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Spatial Assessment of Air Quality and Meteorological Parameters of the Surrounding Area of Active Dumpsite in Port Harcourt Metropolis, Rivers State, Nigeria

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Abstract: - The study assessed the air quality and meteorological parameters of the surrounding area of active dumpsites in Port Harcourt Metropolis, Rivers State, Nigeria. The air quality and meteorological parameters were sampled based on the distance of 0m, 100m, 200m, 300m, 400, and 500m from the dumpsite using standard instrument. The WHO standard was compared with the values of the air quality parameters obtained in the study area. Similarly, meteorological parameters such as temperature, relative humidity, wind speed and direction were recorded using weather tracker at the same distance. Readings were taken in the morning (7-9am), afternoon (12-2pm) and evening (4-6pm) once in a week for a year. Dust Track DRX aerosol monitor was used to measure PM2.5, PM10 and TSP while aeroqual multigas monitor 500 Series was used to measure NO_2, SO_2, CO, H_2S, VOC, O_3, and NH_3. Descriptive statistics were used for the data analysis. Results showed that In Mile 3 Market dumpsite, it was observed that the wind speed was 0.98 m/s while temperature was 32.65 °C and relative humidity was 85.67%. However, findings revealed that the concentration of SO_2 was higher in the dumpsite around Mile 3 Market and Rumuomasi than other dumpsites whereas the relative humidity was highest around Eneka/Igwuruta dumpsite. The study concluded that the air quality and meteorological parameters varied from place to place. Also, distance from the dumpsite was highly influential in determining the level of air quality in the study area.. It is thus recommended among others that environmental education about air quality pollution is required so that residents can understand the effects of landfill sites in the neighbourhood empirically.

Keywords: Air quality, Meteorological parameter, Active dumpsite, Port Harcourt

I. Introduction

Air pollution is becoming a major factor in the quality of life of urban and rural dwellers, posing a risk both to human health and to the environment (Ideriah and Stanley, 2008 & Gobo et al 2012). Over the last three decades there has been increasing global concern over the public health impact attributed to environmental pollution, in particular the global burden of disease. The World Health Organization (WHO) estimates that about a quarter of the disease facing mankind today occur due to prolonged exposure of environmental pollution. Most of these environmentally-related diseases are not easily detected and may be acquired during childhood and manifested later in adulthood (www.undp.org/urbanenvironment).Improper management of solid waste is one of the main causes of environmental pollution and degradation in many cities, especially in developing countries. Many of these cities lack solid waste regulation and proper disposal facilities for harmful waste and thus people's lives are subjected to risk because of the release of the harmful pollutants. Ogbonna et al (2009) agreed that a wide range of inorganic and organic compounds cause contamination especially when they are exposed to rain, its decomposition produces noxious odour, thereby, constituting a health hazard and in addition, Adriano (2001), Kinuthia et al (2020) and Ahmad et al (2021) submitted that major components of these compounds include heavy metals, combustible and putriscible substances, hazardous wastes, explosives and petroleum products. Such waste may be infectious, toxic or radioactive.

Municipal waste dumping sites are designated places set aside for waste disposal depending on a city level of waste management. Such waste may be dumped in an uncontrolled manner segregated from cycling purposes, or simply burnt. Poor waste management posed a great challenge to the well-being of city residents particularly those living adjacent the dump site due to the potential of the waste to pollute water, food source, land, air, and vegetation. The poor disposal and handling of waste thus leads to environmental degradation, destruction of the ecosystem and poses great risk to public health. The state of poor solid waste management in Port-Harcourt, Rivers State capital is poor and has reached an alarming proportion as Port-Harcourt city environmental officials/waste contractors appear unable to combat unlawful and haphazard dumping of solid wastes on the streets and drainages, which are a clear violation of the Rivers state clean Air and Health Edict of 1990 (Agwu, 2012). Wastes are frequently dumped along the streets, in the gutters and informal waste dumps. These dumpsites may contain a mixture of general waste and toxic, infections or radioactive waste and are susceptible to burning and exposure to scavengers.

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II. Materials and Methods

The study was carried out in Port Harcourt Metropolis. Port Harcourt, the Rivers State capital is located in the Southern Nigeria and lies along the Bonny River; an eastern distributaries of the River Niger, 66km upstream from the Gulf of Guinea. Port Harcourt is located geographically between latitudes 4° 7' 5'' N and 4° 8' 15'' N and longitudes between 7° 05' 0'' E and 7° 45' 0'' E (Figure 1). According to Igoni et al. (2007), Port Harcourt, the Rivers State capital is located in the Niger delta region in the southern region of Nigeria. Its population is estimated at about 5,198,716, while the Port Harcourt metropolis is estimated to have 1,356,000 people. Its name was crafted by Lewis Harcourt the then secretary of the English territories. The city has two seasons; the wet season and dry season as also found in other parts of the country. The rainy or wet season is associated with heavy down pour of rain and periodic surge in sea sides and city centers. The wet season starts around the month of April and stops around November whereas the dry season starts toward the end of November and ends around March. Port Harcourt is said to experience larger period of rainfall annually as likened to other states in the nation. The temperature of the region ranges from 24 degrees to 30 degrees centigrade and is majorly warm for most parts of the year. The city of Port Harcourt is hub to many conglomerates and local companies providing an array of services to the public and the country at large. Port Harcourt has the many popular markets in the nation and attracts people from the neighboring towns and all works of live to patronize them. It is located by off Aba road in Rumuokurushi community.

Binafeigha and Enwin, (2017) opined that Port Harcourt was originally designed to be home to its locals has however experienced a high inflow of individuals after the sighting of hydrocarbon in the city. This incessant growth has lingered and has affected villages like Rumuola, Rumuokwuta, Rumuokwurushi, Rumueme, Woji, etc. There are sections under advancement now called the greater Port Harcourt city. From historical perspective, Ikwerres and Okrikas occupied the land of Port Harcourt city before 1913. However, the Ikwerre occupies the main land area of Obio/Akpor LGA, with three different kingdoms, namely, the Akpor, Obio and Evo Kingdoms. They majorly engage in fishing and subsistence farming. The current day urban center has witnessed developments in socio-economic activities, which thus, promotes transportation (land, air, water), exploration and oil production, crafts and tourism. Port Harcourt is now well known for commerce, industry, farming etc.

