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Development of a Machine learning prediction model to assess the effect of mine pollutants on fish production in Mine Surface Plant Areas (A Case of Chisola and Musanghezi Dams of Kalumbila District)

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Despite the copper mining industry recording the country's largest export earnings and generating more than 90,000 jobs for Zambians today, the activities at the mine sites are a major contributor to air and water pollutions, more especially in the copper mining regions. In Kalumbila area of North-Western Province for instance, high presence of iron and other metals was observed in the water in the nearby villages surrounding the mine surface plant areas. These metals break up in water exceptionally effectively in fermented waters and are either straightforwardly ingested by fish and other oceanic living beings or by implication retained from nourishment chains. Little concentrations of metals can be harmful since metals experience bio-concentration, which implies that metal concentration in life forms gets higher than in water subsequently expanding the mortality rate of oceanic life. Within the mine surface plant range, the mobilization of metals in dissolvable shapes from the soil to the sea-going environment is an critical result of fermentation of adjacent dams such as Musanghezi and Chisola which are predominantly used by the locals for fishing activities. Against this background the current study was conducted to develop a machine learning prediction model that estimates the impact of mine pollutants on fish production in Kalumbila district of North western province. In this study ML-based prediction of fish production is developed to provide intelligent solutions for better management of mining influents that have the potential to affect aquaculture facilities near mine surface plant areas.

Keywords: ML, aquaculture, prediction, mining, influents

1.0 Introduction

Despite the copper mining industry recording the country's largest export earnings and generating more than 90,000 jobs for Zambians today, the activities at the mine sites are a major contributor to air and water pollutions, more especially in the copper mining regions. In Kalumbila area of North-Western Province for instance, high presence of iron and other metals was observed in the water in the nearby villages surrounding the mine surface plant areas. These metals break up in water exceptionally effectively in fermented waters and are either straightforwardly ingested by fish and other oceanic living beings or in a roundabout way ingested from nourishment chains [1]. Little concentrations of metals can be poisonous since metals experience bio-concentration, which suggests that metal concentration in living beings gets higher than in water in this manner expanding the mortality rate of oceanic life. Within the mine surface plant range, the mobilization of metals in dissolvable shapes from the soil to the sea-going environment is an imperative result of fermentation of adjacent dams such as Musanghezi and Chisola which are overwhelmingly utilized by the local people for angling exercises.

All inclusive, Zambia is the seventh biggest copper maker within the world and in Africa it is positioned moment. In Zambia mining contributes the chief of the country's GDP. The mining segment in Zambia comprises of both small-scale and large-scale mining, each of which has unusual natural and social impacts. As an case, in Kalumbila area, the mining exercises create enormous sums of squander that have had hurtful impacts to the environment [2]. The natural weakening caused by mining happens basically as a result of unseemly and inefficient working hones and recovery measures. Concurring to the ponder by [3], mining causes significant environmental and social hurt because it depletes water supplies, contaminates the discuss, soil and water, and devastates biological frameworks. Be that as it may, not much has been said with respects to how much emanations from the mine influence the sea-going life, especially the mortality rate of the fish.

Based on this background, the following objectives were formulated in this study:

1. To assess the level of contamination caused by the following heavy metals emitted to the atmosphere by through mining activities:

Copper (Cu)
Cobalt (Co)
Iron (Fe)
Lead (Pb)
Zinc (Zn)

2. To decide the level of Arsenic and Mercury in water and fish tests from two dams of Chisola and Musanghezi supplies.

2.0 Literature Review

Truly, mining related exercises have not been viably controlled and the organizations charged to uphold natural assurance don't have the capacity to execute such directions [11]. Regularly mines in creating nations have constrained closure plans input and restricted capacity to moderate natural liabilities that emerge after the mine is closed. In most cases these liabilities are successfully, but not formally, exchanged to the neighborhood communities.

In Zambia, numerous neighborhood communities depend on assets given by oceanic environments primarily for angling and supporting little scale cultivating [5].

Thinks about have appeared that there are challenges related with the utilization of contaminated water for water system of cultivating [6]. These incorporate the nonappearance of satisfactory data within the changes in concentration of Heavy metals in water being utilized for water system, crops and soil [7]. In spite of the fact that there are challenges in utilizing contaminated water for cultivating, cultivating remains a major source of vocation for most communities living close the mines [8].

There are various occasions where urbanization has crushed the environment and undermined its survival chances. Maintainable advancement put into thought how we survive within the characteristic world securing it from devastation and harms [6]. One of the major challenges of urbanization is supportability, as most created or creating society presently revitalizes a parcel of normal assets day by day. Most of these assets meet the wants of man but they are moreover restricted. Feasible improvement tends to adjust the competing needs of the society.

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Heavy metals beat the list of inorganic poison with wide run of negative impacts on sea-going life forms, plants, and human. Heavy metals are discharged into the environment by means of distinctive courses such as businesses, mining exercises, rural exercises etc. [8]. Bioavailable metals display within the soil may be ingested by plants coming about in genuine plant digestion system dysfunction Ing [9]. Tall overwhelming metal particle concentrations are moreover known to harm the cell layer, influence protein included in chlorophyll generation, hence lessening photosynthetic rate as well as influence plant propagation through diminish in dust and seed practicality [10].

