THE IMPLICATIONS OF SAND DREDGING AND THE SYSTEMATIC ALTERATION OF THE ORIGINAL AQUATIC ENVIRONMENT OF NWORIE RIVER, OWERRI, SOUTHEASTERN NIGERIA

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Abstract
Nworie River is a natural landmark in Owerri in southeastern Nigeria that has been affected by the growing development of housing estates and other infrastructure in Owerri and its environs. The driving force for these is the increasing population of people leaving the rural areas to come to Owerri, in search of better opportunities and the movement of people displaced by the economic predicaments in other urban centres, who decided to come back to Owerri. On the other hand are the Diaspora investors who invest in properties. These pressures have intensified demand for sand in developing estates and other government infrastructure. Therefore, persistence sand dredging on Nworie River has destabilized the existing traditional environment and the natural conservation structure. This has disorganized the entire aquatic ecosystem; inhabitants of Amakohia Owerri no longer use water for domestic purposes; besides, the survival of aquatic resources is highly threatened. Salvador Munoz Vinas' Contemporary theory of conservation guided this research. The study adopted a descriptive survey design which combines the quantitative and qualitative techniques of data collection. The study utilized statistical mean and simple percentages for data analysis. This study therefore examined the impact of sand dredging on Nworie River, taking into cognizance the volume of water and the colour of the water, the destruction of the aquatic resources and the defacing of the land bordering the river. Findings revealed that sand dredging activities disorganized habitats for fish and other organisms, which led to migration of these organisms; the environment bordering the river is defaced and legislations on conservation are not respected. Finally, the study recommends that government should strengthen legislation on conservation of natural sites and that tourism business should be promoted on the river.
Keywords*:* Natural Landmark; Aquatic Ecosystem; Conservation; Development; Sand Dredging.

Introduction
Urbanization comes with heavy cost; it destabilizes the existing traditional habitat, forcing inhabitants to change the entire structure of their existence. The traditional and natural conservation structures are dismantled, exposing the environment to both climatic and man-made changes. It is the pressure on the environment that alters its basic structure, and this position forms the argument proposed in analyzing the current nature of Nworie River in Owerri North, Imo state. Sand is used for all kinds of projects like land reclamations, the construction of artificial islands, coastal stabilization and several constructions particularly infrastructure, and these projects have both

economic and social benefits. But sand dredging results in environmental challenges when activities are not controlled by strong legislation.

Dredging involves the excavation of materials from the river, sea or lake and these are transferred to other locations for infrastructural development. Excavation could be carried out to improve navigation in ports, harbours and shipping channels. It could be for water and flood management; creation of new lands and habitats, and derivation of minerals from underwater deposits, preferably sand. Sand has remained crucial for the development of infrastructure in Owerri. It was observed that since 1999, Owerri has witnessed massive expansion notably in the development of New Owerri and the construction of new housing estates; and all these have put much pressure on Nworie and Otamiri rivers, but Nworie has borne much of this pressure in supply of sand for road and housing construction.

Aldridge (2000) argues that dredging has a direct impact by removing organisms from the environment together with sediment and plants and de Jonge (2000) and Phelps (2001) agree that other dangers associated with dredging include an increase in the amount of suspended matter in the part of the river where the works are carried out, and in some cases a decrease in oxygen concentration and an increase in the trophic status and contamination of the water via resuspension of bottom sediment containing toxic substances that have been subject to substantial human impact.

Dredging removes sediments and debris from the bottom of lakes, rivers, harbours and other water bodies. It is a routine necessity in water ways around the world because sedimentation- the natural process of sand and slit downstream – gradually fills channels and harbours. With regard to Nworie River, flood in Owerri empties itself into Nworie and because there are no proper water channels to free the city from flooding, much damage is experienced. It is in this regard that dredging is carried out to maintain or increase the depth of water. In other climes, dredging improves navigation channels, anchorages or berthing to ensure the safe passage of boats and ships; and vessels which require certain depth to safely navigate. It is also performed to reduce the exposure of fish, wildlife, and people to contaminants and to prevent the spread of contaminants to other areas of the water body. This environmental dredging ensures sediments in and around cities and industrial areas are frequently contaminated with a variety of pollutants; and their disposal are carried out by the Federal, state and local governments, as well as private entities.

