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THE PUBLIC HEALTH IMPLICATION OF CONSUMING SURFACE WATER IN CONTAMINATED SITES, IN AKAMKPA LOCAL GOVERNMENT AREA, CROSS RIVER STATE.

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Abstract:-

Heavy metals and other municipal waste in addition to anthropogenic activities have been observed in surface streams. Since humans consume water every day, it became imperative to evaluate the physicochemical parameters of water and heavy metals concentration in surface streams towards documenting the water quality and streams at Camp2 village, Akamkpa Local Government Area, Cross River State.

Methodology: *Sample collection bottles were used as specie materials which are really cleaned with substance, cleaned with liquid accompanied by real liquid previous placing in 5%HNO3 for over 24hours. Liquid species were gathered from the surface water bodies by simply scooping. Using plastic bowels into 5litre acid washed polypropylene containers. Samples were collected in two study site, the samples were analyzed for various heavy metals and physicochemical parameters i.e. pH, D.O, Temp, Electrical Conductivity, Total dissolved oxygen, Turbidity, and Total hardness by using standard methods and procedures while heavy metals such Ni, Cd, pb, Hg, As, were also analyzed using Atomic Absorption Spectrophotometer (AAS).* ***Results:*** *The physicochemical parameters and heavy metals shows that all the parameters analyzed fell below WHO (2010) Standards for drinking water except for temperature and total hardness which are significantly($P<0.05$) within WHO Standards (2010). Also, the results of the heavy metals concentration were above permissibility limits. Hence, these values were above WHO standard (0.1mg/l) and FAO/WHO standards of (0.2mg/kg) while others were within joint FAO/WHO standard limit.* ***Conclusion:*** *Contamination of surface streams in the community has threating both humans' health and animals including water quality. Therefore, the introduction of physical and chemical heavy metal remediation is required to protect our surface streams within the Environment.*

Key: - *Anthropogenic activities, Camp2, Electrical conductivity, Turbidity, Cadmium, Nickel, Lead.*

1. INTRODUCTIONS

The advancement of a country is more often assessed in terms of its technological knowhow and acquisition, mostly in relation to machinery and power-operated or producing equipment. Because every country is anxious to be identified as developed or progressive, the tendency is to acquire the technology first and then worry later about its consequences, especially consequences to the environment [1]. Quarrying activity is a necessity that provides much of the materials used in traditional hand flooring, such as granite, limestone, marble, sand stone, slate and even manmade activities (anthropogenic factors). Quarrying activities has a significant impact on the environment [2]. In particular, it is often necessary to blast for processing but this method of extraction results in biodiversity and habitat destruction.

Dust from quarry sites is a source of air pollution, although the severity will depend on factors like the local microclimate condition, the concentration of dust particles in the ambient air and the size of the limestone. Quarries produce highly alkaline (and reactive) dust, whereas coal mines produced acidic dust. Air pollution is a nuisance (in terms of deposition on surfaces) with possible effect on health, in particular for those with respiratory problems and dust can also have physical effect on the surrounding plants, such as blocking and damaging their internal structures like the leaves and cuticles, as well as chemical effects which may affect long-term survival [3]. One of the biggest negative impacts of quarrying on the environment is the damage to biodiversity [4]. Biodiversity essentially refers to the range of living species including fish, insects, invertebrates, reptiles, birds, mammals, plants, fungi and micro-organisms.

Quarrying has the potential of destroying habitats and the species they support [5]. Even if the habitats are not directly removed by excavation, they can be indirectly affected and damaged by environmental impacts such as change to ground water or surface water that causes some habitats to dry out or others to become flooded. Again, like many other man-made activities, quarrying involves the production of significant amount of waste materials such as clay and silt [6]. However, there is still potential for damage to the environment particularly with water contamination. There is discharge of dusts that settles on the lands, plants and trees, and also on surface waters used for drinking and other domestic chores by the community.

