



Research Paper

Organochlorine Pesticides Speciation of Ozoro Wetland for Cage Aquaculture Adoption: A Pathway For Solving Food Insecurity In Nigeria

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ABSTRACT

The study is an ex-post facto research that investigated the concentrations of organochlorine pesticides in Ozoro wetlands for its suitability for cage aquaculture adoption. The study answered 3 research questions and tested a hypothesis. To achieve these, Ozoro wetland was mapped out into 5 sampling zones, water samples were collected from 5 sampling spots from each zone, bulked and composites drawn were fixed with HNO₃ and stored in ice cooled boxes for analysis. The analytical standard adopted is USEPA 625 and the analytical instrument utilized for the determination of the pesticides was Agilent intuvo GC/ECD model 9000. The mean results obtained were adrin 0.39±0.21ug/l, diedrin 0.63±0.22ug/l, edrin 0.61±0.24ug/l, DDT 1.25±1.00ug/l and heptachlor 0.40±0.23ug/l. The mean content of the pesticides were subjected to test of significance with ANOVA deploying SPSS model 29 at 0.05 level of significance. The p-value was 0.23 thus reject H₀. The study recommends that cage aquaculture should not be implemented in Ozoro wetlands, the pollution source point should be identified and plugged and remediation should be carried out on the wetland for the rejuvenation of the ecosystem to its hitherto pristine state for deployment of cage aquaculture for solving food insecurity in Nigeria, a country with fragile economy.

Keywords: Food Insecurity, Cage Aquaculture, Organochlorine Pesticides, Human Health, Remediation.

Received 12 Feb., 2023; Revised 22 Feb., 2023; Accepted 24 Feb., 2023 © The author(s) 2023.

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I. INTRODUCTION

Food insecurity is a global malaise with various countries having varying population of its citizen who are food insecure. America for instance has 3.8percent of her population having low food supply (United States Department of Agriculture (USDA), 2021; World Bank, 2021). Europe, according to European Union (2020) has 8.6percent of its citizens who are underfed while Food and Agriculture Organization [FAO] (2021) revealed that Asia is the home for 425million malnourished people representing 9 percent of the total population. Britain according to World Bank (2020) has more than 10 percent (11million people) who are struggling to put food on their table. The World Hunger Index (2019) stated that Algeria in North Africa has 5 percent of its population facing food insecurity. Kenya in East Africa is facing high level of food insecurity with 3.5million (24%) of her people struggling to feed (World Food Programme, 2020; World Bank, 2021). World Bank (2020) and World Food Programme (2021) maintain that South Africa has 11 Percent (6.5million) of the population unable to access adequate food. While Ghana Statistics Service [GSS] (2022) revealed that Ghana food insecurity stands at 11.7percent implying that 3.6million Ghanaians are without proper nourishment. Nigeria according to FAO (2022), WFP (2022) and International Monetary Fund [IMF] (2022) has 21percent of her population facing serious food crisis.

Food Insecurity exists when an individual has limited access to good quality food (Samson, 2019; Betrad 2020; Diouf, 2021). It is the lack of access to good quality food that is culturally appropriate and nutritionally adequate at affordable prices (Eduardo, 2019; Sajim, 2020; Joel, 2020). United States Department of Agriculture [USDA], (2019) defined food insecurity as lack of constant access to enough food for every person in a household to live active life. A person is said to be food insecure when there is lack of access to

enough good quality food that satisfies dietary requirements for normal growth and development for active life (WFP, 2019).

Food insecurity according to Terry (2021) and Sanjol (2020) is the inability to access the kind of food required in the right amount and at when needed. It is the economic and social condition that limits individual access to nutritious food in sufficient amount (McKinsley, 2022). Food Insecurity is a condition in which a household lacks access to adequate food because of limited money or limited food supply.

