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ENVIRONMENTAL AND SOCIO-ECONOMIC IMPACT OF SAND MINING IN ISIODU RIVER, ISIODU, EMOHUA NEW CALABAR RIVER, RIVERS STATE.

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Abstract
This study investigated the environmental and socio-economic impacts of sand mining in Isiodu River, Isiodu, Emohua, within the New Calabar River system of Rivers State, Nigeria. The study was undertaken to assess the abundance and distribution of flora and fauna within selected sand-mining sites. The study area was divided into three sampling points, namely Bridge Point, Mid-point and Last Point, to examine variations in the distribution of biological resources associated with sand-mining activities. Data obtained from the study sites were analysed using the Statistical Package for the Social Sciences (SPSS). The findings on flora abundance showed variations in the distribution of plant species across the three sampling points. Species recorded included Lupinus spp., Tectona grandis, Crinum spp., Phoenix dactylifera, Pandanus spp., Terminalia spp., Paspalum spp., Phragmites australis, Tribulus terrestris and Syngonium podophyllum. Significant variation in flora distribution was observed at the Mid-point (p = 0.028), while the differences at the Bridge Point (p = 0.279) and Last Point (p = 0.809) were not significant. Faunal assessment recorded ten organisms, including mudskipper, periwinkle, catfish, tilapia, crab, flathead mullet, water snail, earthworms, sharptooth and reedfish. Significant differences in fauna distribution were observed at the Bridge Point (p = 0.005) and Last Point (p = 0.002), whereas the difference at the Mid-point was not significant (p = 0.085). The findings indicate that sand-mining activities are associated with variations in the abundance and distribution of flora and fauna within the study area. The study therefore highlights the need for environmentally sustainable sand-mining practices, regular ecological monitoring and effective community participation in the management and conservation of the Isiodu River ecosystem.

Keywords: Environmental, socio-economic, impacts, sand mining.

INTRODUCTION
Sand mining in Isiodu River, of New Calabar River in Emohua LGA of Rivers State serves as a source of livelihood to the inhabitants of Emohua which have early been known that Emohua people are basically Fishermen, civil servants, commercial traders of all kind. Excluding the items provided above for commercialization are the ones got from Isiodu River in Emohua LGA which include the followings sand, gravel, flora and fauna (plants and animals).
The disruption of ecosystems caused by sand mining extends beyond environmental concerns to socio-economic impacts, hence, (Nwala & Balafama, 2024) opined that ecosystems provide essential services to human communities, such as water purification, flood control, and recreational opportunities. Sand mining can disrupt these services by degrading water quality,

increasing flood risks, and reducing the aesthetic and recreational value of natural landscapes (UNEP, 2025). The loss of these ecosystem services can have profound consequences for communities, particularly in regions where livelihoods depend on tourism, agriculture, and fishing like Emohua Local Government Area.
Additionally, sand mining often leads to social conflicts, especially in the case where local communities depend on the same resources for their livelihoods like Isiodu Emohua. Unregulated mining operations can lead to disputes over land ownership and access to natural resources, exacerbating issues of environmental justice and equity (Beiser, 2018.)
Aquatic organisms, particularly fish and invertebrates, are highly sensitive to the toxic effects of heavy metals. Metals such as mercury (Hg), lead (Pb), cadmium (Cd), and arsenic (As) can accumulate in the tissues of these organisms, resulting in chronic exposure that impairs physiological processes and reproductive success (Bisht & Gerber, 2017). This accumulation, termed bioaccumulation, occurs as organisms absorb metals from water, sediments, and their diet over time. The phenomenon of biomagnification amplifies the concentration of heavy metals as they move up the food chain, leading to higher concentrations in predatory species at the top trophic levels (Gavriletea, 2017; Nwala, & Balafama 2024).
The reproductive system of fishes are particularly vulnerable to heavy metal toxicity, with disruptions in the development of eggs and larvae leading to reduced reproductive success and diminished fish populations (Hougaard & Velez-Tirres, 2020). Additionally, heavy metals can interfere with critical metabolic processes by inhibiting essential enzymes, resulting in impaired growth and development in aquatic organisms (Gavriletea, 2017).
Neurotoxic metals, such as mercury, pose severe risks to the nervous system of fishes and other aquatic species. These metals can impair behavior, sensory perception, and neurological functions, ultimately reducing the survival and reproductive capacity of affected organisms (Hougaard & Velez-Tirres, 2020). Which lead the people of Emohua LGA to be socio-economically unviable and loss of expected livelihood in their domain with result to poor reproductive capacity of the organisms. Furthermore, heavy metal accumulation in sediments can impact benthic organisms, which play a critical role in nutrient cycling and the maintenance of aquatic food webs (Hougaard & Velez-Tirres, 2020).