2. MATERIALS AND METHODS

2.1 Reagents/chemicals used

All the reagents and chemicals used were of analytical grades and they include the following: coded International Atomic Energy Agency (IAEA-336) from Sigma, USA Nitric acid (Riedel Haen Germany), perchloric acid (Sigma-Aldrich, Germany), and Distilled deionized water obtained from Central Analytical Laboratory Institute of Oceanography University of Calabar

2.2 Study location

The study area is located in the Southern Senatorial District of Cross River State within latitude $5^{0}24^{1}$N and longitude $8^{0}12^{1}$E. The topography of the area is strongly undulating while the vegetation is typically rainforest which is gradually detoriating via quarry activities. Camp2 in Mfamosing Village is located at Akamkpa Local Government Area of Cross River State. The community is located close to thequarry site of Mfamosing rich in industrial activities with a distance of 36km from calabar to Camp2. The control site for the same study is located at Ugep in Central Senatorial District of Cross River State within the latitude $5^{0}48^{1}$N and longitude $8^{0}5^{1}$E. The village is populated by the Yakurr people. Ugep is believed to be the largest village in Africa by land mass [7]. The National Demographic Survey (2008) also added that the population is indeed predominantly Christian. The predominant occupation of the people of Camp2 and Ugep is farming with over 70% of its people being engaged in various forms of agriculture. The major agricultural produce includes cassava, yam, vegetables, rice, plantain etc. The high yielding quarry operations and tourism potentials of the people of Akamkpa has placed the state in vintage economic position and stability. Hence, the local government is blessed with natural resources that could promote economic growth in the state.

2.3 STUDY MAP OF THE TWO STUDY SITE.

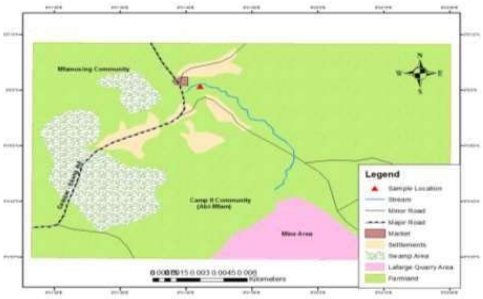
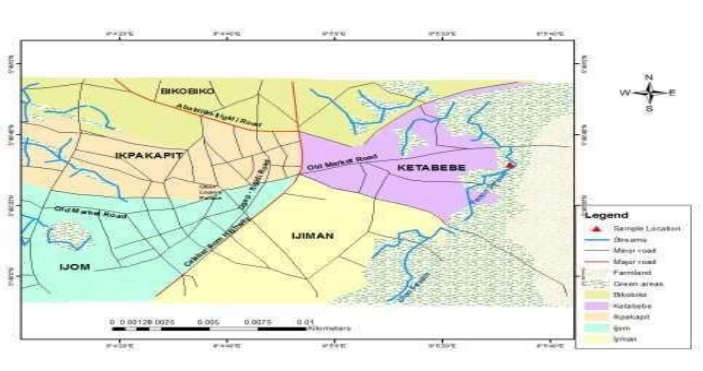


FIG. 1: Map of camp2 showing the features of the quarry site.



The map of the Control Site
Source: Geographic Information System (GIS) Laboratory, Department of Geography and Environmental

2.4 Field work

Sampling points and their locations selecting line were selected to examine the characteristic features of area water found around that region. About six (6) sampling points three (3) each were used in the two study areas in Ugep and Camp2 Akamkpa Local Government Area. This was to enable the investigation of potential source of pollution and establish the impact of the emission of industrial waste from the quarry site to the study community

The following factors were determined within the sampling points.

- Proximity: This has to do with the location of the sampling points from point A – B – C in relation to L_1, L_2 and L_3 respectively.
- Purpose: This has to do with what the water source is used for (either for domestic, agricultural or industrial purposes).
- Population: The size of the population in the villages that depend on both the water and plants that are grown in the communities

Relief, drainage and topography

The Areas were well drained with streams and most of the streams contain water bodies which are used by the surrounding communities extensively for drinking and agricultural purposes. Also, the area consists of two land types which are mountainous area, and is about 250m in height above sea level. Hence the area has a geological formation.

Climate

The job place is section of the wet climate zone of Cross River State. It is also characterized by an annual rainfall occurring within the month of May, June, July, October and November.

2.5 Methods

Collection of surface water samples for physiochemical analyses.

Determination of physicochemical parameters

The physicochemical parameters assayed include temperature, total dissolved solids, electrical conductivity, dissolved oxygen, total hardness, and turbidity; while pH was assessed on place apparatus applying a pH meter (model PHs-3c with serial No.600510099011). The water speice were placed on substance in an apparatus chest and moved to Central Analytical Laboratory, Institute of Oceanography, University of Calabar, Cross River State, Nigeria, at a temperature of $<4^0$C and subsequently used for the determination of physiochemical parameters.

