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The Impact of Dredging on the Physico-Chemical Parameters of River Otamiri-Ochie, Rivers State

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ABSTRACT

The research work focused on discovering the impact of dredging on the physico-chemical parameters in River Otamiri-Ochie, Rivers State. The aim is to show that the indiscriminate dredging pattern by both the locals and mechanized companies as it affects the physico-chemical parameters (Temperature, DO, BOD, p^H, TDS, TSS NO_3, PO_4 and SO_4). Samples collection was carried out for 6 months (August 2019–January 2020) in three stations. The following results were obtained after the laboratory analysis. Temperature variation ranges from 27^0C-28^0C, with an overall mean value of 28^0C ± 1.43^0 C and slight seasonal variation between wet (27.0 ± 1.05^0C) and dry (29.1 ± 1.33^0C) , P^H variation ranges from 3.85-7.33, with an overall mean value of 6.16 ± 1.10 and seasonal variation between wet (7.0 ± 0.87) and dry (6.0 ± 1.17), BOD variation ranges from 0.41mg/l-2.79, with an overall mean value of 1.77 ± 0.36mg/l and slight seasonal variation between wet (1.43± 0.47mg/l) and dry (2.03 ± 0.48mg/l), DO variation ranges from 3.32mg/l-5.75mg/l, with an overall mean value of 4.35± 0.80 and slight seasonal variation between wet (5.0 ± 0.47mg/l) and dry (4.0 ± 0.51mg/l), TDS variation ranges from 8.0mg/l- 172mg/l, with an overall mean value of 24.72 ± 13.49 and seasonal variation between wet (14.0 ± 4.27mg/l) and dry (36.0 ± 21.99mg/l) ,TSS variation ranges from 0.3mg/l-203mg/l, with an overall mean value of 94.76 ± 25.17 and seasonal variation between wet (62.0 ± 53.23mg/l) and dry (128.0 ± 36.04 mg/l), NO_3 variation ranges from 0.01mg/l- 13.1mg/l, with an overall mean value of 34.48 ± 30.0 and seasonal variation between wet (4.57 ± 4.0mg/l) and dry (6.66 ± 5.0 mg/l), PO_4 variation ranges from 0.300mg/l-30.17mg/l, with an overall mean value of 9.32 ± 11.0 and seasonal variation between wet (6.45 ± 9.0mg/l) and dry (9.13± 12.0mg/l), SO_4 variation ranges from 2.0mg/l- 9.2mg/l, with an overall mean value of 27.07 ± 23.0 and seasonal variation between wet (4.0 ± 2.0mg/l) and dry (5.33 ± 3.0 mg/l) Temperature, pH, BOD, TDS, NO_3, PO_4 and SO_4 variations were not significantly different, while DO, and TSS variations were significantly different. Based on the findings, it was imperative to state that dredging has negative impact on the aquatic environment

Keywords: Physico-chemical parameters, Otamiri-Ochie River, fresh water, dredging, Rivers State

INTRODUCTION

Dredging in fresh water environment is a very common activity in Nigeria, but a lot of studies have revealed that physic-chemical parameters variation occurs from one dredging site to another (IMG-Golder, 2004). This is a serious problem that we are facing. The importance is to know that the disparity that occurs in the physic-chemical parameters of freshwater habitat cannot be over emphasized. Comprehension of the essential parameter and the limited factors for academic and practical references should be considered, which will help us to implement policies. Dredging in Otamiri-Ochie River is

mainly for building purposes. The destructive nature of dredging activities on physical parameters is on a large scale (IMG-Golder, 2004). The quiet and oxygen low layers of sediment are uncovered by dredging which eventually are distressed and generates noxious sediments and hence produce contaminants (Nayar et al., 2004).

