PERSISTENT ORGANOCHLORINE PESTICIDES (POPs) IN WATER, SEDIMENT, FIN FISH (*Sarotherodon galilaeus*) AND SHELL FISHES, (*Callinectes Pallidus* and *Macrobrachium Macrobrachium)* SAMPLES FROM OLOGE LAGOON, LAGOS, NIGERIA

EO Clarke[1*], O.J. Aderinola[2] and Adeboyejo, O.A.

[1]Department of Fisheries, Lagos State University, Ojo, Lagos State, Nigeria
[2] Department of Zoology, Lagos State University, Ojo, Lagos State, Nigeria
[3]Department of Fisheries, Lagos State University, Ojo, Lagos State, Nigeria
* Corresponding author

ABSTRACT

The organochlorine pesticides were measured in water, sediment, finfish (*Sarotherodon galileaus*), shellfishes (*Callinectes pallidus* and *Macrobrachium macrobrachium*) from Ologe lagoon. The pesticides analyzed include DDT, DDD, DDE, HCH, HCB, Dieldrin, Alpha (HCH), Beta (HCH), Delta (HCH), Heptachlor, Aldrin, Heptachlor epoxide, Gamma chlordane, Alpha chloride, Endosulphate I, Endosulphate II, Endrin ketone, Endosulfan sulphate, Endrin, Methoxychlor. The analysis was done using Gas Chromatograph with Electron Capture Detector. Mean concentration of OCPs in water ranged from 1.04µg/l - 4.88µg/l between Alpha HCH and Endosulfan II and 0.14µg/l - 7.16 µg/l of Alpha chlordane and Endosulfan sulpfate during dry and wet seasons. 4'4 DDT was not detected in water samples. Endosulfan I had the lowest concentration of OCP and Endosulfan II had the highest mean concentration which ranged between 29.67 – 525.55µg/kg while Beta- BHC in sediment ranged between 33.76 – 436.11µg/kg during the dry and wet seasons, respectively. *Macrobrachium macrobrachium* had a very high concentration of Heptachlor and Heptachlor epoxide during rainy season with values of 1204.93 µg/kg and 698.32µg/kg respectively. All other OCPS in this study was detected in *Callinectes pallidus* except Gamma (Lindane) and DDD which were absent in both seasons. *Sarotherodon galileaus* had a higher mean dry season concentration of Endosulfan sulfate (1240.00 ±47.15), Endrin ketone (1125.00 ±64.95) and Endosulfan II (613.50 ±11.74) and lower mean rainy season concentrations of Endosulfan sulfate (763.79 ±0.90), Endrin ketone (132.04 ±2.73) and Endosulfan II (361.82 ±1.33). Results showed that there was sequestration of OCPs from water into sediment and bioaccumulation in the organisms analyzed, due to exposure. Concentrations of OCPs increased in the order of water, sediment, fin fish & shellfish samples and were found to be higher in both the fin and shell fishes than in the water and sediment samples.

Keywords: Pesticides, Bio-accumulation, Bio-magnification, Lagoon

{Citation: EO Clarke, O.J. Aderinola, Adeboyejo, O.A. Persistent organochlorine pesticides (POPs) in water, sediment, fin fish (*Sarotherodon galiaeus*) and shell fishes, (*Callinectes Pallidus and Macrobrachium Macrobrachium*) samples from Ologe Lagoon, Lagos, Nigeria. American Journal of Research Communication, 2013, Vol 1(6): 122-135} www.usa-journals.com, ISSN: 2325-4076.

1.0 INTRODUCTION

Chlorinated hydrocarbon substances (CLHCs) are synthetic organochlorine compounds and include organochlorine pesticides. Pesticides (OCPs) are a class of non polar toxic chemical compounds classified as dichlorodiphenylethane, cyclodienes and chlorinated benzenes. OCPs are ubiquitous environmental contaminant which have spread globally and have been detected in foodstuffs, drinking water, sediments as well as wide range of biota including fish. There are currently twelve of the most dangerous OCPs and they include; aldrin, chlordane, DDT, dieldrin, endrin, heptachlor, mirex, toxaphene, polychlorinated biphenyls (PCBs), hexachlorobenzene, dioxins, and ferans (EPA, 2004).

The health effects associated with OCPs include reproductive failures, birth defect, endocrine disruption immune system dysfunction and cancer. Studies also revealed that OCPs have strong potential to cross placental barriers even in minute concentration and cause serious neonatal damage. Furthermore, because chlorinated hydrocarbons are persistent in the environment, they accumulate progressively as organisms grow older, and they accumulate into especially large concentrations in top predators, as described previously. In some cases, older individuals of top-predator animals such as raptorial birds and fish-eating marine mammals have been found to have thousands of parts per million (ppm) of DDT and PCBs in their fatty tissues. The toxicity caused by these animals' accumulated exposures to DDT, PCBs, and other chlorinated hydrocarbons is a well-recognized environmental problem (EPA, 2004).

The biomagnifications and food-web accumulation characteristics of DDT are especially well known. Typically, DDT has extremely small concentrations in air and water and, to a lesser degree in soil. However, concentrations are much larger in organisms, especially in animals at or near the top of their food web, such as humans and predatory birds.

This led to a ban on the use of these compounds in 1970. However, the continued use of OCPs in developing countries is of international concern because of their persistence and ability to undergo long distance atmospheric transport and eventually getting deposited in areas far from the point of application, this also led government and researchers to be concerned with their presence in the environment. Most of the pesticides that have been used extensively for long periods in Nigeria are OCPs, the high efficacy and lower cost of OCPs compared with alternative pesticides is the reason for their continued use in Nigeria. The OCPs are widely used in Agriculture, as well as in mosquito and tsetse fly control. Organochlorine pesticides (OCPs) have aroused global concern due to their long persistence, low biodegradability and wide range of distribution in the environment (Aguilar and Borrel 2005; Krishnan *et al.,* 2007). Pesticides play an important role in control of pests in agriculture and public health programmes. The continuous use of pesticides might pose a serious threat to fresh water fish's population and other aquatic fauna.

Nigeria presents diverse environmental problems as the usual methods of waste disposal such as land filling, dumping site and incineration leads to contamination of underground and surface water bodies and resulting in accumulation of the chemicals in edible plankton, commercial shell and fin fish. However, not much work has been done in this regard here in Nigeria, as limited data are available (Chimezie, 2008).

