

# Determination of the Polycyclic Aromatic Hydrocarbons (PAHs) Content of the Wetlands in Utagba-Ogbe Oil and Gas Bearing Community Delta Nigeria

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## ABSTRACT

### Background:

Oil exploitation most often than none comes with environmental degradation issues with concomitant effects on human health. This study therefore investigated the PAHs (Polycyclic Aromatic Hydrocarbons) content in wetlands in Utagba-Ogbe an oil bearing community to establish the suitability of capture and culture fish for human consumption and for animal feeds.

### Materials and Methods:

Four research questions were answered and a hypothesis tested. In achieving these, the wetlands in Utagba Ogbe were mapped out into component quarters they are found. Grab sampling technique was adopted and the samples collected were bulked, composite drawn and fixed with  $\text{HNO}_4$  and stored in ice cooled boxes for analysis. The analytical method adopted was EU 1881/2014 for PAHs in wetland and the instrument of determination was Agilent GC/MS 7000 Triple Quadrupole.

### Result:

The results obtained were; pyrene  $1.03 \pm 0.1 \mu\text{g/l}$ , chrysene,  $1.02 \pm 0.1 \mu\text{g/l}$ , BaP,  $1.04 \pm 0.11 \mu\text{g/l}$ , BaA,  $1.05 \pm 0.10 \mu\text{g/l}$  and BbF,  $1.04 \pm 0.11 \mu\text{g/l}$ . The mean results of the parameters investigated were subjected to test of significance with ANOVA using SPSS model 29 (IBM) and the  $P$  value was 0.43 thus rejecting  $H_0$ .

### Conclusion:

The study concludes that the wetland in Utagba-Ogbe are polluted with PAHs above EU 1881/2014 Maximum Permissible Concentration thus making the produce from the wetlands unfit for both human and animal consumption. They are also not suitable for export. The study recommended that the oil companies operating in Utagba-Ogbe should be mandated to adopt the world best practices in their operations, the monitoring agencies enjoined to carry out their duties expeditiously and the impacted wetlands should be remediated.

**Keywords:** wetlands, oil extraction, PAHs contamination, human health, remediation

## INTRODUCTION

Wetlands are one of the most complex ecosystems on planet Earth and they exist in varying degrees in almost all the continents of the world. They are special, and distinct, clearcut ecosystem that are saturated with water and partially or permanently flooded for most periods of the year.<sup>1,2,3</sup> It is an area where water is present in the soil near the surface or where water covers the soil most period of the year.<sup>4,5,6,7</sup> Wetlands are areas in which land is seasonally or permanently covered with fresh, brackish or marine water.<sup>8,9,10</sup> They are areas of marsh, fen, peatland or water, whether natural or artificial, temporary or permanent with water that is static or flowing, fresh brackish or salt, including areas of marine waters, the depth of which at low tides does not exceed six meters.<sup>11,12,13</sup>

Wetlands are habitat for innumerable species of both terrestrial, aquatic animals and plants.<sup>14,15,16,17</sup> Wetlands riparian vegetation help purify runoffs and protect the shore lines.<sup>18,19</sup> They provide natural products, aesthetics and recreations.<sup>20</sup> Wetlands recharge and replenish underground aquifers, cool the high ground and are emporiums of biodiversity.<sup>21,22,23</sup>

Wetlands pollution is currently a global phenomenon. Wetlands pollution results from fertilizer, and herbicides utilised in the crop production and protection.<sup>24,25,26</sup> Industrial effluents discharges, microplastics, detergent,<sup>27</sup> oil spills from exploitation activities.<sup>29,28,30</sup>

Oil spills occur during oil extraction through wellhead blow out, pipelines corrosion, discharges during loading, pipeline vandalism.<sup>31,32,33,34</sup> Oil contains varying compounds and elements such as carbon,

hydrogen, oxygen, sulphur, metals, polycyclic aromatic hydrocarbons (PAHs).<sup>35,36,37</sup> PAHs are aromatic hydrocarbons containing variable amounts of benzene rings.<sup>38,39,40</sup> Bioavailability of PAHs in a wetland results in their bioaccumulation and biomagnification in aquatic organisms.<sup>41,42,43</sup> Health risk of ingestion of PAHs contaminated aquatic captured and cultured organisms include gene mutation, tetragenetic effects, lung, kidney and uterine cancer.<sup>44,45,46</sup>

