The Impact of Solid Waste Dumpsites on Ambient Air Quality in Obio/Akpor Local Government Area, Rivers State: A Case Study of Nkpolu Community

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ABSTRACT

The impact of solid waste dumpsites on the ambient air quality in Obio/Akpo Local Government Area of Rivers State (using Nkpolu Community as reference) was carried out over a four-month period across four-impacted sites (i.e., dumpsites and a control site). The portable Aeroqual 200/300 series was used for the determination of gases, for particulate matter Aeroqual PM2.5/10 was used with extech meteorology meter utilized for the assessment of meteorological variables, while microbial load was determined using the settling plate technique. Assessment was carried out twice (morning and evening) in each visit for four times/months and the results obtained are ozone (0.021±0.019 - 0.039±0.009 µg/m^3), methane (0±0.000 - 6.213±7.585 µg/m^3), carbon monoxide (0.0125±0.025 - 0.169 µg/m^3), nitrogen dioxide (0.0015±0.001 - 0.0571±0.079 µg/m^3), sulfur dioxide (0.05±0.053 - 0.04±0.037 µg/m^3), carbon dioxide (9.038±2.582 - 10.329±0.006 µg/m^3), ammonia (0.025±0.050 - 0.1713±0.099 µg/m^3), hydrogen sulfide (0.04±0.024 - 0.148±0.091 µg/m^3), volatile organic carbon (3.98±1.260 - 8.55±1.170 µg/m^3), PM2.5 (0.0084±0.002 - 0.064±0.071 µg/m^3), PM10 (0.020±0.007 - 0.115±0.086 µg/m^3), air temperature (30.840C±2.450 - 34.05±2.276 ^{0}C), relative humidity (53.57±0.000 - 58.73±3.101%), and wind speed (3.2±1.921 - 5±2.106 m/s).

All the parameters studied fell under their permissible limits indicating that the investigated solid waste dumpsites have not adversely affected ambient air quality. However, the relocation of these dumpsites out of the Nkpolu residential area is strongly recommended. In conclusion, the air quality parameters should be monitored to reduce the impact on the environment, efforts should be made or carried out periodically to forestall dangers associated with air quality and more research should be carried out during the rainy season as well as to ascertain and compare outcomes.

(Keywords: air quality, dump sites, off-gassing, ozone, methane, carbon monoxide, nitrogen dioxide, sulfur dioxide, carbon dioxide, ammonia, hydrogen sulfide, volatile organic carbon, particulate matter, environmental monitoring, solid waste dumps)

INTRODUCTION

The importance of living in a clean environment cannot be over-emphasized. Once an environment is free from waste, the impact is usually seen in all aspects of life for individuals having contact with that environment. The purpose of this study is to assess the impact of solid waste dumpsite on the people of Nkpolu community.

Nigeria like many other African countries still deals with the scourge of insufficient waste collection and disposal services, which often constitutes both environmental and health hazards for the people. Any substance, mixture, or article for which no direct use is envisaged but which is transported for reprocessing, dumping, elimination, by incineration or other methods of disposal could be regarded as waste (Aboagye-Larb, Acheampong, Kyei and Carboo, 2014).

In Nigeria, a large percentage of waste are generated from commercial, industrial, households, agricultural, and educational establishments (Achudume & Olawale, 2007). These waste products, however, at certain times are not properly disposed or managed, which in turn leads to the occurrence of environmental and public health challenges (Onwughara, Nnorom, Kanno and Chukwuma, 2010). Municipal solid waste management, however, remains a major environmental health challenge in Nigeria which has been attributed to indiscriminate roadside refuse disposal, open dumping of waste products, a massive unplanned urbanization trend, growth of the population, absence of actionable guidelines as regards refuse dumping and refuse dumpsites, inadequacy in funding, laxity in the practice of effective waste management, as well as absence of organized waste management systems, etc. (Igbinomwanhia, 2014).

The four common methods of managing waste according to Seo (2004) are land filling, incineration, composting, and anaerobic digestion. Incineration, composting, and anaerobic digestion are volume reducing technologies. Ultimately, residue from these methods must be land filled.