2. DESCRIPTION OF STUDY AREA

Ologe Lagoon is situated in the south western part of Lagos State lying between longitude 6°27 and 6°30 N and latitude 3°2 and 3°7E with a surface area of 9.4km2 and mean depth of 2.5m Odewumi (1995). Ologe Lagoon is situated in Lagos State, the fast growing African mega city, with the last (2007) census report of over 25 million inhabitants, squeezed within a land mass that is predominantly coastal-marine in the south western-most part of Nigeria. The Ologe lagoon meets several socio-economic needs (aquaculture, fishing, sand dredging and drainage) of the various towns and villages bordering it. More importantly, it drains river Owo, into which partially treated/untreated effluents from the Agbara industrial estate is discharged and river Owo is the main fresh water supply point into the lagoon (Clarke *et al.*, 2004). Ologe Lagoon is a brackish water body which opens into the Atlantic Ocean via the Badagry creeks and the Lagos harbor. Apart from providing income for fishermen in the satellite towns and villages; it is also a sinkhole for domestic wastes. The lagoon is bounded by heavy Industry including paper and pulp, glass, plastics, breweries, pharmaceutical and beverages. These partially/largely untreated discharges coupled with domestic inputs from the Agbara residential estates and satellite communities cause significant levels of pollution. It is therefore of great economic importance not only to Lagos State and Nigeria but to the entire coastal countries of West Africa as upstream ecological damage or destruction, could have grievous consequences down-stream, (through bioaccumulation of chemicals in aquatic organisms at the upper trophic levels of the food chain) if not controlled (Clarke *et al.,*2005).

Very little information is available on the fish and fisheries of Ologe Lagoon and the seasonality. Ologe Lagoon is extensively polluted with different waste substances from sites along its length (Chukwu and Nwankwo, 2004; Ogunwenmo and Kusemiju, 2004; Onyema and Nwankwo, 2006). In spite of the pollution level of the lagoon, it continues to be a source of fisheries supply for Nigerians. In this study, the seasonal occurrence and distribution of the fish fauna in Ologe Lagoon of South-Western Nigeria is reported to fill the gap of the dearth of available materials on the fish fauna.

3.0 MATERIALS AND METHODS

Persistent Organochlorine Pesticides (POPs) are present at parts per trillion level (µg/1) in water samples and at parts per billion or parts per million levels (ppm or µg/kg) in sediments and biota, thereby requiring highly specific, sensitive and reliable analytical methods for carrying out such trace and ultra-trace measurements. Gas chromatography with electron capture detector (GC-ECD) using single or mixed stationary phases on a packed glass column or a single phase on a glass or quartz high resolution capillary column is the major technique used for the determination of chlorinated hydrocarbon compounds in environmental samples.

The methodology employed was according to that prescribed by Osibanjo *et al.,* (1993) following the basic analytical steps below:

- Sample collection and preparation;
- Extraction or removal of the compounds of interest from the sample matrix into one that can be analyzed;
- Clean-up of extracts or enrichment of the concentration relative to that of other sample components;
- Separation or isolation of extracted components;
- Determination (preceded by derivation, if necessary);

- Identification of positive residues and measurements of compounds of interest.

Fin fish (*sarotherodon galileaus*), shell fish (*Callinectes sp*. and macrobrachium sp.), sediment and water samples were collected from Ologe Lagoon. The fin fish, and shell fish samples were refrigerated while the water samples were preserved using formalin. All glassware to be used were washed with soapy water and thoroughly rinsed with tap water, and then they were kept in the oven to dry at a temperature of 130°C for thirty (30) minutes. All materials and chemicals to be used were carefully prepared for the extraction process.

Determination and identification of POPs

The water sample was filtered. The level of the pesticide residues were determined using the Gas Chromatograph, model 5890 using Electron Capture Detector. The following conditions were maintained. Gas pressure was 60psi and injector temperature was 220°C, column temperature was 190°C, detector temperature was 270°C, the carrier gas was nitrogen (at 30 ml/min), column length 200 cm, id 2 mm, the glass spiral column packed with 1.5% 0V - 17 and 1.95% OV-210 on chromosorb WHP 80/100 mesh. There were no peaks when solvents and blanks were chromatographed, before the samples were analyzed under the same condition. Known standards, were also chromatographed. The injection volume was automatic and the compounds were sorted by signal. The retention time (minutes) were used to identify the compounds present in the samples.

EVALUATION

Weight of sample analyzed: Fish = 3g, Shrimp = 2g, Water = 200ml, Sediment = 2g and Crab = 2g.

$$\text{Concentration of OCP in Sample Extracts } (\mu g/Kg/L) = \frac{\text{Concentration (ppm) X 1000}}{\text{Weight of sample}}$$

4.0 RESULTS

The study on persistent organochlorine pesticides (POPs) in Ologe lagoon presents various results in water, finfish, shell-fish and sediment samples. Analysis of water sample revealed the occurrence of twenty (20) POP. However DDT was not detected in significant values but its metabolites were recorded with a mean concentration of DDD (2.25±0.13µg/l), (2.33±0.12 µg/l) and DDE (0.87±0.15 µg/l), (1.36±0.14 µg/l) during dry and wet season respectively. Analyzed water sample showed that Endosulfan II had the highest mean concentration (4.88 ± 0.08µg/l) and (6.01±0.09 µg/l) during dry and wet season in water sample.

Hexachlorobenzen (HCB) which is known to be a major industrial chemical by-product was not detected in the water sample. This is an unusual assertion since Ologe lagoon is an industrialized area. There is a general decrease in the concentration of POP in water sample analyzed compared to the other sample collected as seen below.

The overall range of values with mean and standard deviation in parenthesis of the major POP was detected in shrimp sample between the dry and wet season. POP residue was found to be significant in finfish and shellfish samples than in water samples from the same station and this can be related to their lipophilic nature which makes them bio-concentrate and bio-magnify in fatty tissue of aquatic organisms. *Macrobrachium macrobrachium* had the highest mean concentration of Endosulfan II

(515.81 ±15.32 µg/kg) during dry season. During wet season, Heptachlor had the highest mean concentration in *Macrobrachium macrobrachium* sample (1204.93 ±1.72 µg/kg).

