Impacts Assessment of Coastal Activities on Water Quality of Upper Segment of Qua Iboe River, Akwa Ibom State, South-South, Nigeria

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ABSTRACT: A study was carried out at the supper segment of Qua Iboe River from November, 2018 to August, 2019 in four sampling stations to assess the impacts of coastal activities on water quality. Water samples were collected monthly and analyzed using standard procedures of Associations of Official Analytical Chemist and American Public Health Association. The stations comparisons and location of significant differences were carried out using ANOVA and Least Significant Difference (LSD) test, while paired sample t-test were employed to compare the seasonal difference. The mean ranged values of water temperature were (25.03 – 25.33°C), pH (5.8 – 6.6 mg/l), DO(3.11 - 5.45 mg/l), TDS (18.63 – 32.53mg/l), EC (8.33-13.16μs/cm), Turbidity (7.61 – 18.32 NTU), TSS (90.80 - 165.63 mg/L), NO3 (33.02 – 78.35mg/l), PO4 (4.44 – 7.39mg/l), Cl (43.60 – 63.21mg/l), COD(35.96 – 113.05mg/l), NH3 (0.33 – 0.62 mg/l). Mean values of TSS, EC, TSS, NO3, PO4, Cl and turbidity were higher in wet season, while water temperature, pH, DO, Cl and COD values obtained were higher in dry season. Spatial variations in parameters were ascribed to levels of anthropogenic activities and wastes discharged within the stations; the seasonal variations were emanated from influx of wastes, and dilution as result of surface run-offs during wet season. Based on the findings, the WQI value were poor for human consumption; especially from station 2 to 4. These calls for urgent attention by Federal /State Ministry Health and Environment regards to its effects on human health and consistent water quality monitoring should be put into consideration.

DOI: https://dx.doi.org/10.4314/jasem.v24i7.14

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Dates: Received: 16 May 2020; Revised: 29 June 2020; Accepted: 07July 2020

Keywords: Impact, Assessment, Coastal activities, Water Quality, Qua Iboe River

Pollution indeed is a global problem affecting aquatic ecosystems. Aquatic ecosystem contains diverse habitats which supported myriads of species of organisms; served as important sources of water for human consumption (Adeogun and Fafioye, 2011) and as a medium for survival, reproduction, growth of aquatic biota and recycling of nutrients (Jonah et al., 2019). Unluckily, the available water quality have been impacted negatively upon by both natural and drastic anthropogenic activities leading to scarcity of good water quality and often impede its ecologically functioning and primary productivity. According to George and Atakpa (2015), water quality may describe based on the physical and chemical characteristics. Continuous dumping of wastes, run-offs from agricultural land-used, municipal run-offs and domestic wastes discharged will keep on deteriorating the water system. However, research had been embarked in Nigeria and identified anthropogenic activities outside and within the coastal areas as a threat to aquatic ecosystems (Obasi and Balogun, 2001; Ekiye and Zejioa, 2010; Irfan and Shakil, 2012; Ayobaham et al., 2014; Wanjala et al., 2018 and Jonah et al., 2019), thus rendered the water unsuitable for aquatic life. Qua Iboe River is one of the major tropical rainforest river exposed to various anthropogenic activities, which there is need for continuous monitoring of the river in order to report the level of degradation for effective management. Therefore, the objective of this paper is to assessment the effect of coastal activities on water quality of the upper segment of Qua Iboe River, Akwa Ibom State, Nigeria.

MATERIALS AND METHODS
Study area and Sampling stations: The study area was at the Upper Coastal zone of Qua Iboe River, Akwa Ibom State Southern Nigeria. The studied sections of the river, lie within Latitude 05°43’ - 05°13’ North and Longitude 07°34’ - 07°40’ East (Figure 1). The river flows in South – Eastern direction towards Atlantic Ocean from Ikwuano Local Government Area of Abia State into Usaka community in Obot Akara Local Government Area, Akwa Ibom State. The study stations were selected according to ecological setting.

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and the level of anthropogenic activities. Station 1 (Ikot Amba) is located in Obot Akara Local Government Area; the observed human activities here were bathing and laundry. Station 2 (Ikot Usuru) is located in Ikot Ekpene Local Government Area, 6km away from station 1, the anthropogenic activities here were farming, dredging, washing of motor cycle and laundry. The river at this station also received wastes from municipal through surface run-off. Station 3 (Afaha Ikot Ebak) and station 4 (Ekpenyong Attai) were located in Essien Udim Local Government Area; station 3 is about 4km away from station 2, while station 4 about 3km in a distance away from station 3. The anthropogenic activities observed in these stations include extensive farming, sand dredging, bathing, laundry, loading of sand and other domestic activities.