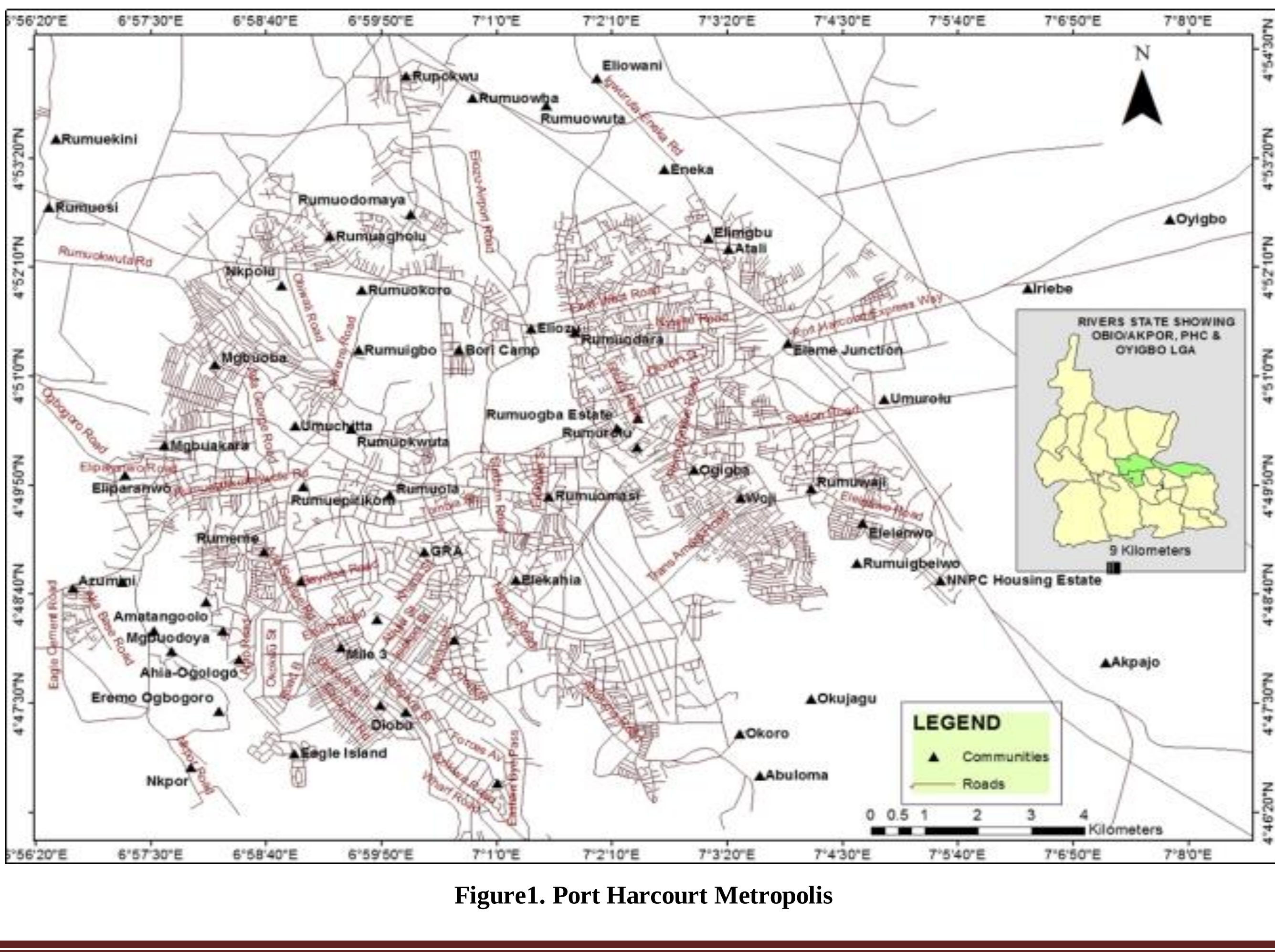

Figure1. Port Harcourt Metropolis

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The air quality and meteorological parameters were sampled based on the distance from the dumpsite. The distance included 0m, 100m, 200m, 300m, 400, and 500m. Air quality parameters investigated were Nitrogen dioxide (NO_2), Sulphur dioxide (SO_2), Methane (CH_4), Hydrogen sulphide (H_2S), Ammonia (NH_3) and Volatile Organic Compounds (VOCs), Carbon monoxide (CO), Particulate matter (PM2.5, PM10), Total suspended particles (TSP) and Ozone (O_3). Air quality samples were taken in the same sample points where other data were collected. The air quality parameters were gotten in the morning (7-9am), afternoon (12-2pm) and evening (4-6pm) once in a week for a year. Dust Track DRX aerosol monitor was used to measure PM2.5, PM10 and TSP while aeroqual multigas monitor 500 Series was used to measure NO2, SO2, CO, H2S, VOC, O_3, and NH_3 (Weli & Obisesan, 2014; Weli & Itam, 2016). Air quality data were collected at the distance of 0m; 100m, 200m, 300m, 400m, and 500m. The WHO standard was compared with the values of the air quality parameters obtained in the study area. Similarly, meteorological parameters such as temperature, relative humidity, wind speed and direction were recorded using weather tracker. The readings were taken at the same locations (0m; 100m, 200m, 300m, 400m, and 500m) where the air qualities were taken.

