ASSESSMENT OF THE SOCIO-ECONOMIC IMPACTS OF RIVER SAND MINING ALONG THE WARRI RIVER, DELTA STATE

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Abstract: The increase in the demand for sand for construction and other purposes has placed immense pressure on the environment where sand resources occur. Thus, this study was carried out to assess the socio-economic impacts of river sand mining along the Warri River, Delta State. Two research questions were put forward and two hypotheses were stated to guide the study. The study employed the survey design using a self-developed questionnaire. Qualitative data were collected from 880 respondents. The data collected were analyzed using percentages, mean, and Analysis of Variance (ANOVA). Findings from the data collected using the questionnaire revealed that erosion, flooding, noise pollution, destruction of buildings, roads, bridges and railways, destruction of farmlands and vegetation, hindrances to hunting, fishing and lumbering businesses, alteration of water transport and accidents are the socio-economic impacts of sand mining in the study area. Findings from the data analyzed using Analysis of Variance (ANOVA) revealed that sand mining has a significant socio-economic impact on the study area. Based on the findings from this study it was recommended that there should be introduction of proper management policies to check the current trend of the illegal river sand mining on the Warri River.

Keywords: Socio-economic, Warri, River, sand, mining, impacts

Introduction

Sand is a granular substance that occurs naturally in nature, consist of thinly divided rock and mineral particles which is formed over time by the breaking down of rock and deposited along coastal areas (Emielu, 2002). Sand occurs on land, hills, floodplains, oceans, streams and rivers (Kondolf *et al*., 2008). An important characteristic of sand is that it can be transported by wind in arid environments and deposited as sand dunes or by flowing water in water environment and deposited along coastal shore as sand beaches. Sand is a vital material for human society in sustaining the environment, safeguarding against storms and tidal waves, a home for aquatic organisms, used for making concrete, filling the roads, building sites, brick -making, glass - making, sandpapers, reclamation and in our tourism industry in beach attractions (Byrnes *et al*., 2004). Natural sand tends to accumulate in the lower course of rivers as depositional features.

Rivers are the most essential life supporting system of nature. For centuries, human beings have enjoyed the natural benefits supplied by rivers with no thought of how the river system functioned and maintains its vitality (Naiman and Billy, 1998; Shaji and Anikuar, 2014). Man has altered the balanced of many river ecosystems through various anthropogenic activities including river sand mining (Mitchell, 2003, Kitetu and Rowan, 2007). River sand mining is the practice of excavating sand from a river bed (Langer, 2003; Ashraf *et al*., 2010). Sand mining has become a flourishing multi-billion dollar business as sand and gravel constitutes the second highest raw material used on earth after water and their usage significantly exceeds their natural replenishment rates (UN Comtrade, 2014). As the society expands with a growing population, urbanization, industrialization and associated developments the demand for sand has increased tremendously (Osei, 2013). To meet the demand for sand supply, there has been indiscriminate mining of sand from rivers. The haphazard extraction and removal of sand from riverbed is becoming a threat to the very existence of the river ecosystem, especially socioeconomic impacts and water quality (Ashraf *et al*., 2011; Ahmad *et al*., 2012; Shaji and Anikuar, 2014).

The Warri River in Delta State, Nigeria is one river in which there is large scale indiscriminate and commercial sand mining activities has been taking place in recent times. River sand mining has major impact on the physical surroundings, biodiversity, water table levels, water quality, climate, landscape, cultural, political and socio-economic activities (Boyd *et al*., 2005; Sonak *et al*., 2006; Thorton *et al*., 2006; John, 2009; Krause *et al*., 2010; Saviour, 2012). Literature survey shows that there is no information on the socio-economic impacts of river sand mining on the Warri River. Thus the objective of this study is to assess the socio – economic impact of river sand mining on the Warri River, Delta State, Nigeria with a view to providing mitigative measures to check the present rate of illegal sand mining in the river environment.

Research questions

The following research questions guided the study: What are the effects of river sand mining on the social activities of the people in the study area? What are the effects of river sand mining on the economic activities of the people in the study area?

Research hypotheses

The study was guided by the following research hypotheses

1. River sand mining operation has no significant impact on the social activities of the people in the study area.
2. River sand mining operation has no significant impact on the economic activities of the people in the study area.

