



Received: 16-03-2024  
Accepted: 26-04-2024

ISSN: 2583-049X

## **Geospatial Characterization of the Polycyclic Aromatic Hydrocarbons (PAHS) in the Wetlands of Uzere Oil Bearing Community Delta Nigeria**

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### **Abstract**

This study is an ex-post facto research that investigated the concentration of PAHs in the wetlands in Uzere oil bearing community. The study answered four research questions and tested a hypothesis. To accomplish these, the study area was mapped out into research grids corresponding to the quarters in Uzere and 5 wetlands were randomly selected. Water samples were collected from 5 spots in each deploying grab sampling technique at 10cm depth and covered subsurface. The samples were bulked, composites drawn, fixed with HNO<sub>4</sub> and stored in ice cooled boxes for analysis. The analytical standard adopted was EU/1881/2014 and the instrument of determination deployed was Agilent GC/MS Triple Quadrupole 7000 model. The mean results obtained were; pyrene 1.03±0.10 µg/l, chrysene; 1.04±0.01 µg/l, BaP;

1.03±0.00 µg/l, BaA; 1.03±0.01 µg/l and BbF; 1.04±0.01 µg/l. The mean results were further subjected to test of significance with ANOVA using SPSS model 29 (IBM) at 0.05 level of significance and the *p* value was 0.42 thus rejecting H<sub>0</sub>. The study concluded that the wetlands in Uzere are polluted higher than EU recommendations thus the produce are not fit for human and for animal consumption. The produce can also not be exported. The study recommended that the oil company should be mindful of the environment and adopt world best practices in its operation, the monitoring agency (NESREA) should increase its surveillance on the oil company's activities and the impacted wetlands should be remediated.

**Keywords:** Wetland, Oil Production, PAHs Contamination, Human Health, Remediation

### **Introduction**

Polycyclic aromatic hydrocarbons (PAHs) are a class of organic compounds that are ubiquitous in nature as they occur in all strata of the biosphere. They are hydrocarbons with mono, di or poly benzene rings in various structural configuration (Ahad *et al.*, 2015, Afreen *et al.*, 2015, Adisa *et al.*, 2015) [16, 12, 9]. PAHs consist of only hydrogen and carbon in simple to complex form with their benzene ring arrangement exhibiting wide variability and diversity in chemical, physical and toxicological characteristics. (Ogwu *et al.*, 2022 [23], Ogwu *et al.*, 2021 [22], Adeyeye *et al.*, 2016). PAHs neither carry substitutions nor heteroatoms with those having four benzene rings being referred to as light while PAHs having more than 4 benzene rings being referred to as are heavy and are more stable (Adam *et al.*, 2015 [4], Ogwu *et al.*, 2021 [22], Adedosu *et al.*, 2011). PAHs have low vapour pressure and high boiling points (Abdulahi *et al.*, 2013, Abrahamson *et al.*, 2014, Achten and Hofmann, 2009 [3]), and are non-polar neutral molecules with hydrophobicity varying according to their molecular weight (Adonis and Git, 2007, Aemig *et al.*, 2015, Atshar-Mohager *et al.*, 2015).

Epidemiological studies have implicated PAHs in exacerbation of asthma, reduced lung functions, cardiovascular diseases, increased rate of obstructive lung disease and carcinogenic (Adetera *et al.*, 2015; Ogwu *et al.*, 2021 [22], Ogwu *et al.*, 2020 [24], Adedosu *et al.*, 2015). PAHs are produced by high pressure processes (incomplete combustion) and they are found occurring in gasoline coal and in crude oil.

Uzere is an oil-bearing community playing host to many oil exploration and exploitation companies it has 43 oil wells yielding 53,000 barrels of crude daily (Nigeria National Petroleum Company (NNPC), 2023, Nigeria Upstream Regulatory Commission (NUPRC), National Bureau of Statistics (NBS), 2023). Oil production results in oil spillage into the environment occasioned by wellheads blowout, pipelines rupture, equipment failure and vandalism (Okonkwo, 2020, Alhassan, 2018, Ioyern, 2019). Ballast water, tank wash (Eromosile and Odion, 2022, Ogwu *et al.*, 2022 [23], Adegbesan, 2023). Oil spills pollute the lands,



the depth of 10cm and covered subsurface. The samples from each were bulked, composites drawn, fixed with nitric acid and stored in ice cool boxes for analysis.

