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Water Quality Status Of A Mangrove Ecosystem In Lobia Community Of Bayelsa State

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ABSTRACT
The study examined water quality status of a mangrove ecosystem in Lobia community of Bayelsa State. This was done by comparing its quality status from three streams in the community with that of World Health Organization (W.H.O) standards. Water samples were collected from three streams in the community and analyzed for physico-chemical, heavy metal and bacteriological concentrations. The results indicated that the content of the physico-chemical parameters varied significantly with of W.H.O standards for domestic water use. Also, the concentration of heavy metals was significantly high as compared with W.H.O limits. The bacteriological concentrations of the streams revealed a high degree of contamination. It was thus recommended that in other to reduce continuous contamination of the rivers as well as protect aquatic lives, government should create national action programmes for sustainable forest development. Also non-governmental and community based organizations should be encouraged to complement government efforts by checking the act of mangrove exploitation.
Keywords: Water quality, Mangrove ecosystem, Lobia community, Physico-chemical parameters, Bacteriological parameters.

INTRODUCTION
Mangroves are of great importance to man and other coastal organisms. This can be seen in the protection of human communities from the various damages caused by storms, tsunami, tidal waves and coastal erosion. There also provide habitat for a variety of terrestrial, estuarine and marine species and serve as both source and sink for nutrients and sediments for other onshore marine habitats such as sea grasses, beds and coral reefs. Mangroves constitutes the economic foundations of many tropical coastal regions as buttressed by the Global Forest Resources Assessment (GFRA) which states that mangrove forest provide at least US $1.6 billion per year in "ecosystem services" worldwide,(GFRA, 2000). Potidoro, 2010 explained further that mangroves account for up to 25.5 million tons of carbon per year and provide more than 10% of essential organic carbon to the global oceans. According to (Saravanakumar et al., 2008), Mangrove ecosystem provides an ideal breeding ground to most of the marine and brackish water fish and shell fish. Bierman et al.,(2009) further posits that these productive marine ecosystems are important habitats for many fish and other marine organisms that are not only a significant source of food for human consumption, but are also vital components of marine ecosystems. Environmental conditions such as salinity, oxygen, temperature, and nutrients influence the composition, distribution, and growth of its biota (Ajithkumar et al., 2006).
In spite of this huge ecological and economic benefits, man's insatiable quest and dependency for survival has caused a rapid decline in the complexity, structure and function of mangroves all over the world. This according to (Spalding, 1997) is estimated to cover18.1million km^2worldwide. However, a more recent estimate by the FAO reveals clearly that the figure may now exist below 15 million km^2 with over 90% of its diversity found around the developing nation of the world (www.fao.org/forestry/mangroves). This accounts to why (Duke et al., 2017) posits that the world mangroves experts opined that the long term survival of mangroves is at great risk as a result of

fragmentation of habitats and other factors such as climate change and also that the services offered by mangroves may likely be totally lost within 100 years. FAO (1992) also observed that more than one in six mangrove species worldwide are in danger of extinction due to coastal development and other factors including climate change, logging and agriculture in IUCN's global assessment on the conservation status of mangrove.

There is an overwhelming evidence of an overall decline in the mangrove forest globally. The world has lost around 3.6m hectares (20%) of mangroves since 1980 (Grumbine, 1994). Grumbine further gave an extensive report stating that the total mangrove area has declined from 18.8m ha (46.4m acres) in 1980 to 15.2m ha (37.5m acres) in 2005. However, the report did not show that there has been a slowdown in the rate of mangrove loss from some 187,000 ha destroyed annually in 1980 to 102,000 ha a year between 2000 and 2005, ie retrogressing from a daunting 2% to 1% annually respectively. This revealed an increased awareness of the value of mangrove ecosystem.

From the foregoing, it could be adduced that as human population continue to increase, his needs grows in arithmetic progression while the corresponding exploitation and subsequent degradation growing geometrically. So the huge thrust accompanied with this poses a very significant problem in terms of degrading the quality of life for plants, animals, humans and of course water bodies.

