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PHYSICO-CHEMICAL PARAMETERS OF WOJI CREEK, RIVERS STATE, NIGERIA

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ABSTRACT: *The water quality of Woji Creek of Rivers State, Nigeria, were study between November 2015 to May 2016. There were significant differences ($p < 0.05$) in all the parameters recorded. The values recorded ranged from 7.13 ± 0.42 to 7.58 ± 0.67 (pH), 30.02 ± 1.52^oC to 31.03 ± 1.92^oC (Temperature), 6.34 ± 5.13mg/L to 9.65 ± 7.91mg/L (Alkalinity), 7.81mg/L ± 3.56mg/L to 12.74mg/L ±4.79mg/L (Salinity), 6.41mg/L ±3.20mg/L to 8.4mg/L ±3.62mg/L (flow Velocity), 15.31mg/L ± 7.19mg/L to 29.31mg/L ± 15.58mg/L (Conductivity), 10.06mg/L ± 4.74mg/L to 15.08mg/L ±4.51mg/L (TDS), 3.25mg/L ±2.33mg/L to 7.59mg/L ±11.30mg/L (TSS), 2.21mg/L + 0.72mg/L to 2.85mg/L ±2.92 (BOD), 11.96mg/L ±3.98mg/L to 14.78mg/L ±3.74mg/L (COD) and Dissolved Oxygen (3.64mg/L ± 1.30mg/L to 7.00mg/L ± 2.33mg/L). There were obvious fluctuation in the ecological variables ($p < 0.05$) except DO concentrations that were not statistically significant ($p > 0.05$). The physico-chemical parameters of Woji Creek were favourable for fish production although some were to a large extent above the WHO limits. The study revealed that environmental regulatory bodies can achieve good water quality by protecting the water bodies from negative impacts of abattoir and domestic wastes, industrial effluent and refuse through satisfactory wastewater treatment and management practices such as waste reduction, reuse and recycling.*

KEYWORDS: Sediments, abattoir, temperature, refuse and recycling.

INTRODUCTION

The physiological process of aquatic life is determined by the physical and chemical properties of water and these as well determine water availability for anthropogenic uses (Cardoso *et al*., 2007). A complex in separable link has been revealed through studies and research between the physicochemical properties of water and species composition, structural assemblages and distribution of planktons, benthos and fish (Boney, 1975, Zabbey & Hart, 2006, Arimoro, 2009).

Flow rates and concentration of pollutants in surface water are determined by precipitation, surface runoff and interflow (Vega *et al*., 1998). Physicochemical properties off interstitial water are crucial for benthic organisms and sediment characteristics have effect on these variables and bore water interaction with local process. Sikoki and Zabby (2006) stated that the chemistry of interstitial water and the overlying water column are mutually inclusive. Spiff and Horsfall (2004)

mentioned that there might be fluxs in the parameters across the sediment water interface according to differential ambient condition.

This search work will add to already established information on the physicochemical properties, chemical pollutants and composition of Woji Creek of Rivers State. In the theoretical and practical view, the study will help to show the relationship between physico-chemical properties of water and chemical pollutants as they affect the food chain, having in mind that fishes, which are consumed by human beings, feeds on them and will encourage further research by the government organizations and non-governmental agencies (local and international) as it highlights the toxic effect of industrial discharge of water in a commonly used water body in over populated urban settlement. This study would go together with various studies as regard water quality assessment and also assist in the isolation of potential indicator and monitor species for the biological monitoring of the environmental quality of the area. This will add to pre-existing data and information to already existing reviews on Niger Delta waters as regards to environmental studies.

MATERIALS AND METHODS

Study Area

Woji Creek is located on the upper reaches of the Bonny River estuary. The creek extends inland into Port Harcourt. The creek head water is fresh, flowing unidirectionally downstream through Rumuodara swamp and traverses Port Harcourt Aba express road at Bridge bus stop. Hart and Zabbey (2005) described the physiographic and hydrologic patterns of Woji Creek (Fig. 1).

