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Effect of Waste Dumpsites on Water and Air Qualities in Abakaliki, Southestern Nigeria

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Author's contribution

The sole author designed, analyzed and interpreted and prepared the manuscript.

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ABSTRACT

An experiment was conducted in Abakaliki Urban to evaluate the effect of the waste dumpsites on air and water qualities. Four replicate water samples were collected from: A – Rain water at CAS Campus (Control- Non-dumpsite); B – River near rice mill waste dumpsite; C – River near domestic waste dumpsite; D – River near timber waste dumpsite. The samples collected from these locations were taken to laboratory for analyses of selected heavy metals (Pb, Zn, Cd, Cu and Cr). Similarly, air was monitored every month for a period of four months for the following gases; NO_2, CO, NH_3, H_2S using portable gas monitors in each of the following sites: A – Non-dumpsite at CAS Campus (control); B – Rice mill waste dumpsite; C – Domestic waste dumpsite; D – Timber waste dumpsite. With exception of Zn and Cr which were non-significant, there was a significant ($p<0.05$) change among the different rivers near the dumpsites in concentrations of Cu, Cd and Pb. Control recorded the lower values of Pb, Zn, Cd, Cu and Cr than the rivers near dumpsites. There was a significant ($p<0.05$) difference in the concentration of CO, H_2S and NO_2 and a non-significant ($p<0.05$) change in NH_3 in the dumpsites studied. Also, the atmospheric environment of the dumpsites had a higher concentrations of CO, H_2S, NO_2 and NH_3 than rain water at CAS campus. With the exception Cd and Pb, these pollutants lie within the acceptable level recommended by World Health organization. This work recommended that a better method of waste management such as reuse, recycling and

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incineration should be adopted in Abakaliki in managing their wastes in order to improve water and air qualities.

Keywords: Dumpsite; environment; pollution and waste.

1. INTRODUCTION

Changes throughout the urban centres in the country over the years, particularly in the demographic expansion have brought about the phenomenal increase in the volume and diversity of waste generated daily in the country. Heaps of refuse and garbage are common sight in the state capitals and urban areas of Nigeria [1]. These large amounts of untreated waste (municipal, industrial and agricultural wastes etc) emptied into the urban environment lead to severe pollution and disruption of its natural ecology [2]. The issue of waste has today become one of the serious environmental problems facing the country due to its potential capacity to cause pollution in the natural environment (water, air, land), degrade structures and monuments (reduction in aesthetic value), and as well pose a lot of hazards to human health and the natural resources of both social and economic importance. [3] purported that pollution is a form of waste and a symptom of inefficiency in industrial production. So if aptly put, one can say that waste and pollution go hand in hand since the presence of the former lead to the occurrence of the latter.

Waste is an unavoidable material resulting from domestic activities or industrial operations and which must be disposed of [4]. It could be liquids, solids and gasses. Pollution is a deadly and monstrous process; no part of our ecosystem is safe at the slightest occurrence of it [5]. So there is need for us to change our everyday habits and practice in pollution prevention to minimize and avoid the creation of waste and pollutants. Waste management is a problem in both rural and urban areas of developing countries. Disposal sites in some developing countries like Nigeria are usually not selected in the line with established criteria aimed at safeguarding environmental and public health [6]. This is the cause of gross inadequacy in waste management in the country. Poorly controlled open dumpsites and illegal roadside dumping and free flow of waste water in open gutters along streets, are common features. So, it is common to find urban streets, roads and drains practically blocked by waste and this contributes to the problem of flood disaster and pollution with its adverse net effects in many of our towns in which Abakaliki urban is not an exception.

The annual average financial resources allocated to sewerage, drainage and refuse services by all the states in Nigeria fell from US$ 163 million between 1981and 1985 to only US$ 1.8 million between 2005 and 2010 [7]. It was not possible to determine the amount allocated exclusively to solid waste services. This was because the national development plan documents 67 that were consulted did not disaggregate the allocation to each category [7]. However, public funds for waste services are not usually adequate, considering the many expanding cities in the country [8]. The objective of this work is to evaluate the effect of waste dumpsites on air and water qualities in Abakaliki South-eastern Nigeria.

2. MATERIALS AND METHODS

2.1 Study Area

The study was carried out at Abakaliki urban which lies at latitude 06° 19′ north and longitude 08°06′ east in the derived savannah of the south-east agro-ecological zone of Nigeria [9] as shown in Fig. 1. Abakaliki was established in 1905 as a station by the British colonial explorers [10] and was in 1906, during the regionalization in the southern protectorate of Nigeria by the British administration elevated to an administrative headquarters for Abakaliki division of the old Ogoja province [11]. Abakaliki being among the thirteen local government areas in Ebonyi state was made the state capital in 1996 [12]. It has an annual rainfall of 1700-1800 mm. The rainfall pattern is bimodal between April-July and September-November with short spell in August. The maximum and minimum temperatures are 30°C and 23°C respectively. The relative humidity of the area is 60 – 80%. The soil belongs to the order ultisol classified as typic haplustult [13].

