



Organochlorine Pesticides Characterization of Umie River Eku Delta State for Cage Aquaculture in Schools: A Tool for Youths Empowerment and Food Security in Nigeria

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ABSTRACT

Food insecurity is a global challenge requiring solutions to achieve food secured nations. Agriculture has been adjudged as viable option to achieving food security in Nigeria especially youths aquaculture through cage aquaculture. Good quality water is an imperative in aquaculture and this underscores this study. Thus, the focus of this study is the determination of organochlorine pesticides content of Umie River Eku for cage aquaculture in schools. To achieve this, Umie River was mapped out into research stations A B C D E. Samples were collected from 5 spots in each sampling station, bulked and composite drawn, fixed with HNO_3 and stored in ice cooled boxes for analysis. The analytical standards adopted were EPA 3570, APHA and Stei ndwandter and Shufter (1978) and the analytical instrument deployed is Agilent 6100 series single quadruple LC/MS. The mean results obtained were beta-lindane $0.66 \pm 0.14 \mu\text{g/l}$; heptachlor, $2.20 \pm 0.16 \mu\text{g/l}$, edrin $2.32 \pm 0.11 \mu\text{g/l}$, cis chordane $2.33 \pm 0.12 \mu\text{g/l}$ and DDT $2.66 \pm 0.14 \mu\text{g/l}$. The results of the organochlorine pesticides were further subjected to test of significance with ANOVA with numerator 4 and denominator 20 at 0.05 level of significance. The F ratio calculated is 8.23 while the F ratio critical value is 4.21. Thus rejecting H_0 and this means that there is significant difference between the concentration of organochlorine in Umie River and WHO maximum permissible concentration for organochlorine pesticides in water. The study recommends that cage aquaculture should not be deployed in Umie River until remediation has been carried out to avoid contamination by toxicants and the concomitant health implications and this will negate efforts towards food security it ought to promote.

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INTRODUCTION

Food crisis is a global phenomenon with varying countries having its fair share of the melee in varying severity. According to the United States Department of

Agriculture (2015) 13.9 percent of Americans are presently facing food crisis. Ecobusiness (2019) reports that Asia is home to almost 65 percent of the world undernourished, food insecurity is a



significant issue in the United Kingdom. Food and Agriculture Organisation (2018) states that 19% of people in the UK are living under 15s while New Independent Premium (2018) puts the population of people in UK who are severely food insecure at 2.2 million people. World Food Programme (2018) Campmass.com (2018) state that an estimated 13.7 million Egyptians or 17 percent of the population are food insecure; Kenya according to Global Hunger Index (2018) is among the 45 countries out of 119 countries ranked in the world that is grappling with Food Insecurity and Standard Medium (2019) reported that 3.4 million Kenyans are severely food insecure while 309,000 have been internally displaced due to food insecurity and drought. South African National Health and Nutrition (2017) revealed that 26 percent of South Africans are experiencing hunger while 50 percent of the country population are food insecure.

Nigeria according to World Bank (2018) has 80 percent of its rural population living below poverty line, 8 percent of Nigerian population are severely malnourished in 2018. FAO (2017) stated that 2.3 million people in Adamawa, Bornu and Yobe regions hardest hit by Boko Haram, ISIS and ISWAP are facing acute food shortage. For International Monetary Fund (2018) 30 million Nigerians mainly at the northeast region are facing acute food insecurity.

Food security according to Escanulla (2017) exists when all people at all times have physical and economic access to sufficient safe and numerous food that meet their dietary needs and food preferences for an active and healthy life. Food security according to United Nations Committee on World Food Security (2015) means that all people at all times have physical social and economic access to sufficient safe and nutritious food that

meets their food preferences and dietary needs for active and healthy life. Full security according to USDA (2016) is a measure of availability of food and individuals ability to access it. Smith (2018) posits that food security cannot be achieved in the face of massive youths and adults unemployment. This position was corroborated by Home (2019) Bernard (2018) Benal (2018) that food security can only be achieved when the citizens are gainfully employed. According to Nigeria Bureau of Statistics (2019) youth's unemployment in Nigeria averaged 21.31 percent from 2016 reaching an all-time high of 23.10 percent in the 3rd quarter of 2018. The rate of youth's unemployment in Nigeria according to World Bank (2019) is 23.63 from 2014 to 2018. Trading Economics (2020) puts youth's unemployment rate in Nigeria at 36.50 percent up till 2019.