Human Health Risks

The presence of heavy metals in aquatic ecosystems not only affects wildlife but also poses risks to human populace. Many communities rely on water sources potentially contaminated by heavy metals for drinking, agriculture, and other domestic purposes.
Chronic exposure to heavy metals, even at low concentrations, can lead to adverse health effects, particularly impacting neurological and developmental well-being in humans (Gavriletea, 2017). Lead and mercury, in particular, are known for their long-term neurotoxic effects, especially in children, which can result in cognitive impairments and developmental delays (Hougaard & Velez-Tirres, 2020).

Ecosystem Health and Biodiversity

Heavy metal contamination has the potential to disrupt the structure and function of aquatic ecosystems, leading to changes in species composition, trophic interactions, and nutrient cycling. As heavy metals interfere with the growth and reproduction of aquatic species, biodiversity can be severely reduced, with long-term consequences for ecosystem resilience and function (Gavriletea, 2017). The accumulation of metals in key organisms, particularly...

Ecological Health and Biodiversity Conservation

Rivers and their associated ecosystems are essential for biodiversity, providing critical ecosystem services and supporting human livelihoods. However, sand mining has the potential to disrupt these ecosystems by altering water quality and habitat structure. By examining the effects of sand mining on physicochemical parameters, pH levels, and heavy metal concentrations, this study seeks to elucidate the mechanisms through which sand mining compromises the ecological health of aquatic environments (Bisht & Gerber, 2017).

Human Well-Being and Livelihoods
Understanding the impact of sand mining on water quality is crucial for safeguarding the health and livelihoods of communities that depend on these water sources. Many local communities rely on rivers for drinking water, agriculture, and other essential services. The degradation of water quality due to increased heavy metal concentrations poses direct risks to human health and economic activities (Hougaard & Velez-Tirres, 2020).

Sustainable Resource Management
The findings from this research have the potential to inform policy and management practices for sustainable resource extraction. By understanding the environmental dynamics of the New Calabar River, evidence-based policies can be developed to minimize the adverse effects of sand mining on water quality and aquatic ecosystems (Gavriletea, 2017). Sustainable sand mining practices, coupled with regular monitoring of physicochemical and heavy metal parameters, are essential for the conservation of biodiversity and the protection of human health.

Community Engagement and Awareness
Engaging local communities and stakeholders is a key component of this research, by raising awareness about the environmental impacts of sand mining. This study seeks to empower communities to advocate for sustainable practices and participate in conservation efforts. Collaboration with local stakeholders is vital for ensuring that the findings of this research leads to tangible improvements in environmental management and policy development (Ejatla, 2020).

