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Remote Sensing Techniques in the Investigation of Polluted Soils at Illegal Dumpsites in Yenagoa Metropolis, Bayelsa State, Nigeria

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Abstract
Remote Sensing Techniques in the evaluation of Polluted soils at illegal dumpsites in urban Soil environment and its effect on human being in Yenagoa metropolis, Bayelsa State compels us to investigate the presences of the following heavy metals, such as Fe, Mn, Cr, Cu, Zn, Ni, Cd, and Pb. The result reveals High-level of heavy metals accumulation at illegal dumpsites. Soil sample by leachate migration from the open dumpsite and all the illegal dumpsites found within the marketplace close to Epie Creek which serves as a significant source of household water and a tributary to River Nun. Our results also show that population increase in migration of human being from villages to the city in land use/land cover map built-up area contains 16.96 km^2 with 4%, and bare land 20% in 1992 and 2020 land use/land cover built-up area contain 93.30 km^2 with 23% and bare land is 35%. Therefore, the percentage from 1992 to 2020 in built-up area especially by 19% and bare land by 15% thereby water bodies and vegetation decreases. The area lacks environmental law for dumping disposals and the government needs to carry out landfill site suitability for solid waste disposal site using Remote sensing and GIS in other to reduce soil pollution by heavy metals in the area over time.
Keywords: Remote sensing; Yenagoa; Heavy metal; Pollution; Evaluation.

1. Introduction
Yenagoa local government in recent time has been undergoing pollution due to lack of enforcement of environmental law resulting from an increase in population and lack of city planning with the wrong location of various market situated in the area leading to high risk to human health and Especially in the industrialized environment in urban soil. Heavy metal contamination is a major environmental problem that is harmful to human beings and plants [1]. These toxic heavy metals in soil strongly impact the natural ecosystem and are a threat to human health through the food chain [2]. Ekeu-wei, *et al.* [3], Landsat 8 satellite serves as indicators such Land Surface Temperature (LST), Soil Adjusted Vegetation Index (SAVI), and geospatial information use to verify the impact of dumpsites on the surroundings and the discovering displays that the average derived LST at the dumpsites were greater than the instant surrounding, and the average SAVI values were lower than the instant surrounding. The excessive values of LST at the dumpsites depict the impact of gases released because of decomposition activities, while low values of SAVI indicate vegetation response to soil and groundwater contamination due to leachate infiltration. According to Tanee and Eshalomi-Mario [4] that generally the accumulation of heavy metals in soil is influenced by different variables in nature as well as human activities. Detection and monitoring of these changes are truly necessary that allows them to identify their source and assess potential risks associated with heavy metal contamination. People used different indices for soil pollution monitoring such as pollution load index, the potential of ecological risk index, geo-accumulation index [1]. Geographic Information System (GIS) and remote sensing that allow for faster and more accurate information have been widely used in numerous studies, and they are a powerful tool for the determination of spatial distribution in soil pollution study [5]. These research objectives use Remote Techniques in the evaluation of Polluted heavy metals due to illegal dumpsites in the urban Soil environment and their effect on the human being.

2. Materials and Methods
2.1. Location and Geology of the Study Area
The area under investigation is the Yenagoa local government area of Bayelsa State and which is among developing cities in Nigeria. It is located in the Southern part of Nigeria and with a good road network that links to various parts of the State such as LGA like Kolokuma/Opokuma, Sagbama, Southern Ijaw, Ogbia, etc. This area lies within longitudes 006^0 17'30" and 006^0 21'30" East of the prime meridian and Latitudes 04^0 55'0" and 04^0 7'30" North of the equator within the coastal area of the recent Niger Delta (Figure 1). The study area lies within the Niger

