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The Effect of Sand Mining on the Physico-Chemical Parameters of Ikot Ekpan River, Akwa Ibom State, Nigeria

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ABSTRACT

This study investigated the effects of sand mining on the physico-chemical parameters of Ikot Ekpan River. Four sampling stations were selected. Station one, was a partially dredged section of the river, station 2 and 4; fully dredged portions while station 3, (under the bridge) was not dredged. Temperature, DO, pH, electrical conductivity, total dissolved solids, turbidity, salinity, acidity, BOD, transparency, depth, nitrate, nitrite, sulphate, phosphate and ammonium were measured using standard methods. There were no spatial significant variations ($p>0.05$) in eleven (temperature, pH, EC, salinity, TDS, BOD, acidity, sulphate, transparency, nitrate and nitrite) of the sixteen parameters measured. However, temperature, EC, salinity, turbidity, sulphate, ammonium, nitrate and nitrite showed significant seasonal variations ($p<0.05$). The remaining parameters did not show significant seasonal variations ($p>0.05$). No parameters exceeded WHO standards except for turbidity, thus indicating water quality to be good.

Keywords: *Sand mining, physico-chemical parameters, stations, DO, Ikot Ekpan River.*

INTRODUCTION

Water quality plays a vital role in the distribution, abundance and diversity of aquatic organisms. The physical and chemical characteristics of water are important parameters as they may directly or indirectly affect its quality and consequently its suitability for the distribution and production of fish and other aquatic organisms [1]. The effects of human activities on water quality are both wide spread and varied in the degree to which they disrupt the ecosystem and restrict water use [2].

Mining practice is known for its hazardous working condition. Mining activity in water environment pollutes the water source of the area, thereby endangering the life of people and aquatic organisms in the area. Waste materials deposited at the mining sites consequently pollute the environment, also the underground, and the surface water of the surrounding [3]. Sand mining from aquatic sources can modify the structure and dynamics of the soft bottom community [4]. In addition, sand mining transforms the riverbeds into large and deep pits; as a result, the groundwater table drops leaving the drinking water wells on the embankments of these rivers dry [5].

Ikot Ekpan River is a first order stream, which runs through Uyo-Eket road in Nsit Ubium Local Government Area, Akwa Ibom state, Nigeria. Its watershed is subject to intensive human and industrial activities resulting in the discharge of a wide range of pollutants. It serves the surrounding communities in various ways: streambed dredging, domestic purposes (bathing, drinking, cooking, etc.), dry season crop production, washing (cars and clothes), amongst others. The objective of the study was to investigate the effect of sand mining on the physico-chemical parameters of Ikot Ekpan River.

MATERIALS AND METHODS

Study Area

Ikot Ekpan River is located in Ikot Ekpan Village in NsitUbium Local Government Area, Akwa Ibom State, Nigeria. It lies within longitude 7°55'01"E and latitude 4°42'34.5"N. Four sampling stations were selected for the study. Station one, was a partially dredged section of the river, station 2 and 4; fully dredged portions while station 3, (under the bridge) was not dredged.

Sample Collection and Analysis

Monthly sampling at the four stations for 6 months was carried-out. Using standard methods according to Stirling [6], the following physico-chemical parameters were determined: water temperature, DO, pH, conductivity, salinity, depth, transparency, total dissolved solids, Biochemical oxygen demand (BOD), turbidity, acidity, nitrate, nitrite, sulphate, phosphate and ammonium.

Statistical Analyses

SPSS (version 20) package was used to determine the means, range, standard deviation, one-way analysis of variance (ANOVA), Duncan Multiple Range Tests and correlation coefficient (r) values of the data obtained from the study area. All statistical test was carried out at 5% probability level.

Results and Discussion

Table1 is the spatial variations of physico-chemical parameters in Ikot Ekpan River, Table 2 summarizes the seasonal variations while, Table 3, is the Pearson correlation of the physico-chemical parameters. There were no spatial significant variations (p>0.05) in eleven (temperature, pH, EC, salinity, TDS, BOD, acidity, sulphate, transparency, nitrate and nitrite) of the sixteen parameters measured. However, temperature, EC, salinity, turbidity, sulphate, ammonium, nitrate and nitrite showed significant seasonal variations (p<0.05). The remaining parameters did not show significant seasonal variations (p>0.05).

