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EFFECT OF TIMBER RESOURCE PROCESSING ON THE EDIBE-EDIBE CREEK IN CALABAR SOUTH LOCAL GOVERNMENT AREA OF CROSS RIVER STATE, NIGERIA.

BY

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Abstract: *This study examines the quality of water and the variation in the physical and chemical properties of water in the Edibe-edibe Creek. It also looked at the microbial characteristics of the Creek. The data for the study were derived from direct field observation, sampling measure in situ measure and laboratory analysis. The phypico-chemical parameters as well as the bacteriological parameters were analysed the laboratory using various instruments. The result of the analysis revealed that: except for electrical conductivity, PH and iron, all other parameters were on the increase from station one to two. However, nitrate had the same values in both, Station one and two. The biological analysis also revealed that the parameters had an increase value from station one to two. Generally, it was discovered that the water in this Creek is not good for domestic purposes because of the availability of nitrate and the acidic nature of the water*.

Keywords: Timber, Resource, Parameters, Utilization, Creek.

1.0 Introduction

Water is the best of all things" said the Greek poet Pintar. It is also in the broad sense, a renewable resource continually reprocessed and delivered to the land by the hydrologic cycle. The central role of water in sustaining life processes of the biosphere cannot be overemphasised. Water is utilised as resource by civilization: for changing the natural pattern of biological productivity through irrigation, for drinking, washing, and bathing; as an industrial raw material and coolant; as a flow resource for diluting and removing waste materials; turning hydroelectric generators, and providing transportation and recreation (Ehrlich P.R 1977).

Despite the relative importance of water in the sustenance of life in the earth's surface, it is suffice to note here that water contamination especially, that of surface water is one of the most serious environmental problems in most of our societies today (Parry and Norgaard 1975). Human activities such as agriculture and industrialization discharge a lot of effluents into nearby water bodies, thereby altering the physical, chemical and biological parameters of the water and making it unfit for man and other organisms. These effluents if not treated tend to reduce the amount of dissolved oxygen in fresh waters thereby limiting or even terminating the life of aquatic organisms (Ekundayo 1981). When the dissolved oxygen is limited, it can lead to anaerobic decay which produces odour and growth of obnoxious weeds (www. Wikipedia.org/water pollution). Eutrophication can also set in as a result of increase in water nutrients caused by these effluents that may be discharged. Also, if these effluents that contain excessive amount of nitrogen and phosphorus-containing compounds are introduced into the water certain, undesirable type of algae may form in a very explosive fashion.

In the Edibe-edibe Creek, the processing of timber products in the timber market at the bank of the creek results in the deposition of the waste into it. Even the Lorries that carry the sawn wood as well as the boats that transport the wood from where there they are harvested from the wetland to the saw mill introduced heavy metals such as lead, mercury, copper, cobalt into the river through washing of the lorries or movement of engine boats in the water body. Other wood-based activities in the area include wood cutting, cabinet work, and bakery, buying and selling of wood, as well as burning of wood for charcoal. Waste dump sites are also found in the area. The problem then is the expected high level of contamination arising from these activities that make the river unfit for consumption. It is this challenge for portable water amidst contamination that warranted this study in the area.

2.0 Study Area

Calabar South Local Government is the study area. It is located along the Nigeria-Cameroon coast between Latitude 4^0 55'N and longitude 8^0 16'E being part of the Calabar mangrove Estuary under

West African mangrove sub formation (Ukpong 1995). Locally, it is bounded on the north, east and west by Calabar Municipality and Odukpani Local Government Areas (L.G.A) respectively. It is bounded to the south east by Akpabuyo L.G.A.The area is flanked on its eastern and western borders by two rivers, the Great Kwa and Calabar River respectively and to the south, by the Atlantic Ocean all in the south south region of Niger delta of Nigeria.