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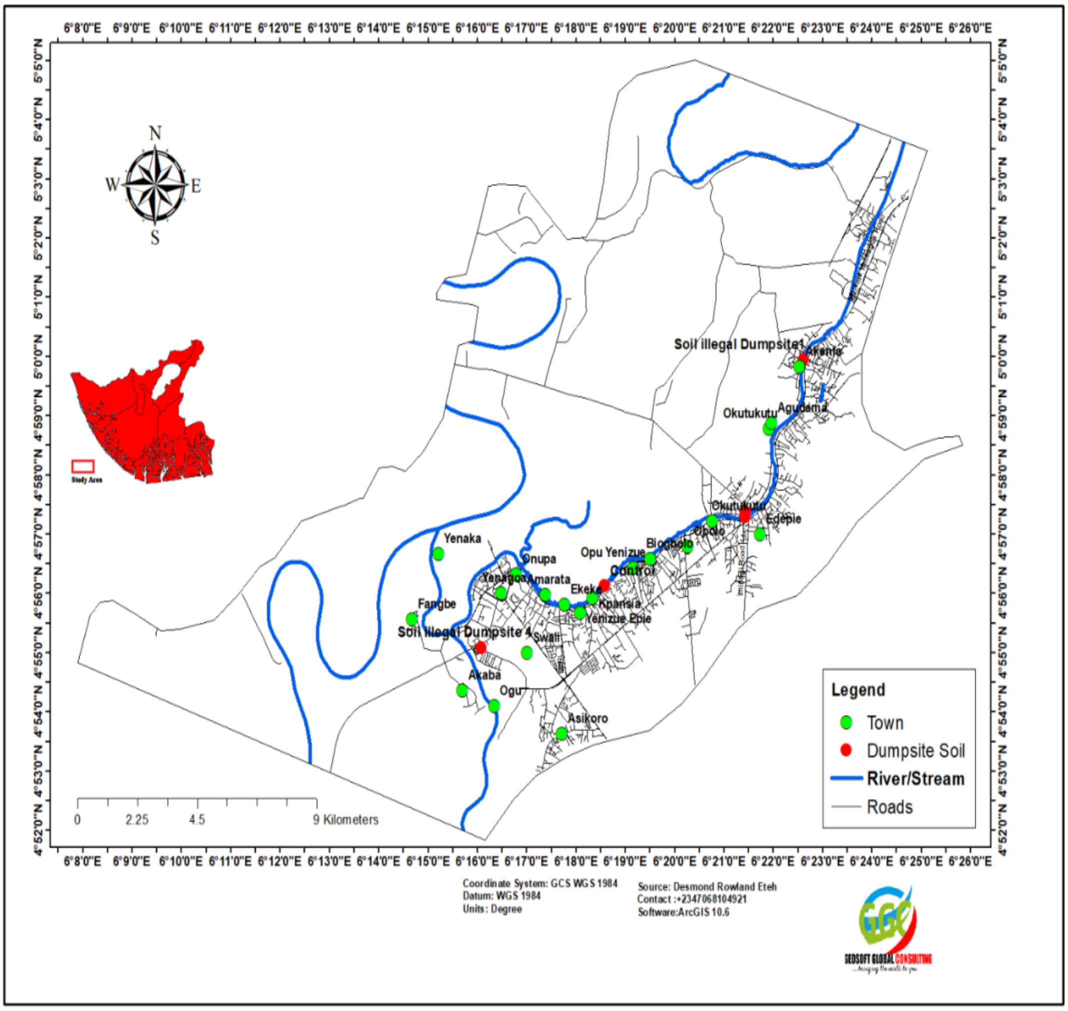
Delta Basin [6]. and the fresh water-bearing zone is the Eocene aged Benin Formation which is overlain in most areas by quaternary deposits by Reyment [7]. Sands and sandstones in the Benin Formation are coarse to fine-grained, commonly granular in texture with can be unconsolidated. The main composition of the Benin Formation is fresh water-bearing continental sands and gravels with some clay and shale intercalations characteristic of partly lagoonal and fluvial-lacustrine/deltaic depositional environment [7, 8]. The clayey intercalation within the Benin Formation gave rise to a multi-aquifer system in the Niger Delta, with the shallow unconfined aquifer occurring at depths between 20m and 40m across the area [9].

Figure-1. Map of the study area (2020)



2.2. GIS and Remote Sensing Data Collection

The following data such as Landsat 8 is downloaded from [10] https://landsate usgs.gov, prior and the spatial locations of some communities and samples were collected in Yenagoa by the use of Garmin72 GPS. An administrative map from where political boundaries and roads were digitized.