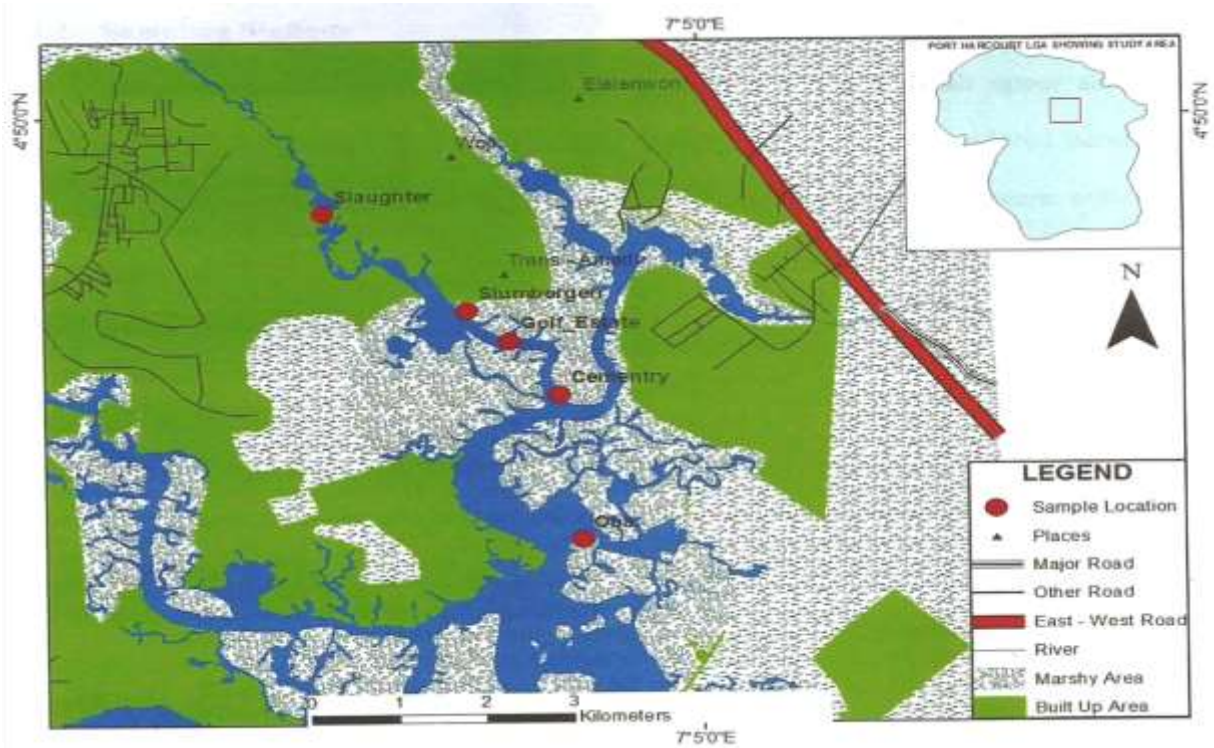

FIG. 1: Map of the Study Area, Woji Creek showing the Five Sampling Stations

Sampling Stations

Five sampling stations were cited about 500m apart along the creek for this study (Fig. 1)
Station 1: This was located adjacent the main Port Harcourt abattoir popularly called "slaughter." It was sited under the overhead bridge, the station has no macrophytes fringing the shores can be attributed to construction work going on across the creek. It is located approximately at latitude N04º 49'48.504" and longitudinally E007º02'29.105" (Fig. 1).

Station 2: This station is downstream from station one. It is located directly opposite the slumberger oil drilling company and serves as a harbor for tugboats belonging to the same company. Latitudinally, it is located N04º48'29.8" and longitudinally E007º03'34.3" (Fig. 1).

Station 3: The station has a landward proximity to the Golf Estate. The marginal vegetation of the location is homogenously Nypa (*Nypa fructicons*) and Mangrove fern. Latitudinally it is located N04º48'14.7" and longitudinally E007º03'49.8" (Fig. 1).

Station 4: This station was cited at the mount of Elelenwo Creek, approximately 110m to the confluence with the Woji Creek. Latitudinally it is located N04º47'48.9" and longitudinally E007º04'08.1" (Fig. 1).

Station 5: This station was cited at the amount of a feeder creek fringing Oba community. Facing upstream of the feeder channel, the intertidal swamps to the left is homogenously nypa palm. Latitudinally it is located N04º46'41.7" and longitudinally E007º04'16.3" (Fig. 1).