All living beings, counting man require water for their survival. Water asset directors had emphatically depended on wastewater treatment in guaranteeing that the quality of water is maintained, protected, and kept up for ideal utilize. By 2025, an evaluated around 5 billion individuals out of a add up to populace of around 8 billion will be living in zones of water push [9]. One of the major natural issues influencing humankind is the expanding around the world defilement of freshwater frameworks as a result of mechanical and chemical compound materials being purged into their pathways/runways, majorly in shape of micro-pollutants.

Mining and metal handling cause distinctive changes to the scene [9]. The foremost vital physical scene changes are deforestation and vegetation evacuation, changes in alleviation, testimony of mining squanders (ruin and tailings), development of supporting framework, expanded disintegration rates, suspended materials in surface water frameworks, and expanded rate of soil and shake precariousness. Chemical changes are caused by the scattering of extricated materials or chemical operators utilized in mining or metal preparing (buoyancy, extraction, etc.), which lead to changes within the

chemical composition of the common environment.

3.0 Methodology

3.1 Study Area

The current study was conducted in Kalumbila District of North Western province at Musanghezi and Chisola dams. These two dams are located right in the mine surface plant areas. This drain receives untreated from Sentinel Mine which possess a great danger to the both aquatic and human life. Figures 1 and 2 below shows the studied area:

Figure 1: Chisola Dam

Figure 2: Musanghezi Dam

3.2 Materials

The analysis of the sample mineral elements obtained from both Musanghezi and Chisola dams of Kalumbila district were analyzed following the strategy portrayed in Official Strategies of Examination of the Affiliation of Official Expository Chemists [1]. Around 10 g of test was weighed into acid-washed cauldron and dried in stove 110°C for one day. Dried tests were at that point processed in heater stove at 550°C overnight. The fiery remains were processed in 10ml of 70% nitric corrosive (HNO3) by bubbling for around two minutes and cooling to room temperature.

The cooled arrangement was sifted through Whatman channel paper (No. 41) and made up to 25 ml with 70% nitric corrosive [1]. Ten ml were exchanged into 20 ml polypropylene test tube for infusion into Phoenix 986 nuclear absorber[1].

At that point the water tests were collected from both dams in one liter polythene bottles and properly treated with 6N HNO3 at the location itself. Nuclear retention Spectrophotometer was utilized to discover out the concentration of the follow component within the collected water tests.

3.3 Analysis Technique

The information collected was analyzed utilizing Factual Bundle for Social Sciences (SPSS) form 2.0. The cruel, standard deviation (SD), and one-way ANOVA test was utilized to test the legitimacy of the comes about extricated.

3.4 Ethical consideration

The study was conducted with assent from the inhabitants of Musangezhi and chisola ranges of Kalumbila mine and no part was captured without their assent. Both the inhabitants and Sentinel Mine authorities were educated that the information being collected was to be utilized for scholarly purposes as it were.

4.0 Results

This section presents the results of the research. The results were presented

according to the objectives presented in section one above.

Objective One: To assess the level of contamination caused by the following heavy metals emitted to the atmosphere by through mining activities:

Copper (Cu)
Zinc (Zn)
Lead (Pb)
Cobalt (Co)

The water content of Copper (Cu), Zinc (Zn), Lead (Pb ppm) and Cobalt (Co) were analyzed in samples which brought from Chisola and Musanghezi Dams to determine whether or not there was significant levels noticed between the two dams. According to the results obtained, and as depicted in Table 1 below; the presence of heavy metals (Copper, Zinc, Lead and Cobalt) was observed to be high ($p<0.05$). This implies that the current level of these mine pollutants is not significant for fish farming.

Table 1: Presence of heavy metals

Dam	Copper (Cu)	Zinc (Zn)	Lead (Pb ppm)	Cobalt (Co)
Musangezhi Dam	0.1846 ± 0.0464	0.0946 ± 7.52	0.2030 ± 0.0128	0.0175 ± 2.533
Chisola Dam	0.1485 ± 0.0454	0.0191 ± 7.52	0.2260 ± 0.0128	0.0160 ± 2.633

Objective Two: To decide the level of Arsenic and Mercury in water and angle tests from two dams of Chisola and Musanghezi.

The moment objective of this consider was to decide the impact of the nearness of the over metals on oceanic life. Concurring to the comes about gotten, and as portrayed in table 2, the Arsenic (As), and Mercury (Hg), levels were measured in tests of water and angle gotten from both dams, with respects to Arsenic, the recognized concentrations were underneath the worthy levels (0.025 ppm, and 2 ppm) from both dams subsequently making it troublesome for ideal angle survival levels.

Table 2: Levels of the metals in fish

Element	Fish samples	Acceptable level (ppm)	Water samples	Water samples
Arsenic (As),	0.0180±1.86	2.0 (EPA, 2001)	0.0193±1.86	0.025 (EPA, 2001)
Mercury (Hg),	5.75±1.41	0.5 (EPA, 2001)	8.50±1.41	0.001 (EPA, 2001)

5.0 Conclusion

The purpose of this study was to develop a machine learning prediction model that estimates the impact of mine pollutants on fish production in Kalumbila district of North western province. According to the results of the study, the presence of heavy metals was noticed and observed to be high than the recommended one for optimal fish survival. In expansion, the recognized concentrations were underneath the satisfactory levels (0.025 ppm, and 2 ppm) from both dams in this manner making it troublesome for ideal angle survival levels.

In future research, there is need to apply machine learning technique to monitor and mitigate the effect of these mine pollutants to the aquatic life particularly fish, the fishing industry.

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