



EFFECTS OF AGRICULTURAL EFFLUENTS ON WATER QUALITY DYNAMICS OF OBINNA RIVER WATERSHED IN ADANI COMMUNITY ENUGU STATE, NIGERIA.

¹Ugwele, O. J., ²Magaji U. I., and ³Abba Sidi, Y.,

^{1,2}Department of General Studies, Federal Polytechnic Ohodo, Enugu. obiomajudith@gmail.com

²Department of Science Laboratory Technology, Federal Polytechnic Ohodo.

Magajinbakut02@gmail.com

³Department of General Studies, Shehu Sule College of Nursing and Midwifery Damaturu. yngnsidi@gmail.com

Abstract

Agricultural activities are the major source of nitrate and phosphate pollution of surface water. The study aims to ascertain the effects of agricultural effluents on water quality dynamics of Obinna River watershed in Adani community. Surface water was collected during wet season at up river, middle and down river. Water samples were analyzed for hardness, ammonia-nitrogen, pH, chloride, dissolved oxygen (DO), turbidity, nitrates, phosphate, chemical oxygen demand (COD), and cations bases (sodium, potassium, calcium and magnesium). The concentration of heavy metals (Fe, Cd, Cr, Pb, Cu, Zc and Ni) in water from Obinna River were analyzed using atomic absorption spectrophotometer Model VPG210. The result obtained were compared with control area, and WHO standard. The data collected for laboratory analysis were subjected to descriptive statistical analysis (Analysis of Variance Test). The result showed that most of the parameters analyzed in water fall within the permissible limit except dissolved solids, ammonia-nitrogen, turbidity and phosphate with highest overall mean value of 8.71mg/l, 13.57mg/l, 8.04NTU and 5.98mg/l respectively which exceeded WHO permissible limit of 6mg/l, 0.2mg/l, 5mg/l and 5NTU. The mean concentration of heavy metals in water from Obinna River were recorded Cd (0.05), Cr (0.06), Cu (0.03), Fe (0.37), Pb (0.14) and Zn (0.07) all in mg/l. The findings showed that Obinna River were polluted mostly due to high turbidity, dissolved solids, ammonia-nitrogen and phosphate obtained in surface water. This could lead to eutrophication due to deposits from the surface run-off emanating from the agricultural activities which includes application of inorganic fertilizer and animal manure into the farm land to promote crop yield. Therefore, the obtained result confirmed the need to keep the concentrations of physico-chemical parameters of Obinna River under control.

Keywords: Agricultural pollution, heavy Metals, physico-chemical parameters, water quality and farming activities.

Introduction

Water pollution has become prevalent with serious detrimental consequences which needs concern to obtain a clean and healthy environment. Water pollution decreases the use of water economically and brings about danger to human health and other aquatic forms of life. Despite the fact that humans greatly benefit from water, they are also primarily responsible for it pollution due to the production of mining waste, agricultural effluents, and industrial waste (Ninhoskinson, 2011). It is estimated that with increase in population and human activities the demand for water will exceed available natural supply by the turn of the 21st century. This constitutes an economic challenge that can only be met by careful planning and intensifying research on sustainable water use practices agriculture, (Cillie & Coombs, 1979).

Cite this article as:

1

Ugwele, O. J. et. al., (2025). Effects of Agricultural Effluents on Water Quality Dynamics of Obinna River Watershed in Adani Community Enugu State, Nigeria. *Journal of Multidisciplinary Innovations and Perspectives(JMIP)*, 1(1) 1-8.

Agricultural activities are the major source of nitrate and phosphate pollution of surface water (Taiwo, Olujimi, Bambo, & Arowolo, 2012). Nitrate may arise from the excessive application of fertilizers or from leaching of wastewater or other organic wastes into surface water and ground water (WHO, 2006). According to Taiwo et al. (2012), the majority of Nigerian rivers have a high concentration of nutrient enrichment. Increasing the nutrient (phosphorous and nitrate) concentrations in freshwater can lead to eutrophication in lakes and rivers as a result of a decrease in the amount of oxygen available to aquatic life, and other aquatic organisms (Revanga, Brunner, Henning, Kassen, & Payne, 2000). Agricultural pollution has increased year by year and became increasingly prominent pollution problem which contributes to poor water quality and water quality is a problem in many areas of the world.