FIELD AND LABORATORY PROCEDURES

Physicochemical Parameters of Water
Physicochemical parameters such as Temperature, Salinity, Total Dissolved Solids, Dissolved Oxygen, pH, Conductivity, Flow velocity were all measured insitu using hand held digital meters. For Biological Oxygen Demand, water surface was collected in 250ml amber BOD glass bottle (Winchester bottles) with BOD bottles corked at the depth of 50cm and water samples for the determination of Total Suspend Solids (TSS) and Chemical Oxygen Demand (COD) were collected using 1 liter sterilized jelly can one for each station, preserved and transported in an ice-chest to Giolee Global Resources Limited (laboratory) in Port Harcourt, where the samples were analyzed.

The physicochemical parameters were determined according to the procedure outlined in the standard methods for the examination of water and waste water (APHA, 1998).

RESULTS AND DISCUSSION

The results of the various physicochemical parameters recorded at various stations during this study are presented in Tables 1 and 2 and Figure 2 and 3 respectively. Water samples from Woji Creek was determined during the seven months sampling (December 2015 to May 2016). The highest and least mean values recorded from November to May for flow velocity, pH, dissolved oxygen, salinity, temperature, alkalinity, conductivity, total dissolved solids, total suspended solids, biological oxygen demand and chemical oxygen demand were 5.49 ± 2.65cm/s to 11.35 ± 3.20cm/s, 7.19 ± 0.49mg/L to 7.58 ± 0.25mg/L, 3.78 ± 2.26mg/L to 7.55 ± 3.12mg/L, 5.24 ± 3.32‰ to 13.71 ± 2.11‰, 28.43 ± 0.68^{o}C to 31.86 ± 0.89^{o}C, 3.30 ± 1.30mg/L to 19.93 ± 4.29mg/L, 10.44 ± 4.96ms/cm to 27.85 ± 4.36ms/cm, 7.91 ± 5.79mg/L to 17.53 ± 3.75mg/L, 1.12 ± 0.71mg/L to 8.20 ± 2.17mg/L, 1.16 ± 0.17mg/L to 4.84 ± 4.29mg/L and 9.51 ± 1.93mg/L to 19.44 ± 00mg/L respectively (Table 1 & 2 and Fig. 2 & 3).

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Table 1: Physico-chemical parameters for the different stations

Parameters	**Stations**					**WHO standard**
	1	**2**	**3**	**4**	**5**	
Flow velocity (cm/s)	7.16±4.19^{a}	8.49±3.62^{a}	6.67±3.10^{a}	7.60±3.57^{a}	6.41±3.20^{a}	NA
pH	7.35±0.34^{a}	7.58±0.67^{a}	7.16±0.45^{a}	7.13±0.42^{a}	9.55±0.29^{a}	6.5-8.5
DO (mg/L)	3.64 ± 1.30^{b}	5.92 ± 1.86^{ab}	6.81±2.79^{a}	6.47±3.26^{a}	7.80±2.33^{a}	>4
Salinity (‰)	7.81±3.56^{b}	8.84±4.95^{ab}	9.94±3.18^{ab}	11.46±3.37^{ab}	12.74±4.79^{c}	NA
Temperature (^{o}C)	30.03±1.44^{a}	30.32±1.20^{a}	31.03±1.92^{a}	30.81±1.51^{a}	30.02±1.52^{a}	25-32
Alkalinity (mg/L)	6.34±5.13^{a}	6.69±5.08^{a}	7.82±7.11^{a}	8.58±7.95^{a}	9.65±7.91^{a}	<500
Conductivity (Ns/cm)	15.31±7.19^{b}	17.74±9.81^{ba}	20.19±6.79^{ba}	29.31±15.58^{ba}	25.42±9.30^{a}	2000
TDS (mg/L)	10.06±4.74^{a}	11.05±6.18^{a}	14.94±7.09^{a}	15.08±4.51^{a}	14.94±7.09^{a}	250
TSS (mg/L)	5.18±3.85^{a}	3.43±2.80^{a}	3.25±2.33^{a}	7.59±11.30^{a}	3.25±2.33^{a}	NA
BOD (mg/L)	2.25±0.71^{a}	2.85±2.92^{a}	2.21±0.72^{a}	2.78±3.02^{a}	2.21±0.72^{a}	0-6
COD (mg/L)	11.96±3.98^{a}	13.79±4.14^{a}	13.98±4.00^{a}	14.78±3.74^{a}	13.98±4.00^{a}	30