The Federal government of Nigeria in effort at downscaling youth unemployment, introduced trade curriculum in secondary schools in photography, GSM repair, blocking making, animal husbandry, fish farming or aquaculture and so on. The rationale of trade curriculum according to Nigeria Education Research and Curriculum Development Council (2013) is to equip every secondary school graduate with relevant skill to enable them to be gainfully employed so as to ensure food security. Adelabu (2018) suggested that youths should be engaged in agriculture so as to curb youth unemployment. The position is equally canvassed by Odofoin (2017), Asiwaju (2016), Adesida (2016) who posit that the antidote to youth's unemployment in Nigeria is through their gainful employment in agriculture. Okafor (2017), Okeke and Achinike (2018) advised that youths should be engaged in aquaculture to



reduce the youth unemployment rate in Nigeria.

Fish is an important source of protein. Aota (2014), Dawodu (2018), Okegbemi (2019) revealed that fish is an important component of our dietary requirement. It contains protein carbohydrate mineral and vitamins. Uzoka (2018) states that fish is the easiest means of meeting daily protein requirement by local population. Audu (2016) revealed that Nigeria annual fish requirement is 2.7 million metric tons but it produces only 750,000 metric tonnes. The deficient has to be bridged through importation. Adesina (2014) states Nigeria spends 100 billion on importation of fish while USDA (2017) revealed that Nigeria spends about 625 United States dollars in importation of fish. Whenever we import fish, we export employment and import unemployment (Ruwani 2018; Akinbode 2016; Audu 2015).

Ojabulu (2016) suggested that youth's unemployment can be reduced by engaging them in aquaculture through less capital-intensive culture methods such as pen culture or cage aquaculture. Cage aquaculture according to Adetiloye (2014); Atigogo (2018) is the practice of culturing fish in natural body of water by deploying cage. It is the practice of constructing a cage and raising fish in a natural water (Ogwu, 2017); Bamgboye (2015); Afolabi (2017) advised carrying out water analysis for presence of toxicants to avoid bioaccumulation and biomagnification. The toxicant that may be found in water are polychlorinated biphenyls (PCBs), volatile organic compound (VOCs), persistent organic pollutants (POPs), petroleum hydrocarbons, heavy metals and pesticides such as organophosphate, organochlorine and carbonated (Adewusi, 2016; Alani, 2011, Anyakora, 2011). Organochlorine pesticides according to International Union of Pure and Applied Chemistry (2011) are

compounds containing carbon and chlorine atoms that are used in the manufacturing of pesticides. Bioaccumulation according to United States Environmental Protection Agency (2015) is the ability of toxicants to enter tissues of organisms while biomagnification is the tendency of these toxicants such as DDT to multiply in the tissues of the organisms in high rapidity. Bell (2014), Salim and Salim (2015) reported that exposure to organochlorines have been associated with several health challenges such as cancer, neurotoxicity, spontaneous, abortion, infertility in both male and female. It is against this backdrop that this study on the assessment of organochlorine residues in Umie River, Eku for cage aquaculture became imperative. The organochlorine pesticides investigated are: beta-lindane, heptachlor, endrin, cis chlordane and DDT.

Objective of the Study

The objective of this study is to determine the concentration of beta lindane heptachlor, edrin, cis chlordane and DDT in Umie River, Eku.

Research Questions

The study was guided by the following research questions:

1. What are the concentrations of beta-lindane, heptachlor, cis chlordane, edrin and DDT in Umie River, Eku?
2. Are the concentrations of the organochlorines within the limits recommended by World Health Organisation (WHO) for organochlorine pesticides in water?
3. Can the schools and youth in Eku and environs deploy cage aquaculture in Umie River?

Hypothesis

The study tested the hypothesis stated below:

Ho: there is no significant difference between the concentrations of the

organochlorine pesticides in Umie River and WHO maximum allowable concentration for organochlorine pesticides in water.

Study Area

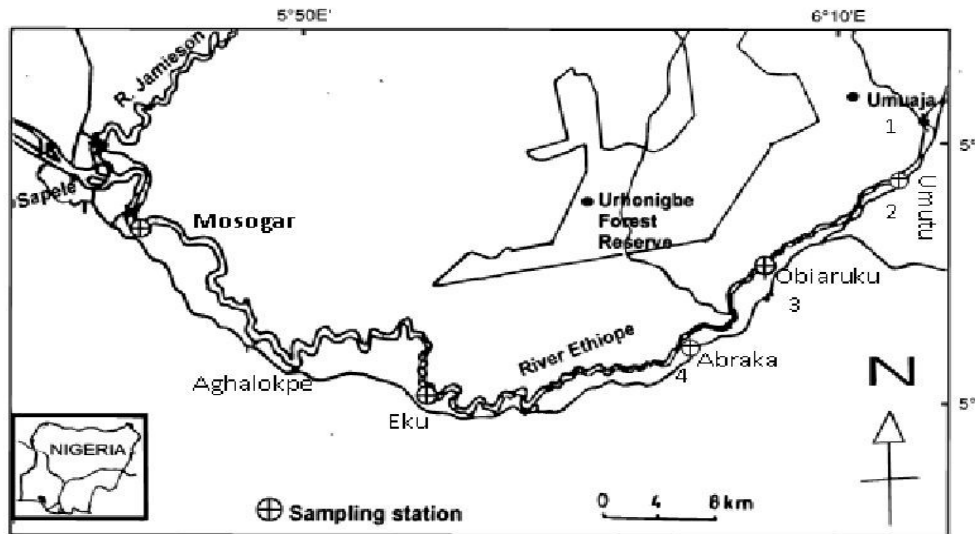


Fig 1: Map of Eku Source: Ikomi R.B. and Arimoro F. O. (2014)