Food insecurity results in a situation of social conflicts, and unemployment (Mackson, 2015; Gerald, 2019). This was corroborated by Benson, (2018) who opined that food insecurity exists in period of war or acute unemployment. Nigeria is faced with high rate of unemployment with 33.3 percent Nigerians not having jobs (National Bureau of Statistics [NBS], 2022). World Bank (2022) puts the rate of unemployment in Nigeria at 36.1percent while International Labour Organization (ILO) revealed that 35.2 percent of Nigerians are out of jobs.

Okonkwo (2019),Abdulsalam (2020) enjoined Nigeria youths and adults who are out of job to embrace agriculture. This position was reiterated by Osawaru (2020); Betiku (2020) and Njoku (2021) that the only antidote to unemployment in Nigeria is engagement in agriculture. Awosika (2020) and Asuquo (2021) admonished unemployed Nigerians to venture into aquaculture, adopting cage due to its low financial outlay. Cage aquaculture is the growing of fishes in a cage submerged in an existing natural body of water (Ogwu 2020; Ogwu 2021; Ojiako, 2019). Banjoko (2018) and Adesina (2019) advised that water analysis should be conducted on the body of water to be utilized for cage aquaculture for possible presence of pollutants to avoid bioaccumulation and biomagnification.Possible water pollutants as highlighted by Ogwu (2021),Bamigboye (2020) include; microplastics, polyaromatic hydrocarbons (PAHs), detergents, heavy metals, pesticides such as organochlorine, organophosphates and carbamates. Organochlorines are compounds containing carbon and chlorine that are used in formulating pesticides (Dara & Mishra, 2012; Astsha&Asthana, 2018). Bioaccumulation is the propensity of a toxicant to penetrate the tissues of organisms while biomagnifications is the tendency of such toxicant to multiply in geometry once inside the organisms (United State Environmental Protection Agency [USEPA], 2020; Ogwu, 2020). Health effects of organochlorines in humans include; cancer, damage to the kidney, liver, bladder, thyroid and central nervous system (USEPA, 2020; World Health Organization [WHO], 2018; Afolabi&Ojoye, 2018). A wetland according to Ogwu (2022), Dawodu (2021) and Amusan (2018) is an ecosystem that harbours water for atleast 3 months in a year.

The focus of this study is the analysis of organochlorine pesticides content of Ozoro wetlands for its suitability for cage aquaculture adoption by youths and adults in Ozoro and environs. The organochlorine pesticides investigated are:adrin, diedrin, dichlorodiphenyltetrachloroethane (DDT), edrin and heptachlor.

The study was guided by research questions as;

1. What are the concentrations of adrin, diedrin, DDT, edrin and heptachlor in Ozorowetland.
2. Are the concentrations of the organochlorine pesticides within the maximum permissible levels stipulated by WHO 2014 and USEPA, 2008
3. Can cage aquaculture be deployed in Ozoro wetlands by people inOzoro and environs

The study tested a hypothesis as;

H₀: There is no significant difference between the concentrations of the organochlorine pesticides investigated and WHO maximum acceptable concentration (MPC) for organochlorine pesticides in Water.

Study Area



Figure 1: Map of Ozoro
Source: Google map

Ozoro is an Isoko settlement and it is the headquarter of Isoko North Local Government Area. It lies within the geographical coordinates of Latitude $5^{\circ}.5383'$ and Longitude $6^{\circ}.2161'$ with a population of 186,000 inhabitation (National Population Census [NPC], 2006) in a land area of 1.136km^2 (City Fact, 2022). Ozoro people are mainly agrarians with a few of them working as civil and public servants, others are traders and artisans. Ozoro wetland is at the North flank and it is the recipient of agricultural input wastes – fertilizer and pesticides thus making them bioavailable in the wetland ecosystem.

II. Materials and Methods

Sampling: Ozoro wetland was mapped out into 5 sampling zones (Abdulwaheed, 2018; Ogunsola, 2018). From each of the sampling zones, water samples were collected with clean plastic sampling bottles tied to a graduated string at 10cm and covered subsurface. The water samples so collected were then bulked and composite taken and fixed with nitric acid (HNO_3), stored in ice cool boxes for laboratory analysis.

