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Environmental Impact of Scrap Metal Industries: Examination of Vertical Seepage of Scrap Metal Effluents (Heavy Metals) into the Aquifer

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ABSTRACT

Research was carried out to determine the extent of damage caused by the release of heavy metals from scrap metal dump sites into the aquifer in Benin City, Nigeria. The nine scrap metal dump sites investigated were located at; i) Osasogie Street by Total Filling Station, Off Benin Sapele Road, ii) Omoragbon Agho, Off Benin Sapele Road, Etete, iii) Evbuotubu Junction by Ekehuan Road iv) Asoro Hill by Upper Ekehuan Road v) Christopher Osewengie Street, Ekae Quarters, off Sapele Road, vi) Akugbe Street, off Saint Saviour Road, vii) Upper Iwehen, off Lagos Street, Oba Market, viii) Evbienwen Street, off Wire Road and ix) Iduowina Road, Iduowina Quarters, off Benin Auchi Road. The control site was located at Uniben Reserved Area, University of Benin, Benin City. Water samples were obtained from hand dug wells, private boreholes and rivers closest to scrap metal dump sites. The distance between the sites and water sources were measured using a global positioning satellite (GPS) device. The Atomic Adsorption Spectrophotometer (AAS) was used to analyze the six heavy metal concentrations of copper (Cu), chromium (Cr), cadmium (Cd), zinc (Zn), lead (Pb) and iron (Fe) in the soil and water. The soil samples were obtained from three (3) depths (0 - 10, 10 - 20 and 20 - 30 cm) respectively, from the nine scrap metal dump sites investigated, using a strategic quadrat random sampling method. Results showed that all the heavy metals investigated except Zn, exceeded the WHO / FEPA limits for drinking water in at least five (5) locations from all the water sources. Presence of the heavy metals at varying concentrations in all the three soil depths was reported in the soil samples. The concentrations of heavy metals in soil samples taken from the scrap metal dump sites exceeded the corresponding soil sample from the control sites at the three depths under investigation. Soil Chromium (Cr) levels exceeded the Ecotoxicity limit (1 mg/kg) in all the three depths at the nine sites. This confirms that the seepage of heavy metals from the scrap metal dump sites lead to soil pollution and consequently the degradation of the soil quality, creating a hazardous environment for man, plants and animals in the Ecosystem. This study thus confirms that the scrap metal industries has a long term negative impact on the environment by the releasing of heavy metals into the environment, and also shows that the sustainability of the environment in the face of this trade is an issue that should be addressed.

1. Introduction

The atmosphere, hydrosphere and lithosphere have been relatively depleted by man's daily activities [1]. In a quest to improve human existence on planet earth, the use of fast and easy means is the basis for emergence of new technologies. The increase in the use of modern technology alongside the outburst in the human population has resulted in a boom in the scrap metal business. Investigations have shown that the scrap metal business is a major source of heavy metal contamination of the environment. The scrap metals consist of iron metals, copper wires, zinc sheets and lead batteries [2]. These scrap metals are major sources of Pb, Zn, Cr, Cd, Cu and Fe. In an attempt to remove these metals from where they are heaped, wear and tear results. These heavy metals are eventually washed off into the environment thus degrading the soil and reducing the water quality.

These anthropogenic sources of heavy metals therefore increase the amount of heavy metals already available in nature [3]. Research in Ghana has shown that gold mining communities experienced heavy metal pollution [4]. It was a major source of Hg, Pb and heavy metal contamination of the environment. Research showed that in the Tarkwa area, a mining area, mineral exploitations, ore transportation, smelting and refining, disposal of the tailings and waste waters around mines, were major sources of heavy metals to the environment [5, 6].

Researchers [5, 7, 8] showed that heavy metals are a major constituent of the toxicants released from the scrap metals that resulted from smelting, refining and disposal of the tailings into the environment. These metallic particles could be washed off by erosion into rivers and the leachates could also seep into the aquifer, thus, degrading the water quality [9, 10, 11, 12, 13]. Man, plants, and animals need water for their survival, thus these inorganic pollutants present in the water pose a great threat to the environment and consequently to human existence [14, 15, 16].