Table-1. List of Data collected for the study area

Satellite Data	Date	Spatial Resolution	Source
Landsat 8	6/1/2020 Path: 189, Row: 56	30 m	https://landsate usgs.gov
Landsat 5	09/01/1992 Path: 189, Row: 57	30 m	https://landsate usgs.gov

2.3. Soil Sampling Data Collection

A total number of 5 soil samples were collected with the aid of a hand auger, and they are randomly taken over the entire study area in Figure 1. Soil samples were collected from the outer surface to 0 m – 1 m depth with a total of 2-3 kg of soil per sample following the Guidance on sampling techniques. They are stored in a polyethylene bag for transport and then analyzed in the laboratory.

2.4. Data Analysis

The following heavy metals ions Fe, Mn, Cr, Cu, Zn, Ni, Cd, and Pb, were analyzed using the atomic absorption spectrometer. Samples were acid digested in the fume hood and filtered. The samples were then filtered and diluted to 100 ml in a 100 ml flask. They were then brought for AAS spectrometer analysis.

2.5. Data Processing

Arc GIS 10.6 spatial analyst extension was used to process the data collected using handheld Global Positioning System (GPS) in degree, minute, second and imported into Microsoft Excel where the data was converted to degree decimal and transferred to Geographical Information System environment in DataBase Format before point map was generated alongside, Open data gotten from [10] https://landsate usgs.gov explorer for Landsat 8 2020 (Table 1) used to generate the land cover/land use map with the aid of remote sensing software known as ERDAS IMAGINE 9.2 and ArcGIS 10.6 [11] using image analysis tools, layer stake, band combination which is also called the near-infrared (NIR) composite of near-infrared (5), red (4) and green (3), subset and defining of the training sites, extraction of signatures from the image and then classify using supervised classification before exporting the data and import it to Microsoft excel software for statistical analysis.

3. Results and Discussion

The results of Heavy metals concentration in soil in the study area are presented below (Table 1) the following heavy meals can is identified from soil samples in the study area which included Cd, Cu, Co, Zn, Fe, Mn, Pb, Ni, Zn, and Fe.

Table-2. Descriptive Statistics for heavy metals in soil

Sample Code	Long	Lat	Fe	Mn	Cu	Cd	Cr	Ni	Zn	Pb
Soil illegal Dumpsite1	6.37696	4.999078	1686.35	2.12	11.01	10.31	44.18	2.90	5.12	22.87
Soil illegal Dumpsite 2	6.357223	4.95617	932.54	38.80	14.17	9.02	15.81	6.51	11.25	4.79
Soil illegal Dumpsite 3	6.357058	4.954938	109.56	22.98	5.18	1.33	5.42	1.29	20.52	10.73
Soil illegal Dumpsite 4	6.267906	4.918096	983.29	39.33	14.25	6.77	17.19	6.22	20.87	11.10
Minimum			109.56	2.12	5.18	1.33	5.42	1.29	5.12	4.79
Maximum			1686.35	39.33	14.25	10.31	44.18	6.51	20.87	22.87
Mean			917.94	24.11	10.67	6.51	22.03	4.12	13.96	12.86
Control	6.309784	4.935432	2.53	0.34	0.05	0.03	0.14	0.02	2.55	0.01

Concentration is expressed in milligrams per kilograms (mg/kg)

3.1. Land Cover/Land use Map in Yenagoa 1992 and 2020

The Landsat 8 imagery classified using Supervised classification with the aid of Erdas Imagine 9.2 and ArcGIS 10.6 software Results from Table 3 is classified and its shows the total area in 1992 land use/landcover is 410.61 km^2 and water body is 44.50 km^2 showing blue colour in Figure 2, vegetation is 266.87 km^2 with the percentage of 65 % in Figure 3 with a Green colour reflected and is highest among all in Figure 2 and 3, the built-up area is 16.96 km^2 which is yellow colour with 4% in Figure 3 and finally, bare land is made up of 82.28 km^2 with 20 % in Figure 3 reflecting red colour in Figure 2. While for land use/land cover map for 2020, the waterbodies is 16.07 km2 in Table 3 showing blue colour in Figure 2, vegetation is 156.8 km^2 with the percentage of 38 % in Figure 4 with a Green colour reflected and is highest among all in Figure 2 and 4, the built-up area is 93.3 km^2 which is yellow colour with 23% in Figure 2 and 4 and finally, bare land is made up of 144.44 km^2 with 35 % in Figure 4 reflecting red colour in Figure 2. There is great in percentage from 1992 to 2020 in the built-up area especially by 19% and bare land by 15% thereby water bodies and vegetation decreases.

