IMPACT: International Journal of Research in Applied, Natural and Social Sciences (IMPACT: IJRANSS)
ISSN (P): 2347–4580; ISSN (E): 2321–8851
Vol. 9, Issue 7, Jul 2021, 1–8

ORGANOCHLORINE PESTICIDES CONTENT ANALYSIS OF UBEJI WETLAND, WARRI SOUTH DELTA NIGERIA FOR CAGE AQUACULTURE ADOPTION

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Received: 30 Jun 2021 **Accepted:** 06 Jul 2021 **Published:** 09 Jul 2021

ABSTRACT

This study is an ex-post facto research that investigated the organochlorine pesticide content of Ubeji wetlands for its suitability for cage aquaculture adoption. The study answered 3 research questions and tested a hypothesis. In achieving these, the study area Ubeji wetland was mapped out into 5 research sampling cells. From each of the sampling cells water samples were collected with clean plastic sampling bottle, bulked, a composite drawn and fixed with HNO_3 and stored in ice cooled box for analysis. The analytical standards adopted were EPA 3870 and Steindwander and Shutfler1978 and the analytical instrument deployed for the determination of the pesticides investigated was Agilent 7000 series Triple Quadrupole GC/MS. The results obtained for the parameters are: endrin aldehyde; 0.71±0.22µg/l, endosulfansulphate, 3.50±0.22µg/l, DDT, 1.55±0.14µg/l, endrin ketone 0.56±0.13µg/l and methoxychlor, 2.32±0.20µg/l. The results of the pesticides content ofUbeji wetland were further subjected to test of significance with numerator 4 and denominator 20 at 0.05 level of significance. The F ratio calculated value was 6.33 while the F ratio critical value was 2.83 thus rejecting HO. The study recommended that cage aquaculture should not be adopted in Ubeji wetland in its present pollution status, the pollution source point should be identified and plugged and decontamination and remediation be embarked upon to return the wetland to healthy status for improved ecosystem services.

KEYWORDS: *Cage Aquaculture; Organochlorine Pesticides; Bioaccumulation, Human Healths*

INTRODUCTION

Fish is an important component of human diet and it is consumed globally. Fish provides the required nutrients for human healthy living (Kalgo, 2019, Sarumi 2010). It contributes more than 60 percent of the world's supply of protein and employs over 250 million people worldwide as fishermen, middlemen or marketers (Food and Agricultural Organisation, 2019). Fisheries has been recognised as major instrument for increased productivity, ensuring food security, improving market access for rural poor and strengthening Africa's performance in the global market (World Fish Center, 2018).

Nigeria has a coastline of 853 km (Ibironke, 2016),numerous inland waterways and varying species of fish yet, it is a net importer of fish (Adebowale, 2017, Nsikak, 2015, Aminu, 2019). It is the 4th greatest importer of fish globally following China, Japan and United States of America (FAO, 2010). The country’s annual fish demand is 2.7 million metric tonneswhile the local production is 850,000 metric tonnes (Adesina, 2014, Oteriba, 2018, Ruwani, 2020).The national expenditure on fishing importation annually is 100 billion naira (Adesina, 2014, Ogbe, 2016). 625 million USD is spent annually on fish importation (United States Agency for International Development (USAID), 2016). Fish importation leads to the depletion of Nigeria's foreign reserve (Adeosun, 2018, Sokoya, 2021). It also leads to unemployment and job loss

(Buhari, 2020, Kaita, 2020). Nigeria unemployment rate stands at 33.3 percent (National Bureau of Statistics, 2021, International Monetary Fund (IMF), 2020, International Labour Organisation (ILO), 2021). A viable solution to unemployment in Nigeria and to curb fish importation and protect foreign exchange is aquaculture (Abiodun, 2021, Okowa, 2020, Abisoye 2018). Aquaculture deploying cage culture due to its low investment outlay will check unemployment and ensure poverty and hunger eradication in Nigeria (Ogwu, 2021, Habib, 2018, Babajide, 2017). Wateranalysis should be carried out before cage aquaculture deployment for possible presence of pollutants. (Afolabi, 2017, Bamgboye, 2018, Musa, 2018).Water pollutants include polychlorinated biphenyls (PCBs), polybrominated biphenyls (PBBs), furans dioxins, microplastics, petroleum tar, heavy metals, pesticides such as organophosphate and organochlorines (Agency for Toxic Substances and Disease Registry (ATSDR), 2013, Atshana & Atshana, 2016). Organochlorine are compounds containing carbon and chlorine atoms that are utilised in formulation of pesticides (International Union of Pure and Applied Chemistry (IUPAC), 2018, United States Environmental Protection Agency (USEPA), 2016). Sources of organochlorines in the environment is mainly through their application in the farm to protect the crops and animal against their enemies, pests and weeds loading, and offloading sites, effluents from manufacturing factories, equipment wash and equipment failure (Osajere 2015, Togun, 2017). Bioavailability of organochlorine pesticides in the aquatic ecosystem will lead to bioaccumulation and biomagnification (Ogwu, 2020, Aviomo, 2018). Bioaccumulation is the penetration of toxicants into organisms tissues while biomagnification is the tendency of the toxicants to multiply rapidly once in organisms tissue from one trophic level to the next (United State Environmental Protection Agency (USEPA), 2015). The health implications that result from the consumption of organochlorinepesticides contaminated fish include: cancer, endometriosis, infertility in male and female and reproductive disorder in females (ATSDR, 2012, USEPA, 2016, Asuelimen, 2019, Garba, 2018). It is against this backdrop that the analysis of Ubejiwetland to ascertain its suitability for cage aquaculture became imperative.

