ORGANOCHLORINE PESTICIDES QUANTIFICATION OF OKUMESI RIVER UMUKWATA DELTA FOR CAGE AQUACULTURE: A ROADMAP FOR WOMEN EMPOWERMENT IN NIGERIA

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Abstract
The economic well-being of a nation is predicated on its productive workforce. women are integral part of the productive economic team, therefore they should be empowered to contribute their quota towards the economic growth of the country for the achievement of sustainable development goals. Agriculture has been highly recommended as a viable option for empowering rural women especially aquaculture deploying cage culture. Water quality is a necessity in cage aquaculture programmes hence this study. The focus of this study therefore is the determination of the organochlorine pesticides content of Okumesi River Umukwata for its suitability for cage aquaculture for women empowerment. The design of the study was an ex-post facto and the study was guided by three research questions and a hypothesis. To achieve this, Okumesi River Umukwata was mapped out into 5 research blocks and from each of the research blocks water was sampled from 5 sampling spots with clean plastic sampling bottle tied to a graduated string at 10 cm depth and covered subsurface. The water from each of the research blocks were bulked, a composite drawn and fixed with HNO_3 and stored in ice-cool boxes for analysis. The analytical standards adopted were: USEPA 3570, APHA, and Steindewanter and Shufler 1978 and the analytical instrument used in the determination of the organochlorine pesticides is Agilent 6100 single series quadrupole LC/MS. The main results of the parameters are: diedrin 1.41 ± 0.32; Pp DDE, 1.98 ± 0.02; endrin, 2.31 ± 0.12, endosulfan II 0.38 ± 0.03 and Pp DDD, 2.50 ± 0.13. The mean concentrations of the parameters were further subjected to test of significance with ANOVA with denominator 20 and numerator 4 at 0.05 level of significance. The F ratio calculated is 4.55while F ratio critical is 2.87 thus rejecting Ho. The study recommends that cage aquaculture should not be deployed in Okumesi River at the present pollution status; the pollution source point should be identified and unplugged and remediation and decontamination should be carried out in Okumesi River Umukwata to allow forthe deployment of cage aquaculture for women empowerment.

Keywords: *Women, Empowerment; Cage Aquaculture; Pollution; Bioaccumulation; Remediation.*

Introduction

Women unemployment has assumed a global challenge status with different countries having varying rates of women who are not empowered and are without jobs. Globally according to the International Labour Organisation (ILO) (2019), globaleconomy.com (2020), World Bank (2019), 8.46 percent of women are unempowered. This was based on the average of 182 countries with Pakistan having 40.14 of its women unengaged while Niger had the lowest percent of 0.36% women not employed. Duffin (2020) revealed that the American rate of women unemployment is 3.6 percent. India's rate of women not empowered according to ILO (2019) is 18.2 percent while Britain according to United kingdom parliament.com (2019) has 24.8 percent totalling about 5.16 million of its women that are not empowered. Country.com (2019) stated that France in 2018 recorded 8.9 percent of women that are out of job and Egypt, according to World Bank (2019), ILO (2019), trading economics (2020) has 22.15 percent of women not on any job. Kenya. Global economics.com (2019) trading economics (2020) surmised has 9.33 percent of its women population without empowerment. Ghana, globaleconomics.com (2020) ILO (2020) World Bank (2019) declared has 4.46 4 percent of its women without meaningful engagement.

Nigeria according to the World Bank (2019) ILO (2019) all africa.com (2020) globaleconomics.com (2019) Tariamo (2019) National Bureau of Statistics (NBS) (2019) has 26.6 percent of its female population not empowered, unemployed and jobless. Empowerment according to Johnson (2019) aremeasures designed to increase the level of autonomy, independence and self-determination of a person or group of persons. It is the measure or process of giving freedom, economic liberty, increase in ability to do or want to do or control. Women empowerment in the opinions of Duncan (2017) Lorde (2013) Sunie (2018) Benson (2019) is action or actions directed at raising the status of women and these include among others acquisition of skills, education, raising awareness, so as to make the women take charge of their lives and be in control of their activities. It is the ability of women to enjoy their rights and exert control on their increased assets, resources and their time and also be able to manage risk and improve their economic standing in the society they belong (Kudiz 2012, Scott 2018; Brandson, 2018).