The climate of the area is humid tropical although rainfall occurs throughout the year. The place experiences double making rainfall regime with peaks in July and September (1880 mm), lowest rainfalls values (240 mm) occur from December to February (Met; serv. 1980). The temperature is uniformly high with a maximum of 30^0C and minimum of 23^0C. The area has a high relative humidity usually between 80% and 100% and vapour pressure in the air averaged 29 millibars throughout the year. High salinity (3.8 ± 0.4%) is limited to the dry season while lower salinity (0.5 ± 0.6%) occurs in the rainy season (Ukpong1995). Tidal amplitude in the estuary ranges from 2.01m at spring tides to 1.07m at neap tides.

The present settlement starts from the mouth of the estuarine coastline and projects to the hinterland and it's growth to the south is limited by the mangrove swamps. Fallow land is available only eastwards up to the Great Kwa River and northward. The area is an interflurial settlement, typical in this part of the country built on high area between two adjacent rivers. This locational advantage permits easy access especially through waterways to intending migrants who are mostly fishermen and traders in wood and craft items to the area. Each mangrove habitat is of variable elevation. However, the swamp as a whole varies by less than 1 in 500 metres in elevation except on the upland forest ecotone where abandoned levees may exceed 1in 500metres(Ukpong 1995).

The settlement pattern following the order above takes the linear shape. Extending 20km of the mangrove forest area to the Atlantic ocean, some clustered fishing settlement pattern are identified otherwise known as "Ine" (Fishing port). The presence of these fishing settlements in the area provided and facilitated easy access into the mangrove forest for rapid exploitation of its resources leading to increased depletion of the ecosystem.

Geologically, the area is composed of tertiary sandy deposits of fluvio-marine origin. These are overlaid by quaternary silty and clayey alluvium eroded from massive pre-Cambrian rocks of Oban hills in the outskirts. This characteristics poorly consolidated, non cohesive and porous rock formation permits large accumulation of water through constant and occasional flooding of the ecological zone. Floodwater recession or tidal retreat permits deposition of alluvial fans and levees quite supportive of plant growth. It accounts for occupational engagement in market gardening among dwellers. The soils are sandy; light hued in some location, but clayey, muddy, dark grey in colour, water logged and boggy.

However, saline mangrove soils, developed on mud, sand or peat occur at the mouths of estuaries inundated by tropical tide waters (Ukpong1995).But more acid soils is identified to be associated in the zonation of Nypa fructican, Rhizophora species dominance.

The predominant vegetation type is mangrove. The mangrove flora consists of trees and shrubs of few general varying species. The common genus is Rhizophora with three: R racemosa, R harisonii and R. mangle. The dominant feature of mangrove is the stilt roots of Rhizophora species. Associated with these species are Avicennia africana and Laguncularia racemosa. There are also palms, Prodococcus bateri, Ancistrophyllum opacum and the gregarious and aggressive Nypa frutican. Salt marshes and sea grasses interact with the mangrove forest to support the entire coastal zone. Hence, because of its status of composition and structure it is known to be part of the most complex vegetation which is the northernmost limits of the Mangrove growth in the Cross River estuary (Ukpong 1995)
This complex plant community of wetland origin formed an ecological niche for reptiles, monkeys, birds, fishes, shrimps, mollusks, and other wildlife. Thus, it is often harvested for wood, fuelwood, tannin, leaves, fibers and dyes. Mangrove environment in particular is important for inland fisheries, serving as highly productive habitat for shell and finfish. These inform the migration of fishermen from Delta, Akwa Ibom and Akpabuyo to settle and take advantage of the rich supply at this point (Nest 1991).

Accurate population data is not made available yet. A newly created local government Area, its population in the past years of 1963, and 1991 are subsumed in the entire Calabar population figures of 99,352 and 320862 respectively. Its estimated population in 2007 stands at 191,515 (NPC 2006); In-migration has formed the major source of its population growth. The immigrant communities include Ibibio, Oron, Ibo, Ijaw, Anang, Urhobo, and other tribes within and outside Nigeria. Despite the ethnic intermix, a fraction of indigenous population mostly of the Efiks/Efut extraction are found in the locality.
This wave of migration brought along changing perception of interaction with the environment which had contributed immensely in remaking of the greater part of the mangrove ecosystem (Fayemi et al 2005).