Materials and Methods

Description of study area

The study area of this research is the Warri River in Delta State, Nigeria. The Warri River is one of the major rivers that drain the environment of Delta State. It is geographically located at latitudes 50.00 and 6.30 North of the equator and Longitudes 50 21 and 6.45 East of the Greenwich Meridian (Odemerho and Ejemeyovwi, 2001). Warri River emerges from Utagba-Uno in Ndokwa West Local Government Area in the northern part of Delta State with an elevation of 30 meters above sea level. It flows southwards through nine local government areas and many settlements before emptying its water into the Atlantic Ocean in the south as Forcados River. Some of the settlements along the river banks are Utagba-Uno, Ukabi, Umukato, Amai and Imodje in in the upstream,

Okan, Agbarho, Otokutu, Ugbromo, Ugbolokposo, and Otokutu in the midstream. Others include, Opete, Okpaka, Enerhen, Ovwian, Warri, Aladja, Ogbe-Ijaw Ode-Itsekiri, Obuto, Gbanabubou and Salvation City in the downstream. The river has an entire length of 135.6 kilometers.

Geology and soil

The Warri River comprises of three different lithological units, the Ameki formation in the upper part of the River with coarse grained sand and gravels. The middle and lower courses of the River is the Agbada formation that consists sandy and clay soils that are transported from the upper course of the River (Morgborukor, 2007). The lower course of the basin is also characterized with deeply weathered sand-rich deltaic plain alluvium deposits that contain fine sand, especially in the swamp vegetation (Stutz and Pikey, 2002). Mogborukor (2007) also described the soil type of the river as ferralsol in the upper course of the river with deeply weathered red and yellowish laterite soil that are easily prone to erosion activities. On the other band, the middle and lower courses, the soil types are predominantly alluvial deposits with fine sandy loam. The middle and the part of the lower course of the river have turned into a place of interest considering its constant sand mining activities that have affected socio –economic activities and water quality.

Climate and vegetation

The area enjoys a tropical equatorial climate with a long wet season that decreases slightly from the lower course via the middle course to the upper course in the northern part of Delta State. Rainy season prevails between April and October with a break in the month of August. The mean annual rainfall varying from 200 to 300 mm. Temperature is about 30 – 32^0C. Relative humidity is also high with a range of 65-90% (Tripathy and Panda, 2001).

Research design

The study adopted survey design. A survey design involves questioning a large group of respondents' questions about a particular issue, then the researcher uses statistical techniques to make conclusion about the population based on the sample, particularly if the population is large (Mugenda, 1999). Also, this design was appropriate and suitable for the study since questionnaire, oral interview and field observation is used to obtain information from the respondents on the scale of the problem.

Population and sample size of the study

The population of the study comprised all the eleven (11) communities that cut across six (6) Local Government Areas of Delta State along the river where sand mining activities is taking place. For adequate coverage and representation of the entire population for the study, Taro Yamane formula (Yamane, 1964) was used in obtaining the sample size. Thus, the sample size used in this study was 915 respondents. The random sampling technique was used in selecting the respondents.

Instrument for data collection

The main instrument used for data collection was the questionnaire titled "Socio-economic Impact of Sand Mining Operations Questionnaire (SISMOQ)". The questionnaire consists of three sections A, B and C. Section A contained information related to the demographic variables. These include; gender, age, academic qualification and occupation. Section B consists of items based on the socio-economic impact of sand mining. In section B, the Likert scale technique was adopted. The response to each of the items was weighted on a 4–points Likert type scoring scale. The respondents were free to choose Strongly Agree (SA) = 4 points, Agree (A) =3 points, Disagree (D) =2 points and Strongly Disagree (SD) =1 point. From the scale, a criterion score of 2.5 was adopted. The criterion score was obtained as follows:

Criterion score = (4+3+2+1)/4 = 2.5

Items having a mean score above the criterion score of 2.5 were accepted as socioeconomic impact while those under 2.5 were not accepted as socioeconomic impact.

Validity of the instrument

The validity of the instrument was made by experts in the Department of Geography and Meteorology, Nnamdi Azikiwe University, Awka. The relevant criticisms, comments and inputs from the experts were thoughtfully considered in the last edition of the instrument. The content validity was done by ensuring that the questionnaire covered all the variables of the study.

Reliability of the questionnaire

The test re-test reliability technique was employed in this study. The questionnaire was administered to thirty (30) respondents who were not a component of the sample and the data collected. After, a week interval, the questionnaire was re-administered to the same set of respondents and a second set of data obtained. The two sets of data were analyzed using the Crochbach's alpha reliability coefficient. The reliability coefficient obtained was 0.86. This shows that the instrument is reliable. Administration of the Questionnaire All the communities used as samples for this study was visited. The researcher met the respondents, introduced the purpose of the questionnaire to them and appealed to them that the information given by them would be treated as confidential. A total of 915 questionnaires was administered, but only 880 questionnaires were recovered and utilized in the study.