Figure-2. Landuse/landcover map (2020)

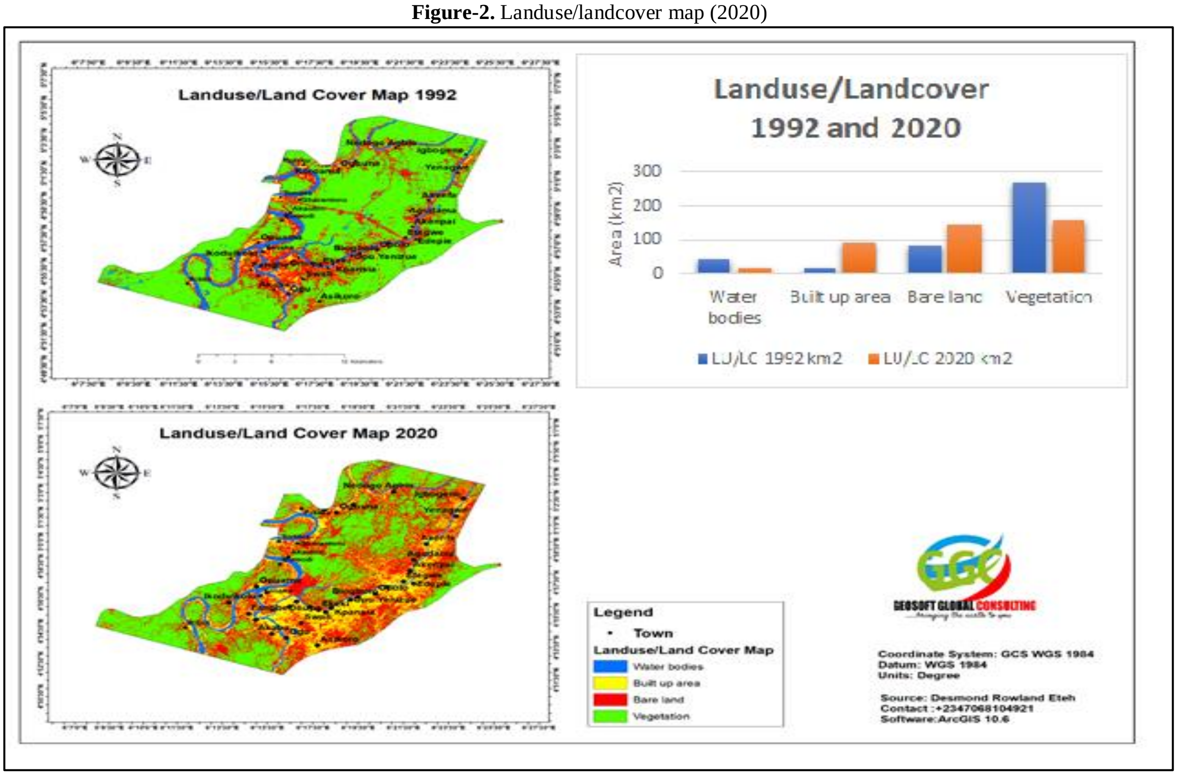


Table-3. Statistics of Landuse/Landcover in Yenagoa for 1992 and 2020

Classification	LU/LC 1992 km2	LU/LC 2020 km2
Water bodies	44.5	16.07
Built-up area	16.96	93.3
Bare land	82.28	144.44
Vegetation	266.87	156.8
Total area	410.61	410.61

Figure-3. Land use/landcover for pie chart (1992)