Consequently, the present study analyzed soil and water samples obtained from scrap metal dump sites in order to determine the extent of heavy metal contamination. The results are compared with the WHO/FEPA standards for drinking water and with the Ecotoxicity limits for soils. These will help in determining the level of contamination of the environment (soil and water) by the releasing of six heavy metals (Cd, Cr, Cu, Pb, Zn and Fe) from the scrap metal dump sites into the soil and through seepages and runoff into the aquifers and rivers respectively, which is the major objective of this research. Earlier scientific studies were conducted to examine plants distribution based on the severity of scrap metal deposition at the sample sites [2]. The aim of this research study is to determine the extent of contamination of water and soil by six heavy metals (Cd, Cr, Cu, Pb, Zn and Fe) released from scrap metal dump sites.

2. Methodology

Soil and water samples were collected between June 5th and June 16th 2016 from nine scrap metal sites and a control site within Benin City. The control site had no record of scrap metal activities.

2.1 Description of Sample Collection Sites

A. Scrap metal site located at Osasogie Street by Total Filling Station, off Benin Sapele Road, Benin City on Latitude 6º 15′ 22.4″N and Longitude 5º 38′ 09.2″E Elevation 47m. Public bore hole close to scrap metal site on Latitude 6º 15′ 22.4″N and Longitude 5º 38′ 05.9″E Elevation 48m. Distance between water source and scrap metal site was 122m. Slope between water point and scrap metal site is a gentle slope surface.
B. Scrap metal site located at Asoro Hill by Upper Ekehuen road, Benin City on Latitude 6º 19′ 40.9″N and Longitude 5º 34′51.7″E Elevation 63m. Ogba River at Akaba Street, close to scrap metal site on Latitude 6º 19′ 17.7″N and Longitude 5º 34′59.9″E Elevation 30m. Distance between Ogba River water source and scrap metal site was 811m. Slope between water point and scrap metal site is a sharp steep surface
C. Scrap metal site located at Upper Iwehen scrap dump site, Off Lagos Street, Oba Market, Road Benin City on Latitude 6º 20′ 35.2″N and Longitude 5º 37′ 25.1″E Elevation 91m. Public bore hole close to scrap metal site on Latitude 6º 20′ 35.4″N and Longitude 5º 37′

25.0″E. Elevation 91m. Distance between water source and scrap metal site was 2.55m. Slope between water point and scrap metal site was a plain surface.

D. Scrap metal site located at Evbienwen Street, off Wire Road, Benin City on Latitude 6º 20′ 34.5″N and Longitude 5º 37′ 15.4″E Elevation 92m. Public bore hole close to scrap metal site on Latitude 6º 20′ 33.5″N and Longitude 5º 37′ 18.9″E Elevation 92m. Distance between water source and scrap metal site was 102m. Slope between water point and scrap metal site is a concave surface.

E. Scrap metal site located at Iduowina Qtrs, Benin City on Latitude 6º 25′ 19.7″N and Longitude 5º 36′ 08.5″E Elevation 125m. Public bore hole close to scrap metal site on Latitude 6º 25′ 20.8″N and Longitude 5º 36′ 11.5″E Elevation 127m. Distance between water source and scrap metal site was 101m. Slope between water point and scrap metal site is a convex surface

F. Metal scrap site located at Omoragbon Agho Street, off Benin Sapele Road, Benin City on Latitude 6º 17′ 40.3″N and Longitude 5º 37′ 70.4″E Elevation 61m. Public bore hole close to metal scrap site on Latitude 6º 17′ 41.3″N and Longitude 5º 37′ 41.8″E Elevation 68m. Distance between water source and metal scrap site was 47.6m. Slope between water point and scrap metal site is a gentle slope surface

G. Metal scrap site located at Evbuotubu junction, by Ekehuan road, Benin City on Latitude 6º 19′ 39.9″N and Longitude 5º 34′ 46.9″E Elevation 76m. Bore hole close to metal scrap site on Latitude 6º 19′ 39.9″N and Longitude 5º 34′ 46.9″E Elevation 66m. Distance between water source and metal scrap site was 156m. Slope between water point and scrap metal site is a steep surface. Run-off water samples were also collected at a distance of 3 m and 5 m from the scrap metal dump site.

H. Metal scrap site located at Christopher Osewenghie street, Ekae qtrs off Benin Sapele Road, Benin City on Latitude 6º 15′ 52.9″N and Longitude 5º 38′ 04.8″E Elevation 55m. Bore hole close to metal scrap site on Latitude 6º 15′ 33.6″N and Longitude 5º 38′ 01.9″E Elevation 58m. Distance between water source and metal scrap site was 636m. Slope between water point and scrap metal site is a steep surface. Run-off water samples weres also collected at a distance of 3 m and 5 m from the scrap metal dump site.