Statement of the Problem
Sand mining is an important socio-economic activity in many riverine communities because it provides constructive materials and creates sources of income and employment for local residents. In Isiodu, Emohua, sand mining activities along the Isiodu River, which forms part of the New Calabar River system, have increased the availability of sand for construction and other developmental activities. However, the continuous and often poorly regulated extraction of sand from the river environment has created significant environmental and socio-economic consequences for the surrounding community. Environmentally, intensive sand mining can alter the natural structure and morphology of the river channel, disturb riverbeds and banks, increase water turbidity, and contribute to the degradation of aquatic habitats. The removal of sediments can also affect water flow, increase bank instability and erosion, and disturb organisms that depend on the river ecosystem. In addition, the movement of mining equipment and associated activities may introduce pollutants into the river and potentially influence physicochemical characteristics of the water. These changes may reduce the quality and ecological integrity of the river and threaten aquatic biodiversity.

The socio-economic effects of sand mining present a more complex situation. On one hand, the activity provides employment, income and business opportunities for miners, boat operators, loaders, transporters and other members of the local community. It may also contribute to the supply of construction materials and support local economic activities. On the other hand, excessive sand mining may negatively affect fishing, farming, transportation and other traditional livelihoods that depend on the river. Environmental degradation may also create long-term economic costs for the community, particularly where residents depend directly on the river for their livelihoods and domestic activities.

Despite the economic importance of sand mining in the area, there is inadequate site-specific information on the extent to which sand mining has affected the environmental condition of the Isiodu River and the socio-economic well-being of the surrounding community. This lack of comprehensive information makes it difficult for relevant authorities and community stakeholders to develop appropriate measures for regulating sand extraction while maintaining the economic benefits of the activity. Therefore, there is a need to investigate the environmental and socio-economic impacts of sand mining in Isiodu River, Isiodu, Emohua, within the New Calabar River system, with a view to providing evidence that can support sustainable sand-mining practices, environmental protection and improved community livelihoods.

Aim and objectives of the study

The aim of the study was to investigate the impact of environmental and socio-economic impacts of sand mining in Isiodu River, Isiodu, Emohua New Calabar River, Rivers State.
Specifically, the objectives of the study are to:

1. Access the abundance of fauna in the sand mining sites
2. Access flora abundance in sand mining sites

Significance of the study

This study is of great significance for understanding the environmental consequences of sand mining in the Isiodu Emohua New Calabar River, offering insights that will benefit a wide range of stakeholders:

1. **The environs of Isiodu community**: Members of Isiodu community will be the first beneficiary because if the aquatic ecosystem of the mentioned river is being controlled and maintained it will surely lead to financial improvement which will accelerate their socio-economic activities welfare and improve their recreation. Then the squabble and grab of the aquatic ecosystem will be dramatically reduced to its minimum.
2. **Future Researchers and the Scientific Community**: The study enriches the scientific literature by offering a detailed analysis of the physicochemical changes and heavy metal concentrations associated with sand mining. It provides a foundation for future research in similar environmental contexts, facilitating further investigations into sustainable resource management. The methodologies and findings can serve as a reference for researchers studying the ecological effects of resource extraction globally.
3. **Environmental Conservation Groups**: Environmental organizations dedicated to conserving aquatic ecosystems will benefit from the study's findings on the broader ecological impact of sand mining. Armed with scientific evidence, these groups can raise awareness and advocate for the protection of rivers, biodiversity, and local ecosystems, ensuring that conservation efforts are aligned with the realities of environmental degradation caused by sand mining.
4. **Policy Advocates and Sustainable Development Practitioners**: By providing data that highlights the need for sustainable practices in resource extraction, this study supports advocates of sustainable development. It will help shape discussions on balancing economic activities, such as sand mining, with environmental stewardship. Additionally, the study offers guidelines that can be applied to other regions facing similar challenges, fostering the adoption of global best practices.
5. **Educational Institutions and Students**: For educational institutions, the findings serve as an important case study that can be incorporated into environmental science curricula. Students and educators can use the study to explore real-world environmental issues, offering practical insights into ecosystem management and sustainability.

