International Journal of Multidisciplinary Research and Development
www.allsubjectjournal.com
ISSN Online: 2349-4182 ISSN Print: 2349-5979
Received: 28-04-2023, Accepted: 15-05-2023, Published: 30-05-2023
Volume 10, Issue 5, 2023, Page No. 55-58

Concentration level of pesticides in Ajiwa dam freshwater

Ibraheem Kabir
Department of Fisheries Technology, Hassan Usman Katsina Polytechnic, Katsina State, Nigeria

Abstract
Concentration Level of pesticides were assessed in the sediment of deep and shallow lakes from Ajiwa Dam, Batagarawa local Government, Katsina State to evaluate the different levels of pesticides in the sediment of lacustrine environments. The catchment areas of the studied environments is characterized by several agricultural activities and human occupations. Sediment samples were collected during the dry and the rainy periods and total pesticides analyzed in gas chromatography coupled to mass spectrometry (GC-MS). The results showed no seasonal difference in the concentration of pesticides in the sediment of the deep and shallow lakes, indicating a high consistency in the presence of the contaminants. Levels varied from 0.0 to 11.4 mg/kg in deep lakes and 0.0 to 8.4 mg/kg in shallow lakes. In deep lakes similar concentrations of pesticides was observed at Station 18 Lake and Station 20 Lake, while at Station 19 Lake it was detected a higher level of contamination. In the sediments of the Station 24 shallow lake highest values of pesticides were detected in relation to Station 23 and Station 23 shallow lakes. Importantly, already banned pesticides and organic contaminants were also detected, thus raising concerns. More studies needs to be done in these lacustrine environments, since they are used for recreational and water supply purposes.

Keywords: concentration level, environments, statistical analysis

Introduction

The application of pesticides for pest control is corresponding to the extent of pollution in our environment (air, water and land). This is because when these chemicals are applied on agricultural fields not all portion reaches the target site (Mustapha, 2020) [9]. Some study suggested that approximately 0.3 % of applied pesticides go to target pest while 99.7% goes into other environmental matrices (Pimentel, 2003) [11]. This shows great persistency in high altitude region, for some that reaches target regions gives a better control of pest and for non-target regions seeps away as run-off to pollute surface waters ways like streams, rivers. Pesticides are mixture of substances wished-for preventing, controlling and destroying any pest, as well as vectors of human or animal disease, unwanted species of plants or animals causing harm during and interfering with the production, processing, storage or marketing of food, agricultural commodities such as fishes in the water bodies (Hashmi and Khan, 2011) [7]. Used of synthetic pesticides in Nigeria started in 1950s (Adeyeye and Osibanjo, 1990) [1]. Farmers in Nigeria have been using different kind of pesticides for control of weeds; weevils of cotton, beans and cereals; borers of plant stalks and yams (Ogunfowokan *et al*., 2012) [10]. Different studies shows that already banned pesticides are still in use in Nigeria. And if appropriate majors were not taken, there may be contamination of water bodies and fishes that are being consumed which may result in human poisoning. Worldwide, approximately three million people are poisoned and 200,000 died almost every year from pesticide poisoning, and a majority of them are from developing nations (Sarkar *et al*., 2008) [14]. There is public concern about the toxicity by pesticides which recently intensified because a number of these chemicals are recognized as hormone disrupters, which can cause malfunctioning of the endocrine and reproductive systems in animals and humans, cardiovascular disease and cancer, obesity and diabetes (Wikipedia, 2016a) [16]. Pesticides also bring serious health effects on ecosystem, and none of them has any important effects. When Pesticides get contract in to the ecosystem, they continue to exist in the environment for so many years, causing complications such as deviation of normal functioning of the ecosystem, loss of species diversity, and immunological disorders in wildlife species and humans (Sweetman *et al*., 2005) [15]. There is therefore the need for broader assessment of banned pesticides in developing countries, Nigeria in particular. This will provide the opportunity of exposure and extent of human and environmental health risks. This study therefore aims at assessing the levels of pesticides in deep and shallow lakes in Ajiwa dam, Batagarawa local government, katsina state.

