

Indiscriminate Dumping of Wastes Contributes to Air Pollution in Abakaliki, Southeast Nigeria

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Abstract: When we mention wastes, the first thought goes for the popular kitchen wastes, which we have direct access to. Most often we do not count the end products of our metabolism as wastes, as they are flushed beyond our view or horizon into unknown destination. When we enjoy products of civilisation, we forget the packaging, cans, plastics, bottles and the expired. Leave it for the marketers to sort, please. When we eat food of assorted kind, we neglect the end products of agriculture, especially the wastes. Where do they go? Back to sender (the soil of course) we may argue. When we enjoy electricity and power. Who cares how, where, when, what, why it is being generated. For the electricity that comes from nuclear fuel, where has the radioactive wastes gone. Wastes contribute to air pollution.

Key words: Wastes • Indiscriminate dumping • Environmental pollution • Civilisation • Beautiful environment • Management approaches

INTRODUCTION

A beautiful environment is always good to behold. Apart from the aesthetic value, it has several moral and psychological healing and pride. They impact on quality of health and well-being. On the other hand, an unkempt environment is not only irritating but annoying. It confers level of civilisation and society attachment to values and principles [1, 2].

All over the world, wastes are generated from agriculture, industry, household, construction, mining and all forms of resource use [3, 4, 5, 6]. As we enjoy all things of nature, so do materials not needed by us come with them. We enjoy food, drink, clothing, but lack the passion and freewill to manage the end products of these resources. We tend to throw them about with little thought of their effects on the environment and overall health of man.

The after effects of these “I don’t care attitude of resource users lead to indiscriminate dumping of wastes on the environment. Once left in the environment uncontrolled, carbon dioxide, carbon monoxide, ammonia, hydrogen sulphide, particulate matter amongst others is generated [3, 6, 7]. In Abakaliki, Ebonyi State, Nigeria; indiscriminate dumping of wastes on our streets has been

persistently problematic. Sachet water, banana peels and other wastes are dumped on roads, markets and public places with reckless abandon. Hence, this work monitored indiscriminate dumping of wastes on key university and public places in the state and their effects on air quality.

MATERIALS AND METHODS

Geographical and Climatic Information: Abakaliki lies within Longitude 08° 06' E and Latitude 06° 19' N at an altitude of 128 meters above sea level. It lies within the derived savannah belt of south eastern Nigeria. The mean annual rainfall for 25 years (1977 – 2012) was 154.75 mm spread across April – November; while the mean annual minimum and maximum temperatures for same period were 23.58 and 32.40°C, respectively; with higher and lower temperatures during the dry and rainy seasons respectively. On the other hand, the average annual sunshine hours for same period was 5.13, while the mean annual relative humidity@09/15 hrs was 80.2 and 59.93%, respectively; with higher and lower relative humidity during rainy and dry season respectively. The rainfall, temperature and relative humidity of the area are presented in Figures 1, 2 and 3 [8]. The soil belongs to the order (Ultisol) classified as Typic Haplult [9].