Analysis: The analytical standard adopted for organochlorine pesticide analysis is USEPA 625 as described by (Islam et al., 2018) and the apparatus and procedures include flint glass pure quartz 1 litre volume that is fitted with screw caps and lined with TFE-fluorocarbons, amber borosilicate can also be utilized. Aluminium foil could be a substitute to for TFE-fluorocarbons if samples are not corrosive. However, if amber bottles are not available, samples should be protected from light. The container and caps to be used must be thoroughly washed with acetone and dried before use. A 1litre of the sample is extracted with 15% methylene chloride using a separator funnel. The extract from methylene chloride were dried and then exchanged with hexane to volume of 10ml. The individual organochlorine pesticides were determined by aspirating them into Agilent intuvo 9000 mass spectrometry with electron capture detector (Agilent intuvo 9000 GC/MS – ECD)

III. Result

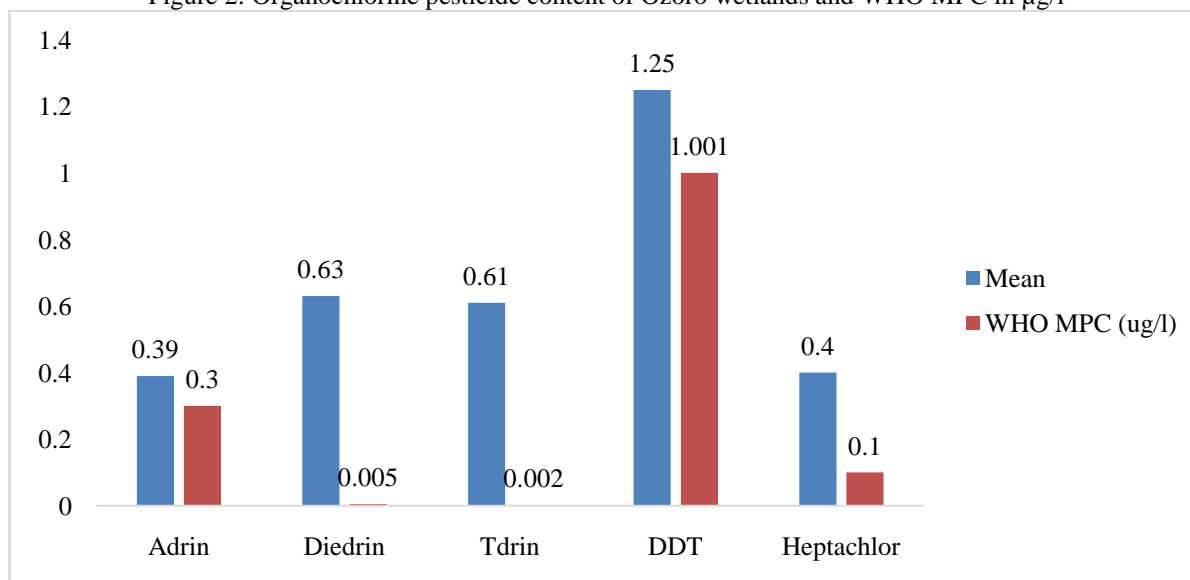
The result of the analysis of the organochlorine pesticides in Ozoro wetland is as in Table 1

Table 1: Organochlorine pesticides content of Ozoro wetlands and WHO maximum permissible concentration for Organochlorine in water ($\mu\text{g/l}$)

Parameter	Sampling Location					X	Sd	WHO MPC ($\mu\text{g/l}$)
	A	B	C	D	E			
Adrin	0.72	0.37	0.27	0.34	0.24	0.39	0.21	0.300
Diedrin	0.62	0.61	0.70	0.69	0.61	0.63	0.14	0.005
Tdrin	0.62	0.61	0.71	0.42	0.68	0.61	0.30	0.002
DDT	1.26	1.41	1.26	1.41	1.18	1.25	0.22	1.001
Heptachlor	0.30	0.41	0.43	0.44	0.42	0.40	0.31	0.100

