River Depth Alterations Resulting from Intensive Mechanical Dredging of Ekole Creek, Nun River Bayelsa State

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Abstract

River banks are crucial to humans, because of the accessibility to water for various purposes. The banks of Ekole Creek are occupied with communities that depend on it for habitation and economic benefits. This study investigated the effects river depth alterations resulting from intensive mechanical dredging. An interview was conducted for 80 respondents using structured questionnaire. The points for sampling were; 'Dredge point I and Dredge point II' of the dredging sites, then 'Upstream and Downstream' taken randomly as control. Hydrographic survey was conducted using an echo sounder installed on a speed boat and driven across the 270m wide creek and observations recorded. Results of the questionnaire indicated that about 72.5 % agreed strongly that Heavy duty mechanical dredgers were used, 87.5 % of the respondents agreed that operations of dredging had lasted for more than five years, the respondents also confirmed that dredging had changed the river depth, while 85 % of participants strongly agreed that fishing activities were difficult in the region. Echo sounding results indicated that the upstream and downstream points had the maximum depth of 8.81m and 12.79m respectively, while Dredge sites I and II had depths of 21.5m and 17.73m respectively. Dredging activities had caused the increased depth variations, hence the scarcity of fish and exposure of the riverbanks to erosion which threat to life and property of residents communities. It is recommended that routine environmental monitoring to promptly detect the alteration of river depth during dredging activities, be carried out.

Keywords: *Ekole Creek, Environmental monitoring, Alteration, Erosion, Hydrographical survey.*

1.0 Introduction

The use of mechanical device to remove or clear seabed deposits on the pathways of the water as a maintenance strategy called dredging; it is mainly an anthropogenic activity but can result in the alterations of the depth of the river when done indiscriminately [1]. Dredging eases movement in the marine traffic, but can be disadvantageous in areas where it is mainly done for commercial reasons (sand mining) [2]. The dredging activity can affect the environment by [3]; releasing into the water column toxic heavy metals and polychlorinated biphenyls from sediments, increasing turbidity which interfere with aquatic metabolism and spawning, and other secondary effects like contaminations.

The research was conducted in Ekole Creek, in Yenagoa. The creek is a location where major activities of dredging take place. The story of commercial dredging (sand mining) has not been different in Bayelsa State, as issues of dredging have taken an unexpected toll on the environment since very powerful and heavy duty dredgers have been used to replace the usually small scale sand mining of canoes and perforated buckets [4]. Dredging activities by these new breed of business ventures in the state are done with the "greedy trader's mindset" [5]. The unchecked and ill-monitored activities of the numerous dredging firms that dot the Ekole Creek in Nun River, is an eyesore. These operations have caused adverse external effects on the downstream usres and the host communities in term of coastal erosion in Famgbe, Obogoro, Yenagoa, Akaba, Swali, Ogu, Agbura, Otuokpoti [6,7] , just to mention a few within a two kilometers distance within the study area. In order to manage the effects on downstream ecosystem disturbances as well as riverbank erosion, the impacts of dredging on the river depth at the downstream must to analyze; therefore this research seeks to analyze the river depth at after dredging at the downstream of Nun.

2.0 Materials and Methods

2.1 Study area

The location of the study is around Yenagoa where Famgba, Akaba, Ogu Ikasikara, Otuegwe ,Otuogori and others as mentioned above are included, and all located in Ekole Creek's bank of Nun River. Yenegoa the capital city of Bayelsa State in Nigeria. Its geographical demography is within latitudes 4°49'N and 5°23'N and also within longitudes 6°10' E and 6°33'E [8]. Ekole creek is one of the major river courses making up the Niger Delta's river as indicated in (Figure1.0), which is located within the lower delta plain, [9] with mean annual maximum temperature range of 31.5^{0}C-33.84^{0}C as observed in the period from November-March, while the mean minimum temperature ranges from 28.8^{0}C-29.46^{0}C, [10]. Plate 1.0 also shows the Pictorial View of Coastal Communities and Active Dredging in Ekole Creek.