Eku is a settlement in Ethiopie East local government area. It lies at geographical position system of 50°45'25" N and 60°03'20" E. It is an agrarian community with government hospital and secondary schools. The adoption of chemical pests control in Eku is quite visible as backpack sprayers are common tools employed by the farmers in the town. Umie River is situated at southeast of Eku and it is a recipient of effluent discharge from agricultural activities through flash floods.

MATERIALS AND METHODS

Sampling: Umie River was mapped out into research sites: A, B, C, D and E according to (Abdulfatai, 2015). From each of the sample sites water samples were collected with clean plastic sampling bottle tied to a graduated cylinder from 5 sports at the

depth of 10 cm and covered subsurface. The sampled water from each sample site were bulked, a composite drawn, fixed with nitric acid (HNO_3) and stored in ice cooled boxes for analysis.

Sample analysis: the analytical methods adopted were American Public Health Association methods, Steindwandter and Shutter (1978) and EPA 3570 standards.

Determination: the determination of the organochlorine pesticides was done using Agilent 6100 series quadrupole LC/MS.

RESULT

The results obtained from the analysis of organochlorine pesticides content of Umie River are as shown in table 1 below.

Table 1: showing the results of the organochlorine pesticides and WHO MPC in $\mu\text{g/l}$

	Reading					Mean	Std. Deviation	Variance	WHO/MPC
	A	B	C	D	E				
β -lindane	0.68	0.43	0.82	0.71	0.68	0.66	0.14	0.02	0.005
Heptachlor	2.00	2.32	2.04	2.31	2.35	2.20	0.17	0.03	0.1
Edrin	2.13	2.32	2.41	2.36	2.40	2.32	0.11	0.01	0.02
Cis Chordane	2.12	2.33	2.41	2.38	2.43	2.33	0.12	0.02	0.005
DDT	2.82	2.73	2.72	2.45	2.66	2.67	0.14	0.02	1.10

The main result of the organochlorine pesticides investigated were presented graphically with bar chart as shown in figure 2.

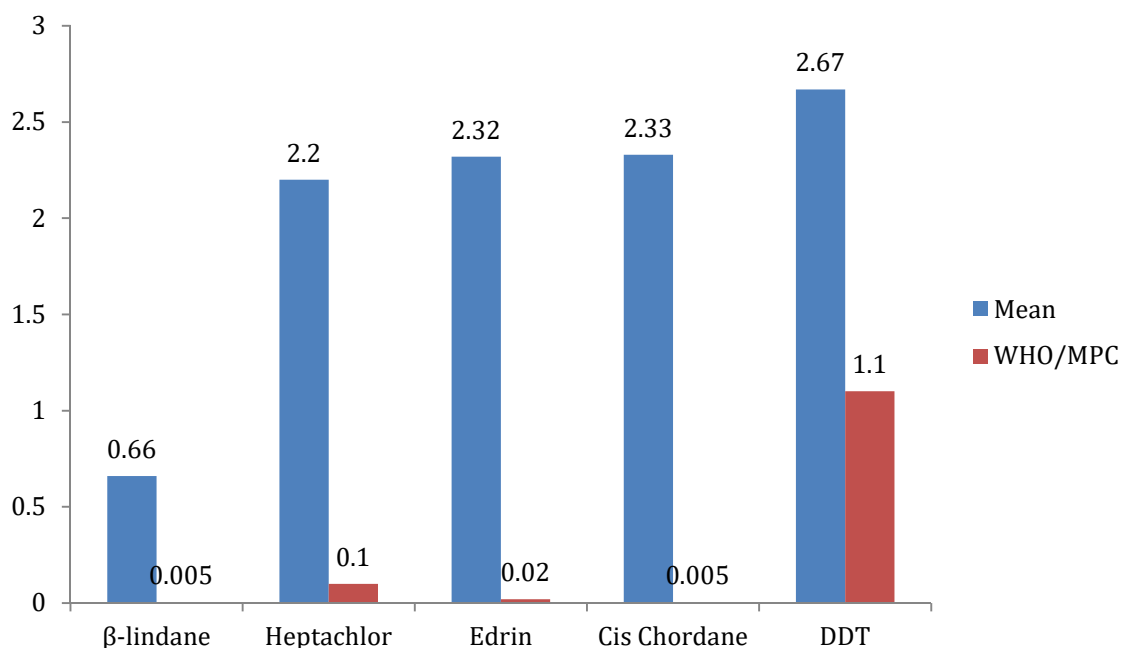


Fig 2: showing the organochlorine pesticides concentration in Umie River in bar chart