There is high level of physical and chemical alteration associated with dredging, which include increase level of suspended sediment and the potential for associated dissolved oxygen reduction and release of natural and industrially-derived chemicals (Narayanan, 2007). Water must be beneficial for human consumption (portable), it must also be colourless, odourless and fit for other domestic uses, this emphasize that it ,should be free of substances that render it hard, (Akuro, 2005).

Effect of suction dredging on water quality and zooplankton community structure in a shallow of eutrophic lake, were evaluated (Zhang, 2010). The results showed that a decreasing trend for levels of phosphorus, organic matter, total suspended solids, chlorophyll and secchi transparency in the water column was found, while level of water depth, electrical conductivity, total dissolved solids and NO_3 concentration increased markedly post-dredging. The effects of dredging on dissolved oxygen, pH value and temperature was almost negligible. The zooplankton community structures responded rapidly to the environmental changes caused mainly by dredging. As a result, the abundance of rotifers decreased while the density of zooplankton increased markedly (Zhang, 2010).

As a result of dredging however, the pH of the dredged canal was decreased from 7.2 to 4.0, dissolved oxygen (DO) decreased considerably from 6.0mg/l to 0.4 mg/l, while BOD_5 was increased from 1.0 mg/l to 18.0 mg/L. COD, oil and grease, conductivity, TDS and sulphate values similarly increased, while nitrate and alkalinity values decreased after dredging. At the dredged canal, turbidity and TSS increased rapidly after dredging, attaining a value of 11,398 NTU and 8200 mg/l respectively. Results of the six-month post dredging monitoring of the river water revealed that the water quality improved significantly during this period. The pH and DO appreciated while COD, BOD, oil and grease, depreciated to values close to pre-dredging concentrations. Therefore they conclude that the impact of dredging on water quality is localized and short term (Elijah,et. al., 2008) .

MATERIALS AND METHODS

The study was carried out for a period of six months (August, 2019 –January, 2020) in Otamiri-Ochie River, in Etche Local Government Area of Rivers State, Nigeria. The Otamiri-Ochie River is the major river that washes through the Ihiagwa autonomous community, in the Owerri West Local Government Area of Imo State, Nigeria, West Africa. This river runs from Egbu where it has its major base or Ishimmiri rather as it is called in the Igbo Language, to Nekede, Ihiagwa, Eziobodo, Olokwu, Umuisi, Mgbirichi, Umuagwo, and finally to Ozuzu in Etche town of Rivers State of Nigeria. Otamiri-Ochie River, is a fresh water system that is non-tidal and passes through a large number of communities that constitute Igbo-Awuru-Asa people in Etche Local Government Area, Rivers State Nigeria, where it finally joins the Atlantic Ocean (Ogbuagu et al., 2011). The Otamiri-Ochie River is made up of two confluences at Etche, the first one is fresh water called Oge-Ochie River, which make up one of the three rivers in Etche, at Nihi, and the second is Imo River making the reach lower at Umuebulu which is also fresh water. 10,000km^2 stretch is what Otamiri water shed covers. It has annual rainfall of 2250-2500mm; the area is tropical and mean temperature is 27(^{O}C) all through the year. The wet and dry season are the two season observed, April-October is the period of wet while November-March is the period of dry with little rain .It lies between longitude 0605’ and 0714E and latitude 0508’ and 04 45 N .The maximum humidity of 90% was observed during wet period and 40% throughout the dry period making it the minimum in that area (Ogbuagu et al., 2011).

Three sampling stations were established along the length of Otamiri-Ochie River. Each of the stations were visited once a month usually at the second week. The three stations investigated in this study is described below base on my personal observations.

Station 1 is situated 30m away from section 2 along the downriver of Otamiri-Ochie at Chokocho water way close to the bridge. No dredging activities, rather other human activities.

Station 2 is located at upstream of Otamiri-Ochie River after Chokocho bridge along the water way. Dredging activities is ongoing in this location.

Station 3 is 60m away from section 1, at the upstream of Otamiri-Ochie River after the dredging site.