The rapid influx of population and economic activities into Abakaliki occasioned by its designation and pronouncement in 1996 as the

Ebonyi State capital has led to the physical growth and expansion of the town. Most people living in Abakaliki urban are traders, civil servants, and students.

2.2 Field Methods

Three dumpsites namely rice mill waste dumpsite; timber waste dumpsite; domestic waste dumpsite; and non- dumpsite (control) were selected for the study after the reconnaissance survey of the study area was carried out. Both the air and river water nearer to these dumpsites were studied.

2.3 Water Sampling

Four replicate water samples were collected randomly from: A – Rain water at CAS Campus (control); B – River near rice mill waste dumpsite; C – River near domestic waste dumpsite; D – River near timber waste dumpsite. The samples collected from these locations were taken to laboratory for the analyses of selected heavy metals (Pb, Zn, Cd, Cu and Cr) [14].

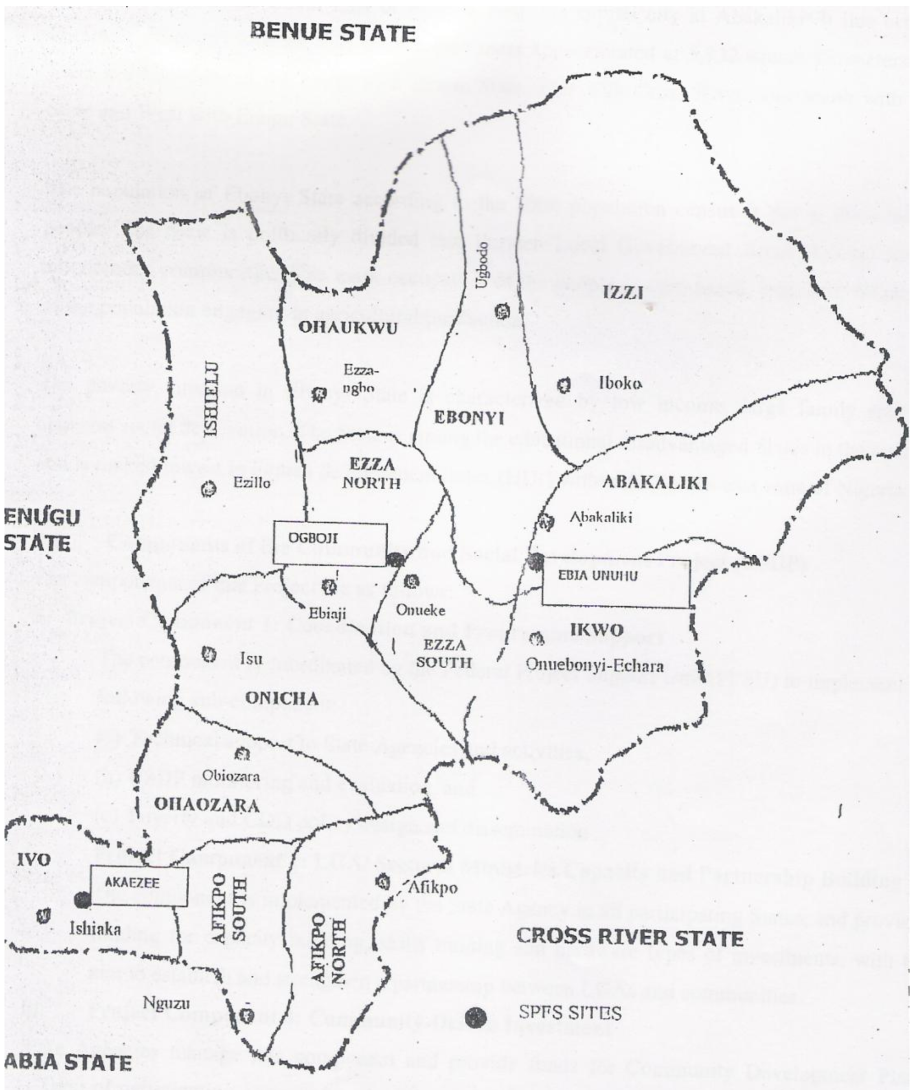

Fig. 1. Map of Ebonyi state showing Abakaliki the study area

2.4 Air Sampling

Air was monitored every month for a period of four months for the following gases; NO_2, CO, NH_3, H_2S using portable gas monitors (GASMAN MODELS) in each sites.