Coastal water has become a major concern in the world due to the socio-economic development and human health values. As human populations continue to grow as well as the expansion of commercial industries, marine water has increasingly become a reservoir for large amounts of pollutants from different sources such as toilet flushing, fish culture, recreation and the assimilation and transport of pollution effluents (Zhou et al., 2007). Water quality and aquatic ecosystem have already been influenced negatively by human activities. This has generated great pressure on these ecosystems which has led to loss of critical habitats, a decline in water quality and biodiversity, and an overall decrease in the quality of life of local residents (Herrera-Silveira & Morales-Ojeda, 2009). It is therefore of great importance to prevent and control marine water pollution and to implement regular monitoring programmes which will help in the understanding of temporal and spatial variations in marine water quality (Simeonov et al., 2003; Singh et al., 2004) and also determine the present condition of coastal water quality.

Good quality of water resources depends on a large number of physico-chemical parameters and the magnitude and source of any pollution load and the monitoring of these parameters (Rajasegar, 2003). Water resource quality of any region/ area is an essential aspect of developmental activities of the region/area. This is because rivers, lakes and manmade reservoirs are all sources of water supply for domestic, industrial and agricultural uses as well as fish culture (Saravanakuma et al., 2008). It is important to note that coastal water quality changes with time and space which is why the continuous water quality monitoring, measurements, assessments and analyses are necessary for effective water quality management.

Furthermore, there exists widespread evidence on the threat to the existence of mangrove forest in Nigeria the large expanse of mangrove forest originally estimated to cover approximately 5,000 to 8,580km^2 of land is gradually dwindling due to human pressure especially in the tropical and subtropical coasts of Niger Delta (http://en.wikipedia.com). This has therefore pose a serious threat to the varieties of life forms that inhibit these coast lands. These according to (Natural Resources Council (NRC), 1993), are all symptoms of widespread destruction and exploitation of mangroves for coastal development, agriculture and heavily logged timber and fuel wood extraction.

In Bayelsa however, there is a new dimension to the threat on the existence of mangrove forests as human impacts from poor land management upstream as well as constant pollution of oil has caused ten to fifteen percent of these economically viable mangrove forests to disappear. For instance, a particular species of mangrove, *Rhirozphora racemosa,* Red mangrove lives higher in the Delta system gradually diminish for a non-native invasive species of palm, *Nypa fruiticans*. The Lobia community in Bayelsa State has its own fair share of mangrove forest depletion as lands, marshes and swamps are been destroyed annually due to intense human pressure for habitation, haphazard/unauthorized conversion of swamps for shrimps cultivation and fish farming, agriculture and tourism as well as petroleum exploitation activities occasioned with natural disasters has polluted and destroyed this hydrospheric ecosystems. Thus, according to Asabere (1997) human impact from

poor land management upstream coupled with the constant pollution of oil in the region is responsible for between five to ten percent of water bodies and mangrove forests disappearance.
This situation has aroused a lot of interest ranging from the government to policymakers, organisations and the general public. Thus, it is against this background that this study is articulated.

MATERIALS AND METHODS

Study Area

The study area lies between latitude 4.6667 and longitude 5.8167 length of Lobia mangrove located at the East-Central part (4^0 40^IN; 5^0 49^IE) of Bayelsa state. The area is situated along the south eastern province known as the South-South part of the country, located along the Niger Delta region in the eastern coast line of Nigeria (Dino, 2012).
The major geologic composition of the area according to (Dino, 2012), is the alluvial sand plains which make up the soils and silts, clay, peat, sandstone and cretaceous sediments together with organic compound occasional islands of detritus especially along the creek areas. The soil of the area is composed of tertiary coastal plains sand, mainly alluvium and detritus particularly muddy and sticky due to high organic decomposition. Dino (2012) further stated that the drainage system is dominated by River Niger navigating eastwards from Fouta Djalor plateau (Rep. of Guinea) and westwards along the Bonny River located in Niger Delta. The water level is relatively very high due to the excetaf and soil structure thereby increasing the propensity for water storage
The climate of the area ranges from 23-27^0C, a completely tropical monsoon climate with heavy rainy season and very short dry season of only between Decembers to January, truly qualifying as the dry season of the year. The harmattan which climatically influences many cities in West Africa is on the apex in Bayelsa with heaviest precipitation occurring during September with an average of 370mm. December appears to be the driest month of the year in Bayelsa with rainfall approximating 20mm.The vegetation of the area is predominantly characterized as tropical rainforest and the mangrove swamps. Anthropogenic activities in the area have gradually reduced the size of this forest. The most predominant economic tree found in the area include; *Kola nitida*, obeche, mahogany etc. the important arable/stable food crops found here include; rice, plantain, banana etc. Cattle rearing are scarce due to moist and water logged nature of the area, although cattle rearing is sporadically found and are understandably restricted to properly drained lands however, poultry and goats are kept for subsistence utilization (Dino, 2012).
The local people of Lobia community and its adjourning villages engage principally in fishing, lumbering and swamp rice cultivation even though oil exploitation is gradually antagonizing with the level of participation of this activity.