*Superscripts of the same alphabet are not statistically significantly different ($p < 0.05$)

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Table 2: Physico-chemical parameters from November 2015 – May 2016

Parameters	**Stations**							**WHO standard**
	November	**December**	**January**	**February**	**March**	**April**	**May**	
Flow velocity (cm/s)	5.73±3.00^{ab}	6.09±2.62^{a}	5.90±3.40^{a}	6.25±1.29^{a}	5.49±2.65^{a}	11.35±3.20^{b}	8.42±3.95^{a}	NA
pH	7.58±0.25^{a}	7.26±0.52^{a}	7.19±0.47^{a}	7.46±0.85^{a}	7.46±0.89^{a}	7.45±0.07^{a}	7.25±0.36^{a}	6.5-8.5
DO (mg/L)	6.94 ± 3.43^{a}	5.64 ± 0.93^{a}	3.78±2.26^{a}	5.37±1.95^{a}	6.28±2.97^{a}	7.55±3.12^{a}	6.82±3.42^{a}	>4
Salinity (‰)	7.53±1.24^{ab}	5.24±3.32^{a}	6.02±4.42^{a}	11.53±2.69^{bc}	11.60±2.48^{bc}	13.71±2.11^{c}	12.63±2.24^{c}	NA
Temperature (^{o}C)	29.58±0.05^{a}	28.43±0.68^{a}	29.54±0.66^{a}	31.05±1.72^{ab}	31.34±0.52^{bc}	31.38±0.89^{bc}	31.86±0.89^{c}	25-32
Alkalinity (mg/L)	6.50±1.12^{a}	3.30±1.30^{a}	3.70±0.67^{a}	5.31±0.58^{a}	8.29±11.75^{a}	19.93±4.29^{b}	6.87±3.22^{a}	<500
Conductivity (µs/cm)	15.15±2.43^{ab}	10.44±4.96^{a}	12.08±8.84^{a}	24.03±5.71^{c}	23.28±5.00^{c}	27.85±4.36^{c}	25.25±0.36^{c}	2000
TDS (mg/L)	10.16±1.66^{b}	6.53±4.14^{a}	7.91±5.79^{a}	15.29±3.51^{bc}	15.34±3.29^{bc}	17.53±3.75^{c}	16.57±2.96^{c}	250
TSS (mg/L)	2.00±0.00^{ab}	1.12±0.71^{a}	3.10±2.33^{ab}	8.05±3.53^{b}	8.20±2.17^{b}	7.30±2.31^{b}	4.80±2.82^{ab}	NA
BOD (mg/L)	1.16±0.17^{a}	4.84±4.29^{b}	2.26±0.36^{ab}	2.19±0.55^{ab}	1.72±0.30^{a}	2.29±0.53^{ab}	1.91±0.59^{a}	0-6
COD (mg/L)	16.71±4.82^{c}	9.51±1.93^{a}	13.35±1.35^{bc}	15.78±1.35^{bc}	19.44±0.00^{a}	16.71±2.90^{cd}	10.06±1.38^{ab}	30

*Superscripts of the same alphabet are not statistically significantly different ($p < 0.05$)