III. Results and Discussions

Meteorological Parameters Around the Dumpsites

The descriptive analyses of meteorological parameters around each of the selected dumpsites in Port Harcourt Metropolis are displayed in Tables 1. In the dumpsite located at Eleme, the mean wind speed was 0.84 m/s, temperature was 32.64 °C while relative humidity was 81.16%. The mean wind speed in Rumuokwuta Dumpsite was 1.53 m/s, temperature was 29.63 °C and relative humidity was 92.16%. In Eneka/Igwuruta dumpsite, the windspeed was 1.79 m/s, temperature was 26.02 °C while the relative humidity was 96.37%. The wind speed in Rumumasi Dumpsite was 2.32 m/s while temperature and relative humidity recorded 29.25 °C and 93.69% respectively. In Mile 3 Market dumpsite, it was observed that the wind speed was 0.98 m/s while temperature was 32.65 °C and relative humidity was 85.67%. The implication of the results is that the wind speed of the study locations was relatively calm except that of Rumumasi which showed the highest (Figure 2). It thus implied that with the calm weather condition being observed generally in the study locations, the air quality may be in danger for the residents of the study location and environs because the pollutants will be relatively transported to another location. The higher temperature in Mile 3 Market dumpsite could be attributed to the numerous commercial activities going on in that location which can as well contribute to the diffusing of pollutants in the area. The relative humidity was relatively varied among the study locations, though all recorded high relative humidity which is expected in the Coastal area of Southern Nigeria due to the influence of the Atlantic Ocean. The higher relative humidity in Eneka/Igwuruta dumpsite may be attributed to the fact that the presence of more vegetation cover than other areas because the peri urban nature of the location.

Table 1: Descriptive Statistics of the Meteorological Parameters across the Sampled Dumpsites

	Locations	N	Minimum	Maximum	Mean	Std. Deviation
Wind speed	Eleme	6	.11	2.10	.8417	.70372
Temperature		6	30.97	33.37	32.6400	.85564
Relative Humidity		6	78.28	93.70	81.1600	6.14805
Wind speed	Rumuokwuta	6	.71	3.60	1.5300	1.04615
Temperature		6	28.91	29.63	29.3400	.27408
Relative Humidity		6	89.58	97.00	92.1600	3.45684
Wind speed	Eneka/Igwuruta	6	1.07	2.16	1.7917	.46093
Temperature		6	23.20	28.63	26.0167	2.05242
Relative Humidity		6	91.60	98.95	96.3717	2.61463
Wind speed	Rumumasi	6	1.32	3.06	2.3233	.82771
Temperature		6	28.47	29.80	29.2450	.45623
Relative Humidity		6	92.95	96.09	93.6883	1.25527
Wind speed	Mile3 Market	6	.71	1.30	.9783	.20213

Temperature		6	30.60	35.40	32.6500	1.85230
Relative Humidity		6	80.40	95.70	85.6667	6.26184

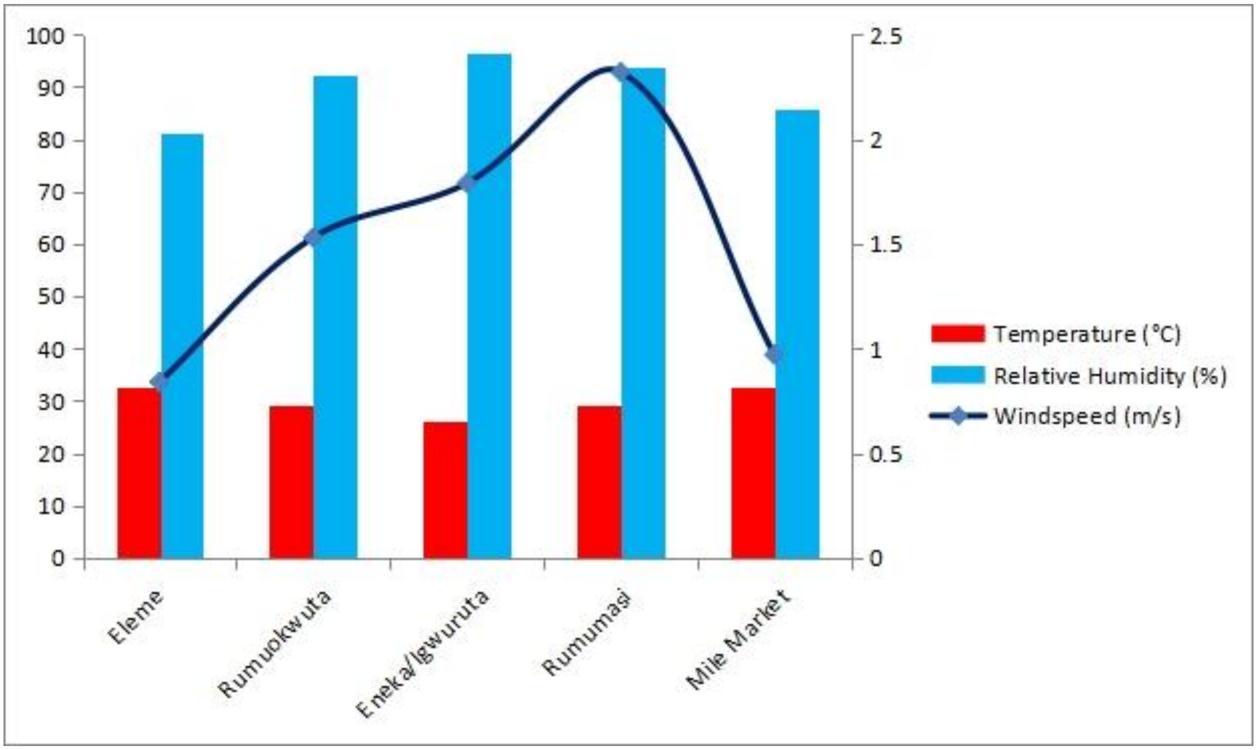

Figure 2. Wind speed, Temperature and Relative Humidity Status in the Study Locations

Distance Effect from the Dumpsite and Meteorological Parameters

Table 2 shows the wind speed in different locations or radii from the dumpsite in all the locations. The mean wind speed at the dumpsite was 2.20 m/s while the wind speed at 100m was 1.17 m/s. The least wind speed was noticed at the distance of 300m while at 500m, the wind speed was 1.73 m/s. Table 3 presents the temperature at different distance in the study locations. It is observed that at the dumpsite which is 0m, the mean temperature was 30.18 °C, at 100m it was 29.78 °C and at 200m the temperature was 30.38°C. The temperature was also 29.47 °C at 500m distance from the dumpsite. Table 4 which presents the relative humidity at different distance from the dumpsite reveals that at the dumpsite which is 0m, the relative humidity was 91.51% while at 100m, it was 93.63%. It is also observed that at the distance of 300m, the relative humidity fell to 89.14% and continued to fall at 300m and 400m which had 88.96% and 88.16% respectively. However at 500m, the relative humidity was 88.77%.