Table1. *Spatial variations of physico-chemical parameters in Ikot Ekpan River*

Parameters	Station 1 Mean ± SE	Station 2 Mean ± SE	Station 3 Mean ± SE	Station 4 Mean ± SE
Temperature (°C)	28.833 ± 2.06^{a}	28.000 ± 2.31^{a}	28.875 ± 3.22^{a}	28.500 ± 1.95^{a}
DO (ppm)	3.468 ± 0.25^{a}	3.107 ± 0.23^{ab}	2.413 ± 0.30^{b}	3.115 ± 0.22^{ab}
pH	7.733 ± 1.77^{a}	6.333 ± 0.58^{a}	7.625 ± 1.62^{a}	6.283 ± 0.69^{a}
EC (µS/cm)	30.250 ± 5.76^{a}	28.868 ± 4.70^{a}	37.375 ±8.72^{a}	40.150 ± 10.93^{a}
Salinity (ppt)	0.035 ± 0.01^{a}	0.034 ± 0.01^{a}	0.031 ± 0.01^{a}	0.033 ± 0.01^{a}
TDS (mg/l)	4.038 ± 0.46^{a}	3.993 ± 0.36^{a}	4.078 ± 0.51^{a}	4.430 ± 0.48^{a}
BOD (mg/l)	3.877 ± 0.63^{a}	3.798 ± 0.77^{a}	5.603 ± 2.48^{a}	4.150 ± 0.94^{a}
Acidity (mg/l)	79.550 ± 5.83^{a}	68.667 ± 4.12^{a}	70.900 ± 4.21^{a}	84.283 ± 7.77^{a}
Turbidity (NTU)	6.400 ± 0.30^{ab}	6.233 ± 0.40^{ab}	5.350 ± 0.25^{b}	6.783 ± 0.46^{a}
Sulphate (mg/l)	6.406 ± 0.30^{a}	5.783 ± 0.77^{a}	8.023 ± 1.88^{a}	6.975 ± 1.26^{a}
Phosphate (mg/l)	1.145 ± 0.37^{a}	0.105 ± 0.02^{b}	0.114 ± 0.03^{b}	0.086 ± 0.02^{b}
Ammonium (mg/l)	2.963 ± 0.40^{a}	2.553 ± 0.29^{ab}	1.740 ± 0.49^{b}	2.045 ± 0.30^{ab}
Transparency (cm)	52.750 ± 7.85^{a}	35.000 ± 5.92^{a}	31.000 ± 9.62^{a}	42.583 ± 10.38^{a}
Depth (cm)	128.500 ± 17.43^{a}	115.333 ± 33.47^{ab}	55.250 ± 8.74^{b}	103.000 ± 13.12^{ab}
Nitrate (mg/l)	1.016 ± 0.13^{a}	1.275 ± 0.29^{a}	1.510 ± 0.46^{a}	1.263 ± 0.22^{a}
Nitrite(mg/l)	0.032 ± 0.01^{a}	0.025 ± 0.01^{a}	0.043 ± 0.02^{a}	0.033 ± 0.01^{a}

Means with different superscripts along the same row are not significantly different (p>0.05)

DO – Dissolved Oxygen; EC – Electrical conductivity; TDS – Total dissolved solids; BOD – Biological oxygen demand