2.5 Data Analysis

The data obtained in both water and air analyses were analyzed using CV%, Standard Deviation, Analysis of Variance (ANOVA) for randomized complete block design (RCBD) and Fishers Least Significant Difference (F-LSD) was used for detecting significant difference between treatment means as recommended by [15].

3. RESULTS AND DISCUSSION

Table 1 shows the concentration of selected heavy metals in rivers near the different dumpsites studied. With exception of Zn and Cr which were non-significant, there was a significant ($p<0.05$) change among the different rivers near the dumpsites in concentrations of Cu, Cd and Pb. Control recorded the lowest copper (Cu) value of 0.5 mg/l. This value was lower than Cu in river near rice mill dumpsite, river near domestic waste dumpsite and river near timber waste dumpsite by 40, 40 and 50%, respectively. This higher Cu concentration in the dumpsite soils might have come from wastes in the dumpsites. The concentration of Cu in the rivers near the different waste dumpsites studied were within the recommended standard (Table 1) meaning that Cu does not accumulate to poisonous for plants, animals and humans consuming water from those rivers. Copper is a micronutrient and plays an important role in human nutrition [16] and when it is above standard it causes gastrointestinal disorder [17]. The work done by [18] in which he reported higher Cu concentration in water bodies nearer to dumpsites than the water bodies located in non-dumpsite zone was in support of this study.

The observed Zn and Cr values in the studied sites were non-significant and are within the standard recommended by [18]. According to [18] Zn is not known to cause any health problem in plants, animals or human beings. Similarly, [14] reported that drinking water with Cr concentration above 0.05 MgL^{-1} causes cancer in human being.

The order of increase in Cd is river near rice mill waste dumpsite>river near domestic waste dumpsite>river near timber waste dumpsite>Control. The Cd values recorded in all the waters studied were above standard (Table 1). According to [5] Cd above the recommended concentration is toxic to kidney. Similarly, control recorded the lowest Pb value of 0.05mg/l while Pb values in dumpsites ranged between 0.06 – 0.08 mg/l. This is in agreement with the work done by [19] who reported increased Pb concentration with an increase rate of urban solid waste applied. Lead values observed in control and rivers nearer the waste dumpsites were above the standard (Table 1). When Pb is above standard, it causes cancer, interfere with vitamin D metabolism, and affect mental development in infants and toxic to central and peripheral nervous system [17].

The effect of different waste dumpsites on NH_3, CO, H_2S and NO_2 is shown in (Table 2). There was a significant ($p< 0.05$) difference in the concentration of CO, H_2S and NO_2 and a non-significant ($p<0.05$) change in NH_3 in the dumpsites studied. The observed values NH_3 were lower in control than dumpsites but are not statistically different to the values recorded in the dumpsites and will not result to adverse environmental effects since they are far below maximum contaminant level [17].

Table 1. Concentration of heavy metals in rivers near different dumpsites (mg/L)

Location	Cu	Zn	Cr	Cd	Pb
A	0.50	0.12	0.01	0.01	0.05
B	0.90	0.16	0.03	0.05	0.06
C	0.90	0.14	0.02	0.03	0.07
D	1.00	0.15	0.04	0.02	0.08
FLSD P = 5%	0.09	NS	NS	0.009	0.014
CV (%)	4.69	NS	NS	13.89	9.23
WHO standard	2.00	3.00	0.05	0.003	0.01

A – Rain water at CAS Campus (Control), B – River near rice mill waste dumpsite, C – river near domestic waste dumpsite, D – river near timber waste dumpsite, NS – Non-significant

Table 2. Effect of different waste dumpsites on NH_3, CO, H_2S and NO_2 (mgm^{-3})

Location	NH_3	CO	H_2S	NO_2
A	0.047	1.74	0.03	0.05
B	0.070	1.86	0.05	0.11
C	0.053	1.90	0.04	0.12
D	0.057	1.83	0.07	0.09
F-LSD (5%)	NS	0.026	0.003	0.011
WHO standard	0.28	30	0.07	0.12

A – Non dumpsite at CAS Campus (Control), B – Rice mill waste dumpsite, C – Domestic waste dumpsite and D – Timber waste dumpsite, NS – Non-significant

Control recorded the lowest CO value of 1.74 mgm^{-3} while the CO in the dumpsites ranged between 1.83 – 1.90 mgm^{-3}. The higher values of CO in waste dumpsites than control might have been attributed the CO emitting from the waste dumpsites. Carbon monoxide is an asphyxiant and interferes with the blood's ability to carry oxygen from the lungs to the body's organs and tissues. With the bloodstream carrying less oxygen, brain function is affected and heart rate increases in an attempt to offset the oxygen deficit [20]. Although, the observed CO in the studied locations were below the maximum recommended concentrations, with continual disposal of wastes in the dumpsites will result to the concentrations above the recommended levels.