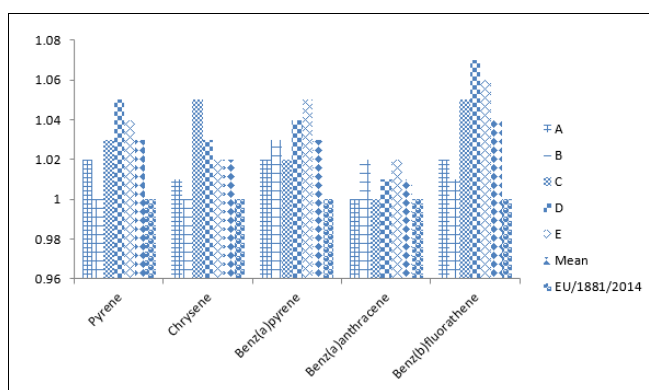
**Analysis of samples**

The analytical standard used in this study was European Union 1881/2014 as described in (Adeyeye *et al.*, 2016, Agarwal *et al.*, 2009). 5ml of samples of the wetland water were measured out into 25 mL centrifuge polypropylene tube and 15ml ethylene acetate 1:1 v/v was added. The mixtures were vortexed for 2 minutes and this was followed by sonication of the centrifuged which was operated at 4500r/minute for 2 minutes. 5 ml vial was used in collecting the upper phase and the samples were injected into Agilent chromatography model 7000 Tripple Quadrupole. Column purification was done with 300 x 25mm styrene divinylbenzene copolymer gels. The mobile phase of the instrument was ethylene acetate cyclohexane calibrated at 2ml/mn. The effluents were used for the determination of the PAHs concentrations.

**Results**

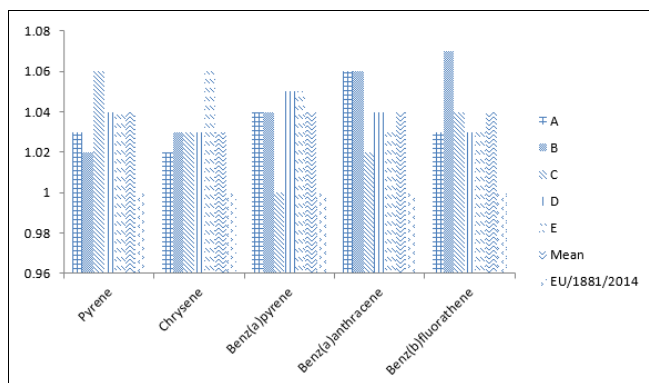
The results of the PAHs content of wetlands water in Uzere were as in Figures 2-6 and the comparative mean result in Fig 7.

The result of the PAHs content in the wetlands in Uhei were as in Fig 2.



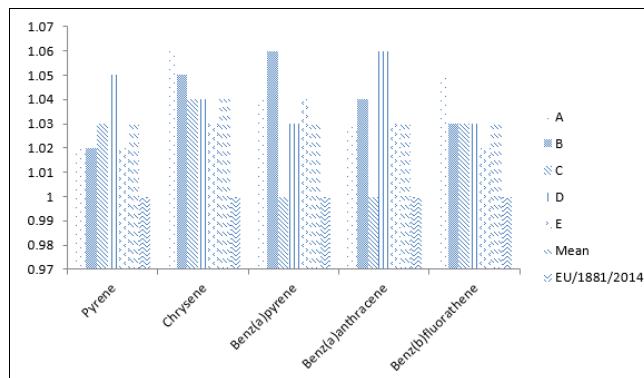
**Fig 2:** Results of the PAHs content in the wetlands in Uhei and the EU 1881/2014 MPC for PAHs in wetland water in  $\mu\text{g/l}$

The results of the PAHs content in Ezedo wetlands were as in Fig 3.