Adekunbi, Elegbede, Akhiromen, Oluwagunke and Oyatola (2018:114) argued that "Nigeria is a developing country whose urban cities, particularly, Lagos, are expanding at a high rate, thus sand dredging will continue to be a major source for land reclamation purpose and building materials for housing development". Sand dredging remains pivotal in the construction industry, and will continue to be because human existence is dynamic. Dredging operations are a continuous activity relevant to the construction industry and as urban expansion has remained a part of

development, it will remain central to the development and expansion of Owerri.

Owerri is at the centre of southeastern Nigeria and its tourism attraction draws people from all parts of the South East including visitors from Rivers and Delta states who visit Owerri every weekend to enjoy night life, particularly called 'Ngwori' or highlife. These regular visits have had multiplier effects on the construction of hotels. Moreover, new estates spring up here and there, and sand dredging promotes construction works and Nworie river provides enough sand for these purposes. Nworie River is a sacred site revered by indigenes and non-indigenes. The river served several purposes such as providing water for domestic use, fishing hub for the protein content of food and a place of leisure for the youth who regularly swim for either competition or relaxation. However, non-indigenes were not required to swim at some designated spots because if they did, they would die. This was the belief of the people and it worked for them. Belief is a strong conviction that leads to the manifestation of the beings that exercise such. Among the Igbo, rivers, shrines, groves and many sacred sites are respected, and it is in this connection that Okonkwo and Eyisi (2018:13) argued that 'a study of groves and shrines will reveal the belief system of host community and explain the relationship between religion and nature.

However, over the years, the persistent sand dredging has had destructive impact on Nworie River and the people living along the river bank. It is against this background that this study examined the impact of sand dredging on Nworie River, with particular attention on disruption of aquatic habitats, the domestic usage of water from the river and the deliberate neglect of the existing legislation on conservation of the natural landscape. Finally, the study assessed the perception of Owerri dwellers on the environmental effects of sand dredging.

Research Questions

The specific research questions that guided the investigation are:

1. To what extent is the aquatic ecosystem altered through sand dredging on Nworie River?
2. How has sand dredging affected the environment of Nworie River?
3. To what extent is conservation laws observed during sand dredging?
4. What are the effects of sand dredging on tourism potentials of Nworie River?

Purpose of the Study

The purpose of this research is to investigate the implications of Sand Dredging and the systematic alteration of the Aquatic environment of Nworie River in Owerri, southeastern Nigeria. But the specific purposes are to:

1. Determine the extent the aquatic environment of Nworie River has been altered,

2. Examine the effects of sand dredging on the environment of Nworie river,
3. Examine the legal issues regarding sand dredging on Nworie river; and
4. Identify the effects of sand dredging on the tourism potentials of Nworie river

Conceptual Framework

Environmental Impact Assessment Practice

The World Conservation Strategy (WES) (1980) stated that humanity, which exists as a part of nature, has no future unless nature and natural resources are conserved which includes both protection and the rational use of natural resources. The WCS emphasized that the opposite of conservation is not development, rather they stressed that there is interdependence between conservation and development. The World Commission on Environment and Development (WCED) approved the concept of sustainable development in its Brundtland Report of 1987 and defined sustainable development as the development that meets the needs of the present without compromising the ability of future generation to achieve their needs and aspiration.

Environmental Impact Assessment (EIA) is a tool for achieving sustainable development and its main objective is to ensure that potential environmental impacts are foreseen at the appropriate stage of project design and addressed before any decision is taken on the project. It is in this regard that EIA is defined as a systematic process for identifying, predicting and evaluating potential impacts associated with a development project. It has to mitigate measures to avoid, reduce or minimize the negative impacts on the environment, public health and property. It must also enhance positive impacts. It deals with monitoring the construction and operational phases, and acting on the results of such monitoring till final abandonment/closure. The Nigerian EIA Act No. 86 of 1992 makes EIA mandatory for development projects likely to have adverse impacts on the environment prior to implementation. Section 14 (1) (a) and (b), Section 14 (1) (d) further states that the Federal, State and Local Council or any of its agencies, prior to environmental assessment of the project in accordance with the EIA Act, shall not "under the provisions of any law or enactment, issue a permit or license, grants an approval or takes any other action for the purpose of enabling the project to be carried out in whole or in part.