I. Metal scrap site located at Akugbe street off Saint Saviour road, Benin City on Latitude 6º 19′ 21.8″N and Longitude 5º 38′ 46.8″E Elevation 88m. Well close to metal scrap site on Latitude 6º 19′ 21.8″N and Longitude 5º 38′ 47.7″E Elevation 88m. Distance between water source and metal scrap site was 76m. Slope between water point and scrap metal site was a plain surface

J. Control site located at University of Benin Reserve Area, Benin city on Latitude 6º 24′ 19.6″N and Longitude 5º 38′ 33.1″E Elevation 58m. Water source was from a well on Latitude 6º 24′ 17.4″N and Longitude 5º 38′ 19.9″E Elevation 38m. Distance between water source and scrap metal site was 409.85m.Sloped between water source and scrap metal site is a sharp steep surface

2.2 Water sample collection

Five hundred (500) ml size clean plastic containers were used to collect water samples, filled to the brim to exclude air. Water samples were carefully collected from boreholes, hand dug wells

and river closest to the scrap metal dump sites. The locations were determined using the GPS device. This was to ensure that the most representative samples possible were obtained [17].
Water sample collection was very difficult as most of the water facilities were not accessible, therefore samples obtained in the study were only accessible sources that were closest to scrap metal dump sites.

2.3 Soil sample collection

Around the scrap metal dump sites, radial demarcations were made, adjacent to the perimeter of each facility within a distance of 3m from the centre (that is 3m radius of scrap metal site). A 3m x 3m quadrat was used for sub-demarcation of each scrap site. Sampling was done using the quadrat system called random sampling method [18]. The soil samples were obtained from three (3) depths (0-10, 10-20 and 20-30 cm) respectively from the scrap metal dump sites for investigation.

2.4 Labouratory Analysis

Soil samples were analyzed for pH and Electrical Conductivity [19, 20] and selected heavy metal content (Fe, Zn, Cu, Cr, Cd, and Pb) according to the methods of [21] and [22].

3. Results and Discussion

3.1 Results

The water quality showed that the concentration of heavy metals obtained from water source close to the nine scrap metal dump sites were higher than that of the control site (Table 1).
Specifically, Iron (Fe), Chromium (Cr) and Lead (Pb) exceeded their WHO/FEPA limits (0.3-I mg/kg, 0.05 mg/kg, 0.05 mg/kg) for drinking water with the ranges of (2.5-15.9 mg/kg, 0.51-2.20 mg/kg, 0.26-0.86 mg/kg) respectively at all the nine scrap metal dump sites.
Copper (Cu) exceeded the WHO/FEPA limits (0.05mg/kg for drinking water with a range of (0.03-0.27 mg/kg) at five (5) locations of the scrap metal dump sites.
Similarly, Cadmium also exceeded the WHO/FEPA limits (0.01/0.005 mg/kg) with a range of (0.02-0.03 mg/kg) at six locations of the scrap metal dump sites. Zinc (Zn) was below the WHO/FEPA limits (1.50 mg/kg) but fully detected in the Aquifers of the nine scrap metal dump sites.

Table 1: Heavy metal concentration obtained from water sources closest to scrap metal sites

Site	Source	Cu	Pb	Zn	Cr	Cd	Fe	pH	Conductivity (µS)/cm
	FEPA/WHO	0.05	0.05	1.50	0.05	0.01/0.005	0.3/1		
A	Borehole	0.05	0.42	0.04	2.20	0.00	5.3	6.37	11.65
	3m run-off	nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
	5m run-off	nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
	River	nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
	Well	nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
B	Borehole	0.04	0.06	0.00	2.20	0.01	5.6	6.28	25.00
	3m run-off	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
	5m run-off	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
	River	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
	well	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
C	Borehole	0.10	0.86	0.13	0.51	0.01	10.6	5.66	11.67
	3m run-off	0.13	0.39	1.00	1.81	0.00	3.10	7.89	1008
	5m run-off	0.27	0.45	0.29	1.54	0.02	15.9	6.17	1265
	River	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
	well	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
D	Borehole	0.10	0.65	0.02	2.10	0.00	6.6	5.66	75.4
	3m run-off	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil

	5m run-off	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
	River	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
	Well	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
E	Borehole	0.15	0.57	0.07	1.84	0.00	2.5	5.76	14.29
	3m from site	0.11	0.53	0.75	1.98	0.03	8.4	5.90	154.5
	5m from site	0.05	0.74	0.17	1.24	0.00	3.5	5.89	148.6
	River	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
	Well	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
F	Borehole	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
	3m run-off	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
	5m run-off	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
	River	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
	Well	0.05	0.26	0.22	1.24	0.00	12.1	6.22	214
G	Borehole	0.16	0.39	0.04	1.93	0.01	4.4	5.52	13.15
	3m run-off	Nil	Nil	Nil	Nil\	Nil	Nil	Nil	Nil
	5m run-off	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
	River	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
	Well	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
H	Borehole	0.07	0.29	0.06	1.80	0.01	3.8	7.39	28.30
	3m run-off	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
	5m run-off	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
	River	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
	Well	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
I	Borehole	0.03	0.31	0.15	1.80	0.03	13.1	6.43	10.00
	3m run-off	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
	5m run-off	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
	River	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
	Well	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
j	Borehole	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
	3m run-off	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
	5m run-off	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
	Well	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
	River	0.16	0.44	0.00	1.60	0.00	4.7	5.85	15.15

Keys

A.) Osasogie Street by Total Filling Station, Off Benin Sapele Road, Benin City, B.) Omoragbon Agho, Off Benin Sapele Road, Etete, Benin City, C.) Evbuotubu Junction by Ekehuan Road Benin City,D.) Asoro Hill by Upper Ekehuan Road Benin City, E.) Christopher Osewengie Street, Ekae Qtrs, off Sapele Road, Benin,
F.) Akugbe Street, off Saint Saviour Road, Benin City, G.) Upper Iwehen, off Lagos Street, Oba Market, Benin City.
H.) Evbienwen Street, off Wire Road, Benin City, I.) Iduowina Road, Iduowina Quarters, off Benin Auchi Road, Benin City, J.) Control Site; Uniben Reserved Area, University of Benin, Benin City.

3.2 Heavy metal concentrations obtained from soil at 3-depths within 3m radius of scrap metal sites during the dry season

The six heavy metals Cu, Cd, Cr, Zn, Pb and Fe were generally observed to be more concentrated in soil samples at depth of 0-10cm compared to the concentrations at depths of 10-20 cm and 20-30 cm (Table 2). Cr metal was generally observed to be present in all the soil samples analyzed above required Ecotoxicity limits. The highest concentration of Cr (3.60 mg/kg) was seen at Christopher at 0-10 cm depth while the least concentration (0.12 mg/kg) was observed at Uniben Reserved Area at 10-20 cm depth. Cd was totally absent at Etete, Akugbe, Iwehen and Uniben Reserved Area. The highest concentration (0.06mg/kg) of Cd was observed at Asoro at 0-10 cm depth. The highest concentration (12.11 mg/kg) of Fe was observed at Akugbe at 0-10 cm depth. While the least Fe concentration (3.24 mg/kg) was observed at Control at 20-30 cm depth. Fe metal was highly concentrated at 0-10 cm depth except for Osasogie (9.60 mg/kg) that was most concentrated at 20-30 cm depth. In Pb, the highest concentration (6.87 mg/kg) was observed at Akugbe, at soil depth of 0-10 cm. The results also revealed that Akugbe at 0-10 cm depth had the highest concentrations of Cu, Pb and Fe.

Table 2: Heavy metals obtained from soil at 3-depths within3m radius of scrap metal sites during dry season (2015)