In order to keep the environment clean from these hazardous materials called waste, several methods of waste disposal system are being practiced throughout the world. Eliminating waste products from the environment, which involves managing waste example, municipal waste has always been a collection and eventual disposal of waste (Tchobanoglous, *et al.,* 2003). The various techniques and methods of waste disposal:

i. **Open Dumping:** The open dumping is the most common and widely used in developing countries .it involves dumping of the waste in a designated sport which is uncovered (Gabara, 2009). Open dumps are unsanitary, unsightly, and generally smelly, with foul smells as they attract rats, insects, flies, snakes, etc. This method is also practiced by households and most low-level industries and commercial houses. It is the cheapest form of waste disposal, but it is a source of a number of public health and safety problems (examples are diseases, air-water pollution and fire outbreaks). It results in offensive odors from sites, defaces the city, blocks drainages, causes health and respiratory problems, and results in injury to visitors and rag pickers to the site. This technique is not recommended for use.

ii. **Land Fills:** They are traditional disposal methods where by refuse is placed in trenches (burrow pits, abandoned mines, or quarry sites) after the sites have been properly designed. Landfills often create a number of environmental impacts (Tchobanoglous, *et. al.,* 2003, Dennison, 1996, and Nester, 1998). Landfill processes are also designed to concentrate and contain refuse without creating a nuisance or hazard to public health or safety (Dockery, *et al.,* 2014). The idea is also to confine the waste, reduce it to the smallest volume, and cover with compacted soil to prevent insects, rodents, and seagull problems, and avoid ground water percolation.

iii. **Incineration:** This is a method of disposing waste by burning at a controlled combustion temperature, combustible waste material using a very high temperature of about 2800^0F – 3200^0F (1400^0C – 2000^0C) mostly for medical waste. Incineration is carried out both on a small scale by individuals and on a larger scale by industries. It is used for disposing hazardous waste and destroying pathogens and toxins at high temperature (Lim, 2001 and Yang, 2002). Incineration under ideal conditions, reduces the volume of waste by 75% to 95%. Modern incineration methods have electrostatic precipitators, dual scrubbers, and filters to reduce the volume of waste to at least 99% of most organic materials (Adewumi, 2015). Burning of waste causes irritation of respiratory tracts, aggravates asthma, and contributes to chronic obstructive pulmonary diseases and acute/chronic respiratory diseases. Even healthy people can experience shortness of breath, sore throats, breathing difficulties, dizziness, headaches, etc. It is also responsible for fluid collection in the lungs and fibrotic changes, growth effects DNA, Immune and reproductive system.

iv. **Composting:** This is a solid waste management strategy by which disposed mixed municipal waste are reduced in size and weight, thus, reducing odor and leachates emissions, resources recovery and reducing cost of disposal. Because of the presence of high percentage of perishable and organic materials in managing solid waste, the composed products can be used as fertilizers by farmers and especially in plants for landscaping (Somare, 2003). Composting is also a biochemical process in which organic materials such as lawn clippings and kitchen scraps decompose to rich solid like material. It is a process of rapid, partial decomposition of moist solid organic waste by aerobic organisms. This is a popular technique in Europe and Asia, where intensive farming centers a demand for compost. It also involves the use of natural microbial organism to decompose the organic fraction of waste. Composting is aerobic and produces primarily carbon dioxide, while anaerobic processes produce methane. Such gas contributes to global warming.

It is noteworthy to state that the government of Nigeria on its own part has played significant roles in ensuring that this menace is curbed through the enactment of regulations and legislations that ensure the practice of adequate waste management. This is however not enough on its own as the populace must also be educated on how best they can adhere to these laws as non-adherence not just only leads to facing penalties from environmental health agencies but can also lead to deterioration in health as well as deaths. This is an issue that must be addressed round the clock despite the many challenges being faced by the relevant waste management authorities.

Environmental health education should be put into play, strict adherence and enforcement of environmental health laws and regulations, provision of adequate waste disposal methods for the populace, timely and proper waste management by relevant authorities, recycling of waste materials etc. are some ways by which the prevailing occurrence of poor waste management can be tackled and thus providing a more healthy environment for labor and productivity (Onwughara, 2010; Karija, 2013; Owoeye and Okojie, 2013; Kafando, 2013).