MATERIALS AND METHODS

Field Study/Sampling

The study made use of water samples obtained from 3 different streams in Lobia community. The water sample for the physico-chemical analysis was collected into a one litre bottle and preserved under temperature of between 4^0c before analyzing in the laboratory for routine parameter assessment. The parameters analyzed for the study include; total suspended solids (TSS), biochemical oxygen demand (BOD), phosphate, nitrate, chloride, magnesium, salinity etc. The samples(apart from the total hydrocarbon and heavy metal status of water quality), were analyzed in the laboratory and matched with the World Health Organization (WHO,1996) and American Public Health Association (APHA, 1989) which was used to determine the nutrients, physical and chemical parameters. Since it was impossible for samples to be conveyed from the point of collection, there were stored in a cooler of ice block to avoid variations in parameters during transportation.

Laboratory Analysis

The titrimetric and spectrophotometric methods were the basic principles method used in determining the chemical characteristics of the samples. Dissolved Oxygen (DO) was determined using the Microprocessor oximeter 196 while the Cyberscan low 20 conductivity meter was used in determining the Conductivity, IDS, Ph&Eh. The Spectrophotometrical methods used include; Nesslenization method (APHA, 1989) in determining Ammonia (NH_4), Formazine standards according to HACH in determining Turbidity (NTU), Turbidimetry using barium chloride (APHA, 1989) in determining

SO_4^{2-}, Molybotenum blue method (Parsons et al., 1984) in determining Phosphate (PO_4), As nitrate after reduction system in determining Nitrate (NO_3^-) and Diazotization method (Parsons et al., 1984) in determining Nitrate (NO_2^-).

Titrimetrical methods employed include: Titration using indicators like nuraxide, etc. in determining Bicarbonate and Alkalinity; Difference between initial oxygen concentration in sample one derived after 5 days of sample collection in DO bottle at standard temperature of 20^oc (APHA, 1989) in determining Biochemical oxygen demands (BODs) and Complexometric technique using EDTA as titrant (APHA, 1989) in determining Magnesium (Mg).

Techniques for data Analysis

Both qualitative and quantitative analytical procedures/ techniques were applied for the evaluation and assessment of all the parameters in the research. Qualitatively, the data collected were analyzed to determine the degree of the parameters of interest, while quantitatively, the concentration or the amount in milligrams per litre of sample (mg/l) was used to determine the toxicity of the pollutants in the samples.

Furthermore, in other to achieve the aim of the study, the method of data analysis used was descriptive, making use of statistical tools such as mean, range, frequency distribution, tables, graphs.

RESULTS AND DISCUSSION

Physico-chemical properties

Table 1 presents the physico-chemical parameter of the water sampled from the stream according to the APHA (1989), WHO (1954, 2006) and EEC (1975) standards. The physical parameters considered for this study were Dissolved Oxygen (DO), Total Dissolved Solids (TDs), Biological Oxygen Demand (BOD), Electrical Conductivity (EC), Temperature, Salinity and pH (Table 2).

The results revealed that the dissolved oxygen (DO) values ranges from 5.26 to 7.24mg/l. This by far exceeds the minimum allowable concentration for FEPA (1989) and WHO (2006). Although the sample obtained from stream 1 in Lobia community was found to be within the WHO (2006) limit, it could be deduced from the values obtained that such concentration of oxygen could impair ecological functions as well as disrupt normal biological processes or functions in an aquatic environment. Therefore, the BOD value for streams 2 and 3 in Lobia community were 7.21mg/l. This means with inferences to FEPA (1988) standard, the water is said to be unfit for any ecological functions.