Utagba-Ogbe is an oil bearing community playing host to many oil extracting and servicing companies. The focus of this study is thus the analysis of the wetland waters of Utagba-Ogbe oil bearing community for the presence of polycyclic aromatic hydrocarbons consequence of oil production activities in the ecosystems. The polycyclic aromatic hydrocarbons investigated were; pyrene, chrysene, benzo(a)pyrene (BaP), benzo(a)anthracene (BaA), benzo(b)fluorathane (BbF).

The research questions that guided this study were as thus;

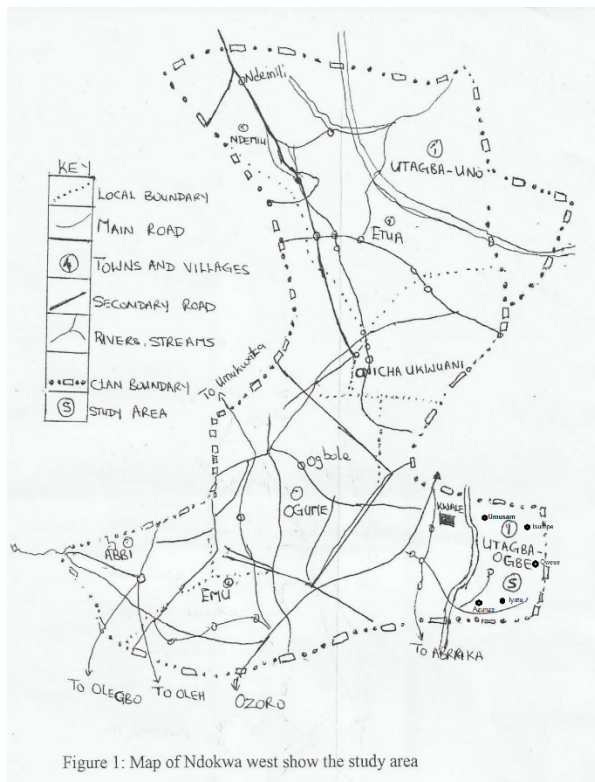
- i. what are the concentrations of pyrene, chrysene, BaP, BaA and BbF in the wetlands in Utagba-Ogbe?
- ii. are the concentrations of the PAHs in the wetlands within the European union 1881/2014 Maximum Permissible Concentration for PAHs in wetland waters of 1.00 µg/l?
- iii. are the produce in the wetlands fit for human consumption and animals feed formulation?
- iv. can the produce from the wetlands scale Codex (1963) standards for agricultural produce exports?

Hypothesis: this study is guided by a

hypothesis as;

H<sub>0</sub>: there is no significant difference between the concentrations of the PAHs in Utagba-Ogbe wetland waters and EU code 1881/2014/2018 MPC for PAHs in wetland waters

### Study Area



Utagba-Ogbe is the local government headquarters of Ndokwa-west local government area. Located in latitude 5.7250°N and longitude 6.4184°E, it is predominantly a wetland settlement with direct linkage with the distributaries of river Niger through Ase creek at Benekuku. With a population of 14,9325,<sup>47</sup> the people of Utagba Ogbe are farmers and fishermen with a handful of them being artisans while a few work as civil and public servants in local government council and as

teachers in public schools. Utagba Ogbe is a host community of many oil companies such as Midwestern Energia, BOGEL, Pillar Oil, Global oil, Pillar Oil, and EPF Oil. The wetlands in Utagba-Ogbe located in Owese, Iyiatu, Azunze, Umusam, Isumpe, Umuseti act as the cesspools of various accidental and intentional pollutions from oil and other industrial activities through erosion and runoffs.