Scope of the Study

The study will focus on the environmental and socio-economic impacts of sand mining in Isiodu River, Isiodu, Emohua, within the New Calabar River system of Rivers State, Nigeria. The environmental aspect of the study will examine the effects of sand mining on selected environmental conditions of the river, including water quality, river-bank stability, sediment characteristics, turbidity, and other relevant physicochemical parameters, as well as possible effects on aquatic organisms and biodiversity. The socio-economic aspect will examine the implications of sand mining for the people living in and around the study area. Specific areas of interest will include employment and income generation, livelihood opportunities, fishing and farming activities, transportation, household economic benefits, and perceived negative effects of environmental degradation on community livelihoods. The study will involve relevant stakeholders and residents in the Isiodu community, particularly individuals directly or indirectly associated with sand-mining activities. These may include sand miners, river users, fishermen, farmers, traders, transporters and other affected community members. The study will be limited geographically to Isiodu River and its immediate surrounding communities in Emohua, and will not cover all sand-mining sites within the wider New Calabar River system. The study will therefore provide a localized assessment of how sand mining influences both the environmental condition of the river and the socio-economic conditions of the people who depend on it.

Appraisal of Reviewed Literature

The reviewed literature provides a thorough examination of the water quality issues affecting rivers in Pune City, Maharashtra, India. MVS Vaishnavi et al. (2017) investigated heavy metal contamination in the Mula Mutha and Pavana Rivers during January 2015, focusing on key pollutants such as cadmium (Cd), lead (Pb), and nickel (Ni). Their study compared the concentrations of these metals against World Health Organization (WHO) standards, offering critical insights into the potential risks of using the river runoff for drinking purposes (Vaishnavi et al., 2017).

Pali Sahu et al. (2017) further this understanding by providing an extensive physicochemical analysis of the Mula Mutha River. This study examines the broader impact of pollution from municipal, industrial, and agricultural sources, dividing the river into multiple sampling stations to capture variations in water quality across different locations and seasons. The computed indices for various periods illustrate the severity of pollution at specific sites and underscore the importance of detailed water quality assessments (Sahu et al., 2017).

Together, these studies offer significant insights into the environmental challenges faced by rivers in Pune. They highlight the urgent need for targeted pollution control measures and effective water management strategies to safeguard water quality. The literature underscores the necessity of continuous monitoring and assessment to track changes in water quality over time, providing a solid foundation for future research and policy development aimed at environmental conservation and sustainable water resource management in the Pune region.

Area of Study

The study was carried out in an area known as the Emohua extension of the New Calabar River, popularly called the Choba Bridge. The study area is situated in Emohua local government area being demarcated by long span of the river through east and west. In order to adequately utilize the area and to study variations, the research study will be carried out in two (2) selected stations and or points namely: Bridge point, Mid-point with representative initials as Bp, Mp respectively. The area of study is the Emohua extension of the "New Calabar River". The long span of the river split across three (3) local governments by boundaries. Emohua Local Government is bordered from East by Obio/Akpor LGA, West by Ahoada-East LGA, North by Ikwerre LGA and South by Akuku-Toru LGA with area covering approximately 831 Km². The National Population Commission holds a population of approximately 201,901 for Emohua LGA and is located between latitudes of 4° 5'0" N. and longitudes 6° 52'0" E respectively with average elevation below 30 metres. Above sea level. Its geological structure comprises basically of alluvial sedimentary basin and basement complex. Its vegetation is characterized by a mix of mangrove and coastal swamp forests, raffia palms and tight rainforest. Due to high rain fall, its soil is usually characterized as sandy or sandy loam.

Data analysis

The analysis of the data was done using a statistical programme for social scientists (SPSS 22) to determine the association between physicochemical heavy metal levels in water from various sampled sites .