Samples were collected in three sampling stations for physico-chemical analysis using a locally made canoe as a means of transportation.

The Temperature (^0C) of the various stations of the river was measured in-situ using mercury in glass thermometer. The thermometer was dipped into the river for 10 minutes, and then the temperature was recorded from the mercury level of the thermometer at 20 cm depth.

A deluxe pH meter, model ME 963-p was used for the determination of pH in the water samples collected from the different sampling locations. The pH meter was switched on, allowed for fifteen minutes to stabilize, the electrode was rinsed with jet of distilled water, and the pH meter that is calibrated in 4.0 and 7.0 buffer solution was used to read the pH meter

Biochemical oxygen demand (BOD) water samples were fixed after collection, by adding 0.5ml of manganese sulphate solution ($MnS0_4$) followed by 0.5ml alkali-iodide-azide reagent. After 2- 3 minutes, 0.5ml concentrated H_2SO_4 was added immediately, and dissolution was completed. The BOD samples was kept for 5 days and incubated at 20°c degree Celsius.

Sample was decanted into a beaker and titrated with 0.5ml thiosulphate ($Na_2S_20_3{\cdot}_5H_20$) solution to a pale strew color, using 0.5ml of starch solution as indicator. It was then run until the first disappearance of the blue color observed.

Dissolved oxygen (DO) samples were collected with 250ml DO bottles and fixed by adding 0.5ml of manganese sulphate solution ($MnS0_4$) followed by 0.5ml alkali-iodide-azide reagent. Thereafter, 0.5ml concentrated (H_2SO_4) was added and dissolution was completed. Samples were decanted into a beaker and titrated with 0.5ml sodium thiosulphate ($Na_2S_2.O_{35}H_20$) solution to a pale strew colour, using 0.5ml of starch solution as indicator. It was then run until the first vanishing of the blue color is observed.

The total dissolved solid (TDS) was determined with automated electrical conductance method using a self-conductance meter (lovibond-tinto meter), type c-m-21, by inserting the conducting probe into 30ml of water sample in a 60ml beaker; values for TDS were read from the meter.

The total Suspended Solid (TSS) was determined with mi 806, the probe was dipped into 30ml of water sample in a 60ml beaker; values for TSS were read from the meter.

In Nitrate (NO_3) determination, the following steps were taken:

1ml of the sample was transferred into l0mi volumetric flask 0.5m1 of Brucine reagent was added, 2m1 of conc. sulphuric acid was rapidly added and mixed for about 30seconds. The flask was allow to stand for 5minutes, 2m1 of distilled water was added and mixed for about 30seconds .Flask was allowed to stand in coke water for about 15minutes to cool.

The absorbance was measured wavelength of 470nm

NO_3^{2-} (mg/l) = Y ÷ Volume of sample

Y = Concentration from calibration curve (248.8X)

X = Absorbance from instrument reading

Volume of sample = 5.5m1

In Phosphate (PO_4) determination the following steps were taken:

50m1 of the sample was transferred into l00ml volumetric flask, 2m1 of Ammonium Molybdate reagent was added and mixed thoroughly, 0.25m1 of Stanrious Chloride was also added and mixed thoroughly. The flask was allowed to stand for 30minutes. Thereafter, the absorbance was measured at wavelength of 690nm

$$PO_4^{3-}0mg/l = \frac{Y \times 10^3}{vol.of\ sample}$$

Y = Instrument reading from calibration curve = (0.0124X + 0.005)

Vol. of sample = 100ml

In Sulphate (SO_4) determination, one hundred milliliters (100 ml) of water sample was measured into a 250 ml Erlenmeyer flask. Five milliliters (5 ml) of conditioning reagent was added and mixed by stirring. One gramme (1 g) of barium chloride crystals was added while stirring and timed for 60 seconds. The absorbance was then determined at 420 nm on the spectrophotometer within 5 minutes. The concentration was then read directly from the calibration curve on the computer screen.