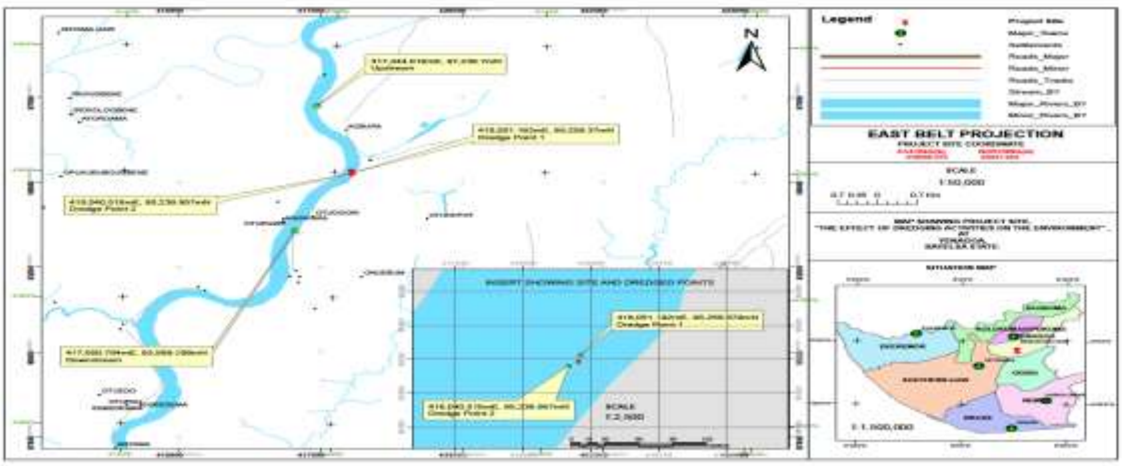


Figure 1 The Map Showing Sampling Locations in Bayelsa State.

A  B 

Plate 1 (a) Pictorial View of Coastal Communities and (b) Active Dredging in Ekole Creek Bayelsa State

2.2 Hydrographic Survey

Hydrographic survey team used an echo sounder which was installed on a speed boat and driven across the width of the creek. At each sampling point, echo sounding was done across the width of the approximately 270 m wide river and observations recorded using SDE-28S Digital Echo Sounder as shown in plate 2.0.

Plate 2 Specifications and Features of SDE-28S Digital Echo Sounder

Two dredging sites of two hundred meter (200m) apart were located and identified as "Dredge Point I and Dredge Point II" where the dredging is taking place, then, two other sampling points identified as "Upstream and Downstream" were randomly taken at about two kilometers (2 km) away from the dredge sites. The Upstream point was a control point where no dredging was noticed, and it was 2,081.89 m from Dredge Point I, while the downstream point was a control point which was 1,952.25 m from Dredge Point II [7]. The depth variations were known using an echo sounder (SDE-28S Digital Echo Sounder) to evaluate the effects of dredging on the depth of the river after dredging and the distance between dredge points and the coastline. The effects of dredging were further analyzed using structured questionnaires.

2.3 Survey and Interviews with Communities Dwellers

Selected amount of questionnaires were randomly distributed amongst communities dwellers at Agbura, Otuokpoti, Otuegwe, Otuogori and Onuebum etc, all coastal communities within the study area.

Baseline socio-economic data were collected following a cross sectional survey of project host communities in April 2014. From each of the five communities above, ten (10) households around the study area were chosen at random and interviewed using structured questionnaires. Other residents including dredge site operators were also interviewed with the help of trained research assistants. This gave a sample total of 50 heads of households and 30 residents making a total of 80 respondents that were involved in this study. Information gathered included demography (Age and Gender), religion (Christianity, Islam and Traditional), educational qualification, occupation (Fishing, Farming, And Civil servant etc. Data was analyzed descriptively using statistics of frequency and percentages.

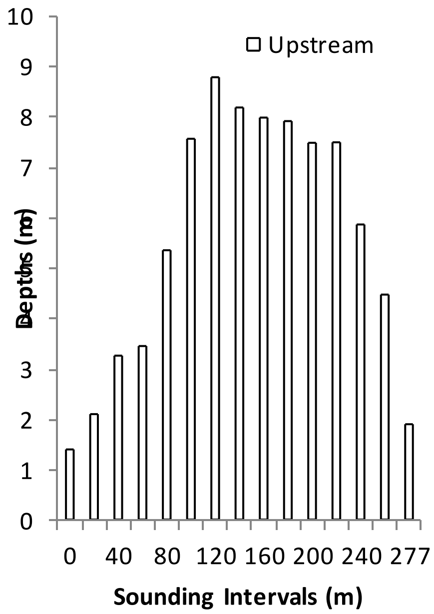
3.0 RESULTS AND DISCUSSION

3.1 River Depth Analysis at the Sampling Points

Table 3: Variation of River Depth of Ekole Creek the study area.