The purpose of this study is to determine the organochlorine pesticide content of Ubeji wetland Warri south Delta State, Nigeria. The organochlorine pesticides investigated are endrin aldehyde, endosulfansulphate, dichlorodiphenyltrichloroethane (DDT), endrin ketone and methoxychlor.

This study was guided by the following research questions:

- What are the concentrations of endrin aldehyde, endolsulfansulphate, DDT, endrin ketone and methoxychlor in Ubeji wetland?
- Are the concentrations of these organochlorines in Ubejiwetlandwithin the limits recommended for the organochlorine pesticides in water by World Health Organisation (2014)?
- Can cage aquaculture be practiced in Ubeji wetland by Ubeji residents?

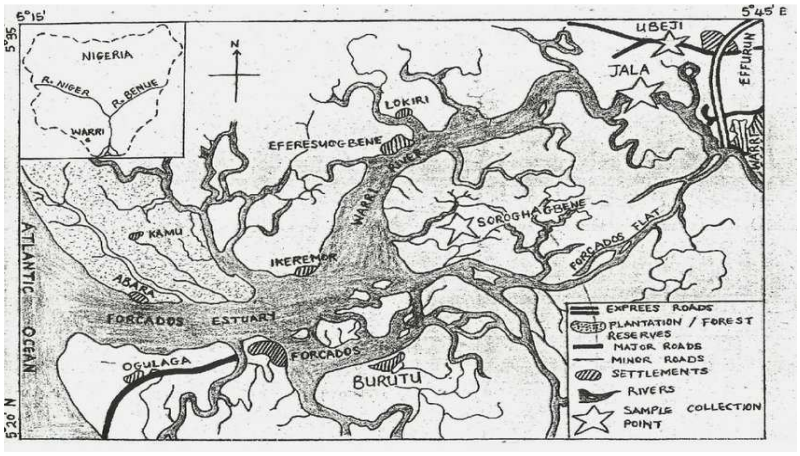
The Hypothesis That Guided This Study Is As Below

Ho: There is no significant difference between the concentrations of the organochlorine pesticides investigated in Ubeji wetland and WHO maximum allowable concentrations for organochlorine pesticides in water.

Study Area

Figure 1 shows Ubeji is an Itsekiri settlement in Warri South local government area of Delta State, Nigeria. It is located at the geographical coordinates of 5° 34' 4"N and 5° 42' 24" E. with a population of 10,000 people (2016 National Population

Commission Estimate). Ubeji people are farmers and fishermen, with few as petty traders and artisans. Ubeji wetland is at the southeast flank of Ubeji and it is the recipient of agricultural waste such as fertilizer and pesticides used in the farms to control crops and animals enemies.



Source: Olele, F.,Tawari-Fufeyin, P. &Okonkwo, J. (2012)

Figure: 1: Map of Warri and Environs Showing Ubeji.

MATERIALS AND METHODS

Ubeji wetlands was mapped out into 5 sampling cells(Ademola, 2013, Rabiu, 2017).From each of the sampling cells, water samples were collected from 10 spots with clean plastic sampling bottle tied to a graduated string at depth of 10 cm and covered subsurface. The samples from each sampling cell were then bulked, a composite drawn, fixed with nitric acid and stored in an ice cooled box for laboratory analysis. The analytical standards adopted were EPA 3570 and Steindwander and Shutfler (1978) with slight modification. The analytical instrument adopted was Agilent 7000 series Triple Quadrupole, Gas Chromatography (GC) and Mass Spectroscopy (MS).

RESULTS

The results of the analysis of the organochlorine pesticides content of Ubeji wetland are as in Table 1.

The mean concentrations of the organochlorine pesticide content of Ubeji wetland were presented in graph as in Figure 2.

Table 1 shows The results of the organochlorine pesticides content of Ubeji wetland were for further subjected to statistical treatment with analysis of variance (ANOVA) with denominator 20 and numerator 4 at 0.05 level of significance. The F ratio calculated value was 6.33 while the F ratio critical value was 2.83 thus rejecting Ho.