Seeing that effective and proper waste management practice is a problem that impacts on the health of individuals in Nigeria, it was necessary to carry this study to ascertain the impact of solid waste dumpsite on ambient air quality in Obio/Akpo Local Government Area as it provided a framework for evaluation of waste management efforts and provided areas that needed further attention in order to ensure the achievement of general public health of the people in Obio/Akpor Local Government Area.

The management of solid waste, perhaps, stands as the most visible environmental problem facing the capital city and communities of Rivers State. The problem is growing daily as a result of increasing urbanization. The solid waste problem is visible in most parts of the communities within Port Harcourt, on the roads, within the neighborhoods and around residential buildings.

The environment of man lies at the mercy of both natural disaster and negligence on the part of man in the course of controlling the gifts of nature. The later takes the form of dumping solid waste in an uncompromising pattern, that can cause; desert encroachment, erosion, depletion of ozone layer, depletion of natural resources, and pollution of land, rivers, the air and generally the environment (Aguwanba,1998). According to Egunlobi (2004), in the early times (pre- colonial days) up till 1970s, the disposal of refuse and other waste did not pose any significant problem. The population was small, and enough land was available for assimilation of waste. Solid waste problem started with urban growth, resulted partly from national increase in population and more importantly from immigration.

Ndakara (2011) also states that the quantity of such waste depends mainly on location, activity, and number of people in the household. However, it was not until the mid-19th century, spurred by increasingly devastating cholera outbreaks and the emergence of a public health debate that the first legislation on the issue emerged. Thus, the social reformer, Sir, Edwin Chadwick's 1842 report on "The Sanitary Condition of the Laboring Population' 'became influential in securing the passage of the first legislation of waste clearance and disposal, in which he argues for the importance of adequate waste removal and management facilities to improve the health and wellbeing of the city's population (Barbalace, 2003).

Early garbage removal trucks were simply open bodied dump trucks pulled by a team of horses. They became motorized in the early part of the 20th century and the first closed body trucks to eliminate odors with a dumping lever mechanism were introduced in the 1920s in Britain. These were soon equipped with "hopper mechanisms" where the scooper was loaded at floor level and then hoisted mechanically to deposit the waste in the truck. The Garwood Load Packer was the first truck in 1938, to incorporate a hydraulic compactor (Herbert, 2007).

Mba (2003) noted that no town in Nigeria, especially the urban and semi-urban centers of high population density, can boast of having found a lasting solution to the problem of filth and huge piles of solid waste. Rather the problem continues to assume monstrous dimensions. To urban and city dwellers, public hygiene starts and ends within their immediate surrounding and indeed the city would take care of itself. The situation has so deteriorated that today the problem of solid waste management has become one of the nation's most serious environmental problem (Okpala, 2002).

Ineffective waste management could result to ill health and undermine all the resources and efforts put in beautifying the environment. Every year, the government of Nigeria, Rivers state inclusively, spends billions of Naira to roll back malaria, without focusing on some environmental factors such as poor waste management that makes malaria to thrive. Blocked drains provide stagnant water which facilitates the breeding of mosquitoes and other sickness causing germs (Ogadima, 2011).

Pathogenic organisms and toxic chemicals are associated with a wide range of negative health effects to mankind. The decomposing waste materials have a major public health impact ranging from infectious diseases, acute toxic effects, allergies, and cancer. Due to this, an improper waste management method has a high risk to health and must therefore be discouraged. Bacteria also grow in wide range of moisture level; bacteria populations of various dumpsites are correlated to the moisture content. The highest bacterial density is found in regions of fairly high moisture content and the optimum level for the activities of anaerobic bacteria at the dumpsites. Numbers of the genera *Pseudomonas, Acromobacter* and *Bacillus* are found in the most anaerobic dumpsites, where conditions are anaerobic and moist *Clostridum* will occur. *Actinomycyes* showed a similar quantitative increase under such conditions (Isselbacher, Adams, Braunwald, Peterdorff, and Wilson, 2019).