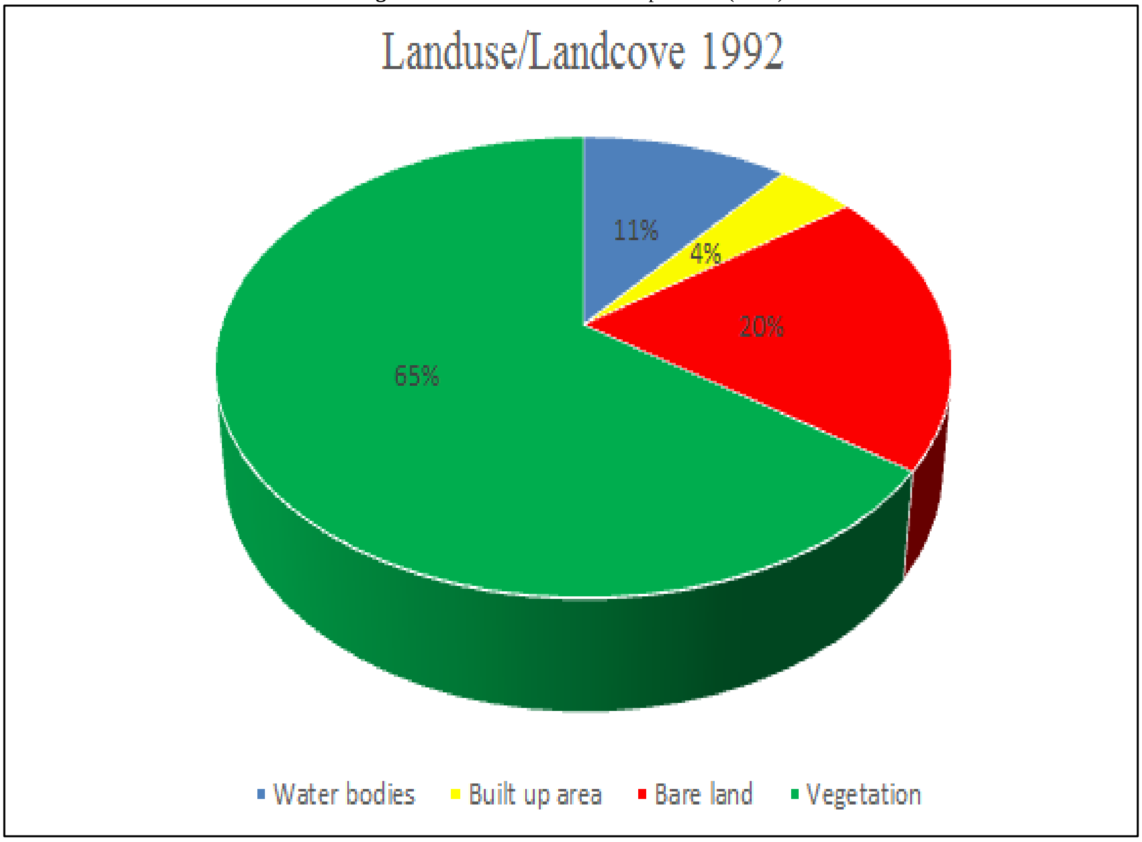
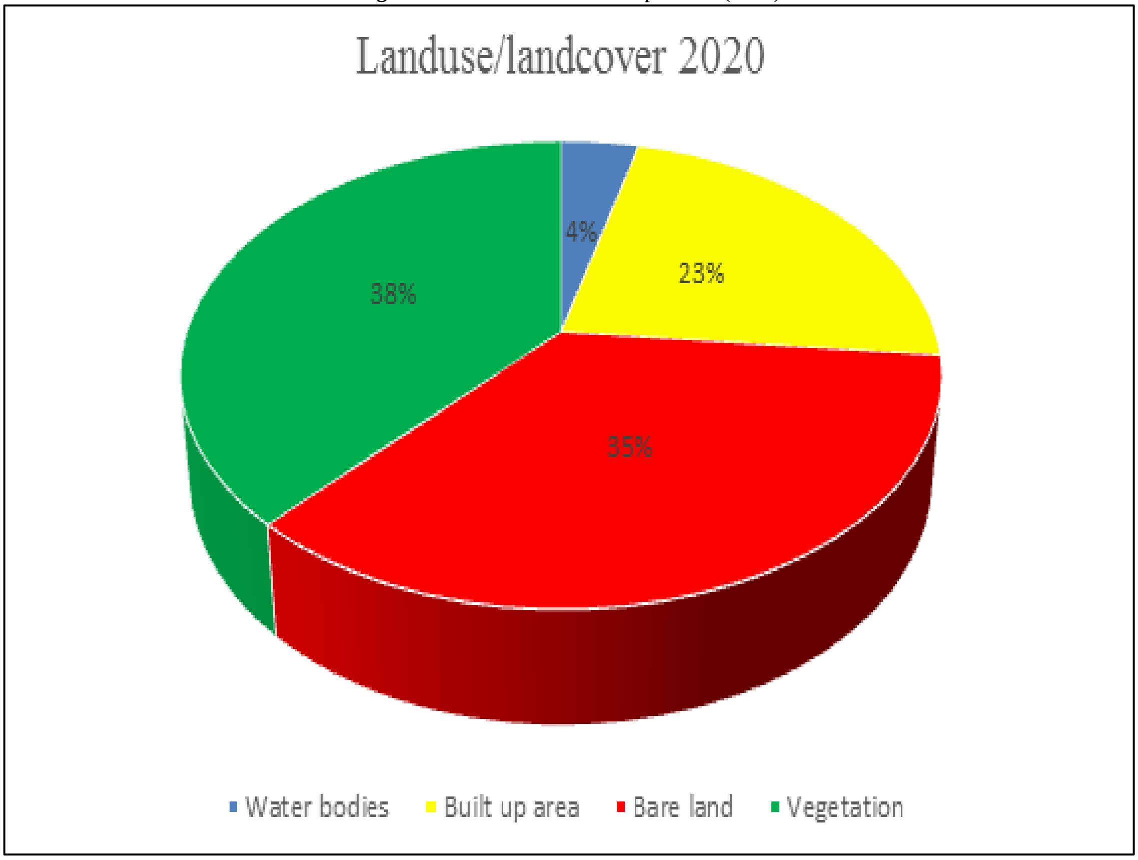