Ugwu, Ijioma, Chukwuleta and Ebere (2018) aver that laws put in place for the protection and management of cultural landscapes, particularly those that prevent them from being destroyed by construction companies and other development projects are not fully implemented. They argued that the non-compliance to the established set of procedures, rules, regulations, and guidelines in the planning and execution of development projects is one of the problems confronting the management and protection of cultural landscapes in Nigeria. The above argument also guides achieving the overall objectives of

current research because so many illegal sand dredging activities have distorted the original environment of many landmarks.

Theoretical Framework

In investigating the implications of sand dredging and the systematic alteration of the original aquatic environment of Nworie River, the research adopted Salvador Munoz Vinas' Contemporary theory of conservation, 2005. This theory relates to metaphysical aspects of conservation and it exists in fragmentary form, with very few exceptions, within a number of recent publications. This theory talks about values and heritage conservation. It argues that there is rational decision-making in the preservation of cultural property; it defines preservation as a non-deliberate action of perceptible changes to heritage items, while restoration deals with deliberate action of perceptible changes to them. The theorist divides preservation into actions of direct preservation and actions of environmental preservation; the former refers to changes in the object and time-limited actions, while the latter refers to changes in the environment in which the object is set and to action with no time limitation. The theory argues that the definition of an object depends on the symbolic power arising from the conservation. It avers that each object of conservation has ascribed meanings based on its private, social and scientific benefits. This theory originally was premised on three principles: reversibility, universality and objectivity, but Appelbaum (1987), Beck (1996) and Vollet-le-duc (1866) faulted the blanket assumptions concerning these three factors. They argued that in the retreatability of the objects, there are no universal culture and that no culture is superior to others and that truth is a matter of choice. However, the theory emphasizes ethical paradigms such as sustainability or adaptability, and if possible, restoration of the state of the object to engender harmony between nature and man, and between man and his environment. It is against this argument that this research tries to argue that Nworie River, as a natural heritage has been affected by the activities of man through sand dredging and this deliberate action has altered the aquatic environment and the benefits of the river to inhabitants of Amakohia in Owerri.

Methodology

The study adopted a descriptive survey design that combined quantitative and qualitative techniques of data collection. These techniques were complemented by observation method of data collection. For quantitative data, the likert instrument was constructed to test 17 question items on the theme of this research. The questionnaire was purposively administered on 60 respondents who included men and women working at the dredging sites and people residing near the site. Responses were collected after completion of the questionnaire, while for qualitative data, eight respondents were interviewed to complement the quantitative data. These respondents were interviewed face-to-face. The observation method was used

to ascertain on-the-spot data. For data analysis, the research adopted the statistical mean and simple percentage for quantitative data; decision rule was 2.5; meaning that any mean value below 2.5 was regarded as rejected while any mean value above 2.5 was regarded as accepted. Content analysis was adopted for qualitative data.These three techniques were adopted to achieve a balanced account of the result.



Plate 1: The Nworie River
Source: Fieldwork, 2019



Plate 2: Dredging Site on Nworie River
Source: Fieldwork, 2019

Results

The results of this study and data analysis are presented here. Tables are used to organize data collected from the field and simple percentages and statistical mean values were calculated from the frequency of responses collected as presented below.

Section 1 presents analysis of responses on the ages, gender and educational level of the respondents. The ages of respondents ranged from 21-69. Respondents between 21 and 30 were 06 representing 10 percent; 31-39 years constitutes 25 representing 42% of respondents; 40-49 years constitutes 19 respondents representing 32%; 50-59 years constitutes 8 respondents representing 13% and 60-69 years constitute 2 respondents representing 3%. From this analysis, respondents between the ages of 31-39 and 40-49 constitute the majority of the workforce dominated by youths and few older people. The unique thing about these respondents is that they have lower educational level qualifications, that is, first school leaving and secondary school certificates.

The analysis also showed 52 out of 60 constituted males representing 87% while 8 constituted females representing 13% The figures showed that sand dredging is a male dominated profession which involves hard labour, whereas, the females were involved in less labour-intensive duties such as office duties. The analysis further showed that respondents with primary school education constituted 11(18%); secondary school 40(67%), NCE/ND 03(05%) and first degree 6(10%). The presentation therefore revealed that respondents with primary and secondary education constituted the majority and also did the bulk of the labour-related duties while those with higher education (ND/NCE and First Degree) constituted the technical and managerial cadre. From this analysis, the research established that the level of education determined the job description of a staff.

Research Question 1: To what extent is the aquatic ecosystem altered through sand dredging in Nworie River?