Materials and methods

1. Study Site

Ajiwa Dam is located at Batagarawa local government area of Katsina state, Nigeria on latitude and longitude 12°54'69" -12°57'58" N and 7°42'53" - 7°47'50" E respectively (Figure 1). The main purpose of the Dam is Fishing, irrigation and water supply to the people of Katsina, Batagarawa, Mashi, and Mani local government areas of katsina state. The Dam was impounded in 1973 and commissioned in 1975 (Parkman and Haskoning, 1996).

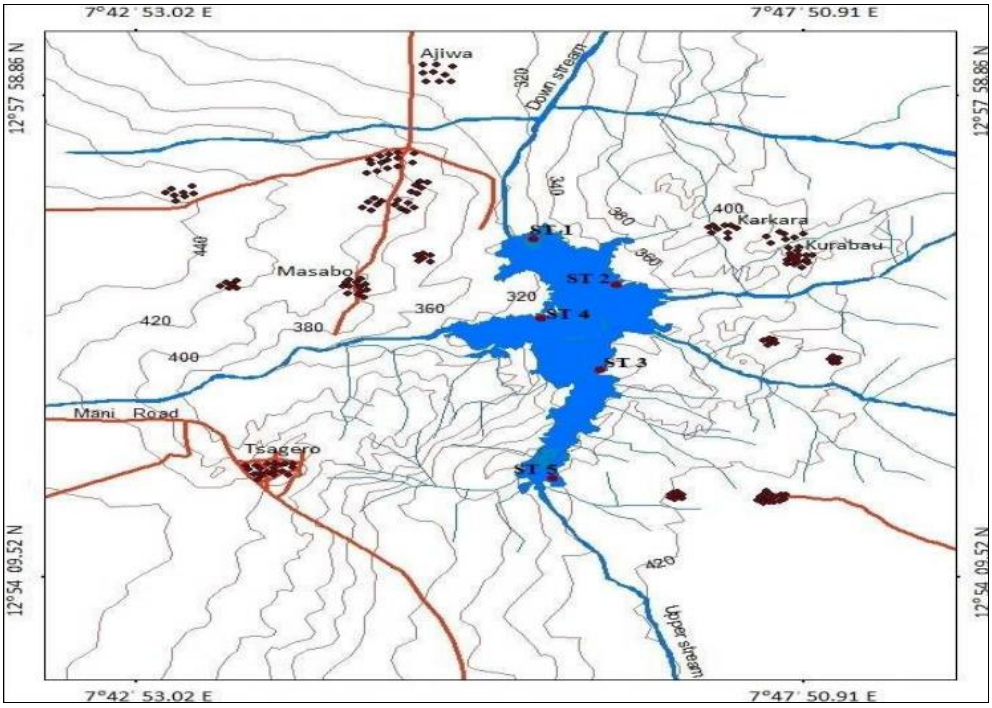

Fig 1: Map of Ajiwa Dam showing sample stations.

2. Data collection

Field samplings surveys were performed in two different seasons (Dry and Rainy), the collected data in this study were categorized monthly according to these flow regimes (wet and dry seasons periods) in 3 deep and 3 shallow lakes whose catchment areas of the studied lacustrine environments is characterized by multiple agricultural activities and human occupations. Pesticides extractions was performed with Soxhlet extractors with a capacity of 60 mL and volumetric flasks of 250mL, and heated (60 ºC) by heating blankets, it was used in a solvent mixture (hexane and dichloromethane; 1:1; v/v). Total pesticides were analyzed in gas chromatography coupled to mass spectrometry (GC-MS) with electron capture detector (GC/ECD).

3. Statistical analysis

The statistical significance of the sets of variables was tested using one-way analysis of variance (ANOVA). All statistical analysis were carried out with the software R version 3.6.1 (R Development Core Team 2019).