RESULTS

The variation of the physico-chemical parameters in the sampling stations and seasons as obtained in this study are presented in Table 1-5 respectively. Temperature variation according to the table ranged from 27^0C- 28^0C with overall mean temperature value of 28.0 ± 1.43^{0}C. Minimum temperature value of 27^0C is in control location, while the maximum temperature was recorded in the text stations. The minimum temperature was recorded in the month of September while the maximum temperature was recorded in the month of January, (dry season. Station 3 (tes station) has the highest mean value of 28.42 ± 1.86 ^{0}C recorded, while the least mean value of 27.7 ±1.59 ^{0}C was recorded in station 1 (control) Table 1. One way analysis of variance showed that temperature is not significantly different ($p< 0.05$) in the various stations across the months. There was slight seasonal variation of temperature between wet (27.0 ± 1.05 ^{0}C) and dry (29.1 ± 1.33 ^{0}C) season.

The table showed that the variations in the pH value ranges from 3.85- 7.32 with the overall mean value of 6.16±1.10 .The minimum value of 3.85 was recorded in the month of November in station 3, while the maximum value of 7.32 was recorded in the month of August in station 1. The highest mean value of 6.97± 0.27 was recorded in station 1 while the least mean value of 5.37±1.32 was recorded in station 3. One way Analysis of variance revealed that pH is not significantly different ($p<0.05$) in the stations across the months. Seasonal variation was observed between wet (7.0± 0.87) seasons and dry (6.0 + 1.17)

The table showed that the variation in BOD values ranges from 0.41mg/l- 2.79 with overall mean values of 1.77±0.56mg/l. The minimum value of 0.41 mg/l was obtained in September in station 3, whereas the maximum value of 2.79 mg/l was recorded in the month of January in station 1. The highest mean value of 2.06± 0.47mg/l was obtained in location 1, whereas the least mean value of 1.40± 0.47 mg/l was obtained in station 3. One way analysis of variance showed that BOD is not significantly different ($p<0.5$) in the various locations during the months of sampling. Seasonal variation between wet (1.43± 0.47 mg/l) and dry (2.03± 0.48mg/l) seasons was observed.

The table showed that the variation in DO values ranges from 3.32 mg/l -5.75 with the overall mean value of 4.35±0.80 mg/I. The minimum value of 3.32 mg/l was recorded in the month of January station 3 while the maximum value of 5.75 mg/l was recorded in the station 1 in the month of September. The highest mean value of 5.02± 0.68 mg/l was obtained in station 1 while the least mean value of 3.80± 0.40 mg/l was recorded in location 3. One way analysis of variance revealed that DO is significantly different ($p< 0.05$) in the various location during the month of sampling. Seasonal variation was observed between wet (5.0± 0.74 mg/l) and dry (4.0±0.51 mg/l) seasons. Slight decreased in DO from station 2 to station 3 was observed.

The table showed that the variation in TDS values ranges from 8.0 mg/l- 172 mg/l with overall mean TDS value of 24.72±13.49 mg/l. The minimum value of 8.0 mg/l was recorded in the month of November in station 1, while the maximum value of 172 mg/l was recorded in the month of December in station 2. The highest mean value of 40.0± 8.13 mg/l was recorded in location 2, while the least mean value of 11.66 ± 3. 09 mg/l was recorded in station 1. One way analysis of variance revealed that TDS is not significantly different ($p<0.05$) as shown in. Significant variation between seasons can be observed in wet (14.0± 4.27mg/l) and dry (36.0±21.99 mg/l) seasons.

Variation in TSS values ranges from 0.3 mg/1-203 mg/l with the overall mean values of 94.76± 25.17mg/l. The minimum value of 0.3 mg/l was recorded in the month August in station 3 while the maximum value 203 0mg/l was recorded in the month of November also in station 3. The highest mean value of 105.56± 28.0 mg/l was recorded in station 2 while the least mean value of 75.83± mg/l7.21 was recorded in station 1. One way analysis of variance revealed that TSS is significantly different ($p< 0.05$).