Figure-4. Landuse/landcover for pie chart (2020)



3.2. Heavy Metals Content in the Soil

Figure-5. Concentration of heavy metals Soil in Mn, Cu, Cd, Cr, Ni, Zn, and Pb (2020)

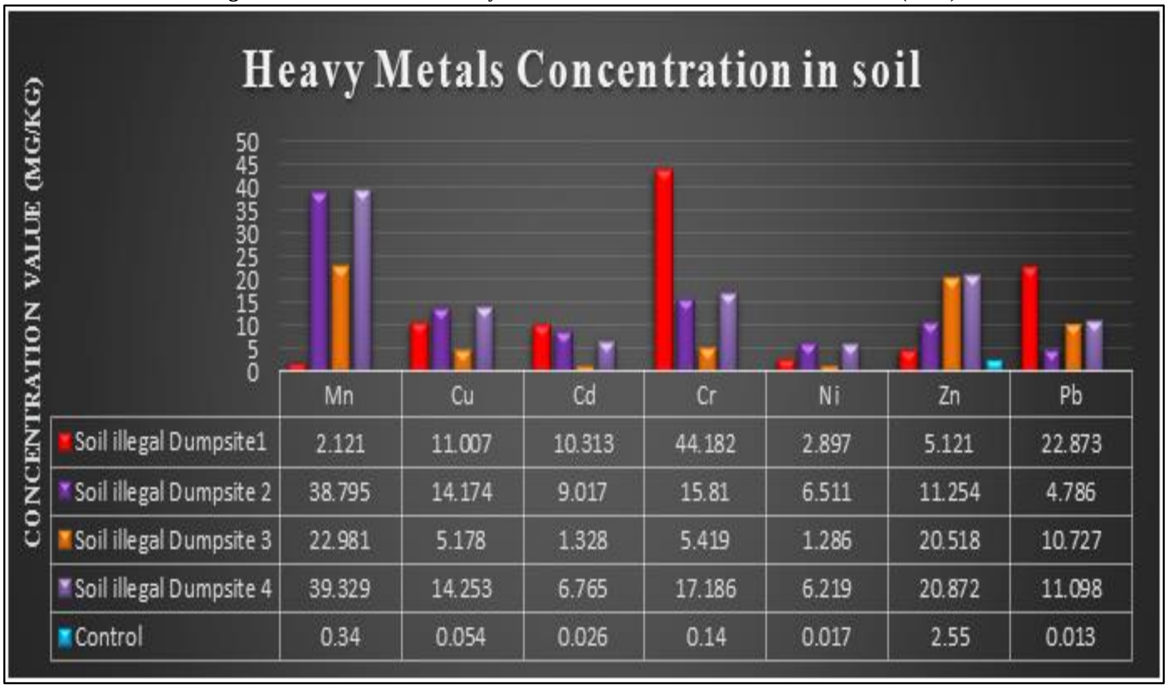
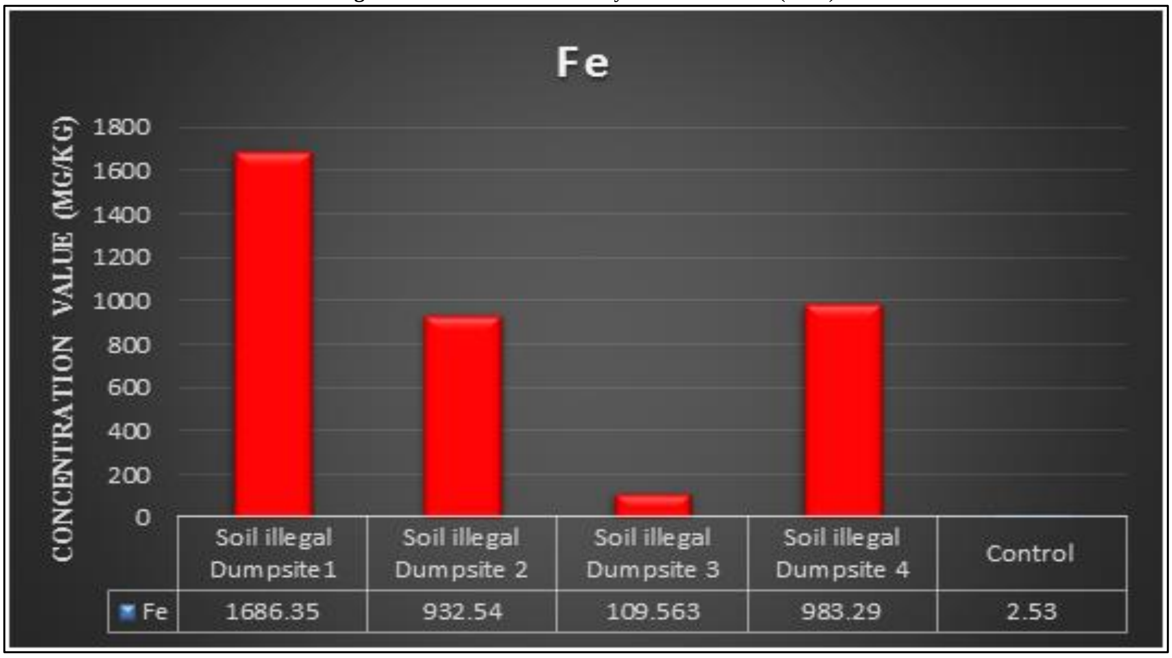


Figure-6. Concentration of heavy metals Soil in Fe (2020)



The result obtained from the analysis for the illegal dumpsite in soil contains iron concentration ranging from 109.56 to 1686.35 mg/kg and is far above the control soil in Figure 6 and Table 2 indicates the soil is polluted. The obtain results in Table 2 shows that the minimum value of Cadmium is 1.33 mg/kg and a maximum of 10.31 mg/kg with a mean value of 6.86 mg/kg of concentration is above the Control value of 0.03 mg/kg, (Figure 6). The concentration of Copper in soil samples demonstrated that the maximum value of Cu is 5.18 mg/kg with a mean value of 11.15 mg/kg which is above the background value of 0.05 mg/kg in Figure 6. The Manganese is found to a range of 2.12 to 39.33 mg/kg and the Mn concentration in the study area is higher than the background value of 0.34 in Figure 5 and Table 2. The concentration of Zinc on soil samples was found to be in the range from 5.12 to 20.87 mg/kg with a mean of 13.96 mg/kg (Table 2) and when compared with the background value of 2.55 mg/kg is above the limit in Figure 5. The Chromium (Cr) concentrations for the analyzed soil sample range from 5.42 – 22.03 mg/kg (Table 2). When compared with the background value in Figure 5. It is observed that the illegal dumpsite soil is above the background value which implies the soil is polluted and as rainfall soil waste and liquid will enter Epie Creek and mix with the water thereby pollute the water also. The Nickel (Ni) concentrations for the analyzed soil sample vary from 1.29 – 6.51 mg/kg (Table 2) and are above the background value of 0.02 mg/kg in Figure 5. Lead (Pb) concentration in illegal dumpsite soil varies from 4.70 to 12.86 mg/kg and is above the control soil. therefore there all area in the illegal dumpsites is polluted by accumulated heavy metals in soil and also the Epie Creek is polluted alongside part of River nun resulting from the wrong location of the various market in the study area and when rainfall it flows into the Epie creek.

