AIR QUALITY ASSESSMENT AND WILDLIFE INCIDENCE AROUND A MAJOR DEFORESTATION SITE IN ODUAL CLAN OF RIVERS STATE

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Abstract: This study was carried out in Odual Clan in Abua/Odual local government area of Rivers State, Nigeria, to determine the effect of deforestation on air quality and wildlife. Three air pollutants were measured at the study sites (CO_2, CH_4, PM) It was observed that the mean concentrations of CO_2 (970.5000000ppm, 548.1250000ppm, 690.2500000ppm) in all the study sites were above the permissible limits by WHO. The mean concentration of Pm_7 (17.6250 µg/m³) in the deforested area was significantly higher than those of the control (7.1250 µg/m³) and the residential area (11.2500 µg/m³). The mean concentration of PM_{10} ranges from 9.2500 µg/m³ to 21.1250 µg/m³ with the deforested area having the highest concentration. T-test revealed a significant difference in the mean concentration of TSP with the deforested area having the highest concentration of 24.5000 µg/m³. Results (68% of respondents) also revealed that there is a loss of wildlife species. The causes of degradation according to the results obtained are chain sawing, illegal farming, over exploitation and illegal mining; 36%, 2%, 26% and 6% respectively

Keywords: Deforestation, air quality and wildlife

INTRODUCTION

Forest covers almost a third of the earth's land surface and providesimportant environmental benefits including soil conservation, climate change mitigation, and preservation of biodiversity and plays a major role in the hydrologic cycle (Sheram, 1993). According to World wildlife Fund, (2016) the forest plays a critical role in mitigating climate change through the carbon sink function, by absorbingatmospheric carbon dioxide that would otherwise be contributingto adverse changes in climate patterns. Forest ecosystem store more than 80% of all terrestrial aboveground carbon (St Clair*et al*, 2005). Deforestation however, undermines the important carbon sink function of the forest asithas been estimated that 25% of all greenhouse gas emissions arise as a result of deforestation (Rhett, 2005). TheForest can act either as a carbon source or as carbon sink, it is considered to be a carbon source when it releases more carbon than it absorbs. Forest carbon is released when trees are fell, burnt, or when they decay after dying as a result of old age, fire, insect attack and other disturbances.Carbon dioxide (CO_2) constitutes 72% of the total anthropogenic greenhouse gases, itis considered one of the most abundant greenhouse gases and a major agent of global warming(Kiehl and Trenberth, 1997). According to report, CO_2 in the atmosphere increased from 280 ppm in the pre-industrial era to 379 ppm in 2005, and is increasing by 1.5ppm annuallydue to human activitiessuch as the burningof fossil fuel, land-use changes and deforestation (IPCC 2001, IPCC (2007). Ideriah *et al*, (2011) reported that traffic density influenced the concentrations of THC and VOC in plant leaves and THCs and VOCs are emitted from a variety of sources including motor vehicles, chemical plants, refineries, factories, consumer and commercial products and other industrial sources.

Deforestation impacts negatively on biodiversity, water sources, soil and the climate (Benson and Yilmaz, 2022).Prejapati (2012) reported that the indiscriminate burning of forests degrades air quality by the release of airborne suspended particulate matter (SPM). Emerhi *et al* (2012)reported high concentrations of particulate matter (TSP, PM_7 and PM_{10})in parts of a fast developing metropolis of the Niger Delta, Nigeria as a result of industrial and commercial activities.Increase in CO_2 concentration, along with other greenhouse gases (GHG), as a result of deforestation has raised concerns over global warming and climate changes. Nigeria's forest cover in 2000 was estimated at 13.5 million hectares compared to 17.5 million hectares in 1990 (FAO, 2005), indicating a forest cover loss close to 400 thousand hectares per annum, or a decline of about 2.6%. In the year 2005, UNFAO (United

Nations Food and Agriculture Organization) graded Nigeria as the nation with the highest rate of deforestation in the world, with about 55.7% of the primary forest lost at an annual deforestation rate of 3.5%,at such an alarming rate, the Nigerian forest ecosystems faces a serious threat of degradation and a corresponding rise in greenhouse gases. The removal of trees and other types of vegetation reduces available food, shelter, water and breeding grounds for wild animals, deforestation therefore, threatens the existence of wildlife species by impacting on the wildlife habitats (Abere, 2016). This study is designed to assesswildlife incidence and air quality around a major deforestation site in Odual clan of Abua/Odual local government area of Rivers State.