There was significant seasonal variation between wet (62.0± 53.23 mg/l) and dry (128.0± 36.04 mg/l) seasons.

The table showed that the variation in nitrate values ranges from 0.0 1mg/l-13.1mg/l with overall mean nitrate value of 34.48±30.0 mg/l. The minimum value of 0.01mg/l was recorded in the month of August in station 2, while the maximum value of 13.1 mg/l was recorded in the month of January in station 2. The highest mean value of 40.0± 8.13 mg/l was recorded in location 2, while the least mean value of 11.66 ± 3. 09 mg/l was recorded in station 1. One way analysis of variance revealed that NO_3 is not significantly different ($p<0.05$) as shown in. Significant variation between seasons can be observed in wet (4.57 ± 4.0mg/l) and dry (6.66± 5.0mg/l) seasons.

The table showed that the variation in phosphate values ranges from 0.300 mg/l-30.17 mg/l with overall mean phosphate value of 9.32±11.0 mg/l. The minimum value of 0.300 mg/l was recorded in the month of September in station 2, while the maximum value of 30.17 mg/l was recorded in the month of December in station 1. The highest mean value of 27.18± 6.0 mg/l was recorded in location 1, while the least mean value of 0.320 ±0.0 mg/l was recorded in station 2. One way analysis of variance revealed that PO_4 is not significantly different ($p<0.05$) as shown in. Significant variation between seasons can be observed in wet (6.45 ± 9.0 mg/l) and dry (9.13 ± 12.0 mg/l) seasons.

The table showed that the variation in sulphate values ranges from 2.0mg/l- 9.2 mg/l with overall mean sulphate value of 27.07±23.0 mg/l. The minimum value of 2.0 mg/l was recorded in the month of October in station 3, while the maximum value of 9.2 mg/l was recorded in the month of January in station 1. The highest mean value of 7.03± 1.0 mg/l was recorded in location 1, while the least mean value of 3.08 ±1.0 mg/l was recorded in station 3. One way analysis of variance revealed that SO_4 is significantly different ($p<0.05$) as shown in. Significant variation between seasons can be observed in wet (4.0 ± 2.0 mg/l) and dry (5.33 ± 3.0 mg/l) seasons.

Table 1: Mean concentration for of physico-chemical parameters of wet season

Parameters	1	2	3
Temperature (O^C)	27.2±0.69	26.93± 1.32	26.76± 0.96
PH	7.17±0.14	6.51± 0.17	6.30 ± 1.22
BOD (Mg/L)	1.68±0.22	1.70± 0.12	1.07± 0.76
DO (Mg/L)	5.67±1.45	4.45±0.46	4.19± 0.06
TDS (Mg/L)	14.33±1.91	9.66± 1.25	16.66± 4.91
TSS(Mg/L)	60.66±26.02	64.76± 27.55	59.80± 25.98
PO_4(Mg/L)	18.75± 1.73	0.313± 3.33	0.311± 3.33
NO_3(Mg/L)	11.0 ± 0.54	1.72 ± 1. 42	1.0 ± 0.64
SO_4(Mg/L)	6.0 ± 0.54	3.0 ± 0.82	3.0 ± 0.57