**Figure 1:** Map of Qua Iboe River showing the sampling stations

Sample collection and Analysis: Water samples were collected from each sampling stations using washed and sterilized plastic bottles. The samples were collected in monthly bases between November, 2018 and August, 2019. Physical parameters (water temperature, dissolved oxygen, electrical conductivity, total dissolved solids, turbidity and hydrogen ion concentration) were determined in-situ using Extech Meter Probes (Exstick 11). Other parameters were analyzed ex-situ, according to Standard Methods of AOAC (2000) and APHA (2005). Statistical Package for Social Science (SPSS) version 20 was employed to compute the mean and standard error in the data obtained, while test for significant difference (p<0.05) among the stations was carried out using one-way analysis of variance (ANOVA), and significant variations were isolated among the stations using Least Significant Difference (LSD) test, while paired sample t-test were used to compare the seasonal difference.

**RESULTS AND DISCUSSION**

The summary of spatial mean values of physicochemical parameters obtained during the study period were presented in Table 2, while seasonal variations in range and mean values were presented in
Dissolved oxygen (DO) had its spatial mean values ranging between 3.11 to 5.45 mg/l. Station 3 had the lowest value of 3.11 mg/l, while station 1 had the highest (5.45 mg/l) followed by station 4 (4.6 mg/l). Seasonal regime recorded higher mean value of 8.31 mg/l in dry season when compared to wet season value (4.87 mg/l). The low means values obtained in station 2 and 3 could be ascribed to high accumulation of organic and inorganic pollutants in the water sample originated from anthropogenic activities. Similar trend were reports by Fakayode (2005) and Adeogun and Fafioye (2011). These authors reported decline of dissolved oxygen concentration from a water sample at a point of organic effluent discharged into water body. The high DO value obtained during dry season may be attributed to low accumulation of organic pollutants, high photoperiod and high intensity of sunlight used by sub-merged green plants for photosynthesis which released dissolved oxygen as a by-product into water body. In this study, ANOVA showed significant difference between the values across the sampling stations; LSD test indicate significant difference between both seasons (p<0.05); the values recorded in station 2 and 3 were below the recommended range (>4) of WHO (2011).

Table 3: Seasonal variation in means values of physico-chemical parameters obtained during the study period

| Param. | Wet season range | Dry season range | Wet season t-value | Dry season t-value |
|--------|------------------|------------------|--------------------|--------------------|
| Temp °C | 21.18-23.4       | 26.3-31.8        | 25.16±0.33         | 29.34±0.41         | -2.913* |
| pH mg/l | 6.2-7.3          | 6.4-8.2          | 6.0±0.27           | 8.5±0.36           | -2.440* |
| DO mg/l | 3.01-5.6         | 5.33-11.4        | 4.87±0.63          | 8.31±0.42          | -4.416* |
| TDS mg/l | 46.18-53.43     | 39.33-61.06      | 46.18±1.13         | 31.13±1.12         | -2.753 |
| EC μs/cm | 4.43-18.2        | 8.72-13.6        | 16.10±0.46         | 13.30±0.53         | -2.163 |
| Tub. NTU | 12.34-17.34      | 5.8-14.8         | 17.03±1.53         | 6.49±1.02          | -4.474* |
| TSS mg/l | 243-300          | 137-264          | 360.18±2.13        | 201.13±2.23        | -2.753* |
| NO₃- mg/l | 55.39-78.10     | 41.16-53.12      | 58.45±0.53         | 31.39±0.02         | -2.782 |
| PO₄ mg/l | 4.10-24.15       | 3.9-13.37        | 12.03±0.39         | 7.10±0.23          | -6.310* |
| CI mg/l | 84.01-88.43      | 45.16-173.16     | 89.31±5.64         | 111.1±5.31         | -3.121 |
| COD mg/l | 89.39-129.01    | 137.15-151.14    | 136.41±5.65        | 5.319*             | -5.319* |
| NH₃ mg/l | 1.62-19.03       | 1.32-10.46       | 4.01±0.43          | 1.10±0.13          | -2.339* |