Table 2: Descriptive Statistics of Wind Speed with Distance from the Dumpsite

Distance from Dumpsite (Wind Speed m/s)	Minimum	Maximum	Mean	Std. Deviation
0m	1.07	3.70	2.2033	1.17212
100m	.87	1.36	1.1650	.19254
200m	.83	3.03	1.5817	.81789
300m	.59	2.03	1.3783	.57946
400m	.35	3.05	1.6400	1.07406
500m	.11	3.60	1.7250	1.42518

N=6

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Table 3: Descriptive Statistics of Temperature with Distance from the Dumpsite

Distance from Dumpsite (Temperature °C)	Minimum	Maximum	Mean	Std. Deviation
0m	28.63	32.83	30.1767	1.60116
100m	27.37	31.60	29.7783	1.49676
200m	26.90	34.30	30.3833	2.87019
300m	25.90	33.13	29.8333	2.33430
400m	24.10	35.40	30.2283	3.81955
500m	23.20	32.65	29.4667	3.46991

N=6

Table 4: Descriptive Statistics of Relative Humidity with Distance from the Dumpsite

Distance from Dumpsite (Relative Humidity %)	Minimum	Maximum	Mean	Std. Deviation
0m	78.70	97.00	91.5083	6.57879
100m	90.90	96.20	93.6300	2.00190
200m	79.00	96.67	89.1383	6.40525
300m	78.76	97.12	88.9567	7.10190
400m	78.52	98.26	88.1567	8.05026
500m	78.28	98.95	88.7667	7.94256

N=6

Air Quality Parameters around the Dumpsite

The descriptive analyses of air quality parameters around each of the selected dumpsites in Port Harcourt Metropolis are displayed in Tables 5, 6, 7, 8, 9, and 10. In the dumpsite located at Eleme, the mean SO_2 was 0.12 ppm, NO_2 was 0.08 ppm, H_2S was 0.15 ppm while CO was 0.63 ppm, VOC was 1.78 ppm and CH_4 was 0.67 ppm. The particulate matter PM0.1 in Eleme was very high (258833.09 ppm) while the mean PM2.5 was 704.04 ppm and PM10 was 6.37ppm. In Rumuokwuta, the mean SO_2 was 0.16 ppm, NO_2 was 0.26 ppm, H_2S was 0.23 ppm while CO was 0.79 ppm, VOC was 0.09 ppm and CH4 was 0.77 ppm. The particulate matter PM0.1 in Rumuokwuta was 155464.83 ppm while the mean PM2.5 was 231.00 ppm and PM10 was 4.58 ppm. In Eneka/Igwuruta, the mean SO_2 was 0.22 ppm, NO_2 was 0.17 ppm, H_2S was 0.33 ppm while CO was 0.72 ppm, VOC was 0.45 ppm and CH4 was 0.33 ppm. The particulate matter PM0.1 was 211312.33 ppm while the mean PM2.5 was 361.61 ppm and PM10 was 4.86 ppm. In Rumuola, the mean SO_2 was 0.17 ppm, NO_2 was 0.31 ppm, H_2S was 0.13 ppm while CO was 0.56 ppm, VOC was 0.14 ppm and CH4 was 0.65 ppm. The particulate matter PM0.1 was 136440.17 ppm while the mean PM2.5 was 470.61 ppm and PM10 was 6.95 ppm. In Rumumasi, the mean SO_2 was 0.05 ppm, NO_2 was 0.08 ppm, H_2S was 0.17 ppm while CO was 0.19 ppm, VOC was 0.10 ppm and CH4 was 0.60 ppm. The particulate matter PM0.1 was 224543.33 ppm while the mean PM2.5 was 1002.44 ppm and PM10 was 14.75 ppm. In Mile 3 market, the mean SO_2 was 0.06 ppm, NO_2 was 0.14 ppm, H_2S was 0.25 ppm while CO was 0.29 ppm, VOC was 0.13 ppm and CH4 was 0.74 ppm. The particulate matter PM0.1 was 223702.83 ppm while the mean PM2.5 was 336.83 ppm and PM10 was 4.13 ppm. NH4 was observed to be more concentrated in Eneka/Igwuruta dumpsite by having 0.771 ppm and Rumumasi dumpsite by having 0.0675 ppm. However, Eleme dumpsite had the least NH4 concentration by having 0.048 ppm. It is thus recorded in the analysis that VOC was highest in Eleme dumpsite while the least was recorded in Rumuokwuta dumpsite (Figure 3). Also significantly observed was the CH_4 which was higher in Rumuokwuta, Rumuola and Mile 3 Market while the least was noticed in Eneka/Igwuruta (Figure 3). The higher CH_4 in these locations could be linked with other human activities going especially the transportation network whereby there is presence of major junctions in the place. The H_2S concentration was higher in Mile 3 market and Eneka/Igwuruta dumpsites. This shows that the level of odour in these locations will be higher than other dumpsites. In Figure 4, the PM 2.5 and PM10 were highest in Rumumasi dumpsite and followed by Eleme dumpsite. Similarly, the PM 0.1 was observed to be higher in concentrations in Eleme, Rumumasi and Mile 3 market dumpsites (Figure 5). By

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implication the health status of the residents in these areas may be in danger because of the health challenges that PM inhalation may lead to.