Table 2: Mean concentration for of physic-chemical parameters of dry season

Parameters	1	2	3
Temperature (O^C)	28.76 ± 2.905	28.65± 0.93	30.07± 0.75
PH	6.77± 0.2	5.79 ± 1.00	4.51± 0.53
BOD (Mg/L)	2.45± 0.33	2.00± 0.55	1.74± 0.12
DO (Mg/L)	4.34 ± 0.20	3.70 ± 0.40	3.40± 0.07
TDS (Mg/L)	9.00± 0.81	70.33± 22.84	28.33 ± 17.32
TSS (Mg/L)	91.06± 20.68	141.00± 1.02	151.33± 36.55
PO_4 (Mg/L)	26.0 ± 3.0	0.75 ± 3.34	0.64 ± 2.73
NO_3 (Mg/L)	13.0 ± 0.81	4.0 ± 0. 14	3.0 ± 1.29
SO_4 (Mg/L)	8.0 ± 0.57	4.0 ± 0.43	4.0 ± 1.57

Table 3: Physico-chemical parameters recorded in section 1

Parameters	August	September	Months October	November	December	January
Temp (O^C)	26.3	28.0	27.30	29.9	26.5	29.9
PH	7.32	7.23	6.98	7.06	6.59	6.66
BOD (Mg/L)	1.52	2.0	1.53	2.56	2.0	2.79
DO (Mg/L)	5.67	5.75	5.67	4.63	4.12	4.29
TDS	17	13	13	8	9	10
TSS (Mg/L)	1.2	3.6	177	12.2	106	155
PO_4 (Mg/L)	16.84	21.08	18.34	23.10	30.17	25.10
NO_3(Mg/L)	10.20	10.5	11.0	14.2	12.3	13.1
SO_4 (Mg/L)	4.92	5.58	6.5	7.9	8.12	9.2

Table 4: Physico-chemical parameters recorded in section 2

Parameters	August	September	Months October	November	December	January
Temp (O^C)	28.7	26.6	28.50	29.33	29.3	27.33
PH	6.64	6.63	6.26	6.47	6.54	4.37
BOD (Mg/L)	1.5	2.2	1.4	1.4	1.86	2.75
DO (Mg/L)	4.12	5.13	5.11	3.5	3.33	4.27
TDS (Mg/L)	9	9	11	10	172	29
TSS (Mg/L)	2.2	4.1	188	188	163	72
PO_4 (Mg/L)	0.319	0.300	0.32	0.308	0.328	0.348
NO_3(Mg/L)	0.01	2.01	3.15	4.17	4.02	4.18
SO_4 (Mg/L)	2.48	3.92	2.06	3.54	3.92	4.58

Table 5: Physico-chemical parameters recorded in section 3

Parameters	August	September	October	Months October	December	January
Temp (O^C)	27.5	25.4	27.40	30.61	29.0	30.61
PH	7.28	7.06	4.58	3.85	4.51	5.18
BOD (Mg/l)	1.4	0.41	1.4	1.56	1.79	1.87
DO (Mg/l)	4.14	4.3	4.13	3.52	3.37	3.32
TDS (Mg/l)	16	11	23	52	22	11
TSS (Mg/l)	0.3	3.1	176	203	127	124
PO_4 (Mg/l)	0.31	0.305	0.318	0.331	0.368	1.234
NO_3 (Mg/L)	1.11	1.12	2.01	5.11	3.11	2.14
SO_4(Mg/L)	3.4	2.5	2.2	4.0	3.1	3.5

DISCUSSION

The mean water temperatures were high and almost uniform as seen in the study. Water temperature varied between 27ºC -28 ºC (28.0 ± 1.43ºC). These values are within the acceptable levels of survival, metabolism and physiology of aquatic organisms as recommended by Federal Ministry of Environment (FME) (27ºC -38ºC); NSAP (25ºC -32ºC); and USEPA (<40ºC). Fresh water temperature in the tropics varies between 25ºC and 35ºC as reported by Alabaster and Lloyd (1980) and which agrees with these findings. The findings in the present study is in accordance with previous findings on temperature in the Niger Delta waters by Seiyaboh et. al. (2013a) = 27.51ºC -28.28ºC; Seiyaboh et al.(2007e) = 26ºC; Dibia (2006) = 25ºC -27ºC; Sikoki & Zabbey (2006) = 26 ºC- 27.8 ºC; Zabbey (2005) = 25.8 ºC -27.8 ºC; Braide et al. (2004) = 26.64 ºC -30.8 ºC; Zabbey (2002) = 26.3 ºC -30.4 ºC.