Table 1: Results of the Organochlorine Pesticides Content Analysis of Ubeji Wetland and WHO Maximum Allowable Concentrations In µg/L

Parameters	A	B	C	D	E	Mean	Std. Div	WHO MPC µg/l
Endrin_Aldehyde	0.62	.38	.98	.77	.80	0.71	0.22	0.05
Endosulfan_sulphate	3.80	3.44	3.21	3.42	3.61	3.50	0.22	0.08
Pp_DDT	1.42	1.78	1.45	1.61	1.47	1.55	0.15	1.10
Endrin_Ketone	0.72	.68	.42	.56	.44	0.56	0.14	0.10
Methoxychlor	2.42	2.32	2.13	2.14	2.61	2.32	0.20	0.10

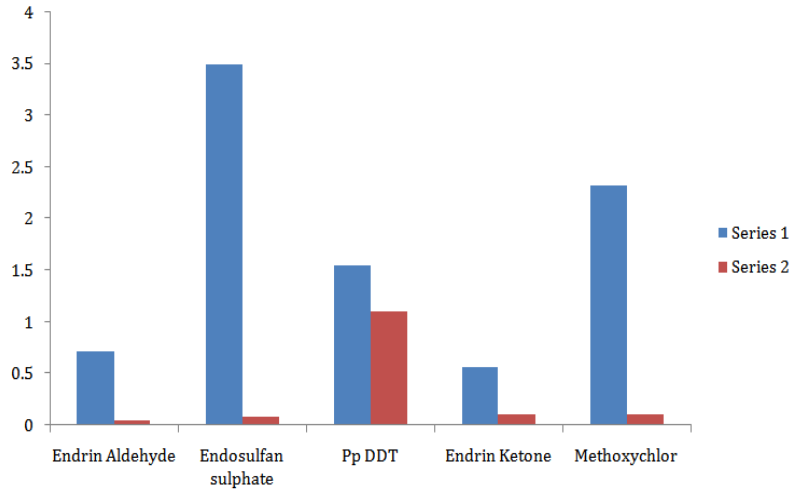


Figure 2: Mean Results of the Organochlorine Pesticides Content of Ubeji Wetland and WHO MAC In µg/L.

DISCUSSION OF FINDINGS

Cage aquaculture adoption has been highly favoured as a veritable tool for increasing fish production to reduce the depletion of Nigeria foreign exchange and to solve unemployment problem in Nigeria. Good quality water is a major factor in cage aquaculture hence this study. The analysis ofUbeji wetland revealed varying concentrations of the various parameters investigated.

The mean concentration of endrin aldehyde in Ubeji wetland is 0.71µg/l. The World Health Organization maximum allowable concentration for endrin aldehyde in water is 0.005 µg/l. Thus the concentration of endrin aldehyde in Ubeji wetland is higher than the acceptable limit for water. Similar result of elevated content of endrin aldehyde was reported by Omojugo & Osaghale (2016) in Ovia River Benin City. Ngede (2018) also reported high endrin aldehyde concentraiton in Tchada River Benue State.

The mean concentration of endosulfansulphate in Ubeji wetland is 3.50 µg/l while WHO maximum permissible concentration of endosulfansulphate in water is 0.08. The concentration of endosulfan in Ubeji wetland is higher than the recommended limit. This result is in consonance with the result of Ogwu (2020) in Okumesi River Amai, Delta State. Ozah & Udome (2018) also reported increased content of endosulfansulphate in Ashaka wetland Ashaka Delta State. The result of the analysis of Ubeji wetland revealed that the mean concentration of DDT is 1.55µg/l. The maximum allowable concentration of DDT in water is 1.10µg/l. The concentration of DDT in Ubeji wetland is higher than the acceptable limit. Ojo&Olalekan (2017) reported similar result of high DDT content in Ogun River by Kara Bridge. High DDT content in water was equally reported by Ademola (2016) in Asa River Kwara State. The result of the analysis of Ubeji wetland water revealed that the mean content of endrin ketone is 0.56 µg/l. The WHO maximum allowable concentration for endrin ketone in water is 0.10 µg/l. The endrin ketone in Ubeji wetland is thus above the WHO permissible limit for endrin ketone in water. This report is at variance with the results of Umar (2019) in Gaji River Bauchi. It is however, similar to the reports of Ibagere&Otiono in Igbide wetland Isoko Delta State. Methoxychlor mean content in Ubeji wetland as revealed by the analysis is 2.32µg/l while the WHO maximum allowable concentration for methoxychlor in water is 0.10µg/l. The methoxychlor concentration in Ubeji wetland is higher than the stipulated limit. High content of methoxychlor was reported by Adedeji (2017) in Erinle River Osun state and Opeyemi & Adewale (2018) in River Ondo State.

CONCLUSION AND RECOMMENDATIONS

Fish transformation agenda of Nigeria federal government was aimed at increasing the national fish production to 4.0 million metric tonnes so as to make the country to be fish sufficient, creat jobs and eradicate poverty and hunger as enshrined in sustainable development goals. Aquaculture, deploying cage aquaculture has been highly recommended as a recipe for achieving such goal. However, cage aquaculture requires water free from toxicants hence this study. The results of the investigation has revealed that Ubeji wetland is highly polluted with the various pesticides investigated, deploying cage aquaculture may not be practicable and not advised. This study thus recommends that:

- Cage aquaculture should not be practiced in Ubeji wetland in its present pollution status.
- The pollution source point should be identified and stopped.
- Decontamination and remediation should be commissioned in Ubeji wetland to return the wetland to its hitherto pristine status.

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