The *Macrobrachium macrobrachium* samples had a high pesticide residue concentrations of Endosulfan II, Aldrin, Heptachlor, Dieldrin and Methoxychlor with mean values of (515.81±15.32 µg/kg), (395.25±14.59 µg/kg), (221.15 ±9.97 µg/kg), (250.42 ±3.68µg/kg) and (288.51±10.71µg/kg) during dry season respectively. The rainy season, *Macrobrachium macrobrachium* samples had a considerably high mean concentration of Heptachlor (1204.93 ±1.72µg/kg), Heptachlor epoxide (698.53 ±1.46µg/kg), Aldrin (405.50 ±1.12µg/kg), Endosulfan II (446.86 ±1.58µg/kg), Endrin (348.05 ±2.88µg/kg) and Endrin aldehyde (364.56 ±0.93µg/kg).

POP residues were found to be significantly high in sediment samples than in water samples from Ologe lagoon and this can be attributed to the fact that POPs are sequestered in sediments over time. Compared to *Macrobrachium macrobrachium*, the sediment had a higher mean concentration of Aldrin (209.59 ±2.02µg/kg), Delta HCH (320.09 ±10.88µg/kg), Heptachlor (305.54 ±4.93 µg/kg), Endosulfan II (246.26 ±1.86µg/kg), DDT (252.53 ±8.32µg/kg) and Endosulfan sulphate (721.59±93.33µg/kg) during dry season as shown in. DDT was significantly low in dry season sediment compared to wet season with mean value of (413.07 ±1.10 µg/kg). Delta (HCH), Heptachlor, Methoxychlor and Endosulfan sulphate also have high mean values of (373.14 ±5.77µg/kg), (324.32 ±3.71µg/kg), (343.22 ±5.19µg/kg) and (326.27 ±1.46µg/kg) respectively during wet season.

POP residue was found to be significant in *Sarotherodon galilaeus* samples than in water samples. This could be due to the fact that POP are lipophlic and are stored in the fatty tissue. In fish sample analyzed during dry season, Endrin ketone, Endosulfan sulphate, Endosulfan II, Heptachlor and Dieldrin were significantly high with statistical mean values of (1125.00±64.95µg/kg), (1240.00±47.15µg/kg), (613.50±11.74µg/kg), (777.30±17.44 µg/kg) and (259.10±8.02µg/kg) respectively, this result is high compared to wet season.

Nevertheless, wet season results showed that Endrin ketone had a concentration of (132.04±2.73µg/kg), Endosulfan sulphate (763.79±2.73µg/kg), Endosulfan II (361.82±1.33µg/kg), Heptachlor (61.83±0.75µg/kg) and Dieldrin (180.89±2.47µg/kg). Generally, there is a decrease in concentration of POPs during wet season which may be due to dilution of water body. There was no significant difference between seasons for *Callinectes Pallidus*. DDD and Gamma (Lindane) were not detected during dry season. Endrin ketone had an increased value of (152.49±0.71µg/kg) during wet season and a decreased value of (125.47±0.59µg/kg) during dry season. Results showed that Endosulfan II had no significant difference between the seasons.

Mean concentration of pesticides in water, finfish, shellfish and sediment in Ologe Lagoon.

The results of pesticide analyses in Ologe lagoon showed a variation between the seasons. Figure 1 show an increased mean concentration of Endosulfan II at both seasons in crab sample. Gamma (lindane) and DDD was not detected in crab. Endrin ketone had an increased value of (152.49±0.71µg/kg) during wet season and a decreased value of (125.47±0.59µg/kg) during dry season. From the data analyzed, there is no significant difference between the seasons.

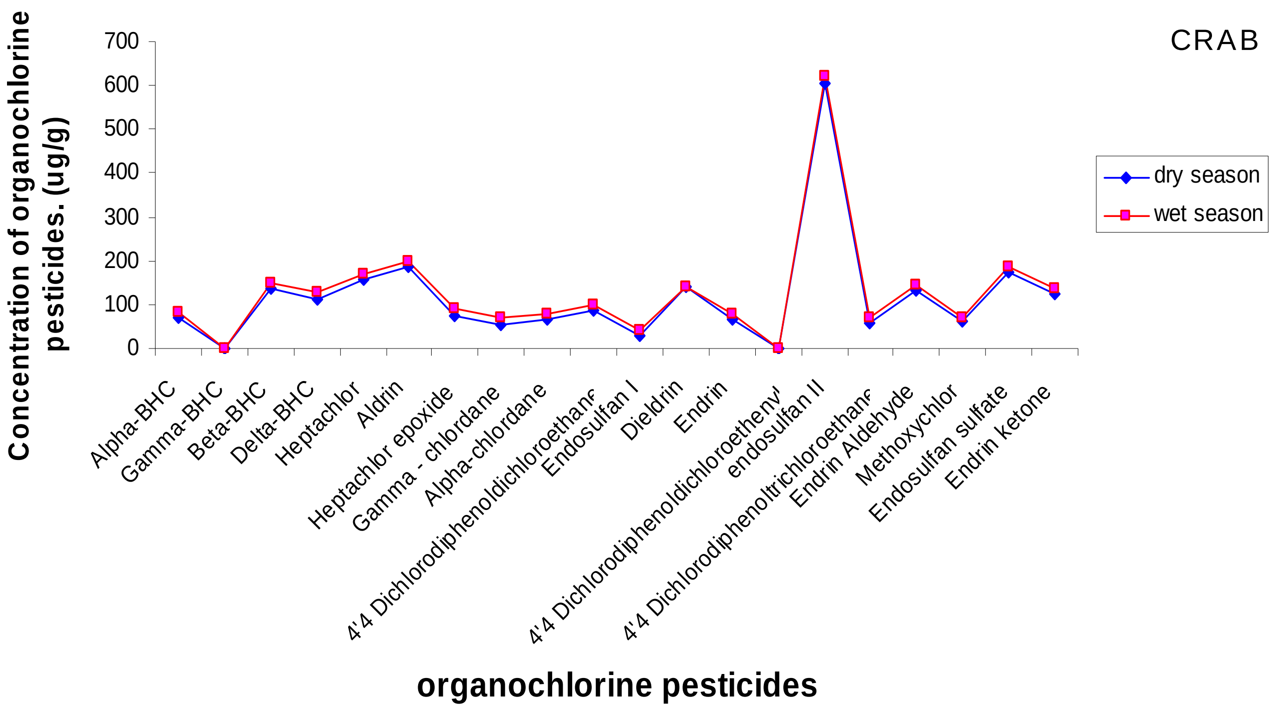

Figure 1: Showing the concentration of pesticides in Crab from Ologe Lagoon, Lagos Nigeria.