Table 1: Analysis of responses on the alteration of the aquatic ecosystem on Nworie River

S/N	Questionnaires items	Total	Mean ($\bar{x}$)	Decision
1.	Sand Dredging affects fishing negatively	60 196	3.2	Accepted
2.	Sand Dredging has improved the quality of fish produced in the river	60 118	1.9	Rejected
3.	Dredging affects the source of drinking water	60 222	3.7	Accepted
4.	Sand Dredging on Nworie river has improved the quality of drinking water	60 96	1.6	Rejected
5.	Sand Dredging has changed the colour of the water	60 232	3.9	Accepted
6.	Sand Dredging has altered the aquatic ecosystem in Nworie River	60 224	3.7	Accepted
7.	Sand Dredging has intensified the disharmony among organisms in the aquatic ecosystem	60 184	3.1	Accepted

	Average Mean		**3.1**	**Accepted**

Source: Fieldwork, 2019

Table above analyses the responses on questionnaire items 1-7 revealing the alteration of the aquatic ecosystem by unlawful sand dredging on Nwories river. From the Table, 3.2 mean value of the respondents agreed that sand dredging has affected fishing negatively. Researchers observed that the species and quality of fishes found in the river were unqual when compared to what people found and caught in the 1980s.; 1.9 mean value of respondents disagreed that sand dredging activities has improved the quality of fish production in the river, This assumption was based on the premise that fishes are scared away by the noise from the heavy duty machines and their natural habitats have been destroyed. It was also observed that the debris that formed natural abodes of water creatures had been washed away, there are no natural habitats such as remains of decayed roots, body, dead leaves and water plants; 3.7 mean value of respondents agreed that sand dredging affected the source of drinking water, A respondent, Calistus Nwangborogwu, argues that:

> *In the past, Nworie used to be the only source of water for domestic usage and our children swarm it for relaxation, but these machines have changed the colour of the water by pumping sand everyday. And in this era of pure water that we cannot determine to hygiene level of water we buy, Nworie would have been the source of good water, but you can imagine the suffering people living around here are going through. Government cannot provide good water neither can everyone drill bore hole in the face of this economic hardship. Our source of water is gone and gone forever since government is not ready to put a stop to the reckless sand dredging going on,* (Mr. Calistus Nwangborogwu, Personal Communication, 2019).

The above respondent exposed government neglect of the welfare of people and other environment. 1.6 mean value of respondents disagreed that sand dredging on Nworie river has improved the quality of drinking water. Researchers observed that following the activities of the machines, sand dredging has consistently distorted the movement of water and that water mixes with sand and remains unhygienic for domestic consumption; but 3.9 mean value of respondents agreed that sand dredging has changed the colour of the water in Nworie river; Kuumar and Singh (2013:13) emphasized the necessity of improving appropriate entertainment activities, upgrading the cleanliness hygiene and sanitation. This argument supports the view that if the river is protected, and deepened and expanded. Rowing of canoe could

become a form of sport to promote the development of youths. Other strategic measures that would enhance appropriate clean up of the river and protection of the water with strong legal measures, would change the social and economic derivatives from the river. 3.7 mean value of respondents agreed that sand dredging has altered the aquatic ecosystem in the river and 3.1 mean value of respondents agreed that sand dredging aggravated the disharmony among the organisms in the aquatic ecosystem. According to our informant:

> *My brother can you see any plant in the river? There is no natural thing growing there anymore because the machines have dredged everything. Dredging has removed natural habitats, thereby chasing organisms away and the symbiotic relationship between these organisms is no longer there. Look at the quality of fish I caught? Making money is rated above the quality of life of people,* (Mr. Sixtus Nwoke, Personal Communication, 2019).

The above respondent sadly revealed that there is nothing natural anymore about the river and he demonstrated this by the size and quality of fish he caught in the water. He affirmed that these were caused by the activities of the dredging machines.

Dabkowski, et al (2016) in their study on the Impact of dredging of a small lowland river on water beetle (Coleptera), support the above view by arguing that species of beetles and the quantity of it collected had reduced drastically and that the richness of the fauna was greater before the dredging. They revealed that what was collected was characterized by somewhat lower species diversity. The percentage of species had decreased from 18.8% to 12.5%, whereas this species maintained its role as eudominant. Finally from the same table, the mean average of 3.1 established that majority of the respondents agreed with the view that the activities of sand dredging altered the aquatic ecosystem of Nworie river, while the minority view rejected the assertion; therefore, this assertion was accepted.