### MATERIALS AND METHODS

This research was conducted from June to November, 2023. Five out of the 6 wetlands in Utagba-Ogbe were randomly selected for the study and these were Owese, Iyiatu, Azunze, Umusam and Isumpe wetlands. The wetlands were mapped out into sampling grids and wetland water samples were collected from 5 spots in each adopting grab sampling techniques.<sup>48,49</sup> The samples were collected within the GPS coordinates: Iyatu 5.7109°N, 6.4413°E,, Azunze: 5.6131°N, 6.4212°E, Owese: 5.5162°N, 6.4314°E, Umusam: 5.5183°N, 6.4201°E and Isumpe: 5.7121°N, 6.4141°E The samples were collected with clean plastic sampling bottle (125ml) at the depth of 10cm and were covered subsurface, then bulked and composite drawn fixed with nitric acid and stored in ice cooled boxes for analysis.

### Analysis of Samples

The wetland waters sampled were analysed deploying gas chromatography coupled with mass spectrometry methods<sup>50,51,52</sup>. Ten (10) ml of samples were measured out into beakers and 2½ gram of anhydrous NaSO<sub>4</sub> was added and vigorously agitated for thorough mixing. The mixture were then transferred into a clean extraction beakers with tight caps and allowed to stand to settle for ½ an hour. 25 g of

dicaflurobiphenyl were then introduced together with sodium hydrosulphate and the tubes vigorously shaken to the point of free flowing slurry. The flasks were left to stand for another ½ an hour. The mixture were later fed into GC/MS Agilent Triple Quadrupole 7000 model for determination of the PAHs of interest.

## RESULTS

The results of the PAHs in the wetlands in Utagba-Ogbe were as in Figures 2-6 and comparative mean PAHs concentrations in the wetlands as in Figure 7.

The result of the PAHs content in Owese wetland were as in Figure 2

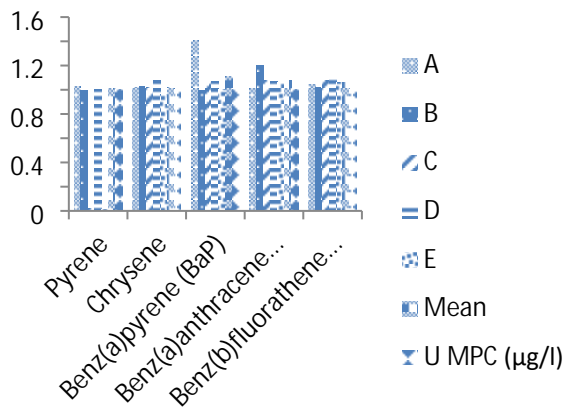


Figure 2: results of the PAHs content of the wetlands water of Owese and the EU 1881/2014/2018 Maximum Permissible Concentration (MPC) in µg/l

The results of the PAHs content of the wetlands water in Iyiatu were as in Figure 3.

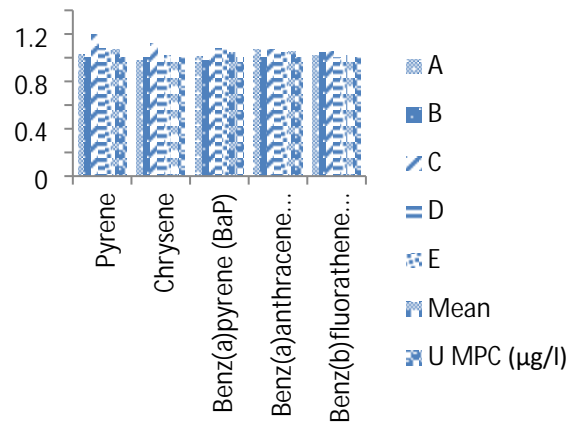


Figure 3: the results of the PAHs content of Iyiatu wetlands and EU 1881/2014/2018 MPC in µg/l.

Results of the PAHs content of the Azunze wetlands water were as in Figure 4.

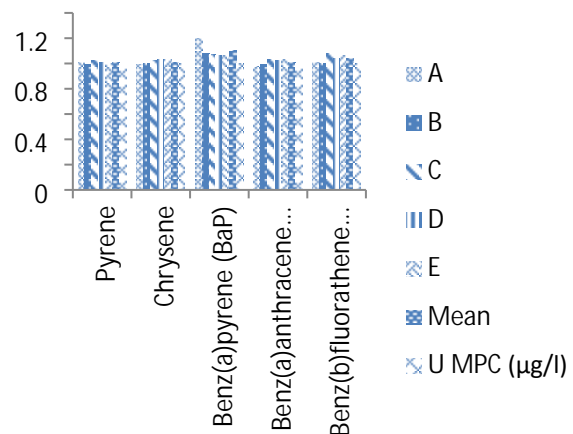


Figure 4: results of the PAHs content of Azunze wetlands water and EU 1881/2014/2028 MPC for PAHs in wetland. Results of the PAHs content of Isumpe wetlands were as in Figure 5.