Results

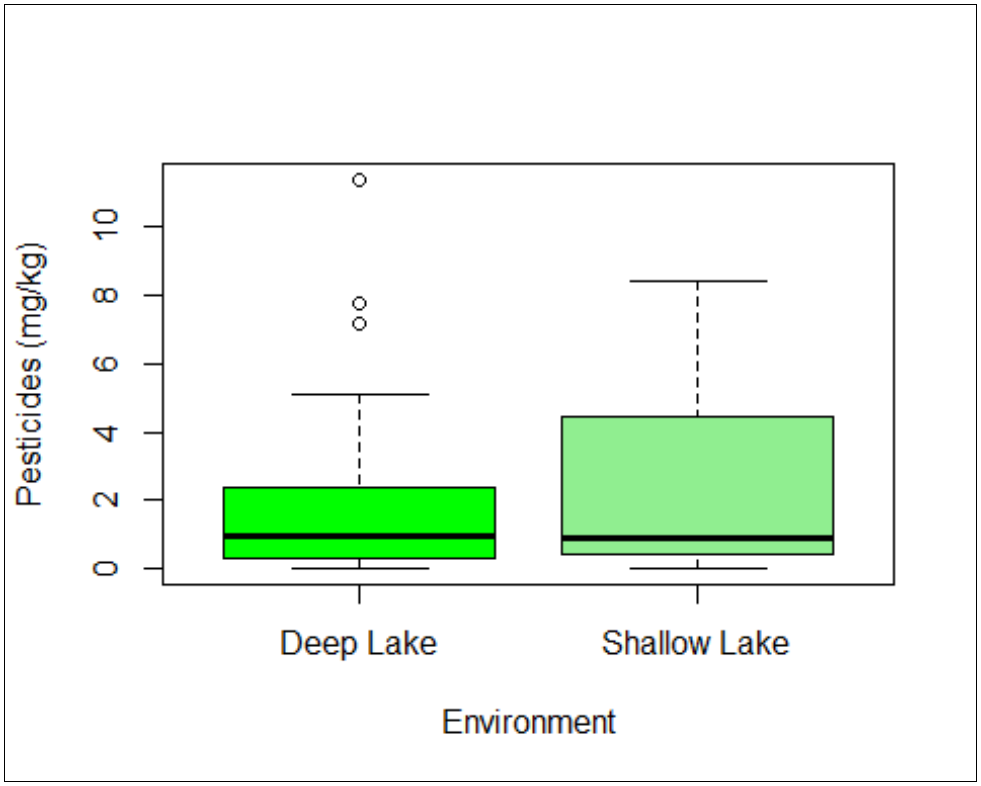

Fig 2: Concentration of pesticides (mg/kg) in the sediments of deep and shallow lakes. P= 0.2549.