The history of agriculture in the world dates back to thousands of years and its development has been driven and designed greatly by different climate culture and technologies especially in the developing countries like Nigeria (Olomola, 2007). As a result, numerous attempts have been made to enhance Nigerian agricultural practices, especially in Adani town in Enugu State. Naturally, Adani town is endowed with vast agricultural lands with extensive rain fed flood area and forest products such as oil palm and timber wood. In Adani Town, the majority of agricultural activity is subsistence-based, with very little being commercial. This is based on the relatively large-scale cultivation of fish, yams, and cassava. The pollution of Obinna River is partially informed by physical observation of the water condition in the stated river. The nutrients that are been washed into the water bodies cause a type of pollution called eutrophication. Eutrophication entails excess of nutrients stimulating an explosive growth of algae. The discoloration of the water in Obinna River indicates the presence of algae bloom and according to (Ferris, 2016) algae in fresh or marine water system is recognized by the discoloration in the water from their pigment.

Therefore, it is crucial to collect adequate data to identify the main causes of water contamination, particularly in the Obinna River watershed. This can pave a way for further assessment of the contribution of each of these factors, so that appropriate measures can be taken to address the problem effectively. This study assessed the physicochemical characteristics of Obinna River watershed and the heavy metals concentration of Obinna River watershed. The findings of this study will provide information to the stakeholders, future researchers and government policy makers which will create an impetus for solving the problems associated with agricultural non-point sources of pollution especially in Obinna River.

Literature Review

Water Pollution from Agriculture

Nitrogen and phosphorus-containing soil and water drain into adjacent bodies of water, the surplus nutrients have an effect on the quality of the surface water. Additionally, pollutants like pesticides, fertilizers, herbicides, and dangerous compounds can find their way into our water supply (Fleşeriu 2010; Smical, Mihaly-Cosmuta and Costin, 2010). The various sources of agricultural non-point pollution carry a lot of sediments, nutrients, toxic and hazardous substances into the rivers, lakes which cause an increase in the level of suspended solid, nitrogen, phosphorus, toxic and hazardous substances concentration and can also lead to eutrophication (Andersen, Schluter, and Aertebjerg, 2006).

Use of fertilizer Today, the world consumes ten times more mineral fertilizer than it did in the 1960s (FAO, 2016). Fertilizers are added to the soil to increase fertility and nutrient quantity of the soil for better crop production. These can be chemical or mineral fertilizers; nitrogen, phosphorous, and potassium are present as primary nutrients in these fertilizers.

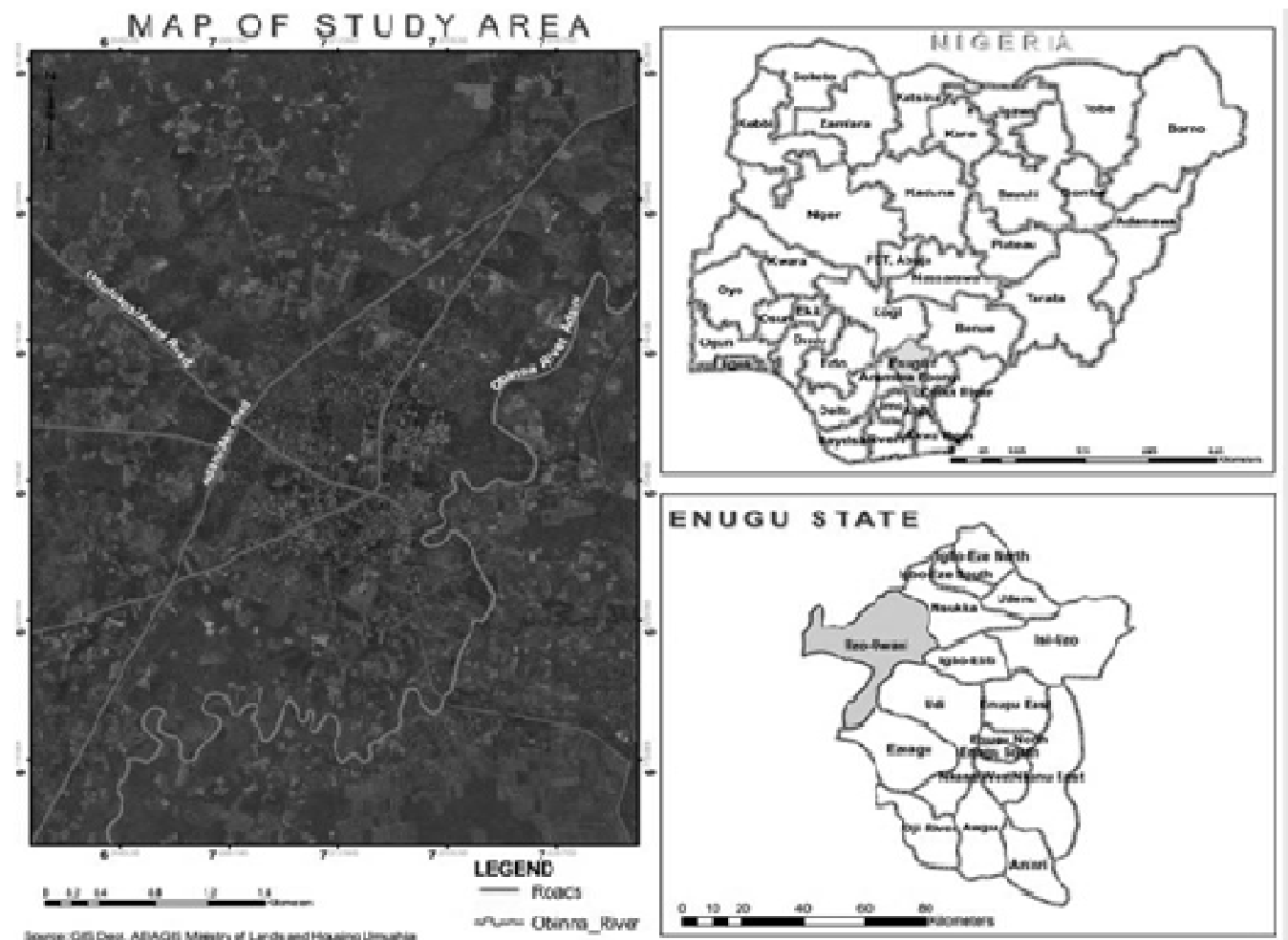
Manure matter Manure is usually collected for use as organic fertilizer, which, if applied in excess, will lead to diffuse water pollution. In many cases, too, manure is not stored in contained areas and during significant rainfall events; it can be washed into watercourses via surface runoff. High concentrations of ammonium, bacteria, and organic matter in manure can contaminate surface waters directly when animals are allowed access to streams.