Site	Soil depth	Heavy metal concentration (mg/kg)							
		Cu	Pb	Zn	Cr	Cd	Fe	pH	Conductivity(µS/cm)
ECOTOXICITY	***LIMIT***	**200**	**50**	**50**	**1**	**4**	**200**	**NA**	**NA**
A	0-10	0.26	5.58	10.50	3.34	0.01	8.50	5.41	201.26
	10-20	0.18	3.10	8.60	1.86	0.01	7.11	5.96	181.65
	20-30	1.30	2.40	12.00	1.26	0.01	9.60	5.80	212.74
B	0-10	0.10	1.10	9.70	2.34	0.00	5.10	5.98	319
	10-20	0.14	4.83	4.90	1.95	0.00	4.12	5.70	66.8
	20-30	0.90	0.81	4.70	1.07	0.00	3.64	5.92	96.2
C	0-10	1.29	2.84	11.50	3.09	0.02	9.46	6.00	98.33
	10-20	1.42	1.93	9.90	1.56	0.01	5.78	6.24	104.71
	20-30	0.22	1.71	5.10	0.89	0.00	4.30	6.36	121.86
D	0-10	1.39	2.80	11.60	2.06	0.06	11.50	5.63	152.77
	10-20	1.52	2.12	9.60	1.68	0.02	8.66	6.45	146.28
	20-30	0.71	1.91	7.30	1.11	0.01	6.58	6.50	141.36
E	0-10	1.09	4.91	12.00	3.60	0.02	11.68	5.55	552
	10-20	1.37	4.01	11.40	1.88	0.01	7.80	5.52	95
	20-30	1.02	1.39	11.30	0.26	0.00	6.90	5.53	175.3
F	0-10	1.60	6.87	9.60	1.68	0.00	12.11	6.01	98.22
	10-20	0.88	2.64	7.40	1.02	0.00	9.29	5.96	101.34
	20-30	0.24	1.91	6.80	0.76	0.00	8.60	6.26	45.8
G	0-10	1.58	5.98	11.80	1.70	0.02	9.64	5.88	124.6
	10-20	0.73	3.78	11.90	1.20	0.03	8.01	6.00	88.0
	20-30	1.27	1.53	11.80	1.09	0.04	7.70	5.21	142.5
H	0-10	1.51	3.95	11.80	1.98	0.00	10.10	5.70	139.67
	10-20	1.00	1.92	8.00	1.14	0.00	7.44	6.10	123.21
	20-30	0.71	1.74	9.20	0.86	0.00	5.38	5.89	131.09
I	0-10	1.43	2.70	9.80	1.72	0.03	8.94	5.44	66.2
	10-20	0.12	0.47	5.20	1.20	0.01	6.94	5.90	44
	20-30	0.10	0.19	6.10	1.06	0.01	6.60	5.86	62.7
J	0-10	0.07	0.66	0.03	0.98	0.00	7.68	5.55	38.0
	10-20	0.05	0.34	0.00	0.12	0.00	6.00	5.70	39.4
	20-30	0.02	0.33	0.00	0.17	0.00	3.24	5.80	25.0

Keys

A.) Osasogie Street by Total Filling Station, Off Benin Sapele Road, Benin City, B.) Omoragbon Agho, Off Benin Sapele Road, Etete, Benin City, C.) Evbuotubu Junction by Ekehuan Road Benin City. D.) Asoro Hill by Upper Ekehuan Road Benin City, E.) Christopher Osewengie Street, Ekae Qtrs, off Sapele Road, Benin F.) Akugbe Street, off Saint Saviour Road, Benin City. G.) Upper Iwehen, off Lagos Street, Oba Market, Benin City. H.) Evbienwen Street, off Wire Road, Benin City, I.) Iduowina Road, Iduowina Quarters, off Benin Auchi Road, Benin City. J.) Control Site; Uniben Reserved Area, University of Benin, Benin City.

3.3 Discussion

Research scientist has shown that heavy metals released from scrap metal dump sites on the environment have greatly influenced the plant species distribution in those areas [2]. The aquatic ecosystem has been polluted by heavy metals. There could be a percolation of the heavy metals into the soil depths (infiltration). The water can also be washed off by erosion down into the streams and rivers.

Some heavy metals are leached into the soil and down to the aquifer. This is a major source of water for boreholes and wells. Man, plants, and animals need water for their survival. Thus, the inorganic pollutants, present in the water poses great hazards to the environment [14, 15]. The present study, showed that the heavy metals; Cu, Pb, Zn, Cd, Cr and Fe were available in water. The water samples obtained from runoffs, wells, boreholes, and rivers around nine scrap metal sites were higher than the control samples. This implies that the scrap metal activities had greatly contributed to the depletion of the water quality in the environment and it commemorates the findings of [23].

Generally, the highest concentration of Cu, Fe and Pb was observed from run-off and bore holes at Evbuotubu, while the least concentration was observed at Iduowina. Thus, it could be inferred that the scrap metal dump site at Evbuotubu had immensely contributed to the high content of Cu, Fe and Pb resulting in the pollution. Previous study conducted by [2] on the sample sites showed that the type, quantity and age of scrap metals deposited on the sites greatly influenced the type of heavy metals released into the environment. Chromium (Cr) also exceeded the required amount in water by FEPA\WHO in all the samples analyzed. It therefore implies that there was high deposition and seepage of Cr from scrap metal dump sites into the Aquifer. Also, this corresponds with the reports of [16, 24].

