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Gas Flaring AndThe Environment: A Preliminary Study Of The Impact On Water And Sediment At The Batan Flow Station, Warri South Local Government Area, Delta State, Nigeria

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Abstract
Gas flaring, a prevalent practice in petroleum extraction, poses significant environmental threats, particularly to water and sediment ecosystems in nearby regions. This preliminary study investigates the impact of gas flaring on water and sediment quality at the Batan Flow Station in Warri South local government area, Nigeria. The research evaluates key environmental parameters, including pH, temperature, Pb, Cu, Cd, Zn and Fe concentrations, levels in water and sediment samples. Findings reveals elevated levels of Pb in water sample. Statistical data showed that contamination level of Cd, Cr and Pb is significant in sediment as sampling distance increase. Similarly, the contamination level of Cu and Zn in water is significant with increasing sampling distance. This study underscores the urgent need for policy interventions and sustainable practices to mitigate the detrimental effects of gas flaring. The results contribute valuable insights to ongoing discussions on environmental management in gas-producing areas, advocating for cleaner and more responsible practices in the oil and gas sector.

Keyword: *Gas flaring, petroleum extraction, environmental threats, water quality, sediment quality.*

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I. Introduction

The Niger Delta region of Nigeria, renowned for its vast reserves of oil and gas, plays a pivotal role in the nation's energy production and economy. However, the environmental and socio-economic costs of resource extraction in this region are profound and far-reaching. Oil and gas exploration, along with associated activities such as gas flaring, have severely affected the region's ecosystems, air quality, water resources, and the health and livelihoods of its inhabitants. Edun et al (2021) have documented how these industrial operations contribute to environmental degradation, including soil infertility, biodiversity loss, and pollution of vital waterways. These impacts pose critical challenges for the sustainability of the Niger Delta's unique ecosystems.

The proximity of communities to gas flow stations exacerbates these issues, exposing residents to heightened risks of environmental pollution and health hazards. Studies by Nwosisi et al (2021) reveal that populations living near oil and gas infrastructure experience elevated rates of respiratory illnesses, skin diseases, and other health conditions linked to the release of harmful pollutants during industrial processes. The historical placement of gas flow stations often predates robust environmental regulations, leaving local communities disproportionately vulnerable to environmental degradation without commensurate benefits (NDES, 2017). This disparity highlights longstanding issues of environmental justice and economic inequality in the Niger Delta.

Nigeria has made efforts to mitigate these impacts through regulatory frameworks such as the Environmental Impact Assessment (EIA) Act of 1992, the National Environmental Protection Regulations (1999), and the Environmental Guidelines and Standards for the Petroleum Industry in Nigeria (EGASPIN). These measures are designed to safeguard the environment and regulate the oil and gas industry. Institutions like the Department of Petroleum Resources (DPR) and the National Oil Spill Detection and Response Agency (NOSDRA) are responsible for overseeing compliance and enforcement. Despite these initiatives, challenges remain, including weak enforcement mechanisms, limited community involvement, and the persistence of harmful practices such as gas flaring (Ola et al., 2024).

The environmental, economic, and social costs of gas flaring in Nigeria are particularly significant. Makanjuola et al (2019) found that sulfur oxides (SOx) concentrations near flaring sites often exceed WHO air quality guidelines, contributing to widespread air pollution and associated health risks. Obi et al. (2022) linked

gas flaring to increased rates of respiratory illnesses and cancer among nearby communities, while Ukhurebor et al (2024) estimated that the practice results in over $1 billion in wasted energy resources annually. Additionally, gas flaring has severe consequences for biodiversity, with Bakpo and Emejuru (2019) noting its detrimental effects on vegetation, wildlife, and ecosystem services. These findings underscore the urgent need to address gas flaring as both an environmental and economic challenge.