Pesticides Many nations heavily employ insecticides, herbicides, and fungicides in their agricultural practices (Schreinemachers and Tipraqsa, 2012). They can contaminate water supplies with carcinogens and other harmful compounds that can harm humans if they are not chosen and managed properly.

Sediment from soil erosion Sediment is mineral or organic solid matter that is washed or blown from land into lakes, rivers, or streams. Sediment derived from land erosion constitutes by far the greatest mass of all waste materials arising from agricultural and forestry operations. Soil erosion and sediment deposition are primary causes of adverse impacts to surface water quality.

Study Area

Adani town in Uzo-Uwani Local Government Area of Enugu State is located between latitudes $6^{\circ} 03'N$ and $6^{\circ} 44'N$ and longitudes $7^{\circ} 01'E$ and $7^{\circ} 03'E$ as shown in figure 1 below. It is bounded to the north by Nsukka Local Government Area, to the east by Udi Local Government Area and to the south by Ayamelum Local Government Area in Anambra State. Adani community has a total population of 43264 (forty-three thousand, two hundred and sixty-four) persons in 2021 projected from the National population census (NPC, 2006). The soil is also predominantly clay as well as hydromorphic especially during the rainy season and the water logged conditions tends to prevail (Ofomato, 2012). It has a tropical savannah climate with average temperature of the area is about $27^{\circ}C$, with variations throughout the year. Adani is characterized by mean annual rainfall of between 2250 millimetres, which arrives intermittently and becomes very heavy during the rainy season.



Methodology

Water sample collection

The water samples were collected at three (3) selected points (sample stations) as S₁, S₂, S₃ and control site in both farming and non-farming season. Sample S₁ represented upriver; the river water or point before the entering point of pollution sources, S₂ represented mid-river; A river water at the point of entry of pollution sources, S₃ represented downriver; A river water or point after the entering point of pollution sources, the control site; this was another water body where farming activities were not carried out. At each sampling station, samples were collected at three different points with the aid of polyvinyl chloride (PVC) plastic water bottles. The sample container was pre-cleaned, dried and stored in a dust free environment as described by (Udousoro, 1997). The Six representative water samples were collected from each sampling station (e.g Upper River) and were labeled well and transported in an ice cooler to the laboratory for pre-treatment and analysis. Thereafter, the six representative water samples from each sampling station (e.g. downriver) were mixed separately to form a homogenous sample. The homogenized samples were labeled sample 1 (upper river), sample 2 (middle river), sample 3 (down river). The parameters sought for and analyzed were, turbidity, total dissolved solid (TDS), pH, calcium, Electrical conductivity, magnesium (mg), chlorine, sodium, potassium, Ammonium (NH₄N), Nitrates (NO₃N) etc..