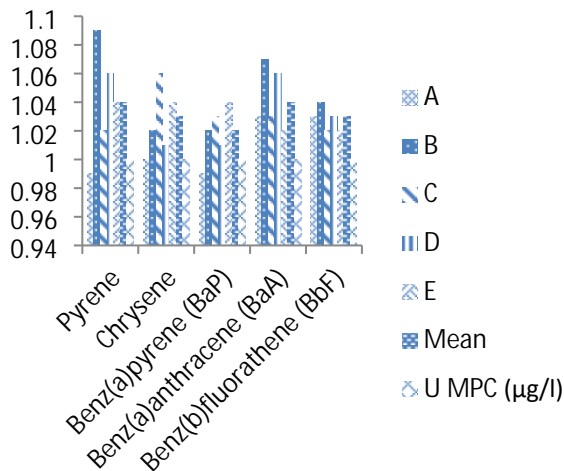


Figure 5: results of the PAHs content of the Isumpe wetlands water and EU 1881/2014/2018 MPC for PAHs in water. The result of the PAHs content of Umusam wetlands water are as in Figure 6

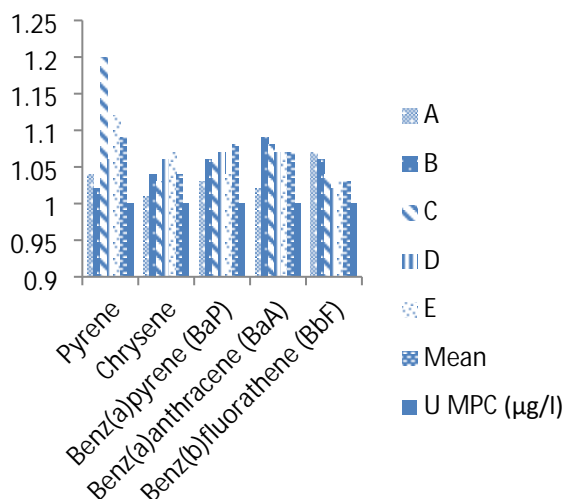


Figure 6 result of the PAHs content in Umusam wetlands water and EU

1881/2014/2018 MPC for PAHs in wetland water in µg/l

The comparative means of the PAHs of the Utagba-Ogbe wetlands were as in Figure 7.

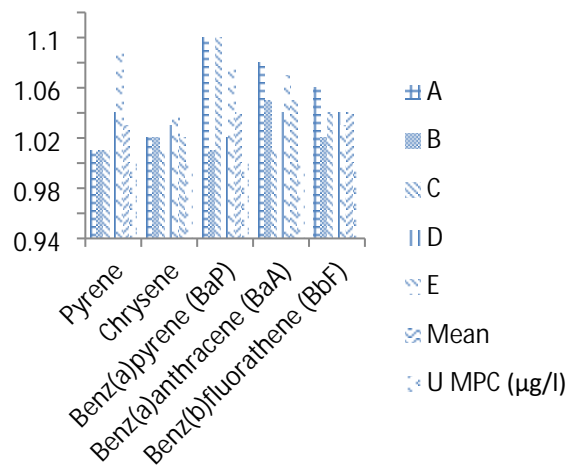


Figure 7: comparative means result of the PAHs content of the wetlands water in Utagba-Ogbe and EU 1881/2014 MPC for PAHs in wetland water in µg/l

The mean results of the PAHs in the wetland waters in Utagba-Ogbe were subjected to test of significance using analysis of variance (ANOVA) deploying special package for social science model 29 (IBM) and the p-value was 0.43 thus rejecting  $H_0$ .