International Fund for Population Activities (IFPA) (2006) revealed that women empowerment is the provision of means of livelihood for women for their autonomy, improvement of their social, health, political and economic status. Zull (2018), Davidson (2019) opined that the participation of women are highly required for reproduction and productive life well including the responsibility of nurturing and caring for children and maintenance of households. United States Agency for International Development (USAID) (2017) declared that changing and transforming the ways in which women are engaged in gender equality and women empowerment programmes are essential for long standing social changes for the achievement of Sustainable Development Goals in 2030.

Abbort (2016) Tennyson (2018) reiterated that empowerment of women will engender economic growth and sustainability of any nation. Succinctly put by Odion (2017) Yari (2018) no economy can achieve its potential when the teeming populations of women are unempowered. Bagudu (2016), Jubril (2013) advised that women in Nigeria can be empowered through engaging them in skills acquisition in pottery making, catering, dressmaking, animal rearing, fish farming/ aquaculture and so on. This was corroborated by Amazia (2018), Gbolahan (2015), Oghenerume (2018) that women empowerment and employment can be achieved in Nigeria by engaging the women in aquaculture. Fish is an important source of protein, carbohydrate, vitamin, minerals and healthy fat (Okome, 2016).According to Adebanjo (2017) fish is the only means through which rural dwellers with low income can meet their daily protein intake of 36 gram as stipulated by World Health Organisation. World Fish Center (2005) revealed that fish has been recognised as a key instrument for increasing productivity, ensuring food security, improving access for rural poor and strengthening Africa's performance in global market.

Nigeria annual fish demand is 2.7 million tons but its domestic production is 750,000 metric tons (Audu, 2015) Adesina (2014) puts foods Nigeria annual fish production at 790,000 metric tonnes while the demand is 2.7 million metric tonnes. Nigeria spends 1.2 billion naira in fish importation (Food and Agriculture Organisation 2017) while Adesina (2014) puts the value of naira spent on food importation in 2014 at 800 billion naira. USAID (2016) stated that Nigeria imports 162 million U.S. dollar of fish annually. Importation of fish means exporting employment and importing unemployment (Audu, 2015, Ruwani, 2019).

Adejumo (2018), Adigwe (2017), enjoined women to venture into aquaculture for their empowerment through adoption of cage aquaculture due to its low capital outlay. Cage aquaculture according to Ogwu (2019), Adiele (2016) is the practice of raising fish in a net anchored in anexisting water. Bamgboye (2015) Babagana (2013) however advised that water analysis should be carried out before cage aquaculture can be deployed for presence of pollutants and toxicants avoid bioaccumulation and biomagnification. Bioaccumulation according to United States Environmental Protection Agency

(USEPA) (2012) is the presence of toxicants in the tissues of organisms while biomagnification is the propensity of the toxicant to multiply rapidly in the organisms tissue from one trophic level to the next. Coker (2016), Clarke (2017) highlighted the possible pollutants in water to include microplastics, polyaromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs),furams, fumes petroleum tar, polybrominated diphenyl ethers PBDEs, heavy metals, detergents, pesticides such as organophosphate, carbamate and organochlorines.

Organochlorine as defined by Atshana and Atshana (2012) are compounds containing carbon and chlorine atoms which are used in pesticides formulation. Human exposure to organochlorines leads to osteoporosis, cancer, endometriosis, infertility in male and female (USEPA, 2012; Alani 2011).

The purpose of this study is to determine the organochlorine pesticides content of Okumesi River Umukwata for it suitability for cage aquaculture for women empowerment in Nigeria.