Heavy Metals Analysis From Obinna River

The determination of heavy metals cadmium (Cd), lead (Pb), chromium (Cr), iron (Fe) and copper (Cu) in sampled water was performed by atomic absorption spectrophotometry. The representative water samples from each sampling station were thoroughly mixed to form a homogenous solution. Mixtures from each sampling station (e.g., middle river) were digested as follow: Two hundred millimeters (200ml) of the water sample was transferred into a glass beaker and 5mL of concentrated nitric acid was added. The beaker with the content was placed on a hot plate and evaporated down to about 50ml. On cooling, the sample was filtered by Whatman No.42 filter paper to remove some insoluble materials that could clog the atomizer and made up to 50ml volumetric flask by double distilled water (Eaton, 2005).

Results And Discussion

The mean concentration of physico-chemical parameter of water in Obinna River during farming season

Sample	pH	Ec	Hard-ness	COD	DO	Ca ²⁺	Mg ²⁺	K ⁺	Na ⁺	NH ₃ N	NO ₃ N	PO ₄	Cl ⁻	Turbi-dity	TDS
9	6.27± 0.23 ^b	24.42± 0.01 ^b	15.26± 0.01 ^c	48.14± 0.03 ^c	8.52± 0.01 ^b	7.66± 0.57 ^a	3.41± 0.36 ^b	1.36± 0.20 ^b	3.30± 1.17 ^b	11.10± 0.10 ^b	7.00± 1.00 ^b	6.00± 1.00 ^b	52.46± 0.56 ^c	16.43± 0.14 ^d	214.8 3± 1.51 ^d
S2	6.29± 0.07 ^b	13.48± 0.24 ^b	12.05± 0.03 ^b	13.41± 0.01 ^b	10.89± 0.05 ^b	10.01± ±0.01 ^b	2.09± 0.01 ^a	1.40± 0.10 ^b	4.20± 0.10 ^b	28.23± 0.20 ^c	9.63± 0.28 ^b	8.46± 0.20 ^c	42.28± 0.87 ^b	7.14± 0.12 ^c	124.8 3± 1.00 ^c
S3	6.52± 0.46 ^a	53.71± 0.56 ^c	15.32± 0.03 ^c	16.93± 0.03 ^b	13.47± 0.06 ^c	12.05± 0.04 ^b	4.38± 0.43 ^c	0.66± 0.03 ^b	2.71± 0.14 ^b	9.40± 0.40 ^b	4.20± 0.10 ^b	5.80± 0.08 ^b	35.65± 3.51 ^a	6.33± 0.25 ^b	29.33 ± 0.45 ^a
Control	5.34± 0.51 ^a	7.49± 0.05 ^a	0.96± 0.01 ^a	3.94± 0.01 ^a	1.94± 0.01 ^a	3.66± 0.57 ^a	2.17± 0.22 ^a	0.43± 0.04 ^a	1.50± 0.10 ^a	5.53± 0.20 ^a	2.66± 0.29 ^a	3.66± 0.57 ^a	35.33± 1.05 ^a	2.26± 0.14 ^a	40.40 ± 0.34 ^b
Mean	6.11	24.78	10.90	20.61	8.71	8.35	3.01	0.96	2.93	13.57	5.87	5.98	41.43	8.04	102.3 48
WHO	6.5- 8.5	1000	100	-	6	150	50	12	200	0.2	50	5	250	5	500
CV (%)	8.60	82.80	62.40	93.00	56.80	43.20	36.30	51.10	38.70	74.10	52.50	32.80	19.40	74.50	84.30

Different alphabet superscripts in the same column means there is a significant difference at $p \leq 0.05$ between treatments while same alphabetical superscripts in the same column means no significant difference at $p \leq 0.05$: between treatments. CV=coefficient of variation, COD= chemical oxygen demand, DO= dissolved oxygen, NH₃N=ammonia-nitrogen, NO₃= nitrate, PO₄=phosphate, TDS= total dissolved solids

Hydrogen ion concentration (pH): The mean values of pH observed at upper, middle and downriver were 6.27, 6.29 and 6.51 respectively with grand mean value of 6.11. These shows the pH values were consistent across the three sampled stations. The pH ranged from 6.27 to 5.52, thus indicates that the water is slightly acidic. The value obtained from control area is 5.34, indicating that the water is acidic. The value observed at upper and middle river was below the acceptable limit of 6.5 — 8.5 by (WHO, 2011). Meanwhile, the value obtained at downriver fall within the recommended limit of (WHO, 2011). The report of this current study was different from the findings of (Oluyemi, Adekunle, Adenuga & Makinde 2010; Ayode & Nathaniel, 2018; who reported pH of 6.95 — 7.88 in tropical man-made lake Osun state, southwestern Nigeria. The result does not compare well with the threshold limit of 6.5 — 8.5 (Venkatesharaju, 2010).