Water samples

Sample collection bottles were used as sample containers which were thoroughly washed with detergent, rinsed with water followed by distilled water before soaking in 5% HNO_3 for about 24hours. Water samples were collected from the surface water bodies by simply scooping. Using plastic bowels into 5litre acid washed polypropylene containers. The samples were kept on icechest and transported to Ministry of Science and Technology Obio Imoh, Uyo, Akwa Ibom State, at temperature of $<4^0$C.

Samples preparation

The samples were digested according to standard methods for the investigation of water quality of the American Public Health Association [8]. The samples were thoroughly mixed, 20ml was transferred into a conical flask, 25ml conc. nitric acid and 5ml of perchlonic acid was added and brought to slow boiling on an evaporating plate to lowest volume (25mI). Nitric acid was added, as necessary. Digestion was completed as shown by light colour and a clear solution. The solution was not allowed

to get dried during digestion. The digest was filtered into 50ml volumetric flask diluted with distilled water [8]. For elemental analysis with Atomic Absorption Spectrophotometer (SOLAAR, 969 AA).

3. Result

Table 1 Showing the results of physiochemical Analyses of surface stream water samples from Camp2, Akampa Local Government Area of Cross River State.

Parameters/Sample code	Camp2	WHO (2010)
Temperature (^{O}C)	26.37 ± 0.35	25.00
Dissolved Oxygen (O_2)	6.80 ± 0.80	14
Ph	6.50 ± 0.14	7.5
Electrical conductivity (µs/cm)	515.67 ± 2.33	50
Turbidity (NTU)	66.03 ± 33.89	400
Total Hardness (mg/L)	16.30 ± 2.55	5.0
Total suspended solids (TSS)	0.42 ± 0.39	0.10

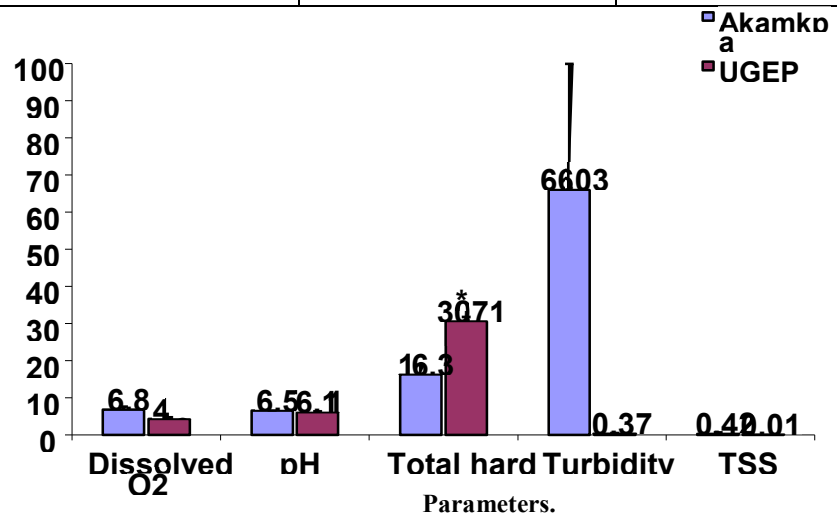


Figure 1 Comparison of physical properties of water sample in the study area.
Values are expressed as mean ± SEM, n = 3.*significantly different from Control site (Akampka) at p<0.05.

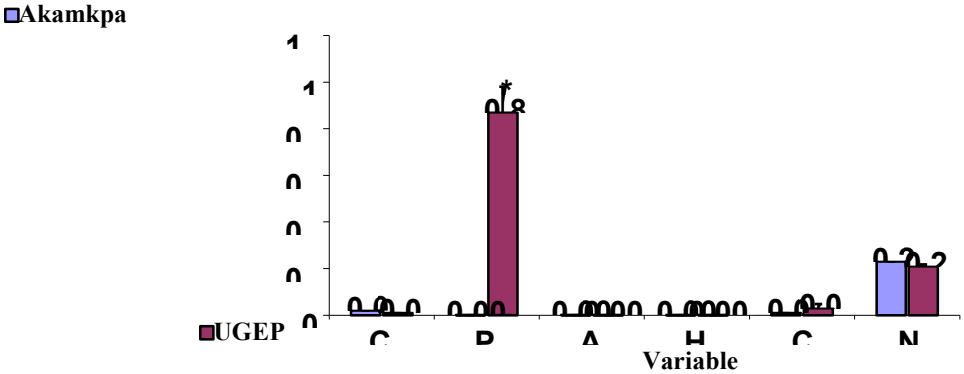


Figure 2 Comparison of heavy metals in water samples in the study area.
Values are expressed as mean ± SEM, n = 3.
***significantly different from Control (Akampka) at p<0.05.**