*standard error; *indicate significant difference at P<0.05

One-way ANOVA showed significant difference between the seasons (p<0.05). The low pH values in station 2 and 4 could be attributed to constant deposition of organic pollutants and dredging activities at the stations. Studies of (Seiyaboh et al., 2013 and Amah-jerry et al., 2017) have reported that human activities like dredging and mining of sand could lower the pH levels of water bodies. High value recorded in dry season (8.5 mg/l) could be ascribed to low volume of water to dilute it's concentration. In this study, the values obtained in station 2 and 4 were below the acceptable limit (6.5-9.0 mg/l) of WHO (2011) suitable for aquatic life.

Table 2: Spatial mean values of physico-chemical parameters of Upper Qua Iboe River obtained during the sampling period

| Param. | STN.1 | STN. 2 | STN. 3 | STN. 4 | P-value |
|--------|-------|--------|--------|--------|---------|
| Temp °C | 25.33±0.35 | 25.26±0.33 | 25.12±0.45 | 25.03±0.38 | P>0.05 |
| pH mg/l | 6.62±0.44 | 5.8±0.15 | 6.5±0.11 | 5.8±0.34 | P>0.05 |
| DO mg/l | 5.45±0.64a | 3.52±0.03b | 3.11±0.31b | 4.6±0.40b | P>0.05 |
| TDS mg/l | 18.63±0.43a | 25.33±0.72a | 32.53±0.40b | 28.43±0.68b | P>0.05 |
| EC μs/cm | 8.33±0.28a | 7.13±0.29a | 11.32±0.54a | 13.16±0.38a | P=0.05 |
| Tub. NTU | 7.61±0.16a | 18.32±0.49a | 12.33±0.70a | 16.38±0.37b | P>0.05 |
| TSS mg/l | 90.80±1.33a | 165.63±1.37b | 153.15±1.51b | 158.33±1.12b | P>0.05 |
| NO₃- mg/l | 33.02±0.13a | 78.33±0.19a | 58.52±0.26b | 62.65±0.31b | P>0.05 |
| PO₄ mg/l | 4.44±0.83a | 7.39±0.63b | 6.74±0.33a | 7.33±0.68b | P>0.05 |
| CI mg/l | 55.93±5.80a | 43.60±6.63 | 57.79±5.74a | 63.21±5.11a | P>0.05 |
| COD mg/l | 35.96±5.63a | 53.28±5.03a | 98.35±6.34b | 113.05±5.36b | P>0.05 |
| NH₃ mg/l | 0.33±0.12a | 0.17±0.28a | 0.53±0.18b | 0.62±0.13b | P>0.05 |

±=Standard error; mean with different superscript on the same row are significantly different at P<0.05

Table 3: The spatial mean values of surface water temperature were observed to be slightly different across the sampling stations, with no significant difference. High value was recorded during dry season (29.34°C) while wet season value was 25.16°C. The seasonal differences could be attributed to the time and weather conditions during sampling. The rising of atmospheric temperature during the dry season could lead to rising of water temperature values as obtained in this study. This affirms the reports of Sowmyashree et al. (2012) that the heat generated during the dry season normally resulted in rising of surface water temperature. The mean values of water temperature obtained were within the permissible limits (24-30°C) of WHO (2011). One-way ANOVA showed significant difference between the seasons (p<0.05). The low pH values in station 2 and 4 could be attributed to constant deposition of organic pollutants and dredging activities at the stations. Studies of (Seiyaboh et al., 2013 and Amah-jerry et al., 2017) have reported that human activities like dredging and mining of sand could lower the pH levels of water bodies. High value recorded in dry season (8.5 mg/l) could be ascribed to low volume of water to dilute it's concentration. In this study, the values obtained in station 2 and 4 were below the acceptable limit (6.5-9.0 mg/l) of WHO (2011) suitable for aquatic life.
were observed in wet season 46.18mg/l when compare to 31.13 mg/l value of dry season. This could be attributed to impact of precipitation which transported dissolved materials from the nearby community and surrounding farmland into the river. The values obtained spatial and seasonal were within the range of WHO (2011). There was no significant difference observed within the stations and in seasons. Electrical conductivity (EC) had its means values range between 8.33μs/cm to 13.32μs/cm. Higher value were recorded in wet season 16.10μs/cm, while the lowest were obtained in dry season 13.30μs/cm. The high value recorded in station 3 could be attributed to dredging activities in the water body. Dredging contributes to the increase in EC value as observed in station 3; similar observations were made by Seiyaboh et al. (2013) and Rehman et al. (2016). The significant increase during wet season is probably owned to high surface run-off of inorganic dissolved salts into the river. Turbidity had its range between 7.61 NTU and 18.32 NTU, while total suspended solids (TSS) had its range between 90.80 mg/l to 165.63 mg/l. Highest mean value of turbidity was recorded in station 2 (18.32 NTU), while the lowest value of TSS was recorded in station 1 (90.80 mg/l). Higher values of these parameters were recorded in wet season, which maybe traceable to impact of surface run-offs from the immediate environment into the water. Ajibade (2004) and Wakawa et al. (2008) reported significant increase in turbidity value in Nigerian rivers. According to the authors, this could be linked to run-offs effects as well as domestic and industrial discharge on the rivers. The finding in this study deviate from the report of Jonah et al. (2019). The authors reported low value of TSS in wet season due to increase in water level resulted in reduction