The study is guided by the following research questions:

1. What are the concentrations of diedrin, Pp DDD, Pp DDE, endrin and endosulfan II in Okumesi River Umukwata?
2. Are the concentrations of these organochlorines within the maximum allowable concentration stipulated by World Health Organisation 2014?
3. Can cage aquaculture be deployed in Okumesi River Umukwata for women empowerment?

The study is guided by a hypothesis:

Ho: there is no significant difference between the concentrations of the organochlorine pesticides in Okumesi River Umukwata and WHO maximum allowable concentration for organochlorine pesticides in water.

Study Area

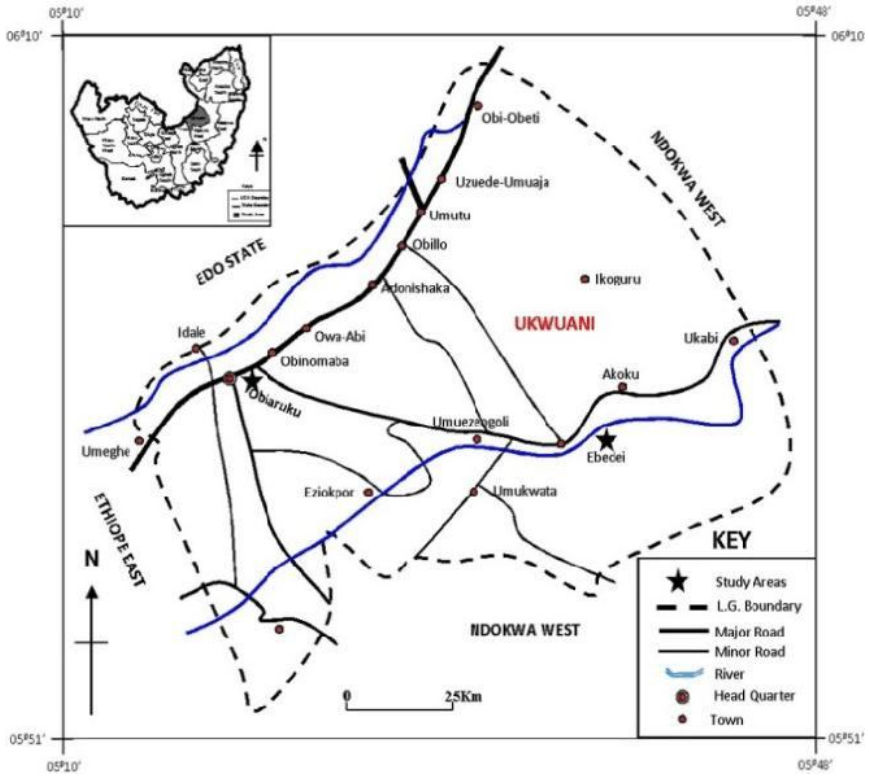

Figure 1: Map of Ukwani showing Umukwata

Source: Ojieh, V. N. (2012).

Umukwata is an agrarian community in Ukwani local government area Delta State, Nigeria. It lies within the geographical coordinates of 5°48′10″N and 6°14′53″Ewith a population of 40,322 persons (National Population Commission 2006). Okumesi River runs at the South East of Umukwata and it is the recipient of agricultural waste such as pesticides and fertilizers generated by the farmers through erosion, runoffs and flash flood.

Materials and Methods

The research design is ex-post facto. Okumesi River, Umukwata was mapped out into research blocks designated blocks A B C D E (Abdulfatai, 2015). From each of the research blocks, water samples were collected from 5 sampling spots at 10cm depth covered subsurface. The samples from each research block were bulked and a composite drawn fixed with nitric acid (HNO_3) and kept in ice-cooled boxes for analysis. The analytical standards adopted were Steindewanter 1978, USEPA 3750 and American Public Health Association (APHA) and the analytical instrument deployed for determination was Agilent 6100 series single quadrupole liquid chromatography and mass spectroscopy (LC/MS).