The rural people are engaged in artisan fishing and the cultivation of vegetables, cassava and maize at commercial and subsistence level. Fishing is done using fishing gears such as small netting size to catch even fingerlings and fries. Shrimp farming is also in vogue. It involves clearing/cutting down the available mangrove forest or aquatic fauna for making ponds. Logging and lumbering of fuel wood for charcoal Production sales and also for timber are common practices. The fish species are Ibat/Ekpai (*Ethmalosa fimbrata*). The bonga and flat Cameroon Sardine (*S. Cammeronesis*). Commercial shrimps and prawns found here are: Pink shrimp (*Penacus duorarum*), salt water prawns (*Newmatopalaema spp*) among others.

Economic wood species harvested are; mangrove, Achi gum (*Oxystigma spp*), Owen (*Mitragyna spp*), Camwood (*Pterocarpus spp*), Mkpenek (*Uapaca spp*) and so on (Fayemi et al 2005).The entire Calabar South is equally blessed with banks. These financial houses serve as indicators for capacity building both at the individual and regional scale. Their presence is a catalyst for agricultural, industrial and trade promotion and advancement. In spite of this, inhabitants monthly income still fall below ₦10,000 about US$ 100 (Animashaun, 2007).

Objectives
The objectivities of this study was to,

i. Examine the physic-chemical purose of the Edibe-Dibe Creek resulting from the timber processing industry in the area.
ii. To examine the microbial characteristics of the Creek.
iii. To provide information on the health and from the utilization of the Creek.

3.0 Methodology
Surface water samples were collected at two points 04^{o}56’07.2’’N and 0818’33.4’’E (upper point of the Creek) and 04^{o}55’’42.8’’ N and 08^{o}18’58.1’’ E (main activity centre). These water samples were collected during dry season. The reason being that during this season, there is maximum concentration of these physic-chemical parameters compared to rainy season where there is a lot of dilution of these chemical parameters by rain water. This dilution may not allow the true picture of these physic-chemical properties to be ascertained. The samples were collected using 1 litre plastic containers and stored in a cool box at approximately 4^{o}C as recommended by Prati et al 1974.

For determination of pH, the suntex pH meter was used. The probe was calibrated using the buffer solution 8.00 for alkalinity and 4.00 for acidity. Then the probe was rinsed with the deionizer water and inserted into 50ml of water samples in a beaker and values were read after the power on button was pressed.

Temperature (^{o}C) was measured in-situ using suntex meter. The meter probe was inserted into the creek while the mode button on the meter was pressed twice and the stabilized values of temperature appeared on the meter. Conductivity and Total Dissolve Solids (TDS) were determined according to APHA 145 APHA 207c respectively using the HANNA instruments combo conductivity/TDS meters after due calibration.

Transparency was measured with sec. disc of 25cm in diameter white-coloured disk, which was attached to a calibrated wire line and emersed in water until it just disappeared, (Akpan, 1998).

Dissolved oxygen was determined with oxygen meter, (Oxyquard) after raising the probe with deionizer water and inserted into standard solution for 10 minutes, after which probe was lowered above the surface of the deionizer water sample and the values read at mg/l.

Biochemical oxygen demand (BODs) was determined by measuring the DO of the Creek sample contained in BOD bottles before and after five days of incubation and 20^{o}C according to APHA-5210B BOD, calculated by difference considering the requisite dilution factor. BODs (mg/l=S_1-S_2) – (B_1-B_2) x percent dilution. Where S_1 = DO for the sample, S_2 = DO after incubation of samples, B_1=DO for the first day for blanks, B_2=DO after incubation for Black. The Chemical Oxygen Demand (COD**)** was determined using the reflux method where the sample, was refluxed and digested in a strongly acidic solution with a known excess of potassium dichromate ($K_2Cr_2O_7$). After digestion, the unreacted. ($K_2Cr_2O_7$) was determined using F_eSO_4 and the value compare with distilled water blank (APHA – 5220B). Nitrate was determined with the HACH spectrophotometer, using the cadium reduction method. 25ml of the sample was introduced into the sample cell and the contents of one HACH Nitra ver5 Nitrate reagent powder pillow added. After allowing a five minute reaction time, the concentration of nitrate was determined spectrorphotometically at a wave length of 500µm using de-mineralized water as reagent blank.