Plate 3: Only Surviving Specie of Fish on Nworie River
Source: Fieldwork, 2019

Table 2: Analysis of Responses on the Effects of Sand Dredging on the Environment Bordering Nworie River

S/N	Questionnaires items	Total	Mean ($\bar{x}$)	Decision
8.	Sand Dredging has not increased the volume of water on Nworie River	60 140	2.3	Rejected
9.	Sand Dredging has not deepened the depth of Nworie River	60 116	1.9	Rejected
10.	Sand Dredging has defaced the land bordering Nworie River	60 206	3.4	Accepted
11.	Sand Dredging has aided road degradation	60 132	2.2	Rejected
12.	Sand Dredging has aided erosion	60 226	3.8	Accepted
	Average Mean		**2.72**	**Accepted**

Source: Fieldwork, 2019

The Table above shows the responses on questionnaire items 8-12 emphasizing the debilitating effects of sand dredging on the environment

bordering Nworie River. The analysis revealed that 2. 3 mean value of respondents rejected the view that sand dredging has not affected the volume of water on Nworie river. However, researchers observed that sand dredging had expanded the size of the river and could improve navigation if put to use for tourism purposes. Respondents might have responded negatively due to their poor understanding of the question item, Data also revealed that there is no evidence or any plans to introduce some entertainment activities on the river considering the massive expansion that had taken place there; Moreover, 3.4 mean value of respondents agreed that sand dredging defaced the land bordering Nworie river. Researchers observed that the landscape bordering the river had been used for dumping and loading of sand and the construction of which had reduced the course of the river. Sewages are also pumped into the river and on the land which encourage erosion. Unfortunately, government seem to neglect its role in regulating the activities of citizens in using natural landmarks. However, 2.2 mean value of respondents disagreed that sand dredging has aided land degradation; Analysis also revealed that 3.8 mean value of respondents agreed that sand dredging has aided erosion around Nworie river. It was observed that dangerous gullies have been created in three spots which allow flood to empty into Nworie river and their depth were about 40 feet, thus exposing the adjoining areas to landslides and incessant collapse of buildings. In fact five buildings had collapsed due to erosion related activities and some of the occupants of these buildings squat with neighbours or have packed out of the area. Moreover, this hazard has also exposed residents to incessant attacks by armed robbers. From the Table items 8, 9 and 11 disagreed with the view that sand dredging has affected the environment bordering Nworie river while 10 and 12 agreed that it has done great damage to the environment. They all have the mean average of 2.72, therefore, the response agreed with the view that sand dredging posed a threat to the environment bordering Nworie river.

Table 3: Analysis of Response on Legal Issues Regarding Sand Dredging on Nworie River

S/N	**Questionnaires items**	**SA**	**A**	**D**	**SD**	**Total**	**Mean ($\bar{x}$)**	**Decision**
13.	Monetary benefits of sand dredging has consistently disregarded legislation on conservation of natural sites	42 168	12 36	2 4	4 4	60 212	3.5	Accepted

Source: Fieldwork, 2019

The table above showed the response on, conservation laws. Analysis established that, 3.5 mean value of respondents agreed that illegality pervades

predominantly in Imo State in the use of rivers because many people indulge in circumventing the law to amass wealth. It is this belief that has influenced the attitude of some powerful politicians and businessmen and women who engage in sand dredging with total disregard for legislation on conservation of natural sites. Ugwu, et al (2018) argue that the essence of any law is the effective articulation of agreed policies and definition of measures that would regulate the particular area of concern which in this case is the protection of cultural heritage. Unfortunately, some of these people are encouraged by powerful people in government who give clearance to whoever is able to pay them. In fact between 2011 and early 2019, relations of those in government granted people areas to operate as long as they are capable of paying them. Rivers and lands were indiscriminately allotted and mismanaged by some selfish individuals in government. The research therefore was of the view that conservation laws were not obeyed because of the monetary benefits attached to sand dredging.

Table 4: Analysis of Responses on the Effects of Sand Dredging Has on Tourism.

