. The values in soil ranges from 0.0162 to 0.387 mg/kg in wet season while the dry season ranges from 0.025 to 4.125 mg/kg which is above the crustal average of 0.003 mg/kg. The tailings have 0.003 to 0.142 mg/kg in dry season while 0.011 to 0.314 mg/kg in the wet season which is above expected limit. Plants mercury concentration confirmed that Rice, Pepper and Sweet Potato are above the allowable range of 0.03-0.1mg/kg and should be a concern for food safety in the area. The mercury in river Uke is above WHO threshold of 0.002 mg/kg. The result indicates positive correlation with low NDVI values and stressed vegetation. The Geoaccumulation Index and Contamination Factor Values, confirmed low contamination with the soil tailings as a point sou. This work developed a GIS-based model using the weighted method in ARCGIS to help predict mercury migration and produce pollution vulnerability map for risk management.

Keywords: Gold, Mercury, Remote Sensing, Tailings, Fish

Word count: 299

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List of Acronyms

Abbreviation	Meaning
AAS	Atomic Absorption Spectroscopy
ANOVA	Analysis of Variance
GIS	Geographic Information System
DMA	Direct Mercury Analyser
WHO	World Health Organisation
UNIDO	United Nations Industrial Development Organisation
UNEP	United Nations Environment Programme
USEPA	United States Enviromental Protection Agency
RfD	Reference Dose
ASM	Artisanal Smale Scale Mining
ASMG	Artisanal Small Scale Mining of Gold
NDVI	Normalised Differential Vegetation Index
NIR	Visible near Infrared
EMR	Electromagnetic Radiation
UV	Ultraviolent Region
LAI	Leaf Area Index
SDVI	Standard Deviation Vegetation Index
MMSD	Federal Ministry of Mines and Steel Development
FMENV	Federal Ministry of Evironment
NESREA	National Environmental Standards and Regulation Enforment Agency.
MCO	Mining Cadastral Office
EIA	Environmental Impact Assessment

VEB	Verticl Engineered barriers
CF	Contamination Factor
Igeo	Geoaccummulation index
LOAHL	Lowest observed Adverse Effect Level
PTWF	Provisional Tolerable Weekly intakes
STEL	Short Term Exposure Level
TLV	Threshold Limits Value
PHE	Potential Harmful Elements
ALT	Alanine Transaminaese
AST	Aspartate Transaminase
ALP	Alkaline Phosphatase
PbA	Lead Acetate
CNS	Central Nervous System
ERA	Ecological Risk assessment
HRA	Health Risk Assessment
SPSS	Statistical Package for the Social Sciences
DEM	Digital Elevation Models