Dredge Point I		Dredge Point II		Downstream		Upstream	
Interval **(m)**	Depth (m)	Interval (m)	Depth (m)	Interval (m)	Depth (m)	Interval (m)	Depth (m)
0	0.51	0	1.39	0	1.39	0	1.43
20	1.39	20	1.69	20	2.96	20	2.13
40	1.8	40	2.1	40	3.14	40	3.29
60	5.74	60	6.04	60	3.33	60	3.48
80	8.71	80	9.01	80	5.23	80	5.38
100	8.33	100	8.63	100	7.44	100	7.59
120	12.41	120	9.22	120	9.54	120	8.81
140	15.03	140	11.09	140	11.02	140	8.21
160	17.78	160	15.74	160	12.79	160	8.01
180	20.98	180	17.73	180	10.21	180	7.94
200	21.5	200	17.72	200	9.47	200	7.51
220	14.57	220	14.87	220	7.81	220	7.52
240	8.41	240	8.71	240	5.74	240	5.89
260	4.11	260	4.41	260	4.35	260	4.5
274	2.14	279	2.44	273	1.78	277	1.93

Depth variations determined with the aid of SDE-28S digital echo sunder [11], and results presented on Table 3. At the Upstream point, the creek recorded a maximum depth of 8.81 m where no dredging activities were noticed in Figure 3.1. This graph indicates almost equal depths within the intervals of 100 m to 220 m. As indicated in Fig. 3.2. of the Downstream chart, a maximum depth of 12.79 m was recorded which shows that it is beyond normal as compared to that of the control point (Upstream) whose deepest points were from 7m - 8.9 m.



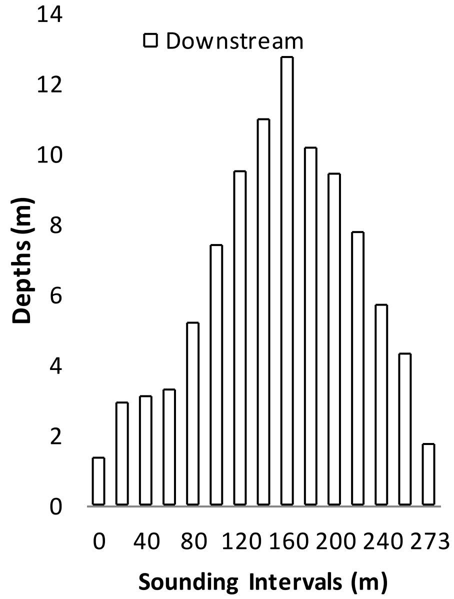
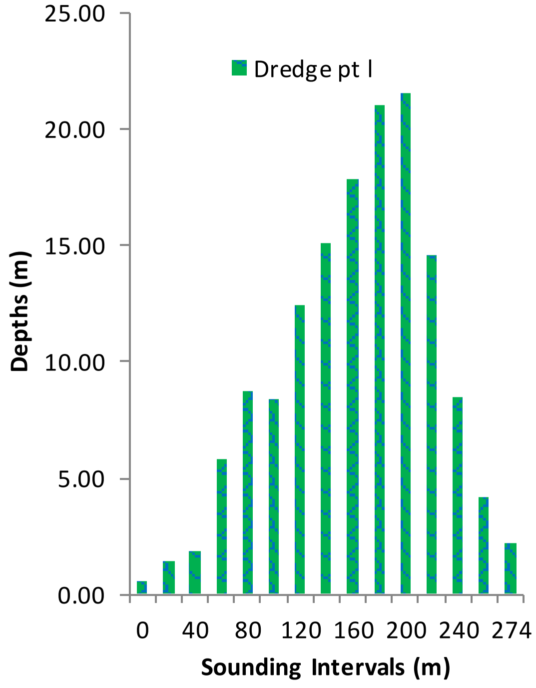


Figure 3.1 Depth Variation at the Upstream point Figure 3.2 Depth Variation at the Downstream point

At Dredge points I and II however, there was a sharp increase in depth where dredging activities were on-going. This depended on the type of dredger, technique, duration and magnitude of dredging operations in the area. Dredge point I showed a very sharp and unbelievable depth variation, where the shallow point was 0.5 m while the deepest part was 21.5 m as shown in (Fig. 3.3) and that of Dredge point II showed a much lesser value of 17.73 m as its maximum depth as show in (Fig. 3.4) bellow.