The Electrical Conductivity (EC) of water quality is measured in terms of the volume of cations and anions that is dissolved in a particular volume of water. The values obtained from Lobia streams 1 and 3 ranged from 76.5 to 82.4ms/cm with a mean of 79.2ms/cm of which was considered to be very low in relation to FEPA (1988), APHA (1989) and WHO (2006) permissible limits of 4000ms/cm. The recorded concentration of EC shows a lower amount of dissolved salts in water samples obtained from the respective locations.

In terms of the total suspended solids, the water quality ranged from 0.029 to 0.0244mg/l. This therefore entails that the values derived from the sample was low in relation to the permissible limit as prescribed by FEPA (1988) of 30mg/l and EEC (1979) of 38.5mg/l of the water quality for all forms of utilization particularly those meant to service biological and physiological functions.

Turbidity is the degree of cloudiness of water. The turbidity recorded for Lobia stream 1 was 0.09 NTU and Lobia stream 3 was 1.28 NTU. These were both within FEPA's (1988) permissible limit. However, The sample obtained from Lobia stream 3 was not within this permissible limits. This means Lobia stream 2 is highly toxic and could impair the quality of life in the area of study and also contributes significantly in a great reduction of oxygen in the water due to the high presence of bacteria. The average temperature obtained from Lobia stream 1 was of 25^oc and lobia stream 3 was 29^oc. These temperature conditions were within FEPA's (1988) standard.

The pH value derived from the study ranges from 6.0 to 6.9 from the water sample collected from Lobia stream 2 and 3. These values by far exceeded the minimum allowable concentration as prescribed by FEPA (1988), WHO (1984) and EEC (1975) for standard drinking water. This is however different for Lobia stream 1 which had a pH value of 6.0 and is thus within the range of consumption as well as ecologically suitable for all forms of life. Although, it is said to be good for consumption and mangrove friendly within this allowable range, it tends to create unpleasantness especially in terms of its corrosive properties when reticulated.

Chemical Parameters

The major chemical substances studied include chloride (Cl), potassium (k), sodium (Na), magnesium (Mg), calcium (Ca), phosphate (Po_4), ammonia (NH_4^+), nitrate (No_3), total hardness etc.

Data gotten from the study area showed a significantly high level of chloride ranging between 2.87, 3.76 to 4.28mg/l in comparison to WHO (2006) allowable concentration limits for impact assessment. This means that chloride level exceeding 2.50mg/l of FEPA (1998) allowable concentration can induce derogatory taste to water, and also attack bones in lower animals, invertebrates and marine mammals.

The concentration of calcium ions (Ca^+) ranges from 14.32 to 32.65 mg/l, potassium ions (k^+), from 2.65 to 7.60 mg/l, while that of sodium ions (Na^+) ranges from 2.06 to 7.60 mg/l. These were all considered to be lower in comparison with FEPA standard of 75mg/l except for EEC (1975) standard of 12mg/l. These cations and ions are essential to the health of organisms, however, when its threshold is exceeded as in the values obtained from Lobia stream 2; it tends to become intolerable to humans and the entire ecological system.

The total hardness of water is an indication of the presence of magnesium and calcium salts. This value is adversely influenced mostly by the average of temporary atmosphere condition of a place offer time. The total hardness of the water obtained range from 21.75 to 38.62 mg/l with a mean value of 29.31mg/l for Lobia stream 1 and 3. These range of values are thus within FEPA (1988), ECC (1975) and WHO (1984) standard of 200mg/l for water quality.

Phosphate concentrations in surface water are derived from biological processes of transformation of organic substances into inorganic forms. The phosphate value range from 2.05 to 4.33mg/l and sulphate value range from 13.10 to 36.00mg/l were higher when compared with the established allowable concentration for FEPA (1988) of 75mg/l and 5.0mg/l.

The total ammonium content derived from Lobia streams 1, 2 and 3were 1.04mg/l, 2.00mg/l and 0.08mg/l respectively. These values were low as compared to WHO (2006), and EEC (1975) of 0.5mg/l. This adds unpleasant taste to the water and also makes the water develop offensive odour.