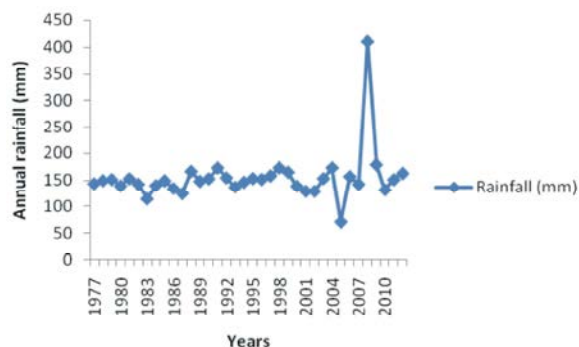


Fig. 1: Annual rainfall for Abakaliki (1977 - 2012) - mm

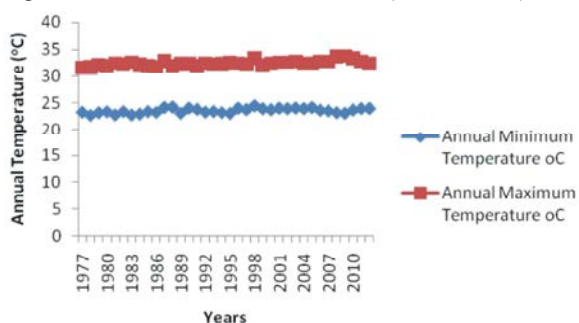


Fig. 2: Annual minimum and maximum temperature for Abakaliki (1977 - 2012) - °C

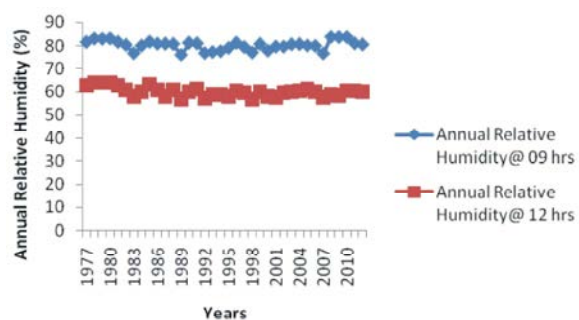


Fig. 3: Annual relative humidity@09/12 hrs at Abakaliki (1977 - 2012) - %

Identification of Indiscriminate Wastes Disposal Places:

Three locations were identified namely: Ebonyi State University (EBSU), College of Agricultural Sciences Eating and Drinking Center, Abakpa Main Market, Afikpo Road Motor Parks; with Abakaliki Government Reserved Area (GRA) as control. The EBSU Eating and Drinking Center is located within the school premises of College of Agricultural Sciences, Abakaliki. The major activities are selling and buying of food like cooked rice, beans, salads, okpa, moi-moi, garri, soup and drinks (beverages) like malts, coke, sprite, fanta, sweetbees,

bottled water, sachet water, other soft drinks and consequent dumping of the wastes on every available space after consumption. The Abakpa main market is one of the major markets in Abakaliki that is located at the end of Sani Abacha Roundabout by Gunning Road. It is joined to meat market and bubbles daily with commercial activities ranging from buying and selling of goods/commodities by both retailers and consumers on items like food, clothes, bags, leather materials, meat, palm oil, vegetables cosmetics, shoes.

Afikpo road motor parks are located at Afikpo road, off Ogoja road. Many parks like Peace Mass Transit; G.O.U Motors; The Young Shall Grow; Ifesinachi Motors are located in these parks. A lot of hawking abounds in these parks. The GRA that served as control is a residential, serene, clean and well maintained environment where minimal or low volume of wastes are generated and properly disposed.

Measurement Techniques: With the aid of potable hand held gas monitors (GASMAN Model) CO19256H; NO₂19835H; NH₃19736H and H₂S19752H with detection limit of 0 – 50 ppm and alarm set at 3 ppm, atmospheric concentrations of the following gases were monitored: carbon monoxide, nitrogen dioxide, ammonia and hydrogen sulphide. The four monitors were hung on a wooden platform raised to a height of 1.5 meters. They were calibrated on each occasion of use due to regular weather changes. The Green Light Emitting Diode (LED) and the sounder operated once every three seconds. The Liquid Crystal Display (LCD) showed zeros. The flashing of red LED is an indicator that concentration of gases has passed alarm range. Hourly timing was done with aid of stop watch. All readings were noted at hourly stability. Each readings were taken at four points (that served as replicates) separated by 10 meter spacing for 5 days per month x 3 months x 3 years (2013 – 2015). All protocols for air monitoring were based on World Health Organisation and Nigerian Standards [[10, 11, 12].

Statistical Analysis: For analysis exercise daily values were pooled on fortnightly basis and subjected to analysis of variance for randomized complete block design (RCBD). The values were captured in parts per million (where 1 parts per million (ppm) is equivalent to 1 mg kg⁻¹ or 1 mg l⁻¹) [13]. Further mean separation and differentiation were done with Fishers Least Significant Difference (FLSD) at 5% probability level or 95% confidence interval [14].

RESULTS

Carbon Monoxide Air Concentrations: There were no statistical variations amongst sites for carbon monoxide air concentrations. However, the Afikpo Parks led with carbon monoxide of 0.60 mg L^{-1} , followed by CAS with 0.57 mg L^{-1} and least in GRA, 0.47 mg L^{-1} . The coefficient of variation was 18.07% (Table 1). Across cumulative fortnightly intervals, the highest carbon monoxide air concentration of 0.64 mg L^{-1} was got at 8 weeks and least, 0.48 mg L^{-1} at 6 weeks; with coefficient of variation (cv) of 2.89% (Table 2). All the values were within the permissible levels set by World Health Organisation (WHO); US/California National Ambient Air Quality and Nigeria Environmental Protection Council (NEPC) standards of 30, 35, 30 ppm or mg L^{-1} respectively [10, 11, 12].