The interconnected issues of environmental degradation, health risks, economic losses, and regulatory enforcement in the Niger Delta underscore the complexity of managing oil and gas activities sustainably. Addressing these challenges requires a multifaceted approach, combining robust regulatory frameworks, advanced technological solutions, and inclusive policies that prioritize the well-being of local communities. This introductory overview provides a foundation for exploring these issues in greater depth, emphasizing the need for comprehensive and collaborative strategies to ensure sustainable development in the Niger Delta (Audu and Umana, 2024).

Giwa et al (2019) in their work on Gas flaring impacts in Niger Delta region of Nigeria concluded that there is threat to the well-being and livelihood of the inhabitants as well as the environment. Contamination of aquatic system has led to biodiversity loss, as pollution-sensitive species are replaced by more tolerant ones, disrupting ecosystem balance. Humans relying on local water sources and food are exposed to health risks, including cancer and neurological damage. Contaminated irrigation water affects crop quality, threatening both food security and livelihoods. ~~These findings underscore the urgent need for stricter regulations and sustainable practices to mitigate the environmental and health impacts of gas flaring in the region~~. Hence, the objectives of this paper is to investigate.

1. Physicochemical properties of water from Batan flow station
2. Physicochemical properties of sediment from Batan flow station
3. Correlation analysis of Pb in water and sediments from Batan flow station

II. Materials And Methods

Study Area

The study was conducted at Batan Flow Station in Warri South, a key site for oil and gas extraction in Delta State's oil-rich Niger Delta. The station was selected for its proximity to gas flaring sites and accessible water bodies for sampling. Surrounded by sensitive ecosystems such as mangrove swamps, wetlands, and riverine environments, the area is highly vulnerable to environmental impacts from industrial activities. Proximity to the Warri River and extensive waterways heightens the risk of pollution affecting aquatic life and soil conditions. The region's climate, characterized by high rainfall, humidity, and stable temperatures, further influences pollutant dispersal and environmental effects.

Fig 1: Batan flow station Warri south LGA

Sample Collection

To access the impact of gas glaring on water and sediment from Batan flow station. Four water samples were collected on the 18th of October 2024.

Table 1. Sampling coordinates

Location		Distance from Flare (m)
N.5.534768^0	E 5.537666^0	**60**
N.5.534381^0	E 5.537873^0	**200**
N.5.534771^0	E 5.537937^0	**1000**
Control		
N.5.534547^0	E 5.540069^0	**Outside the facility**

A total of four water samples were collected from different location (Table 1) using clean, pre-rinsed bottles. The in-situ parameters like pH, TDS, EC, Temp., Turbidity and DO were done at the point of collecting the samples, samples for hydrocarbons and COD analysis were collected into all glass bottles and acidified to pH 2.0 with concentrated sulphuric acid. Similarly samples for heavy metals were preserved with concentrated nitric acid to pH of 2. All samples were stored under ice-chest at 4^0C for laboratory analyses.

Sediment samples were collected from the same locations as water samples, using stainless steel corers to avoid contamination. Sediment samples were taken from the bottom layer, where most of the contamination is expected to accumulate. A total of four sediment samples were collected for analysis. Ekman Grab was deployed into the various sample points, samples for physicochemical and heavy metals analysis were collected in polythene bags. The pH was determined in both soil and sediment using electrometric method. Hanna Temperature Meter was used for the reading. The meter was powered-on and the probe of the meter was inserted into the sample, diluted with distilled water (10g: 25ml).

Sample Preservation

Water samples were collected each from the bank and at the centre of the river. Each of the water sample collected was approximately 500ml. All glass sample bottles used were thoroughly cleaned and rinsed with dichloromethane (DCM) prior to use. A piece of sterile aluminum foil was used immediately to cover each bottle so as to prevent any sort of contamination.

These were kept in ice-packed cooler and transferred to laboratory for pretreatment and analysis. 2ml of 0.2M H_2SO4 was added to the water to bring the pH to about 2.Ensuring the integrity of collected samples, each was well-labelled and preserved in the laboratory following recommended practices outlined in APHA 1060.