S/N	Questionnaires Items	Total	Mean ($\bar{x}$)	Decision
14.	Sand Dredging on Nworie River has improved traditional swimming enjoyed by the people	60 98	1.6	Rejected
15.	Sand Dredging has destroyed the recreational benefits on Nworie River	60 188	3.1	Accepted
16.	Sand Dredging on Nworie River has attracted some tourists to the environment	60 112	1.8	Rejected
17.	Sand Dredging has created jobs for some citizens	60 189	3.2	Accepted
	Average Mean		**2.4**	**Rejected**

Source: Fieldwork, 2019

Table 4 above shows the responses regarding the effects of sand dredging on tourism on Nworie river. Based on this, 1.6 mean value of respondents disagreed with the view that sand dredging on Nworie river has improved traditional swimming enjoyed by the youths. The activities of sand dredging have alienated the youths from swimming in the river. The dredging machines are everywhere operating, the noise scares, and the colour of the water frightens anyone who attempts to use it as leisure; conversely, 3.1 mean value of respondents agreed with the view that sand dredging on Nworie river has destroyed the recreational benefits on Nworie river. This assertion supports the above argument that the river y is no longer suitable for swimming; however, 1.8 mean value of respondents disagreed with the view that sand dredging on Nworie river has attracted some tourists to the

environment. The analysis also revealed that 3.2 mean value of respondents agreed with the view that sand dredging has created jobs for some citizens. It was observed that several youths have been engaged by some of these dredging companies to serve as machine operators, sand loaders and office staff. It really created jobs that took some of the jobless youths off crime and the unemployment market. As a matter of fact, while the activities of the sand dredgers have affected cultural heritage, it has been used as a tool for fighting unemployment. In conclusion, Sand dredging on Nworie river has not benefited tourism, and the research emphasizes the need for government to initiate actions that would promote tourism on the river.

Discussion

The study established that sand dredging on Nworie River are found on four locations: the first at Egbeada; the second at Akwakuma; the third at a location between Akwakuma and Amakohia; the fourth behind Alvan Ikoku Federal College of Education and the last just before the bridge linking Warehouse junction and Control roundabout. Sand dredging has continued unabated with the connivance of powerful people in Imo State who grants rights to operate arbitrarily to those who could afford to pay these individuals. Some of these people circumvent the laws regulating natural sites and those concerning internally generated revenue. Having compromised on this ground, unregulated sand dredging has persistently altered the aquatic ecosystem. Majority of respondents were of the view that sand dredging disorganized the aquatic ecosystem, the debris are wash away, water resources are in disarray and this has led to migration of water creatures. It also affected fishing activities. Then, catfish, electric fish, tilapia, water snails and other organisms were in abundant and youths set traps and used hooks to harvest them. Currently, there were no big fishes except a small tilapia family that could survive the noise and activities of dredging machines, Moreover, other creatures such as water beetles, snakes, periwinkles, etc no longer survive in the water. Those who had made fishing a past time to support their protein intake have been deprived of such leisure, and this has consequently added to the economic hardship embarrassing most Nigerians. A respondent, Gregory Ukoha, who caught some fish corroborated this view by arguing that better species of fishes have escaped to other parts of the river where dredging is not taking place, as a result, only insignificant species of tilapia exists. This was contrary to the cat and electric fishes that were in abundance in the river prior to dredging on the river. To further elaborate on this, the same respondent argued that the natural habitats of these fishes have been disorganized by dredging activities and the fishes are frightened by the sound of dredging machines, which encourage mass migration to areas not affected by sand dredging activities.

Findings further revealed that dredging has motivated the accumulation of mud leading to the reduction in the quantity and quality of water current. This decrease contaminated and changed the colour of the

water making it impossible for Amakohia people and the other communities to collect clean and hygienic water for domestic purposes. The quality of the water has been greatly affected by the turbidity. The lees or sediments are disturbed and made worse as they are mixed with the chemicals from the machines. Therefore, this forced and sudden process causes ecological retrogression which has resulted in domestic water shortage in Amakohia and its environs. Adekunbi, Elegbede, Akhiromen, Oluwagunke and Oyatola (2018:121) corroborated this with their study on Ibeshe area of Lagos Lagoon, "The sand dredging operators' activities influence negatively on the ecological resources and water composition of the lagoon". However, the minority view which disagreed that sand dredging had systematically altered the aquatic ecosystem revealed it had a poor understanding of the biodiversity of rivers. In all, with an average mean of 3.1 the study established that sand dredging impacted negatively on Nworie river.