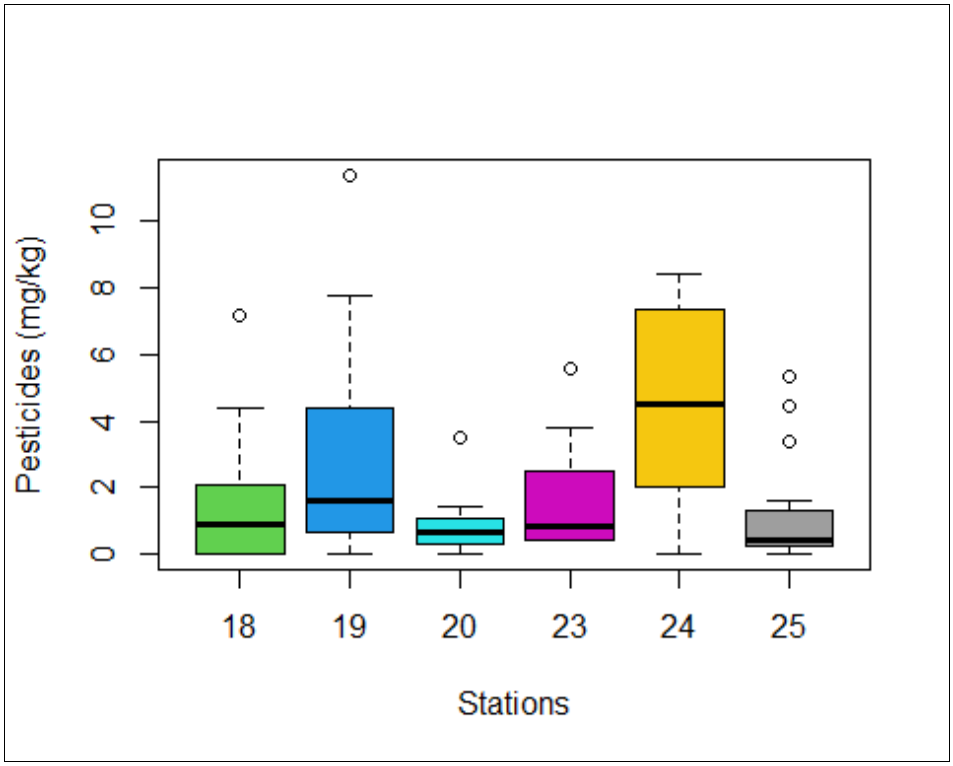

Fig 3: Concentration levels of pesticide in the sediments of lakes. The stations 18, 19 and 20 were in deep lakes (Values ≥ 2.9 mg/kg) while the stations 23, 24 and 25 were in shallow lakes (values ≥ 4.3 mg/kg). P = 0.02593.

Discussion

The global concentration of pesticides in the study area didn't show significant difference between the deep and shallow lakes (P= 0.2549) (Fig 1). Pesticides used gained global consideration owing to their transboundary distribution through different ways such as air, water, and the food web thus affecting human and aquatic organisms far from their origin (Qiu *et al*., 2020; Yao *et al*., 2021; Kidd *et al*., 2007). Global efforts on eradicating the use and production of pesticides have their evolution from the Basel Convention (1989), the Barcelona Resolution (1995), 8 Aarhus Protocol (1998), the Arctic Environmental Protection Strategy (1991), the Rotterdam Convention (1998) and to more recently the Stockholm Convention (2004). As a universal concern, hundreds of countries across the world agreed to eradicate the production, uses, and the release of different types of pesticides 'The Dirty Dozen' during the Stockholm Convention held in Stockholm, Sweden, in May 2001 (Kidd *et al*., 2007; United Nations, 2001) In spite of these resolutions, pesticides continue to be discovered in the water bodies (Fey *et al*., 2019).

Following Global tendencies, many of the pesticides assessed in the present study. For example, the use pesticides for agricultural purposes banned for so many years. In spite of that, up to date, the use of this pesticide for non-agricultural purposes was still allowed and it was freely commercialized (Anvisa *et al*., 2011). Regardless of being already banned for so many years, these pesticides (DDT, DDE, DDD, Dieldrin, Enarin etc.) Were detected in samples analyzed in the present study, their existence is attributed to long-range transport and persistence. This finding could be explained considering the long-term and massive use of these pollutants in the study area. In fact, pesticides are known to be very stable and highly persistent molecules that can adhere to soil and induce chronic environmental impacts (Jayaraj *et al*., 2016). Aquatic compartments most especially sediment (Salem *et al*., 2013) significantly accumulate organic contaminants from industries, agricultural activities, and transboundary mobile contaminants making them fundamental sink for biota (Das *et al*., 2020). Furthermore, Pesticides circulate in the environment and trophic levels through the food chain and exposure from everyday consumables like surfactants and air pollution (Wu, Munschy, Aminot, Bodin, & Vetter, 2021).