Nitrogen Dioxide Air Concentrations: There were no statistical nitrogen dioxide air concentrations amongst locations. The Abakpa market gave highest sulphur dioxide air concentration of 0.05 mg L^{-1} and least, 0.03 mg L^{-1} was at CAS; with cv of 10.51% (Table 1). Across cumulative periods, the highest level, 0.17 mg L^{-1} was at 8 weeks and least, 0.14 mg L^{-1} at 2 and 12 weeks respectively; with cv of 8.22% (Table 2). All the sites exceeded the limits set by WHO [12]; US/California [11] and NEPC [10] of 0.120, 0.025 and 0.120 ppm or mg L^{-1} respectively.

Ammonia Air Concentrations: There were no statistical ammonia air concentrations amongst the sites. The highest ammonia air concentration of 0.04 mg L^{-1} were recorded at CAS and Afikpo Road; while the least, 0.03 mg L^{-1} was at the GRA; with cv of 12.23% (Table 1). Across cumulative intervals, the highest ammonia air concentration of 0.05 mg L^{-1} was at 10 weeks and least, 0.03 mg L^{-1} at 2, 4 and 6 weeks respectively; with cv of 13.67% (Table 2). All the values were below the limits of 0.28 and 0.20 ppm or mg L^{-1} set by WHO and NEPC respectively [19; 38].

Hydrogen Sulphide Air Concentration: There were no statistical hydrogen sulphide air concentrations amongst sites. The highest hydrogen sulphide air concentration of 0.04 mg L^{-1} was at CAS and Afikpo Road; while the least, 0.03 mg L^{-1} were at Abakpa Market and GRA with cv of 9.69% (Table 1). Across cumulative periods, the highest

Table 1: Effect of indiscriminate dumping of wastes on air quality

Pollutants	CO	NO ₂	NH ₄	H ₂ S
CAS, EBSU	0.57	0.03	0.04	0.04
Abakpa market	0.51	0.05	0.03	0.03
Afikpo Parks	0.60	0.04	0.04	0.04
GRA	0.47	0.04	0.03	0.03
FLSD(0.05)	ns	ns	ns	ns
CV(%)	18.07	10.51	12.23	9.69

Values are means of 4 replicates x 5 days m^{-1} x 3 months x 3 yrs

Table 2: Effect of indiscriminate dumping of wastes on cumulative air quality

Pollutant	CO	NO ₂	NH ₃	H ₂ S
2 weeks	0.53	0.14	0.03	0.04
4 weeks	0.58	0.15	0.03	0.04
6 weeks	0.48	0.14	0.03	0.04
8 weeks	0.64	0.17	0.04	0.04
10 weeks	0.56	0.16	0.05	0.03
12 weeks	0.57	0.14	0.04	0.04
FLSD(0.05)	0.37*	ns	0.22*	ns
CV(%)	2.89	8.22	13.67	6.77

Values are means of 4 sites x 4 replicates x 10 days x 3 months x 3 yrs

hydrogen sulphide air concentration of 0.04 mg L^{-1} were at all periods except 0.03 mg L^{-1} at 10 weeks, with cv of 6.77% (Table 2). All the sites passed the permissible limits of 0.07 and 0.03 ppm or mg L^{-1} set by WHO and US/California but failed the 10 ppm or mg L^{-1} set by NEPC [10, 12].

DISCUSSION

Air Quality of the Sites: The fact that GRA gave lower carbon monoxide air concentrations is a proof that wastes contribute to gaseous air concentration. The Afikpo Park with more hawking and indiscriminate wastes disposal, coupled with the high traffic contributed more carbon monoxide in the atmosphere. Other sources like power generating sets and drainages that transport waste water and seepages are not ruled out.

When it comes to nitrogen dioxide, the GRA surpassing that of CAS and other centers of activities, but not without the lead of Abakpa market, confirms wastes as another source of this gas. The GRA value may also be traffic related as the difficulty of separating all the possible sources of emissions still persisted.

In terms of atmospheric ammonia concentrations, the GRA and Abakpa market were lower compared to CAS and Afikpo Road Parks; showing where people are more at risk. This also implicates wastes as major generator of ammonia, compared to traffic and power generating sets based on previous studies. The same trend was recorded

for hydrogen sulphide air concentrations in these sites. The same factors for ammonia are also confirmed here. All the coefficient of variations were classed as little based on Aweto [15] ranking of cvs that gave 0 – 20% as little.