Results

Table 1 Abundance of flora in the mining site

Plant Species	POINT		
	Bridge point	Mid-Point	Last point
Lupines: (Lupinus spp).	1.33±0.58	2.33±0.58	2.67±0.58
Teaks: (Tectona grandis)	0.33±0.58	1.33±0.58	1.00±0.00
Crinum: (Crinum spp.)	1.00±0.00	1.00±0.00	1.67±0.58
Date palm: (Phoenix dactylifera)	1.33±1.53	2.00±1.00	2.00±0.00
Pandans: (Pandanus spp).	1.67±0.58	0.00±0.00	2.00±1.00
Terminalis: (Terminalia spp).	1.33±0.58	1.67±0.58	3.67±0.58
Paspalum: (Paspalum spp).	1.33±0.58	1.67±1.15	2.33±1.53
Reeds: (Phragmites australis)	0.67±0.58	1.67±1.15	2.00±1.73
Puncture vine: (Tribulus terrestris)	0.67±0.58	2.67±1.15	2.33±1.53
Arrowhead plant: (Syngonium podophyllu)	2.00±1.00	2.00±0.00	3.00±1.73
P	.279	.028	.309
Decision	NS	Sig	Nns

Key: NS = Not significant, S = Significant

Table 1: Displays the result of the flora distribution within the mining site. Lupines had the highest mean last point; Crinum had a mean range of 1.00 -1.67 with the last point as the highest. Date palm exhibited a mean range of 1.33- 2.00 with the last points having the highest, Pandans had the highest mean last points. Terminalis recorded the highest at the last point. Paspalum showed a means range of1.33- 2.33. Reeds had a means range of 0.67- 2.00. Puncture vine showed highest mean values at midpoint. Arrowhead plant had a mean range of, 2.00-3.00 with the highest at the last point. The results further indicated no significant difference in the distribution of flora between the bridge (p = 0.279) and last point (p = 0.809). However, a significant difference (p = 0.028) was observed in the distribution of flora at the midpoint in the mining site.

Table 2: Abundance of Fauna in the Mining Site

Species	**Mining Points**		
	Bridge Point	**Midpoint**	**Last Point**
Mudskipper (*Periophthalmus africanus*)	4.00±1.00	3.00±1.73	1.67±0.58
Periwinkle (*Tympanotonus fuscatus*)	2.33±0.58	4.00±2.00	3.33±0.58
Catfish (*Claria gariepinus*)	1.00±0.00	1.33±2.31	3.00±2.00
Tilapia (*Oreochromis aureus*)	0.00±0.00	2.00±1.00	2.00±0.00
Crab (*Cardiosoma armatum*)	2.33±1.53	1.67±0.58	2.33±0.58
Flathead Mullet (*Mugil cephalus*)	0.00±0.00	1.33±0.58	2.00±0.00
Water Snail (*Bolinus globosus*)	0.00±0.00	0.00±0.00	0.00±0.00
Earthworms (*Aporrectedea longa*)	2.00±0.00	2.33±0.58	1.33±0.58
Sharptooth (*Malapterurus beninensis*)	1.67±2.89	2.00±1.00	2.00±0.00
Reedfish (*Erpetoicthys calabaricus*)	2.00±1.00	2.00±1.00	2.00±0.00
P	.005	.085	.002
Decision	Sig	Sig	Sig

Table 2 showed the findings regarding the abundance of fauna in the mining site at various points affected by mining activities. The table delineates ten organisms associated with the mining site, each represented by the mean abundance. These organisms are Mudskipper (*Periophthalmus africanus*) with a mean range of 1.67-4.00., Periwinkle (*Tympanotonus fuscatus*) with a mean range of 2.33-4.00,, Catfish (*Clarias gariepinus*) , with a mean range of 1.00-3.00, Tilapia (*Oreochromis aureus*) with a mean range of 1.00-2.00, . Crab (*Cardiosoma armatum*) with a mean range of 1.67-2.33, , Flathead Mullet (*Mugil cephalus*) with a mean range of 1.00-2.00,, Watersnail (*Bolinus globosus*) ND , Earthworms (*Aporrectodea longa*) with a mean range of 1.33-2.33, Sharptooth (*Malapterurus beninensis*) with a mean range of 1.67-2.00, and Reedfish (*Erpetoichthys calabaricus*) with a mean range of 0.00-2.00, .
The table further indicates a significant difference in fauna distribution at the bridge point (p = 0.005) and last point (p = 0.002), but no significant difference at the midpoint (p = 0.085) due to sand mining activities.