The study proved that dredging of the investigated area affected the environment bordering Nworie river. Data established that sand dredging defaced the land bordering Nworie river and this has encouraged soil erosion around the area. Sixtus Nwoke a respondent who lives on the bank of the river sadly showed the researchers the extent soil erosion had affected the river and its adjoining area and this was confirmed while the researchers were still collecting data. Sixtus Nwoke argued that in an attempt to tackle the problem of flooding in Owerri, government channeled the flow into Nworie River and this action has destroyed the comfort of residents around the area. Data also revealed that owners of vehicles no longer enjoy thoroughfare on the streets bordering the river because it is either their compounds where they parked cars are above the road or the road had been washed away thus making life unbearable.. Therefore, environmental degradation has increased the challenges facing the management of the river and the people living around there.

Sand dredging activities also affected recreational benefits of the river. The area is highly secured by security personnel and nobody dares to enter there without clearance. Data established that mere visits for sight-seeing is not tolerated and that the only people who harvest fish there are staff of the dredging companies. The only positive side is that sand dredging provided jobs for the unemployed which tourism would have, unfortunately the tourism potential of Nworie river has been destroyed through sand dredging.

Finally, the research established that the neglect of legislation on conservation by government officials and their collaborators who engage in sand dredging has destroyed the tourism potentials of the river despite the fact that it widened and deepened the river to the extent that canoe could be used for transportation. It is in this connection that the study argue that the expansion of the river should be exploited for water transport which would ease traffic in Owerri.

Conclusion

The research focuses on the implications of sand dredging and the systematic alteration of the original aquatic environment of Nworie River, Owerri, southeastern Nigeria. As revealed by this study, Nworie River is one of the natural landmarks in Owerri with a long history of providing domestic water, protein and leisure to the people of Ubomiri, Egbeada, Akwakuma and Amakohia. However, the fast development of housing estates and government infrastructure in Owerri displaced those basic needs of the people and the river became the main source and supply of sand. Sand dredging on Nworie River are found on four locations: the first at Egbeada; the second at Akwakuma; the third at a location between Akwakuma and Amakohia; the fourth behind Alvan Ikoku Federal College of Education and the last just before the bridge linking Warehouse junction and Control roundabout. Persistent sand dredging altered the original aquatic environment of the river and at the same time created more dangerous outcomes that has defaced the areas bordering the river.

Sand dredging is found to be profitable due to the persistent demand from sand users who have construction sites, housing estates under construction and other basic infrastructure. The study established that powerful government functionaries alloted sections of the river to owners of dredging machines who dredge and pump sand from the river. It is obvious that dredging activities have had great impact on both aquatic creatures and its habitats including human beings who have been using the river. Research established that the natural habitats of fishes, river beetles and other creatures such as water snails, periwinkles, snakes have been destroyed by the activities of the dredging machines. In fact, many of these creatures have migrated to the lower course of the river to avoid the destabilizing sound of the machines and the forceful clearance of natural habitats of the creatures. Study also established that the species of fishes existing prior to sand dredging have all migrated leaving the small sizes of tilapia as the only surviving specie.

In addition to the destruction of natural habitats of the aquatic creatures is the alteration of the quality of its water. Study further revealed that as a result of the activities of machines, mud had mixed with water and the colour is no longer useful for domestic purposes. This challenge has increased water scarcity in Owerri, which has led to the production and use of sachet water whose price keeps rising. It also revealed that Nworie river has remained stagnant because the current has been slowed and its main source of supply is flood during rainy seasons. By implication, the body of the water has greatly been altered and the creatures originally inhabiting there cannot survive in the face of the illegal actions that government is promoting.

However, the research established that dredging activities have provided job opportunities for the youths who serve as machine operators, sand loaders, transporters and office staff. On the negative side of this is the flagrant abuse of legislation of this conservation site. Finally, government has

not found it beneficial to use the expanded and deepened course of the river to be a tourist site and an alternative form of transport.

Recommendation

In view of the above revelations, this study recommends that:

1. Government should strengthen the laws on conservation of natural habitats and ensure that these are not abused by both government and private individuals.
2. Nworie river should be conserved to reclaim the original or improved habitat for fish farming in order to improve the protein content of food.
3. Nworie river should be developed into a tourist site to generate revenue and could also be used as an alternative means of transport to ease traffic along Orlu road.
4. Government should encourage private investors to build recreational centres such as amusement parks and hotels along the banks of the river.
5. There should be a regulated sand dredging activity on the river in order not to destroy the potential or the resources of the river.
6. Some agricultural experts should be encouraged to look for new ways of reviving fishery production in the river and open up the current free flow of water.

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