Factors Affecting Waste Generation and Disposal:

Several factors influence waste generation in Nigeria. According to Babayemi and Dauda [16] lack of advanced technology, facility for separation at source, strength of waste management policy and enforcement, environmental education and income status of individuals, amongst other factors; affect waste scenario in Nigeria. Abel [17] included education, income and social status to play significant role in per capita waste generation and dumping in Ogbomoso, Oyo State. On the other hand, Sridhar *et al.* [18] described the quantity and categories of wastes with socio-economic groups; with high and middle groups taking the lion share. For Nwachukwu [19] the volume of solid waste generated at Onitsha Metropolis increased with urbanization and population. While, Okpala [20] linked the increased waste generation and dumping in most Nigerian cities to rapid increase in population as well. Adesanya [21] attributed it to poor evacuation of central refuse dump in most Nigerian cities.

Onibokun and Kumuyi [222] attributed urban waste crisis in Nigeria to three fundamental factors namely: rapid increase in urban population; heavy consumption pattern of urban dwellers and inefficiency of the authorities whose statutory responsibilities include efficient waste management in cities. Urban solid waste disposal, according to these workers, are compounded by density, inadequate infrastructure, inadequate disposal sites, poor dumping culture, inadequate enlightenment and information machinery, mixed nature of wastes and poverty.

Methods of Waste Disposal/Dumping and Health/Environmental Consequences:

Scientists define dumping as the discharge, deposit, injection, disposal, spilling, leaking or placing of any solid waste or hazardous waste into or any land or water so that such solid wastes, hazardous wastes or any constituent, thereof may enter the environment or emitted into the air or discharged into any waters including groundwater, from community activities [23].

On the other hand Tajuddin [24] described what should be considered before any method can be adapted for appropriate disposal of waste. They include: refuse

generation, refuse storage, refuse collection and transportation. According to the author, many methods abound namely: burial (landfilling), burning (incineration); recycling (controlled) and tipping. The burial method comprises broken bottles, sanitary landfill composting, which has serious effects on health of man. For instance, nobody would like to have waste burial site within his vicinity because of the harmful effects. After the burial of organic matter, there are leachates that often pollute the aquifers, wells and boreholes. Hole dug in such premises, according to these workers, definitely will not produce portable water for human consumption. Organic matter generates heat when buried, thereby causing the production of methane known as biogas. If methane penetrates further away from the sources of production, it is capable of killing vegetations, with far reaching consequences on man.

Incineration is a common method of disposing waste, but it has its shortcomings: being not an end point itself, but means to an end. It can be open or closed. Recycling on the other hand, refer to recovery of certain solid waste components of waste. Materials that have been recovered from solid waste include paper, cardboard, plastic, glass, ferrous metal. The industries that depend on recovered wastes are paper mill, cardboard factories, steel rolling mills, aluminium industries and plastic industries. The landfilling method has been the most common method of waste dumping generated by different communities for many years [25]. Three types of landfill are integral parts of waste system: open dump, semi-controlled landfill and the sanitary landfill. The majority of urban centers in the developing world use open dumping as their principal method. In Agunwamba [26] records, there were only two landfills in Nigeria in 1998. By 2007, the situation had not changed as Abuja, the capital city of Nigeria, did not have sanitary landfills for waste disposal and all waste from formal collection in the various districts were transported to a single site at Mpape [27].

According to Magizvo [28] open dumps were the preferred (better to say “only available and explored option” methods of landfill in most African countries. In open dumps, refuse is simply dumped in low lying areas such as open lands. Open dumps, according to this worker are characterized by the absences of the engineered measure, no leachate management or consideration, landfill gas management and few, if any operational measures such as registration of users, control of the number of tipped fronts, or compaction of waste. Waste is tipped haphazardly, all kinds of solid waste, whether municipal, industries or clinical/hospital waste are dumped without segregation.

Open dump of waste is a common practice in Nigeria, while some employ the services of streams to transport their solid wastes out of their sights, some directly dump their solid waste by the road sides [16]. In some parts of Nigeria, refuse is generally buried, though some burning is sometimes observed [29]. Several Nigerians have considered it a cheap way of disposing off their solid wastes by setting the mixed waste on fire in a little corner in their backyard or in a very open place. Even mountains of mixed wastes in so called designated places are set on fire, causing serious and dangerous environmental pollution. Some thick and dark smokes from burning of plastic components of electronic have been spiralling up the sky in urban areas. Rice and Saw Millers set the mountain of rice husk (dust) and wood wastes on fire, while awaiting heavy rain to transport the ashes away. These methods are neither hygienic nor safe.