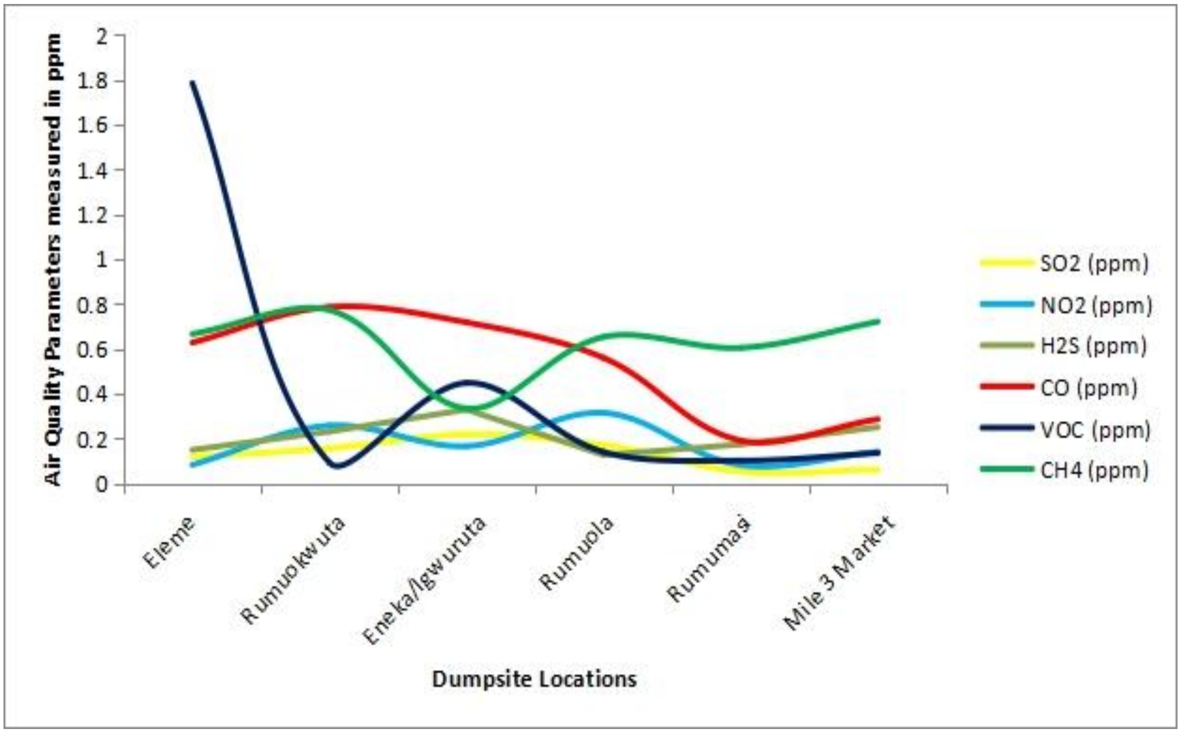

Figure 3: Status of Sulphur oxide, Nitrogen oxide, Hydrogen oxide, Carbon monoxide, Volatile organic compounds and methane in the study locations