RESULT

The result of the organochlorine pesticides content of Okumesi River Umukwata is as presented in Table 1.

Table 1: Concentration of the organochlorine pesticides content of Okumesi River and WHO maximum allowable concentration in µg/l

Parameter	Research					Mean	Std. Dev	WHO MPC in µg/l
	A	B	C	D	E			
Diedrin	1.38	1.98	1.23	1.22	1.25	1.41	0.32	0.05
PP DDE	1.98	2.00	2.01	1.97	1.96	1.98	0.02	0.01
Endrin	2.13	2.32	2.41	2.30	2.42	2.32	0.12	0.02
Endosulfan II	0.38	0.42	0.34	0.38	0.36	0.38	0.03	0.08
PP DDD	2.67	2.62	2.42	2.39	2.40	2.50	0.13	0.01

The mean result of the organochlorine pesticides content of Okumesi River Umukwata was presented graphically with bar chart as in Figure 2.

Figure 2: Concentrations of organochlorine pesticides content of Okumesi River Umukwata and WHO MPC in µg/l

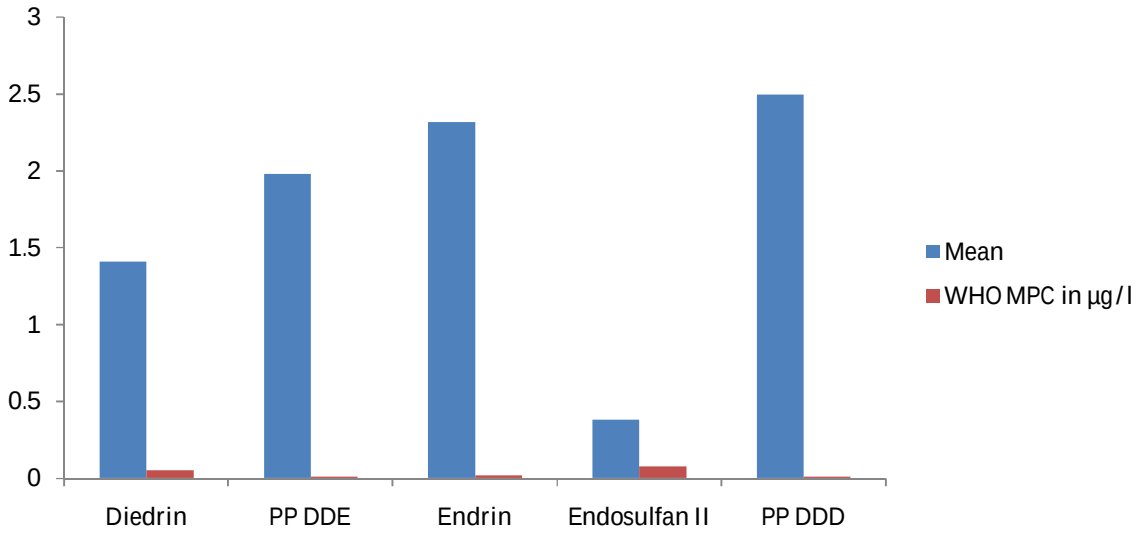

Table 2: Analysis of variance of the organochlorine pesticide content of Okumesi River Umukwata

Source of variation	SS	df	MS	F	p-value	F crit
Between Group	15499.87121	4	3874.967802	273730.1502	4.54757E-47	2.866081
Within Groups	0.2831232	20	0.01415616			
Total	15500.15433	24				

The reports of the analysis of Okumesi River Umukwata were subjected to tests of significance with analysis of variance (ANOVA) with numerator 4 and denominator 20 at 0.05 level of significance. The F ratio calculated value is 4.55 while the F ratio critical value is 2.87, thus rejecting Ho which states that there is no significant difference between the concentrations of the organochlorine pesticides determined in Okumesi River Umukwata and WHO maximum allowable concentrations for the organochlorine pesticides investigated.