The concentration of the organochlorine pesticides in Umie River Eku at decreasing order is as follows: DDT > cis chordane > edrin > heptachlor > b-lindane (bHCH)

DISCUSSION

Youth's unemployment has posed seemingly insurmountable challenge to achieving food security. Aquaculture is being favoured as a veritable tool for youths empowerment especially cage aquaculture. Pollution of the available water sources has



posed as obstacle to achieving the goal of youth empowerment through cage aquaculture for food security in Nigeria and this underscored thus study.

The results of the analysis of the organochlorine pesticides content of Umie River Eku revealed the following; beta lindane mean concentration in Umie River is $0.66\mu\text{g/l} \pm 0.14\mu\text{g/l}$. WHO maximum allowable concentration for beta lindane in water is $0.005\mu\text{g/l}$. The concentration of beta lindane is higher than allowable limit by WHO for water. Increase b-lindane in water was reported by Alani (2011) in Lagos lagoon, and Adelabu (2014) at Olomoaje Creek Badagry, Lagos. The mean concentration of heptachlor in Umie River is $2.20 \pm 0.16\mu\text{g/l}$. The WHO maximum allowable concentration for heptachlor for water is $0.1\mu\text{g/l}$. The mean concentration is higher than WHO allowable limit for water. This result is in tandem with Odinkalu (2015) who reported high heptachlor in Owese Creek Utagba-Ogbe and Ojumu (2017) who recorded high concentration of heptachlor in Ofiki River in Oyo. The mean concentration of edrin in Umie River is $2.32 \pm 0.11\mu\text{g/l}$.

The WHO maximum allowable concentration for edrin in water is $0.002\mu\text{g/l}$. This is higher than allowable limit by WHO. Report of high edrin in water has been reported by Olawole (2016) in Erinle River in Osun state and Oghenerume (2012) who reported high edrin concentration in Ose River, Ondo state. Cis chordane mean concentration of Umie River the investigation revealed is $2.33 \pm 0.12\mu\text{g/l}$. The WHO maximum allowable concentration for cis chordane is $0.005\mu\text{g/l}$. The mean concentration of cis chordane in Umie River is higher than the maximum allowable limit for water. This result is at variance with the report of Adeyinka and Okeke (2014) who reported low concentration of cis chordane in Oyan River, Ogun state and Obeke and

Ozah (2016) who also reported low concentration of cis chordane in River Niger at head bridge Asaba Delta State. The result of the investigation reported the mean concentration of DDT in Umie as $2.66 \pm 0.14\mu\text{g/l}$. WHO maximum permissible concentration for DDT in water is $1.1\mu\text{g/l}$. The mean concentration of DDT in Umie River is higher than WHO maximum allowable concentration for DDT in water. This finding is similar to Ilasami (2015) who reported high DDT content in Ogun, Ogun state and Obed and Corker (2014) who reported high DDT in Ikpoba River Benin City.

The results of the organochlorine pesticides content of Umie River were further subjected to test of significance with analysis of variance (ANOVA) with denominator 20 and numerator 4 at 0.05 level of significance. The F ratio calculated is 6.23 while the F ratio critical value is 3.21. This revealed that H_0 is rejected and H_a accepted that there is significant difference in the concentration of the organochlorine pesticides in Umie River and the WHO maximum allowable limit for organochlorine pesticide in water. The organochlorine concentration in Umie River is higher than WHO permissible limit for water. Deploying cage aquaculture in Umie will certainly not result in food security unless remediation is carried out before its deployment.

CONCLUSION

Food insecurity is a global issue with varying economies adopting varying models to achieve, food security. In Nigeria, a hitherto agrarian country, agriculture has been recommended as a catalyst in achieving food security especially youths aquaculture through cage aquaculture. Again, the global issues of pollution arising from agriculture and industrial activities have posed as hindrance to deploying cage



aquaculture. The results of the analysis of Umie River has revealed that the water body is contaminated and culturing fish in such medium will lead to health complications emanating from bioaccumulation of the organochlorine pesticides. This will be an antithesis to the goals of achieving food security in Nigeria.

RECOMMENDATIONS

Consequent upon the results of this investigation, the study recommends the following:

1. That cage aquaculture should not be adopted in Umie River for now.
2. Pollution source should be identified
3. Remediation of Umie River should be embarked upon before deploying cage aquaculture for security in Nigeria

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