The order of increase in H_2S is timber waste dumpsite>rice mill waste dumpsite>domestic waste dumpsite>Control. According [20] H_2S is toxic to living organisms can reacts to H_2SO_4 that can wear and degrade the monuments and roofing sheets. Similarly, control recorded the lowest value of NO_2 value of 0.05 mgm^{-3} while NO_2 in the dumpsites studied ranged between 0.09 – 0.12 mgm^{-3}. This is in line with the work done by [21] in which he reported higher pollutants in the atmospheric environment of dumpsite than the atmospheric environment of non-dumpsite. Similarly, when NO_2 is above the recommended range, it causes respiratory diseases and atmospheric discolouration [20].

4. CONCLUSION

From the results, air and water nearer to dumpsites recorded higher concentration of pollutants than control. With the exception of Cd and Pb which were above the maximum contaminant levels in all the rivers studied, other pollutants studied in both air and water lie within the acceptable level recommended by World Health Organization. Since, the air and water nearer to dumpsites recorded higher values of these pollutants than the control it then means that wastes dumpsites reduces qualities of air and water in the study area. Therefore, in order to improve water and air qualities in Abakaliki, a better method of waste management such as reuse, recycling and incineration should be adopted in Abakaliki in place of waste dumpsite which is currently used in waste management.

COMPETING INTERESTS

Author has declared that no competing interests exist.

REFERENCES

1. Igwe TS, Njoku C, Ogenyi TE. Effect of Industrial Emissions in Atmospheric Environment in South East Nigeria; New Era Research Journal of Human, Educational and Sustainable Development. 2013;6(4):1–7.
2. Ezeifeoma IN. Agro-industrial waste disposed in Abakaliki Urban of Ebonyi State: Implication for Environmental Sustainability. 2004;1–6.
3. Brudtland Commission: Our Common Future: World Commission on Environment and Development Stockholm; 1987.
4. Agbede OA, Agagbe WO. (2004). Solid Waste Management in South Western Nigeria. International Journal of Environmental. 2004;2(1 and 2):92-97.
5. Ogunji JO, Okogwu O, Mgbeafuruike J. Environment biology and waste management principles. Ruga Enterprises; Enugu Nigeria; 2004.
6. Agunwamba JC, Egbuniwe N, Ugwu FI. (2006). Characteristics of Pollutants in Waste Dumpsite. International Journal of Environment. 2006;8(1and 2):184-192.
7. Amuda SO, Adebisi SA, Jimoda LA, Alade AO. Challenges and possible panacea to the municipal solid wastes management in

Nigeria. Journal of Sustainable Development Studies. 2014;6(1):64–70.
8. Ogu VI. Private sector participation and municipal waste management in Benin City, Nigeria Environment & Urbanization. 2000;12(2):103–117.
9. Crown Agents for Overseas Government and Administration: The Nigerian Handboo, Millian Bank. London; 1954.
10. Talbot PA. The People of Southern Nigeria. London: Frank Cass Company Ltd; 1969.
11. Okafor GA, Okpata FO. Emergence of Ebonyi State. The Journey so far. Enugu: Snaap Press Ltd. 1999;1.
12. Echiegu PU. Urbanization and Its physical planning challenges in Abakaliki Capital Environment, Ebonyi State of Nigeria. JSAF. 2007;7(1):49-56.
13. Federal Department of Agricultural and Land Resources: Reconnaissance Soil Survey of Anambra State Nigeria Soil reports, Kaduna, Nigeria; 1985.
14. Alloway BJ. Heavy metal in soil: Halsted Press, John Wiley and Sons Inc, London; 1996.
15. Steel RGD, Torrie JA. (1980): Principles and procedure of statistics. A biological approach 2nd edition (International Student Edition) McGraw-Hill Book Company Inc. New York; 1980.
16. Wright RO, Baccarelli A. Metals and neurotoxicology. Journal of Nutrition. 2007;137(12):2809–13.
17. World Health Organization. Guidelines for drinking water quality. Recommendations. Second Edition, World Health Organization, Genevan. 1993;1:199.
18. Oniboku A. Governance and waste management in Africa. International Development Research Center, Canada; 1999.
19. Aiyesanmi AF, Imoisi OB. Understand leaching behavior of landfill leachate in Nigeria through dumpsite monitoring. British Journal of Environment and Climate Change. 2011;1(4):190–200.
20. Masters GM, Ela PW. Introduction to environmental engineering and science; PHI Learning Private Ltd, New Delhi, India; 2011.
21. Nabegu AB. An analysis of municipal solid waste in Kano metropolis, journal of human ecology. 2010;31(2):111 – 119.

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