In the stations, in deep lakes similar concentrations of pesticides was observed at Station 18 and Station 20, while at Station 19 it was detected a higher level of contamination (values ≥ 2.9 mg/kg). In the sediments of the Station 24 shallow lake highest values of pesticides were detected (values ≥ 4.3 mg/kg), in relation to Station 23 and Station 25 shallow lakes (Fig 2). Degradation and movements of pesticides from the point of application depends on environmental conditions and the extent of adsorption of the pesticides under any particular soil type, while soil solution conditions depend on the nature and properties of the soil and the physico-chemical properties of the pesticide (Eklo, *et al*., 2019) [4]. The surface runoff accumulates and transports pesticides into lakes, and therefore, the water quality in the upper reach region can be relatively poor. Due to the confluence of water flow and the high precipitation in the lower reaches (higher than the precipitation in the upper reaches), more water and sediments are concentrated in the lower reaches. Especially the wet season is the cultivating season, more pesticides are used and transported to lakes, and the water quality in the lower reaches is lower than that in the upper reach. This result is possible because the addition of soil nutrient is relatively greater than the addition of water. The higher concentration of pesticides during the dry season could be attributed to the effluent from a distillery and the runoff from an agricultural field. During the wet season these concentrations decreased considerably due to the dilution from a higher lake flow.

However, during the wet season the concentration was diluted from the higher water flow. Therefore, lake pollution is largely dependent on the upstream lake flow, which indicates that the control of different upstream lakes in the study area indirectly controls the lakes pollution. The pressure and impact on the lakes is also due to high population density and agricultural activities that emit pesticide at a high level. In order to determine the actual level and severity of the pesticide concentration level, it is important to measure the organic matter content together with the humic substances in the lakes for both shallow and deep lakes. The presence of pesticides in water is a threat to the aquatic environment and humans using the water at regional, national and global scales (Fernandes *et al* 2009). Lake shallowness accelerates metal remobilization, which influences metal contents in water, Yang *et al*. (2020). Shallow lakes showed higher concentration level than deep lakes, In deep lakes similar pattern of pesticides was observed in station 18, and 20 while station 19 showed higher level of contamination, meanwhile in the shallow lakes station 24 showed higher level of pesticide concentration, in turn station 23 and 25 showed similar spatial pattern. The small size and little possibility of dilution or buffering of pollutants can bring shallow lakes to a condition of degradation rarely seen in larger waterbodies (Biggs *et al*., 2005) [3].

Conclusions

In conclusions, Different kind of Pesticides were detected in the samples (DDT, DDE, DDD, Dieldrin, Enarin, Nafa-clordano, Gama- clordano). Shallow lakes showed higher concentration levels of pesticides compared to the deep lakes this shows that shallowness accelerates metal remobilization. The result indicate high consistency in the presence of the contaminants. Pesticides found in this study can affects the normal functioning of the ecosystem, loss in production, changes in growth, development and/ or behavior, altered diversity or community structure, changes in system processes (such as nutrient cycling), and losses of important species in the study areas. This study highlight the need for a nation-wide monitoring program to verify the actual risks of the pesticides. More studies needs to be done in these lacustrine environments, since they are used for recreational and water supply purposes.