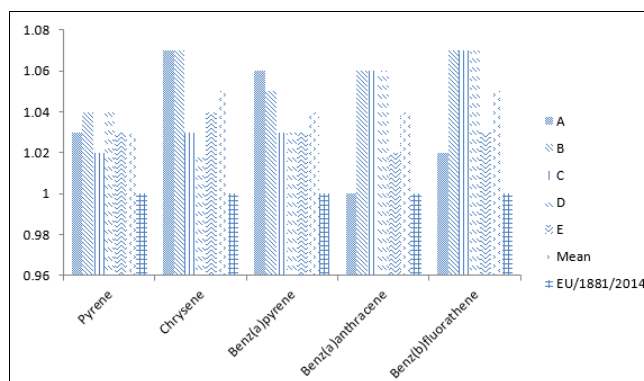
**Fig 3:** Results of the PAHs content in the wetlands in Ezedo and the EU 1881/2014 MPC for PAHs in wetland water in  $\mu\text{g/l}$

The results of the PAHs content in the wetlands in Afikioko were as in Fig 4.



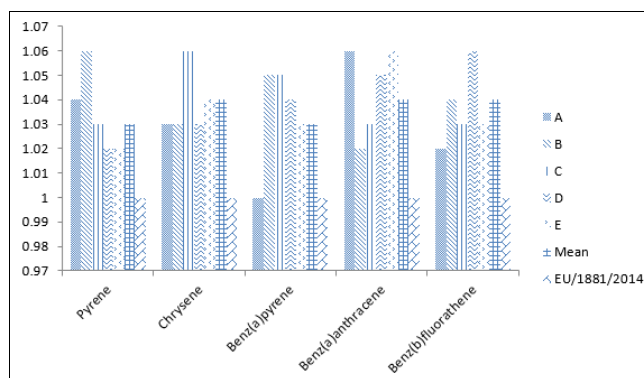
**Fig 4:** Results of the PAHs in the wetlands in Afikioko and EU 1881/2014 MPC for PAHs in wetland in  $\mu\text{g/l}$

The results of the PAHs content of the wetlands water in Abale were as in Fig 5.



**Fig 5:** Results of the PAHs content of the wetland in Abale and EU 1881/2014 MPC for PAHs in wetland in  $\mu\text{g/l}$

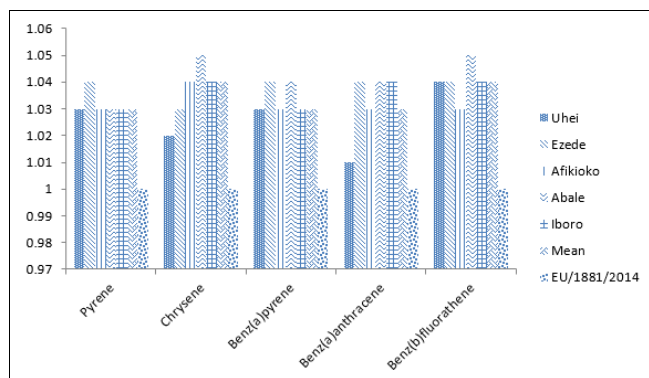
The results of the PAHs in the wetlands in Iboro were as in Fig 6.



**Fig 6:** Results of the PAHs content of the wetlands in Iboro and the EU 1881/2014 MPC for PAHs in wetland water in  $\mu\text{g/l}$

The groups mean results of the PAHs in the wetlands in Uzere oil bearing community were as in Fig 7.





**Fig 7:** Results of the means of the PAHs in the wetlands in Uzere and EU 1881/2014 MPC for PAHs in Wetland water in µg/l

The means results obtained for PAHs in the wetlands in Uzere were subjected to test of significance using special package for the social sciences (SPSS) model 29(IBM) at 0.05 level of significance and the  $p$  value was 0.42 thus rejecting  $H_0$ .

### Discussion of Findings

Wetlands contamination with PAHs as concomitant effect of industrial effluent discharges is a global phenomenon as researches are abound in so many other climes but researches on wetlands contamination of PAHs in Uzere wetlands and environs remain unavailable and that mandated this study.

The study of the PAHs concentrations in wetland in Uzere presented varying concentrations of the variables. The concentration of pyrene in the wetlands in Uzere range from 1.03µg/l in Uhei, Afikioko, Abale and Iboro to 1.04 µg/l in Ezede with a group mean of 1.03 µg/l. This increased content of pyrene is anthropogenic. This report is similar to (Norden *et al.*, 2015, Nigha *et al.*, 2015, Ogwu *et al.*, 2021<sup>[22]</sup>) Pyrene have been implicated in cancer of the lungs and throat (Argawal *et al.*, 2014, Olssan *et al.*, 2010, Orecchio *et al.*, 2016<sup>[34]</sup>).