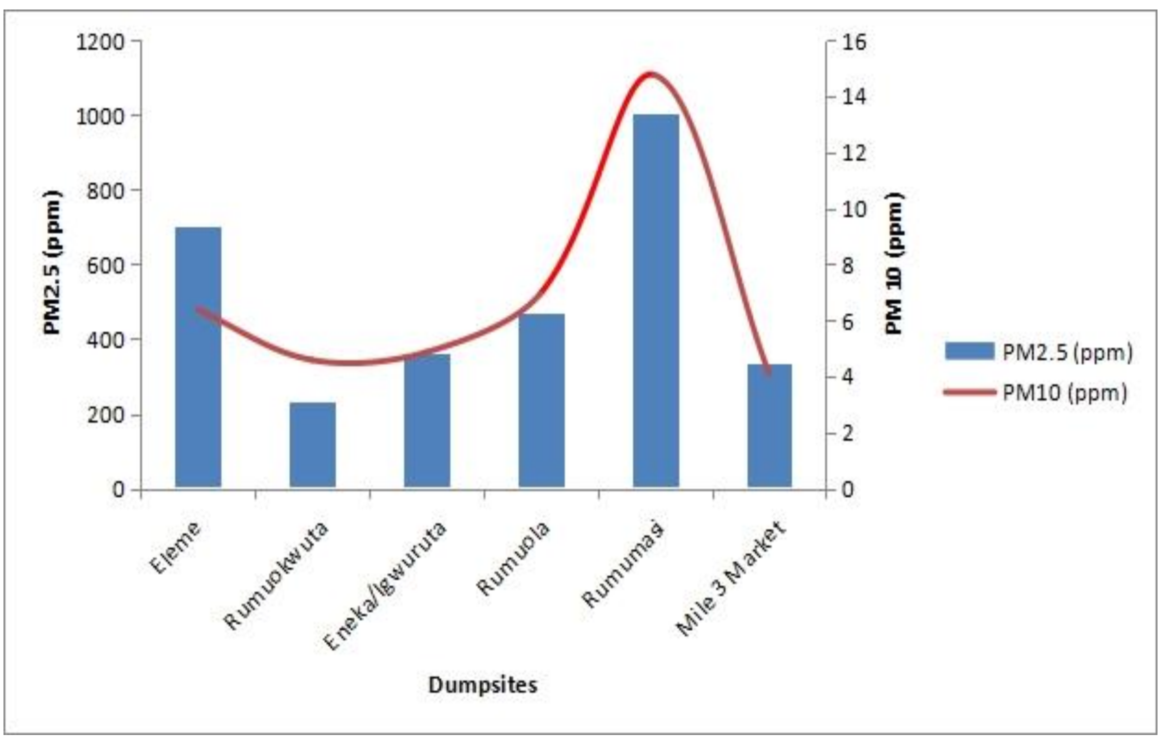

Figure 4: PM 2.5 and PM 10 in the study locations

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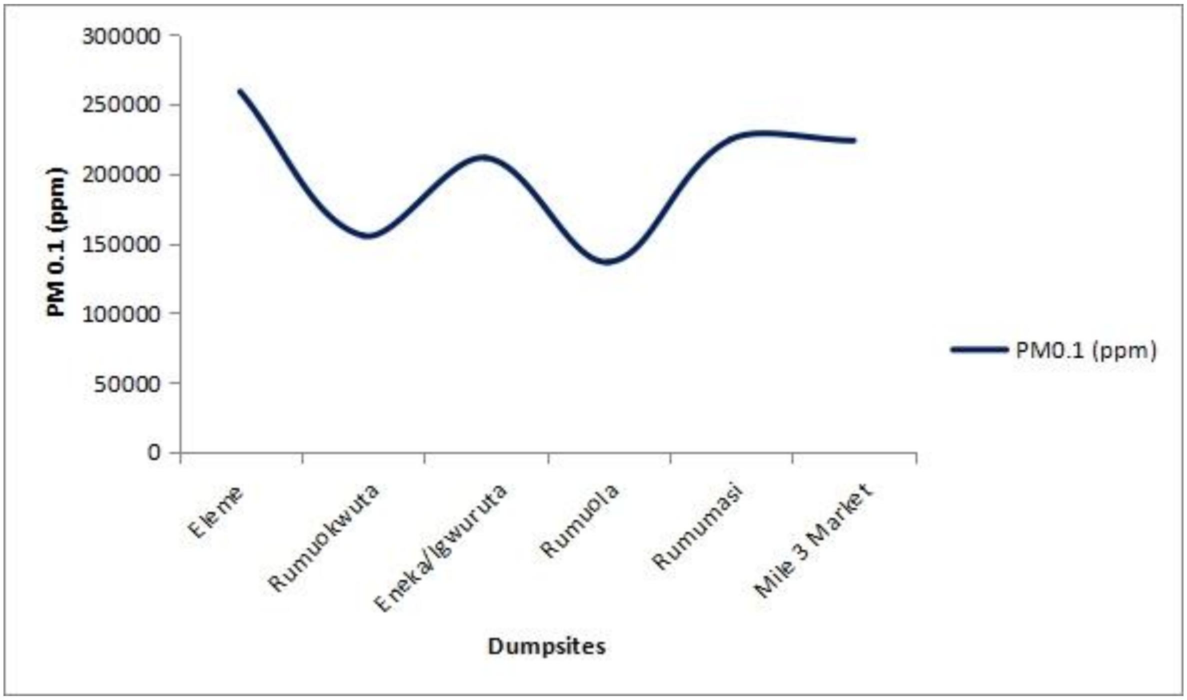

Figure 5: PM0.1 in the study locations

Table 5: Descriptive Statistics of the Air Quality Parameters across the Sampled Dumpsites in Eleme Dumpsite

Parameters	Minimum	Maximum	Mean	Std. Deviation
SO_2 (ppm)	.01	.20	.1183	.07223
NO_2(ppm)	.02	.13	.0817	.03971
H_2S(ppm)	.01	.50	.1483	.18848
CO(ppm)	.28	1.00	.6267	.24492
VOC(ppm)	.99	2.97	1.7828	.88508
CH_4(ppm)	.06	2.00	.6650	.74213
PM0.1(ppm)	245332.61	318000.00	258833.0917	29176.79933
PM2.5(ppm)	628.67	732.00	704.0383	44.62234
PM10(ppm)	4.95	11.00	6.3733	2.29592
NH_4 (ppm)	.00	.01	.0048	.00144

N=6

Table 6: Descriptive Statistics of the Air Quality Parameters across the Sampled Dumpsites in Rumuokwuta Dumpsite

Parameters	Minimum	Maximum	Mean	Std. Deviation
SO_2 (ppm)	.09	.30	.1550	.08118
NO_2(ppm)	.01	.70	.2567	.27976
H_2S(ppm)	.00	.60	.2300	.28237
CO(ppm)	.41	1.13	.7850	.24704

VOC(ppm)	.01	.33	.0915	.12206
CH_4(ppm)	.07	2.00	.7717	.68680
PM0.1(ppm)	95000.00	213000.00	155464.8333	54516.80074
PM2.5(ppm)	108.00	356.00	231.0000	102.29174
PM10(ppm)	.33	7.02	4.5817	2.86014
NH_4 (ppm)	.00	.01	.0093	.00440

N=6

Table 7: Descriptive Statistics of the Air Quality Parameters across the Sampled Dumpsites in Eneka/Igwuruta Dumpsite

Parameters	Minimum	Maximum	Mean	Std. Deviation
SO_2 (ppm)	.10	.50	.2167	.16021
NO_2(ppm)	.10	.23	.1650	.05394
H_2S(ppm)	.13	.60	.3282	.18735
CO(ppm)	.40	1.00	.7167	.23166
VOC(ppm)	.02	1.97	.4468	.77164
CH_4(ppm)	.06	.91	.3333	.29622
PM0.1(ppm)	121666.00	289547.00	211312.3333	54251.69942
PM2.5(ppm)	158.00	520.67	361.6117	136.80516
PM10(ppm)	1.33	7.58	4.8583	2.13442
NH_4 (ppm)	.00	.40	.0771	.15740

N=6

Table 8: Descriptive Statistics of the Air Quality Parameters across the Sampled Dumpsites in Rumuola

Parameters	Minimum	Maximum	Mean	Std. Deviation
SO_2 (ppm)	.02	.37	.1700	.15735
NO_2(ppm)	.15	.59	.3133	.17212
H_2S(ppm)	.02	.33	.1253	.13076
CO(ppm)	.14	.96	.5583	.32835
VOC(ppm)	.01	.41	.1390	.15918
CH_4(ppm)	.32	1.00	.6517	.27946
PM0.1(ppm)	100058.00	298000.00	136440.1667	79354.01423
PM2.5(ppm)	201.00	1690.00	470.6117	597.57193
PM10(ppm)	.67	12.33	6.9500	4.36834
NH_4 (ppm)	.01	.03	.0133	.00826