Analysis of Water Samples

Water samples underwent a comprehensive analysis covering physiochemical parameters and heavy metal concentrations. Physiochemical tests included measurements of pH, Electrical Conductivity, Total Dissolved Solids (TDS), Turbidity, Biological Oxygen Demand (BOD_5), Chemical Oxygen Demand (COD), and Dissolved Oxygen (DO). Heavy metal concentrations of Zinc (Zn), Chromium (Cr), Copper (Cu), Cadmium (Cd), and Lead (Pb) were determined.

Temperature

The temperatures were determined using electrometric method. Hanna Temperature Meter was used for the reading. 50ml of water sample was poured into 100ml plastic beaker, the meter was powered-on and the probe of the meter was inserted into the sample for the reading.

pH

The pH of the water sample was determined using a calibrated Hanna pH Meter. The electrode, sensitive to hydrogen ions (H), was immersed in the sample, and the voltage generated was converted into a pH value. Calibration with standard buffer solutions ensured accurate and reliable measurements of the sample's pH.

Electrical Conductivity and Total Dissolved Solids (TDS)

These were determined using Hanna Instrument (4-in- 1) for pH, TDS, EC, and Temp. The meter probe was dipped into the sample and left for about 3 minutes for equilibration before the reading was recorded. Electrical conductivity was reported in µS/cm while TDS was reported in mg/l.

Turbidity

This was determined using turbidity Meter (Model 800). Water sample was poured into the empty turbidity bottle, and inserted into the chamber of the instrument, and set the meter to read. The meter was allowed to stabilize, and record of the value was taken from the displayed screen.

Dissolved Oxygen (DO)

Dissolved oxygen was determined using Winkler method (Titrimetric). A standard DO bottle was used. The bottle was filled with water sample making sure that bubbles were not trapped. 2ml of $MnSO_4.5H_2O$ was added and 2ml of alkaline-iodide solution was also added. It was thoroughly mixed by rotating and inverting the bottle several times. The precipitate was allowed to settle, then 1ml of sulphuric acid was added, and gently mixed. Then, 100ml of the sample solution was measured into the conical flask and 2ml of starch indicator was added, and titrated against 0.0125N of NaS_2O_3. $5H_2O$. the end point was carefully observed and recorded by colour change from straw yellow to colourless. Thus, it was calculated as:

Biological Oxygen Demand (BOD)

This is dependent on oxygen uptake by bacteria and was determined using the dilution method according to APHA 5210 B. The amount of oxygen consumed during a fixed time period (usually 5 days) is related to the amount of organic matter present in the original sample. Dissolved oxygen of the samples was first determined using the Winkler Method and then incubated for five (5) days at 20°C. DO was again measured after a period of five days and BOD in mg/l was determined from the following calculation and reported accordingly.

Where D= Dilution factor usually 0.5 or 1/2

DO_B= DO of sample before incubation

DO_A= DO of sample after incubation

DO_{SB}= DO of sample blank before incubation

DO_{SA}= DO of sample blank after incubation

Chemical Oxygen Demand

Chemical Oxygen Demand (COD) was determined using Open Reflux Method (APHA 508). After 0.4g Hg_2SO_4 was placed in a 250ml conical flask, 20ml of the water sample was added, followed by 10ml of 0.25N $K_2Cr_2O_7$ solution and 20ml of Conc. H_2SO_4 containing Ag_2SO_4. The mixture was then undergo gentle shaken for a period of 10minutes. Then, the mixture was refluxed for about 2hrs, cooled after which 100ml of distilled H_2O was added and then allowed cooled to room temperature. The excess dichromate was titrated with standard $Fe(NH4)_2(SO_4)_2$ using 2-3 drops of Ferroin indicator.