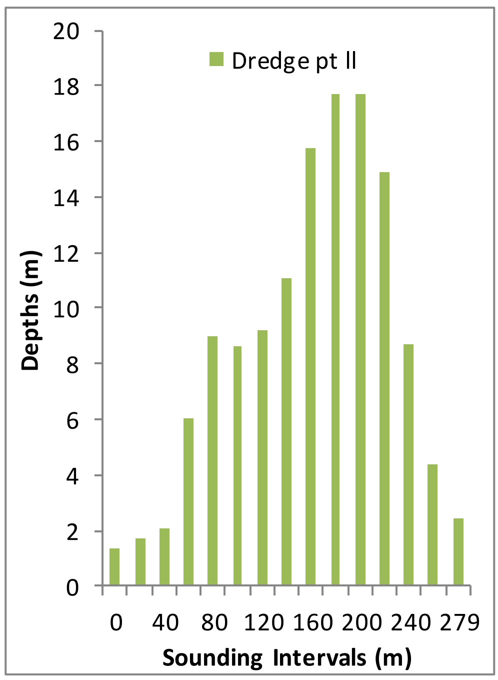


Figure 3.3 Depth Variation at Dredge point I Figure 3.**4** Depth Variation at Dredge point II

These dredging activities have no doubt caused the increased depth variations in the creek which can lead to destruction of marine ecosystem and also river bank erosion that can threaten life, property and the environment of coastal communities within study area.

Generally, the depth at Dredge point I was highest (21 m) followed by that at Dredge point II (17.73 m) and downstream points (12.7 m). This indicated that alterations had been made to the bottom profile of Ekole creek as a result of dredging activities.

It was noticed during the echo sounding operation that dredgers were located nearer to the shores, approximately 74 m and 84 m respectively from shores, whereas the deepest part at the Upstream was about 120 m and 157 m from the two banks of the river which is almost at the middle of the river. This is an indication that during periods of intensive dredging, river bank erosion is also a consequence.

3.2 Questionnaire Survey Response

Table 4 Respondents' Perception of Dredging, Population=150, sample=80

S/N	EFFECTS OF DREDGING	Agree		Strongly Agree		Disagree		Strongly Disagree	
		A	A (%)	SA	SA (%)	D	D (%)	SD	SD (%)
1	Dredging is the major source of water pollution in Ekole creek	10	12.5	65	81.25	5	6.25	-	-
2	Heavy duty mechanical dredgers are used in Ekole creek	20	25	58	72.5	2	2.5	-	-
3	Dredging has been intensive for more than Five years in this region	30	37.5	40	50	8	10	2	2.5
4	River water in Ekole creek is usually coloured	5	6.25	2	2.5	23	28.75	50	62.5
5	Dredging creates employment in this region for community dwellers	6	7.5	-	-	25	31.25	49	61.25
6	Fishing is difficult in this area	11	13.75	68	85	1	1.25	-	-
7	Dredging has changed water colour in recent years	18	22.5	60	75	2	2.5	-	-
8	The other ways we get water to solve the problem are sachet water or borehole water	8	10	72	90	-	-	-	-
9	Dredge operators provide other means to get water for Community dwellers	-	-	-	-	20	25	60	75
10	Dredging has increased the depth of the river in some sections of Ekole creek	10	12.5	70	87.5	-	-	-	-
11	We the residents now experience erosion and flooding	10	12.5	67	83.75	3	3.75	-	-
12	Many families make use of river water for drinking and other domestic purposes	10	12.5	69	86.25	1	1.25	-	-
13	Dredge operators conduct EIA in the area before operations	-	-	-	-	13	16.25	67	83.75
14	Dredging is for commercial purposes	11	13.75	69	86.25	-	-	-	-