N=6

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Table 9: Descriptive Statistics of the Air Quality Parameters across the Sampled Dumpsites in Rumumasi

Parameters	Minimum	Maximum	Mean	Std. Deviation
SO_2 (ppm)	.01	.10	.0517	.03656
NO_2(ppm)	.01	.20	.0800	.08295
H_2S(ppm)	.00	.56	.1728	.25072
CO(ppm)	.00	.29	.1900	.10564
VOC(ppm)	.04	.17	.1005	.04809
CH_4(ppm)	.32	1.00	.6033	.25461
PM0.1(ppm)	110000.00	361250.00	224543.3333	90318.73707
PM2.5(ppm)	213.33	2014.00	1002.4433	816.22300
PM10 (ppm)	1.00	25.61	14.7533	10.70167
NH_4 (ppm)	.01	.15	.0675	.06711

N=6

Table 10: Descriptive Statistics of the Air Quality Parameters across the Sampled Dumpsites in Mile 3 Market

Parameters	Minimum	Maximum	Mean	Std. Deviation
SO_2 (ppm)	.03	.10	.0600	.02608
NO_2(ppm)	.07	.20	.1400	.05215
H_2S(ppm)	.01	.90	.2498	.35296
CO(ppm)	.09	1.00	.2850	.35275
VOC(ppm)	.02	.25	.1343	.09328
CH_4(ppm)	.47	1.00	.7200	.19545
PM0.1(ppm)	196333.33	286666.67	223702.8333	34383.20048
PM2.5(ppm)	206.00	660.00	336.8333	179.67350
PM10(ppm)	2.56	8.33	4.1250	2.18765
NH_4 (ppm)	.00	.06	.0267	.02860

N=6

General Air Quality Status at a given Distance from the Dumpsite

The general air quality conditions at a given distance from the dumpsite are shown in Table 11. The SO_2 concentration revealed that at the dumpsite of 0m the concentration was 0.18 ppm, at 100m it was 0.20 ppm and at 200m from the dumpsite it was 0.09 ppm. It also recorded 0.10 ppm at the distance of 300m from the dumpsite while 0.11 ppm was recorded at each of 400m and 500m from the dumpsite. The NO_2 concentration was discovered that at 0m from the dumpsite, it recorded a mean value of 0.18 ppm and rose to 0.24 ppm at 100m from the dumpsite. At 200m, NO_2 concentration decreased to 0.19 ppm and reduced as with increasing distance from the dumpsite until at 500m when it began to rise to 0.16 ppm. The H_2S concentration was highest at 0m by having 0.58 ppm and continued to decrease till 500m which recorded the least mean value of 0.03 ppm. By implication, the level of odour at the dumpsite will be higher and continue to decrease with increasing distance from the dumpsite.

The CO concentration revealed that the concentration was highest at 200m from the dumpsite (0.80ppm) and it also recorded 0.63 ppm at the 0m from the dumpsite and 0.27 ppm at 500m from the dumpsite. The concentration of VOC showed that the mean VOC at 0m from the dumpsite was 0.98 ppm and continue to decrease with increasing distance as 0.18 ppm was recorded at the 500m distance from the dumpsite. The mean concentration of CH_4 showed that at the 0m of the dumpsite, it recorded 0.83 ppm while the highest concentration was recorded at 100m distance from the dumpsite (1.16 ppm). From the distance of 200m to 500m, CH_4

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concentration decreased from 0.64 ppm to 0.25 ppm. The mean value of PM 2.5 reveals that at 0m distance from the dumpsite, the concentration was 396.55 ppm while at 100m it was 625.45 ppm. At 500m, the mean value of PM2.5 was 327.88 ppm. It is shown that PM 0.1 was highest at the distance of 200m from the dumpsite by having 229430.61 ppm while the least was observed at 167944.54 ppm at the 0m distance from the dumpsite. At 500m distance from the dumpsite, the concentration PM 0.1 was 191739.60 ppm. The analysis on the concentration of PM10 reveals that at 0m distance from the dumpsite, the concentration was 3.11 ppm while it continued to increase in concentration till 500m distance from the dumpsite which has 8.64 ppm. The concentrations of NH_4 recorded 0.0140 ppm at 0m distance from the dumpsite and continued to increase with increasing distance from the dumpsite by having a mean value of 0.0986 ppm at 500m from the dumpsite.

Table 11: Descriptive Statistics of Air Quality Parameters with Distance from the Dumpsite

SO_2	Minimum	Maximum	Mean	Std. Deviation
0	.10	.37	.1783	.10591
100	.08	.37	.1900	.12231
200	.05	.13	.0900	.02966
300	.04	.20	.0983	.05707
400	.02	.30	.1050	.10075
500	.01	.50	.1100	.19339
NO_2	Minimum	Maximum	Mean	Std. Deviation
0	.10	.45	.1833	.13663
100	.10	.70	.2400	.22751
200	.10	.30	.1867	.06683
300	.01	.36	.1417	.12384
400	.01	.41	.1300	.15349
500	.01	.59	.1550	.22906
H_2S	Minimum	Maximum	Mean	Std. Deviation
0	.33	.90	.5827	.18461
100	.21	.58	.3927	.13851
200	.03	.37	.1297	.12173
300	.02	.25	.0802	.08327
400	.01	.15	.0398	.05270
500	.00	.13	.0295	.05051
CO	Minimum	Maximum	Mean	Std. Deviation
0	.17	1.00	.6267	.38082
100	.00	.90	.5550	.37378
200	.17	1.13	.7967	.34645
300	.13	.89	.5317	.30301
400	.11	.65	.3833	.20432
500	.09	.41	.2683	.13136