Table 1: Physico-chemical characteristics of water status sampled around Lobia community of Bayelsa State

Parameters	**Sample Units**			**Guideline WHO/EEC**
	1	**2**	**3**	
Temperature	25.00	29.00	27.00	25
pH	6.0	6.9	2.8	6.5-8.5
Ec (ds/m)	76.5	82.4	65.2	4000
Tss (mg/l)	0.029	0.244	0.008	Nil
Ds (mg/l)	5.26	7.24	0.35	Nil
BOD (mg/l)	7.21	4.75	2.35	Nil
Hardness (mg/l)	21.75	38.62	29.21	200
NH_4^+ (mg/l)	1.04	2.00	0.08	0.5
Acidity (mg/l)	200.12	117.52	48.0	-
Alkalinity (mg/l)	203.35	78.25	66.30	-
Cl (mg/l)	281	376	428	250
Ca (mg/l)	14.32	32.65	7.98	75
Mg (mg/l)	3.368	5.958	1.240	30-150
Na (mg/l)	2.06	0.85	0.05	200
k (mg/l)	15.46	5.90	0.86	12

Source: Researchers' field survey, 2012

Table 2: Contents of excess level of heavy metals in water bodies (mg/l)

Heavy Metals	**Sample Locations**			**WHO guidelines (2006)**
	A	**B**	**C**	
Lead (pb)	0.34-5.70	0.37	0.08	0.01
Manganese (Mn)	0.28	0.61	0.9	0.4
Nickel (Ni)	0.032-0.043	0.85	0.078	0.070
Cadmium (Cd)	0.58-0.95	0.39	0.006	0.003
Mercury (Hg)	0.035-0.75	0.078	0.003	0.006

Source: Researchers' field survey, 2012

Table 3: Critical threshold values/ limits (CTC Standards)

Parameters		**Critical threshold values/ limits (CTC standards)**			
1	**Chemical Parameters (mg/l)**	**Range of Value**	**EEC**	**WHO**	**FEPA**
	Ammonium (NH_4^+)	1.04-2.00	0.5	0.5	1.0
	Calcium (Ca)	14.32-32.65	75	75	Nil
	Phosphate (PO_4)	2.05-4.35	400	450	500
	Sulphate (SO_4)	13.10-36.00	45.0	45.0	10.0
	Nitrate (NO_3)	282-376	250	250	250
	Chloride (Cl^-)	3.368-5.958	30-150	30-150	Nil
	Magnesium (Mg)	35.90-15.06	12	15	Nil
	Potassium (k)	2.06-0.85	200	200	200
	Sodium (NA)				
2	**Physical parameters**				
	Electrical Conductivity (Ns/cm)	76.5-82.4	4000	4000	4000
	BODs (mg/l)	4.75-7.21	-	-	-
	Total suspended solids (TSS) mg/l	0.029-0.244	Nil	Nil	30
	Turbidity (NTU)	0.09-1.28	5.0	5.0	1.0
	Temperature	24-29	25	25	30.0-35.0
	Total dissolved solids (TDS) (mg/l)	5.26-7.24	Nil	Nil	500
	Total hardness		200	200	200

Source: Researchers' field survey, 2012

CONCLUSION

The study examined water quality status of mangrove ecosystem in Lobia, Bayelsa State. Physico-chemical properties of the water quality are greatly influenced by hydro-carbon content in the study area. This unfavorable alteration of the water bodies and mangrove ecosystem affects the biological diversity of the area. However, chemical parameters of the water quality such as calcium, ammonium, potassium and sodium are found to be relatively moderate or within the permissible limits given by

the regulators. These elements are very essential in micro and macro biological functions although it tends to disrupt normal biological functions of organisms when its critical threshold is exceeded.
Physical parameters of the water sampled in Lobia community of Bayelsa State indicated clearly that pH values, turbidity, and dissolved oxygen exceeded the allowable range provided by FEPA (1980). This has influenced biological functions in the ecosystem. The results further revealed that heavy metal status of the water quality and the total hydrocarbon content (THC) were significantly high as compared to ECC (1975) and WHO (2006) standard. This has influence the habitability of organisms in the mangrove ecosystem of Lobia community.
It is recommended that industrial effluents discharges, oil spills as well as other anthropogenic activities are highly degrading activities hence; efforts should be intensified to minimize the direct and indirect impacts of these activities in mangrove swamps with no hesitations.

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