MATERIALS AND METHODS

Area of the Study

Obio/Akpo is a local government area in the metropolis of Port Harcourt, one of the major centers of economic activities in Nigeria, and one major city of the Niger Delta, located in Rivers State. The local government area covers 260 km^2 and at the 2006 census held a population of 464,798.

Sampling Site Locations

The dumpsites at Nkpolu East-West Road is located at geographical coordinates of latitude 4.88774°N and longitude 6.92296°E and the control site is on the outskirts of the Nkpolu community. With latitude 4.88778°N and longitude 6.92272°E. The dumpsites include the following areas in Nkpolu community in Obio/Akpo Local Government Area:

1) Dump Site 1- behind Mercy Land Specialist Hospital, Nkpolu
2) Dump Site 2- main dump site by the roadside by Nkpolu Junction
3) Dump Site 3- 100 meters away from dump site 2 (main dump site) Nkpolu
4) Dump Site 4- dump site by Rumuoapara community secondary school, Nkpolu
5) Neutral area without dump site at Alakahia was used as the control

Research Design

The study is an experimental research effort intended to assess the impacts and implications on the people of Nkpolu Community in Obio/Akpo as a result of solid waste dumpsites.

Sample Collection for Air Quality of Gasses from the Dump Site Area

The instruments used for data collection for this study included;

i. AeroQual 200/300 series Gas monitor
ii. AeroQual particulate Meter 2.5/10
iii. Extech Meteorology Meter
iv. Automated Global Positioning System (GPS)
v. Petri dishes

Sampling Techniques and Procedure for Measuring the Air Quality of Gasses from the Dump Site Area

Samples were automatically analyzed for Ozone, (O_3), Nitrogen Oxides (NO and NO_2), Oxides of Carbon (CO and CO_2), Sulfur Dioxide (SO_2), Methane (CH_4), VOC (Volatile Organic Compounds), Ammonia (NH_3), Hydrogen Sulfide (H_2S), particulate matter for 2.5 and 10 microns (PM 2.5 and PM 10), Temperature, Relative Humidity, and Wind Speed.

Samples were read in-situ at the dump sites in order to effectively determine the extent to which dump sites - landfill emissions affect air quality in areas influenced by landfill. Sampling was carried out for a duration of 4 months from November 2019 to February 2020 taking air quality samples of gases from the dumpsite areas per week. Air quality of gasses were collected morning and evening from across the different locations including the control location.

Measurement was done by holding the sensor to a breathing height of about 1.5 meters in the direction of the prevailing wind and readings was recorded when the monitor had warmed up to about 3 minutes to burn off contaminants on the sensor sucked into the sensor.

RESULTS

Table 1: Range and Mean Values (±SE) of Air Quality Parameters, Particulate Matter, and Meteorological Parameters Across Different Sample Locations.