POP residue was found to be significant in finfish and shellfish samples than in water samples from the same station and this can be related to their lipophilic nature which makes them bio-concentrate and bio-magnify in fatty tissue of aquatic organisms. Results showed that *Macrobrachium macrobrachium* had the highest mean concentration of Endosulfan II (515.81±15.32 µg/kg) during the dry season while Heptachlor had the highest mean concentration in shrimp sample (1204.93±1.72 µg/kg) in the wet season.

Generally, the analyzed shrimp sample had a high pesticide residue of Endosulfan II, Aldrin, Heptachlor, Dieldrin and Methoxychlor with mean values ranging from (515.81±15.32 µg/kg), (395.25±14.59 µg/kg), (221.15±9.97 µg/kg), (250.42±3.68µg/kg) and (288.51±10.71µg/kg) during dry season respectively. During wet season, shrimp sample analysed had a high mean concentration of Heptachlor (1204.93±1.72µg/kg), Heptachlor epoxide (698.53±1.46µg/kg), Aldrin (405.50±1.12µg/kg), Endosulfan II (446.86±1.58µg/kg), Endrin (348.05±2.88µg/kg) and Endrin aldehyde (364.56±0.93µg/kg) as shown in (figure 2). Shrimp sample analyzed showed an increased Heptachlor, Heptachlor epoxide, Alpha-chlordane and Endrin in wet season while, Alpha-BHC and DDT were not significantly different during the dry season.

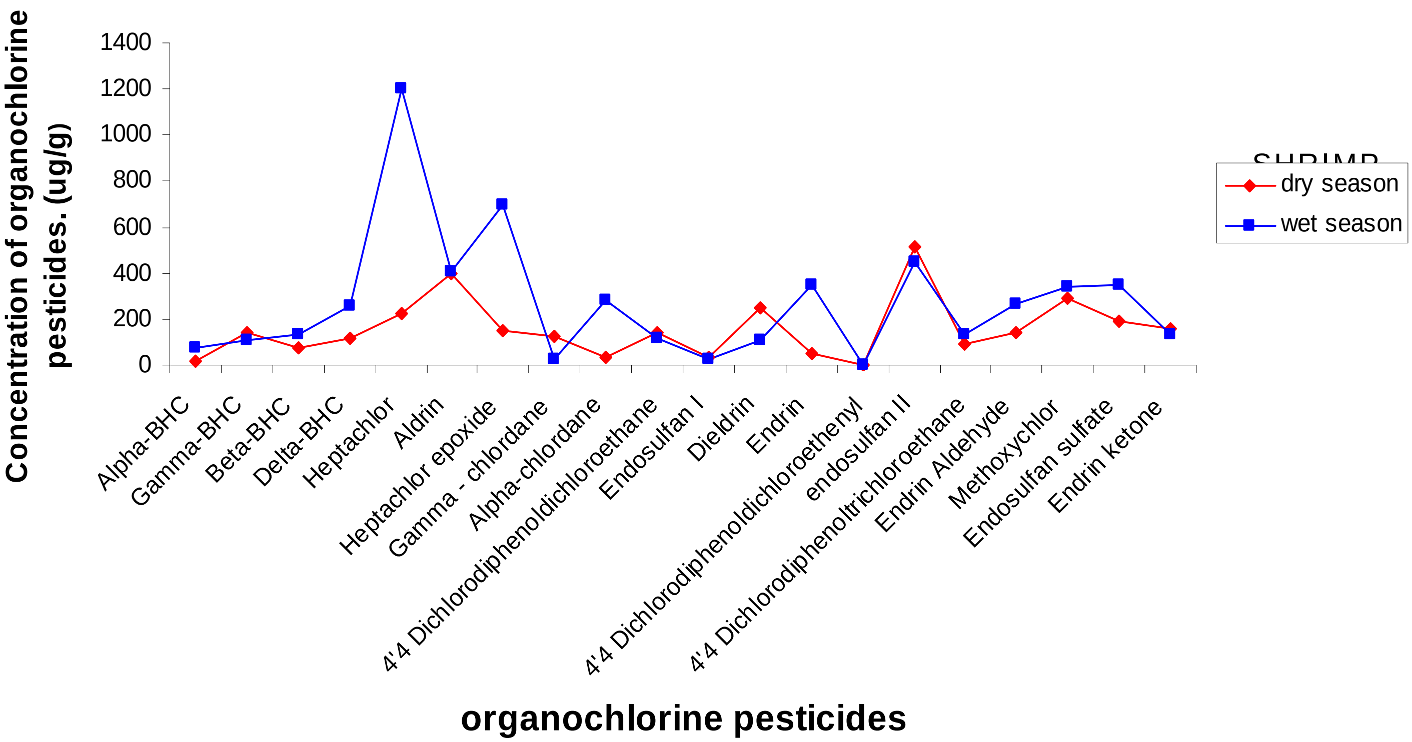

Figure 2: Showing concentration of persistent organochlorine pesticides in Shrimp from Ologe Lagoon, Lagos Nigeria.

POP residue was found to be significant in finfish samples than in water sample. This could be due to the fact that POP are lipophlic and are stored in the fatty tissue. Fish sample analyzed during dry season, showed high mean values of Endrin ketone, Endosulfan sulphate, Endosulfan II, Heptachlor and Dieldrin to be (1125.00±64.95µg/kg), (1240.00±47.15µg/kg), (613.50±11.74µg/kg), (777.30±17.44 µg/kg) and (259.10±8.02µg/kg) respectively, this result is high compared to wet season.