Higher temperature were observed in the dry season and in the dredged locations than the wet season and un-dredged locations, this also agrees with similar result obtained by Seiyaboh et al. (2013a) at Igbedi creek, Upper Num River contrary to the general believe that water temperature is higher during the dry season, this may be as a result of inflow of energy (hot materials) from land and cooling effect of dredges. The low pH value recorded in the dredged locations (3.85-7.28) shows the destructive nature of dredging on water quality and also the low pH value recorded during the dry period (6.7-4.5) is based on the intensive dredging during the dry season and concentration of dissolved substances due to evaporation. The high pH readings obtained during the wet period (6.3 – 7.1) is due to increase dilution of chemical substance by increased flow. This agrees with the results of Akpan (2004). The un-dredged location (Station 1) exhibit slightly alkaline condition this is in line with previous results found in tropical aquatic environment (Seiyaboh et al., 2013c) who obtained a pH of 7.26-0.01 while the dredged locations Umuechem-Egwi, 3-6) recorded acidic condition generally, this can cause acidosis and generally change in fish health as documented by Savage (2008).

BOD values ranges from 0.41 mg/l - 2.79mg/l (1.77 ± 0.56 mg/l), this is in accordance with the values of 1.97 mg/l -2.69mg/l obtained at Okpoka Creek, Niger Delta by (Abowei & George, 2009). The BOD mean value is higher in the un-dredge locations than the dredge locations, the highest mean value of 2.06 ± 0.47mg/l was in location 1and the lowest mean value of 1.40 ± 0.47mg/l was in location 3, this result agrees with the findings of Seiyaboh et al. (2013b) at Igbedi Creek, and in their study, dredged recorded 3.6 ± 0.27mg/l and un-dredge recorded 4.4 ± 0.34mg/l. The low BOD mean values seen in the dredged locations is as a result of low biological activities going on in this locations due to the dredging going on in this locations. The wet season recorded low BOD range (1.68 ± 0.22mg/l-1.7 ± 0.12mg/l) while the dry season recorded higher BOD range of (1.74 ± 0.12mg/ -2.45 ± 0.33mg/l), this may be due to the effect of temperature on metabolic rate of living organisms.

The dissolved oxygen values of 3.32mg/l-5.75mg/I (4.35 ± 0.80 mg/l) obtained in this particular study indicates the pollution level of Otamiri-Ochie River as in accordance with results obtained for many other polluted waters in Nigeria. Seiyaboh et al. (2013a) recorded 2.1mg/l-6.5mg/l for Agoro-Gbene and Ogobiri water; Lawson (2011) 0.58mg/l-10.0mg/l (9.97 ± 0.03); Deeke et al.(2010a; 2010b) 4.00mg/l-7.50mg/l; Ogunwenwo & Kusemiju (2004) 6.9mg/l-8.8mg/l, for some polluted water bodies in Nigeria especially in Niger Delta. The DO values obtained in this studies is not within the acceptable limit of 5.0mg/l – 6.5mg/lby FEPA, >4 (40-60) by USEPA, 6.5mg/l-8.5mg/l by EPA, but the Un-dredged location (control) were within the range of 5.0mg/l-6.5mg/l recorded by FEPA.

The DO values were higher in the wet season (4.19 ± 0.06mg/l- 5.6 ± 1.45) than in dry season (3.4 ± 0.07mg/l- 4.37 ± 0.20), this is in agreement with the results obtained in Mbo River by Essien-Ibok et al., (2010) all in Nigeria, from the result he concluded that tropical African aquatic system generally have low DO in dry season than in the wet season. The un-dredged locations recorded superior DO values than the locations where dredging was ongoing. It can be as a result of dredging activities ongoing at the locations, human faeces, decaying plant remains and domestic wastes. This is because, the level of oxygen input and depletion is dependent on the size and amount of waste added, rate of river flow (water current) and stream temperature.