GASES	STATION 1		STATION 2		STATION 3		STATION 4		STATION 5	
	RANGE	MEAN ±SE	RANGE	MEAN ±SE	RANGE	MEAN ±SE	RANGE	MEAN ±SE	RANGE	MEAN ±SE
Ozone ($\mu g/m^3$)	0.03-0.06	0.039 ±0.009	0.0-0.06	0.026±0.0	0.03-0.07	0.032±0.013	0.01-0.01	0.028±0.016	0-0.06	0.021 ±0.019
CH4 ($\mu g/m^3$)	0.0-0.05	0.575 ±1.093	0-0	0 ±0	0-17	6.125 ±5.981	0-32	6.212 ±7.585	0.1-9	4.388 ±2./155
CO ($\mu g/m^3$)	0.0-0.24	0.169 ±0.078	0.0-0.34	0.16 ±0.0	0.0-0.23	0.123±0.073	0.0-0.1	0.013±0.025	0-0.29	0.16 ±0.098
NO2 ($\mu g/m^3$)	0.0-0.004	0.002 ±0.001	0-0.025	0.00825 ±0.0	0-0.009	0.003875 ±0.0129	0-0.033	0.01075 ±0.000316	0-0.036	0.057125 ±0.005223
S02 ($\mu g/m^3$)	0.0-0.2	0.05 ±0.053	0-0.3	0.0876 ±0.0	0-0.5	0.1 ±0.125	0-0.02	0.1025 ±0.074	0-0.1	0.0375 ±0.037
C02 ($\mu g/m^3$)	0.2-10.34	9.0513 ±1.53	10.31-10.36	10.33 ±0.0	10.31-10.36	10.32 ±0.007	0-10.33	9.038 ±2.582	10.31-10.34	10.33±0.006
NH3 ($\mu g/m^3$)	0-0.2	0.025 ±0.050	0-0.2	0.075 ±0.0	0-0.3	0.0876 ±0.088	0.2-0.28	0.1712 ±0.010	0-0.2	0.075 ±0.063
H2S ($\mu g/m^3$)	0.0-9	0.035 ±0.024	0-0.15	0.08125 ±0.0	0-0.32	0.001 ±0.003	0-0.01	0.0013 ±0.003	0-0.16	0.084 ±0.051
VOC ($\mu g/m^3$)	3.6-0.108	6.076 ±2.912	2.8-17	8.425 ±0.0	2.7-7	4.9125 ±1.869	6-10.7	8.55 ±1.170	2.2-7	3.975 ±1.260
PM10 ($\mu g/m^3$)	0.011-0.066	0.02175 ±0.014	0.67-0.066	0.1076 ±0.0	0.01-0.035	0.01734 ±0.002	0.004-0.026	0.01838 ±0.007	0.22-0.034	0.1145 ±0.09
PM2.5 ($\mu g/m^3$)	0.004-0.027	0.01412 ±0.007	0.005-0.302	0.051375 ±0.0	0.005-0.013	0.008375 ±0.002	0.01-0.025	0.0135 ±0.004	0.01-0.221	0.064125 ±0.071
TEMP (°C)	25.3-35-3	30.75 ±3.36	26.4-39.4	31.35 ±0.0	25.3-34.9	30.84 ±2.450	27.4-35.4	32.3375 ±2.01	28.6-37.3	34.05 ±2.28
RH (%)	43.1-64.3	54.1625 ±4.8	47.2-60.9	53.575 ±0.0	52-60.3	57.9 ±4.17	52.3-63.1	58.725 ±3.1	42.5-68.5	57.825 ±5.53
WS (m/s)	0.3--7.8	3.1875 ±1.921	3.2-9.4	4.9375 ±0.0	0.3-0.8	5 ±2.11	1.7-9.4	4.8625 ±2.25	2.5-7.5	4.9625 ±1.29

DISCUSSION

Gases

In this study, it was observed across all the stations that the mean concentration for ozone in the dumpsite ranged from 0.021±0.019 - 0.039±0.009 µg/m^3. The range of values observed in this investigation compares favorably with the record of Amaechi–Onyerinma, (2019) who reported a range of 0.01 – 0.032 in her study on the effect of gas flaring on the ecosystem using Shell Agbada Flow- Station Igwuruta as a case study.

In the investigation by Maduforoh (2019) on the impact of dumpsite on air quality in Nigeria, the range of values observed for methane was 0.03-0.14 µg/m^3, this range falls within wider range of 0±0 – 6.123±7.585 µg/m^3 observed in this present study. The recorded concentration of methane in this investigation is significantly higher than that of Amaechi-Onyerinma (2019) who reported 0µg/m^3 throughout the period of the investigation. This variation in the concentration of methane could be as a result of differences in the prevalent activities in the different study sites or differences in the season of sampling.

The mean concentration of CO in this investigation varied from 0.012±0.025 - 0.169±0.078 µg/m^3.This compares favorably with the 0.12 – 0.24 recorded by Madufuroh (2019) in a similar study on the impact of dumpsites on the air quality in Nigeria. Similarly, the observed mean value of 0.2 µg/m^3 recorded by Amaechi–Onyerinma (2019) is in close affinity with the report of this investigation. However, it is significantly lower than the observed range of 11.4 – 22.8 recorded in the Environmental Impact Assessment of the Otumara Associated Gas Solution Project of Chevron (2010).