MATERIALS AND METHODS

Study Area

The study site is located in the Odual clan of Abua/Odual local government area of Rivers State, having an area of about 433km^2, a population of 30,028 at the 2006 census (NIPOST, 2009), and lies between latitude 4.8298° North and longitude 6.5674°East with an elevation of 24meters (79 feet). The climate is marked with two distinct seasons; the wet and dry seasons. The wet season has its peak in June/July and September with a period of lower precipitation known as the August break while the dry season lasts from November to March. The annual rainfall ranges between 788mm to 1884mm. Cloud cover is high above 89% during the wet season and 50-60% in the dry season. Mean annual temperature is about 26.2°c and ranges from an average maximum of 31.2°c. Relative humidity follows the pattern of rainfall.

Sample Technique/ collection

Sample locations were selected at random using the systematic random sampling method. A total of 24 sampling sites were selected for the study. 8 locations at the control (SITE 1), 8 locations within the forest (SITE 2) and 8 locations in the residential area (SITE 3) for determination of air pollutants. On each site, two measurements were taken each at 0m and 20m at the North, South, East and West directions. A total of 48 measurements were made, 16 on each site. measurement of air pollutants were taken in all sampling stations. Three air pollutants were monitored in the study area; Carbon dioxide (CO_2), Methane (CH_4) and Total Suspended Particulate (TSP). Particulates were measured according to their mean aerodynamic sizes of PM_1, $PM_{2.5}$, PM_7, PM_{10}.

The Complete Randomized Design (CRD) was used for the analysis of data colected. Means were seperated using Duncan's Multiple Range Test (DMRT) at P≤0.05.

Table 1: Identification of study sites with geographical references

STUDY LOCATIONS	DIRECTION	DISTANCE(M)	GPS
SITE 1	NORTH	0	N04^{0}54'115.76/ E0626.371.16
		20	N0454'15.61/ E0626'37.58
	EAST	0	N0454'15.66/ E062637.84
		20	N0454'16.11/ E062637.78
	WEST	0	N0454'16.11/ E062636.22
		20	N0454'15.09/ E0626'35.40
	SOUTH	0	N0454'16.29/ E062636.86
		20	
SITE 2	NORTH	0	N04511.34/ E062810.10
		20	N04513.36/ E06283.81
	EAST	0	N04512.35/ E0628'448.90
		20	N04513.30/ E062850.11
	WEST	0	N0451'2.90/ E0628'50.56
		20	N0451'2.86/ E062852.78
	SOUTH	0	N0451'3.27/ E06285.60
		20	N0451'4.35/ E062849.32
SITE 3	NORTH	0	N045413.27/ E062625.70

	20	N0454'11.49/ E062621.24
EAST	0	N045414.18/ E062623.53
	20	N045414.18/ E062622.74
WEST	0	N045413.81/ E062624.24
	20	0454'14.35/ E062623.37
SOUTH	0	N0454'13.02/ E062628.01
	20	N045415.40/ E062622.24

Suspended Particulate Matter

An Aerocet 531 Particle Mass Monitor was used to measure PM_1, $PM_{2.5}$, PM_7, PM_{10} and Total Suspended Particle (TSP). Measurements were done by holding the sensor to a height of about two meters in the direction of the prevailing wind and readings recorded at stability.

Methane and Carbon dioxide

An Aeroqual Multi Gas Monitor equipped with infrared sensor was used for the measurement of Methane. The range of detection was between 1- 100 ppm with alarm set at 10 and 20 %. Measurements were done by holding the sensor to a breathing height of about 1.5 meters in the direction of the prevailing wind, readings were taken at stability and recorded when the monitor had warmed up sensors.

Wildlife Incidence

The Odual clan is made up of 7 communities; Adada, Anyu, Emelego, Ekunuga, Ogboloma, Emaarikpoko, Obedum and Odau communities. Five out of the seven communities were randomly selected and questionnaires administered. Ten questionnaires were administered in each community, making it a total of fifty questionnaires. The questionnaire was structured to cover; Demographic data, effects of deforestation on wildlife habitats and effects of deforestation on wildlife species. The questionnaires were administered to local government staffs, hunters, farmers, fishermen and other residents. Oral interviews were also conducted during the course of the study.

RESULTS

Air Quality Measurements

The result on Particulate matter (PM_1, $PM_{2.5}$, PM_7 and PM_{10}), Carbon dioxide (CO_2) and Methane (CH_4) are given in Tables 2, 3 and 4 respectively.

Table 2: Mean Concentration of Particulate Matter

STATION	PM_1 (µg/m³)	$PM_{2.5}$ (µg/m³)	PM_7 (µg/m³)	PM_{10} (µg/m³)	TSP (µg/m³)
1	0.0000^b	127.0000^b	7.1250^b	9.2500^b	11.3750^b
2	0.3750^b	4.7500^b	17.6250^a	21.1250^a	24.5000^a
3	0.5000^b	4.8750^b	11.2500^b	12.1250^b	13.2500^b

Within columns, means with different subscripts are significantly different at $P \leq 0.05$ using Duncan Multiply Range Test (DMRT).