References

1. Adeyeye A, Osibanjo O. Residues of organochlorine pesticides in fruits, vegetables and tubers from Nigerian markets. Sci. Total Env,1990:231:227-333.
2. Anvisa. Agˆencia Nacional de Vigilancia ˆ Sanitaria ´ (ANVISA), Gerˆencia Geral de Toxicologia, Nota T´ecnica Sobre a Reavaliaçao ˜ Toxicologica ´ do Ingrediente Ativo Lindano. Available at, 2011. http://portal.anvisa.gov.br/documents/111215/11 7797/lindano.pdf/39f519f7-ee51–4fd8–9528-23c1826ce2be?version=1.0〉
3. Biggs J, Williamns P, Whitfield M, Nicolet P, Weatherby A. 15 years of pond assessment in Britain: results and lessons learned from the work of pond conservation. Aquat. Conserv. Mar. Freshw. Ecosyst,2005:15:693–714. https://doi.org/10.1002/aqc.745.
4. Eklo OM, Almvik M, Hole H, Nyborg ÅA, Stenrød M, Borgå K, *et al*. Degradation and mobility of pesticides in Norwegian soils. Ejnfs, 2019, 303–305. doi:10.9734/ejnfs/2019/v9i330071
5. Gobas FA, McCorquodale JR, Haffner GD. Intestinal absorption and biomagnification of organochlorines, Environ. Toxicol. Chem,1993:12:567–576
6. Fey P, Bustamante P, Bosserelle P, Espiau B, Malau A, Mercader M. Letourneur Yves, *et al*. Does trophic level drive organic and metallic contamination in coral reef organisms? Sci Total Environ,2019:667:208–221. https:// doi.org/10.1016/j.scitotenv.2019.02.311.
7. Hashmi I, Khan AD. Health Effects of Pesticides Exposure in Agricultural and Industrial Workers of Developing Country, Pesticides - The Impacts of Pesticides Exposure, Prof. Margarita Stoytcheva (Ed.), 2011. ISBN: 978-953-307-531-0, InTech, Available from: http://www.intechopen.com/books/pesticides-the-impacts-of-pesticides-exposure/adverse-healtheffects-ofpesticides-exposure-in-agricultural-and-industrial-workers-of-developing-c. Retrieved on 23/07/2016
8. Kidd KA, Blanchfield PJ, Mills KH, Palace VP, Evans RE, Lazorchak JM, *et al*. Collapse of a fish population after exposure to a synthetic estrogen. Vol. 104, Proceedings of the National Academy of Sciences of the United States of America, 2007, 8897–901.
9. Mustapha Dauda. Quantitative Analysis of Organophosphate Pesticide Residues in Water and Sediment Samples of River Benue, Jimeta Adamawa State. Int. J, Res and Review,2020:7(4):278-292.
10. Ogunfowokan AO, Oyekunle JAO, Torto N, Akanni MS. A study on persistent organochlorine pesticide residues in fish tissues and water from an agricultural fish pond. Emir. J. Food Agric,2012:24(2):165-184.
11. Pimentel D. Amounts of pesticides reaching target pests environmental impacts and ethics J. Agric environ. Ethics,2003:8(1):17-29.
12. Qiu YW, Wang DX, Zhang G. Assessment of persistent organic pollutants (POPs) in sediments of the Eastern Indian Ocean. Sci Total Environ. 710, https:// doi.org/10.1016/j.scitotenv, 2019, 136335-136335.
13. Salem DMSA, Khaled A, El Nemr A. Assessment of pesticides and polychlorinated biphenyls (PCBs) in sediments of the Egyptian Mediterranean Coast. Egyptian Journal of Aquatic Research,2013:39(3):141–152. https://doi.org/ 10.1016/j.ejar.2013.11.001.
14. Sarkar SK, Bhattacharya BD, Bhattacharya A, Chatterjee M, Alam A, Satpathy KK, *et al*. Occurrence, distribution and possible sources of organochlorine pesticide residues in tropical coastal environment of India: An overview. Environment International,2008:34(7):1062–1071.
15. Sweetman M, Vall K, Predouros K, Tones the role of soil organic carbon in the global cycling of persistent organic pollutants (POPs): interpreting and modelling field data. Chemosphere, 2005:60:959–970
16. Wikipedia (2016). Persistent organic pollutant. Retrieved from https://en.wikipedia.org/wiki/Persistent_organic_pollutant on 23/07/2016.
17. Wu Q, Munschy C, Aminot Y, *et al*. High levels of halogenated natural products in large pelagic fish from the Western Indian Ocean. Environ Sci Pollut Res, 2021. https://doi.org/10.1007/s11356-021-14738-0.
18. Yang J, Holbach A, Wilhelms A, Krieg J, Qin Y, Zheng B, Zou H, *et al*. Identifying spatio-temporal dynamics of trace metals in shallow eutrophic lakes on the basis of a case study in Lake Taihu, China. Environ. Pollut,2020:264:114802. https://doi.org/10.1016/j.envpol.2020.11480