Discussion of Findings

The analysis of the water of Okumesi River Umukwata revealed the following concentrations of the organochlorine pesticides measured: diedrin concentration is between 1.22µg/l to 1.98µg/l with a mean concentration of 2.39±0.24µg/l. The WHO maximum allowable concentration for diedrin in water is 0.05µg/l. The concentration of diedrin in Okumesi River Umukwata is higher than the maximum allowable concentration for diedrin in water. Increased concentration of diedrin in water was reported by Ogunzie (2018) in Ikpoba River Benin City. Danladi (2016) also reported high diedrin in Kaduna River, Kaduna State.

The analysis of Okumesi River Umukwata also revealed that the concentration of Pp DDE is between 1.96µg/l and 2.01µg/l with a mean concentration of 1.98±0.21µg/l. The WHO maximum allowable concentration for Pp DDE in water is 0.01µg/l. The concentration of Pp DDE in Okumesi River Umukwatais higher than the allowable concentration of Pp DDE in water by WHO. High concentration of Pp DDE in water was reported by Ojugo (2017) in Umie River, Eku Delta State. This result is equally similar to the report of Odion & Asuelimen (2016) in Ovia River, Benin City.

The concentration of endrin in Okumesi River revealed between 2.13µg/l and 2.42µg/l. The main concentration of endrin is 2.32±0.12µg/l. The WHO maximum allowable concentration for endrin in water is 0.02µg/l. The concentration of endrin is higher than the acceptable limit. This result is similar to the report of Okorie & Duruoma (2017) in Njaaba River, Imo State it is however at variance with the report of Okpor (2017) who reported low concentration of endrin in Iselegu River, Delta State. Endosulfan II concentration in Okumesi River Umukwata is between 0.36µg/l and 0.42µg/l with a mean concentration of 0.38±0.03µg/l. The WHO maximum allowable concentration for endosulfan II in water is 0.08µg/l. The concentration of endosulfan II concentration in Okumesi River Umukwata is higher than the maximum permissible concentration for endosulfan II in water. Similar result was reported by Ojodu & Adebayo (2013) in Ogun River, Ogun State. Adewale & Osaghale (2015) also reported high concentration of endosulfan II in Olomoge lagoon Badagry Lagos.

Pp DDD concentration in Okumesi River Umukwata the analysis revealed is between 2.67µg/l and 2.39µg/l with a mean concentration of 2.50±0.13µg/l. The WHO maximum allowable concentration for PP DDDin water is 0.01µg/l. The concentration of PP DDD in Okumesi River Umukwata is higher than the permissible limits stipulated by WHO (2014). This result is in tandem with the reports of Ozege (2014) in Owesse wetlands Utagba-Ogbe, Delta State and Ojugbeli (2016) who reported high concentration of endosulfan II organochlorine pesticides in Ubeji wetlands Warri, Delta State.

Conclusion

Women empowerment will help propel economic growth and development and engender equality as enshrined in sustainable development goals 5. The result of the analysis of Okumesi River Umukwata revealed that the concentrations of edrin, PP DDD, endosulfan, PP DDE, and ddiedrin are exponentially higher than the recommended concentration for the pesticides in water. High concentration of the organochlorine pesticides in water as hitherto stated will give rise to various diseases conditions such as cancer, infertility, endometriosis and so on. Contamination of Okumesi River will be counter-productive to the rationale of the programme of women empowerment in Nigeria. Cage aquaculture cannot be deployed in Okumesi River Umukwata until decontamination and remediation have been implemented upon in the river to return it to its original pristine status.

Recommendations

Sequel to the result of this investigation, this study recommends as thus:

1. That cage aquaculture should not be deployed in Okumesi River Umukwata because it is polluted with organochlorine pesticides.
2. The source points of the pollutants should be identified and plugged.
3. Remediation and decontamination should be implemented in Okumesi River Umukwata for the deployment of cage aquaculture for women empowerment for the achievement of sustainable developments goals 5.

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