Discussion of the findings

Table 1 displays the result of the flora distribution within the mining site. Lupines had the highest mean last point; Crinum had a mean range of 1.00 -1.67 with the last point as the highest. Date palm exhibited a mean range of 1.33- 2.00 with the last points having the highest, Pandans had the highest mean last points. Terminalis recorded the highest at the last point. Paspalum showed a means range of1.33- 2.33. Reeds had a means range of 0.67- 2.00. Puncture vine showed highest mean values at midpoint. Arrowhead plant had a mean range of, 2.00-3.00 with the highest at the last point. The results further indicated no significant difference in the distribution of flora between the bridge (p = 0.279) and last point (p = 0.809). However, a significant difference (p = 0.028) was observed in the distribution of flora at the midpoint in the mining site.
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The table further indicates a significant difference in fauna distribution at the bridge point (p = 0.005) and last point (p = 0.002), but no significant difference at the midpoint (p = 0.085) due to sand mining activities.

CONCLUSION

Based on the findings of the study, sand mining in Isiodu River has environmental implications for the distribution and abundance of biological resources within the riverine ecosystem. The assessment of flora revealed variations in the abundance of plant species across the Bridge Point, Mid-point and Last Point. Although differences in flora distribution were not significant at the Bridge Point and Last Point, a significant difference was observed at the Mid-point (p = 0.028). This suggests that variations in mining activities and local environmental conditions may influence the distribution of vegetation within the study area. The assessment of fauna also revealed considerable variations in the abundance of aquatic and associated organisms across the three sampling points. Ten faunal species were recorded, with significant differences observed at the Bridge Point (p = 0.005) and Last Point (p = 0.002), while the Mid-point showed no significant difference (p = 0.085). The presence and variation of these organisms demonstrate that the river environment supports diverse biological resources whose distribution may be affected by disturbances associated with sand extraction. Overall, the study concludes that sand mining in

Isiodu River has both environmental and socio-economic dimensions. While sand mining provides livelihood and economic opportunities for members of the surrounding community, continued or poorly regulated extraction may contribute to disturbance of river habitats and changes in the abundance and distribution of flora and fauna. Sustainable management, effective regulation and community participation are therefore necessary to balance the economic benefits of sand mining with the long-term conservation of the Isiodu River ecosystem.

RECOMMENDATIONS

Based on the findings, the following are recommended

1. **Regulation of sand-mining activities**: Relevant environmental authorities and the Emohua Local Government authorities should strengthen the regulation and monitoring of sand-mining activities along Isiodu River to prevent excessive extraction and unnecessary disturbance of the river ecosystem.
2. **Controlled sand extraction**: Sand miners should adopt controlled and environmentally responsible extraction methods that minimize disturbance to riverbanks, riverbeds, vegetation and aquatic habitats.
3. **Regular ecological monitoring**: Periodic monitoring of flora and fauna abundance should be conducted at different points of the river to identify changes in biodiversity associated with sand-mining activities.
4. **Protection of vegetation**: Vegetation around the riverbanks should be protected from unnecessary clearing during sand-mining operations. Where vegetation has been removed, appropriate restoration and replanting programmes should be implemented.
5. **Protection of aquatic organisms**: Measures should be taken to protect aquatic organisms and their habitats from excessive disturbance caused by mining equipment, sediment removal and other mining-related activities.
6. **Community participation**: Members of Isiodu community, particularly sand miners, fishermen, farmers and other river users, should be actively involved in environmental management and conservation programmes.
7. **Environmental awareness**: Environmental education programmes should be organized for sand miners and community members to increase awareness of the ecological consequences of unsustainable sand mining and promote responsible resource use.

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