Nevertheless, the data analyzed during wet season showed that Endrin ketone had a concentration of (132.04±2.73µg/kg), Endosulfan sulphate (763.79±2.73µg/kg), Endosulfan II (361.82±1.33µg/kg), Heptachlor (61.83±0.75µg/kg) and Dieldrin (180.89±2.47µg/kg) as shown in (figure 3). Generally, there is a decrease in concentration during wet season which may be due to dilution of the lagoon water.

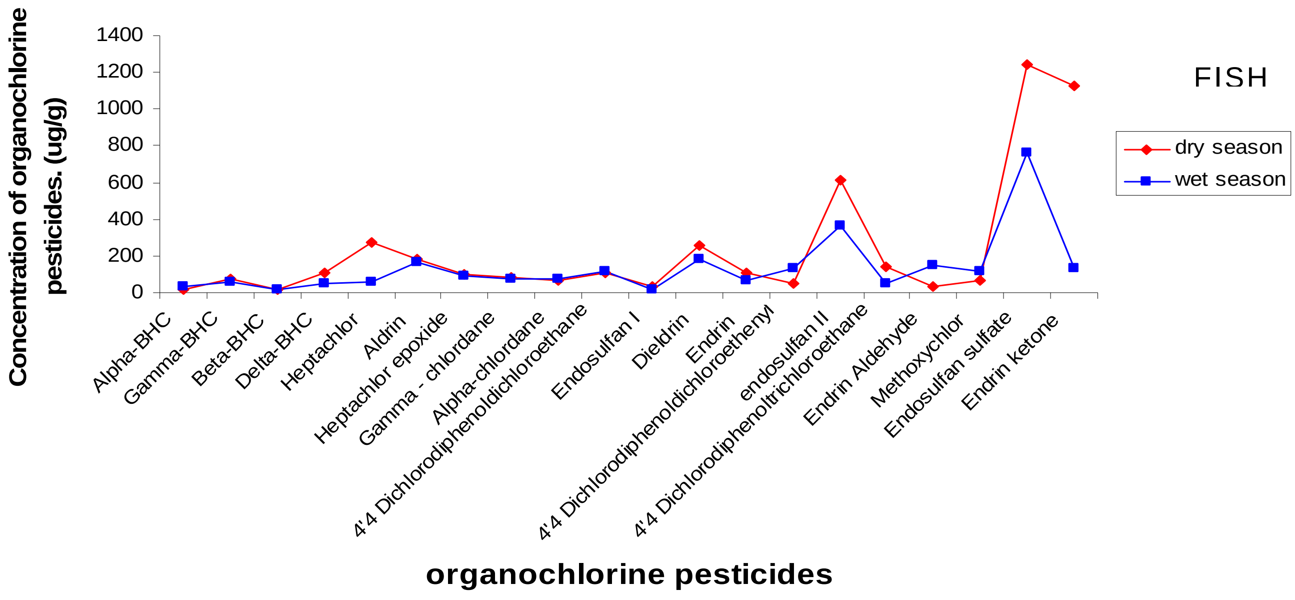

Figure 3: Showing the concentration of pesticides in Fish from Ologe Lagoon, Lagos Nigeria.

POP residue was found to be significant in sediment sample than in water sample from Ologe lagoon and this can be attributed to the fact that POPs sequestered and thus accumulate in sediments. Relative to shrimp sample, sediment had a high mean concentration of Aldrin (209.59±2.02µg/kg), Delta HCH (320.09±10.88µg/kg), Heptachlor (305.54±4.93 µg/kg), Endosulfan II (246.26±1.86µg/kg), DDT (252.53±8.32µg/kg) and Endosulfan sulphate (721.59±93.33µg/kg) during dry season as shown in (figure 5). DDT was significantly low in dry season sediment compared to wet season with mean value of (413.07±1.10 µg/kg). Delta (HCH), Heptachlor, Methoxychlor and Endosulfan sulphate also have high mean values of (373.14±5.77µg/kg), (324.32±3.71µg/kg), (343.22±5.19µg/kg) and (326.27±1.46µg/kg) respectively during wet season (figure 4).

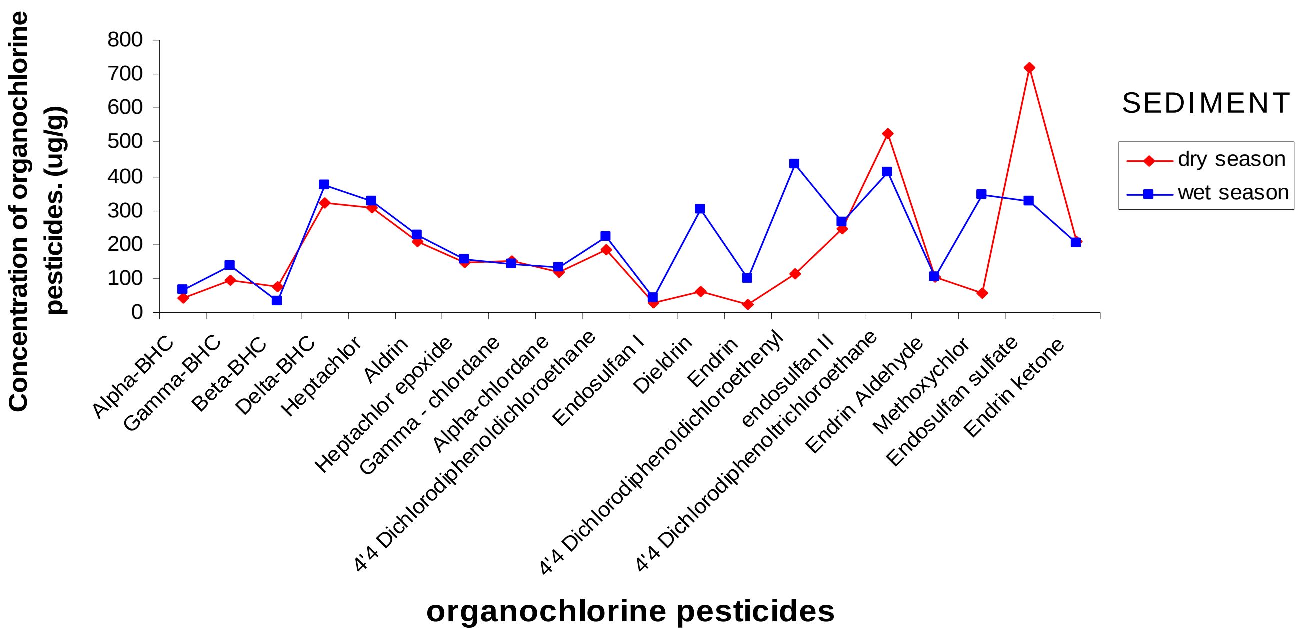

Figure 4: Showing the concentration of pesticides in Sediment from Ologe Lagoon, Lagos Nigeria.