Sulphate content was determined using the HACH spectrophotometer. 25ml of the sample was introduced into sample cell and the contents of one HACH sulfa ver4 reagent powder pillow added. After allowing a five minute reaction time, the concentration of sulphate was determined spectorphotometically at a wavelength of 450µm using de-mineralized water as reagent blank.

Estimation of Coliform Bacilli

The most probable number (MPN) of coliform presumptive test was carried out on each of the water samples by planting three portions in each of three dilutions in geometric series, employing the use of single and doubles straight Macconkey broth. For planting the three portions in each of three dilutions in geometric series, a set of three test tubes, each containing 10ml double strength sterile broth, two sets of three test tubes, each containing 5ml sterile single strength broth were required. A Durham tube was inserted into each for gas collection.

Ten millimetres of water sample was inoculated into each tube of double; 1ml of the same sample was inoculated into each of the first set of three test tubes of single straight and 0.1ml of sample inoculated into each of the other set of three tubes of the single strength. The cultured tubes were carefully agitated to mix the inoculation with the broth medium. They were incubated at 35^{o}C for 18-24 hours. Each tube was observed for acid and gas production to obtain positive tube(s). The combine number of positive tubes in each set were arranged in order of the least diluted to the most diluted; one was read out from the appropriate standard MPN table to obtain – the estimated number of coliform cell present in 100ml of the original water sample.

4.0 Data Presentation and Discussion of Findings

Table 1. Result of the Analysis of Physical and chemical Parameters

S/N	PARAMETERS	**P1** 04^{0}56' 07.2"N 08^{0}18' 33.4"E	**P2** 04^{0}55' 42.8" 08^{0}18' 58.1
1	Nitrate (Mg/L)	0.1	0.1
2	Sulphate (Mg/L)	1.0	2.2
3	Phosphate (Mg/L)	0.18	0.25
4	TDS(Mg/L)	39	48
5	TSS (Mg/L)	2.0	2.0
6	Fe (Mg/L)	0.04	0.02
7	Temperature (^{o}C)	20.7	24.4
8	pH	6.52	5.31
9	Conductivity (Us/cm)	79	97
10	Colour (Ptco)	10	13
11	Turbidity (NTU)	3	6

From table 1. the concentration of nitrates showed a unique distribution pattern throughout the sample sites. Unlike any other parameters, it maintained the same concentration level of 0.1 (Mg/L) throughout the sample stations.The concentration of sulphate was 1.0 at the first sample site and increased at the 2nd sample site to 2.2. This could be as a result of leachate formed during rainfall on the wood waste near the third sample site.

The phosphate concentration was lowest at the first sample site 0.18(Mg/L) and slightly higher at the second sample site 0.25(Mg/L). This could be as a result of algae growth at the second sample site, as algae makes use of sulphate as nutrients to grow. Though a higher growth of algae and water weed were witnessed at the second sample site, this should have reduced the phosphate concentration, but it was still high at this site. This means that the phosphate introduction into the Creek site is higher than required by the sea weeds and algae. The introduction of the phosphate into the Creek site can be as a result of the decomposing wood wastes seen near the Creek.

The Total Dissolved Solids (TDS) was in increasing order from sample point one to two. The lowest was in station one 39 (Mg/L), and highest at station three 48 (Mg/L). The high concentration of TDS in station two could be as a result of the position of the Creek as ii is on the valley side of the timber market. During rainfall, the surface runoff slopes down into the Creek carrying particles of wood, sand and other constituents into the Creek.

The TSS concentration was almost even throughout the sample stations with only a slight decrease at the first station where a concentration of 1.0 (Mg/L) was recorded.The first sample station has an average iron concentration of 0.04 (Mg/L), while the lowest iron concentration was recorded at sample station two 0.02 (Mg/L). This slight decrease in iron concentration at station two could be as a result of large algae growth at the water surface. Since iron is one of the essential substances that encourage eutrophication and the process of eutrophication leads to growth of algae and water weeds. Hence, the weeds use up the iron for their metabolism and hence contribute to the depletion in the area.