Electrical conductivity (EC): the concentration of EC in the water sample of Obinna River in wet season was observed, the value for upper, middle and downriver recorded 24.42, 13.48 and 53.21 μ s/cm respectively. The lowest numerical value was recorded at middle river with value of 13.48 μ s/cm. The ranges of EC of the samples were 13.48-53.71 μ s/cm. The values obtained were high when compared with the control mean value of 7.49. The grand mean value recorded 24.79 μ s/cm. None of the stations of the river water samples analyzed for EC shows above the recommended limit of 1000 μ s/cm set by WHO (WHO, 2011).

Hardness: Mean value of hardness in Obinna River at the upper, middle and downriver were 15.26, 12.05 and 15.32mg/l respectively. The control area recorded 0.96mg/l. The highest numerical value was recorded downriver with mean of 15.32mg/l while the lowest was obtained at middle river with value of 12.05mg/l. The total hardness of the water was observed below WHO standard of 100.0mg/l (WHO, 2011).

Chemical oxygen demand (COD): The concentration of COD in the river recorded 48.14mg/l at upper river, 13.41mg/l at middle river and 16.93 of downriver. The highest value of 48.14mg/l while the minimum value of 13.41mg/l at middle river.

Dissolved Oxygen (DO): Concentration of DO ranged from 9.43mg/ to 16.21mg/l across the river. According to (WHO, 2011), DO standard for drinking water is 6mg/l whereas for sustaining fish and aquatic life is 4 to 50mg/l (Rao, 2005). Surface water quality recommended value for DO by WHO for domestic uses is 10mg/l.

Calcium concentration values of water from Obinna River ranged from 7.66—12.03mg/l and the values at the upper, middle and downriver were 7.66, 10.01 and 12.05mg/l respectively. These values were higher than the control mean value of 3.66mg/l. The mean values of calcium concentration of the samples were lower than the 75.00mg/l permissible limit of (WHO, 2011) guideline. The findings if this work if similar when compared to the findings of (Agu *et al.*, 2014) who reported 8.00 m- 8.81mg/l from the same river.

Magnesium: Magnesium concentration of water from Obinna River ranges from 2.09 — 4.38mg/l and the values at the upper, middle and downriver recorded 3.41, 2.09 and 4.38mg/l respectively and the control mean value recorded 2.17. The mean values of Mg concentration of the water were lower than the WHO limit of 50.00mg/l set standards (WHO, 2011). The result of this finding is higher than the findings of (Agu *et al.*, 2014) who reported 0.49 — 0.51mg/l of magnesium concentration from the same river.

Ammonia-Nitrogen (NH₃N): The observed values of ammonia in water from Obinna river recorded the maximum numerical value of 28.23mg/l at middle river and the lowest numerical value of 9.40mg/l at downriver. The values at the upper, middle and downriver recorded 11.10, 28.23 and 9.40mg/l respectively. Concentration of ammonia-nitrogen in water was observed to be above the WHO admissible limit of 0.2mg/l (WHO, 2011) standard for surface water. The high content of ammonia-nitrogen in Obinna River can be attributed to the use of artificial fertilizer by the local community.

Nitrate (NO₃N): The concentration of nitrate in Obinna River ranged from 4.20 — 9.63mg/l. The maximum concentration of nitrate was recorded 9.63mg/l at middle river while minimum concentration of 4.20mg/l was at downriver. The concentration of nitrate was below the permissible limit of 50.00mg/l set standard by (WHO, 2011). The results of this current study were higher when compared with the impacted Sebeta River with maximum nitrate content of 4.99mg/l (Admasu, 2007) and 4.17- 8.27mg/l reported by (Getachew, 2013). According to Morrison *et al.*, (2001) dumping of industrial and agricultural waste into water bodies increases the level of nitrate. Nitrate is less toxic than the other forms of nitrogen in aquatic environment.