In this study, it was recorded that the mean concentration of nitrogen in the dumpsite area ranges from (0.0015±0.001 - 0.05713±0.079 µg/m^3). This compares favorably with the 0.056-0.090 µg/m^3 recorded by Amaechi-Onyerinma, (2019). Similar result was also observed by Madufuroh (2019) which recorded 0.02 - 0.10 µg/m^3 in a similar work on the impact of dumpsite on air quality in Nigeria. Chevron, (2015) in an EIA report of Otumara AGS Project recorded a mean value of 0.1 µg/m^3 which is slightly higher than that of the present study.

The mean concentration of Sulfur compounds in the report varied from (0.1±0.05 - 0.04±0.037 µg/m^3). This report compares perfectly with and it is in accordance with the 0.09 recorded by an EIA report of Otumara AGS project (Chevron 2015) and in a similar study on the impact of dumpsite on air quality in Nigeria, which recorded 0.01 - 0.10 µg/m^3 is in accordance with the report of this present study. However, it is lower than the value 0.00 µg/m^3 in Amaechi-Onyerinma (2019).

In the investigation by Amaechi-Onyerinma (2019) on her investigation on the effects of gas flaring on the ecosystem using shell Agbada Flow station Igwuruta as a case study recorded a range of (527 - 613 µg/m^3) of carbon dioxide. This range was way higher compared to the range of (9.038±2.582 - 10.329±0.099) in this present report. This variation in the mean concentration of Carbon dioxide could be as a result of location and prevalent activities in the area.

In this report, it was recorded that the mean concentration of ammonia in the dumpsites ranged from (0.025±0.050 - 0.1713±0.099 µg/m^3). The report observed is in line with the EIA of Otumara AGS Project (Chevron 2015) and the reports of Amaechi-Onyerinma (2019) which has a mean of 0.2 µg/m^3, respectively. However, in a similar report by Madufuroh (2019) on the impact of dumpsites on air quality in Nigeria reported 0.01 - 0.10 µg/m^3 this report is significantly higher compared to that of Madufuroh (2019). This maybe because NH_3 is produced from anaerobic decay of buried organic materials in the dumpsite.

In the investigation by Madufuroh, (2019) on the impact of dumpsites on air quality in Nigeria, this ranged value recorded for H_2S was 0.04±0.0240 - 148±0.091 µg/m^3 This range is far higher than 0.04 - 0.15 µg/m^3 in this present study. The recorded concentration of H_2S in this present investigation is significantly higher than that of Amaechi-Onyerinma, (2019) reported 0.00 µg/m^3 throughout the investigation period. Meanwhile the EIA of Otumara AGS Project (Chevron 2015) recorded 0.01 µg/m^3 which was less compared to the report of this study.

In an EIA report of Otumara AGS Project (Chevron 2015), it was reported that the mean concentration of volatile organic compounds was 3.2 µg/m^3, however, this was lower compared to the report on this study (3.98±1.260 - 8.55±1.170 µg/m^3). The recorded concentration of VOC in the present study is significantly higher than of the EIA report Otumara AGS Project (Chevron 2015) who reported 3.2 µg/m^3 in the period of investigation. The fluctuation in mean concentration could be as a result of vehicular movements or human activities in the area.

Particulate Matter

The investigation by EIA of Otumara AGS Project (Chevron 2015) recorded the mean concentration of PM10 (33.1 µg/m^3) which was far higher compared to this present investigation ranging from (0.020 ±0.007 - 0.115±0.086 µg/m^3) it was also observed in an investigation by Madufuroh (2019) on the impact of dumpsite on air quality in Nigeria which recorded 4.10 - 6.70 µg/m^3 which was also higher compared to the present study. Furthermore, the reports recorded by Amaechi-Onyerinma,(2019) 0.012-0.016 in accordance with present study which ranged from (0.02 - 0.12 µg/m^3).

In the study, it was observed across the dumpsite that the mean concentration of PM2.5 (0.01±0.002 - 0.06±0.064 µg/m^3) was recorded, the range of values observed in this study could be compared with the record of Amaechi-Onyerinma (2019) who reported a range of (0.01 - 0.02 µg/m^3) however in the reports of Madufuroh (2019) recorded 7.00 - 9.30 µg/m^3 which was slightly higher compared to this study. Furthermore, in the investigation recorded by EIA/Eja field further oil development projects (2006) (0.09 - 0.22 µg/m^3) by EIA of Dodo North NAG wells Development project (Chevron, 2010) recorded 18.23 µg/m^3 were far higher compared to the reports of this present study, moreover the investigation of EIA of Otumara AGS Project (Chevron, 2015) was recorded higher than both reports of EIA of EA/Eja field further oil development projects (2006). The significant variation from the ranges could be as a result of activities and impact on the area of study.