Table 4: Water Quality Index (WQI) values of Upper Qua Iboe River

| Param. | WHO | std | Wi | wr | Relative Rating (qi) | Sub-index value (S.1=wi X qi) |
|--------|-----|-----|-----|-----|----------------------|-----------------------------|
|        |     |     |     |     | stn.1                | stn.2 | stn.3                  | stn.4 | stn.1 | stn.2 | stn.3 | stn.4 |
| Temp.  | 24-30 | 4   | 0.08 | 101.3 | 101.04 | 104.5 | 100.2 | 8.1 | 8.08 | 8.4 | 8.0016 |
| pH     | 6.5-90 | 4   | 0.08 | 85.7 | 75.3 | 84.4 | 75.3 | 6.8 | 6.03 | 6.7 | 6.02 |
| DO     | ≥ 4  | 4   | 0.08 | 136.3 | 88 | 77.7 | 115 | 10.9 | 7.04 | 6.22 | 9.2 |
| TDS    | 250 | 4  | 0.08 | 7.5 | 10.2 | 13 | 11.4 | 0.6 | 0.8 | 1.04 | 0.909 |
| EC     | 1500 | 4  | 0.08 | 0.56 | 0.47 | 0.75 | 0.87 | 0.045 | 0.037 | 0.060 | 0.070 |
| Tub.   | <5  | 3   | 0.06 | 152.2 | 366.2 | 246.6 | 327.6 | 9.2 | 21.9 | 14.8 | 19.6 |
| TSS    | 500 | 4  | 0.08 | 18.16 | 33.1 | 30.6 | 31.7 | 1.45 | 2.65 | 2.45 | 2.53 |
| NO3−  | 50  | 10  | 0.08 | 66.04 | 156.7 | 117.04 | 125.3 | 6.604 | 15.7 | 11.704 | 12.5 |
| PO4−  | <5  | 3   | 0.08 | 88.8 | 147.8 | 134.8 | 146.6 | 7.104 | 11.8 | 10.78 | 11.7 |
| Cl     | 50  | 3   | 0.06 | 111.8 | 87.2 | 115.5 | 126.4 | 6.708 | 5.23 | 6.93 | 7.58 |
| COD    | 250 | 3   | 0.06 | 14.4 | 21.3 | 39.3 | 45.2 | 0.86 | 1.27 | 2.36 | 2.71 |
| NH3    | 0.4 | 4   | 0.08 | 66 | 114 | 106 | 124 | 5.28 | 9.12 | 8.48 | 9.92 |
| ∑46   |     |     |     |     |     |     |     |     |     |     |     |
| WQI    | 63.6 |     |     |     |     |     |     |     |     |     |     |
| WQI    | 89.6 |     |     |     |     |     |     |     |     |     |     |
| WQI    | 79.9 |     |     |     |     |     |     |     |     |     |     |
| WQI    | 90.7 |     |     |     |     |     |     |     |     |     |     |

The low mean value of chemical oxygen demand (COD) was recorded in station 1 (35.64 mg/l), while the highest value of 113.05 mg/l was obtained in station 4; this is attributed car wash activities in the station. ANOVA showed significant difference between the stations (p<0.05). Remarkable high value of this parameter was recorded in dry season is probably due to low volume of water to dilute organic-

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