## DISCUSSION

Multiple research reports exist on PAHs contamination of wetlands ecosystem emanating chiefly from industrial activities, however, researches on PAHs contamination of wetlands in Utagba-Ogbe is largely unavailable and that underscore this study. The analysis of the wetlands in Utagba-Ogbe for PAHs content revealed varying concentrations

of the variables measured.

The concentration of pyrene the analysis revealed was between 1.01 µg/l in Owese, Iyiatu and Azunze wetlands and 1.09 µg/l in Umusam wetlands with a mean of 1.03 µg/l. High content of pyrene in wetland were documented in Chacho *et al.*<sup>52</sup>, Ogwu *et al.*,<sup>53</sup>, Biswan *et al.*,<sup>54</sup>. The health implications of ingestion of pyrene contaminated aquatic foods include cancer of the lungs, throat and intestinal tracts.<sup>55,56,57</sup>

Analysis of the wetland waters in Utagba Ogbe showed the concentration of chrysene to range between 1.02 µg/l in Owese and Iyiatu wetlands and 1.04 µg/l in Umusam wetland with a mean of 1.02 µg/l. The increased PAHs content is anthropogenic. Similar report was recorded in Carusuo *et al.*,<sup>58</sup>, Chen *et al.*,<sup>59</sup>, Ogwu *et al.*,<sup>60</sup>. Probable health effects of consumption of food contaminated by chrysene include osteoporosis, tetratogenic effects lung cancer.<sup>61,62,63,64</sup>

BaP content analysis of the wetlands water of Utagba-Ogbe wetlands presented varying concentrations of the BaP in the wetlands as they were between 1.01 µg/l in Azunze wetlands to 1.08 µg/l in Umusam with a group mean of 1.04µg/l. The elevated content of PAHs in the wetland is the effect of man's interaction with the environment. This report is in agreement with Cu *et al.*,<sup>65</sup>, Gavani *et al.*,<sup>66</sup>, Garrido *et al.*,<sup>67</sup>. Effects of BaP on human include gastrointestinal cancer<sup>68</sup>. Cancer of the pituitary gland<sup>69</sup>, Dioxyribonucleic acid mutation<sup>70,71</sup>.

The wetland water analysis of Utagba-Ogbe wetlands showed that the BaA content was between 1.01 µg/l in Azunze wetland and 1.08 µg/l in Owese wetland with a mean content of 1.05 µg/l. This increased content of BaA is

traceable to the industrial activities of oil extraction. This report is in tandem with Gul *et al.*,<sup>72</sup>, Hasheni *et al.*,<sup>73</sup>, Hao *et al.*,<sup>74</sup>. BaA causes brain cancer, skin disorder, lung cancer.<sup>75,76</sup>

The analysis of Utagba-Ogbe wetland for the content of BbF revealed the content of BbF to range between 1.02 µg/l in Iyiatu to 1.06 µg/l in Owese with a group mean of 1.04 µg/l. These high content of BbF is the impact of man on the environment. This report is in corroboration with Hafner *et al.*,<sup>77</sup>, Gulani *et al.*,<sup>78</sup>, Gunter *et al.*,<sup>79</sup>. BbF has been implicated in bone marrow cancer osteoporosis, mutation and gastrointestinal cancer.<sup>80, 81, 82</sup>

## Conclusion and Recommendations

Wetland pollution is a global phenomenon impacting dastardly on the ecosystem utility on provision of valuable ecosystem services. The analysis of the wetland waters in Utagba-Ogbe oil bearing community has clearly showed that the industrial activity of oil prospecting and extraction have negatively impacted on the environmental quality of the wetlands water in Utagba-Ogbe thus, making the produce from the wetlands not fit for human consumption and not fit for compounding animal feeds. Also the produce from the wetlands cannot be exported because of its failure to meet Codex Alimentarius commission of 1963 established standards for agricultural produce export.

Corollary to these findings, the study thus recommended that: oil companies operating in Utagba-Ogbe should be enjoined to operate with world best practices, the environmental monitoring agencies; National Environmental Standards Regulation and Enforcement Agency (NESREA) and National Oil Spills Detection and Response Agency (NOSDRA)

should step up their surveillance mandate on the oil companies activities and the impacted wetland should be remediated to return the ecosystems to their hitherto pristine status.

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