The mean concentrations of Pm_1 and $Pm_{2.5}$ recorded in all the sites were not significantly different. However, the mean concentration of Pm_7 (17.6250 µg/m³) in SITE 2 was significantly higher than that of SITE 1(7.1250 µg/m³) and SITE 3 (11.2500 µg/m³). The mean concentration of PM_{10} ranges from 9.2500 µg/m³ to 21.1250 µg/m³ with SITE 2 having the highest concentration. T-test revealed a significant difference in the mean concentration of TSP with SITE 2 having the highest concentration of 24.5000 µg/m³.

Table 3: Mean Concentration of Carbon dioxide

STATION	MEAN CONCENTRATION (ppm)	STANDARD ERROR
1	548.1250000[b]	±58.49524935
2	970.5000000[a]	±142.94354530
3	690.2500000[b]	±10.53183948

Within columns, means with different subscripts are significantly different at P ≤ 0.05 using Duncan Multiply Range Test (DMRT).

The mean concentration of carbon dioxide recorded in SITE 2 (970.5000000ppm) was significantly higher than those recorded for SITE 1(548.1250000ppm) and SITE 3(690.2500000ppm).

Table 4: Concentration of Methane (CH_4)

STATION	MEAN CONCENTRATION ppm	STANDARD ERROR
1	1.3750000[a]	±.98084330
2	.0000000[b]	±.00000000
3	.0000000[b]	±.00000000

Within columns, mean with different subscripts are significantly different at P ≤ 0.05 using DMRT
Methane was recorded in only SITE 1 with a mean concentration of 1.3750000ppm.

Wildlife Incidence

Results on the demographic characteristics of the respondents (sex, age, and marital status, and occupation, level of education and duration of stay in the community) are given in table 5.

Table 5: Demographic Characteristics of Respondents:

Demographic characteristics	Frequency (n=50)	Percentage
SEX		
Male	30	60%
Female	20	40%
AGE		
25 and below	6	12%
26-35	18	36%
36-45	16	32%
46-55	7	14%
Over 55	3	6%
MARITAL STATUS		
Married	21	42%
Single	18	36%
Separated/Widow(er)	11	22%
RELIGION		
Christianity	41	82%
Others	9	12%
EDUCATIONAL QUALIFICATION		
Below Secondary	14	28%
Secondary	19	38%

Tertiary and above	12	24%
None	5	10%
OCCUPATION		
Farming	12	24%
Hunting	4	8%
Students	4	8%
Civil Servants	4	8%
Traders	5	10%
Timber Operators/Dealers	9	18%
Motor Cycle Riders	5	10%
NTFP collectors	6	12%
Unemployed	1	2%
DURATION OF STAY (YEARS)		
1-4	4	8%
5-9	7	14%
10-14	10	20%
15 years and above	29	58%

Table 6: EFFECTS OF DEFORESTATION ON WILDLIFE AND ITS HABITAT

Description	Frequency (n-50)	Percentage
Benefited from forest resources		
Yes	100	100
No	0	0
State of the forest 5 years and beyond		
Intact with no harvesting	7	14%
Close canopy with harvesting	39	78%
Open canopy with harvesting	3	6%
Others	1	2%
Present State of the Forest		
Very good	2	4%
Good	20	40%
Poor	24	48%
Very Poor	6	12%
Any community involvement in forest protection		
Yes	1	2%
No	49	98%
Causes of forest degradation		
Illegal mining	3	6%
Illegal farming	16	32%
Chain sawing	18	36%
Over exploitation of timber resources	13	26%
Most impacted component of the Forest environment		
Vegetation	17	34%
Wildlife	19	38%
Water	10	20%
Air	4	8%
Are therewildlife species found 5 years ago that are no longer seen		
Yes	34	68%
No	16	32%
Threat to wildlife		

Hunting	6	12%
Logging	21	42%
Farming	19	38%
Others	4	8%

DISCUSSION

It was observed from the results given in table1 that the mean concentration of Pm_7, PM $_{10}$ and the TSP (17.6250µg/m^3, 21.1250µg/m^3 and 24.500µg/m^3 respectively) was highest in SITE 2 being the forest area where massive deforestation was observed. This might however be as a result of palm oil production activities ongoing at that site.

The mean concentrations of particulate matter recorded were compared with permissible limits recommended by the Federal Ministry of environment (1991) and were found to be below limits. The concentration of TSP in all stations were below the permissible limits of 100mg/m^3 and therefore do not pose any threat to the environment. Similarly, $PM_{2.5}$ and Pm_{10} showed concentrations much lower than the United States Ambient Air Quality Standards of 25µg/^{m3} and 50µg/m^3 respectively on a 24 hour mean.