Table2. *Seasonal variation of physico-chemical parameters in Ikot Ekpan River*

Parameters	Dry season (Mean ± SD)	Wet season (Mean ± SD)	Significance Level
Temperature (°C)	25.75 ± 0.97	31.85 ± 5.91	S
DO (ppm)	3.00 ± 0.65	3.19 ± 0.66	NS
pH	7.09 ± 3.55	6.75 ± 1.52	NS
EC (µS/cm)	43.88 ± 19.08	21.86 ± 1.52	S
Salinity (ppt)	0.04 ± 0.02	0.02 ± 0.01	S
TDS (mg/l)	4.35 ± 1.10	3.89 ± 0.86	NS
BOD (mg/l)	4.83 ± 3.43	3.54 ± 0.40	NS
Acidity (mg/l)	77.53 ± 19.13	74.82 ± 6.66	NS
Turbidity (NTU)	5.81 ± 0.64	6.82 ± 1.03	S
Sulphate (mg/l)	7.90 ± 2.56	5.23 ± 1.20	S
Phosphate (mg/l)	0.55 ± 0.83	0.19 ± 0.29	NS
Ammonium (mg/l)	2.76 ± 0.77	1.93 ± 0.89	S
Transparency (cm)	35.63 ± 22.86	47.85 ± 15.41	NS
Depth (cm)	106.42 ± 64.90	102.50 ± 42.51	NS
Nitrate (mg/l)	1.61 ± 0.49	0.81 ± 0.41	S
Nitrite(mg/l)	0.05 ± 0.02	0.01 ± 0.01	S

S indicates significant difference (p<0.05), NS indicates no significant difference (p>0.05)

Table3. *Pearson correlation of Physico-chemical parameters in Ikot Ekpan River*

	TEMP.	DO	PH	EC	SAL.	TDS	BOD	EC	ACID.	TURB.	SULPH.	PHOSPH.	AMMO.	TRANSP.	DEPTH	NO
TEMP.	1															
DO	-0.302	1														
PH	0.21	0.088	1													
EC	-0.37	-0.283	0.359	1												
SAL.	-.672**	0.126	0.195	.756**	1											
TDS	-0.376	-0.165	-.551**	0.014	0.169	1										
BOD	-0.085	-.609**	-0.139	0.388	0.33	.489*	1									
EC	-0.168	0.121	-.480*	-0.288	-0.09	0.256	-0.035	1								
ACID.	-0.094	0.241	0.318	.457*	0.346	-0.158	-0.347	-0.208	1							
TURB.	-0.088	0.404	-0.188	-0.205	0.031	0.192	-0.052	0.336	0.158	1						
SULPH.	-.497*	-0.221	0.067	.751**	.695**	0.115	.512*	0.007	0.054	-0.266	1					
PHOSPH.	-0.228	0.3	0.341	0.189	.424*	0.173	0.057	-0.42	0.333	0.165	-0.06	1				
AMMO.	-.703**	0.346	0.026	0.39	.769**	0.292	0.297	-0.187	0.084	0.233	0.371	.657**	1			
TRANSP.	0.401	0.222	0.212	-0.371	-0.316	-0.037	-0.376	-0.045	0.296	0.331	-.664**	.450*	-0.188	1		
DEPTH	-0.109	0.249	0.258	0.079	0.167	-0.06	-0.323	-0.302	0.328	0.061	-0.045	0.25	0.176	0.251	1	
NO	-.750**	-0.217	0.005	.670**	.682**	0.219	.441*	-0.077	0.021	-0.237	.805**	-0.01	.501*	-.652**	0.044	1
NO_2	-.569**	-0.18	0.274	.845**	.816**	0.182	.446*	-0.284	0.222	-0.254	.734**	0.389	.593**	-0.318	0.05	.748**

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

DO was higher in wet season than in dry season ($p>0.05$), this is due to reduced mining activitie during the dry season, this leads to reduced oxidation at this period. Turbidity was significantly higher in wet season than dry season ($p<0.05$). This might be due to allochthonous materials being washed down into the river body during the rains. Transparency was lower in dry season than wet season ($p>0.05$). This is because during the rainy season, water from runoff enters into the river and raises its transparency level. Depth also was not significantly different but was higher in dry season than wet season ($p>0.05$), reasons being that during the dry season sand dredging was seriously going on. The large scale extraction of streambed materials and sand mining below the existing streambed form and shape leads to several impacts such as erosion of channel bed and banks, increase in channel slope and change in channel morphology. These impacts may cause the undercutting and collapse of river banks, the loss of adjacent land structures, upstream erosion as a result of an increase in channel slope and changes in flow velocity and downstream erosion due to increased carrying capacity of the stream.