Where; a = ml Fe $(NH4)_2$ $(SO_4)_2$ used for blank (distilled H_2O)

b = ml Fe $(NH_4)_2$ $(SO_4)_2$ used for sample

c = Normality of Fe $(NH_4)_2$ $(SO_4)_2$

Heavy Metals Analysis in Sediment and Water Samples

To extract heavy metals, the wet oxidation method was employed. For water samples, 50ml of sample was mixed with concentrated nitric acid, evaporated to near dryness, and further digested until a light-colored residue was obtained. This was filtered and made up to 100ml with distilled water for AAS analysis. For sediment samples, 5g of dried, powdered soil was digested with nitric and perchloric acid, heated, filtered, and made up to 50ml. In this study, Atomic Absorption Spectroscopy (AAS) was used to analyze heavy metals such as cadmium, lead, chromium, copper, and zinc. AAS works on the principle that atoms absorb light at specific wavelengths unique to each element, allowing for selective analysis. While magnesium were analyzed using a Flame photometer.

Quality Control

To ensure the reliability of the results, strict quality assurance and control measures were followed throughout the study. First, all analytical instruments were calibrated before sample analysis to ensure accurate measurements. Blank samples, duplicates, and standard reference materials were used to verify the precision and accuracy of the data.

Data Analysis

The data obtained from the analyses of water, soil, and air samples are represented in tabular form and also subjected to statistical analysis using Statistical Package for the Social Sciences.

III. Results And Discussion

Physicochemical properties of water from Batan flow station

The water quality parameters analyzed at varying distances from the flare site (60m, 200m, 1000m, away from the flare and a control site outside the facility) reveal the impact of gas flaring on surrounding water bodies. The data highlight fluctuations in pH, temperature, conductivity, dissolved solids, and organic and inorganic contaminants. The water quality analysis data results gotten can be seen in Table below.

Table 2: Physicochemical properties of water

S/N	PARAMETERS	60M away from flare	200M away from flare	1000m away from flare	Control outside the facility
1.	pH range	6.10	6.32	6.49	6.83
2.	Temperature (Cº)	28.7	29.1	28.9	29.7
3.	Conductivity (µS/cm)	15,142.00	15,022.00	14,987.00	13,564.00
4.	Total Dissolved Solids (mg/l)	8,025.26	7,961.66	7,563.14	6,932.23
5.	BOD (mg/l)	2.40	2.10	1.90	1.40
6.	COD (mg/l)	6.16	5.25	4.72	3.82
7.	Turbidity (NTU)	4.02	5.76	6.24	5.12
8.	DO (mg/l)	4.40	5.10	5.80	6.20
9.	TPH (mg/l)	0.382	0.279	0.196	0.078
10.	PAH's (mg/l)	0.076	0.047	0.021	0.009
11.	Zinc (mg/l)	0.194	0.145	0.122	0.054
12.	Chromium (mg/l)	0.011	0.007	<0.001	<0.001
13.	Lead (mg/l)	0.025	0.018	0.015	0.002
14.	Copper (mg/l)	0.036	0.029	0.023	<0.001
15.	Cadmium (mg/l)	<0.001	<0.001	<0.001	<0.001

The pH of water samples increased with distance from the flare site, from 6.10 at 60m away from the flare to 6.83 at the control location outside the facility. While all samples remain within an acceptable environmental range, the slightly acidic pH closer to the flare (6.10) suggests an influence from gas flaring emissions. The pH range across sites indicates a trend toward increased acidity near the flare (6.10 at 60m compared to 6.83 at the control). This slight acidification near the flare could result from acidic gases like sulfur oxides (SOx) or nitrogen oxides (NOx), common by-products of flaring that can dissolve into water, forming acidic compounds (Soltanieh et al., 2016). Lower pH levels in aquatic systems can negatively impact aquatic organisms, particularly sensitive species that require stable pH levels for physiological processes (Thomas et al., 2022). Acidification may also affect nutrient availability, leading to potential shifts in aquatic ecosystems (Thomas et al., 2022).