The temperature recorded was in increasing order from sample station one to two. The highest reading was recorded in station two 24.4(^{o}C). This could be as a result of the high conductivity as it is seen at the table.pH of 6.52 was recorded at the first station, and 5.31 at the two station. The decrease in the pH of the third station could be as the result of the high concentration of dissolved solids, sulphate and phosphate compounds.

The highest reading recorded on conductivity was at station two. This could be a result of high dissolved solids found in the area as the two are synonymous.
From the table above, it is recorded that station 1 has a colour unit of 10 (Ptco, while station two had a colour unit of 13(Ptco). The increase in colour in station two could be as a result of the increase in concentration of total suspended solid as seen in table 1.

Turbidity is the expression of the optical property that causes light to be scattered and absorbed rather than transmitted in straight lines through the samples. It is not colour. Factors that influence light scattering are particle colour, particle shape, difference between the refractive indexes of the particle and sample fluid. An average turbidity unit of 3.o (NTU) was recorded at the first station. The highest reading was at station two where a turbidity unit of 6.0 (NTU) was recorded.

Total Viable Bacteria

Table 2: Biological Analysis

Sample No	Total variable Bacteria {CFU/100me	Total coliform
Point one $04^{0}56'$ 07.2”N $08^{0}18'$ 33.4”E	0.2	1.00
Point two $04^{0}55'$ 42.8” $08^{0}18'$ 58.1	2.8	1.1 CFU/100ml

Source: Authors Fieldwork, 2012

Table two shows the bacteria count in (CFU/100ml). It is seen that the bacteria count is in increasing order from 0.2(CFU/100ml) in station one, to 2.8 (CFU/100ml) in station two. This could be as a result of decomposing wood wastes found at the station site at the time of reconnaissance survey. The total viable bacteria count in station two is quite high, showing that the water should be treated before consumption.

As seen in the table 2, the coliform count was also on the increase from station one to two. The highest was in station 2 where a count of 1.1 (CFU/100ml) was recorded. This also could be as a result of the decomposing wood waste near the water body. The biological analysis shows that the water in station two should be adequately treated before consumption as the coliform count is greater than 1.0(CFU/100ml).

Table 3: Comparison of the Water Quality of the Edibe-edibe Creek with Federal Ministry of Health Standard.

Parameters PPM	**Maximum Desirable concentration [mg/l]**	**Range of concentration in point 1** $04^0$56' 07.2"N $08^0$18' 33.4"E	**Range of concentration in point 2** $04^0$55' 42.8" $08^0$18' 58.1
Nitrate [mg/l]	10	0.1	0.1
Sulphate [mg/l]	250	1.0	2.2
Phosphate [mg/l]	2	0.18	0.25
TDS [mg/l]	500	39	48
TSS [mg/l]	50	39	2.0
Fe [mg/l]	50	0.4	0.02
Temperature [^oC]	350^c	20.7	24.4
PH	6.5-8.5	6.52	5.31
Conductivity [Us/cm	200	79	97
Colour [Ptco]	15	10	13
Turbidity NTU	50	3.0	6
Total bacteria	5-10	0.2	2.8
Total coliform	0-1	1.0	1.1

Source: Authors Fieldwork, 2012

From table 3 above, it could be seen that the value of some parameters fell above the permissible standard while others were below it. Those that fell above the permissible standards were iron (Fe), Colour (point 2), Total bacteria (point 2) and total coliform (point 2). This point 2 is the main activity centre for timber processing and hence recorded a high increase in the values of these parameters. The other parameters that fell below the permissible standards are nitrates, sulphate, phosphate, Total dissolve solid, Total suspended solid, PH, conductivity and turbidity. It is suffice to note that the parameters whose values fell above the permissible limit are very critical in water consumption. Their presence in high amount renders the water unfit for consumption. Hence it could be summed up here that the Edibe-edibe Creek is very contaminated and requires adequate treatment before it can be used for domestic or other purposes.