4. Conclusion

Therefore, the high-level heavy metals present in the soil are a result of illegal dumpsite which is appreciably contaminated by leachate migration from the open dumpsite. Also, the high level of heavy metals is found to be in the dumpsite which is are close to Epie Creek and all the illegal dumpsite is located in the market environment which serves as a significant source of household water which is a tributary to River Nur causing the water to pollute. Result also shows that population increase in migration of human being from villages to the city in land use/land cover map built-up area contains 16.96 km^2 with 4%, and bare land 20% in 1992 and 2020 land use/land cover built-up area contain 93.30 km2 with 23% and bare land is 35%. The percentage from 1992 to 2020 in the built-up area especially by 19% and bare land by 15% thereby water bodies and vegetation decreases.

References

[1] Zahra, A., Hashmi, M. Z., Malik, R. N., and Ahmed, Z., 2013. "Enrichment and geo-accumulation of heavy metals and risk assessment of sediments of the Kurang Nallah - Feeding tributary of the Rawal Lake reservoir, Pakistan." *The Science of the Total Environment*, vol. 14, pp. 470-471.

[2] Hiller, E., Lachká, L., L., J. C., Durža, O., C., F., Iková, K., and Vozár, J., 2016. "Occurrence and distribution of selected potentially toxic elements in soil of playing sites: A case study from Bratislava, the capital of Slovakia." *Environmental Earth Sciences*, vol. 75, p. 1390.

[3] Ekeu-wei, I. T., Azuma, K. I., and Ferdinand, B. B., 2018. "Assessment of environmental impact of solid waste dumpsites using remote sensing, Ogunmuyiwa." *Nigerian Journal of Technology (NIJOTECH)*, vol. 37, pp. 275-285. Available: http://dx.doi.org/10.4314/njt.v37i1.36

[4] Tanee, F. B. G. and Eshalomi-Mario, T. N., 2015. "Heavy metal contents in plants and soils in abandoned solid waste dumpsites in port harcourt, Nigeria." *Research Journal of Environmental To Xicology*, vol. 9, pp. 342-349.

[5] Awokunmi, E. E., Asaolu, S. S., and Ipinmoroti, K. O., 2010. "Effect of leaching on heavy metals concentration of soil in some dumpsites." *African Journal of Environmental Science and Technology*, vol. 4, pp. 495-499.

[6] Reijers, T. J. A., 2011. "Stratigraphy and sedimentology of the Niger Delta." *Geologic, The Netherlands*, vol. 17, pp. 133-162.

[7] Reyment, R. A., 2018. "Ammonitologist sensu latissimo and founder of cretaceous research Bengtson." *P Cretaceous Research-1926-2016*, vol. 88, pp. 5-35.

[8] Akpokodje, E. U. and Etu-Efeotor, J. O., 1987. "The occurrence and Economic potential of clean sand deposits of the Niger Delta." *Journal of African Earth Science*, vol. 6, pp. 61-65.

[9] Etu-Efeotor, J. O., 1997. *Fundamentals of petroleum geology*. Port Harcourt, Nigeria: Paragraphic Publications. p. 135.

[10] Available: https://landsateusgs.gov

[11] Eteh, D., Francis, E. E., and Francis, O., 2019. "Determination of flood hazard zones using geographical information systems and remote sensing techniques: A case study in part of Yenagoa Metropolis." *Journal of Geography, Environment and Earth Science International*, vol. 21, pp. 1-9.