Results and Discussion

Answering research questions

Research question one

What are the impacts of river sand mining on the social activities of the people in the study area?

The responses of the respondents on the impacts of river sand mining on the social activities of the people in the study area are presented in Table 1. As revealed in Table 1, the respondents indicated that sand mining operations have impacts on the social activities of the people in the study area. This is because the calculated mean for each item and the overall mean of 3.19 were greater than the criterion mean of 2.50.

Table 1: Responses of respondents on the impacts of sand mining on social activities of the people in the study area

S/N	ITEMS	SA (%)	A (%)	D (%)	SD (%)	Mean	STD
1	Sand mining activities cause erosion in the community	256 (28.5)	564 (64.1)	40 (4.55)	25 (2.84)	3.18	0.648
2	Sand mining operations affect the quality of the River water	312 (35.5)	450 (51.1)	72 (8.18)	46 (5.23)	3.17	0.762
3	Sand deposited along the road due to sand mining activities cause accidents	280 (31.8)	500 (56.8)	36 (4.09)	64 (7.27)	3.13	0.708
4	Sand mining activities result in flooding	360 (40.9)	452 (51.4)	40 (4.55)	28 (3.18)	3.30	1.125
5	Sand mining operations cause noise pollution and hearing problems	306 (34.8)	439 (49.9)	76 (8.64)	59 (6.71)	3.13	1.215
6	Sand mining affects the aesthetic view of the surrounding environment	246 (28.1)	473 (53.8)	96 (10.9)	65 (7.39)	3.02	1.080
7	Sand mining affects community buildings	288 (32.7)	489 (55.6)	67 (7.61)	36 (4.09)	3.17	1.143
8	Sand mining affects the community roads, bridges and railways	390 (44.3)	434 (49.3)	34 (3.86)	22 (2.50)	3.35	1.123
9	Sand mining activities affect the recreational activities along the river	376 (42.7)	408 (46.4)	52 (5.91)	44 (5.00)	3.27	1.203
10	Sand mining activities affect the use of the river water for domestic purpose	309 (35.1)	488 (55.5)	35 (3.98)	48 (5.45)	3.20	0.940
	Aggregate mean					**3.19**	**0.439**

Criterion mean = 2.50

Table 2: Respondents Responses on the impacts of sand mining operations on the economic activities of the people in the study area

S/N	ITEMS	SA (%)	A (%)	D (%)	SD (%)	Mean	STD
1	Mining activities affect farmlands along the river bank	256 (29.1)	532 (60.5)	26 (2.95)	66 (7.50)	3.11	0.661
2	Noise from mining operations affect hunting business	238 (27.0)	518 (58.9)	39 (4.43)	85 (9.66)	3.03	0.813
3	Fishing activities along the river is affected by sand mining activities	334 (38.1)	479 (54.4)	43 (4.89)	24 (2.73)	3.28	0.878
4	Lumbering business is affected by sand mining	275 (31.1)	526 (59.8)	29 (3.31)	50 (5.68)	3.17	0.940
5	Sand mining activities provides job for the people	282 (32.0)	521 (59.2)	45 (5.11)	32 (3.64)	3.20	0.609
6	Vegetation along the river bank are affected by sand mining	383 (43.5)	440 (50.0)	36 (4.09)	21 (2.39)	3.35	0.684
7	Those that give their land for the sand mining business benefit financially	365 (41.5)	456 (51.8)	29 (3.31)	30 (3.41)	3.11	0.719
8	Sand mining affects water transport	266 (30.2)	506 (57.5)	64 (7.27)	44 (5.00)	3.13	0.840
9	The community benefits from sand mining activities	381(43.1)	398 (45.2)	69 (7.84)	32 (3.64)	3.28	0.762
10	Sand mining operations, enhance the quality of life in the community	257 (29.2)	545 (61.9)	23 (2.61)	55 (6.25)	3.14	0.708
	Aggregate mean					**3.20**	**0.285**

Criterion mean = 2.50

Research question two

What are the impacts of river sand mining on the economic activities of the people in the study area?

The responses of the respondents to the research question two are shown in Table 2. As revealed in Table 2, the respondents indicated that sand mining operations have economic impacts on the sand mining area along the Warri River. This is because the calculated mean for each item and the overall mean of 3.24 were higher than the criterion mean of 2.50.