TDS value ranges from 8.0 mg/l – 172 mg/l of (1.74 ± 0.12mg/l), this falls within the ranges of 25.00mg/l-85.06mg/l documented by Seiyaboh et al. (2013d) at Igbedi Creek, Upper Nun River. The low mean TDS value that ranged from 9.66± 1.25 mg/l can be credited to dilution during the raining period while the high mean TDS value that ranged from 9.00 ± 0.81mg/l - 70.33± 22.84mg/l this agrees with the result obtained at Mbo River by Essien – Iboke*t al.,* (2010) where they observed that TDS is higher in dry season due to evapo-crystallization process and low precipitation signifying low dilution, the high TDS is higher in dry season due to intensive dredging during the dry season which will result in re-suspension of solids and agitation of the sediment. The highest mean TDS value of 40.0 ± 65.3mg/l was recorded in the un-dredged location 2, while the lowest mean TDS value of 11.67 ± 3.33mg/l was seen in location 1, this may be probably due to the days and time of sampling. The TDS range of 4.4mg/l –

172mg/l is within the recommended limit of 50mg/l by FEPA but below that WHO (1000mg/l) and USEPA (2000mg/l).

TSS ranges from 0.3mg/1-203mg/l (94.76 ± 25.17 mg/l), the highest mean TSS value of 105.56 ± 20.49mg/l was recorded in location 3 (dredged) while the lowest mean TSS value of 75.83 ± 7.21mg/l was recorded in location 1(un-dredged), this can be attributed to the on-going dredging operations in the location causing re-suspension of solid materials in the water. The wet season recorded a low TSS range of 59.8 ± 25.98mg/l- 64.76 ± 27.55mg/l while the dry season recorded a higher TSS range of 91.06 ± 20.68mg/l-151.33 ± 36.55mg/l, this result is abdicative of the impact of dredging on TSS in relation to seasonal variation

The Nitrate level throughout the study period ranged between 0.01mg/l at station 2 and 13.1mg/l at the control station . There were variations between the months and stations. The highest level was recorded in the month of January at the control station while the lowest was recorded in the month of August at station 2. The mean total was 34.48±30.0 mg/l. Analysis of variance (ANOVA) result showed a significant difference ($P<0.05$) between the stations and months. The finding in the present study is in accordance with previous findings on nitrate (1.2-33.6mg/l), the effects of hydraulic dredging and disposal operation on water quality of Nworie River by (Justina et al., 2017)

Phosphate ranged between 0.300mg/l at station 2 and 30.17mg/l at the control station. There were variations between the months. The highest level was recorded in the month December at the control station while the lowest was recorded in the month of September at station 2 where dredging is ongoing. The mean total was 9.32 ± 11.0 mg/, this result is in agreement with the (Dongqiam Lake China (35.2-42.3) by Elsevier 2015). Analysis of variance (ANOVA) result showed that there is a no significant difference ($P>0.05$) both at the stations and months.

Sulphate ranged between 2.0mg/l at station 3 and 9.2mg/l at the control station. There were variations between the months. The highest level was recorded in the month of January at the control station while the lowest was recorded in the month of October at station 3 where dredging is ongoing. The mean total was 27.07 ± 23.0 mg/. This agrees with the result obtained at Nworie River by (Justin et al.,2017). Analysis of variance (ANOVA) result showed that there is no significant difference ($P>0.05$) both at the stations and months.

CONCLUSION

The physico-chemical parameters in the un-dredge locations were better than those in the dredged locations. Therefore, it was concluded that dredging had negative effect on the physico-chemical parameters of Otamiri-Ochie River, and generally affects the aquatic ecosystem negatively.

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