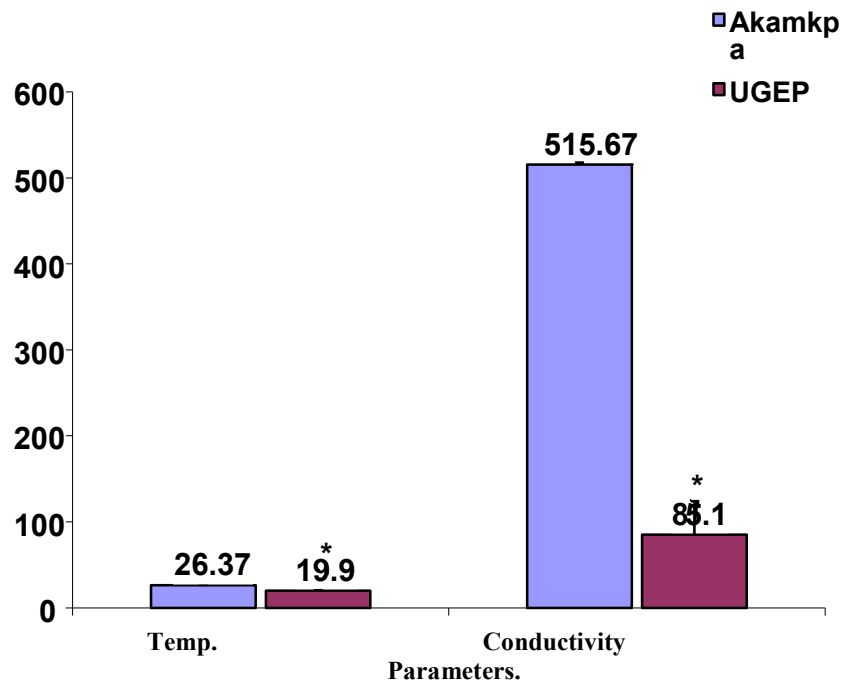


Figure3 Comparison of physical properties of water sample in the study area.
Values are expressed as mean ± SEM, n = 3.
***significantly different from Control site (Akampka) at p<0.05.**

TABLE 2 Concentration (mg/dL) of heavy metals in water samples in the study area

	Cd	Pb	As	Hg	Cr	Ni
CAMP2	0.02±0.00	0.001±0.00	0.001±0.00	0.001±0.00	0.01±0.00	0.23±0.04
CONTROL SITE	0.01±0.00	0.87±0.11*	0.001±0.00	0.001±0.00	0.03±0.02	0.21±0.01

Values are expressed as mean ±SEM, n = 3
* = significantly different from CAMP2 at p<0.05

The physiochemical parameters of surface water from the 2 locations (Camp2 and Ugep control site) within the study areas are presented in Table 1 below. The results of the measurement of physicochemical parameters of the surface water in the 3 locations show that the temperature at Camp2 had a mean value of 26.37±0.35mg/kg compared to that of the control site at 19.90±0.57mg/kg. The pH was 6.50±0.14 in Camp2 while the control site had a value of 6.11±0.40mg/kg.

The turbidity values were also found to be higher in Camp2 (66.03mg/kg) compared to the control site (0.37mg/kg). Also, the dissolved oxygen (DO) in Camp2 (6.80mg/kg) was significantly higher (P<0.05) compared to that of the control site (4.30kg/mg). The electrical conductivity in Camp2 had a maximum mean value of 515.67±2.33mg/kg when compared with that of the control site (85.10±39.77mg/kg). The total suspended solid was also higher in Camp2 (0.42±0.39mg/l) when compared with that of the control site (0.01±0.00Mg/l). Table 2 shows the mean heavy metals concentrations of water samples collected from 2 different locations. The heavy metals levels were compared with those of WHO (1993) and WHO (2004) for drinking water.