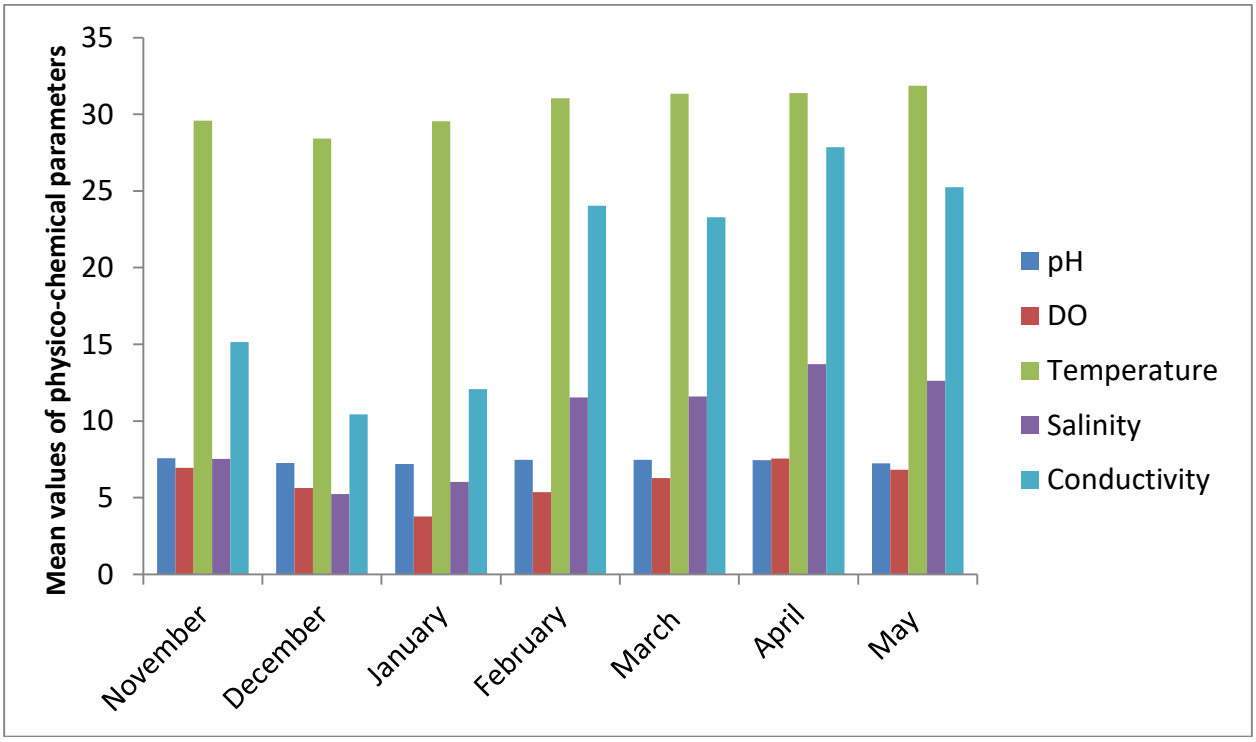

Fig. 2: Mean values of physico-chemical parameters from November 2015 – May 2016.