Phosphate; The concentration of phosphate in water sample from Obinna River ranged from 5.80 — 8.46mg/l and values at upper, middle and downriver recorded 6.00, 8.46 and 5.80mg/l respectively. It recorded control mean values of 3.66mg/l. The highest concentration of phosphate was recorded at middle river with mean value of 8.46mg/l and it is attributed to the discharge of domestic waste, runoff fertilizer from farmlands and biological process. The values of phosphate were significantly different at the three stations of the river. This study showed that phosphate values were higher than 5mg/l permissible limit of WHO standard (WHO, 2011).

Chloride: Chloride concentration in the sample from Obinna River ranged from 35.63 — 52.46mg/l. The maximum numerical value was recorded 52.36mg/l at Upper River and the minimum numerical value of 35.65mg/l was obtained. The control mean value of 35.33 was recorded. The mean values of chloride content of the water from Obinna River was below the WHO set standard of 250mg/l (WHO, 2011).

Turbidity: Turbidity values ranged from 6.33 — 16.43NTU with the mean values for upper, middle and downriver recorded 16.43, 7.14 and 6.33NTU respectively. turbidity of the river decreases down the river and values obtained were significantly varied across the three stations. The turbidity values observed in this study were higher than the WHO standard limit of 5NTU (WHO, 2011).

Total Dissolved solids (TDS): TDS values ranged from 29.33 — 214.83mg/l, the values for upper, middle and downriver recorded 21.83, 124.83 and 29.33mg/l respectively. The mean value of 40.40 was observed at control area. The high values of TDS observed at Upper River is attributed to the geologic material that water passes through in the saturated and unsaturated zone and the quality of infiltrating water (Oram, 2014). The values of TDS recorded in the current study were within the stipulated limit of 500mg/l (WHO, 2011) guideline.

Mean Concentration Of Heavy Metals In Water

Mean concentration (mg/l) of heavy metals in water of Obinna River during farming season

Sample	Cd	Cr	Fe	Pb	Zn	Cu
Down River	0.10±0.00 ^b	0.06±0.00 ^{ab}	0.83±0.01 ^c	0.38±0.01 ^b	0.10±0.00 ^b	0.06±0.00 ^b
Middle River	0.03±0.01 ^{ab}	0.04±0.00 ^{ab}	0.34±0.01 ^b	0.08±0.00 ^{ab}	0.03±0.00 ^a	0.02±0.01 ^a
Upper River	0.04±0.00 ^{ab}	0.11±0.00 ^b	0.18±0.00 ^a	0.08±0.00 ^{ab}	0.02±0.00 ^a	0.02±0.00 ^a
Control	0.02±0.00 ^a	0.01±0.00 ^a	0.11±0.00 ^a	0.01±0.00 ^a	0.14±0.01 ^b	0.03±0.00 ^a
Mean	0.05	0.06	0.37	0.14	0.07	0.03
WHO	0.003	0.05	0.3	0.010	3.00	2.00
CV (%)	75.70	76.40	88.90	120.00	79.10	58.20

Different alphabet superscripts in the same column means there is a significant difference at $p \leq 0.05$ between treatments while same alphabetical superscripts in the same column means no significant difference at $p \leq 0.05$: between treatments. Cd= cadmium, Cr= chromium, Cu= copper, Fe= iron, Pb= lead and Zn= zinc

The cadmium (Cd) concentration values of water from Obinna River ranged from 0.03 — 0.10mg/l, the mean values for upper, middle and downriver recorded 0.04, 0.03 and 0.10mg/l respectively. The mean values of Cd concentration in the river across the stations were higher than the WHO limit of 0.003mg/l for Cd concentration in drinking water (WHO, 2011).

The current findings were similar to the findings of (Nwachukwu, Ihedioha, Eze & Agbazui, 2014) who reported 0.001 — 0.090mg/l Cd on their study of Ezu, Obinna and Iyiakoro River. Oluyemi *et al.*, (2010) observed different values which was 0.77 — 2.24mg/l of cadmium.

Chromium (Cr): Cr concentration values in water from the river under study ranges from 0.04 — 0.11mg/l with mean values for upper, middle and downriver recorded 0.11, 0.40 and 0.06mg/l respectively. The values chromium observed in the present study were significantly different across the river for the three stations.

The values of Cr concentration of the river across the stations were higher than the WHO limit of 0.005mg/l for Cr level in drinking water (WHO, 2011). The values of Cr in the current study were similar when compare with the findings of (Nwachukwu *et al.*, 2014) who reported 0.01 — 0.44mg/l in the study of Ezu, Obinna and Iyiakoro river.