The heavy metals assayed were cadmium (Cd), lead (Pb), Arsenic (As), Mercury (Hg), Chromium (Cr) and Nickel The results obtained show that there was an increase in value of heavy metal concentration in Camp2 with a mean value of Cd (0.02±0.00µg/l), Pb (0.01±0.00µg/l), Ag (0.01±0.00µg/l), Hg (0.01±0.00µg/l), Cr (0.01±0.00µg/l) and Nl (0.23±0.04µg/l). The concentration of heavy metals in H_2O samples of camp2 were generally not significantly different (p>0.05) from those of the control except for Pb which was 0.87mg/dL (control) and 0.001mg/Dl camp2.

4. **DISSCUSSIONS**

There has been an increase rise in the level of heavy metal like nickel, cadmium and lead in Camp2 site in Akamkpa Local Government Area of Cross River State. This increase level of heavy metal is as a result of industrial activities going on in this area, this pollution as resulted to severe public health effect on the people living around this community. The bioaccumulation of heavy metals generates oxidative stress in biological system resulting to programmed cell death. On the centrally it is imperative to explore an efficient method to mob or reduce the level of heavy metals in our environments. The effect of heavy metals has caused a lot of devastation in biodiversity within our communities. The results of temperature of the surface water of camp2 (26.37ºC) was above the WHO standard of 25ºC for surface water. While that of the control site (199ºC) was within WHO specification [9]. For domestic water supply. Similar reports were found in Kubwa Area Council, Federal Capital Territory, and Abuja, Nigeria [10]. A mean worth of 26.33±0.89°C was stated for Samaru Zaria, country. Similarly, the range of temperature 25.7°C – 26.50°C reported for surface water from different points along Camp2 village and the control site in Yakurr Local Government Area of Cross River State. The observed high temperature could be attributed to the climatic condition of the study area which is characterized by the weather condition of the area. Again, the temperature could be affected by the water chemistry such as saturation and concentration of dissolved gas especially oxygen. The rates of chemical reactions generally increase as temperature increases. Also, the hotness of the area liquid will alter regarding to the light amount whereas the beneath of the surface water reaction constantly cold [11]. The pH values of 6.11 to 6.50 obtained for water from both sample sites, are within the guidelines of the WHO (9.2) and Nigerian standards for drinking water quality (NSDWQ) [12]. The pH of liquid assesses the dissolved and functional accessibility of structural components which are nutrient and massive materials [13]. The findings of this study show that the P^H of the two study areas was within WHO permissibility limit for drinking water

The value for dissolved oxygen in Camp2 (6.80mg/L) and control site (4.30mg/L) were within the WHO permissible limits of 7.5mg/L [14]. The state of soluble air is vital in controlling water life and the air standard water [15]. The electrical conductivity recorded at Camp2 was found to be above WHO permissibility limit of 250µs/cm. This indicates electrolyte contaminants [16]. The maximum state may also be as a result of the upper amount of substance and materials in the surface liquid origin. It could also be linked to emission of dust and sewage materials in addition to leaching of inorganic contaminants. These results might be that surface and agricultural run-offs might have contributed to the increased concentration of ions in the surface water. Since all the conductivity values in the control area fall within the WHO limit for intaking liquid, it could be finalized that absence severe wellbeing impact related with the apparatus suitable of liquid stem in the control site and its environment. Hardness forms part of the suitability of water for home, intaking and firm application. In this study the total hardness was determined, the value recorded for total hardness at the control site was found to be significantly higher ($P<0.05$) with a mean value of 30.71±1.18mg/l compared to the mean value of the study area at Camp2 village with the mean value of 16.30±2.55mg/l. Both results were found to be within the WHO acceptable limit of 150-500mg/l respectively [17]. Comparing the result found in the both study area could be described safe for domestic propose. Again, the increase in the result from Camp2 village may be as a result of weathering of limestone sedimentary rocks and Calcium bearing mineral activities, another origin which are additional use of period to the soil in planting places may contribute to the upper massive value in this work. On the contrary, works have displayed that heat ailment are small usual in places of massive liquid than in the places of soft liquid [15] this is not detrimental to health**.** The temperature mean value is 26.37 ± 0.35, a value quite acceptable when compared to WHO [18]. Stipulated standard of 25ºC - 28ºC. It can be stated that temperature wise, the surface streams in Camp2 are considered not fit for human consumption since the temperature falls within the range of temperature required for biochemical reactions in the body of a living organisms. The pH of the water samples from various locations were seen to be acidic with the mean value of 6.50 ± 0.14. The acidity was probably due to the presence of dissolved organic matter from the soil which holds the water. Exposure to this low pH according to WHO Working Group [19]. Results in irritation in eyes, skin and mucous membrane, and also cause hair fibers in human to swell with the severity of which increases with decreasing p^H. Therefore, pH wise, the surface streams are considered not fit for human consumption because it falls outside WHO standard [18]. Conductivity measures the capacity of an aqueous solution to conduct electrical current, which serves as gauge for the number of ions present in the solution.