However, Endosulphan sulphate had an all-time- high mean value in the sediment during the dry season of the study period. Figure 5 shows the mean concentration of POP in water sample during dry and wet season and is summarized with respect to the sample location. Analysis of water sample revealed the occurrence of twenty (20) POPs.

However DDT and Endrin aldehyde was not detected but its metabolites were recorded with a mean concentration of DDD (2.25±0.13µg/l), (2.33±0.12 µg/l) and DDE (0.87±0.15 µg/l), (1.36±0.14 µg/l) during dry and wet season respectively. Analysed water sample showed that Endosulfan II had the highest mean concentration (4.88 ± 0.08µg/l) and (6.01±0.09 µg/l) during dry and wet season in water sample.

Hexachlorobenzen (HCB) which is known to be a major industrial chemical by-product was not detected, Alpha chlordane was not significant in the water sample. This is an unusual assertion since Ologe lagoon is an industrialized area. There is a general decrease in the concentration of POP in water sample analysed compared to the other sample analysed.

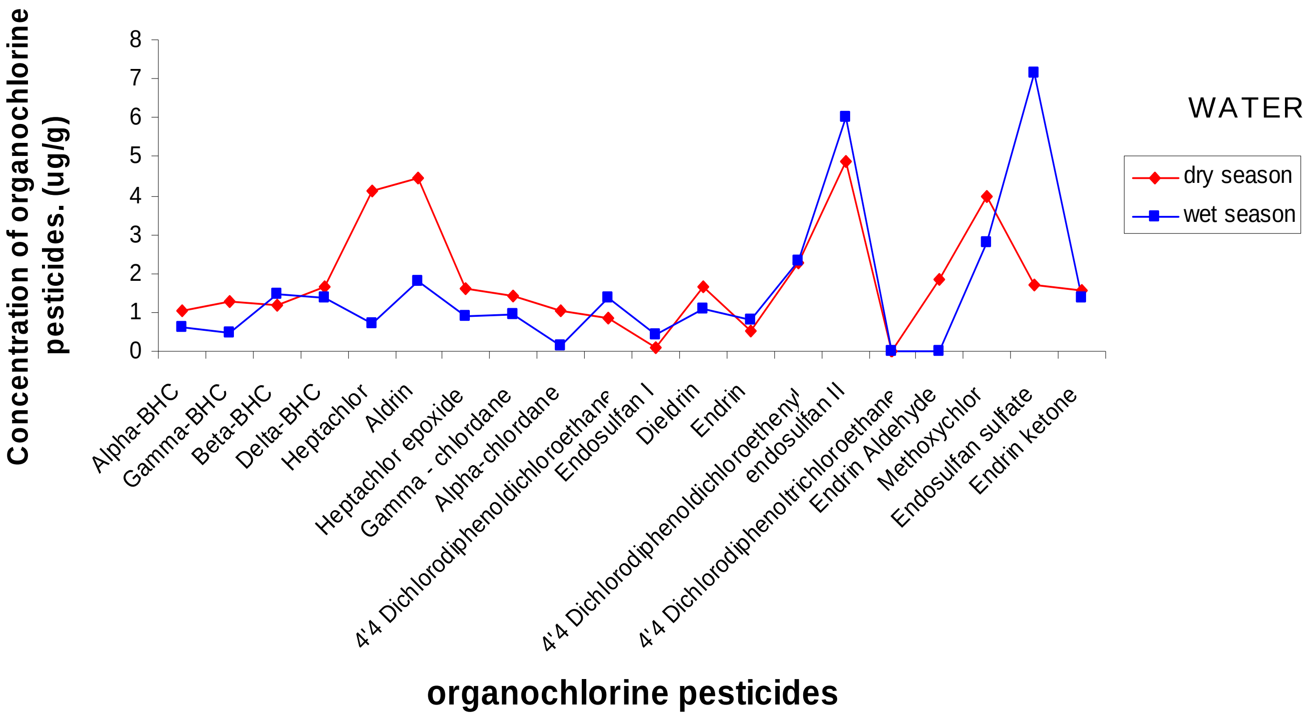

Figure 5: Showing the concentration of pesticides in Water from Ologe Lagoon, Lagos Nigeria.

5.0 DISCUSSION

Persistent Organochlorine pesticide (POPs) have been detected and quantified from (water, sediment, fish, shrimp, and crab) in Ologe lagoon, Lagos state, Nigeria. The catchment area is largely sites of urbanization and industrialization. They are characterized by the presence of fishing activities, residence and intensive industrial activities in the neighborhood which direct its waste into the Lagoon. Though the use of pesticides for agricultural activities is not a major occupation in this area, The OCPs level in Ologe Lagoon may be due to the discharge of the municipal water into the lagoon as one of the major underground drainage systems in that part of the State empties into the lagoon few meters away.

The levels of organochlorine pesticides residues exhibited in samples collected from the same point at different times were different. The residue levels exhibited by all the pesticide during dry season were significantly different from the levels during the rainy season. These differences in concentration could be due to the fact that when the water is turbulent, there is mixing compared with when the tide is low and the water is calm. Dry season samples were collected when lagoon water volume was low, while rainy season samples were collected at higher Lagoon water volume.