Water temperature varied minimally across sampling locations, ranging from 28.7°C to 29.7°C. Although this suggests limited direct thermal pollution from flaring, slight increases close to the flare site (28.7°Cat 60m) could indicate some thermal effect. Temperatures recorded near the flare (28.7–29.1°C) were slightly elevated compared to the control (29.7°C). While these temperatures remain within WHO permissible limits for surface water quality, the increase aligns with studies that attribute thermal pollution to heat generated by flaring. Elevated temperatures can indirectly lead to oxygen depletion and disrupt sensitive aquatic life, supporting findings by Booth et al. (2023) in similar gas-flaring regions.

Conductivity decreased with distance from the flare, showing the highest level at 60m away from the flare (15,142 µS/cm) and the lowest at the control point (13,564 µS/cm). This trend was similarly observed in TDS, where concentrations ranged from 8,025.26 mg/L at 60m to 6,932.23 mg/L at the control (Table 2). High conductivity and TDS values near the flare site indicate potential contamination by ions and dissolved solids, likely from pollutants generated by gas flaring. Conductivity and TDS decrease as distance from the flare increases, indicating that dissolved ions and solids are more concentrated closer to the flare site. This could stem from atmospheric deposition of particulate matter and salts produced during flaring. High TDS can affect aquatic habitats by altering the osmotic balance for organisms, leading to stress or mortality for species not adapted to such conditions. Increased ionic concentrations may also affect water's suitability for use in agriculture, industry, or drinking water sources Both parameters were elevated close to the flare (15,142 µS/cm for conductivity and 8,025.26 mg/l for TDS) and decreased with distance. WHO recommends a TDS limit of 500 mg/l for drinking water, indicating that levels near the flare significantly exceed safe limits, suggesting possible contamination by ions and dissolved solids from atmospheric deposition. These results are consistent with Raimi, et al. (2022), who documented high TDS levels near gas-flaring sites in Nigeria.

BOD and COD levels decrease with distance from the flare site, with BOD ranging from 2.40 mg/L at 60m to 1.40 mg/L at the control site (Table 2). COD follows a similar trend, from 6.16 mg/L to 3.82 mg/L (Table 2). These values suggest that water near the flare site contains more organic pollutants, increasing oxygen demand and stressing aquatic life. BOD and COD levels decline with distance from the flare, indicating higher organic pollution near the flare. This may result from hydrocarbons and organic compounds released during incomplete combustion in flaring. Elevated BOD and COD close to the flare can deplete dissolved oxygen in water, creating hypoxic conditions that harm fish and other aquatic organisms. Higher organic content may also stimulate microbial activity, further reducing oxygen levels (Freixa et al., 2016).

Turbidity readings were highest 1000m from the flare 6.24 NTU (Table 2) but remained elevated across all sampling points compared to the control 5.12 NTU. This increase suggests particulate matter contamination, potentially from airborne pollutants settling into the water, as seen in flaring areas. The variation in turbidity indicates that flaring may indirectly influence water clarity. Increased turbidity reduces light penetration, disrupting photosynthesis in aquatic plants and algae. The elevated turbidity near the flare site may result from particulate fallout, supporting findings by Kolawole and Iyiola, (2023), which linked turbidity to gas flaring emissions. High turbidity can hinder light penetration, affecting photosynthesis for aquatic plants and leading to reduced biodiversity over time.