However, the mean concentration of CO_2 recorded in all the sites (Table 2) were above the maximum standard natural concentration (600ppm) of CO_2 in fresh air and above the recommended WHO Threshold Limit Value of 500ppm safe for an adult within an eight-hour working day. This high level of CO_2 recorded at the study area might be attributed to the release of CO_2 caused be tree felling as proposed by WWF, 2016 and Pinker, 1980, that deforestation increases the concentration of CO_2 in the atmosphere.

Results from table 5 shows that majority of the respondents are farmers (24%) followed by timber business men which recorded 18%. of the total respondents, 58% have stayed in each respective community for a period of 15 years and beyond. 1-5, 5-9-, and 10-14-years duration were 8%, 14% and 20% respectively. In table 6, 100% of the respondent agreed they obtain benefits in accessing the forest resources. 78% of the respondents were of the opinion that the forest had a close canopy even with harvesting five years ago and beyond. Majority (48%) of respondent were of the opinion that the state of the forest is currently poor. Only 2% of the respondents were of the opinion that the community is involved in protecting the forest. The causes of degradation according to the results are chain sawing, illegal farming, over exploitation and illegal mining; 36%, 2%, 26% and 6% respectively. 38% of the respondents were of the opinion that wildlife is the most impacted of the environmental components while another 38% were of the opinion that the vegetation is the most impacted. 68% of respondents agreed that there is a loss of wildlife species. This result is in agreement with WWF, 2017 report, which states that "forest is vulnerable to deforestation and when wildlife loses their homes, they become more accessible to a hunter which leads to decrease in their population and sometimes extinction.

CONCLUSION

The need for timber, new farm lands and forest products has forced the residents of Odual clan to venture deeper into the forest. The forest ecosystem therefore has been depleted considerably as a result of human activities which include farming, logging and exploitation of the forest resources. Wildlife population have also been reduced considerably and some species are perceived to have gone into extinction as a result of deforestation. Air quality within the clan is also poor as results have shown concentrations of $C0_2$ higher than recommended standards. Appropriate measures should be taken by the Government and the leaders of communities to control the ever-growing problem of forest depletion/deforestation.

REFERENCES

1. Abere S. A. (2016). Causes and Effects of Deforestation, AfricanSociety for Scientific Research; with reference to The Proceedings of the first International Technology, Education and Environment conference.

2. Benson Njora and Hasan Yilmaz (2022) Analysis of The Effects of Deforestation on the Environment and Agriculture in Kenya. *Int. Journal of Water Management and Diplomacy. Issue 4 e-ISSN:2717-8277*
3. Emerhi, E.A., Ideriah, T.K.J and Trinya, W. (2012). Distribution of Ambient Suspended Particulates and Volatile Organic Carbons in a Fast Developing Metropolis in the Niger Delta. *International Journal of Recent Trends in Science And Technology, E-ISSN 2249-8109, Vol 2(2) 09-24*
4. FAO (2005). "Mobilizing resources to halve world hunger". Paper prepared for the 2005 worldSummit, Rome.
5. Federal Ministry of Environment (1991). Guidelines and standards for Industrial effluents, gaseous emissions and hazardous waste management in Nigeria.
6. Ideriah, T.J.K., Emerhi, E.A., Abere, S.A. and Trinya, W. (2011). Levels of Total Hydrocarbon Content in Plants along Selected Roadsides in Port Harcourt Metropolis, Nigeria. *Journal of Agriculture and BiologicalSciences, 2,(3), 065 – 070.*
7. IPCC, 2001: Climate Change 2001: The Scientific Basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change [Houghton, J.T., Y. https://www.ipcc.ch › uploads › 2018/07 › WG1_TAR_FM

8. IPCC, 2007: Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L.https://www.ipcc.ch › uploads › 2018/03 › ar4-wg2-intro
9. Kiehl, J.T. and Trenberth, K.E. (1997) Earth's Annual Global Mean Energy Budget. Bulletin of the American Meteorological Society, 78, 197-208. https://doi.org/10.1175/1520-0477(1997)078%3C0197:EAGMEB%3E2.0.CO;2
10. Prejapati,S.K. (2012) Ecological Effect of Airborne Particulate Matter on Plants. *Journal of Environmental Skeptics and Critics,1(1):12-22*
11. Rhett, A. B. (2005) Deforestation Causes 25% of Greenhouse Gas Emission. Conservation News at Mongabay.com accessedat https://news.mongabay.com/2005/12/deforestation-causes-25-of-greenhouse-gas-emissions
12. Sheram, K. 1993. The Environmental Data Book. The World Bank, Washington DC.
13. St. Clair, J.B., Nancy, L., Mandel, K.W., &Vance Borland (2005) genecology of douglas fir in western oregon and Washington. *Journal of Annal Botany 96 (7) 1199-1214.*