Copper (Cu): Concentration of Cu in the water from Obinna River was observed in Table 4.2. The mean value of Cu recorded 0.02mg/l at Upper River, 0.02mg/l for middle river and 0.06mg/l for downriver. The values ranged from 0.02—0.06mg/l. the highest value recorded at downriver with mean value of 0.06mg/l while the lowest value was recorded 0.02mg/l at Upper River and middle river. The control area recorded 0.03mg/l. None of the stations of the river analyzed for Cu shows above the recommended limit of 2.0mg/l set by WHO (WHO, 2011) guideline. Therefore, the values recorded showed concentration below the standard recommended for surface water.

The current findings were similar to the findings of (Nwachukwu *et al.*, 2014) who reported 0.02 — 0.45mg/l of Cu in the study of Ezu, Obinna and Iyiakoro River.

Iron (Fe): The concentration of iron in the water from Obinna river showed that the mean values of Fe recorded 0.18mg/l at upper river, 0.34mg/l for middle and 0.83mg/l for downriver. The values ranges from 0.18 — 0.83mg/l. The highest value recorded 0.83mg/l while the lowest value was obtained at upper river with mean value of 0.18mg/l. The control area recorded 0.11mg/l and the iron concentrations in the river across the stations were within the admissible limit of 0.3mg/l set standard by (WHO, 2011). The current findings were different from the findings of (Agu *et al.*, 2014) who reported 0.00— 0.1mg/l of Fe on the same river.

Lead (Pb): Concentration of Pb in water from Obinna river ranges from 0.08 — 0.38mg/l with the mean value for upper, middle and down river recorded 0.08, 0.08, and 0.38mg/l respectively. The highest value of 0.38mg/l was recorded down the river and lowest value of 0.08mg/l was observed at Upper River. The control area recorded mean value of 0.01mg/l. The concentration of Pb observed in the current research showed that the values of Pb were higher than the WHO permissible limit of 0.01mg/l (WHO, 2011). The findings of this report were different from the findings of (Agu *et al.*, 2014) who reported a higher value of 18.9- 39.7mg/l of Pb in the same river. Tadesse, Tsegaye & Girma, (2018) reported 0.07 — 0.16mg/l in Rebu River, Ethiopia.

Zinc (Zn): Concentration of Zn in the water from Obinna River showed that the values of Zn ranged from 0.02 — 0.10mg/l with the mean values for upper, middle and downriver recorded 0.02, 0.03 and 0.10mg/l respectively. The control mean values of 0.14mg/l was observed. However, the values of Zn in the water were lower than 3.0mg/l WHO recommended safely thresholds limit for drinking water (WHO, 2011). The findings of present study are lower when compare with the findings of Tadesse *et al.*, (2018) and Admasu (2007) who reported 0.21 — 0.39mg/l in Rebu river and 0.0869 — 0.1469mg/l in Awash River respectively.

Conclusion

The study was carried out to evaluate the effects of agricultural effluents on Obinna River through the analysis of the physicochemical properties of surface water and the investigation carried out yield the following findings; The overall mean concentration observed for surface water parameters indicate levels that were within the water quality guidelines with the exception of dissolved solids, ammonia-nitrogen, phosphate and turbidity. Therefore, the obtained results confirmed the need to keep the concentration of the physicochemical parameters in surface water of this catchment area under control, especially considering increasing trends of these nutrients which can lead to increasing environmental overload and to rapid development of eutrophication.

References

- Admasu, T. (2007). Assessment of Biological integrity using physicochemical parameters and Macro invertebrate community index. M.Sc. Thesis, School of Graduate studies, Addis Ababa University, 1-192.
- Agu, C.C., Menkiti, C.M., Okolo, I.B., and Nnaji, C.P. (2014). Evaluation of the level and impact of fertilizer effluent on Obinna River, Adani, Enugu state. *Journal of water Resource and Protection*, 6(2), 722-730.
- Ayoade, A.A., & Nathaniel, O.G. (2018). Assessment of Heavy metals contamination of surface water and sediment of a tropical man-made lake Southwestern Nigeria. *International Journal of environmental and Pollution Research*, 6(3): 1-10
- Andersen, J.H., Schluter, L., and Aertebjerg, G. (2006). Coastal Eutrophication: recent developments in definitions and implications for monitoring strategies. *Journals of Planckton Research*, 28(7), 621-628.
- Cillie, G.G., and Coombs, P. (1979): National Institute for water research, Pretoria. *Water pollution research in South Africa*, 51(3), 1-21
- FAO (2016) FAOSTAT. Database. Available at <http://faostat3.fao.org/browse/R/RP/E.Rome>, Food and Agricultural Organization of the United Nation (FAO). [Accessed June 10, 2018]