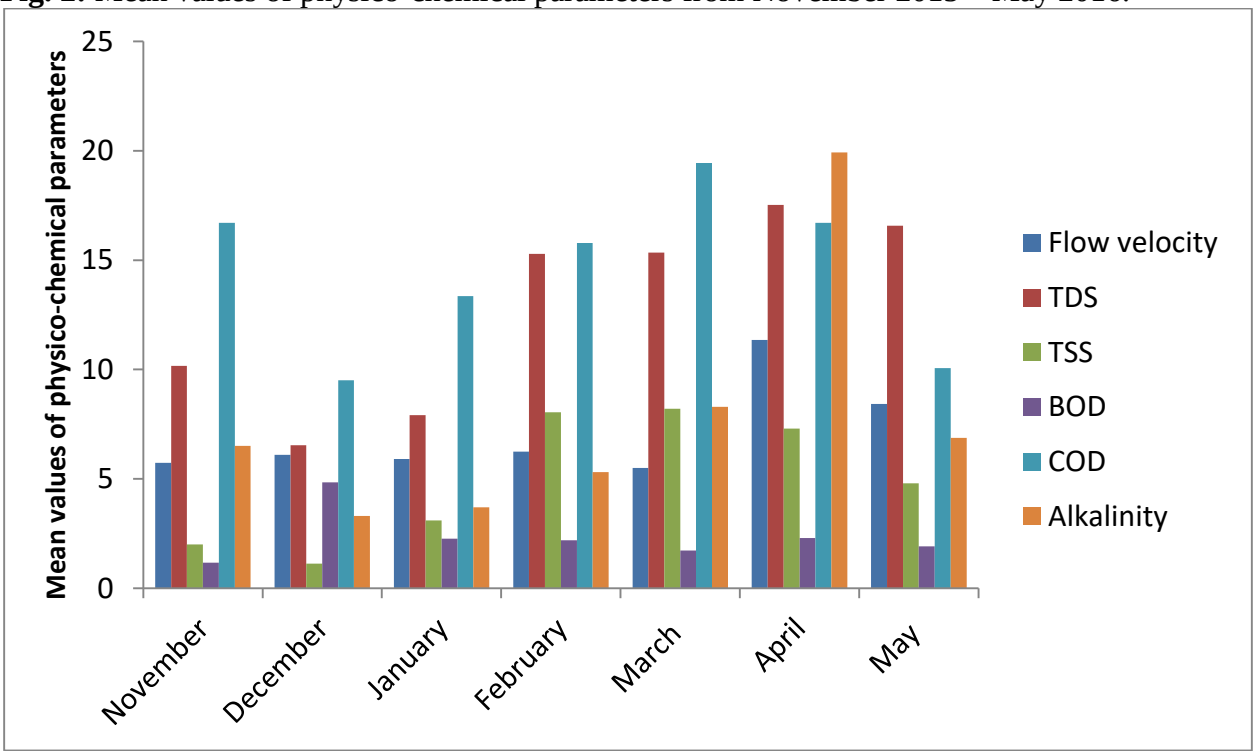

Fig. 3: Mean values of physico-chemical parameters from November 2015 – May 2016

DISCUSSION

In aquatic ecosystem, variations exists between the different environmental compartments which ranged from physical, chemical and biological characteristics (Mrimoro, 2009). However, the pH of the water samples was slightly basic with values ranging from 7.13 ± 0.45 and with the least values in station 4, to highest value of 7.58 ± 0.67 as recorded in station 2. The differences in pH values across the different sampling stations was not statistically significant ($p > 0.05$). The obtained values for pH were within WHO, 2006 standard for survival of aquatic lives. Low pH values may be as a result of presence of decaying of organic matter content, which also contributes to salinity of the water (Abowei, 2010). Woke and Wokoma (2006) recognized pH as an essential environmental factor that has a strong connection with the physiology of aquatic organism.

The temperature ranges is in line with temperature of brackish waters of Niger Delta as reported by Dubblin-Green, (1990). The fairly high temperature in streams is conducive to vigorous microbial activities that degrade organics, which results to purification of a stream (Agwa *et al*, 2013), this may also be the case of Woji Creek. The recorded values for the dissolved oxygen showed that the values were all within the standard value. WHO (2006), for the survival of aquatic lives except for station 1 whose values was slightly below the value with 3.64 ± 1.30mg/L.This may be attributed to discharge of abattoir waste, domestic/industrial waste, sewage waste into the water and absence of vegetation as a result of on-going construction (Woke, Babatude and Wokoma, 2013). The differences in mean values in the different stations were statistically significant ($p > 0.05$). The mean values for alkalinity were within the WHO recorded limit of < 500mg/L and the differences in the mean values were not statistically significant ($p > 0.05$).

The salinity and flow velocity of the different sampling stations were constant although, the differences in mean values of salinity were statistically significant ($p < 0.05$). There is a gradual increase from station 1 with the highest salinity recorded in station 5 followed by station 4. This may be as result of the creek getting close to Bonny tributary (Woke & Wokoma, 2006).

The means values of Conductivity, Total Dissolved Solids (TDS), Total Suspended Solids (TSS), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD) were all within limits for the survival of aquatic lives and make the water suitable for domestic use (FEPA, 1991, WHO, 2006). BOD and COD provide important information as to quality of water as they both of them indicates the level of organic pollution (Agwa *et al*., 2013). High BOD levels in water bodies speed up bacterial growth and oxygen levels is consumed in water but due to atmospheric mixing and as algal photosynthesis. The river re-aerates causing oxygen to be added into water. This may be reason for high levels in station 5. The variations in mean values were not statistically significant ($p > 0.05$) for TDS, TSS, BOD and COD in Woji Creek, which indicates that activities in the water can elevate its range if not monitored (Perlman, 2014).

Finally, the knowledge of stress condition, organic/inorganic loads and survival potentials of organisms present in that water will in assessment of the physical and chemical parameters for

good quality of aquatic environment. Early detection of unfavourable changes in water will give way for proper management of the water resource and zoo fauna present in them. This study would go together with various studies as regard water quality assessment and also assist in the isolation of potential indicator and monitor species for biological monitoring of the environmental quality of the area. A significant improvement of the water quality can be achieved by connecting households, institutions and factors to a sewage system that transport sewage to a waste water treatment plant. This will add to preexisting data and information to already existing reviews on Niger Delta waters as regards to environmental studies.

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