Meteorological Parameters

In this report, the results gotten from the mean temperature across the dumpsites was recorded as (30.84±2.450 - 34.05±2.276 µg/m^3). More so, the investigation carried out by EIA of Soku Gas Plant-San Barth Manifold pipeline project for Assessment for Gbaran (2006) recorded 24.2 - 27.1^{0}C is slightly lower compared to this report. However, it was also observed in the mean temperature of EIA of EA/Eja field further oil development projects (2006) recorded 26.2 - 32.6°C, EIA of Otumara AGS Project (Chevron 2015) recorded 30.0^{0}C, EIA of Dodo North NAG wells Development project (Chevron, 2010) recorded 32.3^{0}C and Madufuroh (2019) recorded 27.9 - 36.0^{0}C. It is noteworthy that the mean temperature of by EA/Eja field further oil development projects (2006) and Amaechi-Onyerinma, (2019) fell in accordance with the investigation of changes in the study area.

The investigation carried out in this work recorded the mean RH value of (53.4±0.000 - 58.7±3.101%) which is comparably lower compared to the report carried out by Amaechi-Onyerinma, (2019) on her work on gas flaring on the ecosystem in Igwuruta gas flow station and recorded (65.3 - 78.1%). This could be as a result of the flow station in her study area. Similar research carried out by Madufuroh (2019) on the impact of dumpsite on air quality in Nigeria, recorded (49 - 64%) which affirms with the records of this present investigation (53.4±0.000 - 58.7±3.101%) as there were no slight difference. However, EIA of Dodo North NAG wells Development project (chevron 2010) recorded 75.1%, EIA of Otumara AGS Project (Chevron, 2012) recorded 70.5% were higher than the investigation varied out in this present study. The reports of EIA Soku Gas plant-San Barth Manifold pipeline project for Assessment for Gbaran (2006) also recorded 57 - 63% in affirmation of this report.

This research shows the value gotten from the mean wind speed across the dumpsites and recorded (3.2±1.921 - 5±2.106m/s) is far lower compared to the recorded value from the control 4.8 m/s. However, of EIA Soku Gas Plant-San Barth Manifold pipeline project for Assessment for Gbaran (2006) recorded 1 - 3.7, EIA of Dodo North NAG wells Development project (chevron 2010) recorded 1.33 m/s, EIA of Otumara AGS Project (Chevron 2012) recorded 0.8 m/s, EA/Eja field further oil development projects (2006) recorded 0.50 - 2.60 m/s which is in line with the work of Amaechi-Onyerinma (2019) on her work on gas flaring on the ecosystem in Igwuruta gas flow station and recorded (0.9 - 2.0 m/s), the values gotten could be as a result of the climatic condition of the study area at the time.

The research carried out by (Kirti Bomaka, 2016) on the microbiological indoor and outdoor air quality of selected places in Visaknaptnan city, India revealed the fungal mean concentration in indoor and outdoor air of selected sites was recorded to range from $4.2x10^2$ — $9.2x10^2$ which is far lower when compared to that of this study as it recorded a mean concentration of $0.7x10^4$ — $5.6x10^4$.

The same research carried out by Kirti-Bomala, (2016) on the microbiological indoor and outdoor air quality of selected places in Visaknapatnan city, India also observed that the bacterial mean concentration of indoor-outdoor air of selected places recorded $7.2x10^2$ – $10x10^2$ which was quiet lower compared to this study as it recorded $8.1x10^4$ – $38.3x10^4$.

CONCLUSIONS

This research on the dumpsites in the Nkpolu community has revealed that all the parameters investigated fell below the permissible limits and standards of DPR (2002) meaning that the dumpsites thus far have not impacted negatively on the ambient air quality of the area.

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