- Fleseriu, A. (2010). Endocrine disrupting pesticides and their impact on wildlife and human health. *H VM Bioflux* 2(1): 1-4
- Getachew, B. (2013). The family chironomidae (insecta: Deptera) as indicator of environmental stress, and micro-invertebrate based on multimetric index development in some selected rivers in Ethiopia. Ph.D Dissertation, School of Graduate studies Addis Ababa University
- National Population Commission (NPC) (2006). Nigeria National Census: Population Distribution by Sex, State, LGAs and Senatorial District: Census priority. 3(volume 3) <https://www.population.gov.ng/index.php/publication/140-popn-distri-by-sex-state-jgas-and-senatorial-distri-2006>
- Ninhoskinson, E. (2011). Research draft: Water Pollution: Humans contributing to their Downfall. Available at: envirowriters.wordpress.com/2011/.../
- Nwachukwu, E.R., Ihedioha, J.N., Eze, I.S. and Agbazui, V.E. (2014). Health risk assessment in relation to heavy metals in water sources in rural regions of south East Nigeria. *International Journal of physical Science*, 9(6): 29-41.
- Olomola, A.S. (2007). Strategic for managing the opportunities and challenges of the current agricultural commodity booms in SSA. A Seminar paper on commodity booms in sub-sahara Africa: A publication of the AERC Senior Policy Seminar ix. Africa Economic Research Consortium (AERC), Nairobi, Kenya.
- Oluyemi, E.A., Adekunle, A.S., Adenuga, A.A. & Makinde, W.W. (2010). Physicochemical properties and heavy metals content of water resources in Ife North Local Government Area of Osun state, Nigeria, *African Journal of Environmental Science and Technology*, 4(10): 691-697.
- Oram, B. (2014). Water quality terms glossary. <http://www.water-research.com/> [Accessed 4 April 2021]
- Revenga, C., Brunner, J., Henninger, N., Kassen, K., & Payne, R. (2000) Pilot Analysis of Global Ecosystems: Freshwater Ecosystems. World Resources Institute (WRI), Washington DC. Review on soil fertility investigations in Nigeria. *Niger Agric. J.* 30: 59-75.
- Schreinemachera, P., and Tipraqsa, P. (2012). Agricultural pesticides and land use intensification in high, middle and low income countries. *Food Policy*, 37(6): 616-626.
- Smical, I., Mihaly-Cosmuta, L., and Costin, D. (2010). Research concerning the influence of several factors on Pb^{2+} , Cu^{2+} , and Zn^{2+} ions adsorption by natural Zeolite tuff from Maramures county Northern Romania. *AES Bioflux* 2(2): 171-180.
- Tadesse, M., Tsegaye, O. & Girma, G. (2018). Assessment of the level of some physicochemical parameters and heavy metals of Rebu River in Oromia Rrgion, Ethiopia. *Moj Biol Med.* 3(3), 99-118. Doi:10.15406/journal of biology and medicine.2018.03.00085.
- Taiwo, A.M., Olujimi, O.O., Bamgbos, O., & Arowolo, T.A (2012). *Surface water quality monitoring in Nigeria: Situational analysis and future management strategy, water quality monitoring and assessment.* InTech, Rijeka. <http://www.intechopen.com/books/waterquality-mointoring-and-assessment/surface-water-quality-monitoring-in-nigeria-situational-analysis-and-futuremanagement-strategy>
- Udousoro, I.I. (1997). Physic-chemical quality assessment of Ogun River and the environmental impact on the Lagos. Ph. D Thesis, chemistry department, University of Ibadan, Nigeria.
- Venkatesharaju, K., Ravikumar, D., Somashakar, R.K., & Prakash, K.L. (2010). Physco-chemical and Bacteriology nvestigation on River Canvery of Kollagal stretch Karnataka, Kathmandu University. *Journal of Science, Engineering and Technology*, 6(1): 50 - 59.
- World Health Organization (2006). Guidelines for Drinking Water Quality. First Addendum to third Edition. WHO Geneva.
- WHO (World Health Organization) 2011. Guidelines for drinking water quality 4th edition, pp.1-564. Available from <http://who.int/water-sanitation-health/publication/2011/dwq-guidelines/en/> (Accessed May 16th, 2018)