DO levels increased with distance from the flare site, from 4.40 mg/L at 60m to 6.20 mg/L at the control site (Table 2). Lower DO values close to the flare indicate oxygen depletion, likely due to the increased BOD and COD, which can inhibit aquatic life, especially for oxygen-sensitive species, increased microbial activity consuming available oxygen. Lower DO levels close to the flare can create hypoxic zones, stressing or killing aerobic organisms. Sensitive species may be displaced or outcompeted by more tolerant organisms, potentially reducing local biodiversity. WHO suggests a minimum DO level of 5 mg/l for aquatic health, indicating that oxygen levels near the flare may be compromise Similar findings were reported in the Niger Delta by Anejionu et al (2015), where low DO near flare sites correlated with organic contamination. Low DO near the flare can result in hypoxic conditions, stressing aerobic organisms and potentially leading to ecosystem imbalances. Near the flare, both BOD (2.40 mg/l) and COD (6.16 mg/l) were higher, decreasing at greater distances (Table 2). This trend aligns with WHO limits for COD in surface water, which suggests that higher organic and chemical pollutants are likely due to hydrocarbons and organic matter from flaring. Review work by Kjelland et al. (2015) confirm similar BOD and COD values near flaring sites, with potential impacts on DO and aquatic species. Elevated BOD and COD levels indicate higher organic load, which can lead to hypoxic conditions detrimental to fish and other aquatic life.

Concentrations of heavy metals, such as zinc, chromium, lead, and copper, were highest close to the flare site, with values tapering off at more distant points and the control. Lead, for example, decreased from 0.025 mg/L at 60m to 0.002 mg/L at the control (Table 2). Cadmium was below detectable limits across all samples. The presence of metals in water near the flare suggests leaching of contaminants from flaring activities, with potential ecological and human health implications.

Concentrations of metals such as zinc, lead, and chromium were highest near the flare, supporting WHO and EPA findings that these metals, even at trace levels, can be toxic. For instance, lead concentrations near the flare site (0.025 mg/l) exceed WHO safe limits for drinking water, indicating contamination from flaring emissions. The results are consistent with findings from Okoye et al. (2022), who identified heavy metal contamination near flaring sites in Nigeria. Heavy metals like lead, chromium, and cadmium can bioaccumulate, posing long-term risks to aquatic organisms and humans through food chain transfer.

Heavy metal concentrations decrease with distance, indicating that flaring emissions likely contribute to local heavy metal contamination. These metals may deposit in water bodies from atmospheric fallout. Metals like lead, cadmium, and chromium are toxic even at low concentrations, and bioaccumulation in aquatic organisms can lead to food chain contamination, affecting both wildlife and humans (Phaenark et al., 2024). They can impair reproductive and neurological functions in fish and other aquatic species (Phaenark et al, 2024).

Table 3. Statistical output for heavy metals in water samples

Metal	Distance (m)				p-value at 0.05		
Zinc	60	200	1000	control	0.000		
Copper	60	200	1000	control	0.000		
Chromium	60	200	1000	control	0.343		
Cadmium	60	200	1000	Control	0.251		
Lead	60	200	1000	control	0.141		

The result as seen in Table 3 reveals that Zn and copper level of contamination in water increases with the sampling distance and this effect is significant. In contrary, Cr, Cd and Pb change with sampling distance are not significant.

Physicochemical properties of sediment from Batan flow station

The sediment quality data at distances of 60m, 200m, 1000m from the flare site, and a control site outside the facility, provide insight into the impact of gas flaring on the surrounding environment. The results show variations in pH, as well as concentrations of metals such as iron, manganese, chromium, cadmium, and lead, which can influence soil and sediment chemistry and potentially affect plant and aquatic life in the vicinity (Table 4).

Table 4: Physicochemical properties of sediment

S/N	parameters	60m away from flare	200m away from flare	1000m away from flare	Control outside the facility
1.	pH	4.62	5.71	5.89	5.92
2.	Iron, µg/g. dried wt.	3,657.821	3,147.637	2,916.671	2,102.835
3.	Manganese,µg/g. dried wt.	583.329	498.661	435.682	278.671
4.	Chromium, µg/g. dried wt.	57.871	38.117	27.821	15.203
5.	Cadmium, µg/g. dried wt.	15.987	9.781	4.543	1.283
6.	Lead, µg/g. dried wt.	79.812	63.291	51.292	18.782