This difference in concentration of residues exhibited at different times is comparable with studies by some researchers as cited by (Osibanjo and Tongo, 1985). The levels of OCPs residues in sediment were higher than that obtained in the water samples from the same Lagoon. Result from water sample shows that concentration of DDT in water is not significant. This may be due to its long term use and because it has been converted into its metabolites (DDD and DDE), which is present in water and remain in this state for longer periods. According to Freedman (1994) DDT has extremely small concentration in air, water and to a lesser degree in soil because they have a very sparse solubility in water. Heptachlor and aldrin as the highest concentration during dry season which may be due to their commercial use as fire ant control in power transformers, important metabolites of heptachlor is heptachlor epoxide (ATSDR, 2000). If water contaminated by heptachlor is ingested by human and animals, it readily converts to its most persistent toxic metabolites which are stored in fatty tissue, liver, kidney and muscle. It is excreted in the urine and faeces (WHO 2000). This indicates a higher level of pollution and agrees with the work of Ogunlowo, (1991), Nwankwoala and Osibanjo, (1992) who reported a general contamination of African inland waters by a broad spectrum of Organochlorine pesticides (OCPs). The mean pesticide levels obtained for all the water samples were higher than those obtained by past researchers from studies carried out in some waters in Nigeria. This indicates an increase in the use of pesticides over the years despite its ban. Water samples from Ologe contained maximum–HCH (1.63 ng/L) and -HCH (1.45ng/L) during dry and rainy season respectively, both did not exceed the Romanian reference value (100 g/kg for -HCH and 50 g/kg for -HCH) which is in accordance with the work of (Frenecz 2010).

However the concentration of higher (OCPs) in sediment than water is due to the fact that it contains a large concentration of organic matter, than the overlaying water (Freedman, 1994). The data for Ologe lagoon illustrates a substantial biomagnification of OCPs from water and to a lesser extent from sediment as well as a marked food web accumulation from herbivores to carnivores. DDT and Endosulfan had a mean concentration of 525.53µg/kg and 413.06µg/kg, 721.59µg/kg and 326.26µg/kg in sediment during dry and rainy season respectively which could be due to its domestic use as insecticides in combination with dicofol. DDT is now less effective in tropical regions due to the continuous life cycle of mosquitoes and poor infrastructure and also because mosquitoes are developing resistance to it (Osibanjo and Adeyeye 1997). Endosufan sulfate, DDT, Endrin aldehyde, DDE, Aldrin, Endosulfan II, Heptachlor, Delta HCH were found in significant concentrations at this site in all the seasons, indicating their wide use. Gamma chlordane and Alpha chlordane varied from 149.51µg/g to 141.99µg/g and 119.45µg/g to 134.09µg/g respectively during dry and wet season with a detection frequency. Reports suggest that heptachlor has been used to dress beans and maize seeds (NEMA, 2000).

As a result, these pesticides find their way into the soil and subsequently into the water body. Dominance of DDT in the sediments may be attributed to the slow degradation of DDTs or recent input of DDT in the environment, this correlate with the work of (Puneeta *et al* 2011). Moreover, pre-dominance of Heptachlor epoxide suggests the decomposition of Hetachlor to Heptachlor epoxide. The results of the present study are consistent with the findings of (Cavanagh *et. al* 1999) that the volatilization of POPs such as OCPs occurs in warmer climate of tropical regions. Methoxychlor is tightly bound to soil and is insoluble in water, so it is not expected to be very mobile in moist soils. Methoxychlor breaks down slowly in air, water and soil by sunlight and microscopic organisms. It may take several months, thus, explaining its abundance in sediments (ATSDR 2002). The POPs residue in shellfish was found to be high in samples analysed. The entire major (POPs) were detected except gamma–bhc, ddd and hexachlorobenzen (HCB). This agrees with the work done by (Ize-iyamu *et al.,* 2007) which states that pesticides concentration settle at the bottom of the water which tends to bind with the sediment and also bio accumulate in the tissue of shell fish (*Callinectes pallidus*) due to their behavioural and feeding adaptation with the sediment. Crab had a mean value of Aldrin of 156.27µg/kg and 157.53µg/kg; Dieldrin of 141.53µg/kg and 139.58µg/kg between dry and wet season respectively. This shows gradual oxidation of aldrin to form active compound dieldrin which tends to biomagnify as it pass along the food chain. They are by-product of various industrial processes (i.e bleaching paper pulp, chemicals and pesticides manufacture). When not properly disposed or burnt with refuse, produce dioxins. Long- term exposure has proven toxic to a very wide range of animals including humans (Kegley and Orme 2007). Shrimp contained maximum of -HCH (142ng/g) and -HCH (258 ng/g) during dry and wet season respectively, both exceeded the Romanian reference value (100 g/kg for -HCH and 50 g/kg for -HCH) which correlate with the study of (Frencez, 2010) and **(**Acevedo, 2010). Nevertheless, the levels of POPs residue detected in all the shellfish samples were lower relative to that in finfish samples. This could be attributed to the pesticide being lipophilic; they reside and accumulate in fatty tissues. Pesticides enter fishes not only by ingestion but also through dermal absorption and respiration. When these chemicals are taken in by the fish, they bio accumulate, bio magnify and remain in the fish till they are caught and consumed by man or eaten by bigger fishes which are eventually eaten by humans. These study reviews that organism at or near the top of their food web, such as humans have higher concentrations of POPs which may be hazardous to man's health causing carcinogenic, respiratory, reproductive problems and brain damage especially in children (Eskenazi 2009).

The finfish (*Sarotherodon galileaus*) had significantly higher concentration of these chemicals that far exceeds 10ng/l which is the recommended guideline for the protection of freshwater aquatic life in Canada (Merriman and Metcalf,1988), this agrees with the study reported by Osibanjo and Tongo (1985). In Nigeria, the detection of OCPs in some fresh water fish samples has been reported. The concentrations of OCPs in these samples were in ppb range as shown: DDE 2.0-30.0 ng g^{-1}; DDD 2.0-60.0 ng g^{-1}; DDT 3.0-18.0 ng g^{-1}; HCB 9.0-130.0 ng g^{-1} and HCH 0.2-5.0 ng g^{-1}. The detection and quantization of OCPs in South Eastern Nigeria have also been reported, the concentration ranges were HCH 0.2-7.4 ng g^{-1}; DDE 0- 4.2 ng g^{-1} and DDD 0-8 ng g^{-1} (Osibanjo 1994). The concentrations of OCPs detected in finfish samples in this study are much higher when compared to Federal Environmental Protection Agency (FEPA) allowable limit of <0.01 ppm (FEPA, 1991).