Table 4 is the summary of the respondent's assessment s of variations of river depth in Ekole

creek as about 72.5 % of the respondents agreed strongly that Heavy duty mechanical dredgers were being used, 87.5 % of the participants agreed that operations of dredging have lasted for more than five years in the study area. The respondents also confirmed that dredging has changed both the water colour and river depth [12].
Majority of the participants 68 (85 %) strongly agreed that fishing activities were difficult in the region; they were supported by an additional 11 (13.75 %) participants who also agreed to that. All the study participants agreed that the only alternative means of getting water to cope with the pollution problems in the area was buying of sachet water "pure water" or drilling of personal boreholes. About 86.3% also strongly agreed that many families that cannot afford either sachet water or drilling of boreholes still consume the water from the river. The majority of respondents 67 (83.8 %) also strongly agreed that they now experience erosion and flooding in the area.
However, a majority of the participants 60 (75 %) strongly disagreed that the dredge operators provide other means of water supply to the residents to make-up for the pollution they have caused. Also, a majority of 67 (83.8 %) agreed strongly that no EIA was conducted in the area before commencement of dredging operations.

4.0 Conclusion

Conclusively, it was observed that as a result of dredging in Ekole creek, increasing the depth of creek will portends a survival risk to aquatic life and community at the creek banks because it poses ecosystem disturbances and causes erosion. Some ecosystem disturbances by dredging activities are "increase in pH and heavy metal of the sediment in water downstream" as inferred by Simon and Ogunlowo [14]. The respondents of the survey conducted in the study area indicated that not only did most of them agree to the issues raised, a majority of them strongly agreed. A majority of 69 (86.25 %) of the participants also strongly agreed that dredging is done in the region for commercial purposes (sand mining) indiscriminate, which is why it has been a perpetual problem for as long as the operators can access the resources. The opinion survey also suggested that dredging had compromised the quality of water in Ekole creek and the residents' livelihood (fishing) adversely affected. Routine environmental monitoring is recommended to detect on time, incidental or eventual alterations of riverbed profile, especially in downstream which are prone to changes from intensive dredging activities.

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Conflicts of Interest
The authors declare no conflicts of interest.

References

[1] National Oceanographic Center [internet](.2014) [cited 2021 May 14]. Available from http://noc.ac.uk/research-at-sea/ships/onboard-equipment/echo-sounders.
[2] Orunba, C.O. (2000). *Water Resources, Environment and Sustainable Development in Nigeria*. Journal of Human Ecology. 19:169-181.
[3] OSPA Commission (2009). Assessment of the Environmental Impact of Dredging for Navigational Purposes,13

[4] Garg, S.K. (2010). Hydrology and Water Resources Engineering, *Khanna Publishers, New Delhi India*. 1:45.

[5] NEW Delta Project (2007). *Framework for a Sustainable Dredging Strategy*. NEW Delta Theme 6:.2 2007.

[6] Nwankwoala, H.O., Amadi, A.N., and Oborie, F.A. (2011). *Hydrological Factors and Correlation Analysis in Ground Water Quality in Yenagoa, Bayelsa State, Nigeria*. Applied Ecology and Environmental Science, 100-105.

[7] Ogunlowo, O.O., and Simon, C.E (2021). *Effects of Dredging on Downstream Water Quality: Ekole Creek, Nigeria*, International Journal of Engineering Technologies and Management Research, 8(12): 17-25

[8] Koinyan, A. A., Nwakwoala, H. O. and Eludoyin, O. S. (2013). *Water Resources Utilization in Yenagoa, Central Niger Delta*. International Journal of Water Resources and Environmental Engineering, 2.

[9] Oguntoyinbo, J. and Hayward, D. 1987*Climatology of West Africa.* Hutchinson South Africa and Noble Books Totowa, New Jersey, USA 33-37.

[10] Anyadike, R.N.C & Obeta, M.C (2012). *Fundamentals of Hydrology*. Chuka Educational purblishers, Nsuka Nigeria, 117

[11]South SDE-28S [internet] (2010). *Operational Manual*. [cited 2021 May 17th]. Available from www.southgnss.com.

[12] World Health Organization (1993) Guidelines for Drinking Water Quality. *Incorporating First Addendum, 3rd ed., Geneva :WHO* , 1

[13] Akhionbare, S.M.O., Akhionbare, W.N., and Nwachukwu, J.I (2013). The Environment: Issues, Cases and Sustainability; Metals in Environmental Pollution. Springfield Publishers, New owerri Nigeria, 250-265.

[14] Simon, C.H & Ogunlowo, O.O (2022). Downstream Sediment Analysis of Dredged Site along Onuebum/Agura Axis of Ekole Creek, Nigeria. American Journal of Sciences and Engineering Research 5(1):1-9.