The organochlorine pesticide content of Ozoro wetlands were presented in graph as in Figure 2

Figure 2: Organochlorine pesticide content of Ozoro wetlands and WHO MPC in $\mu\text{g/l}$



The concentration of the organochlorine pesticides in Ozoro wetland in the decreasing order is thus DDT > diedrin > edrin > heptachlor > adrin

The mean concentrations of the organochlorine pesticides content of Ozoro wetlands were subjected to test of significance using analysis of variance (ANOVA) deploying SPSS model 29 at 0.05 level of significance. The p-value was 0.32 thus rejecting H_0

IV. Discussion

The analysis of the water from the wetland in Ozoro presented varying concentrations of organochlorine pesticides investigated.

The mean concentration of adrin analysis revealed is $0.39\mu\text{g/l}$. The WHO maximum permissible concentration for adrin in water is $0.30\mu\text{g/l}$. The increased concentration of adrin in Ozoro wetland is traceable to agrochemical usage in the area. This result is similar to the result of Ogwu (2021) who reported increase adrin in Igiwetland Utagba-Uno and Ekpeyonng and Njoku (2018) who reported high content of adrin in OmambalaRiver inAnambrastate, Nigeria

The diedrin mean content inOzoro wetland the analysis showed is $0.63\mu\text{g/l}$ while the WHO MPC for diedrinin water is $0.05\mu\text{g/l}$. The concentration of diedrin in Ozoro wetland is higher than the stipulated. This result is similar to Adamu and Usman (2019) who reported high content of diedrin in Gamji river banch but at variance with Eweka (2018) who recorded low concentration of diedrin in Gelegele wetlands, Benin City, Nigeria.

The wetland water analysis of Ozoro showed also that the mean concentration of edrin in the wetland is $0.61\mu\text{g/l}$. WHO MPC for edrin in water is $0.005\mu\text{g/l}$.The concentration of edrin in Ozoro is quite elevated and this is the concomitant effect of chemical pest control adoption. Increased concentration of edrin was reported in Ovia river by (Eromosele, 2020) .Ogwu (2021) also reported high concentration of edrin in AseCreek at BenekuNdokwa East, Delta State, Nigeria.

The mean concentration of DDT in Ozoro wetland, as shown by the analysis was 1.25ug/l and the WHO MPC for DDT in water is 1.10ug/l. The concentration of DDT in Ozoro wetland is higher than recommended concentration. Adelabu and Biobaku (2018) gave similar report in Ogun river at Kara bridge, Lagos. High content of DDT in water was equally reported by Abdulmalik (2020) in Olomoge wetland Badagry Lagos. The high content of DDT in the wetland is the after effect of chemical pest control in Ozoro.

The wetland water analysis of Ozoro also presented varying concentrations of heptachlor with a mean content of 0.40ug/l while the WHO MPC is 0.10ug/l. The increased content of Heptachlor is the outcome of pesticides usage in pest control. This report is similar to Maduaka and Okorie (2018) who reported high content of heptachlor in Njaaba River, Imo state. Clarke and Aho (2019) equally reported high heptachlor concentration in Iba wetlands, Lagos state.

V. CONCLUSION

Food insecurity is global social threat that has varying severity in varying countries. Many models have been suggested and adopted to curb the seemingly intractable problem but agriculture has been the most highly rated especially aquaculture deploying cage culture. Good quality water is a major factor in aquaculture and that underscores this study.

The result of the study revealed that the concentrations of the various organochlorine pesticides measured are higher than the acceptable concentrations and thus deploying cage aquaculture in such polluted water will be counterproductive in solving food insecurity in Nigeria.

VI. RECOMMENDATION

Consequent upon the result of this investigation, the study recommends as follows:

1. Cage aquaculture should not be implemented in Ozoro wetland in its present pollution status
2. The pollution source point should be identified and plugged.
3. Remediation should be carried out in the wetland to bring the ecosystem back to its original pristine health for deployment of cage aquaculture for solving food insecurity problem in Nigeria.

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