The results of the analysis from the four stations indicated that most of the parameters did not exceed the safe limits set by WHO standard. The mean pH of the river was neutral even with the ongoing sand mining projects. Abandoned dredging machines and materials can lead to low pH [7]. Turbidity was higher in the partially and dredged stations (1, 2 and 4) as compared to the not dredged station (3). This might enhance the increase in depth of the river thus endangering those aquatic species requiring specific depth for survival thereby setting the stage for their migration elsewhere [8]. EC and salinity were lower during the wet season indicating that the rainy season, fresh water from water runoff or rainfall mixes with the water thereby causing the reduction of salinity in the river [9]. Lower DO was recorded in dry season compared to wet season. This could be attributed to oxidation of humid compounds available for decomposition and wind velocity that seemed to be lower, thus reducing the movement of the waters by wind action [10]. In fast moving water, rushing water is aerated by bubbles as it churns over rocks and falls down hundreds of tiny waterfalls. These streams, if unpolluted, are usually saturated with oxygen. In slow, stagnant waters, oxygen only enters the top layer of water, and deeper water is often low in DO concentration due to decomposition of organic matter by bacteria that live on or near the bottom of the reservoir. The high DO value during the wet season could lower water temperature and increase aeration due to increased agitation of the water [11]. Higher dry season TDS values may be because of evapo-crystallization process and low precipitation signifying low dilution [12]. According to Moore and Moore [13], BOD mean value of 4.24±0.57 mg/l in all stations classifies this stream as fairly clean.

Conclusion

Sand mining activities poorly planned stockpiling and uncontrolled dumping of overburden and chemical/fuel spills will cause reduced water quality for downstream users, increased cost for downstream water treatment plants and poisoning of aquatic life. However, at the study area, no parameters exceeded WHO standards except for turbidity, thus indicating water quality to be good. However, the water quality of Ikot Ekpan River can be improved by supervision and advice to the road construction companies to reduce the number of times a particular site is being dredged and prohibition of the dumping and discharge of refuse into the stream.

REFERENCES

[1] Moses BS. Introduction to tropical fisheries. Ibadan, Nigeria: Ibadan University Press; 1983.

[2] King RP, Johnathan GE. Aquatic environmental peturbations and monitoring. USE: African Experience; 2003.

[3] Saliu MA, Lawal AI, Okewale IA. Environmental Impacts of Sand Dredging in Awoyaya, Lagos State, Nigeria, *Civil and Environmental Research*. 2013; 3(2): 115-120.

[4] Lewis MA, Wber DE, Stanley RS, Moore JC. Dredging impact on urbanized Florida Bayou: Effects on benthos and algal periphyton. *Environmental Pollution*.2001; 115: 161-171.

[5] Kumar M, Kumar R. Assessment of Physicochemical properties of Ground Water in granite mining area in Goramachia. *Jhansi (India)*.2003; 2(1): 19-24.

[6] Stirling HP. Chemical and Biological Methods of Water Analysis for Aquaculturist. Scotland: Pisces Ltd.; 1999.

[7] OhimainEI. Environmental impacts of dredging and canalization in the Niger Delta. Paper presented at the 2008 Annual Workshop of the Nigerian Mining and Geosciences Society, Port Harcourt; 2008.

[8] Umunnakwe JE, NnajiEAO, Ejimmaduekwu PI. Preliminary assessment of some physico-chemical parameters during dredging of Nworie River, Owerri. *Pakistan Journal of Nutrition*. 2011;10(3): 269-273

[9] Saviour MN,Stalin P. Consequences of soil and sand mining: Causes, consequences and management. *Journal of Pharmacy*, 2013; 2(4): 1-6.

[10] George ADI, AboweiJFN, Allison ME. The sediment characteristics of Okpoka Creek, Niger Delta, Nigeria. *Asian Journal of Agricultural Science*.2010; 2(1): 9-14.

[11] Ogbeibu AE. Distribution, Density and diversity of Dipterans in a temporary pond in Okomu Forest Reservoir, Southern Nigeria. *Journal of Aquatic Science*.2001; 16:43-52.

[12] Essien-Ibok MA, Akpan AW, Udo MT, Chude AL, Umoh IA, Asuquo IE. Seasonality in the Physical and Chemical Characteristics of Mbo River, AkwaIbom State, Nigeria. *Nigerian Journal of Agriculture, Food and Environment.* 2010; 6(1&2): 60-72.

[13] Moore WJ, Moore EA. Environmental Chemistry. London: Academic Press Incorporation; 1976.

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