The wetlands water analysis in Uzere revealed the concentrations of chrysene to be between 1.02 µg/l in Uhei to 1.05 µg/l in Abale with a mean of 1.04 µg/l. This elevated content of chrysene is attributable to the oil activities and discharges into the wetland ecosystem. This report is a corroboration of the reports in (Oliva *et al.*, 2012, Ogwu *et al.*, 2021, Osawaru *et al.*, 2016)<sup>[32, 22, 35]</sup>. Epidemiological studies implicated chrysene in exacerbation of asthma and cardiovascular diseases (Pazos *et al.*, 2010, Pena *et al.*, 2015<sup>[42]</sup>), skin irritation (Ozaki *et al.*, 2015)<sup>[36]</sup>.

Analysis of the Uzere wetlands water for the contents of BaP showed that the concentrations were between 1.03 µg/l in Uhei, Afikioko and Iboro to 1.05 µg/l in Ezede and Abale with a mean of 1.03 µg/l. High content of BaP in wetlands were in reports of (Paoli *et al.*, 2015<sup>[37]</sup>, Pava *et al.*, 2012, Patil *et al.*, 2014<sup>[40]</sup>). Health implication of ingestion of BaP contaminated foods include cancer of the gastrointestinal tracts, obstructive lung disease (Shamsiper *et al.*, 2015, Shih *et al.*, 2016<sup>[47]</sup>), cardiovascular disease (Shen *et al.*, 2014, Ogwu *et al.*, 2022)<sup>[46, 23]</sup>.

Uzere wetlands water analysis for the contents of BaA revealed varying concentrations of 1.01 µg/l in Uhei to 1.04 µg/l in Ezede, Abale and Iboro with a mean concentration of 1.03 µg/l. This report is in agreement with the reports in (Song *et al.*, 2013<sup>[51]</sup>, Sundt *et al.*, 2012<sup>[52]</sup>, Tang *et al.*,

2013). Health problems associated with BaA contamination include lung cancer, cancer of the bone marrow, osteoporosis (Tinbel *et al.*, 2013, Zhi *et al.*, 2015<sup>[56]</sup>), increased rate of obstructive lung disease (Zheng *et al.*, 2012)<sup>[55]</sup>.

The analysis of the wetlands water in Uzere presented different concentrations of BbF ranging from 1.03 µg/l in Afikioko to 1.05 µg/l in Abale with a mean concentration of 1.04 µg/l. This increased content of BbF is EFFECT of man's interaction with environment through oil production and it is in tandem with the reports in (Snyder *et al.*, 2014, Ogwu *et al.*, 2022, Slezakova *et al.*, 2013)<sup>[50, 23, 49]</sup>. BbF has been fingered in various health problems ranging from skin cancer, cancer of the gastrointestinal tract, lung cancer (Shukla *et al.*, 2010, Pham *et al.*, 2013, Perra *et al.*, 2011)<sup>[48, 44, 43]</sup>. Cardiovascular disease, bone disease (Pazos *et al.*, 2010, Pena *et al.*, 2015<sup>[42]</sup>, Ogwu *et al.*, 2022<sup>[23]</sup>).

### Conclusion and recommendations

Reports on wetlands contamination is replete in the researches in cyberspace especially contamination emanating from industrial activities of oil activities. The analysis of the wetlands water of Uzere has further affirmed the reports in research domain of the environmental degradation occasioned by oil activities. The analysis of the wetlands in Uzere showed that the content of the PAHs measured were higher than the level stipulated by EU/1881/2014. High content of the PAHs in the wetlands have made the produce from Uzere unhealthy for human consumption and equally unhealthy for their utility for animal feeds formulation. The produce can also not be exported because of the failure to scale Codex 1963 (Codex Alimentarius Commission) standards for agricultural produce exports.

Consequent upon these, the study recommended that;

1. oil company (shell Oil Company) operating in Uzere should take the environment into consideration and operate with mantra of sustainable development in its activities.
2. monitoring agency, Nigeria Environmental Standards Regulation and Enforcement Agency (NESREA) should carry out its duties more expeditiously.
3. The impacted environment should be remediated to return the wetlands ecosystem to their original pristine states.

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