Possible Health Implications that May Arise from the Utilisation of Edibe-edibe Creek

1. **Cooking and Food Preservation:** Nitrates are also present in the river. These inorganic substances have harmful effects on man. Nitrate may also cause mathemolglobinomia (infact cynanosis or blue baby diseases which is very fatal). In fants who have been given food prepared with water having high levels of Nitrates are likely to suffer this. Blue baby diseases arise because the Nitrate is reduced to Nitrite, which then combines with haemoglobin resulting in serious reduction of Oxygen O_2 transport in the blood. If the trend is not checked the person could die of suffocation.
2. **Food Processing:** The water of Edibe-edibe Creek is used for household food processing. Also, the evidence of faecal coliform contamination was established in the course of the study. And since this faecal coliform contamination in water are the cause of bacteria and other micro-organism pathogens. These pathogens are most frequently transmitted through water. This can cause dysentery, Cholera and Diarrhoea.

3. **Recreational Purposes:** The type of recreational use of water considered here is the primary contact recreation. This has been defined as activities in which there is prolonged and intimate contact with the water involving considerable risk of ingesting water in quantities sufficient to pose a significance health hazard. Examples are wading and dabbling by children, swimming and diving, diving. The major implication of the use of this surface water for this purpose is that caused by the pH level. For instance, the lacrimal fluid of human eye has a normal pH of approximately 7.4 and a very high buffering capacity, through primarily to the presence buffering agents of the complex organic type. As is true of many organic buffering agents, those of the lacrimal fluid are able to maintain the pH within a very narrow range until their buffering capacity is exhausted. When the lacrimal fluid, through exhaustion of its buffering capacity, is unable to adjust the immediate contact layer of any fluid that comes in contact with the eye to a pH of 7.4 eye irritation results. Its deviation of 0.1 unity from the normal ph of the eye may result in discomfort and irritation. Appreciation deviation will cause severe pain.
4. **Washing:** As stated earlier, the water from River is used for various domestic activities example, washing of clothes. If the pH of the water is acidic, this can cause bleaching of the cloth material and easy wearing and tearing. Therefore the life span of the cloth material is not prolonged.

5.0 Conclusions

This study was able to identify that a greater part of the Edibe-edibe Creek was covered with weeds and other aquatic plants. This was due to the high nutrient load that entered the Creek through timber waste discharge. It invariably caused the nutrient levels of nitrate, iron, colour, total bacteria and total coliform, and phosphate to rise above the permissible level. The resultant effect was the growth of algae as seen in the study. This scenario also results in oxygen depletion, destruction of fishes and other aquatic organisms as fishing was observed not to be practiced around the area anymore. Thus, it could be realised that the major contaminant was dissolved solids which could have caused the acidity of the Creek and increase in colour, turbidity, phosphate and nitrate concentration. The dumping of timber waste and debris into the Creek also accounted for the increase in faecal coliform count in the area. Also, the timber processing market is seen to be located in the valley. This has speed up the surface runoff from the market into the Creek carrying timber debris and other waste. From the forgoing, one could see that this study has not only identified some deleterious effects of locating an industry near a source of water used for consumption based on the substances injected into it, but has also drawn a comparison between the physico-chemical parameters found in the Creek and the Federal Ministry of Health Standard. Hence, it could be concluded here that in all ramifications, water as an essential element for the sustenance of mankind should be viewed with high level of integrity. This is due to the various ways in which it is be put into use – cooking, drinking, washing, transportation, and agricultural purposes. This unquantifiable role of water as a resource for man and other organisms invariably calls for it safety if man must continue to thrive on the surface of the earth. Lack of good water can lead to many undesirable situations ranging from outbreak of disease, death of aquatic habitats and other organisms. Thus, inorder to forestall this ugly scenario, it is suggested in this paper that since anthropogenic factors play a dominant role in water contamination, the location of industries near sources of water as well as dumping of wastes into water bodies should be as a matter of fact completely discouraged.

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