Although OCPs is reported to have been gradually abandoned owing to pest resistance and international concern, DDT seems to have continued to be secretly used by farmers (NEMA, 2000). In a recent interview (Wasswa, 2009), 2% of the farmers confessed to using DDT. Its residues have also been detected in fish samples from Lake Edward (Ssebugere et al., 2009), as well as in soil samples in western Uganda (Ssebugere et al., 2010). The results of this study showed that investigated fish samples contained detected concentration of Lindane, but at concentration below limit (MRL). No differences were found in the Lindane concentration between the seasons analysed for fish samples, this correlate with the work done by (Davodi *et al* 2011). The result of this research indicates that *Sarotherodon galileaus* during dry season had the highest organochlorine pesticides with DDT been most prevalent and 4'4DDE contributing to the total DDT. The highest concentration of HCH was found to be Delta (HCH) with 108.60µg/g during dry season and Gamma (HCH) was predominant at rainy season among HCH isomers in fish sample. Organochlorine pesticides level in fish were relatively low, but the levels of several ocps in the fish sample exceed the guide lines for food safety issued by the European union (EU) and US Food and Drug Administration (FDA) (Takahashi *et al* 2010 and Davodi *et al* 2011).

CONCLUSION

In Africa, including Nigeria, rapid urbanization as well as severe pest problems, weeds, rodents, locust and grain eating birds have increased reliance on the use of pesticides. OCPs are a cheap form of insecticides and are widely used. Also co-disposal of industrial, domestic and medical waste in open dumps has contributed immensely to pollution menace in the region. This study shows some degree of water contamination in Ologe Lagoon, Lagos State by the OCPs residues which poses an ecological threat. The continuous use of the contaminated water for drinking and other domestic purposes over a long period of time, and the use of pesticides for fishing by artisanal fishermen in these areas will definitely lead to a dangerous high concentration of the not easily metabolized chemical in human body. There is serious need for the monitoring of these pesticide residues in water, food and the environment, as this will go a long way towards preventing various environmental and public health hazards.

REFERENCES

Agency for Toxic Substances and Disease Registry. (2002). *Toxicological Profile for Heptachlor/Heptachlor Epoxide*, ATSDR/TP-88/16. ATSDR, US. Public Health Service.

Acevedo, F., Pizzul, L., Castillo, MdP., González, M.E., Cea, M., Gianfreda, L., Diez, M.C. (2010). Degradation of polycyclic aromatic hydrocarbons by free and nanoclay-immobilized manganese peroxidase from *Anthracophyllum discolor*. Chemosphere 80(3), 271-278.

APHA/AWWA/WPCF (1985). Standard methods for the examination of water and wastewater. 16th ed. Washington, *American Public Health Association*, (12)68p.

Chukwu, L.O. and D.I. Nwankwo, (2004). The impact of land based pollution on the hydrochemistry and macrobenthic community of a tropical West African creek. *Ekologia*, (2): 1-9p.

Clarke EO, Anetekhai MA, Akin-Oriola GA, Onanuga AIS, Olarinmoye OM, Adeboyejo OA, Agboola I (2004). The Diatom (*Bacillariophyta*) diversity of an open access lagoon in Lagos, Nigeria. *J. Res. Rev. Sci.* (3):70 – 77p.

Eskenazi, Brenda (2009). "The Pine River Statement: Human Health Consequences of DDT Use". *Enviro. Health Perspect.* 21.11

Federal Environmental Protection Agency, FEPA (1992): Guidelines and Standards for Environmental Pollution Control.

Freedman, B. (1994).*Environmental Ecology.* 2nd ed. San Diego: Academic Press.

Ize-Iyamu O.K., I.O. Abia and P.A. Egwakhide, (2007). Concentrations of residues from organochlorine pesticide in water and fish from some rivers in Edo State, Nigeria. *Int. J. Physical Sci.*, (2): 237-241p.

Kegley, S.; B. Hill; S. Orme, (2007) PAN Pesticide Database, Pesticide Action Network, North America (San Francisco, CA. http://www.pesticideinfo.org

NEMA – National Environment Management Authority, Uganda, (2000). Status of Persistent Organic Pollutant Pesticides in Uganda: A Historical Overview. NEMA Secretariat, Kampala.

Ogunlowo, S.O., (1991). Priority chemical pollutants in some rivers along the cocoa growing area of Ondo State. *MSc. Thesis, Department of Chemistry, University of Ibadan.*

Ogunwenmo, C.A. and K. Kusemiju, (2004). Annelids of a West African estuarine system. *J. Environ. Biol.*, (25): 227-237p.

Onyema, I.C. and D.I. Nwankwo, (2006). The epipelagic assemblage of a polluted estuarine creek in Lagos, Nigeria. *Pollut. Res*., (25): 459-468p.

Osibanjo O, Adeyeye A (1997). OCPs residues in foodstuffs of Animal origin in Nigeria. *Bull. Environ. Contam. Toxicol*. 58: 206–212.

Osibanjo, O. (1994). Review of chlorinated hydrocarbon substances in African aquatic environment. *F.A.O Fish Rep*., (502): 37-45p.

Osibanjo, O. and A. Adeyeye, (1995). OCPs residues increase. *Toxicology,* (54): 460-465p.Puneeta Pandey, P. S. Khillare, Krishan Kumar (2011). Assessment of Organochlorine Pesticide Residues in the Surface Sediments of River Yamuna in Delhi, India. School of Environmental Sciences, Jawaharlal Nehru University, New Delhi, India. Email: puneetapandey@gmail.com Received February 4th, 2011; revised

Takahashi S, Oshihoi T, Ramu K, Isobe T, Ohmori K, Kubodera T, Tanabe S.(2010) Organohalogen compounds in deep-sea fishes from the western North Pacific, off-Tohoku, Japan: Contamination status and bioaccumulation profiles. Marine Poll. Bull. 60 (2): 187-96.

USEPA. (1990). Suspended, Canceled, and Restricted Use Pesticides. Office of Compliance Monitoring, Office of *Pesticides and Toxic Substances*, US EPA, Washington, DC.

World Health Organization. (1984). Environmental Health Criteria 38: Heptachlor. WHO, Geneva, Switzerland. Davodi M, Esmaili-Sari A, Bahramifarr N. Concentration of polychlorinated biphenyls and organochlorine pesticides in some edible fish species from the Shadegan Marshes (Iran). Ecotox. Environ. Safe. 2011; 74 (3): 294-300.