Testing of Hypotheses

Testing of hypothesis one (H0)

Hypothesis one states that river sand mining operation has no significant impacts on the social activities of the people in the study area. To test the above hypothesis, analysis of variance (ANOVA) was employed. The test was performed at the 0.05 level of significance. The result is presented in Table 3. The result in Table 3 showed that the F-calculated value of 207 is greater than F-critical value of 2.866 at the 0.05 level of significance. Therefore, hypothesis one is rejected. This implies that, sand mining activities have significant impacts on the social activities of the people in the study area.

Table 3: Summary result of Analysis of Variance of the social impacts of sand mining

Source of Variation	SS	df	MS	F-cal	P-value	F crit	Decision
BG	1239373	3	413124.2	207	9.25E-23	2.866	Sig.
WG	71763.4	36	1993.428				
Total	**1311136**	**39**					

BG = Between Groups; **WG** = Within Groups; **Sig.** = Significant

Table 4: Summary result of Analysis of Variance of the economic impacts of sand mining

Source o Variatio	SS	df	MS	F	P-value	F crit	Decision
BG	1436066	3	478688.6	290	2.89E-25	2.866	Sig.
WG	59389.6	36	1649.711				
Total	**1495456**	**39**					

BG = Between Groups; **WG** = Within Groups; **Sig.** = Significant

Testing hypothesis two (H_0)

H_0: Hypothesis two states that river sand mining operation has no significant impacts on the economic activities of the people in the study area.

To test the above hypothesis, analysis of variance (ANOVA) was employed. The test was performed at the 0.05 level of significance. The result is presented in Table 4.

The result in Table 4 showed that the F-calculated value of 290 is greater than F-critical value of 2.866 at the 0.05 level of significance. Therefore, hypothesis two is rejected. This implies that, sand mining activities have significant impacts on the economic activities of the people in the study area.

The results of this study revealed that river sand mining has significant impacts on the socio-economic activities of the people in the study area. The socio-economic impacts of sand mining include: erosion, poor quality of the River water, accidents, flooding, noise pollution and hearing problems, poor aesthetic view of the surrounding environment, collapsed buildings, destruction of roads, bridges and railways, hindrance to recreational activities along the river, destruction of farmlands and vegetation, reduction of hunting business, fishing activities, lumbering business, job creation, financial benefits for land owners, alteration of water transport, compensation for community and enhance the quality of life.

This study recorded that one of the socio-economic impacts of river sand mining is the destruction of farmlands. This result is in line with others reported in literatures. For instance, Akabzaa and Darimani (2001) reported negative impact of river sand mining on farmlands in Tarkwa, Ghana. According to them the process of river sand mining has destroyed most farmlands in the area. Aromoloran (2012) also observed the degradation of some agrarian communities in Ogun State, Nigeria as a result of river sand mining. The activities of the sand miners disturb the free flow of the water with the consequential effects that fishes become out of reach of the fishermen who rely on the river for their livelihood. This corroborates the works of Orrin *et al.* (2007) who asserted that excessive disturbance in the river ecosystem has led to loss of fishes, biodiversity and recreational potentials in most river environments. Thus, sand mining hinders the movement of fish between pools, thereby affecting their productivity. Dharkwa *et al.* (2005) in a study carried out in the Offin River Basin in Ghana equally affirmed that river sand mining affects fish community.

River sand mining has negative effects on the vegetation of the area. This result is in agreement with those of Howarth and Farber (2002) and Turner *et al*. (2003) along the Okavango River in Namibia, where 49 percent of the vegetation was destroyed due to river sand mining. Stebbins (2006) also found out that river sand mining results in the removal of vegetation and destruction of the topsoil. The result revealed that vibration from dredging machines affect buildings in the area. This could lead to collapse of buildings that are close to mining sites in the area. This finding corroborates the work of Ashraf *et al*. (2010) who asserted that river sand mining lead to destruction of public structures such as buildings. The result showed that river sand mining is inimical to the environment as it destroys the ecosystem vis-à-vis the quality of water and other social activities. However, sand mining is favourable as it is beneficial to the people as indicated by the respondents' responses. This result corroborates the works of Schaetzl (2001), Goddard (2007), Kondolf (2008) and Chimbodza (2012) who severally enumerated the socio-economic importance of river sand mining to the people and to the community.

Conclusion and Recommendation

The study has revealed that the river sand mining operation has drastic impacts on the socio-economic activities of the people of the study area. This negative effect is attributed to the unregulated method of operation that is done illegally. Based on the findings from this study, it is recommended that there should be introduction of proper management policies to check the current trend of the illegal river sand mining on the Warri River.

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