Pb, Cr and Fe exceeded the set limits of FEPA/WHO in all the sites studied. For Cd, six sites exceeded the FEPA / WHO limits for drinking water and the highest concentration was observed at 3 m run-off at Christopher Osewengie. The high concentrations of heavy metals in the water samples obtained from water run-offs from scrap metal dump sites at Evbuotubu and Christopher Osewengie shows that the heavy metals are washed off by erosion and there could be seepage of the heavy metals into the aquifer. This is similar to the findings of [25].

Generally, Cr, Pb, and Fe were the most prevalent metals that exceeded the set limits by FEPA\WHO in all the sites investigated. This implies that the dump sites contained scrap metals whose constituents consist of some heavy metals. Similarly, [26] has shown the effect of some heavy metals on the growth of cabbage. The results showed that the levels of all the metals had appreciated compared to baseline studies. This study therefore showed that water sourced from run-offs, wells, boles and rivers from around the nine scrap metal dump sites in Benin City had been highly polluted with heavy metals when compared with the standard of FEPA / WHO. These heavy metals could be hazardous to human health when biomagnified in the tissues and organs of man. Corresponding findings had been reported by [27].

3.4 Heavy metal pollutants in environment: Impact on soil quality

Plate 1 below shows the picture of a scrap metal dump site at Etete. The site serves as a collection point for recyclers of scrap metals. The picture also reveals that the scrap metal dump site is located in the heart of the city were people reside**.** A close view at Plate 2 shows that in Etete scrap metal dump site, the scrap metals were heaped directly on the plain soil, exposing the soil directly the eroded metals. This therefore shows that the soil serves as a bed for water run-off from the scrap metal dump site**.** In plate 3 below, the borehole located around the scrap metal dump site at Etete, pumps water from the ground into the black tank. This polluted water serves as a source of drinking water to the people residing in that area. Similar conditions were seen in all the sampled sites.

Plate 1: Heap of scrap metals at Etete, Benin City, Nigeria

Plate 2: Heap of scrap metal at Etete

Plate 3: Bore hole close to scrap metal

The concentration of heavy metals varied greatly with soil depths. Leachates of heavy metals released from scrap metal dump sites are buried in the soil at various depths. Research showed that heavy metals were mostly concentrated on the top soil at 0 – 10 cm, followed by 10 – 20 cm and 20 – 30 cm. The heavy metal concentrations at various depths therefore show that leachates of heavy metals could seep into the aquifer. This agrees with the research carried out by [28], who examined the concentrations of Co, Ni, Cd, Cu, and Pb for soils and water from two scrapyards located at Abeokuta and Lagos State metropolis, in Nigeria. Generally, the levels of all heavy metals studied in the scrapyard area were found to be higher than those of the control samples.

Also, the present study showed that Cd, Pb, Zn, Fe Cr and Cu were present in soil samples analyzed from scrap metal dump sites investigated and the levels of concentration of heavy metals in the samples were higher than that of the control samples. Thus, the study showed that the scrap metal activities had impacted on the environment by increasing the heavy metal content in the soil. This research corresponds to the study of [29, 30, 31, 28, 32]

4. Conclusion

The research has shown a high level of degradation of the soil, and the contamination and pollution of the aquifer by the scrap metals dump sites resulting in the reduction of the water qualities harvested from boreholes, wells and rivers around the scrap metals dump sites. This call for immediate action as human lives, plants and animals are endangered. This also raises another critical issue of the sustainability of the environment that is gradually and undisputedly being eroded and destroyed by the same flourishing industry that is admired and encouraged. It is presently a money spinning enterprise, a gainful employer of labour, and tagged "WASTE TO WEALTH". This is an implosion, a type of cancer to the environment, a monster threatening the environment, a catastrophe that must come in the near future. As Cancer is treated, let us take up the jingles in the air and in the print media, organize seminars for the policy makers, put up city wide campaign, interpret and display this type of research work in pictures as is done in this research work for the common man to see and understand. Put up a strong legislation and sanctions for the conduct of the business of the scrap metal industries. Set up an institution as is done for other critical national emergencies to take up the responsibilities of ensuring that the scrap metal industries is properly monitored and midwifed to produce wealth for all and an environment free from contamination and pollution. In the meantime this research recommends the phytoremediation model which could serve as a preventive measure in cleaning up and protecting the soil from further degradation through water runoff, seepages and leaching.

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