In Nigeria, it generally believed that individuals, governmental agencies pay little or no attention to the environmental impact of waste disposal. Even when it is a statutory responsibility of the parties concerned. Agencies like the Nigeria Environmental Standard, Regulatory and Enforcement Agency (NESREA), Ministry of Environment; Environmental Protection Agency and even local authorities responsible for planning a defined line of action for the disposal and management of wastes generated on daily basis. Unfortunately, many Nigerians believe they have failed in this regard. The reports that refuse dumps have caused traffic delays in some strategic parts of our urban centers as typical examples of failure or poor disposal or management of refuse dumps in Nigerian towns and cities [30].

Environmental and Health Consequences of Wastes Disposal:

The unsatisfactory conditions in which wastes are collected and disposed off, contribute greatly to urban environmental degradation [31]. The UN Secretary-General [32] defined degradation of the environment as activities that can prejudice life itself, as well as the means of livelihood for all. Oguji *et al.* [33] lists pollutants as threat to natural system (plants, animals, land, water and air), human health and aesthetic sensibilities. Oyediran [34] reported that the indiscriminate dumping and poor disposal of waste has various effects on the life of the people and the environment. According to the author, the environment in which one lives, works and plays influence his health and development. Lack of good sanitation constantly exposes half of the world's populations to a range of diseases. Furthermore,

according to the worker, there exist visible features of urban centers in Nigeria where mountains of waste emit foul odours, as well as breeding ground for pathogenic agents.

Bucket and Smith [35] enumerated the consequences of indiscriminate disposal of waste to include: uncollected wastes that often end in drains, causing blockages, which result in flooding and unsanitary conditions. According to Porteous [36] hazardous waste often causes pollution, damage to health and even death. The environmental problem posed by wastes ranges from health hazards, soil and water pollution, repulsive sight; offensive odour and occupancy, to increase in ambient temperature levels. According to these workers, there are worst experiences where the waste is not properly disposed off or managed. The resultant effect of these is the degradation of environmental qualities.

Many workers in Nigeria are of the opinion that the manner of waste disposal in general and the city centers in particular, are central to poor health and environmental deterioration. According to them, domestic and municipal wastes affect water, soil, food quality and this remains the major problem for environmental pollution and disease vectors' menace. Buckets and Smith [35] in addition to effects of heaps of wastes on drainage system blockage and flooding included source of erosion and breeding ground for mosquitoes that causes malaria. According to most of these workers, toxic wastes infiltrate underground water making it unsafe for human consumption. Similarly, are surface water that is polluted through drainage and overland flow. They reduce oxygen concentration of water and promote bacterial activities. The contaminated water causes cholera, typhoid fever, dysentery. Madu [37] included diseases like fly borne, rodent borne and ooziness. The health risks include poisoning, chemical burns and other occupational injuries. Others include irritation of skin, nose and eye gastro intestinal problems, psychological disorders and allergies [38].

CONCLUSIONS

Apart from menace of wastes, there are still some benefits. Some of them have produced what we are currently enjoying as natural resources e.g. crude oil, coal and what is being accumulated now are resources for future generations. Just as life will be incomplete without excretion, so will civilisation be incomplete without wastes. Again, the global physicobiogeochemical cycling of nutrients requires these wastes to ensure nature

continuum. But the onus lies on humanity to judiciously explore and management natural resources and their end products. There can be no world without excretion or generation of metabolites such as carbon dioxide, water vapour, sweat, urine, faeces, tannins, gums, seepage, coal, crude oil, radioactive materials. Life cannot function without these metabolites. Sciences and Arts cannot advance without challenges from these metabolites. Human being is also part of the terrestrial ecosystem and their comfort cannot be compromised on the altar of other environmental variables. Man cannot exist as an entity without living side by side with these environmental and health challenges. It is part of processes that drive human generations. But to each generation lies the task to conquer and occupy the planet at their own risks and perils. Nevertheless, before Abakaliki citizens forget, they must address the problems of indiscriminate waste disposal bearing in mind that every generation is subject to account for their own mess as applicable in all corners of the world.

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