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VOC	Minimum	Maximum	Mean	Std. Deviation
0	.10	2.97	.9800	1.20197
100	.07	2.86	.6712	1.08168
200	.11	1.33	.3623	.47860
300	.02	1.33	.2678	.51945
400	.01	1.23	.2313	.48959
500	.01	.99	.1823	.39587
CH_4	Minimum	Maximum	Mean	Std. Deviation
0	.07	1.00	.8300	.37406
100	.32	2.00	1.1533	.69298
200	.26	1.00	.6350	.24378
300	.26	.76	.5117	.19333
400	.07	.58	.3633	.19957
500	.06	.47	.2517	.16204
PM 2.5	Minimum	Maximum	Mean	Std. Deviation
0	220.00	669.00	396.5550	212.96802
100	213.33	1690.00	625.4450	544.43443
200	244.00	1180.00	538.1117	363.00333
300	235.00	1902.00	639.4600	645.07940
400	120.00	2014.00	579.0867	737.61430
500	108.00	731.28	327.8800	221.04510
PM0.1				
0	95000.00	286666.67	167944.3350	82045.70501
100	110000.00	318000.00	211444.3883	89103.42666
200	115333.33	361250.00	229430.6100	79330.45112
300	103258.00	263000.00	208666.8483	55889.03566
400	100325.00	261000.00	201070.8083	56351.91411
500	100058.00	289547.00	191739.6017	73952.94337
PM 10	Minimum	Maximum	Mean	Std. Deviation
0	.33	8.33	3.1100	3.27668
100	1.00	12.33	5.8900	4.73884
200	3.33	16.25	7.5233	4.90498
300	3.01	21.30	8.3533	6.64703
400	2.85	22.36	8.1233	7.11170
500	2.56	25.61	8.6417	8.51647

NH_4	Minimum	Maximum	Mean	Std. Deviation
0	.00	.06	.0140	.02407
100	.01	.05	.0146	.01817
200	.01	.04	.0145	.01355
300	.00	.11	.0260	.04102
400	.00	.13	.0310	.04738
500	.00	.40	.0986	.15679

IV. Discussion of Findings

The concentration of SO_2 in air quality parameter was higher in Mile 3 Market and Rumumasi than the values recorded in other dumpsites whereas the relative humidity was highest around Eneka/Igwuruta dumpsite. Distance from the dumpsite was highly influential in determining the level of air quality in the study area.

In Mile 3 Market dumpsite, it was observed that the wind speed was 0.98 m/s while temperature was 32.65 °C and relative humidity was 85.67%. The implication of the results is that the wind speed of the study locations was relatively calm except that of Rumumasi which showed the highest. It thus implied that with the calm weather condition being observed generally in the study locations, the air quality may be in danger for the residents of the study location and environs because the pollutants will be relatively transported to another location. The higher temperature in Mile 3 Market dumpsite could be attributed to the numerous commercial activities going on in that location which can as well contribute to the diffusing of pollutants in the area. The relative humidity was relatively varied among the study locations, though all recorded high relative humidity which is expected in the Coastal area of Southern Nigeria due to the influence of the Atlantic Ocean. This is corroborated in Oyewole et al., (2014) where it was asserted that there is virtually no month when it does not rain in Port Harcourt, Calabar and Lagos is due to the fact that these stations are located along the coast and are also at a lower latitude compared to other stations in this study From May to September the Tropical maritime air mass dominates the whole of Nigeria and it originates from south Atlantic. The higher relative humidity in Eneka/Igwuruta dumpsite may be attributed to the fact that the presence of more vegetation cover than other areas because the peri urban nature of the location.

Procházka et al (2011) noted that the relation between the amount of vegetation, represented by the NDVI, and the temperature regime showed a significant negative correlation in the study localities. This means that an increase in the amount of vegetation cover leads to a decrease in surface temperature. At the same time, we observed a positive correlation between surface moisture, expressed by the WI and NDVI indices. This interdependence indicates the ability of vegetation cover to retain water and release it by transpiration, with heat being consumed and the environment cooling down. The cooling down of the environment through the transformation of heat into latent heat of evaporation and the formation of undergrowth microclimate lead to the stabilisation of the temperature regime of the landscape. The wind speed is generally low in the study locations and the implication is that much of the air pollutant will not be dispersed to the neighbourhood, rather they will be retained in most of the study locations. This is supported in the studies of (Zhou and Levy (2007) and Kim et al., (2015) which stated that the greater the distance from the pollution source, the greater the effect of meteorological conditions such as wind direction and wind speed, on horizontal dilution and the mixing layer height, which controls vertical dilution. Air pollution levels measured at roadside air quality monitoring stations, located next to the intersections of busy arterial roads, are used as an in- dicator of the impact of vehicle emissions on urban air quality. However, the effect of meteorological conditions, in particular wind direction and speed, on pollutant concentrations should also be considered at the roadside and even on roads. Similarly, Pillay et al (2011), wind speed ranging between 0.51m/s and 1.8m/s was regarded as calm. The calmness could be attributed to the dry season when the data was collected. Ogba and Utang (2009) submitted that the percentage of calmness of wind is higher during the dry season than the rainy season. The reason is that the prevailing winds in the Niger Delta change with time and location. The wind direction throughout the time of study was north easterly. This could be attributed also with the dry season but Ogba and Utang (2009) affirmed that north easterly wind is one of the predominant winds during the year in the study area.

V. Conclusion and Recommendations

It can be concluded that the study has revealed the effects of dumpsites on air quality in Port Harcourt Metropolis as it is shown that air quality parameters varied with respect to the location of the dumpsite and distance from the dumpsite. The concentration of SO_2 in air quality parameter was higher in Mile 3 Market and Rumumasi than the values recorded in other dumpsites whereas the relative humidity was highest around Eneka/Igwuruta dumpsite. Distance from the dumpsite was highly influential in determining the level of air quality in the study area. It is recommended that environmental education about air quality pollution is required so that residents can understand the effects of landfill sites in the neighbourhood empirically. Also, on the air quality variations with seasons are required so as to understand the effects of seasons on the air quality and groundwater quality parameters.

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