Sediment pH values were more acidic near the flare site, with values of 4.62 at 60m and increasing to 5.92 at the control site. Acidic sediment can harm benthic organisms and facilitate the leaching of toxic metals, worsening the ecosystem impact. Lower sediment pH near the flare indicates acid deposition, possibly from gas combustion by-products, which can alter sediment chemistry. Acidic conditions can mobilize toxic metals in sediments, increasing their availability and toxicity to organisms. Low pH can also inhibit microbial activity, affecting nutrient cycling. Iron concentrations were highest near the flare (3,657.821 µg/g) and decreased to 2,102.835 µg/g at the control site (Table 4). Manganese followed a similar pattern, with values decreasing from 583.329 µg/g at 60m to 278.671 µg/g at the control (Table 4). These elevated levels near the flare suggest sediment contamination from particulate matter settling from flaring emissions. Elevated levels of iron and manganese near the flare suggest atmospheric deposition of these metals. Iron and manganese oxides could accumulate in sediments, affecting microbial communities (Xu and Li, 2024). Excess iron and manganese can affect the availability of essential nutrients and disrupt benthic habitats (Xu and Li, 2024).

Chromium, Lead, and Cadmium

Sediment near the flare site showed elevated levels of chromium, lead, and cadmium, which declined with distance. Chromium, for example, dropped from 57.871 µg/g at 60m to 15.203 µg/g at the control site (Table 4). High levels of these metals close to the flare are likely attributable to the release of metal-containing compounds in gas flaring, with potential toxic effects on sediment-dwelling organisms. High levels of chromium, cadmium, and lead in sediments near the flare site are indicative of heavy metal pollution linked to flaring. These metals can bioaccumulate in benthic organisms, leading to toxicity through the food chain (Raimi et al., 2021). High cadmium and lead levels, even at microgram concentrations, can disrupt biological processes.

Table 5. Statistical output for heavy metals in sediments samples

Metal	Distance (m)				p-value at 0.005
Chromium	60	200	1000	control	0.000
Cadmium	60	200	1000	control	0.000
Lead	60	200	1000	control	0.000

The concentrations of Chromium, Lead and Cadmium, decreases with distance as seen in Table 4. However, their effect in sediment are still significant. Statistical output shows p-value for the metals to be less that 0.05 (Table 5).

Table 6. Correlation of heavy metals in water and sediment

		Water	Sediment
Water	Pearson Correlation	1	.875**
	Sig. (2-tailed)		.000
	N	12	12
Sediment	Pearson Correlation	.875**	1
	Sig. (2-tailed)	.000	

	N	12	12
**. Correlation is significant at the 0.01 level (2-tailed).			

Table 6 shows correlation studies for lead (Pb) in water and sediment. It indicate that Pb from the water can easily accumulate in the sediment. ~~with the .strongest correlations frequently observed between metals with similar sources of pollution (0.875~~). These findings are important for comprehending the environmental impact of metal contamination and locating possible pollution hotspots. Generally, they show significant relationships between the concentrations of various metals in the water column and the sediment layer. Also the p-value 0.00 is an indication that the correlative effect is not influenced by other matrix.

IV. Conclusion

Lead concentrations near the flare site (0.025 mg/l) exceed WHO safe limits for water, indicating contamination from flaring emissions. There is strong positive correlation (0.875) between lead in water and sediment. This implies possible inter-leaching from both matrixes. More also, there is possibility of bioaccumulation of Metals such as Cadmium, Zinc and Chromium that can accumulated in sediments which can be a potential long-term ecological damage. This can affect not only aquatic species but also the livelihoods of local fishing communities dependent on these resources.

V. Recommendation.

Environmental monitoring program is essential to track water and sediment quality around the flare site. Regular monitoring will allow early detection of pollution, enabling prompt interventions to protect public health and ecosystems. Periodic reporting to environmental agencies ensures transparency and accountability in managing pollution.

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