The turbidity mean value of the samples was 66.03 ± 33.89 which is very high compared to WHO standard [18]. Of 5.0 NTU. Turbidity depends on a number of factors such as the size, shape, and refractive index of the clay, colloidal particles and the micro-organisms. The consumption of this high turbid water would be a health risk due to micro-organisms as the probable part in it. Further turbidity can also protect the pathogens from the effects of disinfectants, facilitate their growth and increase the chlorine demand [19]. Therefore, Turbidity wise, the water sources are considered not fit for consumption. In general, TSS particles have an overall negative impact on the aquatic ecosystem. As levels of TSS increase, water body begins to lose its ability to support a diverse aquatic ecosystem. Suspended solids absorb heat and sunlight, which increases water temperature, resulting in decreased dissolved oxygen levels. The mean Total suspended solids value from water samples from Camp2 is 0.42 ± 0.39 which is opposed to WHO acceptable level standard [18]. Of 0.1mg/L. Therefore, with this value which is above the WHO limit the water sources are considered not too fit for consumption. The mean value for the dissolved oxygen in 6.80 +0.80. It is an important parameter in assessing water quality because of its influence on the organisms living in water. In limnology (the study of lakes), dissolved oxygen is an essential factor second only to water itself. A dissolved oxygen level that is too high or too low can harm aquatic life and affect water quality [19]. Therefore, since the mean value of dissolved oxygen falls below WHO standard, the water sources used for this research are not

considered fit for consumption. Dissolved oxygen analysis measures the amount of gaseous oxygen (O_2) dissolved in an aqueous solution. Oxygen gets into water by diffusion from the surrounding air, by aeration (rapid movement) and as a waste product of photosynthesis. Environmental impact of total dissolved solids gas concentration in water should not exceed 110% (above 13-14 mg/l). Concentration above this level can be harmful to aquatic life. Fish in waters containing excessive dissolved gases may suffer from "gas bubble disease"; however, this is a very rare occurrence.

The heavy metals in water in this study show a significant difference within the two study areas, though there was a decrease from the study area. This may be due to the dust from the quarry site, which settles at the bottom of the soil carried by leaching to the water [20]. It may also be attributed to anthropogenic activities within the areas and other effluent such as mining, from the quarry and smoke from automobile [20]. Pollution of water bodies with heavy metals from variety of sources is becoming a serious matter of global concern [21]. Although their effects of contamination on drinking water are not felt on short-term, their accumulation over a long period of time in the body has a significant impact on health [22]. Contamination of water by heavy metals in some areas are due to natural processes such as weathering of rocks and anthropogenic activities such as industrial, domestic effluent and agricultural activities [23]. Rivers flowing along urban centers are used for irrigation of the vegetables grown on their banks. Water of such rivers have often been reported to be polluted by heavy metals and most of these lands are usually contaminated with heavy metals through anthropogenic activities. Plants grown on the contaminated sites are unsafe for consumption [24]. Industrial effluent thus affects the ecosystems in such a way that waste water from the industries of mining, electroplating plants or chemical laboratories often contains high concentrations of heavy metals, including Cd, Ni and Pb. These elements at high concentration exceeding the physiological demand of the plants could penetrate or enter food chains, get biomagnified and pose a potential threat to human health [25]. Heavy metals present in food crops like vegetables grown on land are rich source of organic matter and other nutrients such as Mn, Cu, Zn, Pb, Cd, Ni and Co, are usually toxic due to their solubilities in water [26].

Conclusion:

Contamination of surface streams in the community has threating both humans' health and animals including water quality. Therefore, the introduction of physical and chemical heavy metal remediation is required to protect our surface streams within the Environment.

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Conflict of interest

The authors declare that they have no competing interests.

Highlight of the Authors Contributions.

Author Contribution: Eteng ofem conceived the idea and designed the research work, Joe Enobong and Kenyoh Abam, Savour Ufort carried out the Experiment, Victor Ekam supervised the work, Joe Enobong did the statistical Analysis, Eteng ofem and Grace Ekpo wrote the paper, and finally Professor Eyong Ubana read and approved the final manuscript

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